MAMMALS OF UTAH

STEPHEN D. DURRANT

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August 10, 1952

MAMMALS OF UTAH

Taxonomy and Distribution

BY

STEPHEN D. DURRANT

University of Kansas
Lawrence
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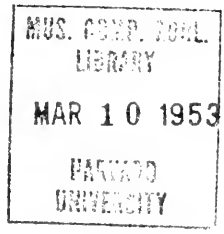

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MAMMALS OF UTAH

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INTRODUCTION

The mammals of Utah long have attracted students who are concerned with studies of taxonomy, distribution and speciation. By reason of its location, climate, and topography the state possesses as wide a range of habitats for mammals as any of the mountain states and a wider range than most. The altitudinal range varies from the dry desertlike Beaverdam Wash at an elevation of 2,250 feet, to the high, well-watered Uinta Mountains at an elevation of more than 13,000 feet. The plant life varies from the catclaw (*Acacia greggii*) and Joshua tree (*Yucca brevifolia*) of the low desert to lichens occurring above timberline. For a student of mammals interested in altitudinal distribution, and especially in ecology, Utah is an ideal area, because it is possible, in a linear distance of ten miles or less, to ascend from the semidesert at approximately 4,000 feet elevation, to above timberline (10,500 feet) to more than 12,000 feet. To students of the distribution and the speciation of mammals, the effects of the widely varied topography and the barriers formed by the deserts, high mountains and deeply entrenched rivers, are dramatically reflected in that 2 genera, 35 species and 85 subspecies have marginal records of occurrence in Utah, and one species and 70 subspecies are at present restricted to the state. Moreover, Utah appears to be the common meeting ground for many species the principal part of the ranges of which are beyond the state. For a short distance within each of its boundaries Utah contains representatives of some species and genera of mammals that are not found elsewhere within the state. For example, the fauna of the southwestern area of the state possesses *Dipodomys deserti, Peromyscus eremicus* and *Onychomys torridus* which occur as far south as northern Mexico; the western area contains *Microdipodops megacephalus,* which otherwise is restricted to the Great Basin area of Nevada, Oregon and California; the northwestern corner contains *Citellus beldingi* and *Eutamias amoenus* which range northwestward into Oregon and northwestern Canada, respectively; the northeastern area contains *Citellus tridecemlineatus* which ranges as far to the east as Illinois; the southeastern area, south of the Colorado River, contains *Sciurus aberti, Citellus spilosoma* and *Neotoma albigula* which range southward into Mexico, *Cynomys gunnisoni* which occurs to the south and east in New Mexico and Arizona, and *Mustela nigripes,* which is an inhabitant of the western Great Plains; the

southern area contains *Peromyscus nasutus* and *Neotoma stephensi*, which occur to the south in Arizona and New Mexico, and *Microtus mexicanus*, which ranges southward into Mexico. In addition, many subspecies known to occur outside the state, also occur just within its boundaries. The aforementioned distributional data indicate why Utah is considered one of the critical areas in understanding the distribution of the mammals of the western United States.

Mammalogists have been interested in the fauna of Utah for a long time. Shortly after Utah was settled by the Mormon pioneers in 1847, specimens were obtained, which are for the most part in the United States National Museum. As early as 1850, Captains H. Stansbury and J. W. Gunnison were in the area, and obtained the first specimens from Utah upon which a kind of mammal new to science was named. These foxes (skins only) were the basis for the name *Vulpes macrourus* [= *Vulpes fulva macroura* (Baird, 1852:309)]. In the next decade several exploring parties, under the supervision of the Department of War, were in the territory and were engaged in surveying routes for wagons and railroads. These parties usually included someone who was delegated to obtain and prepare objects of natural history. The most important of these parties were those of Captain J. W. Gunnison in 1853 and of Captain J. H. Simpson in 1858-1859. The latter party obtained specimens of the second new mammal from Utah (*Citellus townsendii mollis* Kennicott, 1863:157), and also the holotype of *Neotoma lepida lepida* (Thomas, 1893:234), which was obtained somewhere between Camp Floyd (Fairfield), Utah, and Genoa, Nevada. Doctor H. C. Yarrow and H. W. Henshaw collected specimens in Utah in 1872 and C. Hart Merriam also collected some in 1872 and 1891. Other collectors, under the auspices of the United States Government, who obtained materials from Utah were Vernon Bailey in 1888, 1889, 1890 and 1893; J. A. Loring in 1893; W. H. Osgood in 1908 and A. M. Moore in 1927 and 1928. Sometime prior to 1874, J. A. Allen was in Utah. The American Museum of Natural History sent Charles P. Rowley to Utah in 1892 and Walter W. Granger in 1895 and 1896. George P. Engelhardt obtained mammals in Utah for the Brooklyn Institute in 1904 and 1917. Doctor and Mrs. A. Svihla obtained mammals from the north slopes of the Uinta Mountains in 1928. During the past 30 years, the University of California, University of Utah, Brigham Young University, Utah State Agricultural College and the Carnegie Museum have been the principal institutions which have been

active in obtaining specimens of mammals from Utah. As a result of this activity, many specimens are in the several collections, and 99 kinds (species and subspecies) have been named from mammals from the state.

In spite of the fact that mammals have been gathered from Utah and prepared as specimens throughout the past 100 years, no comprehensive report upon the kinds and their distribution, based upon actual specimens and supplemented by precise field data, has yet appeared. This does not imply that nothing has been done, because a considerable number of articles has already been published relative to the mammals of Utah. The earliest record of mammals in Utah was, insofar as I have been able to ascertain, the report of Father Escalante, who on September 13, 1776, recorded the killing of a bison near the present town of Jensen, Uinta County (Auerbach, 1943:55). Approximately 250 papers have appeared in which mention is made of mammals from Utah (see Hayward, 1936, 1941). Among the more important early papers are those of Allen (1874, 1893b and 1896), Baird (1852, 1858 and 1859), Coues (1875 and 1877), Coues and Allen (1877), Coues and Yarrow (1875) and Newberry (1857). Since 1890, the literature pertaining to mammals from Utah mainly consists of original descriptions and short papers dealing with new records of occurrences, notes on life histories and extension of ranges, and references in monographs of several kinds in the North American Fauna series. Longer papers, on the mammals of Utah, are those of Barnes (1922 and 1927), Hall (1931), Svihla (1931), Stanford (1931), Marshall (1940), Long (1940), Hardy (1941 and 1945), Durrant and Setzer (1945) and Durrant (1946).

Barnes (1922 and 1927) prepared the first accounts of the mammals of Utah, by bringing together all information known at that time. In his last (1927) publication, he listed 122 kinds (species and subspecies) as occurring in Utah. Of this number 12 are no longer known to occur in the state, and, at present, 49 have scientific name-combinations different from those that he applied to them. The present report is based upon studies pursued in the field and museum over the past 18 years. Whereas Barnes (*op. cit.*) recorded 122 different kinds of mammals as occurring in Utah, the present paper lists 247 kinds, of which 244 are represented by specimens in collections. The remaining three kinds, *Procyon lotor pallidus*, *Martes pennanti columbiana* and *Gulo luscus luscus*, are included on the basis of what I consider to be unimpeachable evidence of their occurrence. Moreover, I have attempted to point

out the factors responsible for the present distribution of mammals in Utah, and hope that I have, in part, explained why so many subspecies have evolved within, and are as yet restricted to, the state. I am keenly aware that reports upon research are only progress reports, and that much yet remains to be done in Utah to complete the list of kinds that occur in the state. My hope is that this report will evoke as many problems as it answers, that it will be of service to my colleagues, and that it will stimulate additional investigations in mammalogy in Utah and elsewhere. If it fulfills these hopes, the present report will have been well justified.

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AIMS

The preparation of this account of the Recent mammals of Utah had the following main objectives:

1. To determine what kinds of mammals occur within the political confines of the state.
2. To ascertain the geographic range of each kind, and to provide maps of distribution.
3. To provide, insofar as possible, a complete synonymy of each kind (species and subspecies), as pertains to Utah.
4. To provide an adequate description for each kind prepared from specimens from Utah.
5. To furnish keys from orders to species, to enable each of the several kinds of mammals to be readily identified.
6. To catalogue and evaluate taxonomically the extent of variation—individual, specific, subspecific and geographic.
7. To show the effect of physiography, especially since the beginning of Pleistocene time, upon speciation.
8. To present evidence, as regards time, on the rate of speciation in mammals.

TREATMENT

The arrangement of the major taxonomic categories, from order to genus, is after Simpson (1945:48-162). Although I have followed the above arrangement, I have, nevertheless, deviated from it in the usage of some generic names. For example, I do not feel that *Lynx* is a synonym of *Felis* since the anatomical differences of taxonomic import outweigh the similarities, and each has evolved well marked species with subspecies. In arranging the species I have followed Miller (1924). I have departed from his arrangement in those cases where a revisionary work exists for the genus. The arrangement of the subspecies is from north to south and west to east within the state (see list of counties).

Lest I be criticized for slighting the major taxonomic categories, a check list has been included. To insure clarity, and for continuity in the text, each order is introduced by a brief characterization, followed by a summary of the kinds in Utah and a key to the species.

Each subspecies is treated under the following eight headings:

1. The *accepted scientific name,* employed in agreement with the international rules of zoölogical nomenclature, followed on the same line by the name of the author. There are several departures in this account from name combinations known to be employed elsewhere in the literature. Some kinds formerly regarded as full species are here regarded as only subspecies, for example red squirrels of the genus *Tamiasciurus* are considered in Utah as belonging to the species *Tamiasciurus hudsonicus,* rather than to two species, *Tamiasciurus hudsonicus* and *Tamiasciurus fremonti,* and *T. fremonti* is arranged as a subspecies of *T. hudsonicus.* Other kinds such as prairie dogs, *Cynomys leucurus* and *Cynomys parvidens,* are retained as distinct species, even though some authors consider the latter to be only a subspecies of the former. Reasons are indicated for all such changes initiated in the present work. I concur with Hall (1946:8) in his definition of a Recent mammalian species "A species is an evolved (and often evolving), reproductively isolated natural population in which individuals of similar age and sex (in at least one age group of one sex) possess in common certain heritable, morphological characters that are distinctive." Generally, if intergrades occur in areas where the geographic ranges of closely related forms come in contact, the distinct kinds were considered as subspecies of the same species. If no interbreeding occurred in the aforementioned areas the distinct kinds were regarded as belonging to two distinct species. In some cases, however, certain kinds are considered to be subspecies even though no intergrades were found. The chisel-toothed kangaroo rat *Dipodomys microps alfredi* is known to occur only on Gunnison Island in Great Salt Lake, and no intergrading animals are known between it and *Dipodomys microps bonnevillei* of the adjacent mainland. My reason for considering the insular kind as a subspecies, even though no intergrades are known, is that the differences between *D. m. alfredi* and *D. m. bonnevillei* are no greater than those between *D. m. bonnevillei* and other recognized kinds from the mainland with which *D. m. bonnevillei* is known to intergrade.

2. The *vernacular name,* applied only to species and meant to apply to all of the subspecies of the species. The coining of vernacular names for subspecies, seems to me to add little to the understanding of mammals, since below the level of the species, names usually are of concern only to the specialist who is already familiar with the accepted trinomial.

3. The *synonymy,* in which the first citation is to the original description, followed by the designation of the type locality. The second citation is the first usage of the name combination (generic, specific and subspecific) employed in the present work, unless the combination is the same as that of the original description. While recognizing that the first usage of the binomial such as *Sorex obscurus,* nomenclaturally, is considered to be the same as *Sorex obscurus obscurus,* I have, nevertheless, included both combinations of names in the account for completeness as concerns the names applied to

Utah-taken specimens. The remaining citations consist of the different name combinations, arranged chronologically with author and reference, that have been applied to Utah-taken specimens. A pure synonym is recognizable as such because the citation is followed by the designation of the type locality. Throughout the synonymy, a comma is placed between the scientific name and the author if the author did not originally propose the name; conversely, the absence of a comma indicates that the author did propose the name. I have attempted to furnish as complete a synonymy as possible pertaining strictly to Utah-taken specimens. Names occurring in papers not considered as being valid publications, and those papers containing only vernacular names have not been included.

4. The *range,* in this account, is considered to be generally only the geographic distribution.

5. The paragraph entitled *description and comments* begins with the standard measurements of the individual taken soon after its death. These measurements (in millimeters, unless otherwise stated) are (a) total length (tip of nose to distal end of caudal vertebrae), (b) length of tail (from place where tail bends at a right angle with the back to the end of the fleshy part of the tail, not including the hairs which project beyond its tip), (c) length of hind foot (from proximal end of heel to end of longest claw), and (d) length of ear (from notch). Unless otherwise indicated, measurements are of adults. When more than three animals of each sex were measured, the measurements are reported as average, maximum and minimum. If fewer than three were measured, each is listed by its catalogue number and collection with its individual measurements. Next, there is a description of the skin and skull. In the course of preparing the species accounts, my students and I named and described 32 new kinds of mammals, and reported four kinds previously unreported from the state. In addition to these 32 new kinds, each of the other kinds known to occur in Utah is redescribed in the present work. It was considered advantageous to have in a single volume, descriptions of all kinds of mammals known from the state, prepared by a single person, insofar as possible, from specimens taken from Utah. All capitalized color terms are after Ridgway (1912). Comparisons are given in detail sufficient to enable anyone to distinguish the members of any subspecies in question from all kinds with which it might be confused. Remarks follow on details of range, problems of intergradation, reasons for assignments of intergrading specimens to certain subspecies, extent of geographic variation, and in some few cases there are pertinent remarks on natural history.

6. Under *specimens examined,* the first report is the total number of specimens that I personally examined. This is followed by the exact localities of capture, the numbers from each locality, and designations as to ownership of the specimen. With rare exception, the localities of capture here reported are taken directly from the labels on the specimens. In some few cases, however, I have placed specimens from several localities under a general heading where the localities are in such close proximity to each other that I felt the repetition to be needless and to add nothing of importance. This study is based upon 7,648 specimens, the majority of which are in the collection of the Museum of Zoölogy, University of Utah. Unless otherwise

indicated, specimens are in the aforementioned collection. Abbreviations designating specimens from other collections are as follows:

(A. M. N. H.) ... American Museum of Natural History.
(B. Y. U.)..... Brigham Young University.
(C. M.) ..... Carnegie Museum.
(CL. M. N. H.).. Cleveland Museum of Natural History.
(C. M. N. H.)... Colorado Museum of Natural History.
(D. J. C.)..... Dixie Junior College.
(K. U.) ..... Museum of Natural History, University of Kansas.
(M. V. Z.) ..... Museum of Vertebrate Zoölogy, University of California.
(N. H. M. S. D.), Natural History Museum of San Diego.
(R. H.) ..... Collection of Ross Hardy.
(U. M.) ..... Museum of Zoölogy, University of Michigan.
(U. S. A. C.).... Utah State Agricultural College.
(U. S. N. M.)... United States National Museum.

The order of listing of localities within a county is from north to south; where two localities occur on the same parallel, the western one is first. The counties are in the following sequence (see fig. 89):

Boxelder	Summit	Sanpete	Piute
Cache	Daggett	Carbon	Wayne
Rich	Utah	Millard	Iron
Weber	Wasatch	Sevier	Garfield
Morgan	Duchesne	Emery	Washington
Tooele	Uintah	Grand	Kane
Davis	Juab	Beaver	San Juan
Salt Lake			

7. *The additional records,* are records from the literature, or from field notes of unquestioned accuracy. If I have examined specimens from localities already recorded in the literature, these localities are omitted from this section since they are included under specimens examined.

8. *The tables of cranial measurements,* unless otherwise indicated, are based on animals measured by me. If the name of the state does not follow the locality in the table, the locality is in Utah.

The distribution maps show localities from which specimens have been obtained, and second, by shading, the area in which I suppose the animal occurs. It should be kept in mind that the animals occupy only those areas within the supposed range which contain suitable habitats.

TOPOGRAPHY AND CLIMATE

Utah is one of the mountain states of the western United States, situated between the Rocky Mountains and the Sierra Nevada, within a region characterized as an upland plateau. This generally high inland plateau region contains many mountains and higher plateaus which have been cut by numerous canyons and is dotted with many lakes and inland valleys. The major part of the state consists of two large drainage basins (Great Basin and Colorado Basin), which Atwood (1940:12) considers to be parts of two large physiographic subprovinces. These two drainage basins are sepa-

rated by a long chain of mountains and high plateaus which divide the state into nearly equal halves. This mountainous division begins in the north at the southwest corner of Wyoming, proceeds southward approximately two-thirds of the length of Utah, whence it bears westward to the southwest corner of the state. The only exception to the above account is that the northern slopes of the Raft River Mountains, in extreme northwestern Utah, drain into the Snake River in Idaho. The two major drainage systems are markedly different from each other as concerns drainage. That part of Utah within the Colorado Basin drains into large streams which are deeply entrenched and flow generally from north to south. The drainage within the Great Basin has no outlet to the ocean and the water, where sufficient, collects into depressions in the valleys where it evaporates.

Great Basin.—Practically all of western Utah, west of the central mountain chain, is in the Great Basin. More exactly it contains the entire drainage system of Pleistocene Lake Bonneville, comprising roughly the region between the Idaho-Utah boundary and Iron County and Salt Lake City and the Utah-Nevada boundary. As this lake disappeared, the drainage was subdivided into many separate basins, each with its brackish or salty lake, or barren whitish playa in the bottom. Among these many separate basins, the Great Salt Lake, Sevier Lake and Little Salt Lake are the more important.

The eastern margins of the Great Basin in Utah contain some of the highest mountains and plateaus within the state, such as the Wasatch, San Pitch, Pavant, Tuchar, Cañon, Markagunt and others which range in elevation from 9,000 to 12,000 feet. On the east side of the Great Basin, between these mountains and the divide separating them from the Colorado Basin drainage, there are long, narrow, deep valleys. Waters from these narrow, deep drainage basins flow westward into the lower parts of the Great Basin. To enable this westward flow of these waters, the mountains have been traversed by canyons, and some of the major streams within the Great Basin have been developed. The southern narrow valleys are drained by the Sevier River which flows northward to meet the San Pitch River which flows southward. These streams drain valleys of the same names and flow collectively 140 miles before uniting. They then flow to the west into Sevier Lake in the lower parts of the Great Basin. Farther north, the Spanish Fork, Provo, Weber, Ogden and Logan rivers flow westward through canyons of the same names and empty into the lower reaches of the Great Basin. The Bear River merits separate comment. It arises in Utah, flows

through southwestern Wyoming and southeastern Idaho in making its detour around the northern end of the Wasatch Mountains at Alexander, Idaho, from there it flows southward to empty into the Great Salt Lake.

In Utah, the remainder of the Great Basin, lying between the aforementioned mountains and the Utah-Nevada boundary consists generally of lowlands ranging in elevation from 4,200 to 5,500 feet. These lowlands, however, are interspersed with numerous mountains which lie in a north-south direction and attain elevations of 3,000 to 5,000 feet above the valley floor. These mountains are for the most part block mountains, caused by faulting. Some, however, show evidence of folding (Atwood, 1940:395). The lowland areas on the floor of the basin, between these mountains, are for the most part desertlike. Throughout the basin, the soil varies from pure crystalline salt (Great Salt Lake Desert) through varying stages of salinity to nonsaline.

Colorado Basin.—Among the outstanding features of this basin are its two large rivers, the Green and Colorado. The Green River arises in Wyoming and enters Utah from the north in Daggett County. It turns abruptly eastward and, after flowing approximately 30 miles, cuts through the eastern end of the Uinta Mountains into Colorado and then turns back into Utah. It then flows southward half the length of the state to enter the Colorado River. The Colorado River arises in the Rocky Mountains of Colorado, enters Utah approximately near the middle of the east side and flows southwestward through deep canyons to leave the state near the middle of its southern boundary. The more important tributary streams which drain the slopes from the Great Basin divide are Uinta, Duchesne, Price, San Rafael, Fremont (Dirty Devil), Escalante, Paria, Kanab and Virgin rivers. The White River from northwestern Colorado and the San Juan River which enters Utah near "four corners" are the main eastern tributaries. An equally outstanding feature of this entire drainage system is the steep gradient of the streams, which have cut through mountains (LaDore Canyon, Flaming Gorge), and have deeply entrenched themselves in U-shaped gorges. As a result, the topography of the entire system is one of highly dissected mesas and mountains, giving to eastern and southeastern Utah its characteristic cliff and rock exposure type of physiography. This broken-up terrain has acted importantly in the speciation of mammals through the development of small geographic ranges and physical barriers. The gradient of this river system can be appreciated better with the following data in mind:

Green River enters Utah in Daggett County at an elevation of 5,855 feet and the Colorado River enters Grand County at 4,330 feet. At their confluence the elevation is 3,875 feet, and where the Colorado River leaves Utah, the elevation is 3,160 feet. Westwardly in Washington County, the Virgin River and Beaverdam Wash leave Utah to enter Arizona at 2,250 feet. Hence, the Virgin River Basin is the lowest, both within the Colorado Basin drainage in Utah and the entire state, and is alone in possessing elements of the Lower Sonoran Life-zone.

The Uinta Mountains are the largest mountains in North America that have their long axis in an east-west direction. These mountains are wholly limited to Utah, extending roughly just inside its northern boundary from southwestern Wyoming to Colorado. With the exception of the extreme western part (origin of Bear, Weber and Provo rivers), these mountains are totally within the Colorado Basin drainage. The northern slopes drain into Green River proper, while the southern slopes drain into the Duchesne River which is a tributary of the Green River. The highest areas in Utah are in these mountains. Kings Peak, at 13,498 feet, is the highest, but there are six others over 13,000 feet. Uinta Basin located immediately south of the Uinta Mountains is underlaid by strata which gradually rise to the south, forming the East Tavaputs and West Tavaputs plateaus. On their south faces, these plateaus break off abruptly into high escarpments which are known as the Bad Land, Roan and Book cliffs. This escarpment extends eastward from the Great Basin-Colorado Basin divide to Colorado. The only major break in this escarpment is the deep canyon of the Green River, which emerges at Greenriver, Utah.

The Colorado Basin drainage is further characterized in having four isolated mountain systems. In Grand and San Juan counties, east of the Colorado River, the isolated La Sal, Abajo and Navajo mountains attain heights of 13,089, 11,357 and 10,416 feet, respectively. East of the Colorado River, in Garfield County, the Henry Mountains (laccoliths) rise to 11,485 feet.

Climate.—Utah receives the major part of its moisture from the Pacific Ocean, although some moisture-laden air occasionally reaches Utah from the Gulf of Mexico. High mountains intercept the moisture-laden air between Utah and the Pacific Ocean and extract much of its water. Inasmuch as Utah is in the rain shadow of these mountains, it belongs to some of the driest regions of the North American continent. The desert valleys average four to ten inches of precipitation annually. Proportionate to their increase

in elevation above the valley floor, mountains receive more precipitation. The rate is usually one inch for each 160-200 feet rise in elevation. Another feature of precipitation is the unequal yearly distribution. Southern Utah has two periods of deficiency, late spring and early summer, and late fall, and two periods of maxima, late winter and late summer. In the north, however, there is but a single seasonal cycle, with a minimum in midsummer and a maximum in early spring. The kind of precipitation also varies from that of little snow in the Virgin River Basin to nearly all snow in the high northern mountains. Utah is further characterized by having torrential rains called "cloudbursts". Utah is also endowed with features of climate such as periods of prolonged drouth, heavy rains and blizzards, all of which alter both the cyclic and average yearly rates of precipitation.

The bulk of the utilizable water in Utah falls in the form of snow in the mountains. Here it is held in storage as snow and is unavailable to organisms until it melts. Upon melting it seeps into the soil which acts as a reservoir of water in the liquid state. If the soil is porous, the melting snow or rain will seep into the interstices. When more water is available than the soil can absorb, then runoff occurs. Nearly all streams in Utah are subject to heavy runoff in spring thaws and heavy summer rains, because of lack of porous soil on the watersheds. This has been enhanced further throughout the state because of loss of top soil through misuse and overgrazing. Where good soil exists, the excess soil water percolates downward and serves to supply water tables and springs. Permanent streams are maintained by springs which utilize this percolating water. Utah has many waterways which have only temporary streams, and this is indicative of aridity.

Temperature in Utah is variable and has wide ranges. Daily minima and maxima may be thirty degrees different, and the summer maximum may be 100 or more degrees higher than the winter minimum. In summer the relative humidity is extremely low and the evaporation rate is high. Scanty precipitation combined with high rates of evaporation and low relative humidity result in desert conditions, common to Utah. The average relative humidity in Utah is near 50 per cent and is like that of Arizona and Nevada. In contrast, other western mountain states have 50-65 per cent; great plains, 70-75 per cent and the seacoast, 75-80 per cent. Because of the low humidity and high temperatures, the evaporation rate in Utah is extremely high, averaging 45-55 inches per year from free water surfaces in the western valleys.

CHECK-LIST OF MAMMALS OF UTAH

Order INSECTIVORA—insectivores

Family SORICIDAE—shrews

Genus **Sorex** Linnaeus—long-tailed shrews

Order CHIROPTERA—bats

Family VESPERTILIONIDAE—vespertilionid bats

Genus **Myotis** Kaup—mouse-eared bats

Genus **Lasionycteris** Peters—silvery-haired bats

Genus **Pipistrellus** Kaup—pipistrelles

Genus **Eptesicus** Rafinesque—serotine bats

Genus **Lasiurus** Gray—hairy-tailed bats

Genus **Corynorhinus** H. Allen—long-eared bats

Genus **Euderma** H. Allen—spotted bat

Genus **Antrozous** H. Allen—nyctophyline bats

Family MOLOSSIDAE—molossid bats

Genus **Tadarida** Rafinesque—free-tailed bats

Order LAGOMORPHA—hares, rabbits and pikas

Family OCHOTONIDAE—pikas

Family LEPORIDAE—hares and rabbits

Order RODENTIA—rodents

Family SCIURIDAE—squirrels

Genus **Dipodomys** Gray—kangaroo rats		PAGE
Dipodomys ordii celeripes Durrant and Hall	Ord kangaroo rat	252
Dipodomys ordii utahensis (Merriam)		
Dipodomys ordii marshalli Goldman		
Dipodomys ordii cineraceus Goldman		
Dipodomys ordii priscus Hoffmeister		
Dipodomys ordii pallidus Durrant and Setzer		
Dipodomys ordii uintensis Durrant and Setzer		
Dipodomys ordii sanrafaeli Durrant and Setzer		
Dipodomys ordii nexilis Goldman		
Dipodomys ordii fetosus Durrant and Hall		
Dipodomys ordii fremonti Durrant and Setzer		
Dipodomys ordii cinderensis Hardy		
Dipodomys ordii panguitchensis Hardy		
Dipodomys ordii cupidineus Goldman		
Dipodomys ordii longipes (Merriam)		
Dipodomys microps bonnevillei Goldman	chisel-toothed kangaroo rat,	269
Dipodomys microps russeolus Goldman		
Dipodomys microps alfredi Goldman		
Dipodomys microps subtenuis Goldman		
Dipodomys microps celsus Goldman		
Dipodomys microps woodburyi Hardy		
Dipodomys merriami vulcani Benson	Merriam kangaroo rat	278
Dipodomys merriami merriami Mearns		
Dipodomys deserti deserti Stephens	desert kangaroo rat	280

Family CASTORIDAE—beavers

Genus **Castor** Linnaeus—beavers		
Castor canadensis pallidus Durrant and Crane	beaver	284
Castor canadensis rostralis Durrant and Crane		
Castor canadensis duchesnei Durrant and Crane		
Castor canadensis repentinus Goldman		

Family CRICETIDAE—native rats and mice

Genus **Reithrodontomys** Giglioli—American harvest mice		
Reithrodontomys megalotis megalotis (Baird)	western harvest mouse	295
Reithrodontomys megalotis ravus Goldman		
Reithrodontomys megalotis aztecus Allen		

Order CARNIVORA—carnivores

Family CANIDAE—foxes, coyotes and wolves

Family URSIDAE—bears

Family PROCYONIDAE—raccoons and allies

Family MUSTELIDAE—weasels and allies

ACCOUNTS OF SPECIES AND SUBSPECIES

KEY TO ORDERS OF MAMMALS IN UTAH

1.–Forelimbs modified as flight organs; elongated fingers longer than forearm and supporting a membraneous wing.....Chiroptera (Bats), p. 38

1'.–Forelimbs not modified as flight organs; fingers shorter than forearm and not supporting a membraneous wing.

2.–Upper incisors present; feet provided with claws.

3.–Tooth-rows continuous, no diastemae, that is, no spaces devoid of teeth as long as first molar; canines present.

4.–Canine teeth approximately same size as teeth on either side of them; middle incisors largest; snout long.

Insectivora (Shrews), p. 30

4'.–Canine teeth larger than teeth on either side of them; incisors of approximately the same size.

Carnivora (Flesh eaters), p. 392

3'.–Tooth-rows with large diastemae (spaces devoid of teeth, longer than lower first molar); canines absent.

5.–Incisors 2 above and 2 below..Rodentia (Rodents), p. 92

5'.–Incisors 4 above and 2 below.

Lagomorpha (Rabbits, Hares), p. 66

2'.–Upper incisors absent; feet provided with hooves.

Artiodactyla (Deer, Sheep, etc.), p. 452

Order INSECTIVORA

Insectivores

Genus Sorex Linnaeus

Long-tailed Shrews

Small mammals (averaging less in size than mice), nose long and pointed, mouth markedly subterminal, eyes minute, pelage velvet-like, ears well developed, but hidden in fur, bones of skull coalesced in adults, zygomatic arches lacking, caudal margin of palate truncate, tooth rows continuous (no diastema) and teeth with high cusps, first incisors enlarged in both jaws, teeth unicuspidate from I1 to P3, and i1 to m1, dental formula, i. $\frac{3}{1}$, c. $\frac{1}{1}$, p. $\frac{3}{1}$, m. $\frac{3}{3}$.

The genus *Sorex* is represented in Utah by four kinds, belonging to four full species.

Key to Species of *Sorex* in Utah

1.–Total length usually less than 130; hind foot not fimbriated, less than 17.

2.–Third unicuspid tooth smaller than fourth.

3.–Tail usually less than 44; interorbital breadth less than 3.3, *Sorex vagrans*, p. 31

3'.–Tail usually more than 44; interorbital breadth more than 3.3, *Sorex obscurus*, p. 34

2'.–Third unicuspid tooth not smaller than fourth *Sorex merriami*, p. 31
1'.–Total length usually more than 130; hind foot fimbriated, more than 17 ..... *Sorex palustris*, p. 35

Sorex merriami leucogenys Osgood

Merriam Shrew

Sorex leucogenys Osgood, Proc. Biol. Soc. Washington, 22:52, April 17, 1909, type from mouth of the canyon of Beaver River approximately 3 miles east of Beaver, Beaver County, Utah; Barnes, Bull. Univ. Utah, 17 (no. 12):15, June, 1927.
Sorex merriami leucogenys, Benson and Bond, Journ. Mamm., 20:348, August 14, 1939.

Range.—Known only from the type locality and War God Spring, San Juan County.

Description and comments.—Osgood (1909a:53) gives the following measurements of the type: Total length, 107; length of tail, 38; length of hind foot, 12.5. Color: Upper parts pale Hair Brown grading through Light Drab on flanks to nearly white on underparts; chin, lips and sides of face below eyes pale Olive-Buff; feet white, tinged with Light Buff; tail markedly bicolored, Drab dorsally, white ventrally and tipped with white. Skull: Braincase rising abruptly in frontal region; unicuspid tooth rows diverging posteriorly; third unicuspid not smaller than fourth; posterior margin of infraorbital foramen anterior to, or in a plane with, interspace between M1 and M2.

Compared with *Sorex merriami merriami*, of more northern distribution, which may occur in Utah although no specimen has been recorded to date, S. *m. leucogenys* is larger, of same color, has a larger skull, more vaulted braincase and less nearly parallel unicuspid tooth rows.

Six of the ten known specimens, including the holotype, of the subspecies are from Utah. Although recorded from only two localities in Utah, the known distribution of the species S. *merriami* outside the state would indicate a state wide distribution for it and possibly for the subspecies S. *m. leucogenys*.

Specimens examined.—Total, 5, from: *San Juan County:* War God Spring, 8,400 ft., 5 (M. V. Z.).

Additional record (Osgood, 1909:52).—*Beaver County:* Mouth of Beaver Canyon, 3 mi. E Beaver.

Sorex vagrans monticola Merriam

Vagrant Shrew

Sorex monticolus Merriam, N. Amer. Fauna, 3:43, September 11, 1890, type from San Francisco Mountain, 11,500 ft., Coconino County, Arizona.
Sorex vagrans monticola Merriam, N. Amer. Fauna, 10:69, December 31, 1895; Jackson, N. Amer. Fauna, 51:110, July 24, 1928; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 9, 1942; Hayward, The Great Basin Nat., 6:109, November 15, 1945.

Sorex vagrans dobsoni Merriam, N. Amer. Fauna, 10:69, December 31, 1895 (The name *Sorex dobsoni* was proposed by Merriam, N. Amer. Fauna, 5:33, July 30, 1891, with type from Alturus or Sawtooth Lake, east base of Sawtooth Mountains, 7,200 ft., Blaine County, Idaho, but now is regarded as a synonym of *Sorex monticolus* Merriam); Warren, The mammals of Colorado, The Knickerbocker Press, p. 264, 1910; Barnes, Bull. Univ. Utah, 17 (no. 12):11, June, 1927.
Sorex dobsoni, Barnes, Bull. Univ. Utah, 12 (no. 15):153, April, 1922.

Range.—State-wide in mountain ranges and adjacent valleys.

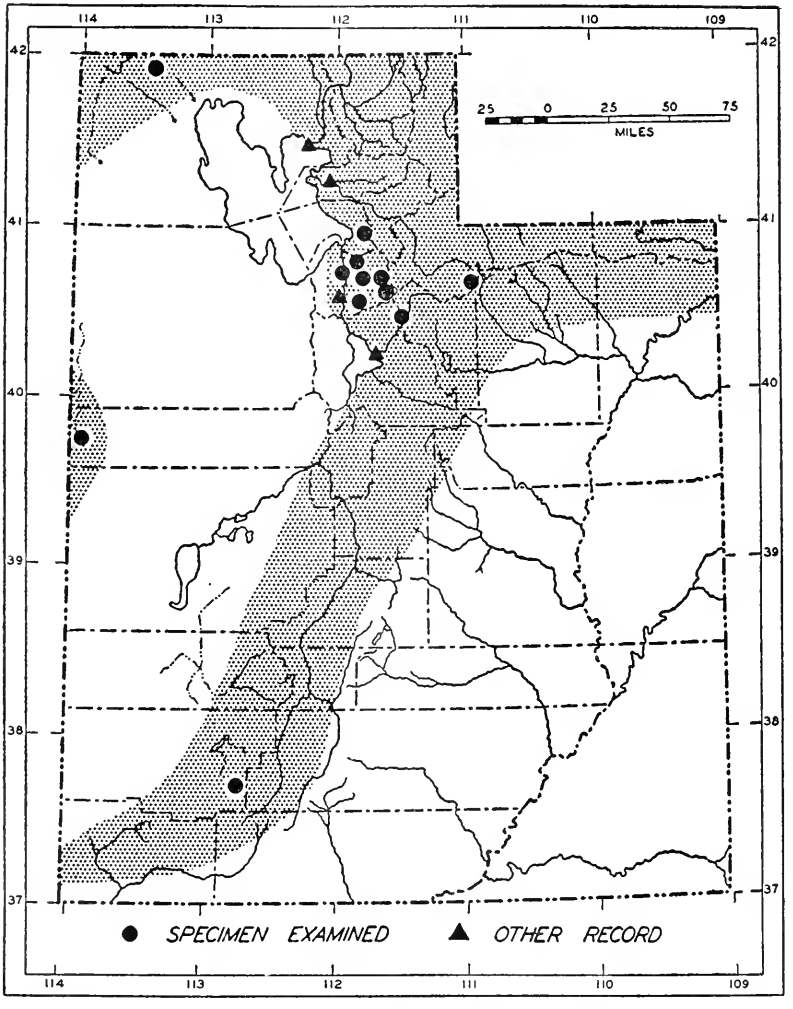

FIG. 1. Distribution of *Sorex vagrans monticola*.

Description and comments.—Average and extreme measurements of 4 males, and measurements of 2 females numbers 4232 and 4416, from one mile west of Draper, 4,500 feet, Salt Lake County, are, respectively, as follows: Total length, 114 (119-102), 112, 109; length of tail, 36 (39-34), 39, 34; length of hind foot, 12 (13-12), 14, 13; length of ear, 5 (5-6), 5, 4. Color: Upper parts brown grading over sides and flanks through Drab to Pinkish Buff on underparts; tail bicolored, brown above, Pinkish Buff below. Skull: Small; rostrum narrow; third unicuspid tooth not larger than fourth (in some specimens nearly same size); unicuspid teeth small and weak; narrow interorbitally.

The only subspecies known from Utah is *S. v. monticola.* Comparing only specimens from Utah, *S. v. monticola* is difficult to distinguish from *Sorex obscurus,* but differs in: Tail shorter; color usually darker; rostrum shorter and narrower; braincase a trifle more vaulted; palate narrower and shorter; interorbital breadth relatively narrower; teeth smaller, especially unicuspids, and protoconid of m1.

Sorex v. monticola and *Sorex o. obscurus* occur in the same areas in the Wasatch and Uinta mountains and at Brian Head in Iron County. Otherwise all of the *S. v. monticola* were taken at elevations lower than *S. obscurus* which is known only from the high mountain country. *S. v. monticola* occurs in valleys and marshes and has been taken in a far wider range of ecological conditions than has *S. obscurus.* Four specimens from Queen of Sheba Canyon, on the west side of the Deep Creek Mountains are not typical and appear to be intergrades between *S. v. monticola* and *Sorex vagrans amoenus.* The majority of the characters are more as in *S. v. monticola.*

Specimens examined.—Total, 43, distributed as follows: *Boxelder County:* S Fork George Creek, 5 mi. SE Yost, 6,700 ft., Raft River Mountains, 1. *Davis County:* Mueller Park, 1. *Salt Lake County:* City Creek Canyon, 6 mi. NE Salt Lake City, 4,600 ft., 2; ¾ mi. above Forks, City Creek Canyon, 2; 1 mi. above mouth City Creek Cayon, 4,600 ft., 1; Salt Lake City, Ft. Douglas Reservation, 4,500 ft., 6; University of Utah Campus, Salt Lake City, 4,500 ft., 1; mouth of Emigration Canyon, 3½ mi. SE Salt Lake City, 4; Salamander Lake, head Lambs Canyon, 9,000 ft., 1; Copper Lakes, 7½ mi. SW Salt Lake City, 1 (C. M. N. H.); Brighton, Silver Lake Post Office, 8,750 ft., Big Cottonwood Canyon, 2; Draper, 4,500 ft., 4; 1 mi. W Draper, 4,500 ft., 8; 1½ mi. SW Draper, 4,500 ft., 1. *Summit County:* SW Slope Bald Peak, Uinta Mountains, 10,500 ft., 1 (M. V. Z.). *Wasatch County:* Midway, 5,600 ft., 1. *Juab County:* Queen of Sheba Canyon, W side Deep Creek Mountains, 5,600 ft., 4. *Iron County:* Mammoth Summit, Brian Head, 11,000 ft., 2 (M. V. Z.).

Additional records (Jackson, 1928:113).—*Boxelder County:* Mouth of Bear River. *Weber County:* Ogden. *Salt Lake County:* Midvale. *Utah County:* Provo, near shore of Utah Lake.

Sorex obscurus obscurus Merriam

Dusky Shrew

Sorex obscurus Merriam, N. Amer. Fauna, 10:72, December 31, 1895 (renaming of *similis* Merriam), type from near Timber Creek, Lemhi Mountains, 10 miles west of Junction, 8,200 feet, Lemhi County, Idaho; Warren, The mammals of Colorado, Knickerbocker Press, p. 264, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):155, April, 1922.

Sorex vagrans similis Merriam, N. Amer. Fauna, 5:34, July 31, 1891 (not *similis* of Hensel, 1855).

Sorex obscurus obscurus, Miller, U. S. Nat. Mus. Bull., 79:15, December 31, 1912; Barnes, Bull. Univ. Utah, 17 (no. 12):12, June, 1927; Jackson, N. Amer. Fauna, 51:117, July 24, 1928; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 10, 1942.

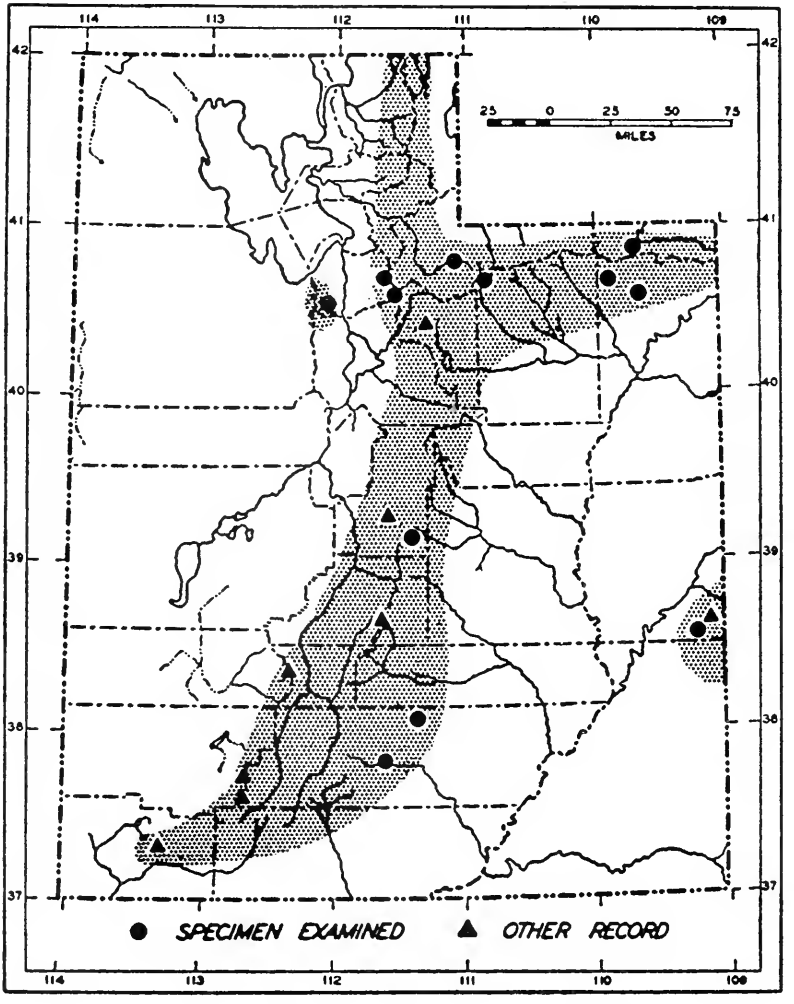

FIG. 2. Distribution of *Sorex obscurus obscurus*.

Range.—All the high mountains of the state, with the possible exception of the Deep Creek and Raft River mountains.

Description and comments.—The measurements of one female, number 707, from Mirror Lake, 10,000 ft., Duchesne County, are as follows: Total length, 104; length of tail, 43; length of hind foot, 11; length of ear, 6. Color: Upper parts Hair Brown mixed with gray, paling over sides to Pale Smoke Gray overlaid with Light Buff on underparts; tail bicolored, lighter below; feet white. Skull: Braincase moderately inflated; palate and rostrum long; dentition moderately heavy; protoconid of m1 well developed.

This shrew is the only member of the species *Sorex obscurus* known to occur in Utah. Superficially it resembles *Sorex vagrans monticola.* Differences between the two are given in the account of the latter form.

Specimens examined.—Total, 42, distributed as follows: *Summit County:* Smith and Morehouse Canyon, 7,000 ft., 1. *Daggett County:* Junction Deep and Carter Creeks, 7,900 ft., 1. *Duchesne County:* Mirror Lake, 10,000 ft., 2. *Uintah County:* Paradise Park, 10,000 ft., Uinta Mountains, 7; Junction Trout Creek and Ashley Creek, 9,700 ft., 1. *Salt Lake County:* Salamander Lake, head Lambs Canyon, 9,000 ft., 3; The Firs, Millcreek Canyon, 7,000 ft., 1; Brighton, Big Cottonwood Canyon, 8,685 ft., 14; Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 7,000 ft., 1. *Grand County:* Warner R. S., La Sal Mountains, 9,700 ft., 2. *Sanpete County:* Mt. Baldy R. S., Manti National Forest, 9,600 ft., 1. *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 7; 18 mi. N Escalante, 9,500 ft., 1.

Additional records (Jackson, 1928:122, unless otherwise indicated).—*Wasatch County:* Current Creek, Uinta Mountains; Wasatch Mountains. *Sanpete County:* Manti. *Sevier County:* Fish Lake Plateau. *Grand County:* La Sal Mountains, 11,000 ft. *Beaver County:* Puffer Lake, Beaver Mountains. *Iron County:* Brian Head, Parowan Mountains; Cedar Breaks (listed as occurring, no specimen listed, Presnall, 1938:6). *Washington County:* Pine Valley Mountains, 8,300 ft.

Sorex palustris navigator (Baird)

Water Shrew

Neosorex navigator Baird, Report Pacific R. R. Survey, 8, pt. 1, Mammals, p. 11, 1857, type from near head of Yakima River, Cascade Mountains, Washington; Warren, The mammals of Colorado, Knickerbocker Press, p. 266, 1910; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 11, 1942.

Sorex palustris navigator, Stephens, California mammals, p. 254, June, 1906; Barnes, Bull. Univ. Utah, 17 (no. 12):13, June, 1927; Jackson, N. Amer. Fauna, 51:184, July 24, 1928.

Sorex (Neosorex) palustris navigator, Merriam, N. Amer. Fauna, 10:92, December 31, 1895.

Neosorex palustris navigator, Barnes, Bull. Univ. Utah, 12 (no. 15):157, April, 1922.

Range.—Nearly all permanent streams in mountainous areas.

Description and comments.—Average and extreme measurements of 4 adult males and 4 adult females from City Creek Canyon, Salt Lake County, are respectively as follows: Total length, 145 (150-138), 133 (142-127); length of tail, 68 (70-65), 66 (72-62); length of hind foot, 19 (20-15), 19 (20-18); length of ear, 4 (4-4), 5 (6-4). Inner margin of hind feet fimbriated. Color: Upper parts Mouse Gray with numerous white-tipped hairs, giving a salt and

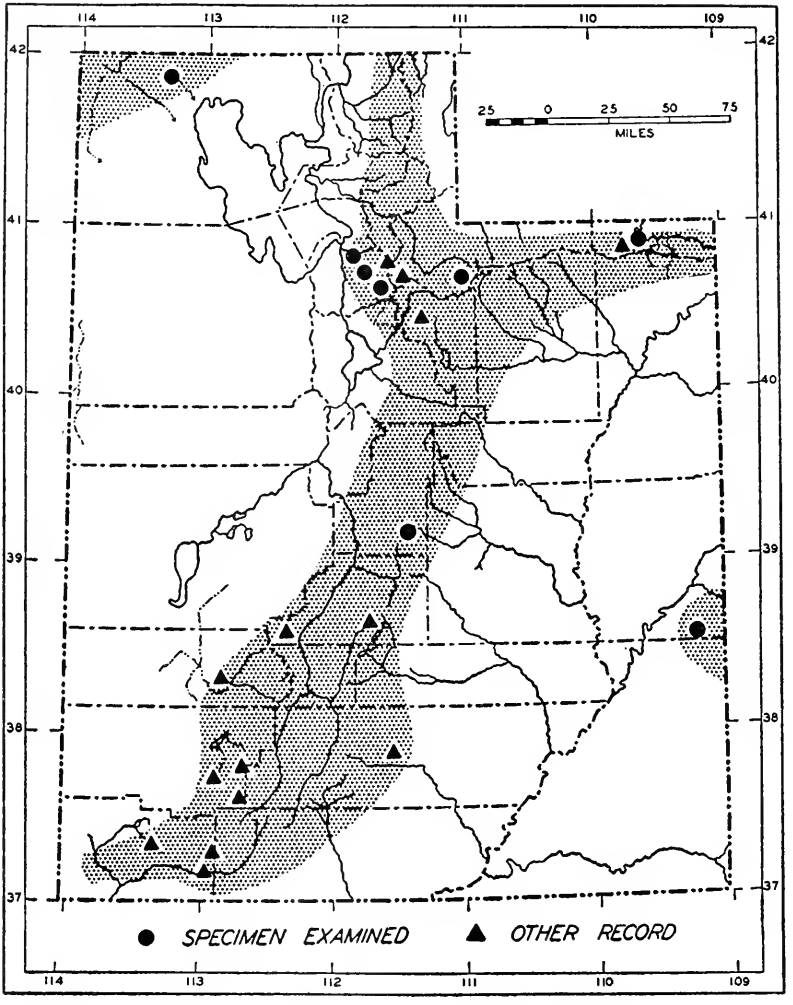

FIG. 3. Distribution of *Sorex palustris navigator*.

pepper appearance, extent of white sometimes gives a silvery sheen to pelage; more brownish in summer; underparts, lips, and chin Pale Smoke Gray, hairs tipped with white, or Pale Olive-Buff; tail bicolored, blackish brown above, white below, white extending nearly to tip; tip white in some specimens. Skull: Flat, braincase rising but little above dorsal margin of rostrum; interorbital breadth actually as well as relatively narrow; dentition relatively weak; posterior margins of molariform teeth markedly emarginate.

This shrew is the largest insectivore in the state. It is further distinguished from all other members of its genus, within the state,

by its grizzled salt and pepper appearance and markedly fimbriated hind feet.

City Creek Canyon, immediately north of the state capitol building has yielded many specimens. My observations show them to be perfectly at home on the water, in the water and under the water. All specimens that I have trapped were at the edge of the water.

Specimens examined.—Total, 34, distributed as follows: *Boxelder County:* Pine Canyon, 6,600 ft., Raft River Mountains, 2 (M. V. Z.). *Salt Lake County:* City Creek Canyon, 19; Ft. Douglas Reservation, 4,500 ft., 2; mouth of Emigration Canyon, 1. *Summit County:* SW Slope Bald Peak, Uinta Mountains 10,500 ft., 2 (M. V. Z.). *Daggett County:* Carter Creek, 9,000 ft., 1. *Sanpete County:* Mammoth R. S., Manti National Forest, 2. *Grand County:* Warner R. S., 9,700 ft., La Sal Mountains, 5.

Additional records (Jackson, 1928:188, unless otherwise indicated).—*Salt Lake County:* Wasatch Mountains; Barclay. *Summit County:* Park City. *Daggett County:* Beaver Creek, 8,450 ft., (Svihla, 1931:258). *Wasatch County:* Current Creek, Uinta Forest. *Sevier County:* Fishlake Plateau; Clear Creek. *Beaver County:* Puffer Lake; Beaver (Long, 1940:172); 4 mi. E Beaver, 6,500 feet (Long, *loc. cit.*). *Iron County:* Brian Head, Parowan Mountains; Cedar Breaks (Presnall, 1938:6); Cedar City (Long, *loc. cit.*). *Garfield County:* Kaiparowits Plateau (Tanner, 1940a:111). *Washington County:* Pine Valley; Zion National Park (Presnall and Hall, 1936:211); Springdale, 3,850 feet (Presnall and Hall, *loc. cit.*).

TABLE 1

Cranial Measurements of Sorex

NAME AND LOCALITY	Number of individuals averaged or catalog number	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth-row	Wear of teeth*
S. m. leucogenys									
type	157952 USNM	♀	.....	7.0	8.4	3.7	5.2	7.4	.....
(Osgood, 1909a:53)									
S. v. monticola									
1 mi. W Draper	4 av...	♂	15.8	6.3	8.1	3.1	4.6	6.0	2
1 mi. W Draper	max...	♂	16.0	7.0	8.4	3.2	4.7	6.4	2
1 mi. W Draper	min....	♂	15.6	5.7	7.8	3.0	4.5	5.8	2
1 mi. W Draper	4232...	♀	15.9	6.4	8.2	3.2	5.0	5.9	3
1 mi. W Draper	4416...	♀	15.9	6.4	8.1	3.1	4.8	5.8	1
S. o. obscurus									
Mirror Lake	707....	♀	17.2	7.2	8.5	3.4	5.1	7.1	1
S. p. navigator									
City Creek Canyon	4 av...	♂	19.7	8.4	9.9	3.8	5.9	7.6	2
City Creek Canyon	max...	♂	19.7	8.5	10.0	3.9	6.1	7.7	2
City Creek Canyon	min....	♂	19.6	8.3	9.7	3.7	5.6	7.3	2
City Creek Canyon	4 av...	♀	19.7	8.4	9.3	3.8	5.8	7.4	2
City Creek Canyon	max...	♀	20.1	8.6	9.3	3.9	6.1	8.0	2
City Creek Canyon	min....	♀	19.0	8.3	9.3	3.7	5.4	7.2	2

* 1, unworn; 2, moderately worn; 3, well worn.

Order CHIROPTERA

Bats

The only mammals capable of sustained flight. The bones of the arms and particularly of the hands greatly elongated for support of flight membrane, a double layered extension of the body integument, which is further attached to hind legs and tail. Calcar and clavicle well developed; sternum keeled; thumb free and clawed; knee joint directed backwards and outward; toes free, five in number and with curved claws; ulna markedly reduced; tragus well developed; eyes minute; dentition tuberculosectorial; molars with W-shaped pattern of cusps.

All bats from Utah belong to the suborder Microchiroptera. The nineteen kinds known to occur within the state represent two families, nine genera and seventeen full species.

KEY TO BATS OF UTAH

1.–Tail projecting conspicuously beyond interfemoral membrane; fifth finger markedly shortened; anterior margin of palate emarginate. Molossidae

1'.–Tail not projecting conspicuously beyond interfemoral membrane; fifth finger not markedly shortened; anterior margin of palate rounded or truncate ..... Vespertilionidae

Molossidae

1.–No pocket in membrane at angle of femur and tibia; second phalanx of fourth finger more than 5; lower incisors 2 or 3 on each side; ears shortened not extending markedly beyond muzzle when laid forward. *Tadarida mexicana*, p. 63

1'.–Pocket present in membrane at angle of femur and tibia; second phalanx of fourth finger less than 5; lower incisors 2 on each side; ears extending markedly beyond muzzle when laid forward. *Tadarida molossa*, p. 63

Vespertilionidae

1.–Dorsal surface of interfemoral membrane heavily furred; ears short and round.

2.–Upper incisors one on each side; dorsal coloration reddish or brownish, the hairs tipped with white.

3.–Size large; upper parts grayish (frosted); ears with black rim. *Lasiurus cinereus*, p. 56

3'.–Size medium; upper parts reddish; ear without black rim. *Lasiurus borealis*, p. 56

2'.–Upper incisors two on each side; dorsal coloration blackish the hairs tipped with white..... *Lasionycteris noctivagans*, p. 50

1'.–Dorsal surface or interfemoral membrane not densely furred; ears usually pointed.
4.–Ear long, more than 25 from notch.
5.–Ears joined by membrane across forehead; three white spots on black dorsal surface . . . *Euderma maculatum*, p. 59
5'.–Ears not joined by membrane across forehead; dorsal surface never black and white.
6.–Length of ear from notch more than ½ the length of forearm; a distinct, large, clublike excrescence on each side of rostrum . . . . . *Corynorhinus rafinesquii*, p. 58
6'.–Length of ear from notch less than ½ the length of forearm; no clublike excrescence on rostrum.
Antrozous pallidus, p. 60
4'.–Ear less than 25 from notch.
7.–Length of tragus usually less than ½ the length of ear from notch . . . . . *Pipistrellus hesperus*, p. 51
7'.–Length of tragus usually more than ½ the length of ear from notch.
8.–Tragus broadly rounded at tip; teeth 32.
Eptesicus fuscus, p. 53
8'.–Tragus usually long, slender and sharply pointed; teeth 38 . . . . . *Myotis*, p. 40

Genus Myotis

1.–Foot small, 7 or less.
2.–Hairs on back with long, shiny tips, giving a burnished appearance; third metacarpal shorter than forearm . . . . . *Myotis subulatus*, p. 48
2'.–Hairs on back dull-tipped; third metacarpal as long as forearm.
Myotis californicus, p. 46
1'.–Foot large, 8 or more.
3.–Under side of wing furred to elbow; ratio of foot to length of tibia less than 41 . . . . . *Myotis volans*, p. 44
3'.–Under side of wing not furred to elbow; ratio of foot to length of tibia 48-60.
4.–Ear relatively long, 16 or more . . . . . *Myotis evotis*, p. 43
4'.–Ear relatively short, less than 16.
5.–Length of forearm more than 42 . . . . . *Myotis velifer*, p. 43
5'.–Length of forearm less than 40.
6.–Length of forearm 33-37; total length usually less than 80; dorsal hairs dull-tipped.
Myotis yumanensis, p. 42
6'.–Length of forearm 37-40; total length usually more than 80; dorsal hairs bronzy-tipped.
Myotis lucifugus, p. 40

Myotis lucifugus carissima Thomas

Big Myotis

Myotis (Leuconoe) carissima Thomas, Ann. and Mag. Nat. Hist., (ser. 7) 13:383, May, 1904, type from Yellowstone Lake, Yellowstone National Park, Wyoming.

Myotis lucifugus carissima, Miller and Allen, Bull. U. S. Nat. Mus., 144:50, May 25, 1928; Hardy, Journ. Mamm., 22:289, August 14, 1941.

Myotis lucifugus longicrus, Barnes, Bull. Univ. Utah, 12 (no. 15):163, April, 1922.

Range.—The known areas of occurrence in Utah are from Utah, Davis, Salt Lake, Uintah, Boxelder and Wayne counties.

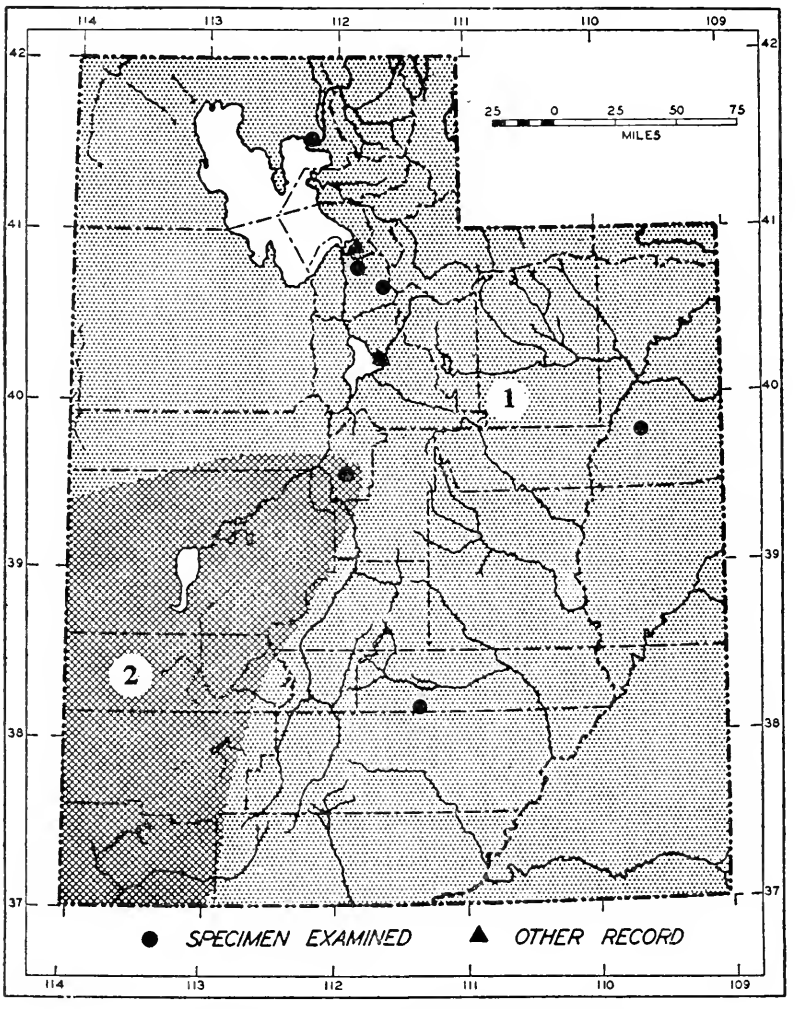

FIG. 4. Distribution of *Myotis lucifugus.*
1. *M. l. carissima.* 2. *M. l. phasma.*

Description and comments.—Average and extreme measurements of 7 females from mouth of Bear River, Boxelder County, are as follows: Total length, 83 (90-79); length of tail, 36 (40-31); length of hind foot, 8.3 (9.0-8.0); length of ear from meatus, 13.5 (14.5-12.0); length of forearm, 38.5 (39.0-37.5) (Miller and Allen, 1928:52); foot large, more than half as long as tibia; ears reaching nostril when laid forward. Color: Upper parts with gold-tipped hairs, base of hairs plumbeous; general over-all color Cinnamon-Buff; shoulder spots Ochraceous-Tawny; membranes pale-edged; underparts Cartridge Buff; ears, feet and proximal parts of membranes black. Skull: Small; rostrum short; braincase subcircular; tooth formula i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$.

Myotis l. carissima differs from *Myotis lucifugus phasma* in more golden-color, black, instead of brown, ears and proximal parts of membranes; smaller foot; and shorter thumb.

Miller and Allen (1928:52) list specimens from Boxelder, Davis and Utah counties. In their account of *Myotis l. phasma* (1928:53) they mention two specimens from Bear River, Boxelder County, which . . . "seem better referred to *carissima*." According to their distribution map (*op. cit.*:38) these two kinds of bats may intergrade in Boxelder County; but no specimens are available to show this. To date, the most southerly known record of occurrence of *M. l. carissima* in Utah was from Provo, Utah County (Miller and Allen, 1928:52). Six specimens in the collections of the Department of Vertebrate Zoölogy, University of Utah, now show the range of this subspecies to extend 125 miles farther south into Wayne County. These animals from Wayne County have darker (more golden) color on the upper parts and the proximal parts of the membranes and ears are darker than in the one specimen of *M. l. phasma* that I have seen and the specimens are here referred to *M. l. carissima.*

Specimens examined.—Total, 12, distributed as follows: *Boxelder County:* Bear River Migratory Bird Refuge, 1. *Salt Lake County:* Salt Lake City, 4,300 ft., 2; Silver Lake Post Office (Brighton), 8,750 ft., 2. *Uintah County:* Willow Creek, 5,250 ft., 25 mi. S Ouray, 1. *Wayne County:* Donkey Lake, Boulder Mountain, 10,000 ft., 6.

Additional records (Miller and Allen, 1928:52).—*Davis County:* Bountiful. *Utah County:* Provo.

Myotis lucifugus phasma Miller and Allen

Big Myotis

Myotis lucifugus phasma Miller and Allen, Bull. U. S. Nat. Mus., 144:53, May 25, 1928, type from Snake River, south of Sunny Peak, Routt County, Colorado; Hardy, Journ. Mamm., 22:289, August 14, 1941.

Range.—Recorded only from Juab County.

Description and comments.—Measurements of a male, number 1418, from Burriston are: Total length, 88; length of tail, 29; length of hind foot, 15; length of tragus, 8; length of forearm, 38.2. Color: Hairs on upper parts

somewhat tricolored, plumbeous at base, followed by Ochraceous-Buff, and Light Buff terminally; coat characteristically pinkish, with gold sheen, owing to light colored tips of hairs; shoulder spots pale Cinnamon; muzzle, ears, feet and membranes brownish; posterior edge of wings and median distal interfemoral membranes white; underparts white, with wash of pale buff. Skull: as in *Myotis lucifugus carissima.*

For comparison with *M. l. carissima,* see account of that subspecies. *M. l. phasma* closely resembles *Myotis yumanensis* in color, but has longer hair with glossy, instead of non-glossy tips, longer wings and a more nearly flat skull.

In the original description of *M. l. phasma,* Miller and Allen noted that "Its presence in southern Utah can not be doubted, but no specimens are at hand." Subsequently Hardy (1941:289) obtained specimens at Burriston, from a deserted building.

Specimen examined.—One from Burriston, Juab County.

Myotis yumanensis yumanensis (H. Allen)

Yuma Myotis

Vespertilio yumanensis H. Allen, Smithsonian Misc. Coll., 165:58, June, 1864, type from right side of Colorado River, Old Fort Yuma, Imperial Valley, California.

Myotis yumanensis, Miller, N. Amer. Fauna, 13:66, October 16, 1897; Barnes, Bull. Univ. Utah, 12 (no. 15):158, April, 1922.

Myotis yumanensis yumanensis, Barnes, Bull. Univ. Utah, 17 (no. 12):17, June, 1927; Hardy, Journ. Mamm., 22:289, August 14, 1941.

Range.—The only definite records are from Washington County. See figure 17.

Description and comments.—A female, number 5553 K.U., from Pyramid Lake, Nevada, has the following measurements: Total length, 80; length of tail, 35; length of hind foot, 9.4; length of ear, 13.4; length of tragus, 7.0. Color: Upper parts pale buff, hairs nearly Fuscous for basal half; underparts Cartridge Buff, basal part of hairs like those of dorsal surface; posterior ventral surface with white hairs; membranes pale brown; edge of interfemoral membrane and tip of tail white. Skull: Similar to *Myotis lucifugus,* but smaller throughout. For comparison, see account under *M. l. phasma.*

Miller (1897:67) lists one specimen of *Myotis y. yumanensis* from Provo, Utah County, and Hardy (1941:289) cites this occurrence without comment. However, in the revision by Miller and Allen (1928:52) no specimen of this form is listed from Utah, and one specimen from Provo is listed as *Myotis lucifugus carissima.* In fact this is the only specimen of any kind of *Myotis* recorded in the revisionary paper by Miller and Allen (1928) from Provo. Probably there was only one specimen which at different times was assigned to two different species, latterly to *M. l. carissima.* The two species of *Myotis* concerned, *M. lucifugus* and *M. yumanensis,*

are easily confused. It appears from the distribution of the known specimens and from the probable reassignment of the Provo specimen that *M. y. yumanensis* occurs in only the extreme southern part of the state.

Records of occurrence (Hardy, 1941:289).—*Washington County:* Apex mine; St. George.

Myotis velifer incautus (J. A. Allen)

House Bat

Vespertilio sp., J. A. Allen, Bull. American Mus. Nat. Hist., 8:71, April 22, 1896, type from San Antonio, Bexar County, Texas.
Vespertilio incautus, J. A. Allen, Bull. American Mus. Nat. Hist., 8:239, November 21, 1896.
Myotis velifer incautus, Miller and Allen, U. S. Nat. Mus. Bull., 144:92, May 25, 1928; Hardy, Journ. Mamm., 22:290, August 14, 1941.

Range.—Recorded only from Thistle Valley.

Description and comments.—"Size maximum for the species and for the American members of the genus . . ., greatest length of skull 15.8 to 17.6 . . .; color pallid" (Miller and Allen, 1928:93).

Record of occurrence (Miller and Allen, 1928:93).—*Utah County:* Thistle Valley, 2 young specimens not seen by the present writer.

Myotis evotis evotis (H. Allen)

Long-eared Myotis

Vespertilio evotis H. Allen, Smithsonian Misc. Coll., 165:48, June, 1864 (part), type from Monterey, California (*fide* Dalquest, 1943:2).
Myotis evotis, Miller, N. Amer. Fauna, 13:77, October 16, 1897; Barnes, Bull. Univ. Utah, 12 (no. 15):165, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):19, June, 1927.
Myotis evotis chrysonotus, Hardy, Journ. Mamm., 22:290, August 14, 1941.

Range.—Recorded only from eastern and southern Utah. See figure 17.

Description and comments.—Measurements of an unsexed specimen, number 656, from Zion National Park are: Total length, 85; length of tail, 40; length of hind foot, 9; length of ear, 19 (dry); length of tragus, 9 (dry); length of forearm, 38. Color: Upperparts golden brown; ears long and black, extending beyond nose when laid forward; underparts nearly white, hairs washed with Light Buff; membranes dark brown.

This long eared, small bat is apparently nowhere common, and usually is found singly. In Utah, it has been taken at only four places of which three are in the extreme southern part of the state but record stations of occurrence outside the state (Davis, 1939:114; Warren, 1942:20; and Hall, 1946:138) indicate that the species occurs throughout Utah in appropriate habitat.

Specimens examined.—Total, 3, distributed as follows: *Uintah County:* Willow Creek, 5,250 ft., 25 mi. S Ouray, 1. *Washington County:* Zion National Park, 1. *San Juan County:* Verdure, 1.

Additional record (Hardy, 1941:290).—*Washington County:* St. George.

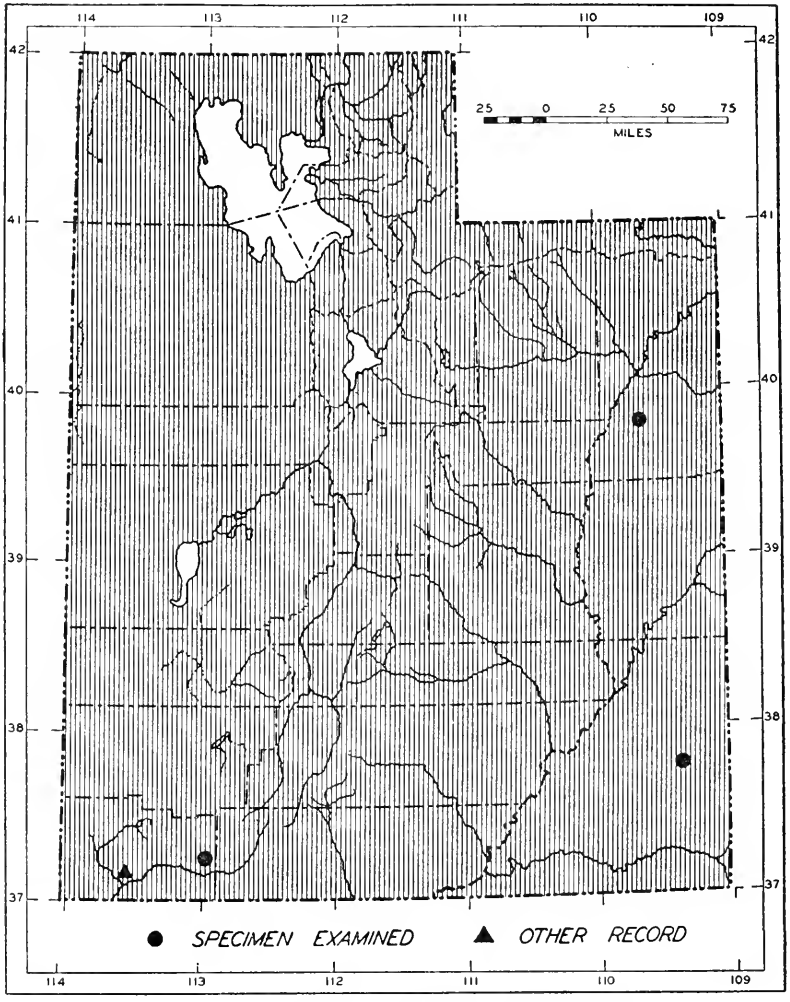

FIG. 5. Distribution of *Myotis evotis evotis*.

Myotis volans interior Miller

Hairy-winged Myotis

Myotis longicrus interior Miller, Proc. Biol. Soc. Washington, 27:211, October 31, 1914, type from Twining, Taos County, New Mexico (*fide* Miller and Allen, Bull. U. S. Nat. Mus., 144:143, May 25, 1928).

Myotis volans interior, Miller and Allen, Bull. U. S. Nat. Mus., 144:142, May 25, 1928; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935; Hardy, Journ. Mamm., 22:290, August 14, 1941; Hayward, Great Basin Nat., 6:109, November 15, 1945.

Range.—Recorded only from Boxelder, Utah, San Juan and Carbon counties.

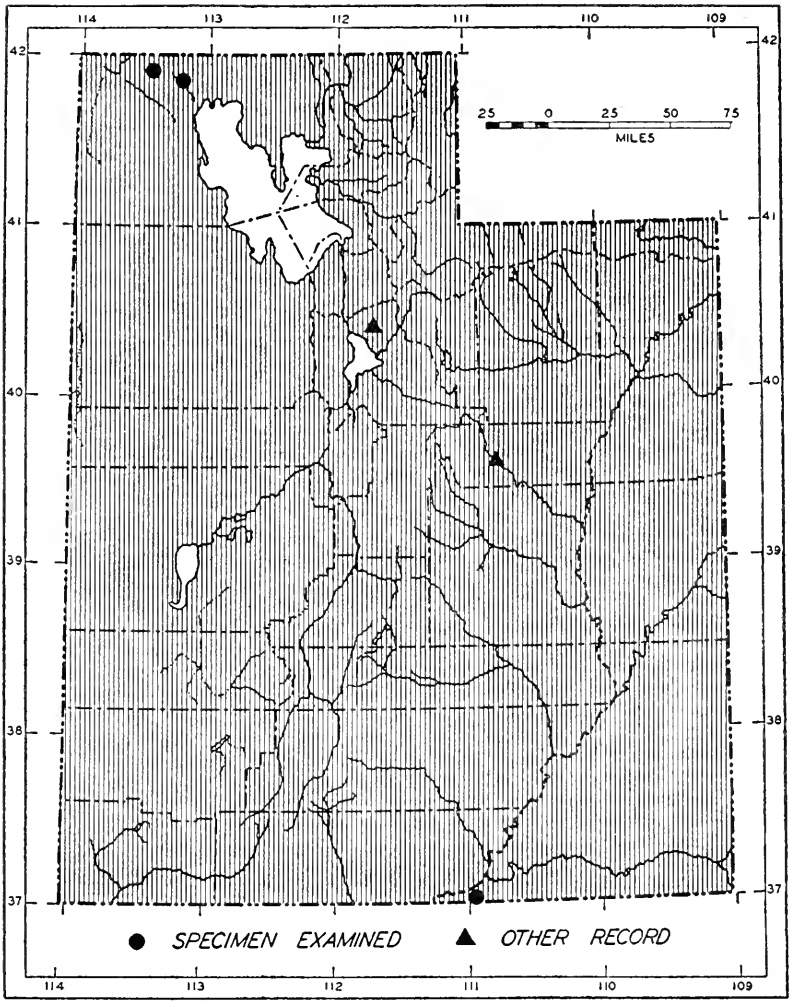

FIG. 6. Distribution of *Myotis volans interior.*

Description and comments.—Measurements of the type, a male, number 133426 U. S. N. M. are: Total length, 91; length of tail, 38.2; length of hind foot, 8.0; length of forearm, 38.0 (Miller and Allen, 1928:146). Ears short and blunt, barely reaching end of nose when laid forward; calcar distinctly keeled; underside of wing furred to level of elbow. Color: Upper parts Ochraceous-Buff to Ochraceous-Tawny, hairs black at base; underparts pale buff, hairs black at base; ears and membranes black. Skull: Small, light; rostrum short; braincase elevated; occiput high.

Specimens examined.—Total, 8, distributed as follows: *Boxelder County:* George Creek, 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 2; 5 mi. S Yost, Raft River Mountains, 4; Clear Creek, Raft River Mountains, 5 mi. SW Nafton,

6,500 ft., 1. *San Jaun County:* "near" Rainbow Bridge National Monument, 1 (M. V. Z.).

Additional records.—Utah County: [probably] Mount Timpanogos (Hayward, 1945:66, 109). *Carbon County:* Price (Hardy, 1941:290).

Myotis californicus stephensi Dalquest

California Myotis

Myotis californicus stephensi Dalquest, Proc. Biol. Soc. Washington, 59:67, March 11, 1946, type from Vallecito, San Diego County, California.

Myotis californicus, Barnes, Bull. Univ. Utah, 12 (no. 15):162, April, 1922.

Myotis californicus californicus, Barnes, Bull. Univ. Utah, 17 (no. 12):18, June, 1927.

Myotis californicus pallidus, Miller and Allen, Bull. U. S. Nat. Mus., 144: 157, May 25, 1928; Hardy, Journ. Mamm., 22:290, August 14, 1941.

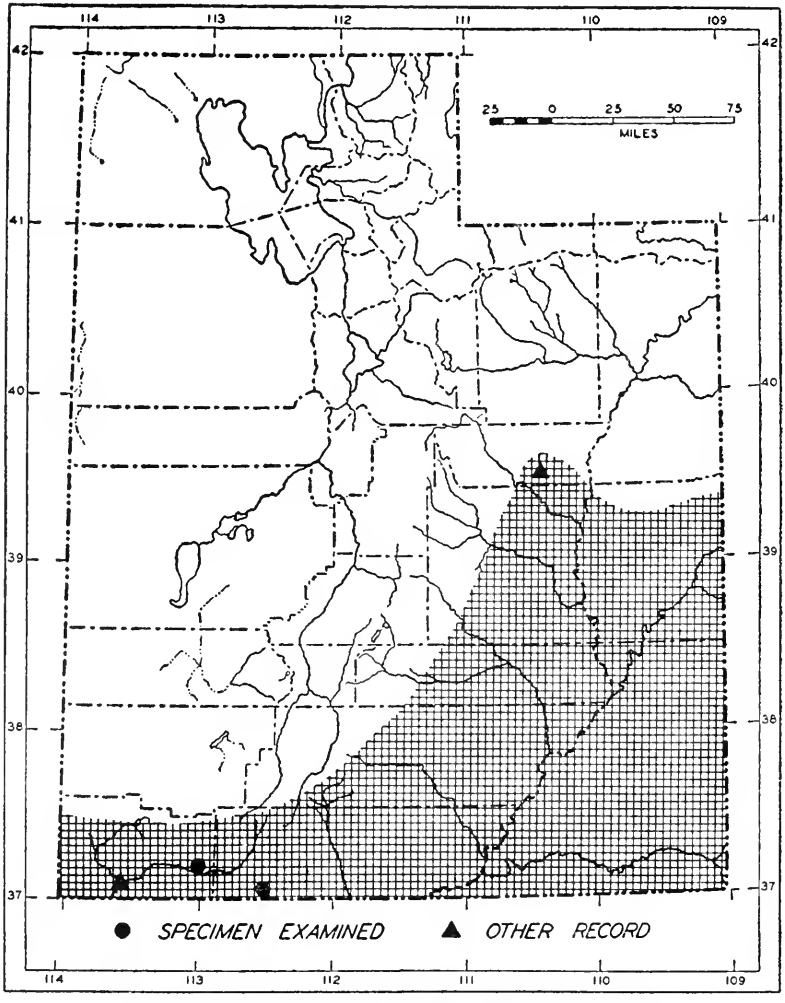

FIG. 7. Distribution of *Myotis californicus stephensi.*

Range.—Southern and eastern Utah.

Description and comments. — Measurements of an adult male, number 161291 U. S. N. M., from Kanab, are as follows: Total length, 85; length of tail, 42; length of hind foot (dry), 6.7; length of ear (dry), 11.0; length of tragus (dry), 7.0. Tail long; foot small and slender; calcar keeled. Color: Upper parts with hairs tricolored, being plumbeous basally, followed by white band and tipped with Light Ochraceous-Buff; hairs behind ears white to base; underparts nearly white or Light Buff. Skull: Delicate; rostrum long and tapering; forehead high and abrupt; braincase flat-topped; lambdoidal crest low.

This subspecies may be easily confused with *Myotis subulatus melanorhinus* and *Myotis lucifugus carissima.* From *M. s. melanorhinus, M. c. stephensi* differs in smaller size, lighter ears and membranes, and smaller skull with higher and more abruptly rising forehead. From *M. l. carissima, M. c. stephensi* differs in smaller size, smaller hind foot, more ochraceous color, and markedly smaller, less robust skull.

There are only six specimens of *M. c. stephensi* known from Utah, and they indicate that the range of this subspecies in Utah is in the drainage of the Colorado River south of the Book Cliffs. Owing to fading by preservation in formalin, of the three specimens, referable to the species *Myotis californicus,* available to Hardy, only one from St. George could be definitely assigned to *M. c. pallidus* [= *stephensi*] (Hardy, 1941:290). The specimen from Sunnyside, which is the most northerly known locality of occurrence within the state, was assigned to *M. c. pallidus* [= *stephensi*] on basis of geographic probability (Hardy, *loc. cit.*). Although not having examined the animal from Sunnyside, I am inclined to accept the designation of Hardy, because from the now known distribution of the various subspecies of *Myotis californicus* only *M. c. stephensi* would be expected to occur as far north as Carbon County. Furthermore, other kinds of mammals, less mobile than bats, and known only from the drainage of the Colorado River, have been able to extend their ranges far northward in this part of Utah. Specimens referred to by Tanner (1927:250) and Hardy (1941:290) under the name *Myotis californicus californicus,* from Aspen Grove, Mount Timpanogos, Utah County, have been lost, according to Vasco M. Tanner (*in Litt.*) and hence I have been unable to verify the occurrence.

Specimens examined.—Total, 3, distributed as follows: *Washington County:* Camp ground, Zion National Park, 4, 297 ft., 2. *Kane County:* Kanab, 1 (U.S.N.M.).

Additional records (Hardy, 1941:290).—*Carbon County:* Sunnyside. *Washington County:* St. George.

Myotis subulatus subulatus (Say)

Small-footed Myotis

Vespertilio subulatus Say, Long's Exped. to Rocky Mountains, 2:65, 1823, type from Arkansas River, near La Junta, Otero County, Colorado.
Myotis subulatus subulatus, Miller and Allen, Bull. U. S. Nat. Mus., 144:168, May 25, 1928; Hardy, Journ. Mamm., 22:291, August 14, 1941.

Range.—Recorded only from Carbon County. See figure 17.

Description and comments.—Measurements of a male from Avalo, Colorado, number 203960 U.S.N.M., are: Total length, 75.6; length of tail, 37.0; length of hind foot, 6.2; length of ear from crown, 10.8; length of forearm, 33.8 (Miller and Allen, 1928:173). Color: Upper parts from Light Buff to Warm Buff; outer base of ears and top of head white, tips of hairs washed with Light Buff; hairs on upper surface tri-colored, being plumbeous basally, nearly white in a middle band and buff at tips; underparts Light Buff to nearly white; muzzle, ears and membranes, blackish. Skull: Slender, delicate, much as in *Myotis californicus* but longer, broader and rising much less abruptly in frontal region.

The two specimens recorded by Hardy (1941:291) from Carbon County in the northeastern part of the state have not been examined by the present writer.

Record of occurrence (Hardy, 1941:291).—*Carbon County:* Soldier Canyon.

Myotis subulatus melanorhinus (Merriam)

Small-footed Myotis

Vespertilio melanorhinus Merriam, N. Amer. Fauna, 3:46, September 11, 1890, type from Little Spring, north base of San Francisco Mountain, 8,250 feet, Coconino County, Arizona.
Myotis subulatus melanorhinus, Miller and Allen, Bull. U. S. Nat. Mus., 144:169, May 25, 1928; Woodbury, Ecol. Monogr., 3:174, April, 1933; Presnall, Zion-Bryce Mus. Bull., 2:6, January, 1938; Hardy, Journ. Mamm., 22:291, August 14, 1941; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Known from Boxelder, Tooele, Emery, Grand, Washington, Kane and San Juan counties; limits of distribution unknown.

Description and comments.—Measurements of 2 males, numbers 922 and 4424, from the Colorado River and Parrish Ranch respectively, are as follows: Total length, 80, 71; length of tail, 30, 35; length of hind foot, 9, 5; length of ear, 15, 11; length of tragus, 9, 6; length of forearm, 31, 31. Hind foot small, weak. Color: Upper parts Warm Buff, hairs plumbeous at base; top of head and base of ears buffy white; underparts Light Buff, hairs plumbeous at base; sides of face, muzzle, chin, tragus and ears blackish (lighter in some specimens). Skull: Small, delicate; forehead not abrupt, but sloping; braincase flat.

M. s. melanorhinus differs from *Myotis subulatus subulatus* in darker color throughout and more glossy back.

Among the species of *Myotis*, *M. californicus* most closely resembles *M. subulatus*. Specimens of *M. californicus* may be distinguished from those of *M. subulatus* by shorter thumb, smaller teeth, less flattened braincase, and non-glossy hair.

One specimen from the Colorado River, 5 miles east of Moab, is not typical, but seems to be an intergrade between *M. s. subulatus* and *M. s. melanorhinus.* It is more pallid dorsally, and has paler ears, membranes and muzzle than *M. s. melanorhinus.*

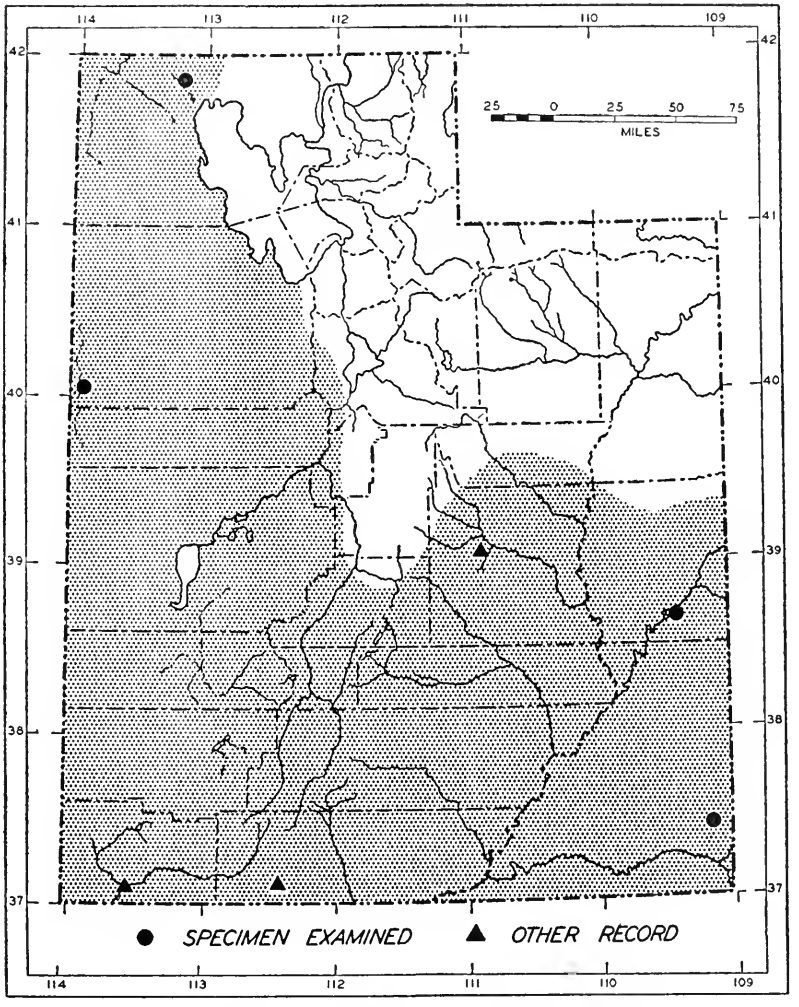

FIG. 8. Distribution of *Myotis subulatus melanorhinus.*

Specimens examined.—Total, 7, distributed as follows: *Boxelder County:* Clear Creek, Raft River Mountains, 5 mi. SW Nafton, 6,500 ft., 1. *Tooele County:* Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 4. *Grand County:* Colorado River, 5 mi. E Moab, 5,000 ft., 1. *San Juan County:* Hatch's Trading Post, 25 mi. (air) SE Blanding, 4,500 ft., 1.

Additional records (Hardy, 1941:291).—*Emery County:* Ferron. *Washington County:* St. George. *Kane County:* 4 mi. N Kanab.

Lasionycteris noctivagans (LeConte)

Silvery-haired Bat

V[espertilio]. noctivagans LeConte, McMurtrie's Cuvier Animal Kingdom, 1:431, June, 1831, type from eastern United States.

Lasionycteris noctivagans, Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, 1865, p. 648; Barnes, Bull. Univ. Utah, 12 (no. 15):159, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):19, June, 1927; Tanner, Great Basin Nat., 1:104, June 30, 1940; Hardy, Journ. Mamm., 22:291, August 14, 1941.

Range.—Seemingly state-wide in distribution.

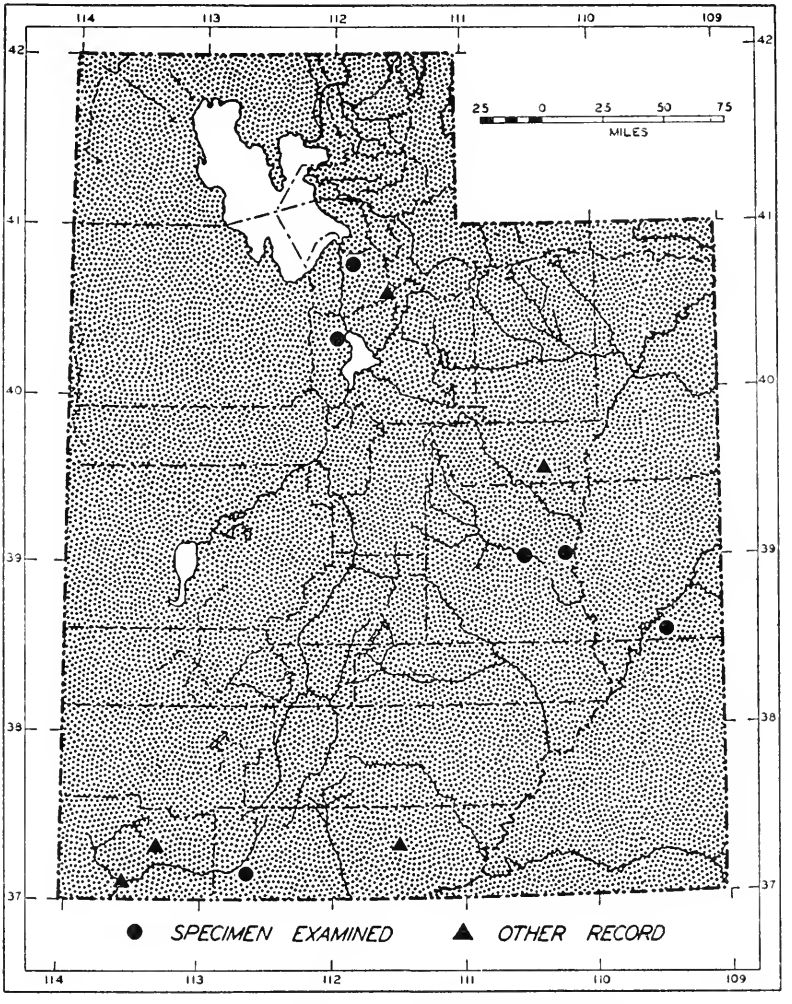

FIG. 9. Distribution of *Lasionycteris noctivagans*.

Description and comments.—Measurements of a female, number 920, from 5 miles east of Moab are: Total length, 91; length of tail, 37; length of hind foot, 10; length of ear, 17; length of tragus, 8; length of forearm, 41.4. Dorsal surface of interfemoral membrane furred. Color: Black or dark brown, hairs tipped with white giving a salt and pepper appearance, white-tipped hairs more concentrated in middorsal region; white-tipped hairs absent from throat, muzzle and top of head. Skull: Broad and flat; rostrum markedly broad with reference to braincase; tooth formula, i.$\frac{2}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{3}$, m.$\frac{3}{3}$.

Specimens examined.—Total, 6, distributed as follows: *Salt Lake County:* Salt Lake City, 1. *Utah County:* W side Utah Lake, S Pelican Point, 1. *Emery County:* Green River at Gunnison Butte, 1; San Rafael River, 15 mi. SE Huntington, 5,200 ft., 1. *Grand County:* Colorado River, 5 mi. E Moab, 5,000 ft., 1. *Kane County:* Hamblin Ranch, Cave Lake Canyon, 5 mi. NW Kanab, 5,500 ft., 2.

Additional records (Hardy, 1941:291).—*Salt Lake County:* Big Cottonwood [Canyon]. *Washington County:* Leeds; St. George. *Kane County:* Kaiparowits Plateau (Tanner, 1940:104).

Pipistrellus hesperus hesperus (H. Allen)

Western Pipistrelle

Scotophilus hesperus H. Allen, Bats N. America, Smithsonian Misc. Coll., 165:43, June, 1864, type from right side of Colorado River, Old Fort Yuma, Imperial County, California.

Pipistrellus hesperus, Miller, N. Amer. Fauna, 13:88, October 16, 1897: Barnes, Bull. Univ. Utah, 12 (no. 15):161, April, 1922.

Pipistrellus hesperus hesperus, Barnes, Bull. Univ. Utah, 17 (no. 12):21, June, 1927; Stanford, Journ. Mamm., 12:362, November 11, 1931; Benson, Univ. California Publ. Zoöl., 40:443, December 31, 1935; Hatfield, Journ. Mamm., 17:257, August 14, 1936; Presnall, Zion-Bryce Mus. Bull., 2:6, January, 1938; Tanner, Great Basin Nat., 1:104, June 30, 1940; Hardy, Journ. Mamm., 22:291, August 14, 1941.

Vesperugo hesperus, J. A. Allen, Bull. American Mus. Nat. Hist., 5:83, 1893.

Range.—Southern Utah and western Utah as far north as Tooele County.

Description and comments.—Average and extreme measurements of 6 females from 5 miles east of Moab Bridge are as follows: Total length, 72 (75-70); length of tail, 30 (32-27); length of hind foot, 7 (7-6); length of ear, 11 (11-10); length of tragus, 4 (4); length of forearm, 30.2 (31.3-29.6). Color: Upper parts dark gray with brownish cast on top of head and around base of ears; underparts pale smoke gray, the hairs everywhere with plumbeous bases; ears, muzzle and membranes black. Skull: Small, delicate; rostrum wide; braincase vaulted (essentially a replica of that of *Lasionycteris*, but markedly smaller); tooth formula, i.$\frac{2}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{3}{3}$.

In his revision of this group, Hatfield (1936:257) gave the distribution of this subspecies as extending across southern Utah as far east as Goodridge, San Juan County. Specimens now available show its range to extend northward to Tooele County in western Utah, and as far north in eastern Utah as Moab in Grand County. It probably is nearly statewide in distribution.

On April 10 and 11, 1934, an interesting flight of bats was ob-

served on the Colorado River, 5 miles east of Moab, Grand County, Utah. Just before dusk there was a flight of *Lasionycteris noctivagans* over the *Salix* that grew along the stream. Shortly after this there was a second flight consisting of *Pipistrellus h. hesperus* of which 10 were collected. This second flight was followed by yet a

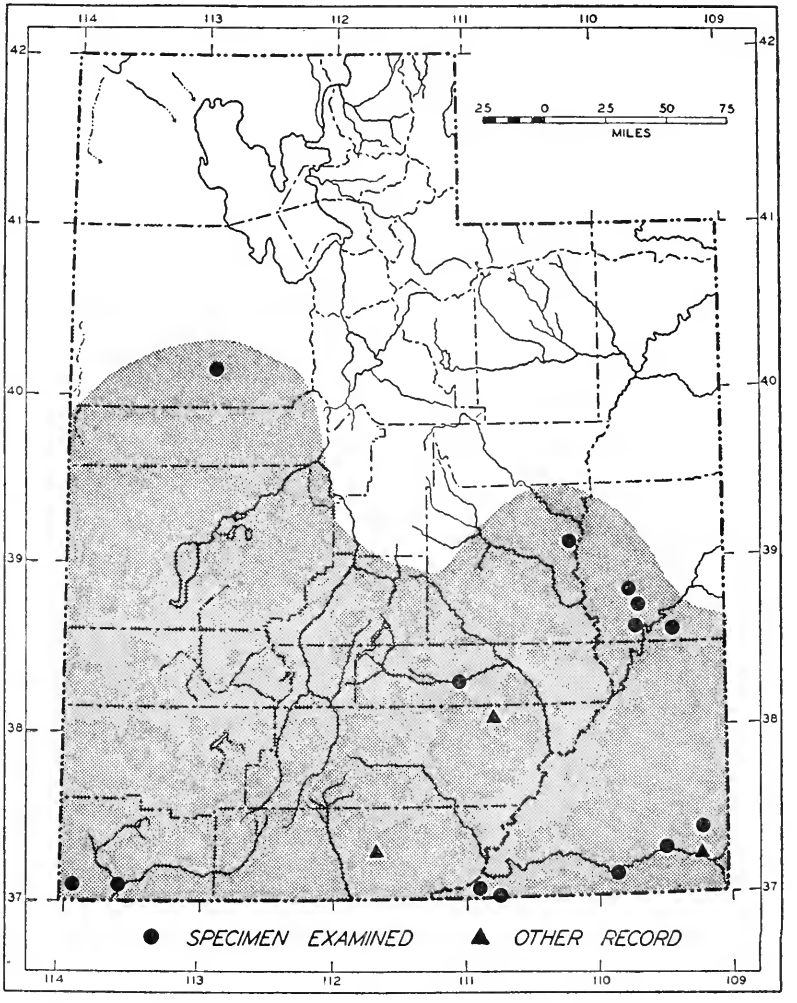

FIG. 10. Distribution of *Pipistrellus hesperus hesperus.*

third consisting of *Myotis.* The *Myotis* flew just before and after dark and one *Myotis subulatus melanorhinus* was shot after dark. The *Lasionycteris* flew well above the trees; the numerous *Pipistrel-*

lus flew mostly just above the water, while the *Myotis* generally flew above the higher brush and around the crowns of the trees. This large flight of *Pipistrellus* consisted of both males and females; 7 females and 3 males were collected. Specimens from the Old Lincoln Highway in Tooele County were taken as they likewise fluttered low over a water hole.

Specimens examined.—Total, 53, distributed as follows: *Tooele County:* Old Lincoln Highway, 18 mi. SW Orr's Ranch in Skull Valley, 4,400 ft., 3. *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 3; 1 mi. E Highway 160, 10 mi. S Valley City, 4,000 ft., 1; Colorado River, 5 mi. E Moab Bridge, 10; mouth Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 4,000 ft., 1. *Emery County:* 7 mi. N Greenriver, 4,100 ft., 1; 4 mi. N Greenriver, 1. *Wayne County:* Notom, 5,200 ft., 1. *Washington County:* Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 5; Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 3. *San Juan County:* Hatch Trading Post, Montezuma Creek, 25 mi. SE Blanding, 4,500 ft., 1; ½ mi. N Bluff, 4,500 ft., 7; Bluff, 1 (M. V. Z.); Goodridge, 1½ mi. S Mexican Hat, 13 (M. V. Z.); Rainbow Bridge, 1 (M. V. Z.); Navajo Mtn. Trading Post, 5 mi. SE Navajo Mtn., 1 (M. V. Z.).

Additional records (Hardy, 1941:291).—*Garfield County:* King Ranch, Henry Mountains. *Kane County:* Willow Springs Tank. *San Juan County:* Riverview.

Eptesicus fuscus pallidus Young

Big Brown Bat

Eptesicus pallidus Young, Proc. Acad. Nat. Sci. Philadelphia, 1908:408, October 2, 1908, type from Boulder, Boulder County, Colorado.

Eptesicus fuscus pallidus, Miller, Bull. U. S. Nat. Hist., 79:62, December 31, 1912; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935; Engels, Amer. Mid. Nat., 17:656, May, 1936; Presnall, Zion-Bryce Mus. Bull., 2:6, January, 1938; Hardy, Journ. Mamm., 22:292, August 14, 1941; Fautin, Ecol. Monogr., 16:304, October, 1946.

Vesperus fuscus, J. A. Allen, Bull. American Mus. Nat. Hist., 5:83, April 28, 1893.

Vespertilio fuscus, Miller, N. Amer. Fauna, 13:98, October 16, 1897; Barnes, Bull. Univ. Utah, 12 (no. 15):161, April, 1922.

Eptesicus fuscus fuscus, Barnes, Bull. Univ. Utah, 17 (no. 12):22, June, 1927; Long, Journ. Mamm., 21:172, May 16, 1940.

Eptesicus fuscus subsp., Stanford, Journ. Mamm., 12:363, November 11, 1931.

Range.—State-wide in distribution.

Description and comments.—Average and extreme measurements of 4 males and measurements of 3 females, numbers 3390, 3391 and 3474, from Draper are, respectively, as follows: Total length, 122 (125-120), 123, 125, 110; length of tail, 47 (52-42), 49, 49, 41; length of hind foot, 12 (14-9), 7, 9, 11; length of ear, 16 (17-14), 16, 13, 15; length of tragus, 8 (10-6), 10, 5, 7; length of forearm (dry), 47 (48-47), 49, 52, 45. Ears short, rounded and furred on the medial side at the base. Color: Upper parts Dresden Brown, bases of hairs plumbeous; underparts paler, bases of hairs dark, except in region of throat and base of tail. Skull: Large, robust; rostrum nearly as broad as long; skull flattened, nearly straight in superior outline; tooth formula, i.$\frac{2}{3}$, c.$\frac{1}{1}$, p.$\frac{1}{2}$, m.$\frac{3}{3}$.

Engels (1936:657) placed all the bats of this genus from the Great Basin in the subspecies *Eptesicus fuscus pallidus*. He further commented (*loc. cit.*) that of all of the subspecies of *Eptesicus fuscus, E. f. pallidus* showed the widest variation in color, and Hardy (1941:292) further commented upon this variation, but allocated

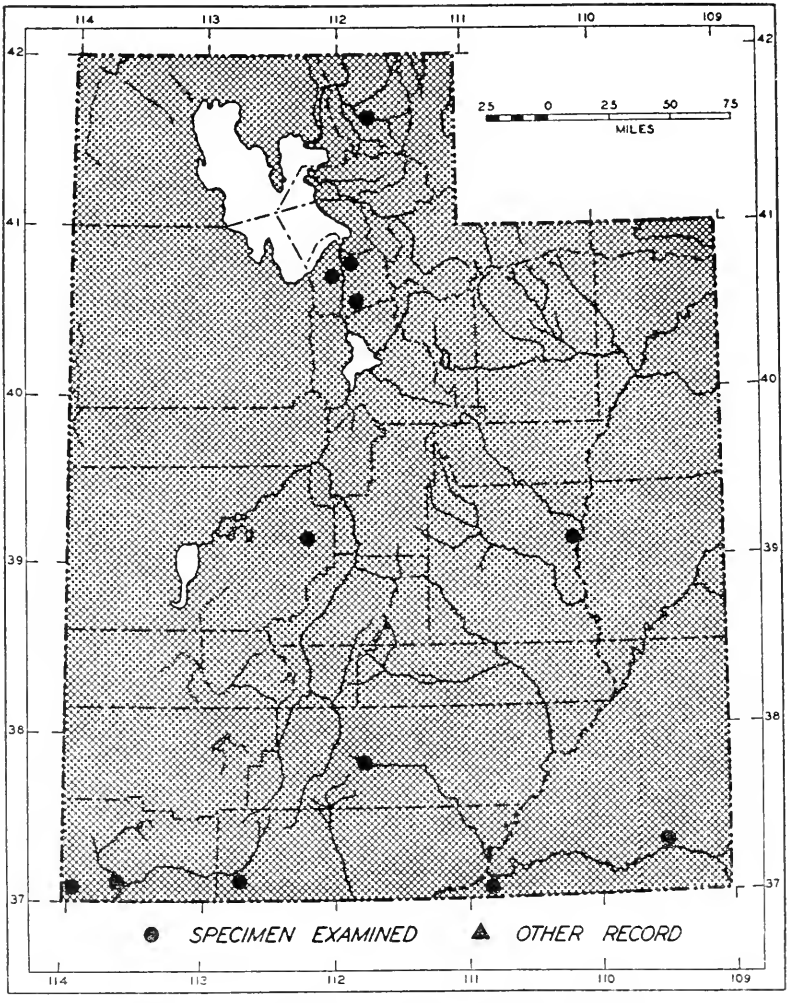

FIG. 11. Distribution of *Eptesicus fuscus pallidus*.

all specimens from Utah to *E. f. pallidus*. The specimens in the collections of the University of Utah vary in color. In a series of 7 specimens from Draper, Salt Lake County, two are considerably

darker than the others. Another specimen from two miles west of Murray, Salt Lake County, is likewise dark. None of the series from the various localities shows complete uniformity in color.

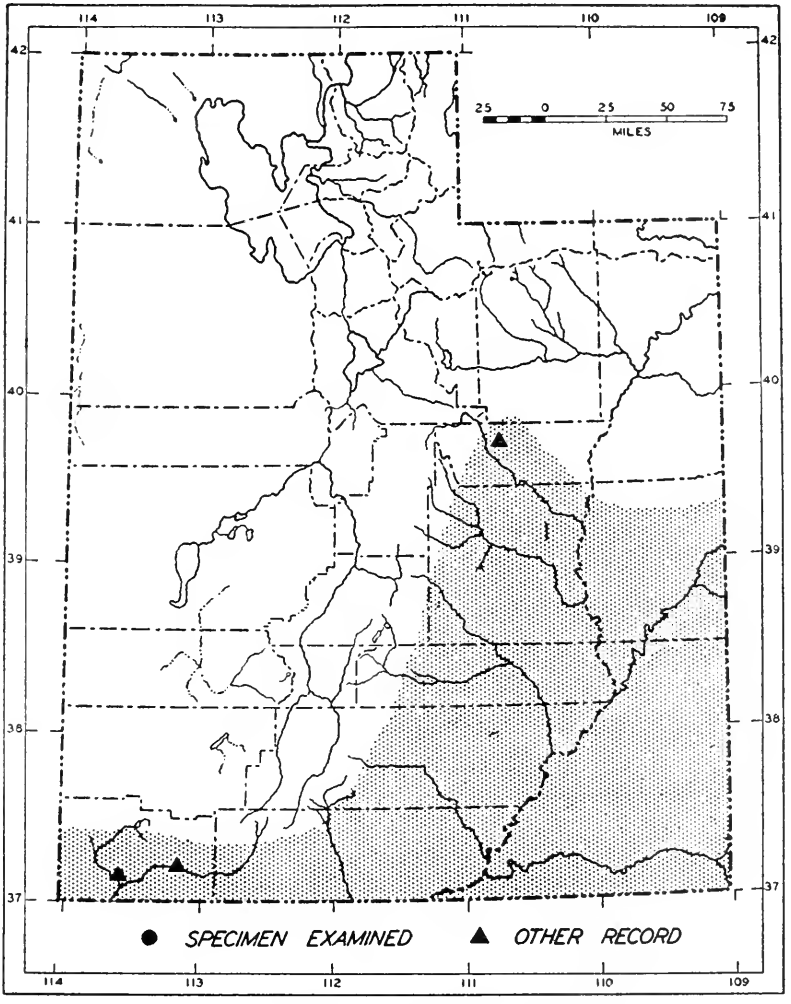

FIG. 12. Distribution of *Lasiurus borealis teliotis*.

Specimens examined.—Total, 32, distributed as follows: *Cache County:* Hyrum, 1. *Salt Lake County:* Salt Lake City, 4,300 ft., 2; 2 mi. W Murray, 4,300 ft., 1; Draper, 4,500 ft., 7. *Millard County:* Fillmore, 5,700 ft., 2 (K. U.). *Emery County:* 7 mi. N Greenriver, 1. *Garfield County:* 5 mi. W Escalante, 5,500 ft., 3. *Washington County:* Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 6; Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 5. *Kane County:* Hamblin Ranch, Cave Lake Canyon, 5 mi. NW Kanab, 5,500 ft., 1. *San Juan County:* ½ mi. NW Bluff, 4,500 ft., 2; Navajo Mountain Trading Post, 1 (M. V. Z.).

Lasiurus borealis teliotis (H. Allen)

Red Bat

Atalapha teliotis H. Allen, Proc. Amer. Philos. Soc., 29:5, April 10, 1891, type from unknown locality, probably somewhere in California.
Lasiurus borealis teliotis, Miller, N. Amer. Fauna, 13:110, October 16, 1897; Hardy, Journ. Mamm., 22:292, August 14, 1941.
Nycteris borealis teliotis, Presnall and Hall, Proc. Utah Acad. Arts Sci. and Letters, 13:211, 1936; Presnall, Zion-Bryce Mus. Bull., 2:6, January, 1938.

Range.—Recorded only from Carbon and Washington counties, limits of range unknown.

Description and comments.—Measurements of a male from Tehema, California, and a female from Bakersfield, California, are, respectively, as follows: Total length, 107, 100; length of tail, 57, 45; length of hind foot, 8.0, 8.6; length of ear (from meatus), 9.4, 10.0; length of tragus, 6.6; length of forearm, 39, 40 (Miller, 1897:115). Interfemoral membrane completely furred dorsally; hair on underside of membrane extends to base of digits. Color: Upper parts buffy red, deepest on interfemoral membrane; hairs of back tipped with gray, base of hair plumbeous; underparts buffy. Skull: Short and deep; tooth formula, i.$\frac{1}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{3}{3}$.

This bat is easily distinguished from all others in Utah by its red color and furred interfemoral membrane.

Records of occurrence (Hardy, 1941:292).—*Carbon County:* Kenilworth Mine. *Washington County:* La Verkin Cave; St. George.

Lasiurus cinereus cinereus (Beauvois)

Hoary Bat

Vespertilio linereus (misprint for *cinereus*) Palisot de Beauvois, Catal. Peale's Museum, Philadelphia, p. 15, 1796, type from Philadelphia, Philadelphia County, Pennsylvania.
Lasiurus cinereus, H. Allen, Monogr. N. Amer. Bats, p. 21, 1864; Barnes, Bull. Univ. Utah, 12 (no. 15):165, April, 1922; Hardy, Journ. Mamm., 22: 292, August 14, 1941.
Atalapha (*Lasiurus*) *cinereus*, Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Report of Explorations west of the 100th Meridian, 5:90, 1875.
Atalapha cinerea, H. Allen, Bull. U. S. Nat. Mus., 43:155, 1893.
Nycteris cinerea, Barnes, Bull. Univ. Utah, 17 (no. 12):23, June, 1927; Hayward, Great Basin Nat., 6:109, November 15, 1945.

Range.—State-wide in distribution.

Description and comments.—Measurements of a female, number 4385, from Salt Lake City, are: Total length, 130; length of tail, 50; length of hind foot, 13; length of ear, 19; length of tragus, 9; length of forearm, 52.5. Ears small, rounded, and rimmed with black; interfemoral membrane fully haired dorsally. Color: Upper parts a mixture of yellow and brown, the tips being white which gives a frosted or hoary appearance; muzzle black; membranes dark brown and haired to bases of digits, some hairs parallel the digits; underparts similar to upper parts, but with less white-tipped hairs. Skull: Large, robust; tooth formula, i.$\frac{1}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{3}{3}$.

This bat differs from all other kinds in Utah in its hoary appearance, black-rimmed ears and large, robust skull. There are less

than a dozen specimens known from Utah, but these are from localities so widely separated as to indicate that the hoary bat is state-wide in distribution. Usually it is taken singly, hanging in a tree or low bush. Nevertheless, I have taken specimens by shooting over desert water holes. Allen (1893:162) lists a specimen from La Boule River, Utah, a locality unknown to me.

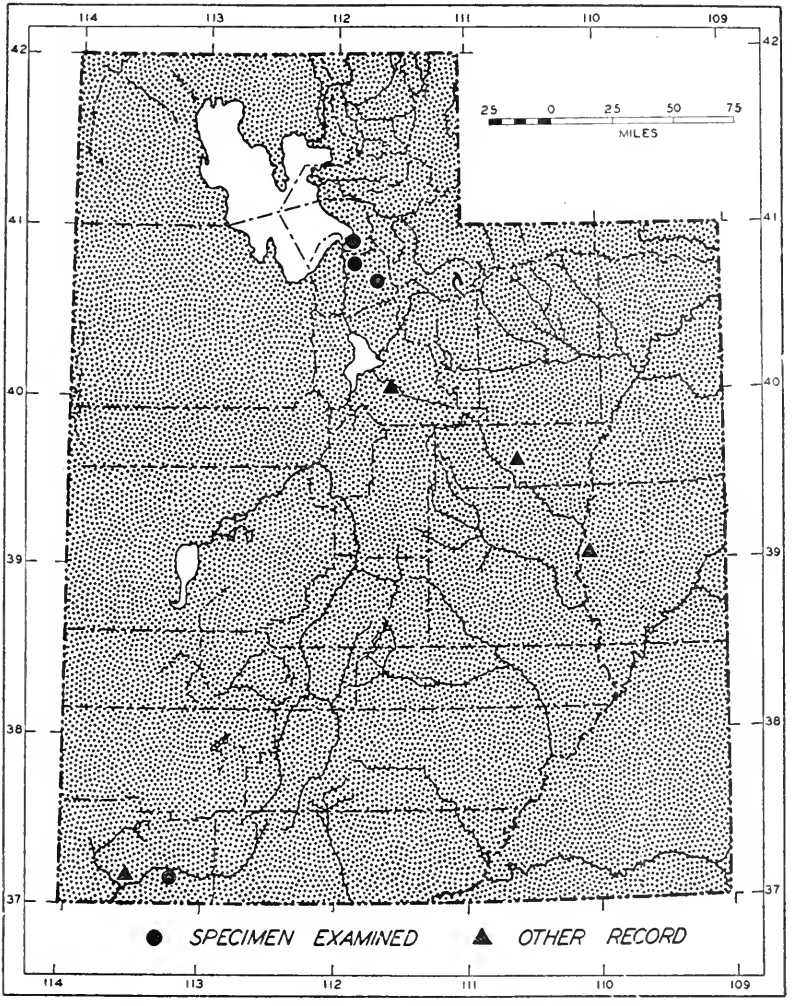

FIG. 13. Distribution of *Lasiurus cinereus cinereus*.

Specimens examined.—Total, 4, distributed as follows: *Davis County:* Bountiful, 1. *Salt Lake County:* Salt Lake City, 4,300 ft., 1; The Firs, Millcreek Canyon, 7,500 ft., 1. *Washington County:* Hurricane, 1.

Additional records (Hardy, 1941:292).—*Utah County:* Thistle Valley. *Carbon County:* Soldier Canyon. *Grand County:* 4 mi. N Elgin. *Washington County:* St. George.

Corynorhinus rafinesquii pallescens Miller

Long-eared Bat

Corynorhinus macrotis pallescens Miller, N. Amer. Fauna, 13:52, October 16, 1897, type from Keam Canyon, Navajo County, Arizona.
Corynorhinus rafinesquii pallescens, Grinnell, H. W., Univ. California Publ. Zoöl., 17:340, January 31, 1918; Barnes, Bull. Univ. Utah, 17 (no. 12) :25, June, 1927; Woodbury, Ecol. Monogr., 3:174, April, 1933; Long, Journ. Mamm., 21:172, May 16, 1940; Hardy, Journ. Mamm., 22:293, Aug. 14, 1941; Hayward, Great Basin Nat., 6:109, November 15, 1945.
Corynorhinus townsendii, H. Allen, Bull. U. S. Nat. Mus., 43:58, 1893.

Range.—Southern two-thirds of the state.

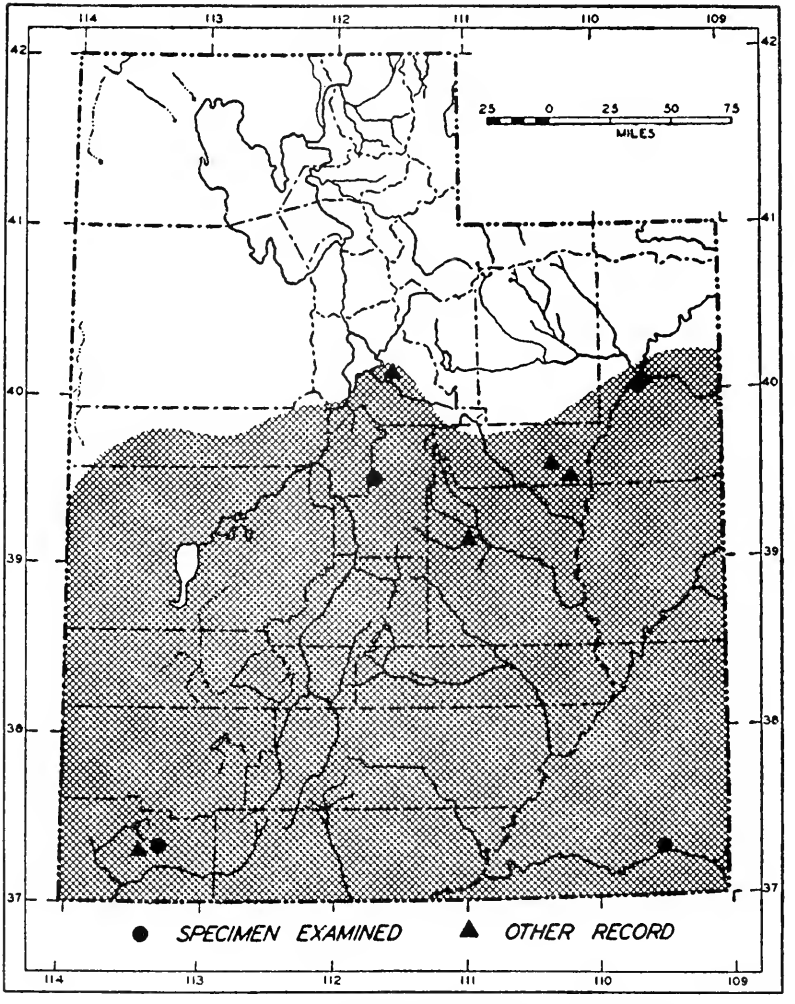

FIG. 14. Distribution of *Corynorhinus rafinesquii pallescens*.

Description and comments.—Average and extreme measurements of 7 females from Bluff and the measurements of a male, number 271, from Wales, are, respectively, as follows: Total length, 96 (100-93), 100; length of tail, 45 (47-41), 49; length of hind foot, 10 (12-7), 9; length of ear, 34 (36-33), 32; length of tragus, 15 (16-14), —; length of forearm, 43.1 (45-41), 43.5. Ears long, joined by basal membrane; hump present between ear and nose. Color: Upper parts yellowish gray; palest on head, tips of hairs lighter and bases plumbeous; underparts light brown, paler than upper parts, bases of hairs light plumbeous. Skull: Slender; braincase well inflated dorsally; rostrum narrow; tooth formula, i.$\frac{2}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{3}$, m.$\frac{3}{3}$.

Both *Corynorhinus* and *Euderma* have extremely long ears. Specimens of *Corynorhinus* are easily distinguished from those of *Euderma* by smaller ears, lighter color throughout, and lack of the three white spots on upper parts.

This bat, as indicated by Hardy (1941:293), is the kind most commonly found in mines and caves. On February 19, 1933, I took eight as they were hanging from the roof of a coal mine in Pete Canyon west of Wales, Sanpete County, Utah, where they were suspended in small clusters or singly from the cracks in the roof of the tunnels. They were hibernating but moved when handled.

Specimens examined.—Total, 20, distributed as follows: *Uintah County:* E side confluence Green and White rivers, 1 mi. SE Ouray, 4,700 ft., 1. *Sanpete County:* Coal Mine, Pete Canyon, W Wales, 5,800 ft., 8. *Washington County:* Apex mine, 3. *San Juan County:* Bluff, 3,300 ft., 8.

Additional records (Hardy, 1941:293).—*Utah County:* E of Springville. *Carbon County:* Range Creek; Sunnyside. *Washington County:* Mineral Mountain; Bloomington Cavern.

Euderma maculatum (J. A. Allen)

Spotted Bat

Histiotus maculatus J. A. Allen, Bull. American Mus. Nat. Hist., 3:195, February 20, 1891, type from near Piru, Ventura County, California.
Euderma maculatum, Hall, Journ. Mamm., 16:148, May 15, 1935; Durrant, Journ. Mamm., 16:226, August 12, 1935; Hardy, Journ. Mamm., 22:293, August 14, 1941.

Range.—Known only from Salt Lake County; reported as observed in Washington County. See figure 17.

Description and comments.—A female, number 1135, from Salt Lake County, measures: Total length, 115; length of tail, 47; length of hind foot, 12; length of ear, 47; length of tragus, 17; length of forearm, 51. Ears large (largest of all Utah bats) and nearly three fourths as long as forearm, joined by membrane. Color: Upper parts black, lighter on head; two "saddle marks" and spot at base of tail, white; underparts white; bases of hairs plumbeous. Skull: Large, robust; lacrimal region ridged; dorsal profile nearly straight; braincase broad; tooth formula, i.$\frac{2}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{3}{3}$.

This rare bat is easily distinguished from all others by its immense ears and three white spots on an otherwise black dorsum.

The only specimen known from Utah was taken in Salt Lake County, but Hardy (1941:293) had reports of individuals seen in Crocodile Cave, 4 miles north of Kanab in Kane County and at Hatch in Garfield County. The occurrence in Salt Lake County provides the most northeastern record for the species.

Specimen examined.—One from 48th South and Redwood Road (southwest of Salt Lake City), Salt Lake County.

Antrozous pallidus pallidus (LeConte)

Pallid Bat

V[espertilio]. pallidus LeConte, Proc. Acad. Nat. Sci., Philadelphia, VII (1854-1855), p. 437, 1856, type from El Paso, El Paso County, Texas.
Antrozous pallidus, H. Allen, Smithsonian Misc. Coll., 7, article 1:68, June, 1864; J. A. Allen, Bull. American Mus. Nat. Hist., 5:83, April 28, 1893.
Antrozous pallidus pacificus, Miller, N. Amer. Fauna, 13:45, October 16, 1897; Presnall, Zion-Bryce Mus. Bull., 2:6, January, 1938.
Antrozous pallidus pallidus, Hardy, Journ. Mamm., 22:293, August 14, 1941; Fautin, Ecol. Monogr., 16:304, October, 1946.
Antrozous pallidus cantwelli, Hardy, Journ. Mamm., 22:293, August 14, 1941.

Range.—Southern and eastern Utah.

Description and comments.—Measurements of 2 females, numbers 4138 and 4139, and one male, number 4108, from Beaverdam Wash, 8 miles north of Utah-Arizona Border are as follows: Total length, 109, 106, 119; length of tail, 41, 40, 45; length of hind foot, 12, 12, 12; length of ear, 35, 33, —; length of tragus, 17, 16, 15; length of forearm, 52.7, 52.5, 52.3. Ears long and broad. Color: Upper parts yellowish gray, hairs with dusky tips; underparts grayish white, washed with buff. Skull: Small, sagittal crest well developed; dentition weak; tooth formula, i.$\frac{1}{2}$, c.$\frac{1}{1}$, p.$\frac{1}{2}$, m.$\frac{3}{3}$.

Specimens of *A. p. pallidus* may be distinguished from those of *Antrozous pallidus cantwelli* by lighter color, and smaller skull.

Hardy (1941:294) placed all bats of this species from western Utah in the subspecies *Antrozous pallidus cantwelli* and referred one specimen from eastern Utah to the subspecies *A. p. pallidus.* The animals from the western part of the state were regarded as intergrades between *A. p. pallidus* and *Antrozous pallidus pacificus.* Although he considered them to be intergrades between the two aforementioned subspecies, he referred them to the subspecies *A. p. cantwelli* on the basis of size and color. As Hardy said they average slightly larger to the northward in Utah and he regarded this tendency to larger size and more buffy color as more closely allying specimens from western Utah with the subspecies *A. p. cantwelli* than with the subspecies *A. p. pallidus.* My understanding of *A. p. cantwelli* is that it is not only large, but that it is also a darker animal than any of these from Utah. Furthermore, I

know of no specimens from the area intervening between the occurrence in Utah and those of *A. p. cantwelli* in Oregon and northwestern Nevada. This argues against specimens from western Utah actually being intergrades. Pending a careful study of all the populations of the species, it seems best to me to apply the name

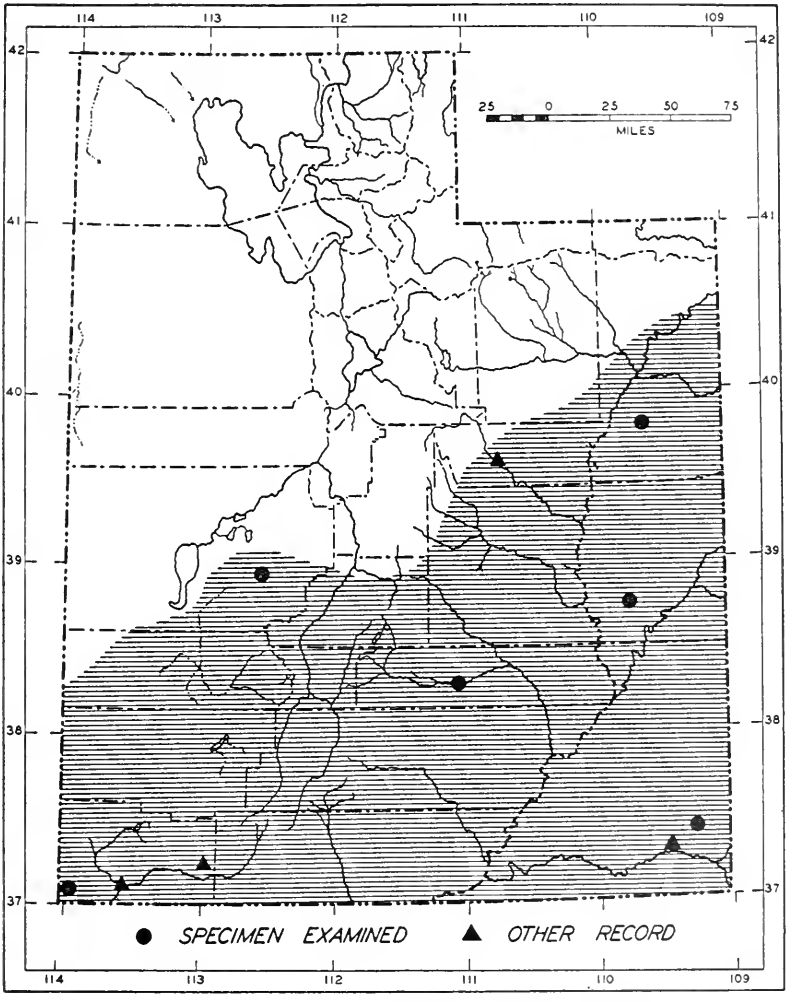

FIG. 15. Distribution of *Antrozous pallidus pallidus*.

Antrozous pallidus pallidus to all specimens from Utah, although it is recognized that the northernmost specimens average larger than those from farther south.

These bats are frequently found in company with the big brown

bat *Eptesicus fuscus*. Of nine bats obtained in Beaverdam Wash while they were flying around the crowns of cottonwood trees, 5 were *Eptesicus* and 4 were *Antrozous*.

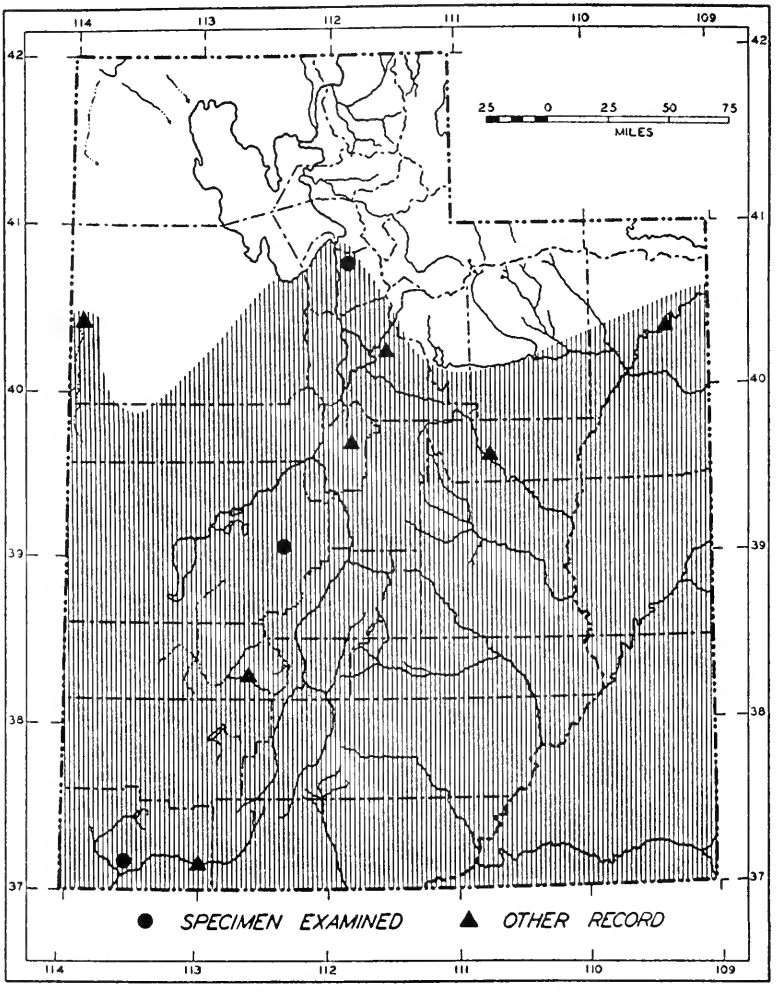

FIG. 16. Distribution of *Tadarida mexicana*.

Specimens examined.—Total, 14, distributed as follows: *Uintah County:* Willow Creek, 5,250 ft., 25 mi. S Ouray, 3. *Millard County:* volcanic caves, 10 mi. W Meadow, 1. *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 1. *Wayne County:* Notom, 6,200 ft., 4. *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona Boundary, 2,800 ft., 4. *San Juan County:* Hatch Trading Post, Montezuma Creek, 25 mi. SE Blanding, 4,500 ft., 1.

Additional records.—*Carbon County:* Price (Hardy, 1941:293). *Washington County:* Zion National Park; St. George (Hardy, *loc. cit.*). *San Juan County:* Bluff (Allen, 1893:83).

Tadarida mexicana (Saussure)

Mexican Free-tailed Bat

Molossus mexicanus Saussure, Revue et Magasin de Zoologie (ser. 2)12:283, July, 1860, type from Cofre de Perote, 13,000 feet, Vera Cruz, Mexico.
Tadarida mexicana, Miller, Bull. U. S. Nat. Mus., 128:86, April 29, 1924; Shamel, Proc. U. S. Nat. Mus., 78:4, May 6, 1931; Woodbury, Ecol. Monogr., 3:174, April, 1933; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938; Long, Journ. Mamm., 21:173, May 16, 1940; Hardy, Journ. Mamm., 22:294, August 14, 1941; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 32, 1942; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Practically state-wide in distribution.

Description and comments.—A male, number 1458, from Salt Lake City, measures: Total length, 90; length of tail, 32; length of hind foot, 9; length of ear, 18; length of tragus, 6; length of forearm, 43. Tail extending more than 15 mm. beyond end of interfemoral membrane. Color: Upper parts Mummy Brown; underparts slightly lighter; ears and muzzle nearly black. Skull: Rostrum relatively narrow; braincase well inflated; tooth formula, i.$\frac{1}{2}$ or $\frac{1}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{3}{3}$.

There is only one other species of free-tailed bat known from Utah, *Tadarida molossa;* from it, *Tadarida mexicana* can be readily distinguished by its smaller size.

This bat seems to be far more abundant in the southern part of the state than elsewhere. The northern records are few but are widely distributed. This species is often found in caves and houses together with *Eptesicus fuscus pallidus.* Long (1940:173) found them together in buildings in Beaver County, Utah.

Specimens examined.—Total, 15, distributed as follows: *Salt Lake County:* Salt Lake City, 4,250 ft., 2. *Millard County:* Fillmore, 5,700 ft., 12 (K. U.). *Washington County:* St. George, 1.

Additional records (Hardy, 1941:294).—*Uintah County:* Jensen. *Tooele County:* Cave at Salt Springs, near Utah-Nevada Boundary. *Utah County:* Rock Canyon, E Provo. *Carbon County:* Price. *Juab County:* near Nephi. *Beaver County:* Beaver, colony. *Washington County:* Zion National Park.

Tadarida molossa (Pallas)

Big Free-tailed Bat

V[espertilio]. *Molossus* Pallas, Miscellania Zoologica, p. 49, 1776, type from America, not improbably from Surinam.
Tadarida macrotis, Miller, Bull. U. S. Nat. Mus., 128:86, April 29, 1924; Woodbury, Journ. Mamm., 18:515, November 14, 1937; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938; Durrant and Behle, Journ. Mamm., 19:500, November 14, 1938; Hardy, Journ. Mamm., 22:294, August 14, 1941; Durrant and Setzer, Journ. Mamm., 24:501, November 17, 1943.

Range.—Known only from southwestern and extreme western Utah.

Description and comments.—A female, number 3876, from Desert Range Experiment Station measures: Total length, 141; length of tail, 50; length of hind foot (dry), 11; length of ear, 27; length of tragus, 6; length of forearm, 60.5. Ears long; tail free for considerable distance beyond interfemoral mem-

brane. Color: Upper parts and underparts Mummy Brown, slightly lighter on underparts; membranes, ears and muzzle nearly black. Skull: Large; rostrum long and narrow.

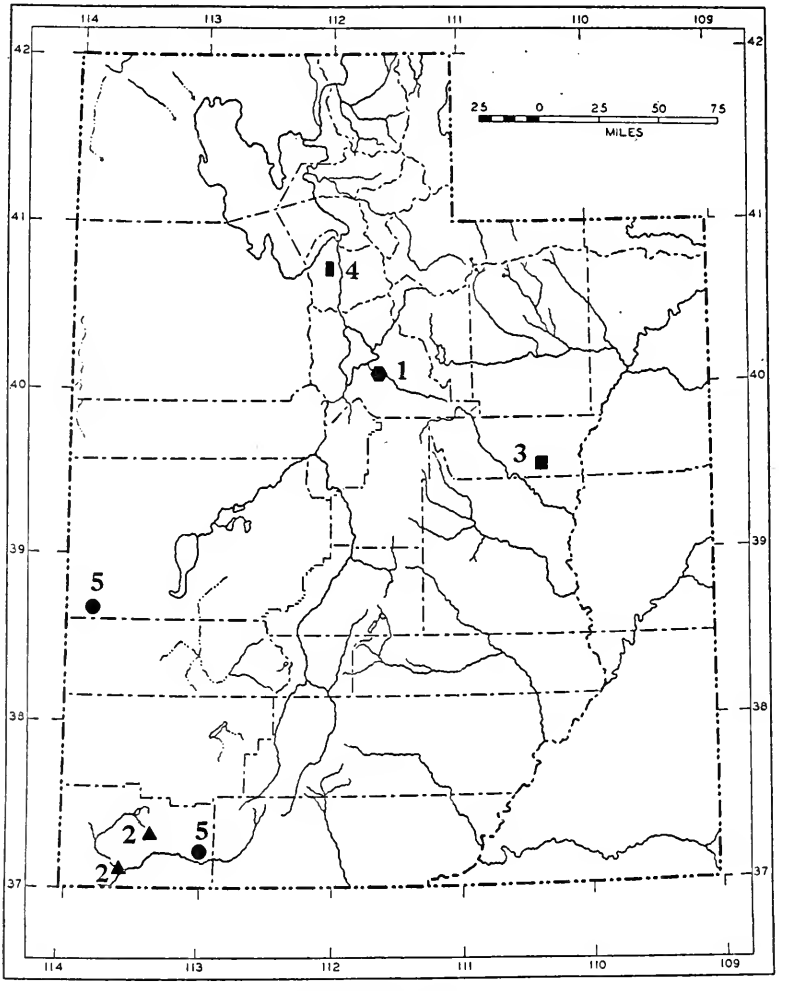

FIG. 17. Distribution of five bats.

Guide to subspecies

1. *Myotis velifer incautus.*
2. *Myotis yumanensis yumanensis.*
3. *Myotis subulatus subulatus.*
4. *Euderma maculatum.*
5. *Tadarida molossa.*

Specimens examined.—Total, 3, distributed as follows: *Millard County:* Pine Valley, Desert Range Experiment Station of the U. S. Forest Service, Sec. 33, T. 25 S., R. 17 W. Salt Lake Meridian, 1. *Washington County:* Zion National Park, 2, 1 (M. V. Z.).

Additional record (Hardy, 1941:294).— *Washington County:* St. George.

TABLE 2

Cranial Measurements of Chiroptera

NAME AND LOCALITY	Number of individuals averaged or catalog number	Sex	Condylobasal length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Maxillary breadth at M3	Alveolar length of Maxillary tooth-row	Amount of wear of teeth*
Myotis l. carissima									
Mammoth Hot Springs, Wyo.	16 av..	♀	14.5	9.2	3.95	7.3	6.0	5.45	.....
Mammoth Hot Springs, Wyo.	max...	♀	14.8	9.6	4.1	7.5	6.2	5.7	.....
Mammoth Hot Springs, Wyo. (Miller and Allen, 1928:60)	min....	♀	13.6	8.7	3.8	7.1	5.8	5.2	.....
Myotis l. phasma									
Burriston	1418...	♂	11.5	9.0	3.5	7.2	6.0	5.4	2
Myotis y. yumanensis									
Pyramid Lake, Nevada	5553KU	♀	12.7	.....	4.0	7.5	5.3	5.2	1
Myotis v. incautus									
Carlsbad, New Mexico	5 av...	♂	15.6	10.5	4.0	7.9	6.9	6.5	.....
Carlsbad, New Mexico	max...	♂	16.0	11.0	4.2	8.0	7.0	6.6	.....
Carlsbad, New Mexico. (Miller and Allen, 1928:96-97)	min....	♂	15.0	10.2	3.8	7.8	6.8	6.2	.....
Carlsbad, New Mexico	8 av...	♀	15.5	10.4	4.0	7.9	6.9	6.6	.....
Carlsbad, New Mexico	max...	♀	15.8	11.0	4.2	8.0	7.2	6.8	.....
Carlsbad, New Mexico. (Miller and Allen, 1928:96-97)	min....	♀	15.2	10.0	3.8	7.6	6.8	6.2	.....
Myotis e. evotis									
Zion National Park	656....	?	14.8	9.5	4.1	8.2	5.6	6.2	1
Myotis v. interior									
type (Miller and Allen, 1928:147)	133426 USNM	♂	14.0	8.8	5.0	7.4	5.5	5.2	2
Myotis c. pallidus									
Kanab	161291 USNM	♂	11.7	7.8	3.0	6.1	4.8	5.0	1
Myotis s. subulatus									
Avalo, Colorado (Miller and Allen, 1928:174)	159715 USNM	♂	13.2	9.0	3.2	6.8	5.6	5.4	1
Myotis s. melanorhinus									
Colorado River	922....	♂	12.9	8.0	3.1	6.6	5.4	5.1	2
Parrish Ranch	4424...	♂	12.9	8.1	3.3	6.2	5.2	5.1	1
Lasionycteris noctivagans									
5 mi. E Moab Bridge	920....	♀	14.3	9.7	4.1	7.9	6.7	6.1	2
Pipistrellus h. hesperus									
5 mi. E Moab Bridge	6 av...	♀	10.5	7.3	3.2	6.0	5.1	3.9	1
5 mi. E Moab Bridge	max...	♀	11.0	7.5	3.5	6.2	5.4	4.2	1
5 mi. E Moab Bridge	min....	♀	10.2	7.0	3.0	5.6	4.8	3.7	1
Eptesicus f. pallidus									
Draper	4 av...	♂	17.5	12.6	4.5	8.7	8.1	7.2	1
Draper	max...	♂	18.2	12.7	4.5	8.8	8.5	7.5	1
Draper	min....	♂	17.1	12.4	4.4	8.5	7.9	7.0	1
Draper	3391...	♀	16.8	12.2	4.1	8.4	8.1	6.7	2
Lasiurus b. teliotus									
4 mi. N Dixon, Calif. (Hall, 1946:170)	71601..	♂	11.7	8.7	4.3	7.3	5.5	4.5	1
Lasiurus c. cinereus									
Salt Lake City	4385...	♀	14.7	12.3	5.4	9.2	8.9	6.5	1

TABLE 2.—*Concluded*

NAME AND LOCALITY	Number of individuals averaged or catalog number	Sex	Condylobasal length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Maxillary breadth at M3	Alveolar length of Maxillary tooth-row	Amount of wear of teeth*
Euderma maculatum									
Salt Lake County	1135...	♀	16.2	10.2	4.0	10.0	6.8	6.1	1
Corynorhinus r. pallescens									
Bluff	7 av...	♀	14.2	8.8	3.7	8.3	6.2	5.1	1
Bluff	max...	♀	14.7	9.0	3.8	9.0	6.5	5.4	1
Bluff	min....	♀	13.7	8.7	3.5	8.0	5.9	4.6	1
Wales	271....	♂	14.0	.....	3.5	.....	6.8	5.2	1
Antrozoas p. pallidus									
Beaverdam Wash	4138...	♀	17.2	12.3	4.3	8.9	8.1	7.3	2
Beaverdam Wash	4139...	♀	16.8	12.1	4.1	8.5	7.9	7.5	3
Beaverdam Wash	4108...	♂	17.4	12.5	4.2	8.7	8.0	7.2	3
Tadarida mexicana									
Salt Lake City	1458...	♂	15.1	9.6	3.9	8.5	7.0	6.3	1
Tadarida mollosa									
Desert Exp. Station	3876...	♀	20.5	12.3	4.3	10.4	9.0	9.0	2

* 1, unworn; 2, moderately worn; 3, well worn.

Order LAGOMORPHA

Pikas, Hares, Rabbits

KEY TO SPECIES OF LAGOMORPHS IN UTAH

1.–Ears short and rounded; no visible tail; upper cheek teeth 5 on each side ..... *Ochotona princeps,* p. 67

1'.–Ears long, not rounded; tail visible; upper cheek teeth 6 on each side.

2.–Interparietal not present; hind foot measures more than 105.

3.–Length of ear less than 100; no anterior projection on supraorbital process; turns white in winter .. *Lepus americanus,* p. 76

3'.–Length of ear more than 100; anterior projection on supraorbital process present, white or brown in winter.

4.–Tail completely white; turns white in winter ..... *Lepus townsendii,* p. 74

4'.–Tail black on top; never turns white in winter ..... *Lepus californicus,* p. 78

2'.–Interparietal present; hind foot measures less than 105.

5.–Lower surface of tail white; end of posterior projection of supraorbital process touches the skull; anterior face of first upper premolar with 3 re-entrant angles.

6.–Ears less than 72; inside of ears densely haired; anterior projection of supraorbital process pointed. *Sylvilagus nuttallii,* p. 81

6'.–Ears more than 72; inside of ears thinly haired; anterior projection of supraorbital process blunted or denticulate ..... *Sylvilagus audubonii*, p. 84

5'.–Lower surface of tail not white; end of posterior projection of supraorbital process does not touch the skull; anterior face of first upper premolar with one re-entrant angle ..... *Sylvilagus idahoensis*, p. 88

Ochotona princeps

Pika

Small, rabbitlike mammals with dense pelage; small, round, scantily haired ears; fore and hind legs of approximately the same size; tail not visible; soles haired; digits 5 in front, 4 behind; postorbital process of frontal lacking; jugal projecting caudad as a spine beyond the anterior border of squamosal; rostrum short and slender; palate short; tooth formula, i. $\frac{2}{1}$, c. $\frac{0}{0}$, p. $\frac{3}{2}$, m. $\frac{3}{3}$. Some workers consider the cheek teeth to be p. $\frac{3}{2}$, m. $\frac{2}{3}$.

There are five kinds of pikas known to occur in Utah and they all belong to the species *Ochotona princeps.*

Ochotona princeps uinta Hollister

Pika

Ochotona uinta Hollister, Proc. Biol. Soc. Washington, 25:58, April 13, 1912, type from Uinta Mountains, near head of E. Fork Bear River, Summit County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):93, April, 1922.

Ochotona princeps uinta, Howell, N. Amer. Fauna, 47:19, August 21, 1924; Barnes, Bull. Univ. Utah, 17 (no. 12):140, June, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Svihla, Journ. Mamm., 12:264, August 24, 1931; Hall and Bowlus, Univ. California Publ. Zoöl., 42:336, October 12, 1938; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Range.—Uinta and Wasatch mountains.

Description and comments.—Measurements of an adult male, number 203, and an adult female, number 615, from Smith and Morehouse Creek are, respectively, as follows: Total length, 203, 187; length of tail, – –, 4; length of hind foot, 30, 28; length of ear, – –, 21. Color (*summer pelage*): Upper parts Cinnamon-Buff or Pinkish Buff, darkest on head and middorsal region; ears grayish, margined with light buff; feet light buff; soles Hair Brown; palms Pinkish Buff; sides and throat Pinkish Cinnamon; underparts white, heavily washed with buff. Skull: Size medium; nasals long; palatal bridge wide; interpterygoid space narrow and parallel sided; tympanic bullae large.

From topotypes of *Ochotona princeps fuscipes, O. p. uinta* differs in larger size, lighter (more buff, less gray) color, lighter hind feet, larger, more robust skull, with shorter incisive foramina, longer palatal bidge and relatively smaller tympanic bullae.

From topotypes of *Ochotona princeps cinnamomea, O. p. uinta*

differs in larger size, larger hind feet, lighter (less cinnamon) color and cranially in much the same manner as from *Ochotona princeps fuscipes.*

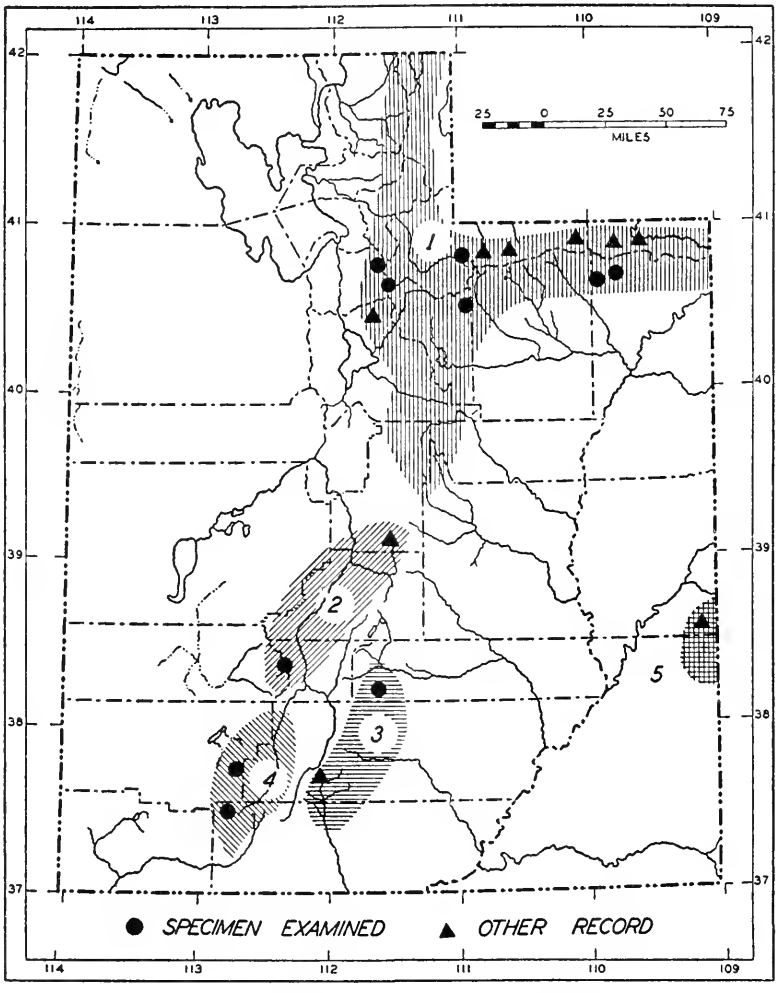

FIG. 18. Distribution of *Ochotona princeps.*

Guide to subspecies
1. *O. p. uinta.*
2. *O. p. cinnamomea.*
3. *O. p. utahensis.*
4. *O. p. fuscipes.*
5. *O. p. saxatilis.*

From *Ochotona princeps saxatilis, O. p. uinta* differs in more buffy, less grayish color and smaller skull.

These pikas are known to occur only at high elevations in the Wasatch and Uinta mountains. In the few specimens available, no

intergradation with other subspecies was noted. Further collecting in the continuous north-south mountain chain may show that pikas are almost continuously distributed from Utah County southward to the known localities of occurrence of *O. p. cinnamomea*, and probably will reveal intergradation between *O. p. cinnamomea* and *O. p. uinta*.

Specimens examined.—Total, 22, distributed as follows: *Salt Lake County:* 10 mi. above lower powerhouse, Big Cottonwood Canyon, 2; 2 mi. above Alta, 10,000 ft., 6; Mountain Lake, 10,000 ft., "near" Alta, Little Cottonwood Canyon, 2; "near" Lake Solitude, 9,000 ft., Silver Lake P. O. (Brighton), 2; Silver Lake P. O. (Brighton), 9,000 ft., 3. *Summit County:* Smith and Morehouse Creek, 3. *Wasatch County:* Wolf Creek Pass, 8,000 ft., 1. *Uintah County:* Paradise Park, R. S., 10,050 ft., 1 mi. SW Marsh Peak, 3.

Additional records.—Summit County: Near head of Bear River (Howell, 1924:20); near head of Black Fork (Howell, *loc. cit.*); SW Slope Bald Mountain (Hall and Bowlus, 1938:336). *Daggett County:* Granite Park, The Nipple, Spirit Lake, Elk Park (Hall and Bowlus, 1938:337). *Utah County:* Mt. Timpanogos (Tanner, 1927:251); Hidden Lake Cirque (Hall and Bowlus, *loc. cit.*); Aspen Grove, Mt. Timpanogos (Hall and Bowlus, *loc. cit.*).

Ochotona princeps cinnamomea Allen

Pika

Ochotona cinnamomea Allen, Mus. Brooklyn Inst. Arts and Sci., Sci. Bull., 1:121, March 31, 1905, type from Briggs [Britts] Meadow, 11,000 ft., Beaver Mountains, Beaver County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):92, April, 1922.

Ochotona princeps cinnamomea, Hall, Proc. Biol. Soc. Washington, 47:103, June 13, 1934; Long, Journ. Mamm., 21:179, May 16, 1940; Hall and Hayward, Great Basin Nat., 2:108, July 20, 1941; Hall, The mammals of Nevada, Univ. California Press, p. 591, July 1, 1946.

Lagomys princeps, Allen, Bull. Essex Inst., 6:66, 1874.

Ochotona schisticeps cinnamomea, Howell, N. Amer. Fauna, 47:46, August 21, 1924; Barnes, Bull. Univ. Utah, 17 (no. 12):138, June, 1927.

Ochotona princeps nevadensis, Moore, Journ. Mamm., 11:87, February 11, 1930.

Range.—Beaver Mountains.

Description and comments.—Measurements of an adult female topotype, number 1431, are: Total length, 176; length of hind foot, 28; length of ear, 22. Color (*summer pelage*): Upper parts Cinnamon or Vinaceous-Cinnamon mixed with Fuscous-Black; nose, face and anterior margin of ears Smoke Gray; top of head blackish; nape grayish; ears Chaetura Black, margined with white or buffy white; upper surface of feet buffy white; sides pure Cinnamon; soles Hair Brown, palms whitish; underparts Pinkish Cinnamon. Skull: Size medium; palatal bridge short; incisive foramina large; nasals long; interpterygoid fossa widest anteriorly.

Among named subspecies of *Ochotona princeps*, *O. p. cinnamomea* most closely resembles *Ochotona princeps fuscipes*, its nearest geographic neighbor, from which it can be distinguished by smaller size, lighter color (more Cinnamon), smaller skull and smaller tympanic bullae.

Comparison of topotypes of *O. p. cinnamomea* with near topo-

types of *Ochotona princeps utahensis* shows the former to differ in smaller size, lighter (more Cinnamon) color, narrower palatal bridge and smaller tympanic bullae.

From *Ochotona princeps saxatilis, O. p. cinnamomea* differs in essentially the same manner as it does from *O. p. utahensis.*

For comparison with *Ochotona princeps uinta,* see account of that subspecies.

Insofar as known, this subspecies occurs only at the type locality and its near vicinity. Moore (1930:87) assigned 3 specimens from Sanpete County to *Ochotona princeps nevadensis.* I have studied two of these animals (248436 U.S.N.M. and 248437 U.S.N.M.), reported upon by Moore (*loc. cit.*), and find them to differ markedly from *O. p. nevadensis.* Comparisons of these two specimens with 6 near topotypes of *O. p. nevadensis* from Three Lakes, Ruby Mountains, Elko County, Nevada (K. U.), show the specimens from Utah to differ in smaller size, darker color, narrower basisphenoid, and wedge-shaped as opposed to parallel-sided basioccipital. In color, these two specimens are intermediate between *O. p. uinta* and *O. p. cinnamomea,* but resemble the latter more closely. Cranially, they are also intermediate between the two above mentioned subspecies, but resemble *O. p. cinnamomea* in the shape of the basioccipital, shape and width of the palate, and shape of the basisphenoid. Adequate material from the Wasatch Plateau may prove the existence there of an unnamed kind of pika. Until sufficient material becomes available, I am tentatively referring these specimens from Sanpete County to *O. p. cinnamomea.*

Specimens examined.—Total, 3, from Puffer Lake, 9,000 ft., Beaver County, Utah.

Additional record (Moore, 1930:87).—*Sanpete County:* Baldy Ranger Station, U. S. National Forest, 17 mi. E and 2 mi. S Gunnison.

Ochotona princeps fuscipes Howell

Pika

Ochotona schisticeps fuscipes Howell, Proc. Biol. Soc. Washington, 32:110, May 20, 1919, type from Brian Head, Parowan Mountains, Iron County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):94, April, 1922; Howell, N. Amer. Fauna, 47:47, August 21, 1924; Barnes, Bull. Univ. Utah, 17 (no. 12):139, June, 1927.

Ochotona princeps fuscipes, Presnall and Hall, Utah Acad. Sci. Arts and Letters, 13:212, 1936; Miller, Journ. Mamm., 17:175, May 14, 1936; Presnall, Zion-Bryce Mus. Bull., 2:18, January, 1938; Long, Journ. Mamm., 21:179, May 16, 1940; Hall and Hayward, Great Basin Nat., 2:108, July 20, 1941.

Range.—Markagunt Plateau.

Description and comments.—Measurements of an adult male, number 1427, and an adult female, number 1426, from Kane County, are, respectively,

as follows: Total length, 183, 185; length of hind foot, 30, 29; length of ear, 23, 24. Color (*summer pelage*): Upper parts resembling those of *Ochotona princeps cinnamomea* but darker, less Cinnamon; nose Fuscous-Black; face Smoke Gray, buff and blackish; ears Fuscous-Black margined with Light Buff; sides Cinnamon mixed with black; front and hind feet Cinnamon-Buff or whitish buff; palms Hair Brown; soles Fuscous; underparts heavily washed with Pinkish Cinnamon. Skull: Similar to that of *O. p. cinnamomea*, but larger and broader; tympanic bullae larger.

From near topotypes of *Ochotona princeps utahensis*, *O. p. fuscipes* differs in smaller size, more rufescent, less grayish color, narrower palatal bridge and larger tympanic bullae.

Topotypes of *O. p. fuscipes* differ from *Ochotona princeps saxatilis* in much the same way as they do from *O. p. utahensis.*

For comparisons of *O. p. fuscipes* with *Ochotona princeps uinta* and *O. p. cinnamomea,* see accounts of those subspecies.

The range of *O. p. fuscipes* is restricted to the Markagunt Plateau, which extends approximately 30 miles south from Iron County into Kane and Garfield counties. The type locality, Brian Head, is at the northern extremity of the range of this subspecies, and the range of another subspecies, *O. p. cinnamomea,* is not far removed to the northward in Beaver County. Howell (1924:48) remarked that *O. p. fuscipes* more closely resembled *Ochotona princeps schisticeps* from the Sierra Nevada, and *Ochotona princeps taylori* from the lava beds of Oregon than it did its near neighbor, *O. p. cinnamomea.* Hall (1946:591) thought that *O. p. cinnamomea* most closely resembled *Ochotona princeps tutelata* from central Nevada. In other words, both of the subspecies which are restricted to southern Utah, although situated in close proximity to each other, resemble geographically distant subspecies more than they do each other. A detailed study of large series is needed to determine whether *O. p. fuscipes* and *O. p. cinnamomea* are only local populations of one subspecies.

Specimens examined.—Total, 5, distributed as follows: *Iron County:* Brian Head, 11,315 ft., 2. *Kane County:* Duck Creek, 9,000 ft., 3.

Ochotona princeps utahensis Hall and Hayward

Pika

Ochotona princeps utahensis Hall and Hayward, Great Basin Nat., 2:107, July 20, 1941, type from 2 miles west of Deer Lake, Garfield County, Utah.

Range.—Aquarius Plateau and environs.

Description and comments.—According to Hall and Hayward (1941:108), average and extreme measurements of 5 individuals (3 males and 2 females from the type locality) are: Total length, 191 (180-200); length of hind foot,

29.2 (28-30). Color: Upper parts dark gray, mixed with Cinnamon Buff and Fuscous Black, darkest on hinder part of back, lightest on shoulders; top of head like middorsal region; ears blackish externally, whitish internally, with subterminal wide band of dark brown, margined with white; upper surface of feet Light Buff; palms buffy; soles Hair Brown; underparts white, washed with buff. Skull: Large, robust; palatal bridge wide; interpterygoid fossa slightly spatulate or parallel sided; nasals broad proximally; tympanic bullae large.

O. p. utahensis closely resembles *Ochotona princeps saxatilis,* but the former has larger tympanic bullae (Hall and Hayward, 1941:108).

For comparisons with other members of the genus known to occur in Utah, see accounts of those subspecies.

This subspecies, known only from the Boulder Mountain area in Garfield and Wayne counties, probably inhabits also the Kaiparowits Plateau. According to Hall and Hayward (1941:108), this subspecies more closely resembles *O. p. saxatilis* from Colorado than any other. Here again, a subspecies of pika restricted, so far as known, to Utah more closely resembles a geographically distant subspecies than it does its near neighbors. This situation is even more remarkable than that noted under the account of *O. p. fuscipes,* since the northern mountainous areas are inhabited by other distinct subspecies and the Green and Colorado rivers are interposed between the ranges of *O. p. saxatilis* and *O. p. utahensis.*

Specimens examined.—Total, 4, from Donkey Lake, Boulder Mountain, 9,000 ft., Wayne County.

Additional record (Hall and Hayward, 1941:108).—*Garfield County:* 2 mi. W Deer Lake.

Ochotona princeps saxatilis Bangs

Pika

Ochotona saxatilis Bangs, Proc. New England Zoöl. Club, 1:41, June 5, 1899, Type from Montgomery, near Mount Lincoln, Park County, Colorado.
Ochotona princeps saxatilis, Howell, N. Amer. Fauna, 47:23, August 21, 1924; Barnes, Bull. Univ. Utah, 17 (no. 12):141, June, 1927; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 251, 1942.

Range.—Southeastern Utah, known only from the La Sal Mountains.

Description and comments.—Measurements of 2 males, numbers 6411 and 6409, and 2 females, numbers 6408 and 6410 from Warner Ranger Station, are as follows: Total length, 178, 178, 182, 189; length of tail, 6, 6, 6, 7; length of hind foot, 31, 30, 30, 30; length of ear 24, 23, 22, 24. Similar to *Ochotona princeps utahensis;* see account of that subspecies.

For comparisons with other subspecies of pikas known to occur in Utah, see accounts of those subspecies.

On the basis of a single specimen from the La Sal Mountains, Howell (1924:24) showed the range of *O. p. saxatilis* to extend as far westward as extreme eastern Utah. Four additional specimens, obtained from the aforementioned mountains during the summer of 1947 are now in the collections of the University of Utah. Comparisons of these four animals with one specimen, number 5587, of *O. p. saxatilis,* from Outlet Columbus Basin, 10,600 ft., 4 miles north of La Plata City, La Plata County, Colorado, and with Howell's account (1924:23) indicate that these four animals belong to this subspecies, and that Howell was correct in the assignment of the single specimen available to him from Utah.

Specimens examined.—Total, 4, from Warner, R. S., 9,750 ft., La Sal Mountains, Grand County.

TABLE 3

Cranial Measurements of Ochotona

Sex and age	Catalog number	Basilar length	Length of nasals	Zygomatic breadth	Width across mastoid bullae	Interorbital breadth	Postorbital breadth	Length of palatal bridge	Breadth of braincase	Alveolar length of molariform teeth
		Ochotona princeps uinta, Smith and Morehouse Creek								
♂	203	38.0	15.2	22.0	21.9	5.3	14.1	3.9	19.0	9.0
♀	615	35.4	14.3	22.0	21.0	5.0	14.7	2.5	18.0	8.8
		Ochotona princeps cinnamomea, Beaver Mountains (Howell, 1924:50)								
♂	158089 USNM	.....	13.0	20.9	.....	5.3	.....	1.6	17.8	.....
♀	158093 USNM	.....	12.2	20.1	.....	5.0	.....	1.4	17.5	.....
		Ochotona princeps fuscipes, Duck Creek								
♂	1427	34.6	14.1	23.0	20.9	4.8	.....	1.6	18.4	8.7
♀	1426	33.3	13.6	21.5	20.6	5.5	14.2	1.7	18.1	8.5
		Ochotona princeps utahensis, Donkey Lake								
♀	4821	35.9	15.7	22.7	22.0	5.4	14.8	2.2	17.6	8.4
		Ochotona princeps saxatilis, Warner, R. S.								
♂	6409	36.5	15.2	22.6	21.8	5.2	14.9	2.3	17.5	9.1
♂	6411	.....	15.4	23.0	.....	5.2	15.0	2.9	.....	9.4
♀	6408	34.8	15.2	21.4	21.5	5.3	14.4	2.4	17.3	8.7
♀ sad.	6410	35.1	.....	22.6	21.5	5.1	15.1	3.0	18.6	9.3

Family LEPORIDAE

Hares and Rabbits

Medium to small sized mammals with long, dense pelage; long ears; large eyes; short recurved tail; hind legs longer than front legs; hind feet large and fully furred; skull with highly fenestrated sides of rostrum; incisive foramina large and usually confluent; jugal continuing caudad as a spine; supraorbital plate of frontal with posterior and anterior projections; palatal bridge short; tympanic bullae large; clavicle reduced; tibia fused to fibula; teeth lophodont; tooth formula, i. $\frac{2}{1}$, c. $\frac{0}{0}$, p. $\frac{3}{2}$, m. $\frac{3}{3}$.

In Utah, the family Leporidae is represented by the genus *Lepus* with three species, and the genus *Sylvilagus* with three species.

Lepus townsendii townsendii Bachman

White-tailed Jack Rabbit

Lepus townsendii Bachman, Journ. Acad. Nat. Sci. Philadelphia, 8 (pt. 1); 90, 1839, type from Old Fort Walla Walla, near present town of Wallula, Walla Walla County, Washington.

Lepus townsendii townsendii, Barnes, Bull. Univ. Utah, 17 (no. 12):141, June, 1927; Svihla, Journ. Mamm., 12:264, August 24, 1931; Presnall, Zion-Bryce Mus. Bull., 2:18, January, 1938.

Lepus townsendi townsendi, Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 256, 1942.

Lepus campestris, Allen, Bull. Essex Inst., 6:66, 1874; Coues and Yarrow, Rept. upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871-74, Wheeler's Rept. Expl. W. 100th M., 5:127, 1875; Allen, Bull. American Mus. Nat. Hist., 8:244, November 25, 1896.

Lepus campestris townsendi, Nelson, N. Amer. Fauna, 29:78, August 31, 1909; Warren, The mammals of Colorado, Knickerbocker Press, p. 37, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):101, April, 1922.

Range.—All of the state except the western and southeastern parts.

Description and comments.—Measurements of an adult male, number 501, from Summit County and of an adult female, number 695, from Salt Lake County, are, respectively, as follows: Total length, 640, 606; length of tail, 100, 87; length of hind foot, 165, 137; length of ear, 140, 137. Ears long; hind feet large. Color (*summer pelage*).—Upper parts grayish white; tail white at all seasons. *Winter pelage:* White all over except tips of ears and top of head which is grizzled. Skull: Large tympanic bullae small; nasals short and wide; supraorbital processes large; lacrimal forms a distinct process.

These hares are easily distinguished from all other kinds known to occur in Utah by their large size and seasonal color changes. *Lepus californicus* does not have seasonal color changes, and *Lepus americanus* although changing color seasonally is much smaller than *L. t. townsendii.*

In the northern part of the range in Utah this species is fairly common and inhabits the mountains and foothills. The animals

are not numerous in the southern part of their range, where they seem to be more restricted to higher elevations. Janson (*MS*) records them from as low as 5,000 feet in the north, although he never observed them at elevations of less than 8,000 feet in the south. The upper distributional limits of elevation at 10,000 to

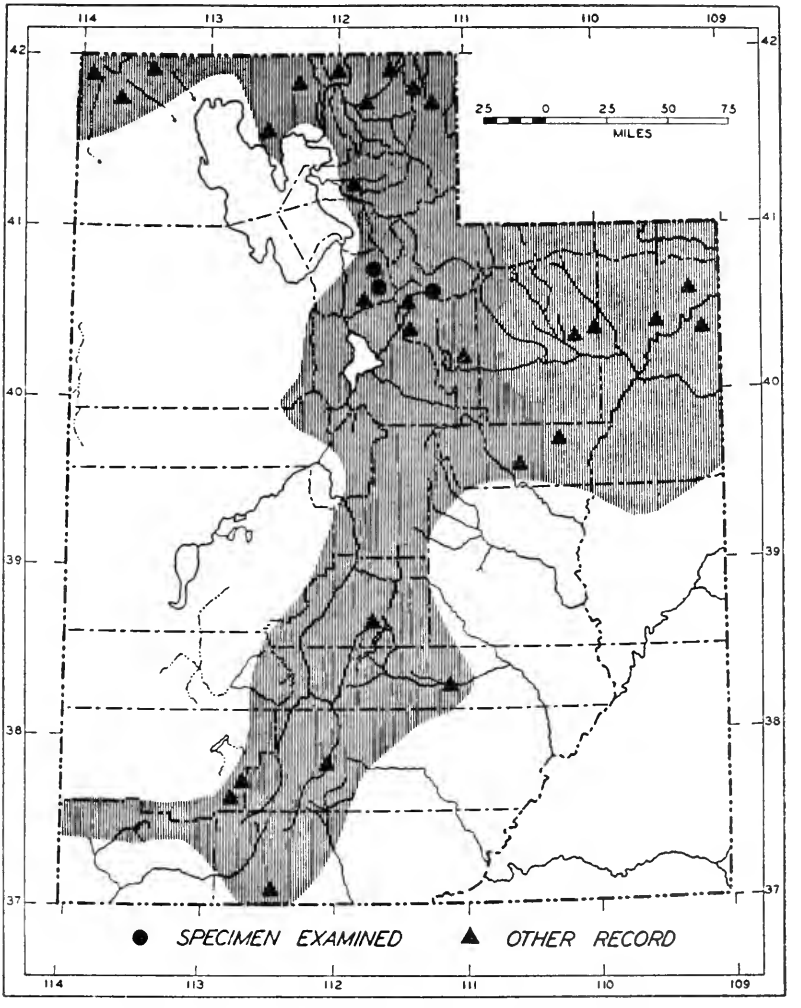

FIG. 19. Distribution of *Lepus townsendii townsendii*.

11,000 feet are attained throughout their range. I have taken them west of Garland, Boxelder County, in the same environment as the black-tailed jack rabbit (*Lepus californicus deserticola*) and the cottontail (*Sylvilagus nuttallii grangeri*).

Specimens examined.—Total, 5, distributed as follows: *Salt Lake County:* Between Emigration and Parleys canyons, 1; mouth of Millcreek Canyon, 1. *Summit County:* Woodland, 3.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Boxelder County:* 4 mi. SW Standrod; 10 mi. NW Grouse Creek; 7 mi. NE Howell; 8 mi. NE Grouse Creek; 22 mi. W Corinne. *Cache County:* 5 mi. NE Clarkston; 17 mi. NE Logan; 3 mi. NE Logan. *Rich County:* 3 mi. W Laketown; 5 mi. NW Randolph. *Weber County:* 5 mi. E Ogden. *Salt Lake County:* Draper. *Wasatch County:* 3 mi. N Heber; 10 mi. SW Heber; Strawberry Reservation. *Duchesne County:* 18 mi. E Mountain Home; 12 mi. SE Mountain Home. *Uintah County:* 17 mi. NE Vernal; 3 mi. SW Vernal; 18 mi. E Vernal. *Carbon County:* 23 mi. NE Price; 5 mi. E Price. *Sevier County:* 2 mi. W Fishlake. *Wayne County:* 17 mi. E Teasdale. *Iron County:* 5 mi. NE Lowder Ranger Station; Lowder Ranger Station. *Garfield County:* 3 mi. S Winder. *Kane County:* 3 mi. N Kanab.

Lepus americanus bairdii Hayden

Snowshoe Rabbit

Lepus Bairdii Hayden, American Nat., 3:115, May, 1869, type from near Freemont Peak, summit Wind River Mountains, Fremont County, Wyoming.

Lepus Bairdii, Nelson, N. Amer. Fauna, 29:109, August 31, 1909; Barnes, Bull. Univ. Utah, 12 (no. 15):104, April, 1922.

Lepus americanus Bairdii, True, Proc. U. S. Nat. Mus., 7:601, 1885.

Lepus bairdii bairdii, Barnes, Bull. Univ. Utah, 17 (no. 12):144, June, 1927; Svihla, Journ. Mamm., 12:264, August 24, 1931; Stanford, Journ. Mamm., 12:362, November 11, 1931.

Lepus bairdi bairdi, Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 259, 1942; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Range.—Wasatch and Uinta mountains, and central mountains of the state as far south as Kane County.

Description and comments.—Measurements of an adult male, number 618, from Summit County and of an adult female, number 566, from Salt Lake County are, respectively, as follows: Total length, 411, 420; length of tail, 44, 32; length of hind foot, 140, 140; length of ear, 93, 95. Hind foot large. Color (*summer pelage*): Upper parts grizzled with admixture of brown and black, darkest on middorsal region and rump; cheeks and top of head buffy; outside of ears brownish, tipped with blackish; inner margin of ear margined with white; hind feet white; forelegs buffy; tail brownish above, dusky beneath; underparts white. Winter pelage all white except eye ring, which is black. Skull: Small; supraorbital plate well developed, but slender; nasals long and slender; lacrimal bone forms distinct process; incisive foramina large, somewhat constricted posteriorly.

The characters as set forth under the description readily distinguish these hares from all other kinds in Utah.

Insofar as I know, these hares are strictly Boreal and are found only in the Uinta, Wasatch, Wasatch Plateau, Fishlake, Beaver, Iron and Boulder mountains, where they are limited to coniferous forests. From the known information, this subspecies is never abundant in Utah, and is rare at the southern limits of its range.

Specimens examined.—Total, 4, distributed as follows: *Salt Lake County:* The Stairs, Big Cottonwood Canyon, 1; Brighton, Silver Lake P. O., 9,000 ft., Big Cottonwood Canyon, 1. *Summit County:* Smith and Morehouse Canyon, 1. *Sanpete County:* Manti National Forest, 1.

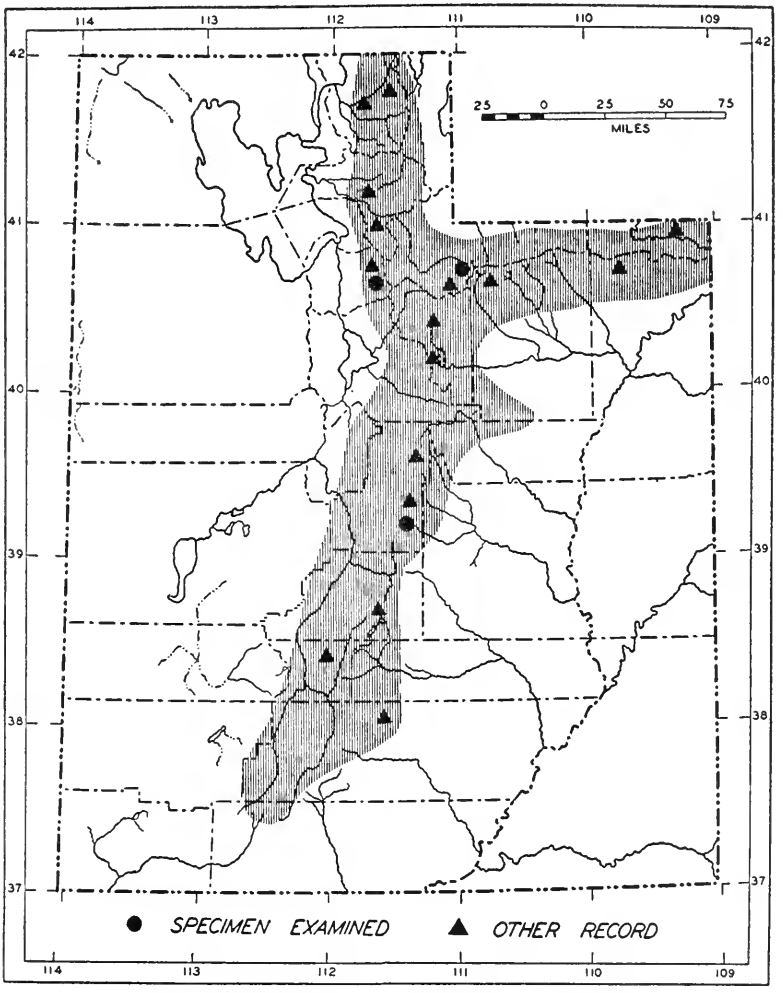

FIG. 20. Distribution of *Lepus americanus bairdii.*

Additional records (Localities determined from Janson, MS., Distribution Map).—*Cache County:* 12 mi. NE Logan; 3 mi. NE Logan. *Morgan County:* 7 mi. SE Riverdale; 7 mi. SW Morgan. *Salt Lake County:* 10 mi. SE Salt Lake City. *Summit County:* 20 mi. E Park City. *Daggett County:* 18 mi. SE Manila. *Wasatch County:* 15 mi. N Strawberry Reservoir; 3 mi. W Strawberry Reservoir. *Duchesne County:* 28 mi. N Fruitland. *Uintah County:* 30 mi. N Fort Duchesne. *Sanpete County:* 16 mi. NE Moroni; 7 mi. NE U. S. Forest Service Experiment Station; 3 mi. N U. S. Forest Service Experiment Station. *Sevier County:* 2 mi. N Fishlake. *Piute County:* 10 mi. E Maysvale. *Garfield County:* 21 mi. N Escalante.

Lepus californicus deserticola Mearns

Black-tailed Jack Rabbit

Lepus texianus deserticola Mearns, Proc. U. S. Nat. Mus., 18:564, June 24, 1896, type from western edge of Colorado Desert, east base of Coast Range Mountains, near Mexican Boundary, Imperial County, California.

Lepus californicus deserticola, Nelson, N. Amer. Fauna, 29:137, August 31, 1909; Barnes, Bull. Univ. Utah, 12 (no. 15):105, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):146, June, 1927; Stanford, Journ. Mamm., 12:362, November 11, 1931; Marshall, Journ. Mamm., 21:154-157, May 14, 1940; Long, Journ. Mamm., 21:179, May 16, 1940; Fautin, Ecol. Monogr., 16:304, October, 1946.

Lepus c. deserticola, Tanner, Great Basin Nat., 1:104, June 30, 1940.

Lepus callotis (?), Merriam, Mammals, in F. V. Hayden's sixth annual report of the U. S. Geol. Surv. of the Terr. embracing portions of Montana, Idaho, Wyoming and Utah, being a report of progress of the explorations for the year 1872, p. 666, 1873; Allen, Bull. Essex Inst., 6:66, 1874; Coues and Yarrow, Report upon the collection of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona during the years 1871-74, Wheeler's Report Expl. W 100th M., 5:127, 1875.

Lepus texianus, Allen, Bull. Brooklyn Inst. Mus. Sci., 1:121, 1905.

Range.—Entire state, except area east of Green and Colorado rivers, and the Uinta and Wasatch mountain region.

Description and comments.—Measurements of an adult male, number 556, and of an adult female, number 555, from Holden, are, respectively, as follows: Total length, 545, 594; length of tail, 69, 95; length of hind foot, 119, 125; length of ear, 137, 150. Ears long. Color: Upper parts, top of head and upper sides ashy gray, owing to mixture of black and white and sometimes pale buff; lower sides, throat and pectoral region cinnamon; front half of ears buffy gray; posterior half of ears white or grayish white; tips of ears blackish; inside margin of ear white, which grades into buff at the tips; inside of ears grayish brown; front legs buffy white anteriorly; nearly white posteriorly; entire underparts, except pectoral region, white; tail whitish beneath, black above. Skull: Small, slender; rostrum slender; nasals slender, straight; incisive foramina narrow, terminating posterior to the second premolar.

Compared with specimens of *Lepus californicus texianus* from Utah, *L. c. deserticola* may be distinguished as follows: Size smaller; ears average shorter. Color: Upper parts lighter, less brownish; black on rump less extensive. Skull: Smaller in all measurements taken; nasals slenderer, shorter, straight as opposed to convex; rostrum lighter; incisive foramina narrower posteriorly and extending posteriorly beyond the second upper premolar rather than extending only to the second premolar.

This is the commonest member of the *Lagomorpha* occurring in Utah. These animals are found throughout all the state, except the southeastern part, usually in the Upper Sonoran and Transition Life-zones, although I have found them occasionally at much higher elevations. It is not uncommon to find them in the same area and environment as *Lepus townsendii* and *Sylvilagus nuttallii.*

It has been my observation that these hares fluctuate markedly in numbers. This is easily noted since they are constantly hunted for sport, and are known to vary from abundant to rare in different years in many areas. The Colorado River evidently acts as an efficient barrier separating this subspecies from *L. c. texianus*. No

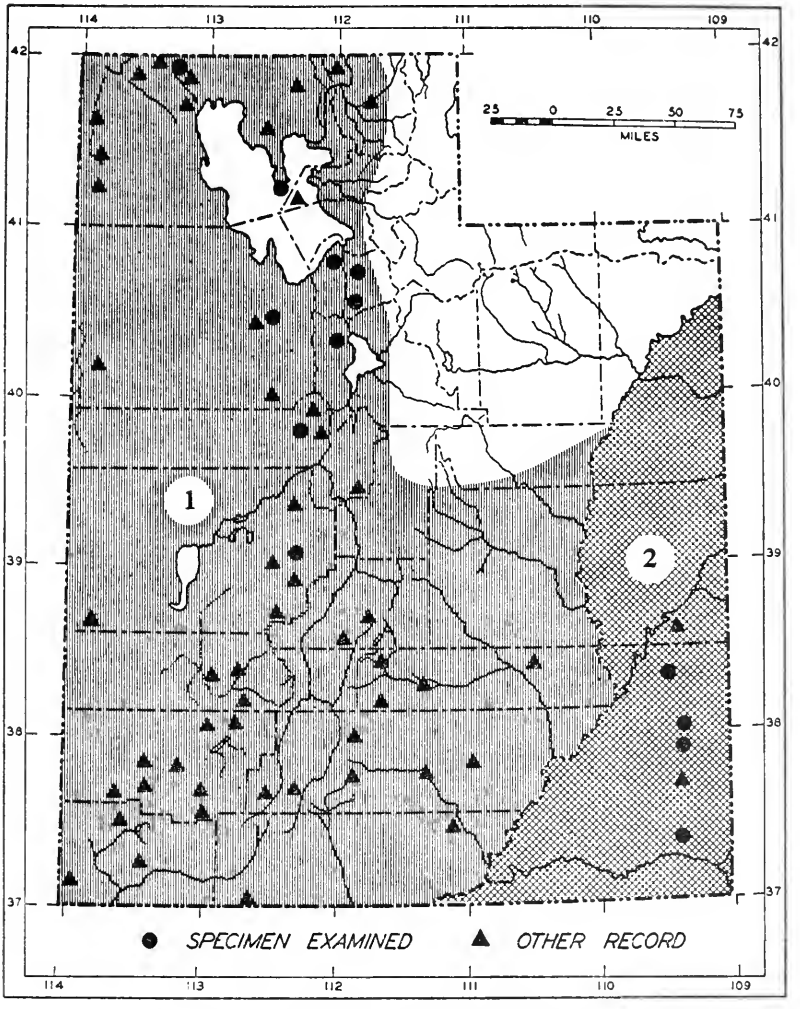

FIG. 21. Distribution of *Lepus californicus*.
1. *L. c. deserticola*. 2. *L. c. texianus*.

specimens examined by me are intergrades, but those from southeastern Uintah County would probably be intergrades between *L. c. deserticola* and *L. c. texianus*.

Specimens examined.—Total, 18, distributed as follows: *Boxelder County:* Standrod, 5,500 ft., Raft River Mountains, 1; Promontory Point, 6. *Tooele County:* St. John, 1. *Salt Lake County:* ½ mi. W Salt Lake City Airport, 4,250 ft., 1; Fort Douglas, 5,000 ft., 1; Skyline Drive, E City Cemetery, Salt Lake City, 1; 4 mi. N Draper, 4,500 ft., 1. *Utah County:* Cedar Fort, 2. *Juab County:* Dog Valley, W Nephi, 4,500 ft., 1. *Millard County:* Holden, 3.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Boxelder County:* Holstein Ranger Station; 10 mi. NW Holstein Ranger Station; 10 mi. NW Park Valley; 10 mi. NW Garland; 3 mi. NW Kelton; 3 mi. N Grouse Creek; 10 mi. E Rozel; 10 mi. S Grouse Creek; 3 mi. N Lucin. *Cache County:* 3 mi. NW Clarkston; 3 mi. NW Logan. *Weber County:* Fremont Island, Great Salt Lake. *Tooele County:* 8 mi. SW Iosepa; 12 mi. NW Iosepa; 8 mi. N Benmore. *Juab County:* 3 mi. NW Silver City; 25 mi. NW Nephi; 10 mi. S Levan. *Millard County:* 3 mi. W Oak City; 10 mi. W Fillmore; 3 mi. SW Fillmore; 5 mi. SW Kanosh; Desert Range Experiment Station. *Sevier County:* 3 mi. N Burrville; 7 mi. SE Koosharem. *Beaver County:* 5 mi. N Beaver; 5 mi. N Minersville; 10 mi. S Beaver. *Wayne County:* 20 mi. NW Teasdale; 5 mi. W Hanksville; 10 mi. E Teasdale; 15 mi. SW Teasdale. *Iron County:* 12 mi. NW Parowan; 10 mi. NE Parowan; 35 mi. W Parowan; 23 mi. W Parowan; 10 mi. NE Newcastle; 10 mi. SW Cedar City; 2 mi. NW Newcastle; 17 mi. S Cedar City. *Garfield County:* 5 mi. N Winder; 19 mi. E Escalante; 2 mi. S Escalante; 29 mi. E Escalante; 5 mi. NE Hatch; 7 mi. W Hatch. *Washington County:* 5 mi. W Pinto; 7 mi. W Leeds; Beaverdam Wash. *Kane County:* 15 mi. W Colorado River; 7 mi. W Kanab.

Lepus californicus texianus Waterhouse

Black-tailed Jack Rabbit

Lepus texianus Waterhouse, Nat. Hist. Mamm., 2:136, 1848, type probably from western Texas.

Lepus californicus texianus, Nelson, N. Amer. Fauna, 29:142, August 31, 1909; Cary, N. Amer. Fauna, 33:157, August 17, 1911; Barnes, Bull. Univ. Utah, 17 (no. 12):147, June, 1927; Benson, Univ. California Publ. Zoöl., 40:454, December 31, 1935.

Range.—Southeastern Utah.

Description and comments.—Measurements of an adult female, number 2937, from San Juan County are as follows: Total length, 768; length of tail, 143; length of hind foot, 91; length of ear, 172. Color: Similar to *Lepus californicus deserticola,* but with greater mixture of brown on upper parts. Skull: Large, robust; rostrum long, heavy and depressed tip; nasals long and convex dorsally; posterior ends of incisive foramina do not extend beyond posterior border of second premolar.

For comparison with *L. c. deserticola,* see account of that subspecies.

The subspecies *L. c. texianus* is the largest of the black-tailed jack rabbits known to occur in Utah, and is found only in that part of the state to the east of the Colorado River. The area within the state, to the east of the Green River, is not represented by specimens. Consequently the effect of this river on the distribution of these animals is not completely known.

Specimens examined.—Total, 4, distributed as follows: *San Juan County:* 19 mi. S Moab, Block Canyon, Cove Spring, 1; 12 mi. N Monticello, 1; N Monticello, 1; Highway 47, 15 mi. S Blanding, 5,200 ft., 1.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Grand County:* 5 mi. NE Moab. *San Juan County:* 3 mi. N Blanding.

Sylvilagus nuttallii grangeri (Allen)

Nuttall Cottontail

Lepus sylvaticus grangeri Allen, Bull. American Mus. Nat. Hist., 7:264, August 21, 1895, type from Hill City, Pennington County, South Dakota.

Sylvilagus nuttallii grangeri, Warren, The mammals of Colorado, Knickerbocker Press, p. 49, 1910; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 271, 1942; Fautin, Ecol. Monogr., 16:304, October, 1946.

Sylvilagus nuttalli grangeri, Nelson, N. Amer. Fauna, 29:204, August 31, 1909; Barnes, Bull. Univ. Utah, 12 (no. 15):97, April, 1922; Barnes,

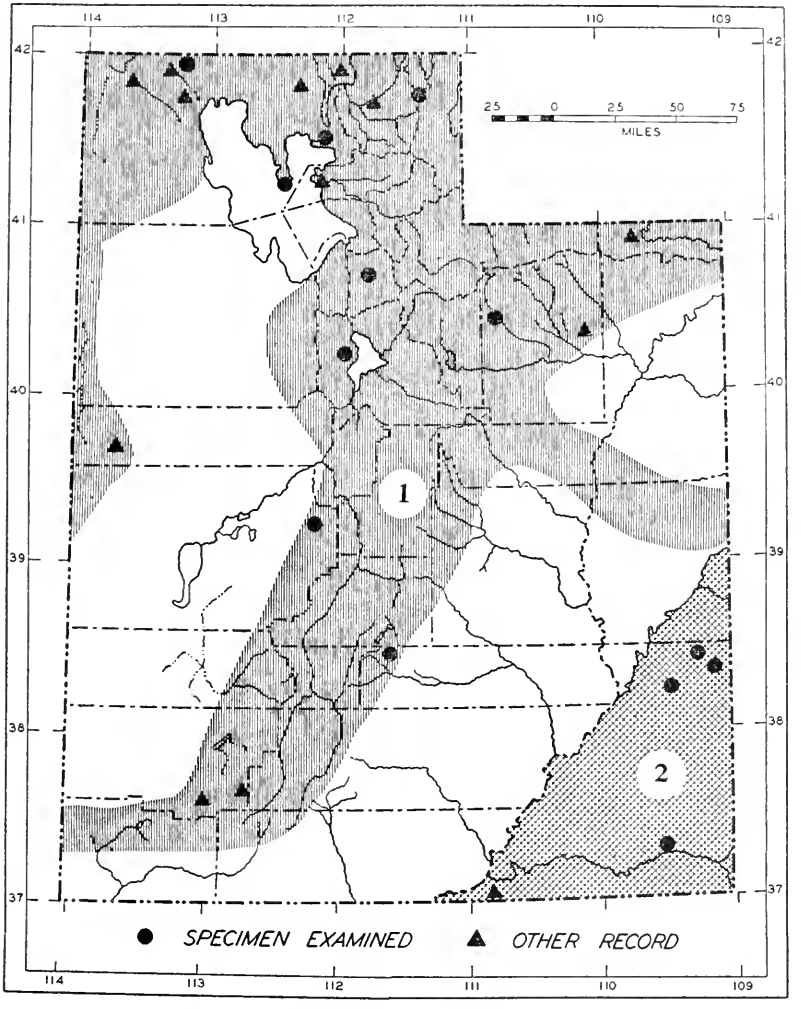

FIG. 22. Distribution of *Sylvilagus nuttallii*.
1. *S. n. grangeri.* 2. *S. n. pinetis.*

Bull. Univ. Utah, 17 (no. 12):150, June, 1927; Svihla, Journ. Mamm., 12:264, August 24, 1931; Stanford, Journ. Mamm., 12:362, November 11, 1931; Marshall, Journ. Mamm., 21:153, 154, 156, May 16, 1940; Long, Journ. Mamm., 21:180, May 16, 1940.

Lepus sylvaticus var. *artemesia*, Allen, Bull. Essex Inst., 6:66, 1874.

Lepus nuttalli, Allen, Bull. American Mus. Nat. Hist., 8:245, August 25, 1896.

Lepus arizonae (?), Allen, Bull. Brooklyn Inst. Mus. Sci., 1:121, March 31, 1905.

Range.—Practically the same distribution as *Lepus townsendii townsendii*.

Description and comments.—Measurements of an adult male, number 509, from Duchesne County and of an adult female, number 1366, from Boxelder County, are respectively, as follows: Total length, 365, 365; length of tail, 44, 41; length of hind foot, 103, 96; length of ear, 84, 60. Color: Upper parts buffy mixed with fawn and black; top of head grizzled; rump iron gray; nape rufous; ears gray, edged with black; tail dusky brown dorsally, white ventrally; dorsal surface of hind feet white; front of front legs Cinnamon; throat Ochraceous-Buff; entire underparts white. Skull: Size small, slender; rostrum slender; tympanic bullae small; interparietal small; posterior border of palatal bridge straight, without median spine; interpterygoid fossa well constricted posteriorly; inferior border of lower jaw straight; supraorbital plate and processes short and slender; molariform teeth large.

Sylvilagus nuttallii may be distinguished from *Sylvilagus audubonii* as follows: Ears shorter and more heavily haired; hind feet heavier and more heavily haired; tympanic bullae less inflated (smaller); supraorbital plates narrower; anterior projections of supraorbital plate shorter and narrower; posterior projections of supraorbital plates narrower and not so closely appressed to skull; interparietal smaller; basioccipital less constricted in middle; posterior margin of palatal bridge without median spine, and usually nearly straight rather than biconcave and usually with a median spine; interpterygoid fossa more constricted posteriorly; inferior border of lower jaw straight rather than convex; when looked at from side, distal point of contact with substratum is immediately proximal of the incisors rather than at middle of jaw, causing lower incisors to be more procumbent.

From specimens of *Sylvilagus nuttallii pinetis* from Utah, *S. n. grangeri* from Utah differs in smaller size, shorter ears and smaller skull including tympanic bullae.

In Utah the distribution of *S. n. grangeri* closely corresponds to that of *Lepus townsendii townsendii*. *S. n. grangeri* seems to inhabit mostly the lower slopes of the mountains in northern Utah where it is more abundant than elsewhere in the state, but it occurs at high elevations in the southern part of its range. The vertical distribution is from the Upper Sonoran Life-zone into the Boreal Life-zones.

There are no evidences of intergradation with the eastern form S. *n. pinetis.*

Specimens examined.—Total, 12, distributed as follows: *Boxelder County:* Standrod, Raft River Mountains, 5,500 ft., 1; Promontory Point, 3; ½ mi. E Bear River Gun Club, 4,300 ft., 1. *Rich County:* 5 mi. SW Laketown, 6,500 ft., 1. *Duchesne County:* Stockmore, 1. *Salt Lake County:* Dudley Spring, near mouth Parleys Canyon, 1. *Utah County:* W side Utah Lake, 1. *Millard County:* Holden, 2. *Wayne County:* 1 mi. E Fremont, 8,400 ft., 1.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Boxelder County:* 5 mi. S Standrod; 12 mi. SW Holstein Ranger Station; 7 mi. W Kelton; 5 mi. NE Howell. *Cache County:* 3 mi. NE Clarkston; 3 mi. NE Logan. *Weber County:* Mouth Weber River. *Daggett County:* 7 mi. S Manila. *Duchesne County:* 10 mi. E Mountain Home. *Juab County:* Trout Creek. *Iron County:* 5 mi. NE Lowder Ranger Station; 3 mi. SE Cedar City.

Sylvilagus nuttallii pinetis (Allen)

Nuttall Cottontail

Lepus sylvaticus pinetis Allen, Bull. American Mus. Nat. Hist., 6:348, December 7, 1894, type from White Mountains south of Mount Ord, Arizona.

Sylvilagus nuttallii pinetis, Warren, The mammals of Colorado, Knickerbocker Press, p. 47, 1910; Benson, Univ. California Publ. Zoöl., 40:446, December 31, 1935.

Range.—Southeastern Utah, east of Colorado River.

Description and comments.—Measurements of one male, number 2944, and of three females, numbers 2938, 2939 and 2941, from San Juan County are, respectively, as follows: Total length, 552, 580, 545, 500; length of tail, 47, 41, 45, 51; length of hind foot, 95, 95, 97, 90; length of ear, 91, 89, 91, 100. Ears long; hind feet large and heavily furred; pelage long. Color: Upper parts Ochraceous-Buff mixed with black and gray, heaviest middorsally; top of head Pinkish Buff mixed with black grading to creamy buff of sides of head; rump patch iron gray, not well marked; nape Cinnamon-Rufous, external part of ears buffy gray, black tipped; inside of ears whitish; tail brownish gray above, white beneath; front and sides of front legs, back and sides of hind legs Cinnamon-Rufous; front and hind feet Cinnamon-Buff; throat Ochraceous-Buff; under parts white. Skull: Size large, robust; rostrum long; supraorbital processes large; tympanic bullae proportionately small; braincase broad and well inflated; jugals deeply grooved on lateral side; basioccipital but little constricted midway of its length; teeth robust.

For comparisons with *Sylvilagus nuttallii grangeri*, see account of that subspecies.

This subspecies is restricted to southeastern Utah. With the exception of one specimen from one half mile northwest of Bluff all other available known specimens are from the La Sal Mountains. One was observed on Navajo Mountain (Benson, 1935:446). The Abajo Mountains of San Juan County situated between the La Sal Mountains and Navajo Mountain probably is inhabited by these animals.

The valleys in this region are inhabited by members of another species *Sylvilagus audubonii.* Collections made in the La Sal Mountains at 5,400 feet contained both species. At elevations above 5,400 feet only *S. n. pinetis* was found. None of the specimens indicates intergradation with *S. n. grangeri* to the north. The relatively inaccessible Tavaputs Plateau of southern Uintah and northern Grand counties, east of the Green River, might be inhabited by intergrades between *S. n. pinetis* and *S. n. grangeri.*

Specimens examined.—Total, 7, distributed as follows: *San Juan County:* 5 mi. NE La Sal P. O., 8,000 ft., 1; Block Canyon, 19 mi. SE Moab, 5,400 ft., 4; Hatch Wash, 3 mi. S La Sal Junction, 1; ½ mi. NW Bluff, 4,500 ft., 1.

Additional record (Benson, 1935:454).—Navajo Mountain, San Juan County.

Sylvilagus audubonii baileyi (Merriam)

Audubon Cottontail

Lepus baileyi Merriam, Proc. Biol. Soc. Washington, 11:148, June 9, 1897, type from Spring Creek, east side Bighorn Basin, Bighorn County, Wyoming.

Sylvilagus audubonii baileyi, Barnes, Bull. Univ. Utah, 17 (no. 12):154, June, 1927.

Sylvilagus auduboni baileyi, Nelson, N. Amer. Fauna, 29:232, August 31, 1909; Warren, The mammals of Colorado, Knickerbocker Press, p. 49, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):95, April, 1922; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 272, 1942.

Range.—Uinta Basin, limits unknown.

Description and comments.—Nelson (1909:213) gives the following average measurements of 5 specimens (sex?), from Bighorn Basin and Lander, Wyoming: Total length, 411; length of tail, 57.0; length of hind foot, 96.4; length of ear (dry), 64.3. Color: Upper parts pale, creamy buff with light wash of black; sides of head and body paler than back; rump iron gray, not forming patch; top of tail like rump, under side white; outside of ear grayish white; nape light rufous; forelegs Ochraceous-Buff; back and sides of hind legs dark buff, underside of neck buff (Janson, MS). Skull: Supraorbitals heavy; rostrum heavy; interorbital width narrow; zygomatic arches heavy and grooved; tympanic bullae large and well inflated; basioccipital deeply constricted and troughlike; molariform teeth large (Nelson, 1909:233).

For comparisons with other kinds of *Sylvilagus audubonii,* known to occur in Utah, see accounts of those subspecies.

From the known records of occurrence, this subspecies is limited in Utah to the Uinta Basin and to that part of Uintah County formerly known as the Uncompahgre Indian Reservation. This animal probably occurs along the northern foothills of the Uinta Mountains and in eastern Rich County.

Records of occurrence (Localities determined after Janson, MS., Distribution Map).—*Duchesne County:* 10 mi. E Mountain Home; 6 mi. NW Duchesne; 8 mi. S Myton. *Uintah County:* Vernal; 7 mi. SE Vernal; 17 mi. SW Vernal.

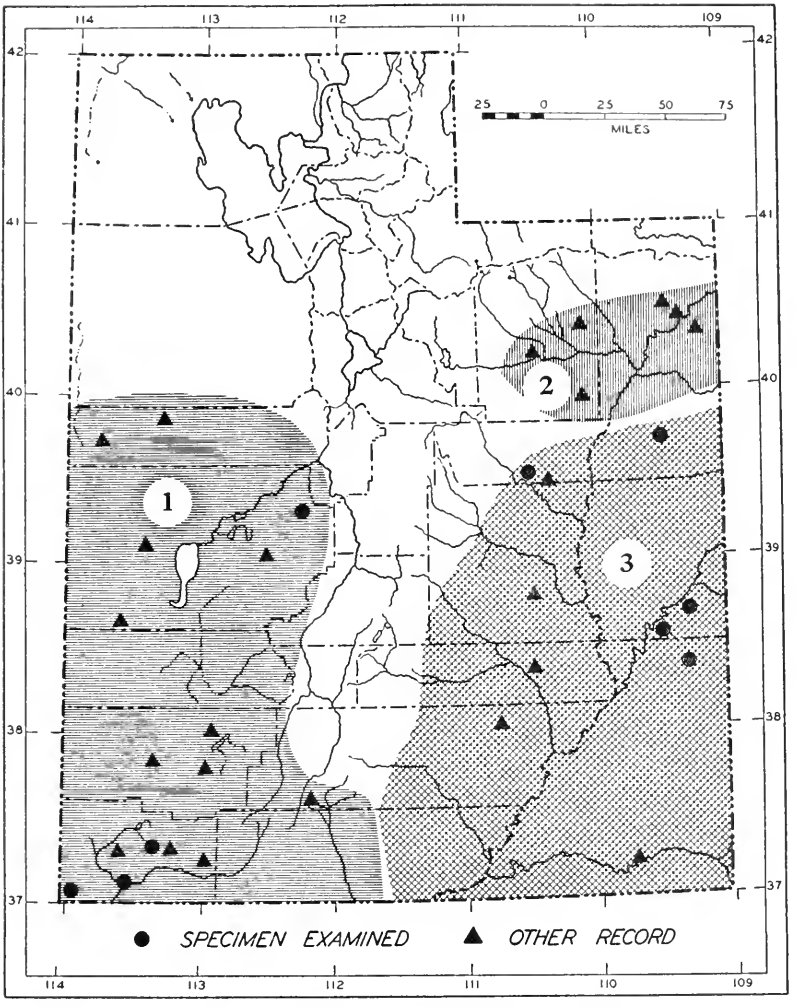

FIG. 23. Distribution of *Sylvilagus audubonii*.
1. *S. a. arizonae.* 2. *S. a. baileyi.* 3. *S. a. warreni.*

Sylvilagus audubonii arizonae (Allen)

Audubon Cottontail

(*Lepus sylvaticus*) var. *arizonae* Allen, Monogr. N. Amer. Rodentia, p. 332, 1877, type from Beal Springs, 3 miles northwest of Kingman, Mohave County, Arizona.

Sylvilagus audubonii arizonae, Barnes, Bull. Univ. Utah, 17 (no. 12):152, June, 1927.

Sylvilagus audubonii arizonae, Nelson, N. Amer. Fauna, 29:222, August 31, 1909; Presnall, Zion-Bryce Mus. Bull., 2:18, January, 1938; Hardy, Ecol. Monogr., 15:87, January, 1945.

Range.—Southwestern and south-central parts of state.

Description and comments.—Measurements of one adult male, number 2958, from Washington County, are as follows: Total length, 495; length of tail, 40; length of hind foot, 94; length of ear, 89. Ears long and sparsely haired. Color: Upper parts light buffy gray, with admixture of black; heaviest in middorsal region; sides of head and body gray; rump patch iron gray; nape Rufous; dorsal side of tail like back, white beneath; ears pale gray, with blackish tips; front side of forelegs Cinnamon; top of hind feet white; throat Drab; underparts white. Skull: Small, light; rostrum slender; zygomatic arches not widely spreading; supraorbital processes narrow both anterior and posterior; tympanic bullae large; basioccipital strongly constricted.

This subspecies may be easily distinguished from *Sylvilagus audubonii warreni* and *Sylvilagus audubonii baileyi* by its small size and small slender skull with large auditory bullae.

These animals range from the lower Sonoran Life-zone into the Upper Sonoran Life-zone. Those from that part of Utah formerly occupied by the Pleistocene Lake Bonneville present a perplexing problem. Janson (MS) stated that they were different from named subspecies and probably merited separation, but referred his specimens tentatively to S. *a. warreni.* Hall (1946:614) referred 3 specimens from White Pine County, Nevada, to S. *a. arizonae.* This Nevadan locality is on the western margin of the ancient lake. I had one skin and skull and 6 skulls only, from Holden, Millard County, and they showed no characters typical of S. *a. warreni,* but were more like S. *a. arizonae.* They also have some characteristic differences from S. *a. arizonae.* The ears are shorter and have a brownish rather than a grayish cast. They are slightly darker in dorsal coloration. The skulls differ in wider basioccipital; narrower, more grooved zygomatic arches; shorter palatal bridge and heavier supraorbital processes. The material is not sufficient, nor well enough prepared, to provide answers to the questions raised. It is possible, however, than an unnamed kind of *Sylvilagus audubonii* inhabits this region of the Great Basin. On geographic grounds only, I am referring these specimens for the present to S. *a. arizonae.*

Specimens examined.—Total, 11, distributed as follows: *Millard County:* Holden, 7. *Washington County:* Danish Ranch, 6 mi. NW Leeds, 3,300 ft., 1; Tonaquint Fields, St. George, 2; Beaverdam Wash, 2,100 ft., 1.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Juab County:* 2 mi. SW Fish Springs; Trout Creek. *Millard County:* 35 mi. SW Deseret; 10 mi. NW Fillmore; Desert Range Experiment Station. *Iron County:* 15 mi. NW Parowan; 25 mi. NW Cedar City; 10 mi. N Cedar City. *Garfield County:* 7 mi. SW Tropic. *Washington County:* 5 mi. W Leeds; 15 mi. SW Pine Valley; 5 mi. N Springdale.

Sylvilagus audubonii warreni Nelson

Audubon Cottontail

Sylvilagus audubonii warreni Nelson, Proc. Biol. Soc. Washington, 20:83, July 22, 1907, type from Coventry, Montrose County, Colorado; Nelson, N. Amer. Fauna, 29:231, August 31, 1909; Barnes, Bull. Univ. Utah, 12 (no. 15):97, April, 1922; Stanford, Journ. Mamm., 12:362, November 11, 1931.

Sylvilagus audubonii warreni, Barnes, Bull. Univ. Utah, 17 (no. 12):154, June, 1927; Benson, Univ. California Publ. Zoöl., 40:443, December 31, 1935.

Sylvilagus a. warreni, Tanner, Great Basin Nat., 1:109, June 30, 1940.

Range.—Eastern Utah on both sides of the Colorado and Green rivers.

Description and comments.—Measurements of an adult male, number 2940, and an adult female, number 2938, from San Juan County, are, respectively, as follows: Total length, 505, 580; length of tail, 52, 41; length of hind foot, 92, 95; length of ear, 101, 89. Ears long; pelage long. Color: Upper parts cream buff heavily mixed with dark buff and black on back; rump patch and dorsal surface of tail iron gray; outside of ears grayish black, tipped with black; under surface of tail white; nape Cinnamon; front of front legs and backs of back legs Cinnamon; front and hind feet white washed with buff; throat buffy; underparts white. Skull: Large, robust; rostrum heavy; supraorbital processes long and heavy; tympanic bullae large and well inflated; basioccipital strongly constricted and troughlike; teeth heavy; lower border of mandible convex.

Nelson (1909:231) stated that this subspecies is separable from *Sylvilagus audubonii baileyi* only by darker color.

In his monograph of the rabbits of North America, Nelson (1909: 232) listed specimens from eastern Kane and Garfield counties under this subspecies. His distribution map shows no ascribed range west of the Colorado River, although the localities listed, are from that area. Specimens available for this study are from both sides of the river. This is in keeping with the findings of Janson (MS) who likewise had specimens from west of the river from Emery, Carbon and Wayne counties. The river is known to freeze over in places and therefore is not a barrier in the case of these rabbits, because they could cross on the ice. One animal from Carbon County adjacent to the range of *S. a. baileyi* is typical of *S. a. warreni.* The area of the Roan Cliffs and Book Cliffs is inhabited by another species (*Sylvilagus nuttallii*), and seems to be an effective barrier between these two subspecies of *Sylvilagus audubonii.* Insofar as I know, the rabbits of this species are inhabitants of valleys and not mountains.

Specimens examined.—Total, 6, distributed as follows: *Uintah County:* Willow Creek, 5,250 ft., 25 mi. S Ouray, 1. *Carbon County:* Wellington, 1. *Grand County:* Near Castleton, 1; Moab, 1. *San Juan County:* Block Canyon, 19 mi. SE Moab, 5,400 ft., 2.

Additional records (Localities determined from Janson, MS., Distribution Map).—*Carbon County:* 7 mi. SW Sunnyside. *Emery County:* 23 mi. SW Greenriver. *Wayne County:* 5 mi. E Hanksville. *Garfield County:* 25 mi. NW Hite. *San Juan County:* 5 mi. W Bluff.

Sylvilagus idahoensis (Merriam)

Pigmy Rabbit

Lepus idahoensis Merriam, N. Amer. Fauna, 5:76, July 30, 1891, type from Pahsimeroi Valley, near Goldburg, Custer County, Idaho.
Sylvilagus idahoensis, Grinnell, Dixon and Linsdale, Univ. California Publ. Zoöl., 35:553, October 10, 1930.
Brachylagus idahoensis, Stanford, Journ. Mamm., 13:79, February 9, 1932; Shantz, Journ. Mamm., 28:187, June 1, 1947.

Range.—Known only from Boxelder, Cache and Iron counties. Probably occurs in intervening area along eastern margins of Pleistocene Lake Bonneville.

Description and comments.—Measurements of 2 adult males, numbers 6616 and 6617, and 2 adult females, numbers 6618 and 6619, from Yost are as follows: Total length, 257, 280, 260, 254; length of tail, 14, 14, 25, 25; length of hind foot, 70, 70, 65, 68; length of ear, 50, 50, 50, 49. Size small, smallest of Utah rabbits; legs and feet short; tail inconspicuous. Color: Upper parts grayish brown; tail brown, no white; nape and legs Rufous; underparts white. Skull: Short, broad posteriorly; sloping anteriorly; tympanic bullae large; rostrum short; supraorbital processes small and delicate; jugals heavy with large lateral pits; basioccipital small, narrow and troughlike; palatal bridge narrow; interpterygoid fossa deep and broad; lower margin of lower jaw convex.

Janson (MS) states that these small rabbits are limited to sage brush and loose soil. In northern Utah they occupy the same area as *Lepus townsendii, Lepus californicus* and *Sylvilagus nuttallii.* The pigmy rabbits, so far as I know, are restricted to the Upper Sonoran Life-zone.

Reference to the distribution map (fig. 24) will inform the reader that the range of these small rabbits in Utah is thought to include nearly all of the state that is within the Great Basin. The localities from which animals have been reported, however, are all marginal to the area formerly occupied by Pleistocene Lake Bonneville. This ancient lake is known to have greatly affected the distribution of many kinds of mammals, and the lack of specimens of S. *idahoensis* from the basin of the lake, where suitable habitats are known to exist, would indicate that the lake has also been operative in the distribution of these rabbits, by excluding them from certain areas and by permitting them to reach other areas.

Specimens examined.—Total, 9, distributed as follows: *Boxelder County:* Yost, 4; Grouse Creek, 3 mi. S Yost, 6,500 ft., Raft River Mountains, 1. *Iron County:* 2 mi. W Cedar City, 4, 3 (U. S. A. C.).

Additional records (Localities determined from Janson, MS., Distribution Map).—*Boxelder County:* 7 mi. SW Snowville; 7 mi. NE Howell; 5 mi. E Rozel; 7 mi. S Grouse Creek; 15 mi. SW Holstein Ranger Station; 10 mi. SE Rozel; 3 mi. N Lucin. *Cache County:* 3 mi. NE Clarkston. *Utah County:* W side Utah Lake. *Juab County:* Fish Springs. *Iron County:* 15 mi. NW Parowan; 5 mi. E Jozella Ranch; 20 mi. W Parowan; 2 mi W Parowan; 7 mi. NE Cedar City; 10 mi. S Modena; 10 mi. SW Cedar City.

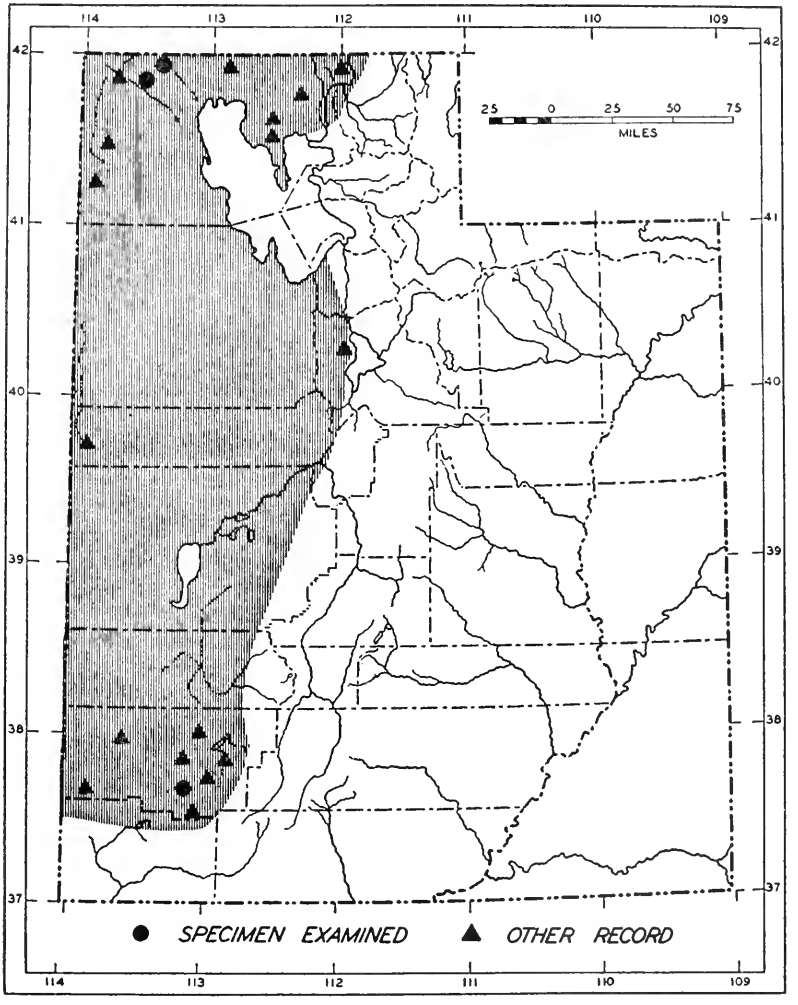

FIG. 24. Distribution of *Sylvilagus idahoensis.*

TABLE 4. Cranial Measurements of Lepus and Sylvilagus

Sex	Catalog number	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Length of palatal bridge	Diameter of ext. auditory meatus	Alveolar length of molariform teeth
		Lepus townsendii townsendii, ♂ Summit County ♀ Salt Lake County								
♂	501	75.3	40.0	46.2	31.7	19.5	12.6	6.2	4.9	17.1
♀	695	72.0	42.2	46.7	32.4	23.2	14.3	5.2	5.7	18.1
		Lepus americanus bairdii, ♂ Summit County ♀ Salt Lake County								
♂	618	56.1	30.3	37.2	25.0	15.1	10.7	5.2	5.1	13.2
♀	566	55.4	28.3	38.2	24.7	16.2	11.7	5.6	5.2	13.7
		Lepus californicus deserticola, Holden								
♂	556	67.7	35.1	41.2	27.8	16.4	13.5	5.7	6.1	16.1
♀	555	70.5	36.0	41.1	28.3	17.0	12.5	6.5	5.6	16.0
		Lepus californicus texianus, San Juan County								
♀	2937	73.3	41.5	42.7	30.3	17.1	12.8	7.1	6.0	16.2
		Sylvilagus nuttallii grangeri, ♂ Duchesne County ♀ Boxelder County								
♂	509	51.9	30.3	34.4	25.8	12.8	11.4	6.2	5.3	13.0
♀	1366	49.0	28.0	33.3	24.0	11.7	9.3	5.4	5.2	13.0
		Sylvilagus nuttallii pinetis, San Juan County								
♂	2944	52.0	30.2	35.3	24.1	13.1	12.0	6.0	5.1	13.1
♀	2939	54.1	32.0	34.0	23.7	13.6	11.0	6.0	5.0	14.0
♀	2941	51.4	29.0	34.6	23.6	12.4	11.3	6.2	5.4	12.5
♀	2943	53.9	30.7	34.9	24.4	13.1	11.0	6.7	5.5	14.1
		Sylvilagus audubonii baileyi, Wyoming (Nelson, 1909: 213)								
?		52.9	30.4	.....	.....	17.6	.....	.....	.....	.....
		Sylvilagus audubonii arizonae, Washington County								
♂	2958	50.5	27.5	32.7	20.8	12.5	11.6	4.7	5.0	12.3
♀	612	50.9	27.0	32.9	21.1	12.3	11.0	4.9	5.1	12.2
		Sylvilagus audubonii warreni, San Juan County								
♂	2940	50.3	29.9	34.9	21.0	11.3	11.3	6.3	5.7	12.7
♀	2938	51.7	30.0	33.7	21.5	12.2	11.7	5.8	5.2	12.7
		Sylvilagus idahoensis, Yost								
♂	6616	38.1	18.1	27.7	22.7	9.5	9.9	3.6	4.8	9.3
♂	6617	38.2	18.0	27.1	22.0	9.5	10.4	4.2	4.8	9.7
♀	6618	38.6	17.1	27.3	23.5	8.8	9.3	3.4	5.1	9.2
♀	6619	37.7	17.6	26.4	23.0	9.3	9.0	3.8	4.6	9.0

Order RODENTIA

Rodents

Mostly small, five-toed, unguiculate, plantigrade or semi-plantigrade, herbivorous mammals, possessing a wide range of adaptive radiation as illustrated by modification into terrestrial, arboreal, fossorial, natatorial and partially volant kinds. Anatomical features common to all rodents are: one pair of chisellike, curved, continually growing incisors in both upper and lower jaws; canines absent; a wide diastema separating the incisors from the cheek teeth; premolars reduced or lacking; orbital and temporal fossae confluent; glenoid fossae shallow and elongate, permitting anteroposterior and lateral motions of lower jaw; testes inguinal or abdominal; intestine usually with well-developed caecum; uterus bicornuate.

KEY TO FAMILIES OF RODENTS IN UTAH

1.–Body and tail provided with quills; infraorbital foramen larger than foramen magnum ..... Erethizontidae, p. 389

1'.–Body and tail without quills; infraorbital foramen smaller than foramen magnum.

2.–Tail flattened dorsoventrally, scaly; teeth with 8-10 transverse ridges ..... Castoridae, p. 284

2'.–Tail not flattened dorsoventrally; teeth without 8-10 transverse ridges.

3.–External fur-lined cheek pouches present.

4.–Tail short, never as long as head and body; front feet larger than hind and with larger claws; tympanic bullae not exposed on parietal face of skull; upper incisors not distinctly grooved ..... Geomyidae, p. 156

4'.–Tail as long as, or longer than, head and body; hind feet larger than front; tympanic bullae exposed on parietal surface of skull; upper incisors distinctly grooved.... Heteromyidae, p. 232

3'.–Fur-lined cheek pouches never present.

5.–Cheek teeth always more than three in each jaw; infraorbital foramen never a long vertical slit.

6.–Postorbital processes present..... Sciuridae, p. 92

6'.–Postorbital processes absent..... Zapodidae, p. 385

5'.–Cheek teeth never more than three in each jaw; infraorbital foramen a long vertical slit.

7.–Upper molars with three longitudinal rows of cusps..... Muridae, p. 381

7'.–Upper molars with two longitudinal rows of cusps or consisting of numerous triangles and transverse enamel folds..... Cricetidae, p. 292

Family SCIURIDAE

Squirrels

Arboreal, terrestrial or fossorial mammals of from small to moderate size. Features common to all forms are: skull somewhat arched (except in marmots); postorbital processes well developed; palate broad; infraorbital foramina small; skull at lateral base of rostrum, and zygomatic arch in this region well grooved for reception for the anterior division of the masseter muscle; cheek teeth low crowned, trituberculate and rooted; third premolar reduced or sometimes lacking; tooth formula, i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$ or $\frac{1}{1}$, m.

In Utah, this family is represented by the following genera: *Sciurus,* with one species; *Tamiasciurus,* with 3 subspecies belonging to a single species; *Marmota,* with 3 subspecies belonging to a single species; *Cynomys,* with 3 species; *Citellus,* with 13 subspecies belonging to 8 species; *Eutamias,* with 11 subspecies belonging to 4 species, and *Glaucomys,* with one kind.

KEY TO SPECIES OF SCIURIDAE IN UTAH

1.–Tail less than ¼ of total length.
2.–Forefeet with 4 claws, pollex having only a flat nail; molar series parallel ..... *Marmota flaviventer,* p. 101
2'.–Forefeet with 5 claws; molar series converging posteriorly.
3'.–Terminal part of tail with gray center.... *Cynomys gunnisoni,* p. 109
4.–Interorbital breadth less than 13.5.... *Cynomys leucurus,* p. 105
4'.–Interorbital breadth more than 13.5.. *Cynomys parvidens,* p. 108

1'.–Tail more than ¼ of total length.
5.–A loose fold of skin between fore and hind leg, or black line separating light-colored underparts from dark-colored upper parts; front part of zygoma vertical.
6.–A loose fold of skin between fore and hind leg; no black line separating light-colored underparts from dark-colored upper parts; third upper premolar well developed, *Glaucomys sabrinus,* p. 151
6'.–No loose fold of skin between fore and hind leg; black line separating light-colored underparts from dark-colored upper parts present; third upper premolar vestigeal.
7.–Size large, ears tufted..... *Sciurus aberti,* p. 94
7'.–Size small, ears not tufted..... *Tamiasciurus hudsonicus,* p. 95
5'.–No loose fold of skin between fore and hind leg, and no black line separating light-colored underparts from dark-colored upper parts; front part of zygoma nearly horizontal.
8.–Sides of head without stripes; infraorbital foramen large; anterior border of zygomatic notch in maxillary opposite first upper molar.
9.–Upper parts grayish or brownish or mixture of both, not striped or dappled.
10.–Hind foot less than 40; length of skull less than 41; color usually grayish, *Citellus townsendii,* p. 111

10'.–Hind foot more than 40; length of skull more than 41; color usually brownish.
11.–Under surface of tail grayish,
Citellus armatus, p. 114
11'.–Under surface of tail Hazel,
Citellus beldingi, p. 113
9'.–Upper parts striped or dappled.
12.–Tail more than 135; length of skull more than 50,
Citellus variegatus, p. 118
12'.–Tail less than 135; length of skull less than 50.
13.–Upper parts dappled with white (not striped),
Citellus spilosoma, p. 117
13'.–Upper parts striped.
14.–Upper parts with 13 longitudinal stripes,
Citellus tridecemlineatus, p. 115
14'.–Upper parts of body with less than 13 longitudinal stripes.
15.–Tail white beneath; 2 white stripes on upper parts..... *Citellus leucurus*, p. 121
15'.–Tail reddish beneath; 2 white stripes bordered with black on upper parts,
Citellus lateralis, p. 126
8'.–Sides of head striped; infraorbital foramen small; anterior border of zygomatic notch in maxillary opposite fourth upper premolar.
16.–Head and body usually less than 110; hind foot usually 30 or less; skull length usually less than 31.5,
Eutamias minimus, p. 132
16'.–Head and body usually more than 110; hind foot usually more than 30; skull length more than 31.5.
17.–Dorsal stripes, especially the lateral ones obscure; general color grayish; edges of tail whitish,
Eutamias dorsalis, p. 149
17'.–Dorsal stripes conspicuous; general color ochraceous; edges of tail ochraceous or buffy.
18.–Length of head and body usually less than 120; length of skull less than 33.5,
Eutamias amoenus, p. 141
18'.–Length of head and body more than 120; length of skull more than 33.5,
Eutamias quadrivittatus, p. 142

Sciurus aberti navajo Durrant and Kelson

Abert Squirrel

Sciurus aberti navajo Durrant and Kelson, Proc. Biol. Soc. Washington, 60:79, July 2, 1947, type from 1 mile east of Kigalia Ranger Station, 30 miles west of Blanding, Natural Bridges National Monument Road, 8,000 feet, San Juan County, Utah.
Sciurus aberti minus, Durrant, Jour. Mamm., 28:66, February 17, 1947.

Range.—Known only from the type locality. See figure 36.

Description and comments.—Measurements of the two available adult males, numbers 4775 and 4776, are as follows: Total length, 486, 510; length of tail, 220, 231; length of hind foot, 67, 74; length of ear, 31, 44. Color: Upper parts a grizzled Iron Gray owing to black and white banded hairs, grading to pure black on the sides; dorsal stripe Cinnamon-Rufous, confined to posterior regions, and nearly obsolete; ear tufts short and black; postauricular spots Cinnamon-Rufous and reduced in size; top and especially sides of head lighter than back, grading to white on lips and eye ring; vibrissae black; dorsal surface of tail like upper parts of body, but overlaid with long, white-tipped guard hairs; sides of tail broadly edged with white; underparts white, hairs being Dark Plumbeous at base except on front legs; ventral surface of tail white (hairs white to base) except proximal part of tail which is grizzled gray same as upper parts; front and outer surfaces of legs to tarsal and carpal joints same as upper parts; inner surfaces of legs white. Skull: Supraorbital ridge with deep notch; foramen magnum ovoid; lambdoidal crest platelike rather than ridged; braincase broad and well inflated.

It is remarkable that the presence in Utah of an animal as large and as spectacular as the Abert squirrel remained unknown to zoologists until so recently as 1947. The known geographic range of this subspecies is, however, in an area that is fairly remote and that was until recent years almost inaccessible. Messrs. Tom Phillips and Julian Thomas, U. S. Forest Rangers of the La Sal National Forest, report that the animals are nowhere common and that the range is small.

These animals live on a broad flat-topped table land abutting on the west slope of the Abajo Mountains in San Juan County. This highland area is completely isolated from any other mountains by tangled canyons of the Colorado River and its feeders to the west, by sage plains to the south and east, and by mixed-shrub desert to the north. The Abert squirrel, it will be recalled, is closely associated with the one species of plant, yellow pine. The squirrel seems to be entirely dependent upon the yellow pine which is the source of food; the animal is not known to occur in any locality where this kind of tree is lacking. Hence, the squirrels in this region consist of isolated populations living in the small discontinuous stands of yellow pine. It seems that the present distribution of these forests is a result of past climatological change which at one

time permitted the existence of "bridges" of yellow pine across what is now arid, desert land, thus affording a possible means of dispersal to the squirrels. With reference to past climatic conditions, it is recognized that much of the higher part of this country of southern Utah supported glaciers (Gregory, 1938:64). At least the presence of certain relict flora of the region is mute evidence of a different past climatic condition.

Insomuch as these squirrels remained so long undetected in Utah, perhaps other isolated populations will be found when the yellow pine associations of similar desert mountains in the western United States are more thoroughly studied.

Specimens examined.—Total, 2, from: *San Juan County:* 1 mi. E Kigalia Ranger Station, 30 mi. W Blanding on Natural Bridges National Monument Road, 8,000 ft., 1; Elk Ridge, La Sal National Forest, 8,000 ft., 1.

Tamiasciurus hudsonicus ventorum (Allen)

Red Squirrel (Chickaree)

Sciurus hudsonicus ventorum Allen, Bull. American Mus. Nat. Hist., 10:263, July 22, 1898, type from South Pass City, Wyoming; Barnes, Bull. Univ. Utah, 17 (no. 12):96, June, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Hatt, Roosevelt Wildlife Annals, 2 (no. 1):17, March, 1929.

Tamiasciurus hudsonicus ventorum, Davis, The Recent mammals of Idaho, Caxton Printers, Caldwell, Idaho, p. 229, April 9, 1939; Hayward, Journ. Mamm., 21:220, May 16, 1940; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Sciurus hudsonius, var. *Fremonti,* Allen, Bull. Essex Inst., 6:65, 1874.

Sciurus hudsonius ventorum, Barnes, Bull. Univ. Utah, 12 (no. 15):33, April, 1922.

Tamiasciurus fremonti fremonti, Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—Wasatch Mountains, limits unknown.

Description and comments.—Measurements of one male, number 883, from Rich County and of one female, number 881 from Cache County, are, respectively, as follows: Total length, 330, 320; length of tail, 132, 130; length of hind foot, 51, 50; length of ear, 27, 26. Color (Summer pelage): Upper parts, in general tone, between Dresden Brown and Buckthorn Brown, owing to banding of individual hairs as follows: basal band Plumbeous, followed alternately by bands of between Cinnamon-Buff and Clay Color, and black (these bands are usually 7 in number, 5 in some hairs); end of hair is black; top of head darker than back because of greater admixture of black; top of nose Bister; sides of nose Pinkish Buff; ears lightly tufted and similar to upper parts in color; ocular patches creamy white; front and hind feet Cinnamon-Buff or Clay Color; dorsal surface of tail Sayal Brown, bordered subterminally by band of black (long at tip) and terminally by Ochraceous-Buff or Antimony Yellow; sides, front legs and outer surface of thighs Ochraceous-Tawny; lateral stripe dusky, nearly obsolete; entire underparts white, lightly washed with Pale Pinkish Buff; ventral surface of tail between Warm Buff and Antimony Yellow with heavy suffusion of black, terminal and subterminal banding as on

dorsal surface. Skull: Rostrum short and wide; nasals widely flaring distally; interorbital breadth wide; tympanic bullae large.

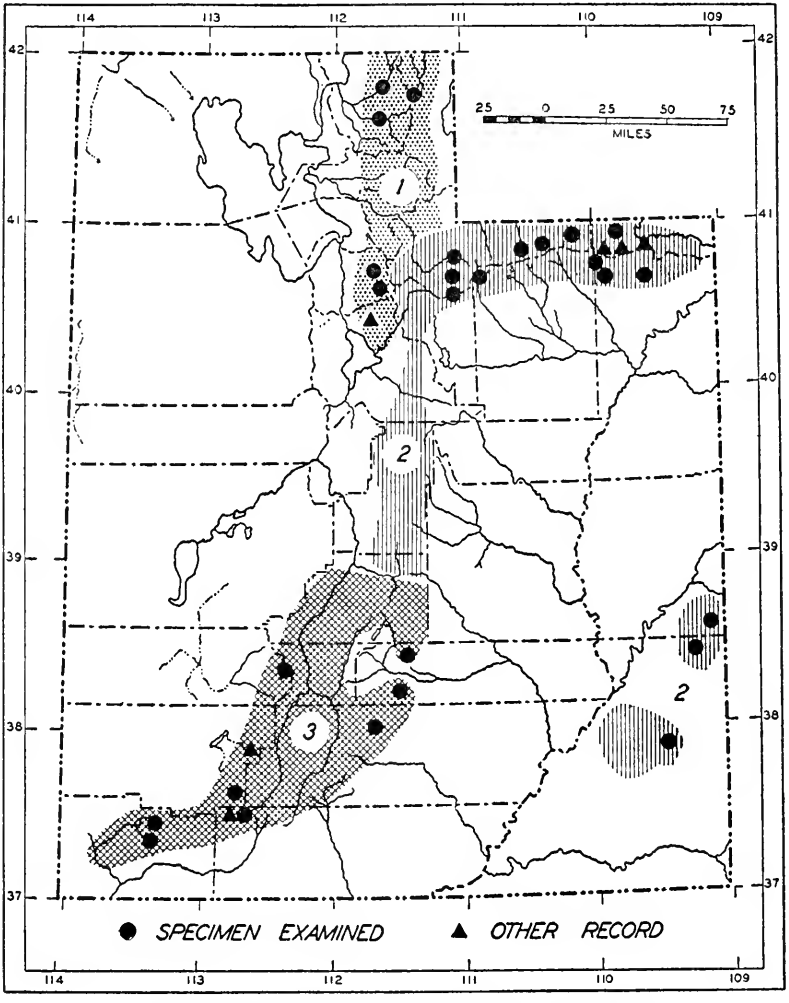

FIG. 25. Distribution of *Tamiasciurus hudsonicus*.
1. *T. h. ventorum.* 2. *T. h. fremonti.* 3. *T. h. dixiensis.*

Animals belonging to this subspecies can be distinguished from all other members of the genus known to occur in Utah by: Color: Lighter dorsally, owing to greater admixture of Sayal Brown; tail yellow-tipped instead of white-tipped; lateral stripe nearly obliterated (when present much lighter in color); feet lighter. Skull:

More angular; zygomatic processes of maxillae project more abruptly; zygomatic arches usually weaker and narrower dorsoventrally; tympanic bullae larger and more inflated ventrally; posterior ends of nasal bones usually do not extend beyond premaxillary bones.

In 1877, Allen placed all the chickarees (*Tamiasciurus*) in one species. In his later study in 1898, he recognized as valid the several species which he had previously synonymized, because even though he had more material in 1898 he found no intergrades. In the collections of the University of Utah there are four specimens from Smith and Morehouse Creek, which are intergrades between *T. h. ventorum* and *Tamiasciurus hudsonicus fremonti.* The intermediate nature of these specimens was corroborated by the late A. H. Howell of the U. S. National Museum who studied them. Their dorsal coloration is intermediate between that of the two aforementioned subspecies; the head is like that of *T. h. ventorum;* the size and coloration of the lateral stripe is as in *T. h. ventorum;* the tail is like that of *T. h. ventorum* in one, like that of *T. h. fremonti* in one, and intermediate in two. They are like *Tamiasciurus hudsonicus fremonti* in more than half of the cranial characters. The total of diagnostic characters places these 4 animals with *Tamiasciurus hudsonicus fremonti.*

Further intergradation is found in one specimen from Soapstone, another from Mirror Lake, 10,500 feet, and another from the dam in Parleys Canyon. The two animals first mentioned are referable to *Tamiasciurus hudsonicus fremonti* and the latter resembles *Tamiasciurus hudsonicus ventorum.*

It appears that, in the area where the west end of the Uinta Mountains contacts the Wasatch Mountains, the ranges of *T. h. ventorum* and *T. h. fremonti* meet. All the animals, although few in number, that the author has seen from this area are intergrades in varying degree.

The described intergradation indicates that in Utah all the animals of this genus belong to one species. The specific name *Tamiasciurus fremonti* therefore, is arranged as a subspecies of the earlier proposed name *Tamiasciurus hudsonicus.*

Specimens examined.—Total, 15, distributed as follows: *Cache County:* Logan Canyon, 6,000 ft., 1; Anderson Ranch, Blacksmith Fork, 5,500 ft., 1. *Rich County:* Between Laketown and Blacksmith Fork, 1. *Salt Lake County:* The dam, Parleys Canyon, 1; 10 mi. above lower powerhouse, road to Cardiff Mine (Big Cottonwood Canyon), 1; Big Cottonwood Canyon, 1 mi. above "Spruces," 7,400 ft., 2; Silver Lake Post Office (Brighton), 9,000 ft., 8.

Additional record (Tanner, 1927:251).—*Utah County:* Mount Timpanogos.

Tamiasciurus hudsonicus fremonti (Audubon and Bachman)

Red Squirrel (Chickaree)

Sciurus fremonti Audubon and Bachman, Quad. N. Amer. 3:237, 1853, type from Colorado (see Allen, 1898:289-290); Allen, Bull. American Mus. Nat. Hist., 10:287, July 22, 1898; Warren, The mammals of Colorado, Knickerbocker Press, p. 185, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):35, April, 1922.

Sciurus fremonti fremonti, Barnes, Bull. Univ. Utah, 17 (no. 12):98, June, 1927; Svihla, Journ. Mamm., 12:261, August 24, 1931; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 154, 1942.

Range.—Northeastern Utah in Uinta Mountains; eastern Utah in the La Sal and Abajo mountains, and Wasatch Plateau, limits unknown.

Description and comments.—Measurements of 3 adult males, numbers 517, 519 and 544, and one female, number 518, from Grand County, are, respectively, as follows: Total length, 305, 330, 320, 322; length of tail, 93, 130, 125, 130; length of hind foot, 51, 47, 51, 50; length of ear, 16, 15, 16, 15. Color (Summer pelage): Upper parts (general tone) Dresden Brown owing to mixture of gray and Ochraceous-Buff (individual hairs banded as follows: base Plumbeous, followed alternately by Ochraceaus-Buff and black terminating in black, 5 bands usually present); top of head darker owing to greater admixture of black; top of nose black; sides of nose Cinnamon-Buff; ears tufted, colored like back; front feet, hind feet and scapular region Tawny; rump and thighs Smoke Gray suffused with Ochraceous-Tawny; dorsal surface of tail mixed Ochraceous Tawny black and white, with subterminal black band (longest distally) and with terminal white band (longest laterally); sides and flanks like back but more heavily suffused with black; lateral stripe black; entire underparts white (considerable exposure of Plumbeous bases of hairs); eye ring white; ventral surface of tail yellowish gray proximally, bordered subterminally by black and terminally by white. Skull: Similar to that of *Tamiasciurus hudsonicus dixiensis,* but markedly smaller.

For comparisons with other kinds of *Tamiasciurus* in Utah, see accounts of those subspecies.

In Utah, this subspecies is known only from the Uinta, La Sal and Abajo mountains. There is evidence of intergradation with *Tamiasciurus hudsonicus ventorum* in specimens from the western part of the Uinta Mountains (see remarks under *T. h. ventorum*). The 5 specimens from the Abajo Mountains situated in the extreme southeastern part of the state are, insofar as I know, the first to be obtained from these mountains. They are not typical of *T. h. fremonti* and in the larger skulls and lighter color they show some characters of *Tamiasciurus hudsonicus mogollonensis* from Arizona. Pending the acquisition of more material, it appears best for the present to refer them to *T. h. fremonti.*

Specimens examined.—Total, 47, distributed as follows: *Summit County:* Hoop Lake, 8,000 ft., Ashbury [Ashley] National Forest, Dagget [Summit], 1; Henry's Fork, 8,300 ft., 1; 3 mi. SW Bridger Lake, 9,000 ft., 8 (M.V.Z.); Smith and Morehouse Creek, Weber River, 4; 10 mi. E Kamas, 2 (M.V.Z.); Soap-

stone, 1. *Daggett County:* Junction Deep and Carter Creeks, 7,900 ft., 2. *Wasatch County:* Elk Lake, Norway Flats, 8,900 ft., 20 mi. NE Kamas, 1. *Duchesne County:* Mirror Lake, 10,500 ft., 1. *Uintah County:* 9 mi. NW Paradise Park, 11,000 ft., Ashley National Forest, 1; Paradise Park, 10,100 ft., 6; Iron Springs, 9,000 ft., 6. *Grand County:* Clark Lake, La Sal Mountains, 4. *San Juan County:* 3 mi. W Geyser Pass, La Sal Mountains, 10,000 ft., 2; 1 mi. W Geyser Pass, La Sal Mountains, 11,000 ft., 1; 1 mi. E Geyser Pass, La Sal Mountains, 9,700 ft., 1; 1 mi. E Jackson Camp, 21 mi. N Blanding, Abajo Mountains, 10,200 ft., 2; Jackson Ridge, 25 mi. N Blanding, Abajo Mountains, 9,500 ft., 3.

Additional records (Svihla, 1931:261).—*Daggett County:* Summit Springs; Beaver Creek; Carter Creek; Granite Park; Spirit Lake.

Tamiasciurus hudsonicus dixiensis Hardy

Red Squirrel (Chickaree)

Tamiasciurus fremonti dixiensis Hardy, Proc. Biol. Soc. Washington, 55:87, June 25, 1942, type from "near Further Water," Dixie National Forest, Pine Valley Mountains, 9,500 ft., Washington County, Utah.
Tamiasciurus fremonti fremonti, Presnall, Zion-Bryce Mus. Bull., 2:13, January, 1938; Long, Journ. Mamm., 21:175, May 16, 1940.

Range.—Mountains of south-central and southwestern Utah.

Description and comments.—Measurements of the type are as follows: Total length, 339; length of tail, 131; length of hind foot, 53; length of ear, 28. Color (Summer pelage): Upper parts (general tone) near Raw Umber, owing to banding of individual hairs as follows: basal band Plumbeous, followed alternately by bands of Isabella Color and black (black bands wider) most hairs terminating in black (5 to 9 bands); top of head slightly darker than back, owing to greater admixture of black; top of nose black; sides of nose Cartridge Buff; front and hind feet Cinnamon-Buff; thighs like back, but with greater admixture of Isabella Color; scapular region tinted with Chamois; dorsal surface of tail mixed Isabella Color, black and white, subterminal bands long and black, terminal band white; lateral stripes nearly black, slightly suffused with Isabella Color; entire underparts and eye ring white; ventral surface of tail grizzled black and white, white terminal band longest. Skull: Large, robust; nasals long; alveolar length of upper molariform teeth long.

Topotypes of *T. h. dixiensis* may be distinguished from specimens of *T. h. fremonti* from Utah by: Size larger; hind foot longer; color darker above (much more black in pelage); skull larger; nasals longer; alveolar measurements of upper molariform series longer. For comparison with *Tamiasciurus hudsonicus ventorum*, see account of that subspecies.

The range is far south of that of *T. h. ventorum* and separated from the main range of *T. h. fremonti* by the Colorado River and its tributaries. Nevertheless, specimens from the Beaver Mountains and Iron Mountain in south-central Utah are not typical of *T. h. dixiensis;* they are intergrades between *T. h. dixiensis* and *T. h. fremonti.* The majority of the diagnostic characters are as in *T. h. dixiensis* to which the specimens are here referred. Two specimens

from 18 miles north of Escalante are also intergrades and resemble *T. h. fremonti* in dorsal coloration. The majority of the diagnostic characters, however, are as in *T. h. dixiensis,* to which they are here assigned.

Critical consideration of the diagnostic characters of *T. h. dixiensis* indicates that it is the least differentiated of all the subspecies of *Tamiasciurus hudsonicus* which occur in Utah, and that this subspecies is actually in the process of evolving. Animals from the semi-isolated Pine Valley Mountains in extreme southwestern Utah are readily distinguishable. The remainder of the available specimens, from south to north within the range of *T. h. dixiensis,* show a progressively closer approach toward *T. h. fremonti.* The northernmost specimens are perplexing, and could be assigned with equal propriety to either *T. h. fremonti* or *T. h. dixiensis.*

Specimens examined.—Total, 19, distributed as follows: *Beaver County:* Puffer Lake, 9,500 ft., 1. *Wayne County:* Elkhorn G. S., 9,400 ft., 14 mi. N Torrey, Fishlake Plateau, 3; Donkey Lake, Boulder Mountains, 10,000 ft., 5. *Iron County:* Cedar Mts., 8,500 ft., 1. *Garfield County:* 18 mi. N Escalante, 9,500 ft., 2. *Washington County:* "Near" Further Water, Dixie National Forest, Pine Valley Mountains, 9,500 ft., 1; "near" Whipple Valley, 5 mi. E Pine Valley, 9,000 ft., 1. *Kane County:* Duck Creek, Cedar Mountains, 9,000 ft., 5.

Additional records (Hardy, 1942:89).—*Iron County:* Parowan Canyon, 6,500 ft. *Kane County:* Near Navajo Lake, 10,000 ft.

TABLE 5

Cranial Measurements of Sciurus and Tamiasciurus

Sex	Catalog number	Occipitonasal length	Length of nasals	Zygomatic breadth	Cranial breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of upper molariform tooth-row
		Sciurus aberti navajo, type and topotype							
♂	4775....	60.6	20.6	37.1	26.6	19.4	19.2	26.7	11.0
♂	4776....	61.0	21.0	35.4	26.1	18.7	19.4	26.4	11.5
		Tamiasciurus hudsonicus ventorum, Cache County							
♂	883.....	47.2	13.0	28.1	22.6	15.5	15.1	20.5	9.2
♀	881.....	48.5	15.0	27.5	21.8	15.3	15.3	21.0	8.7
		Tamiasciurus hudsonicus fremonti, Clark Lake, La Sal Mountains							
♂	517.....	45.5	15.0	25.9	20.5	14.4	15.2	19.8	8.8
♂	544.....	45.5	14.4	25.5	20.2	13.6	15.3	20.3	8.3
♀	518.....	45.9	14.8	25.9	20.8	14.3	14.1	20.3	8.6
		Tamiasciurus hudsonicus dixiensis, type							
♂	4374....	47.8	16.1	27.5	21.1	14.9	14.6	21.6	9.2

Marmota flaviventer nosophora Howell

Yellow-bellied Marmot

Marmota flaviventer nosophora Howell, Proc. Biol. Soc. Washington, 27:15, February 2, 1914, type from Willow Creek, 7 miles east of Corvallis, Ravalli County, Montana.

Arctomys flaviventer, Allen, Bull. Essex Inst., 6:66, 1874.

Marmota flaviventris nosophora, Howell, N. Amer. Fauna, 37:46, April 7, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):58, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):76, June, 1927; Tanner, Journ. Mamm., 8:250, August 9, 1927; Svihla, Journ. Mamm., 12:260, August 24, 1931; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—Northern Utah in the Raft River, Wasatch and Uinta mountains.

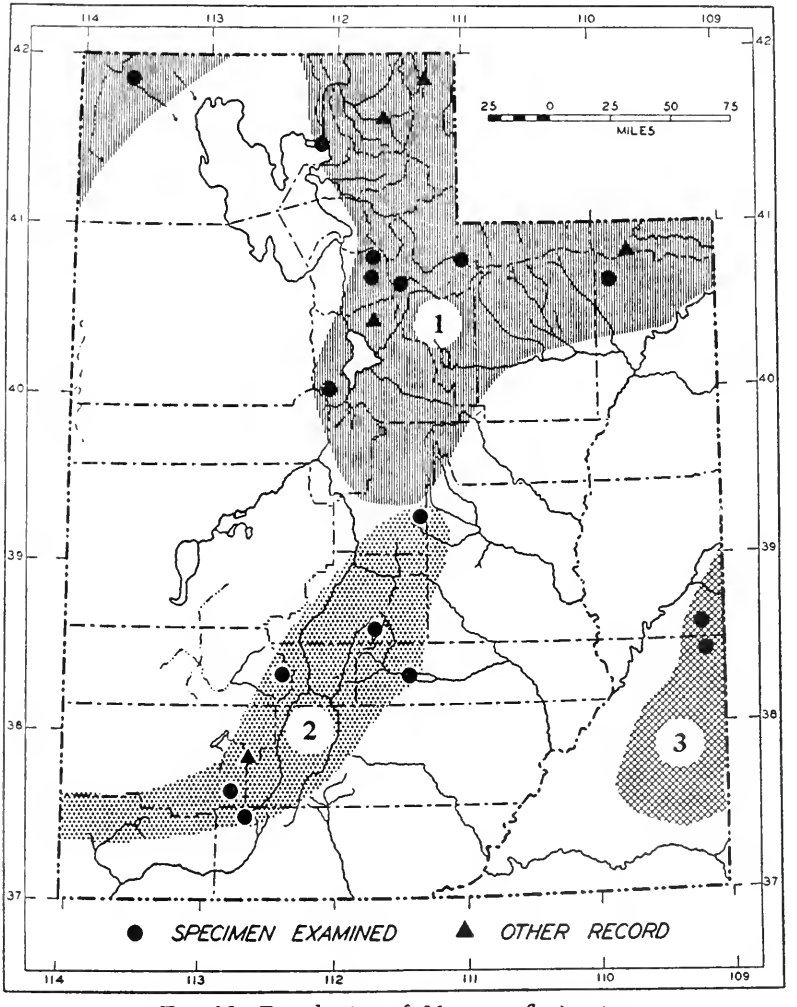

FIG. 26. Distribution of *Marmota flaviventer*.
1. *M. f. nosophora.* 2. *M. f. engelhardti.* 3. *M. f. luteola.*

Description and comments.—Measurements of 2 subadult males, numbers 3436 and 3435, from 2 miles east of Park City and of 2 adult females, number 1377, from the mouth of Parleys Canyon, and number 3006, from six and one half miles west of Brigham City, are, respectively, as follows: Total length, 540, 536, 598, 550; length of tail, 150, 147, 203, 160; length of hind foot, 79, 78, 81, 70; length of ear, 24, 23, 32, 24. Color: Upper parts brownish buff mixed with white and light buff; base of underfur on forepart of back Fuscous-Black, grading to Fuscous on hind part of back, succeeded by Tilleul Buff on forepart, grading to Pinkish Cinnamon on hind part of back (Russet in some specimens); long hairs of back with wide proximal band of Fuscous or black, succeeded by a narrower band of Ochraceous-Buff or Warm Buff on forepart of back, and by white or buffy white on hind part of back; all long hairs inconspicuously tipped with black; rump, upper surface of thighs and base of tail Cinnamon-Buff; top of head, cheeks and nape brownish black sparsely mixed with light tipped hairs in postorbital and cheek regions; broad band in front of eyes white, buffy or buffy white; face white or mixed Cinnamon and white; nose, lips and throat white or buffy white; sides of neck and postauricular patches light Ochraceous-Buff; front legs and most of underparts Kaiser Brown tipped with Hazel; throat and midbelly Chestnut; front and hind feet between Liver Brown and Carob Brown, some hairs tipped with Hazel; tail Chestnut-Brown above, tipped with Hazel and Cinnamon-Buff, and under surface nearly black. Skull: Large and robust; tympanic bullae relatively large; rostrum broad.

Specimens of *M. f. nosophora* from Park City differ from near topotypes of *Marmota flaviventer engelhardti* in relatively shorter tail, slightly darker upper parts, darker legs, feet and underparts and relatively larger tympanic bullae.

In Utah, marmots are usually thought of as mountain dwelling animals. Usually they inhabit rocky areas. An adult, lactating female, was taken, however, six and one half miles west of Brigham City on the marshy mud flats, more than 6 miles from the mountains or any rocky areas. Mr. John Van den Akker of the Bear River Migratory Waterfowl Refuge informs me that marmots are at present inhabiting man-made rocky areas on the refuge proper. This entire area of the refuge consists largely of marshes and sloughs. It seems that these animals are far more adaptable and less restricted to mountains than was formerly supposed.

Specimens examined.—Total, 13, distributed as follows: *Boxelder County:* 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 1; 6¾ mi. W Brigham City, 4,300 ft., 1. *Salt Lake County:* Mouth of Parleys Canyon, 4,400 ft., 1; 1 mi. above mouth Dry Canyon, NE Salt Lake City, 4,800 ft., 3; City Creek Canyon, 1½ mi. above Forks, 4,700 ft., 2. *Summit County:* Smith and Morehouse Creek, 8,250 ft., 1; 2 mi. E Park City, ½ mi. S Silver King Coalition Shaft, 8,500 ft., 2. *Uintah County:* Paradise Park, Uinta Mountains, 10,000 ft., 1. *Utah County:* 6 mi. E Eureka, Highway 6, 1.

Additional records.—Cache County: Blacksmith Fork (Howell, 1915:49). *Rich County:* Laketown (Howell, *loc. cit.*). *Daggett County* (Svihla, 1931: 260): Beaver Creek; Carter Creek. *Utah County:* Mount Timpanogos (Tanner, 1927:250).

Marmota flaviventer engelhardti Allen

Yellow-bellied Marmot

Marmota engelhardti Allen, Mus. Brooklyn Inst. Arts and Sci., Sci. Bull., 1:120, 1905, type from Briggs (Britts) Meadows, 10,000 feet., Beaver Range Mountains, Beaver County, Utah.

Marmota flaviventris engelhardti, Howell, N. Amer. Fauna, 37:45, April 7, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):57, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):73, June, 1927; Woodbury, Ecol. Monogr., 3:192, April, 1933; Presnall, Zion-Bryce, Mus. Bull., 2:11, January, 1938; Long, Journ. Mamm., 21:173, May 16, 1940; Tanner, Great Basin Nat., 1:146, June 30, 1940.

Range.—High mountains of south-central and central Utah, limits unknown.

Description and comments.—Measurements of one old male, number 1419, from Cedar Mountain are as follows: Total length, 665; length of tail, 201; length of hind foot, 82; length of ear, 31. Color: Upper parts and sides brownish buff, mixed with white and buffy white; underfur Fuscous at base, succeeding layer Pinkish Buff on forepart of back, Cinnamon-Buff on hind part of back, and shading to Roods Brown on sides; all long hairs buffy white or white subterminally, and inconspicuously tipped with black; rump and upper surface of thighs Pinkish Buff; top of head and cheeks brownish black sparsely mixed with light-tipped hairs; irregular broad band of white present across head in front of eyes; face, nose, lips and chin white; sides of neck Pinkish Buff; postauricular patches Cinnamon-Buff; front legs and major part of underparts Ochraceous-Buff or Clay Color; throat and midline of belly Ochraceous-Tawny or Russet; front and hind feet Russet, with a mixture of Cinnamon-Buff on toes; tail Chestnut-Brown above, tipped with Hazel; under side of tail dark brown, nearly black. Skull: Large and robust; tympanic bullae relatively small.

For comparison of *M. f. engelhardti* with *Marmota flaviventer nosophora* and with *Marmota flaviventer luteola,* see accounts of those subspecies.

With the exception of one specimen from Midvale, Idaho (Howell, 1915:46), all other known specimens of *M. f. engelhardti* are from Utah. Howell (1915:48) judged that intergradation probably occurred between *M. f. engelhardti* and *M. f. nosophora* in Utah. Specimen number 314, from Fishlake, does show intergradational tendencies. It has the general darker color, especially of the underparts, and the buffy mantle over the forepart of the back, which are characteristic of *M. f. nosophora.* The face and facial band are as in *M. f. engelhardti.* Still another specimen, number 313, from the same place has the ventral coloration of *M. f. nosophora* and the dorsal coloration of *M. f. engelhardti.* Both of these animals are immature, but a comparison of their skulls with those of immature specimens of *M. f. nosophora* from Salt Lake County shows the tympanic bullae to be actually, as well as relatively, small, which is characteristic of *M. f. engelhardti.*

It seems advisable at this time to treat these specimens as intergrades referable to *M. f. engelhardti.*

Specimens examined.—Total, 12, distributed as follows: *Sanpete County:* 5 mi. E Great Basin Experiment Station, 1 (M.V.Z.). *Sevier County:* Fishlake, 3. *Beaver County:* Britts Meadow, 8,500 ft., Beaver Range Mountains, 4 (M.V.Z.). *Wayne County:* Torrey, 6,800 ft., 1. *Iron County:* Cedar Breaks, 10,000 ft., 1 (M.V.Z.). *Kane County:* Duck Creek Sink, Cedar Mountain, 8,300 ft., 1; Duck Creek, Cedar Mountain, 8,700 ft., 1.

Additional record (Howell, 1915:46).—*Iron County:* Parowan Mountains.

Marmota flaviventer luteola Howell

Yellow-bellied Marmot

Marmota flaviventer luteola Howell, Proc. Biol. Soc. Washington, 27:15, February 2, 1914, type from Woods Post Office, Medicine Bow Mountains, 7,500 ft., Albany County, Wyoming.

Marmota flaviventer warreni Howell, Proc. Biol. Soc. Washington, 27:16, February 2, 1914, type from "Smith Trail," 2 miles west of Crested Butte, Gunnison County, Colorado.

Range.—Known only from the La Sal Mountains.

Description and comments.—Measurements of one adult female, number 5589, from 4 miles west of Geyser Pass, La Sal Mountains, and of 2 females, numbers 6473 and 6474, from Warner Ranger Station, La Sal Mountains, are, respectively, as follows: Total length, 547, 603, 565; length of tail, 84 (?), 184, 154; length of hind foot, 73, 75, 72; length of ear, 34, 30, 29. Color: Upper parts brownish buff with mixture of reddish brown, mixed with white or buffy white; underfur Fuscous to black at base, followed by Light Ochraceous-Buff on forepart of back, Clay Color on hind part of back, grading to Sayal Brown on sides; all long hairs white or buffy white subterminally and inconspicuously tipped with black or dark brown; rump and upper surface of thighs between Cinnamon-Buff and Pinkish Buff (entire upper parts darker in one specimen); top of head Mars Brown, heavily mixed with black and sparsely mixed with buff; cheeks brownish mixed with light-tipped hairs; nose, lips and chin white; sides of neck Cinnamon-Buff or Clay Color; postauricular patches Cinnamon-Buff; throat, midline of belly, front legs and major part of underparts Buckthorn Brown or Russet; front and hind feet Russet, toes lighter approaching Buckthorn Brown; tail Mars Brown above, Carob Brown beneath. Skull: Size large; angular; postorbital processes robust and strongly curved downward; interorbital region markedly depressed; tympanic bullae small; zygomatic arches robust; molariform teeth small.

From near topotypes of *Marmota flaviventer engelhardti,* specimens of *M. f. luteola* from the La Sal Mountains differ in more reddish dorsal coloration, lack of white on top of head, lighter tip of tail, more angular skull, larger more decurved postorbital processes, more depressed interorbital region, smaller tympanic bullae and smaller molariform teeth.

From specimens of *Marmota flaviventer nosophora,* from 2 miles east of Park City, the aforementioned specimens of *M. f. luteola*

differ in darker (more reddish) dorsal coloration, less buffy forepart of back, reddish brown as opposed to black on top of head, no white on top of head, lighter tip of tail, more angular skull, larger and more decurved postorbital processes, more depressed interorbital region, larger nasolacrimal canal, smaller tympanic bullae and smaller molariform teeth.

Howell (1914a:16) assigned animals from western Colorado to *Marmota flaviventer warreni*. He commented (*loc. cit.*) that animals from eastern Utah, when they became known, would likely prove to be intergrades between *M. f. warreni* and *M. f. engelhardti*. In his paper on the marmots of Colorado, Warren (1936:393) reported that he was unable to find significant differences and arranged *Marmota flaviventer warreni* as a synonym of *Marmota flaviventer luteola*, and assigned all specimens from western Colorado, formerly thought to belong to *M. f. warreni*, to *M. f. luteola*.

The few specimens from Utah available for this study are all from the La Sal Mountains. They are not intergrades with any other kind known to occur in Utah. In fact, they are, insofar as cranial characters are concerned, the most distinct of all marmots known from the state. There are too few specimens from eastern Utah to enable me to determine whether the name *Marmota flaviventer warreni* is a valid one and would apply to animals from this part of Utah. From the material at hand and after analyzing the data and conclusions set forth by Howell (*op. cit.*) and Warren (*op. cit.*), I choose for the present to refer animals from east central Utah to *M. f. luteola*. I suspect, however, that adequate material may prove the marmots from this part of eastern Utah to belong to an as yet unnamed subspecies.

Specimens examined.—Total, 5, distributed as follows: *Grand County:* Warner R. S., 9,750 ft., La Sal Mountains, 4. *San Juan County:* 4 mi. W Geyser Pass, La Sal Mountains, 10,000 ft., 1.

Cynomys leucurus Merriam

White-tailed Prairie Dog

Cynomys leucurus Merriam, N. Amer. Fauna, 3:59, September 11, 1890, type from Fort Bridger, Uinta County, Wyoming; Allen, Bull. American Mus. Nat. Hist., 8:254, November 25, 1896; Hollister, N. Amer. Fauna, 40:24, June 20, 1916; Barnes, Bull. Univ. Utah, 12 (no. 15):52, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):87, June, 1927; Hardy, Utah Acad. Sci. Arts and Letters, 14:198, 1937; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 139, 1942.
Cynomys leucurus leucurus, Svihla, Journ. Mamm., 12:260, August 24, 1931.

Range.—Eastern Utah north and west of the Colorado and Green rivers, also in Summit County and one small population in extreme southeastern Utah County.

Description and comments.—Measurements of 3 females, numbers 904, 905, and 906, and of one male, number 907, from between Moab and Greenriver, are, respectively, as follows: Total length, 345, 322, 333, 363; length of tail, 53, 51, 52, 58; length of hind foot, 61, 51, 56, 63; length of ear, 15, 12, 14, 18.

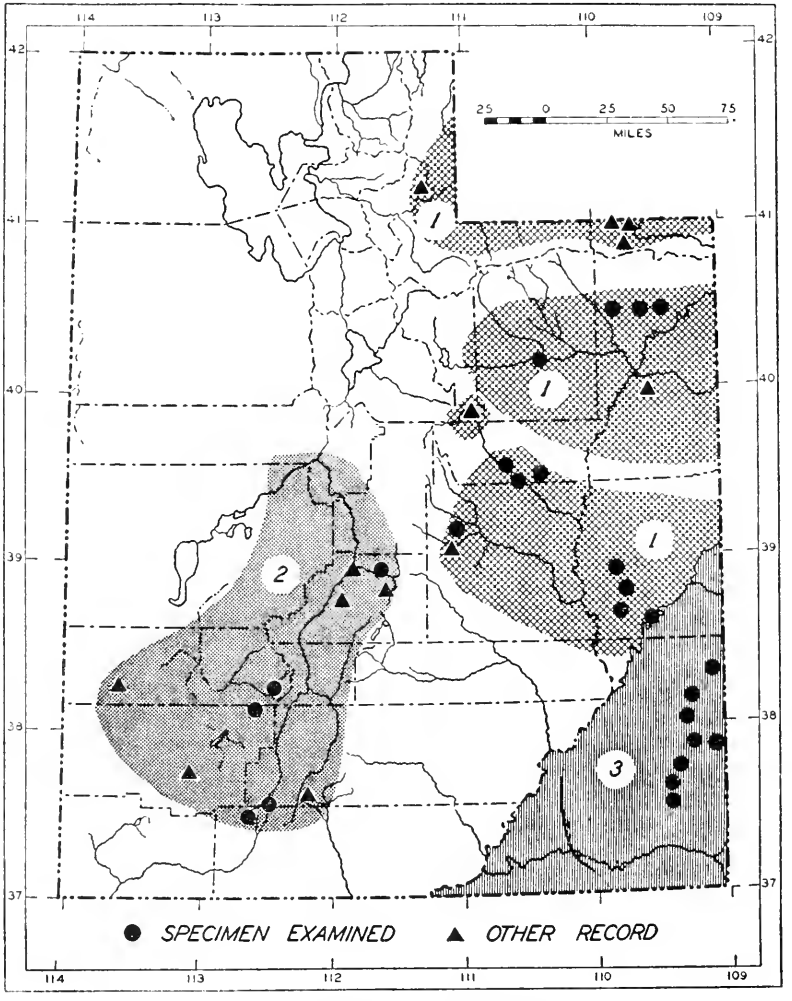

FIG. 27. Distribution of *Cynomys*.

Guide to species

1. *C. leucurus.*
2. *C. parvidens.*
3. *C. gunnisoni zuniensis.*

Color: Upper parts Pinkish Buff mixed with black, heaviest on middorsal region and rump; spots above eyes and cheeks brownish black; nose Maize Yellow; front and hind feet and legs Pale Pinkish Buff; claws deep brown

tipped with white; underparts Pale Pinkish Buff grading to Pinkish Buff in axillary and inguinal regions; dorsal surface of proximal part of tail like rump; distal half of tail white. Skull: Large, robust; zygomatic arches widely spreading; postorbital processes robust and sharply down curved; tympanic bullae large and well inflated ventrally; mastoids flat; cheek teeth large, markedly widened lateromedially.

Specimens of *C. leucurus* from eastern Utah differ from near topotypes of *Cynomys parvidens* as follows: Size larger. Color: Lighter throughout, Pinkish Buff as opposed to Clay Color above, and Light Pinkish Buff as opposed to Pinkish Buff below. Skull: Least interorbital breadth less; cheek teeth appreciably wider in mediolateral measurement.

Compared to specimens of *Cynomys gunnisoni zuniensis* from southeastern Utah, specimens of *C. leucurus* from eastern Utah differ as follows: Size larger. Color: Lighter throughout. Skull: Larger throughout; maxillary process of zygomatic arches less widely spreading; tympanic bullae larger and more inflated ventrally; the cheek teeth markedly wider in their mediolateral measurements.

This prairie dog has an interesting distribution in Utah, in that it consists of one major range and an isolated population in each of two smaller areas. On Hardy's (1937:198) distribution map of *Cynomys* in Utah, that part of the range, of this subspecies, shown to extend into Summit County, Utah, from Wyoming, should be enlarged to include also eastern Morgan County where another population was observed in 1946 by Mr. George Edmunds of the University of Utah. The population near Colton is isolated because the territory between this locality and the main range to the east is inhospitable to *Cynomys*. *Cynomys leucurus* is the kind of prairie dog which will be found to occur in all sites suitable for *Cynomys* in all of eastern Utah west of the Colorado and Green rivers and also to the east of the central mountain ranges of the state.

Specimens examined.—Total, 22, distributed as follows: *Duchesne County:* Duchesne, 1. *Uintah County:* Vernal, 1; 4 mi. W Vernal, 1; 1½ mi. N Tridell, 6,700 ft., 1. *Carbon County:* Price, 1; 8 mi. E Sunnyside, 6,700 ft., 5; 10 mi. SW Sunnyside, 6,000 ft., 1; 5 mi. E Wellington, 1; 1 mi. N Mounds, 1. *Emery County:* 5 mi. S Castle Dale, 5,600 ft., 2. *Grand County:* Between Moab and Greenriver, 5,000 ft., 4; 11 mi. S Valley City, Highway 160, 4,000 ft., 1; 8 mi. NW Moab, 1; N side Colorado River, 4,500 ft., 1.

Additonal records.—Daggett County (Hollister, 1916:27): Uinta Mountains; Manila; Linwood (Svihla, 1931:260). *Uintah County* (Hollister, 1916:27): Uncompahgre Indian Reservation. *Utah County* (Hardy, 1937:197): Emma Park, head of Price River, near Colton. *Emery County* (Hardy, 1937:197): Ferron.

Cynomys parvidens Allen

Utah Prairie Dog

Cynomys parvidens, Allen, Science Bull., Mus. Brooklyn Inst. Arts and Sci., 1:119, March 31, 1905, type from Buckskin Valley, Iron County, Utah; Hollister, N. Amer. Fauna, 40:27, June 20, 1916; Barnes, Bull. Univ. Utah, 12 (no. 15):54, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):88, June, 1927; Stanford, Journ. Mamm., 12:359, November 11, 1931; Hardy, Utah Acad. Sci. Arts and Letters, 14:197, 1937; Presnall, Zion-Bryce Mus. Bull., 2:12, January, 1938; Long, Journ. Mamm., 21:175, May 16, 1940; Tanner, Great Basin Nat., 1:109, June 30, 1940.

Cynomys columbianus (*C. gunnisoni* Baird), Allen, Bull. Essex Inst., 6:66, 1874.

Cynomys columbianus, Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona during the years 1871-74, Wheeler's Report, Expl. W of 100th M., 5:123, 1875.

Range.—South-central Utah.

Description and comments.—Measurements of one male topotype, number 1898, and one female, number 1896, from head of Sevier River, 7,300 ft., Kane County, are as follows: Total length, 342, 341; length of tail, 49, 60; length of hind foot, 66, 61; length of ear, 12, 16. Color: Upper parts Cinnamon or Clay Color with admixture of buff and black-tipped hairs, tending to be slightly darker on rump; individual hairs black at base, then pale buff, then Cinnamon and then tipped with dark brown or pale buff; spot above eyes, cheeks, and vibrissae dark brown; eye ring Cinnamon-Buff; chin, sides of nose and lips buffy white; front feet and legs, and hind feet and legs Cinnamon-Buff; claws deep brown with white tips; underparts Cinnamon-Buff, grading to Cinnamon on pectoral and inguinal regions (some specimens lighter, nearly Pale Pinkish Buff); dorsal surface of proximal part of tail like rump; distal half of tail white; under surface of tail Cinnamon proximally and white distally. Skull: Large, angular, robust; interorbital region broad; teeth relatively as well as actually small; postorbital processes not abruptly projecting.

For comparisons with the species *Cynomys leucurus*, see remarks under that species. Near topotypes of *C. parvidens* can be distinguished from specimens of *Cynomys gunnisoni zuniensis* from Utah as follows: Size larger. Color: Similar, but more reddish; tail white as opposed to mixed gray and white. Skull: Larger in almost every measurement taken; interorbital breadth wider; zygomatic arches relatively weaker; nasals longer and narrower posteriorly; posterior ends of nasals rounded rather than truncate; alveolar length of upper molariform series more; teeth smaller relatively to size of skull.

Insofar as I know, this prairie dog is endemic to Utah. The affinities of these animals are undoubtedly with *Cynomys leucurus*, but in the material at hand I can not see evidence of intergradation, and specimens of the two species are readily distinguishable on the basis of either skins or skulls.

Specimens examined.—Total, 10, distributed as follows: *Sevier County:* Coal Mine Flat, 20 mi. E Salina, 4,875 ft., 2. *Iron County:* Head of Buckthorn Flat, 1 mi. S Beaver-Iron County line, 6,000 ft., 1. *Garfield County:* U. S. Highway 89, ¼ mi. N Garfield-Kane County line, 1. *Kane County:* Head of Sevier River, 7,200 ft., 6.

Additional records (Allen, 1905:120, unless otherwise indicated).—*Iron County:* W of Cedar City (Long, 1940:175). *Sevier County* (Stanford, 1931:359): Salina (Ivie Farm) head of Salina Canyon. *Beaver County:* Pine Valley. *Garfield County:* Bryce Canyon (Presnall, 1938:12).

Cynomys gunnisoni zuniensis Hollister

Zuni Prairie Dog

Cynomys gunnisoni zuniensis Hollister, N. Amer. Fauna, 40:32, June 20, 1916, type from Wingate, McKinley County, New Mexico; Barnes, Bull. Univ. Utah, 12 (no. 15):55, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):90, June, 1927; Moore, Journ. Mamm., 10:260, August 10, 1929; Tanner and Hayward, Proc. Utah Acad. Sci. Arts and Letters, 11:212, July, 1934; Hardy, Proc. Utah Acad. Sci. Arts and Letters, 14:197, 1937; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 141, 1942; Scheffer, Trans. Kansas Acad. Sci., 49:401, 1947.

Range.—Southeastern Utah, in Grand and San Juan counties.

Description and comments.—Average and extreme measurements of 4 females from 10 mi. N Monticello, 5,500 ft., San Juan County, and measurements of one male, number 812, from between Bluff and Blanding, San Juan County, are, respectively, as follows: Total length, 318 (325-310), 353; length of tail, 44 (45-43), 54; length of hind foot, 52.5 (54-51), 53; length of ear, 12 (13-12), 14. Color: Upper parts Cinnamon-Buff, heaviest in middorsal region and on rump, streaked with pale Cinnamon-Buff and blackish; hairs, from base to tips marked with black, buff, cinnamon, buff and black bands; eye ring, ears and nose pale Cinnamon-Buff; crown, blackish, mixed Cinnamon-Buff, black and gray; supraorbital patches dark brown, cheeks similar to supraorbital patches, but brown less intense; lips buffy white; chin and throat white or faintly buffy; dorsal part of proximal half of tail like rump; distal half mixed gray, white and Cinnamon-Buff, edged and tipped with white (some specimens lack white); front legs and feet, and hind legs and feet, Pinkish Buff; claws dark brown tipped with white; entire underparts, except throat, between Pinkish Buff and Warm Buff, color being purest on pectoral and inguinal regions; underpart of tail Cinnamon-Buff, edged and tipped with white. Skull: Large, robust, heavily ridged; zygomatic processes of maxillae widely spreading; nasals usually square posteriorly; tympanic bullae relatively small; braincase slightly inflated.

For comparisons of *Cynomys gunnisoni zuniensis* from east of the Colorado River, with *Cynomys leucurus* and *Cynomys parvidens,* see accounts of those two species.

I have never obsereved *C. g. zuniensis* west of the Colorado River, which is a barrier to their westward migration in Utah. As late as 1949 when driving along U. S. Highways 84 and 89 from Greenriver in Emery County to Monticello in San Juan County, I closely observed *Cynomys,* and found that from Greenriver to the Colorado

River Bridge at Moab all the animals were *C. leucurus*. East of this bridge and on into San Juan County every individual seen was *C. g. zuniensis*.

Specimens examined.—Total, 17, distributed as follows: *San Juan County:* Hewit Ranch, East Canyon, 1; 10 mi. S La Sal Junction, 6,500 ft., 1; 12 mi. N Monticello, 1; 10 mi. N Monticello, 5,500 ft., 4; Highway 160, 7 mi. N Monticello, 6,400 ft., 1; Monticello, 1; 16 mi. E Monticello, 6,700 ft., 1; 18½ mi. E Monticello, 6,720 ft., 1; Blanding, 6,000 ft., 1 (M.V.Z.); 2 mi. S Blanding, Galbraith Ranch, 3 (M.V.Z.); between [towns of] Monticello and Blanding, 2.

TABLE 6

Cranial Measurements of Marmota and Cynomys

Sex and age	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Palatar length	Alveolar length of upper molariform tooth-row
		Marmota flaviventer nosophora, ♂ 2 mi. E Park City; ♀ 1377, mouth Parleys Canyon; ♀ 3006, 6½ mi. W Brigham City							
♂ Sad.	3436....	82.5	34.1	51.5	39.5	15.9	18.7	37.2	21.0
♂ Sad.	3435....	79.7	33.2	48.8	37.2	15.4	18.5	36.7	19.8
♀	1377....	84.4	33.8	55.3	39.3	17.7	16.5	39.2	21.0
♀	3006....	80.7	33.5	49.6	37.7	16.8	15.8	38.8	19.6
		Marmota flaviventer engelhardti, Cedar Mountain							
♂	1419....	91.7	39.7	60.8	43.8	21.1	14.8	44.0	20.6
		Marmota flaviventer luteola, La Sal Mountains							
♀	5589....	85.4	35.1	55.3	38.9	18.3	15.6	43.5	21.3
♀	6473....	83.3	35.0	52.1	37.6	18.2	14.5	39.9	21.0
♀	6474....	79.7	33.2	53.8	37.3	19.6	17.2	39.8	20.2
		Cynomys leucurus between Moab and Greenriver							
♂	907.....	60.3	24.7	43.4	28.6	12.6	12.8	30.5	15.0
♀	904.....	59.0	21.0	40.6	27.2	12.5	12.5	29.5	15.3
♀	905.....	58.5	20.1	42.3	28.1	12.5	12.7	29.0	15.1
♀	906.....	58.0	20.5	41.5	27.6	12.8	12.8	29.0	15.4
		Cynomys parvidens, ♂ topotype; ♀ near topotype							
♂	1898....	61.7	23.3	44.7	.....	14.3	14.1	31.0	15.5
♀	1896....	60.7	23.0	45.1	29.0	14.0	14.0	30.3	15.5
		Cynomys gunnisoni zuniensis, ♂ between Bluff and Blanding; ♀ 10 mi. N Monticello							
♂	812.....	59.0	22.4	43.7	27.7	12.7	12.7	30.1	15.0
♀	4 av....	57.0	20.5	41.5	26.7	13.7	13.5	28.3	14.8
♀	Max....	57.1	21.0	42.0	27.2	15.5	15.2	28.8	15.6
♀	Min....	56.9	20.0	40.4	26.0	12.0	12.0	27.6	14.4

Citellus townsendii mollis (Kennicott)

Townsend Ground Squirrel

Spermophilus mollis Kennicott, Proc. Acad. Nat. Sci. Philadelphia, p. 157, 1863, type from Camp Floyd, near Fairfield, Utah County, Utah.
Citellus townsendii mollis, Howell, N. Amer. Fauna, 56:63, May 18, 1938; Marshall, Journ. Mamm., 21:151, May 16, 1940; Long, Journ. Mamm., 21: 174, May 16, 1940; Fautin, Ecol. Monogr., 16:304, October, 1946.
Citellus mollis, Barnes, Bull. Univ. Utah, 12 (no. 15):48, April, 1922.
Citellus mollis mollis, Barnes, Bull. Univ. Utah, 17 (no. 12):83, June, 1927; Stanford, Journ. Mamm., 12:358, November 11, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938; Davis, The Recent mammals of Idaho, Caxton Printers, Caldwell, Idaho, p. 190, April 5, 1939.

Range.—Western Utah, west of north-south, central mountain ranges.

Description and comments.—Measurements of 2 adult males, numbers 577 and 579, and of one female, number 578, all from St. Johns Railroad Station are, respectively, as follows: Total length, 218, 210, 217; length of tail, 49, 46, 45; length of hind foot, 29, 29, 26. Color: Upper parts between Pale Smoke Gray and Smoke Gray; subterminal bands of hairs between Snuff Brown and Bister, causing a brownish dappled coat; nose and top of head Cinnamon; sides of face, upper and lower eyelids white, washed with Pinkish Buff; front feet Smoke Gray with wash of pale buff; hind feet Smoke Gray; upper and lower surfaces of tail Smoke Gray washed with Snuff Brown or Bister; thighs washed with Cinnamon or Snuff Brown; underparts Pale Pinkish Buff. Skull: Small, robust; zygomatic arches not widely spreading, but robust and markedly flattened dorsoventrally; nasals long and narrow; posterior end of nasals usually extend caudad of premaxillo-frontal suture; rostrum long and narrow.

This small ground squirrel can be readily distinguished from *Citellus leucurus leucurus* which also occurs in the same area by the lack of white on the underside of the tail, and by the lack of white stripes on the sides.

This ground squirrel inhabits the northern three-fourths of the western half of the state, an area commonly designated as the west desert region. The easternmost localities of occurrence of this subspecies are Salt Lake City, three miles north of Saratoga Springs, Manti, Fayette and Salina Canyon.

My observations indicate the presence of this ground squirrel throughout this xerophytic region, both in the valleys and the mountains. Nevertheless, it shows a marked increase in numbers in irrigated land and at desert springs. In May, 1938, at Antelope Springs on House Mountain, in western Millard County, these animals were abundant. Their burrows were under rocks, at the bases of bushes and were so common in the open ground that at almost every step I broke into a burrow. In Delta Valley, they were numerous and are known by the local name of "Quimps". It seems that they are capable of maintaining themselves anywhere

in this desert region, but they show a marked predilection for moist areas, owing to the increased forage in these places. The type locality of *C. t. mollis* is an area of numerous springs and there also I have noted heavy concentrations of these animals.

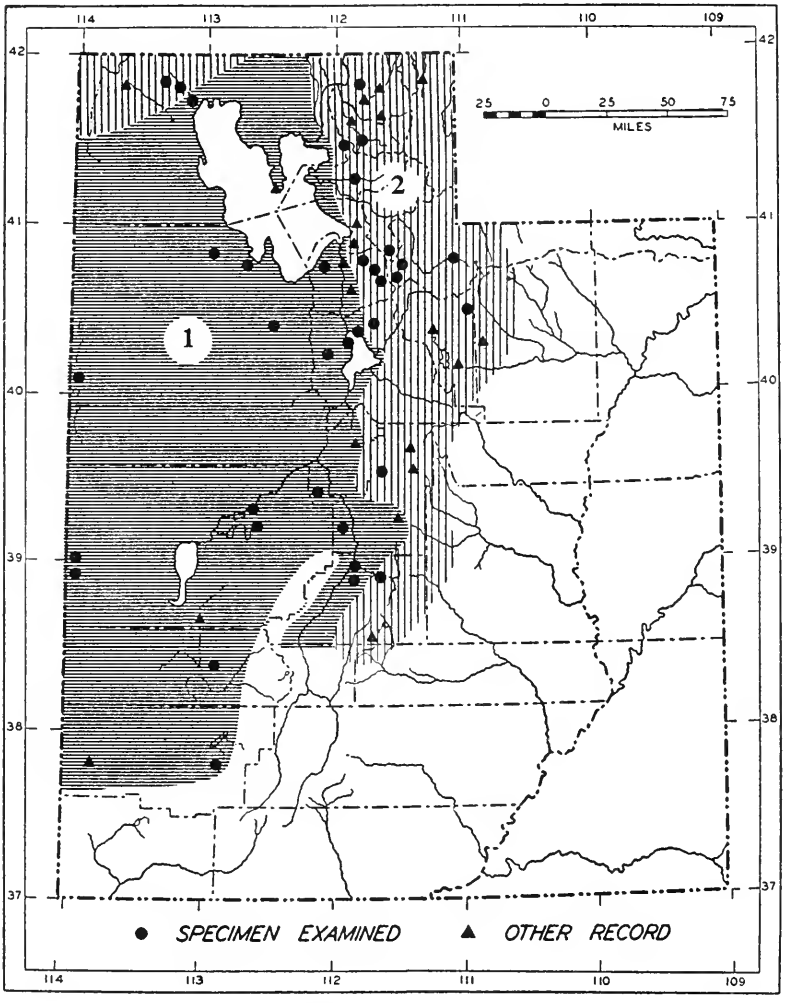

FIG. 28. Distribution of:
1. *Citellus townsendii mollis.* 2. *Citellus armatus.*

Specimens examined.—Total, 45, distributed as follows: *Boxelder County:* Kelton, 4,225 ft., 4 (3, M. V. Z.). *Tooele County:* Timpie Railroad Station, 4,300 ft., 1; Low, 2 (M. V. Z.); St. Johns Railroad Station, 4,300 ft., 4; Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 1. *Salt Lake County:* 3 mi. W Salt Lake Airport, 1. *Utah County:* 3 mi. N Saratoga Springs, 1; Fairfield, 4,860

ft., 10; W side Utah Lake, 2. *Juab County:* Sevier Dam (Yuba Dam), 1. *Sanpete County:* Fayette, 2. *Millard County:* Deseret, 1 (M. V. Z.); 6 mi. S Deseret, 1 (M. V. Z.); Garrison, 5,400 ft., 1 (M. V. Z.); 5 mi. S Garrison, 5,400 ft., 4 (M. V. Z.). *Sevier County:* 3.3 mi. N Redmond, 4; Salina, 1; Richfield, 1. *Beaver County:* Milford, 2. *Iron County:* 2 mi. W Cedar City, 1 (K. U.).

Additional records (Howell, 1938:65, unless otherwise indicated).—*Boxelder County:* Promontory. *Salt Lake County:* Salt Lake City; Midvale. *Juab County:* Nephi. *Sanpete County:* Manti. *Millard County:* Malone. *Iron County:* Modena. *Sevier County:* Salina Canyon (Stanford, 1931:358).

Citellus beldingi crebrus Hall

Belding Ground Squirrel

Citellus beldingi crebrus Hall, The Murrelet, 21:59, December 20, 1940, type from Reese River Valley, 7 miles north of Austin, Lander County, Nevada; Porter, Journ. Mamm., 31:198, May, 1950.

Range.—Known only from the north slopes of the Raft River Mountains, Boxelder County.

Description and comments.—Measurements of two adult males, numbers 7080 and 7121 from Standrod, Boxelder County, are as follows: Total length, 272 and 292; length of tail, 65 and 80; length of hind foot, 42 and 44; length of ear, 17 and 18. Color: Upper parts Smoke Gray mixed with Pinkish Cinnamon, grading to Sayal Brown in middorsal region; forehead Pinkish Cinnamon; underparts grayish washed with Pinkish Cinnamon purest in pectoral region; front feet and legs and hind feet Pinkish Cinnamon; upper surface of tail like upper parts but darker owing to presence of more black submarginally; under surface of tail Hazel. Skull: Rostrum broad; interorbital region wide; postorbital region narrow; nasals short, not projecting posteriorly beyond the premaxillae.

Superficially, *Citellus beldingi crebrus* resembles *Citellus armatus* and *Citellus richardsoni;* for comments on distinguishing characters, see account of *C. armatus.*

When Hall (1940:59) named *C. b. crebrus,* he published a distribution map (p. 61) for the species *Citellus beldingi,* and ascribed to his newly-named subspecies the southeastern part of the range of the species that Howell (1938:81, fig. 6) formerly ascribed to *Citellus beldingi oregonus.* Both aforementioned distribution maps showed the range of *C. beldingi* as bordering upon the extreme northwestern corner of Utah. No animals were known, however, from that state. For many years I suspected their occurrence in extreme northwestern Utah, and repeatedly I and others sought specimens in vain. In 1949 Richard D. Porter obtained two adult males from 5 feet south of the Utah-Idaho boundary at Standrod, Boxelder County. Study of these specimens and comparisons of them with the published accounts prove them to be referable to *C. b. crebrus.*

Specimens examined.—Total, 2, from Boxelder County: 5 ft. S Utah-Idaho boundary, Standrod, 6,000 ft.

Citellus armatus (Kennicott)

Uinta Ground Squirrel

Spermophilus armatus Kennicott, Proc. Acad. Nat. Sci. Philadelphia, p. 158, 1863, cotypes from Foothills of Uinta Mountains, near Fort Bridger, Uinta County, Wyoming.

Citellus armatus, Trouessart, Catalogus Mamm. viv. et foss. suppl., p. 339, 1904; Barnes, Bull. Univ. Utah, 12 (no. 15):49, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):82, June, 1927; Hall, Univ. California Publ. Zoöl., 37:2, April 10, 1931; Stanford, Journ. Mamm., 12:358, November 11, 1931; Howell, N. Amer. Fauna, 56:78, May 18, 1938; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Citellus elegans, Warren, The mammals of Colorado, Knickerbocker Press, p. 156, 1910 (part).

Range.—From northern Utah south to Fishlake Plateau in central mountain ranges, west into Raft River Mountains in Boxelder County.

Description and comments.—Average and extreme measurements of 5 males and 5 females, from Salt Lake City and environs, are, respectively, as follows: Total length, 293 (297-289), 290 (303-270); length of tail, 67 (70-65), 65 (78-43); length of hind foot, 41 (45-35), 41 (43-37); length of ear, 15 (18-14), 15 (17-10). Color: Upper parts Sayal Brown owing to mixture of tricolored hairs (base fulvous, subterminal band Pinkish Buff, terminal band blackish); nose, front of face and ears Cinnamon; sides of head Smoke Gray; eyelids Cartridge Buff; sides lighter than dorsum owing to increase in length of band of subterminal Cartridge Buff on hairs; thighs and front legs Cinnamon-Buff grading to Pinkish Buff on feet; underparts Pinkish Buff grading to Cinnamon-Buff on pectoral and inguinal regions; throat, chin and axillae creamy white; tail fuscous on both surfaces; long hairs of tail six-banded, being: black, white, black, creamy white, black, pale buff from base to tip. Skull: Large, robust; zygomatic arches robust, but not widely spreading; rostrum and nasals broad; tympanic bullae broad.

Superfically, *Citellus armatus* resembles *Citellus richardsoni elegans* and *Citellus beldingi crebrus*. *C. richardsoni* has not been found to date in Utah, but may occur in the state. *Citellus armatus* differs from *C. richardsoni elegans* in larger body, longer hind foot, larger ears, darker-colored upper parts, less buffy under surface of tail and larger skull, with broader rostrum, nasals and interorbital region. From *C. b. crebrus*, *C. armatus* differs in darker color and grayish rather than reddish under surface of tail.

In Utah, animals of this species inhabit the mountains, foothills and high valleys. The Wasatch front marks the extreme western limit of their dispersal except in the Raft River Mountains. Their range meets that of *Citellus townsendii mollis* of the west desert. I found them to be numerous in cultivated fields, pastures and adjoining sagebrush-covered lands as early as March in Heber Valley, Wasatch County, and at Wales, Sanpete County. They favor well drained places, such as knolls and spoil banks of canals for their burrows.

Specimens examined.—Total, 132, distributed as follows: *Boxelder County:* 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 6; Pine Canyon, 17 mi. NE Kelton, 6,600 ft., 1 (M.V.Z.); Mantua, 4. *Cache County:* Richmond, 1; Logan, 4,506 ft., 1. *Morgan County:* East Canyon, 18 mi. NW Park City, 6,000 ft., 3. *Summit County:* 1 mi. N Parleys road, East Canyon, 1; mouth of East Canyon, 1; Smith and Morehouse Creek, 1; 4 mi. NE Snyderville, 5,600 ft., 3; Park City, 6,970 ft., 1 (M.V.Z.); 2 mi. E Park City, 8,500 ft., 2. *Salt Lake County:* City Creek Canyon, 4; University of Utah Campus, Salt Lake City and environs, 4,300 ft., 51; Fort Douglas, 12; Emigration Canyon, 12; 12 mi. E Salt Lake City, 5,000 ft., 2; 12 mi. above mouth Parleys Canyon, 5,526 ft., 18; 7 mi. SE Salt Lake City, 2; Lake Catherine, Silver Lake P.O. (Brighton), 10,000 ft., 1. *Wasatch County:* Wolf Creek Pass, 3. *Sanpete County:* Maple Canyon, 1. *Sevier County:* Coal Mine Flats, 2 mi. S Salina, 1.

Additional records (Howell, 1938:80).—*Cache County:* Lakota; Hyde Park; Logan Canyon; Wellsville; Sardine Canyon; Blacksmith Fork. *Rich County:* Laketown. *Weber County:* Ogden Canyon. *Davis County:* Farmington; Bountiful. *Utah County:* Mt. Timpanogos. *Wasatch County:* Currant Creek. *Duchesne County:* Fruitland; Strawberry Valley. *Sanpete County:* Mammoth Ranger Station; Mt. Pleasant. *Sevier County:* Fishlake.

Citellus tridecemlineatus parvus (Allen)

Thirteen-lined Ground Squirrel

Spermophilus tridecemlineatus parvus Allen, Bull. Amer. Mus. Nat. Hist., 7:337, November 8, 1895, type from Kennedys Hole, Uncompahgre Indian Reservation, 20 miles northeast of Ouray, Uintah County, Utah; Allen, Bull. Amer. Mus. Nat. Hist., 8:254, November 8, 1895.

Citellus tridecemlineatus parvus, Trouessart, Catalog. Mamm., viv. et foss., suppl., p. 341, 1904; Warren, The mammals of Colorado, Knickerbocker Press, p. 161, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):45, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):84, June, 1927; Howell, N. Amer. Fauna, 56:117, May 18, 1938; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 130, 1942.

Range.—Northeastern Utah, in Uinta Basin, north to Diamond Mountain.

Description and comments.—Measurements of 2 males, numbers 8761 (C. M.) and 8762 (C. M.) and 2 females, numbers 8764 (C. M.) and 8763 (C. M.), from Pariette Bench, 12 miles southwest of Ouray, Uintah County, are, respectively, as follows: Total length, 195, 187, 202 and 170; length of tail, 72, 69, 72, and 55; length of hind foot, – –, 28, 27, and 28; length of ear, 9, 9, 11 and 11. Color: Upper parts with alternate, longitudinal dark and light stripes. Dark stripes (7 in number) wider than light stripes; center of each dark stripe having broken line of buffy white spots; light stripes (6 in number) continuous except 2 median stripes which in posterior half or more are broken up into spots; dark stripes Snuff Brown; light stripes buffy white; face Pinkish Buff; eyelids buffy white; sides of head, neck and front feet Pinkish Buff; hind feet, white; underparts white; tail Cinnamon on both surfaces, grading distally to darker color. Skull: Small, but relatively broad; nasals short; tympanic bullae large.

The subspecies *Citellus tridecemlineatus parvus* is the only subspecies of thirteen-lined ground squirrel found in Utah. The distinctively lined dorsal color pattern easily distinguishes *C. t. parvus* from all other members of the genus *Citellus* occurring within the state of Utah.

When Howell (1938:119) revised the group he had only 11 specimens from Utah, and so far as I am aware there are only 13 specimens known from the state. I have tried several times to collect some and the late W. S. Long made a special trip to Uinta Basin

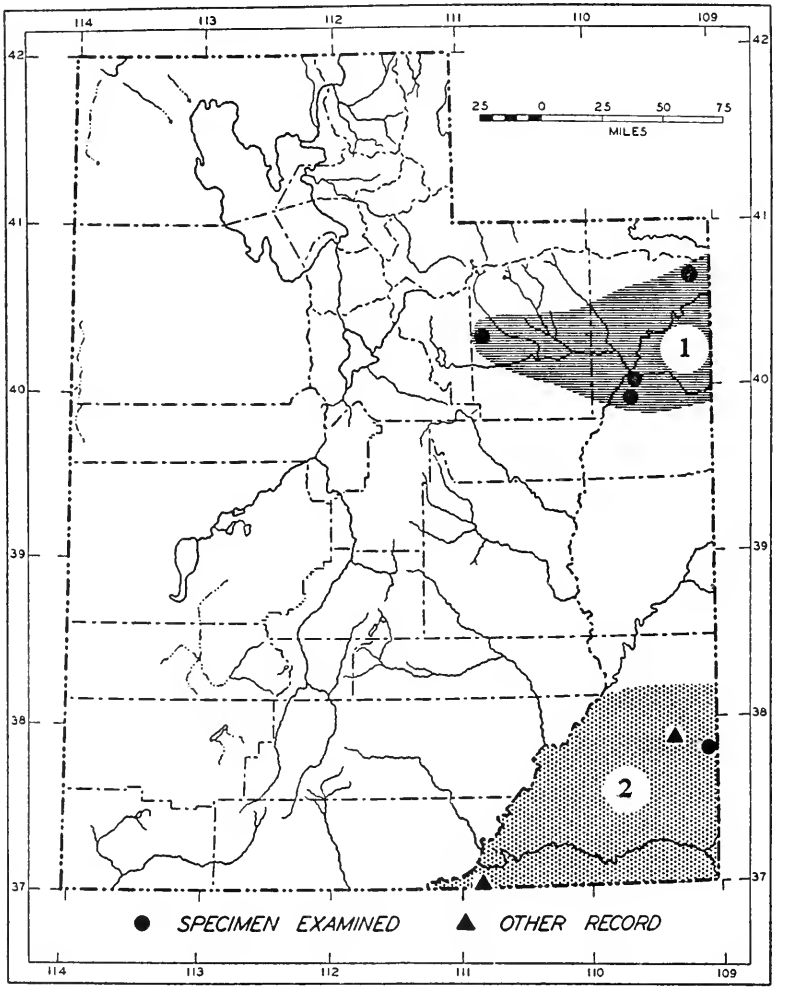

FIG. 29. Distribution of:
1. *Citellus tridecemlineatus parvus.* 2. *Citellus spilosoma cryptospilotus.*

to collect some, but neither of us found any. In conversation with long-time residents, Long learned that they had not seen any of these animals (locally called "corn weasels"), for several years.

Long was of the opinion that they are almost if not wholly extinct in the Uinta Basin.

The three specimens from Red Creek near Fruitland, Duchesne County, are markedly different in color from near topotypes from 12 miles southwest of Ouray, Uintah County. The dark dorsal stripes are much darker being Chestnut Brown as opposed to Snuff Brown. The light stripes have a heavy admixture of dark brown as contrasted with buffy white. The sides and underparts are buff instead of white. The skulls, however, are not so distinctive, but do show some differences; the braincase is wider. A larger series of animals from Duchesne County might reveal that they were subspecifically different from *C. t. parvus.*

Specimens examined.—Total, 9, distributed as follows: *Duchesne County:* Red Creek, 2 mi. N Fruitland, 6,700 ft., 3 (C. M.). *Uintah County:* Diamond Mountain, 2; Pariette Bench, 12 mi. SW Ouray, 4 (C. M.).

Citellus spilosoma cryptospilotus (Merriam)

Spotted Ground Squirrel

Spermophilus cryptospilotus Merriam, N. Amer. Fauna, 3:57, September 11, 1890, type from "Tenebito" [= Dinnebito] Wash, Painted Desert, Coconino County, Arizona.

Citellus spilosoma cryptospilotus, Trouessart, Catalog. Mamm. viv. et foss., suppl. p. 341, 1904; Moore, Journ. Mamm., 11:87, February 11, 1930; Howell, N. Amer. Fauna, 56:130, May 18, 1938; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 132, 1942.

Citellus spilosoma (?), Benson, Univ. California Publ. Zoöl., 40:449 December 31, 1935.

Range.—Recorded only from southeastern Utah in San Juan County. See figure 29.

Description and comments.—Howell (1938:130) gives the following average and extreme measurements of 6 adults from Painted Desert, Arizona: Total length, 199.5 (210-190); length of tail, 65 (72-58); length of hind foot, 31.8 (33-31). Color: Upper parts Avellaneous with small squarish white spots, most heavily concentrated on rump; sides Pinkish Buff; feet Cartridge Buff; eye ring pale buff; tail edged with Pinkish Buff; under side of tail Pinkish Buff; tip of tail Fuscous; underparts white. Skull: Small; nasals short; braincase broad; tympanic bullae large.

This small ground squirrel is easily distinguished from all others occurring within the state by its reddish brown upper parts, sprinkled with white dots.

Like the prairie dog *Cynomys gunnisoni zuniensis,* this ground squirrel has not extended its range in Utah westward beyond the Colorado River.

Specimen examined.—One, from Lockerby, San Juan County.

Additional records.—*San Juan County:* Monticello (Howell, 1938:130); 5 mi. S Summit of Navajo Mountain (Benson, 1935:449).

Citellus variegatus utah Merriam

Rock Squirrel

Citellus grammurus utah Merriam, Proc. Biol. Soc. Washington, 16:77, May 29, 1903, type from foot of Wasatch Mountains, near Ogden, Weber County, Utah.

Citellus variegatus utah, Elliot, Field Columb. Mus. Publ. Zoöl., 6 (pub. 105):115, 1905; Warren, The mammals of Colorado, Knickerbocker Press, p. 163, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):50, April, 1922; Howell, N. Amer. Fauna, 56:146, May 18, 1938; Long, Journ. Mamm., 21:173, May 16, 1940; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Spermophilus grammurus, Merriam, Mammals, in F. V. Hayden's sixth annual report of the U. S. Geological Survey of the territories embracing portions of Montana, Idaho, Wyoming and Utah, p. 663, 1873; Allen, Bull. Essex Inst., 6:66, 1874.

Otospermophilus grammurus utah, Barnes, Bull. Univ. Utah, 17 (no. 12):79, June, 1927.

Range.—From north-central Utah south into Iron County, east into Carbon County.

Description and comments.—Measurements of 3 males, numbers 1094, 1106, 4193, and of 3 females numbers 1337, 2326, 3012, all from Salt Lake City, are, respectively, as follows: Total length, 450, 455, 430; 471, 428, 457; length of tail, 160, 192, 165; 197, 180, ---; length of hind foot, 70, 56, 55; 59, 55, ---; length of ear, 20, 28, 28; 27, ---, 26. Color: Upper parts a variegated mixture of Pinkish Buff, black, white and brown divisible into three general regions, that is, head, forepart of back and hind part of back; hairs on head mixed, Fuscous at base, tipped with Pinkish Buff; interauricular region darker owing to greater admixture of Fuscous; eye ring conspicuous, creamy white to Light Buff; anterior base of ear with white spot; sides of head and face grayish owing to admixture of white-tipped hairs; forepart of back, shoulders and flanks grayish with mixture of hairs with Fuscous bases and subterminal white bands; hind part of back a mixture of Snuff Brown, Mikado Brown or Sayal Brown and Fuscous and Light Buff; underparts white with wash of Pale Pinkish Buff; inguinal and pectoral regions Pinkish Buff; feet Pinkish Buff; nose Cartridge Buff; tail mixed buff, Fuscous and white; terminal hairs have 7 alternating light and dark bands. Skull: Similar to that of *Citellus variegatus grammurus*, but usually larger in most measurements.

The specimens of *C. v. utah* vary extensively. In his revision of the ground squirrels Howell (1938:147) commented upon this marked variation, but found he could readily separate topotypes of *C. v. utah* from those of *C. v. grammurus*. Comparisons of topotypes and near topotypes of *C. v. utah* with specimens of *C. v. grammurus* from east of the Colorado River in Grand County show the same diagnostic differences as observed by Howell (*loc. cit.*) when he compared *C. v. utah* with topotypes of *C. v. grammurus*. All specimens of *C. v. utah* in the state of Utah, other than topotypes are intergrades of varying degree between the two subspecies. One large series from Salt Lake City and environs shows gradations

in color from as dark as the darkest topotypes of *C. v. utah* to as light as the lightest specimens of *C. v. grammurus* from Grand County. The assignments of the intergrades to subspecies were made on the basis of color and average differences in cranial measurements.

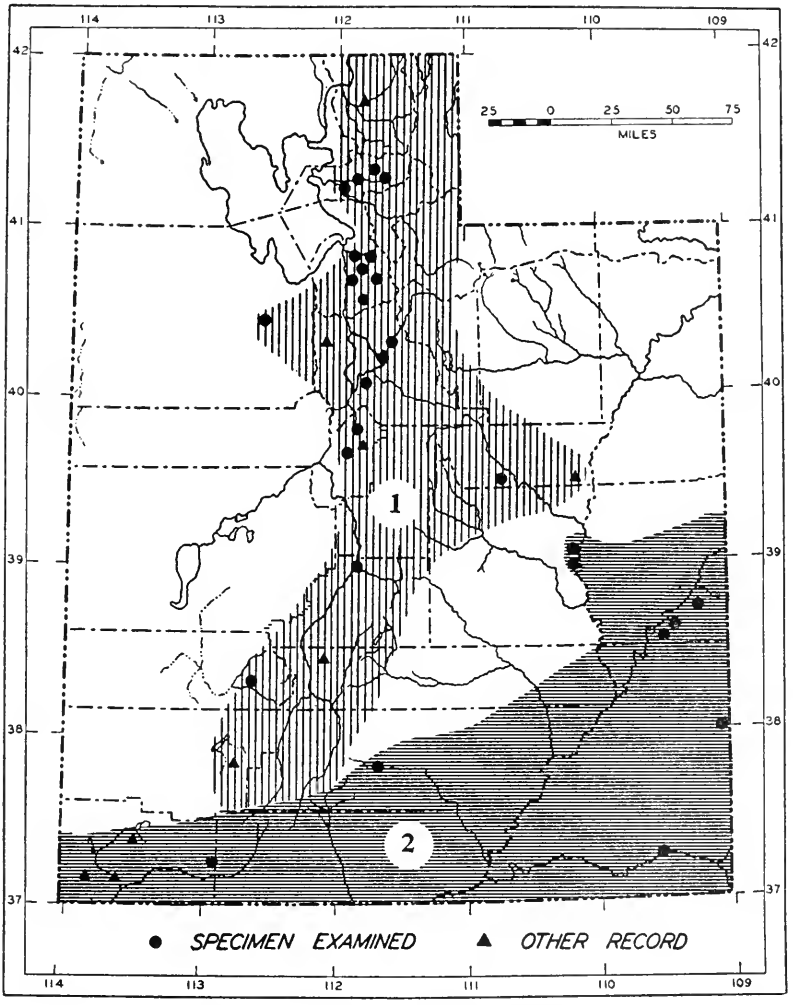

FIG. 30. Distribution of *Citellus variegatus*.
1. *C. v. utah*. 2. *C. v. grammurus*.

These ground squirrels are commonly known as rock squirrels and are seldom found in the valleys. I have seen them in the valley at Bountiful, Davis County, where they inhabited steep ditch banks. In Salt Lake County they range from the foothills east of the

city at an elevation of 4,500 feet up to 9,000 feet in Big Cottonwood Canyon.

If these animals hibernate, they do so for a short period in this region, since I have seen them active above ground as early as the 14th of January in Salt Lake City and as late as the 22nd of October at elevations of 8,000 feet in Sanpete County; of course animals of the year may be active later in the autumn than are older individuals, as is the case in the closely related species, *Citellus beecheyi;* but I have no exact information in this respect for *Citellus variegatus.*

Specimens examined.—Total, 50, distributed as follows: *Weber County:* Beaver Canyon, 8,000 ft., 1; Ogden Canyon, 9 mi. E Ogden, 4,840 ft., 1; S Fork Ogden River, 18 mi. E Ogden, 4 (M.V.Z.); Ogden, 4,293 ft., 3 (M.V.Z). *Tooele County:* Willow Springs, 1. *Salt Lake County:* City Creek Canyon, 6; Dry Canyon, 2 mi. NE Salt Lake City, 4; E Salt Lake City (Fort Douglas), 5; mouth of Parleys Canyon, 3; 8 mi. above mouth of Emigration Canyon, 2; mouth of Emigration Canyon, 2; 2 mi. above mouth of Emigration Canyon, 1; Sugarhouse, 1; Salt Lake City, 2; 2 mi. W Murray, 4,300 ft., 2; 2 mi. E Holladay, 4,700 ft., 1; 1 mi. NE Draper, 4,500 ft., 1. *Utah County:* 8 mi. NE Provo, 4,510 ft., 1 (M.V.Z.); 6 mi. W Spanish Fork, 4,568 ft., 1. *Juab County:* 7 mi. N Nephi, 5,730 ft., 1; 1½ mi. SW Nephi, 5,721 ft., 1. *Carbon County:* 3½ mi. SE Price, 5,547 ft., 1. *Sevier County:* Salina, 1; Salina Canyon, 2. *Beaver County:* Beaver, 6,000 ft., 2 (M.V.Z.).

Additional records (Howell, 1938:147).—*Cache County:* Logan. *Utah County:* Cedar Fort; Provo; Provo Canyon. *Juab County:* Nephi. *Carbon County:* Florence Canyon, 35 mi. N Greenriver (city). *Piute County:* Marysvale. *Iron County:* Parowan.

Citellus variegatus grammurus (Say)

Rock Squirrel

S*[ciurus]. grammurus* Say, Long's Expedition to Rocky Mountains, 2:72, 1823, type from Purgatory River near mouth of Chacuaco Creek, Los Animas County, Colorado.

Citellus variegatus grammurus, Elliott, Field Colum. Mus. Publ. 95, zoöl., ser., 4:149, 1904; Barnes, Bull. Univ. Utah, 12 (no. 15):50, April, 1922; Howell, N. Amer. Fauna, 56:142, May 18 ,1938.

Otospermophilus grammurus grammurus, Barnes, Bull. Univ. Utah, 17 (no. 12):78, June, 1927; Woodbury, Ecol. Monogr., 3:192, 208, April, 1933; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 117, 1942.

Citellus grammurus grammurus, Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935.

Citellus grammurus utah, Presnall, Zion-Bryce Mus. Bull., 2:11, January, 1938.

Range.—Extreme southern Utah, extending northward in eastern Utah to Grand and Emery counties.

Description and comments.—Measurements of one female, number 970, from Castle Valley, 18 miles northeast of Moab, are as follows: Total length, 462; length of tail, 188; length of hind foot, 55; length of ear, 25; corresponding measurements of one male, number 656, from East Rim, Zion National Park, are 464, 200, 57, 29. Color: Upper parts a variegated mixture of buff, black and white, somewhat divisible into three general regions of fore-back, head, and hind back; top of head Pinkish Buff interspersed with Fuscous in

most specimens, some may be Cinnamon-Buff or even as dark as Cinnamon; forepart of back, shoulders and sides grayish, owing to variegated mixture of black and white; hind part of back and rump Cinnamon-Buff, mixed with Sayal Brown, but bases of hairs Warm Sepia to Clove Brown; ears Hair Brown; eye ring white; nose Cartridge Buff; front legs pale buff; hind legs Cinnamon-Buff; front and hind feet Cartridge Buff; underparts white, washed with Pinkish Buff; tail Pinkish Buff with marked banding of Bone Brown, and white distally, tail hairs have 7 distinct alternating dark and light bands. Skull: Large; nasals long; interorbital region wide; braincase broad; rostrum broad; postorbital processes long, stout and decurved; tympanic bullae relatively long and narrow; dentition relatively light.

Citellus variegatus grammurus may be distinguished from *Citellus variegatus utah* as follows: Color lighter, especially on top of head and posterior part of back; underparts more Cinnamon especially in pectoral and inguinal regions; tail with greater suffusion of Cinnamon Buff. Skull: Smaller in almost all measurements taken; tympanic bullae more rounded and less ridged ventrally.

The geographic range of this ground squirrel is difficult to delimit because the available specimens, except those from east of the Colorado River in San Juan and Grand counties, are intergrades between *C. v. grammurus* and *C. v. utah.* This intergradation is discussed in the account of *C. v. utah.*

Specimens examined.—Total, 22, distributed as follows: *Emery County:* 7 mi. N Greenriver, 4,100 ft., 4; pump station, 4 mi. N Greenriver, 4,100 ft., 3. *Grand County:* Castle Valley, 18 mi. NE Moab, 6,000 ft., 1; mouth of Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 3,995 ft., 3; Moab, 4,500 ft., 3. *Garfield County:* ½ mi. N Escalante, 5,300 ft., 1. *Washington County:* E Rim Zion National Park, 6,500 ft., 1; Zion National Park, 4,500 ft., 4. *San Juan County:* 18½ mi. E Monticello, 6,270 ft., 1.; Bluff, 4,400 ft., 1 (M.V.Z.).

Additional records (Howell, 1938:145).—*Washington County:* Pine Valley; Santa Clara; Beaverdam Mountains.

Citellus leucurus leucurus (Merriam)

Antelope Ground Squirrel

Tamias leucurus Merriam, N. Amer. Fauna, 2:20, October 30, 1889, type from San Gorgonio Pass, Riverside County, California.

Citellus leucurus, Elliot, Field Columb. Mus. Publ., 79, zoöl. ser., 3:210, June, 1903; Barnes, Bull. Univ. Utah, 12 (no. 15):43, April, 1922.

Spermophilus Harrisi, Allen, Bull. Essex Inst., 6:66, 1874.

Ammospermophilus leucurus leucurus, Barnes, Bull. Univ. Utah, 17 (no. 12):85, June, 1927; Stanford, Journ. Mamm., 12:359, November 11, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938.

Citellus leucurus leucurus, Howell, N. Amer. Fauna, 56:170, May 18, 1938; Fautin, Ecol. Monogr., 16:304, October, 1946.

Citellus leucurus subsp?, Long, Journ. Mamm., 21:174, May 16, 1940.

Ammospermophilus leucurus cinnamomeus, Hall, Univ. California Publ. Zoöl., 37:2, April 10, 1931.

Range.—Western Utah as far east as the central mountain ranges.

Description and comments.—Measurements of 2 males, numbers 589 and 592, from Willow Springs are: Total length, 225, 240; length of tail, 58, 65; length of hind foot, 34, 35. Color: Upper parts Vinaceous-Buff or Avellaneous (this color due to subterminal bands); base of hairs Fuscous; lateral stripes white; eye ring, entire underparts, ventral surface of front and hind legs, white

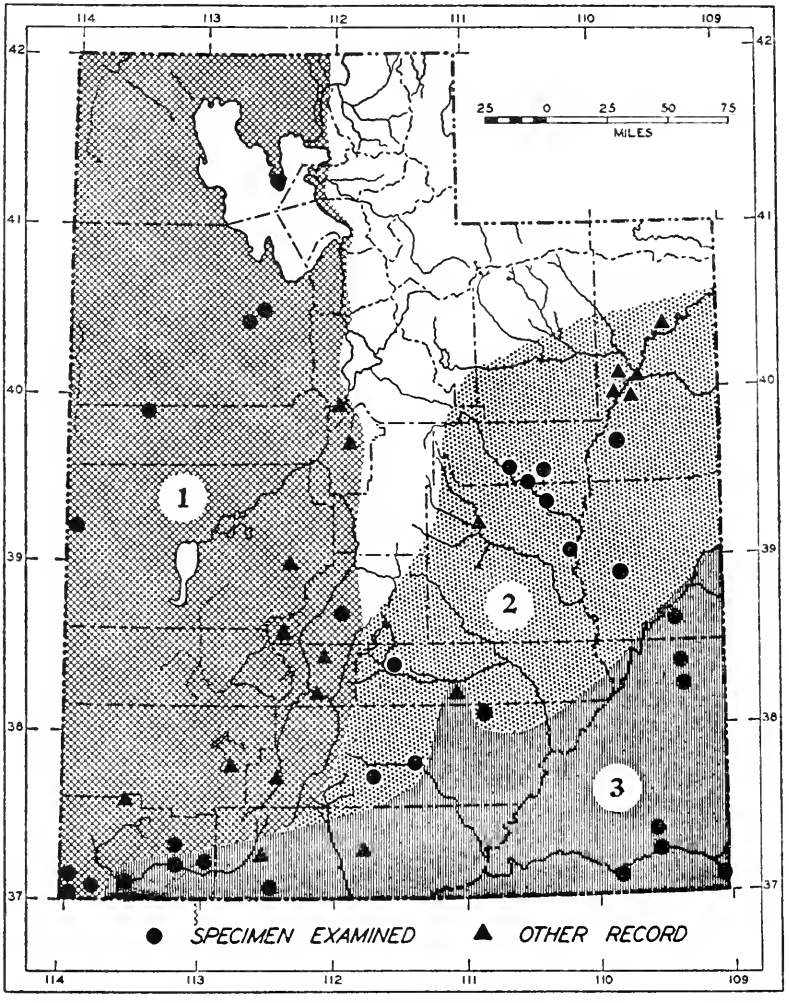

FIG. 31. Distribution of *Citellus leucurus*.
1. *C. l. leucurus.* 2. *C. l. pennipes.* 3. *C. l. cinamomeus.*

or pale buffy white; shoulders, front of thighs, dorsal surface or front legs and dorsal surface of hind legs and feet Light Pinkish Cinnamon; proximal part of dorsal surface of tail like back; distal three-fourths of dorsal part of tail black and white, owing to banding of hairs which are white-tipped; ventral surface of tail, white with subterminal blackish border. Winter pelage with consider-

able more gray. Skull: Small (smallest of subspecies occurring in Utah); nasals short.

C. l. leucurus differs from *Citellus leucurus cinnamomeus* in smaller size, grayer, less reddish and brownish color and smaller skull. From *Citellus leucurus pennipes, C. l. leucurus* differs in grayer, less vinaceous color, and smaller skull.

Specimens from the area in western Utah formerly occupied by the Pleistocene Lake Bonneville are the most typical, of *C. l. leucurus,* of any specimens from the state. Howell (1938:171) mentioned 8 specimens from St. George, Washington County, that showed intergradation between *C. l. leucurus* and *C. l. cinnamomeus.* Animals from still farther west in Washington County show this same intergradation. One specimen from Terry's Ranch in Beaverdam Wash resembles *C. l. leucurus* in color. Three other animals from the same locality are intermediate in color, but have the increased amount of red and brown characteristic of *C. l. cinnamomeus.* The small size of the skulls of these specimens has influenced me to refer them to *C. l. leucurus.* Two specimens from eastern Washington County, from La Verkin and Toquerville, are also intergrades between the aforementioned subspecies, but are referable to *C. l. leucurus* on the basis of cranial characters.

The geographic range of this squirrel coincides with that of *Citellus townsendii mollis,* but according to my observations the antelope ground squirrel lives mainly, or entirely, in stony situations and amid rocks, whereas the Townsend squirrel is generally distributed being less narrowly restricted as regards habitat.

Specimens examined.—Total, 20, distributed as follows: *Boxelder County:* Promontory Point, 2. *Tooele County:* ¼ mi. W Johnson's Pass, 4,000 ft., 1; Willow Springs, 2. *Juab County:* Fish Springs, 4,400 ft., 1. *Millard County:* Hendry Creek, 5,000 ft., 17 mi. S Gandy, 3 (M. V. Z.); Robison Ranch, 5,300 ft., 17 mi. S Gandy, 1 (M. V. Z.). *Sevier County:* Monroe, 1. *Washington County:* Toquerville, 1; La Verkin, 1; Terry's Ranch, Beaverdam Wash, 1; Beaverdam Wash, 8 mi. N Utah-Arizona border, 2,300 ft., 2; Beaverdam Wash, 5 mi. N Utah-Arizona border, 2,600 ft., 3; W slope Beaverdam Mountains, 5 mi. N Utah-Arizona border, 3,300 ft., 1.

Additional records (Howell, 1938:173).—*Utah County:* Elberta. *Juab County:* Nephi. *Millard County:* Fillmore. *Sevier County:* Clear Creek. *Piute County:* Marysvale; Junction. *Iron County:* Parowan. *Garfield County:* 10 mi. S Panguitch. *Washington County:* Hebron; St. George; Canaan Spring, near Arizona line.

Citellus leucurus pennipes (Howell)

Antelope Ground Squirrel

Ammospermophilus leucurus pennipes Howell, Journ. Mamm., 12:162, May 14, 1931, type from Grand Junction, Mesa County, Colorado; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 134, 1942.

Citellus leucurus pennipes Howell, N. Amer. Fauna, 56:175, May 18, 1938.

Tamias leucurus, Allen, Bull. American Mus. Nat. Hist., 8:255, November 25, 1896.

Ammospermophilus leucurus cinnamomeus, Stanford, Journ. Mamm., 12:359, November 11, 1931.

Range.—South-central and eastern Utah.

Description and comments.—A male, number 1415, from Sunnyside, measures: Total length, 200; length of tail, 49; length of hind foot, 34; length of ear, 11. Color: Upper parts near (*c*) Light Vinaceous-Cinnamon, thickly mixed with white tipped hairs; flanks and legs Vinaceous-Cinnamon; feet Pale Pinkish Buff; lateral stripes buffy white; eye ring, sides of nose and cheeks, buffy white; underparts white, tinged with pale buff; proximal dorsal surface of tail like back; remainder of dorsal surface of tail grayish, almost white; under surface of tail creamy white with submarginal black band. Summer pelage lighter. Skull: Similar to *Citellus leucurus cinnamomeus,* but generally smaller.

For comparisons see accounts of other members of the species.

In Utah, the geographic range of this subspecies is confined to the area north and west of the Colorado River and east of the central mountain ranges. With the exception of animals from the extreme southern part of the range the specimens resemble topotypes of *C. l. pennipes.* One specimen from 18 miles west of Escalante and another from 8 miles south of Escalante are intergrades between *C. l. pennipes* and *C. l. cinnamomeus,* but are referred to the former on the basis of color.

Specimens examined.—Total, 17, distributed as follows: *Uintah County:* Willow Creek, 29 mi. S Ouray, 5,400 ft., 1. *Carbon County:* Sunnyside, 7,000 ft., 1; Wellington, 1; between Wellington and Woodside, 1. *Emery County:* Woodside, 1; Gunnison Butte, Green River, 4,700 ft., 1. *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 3. *Wayne County:* ½ mi. E Bicknell, 1; ½ mi. E Bicknell, 1; 2½ mi. E Bicknell, 1. *Garfield County:* King Ranch, Henry Mountains, 2; 18 mi. W Escalante, 8,000 ft., 1; 8 mi. S Escalante, 5,200 ft., 1.

Additional records (Howell, 1938:176).—*Uintah County:* Vernal; junction of Green and White rivers; Uncompahgre Indian Reservation; 8 mi. SW Ouray; 15 mi. SW Ouray. *Emery County:* Near Huntington.

Citellus leucurus cinnamomeus (Merriam)

Antelope Ground Squirrel

Tamias leucurus cinnamomeus Merriam, N. Amer. Fauna, 3:52, September 11, 1890, type from Echo Cliffs, Painted Desert, Coconino County, Arizona; Allen, Bull. American Mus. Nat. Hist., 5:82, April 28, 1893.

Citellus leucurus cinnamomeus, Elliot, Field Columb. Mus. Publ., zool. ser., 6:97, 1905; Howell, N. Amer. Fauna, 56:174, May 18, 1938.

Citellus l[eucurus] cinnamomeus, Tanner, Great Basin Nat., 1:104, June 30, 1940.

Ammospermophilus leucurus cinnamomeus, Warren, The mammals of Colorado, Knickerbocker Press, p. 164, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):47, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):86, June, 1927; Woodbury, Ecol. Monogr., 3:213, April, 1933; Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935; Presnall, Zion-Bryce Mus. Bull., 2:11, January, 1938; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 133, 1942.

Range.—Southern Utah and southeastern Utah east of the Colorado River.

Description and comments.—Measurements of a male, number 2950, from Block Canyon, 19 miles south of Moab and of a female, number 536, from Little Castle Valley, are: Total length, 215, 200; length of tail, 57, 59; length of hind foot, 42, 38; length of ear, 7, 7. Color: Upper parts Vinaceous-Cinnamon, most marked on shoulders, mixed with Mikado Brown, heaviest on rump, considerable mixture of white, especially on forepart of back; lateral stripes buffy white; sides and flanks nearly pure Vinaceous-Cinnamon; nose and cheeks, Fuscous; eye ring buffy white; front and hind legs Vinaceous-Cinnamon, paler on front legs; feet creamy white (in some specimens only slighter lighter than legs); proximal dorsal surface of tail like rump; remainder of dorsal surface of tail mixed black and white; lower surface of tail creamy white, bordered by black, owing to subterminal banding of hairs; underparts uniform Cartridge Buff. Summer pelage slightly lighter dorsally. Skull: Similar to that of *Citellus leucurus leucurus,* but larger, with longer nasals and heavier dentition.

Utah-taken specimens of *C. l. cinnamomeus* differ from *Citellus leucurus pennipes* in more vinaceous color and larger skull, except for mastoid and postorbital breadths which are approximately equal. For comparison with *Citellus leucurus leucurus,* see account of that subspecies.

From the available specimens, it appears that the only animals from Utah which are clearly referable to this subspecies are those from San Juan and Grand counties, east of the Colorado River. The remainder of the specimens here referred to *C. l. cinnamomeus* are intergrades of varying degree between *C. l. cinnamomeus* and *C. l. leucurus* or *C. l. pennipes* and *C. l. cinnamomeus.* One specimen from Kanab is intermediate in color between *C. l. cinnamomeus* and *C. l. leucurus,* but has the larger cranial measurements characteristic of the former subspecies. Another specimen from Little Castle Valley is assigned to *C. l. cinnamomeus* on the basis of rufescent color. Two specimens from Garfield County are intergrades between *C. l. cinnamomeus* and *C. l. pennipes,* but are referred to the latter (see account of that subspecies). Another intergrade between *C. l. pennipes* and *C. l. cinnamomeus* is from southern Uintah County. It is lighter than the latter, but the pelage is so worn that the color is untrustworthy for subspecific identification. I refer the specimen to *C. l. cinnamomeus* on the basis only of geographical probability.

Specimens examined.—Total, 28, distributed as follows: *Grand County:* Little Castle Valley, 1. *Washington County:* Zion National Park, 1 (M.V.Z.); 2 mi. N Springdale, 1 (K.U.); Springdale, 5 (K.U.); 3 mi. NE St. George, 1; 2 mi. W St. George, 6 (K.U.); Hurricane, 1 (M.V.Z.). *Kane County:* 2 mi. N Kanab, 1 (K.U.); 3 mi. SW Kanab, 1; Kanab, 2 (1, M.V.Z.). *San Juan County:* Block Canyon, mouth of Kane Spring, 19 mi. S Moab, 1; 25 mi. N

Monticello, 5,000 ft., 2 (M.V.Z.); Cottonwood Wash, 8 mi. N Bluff, 4,700 ft., 1 (M.V.Z.); ½ mi. NW Bluff, 4,500 ft., 1; Bluff, 2; 1½ mi. S Mexican Hat, 1 (M.V.Z.).

Additional records (Howell, 1938:175).—*Wayne County:* Notom. *Kane County:* Mt. Carmel; Willow Tank Spring. *San Juan County:* Noland Ranch.

Citellus lateralis trepidus (Taylor)

Golden-mantled Ground Squirrel

Callospermophilus trepidus Taylor, Univ. California Publ. Zoöl., 5:283, February 12, 1910, type from head of Big Creek, Pine Forest Mountains, 8,000 ft., Humboldt County, Nevada.

Citellus l[ateralis]. trepidus, Hall, The Murrelet, 12:2, May, 1931.

Callospermophilus lateralis trepidus, Howell, N. Amer. Fauna, 56:206, May 18, 1938.

Callospermophilus chrysodeirus trepidus, Hall, Univ. California Publ. Zoöl., 37:2, April 10, 1931.

Range.—Extreme western Utah, probably occurs throughout the Great Basin area of the state.

Description and comments.—Average and extreme measurements of 4 males and 6 females from the type locality are as follows: Total length, 268.6 (288-252); length of tail, 101.2 (108-90); length of hind foot, 40.5 (44-39); length of ear from notch (dry); 13.9 (16-13). Color: Crown and nape Hazel; cheeks, sides of head and shoulders Ochraceous-Tawny with mixture of Cinnamon-Buff; eye ring creamy white; ears Cinnamon-Buff; middorsal region and rump between Vinaceous-Fawn and Avellaneous mixed with grayish white, darker on rump, thighs and basal dorsal part of tail; light lateral stripes creamy white or Pinkish Buff; dark lateral stripes of approximately same width as medium dark stripes and black, grading gradually into the color of rump; front and hind feet Pale Pinkish Buff; upper surface of tail blackish, mixed with Warm Buff, hairs tipped with Pale Pinkish Buff; under surface of tail Tawny, hairs with wide black subterminal band and tipped with Pale Pinkish Buff; sides Smoke Gray mixed with Pale Pinkish Buff; entire underparts white, or Pale Pinkish Buff. Skull: Similar to that of *C. l. castanurus,* but slightly larger in most measurements.

For comparisons of this subspecies with *C. l. castanurus* and *Citellus lateralis lateralis,* see accounts of those subspecies.

The only available specimens from Utah are from the Raft River Mountains in the extreme northwestern corner of the state. Occasionally I have seen golden-mantled ground squirrels in the Oquirrh Mountains, Tooele County, and in the Deep Creek Mountains in Juab County. Although I was unsuccessful in capturing any at these places, their pale color leads me to think that they are *C. l. trepidus* and I suspect that, in suitable habitat, this subspecies occurs throughout the Lake Bonneville Basin.

Specimens examined.—Total, 11, distributed as follows: *Boxelder County:* 1 mi. SE Yost, 6,100 ft., 1; George Creek, rd. junction, 6,700 ft., 5 mi. SE Yost, Raft River Mountains, 1; George Creek, 7½ mi. SE Yost, Raft River Mountains,

6,500 ft., 3; Pine Creek, 3 mi. N Rosette, Raft River Mountains, 6,100 ft., 3 (2,M.V.Z.); Divide, 6 mi. SW Rosette, Raft River Mountains, 6,700 ft., 1; Clear Creek, 5 mi. SW Nafton, 6,500 ft., 2.

Additional records (seen in field by writer).—*Tooele County:* Oquirrh Mountains. *Juab County:* Deep Creek Mountains.

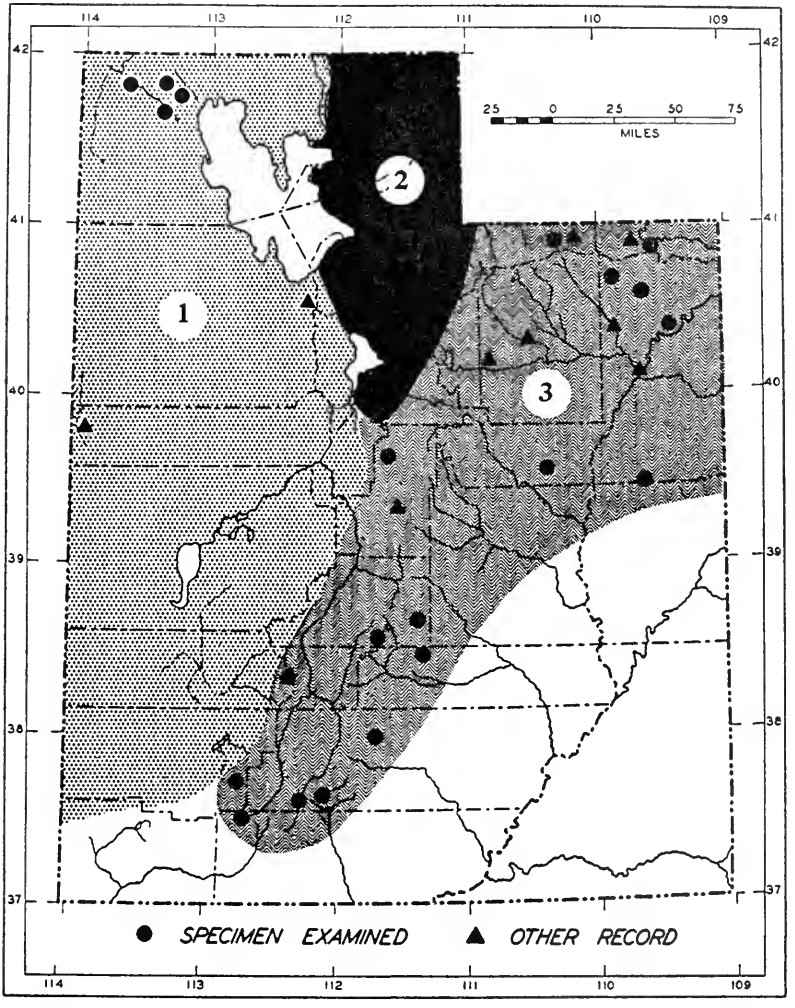

FIG. 32. Distribution of *Citellus lateralis*.
1. *C. l. trepidus.* 2. *C. l. castanurus.* 3. *C. l. lateralis.*

Citellus lateralis castanurus (Merriam)

Golden-mantled Ground Squirrel

Tamias castanurus Merriam, N. Amer. Fauna, 4:19, October 8, 1890, type from Park City, Summit County, Utah.
Citellus lateralis castanurus, Howell, N. Amer. Fauna, 56:201, May 18, 1938; Hayward, Great Basin Nat., 6:110, November 15, 1945.
Citellus castanurus, Barnes, Bull. Univ. Utah, 12 (no. 15):47, April, 1922.
Callospermophilus castanurus, Barnes, Bull. Univ. Utah, 17 (no. 12):80, June, 1927; Stanford, Journ. Mamm., 12:358, November 11, 1931.

Range.—Limited to the Wasatch Mountains.

Description and comments.—Two male topotypes, numbers 3438 and 3437, measure: Total length, 270, 265; length of tail, 84, 82; length of hind foot, 37, 35; length of ear, 18, 14. Color: Top of head, ears and shoulders Mikado Brown mixed with black and white; cheeks and throat Cinnamon-Buff; eye ring buffy white; middorsal region and rump Fawn mixed with grayish white and black; light lateral stripes Pinkish Buff; lateral stripes black and as wide as, or wider than, pale stripes; upper parts of thighs Mikado Brown; dorsal surface of hind feet Pale Pinkish Buff; front legs and feet Pinkish Buff or Cinnamon-Buff; dorsal surface of tail blackish, the hairs tipped with Cinnamon-Buff and with considerable Ochraceous-Tawny on proximal bands; under surface of tail Russet, hairs tipped with Cinnamon-Buff; entire underparts Pinkish Buff or Pale Pinkish Buff. Skull: Braincase well inflated; nasals narrow, and long; posterior ends of nasals rounded and extending beyond premaxillo-frontal suture; zygomatic processes of frontals well developed.

Compared to Utah-taken specimens of *Citellus lateralis trepidus*, topotypes of *C. l. castanurus* differ in: Color: Sides of head, sides of neck and shoulders darker; under surface of tail darker; entire underparts uniformly darker. Skull: Smaller in nearly every measurement taken; nasals less flared distally; braincase more inflated. For comparison with *Citellus lateralis lateralis*, see account of that subspecies.

In Utah, this subspecies is restricted to the Wasatch Mountains and primarily to the northern section. Two immature specimens, numbers 1223, from Daggett County and 2923 from Summit County, are here referred to *C. l. lateralis*. In color, however, they show slight indications of intergradation with *C. l. castanurus*.

Specimens examined.—Total, 18, distributed as follows: *Cache County:* White Pine Lake, Logan Canyon, 1; Tony Grove, Logan Canyon, 2. *Salt Lake County:* Catherine Divide, Silver Lake P.O. (Brighton), 10,250 ft., 1; 1 mi. above Alta, 2. *Morgan County:* East Canyon, 18 mi. NW Park City, 6,000 ft., 1. *Summit County:* 3 mi. NE Park City, 7,900 ft., 2; Park City, 6,970 ft., 3 (M.V.Z.); *Utah County:* Santaquin Canyon, upper saw mill, north Nebo, 6.

Additional records (Howell, 1938:202).—*Cache County:* Blacksmith Fork; Sardine Canyon. *Rich County:* E side Bear Lake. *Salt Lake County:* Barclay.

Citellus lateralis lateralis (Say)

Golden-mantled Ground Squirrel

S[*cirurus*]. *lateralis* Say, Long's Expedition to Rocky Mountains, 2:46, 1823, type from Arkansas River, near Canon City, Fremont County, Colorado.
Citellus (*Callospermophilus*) *lateralis*, Allen, Bull. Brooklyn Inst. Arts and Sci., 1:119, March 31, 1905.
Citellus lateralis lateralis, Howell, N. Amer. Fauna, 56:191, May 18, 1938; Long, Journ. Mamm., 21:174, May 16, 1940.
Citellus l[*ateralis*]. *lateralis*, Tanner, Great Basin Nat., 1:109, June 30, 1940.
Tamias lateralis, Allen, Bull. Essex Inst., 6:66, 1874.
Callospermophilus lateralis, Barnes, Bull. Univ. Utah, 12 (no. 15):46, April, 1922.
Callospermophilus lateralis lateralis, Barnes, Bull. Univ. Utah, 17 (no. 12):81, June, 1927; Stanford, Journ. Mamm., 12:358, November 11, 1931; Svihla, Journ. Mamm., 12:260, August 24, 1931; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 120, 1942.

Range.—Mountains and foothills from northeastern Utah southwest to Kane County.

Description and comments.—Measurements of one male, number 1416, from Range Creek, Carbon County, and one female, number 1397, from Brian Head, Iron County, are, respectively, as follows: Total length, 273, 262; length of tail, 90, 81; length of hind foot, 41, 40; length of ear, 16, 19. Color: Upper parts Pinkish Cinnamon, with great admixture of Light Smoke Gray; top of head and face varying from Pinkish Cinnamon to Mikado Brown; eye ring buffy white; ears like crown, but with pale buff margins; rump and thighs Fawn; sides of neck and shoulders vary from Pinkish Cinnamon to Mikado Brown; light lateral stripes pale buff; median dark stripe absent or greatly reduced; lateral dark stripes blackish and never so long as light stripes; sides Pale Pinkish Buff; hind feet buffy white; front legs and fore feet Pinkish Cinnamon; dorsal surface of tail a mixture of Fuscous, black and Pinkish Cinnamon; underparts Pale Pinkish Buff; ventral surface of tail Pinkish Buff with subterminal black bands. Skull: Similar to that of *Citellus lateralis castanurus*, but larger in most measurements taken.

Utah-taken specimens of *C. l. lateralis* may be distinguished from those of *C. l. castanurus* as follows: Color: Usually lighter on upper parts; median pair of black stripes absent or reduced, as opposed to well marked; lateral pair of black stripes much less prominent; under surface of tail much lighter. Skull: Larger in nearly all measurements taken.

Comparisons of specimens of *C. l. lateralis* with those of *Citellus lateralis trepidus* show the following differences: Upper parts more Pinkish Cinnamon, less gray; black stripes less marked; underparts darker, Pale Buff as opposed to white. Skull: Larger in all measurements taken.

This subspecies has the largest geographic range of any of the *Citellus lateralis* group known to occur within the state. It occurs in all the mountains and foothills of the state except in the Wasatch Mountains and the mountains of the basin of Lake Bonneville. No overlap has been found in the geographic range of this subspecies with that of *C. l. castanurus* which inhabits the Wasatch Mountains proper. In his revision of the ground squirrels Howell (1938:193) commented on the fact that intergradation between *C. l. lateralis* and *C. l. castanurus* was unknown. Both subspecies are remarkably constant over their respective ranges as judged by the material at hand. One specimen from Maple Canyon, Sanpitch Mountains, Sanpete County, does however, show some evidences of intergradation. The dorsal coloration, and mantle are as in *C. l. castanurus;* the black lateral stripes are as in *C. l. lateralis* and the color of the under surface of the tail is midway between the colors in the two subspecies. The majority of the characters which can be ascertained from the skin are, however, like those of *C. l. lateralis* to which it is here referred. The skull of this specimen was not available for study. Six animals from Santaquin Canyon, north of Mt. Nebo, are intergrades between *C. l. lateralis* and *C. l. castanurus.* They resemble the former in reduction of dark stripes, particularly the medial stripes. The darker dorsal coloration, and more reddish suffusion, plus cranial characters prove them to be referable to the latter subspecies. Specimens from the southern part of the range are markedly lighter in dorsal coloration than those from farther north.

Specimens examined.—Total, 57, distributed as follows: *Summit County:* Henrys Fork, 8,000 ft., 1. *Daggett County:* Junction Deep and Carter creeks, 8,000 ft., 6. *Wasatch County:* Wolf Creek Summit, 1. *Uintah County:* Paradise Park, Uinta Mountains, 10,000 ft., 13; junction Trout Creek and Ashley Creek, 9,700 ft., 2; Vernal, 1 (M.V.Z.); P. R. Springs, 7,950 ft., 43 mi. S Ouray, Uintah-Grand County line, 8. *Sanpete County:* Maple Canyon, 1. *Carbon County:* Range Creek, 7,500 ft., 1. *Sevier County:* Fishlake, 8,730 ft., 1; Experiment Station, Fishlake National Forest, 8,000 ft., 1; 4 mi. E Mt. Alice, between Emery and Loa, 7,450 ft., 3. *Beaver County:* Britts Meadow, Beaver Range Mountains, 8,500 ft., 4 (M.V.Z.). *Wayne County:* Elkhorn G. S., 9,400 ft., 14 mi. N Torrey, Fishlake Plateau, 9. *Iron County:* Brian Head, 11,000 ft., 1. *Garfield County:* 18 mi. N Escalante, 6,500 ft., 1; head of Sevier River, S Hatch, 7,000 ft., 1; Bryce National Park, 8,200 ft., 1. *Kane County:* Duck Creek, Cedar Mountains, 9,000 ft., 1.

Additional records (Howell, 1938:194).—*Summit County:* Beaver Creek, 4 mi. S Lonetree, Wyoming; Gilbert Peak, 10,000 ft. *Daggett County:* Uinta Mountains; 10 mi. SE Manila. *Duchesne County:* Mount Delano; Petty Mountain, 15 mi. N Mountain Home; Currant Creek, Uinta National Forest. *Uintah County:* Whiterocks; junction of Green and White rivers. *Sanpete County:* Ephraim.

TABLE 7

Cranial Measurements of Citellus

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of upper molariform tooth-row
		Citellus townsendii mollis, St. Johns R. R. Station							
♂	577.....	38.0	12.8	23.0	17.0	8.1	11.0	17.7	8.8
♂	579.....	36.3	12.2	23.0	17.0	7.5	9.6	16.3	8.2
♀	578.....	37.3	12.8	24.6	.....	8.0	10.1	17.1	8.5
		Citellus beldingi crebrus, Standrod							
♂	7080....	44.2	15.1	28.4	20.0	8.6	11.5	21.8	10.3
♂	7127....	46.0	16.1	29.4	21.9	9.0	10.6	22.0	10.0
		Citellus armatus, Salt Lake City							
♂	5 av....	47.6	17.8	30.3	21.7	10.0	11.2	22.8	10.0
♂	Max....	50.0	18.1	31.2	22.0	10.2	11.7	23.8	10.6
♂	Min....	46.1	16.6	29.7	20.8	9.9	10.9	21.6	9.9
♀	5 av....	47.9	17.2	30.4	21.5	10.2	10.8	22.7	10.3
♀	Max....	48.5	18.3	31.2	22.0	10.8	11.3	23.4	10.8
♀	Min....	45.5	16.5	29.1	21.0	9.6	9.7	21.5	9.7
		Citellus tridecemlineatus parvus, 12 mi. SW Ouray							
♀	8764 CM	33.3	9.5	19.4	16.4	7.0	11.1	14.9	6.5
		Citellus spilosoma cryptospilotus, 6 adults, Painted Desert, Arizona (Howell, 1938: 130)							
	6 av....	36.2	12.5	21.0	.....	7.9	12.9	15.9	7.0
	Max....	36.8	13.5	22.4	.....	8.6	13.8	16.5	7.4
	Min....	35.1	11.7	20.9	.....	7.2	11.9	14.5	6.3
		Citellus variegatus utah, Salt Lake City							
♂	1094....	59.6	21.5	36.6	26.1	13.7	17.6	28.5	11.1
♂	1106....	61.0	21.0	37.8	26.8	14.7	17.6	29.2	11.5
♂	4139....	59.0	20.7	38.3	25.7	14.5	17.7	28.8	11.5
♀	1337....	61.5	21.5	37.5	25.5	14 6	17.3	30.1	12.1
♀	3012....	60.3	21.2	36.2	25.5	14.7	17.3	29.2	12.3
♀	2326....	57.2	20.3	35.5	24.9	12.6	17.1	27.8	11.8
		Citellus variegatus grammurus, ♂ Zion National Park; ♀ 18 mi. NE Moab							
♂	656.....	60.2	20.6	38.0	27.3	13.8	18.0	28.1	11.0
♀	970.....	59.0	20.4	37.6	24.7	13.8	18.3	28.2	11.5
		Citellus leucurus leucurus, Willow Springs							
♂	590.....	40.1	13.0	23.5	18.6	9.9	13.9	17.9	7.2
♂	589.....	37.0	10.5	20.9	17.5	8.8	13.2	16.4	6.5

TABLE 7.—*Concluded*

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of upper molariform tooth-row
		Citellus leucurus pennipes, ♂ Woodside; ♀ Sunnyside							
♂	528.....	37.5	11.1	.....	18.4	10.0	14.1	17.1	6.9
♀	1415....	37.5	11.0	21.0	18.4	9.6	14.2	17.2	7.1
		Citellus leucurus cinnamomeus, ♂ 19 mi. S Moab; ♀ Castle Valley							
♂	2950....	40.1	13.0	23.6	18.3	10.0	13.7	18.5	7.5
♀	536.....	38.2	12.0	22.0	18.0	9.5	14.3	17.8	7.5
		Citellus lateralis trepidus, 7 adults, topotypes (Howell, 1938: 207)							
	7 av....	42.8	14.9	26.5	.....	9.5	12.2	19.8	8.4
	Max....	44.0	15.4	27.7	.....	9.8	14.0	20.2	9.3
	Min....	41.8	14.4	25.6	.....	9.1	11.4	19.0	8.1
		Citellus lateralis castanurus, topotypes							
♂	3438....	42.7	14.3	26.4	19.8	9.9	12.9	19.5	8.5
♂	3437....	41.0	14.1	25.2	19.0	9.0	12.7	18.4	8.4
		Citellus lateralis lateralis, 1424, Duck Creek; 1397, Brian Head							
♀	1424....	43.8	14.7	27.8	19.2	10.8	12.7	20.1	8.5
♀	1397....	44.1	15.1	26.8	19.0	10.5	12.9	19.9	8.6

Eutamias minimus consobrinus (Allen)

Least Chipmunk

Tamias minimus consobrinus Allen, Bull. American Mus. Nat. Hist., 3:112, June, 1890, type from "near" Barclay, Parleys Canyon, Wasatch Mountains, Salt Lake County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):39, April, 1922.

Eutamias minimus consobrinus, Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:42, December 27, 1901; Warren, The Mammals of Colorado, Knickerbocker Press, p. 179, 1910; Howell, Journ. Mamm., 3:183, August 4, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):92, June, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Howell, N. Amer. Fauna, 52:46, November 30, 1929; Svihla, Journ. Mamm., 12:261, August 24, 1931; Stanford, Journ. Mamm., 12:359, November 11, 1931; Presnall, Zion-Bryce Mus. Bull., 2:12, January, 1938; Long, Journ. Mamm., 21:175, May 16, 1940; Tanner, Great Basin Nat., 1:112, June 30, 1940; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 146, 1942; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Eutamias lectus Allen, Sci. Bull. Brooklyn Inst. Arts and Sci., 1:117, March 31, 1905, type from Beaver Valley, Beaver County, Utah.

Tamias lectus, Barnes, Bull. Univ. Utah, 12 (no. 15):41, April, 1922.

Range.—The central north-south mountain ranges and the Uinta Mountains.

Description and comments.—Average and extreme measurements of 6 males and 4 females from Rich County are, respectively, as follows: Total length, 184 (190-178), 185 (190-182); length of tail, 82 (85-76), 80 (82-74); length

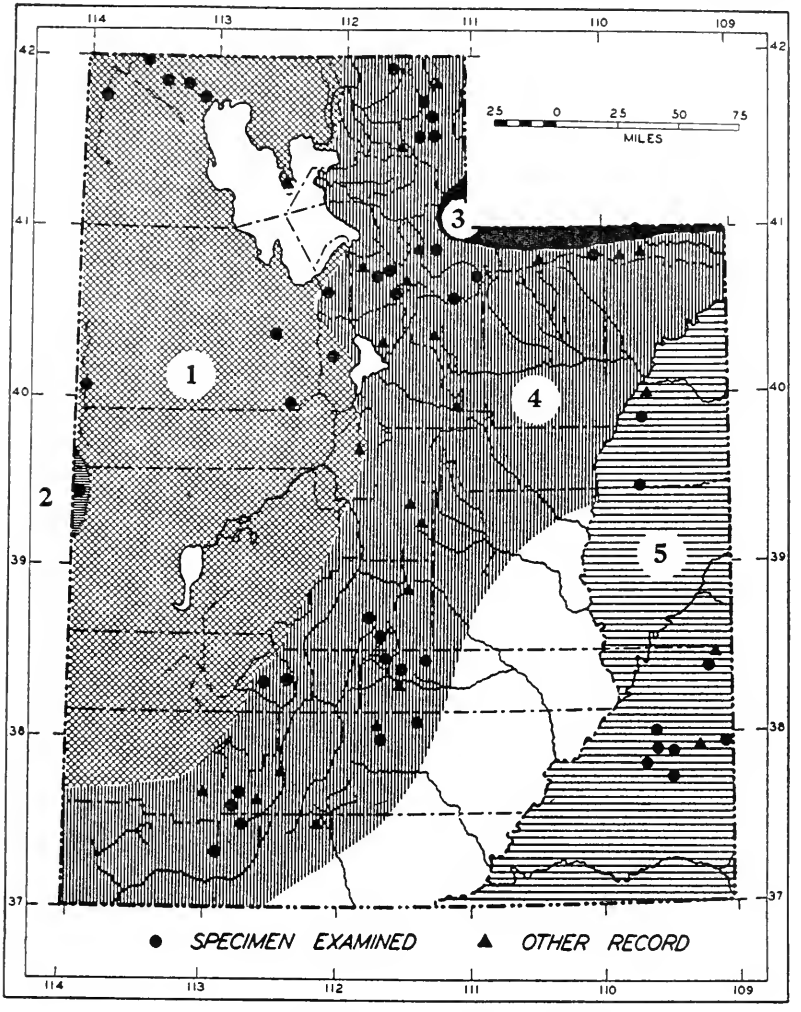

FIG. 33. Distribution of *Eutamias minimus.*

Guide to subspecies
1. *E. m. pictus.*
2. *E. m. scrutator.*
3. *E. m. minimus.*
4. *E. m. consobrinus.*
5. *E. m. operarius.*

of hind foot, 30 (31-28), 30 (31-29); length of ear, 14 (16-13), 15 (16-15). Color (Summer pelage): Median dorsal stripe long, extending foreward in most specimens to between ears, black, bordered with Tawny; medial pair of dark dorsal stripes colored like median stripe except for greater admixture of

Tawny; lateral pair of dark dorsal stripes wide, short and black, with heavy suffusion of Tawny; medial pair of light dorsal stripes grayish white, with slight admixture of Tawny; lateral pair of light dorsal stripes white; postauricular patches small and grayish; top of head mixed Smoke Gray and Tawny, or Ochraceous-Tawny; dark facial stripes Fuscous-Black or Fuscous, with admixture of Tawny in some specimens; light facial stripes white; rump and thighs Smoke Gray with wash of Cinnamon-Buff; front and hind feet Pinkish Cinnamon, or Pinkish Buff; sides and flanks vary from Ochraceous-Tawny to nearly Sayal Brown; dorsal surface of tail Fuscous to Fuscous-Black, hairs tipped with Cinnamon-Buff; underparts pale grayish white and tinged with Pale Pinkish Buff, which usually is most intense in midventral region; under parts of tail Tawny, edged subterminally by Fuscous-Black and terminally by Cinnamon-Buff. Winter Pelage: Less contrasted, more gray. Skull: Small, delicate, similar in general appearance to that of *Eutamias minimus minimus,* but averaging slightly larger.

Near topotypes of *E. m. consobrinus* from several localities in the northern part of the Wasatch Mountains differ from specimens of *Eutamias minimus operarius* from Utah as follows: Size smaller, except ears which averaged longer. Color: Similar, but in most specimens slightly darker above owing to greater amount of black in dorsal stripes; sides less Tawny; tail narrower and lighter on under surface. Skull: Smaller in all measurements taken.

From near topotypes of *Eutamias minimus pictus,* the specimens mentioned above of *E. m. consobrinus* differ in: Size slightly larger in most external measurements. Color: Markedly darker above, less gray in upper parts; sides and flanks more Tawny; front and hind feet darker; underparts more buffy; upper surface of tail lighter because of lighter tipped hairs; under surface of tail darker (Tawny as opposed to Light Pinkish Cinnamon). Skull: Larger in nearly every measurement taken.

From topotypes of *Eutamias minimus scrutator, E. m. consobrinus* differs in being darker throughout, and in having the braincase more inflated and less flattened in fronto-parietal region. For comparison of *E. m. consobrinus* with *Eutamias minimus minimus,* see account of that subspecies.

Animals from marginal localities intergrade with adjacent subspecies. Specimens referred to *E. m. consobrinus,* from Woodruff Park, 14 miles west of Woodruff, are intergrades with *E. m. minimus,* whereas the intergrades from the north side of the Uinta Mountains are referred to *E. m. minimus* (see account of *E. m. minimus*). Slight intergradational tendencies with *E. m. pictus* are noted in specimens from the Onaqui Mountains, Tooele County. Intergradation is chiefly that of color which while being more nearly more like that in *E. m. pictus* shows darkening toward that of

E. m. consobrinus. The cranial features are like those of *E. m. pictus* to which these animals are referred.

Specimens examined.—Total, 88, distributed as follows: *Cache County:* 12 mi. W Garden City, 1 (M.V.Z.). *Rich County:* Between Laketown and Blacksmith Fork, 8,000 ft., 2; 8 mi. W Randolph, 1 (M.V.Z.); Woodruff Park, 14 mi. W Woodruff, 8,000 ft., 5; Monte Cristo, 8 mi. W Woodruff, 8,000 ft., 2. *Salt Lake County:* Emigration Canyon, 5 mi. above mouth, 5,345 ft., 1; Emigration Canyon, 8 mi. above mouth, 6,000 ft., 2; Wasatch foothills, 24 mi. E Salt Lake City, 20 (M.V.Z.); Lake Catherine, Brighton, Big Cottonwood Canyon, 10,000 ft., 2; Silver Lake P. O. Brighton, 8,750 ft., 2; 2 mi. above Alta, 9,500 ft., 1; Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 8,000 ft., 7. *Summit County:* Chalk Creek, E Coalville, 1; SW slope Bald Peak, Uinta Mountains, 10,500 ft., 4 (M.V.Z.); Hoop Lake, 8,000 ft., Ashley National Forest, Dagget [Summit] Co., 1; ½ mi. E Woodland, 5,200 ft., 1. *Sevier County:* 10 mi. SE Sigurd, 1 (M.V.Z.); Fishlake, 8,730 ft., 1. *Beaver County:* Beaver, 6,000 ft., 1 (M.V.Z.); Britts Meadow, 8,500 ft., Beaver Mountain Range, 5 (M.V.Z.). *Wayne County:* Elkhorn G. S., 14 mi. N Torrey, Fishlake Plateau, 9,400 ft., 3; Neff's Ranch, Horse Valley, Lyman, 1. *Iron County:* Brian Head, 11,000 ft., 1 (M.V.Z.); Lower Bear Valley, 7,300 ft., 10 (M.V.Z.). *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 4; 18 mi. N. Escalante, 9,500 ft., 1. *Washington County:* E Rim, just outside Zion National Park Boundary, 6,500 ft., 4. *Kane County:* Duck Creek Ranger Station, 22 mi. SE Cedar City, 8,554 ft., 3.

Additional records (Howell, 1929:48), unless otherwise indicated.—*Cache County:* Blacksmith Creek. *Rich County:* Laketown. *Salt Lake County:* Salt Lake City; 18 mi. E Salt Lake City. *Summit County:* Uinta Mountains, S Fort Bridger, Wyo.; Coalville; Park City. *Daggett County* (Svihla, 1931:261): Nipple, Beaver Creek; Summit Springs. *Utah County:* Mt. Timpanogos (Tanner, 1927:251); near Soldier Summit. *Wasatch County:* Currant Creek. *Uintah County:* Uncompahgre Indian Reservation. *Sanpete County:* Baldy Ranger Station; Ephraim. *Sevier County:* Head Salina Canyon (Stanford, 1931:359). *Wayne County:* Thurber. *Iron County:* Cedar City (Long, 1940:175). *Garfield County:* Panguitch Lake; Panguitch. *Kane County:* Bryce National Park (Presnall, 1938:12).

Eutamias minimus minimus (Bachman)

Least Chipmunk

Tamias minimus Bachman, Journ. Acad. Nat. Sci. Philadelphia, 8:71, 1839, type from Green River, "near" mouth of Big Sandy Creek, Sweetwater County, Wyoming.

Eutamias minimus, Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:42, December 27, 1901; Warren, The mammals of Colorado, Knickerbocker Pres, p. 177, 1910.

Eutamias minimus minimus, Svihla, Journ. Mamm., 12:260, August 24, 1931.

Range.—Northeastern Utah, on the north slopes of the Uinta Mountains.

Description and comments.—Average and extreme measurements of 8 males from Henrys Fork are as follows: Total length, 183 (190-170); length of tail, 82 (92-72); length of hind foot, 30 (32-27); length of ear, 14 (16-12). Color (Summer pelage): Median dorsal stripe narrow, black, bordered with Sayal Brown; medial pair of dark dorsal stripes Sayal Brown, with admixture of Fuscous; lateral pair of dark dorsal stripes usually a trifle shorter and Fuscous in color; medial pair of light dorsal stripes, grayish white, mixed with Light Buff; lateral pair of light dorsal stripes nearly pure white, slightly mixed with gray; postauricular patches and posterior lateral part of ear, grayish white; top of head and occiput Avellaneous, with admixture of grayish white and

Pinkish Buff; dark facial stripes (3 in number) Snuff Brown; supraorbital and suborbital light facial stripes, white; ears Drab, washed with Pinkish Cinnamon; thighs and rump Smoke Gray washed with Light Buff; sides and flanks Pinkish Cinnamon or Pinkish Buff; front and hind feet Pale Pinkish Buff; dorsal surface of tail Fuscous-Black, hairs tipped with Cinnamon-Buff; underparts creamy white, with wash of Pale Pinkish Buff, especially in axillary and inguinal regions; ventral surface of tail Sayal Brown or Clay Color, bordered subterminally by black and terminally by Cinnamon-Buff. Winter pelage resembles summer pelage, except that upper parts more grayish. Skull: Small, delicate; braincase rounded and well inflated; zygomatic arches weak and not widely spreading, nearly paralleling sides of skull; nasals short; tympanic bullae well inflated.

Compared to near topotypes of *Eutamias minimus consobrinus*, *E. m. minimus* differs as follows: Dark dorsal stripes lighter, and narrower; dark facial stripes, sides and flanks lighter. Skull: Shorter; breadth of braincase with reference to occipitonasal length relatively greater.

Compared to near topotypes of *Eutamias minimus pictus*, *E. m. minimus* differs as follows: Color: Upper parts darker, less gray on rump and thighs; tail darker on ventral surface, but less blackish on dorsal surface. Skull: Foramen magnum circular as opposed to roughly ovoid, owing to concavity on dorsal border in *E. m. pictus*.

Compared to *Eutamias minimus operarius* from southeastern Utah, *E. m. minimus* differs in: Size smaller in every measurement taken. Color: Markedly lighter on upper parts; sides and flanks less rufescent; dark dorsal stripes narrower; dorsal surface of tail more grayish, less rufescent, owing to lighter tips on hairs; ventral surface of tail lighter. Skull: Markedly smaller in every measurement taken.

In comparison with topotypes of *Eutamias minimus scrutator*, *E. m. minimus* differs in size and color in the same manner as it does from *E. m. pictus*. The skull is smaller and more convex dorsally; the braincase is more inflated; less flattened in frontoparietal region and the interlacrimal breadth is less.

The first definite report of the occurrence of *E. m. minimus* in Utah was that of Svihla (1931:260), based on 4 specimens from Henrys Fork at Linwood, and one from north of Linwood, Daggett County. Howell, in his revision of the genus (1929:38) listed no specimens of *E. m. minimus* from Utah, but did refer animals from Wyoming, from 4 miles north of Linwood and from Henrys Fork, 5 miles west of Lone Tree (both localities just north of the Utah-Wyoming border), to *E. m. minimus*. Howell noted that intergradation between *E. m. minimus* and *E. m. consobrinus* occurred in animals from this area. The specimens available for my study

are all from Henrys Fork, 8,000 feet, Summit County, Utah, and although taken higher on the north slopes of the Uinta Mountains, than were the animals reported upon by Howell (*loc. cit.*), are likewise intergrades between *E. m. minimus* and *E. m. consobrinus*. They resemble *E. m. consobrinus* in the color of the dark dorsal stripes, which, however, are narrower as in *E. m. minimus*. The color of the rump and thighs is as in *E. m. minimus*. Intergradation is only slightly indicated in the skulls which are nearly typical of *E. m. minimus*. The majority of the characters show these animals to be referable to *E. m. minimus*. Svihla (*loc. cit.*) also noted that the animals from Daggett County were intergrades between the two aforementioned subspecies, and referred them to *E. m. minimus*. The evidence indicates that no animals typical of *E. m. minimus* occur in the state, and that the chipmunks of the species *E. minimus* from the north slopes of the Uinta Mountains, in Summit and Daggett counties, are intergrades referable to *E. m. minimus*.

Specimens examined.—Total, 8, from Henrys Fork, 8,000 ft., Summit County.

Additional records (Svihla, 1931:260).—*Daggett County:* Henrys Fork, at Linwood; "just" north of Linwood.

Eutamias minimus pictus (Allen)

Least Chipmunk

Tamias minimus pictus Allen, Bull. American Mus. Nat. Hist., 3:115, June, 1890, type from Kelton, Boxelder County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):40, April, 1922.

Eutamias minimus pictus, Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:42, December 27, 1901; Barnes, Bull. Univ. Utah, 17 (no. 12):91, June, 1927; Howell, N. Amer. Fauna, 52:39, November 30, 1929; Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Hall and Hatfield, Univ. California Publ. Zoöl., 40:321, February 12, 1934; Davis, The Recent mammals of Idaho, Caxton Printers, Caldwell, Idaho, p. 208, April 5, 1939.

Eutamias pictus, Merriam, Proc. Biol. Soc. Washington, 11:194, July 1, 1897.

Eutamias minimus consobrinus, Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Western Utah in area formerly occupied by Pleistocene Lake Bonneville.

Description and comments.—Average and extreme measurements of 5 males, and measurements of one female, number 3724, from Tooele and Boxelder counties are, respectively, as follows: Total length, 172 (182-140(?)), 191; length of tail, 77 (85-60(?)), 82; length of hind foot, 29 (31-27), 31; length of ear, 14 (14-14), 14. Color (Summer pelage): Median dorsal stripe long, blackish, bordered by Sayal Brown; medial pair of dark dorsal stripes wide, Snuff Brown and black; lateral pair of dark dorsal stripes Snuff Brown with slight admixture of black; medial pair of light dorsal stripes grayish white; lateral pair of light dorsal stripes white; postauricular patches small, indistinct posteriorly, grayish white (slightly buffy in some specimens, nearly pure white

in others); forepart of upper parts behind postauricular area grey, in some specimens this gray extending well onto sides in postaxillary region; rump and hind legs Smoke Gray; top of head Smoke Gray mixed with Light Pinkish Cinnamon; dark facial stripes Snuff Brown or Snuff Brown mixed with black; ocular stripe indistinct in preocular region; supraocular and subocular light stripes white, grading into gray in auricular region; dorsal surface of tail blackish brown, hairs thereon tipped with Pinkish Buff; sides and flanks Light Pinkish Cinnamon; entire underparts nearly white with wash of Light Buff in axillary and perineal regions; front and hind feet Pale Pinkish Buff; ventral surface of tail Pinkish Buff bordered subterminally by black and terminally by Pale Pinkish Buff. Winter pelage: Duller, more gray. Skull: Small, delicate, like that of *Eutamias minimus minimus*, but braincase deeper and forearm magnum more ovoid.

In Utah, the subspecies morphologically most like *E. m. pictus* is *Eutamias minimus scrutator*. In cursory examination many individuals of the two subspecies are indistinguishable from each other. Critical comparison of topotypes, however, shows *E. m. pictus* to differ from *E. m. scrutator* as follows: Tail longer. Color: Lighter on upper parts and gray on upper parts more extensive; dark stripes on face lighter; medial pair of dark dorsal stripes narrower and lighter (Snuff Brown as opposed to Mikado Brown); sides lighter, color not extending onto sides of neck; tail lighter above and not so bright buff below; feet lighter. Skull: Similar, but generally smaller; narrower across lacrimals; postorbital depth of braincase greater.

For comparisons with *Eutamias minimus minimus, Eutamias minimus consobrinus* and *Eutamias minimus operarius*, see accounts of those subspecies.

In his revision of the American chipmunks, Howell (1929:37) ascribed the second largest range of any subspecies of *Eutamias minimus* to *E. m. pictus*. Howell further commented on the small amount of variation exhibited by the animals over this entire geographic region. Hall and Hatfield (1934:321) named *Eutamias minimus scrutator* from Mono County, California, and furthermore ascribed the major part of the range formerly thought to belong to *E. m. pictus* to *E. m. scrutator*. As a result, the range of *E. m. pictus* as known at present, extends from south central Idaho southward to include the area formerly occupied by the Pleistocene Lake Bonneville.

Intergradation is noted in Utah between *E. m. pictus* and *E. m. scrutator* in 2 specimens from Ibapah, Tooele County. Even though this locality is but a short distance from the type locality of *E. m. pictus* the following characters of *E. m. scrutator* are present in these 2 animals: brighter color of the sides; wider medial dark

dorsal stripes; wider interlacrimal region. Most of the characters, including, especially, the dorsal outline of the skull, are more like those in *E. m. pictus*, to which the specimens are here referred. Howell (1929:40) states that specimens from Fairfield and Nephi approach *E. m. consobrinus*. Additional comments on intergradation with *E. m. consobrinus* are made in the account of that subspecies.

Specimens examined.—Total, 34, distributed as follows: *Boxelder County:* 3 mi. NW Yost, 5,700 ft., Raft River Mountains, 1; George Creek rd. junction, 5 mi. SE Yost, Raft River Mountains, 5; Pine Canyon, 6,600 ft., 17 mi. NW Kelton, Raft River Mountains, 2 (1, M.V.Z.); Grouse Creek, 1; Kelton, 4,225 ft., 20 (M.V.Z.). *Tooele County:* Clover Creek, Onaqui Mountains, 5,500 ft., 2; Little Valley, Sheeeprock Mountains, 5,500 ft., 1; Ibapah, 5,000 ft., 2.

Additional records (Howell, 1929:41).—*Boxelder County:* Promontory. *Utah County:* Fairfield (*ibid.*:48). *Juab County:* Nephi.

Eutamias minimus scrutator Hall and Hatfield

Least Chipmunk

Eutamias minimus scrutator Hall and Hatfield, Univ. California Publ. Zoöl., 40:321, February 12, 1934, type from "near" Blanco Mountain, White Mountains, 10,500 ft., Mono County, California; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938.

Range.—Extreme western Utah, limits unknown.

Description and comments.—Measurements of 2 females, numbers 27345 M.V.Z. and 27355 M.V.Z. and of one male, number 27353 M.V.Z., from the type locality are, respectively, as follows: Total length, 185, 177, 175; length of tail, 77, 73, 77; length of hind foot, 28.5, 28.5, 29; length of ear, 10, 9, 10. Color (Summer pelage): Median dorsal stripe Fuscous-Black, bordered with Tawny; medial pair of dark dorsal stripes wide and similar in color to medial stripe, but with greater admixture of Tawny and Sayal Brown; lateral pair of dark dorsal stripes Sayal Brown mixed with Fuscous; medial pair of light dorsal stripes grayish white; lateral pair of light dorsal stripes white, with gray wash in some specimens; top of head Smoke Gray mixed with Cinnamon and Fuscous; dark facial stripes Mikado Brown; ocular stripe nearly Fuscous-Black; light facial stripes white; ears Fuscous; postauricular patches small and buffy white; thighs and rump Smoke Gray; front and hind feet Cinnamon-Buff; dorsal surface of tail Fuscous-Black overlaid with Warm Buff; sides and flanks Ochraceous-Tawny; entire underparts white or creamy white; ventral surface of tail Isabella Color, bordered subterminally by black and terminally by Warm Buff. Skull: Flattened, depth averaging less than 55 per cent of zygomatic breadth; zygomatic process of squamosal arises abruptly from skull; rostrum broad.

For comparisons of *E. m. scrutator* with other subspecies of *Eutamias minimus* known to occur in Utah, see accounts of those subspecies.

The only known record of occurrence of this animal in Utah is a single specimen from 4 miles south of Gandy, Millard County (Hall

and Johnson, 1938:121). I have examined this specimen and agree with the identification, although it is lighter colored than topotypes of *E. m. scrutator* and in this respect is an intergrade with *E. m. pictus.*

Specimens examined.—1, as noted above.

Eutamias minimus operarius Merriam

Least Chipmunk

Eutamias amoenus operarius Merriam, Proc. Biol. Soc. Washington, 18:164, June 29, 1905, type from Gold Hill, Boulder County, Colorado; Cary, N. Amer. Fauna, 33:76, August 17, 1911; Barnes, Bull. Univ. Utah, 12 (no. 15):40, April, 1922.

Eutamias minimus operarius, Howell, Journ. Mamm., 3:183, August 4, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):93, June, 1927; Howell, N. Amer. Fauna, 52:48, November 30, 1929.

Range.—Eastern Utah, east of the Colorado and Green rivers.

Description and comments.—Average and extreme measurements of 5 females from San Juan County are as follows: Total length, 196 (202-190); length of tail, 82 (90-77); length of hind foot, 29 (30-27); length of ear, 13 (14-12). Color (Summer pelage): Median dorsal stripe wide, extending to occiput, black, bordered with Tawny; medial pair of dark dorsal stripes wide and mixed black and Tawny, tawny color being most marked in anterior parts of stripes; lateral pair of dark dorsal stripes like medial pair except for greater amount of Tawny, anteriorly these stripes fading into sides; medial pair of light dorsal stripes grayish white, with slight admixture of Tawny; lateral pair of light dorsal stripes white; top of head mixed Smoke Gray, Fuscous and Tawny; dark facial stripes Fuscous or Fuscous-Black mixed with Ochraceous-Tawny; supraorbital and suborbital light stripes white or buffy white; sides and flanks Tawny to Ochraceous-Tawny (paling to Pale Pinkish Buff on cheeks in some specimens); rump and thighs Smoke Gray; front and hind feet Light Pinkish Cinnamon; upper surface of tail Fuscous-Black mixed with Clay Color, hairs tipped with either Clay Color or Pale Pinkish Buff; entire underparts grayish white, washed with pale buff; under surface of tail Sayal Brown or Ochraceous-Tawny, edged subterminally by Fuscous-Black and terminally by Clay Color or Pale Pinkish Buff. Winter pelage similar but with less contrast in color. Skull: Largest of all members of the species *Eutamias minimus* found in Utah.

From near topotypes of *Eutamias minimus pictus, E. m. operarius* differs in larger size including skull, in all measurements taken, and in markedly darker color throughout, excepting lateral pair of light dorsal stripes and ventral surface of body which are nearly the same in both subspecies. Utah-taken specimens of *E. m. operarius* differ from topotypes of *Eutamias minimus scrutator* in much the same manner that *E. m. operarius* differs from *E. m. pictus.* The difference in dorsal coloration is less since *E. m. scrutator* is darker than *E. m. pictus,* but still markedly lighter than

E. m. operarius. For comparisons with *Eutamias minimus minimus* and *Eutamias m. consobrinus*, see accounts of those subspecies.

In Utah, *E. m. operarius* is restricted to the area east of the Colorado and Green rivers. These rivers are an effective barrier to dispersal as they are also to other kinds of mammals such as *Citellus spilosoma crytospilotus* and *Cynomys gunnisoni zuniensis.* Specimens of *E. m. operarius* from Utah agree with those from La Plata and Montezuma counties, Colorado, to the eastward.

Specimens examined.—Total, 74, distributed as follows: *Uintah County:* Brown's Corral, 20 mi. S Ouray, 6,250 ft., 3; P. R. Springs, 43 mi. S Ouray, Uintah-Grand County line, 7,950 ft., 3. *San Juan County:* 1 mi. E Geyser Pass, 9,700 ft., La Sal Mountains, 2; Quaking Aspen, La Sal Mountains, 1 mi. SE Mesa R. S., 9,200 ft., 12; 5 mi. NE La Sal P. O., 8,000 ft., 3; Jackson Camp, 8,600 ft., 21 mi. N Blanding, Abajo Mountains, 10; 8 mi. W Monticello, 9,200 ft., Abajo Mountains, 1; Dalton Spring, 5 mi. W Monticello, 8,300 ft., Abajo Mountains, 2; 1 mi. W Baker R. S., 7,000 ft., 2; Monticello, 1; Snyder's Pond, 22 miles (air) ENE Monticello, 6,650 ft., 1; Gooseberry R. S., 8,300 ft., Elk Ridge, 8; 14 mi. N Blanding, Johnson Creek, 7,500 ft., 3; 18½ mi. E Monticello, 6,720 ft., 17; 8 mi. N Blanding, 6,000 ft., 2; Devil Canyon, 14 mi. S Monticello, 6,800 ft., 1; Blanding, 3.

Additional records (Howell, 1929:48, 51).—*Uintah County:* Uncompahgre Indian Reservation. *San Juan County:* Monticello; La Sal Mountains, 11,000 ft.

Eutamias amoenus amoenus (Allen)

Yellow-pine Chipmunk

Tamias amoenus Allen, Bull. American Mus. Nat. Hist., 3:90, June, 1890, type from Fort Klamath, Klamath County, Oregon.

E[utamias]. amoenus, Merriam, Proc. Biol. Soc. Washington, 11:191, July 1, 1897.

Eutamias amoenus amoenus, Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931.

Range.—Known only from Raft River Mountains in northwest corner of the state.

Description and comments.—Average and extreme measurements of 4 males and measurements of 2 females, numbers 44831 M. V. Z. and 44832 M. V. Z., from Boxelder County are, respectively, as follows: Total length, 201 (205-194), 202, 203; length of tail, 89.5 (94-86), 94, 85; length of hind foot, 30.5 (31.0-30.0), 30.0, 31.0; length of ear, 11 (12-10), 12, 10. Color (Summer pelage): Median dorsal stripe long, extending forward to between ears, black, bordered by Ochraceous-Tawny; medial pair of dark dorsal stripes wide, colored like medial stripe, but with greater admixture of Ochraceous-Tawny; lateral pair of dark dorsal stripes, markedly reduced, color a mixture of black and Ochraceous-Tawny; medial pair of light dorsal stripes Pale Smoke Gray; lateral pair of light dorsal stripes white; top of head Smoke Gray mixed with Cinnamon; dark facial stripes Fuscous, ocular one darkest, being nearly Fuscous-Black; light facial stripes white; postauricular patches buffy white; ears Fuscous anteriorly, buffy white posteriorly; rump and thighs Smoke Gray, washed with Cinnamon-Buff; front and hind feet Light Pinkish Cinnamon; sides and flanks uniformly Ochraceous-Tawny or Tawny; dorsal

surface of tail Fuscous-Black overlaid with Clay Color; entire underparts creamy white washed with Light Buff; ventral surface of tail Sayal Brown bordered subterminally by Fuscous-Black and terminally by Clay Color. Skull: Large; nasals long; rostrum long and narrow.

Of the small chipmunks of Utah, *E. a. amoenus* most closely resembles *Eutamias minimus operarius,* but differs from it as follows: Tail longer and narrower; hind foot longer; sides more Tawny; underparts more buffy; dorsal surface of tail darker; ventral surface of tail lighter; and skull, larger in all measurements taken.

The first record of occurrence of this animal in Utah was that of Hall (1931:3), from the Raft River Mountains in the northwestern part of the state. In these mountains there are two full species of small chipmunks, *Eutamias minimus pictus* and *Eutamias amoenus amoenus; E. m. pictus* inhabits the foothills and valley floor, and *E. a. amoenus* is restricted to the higher elevations of these mountains.

Specimens examined.—Total, 11, distributed as follows: S Fork George Creek, 5 mi. SE Yost, Raft River Mountains, 7,000 ft., 4; Clear Creek, N slope Raft River Mountains, 6,500 ft., 5 mi. SW Nafton, 1; Pine Canyon, Raft River Mountains, 17 mi. NW Kelton, 6,600 ft., 6 (M. V. Z.).

Eutamias quadrivittatus umbrinus (Allen)

Say Chipmunk

Tamias umbrinus Allen, Bull. American Mus. Nat. Hist., 3:96, June, 1890, type from Blacks Fork, Uinta Mountains, 9,500 ft., Summit County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):38, April, 1922.

Eutamias quadrivittatus umbrinus, Hayward, Great Basin Nat., 6:62, November 15, 1945.

Tamias quadrivittatus, Merriam, Mammals in F. V. Hayden's sixth annual report of the Geological survey of the Territories embracing portions of Montana, Idaho, Wyoming and Utah, p. 663, 1873; Allen, Bull. Essex Inst., 6:66, 1874; Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:117, 1875.

Eutamias umbrinus, Barnes, Bull. Univ. Utah, 17 (no. 12):95, June, 1927; Howell, N. Amer. Fauna, 52:94, November 30, 1929; Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931; Svihla, Journ. Mamm., 12:261, August 24, 1931; Stanford, Journ. Mamm., 12:359, November 11, 1931.

Range.—Uinta and Wasatch mountains.

Description and comments.—Average and extreme measurements of 6 males and measurements of 2 females, numbers 1233 and 1234, from Henrys Fork are, respectively, as follows: Total length, 216 (243-195), 224, 205; length of tail, 91 (103-83), 94, 98; length of hind foot, 34 (35-32), 34, 35; length of ear, 17 (19-15), 18, 18. Color (Summer pelage): Median dark dorsal stripe long, extending forward between ears, black, edged with Sayal Brown; medial pair of dark dorsal stripes broad, Fuscous-Black or black, mixed with Sayal Brown; lateral pair of dark dorsal stripes nearly obliterated, Fuscous or Sayal

Brown; median pair of light dorsal stripes grayish white, mixed with Sayal Brown; lateral pair of light dorsal stripes white; postauricular patches grayish white; top of head Pale Smoke Gray mixed with Fuscous and Cinnamon; supraocular dark facial stripe Fuscous (Bister in some specimens); ocular

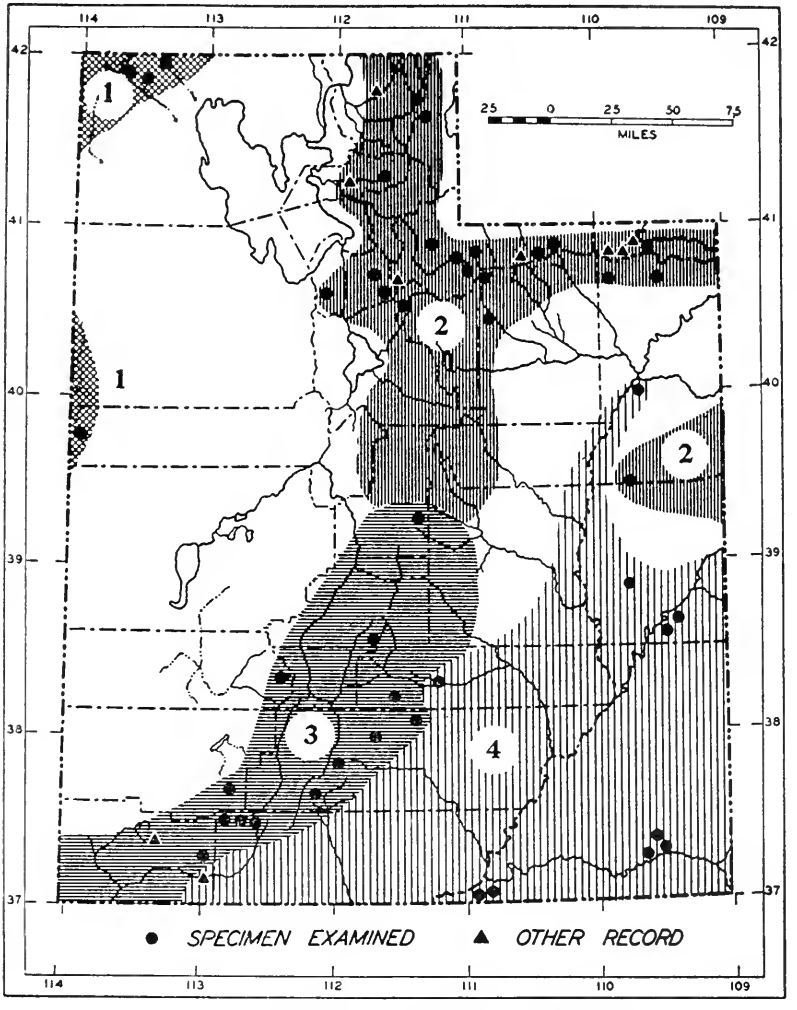

FIG. 34. Distribution of *Eutamias quadrivittatus.*

1. *E. q. inyoensis.*
2. *E. q. umbrinus.*
3. *E. q. adsitus.*
4. *E. q. hopiensis*

stripe a trifle darker than supraocular; submalar stripe Snuff Brown or Bister; light facial stripes white; ears Fuscous-Black anteriorly, posterior margin white; rump and thighs Smoke Gray washed with Sayal Brown; front and hind feet Pinkish Buff; dorsal surface of tail Fuscous or Fuscous-Black mixed

with Sayal Brown or Tawny and tipped with Cinnamon-Buff or Pinkish Buff; sides and flanks Sayal Brown mixed with Clay Color and Cinnamon; entire underparts white; ventral surface of tail Ochraceous-Tawny or Sayal Brown, edged subterminally by Fuscous-Black and terminally by Pinkish Buff or Cinnamon-Buff. Winter pelage similar, but duller. Skull: Large; braincase well inflated; zygomatic arches widely spreading.

Topotypes of *E. q. umbrinus* can be readily distinguished from *Eutamias quadrivittatus hopiensis* by color characters alone, being dark dorsally as opposed to light tawny.

Among named subspecies in Utah, *E. q. umbrinus* most closely resembles *Eutamias quadrivittatus adsitus*. *E. q. umbrinus* can be distinguished from *E. q. adsitus* by dorsal coloration lighter (less black, more brown in dorsal stripes); tail longer; under surface of tail darker; dorsal surface of tail lighter; sides less Tawny. Skull: Similar, but slightly smaller.

For comparison with *Eutamias quadrivittatus inyoensis*, see account of that subspecies.

Howell (1929:95) stated that *E. q. umbrinus* was clearly a member of the *E. quadrivittatus* group, but felt that since no intergrades were known it was best to consider *E. umbrinus* as a distinct species. In the same paper, he stated that *Eutamias adsitus* from southern Utah was clearly related to *E. umbrinus*. Hardy (1945b:87) reduced *E. adsitus* to a subspecies of *E. quadrivittatus* (see remarks under *E. q. adsitus*). Hayward (1945:110) used the name combination *Eutamias quadrivittatus umbrinus* for animals from Mount Timpanogos without explanation. The specimens available for the study here reported on do not markedly change the range of *E. q. umbrinus* known to Howell. None of these animals is an intergrade, but I am of the opinion that when specimens are collected in the intervening areas, intergradation between *E. q. umbrinus* and *E. q. adsitus* will be shown to exist. Critical studies of all of the larger chipmunks of Utah indicate close relationship, and in some forms intergradation is known to exist. I have been unable to find any characters in the available specimens of *E. q. umbrinus* which could be considered sufficiently distinctive to retain it as a full species. Cranial differences are difficult to demonstrate and when present are limited to a few small, quantitative characters. The chief diagnostic characters of *E. q. umbrinus* are largely those of color.

Specimens examined.—Total, 62, distributed as follows: *Rich County:* Between Laketown and Blacksmith Fork, 8,000 ft., 3; Monte Cristo, 18 mi. W Woodruff, 8,000 ft., 2. *Weber County:* South Fork Ogden River, 18 mi. E Ogden, 1 (M.V.Z.). *Salt Lake County:* Emigration Canyon, 1 mi. above mouth, 6,000 ft., 1; Salamander Lake, Lambs Canyon, 9,000 ft., 1; Head

Lambs Canyon, 9,000 ft., 2; "near" Cardiff Mine, Big Cottonwood Canyon, 1; Silver Lake P.O. (Brighton), 9,000 ft., 4; Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 8,000 ft., 3. *Summit County:* Chalk Creek, E Coalville, 2; Henrys Fork, 8,300 ft., 11; SW Slope Bald Peak, Uinta Mountains, 10,500 ft., 5 (M.V.Z.); 3 mi. SW Bridger Lake, 9,000 ft., 1 (M.V.Z.); Smith and Morehouse Creek, 2; Weber Canyon, 18 mi. NE Oakley, 6,800 ft., 1. *Daggett County:* Junction Deep and Carter creeks, 7,900 ft., 2. *Wasatch County:* Snake Creek Canyon, 3 mi. NW Midway, 6,000 ft., 1. *Duchesne County:* Mirror Lake, 10,000 ft., 8; Stockmore, 4. *Uintah County:* Paradise Park, 10,000 ft., Uinta Mountains, 5; Iron Springs, 9,000 ft., Uinta Mountains, 1; P. R. Springs, 43 mi. S Ouray, Uintah-Grand County line, 7,950 ft., 1.

Additional records (Howell, 1929:95, unless otherwise indicated).—*Cache County:* Spring Hollow, Logan Canyon (Stanford, 1931:359). *Weber County:* Wasatch Mountains, "near" Ogden. *Summit County:* Uinta Mountains, S of Fort Bridger, Wyo.; Park City. *Daggett County* (Svihla, 1931:261): Sheep Creek; W of Summit Springs; Beaver Creek; Granite Park; Beaver Dams, 10,500 ft.; Nipple.

Eutamias quadrivittatus inyoensis Merriam

Say Chipmunk

Eutamias speciosus inyoensis Merriam, Proc. Biol. Soc. Washington, 11:202, July 1, 1897, type from (about 9,000 ft., at southern end, "near" head of Black Canyon, *fide* Grinnell, Univ. California Publ. Zoöl., 40:129, September 26, 1933), Inyo County, California.

Eutamias quadrivittatus inyoensis, Howell, N. Amer. Fauna, 52:84, November 30, 1929.

Range.—Extreme western Utah in the Deep Creek and Raft River Mountains.

Description and comments.—Measurements of 3 males, numbers 3757, 3759 and 3770, and average and extreme measurements of 4 females, from Deep Creek Mountains are, respectively, as follows: Total length, 200, 204, 218, 210 (220-201); length of tail, 83, 87, 95, 87 (95-76); length of hind foot, 31, 32, 34, 33 (34-31); length of ear, 19, 18, 17, 17 (19-14). Color (Winter pelage): Median stripe long, extending forward to between ears and backward well onto rump, black, bordered with Verona Brown or Sayal Brown; medial pair of dark dorsal stripes heavily suffused anteriorly with Verona Brown; lateral pair of dark dorsal stripes nearly obsolete; medial pair of light dorsal stripes grayish white; lateral pair of light dorsal stripes white; top of head Smoke Gray; dark facial stripes Verona Brown; ocular stripe dark brown or black in front and behind eye, remainder Verona Brown; light facial stripes grayish white or white; postauricular patches grayish white (buffy white in some specimens); rump and thighs Smoke Gray; front and hind feet with wash of Pinkish Buff; dorsal surface of tail blackish overlaid with Pale Buff or Warm Buff; sides and flanks washed with Verona Brown; ventral surface of tail Ochraceous-Tawny bordered subterminally by black and terminally by same color as dorsal edgings. Skull: Large and well arched dorsally; nasals long and extending posteriorly beyond premaxillae; upper incisors long and only slightly recurved.

From *Eutamias quadrivittatus hopiensis, E. q. inyoensis* differs in markedly darker dorsal coloration, longer skull, longer palate and longer incisors.

From *Eutamias quadrivittatus umbrinus, E. q. inyoensis* differs in generally lighter color, longer nasals, wider zygomatic breadth, narrower interorbital breadth and shorter palatilar length.

Among named subspecies of *E. quadrivittatus,* known from Utah, *E. q. inyoensis* most closely resembles *Eutamias quadrivittatus adsitus,* but differs from *E. q. adsitus* in lighter color, longer skull, longer nasals and longer palate.

The animals, from Utah, referable to *E. q. inyoensis* are not typical, but are intergrades with other subspecies. Seven animals from Queen of Sheba Canyon, west side Deep Creek Mountains are referable to *E. q. inyoensis* but show some characters of *Eutamias quadrivittatus nevadensis.* They have, in addition, some characters that differ from either of the two aforementioned subspecies. In comparable pelages, the animals from the Deep Creek Mountains resemble *E. q. nevadensis* in the grayish cast on the upper parts and in wide, black dorsal stripes. The buffy edgings of the tail, the reddish cast on the head, the buffy cast on thighs, the dark facial stripes, the deep buffy hind feet and the dark (black) medial side of pinnae are characters more like those of *E. q. inyoensis.* They differ from either in the darker color of the underneath side of the tail, and in having more black in the dark facial stripes. In the majority of the characters, they are closer to *E. q. inyoensis* to which they are here referred.

A series of 14 animals from the Raft River Mountains in extreme northwestern Utah are intergrades between *E. q. inyoensis* and *E. q. umbrinus.* In most characters they are intermediate between the two subspecies. The lighter general over-all coloration makes it appear best to refer them to *E. q. inyoensis.*

Hardy (1945b:85-87) reported upon the taxonomic status of the chipmunks of the species *Eutamias quadrivittatus* from south-central and southwestern Utah. He stated (*op. cit.*:87) that no animals known to him from Utah belonged to *E. q. inyoensis,* and as a result that the name combination *Eutamias quadrivittatus inyoensis* should be deleted from the list of mammals known to occur in Utah. The present study, based upon additional material which was unknown to Hardy, shows animals from extreme western and northwestern Utah to belong to *E. q. inyoensis.*

Specimens examined.—Total, 25, distributed as follows: *Boxelder County:* George Creek, 5 mi. SE Yost, Raft River Mountains, 7,000 ft., 11; George Creek, 7½ mi. SE Yost, Raft River Mountains, 7,000 ft., 1; Head of George and Clear creeks, 5 mi. S Stanrod, Raft River Mountains, 8,500 ft., 2. *Juab County:* Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 11.

Eutamias quadrivittatus adsitus Allen

Say Chipmunk

Eutamias adsitus Allen, Sci. Bull. Brooklyn Inst. Arts and Sci., 1:118, March 31, 1905, type from Briggs (Britts) Meadow, Beaver Mountains, 10,000 ft., Beaver County, Utah; Barnes, Bull. Univ. Utah, 17 (no. 12):96, June, 1927; Howell, N. Amer. Fauna, 52:93, November 30, 1929; Burt, Journ. Mamm., 12:300, August 24, 1931; Tanner, Great Basin Nat., 1:109, June 30, 1940.

Eutamias quadrivittatus adsitus, Hardy, Proc. Biol. Soc. Washington, 58:87, June 30, 1945.

Tamias adsitus, Barnes, Bull. Univ. Utah, 12 (no. 15):42, April, 1922.

Eutamias quadrivittatus inyoensis, Howell, N. Amer. Fauna, 52:84, November 30, 1929; Presnall, Zion-Bryce Mus. Bull., 2:12, January, 1938; Long, Journ. Mamm., 21:175, May 16, 1940.

Range.—Mountains of south-central and southwestern Utah.

Description and comments.—Measurement of 2 males, numbers 41355 (M.V.Z.) and 41358 (M.V.Z.), and of 3 females, numbers 41354 (M.V.Z.), 41356 (M.V.Z.) and 41357 (M.V.Z.) from the type locality are, respectively, as follows: Total length, 200, 211, 212, 212, 212; length of tail, 84, 84, 91, 81, 91; length of hind foot, 33, 33, 30, 30, 32; length of ear, —, 11, 11, 12, 12. Color (Summer pelage): Median dark dorsal stripe long, extending forward to between ears, black, bordered with Russet; medial pair of dark dorsal stripes wide, Fuscous-Black or black, mixed with Russet; lateral pair of dark dorsal stripes nearly obsolete; medial pair of light dorsal stripes narrow, grayish white; outer pair of light dorsal stripes pure white; postauricular patches white; top of head grayish white (Pale Smoke Gray) mixed with Cinnamon; supraocular dark stripe Bister; ocular stripe Fuscous or Fuscous-Black mixed with Sayal Brown; submalar stripe Sayal Brown; light facial stripes white; ears Fuscous anteriorly, white or grayish white posteriorly; rump and thighs Smoke Gray mixed with Cinnamon and Fuscous; hind feet Cinnamon-Buff or Pinkish Buff; front feet Cinnamon-Buff or Light Pinkish Cinnamon; dorsal surface of tail Fuscous-Black, with admixture of Cinnamon, tipped with Tilleul Buff; sides and flanks Russet with admixture of Tawny or Ochraceous-Buff; entire underparts white; ventral surface of tail Sayal Brown, Tawny or Cinnamon, bordered subterminally by Fuscous-Black and terminally by Tilleul Buff. Winter pelage similar to summer, but duller. Skull: Similar to that of *Eutamias quadrivittatus umbrinus*, but slightly smaller.

Topotypes of *E. q. adsitus* may be distinguished from specimens of *Eutamias quadrivittatus hopiensis* by darker dorsal coloration, dark stripes darker and light stripes more nearly white; tail shorter, darker above and paler below. Skull: Slightly wider and shorter.

Among named subspecies of *E. quadrivittatus* occurring in Utah, *E. q. adsitus* most nearly resembles *E. q. umbrinus*. For comparison, see account of that subspecies.

This subspecies of chipmunk, *E. q. adsitus*, was originally described as *Eutamias adsitus*. In Howell's revision of the chipmunks (1929:93) it still was accorded full specific status. In 1945, Hardy

restudied material from southern Utah and found the animals from Markagunt Plateau and Pine Valley Mountains, to be intergrades between *Eutamias quadrivittatus inyoensis, Eutamias quadrivittatus nevadensis* and *Eutamias adsitus* (Hardy, 1945b:85). He, therefore reduced *E. adsitus* to subspecific status under *E. quadrivittatus.* From the specimens which I have seen I am in agreement with the conclusions of Hardy.

Specimens examined.—Total, 33, distributed as follows: *Sanpete County:* Great Basin Exp. Station, 1 (M. V. Z.). *Sevier County:* Fishlake, 8,730 ft., 1. *Beaver County:* Britts Meadow, Beaver Range Mountains, 8,500 ft., 7 (M. V. Z.). *Wayne County:* Donkey Lake, Boulder Mountain, 10,000 ft., 4. *Iron County:* Cedar Breaks, 10,000 ft., 2 (M. V. Z.). *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 5; 18 mi. N Escalante, 9,500 ft., 1; 7 mi. E Widsoe, Escalante Mountains, 1 (M. V. Z.); Bryce Canyon, 8,200 ft., 1. *Washington County:* West Rim, Zion National Park, 6,500 ft., 6. *Kane County:* Navajo Lake, 10,000 ft., 1; Duck Creek, Cedar Mountains, 9,000 ft., 2; "near" Cave Lake on Mammoth, Cedar Mountain, 8,000 ft., 1.

Additional record (Hardy, 1945b:87).—*Washington County:* Pine Valley Mountains.

Eutamias quadrivittatus hopiensis Merriam

Say Chipmunk

Eutamias hopiensis Merriam, Proc. Biol. Soc. Washington, 18:165, June 29, 1905, type from Keam Canyon, Painted Desert, Navajo County, Arizona; Warren, The mammals of Colorado, Knickerbocker Press, p. 175, 1910; Cary, N. Amer. Fauna, 33:75, August 17, 1911; Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935.

Eutamias quadrivittatus hopiensis, Howell, Journ. Mamm., 3:184, August 4, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):94, June, 1927; Howell, N. Amer. Fauna, 52:83, November 30, 1929; Stanford, Journ. Mamm., 12:359, November 11, 1931; Woodbury, Ecol. Monogr., 3:193, April, 1933; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 149, 1942.

Tamias quadrivittatus gracilis, Allen, Bull. American Mus. Nat. Hist., 5:82, April 28, 1893.

Tamias hopiensis, Barnes, Bull. Univ. Utah, 12 (no. 15):36, April, 1922.

Range.—Colorado River drainage, in southern and southeastern Utah, limits unknown.

Description and comments.—Measurements of 3 males, numbers 523, 783 and 785, and of 3 females, numbers 784, 828 and 918, from Moab, Grand County, are, respectively, as follows: Total length, 216, 208, 197, 228, 213, 219; length of tail, 89, 85, 77, 104, 90, 85; length of hind foot, 28, 32, 26, 32, 31, 31; length of ear, 15, 16, 18, 18, 19, 16. Color (Summer pelage): Median dark dorsal stripe, Tawny, grading to Russet on posterior part of back, mixed with black on posterior part of back; medial and lateral pairs of dark dorsal stripes Tawny or Russet; medial pair of light dorsal stripes grayish white; lateral pair of light dorsal stripes white or buffy white; top of head Drab mixed with gray; dark facial stripes Tawny or Ochraceous-Tawny (Sayal Brown or Snuff Brown in some specimens); ocular stripe with black spot at antorbital and postorbital angles; light facial stripes white or buffy white; postauricular patches white or buffy white; anterior margin of ear Ochraceous-

Tawny; posterior margin of ear buffy white or white, blending with postauricular patch; tip of ear Cheatura Drab; rump and thighs Smoke Gray washed with Cinnamon-Buff; front and hind feet between Pinkish Cinnamon and Light Pinkish Cinnamon; dorsal surface of tail Cinnamon, bordered with Fuscous and overlaid with Cinnamon-Buff; shoulders Pinkish Buff; sides and flanks Cinnamon with Ochraceous-Buff; underparts creamy white; under surface of tail Ochraceous-Tawny bordered subterminally by Fuscous and terminally by Cinnamon-Buff. Winter pelage darker. Skull: Large and relatively long; nasals long; braincase long and narrow.

This subspecies is one of the most distinctive found in the state and can be readily distinguished from all others by its large size and reddish (Tawny) dorsal coloration.

Howell (1929:85) commented upon the Utah specimens of *E. q. hopiensis* as being among the purest for the diagnostic characters of the subspecies. He further commented on lack of intergradation of *E. q. hopiensis with Eutamias quadrivittatus umbrinus* or with *Eutamias quadrivittatus adsitus.* All of Howell's material from Utah was from the south (east) side of the Colorado River. I have seen specimens from both sides of the river and find no evidence of intergradation with *E. q. adsitus.* Obviously the barrier which the Colorado River comprises has not resulted in restricting this subspecies to only one side of the river as has been the case with subspecies of some other species of the family Sciuridae.

Specimens examined.—Total, 51, distributed as follows: *Uintah County:* E side confluence Green and White rivers, 1 mi. SE Ouray, 4,700 ft., 3. *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 2; Rock Canyon Corral, 5 mi. SE Valley City, 1; mouth Nigger Bill Canyon, E Side Colorado River, 4 mi. N Moab Bridge, 3,995 ft., 12; Colorado River above Moab, 3; Moab Bridge over Colorado River, 3,995 ft., 1; Moab, 4,500 ft., 4; Colorado River, 5 mi. E Moab Bridge, 1. *Wayne County:* Fruita, 2 (1, U.S.A.C.). *San Juan County:* Big Indian Wash, "near" Sand Rock, 1; Bluff, 4,400 ft., 12 (M.V.Z.); Desert, 1 mi. SW Bluff, 1 (M.V.Z.); Rainbow Bridge, 4,000 ft., 2 (M.V.Z.); War God Spring, Navajo Mountain, 5 (M.V.Z.); Soldier Spring, Navajo Mountain, 1 (M.V.Z.).

Additional record (Woodbury, 1933:193).—Zion National Park.

Eutamias dorsalis utahensis Merriam

Cliff Chipmunk

Eutamias dorsalis utahensis Merriam, Proc. Biol. Soc. Washington, 11:210, July 1, 1897, type from Ogden, Weber County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):37, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):95, June, 1927; Howell, N. Amer. Fauna, 52:133, November 30, 1929; Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931; Svihla, Journ. Mamm., 12:261, August 24, 1931; Burt, Journ. Mamm., 12:301, August 24, 1931; Davis, Murrelet, 15:20, January, 1934; Presnall, Zion-Bryce Mus. Bull., 2:12, January, 1938; Long, Journ. Mamm., 21:175, May 16, 1940; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 150, 1942; Hardy, Journ. Mamm., 30:434, November 17, 1949.
Tamias dorsalis, Barnes, Bull. Univ. Utah, 12 (no. 15):35, April, 1922.

Range.—Probably state-wide in the mountains, limits unknown.

Description and comments.—Measurements of one male, number 4191, from Draper, Salt Lake County, are: Total length, 192; length of tail, 58(?); length of hind foot, 33; length of ear, 20. Color: Dorsal stripes faint; upper parts Pale Smoke Gray or Smoke Gray; median dorsal stripe most prominent

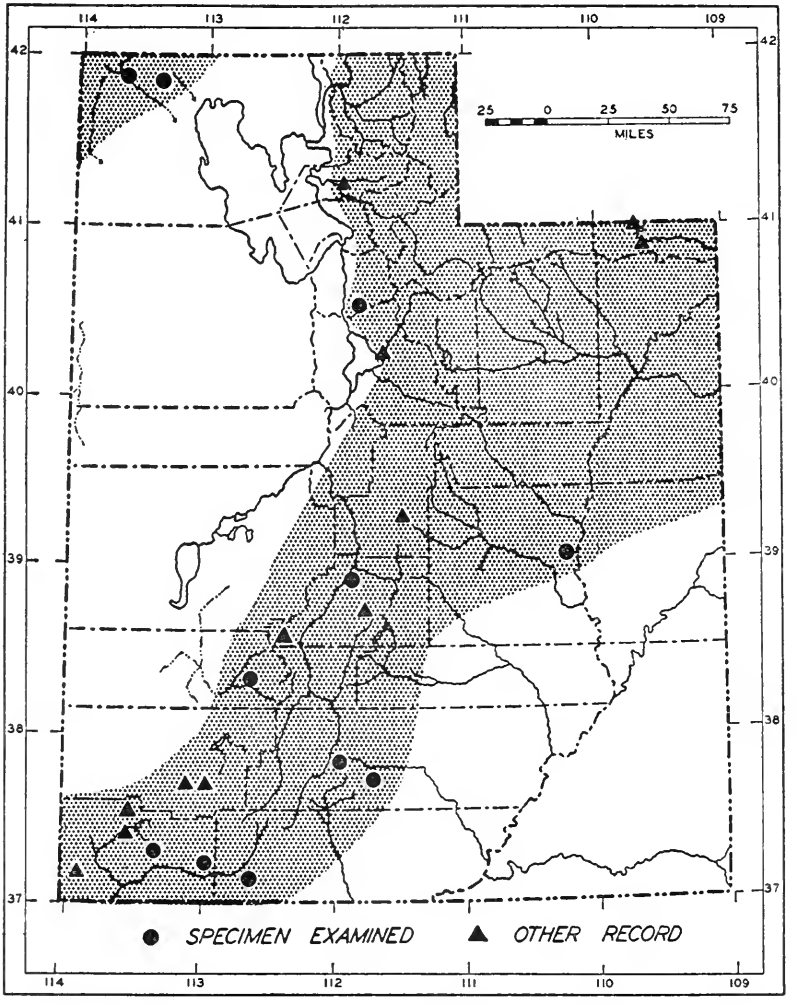

FIG. 35. Distribution of *Eutamias dorsalis utahensis.*

(nearly obliterated on some specimens), Fuscous to Fuscous-Black; lateral dark dorsal stripes Snuff Brown when present, usually nearly obliterated; lateral light stripes nearly obliterated, creamy white; top of head like back, but mixed with Cinnamon; dark facial stripes Sayal Brown or Fuscous with slight admixture of black; suborbital dark stripe reduced, obliterated anteriorly in most

specimens; light facial stripes creamy white; postauricular patches not sharply demarked, grayish white; posterior margin of ear grayish white, anterior margin Fuscous; front and hind feet Cinnamon-Buff, front feet a trifle lighter; upper surface of tail Fuscous-Black tipped with Tilleul Buff; sides and flanks Pinkish Cinnamon; under surface of tail Cinnamon-Buff, bordered subterminally by Fuscous-Black and terminally by Tilleul Buff; entire underparts creamy white. Winter pelage, generally darker. Skull: Large; rostrum relatively short, heavy and depressed; zygomatic arches robust, nearly paralleling the sides of skull; braincase and tympanic bullae well inflated.

This chipmunk is the most distinctive of any species occurring in the state. The subspecies *Eutamias dorsalis dorsalis* which to date is unrecorded from the state should be looked for in the southeastern part of the state. Typical specimens of *E. d. utahensis* can be readily distinguished from those of *E. d. dorsalis* by paler color and smaller skulls.

The one specimen available from Zion National Park is markedly darker than *E. d. utahensis* from more northern localities, and suggests intergradation with the darker form *E. d. dorsalis* known from Arizona. Topotypical and near topotypical specimens of *E. d. utahensis* are very pale, and increased depth and extension of color are noted in animals from the southern part of the range. The darkest specimen seen is the aforementioned one from Zion National Park.

Specimens examined.—Total, 20, distributed as follows: *Boxelder County:* George Creek rd. junction, 5 mi. SE Yost, Raft River Mountains, 6,700 ft., 7; Clear Creek, 6,500 ft., 5 mi. SW Nafton, 1. *Salt Lake County:* Draper, 4,500 ft., 1. *Emery County:* 7 mi. N Greenriver, 4,100 ft., 1. *Sevier County:* 6.9 mi. SE Sigurd, 1. *Beaver County:* Beaver, 6,000 ft., 3 (M. V. Z.). *Garfield County:* 5 mi. E Widsoe, 5,700 ft., 1; 8 mi. S Escalante, 5,200 ft., 1. *Washington County:* Danish Ranch, 5 mi. NW Leeds, 3,500 ft., 1; Zion National Park, 4,350 ft., 1. *Kane County:* Hamblin Ranch, 5,500 ft., Cave Lake Canyon, 5 mi. NW Kanab, 1; 2 mi. SW Cave Lake Canyon, 5 mi. NW Kanab, 1.

Additional records (Howell, 1929:134, unless otherwise indicated).—*Weber County:* Ogden. *Daggett County* (Svihla, 1931:261): 1 mi. N Linwood; Sheep Creek; Hide Out. *Utah County:* Provo. *Sanpete County:* Manti. *Sevier County:* Clear Creek. *Iron County* (Long, 1940:175): 8 mi. W Cedar City; "near" Cedar City. *Washington County:* Hebron; Pine Valley; Beaverdam Mountains.

Glaucomys sabrinus lucifugus Hall

Northern Flying Squirrel

Glaucomys sabrinus lucifugus Hall, Occ. Papers Mus. Zoöl. Univ. Michigan, no. 296:1, November 2, 1934, type from 12 miles east of Kamas, Summit County, Utah; Tanner, Great Basin Nat., 1:126, June 30, 1940; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Sciuropterus volucella, Allen, Bull. Essex Inst., 6:66, 1874.

Glaucomys sabrinus bangsi, Barnes, Bull. Univ. Utah, 17 (no. 12):99, June, 1927; Tanner, Proc. Utah Acad. Sci. Arts and Letters, 4:23, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Svihla, Journ. Mamm., 12:261, August 24, 1931.

Range.—Known from Uinta, Wasatch, Boulder and Cedar mountains, possibly occurs in all higher mountains of the state.

Description and comments.—Measurements of one female, number 2913, from Henrys Fork and another female, number 2887, from Wolf Creek Summit, Summit County are, respectively, as follows: Total length, 310, 325;

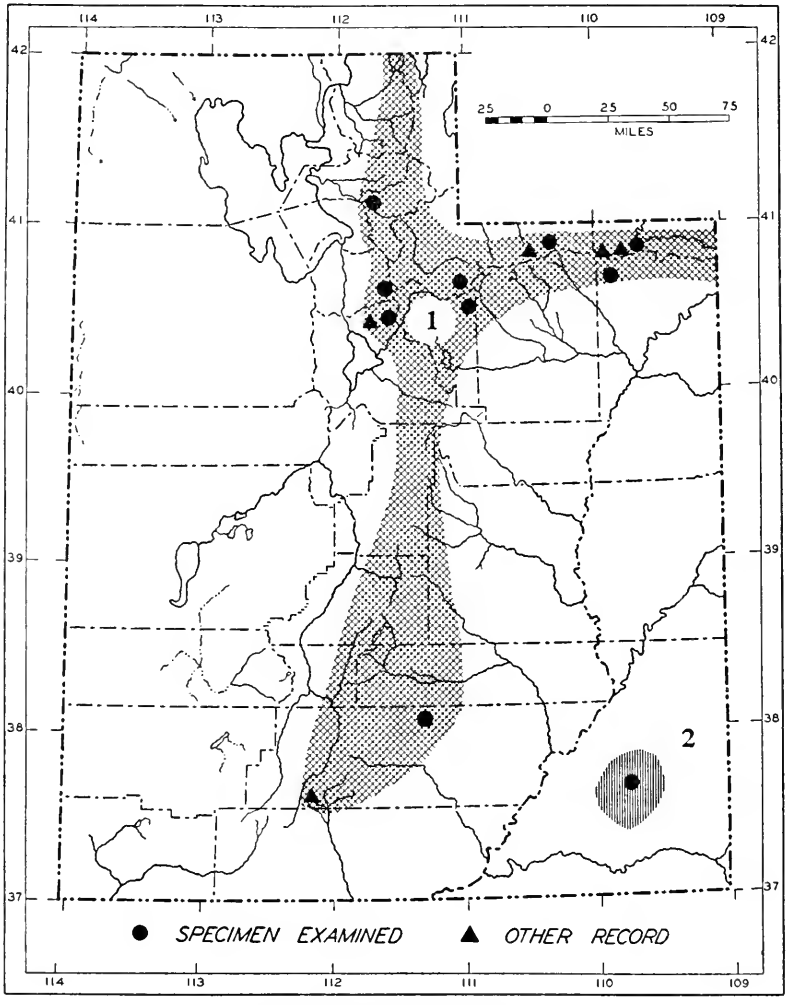

FIG. 36. Distribution of:
1. *Glaucomys sabrinus lucifugus.* 2. *Sciurus aberti navajo.*

length of tail, 150, 147; length of hind foot, 40, 47; length of ear, 25, 22. Color: Upper parts Avellaneous, hairs Dark Neutral Gray basally; face gray; front and hind feet Drab; ears relatively naked, brown; dorsal surface of tail Light Drab, darkest distally; entire underparts white, faintly washed with

Light Pinkish Cinnamon; ventral surface of tail between Tilleul Buff and Vinaceous-Buff. Skull: Small; tympanic bullae large; rostrum, interorbital and postorbital regions narrow.

All specimens available for this study are definitely referable to the subspecies *G. s. lucifugus*. No material is available from the northern Wasatch Mountains in Cache and Rich counties. Probably material from this region, when available, will show intergradation to exist between *G. s. lucifugus* and *Glaucomys sabrinus bangsi*. This intergradational tendency is reflected in one specimen from Wolf Creek Summit in the coloration of its underparts which have considerable Light Pinkish Cinnamon, and in that the width of the rostrum amounts to a trifle more than 53 per cent of the length of the nasals (percentage computed as by Hall, 1934:2).

The southernmost record (Tanner, 1940b:126) of this species in the Great Basin seems to be Bryce National Park, and there is one specimen from northern Garfield County in the collections of the Department of Zoology, University of Utah. Each of these two localities is approximately 200 miles farther south than the locality of capture of any other specimen. Howell (1918:31), however, reports animals being observed in Emery County. This suggests that the species may have a continuous geographic range from the Wasatch Mountains to Bryce National Park. Also I have reports of what seem to be flying squirrels in the Abajo Mountains.

Flying squirrels and red squirrels are fairly common in the Wasatch Mountains, and although sought for diligently, neither kind was obtained from the Oquirrh Mountains. These mountains are adjacent to the Wasatch Mountains, which lie to the east of the Oquirrh Mountains and the two mountain ranges are separated from each other by the Jordan River Narrows. Other montane mammals, such as jumping mice and northern pocket gophers are found on both mountains. Pleistocene Lake Bonneville inundated the aforementioned Jordan River Narrows and isolated the Oquirrh Mountains possibly before these sciurids had obtained access to them.

Specimens examined.—Total, 13, distributed as follows: *Morgan County:* "Near Peterson," 1. *Salt Lake County:* Silver Lake (Brighton), 9,000 ft., 1. *Summit County:* Henrys Fork, 8,000 ft., 1; 12 mi. E Kamas, 1 (M.V.Z.). *Wasatch County:* Wolf Creek Summit, 9,800 ft., 2. *Daggett County:* Junction Deep and Carter creeks, 7,900 ft., 2. *Utah County:* S Fork, American Fork Canyon, 1. *Uintah County:* Paradise Park, 10,000 ft., Uinta Mountains, 3. *Garfield County:* S point top, Boulder Mountain, 11,000 ft., 1.

Additional records.—*Summit County:* Head of Smiths Fork (Howell, 1918: 31). *Daggett County:* Beaver Creek; Granite Park (Svihla, 1931:261). *Utah County:* Mt. Timpanogos (Tanner, 1927:251). *Garfield County:* Bryce National Park (Tanner, 1940b:126).

TABLE 8

Cranial Measurements of Eutamias and Glaucomys

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Cranial breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of upper molariform tooth-row
		Eutamias minimus consobrinus, Rich County							
♂	6 av.	29.3	8.8	16.5	15.3	6.8	9.8	12.1	4.8
♂	Max.	29.6	9.0	17.0	15.5	6.9	9.9	12.1	5.0
♂	Min.	29.1	8.6	16.2	15.1	6.7	9.5	12.0	4.5
♀	4 av.	29.5	9.0	16.5	15.3	6.5	9.8	12.5	4.9
♀	Max.	29.6	9.2	16.9	15.6	6.7	10.6	13.0	5.1
♀	Min.	29.1	8.8	16.3	15.0	6.3	9.1	12.1	4.7
		Eutamias minimus minimus, Henrys Fork							
♂	2908	29.0	8.8	16.6	15.2	6.7	10.0	12.2	4.9
		Eutamias minimus pictus, Boxelder and Tooele counties							
♂	5 av.	28.4	8.5	16.0	14.8	6.6	10.1	11.8	5.0
♂	Max.	28.8	8.9	16.2	15.3	7 0	10.3	12.0	5.1
♂	Min.	88.0	8.0	15.6	14.4	6.5	9.9	11.5	4.7
♀	3724	29.1	.....	16.8	15.1	7.0	10.5	12.1	5.1
		Eutamias minimus scrutator, topotypes							
♂	27353 M. V. Z.	28.9	8.8	16.3	15.1	6.8	10.4	12.3	5.0
♀	27354 M. V. Z.	29.2	8.7	16.5	15.2	6.7	10.1	12.3	5.0
♀	27355 M. V. Z.	29.2	9.0	.....	.....	7.2	10.1	.....	5.1
		Eutamias minimus operarius, San Juan County							
♂	2592	31.0	9.2	17.7	16.1	7.3	10.4	13.0	5.0
♀	5 av.	31.2	9.4	17.4	15.6	7.5	10.4	13.1	5.1
♀	Max.	31.3	9.6	17.7	15.6	8.0	10.6	13.2	5.1
♀	Min.	31.0	9.1	17.1	15.5	7.0	10.1	13.0	5.0
		Eutamias amoenus amoenus, Raft River Mountains							
♂	4 av.	31.2	10.0	17.5	15.8	7.2	10.3	13.4	5.4
♂	Max.	31.8	10.3	17.6	16.1	7.5	11.0	13.8	5.6
♂	Min.	30.4	9.5	17.4	15.6	6.9	10.1	13.1	5.3
♀	44831 M. V. Z.	31.1	10.1	17.4	15.8	7.0	10.7	13.4	5.5
♀	44832 M. V. Z.	31.8	10.2	18.0	16.2	7.3	10.7	13.4	5.4

TABLE 8.—*Concluded*

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Cranial breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of upper molariform tooth-row
		Eutamias quadrivittatus umbrinus, Henrys Fork							
♂	6 av.	33.5	10.4	18.7	16.7	8.2	11.7	14.7	5.5
♂	Max.	34.2	11.0	19.0	17.3	8.3	12.0	15.1	5.7
♂	Min.	32.4	9.8	18.0	16.1	8.0	11.2	14.3	5.3
♀	1233	34.1	11.2	18.6	.....	8.1	11.0	14.5	5.4
♀	1234	34.6	11.0	19.2	16.5	9.1	11.6	14.7	5.7
		Eutamias quadrivittatus inyoensis, Juab County							
♂	3757	33.9	11.0	18.9	16.1	7.9	10.7	14.7	5.5
♂	3759	34.6	11.6	19.3	16.4	8.1	11.5	14.8	5.6
♂	3770	34.6	11.3	19.1	16.4	8.3	11.2	15.5	5.7
♀	4 av.	34.6	11.5	19.3	16.7	8.4	11.2	15.1	5.9
♀	Max.	34.7	12.0	19.6	17.0	8.8	11.5	15.5	6.1
♀	Min.	34.5	11.1	19.0	16.5	8.0	10.8	14.7	5.7
		Eutamias quadrivittatus adsitus, topotypes							
♂	41357 M. V. Z.	33.5	10.3	19.3	16.2	8.5	11.1	15.0	5.7
♂	41355 M. V. Z.	32.5	9.9	18.6	16.9	8.8	11.6	14.1	5.6
♀	41354 M. V. Z.	33.8	10.6	19.0	16.4	8.0	11.5	14.2	5.6
♀	41356 M. V. Z.	35.2	11.4	19.2	16.5	8.3	10.7	15.0	5.7
♀	41357 M. V. Z.	34.2	11.0	19.7	16.7	8.1	11.4	15.1	5.8
		Eutamias quadrivittatus hopiensis, Moab							
♂	5 av.	33.4	10.1	19.3	17.0	7.9	11.5	14.2	5.8
♂	Max.	33.5	10.1	19.5	17.2	8.2	12.0	14.5	6.0
♂	Min.	33.1	10.0	19.0	16.8	7.6	11.3	14.0	5.6
♀	784	35.1	10.5	20.1	17.5	8.8	11.5	15.1	5.8
♀	828	33.6	10.6	19.2	17.1	8.5	11.6	14.5	5.6
♀	918	33.8	10.1	19.6	16.8	7.8	11.0	14.9	5.7
		Eutamias dorsalis utahensis, Draper							
♂	4191	35.8	11.3	20.1	17.5	8.3	11.9	14.7	5.7
		Glaucomys sabrinus lucifugus, 2913, Henrys Fork; 2887, Wolf Creek Summit							
♀	2913	40.4	12.3	24.6	19.5	7.8	9.5	18.4	8.2
♀	2887	39.5	12.0	24.5	18.9	7.7	9.6	18.2	8.5

Family GEOMYIDAE

Pocket Gophers

This family is represented in Utah by the single genus *Thomomys*. This genus may be characterized as follows: Highly specialized fossorial rodents, with heavy, thick bodies; all four legs of approximately equal length, but front legs more muscular for digging, and feet provided with long claws; external fur-lined cheek pouches; small eyes, short ears and tail; upper incisors long and projecting external to lips. Skull: Stout and flattened; zygomatic arches well developed and usually widely spreading; all teeth with permanent pulp cavities; incisors superficially smooth, but fine median groove present on anterior face of each upper incisor; dental formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{1}{1}$, m.$\frac{3}{3}$; external auditory canal long; stapedial artery small and enclosed within an osseus canal.

In Utah, the genus *Thomomys* is represented by only two species, *Thomomys talpoides*, with 11 subspecies and *Thomomys bottae*, with 24 subspecies. *Thomomys talpoides* is a northern species that in Utah approaches the southern limits of its range. The animals of this species inhabit the mountains and high valleys. *Thomomys bottae* is a southern species that, within the Great Basin, reaches the most northern limits of its distribution in Utah. The animals of this species inhabit the lower valleys, and with the exception of the Oquirrh Mountains, also inhabit the mountains in that part of the state west of the central mountain ranges.

KEY TO THE POCKET GOPHERS OF UTAH

1.–Color brownish; sphenorbital fissure absent; anterior openings of infraorbital canals posterior to anterior palatine foramina ..... *Thomomys talpoides*, p. 156

1'.–Color grayish, blackish or ochraceous; sphenorbital fissure present; anterior openings of infraorbital canals not posterior to anterior palatine foramina ..... *Thomomys bottae*, p. 180

Thomomys talpoides gracilis Durrant

Northern Pocket Gopher

Thomomys quadratus gracilis Durrant, Bull. Univ. Utah, 29 (no. 6):3, February 28, 1939, type from Pine Canyon, 6,600 ft., 17 miles northwest of Kelton, Boxelder County, Utah.

Thomomys talpoides gracilis Durrant, Bull. Univ. Utah, 30 (no. 5):6, October 24, 1939; Goldman, Journ. Mamm., 25:414, December 12, 1944; Durrant, Univ. Kansas, Publ. Mus. Nat. Hist., 1:6, August 15, 1946.

Thomomys quadratus fisheri, Hall, Univ. California Publ. Zoöl., 37:4, April 10, 1931.

Thomomys uinta, Bailey, N. Amer. Fauna, 39:113, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):83, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):104, June, 1927.

Range.—Mountainous areas of extreme northwestern Utah.

Description and comments.—Average and extreme measurements of 4 adult males, and measurements of 2 adult females, topotypes, numbers 44872 M. V. Z. and 44870 M. V. Z., are, respectively as follows: Total length, 204 (210-194), 194, 185; length of tail, 53 (63-47), 61, 54; length of hind foot, 28 (28-27), 27, 27. Color: Upper parts Buckthorn Brown grading over sides and flanks to Light Buff on underparts; chin white; nose and postauricular patches grayish black. Claws on front feet long and slender. Skull: Long and slender; rostrum long and narrow; zygomatic and mastoidal breadths slight; palatal pits deep; upper incisors narrow; basioccipital wide.

Compared with topotypes of *Thomomys talpoides fisheri, T. t. gracilis* is of approximately the same size. Upper parts darker and underparts lighter; postauricular patches larger and darker; claws on front feet longer and slenderer; skull generally longer and narrower; nasals and rostrum longer; basioccipital wider.

As compared with *Thomomys talpoides uinta, T. t. gracilis* is of approximately the same size but differs as follows: Color: Lighter throughout; postauricular patches markedly smaller and lighter; inguinal and pectoral regions much lighter. One difference is in the ear. In *T. t. uinta* the external opening of the ear is much larger; the pinnae of the ears are larger, more rounded at the tip, and lack most of the pigmentation on the inner margin. Skull: Narrower and longer; nasals longer; zygomatic arches weaker and less angular; upper incisors narrower.

This subspecies is easily distinguished from *Thomomys talpoides bridgeri* by smaller size, and longer, narrower and less angular skull.

The subspecies of *Thomomys talpoides* geographically nearest to *T. t. gracilis* is *Thomomys talpoides oquirrhensis* to the southeast. *T. t. gracilis* can be distinguished from it by: Total length and ear shorter. Color: Generally lighter, except the underparts which are about the same; postauricular patches larger and more deeply pigmented. Skull: Braincase less inflated; nasals truncated posteriorly as opposed to rounded; zygomatic and mastoidal breadths less; rostrum shorter but narrower; upper incisors narrower and shorter.

For comparison with *Thomomys talpoides wasatchensis,* see account of that subspecies.

In general, this mountain form can be distinguished from all other *T. talpoides* in Utah by lighter color, narrow, weak, slender "graceful" skull whence the name *gracilis* is derived.

In Utah, *T. t. gracilis* is limited to the extreme northwestern corner of the state. This part of the state is in the Snake River

drainage. The main part of the range of this subspecies lies in southcentral and southwestern Idaho and northeastern Nevada. The center of its range might be considered to be in the Jarbidge Mountain area of Nevada. The south slopes of these mountains are in the Humboldt River drainage, whereas the north slopes are

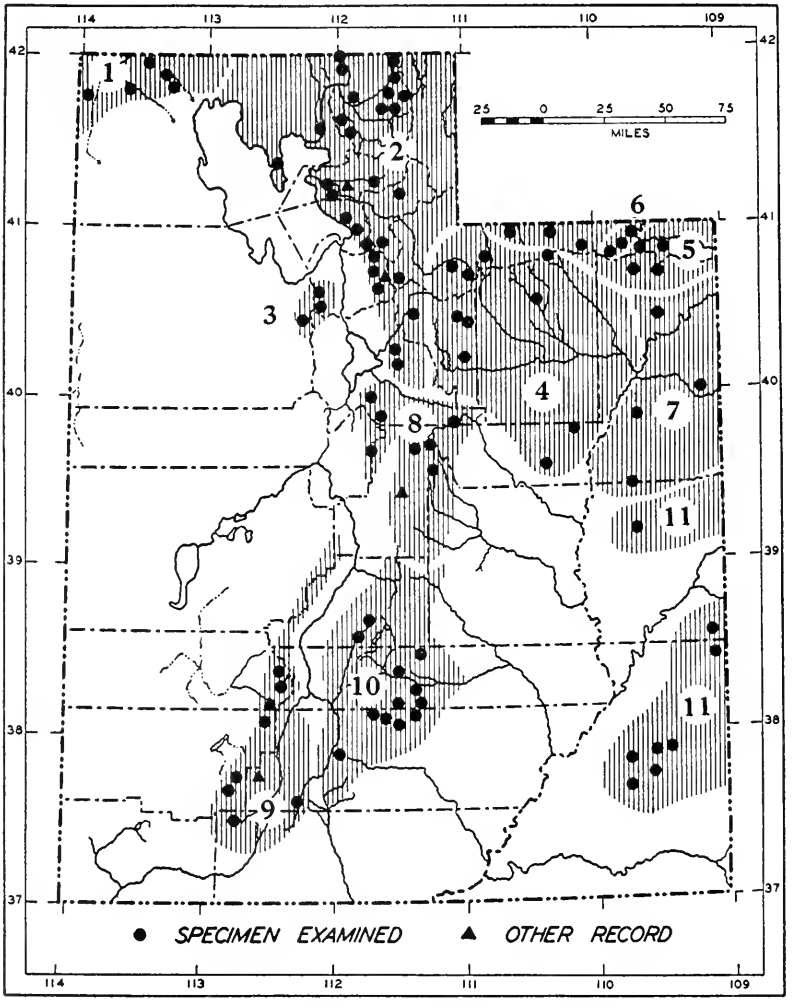

FIG. 37. Distribution of *Thomomys talpoides*.

Guide to subspecies

1. *T. t. gracilis.*
2. *T. t. wasatchensis.*
3. *T. t. oquirrhensis.*
4. *T. t. uinta.*
5. *T. t. ravus.*
6. *T. t. pygmaeus.*
7. *T. t. ocius.*
8. *T. t. moorei.*
9. *T. t. parowanensis.*
10. *T. t. levis.*
11. *T. t. durranti.*

in the Snake River drainage, and this subspecies occurs as far north as the Snake River and south and west almost to central Nevada.

No specimens from Utah indicate intergradation between *T. t. gracilis* and *T. t. wasatchensis*, the form to the east, but specimens from farther north at Albion, Cassia County, Idaho, do show intergradation. Bailey (1915:116), Hall (1931:4) and Durrant (1939:6) have reported on these specimens which at the present time seem best referred to *T. t. gracilis*.

Specimens examined.—Total, 44, distributed as follows: *Boxelder County:* Yost, 4 (U. S. A. C.); 7 mi. SE Yost, George Creek, 6,500 ft., Raft River Mountains, 8; 7½ mi. SE Yost, George Creek, 6,500 ft., Raft River Mountains, 4; Head Clear and George creeks, 5 mi. S Stanrod, Raft River Mountains, 8,500 ft., 7; Pine Canyon, 6,600 ft., 17 mi. NW Kelton, 7 (M. V. Z.); Pine Canyon, N Rosette, 6,100 ft., Raft River Mountains, 1; Lynn Canyon, Raft River, 4; Park Valley, 3 (U. S. A. C.); Etna, 4 (U. S. A. C.); Raft River Mountains, Clear Creek Camp of Minnedoka National Forest, 1 (R. H.); 1,500 ft. above Clear Creek Camp of Minnedoka National Forest, 1 (R. H.).

Thomomys talpoides wasatchensis Durrant

Northern Pocket Gopher

Thomomys talpoides wasatchensis Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:8, August 15, 1946, type from Midway, 5,500 ft., Wasatch County, Utah.

Thomomys quadratus uinta, Hall, Univ. California Publ. Zoöl., 37:4, April 10, 1931.

Thomomys talpoides uinta, Goldman, Journ. Mamm., 20:234, May 15, 1939.

Thomomys uinta, Bailey, N. Amer. Fauna, 39:113, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):83, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):104, June, 1927; Stanford, Journ. Mamm., 12: 360, November 11, 1931.

Thomomys talpoides moorei, Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—Wasatch Mountains and neighboring high valleys as far south as Spanish Fork Canyon, Utah County.

Description and comments.—Average and extreme measurements of 10 adult males and 19 adult female topotypes are, respectively, as follows: Total length, 221 (237-204), 205 (222-180); length of tail, 67 (75-60), 62 (70-52); length of hind foot, 28 (31-26), 27 (30-23). Color: Upper parts Snuff Brown, finely mixed with black; sides and flanks Sayal Brown; underparts overlaid with Cinnamon-Buff, with suffusion of black of underfur; postauricular patches black, extending around ear; ears pointed and covered with black hairs; nose, cheeks, chin and top of head dusky; front feet, hind feet and distal part of tail white; tail covered proximally with light brown hairs. Skull: Moderately heavy and ridged; nasals long, wide posteriorly and not markedly dilated distally; posterior ends of nasals emarginate; zygomatic arches fairly widely spreading and angular, being nearly straight in adults, but tending to bow out slightly at the posterior ends in young; zygomatic processes of maxillae heavy; interparietal small and variously shaped, but always greater in width than length; interorbital region fairly wide; well marked dorsal depression in frontals posterior to ends of nasals; interpterygoid space narrowly V-shaped;

tympanic bullae large; occipital condyles large and widely separated; foramen magnum large and higher than wide; basioccipital wide; dentition light.

From topotypes of *Thomomys talpoides moorei, T. t. wasatchensis* differs as follows: Size slightly larger; ears longer and more pointed. Color: Generally darker throughout; postauricular patches smaller. Skull: Zygomatic arches not so widely spreading; zygomatic processes of squamosals dip farther ventrally; premaxillae less extended posterior to nasals; nasals wider posteriorly and less dilated distally; median dorsal depression of frontals present; tympanic bullae generally larger, but inflated ventrally; foramen magnum larger especially in dorsoventral dimension; occipital condyles farther apart; basioccipital wider; alveolar length of upper molar series less; molariform teeth smaller; upper incisors wider and shorter.

Topotypes of *T. t. wasatchensis* differ from topotypes and near topotypes of *Thomomys talpoides uinta* as follows: Size larger in every measurement taken. Color: Darker throughout; ears longer and more pigmented; opening of external ear smaller; postauricular patches larger. Skull: In females larger throughout, more massive and angular; nasals longer, wider and not so dilated distally; rostrum longer but wider; zygomatic arches wider, more angular and less widely spreading posteriorly; extension of premaxillae posterior to nasals less; tympanic bullae larger, but less inflated ventrally; foramen magnum larger and more ovoid; width across occipital condyles greater; basioccipital wider; molariform teeth smaller; upper incisors shorter and wider.

Topotypes of *T. t. wasatchensis* can be readily distinguished from those of *Thomomys talpoides levis* and *Thomomys talpoides parowanensis* by larger size; more massive, ridged, angular skulls; larger tympanic bullae; large, ovoid foramen magnum; and relatively smaller interparietal.

Specimens from Mount Timpanogos and environs are intergrades between *T. t. moorei* and *T. t. wasatchensis.* They resemble *T. t. moorei* in the shape and size of the tympanic bullae, and are intermediate in the size and shape of the foramen magnum. In the majority of characters they resemble *T. t. wasatchensis* to which they are here referred. The animals from east of Salt Lake City in Salt Lake County are intergrades between *T. t. oquirrhensis* and *T. t. wasatchensis* and show some characters of *T. t. uinta,* but are referable to *T. t. wasatchensis.* Animals from Morgan County and western Summit County are intergrades between *T. t. wasatchensis* and *T. t. uinta.* They resemble *T. t. uinta* in size, shape of nasals and size of tympanic bullae. The remainder of the cranial details

place them with *T. t. wasatchensis.* Morphologically the animals from Wellsville, Cache County, were the closest to the topotypes of any obtained, and are nearly indistinguishable from them. Like the topotypes of *T. t. wasatchensis* this population inhabits a high valley, The remaining specimens from Cache County resemble those from Morgan and Summit counties.

Specimens examined.—Total, 148, distributed as follows: *Boxelder County:* Bear River City, 1; Cedar Springs, Promontary Peninsula, 2. *Cache County:* Logan Canyon, Beaver Basin, Utah-Idaho Line, 2 (U. S. A. C.); 400 yds. E Utida Depot, 3; 1 mi. NE Cornish, 2; Logan Canyon, Tony Grove Camp, 6 (U.S.A.C.); Logan Canyon, Green Camp, 3 (U.S.A.C.); Logan Canyon, 3 (U. S. A. C.); Logan, 1; Logan Mountains, 20 mi. E Logan, 3 (U. S. A. C.); Logan Peak area, 13 (U. S. A. C.); "near" Providence Peak, Logan Mountains, 1 (U. S. A. C.); Wellsville, 10 (U. S. A. C.); Hardware Ranch, Blacksmith Fork, 1 (U. S. A. C.); Avon, 1 (U. S. A. C.). *Weber County:* South Fork, Ogden River, 18 mi. E Ogden, 4 (M.V.Z.); Riverdale, 5; Roy, 1. *Morgan County:* East Canyon, 18 mi. NW Park City, 1. *Davis County:* 2 mi. S Kaysville, 2; midway between Kaysville and Farmington, 1; 8 mi. NE Salt Lake City, 1. *Salt Lake County:* Mouth of Dry Canyon, 1 mi. NE Salt Lake City, 1; 4 mi. above mouth City Creek Canyon, 5,000 ft., 1; "above" reservoir, Red Butte Canyon, 5,500 ft., 1; mouth of Emigration Canyon, 1; mouth of Millcreek Canyon, 1; Lambs Canyon, 13 mi. SE Salt Lake City, 2 (C. M.); Salamander Lake, Lambs Canyon, 9,000 ft., 7; mouth of Big Cottonwood Canyon, 1; Silver Lake, Brighton, 9,000 ft., 7. *Summit County:* Park City, 1 (U. S. N. M.). *Wasatch County:* Midway, 5,500 ft., 29. *Utah County:* Mt. Timpanogos, 1 mi. N Aspen Grove, 7,500 ft., 20; Aspen Grove, Mt. Timpanogos, 5 (1, U. S. A. C.) (4, B. Y. U.); Head of Grove Creek, 4 (B. Y. U.).

Additional records (Bailey, 1915:114).—*Weber County:* Ogden. *Salt Lake County:* Parleys Canyon.

Thomomys talpoides oquirrhensis Durrant

Northern Pocket Gopher

Thomomys talpoides oquirrhensis Durrant, Bull. Univ. Utah, 30 (no. 5):8, October 24, 1939, type from Settlement Creek, Oquirrh Mountains, 6,500 ft., Tooele County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:11, August 15, 1946.

Range.—Known only from the Oquirrh Mountains, in Salt Lake, Tooele and Utah counties, Utah.

Description and comments.—Average and extreme measurements of 4 adult male and 7 adult female topotypes are, respectively, as follows: Total length, 209 (216-197), 203 (215-193); length of tail, 58 (60-55), 56 (59-52); length of hind foot, 28 (29-28), 27 (28-25). Ears long; tail short, claws on front feet long and slender. Color: Upper parts Buckthorn Brown, mixed with black, grading over the sides and flanks to Pinkish Buff on the ventral surface; feet white; nose grayish black; postauricular patches medium in size and black; chin and throat with varying amounts of white; proximal two-thirds of tail dark brown, distal third white. Skull: Long and slender, but relatively wide across mastoidal region; nasals long and rounded posteriorly; rostrum long and narrow; zygomatic arches weak and not widely spreading, tending to be slightly bowed out posteriorly, but in the main roughly parallel to the sides of the skull; outer margin of zygomatic arch slightly concave, and zygomatic arch dips deeply ventrad; dorsal surface of skull smooth, with weakly defined

parietal crests; parietal crests nearly parallel, but bowed medially, in parietal region, and flaring widely posteriorly to pass lateral to interparietal; tympanic bullae large, truncate anteriorly and markedly inflated ventrally; upper incisors short and fairly robust.

From *Thomomys talpoides uinta, T. t. oquirrhensis* differs as follows: Color: Darker throughout; postauricular patches larger and darker; ears longer and more pointed; inner margin of pinnae heavily pigmented; external opening of ear smaller. Skull: Nasals rounded posteriorly rather than deeply emarginate, and less flaring distally; zygomatic arches weaker and markedly less widely spreading; pterygoid hamulae weaker; basisphenoid narrower; upper incisors shorter and wider.

For comparisons of *T. t. oquirrhensis* with *Thomomys talpoides gracilis,* and *Thomomys talpoides wasatchensis,* see accounts of those subspecies.

Topotypical specimens of *T. t. oquirrhensis* can be distinguished from those of *Thomomys talpoides moorei* as follows: Color generally darker, owing to greater admixture of black; terminal bands or hair actually lighter; postauricular patches larger and darker; ears longer, more pointed and with more heavily pigmented pinnae; tail shorter. Skull: Approximately same size; smoother; zygomatic arches weaker and less widely spreading; nasals rounded posteriorly as opposed to emarginate; mastoid breadth less; pterygoid hamulae weaker; upper incisors wider.

This subspecies is limited to the Oquirrh Mountains, a high mountain range that lies parallel to, and just west of the Wasatch Mountains, in Utah, Salt Lake and Tooele counties. These mountains were connected in past times to the Wasatch Mountains by the Transverse Range, and by a sand and gravel bar deposited by the Pleistocene Lake Bonneville. The Jordan River in its course from Utah Lake to the Great Salt Lake has cut a channel through the aforementioned bar. This channel has been cut to the level of the surrounding valleys as is indicated by the meandering nature of the stream through this part of its course. As a result, the Oquirrh Mountains are relatively isolated. Although separated from the Wasatch Mountains by a distance of only a few miles, the pocket gophers are distinct. Davis (1939:240) comments on the fact that rivers that freeze over afford no barrier to movement of pocket gophers. The Jordan River freezes over periodically; nevertheless, the pocket gophers remain distinct on each mountain. A population of *Thomomys bottae* is interposed between the two mountain

ranges as is indicated by specimens from Riverton, 6 miles north of the Transverse Range, and is subspecifically the same on the two sides of the river.

On the east side of the Oquirrh Mountains, pocket gophers collected from the Jordan Valley up Rose Canyon to about 5,000 feet elevation were all of the species *T. bottae*. Between 5,000 and 6,000 feet there is an area in which the ranges of *T. bottae* and *T. talpoides* overlap. When trapping, it is possible to predict what species will be taken, by the types of burrows and soil. Gophers of the *T. bottae* group have their burrows in the area of the deepest soil and heaviest vegetation, whereas the areas of shallow, rocky soil, covered with sparse vegetation are the habitat of *T. talpoides*. Above 6,000 feet the only gopher found is *T. talpoides*. Along Settlement Creek on the west side of the Oquirrh Mountains, which is the type locality of *T. t. oquirrhensis*, *T. bottae* and *T. talpoides* have essentially the same vertical distributions as in Rose Canyon. On this mountain the two species appear to be in competition.

The available information, based on collections, indicates that the Oquirrh Mountains are the only mountains west of the Wasatch Range upon which *T. talpoides* occurs. All other mountains to the west, in Utah, as far as known, are inhabited by subspecies of *T. bottae*.

Specimens examined.—Total, 44, distributed as follows: *Tooele County:* Settlement Creek, Oquirrh Mountains, 6,500 ft., 14. *Salt Lake County:* Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 7,000 ft., 3; Rose Canyon, Oquirrh Mountains, 5,650 ft., 27.

Thomomys talpoides uinta Merriam

Northern Pocket Gopher

Thomomys uinta Merriam, Proc. Biol. Soc. Washington, 14:112, July 19, 1901, type from north base Gilbert Peak, Uinta Mountains, 10,000 ft., Summit County, Utah; Bailey, N. Amer. Fauna, 39:113, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):83, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):104, June, 1927; Goldman, Journ. Washington Acad. Sci., 28:333, July 15, 1938; Davis, The recent mammals of Idaho, Caxton Printers, Caldwell, Idaho, pp. 239, 259, April 5, 1939.

Thomomys talpoides uinta, Goldman, Journ. Mamm., 20:234, May 15, 1939; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:13, August 15, 1946.

Thomomys quadratus uinta, Hall, Univ. California Publ. Zoöl., 37:4, April 10, 1931.

Range.—Uinta Mountains in Duchesne County, eastern Wasatch and Summit counties, and western Uintah County south to the Roan, Brown and Book cliffs in Carbon County.

Description and comments.—Average and extreme measurements of 5 adult males and measurements of 2 adult females, numbers 41374 M.V.Z. and 41376

M.V.Z., from SW slope Bald Peak, Uinta Mountains, are respectively, as follows: Total length, 199 (208-185), 185, 177; length of tail, 51 (54-47), 50, 47; length of hind foot, 27 (28-26), 25, 25. Color: Upper parts Snuff Brown finely mixed with black, paling over sides and flanks to near Pinkish Buff on underparts; postauricular patches relatively small and dusky; external opening of ear large; pinnae usually lightly pigmented; hind feet white; front feet usually white only at base of toes; distal third to half of tail white; tail usually light below, with proximal dorsal half covered with darker hairs; nose, chin, cheeks and top of head dusky; usually considerable white present on throat. Skull: Small, slender and not heavily ridged; nasals short and dilated distally; posterior margins of nasals emarginate; zygomatic arches moderately widely spreading, widest posteriorly; interparietal pentagonal or subquadrangular; interpterygoid space V-shaped; tympanic bullae well inflated ventrally; upper incisors long and narrow.

For comparisons with other subspecies of *Thomomys talpoides,* see accounts of those subspecies.

The range formerly ascribed to *T. t. uinta* (Bailey, 1915:114; Barnes, 1922:83, 1927:104) is now known to be inhabited by animals belonging to three distinct subspecies. The range of *T. t. uinta* as now understood is restricted to the southern and western parts of the Uinta Mountains and environs. Three specimens from the Book Cliffs, Sunnyside, Carbon County, were studied. They are not typical, but in a majority of their characters agree with *T. t. uinta* to which they are here referred.

In this study, I have seen only one topotype of *T. t. uinta.* It is one of the series on which Merriam (1901:112) based his original description. In addition, I have studied several large series of near topotypes. From the material at hand, and from Merriam's description (*loc. cit.*), I am of the opinion that the animals on which the name *T. t. uinta* was based are intergrades between *Thomomys talpoides ravus,* the subspecies to the northeast on the one hand and the animals of the western and southern parts of the Uinta Mountains on the other hand. The affinities of the type series are with the animals from the latter area which are here all referred to *T. t. uinta.*

Specimens examined.—Total, 45, distributed as follows: *Summit County:* 2 mi. S junction Bear River and Haydens Fork, 2 (C. M.); N base Gilbert Peak, 10,000 ft., 1 (U. S. N. M.); Smith and Morehouse Creek, 2; Bald Peak, 25 mi. NE Kamas, 15 (8, M.V.Z.; 6, C.M.). *Duchesne County:* Petty Mountain, 15 mi. N Mountain Home, 9,500 ft., 6 (C.M.). *Wasatch County:* Wolf Creek Pass, 18 mi. NE Hanna, 1 (U. S. A. C.); Lost Lake, Uinta Mountains, 10 (B. Y. U.); Currant Creek, Uinta Mountains, 1 (U. S. N. M.). *Carbon County:* Christensen Ranch, 6,300 ft., Nine Mile Canyon, 10 mi. E Summit, 4; Forks, Sunnyside, 9,000 ft., 3.

Thomomys talpoides pygmaeus Merriam

Northern Pocket Gopher

Thomomys pygmaeus Merriam, Proc. Biol. Soc. Washington, 14:115, July 19, 1901, type from 10 mi. NE Montpelier, in open sagebrush of Transition Life-zone, 6,600 ft., Bear Lake County, Idaho; Svihla, Journ. Mamm., 12:261, August 24, 1931.

Thomomys talpoides pygmaeus, Davis, The Recent mammals of Idaho, The Caxton Printers, Caldwell, Idaho, p. 252, April 5, 1939; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:14, August 15, 1946.

Range.—Limited to Daggett County.

Description and comments.—Measurements of 1 adult male topotype, number 55270 U. S. N. M., and 1 adult female, number 178868 U. S. N. M., from Fossil, Wyoming, are respectively as follows: Total length, 165, 167; length of tail, 40, 52; length of hind foot, 20, 20. Color: Upper parts near Bister slightly mixed with black, grading over sides and flanks to Ochraceous-Buff on underparts; postauricular patches small and dusky; hind feet white; front feet dusky being white only at base of claws; chin and nose dusky; tail brown, lighter below and tipped with white. Skull: Very small, slender and smooth; nasals short and slender; zygomatic arches weak and not widely spreading; rostrum narrow; extension of premaxillae posterior to nasals very short; parietal ridges hardly noticeable; interparietal large; extension of supra-occipital posterior to lambdoidal suture long; tympanic bullae actually small, but relatively large; basioccipital narrow; interpterygoid space narrow and acutely angled; upper incisors markedly recurved; molariform teeth relatively large.

This very small pocket gopher can be distinguished from all other members of *Thomomys talpoides* occurring in Utah by remarkably small size, and slender, weak, small skulls with strongly recurved upper incisors.

The specimens used in this study were those recorded by Svihla (1931:261). She reports that they were obtained in the flood plain banks of the streamsides, and preferred the pine belt. This shows probably an extension of range with reference to life-zones, as heretofore, the main reported localities of capture have been in sagebrush in the Transition Life-Zone.

Insofar as I am aware, Mrs. Svihla's specimens are the only ones of this subspecies ever obtained in Utah. Additional work is necessary in southwestern Wyoming to outline accurately the geographic distribution of this subspecies. In comparison with topotypes the specimens from Utah are lighter in color and some specimens have slightly larger skulls, suggesting slight intergradation with *Thomomys talpoides uinta.*

Specimens examined.—Total, 18, distributed as follows: *Daggett County:* Sheep Creek, 4; 1 mi. W Summit Springs, 4; Beaver Creek, 22 mi. S Manila, 9; Granite Park, 24 mi. S Manila, 1 (All above specimens in collection of Museum of Zoölogy, University of Michigan).

Thomomys talpoides ravus Durrant

Northern Pocket Gopher

Thomomys talpoides ravus Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:15, August 15, 1946, type from Vernal-Manila Highway, 19 mi. N Vernal, 8,000 feet, Uintah County, Utah.

Range.—Uinta Mountains in Daggett, northern Uintah and northern Summit counties.

Description and comments.—Measurements of 3 adult male topotypes numbers 13685 C. M., 13678 C. M., and 13690 C. M., and measurements of one female topotype, number 13684 C. M., are respectively, as follows: Total length, 248, 253, 244, 241; length of tail, 74, 74, 70, 71; length of hind foot, 29, 30, 30, 28. Ears relatively narrow; hind foot relatively small. Color: Upper parts between Drab and Light Drab, darkest along middorsal line owing to mixture of hairs tipped with light brown; sides and flanks Light Drab; entire underparts creamy white; front and hind feet, ventral surface of tail and end of tail white; dorsal proximal two-thirds of tail covered with light brown hairs; nose and cheeks dusky; postauricular patches black. Skull: Large, heavy and ridged; rostrum long and narrow; nasals long, moderately dilated distally and with a distal hump; posterior ends of nasals emarginate; parietal and lambdoidal crests well developed; zygomatic arches moderately heavy and widely spreading, widest posteriorly; zygomatic processes of maxillae moderately heavy and flaring out abruptly from base of rostrum; marked middorsal depression in frontals present; interparietal pentagonal; extension of premaxillae posterior to nasals long; posterior tongues of premaxillae long, slender and rounded proximally; braincase high, vaulted and relatively narrow; tympanic bullae well inflated ventrally, and ridged in old animals; pterygoid hamulae long; interpterygoid space narrowly V-shaped; upper incisors long and narrow; molariform teeth medium.

From topotypes of *Thomomys talpoides bridgeri, T. t. ravus* differs as follows: Size larger; hind foot smaller; ears narrower. Color: Lighter throughout, grayish as opposed to brown. Skull: Smaller, narrower, less angular and less massive; nasals, rostrum, zygomatic processes of maxillae, ascending branches of premaxillae and posterior tongues of premaxillae all narrower; extension of premaxillae posterior to nasals longer; interparietal wider; braincase higher and narrower; tympanic bullae approximately the same size, but more inflated ventrally; interpterygoid space more narrowly V-shaped; upper incisors narrower; molariform teeth weaker.

From topotypes and near topotypes of *Thomomys talpoides uinta, T. t. ravus* differs as follows: Size larger in every measurement taken. Color: Lighter throughout, being grayish as opposed to brown. Skull: Larger in every measurement taken; rostrum and nasals actually as well as relatively longer; extension of premaxillae

posterior to nasals longer; upper incisors longer and wider; molariform teeth larger.

There is only one other gray subspecies of *Thomomys talpoides* in Utah, *Thomomys talpoides ocius.* Topotypes *of T. t. ravus* differ from it as follows: Size markedly larger in every measurement taken. Color: Darker, more brown hairs. Skull: Larger in every measurement taken; premaxillae extending farther posteriorly to nasals; extension of supraoccipital posterior to lambdoidal suture markedly less; tympanic bullae actually as well as relatively smaller; upper incisors longer and more procumbent.

This subspecies can be readily distinguished from all other subspecies of *Thomomys talpoides* occurring in Utah by markedly greater size and paler, more grayish color.

The range of this subspecies appears to be limited to the north slopes of the Uinta Mountains, except in Daggett and Uintah counties where it occurs also on the south slopes. Intergradation in color and in cranial details with *T. t. bridgeri* is shown by animals from the East Fork of Blacks Fork, 31 miles southwest of Fort Bridger, and by those from Henrys Fork, 8,300 feet, both in Summit County. Owing to the grayish color and the narrower, weaker skull they are referred to *T. t. ravus.* Intergradation with *T. t. uinta* is shown by specimens from the type locality of the latter subspecies. The type series of *T. t. uinta* consists of intergrades between *T. t. ravus* and the animals to the west and south (see account of *T. t. uinta*).

It is doubtful whether *T. t. bridgeri* occurs in Utah. Material from Rich County and extreme northern Cache County would settle this question. Perhaps *T. t. bridgeri* is restricted to the lower valleys in southwestern Wyoming. Two specimens from northern Cache County, from Logan Canyon, Beaver Basin, Utah-Idaho line appear to be intergrades between *T. t. bridgeri* and *Thomomys talpoides wasatchensis,* but referable to the latter subspecies.

Specimens examined.—Total, 60, distributed as follows: *Summit County:* Henrys Fork, 8,300 ft., 8; E Fork, Blacks Fork, 31 mi. SSW Fort Bridger, 4 (C. M.); Hoop Lake, 8,000 ft., Ashbury [Ashley] National Forest, Daggett [Summit County], 1. *Daggett County:* Vernal-Manila Road, 4 mi. W Greens Lake, 7,500 ft., 6 (C. M.); Elk Park, Uinta Mountains, 5 (B. Y. U.); Junction Deep and Carter creeks, 7,900 ft., 3. *Uintah County:* Trout Creek, SE Trout Peak, 22 mi. NW Vernal, 9,300 ft., 5 (C. M.); Junction Trout and Ashley creeks, 9,700 ft., 14; Vernal-Manila Highway, 19 mi. N Vernal, 8,000 ft., 6 (C. M.); Taylor Peak, 17 mi. N Vernal, 4 (C. M.); Iron Springs, Uintah [Uinta] Mountains, 9,000 ft., 4.

Thomomys talpoides ocius Merriam

Northern Pocket Gopher

Thomomys clusius ocius Merriam, Proc. Biol. Soc. Washington, 14:114, July 19, 1901, type from Mountainview on Smiths Fork, 4 miles (airline) southeast of Fort Bridger, Uintah County, Wyoming, *fide* Hooper (1943: 503).

Thomomys talpoides ocius, Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:17, August 15, 1946.

Thomomys clusius, Allen, Bull. American Mus. Nat. Hist., 8:246, November 25, 1896; Warren, The mammals of Colorado, Knickerbocker Press, p. 80, 1910.

Thomomys ocius, Bailey, N. Amer. Fauna, 39:107, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):83, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):102, June, 1927; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 161, 1942.

Thomomys talpoides clusius, Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 162, 1942.

Range.—Eastern Utah, generally east of the Green River and north of the Colorado River.

Description and comments.—Measurements of one adult male, number 177506 U. S. N. M., from 12 miles west of Linwood, Henrys Fork, Wyoming, and 3 adult females, numbers 18854, 18861, and 18863 U. S. N. M., topotypes, are respectively, as follows: Total length, 200, 196, 205, 202; length of tail, 62, 57, 60, 64; length of hind foot, 26, 25.5, 25, 25.5. Color: Upper parts Tilleul Buff overlaid with Avellaneous, grading over sides and flanks to nearly white on underparts; underparts with faint wash of creamy white; postauricular patches small and dusky and completely encircling ear; nose and cheeks dusky; front feet, hind feet, ventral surface of tail and distal half of tail white. Skull: Small, slender but compact; nasals rounded posteriorly; extension of premaxillae posterior to nasals short; zygomatic arches robust, but not widely spreading, widest posteriorly; interparietal large and pentagonal in shape; extension of supraoccipital posterior to lambdoidal suture long; tympanic bullae actually as well as relatively large; basioccipital narrow; pterygoid hamulae long and ridged; upper incisors short and strongly recurved.

From one topotype and seven near topotypes of *Thomomys talpoides pygmaeus, T. t. ocius* differs as follows: Size larger in every measurement taken. Color: Lighter throughout, grayish as opposed to brown; distal half of tail white as opposed to only a few white hairs at tip of tail. Skull: Larger in every measurement taken; skull more compact; zygomatic arches heavier and more widely spreading posteriorly; tympanic bullae larger; upper incisors larger, but equally strongly recurved; molariform teeth larger.

Topotypes of *T. t. ocius* can be distinguished from those of *Thomomys talpoides uinta* as follows: Color: Lighter throughout, grayish as opposed to brown. Skull: Nasals rounded posteriorly as opposed to emarginate; zygomatic arches more robust; interparietal pentagonal in shape as opposed to subquadrangular; extension of supraoccipital posterior to lambdoidal suture greater; tym-

panic bullae actually as well as relatively much larger; upper incisors short and strongly recurved as opposed to long and procumbent.

Specimens of this subspecies can be distinguished from all other members of the species *Thomomys talpoides* occurring in Utah by their grayish color, and by small, compact skulls with very large tympanic bullae and short, strongly recurved upper incisors.

Two specimens from Vernal, Uintah County, are intergrades between *T. t. ocius* and *T. t. uinta.* They resemble *T. t. uinta* in size and color dorsally, but are tending slightly toward *T. t. ocius* in color. Ventrally they are intermediate in color but more like *T. t. ocius.* The skulls are more nearly like those of *T. t. ocius* in general appearance, extension of supraoccipital posterior to lambdoidal suture, shape and thickness of the zygomatic arches, length of extension of posterior tongues of premaxillae, size of tympanic bullae and recurved upper incisors. They more closely resemble those of *T. t. uinta* in shape of posterior ends of nasals, basioccipital and shape of the zygomatic processes of the squamosals. In all of the above mentioned characters, they are intermediate between the two named subspecies, but tend toward one or the other as listed. The majority of characters are more as in *T. t. ocius* to which the specimens are here referred.

When Goldman (1939a:233, 234) listed the named subspecies of *Thomomys talpoides,* he hesitated to include *T. ocius* and merely mentioned that *T. ocius, T. pygmaeus* and *T. idahoensis* might also belong to *T. talpoides.* Davis (1939:240, 241) found intergradation between *T. t. idahoensis* and *T. t. fuscus* and also between *T. t. idahoensis* and *T. t. pygmaeus,* and, therefore, arranged the last two mentioned kinds as subspecies of *T. talpoides.* The study here reported upon reveals intergradation between *T. t. ocius* and *T. t. uinta,* and also between *T. t. ocius* and *T. t. durranti* (see account of *T. t. durranti*). Therefore, *T. t. ocius* is properly to be treated as a subspecies of the series of intergrading forms of which *T. talpoides* is the earliest named.

All specimens of *T. t. ocius* known from Utah are from the extreme eastern part of the state. The type locality of *T. t. ocius* is near Fort Bridger, Wyoming, which is north of Utah. I have seen one specimen from 12 miles west of Linwood, Daggett County, Utah, on Henrys Fork in Wyoming. Additional collecting in northern Utah probably will reveal that *T. t. ocius* inhabits also parts of northern Utah.

Specimens examined.—Total, 12, distributed as follows: *Uintah County:* Vernal, 2 (C.M.); Uncompahgre Indian Reservation, 2 (A.M.N.H.); Brown Corral, 20 mi. S Ouray, 6,250 ft., 3; P.R. Springs, 43 mi. S Ouray, 7,950 ft., Uintah-Grand County Line, 5.

Thomomys talpoides moorei Goldman

Northern Pocket Gopher

Thomomys fossor moorei Goldman, Journ. Washington Acad. Sci., 28:335, July 15, 1938, type from 1 mile South of Fairview, 6,000 ft., Sanpete County, Utah.

Thomomys talpoides moorei Goldman, Journ. Mamm., 20:234, May 15, 1939; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:19, August 15, 1946.

Range.—Wasatch Mountains south of Spanish Fork Canyon and Wasatch Plateau in Sanpete, Utah, Carbon and Emery counties.

Description and comments.—Average and extreme measurements of 7 adult male and 5 adult female topotypes are, respectively, as follows: Total length, 216 (236-203), 206 (213-198); length of tail, 65 (72-52), 62 (69-55); length of hind foot, 29 (31-27), 26 (28-24). Color: Upper parts between Cinnamon and Sayal Brown, with mixture of black hairs, grading through Cinnamon on sides and flanks to Pale Pinkish Buff on underparts, clearest on inguinal and pectoral regions; nose and cheeks dusky; postauricular patches medium in size and black; ears black; chin buffy white; front and hind feet white; tail mostly white with brownish hairs on dorsal surface. Skull: Large, robust; nasals long and deeply emarginate on posterior ends, and dilated distally; zygomatic arches robust and widely spreading; zygomatic processes of maxillae heavy; interparietal comparatively small, but always wider than long; extension of premaxillae posterior to nasals short; tympanic bullae moderate in size, but markedly inflated ventrally; pterygoid hamulae long; interpterygoid space narrowly V-shaped; upper incisors long and moderately recurved; molariform teeth light.

Topotypes of *T. t. moorei* differ from topotypes and near topotypes of *Thomomys talpoides uinta* as follows: Size slightly larger. Color: Upper parts and sides lighter; tail lighter; postauricular patches larger and darker; ears more pointed, smaller and darker. Skull: Larger, heavier and more massive; nasals longer, but deeply emarginate posteriorly as in *T. t. uinta;* rostrum wider and longer; zygomatic arches heavier and more angular; zygomatic processes of maxillae heavier; interparietal generally smaller and shorter; braincase wider; tympanic bullae more inflated ventrally; interpterygoid space more narrowly V-shaped; upper incisors longer, but not so procumbent; molariform teeth smaller.

Topotypes of *T. t. moorei* can be distinguished from those of *Thomomys talpoides oquirrhensis* as follows: Size slightly larger; tail longer; ears larger, less pointed. Color: Lighter throughout; postauricular patches larger. Skull: More ridged and angular;

nasals narrower posteriorly, but more dilated distally; posterior ends of nasals more deeply emarginate (although shallowly emarginate in *T. t. oquirrhensis,* they tend to be somewhat rounded); rostrum narrower; extension of premaxillae posterior to nasals greater; least interorbital breadth less; zygomatic arches more angular and widely spreading; zygomatic processes of maxillae heavier; interparietal smaller; tympanic bullae larger and more inflated ventrally; upper incisors generally longer.

The characters that distinguish *T. t. moorei* from *Thomomys talpoides parowanensis* are: Color: Lighter throughout. Skull: Broader, more angular and more nearly flat; zygomatic arches more widely spreading; zygomatic processes of maxillae heavier; posterior ends of nasals emarginate rather than rounded; upper incisors longer.

For comparisons of *T. t. moorei* with *Thomomys talpoides levis* and *Thomomys talpoides wasatchensis,* see accounts of those subspecies.

Specimens from Colton show intergradation between *T. t. moorei, T. t. uinta* and *T. t. wasatchensis,* but are referable to *T. t. moorei* in the majority of characters. Specimens from Mount Nebo, and the mouth of Reddicks Canyon, in the Wasatch and Sanpitch mountains respectively, are intergrades between *T. t. moorei* and *T. t. wasatchensis,* but are referable to *T. t. moorei.*

That part of the Wasatch Mountains south of Spanish Fork Canyon is inhabited by pocket gophers that are intergrades between *T. t. moorei* and *T. t. wasatchensis,* but the cranial details show them to be referable to *T. t. moorei.* The range here ascribed to *T. t. moorei* consists of the Wasatch Plateau to the east of Sanpete Valley, the Sanpitch Mountains and the southern part of the Wasatch Mountains. The type locality of *T. t. moorei* is situated in the southern end of a high valley that separates the Wasatch Plateau from the Sanpitch and Wasatch mountains. Topotypical animals are larger and have more ridged, angular skulls than those from the mountains.

Specimens examined.—Total, 54, distributed as follows: *Utah County:* "Near" Payson Lake, 1 (R.H.); Mount Nebo, 25 mi. SE Payson, 10,000 ft., 20; Colton, 8 (B.Y.U.). *Sanpete County:* Fairview, 1; 1 mi. S Fairview, 6,000 ft., 12 (U.S.N.M.); Mammoth R.S., Manti National Forest, 9,000 ft., 5. *Juab County:* Mouth of Reddicks Canyon, Wales Mountain (= Sanpitch Mountains), 7,500 ft., 5. *Emery County:* Lake Creek, 11 mi. E Mt. Pleasant, 2 (C.M.).

Additional record (Goldman, 1938a:336).—*Sanpete County:* Ephraim.

Thomomys talpoides durranti Kelson

Northern Pocket Gopher

Thomomys talpoides durranti Kelson, Proc. Biol. Soc. Washington, 62:143, August 23, 1949, type from Johnson Creek, 14 miles north of Blanding, 7,500 ft., San Juan County, Utah.

Thomomys fossor, Bailey, N. Amer. Fauna, 39:111, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):102, June, 1927; Hall, Univ. California Publ. Zoöl., 37:4, April 10, 1931.

Thomomys talpoides fossor, Goldman, Journ. Mamm., 20:234, May 15, 1939; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 163, 1942; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:21, August 15, 1946.

Range.—The mountains east of the Green and Colorado rivers in Utah, bounded by the southern flank of the East Tavaputs Plateau on the north and the Abajo (Blue) Mountains on the south.

Description and comments.—Average and extreme measurements of 6 adult males and 8 females all topotypes are, respectively as follows: Total length, 208 (224-201), 208 (220-195); length of tail, 61 (66-54), 59 (63-55); length of hind foot, 28 (32-26), 28 (31-26). Color: Upper parts Cinnamon-Brown grading to Cinnamon-Buff on flanks and inguinal region; underparts Avellaneous with Deep Mouse Gray undertone; chin and openings of pouches white; ears of medium size, rounded or pointed pinnae and moderately pigmented; postauricular patches reduced, between Dusky Neutral Gray and black; proximal dorsal half of hind feet same color as upper parts; distal half white; tail white below; proximal dorsal half of tail Cinnamon-Brown grading to white distally. Skull: Size medium, angular and narrow; frontonasal region flattened; nasals rounded proximally; premaxillae extending posterior to nasals; rostrum long; interparietal broadly triangular; tympanic bullae large and well inflated ventrally; basioccipital narrow; supraoccipital developed as a shelf rather than as a crest; upper incisors long and slightly recurved; molariform teeth light.

From *Thomomys talpoides ocius*, *T. t. durranti* differs as follows: Size larger in every measurement taken. Color: Darker, brownish as opposed to grayish. Skull: More massive and angular; frontonasal region flatter; rostrum and nasals longer; supraoccipital shelf extending farther caudad; tympanic bullae actually as well as relatively smaller; upper incisors markedly longer and less recurved; interparietal triangular rather than suborbicular.

T. t. durranti differs from *Thomomys talpoides uinta* in longer and narrower skull, longer rostrum and nasals, triangular rather than pentagonal interparietal, larger, more ventrally inflated tympanic bullae, narrower basioccipital, shelflike rather than crestlike supraoccipital and flatter frontonasal region.

Among named subspecies of *Thomomys talpoides*, *T. t. durranti* most nearly resembles *Thomomys talpoides fossor*. The type series of *T. t. durranti* differs from near topotypes of *T. t. fossor* from La Plata City, La Plata County, Colorado, as follows: Tail shorter.

Color: Slightly lighter. Skull: More angular; frontonasal region flatter; basilar length greater; extension of premaxillae posterior to nasals greater; rostrum broader; supraoccipital longer (more shelf-like, less crestlike); width of interparietal relative to length greater; cranial root of zygomatic arch heavier; upper incisors less procumbent.

Animals from the La Sal Mountains in Grand and San Juan counties are intergrades between *T. t. durranti* and *T. t. fossor.* They are like *T. t. durranti* in the extent of the supraoccipital shelf, heavy cranial root of the zygomata, length and curvature of the upper incisors, length of tail and over-all coloration. They resemble *T. t. fossor* in the length of the hind foot. In the shape of the frontonasal region they are intermediate between the two subspecies, as they are also with respect to the extension of the premaxillae posterior to the nasals. In addition, they exceed both *T. t. durranti* and *T. t. fossor* in total length, basilar length and breadth of the rostrum. The majority of the characters are more like those of *T. t. durranti* to which they are here referred.

Durrant (1946:22) considered specimens from Oak Spring, Middle Fork Willow Creek, 14 miles north of Thompson, Grand County, Utah to be intergrades between *T. t. ocius* and *T. t. fossor.* These specimens now prove to be intergrades between *T. t. ocius* and *T. t. durranti.* Animals from P.R. Springs, 43 miles south of Ouray and from Brown's Corral, 20 miles south of Ouray are likewise intergrades between *T. t. durranti* and *T. t. ocius.* In color the specimens from P.R. Springs resembles *T. t. durranti,* while those from Brown's Corral resemble *T. t. ocius.* Cranially these animals all resemble *T. t. ocius,* but are like *T. t. durranti* in the shape of the interparietal and size of the tympanic bullae. The majority of characters prove these animals to be referable to *T. t. ocius.*

In eastern Utah, intergradation is known between *T. t. ocius* and *T. t. uinta* (Durrant, 1946:18), between *T. t. uinta* and *Thomomys talpoides ravus,* and *T. t. uinta* and *Thomomys talpoides pygmaeus* (Durrant, 1946:15-16). These facts considered in light of those of the preceding paragraph demonstrate intergradation between all of the various subspecies of *Thomomys talpoides* known to occur in eastern Utah, wherever the ranges of the several kinds come in contact with each other.

In his revision of the genus *Thomomys,* Bailey (1915:111) remarked that *Thomomys fossor* was one species that held its distinctive characters over a wide range. At that time, its range was understood to include practically all of the mountainous parts of

Colorado, Utah as far west as the central part of the state, and parts of New Mexico, Arizona and Wyoming. Subsequently Goldman (1938a:334-337) named three new subspecies from central Utah; there is more geographic variation than was formerly supposed. At a later date, in his study of the pocket gophers of the *Thomomys talpoides* group, Goldman (1939a:234) arranged *Thomomys fossor* and *Thomomys quadratus* as subspecies under the earlier proposed name *Thomomys talpoides.* Durrant (1946:21) thought that the range of *Thomomys talpoides fossor* in Utah, was the mountainous part of the state east of the Green and Colorado rivers. The range in Utah ascribed to *T. t. fossor* by Durrant (*loc. cit.*) is now known to be inhabited by animals referable to *T. t. durranti* (Kelson, 1949:143). My study supported by those of the aforementioned authors, now proves that the populations formerly arranged under the name *Thomomys fossor* are highly variable; the subspecific name *T. t. fossor* now does not apply to specimens from Utah. Also, my study of specimens from places near the type locality of *T. t. fossor* in southern Colorado shows the animals there to be highly variable; critical study of pocket gophers from this part of Colorado might prove that *T. t. fossor* is even more restricted geographically than is now understood.

Specimens examined.—Total, 71, distributed as follows: *Grand County:* Oak Spring, Middle Fork Willow Creek, 15 mi. N Thompson, 8 (C.M.); La Sal Mountains, 1 (U.S.N.M.); Warner Ranger Station, La Sal Mountains, 9,750 ft., 6 (3, B.Y.U.). *San Juan County:* 1 mi. SE Mesa R.S., La Sal Mountains, 9,200 ft., 4; 3 mi. W Geyser Pass, La Sal Mountains, 10,000 ft., 5; Geyser Pass, 18 mi. SE Moab, La Sal Mountains, 3 (1, B.Y.U.), (2, C.M.); Dalton Spring, 5 mi. W Monticello, Abajo (Blue) Mountains, 8,300 ft., 15 (1, C.M.); Cooley Pass, 8 mi. W Monticello, 2 (C.M.); Gooseberry R.S., Elk Ridge, 8,300 ft., 5; Duck Lake, 1 mi. S Gooseberry R.S., Elk Ridge, 8,400 ft., 5; Joshua Flat, Elk Ridge, 8,300 ft., 3 (M.V.Z.); Johnson Creek, 14 mi. N Blanding, 7,500 ft., 14.

Thomomys talpoides parowanensis Goldman

Northern Pocket Gopher

Thomomys fossor parowanensis Goldman, Journ. Washington Acad. Sci., 28:334, July 15, 1938, type from Brian Head, Parowan Mountains, 11,000 ft., Iron County, Utah.

Thomomys talpoides parowanensis Goldman, Journ. Mamm., 20:234, May 15, 1939; Long, Journ. Mamm., 21:176, May 16, 1940; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:22, August 15, 1946.

Thomomys fossor, Bailey, N. Amer. Fauna, 39:111, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):102, June, 1927; Hall, Univ. California Publ. Zoöl., 37:4, April 10, 1931; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938; Tanner, Great Basin Nat., 1:111, June 30, 1940.

Range.—High mountains of eastern Iron and Beaver counties, and western Kane and Garfield counties.

Description and comments.—Measurements of 1 adult male, number 158601

U. S. N. M., and average and extreme measurements of 4 adult females from Britts Meadow, Beaver Mountains, are respectively, as follows: Total length, 228, 221, (240-207); length of tail, 69, 58 (66-50); length of hind foot, 29, 29 (30-28). Color: Upper parts Sayal Brown moderately mixed with black, lightest on head; sides lightly washed with buff; underparts Pinkish Buff, clearest on inguinal and pectoral regions; nose and cheeks dusky; postauricular patches large and black; front feet, hind feet and distal half of tail white. Skull: Long and fairly slender; zygomatic arches not widely spreading; nasals long; rostrum long and slender; posterior ends of nasals truncate or moderately emarginate; extension of premaxillae posterior to nasals usually short; tympanic bullae relatively small; upper incisors long and narrow; molariform teeth large.

From *Thomomys talpoides kaibabensis, T. t. parowanensis* differs as follows: Size smaller. Skull: Shorter; nasals shorter; zygomatic breadth less; nasals truncate or shallowly emarginate posteriorly as opposed to rounded; upper incisors narrower.

Topotypes of *T. t. parowanensis* differ from topotypes and near topotypes of *Thomomys talpoides uinta* as follows: Size larger. Color: Usually lighter; postauricular patches larger and darker; ears small with pinnae deeply pigmented as opposed to large and lightly pigmented. Skull: Larger; zygomatic arches more widely spreading; nasals longer; rostrum longer; posterior ends of nasals truncate or shallowly emarginate as opposed to deeply emarginate; sides of zygomatic arches nearly parallel and not so divergent posteriorly; interparietal larger and less quadrangular; extension of premaxillae posterior to nasals less; upper incisors less procumbent; molariform teeth larger.

Among named subspecies of *Thomomys talpoides, T. t. parowanensis* most closely resembles *Thomomys talpoides levis,* the subspecies geographically nearest to the east. It differs from it as follows: Size larger. Skull longer and wider; rostrum and nasals longer; interparietal quadrangular as opposed to roughly elliptical; upper incisors longer.

For comparisons with *Thomomys talpoides moorei* and *Thomomys talpoides wasatchensis,* see accounts of those subspecies.

The mountains of south central Utah are inhabited by pocket gophers that have been designated as *T. t. parowanensis* and *T. t. levis* by Goldman (1938a:334, 336). They are nearly indistinguishable in color and each is variable in cranial details. The diagnostic characters of each subspecies occasionally appear, in varying degree, throughout the range of the other. The Sevier River Valley separates the ranges ascribed to these two subspecies. This valley is inhabited by pocket gophers that belong to a different species, *Thomomys bottae.* The ranges of these two subspecies of *T. talpoides* converge southward at the headwaters of the Sevier River.

Specimens of *T. t. parowanensis* from the northern limits of its range from the Beaver Mountains in eastern Beaver County and those of *T. t. levis* from the northern limits of its range in the Fishlake Mountains are readily distinguishable from each other. As the ranges converge to the southward, there is progressively more intergradation. The type locality of *T. t. parowanensis* is in the southern part of its range, whereas that of *T. t. levis* is in the extreme northern part of its range. There, owing to convergence of the two ranges at the south, the specimens from localities near the type locality of *T. t. parowanensis* show the greatest amount of intergradation, if we regard specimens of *T. t. parowanensis* from the type locality as typical of the subspecies. Four specimens from Webster Flat, 16 miles east of Cedar City, Iron County, and 3 from Duck Creek, Cedar Mountains, Kane County could equally well be assigned to either *T. t. levis* or *T. t. parowanensis.*

Specimens examined.—Total, 24, distributed as follows: *Beaver County:* Britts Meadows, Beaver Mountains, 8,500 ft., 7 (3, M.V.Z.; 2, U.S.N.M.; 2, C.M.); Puffer Lake, Beaver Mountains, 1 (U.S.N.M.); Kents Lake, Beaver Mountains, 1 (R.H.). *Iron County:* Lava beds, 3½ mi. SW Panguitch Lake, 1 (C.M.); Brian Head, Parowan Mountains, 2 (1, U.S.N.M.; 1, C.M.); Webster Flat, 16 mi. E Cedar City, 4; Bear Valley, 2 mi. E B. V. Ranger Station, 1 (R.H.). *Garfield County:* ¼ mi. W Sunset Point, Bryce National Park, 8,000 ft., 1 (M.V.Z.). *Kane County:* Navajo Lake 3 (R. H.); Duck Creek, Cedar Mountains, 9,000 ft., 3 (1, R.H.).

Additional records.—Garfield County: Panguitch Lake (Goldman, 1938a: 335). *Iron County:* Beaver Mountains (Bailey, 1915:112).

Thomomys talpoides levis Goldman

Northern Pocket Gopher

Thomomys fossor levis Goldman, Journ. Washington Acad. Sci., 28:336, July 15, 1938, type from Seven Mile Flat, 5 miles north of Fishlake, Fishlake Plateau, 10,000 ft., Sevier County, Utah.

Thomomys talpoides levis Goldman, Journ. Mamm., 20:234, May 15, 1939; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:24, August 15, 1946.

Thomomys fossor, Bailey, N. Amer. Fauna, 39:111, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):102, June, 1927.

Range.—Fishlake Plateau in Sevier County south into Garfield County, Utah.

Description and comments.—Measurements of 2 female topotypes, numbers 158076 and 158077 (U. S. N. M.), are as follows: Total length, 206, 199; length of tail, 70, 61; length of hind foot, 27, 26. Color: Upper parts near Sayal Brown, moderately mixed with black, darkest on head and middorsal region, grading to Cinnamon-Buff on sides and flanks; underparts Pinkish Buff, clearest on inguinal and pectoral regions; chin, cheeks and nose dusky; postauricular patches large and black; front feet, hind feet and distal half of tail white; ears small and deeply pigmented. Skull: Slender and weak; zygomatic arches not widely spreading; posterior ends of nasals rounded; nasals moderately long and narrow; rostrum long and narrow; extension of

premaxillae posterior to nasals short; interparietal usually much wider than long; pterygoid hamulae ridged; interpterygoid space usually narrowly V-shaped; upper incisors short.

From topotypes of *Thomomys talpoides moorei, T. t. levis* differs as follows: Size smaller; tail shorter. Color: Darker throughout, especially on dorsal surface owing to more black of the underfur; underparts deeper buff. Skull: Narrower, less massive; zygomatic processes of maxillae weaker and not so widely spreading; interparietal generally wider; extension of premaxillae posterior to nasals less; posterior ends of nasals rounded rather than emarginate; upper incisors shorter, less procumbent.

Topotypes of *T. t. levis* differs from near topotypes of *Thomomys talpoides uinta* as follows: Size larger. Color: Upper parts slightly darker; postauricular patches much darker and larger; ears small and deeply pigmented as opposed to large and lightly pigmented; tail darker all around at base, with white part more extensive and with fewer buff colored hairs. Skull: More convex dorsally; zygomatic arches more widely spreading and angular; nasals longer; rostrum longer; interparietal wider and more elliptical; posterior ends of nasals rounded as opposed to emarginate; extension of premaxillae posterior to nasals less; pterygoid hamulae more rigid; interpterygoid space more narrowly V-shaped; upper incisors shorter and less procumbent.

Topotypes of *T. t. levis* are markedly smaller in all measurements than those of *Thomomys talpoides kaibabensis.*

For comparisons with *Thomomys talpoides parowanensis* and *Thomomys talpoides wasatchensis,* see accounts of those subspecies.

Specimens from the Escalante Mountains and the Aquarius Plateau are not typical. They are of approximately the same color as *T. t. levis,* but are larger than *T. t. levis* and have cranial details that indicate intergradation with *T. t. kaibabensis* to the south. They resemble *T. t. kaibabensis* in large size, long nasals and widely spreading zygomatic arches, but are like *T. t. levis* in shape of the interparietal, extension of premaxillae posterior to the nasals, rounded posterior ends of nasals, ridged pterygoid hamulae and relatively short upper incisors. Additional material from these regions may prove these animals to merit separation and naming.

Specimens examined.—Total, 41, distributed as follows: *Sevier County:* Seven Mile Flat, 5 mi. N Fishlake, Fishlake Plateau, 10,000 ft., 2 (U. S. N. M.); Fishlake Experiment Station, 2 (U. S. A. C.). *Wayne County:* Elkhorn G. S., 9,400 ft., 14 mi. N Torrey, Fishlake Plateau, 8; Teasdale, 1; 2 mi. SE Torrey, 7,000 ft., 5; Carcass Creek, Grover, 7,250 ft., 2; 1 mi. NE Donkey Lake, Boulder Mountain, 9,500 ft., 4. *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 6; Posy Lake, Aquarius Plateau, 2 (B.Y.U.); 18 mi. N Escalante, 9,500 ft., 3; Steep Creek, Boulder-Teasdale Rd., Boulder Mountain, 4 (B. Y. U.); Summit Birch Creek, Escalante Mountains, 2 (B. Y. U.).

TABLE 9

Cranial Measurements of Thomomys talpoides

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		T. t. gracilis, topotypes								
♂	4 av.	31.5	13.4	21.7	18.3	6.4	7.6	1.3	15.4	7.2
♂	Max.	33.5	14.2	22.0	19.0	6.5	7.9	1.7	16.4	7.5
♂	Min.	30.3	12.9	21.1	17.8	6.3	7.3	1.0	14.7	6.7
♀	44872 M. V. Z.	29.9	12.0	19.7	17.6	6.5	7.4	1.4	14.0	6.6
♀	44870 M. V. Z.	29.5	11.9	19.7	16.9	6.3	7.2	1.1	14.0	6.4
		T. t. wasatchensis, topotypes								
♂	10 av.	31.3	13.4	21.5	18.9	6.5	7.4	1.1	15.1	7.4
♂	Max.	34.5	15.2	23.7	20.4	7.3	8.0	2.0	16.5	8.2
♂	Min.	27.4	11.6	19.1	17.2	6.0	6.6	0.9	14.0	6.7
♀	19 av.	31.5	12.7	20.5	18.0	6.5	7.4	0.9	14.6	7.2
♀	Max.	32.5	14.5	22.0	19.9	6.7	8.1	1.2	16.2	7.5
♀	Min.	28.1	11.2	19.3	17.2	6.2	6.0	0.6	13.0	6.8
		T. t. oquirrhensis, topotypes								
♂	4 av.	32.2	13.9	21.9	19.0	6.9	7.6	0.9	15.8	7.7
♂	Max.	32.8	14.3	22.8	19.5	7.1	7.9	1.0	16.2	7.9
♂	Min.	31.9	13.7	21.4	18.5	6.7	7.2	0.6	15.5	7.5
♀	7 av.	30.2	12.9	20.4	18.2	6.8	7.5	0.8	14.8	7.2
♀	Max.	31.5	13.3	21.0	19.1	7.2	8.0	1.0	15.5	7.5
♀	Min.	28.5	12.2	19.5	17.5	6.6	6.7	0.5	14.2	6.9
		T. t. uinta, SW slope Bald Peak, Uinta Mountains								
♂	5 av.	31.5	13.1	21.7	19.4	6.3	7.6	1.1	15.2	7.4
♂	Max.	32.8	13.8	22.2	20.0	6.5	7.8	1.4	15.6	7.6
♂	Min.	29.6	12.1	20.3	19.0	5.7	7.3	0.7	13.5	7.2
♀	41376 M. V. Z.	28.4	11.6	19.8	17.2	6.4	7.3	1.5	13.3	6.8
♀	41374 M. V. Z.	28.3	11.6	.....	17.4	6.7	7.0	1.1	13.6	6.8
		T. t. pygmaeus, ♂ topotype; ♀ Fossil, Wyoming								
♂	55270 USNM.	24.6	10.2	16.3	15.1	5.4	5.9	0.7	12.0	5.7
♀	178868 USNM.	24.0	10.2	16.5	14.8	5.2	5.6	0.7	11.1	5.8
		T. t. ravus, topotypes								
♂	13690 C. M.	35.1	14.3	25.0	21.2	6.7	8.2	2.2	17.2	8.5
♂	13685 C. M.	35.9	15.1	25.7	22.5	6.7	8.4	2.7	17.5	8.5
♂	13678 C. M.	34.5	14.3	23.6	20.5	6.0	8.2	2.2	16.7	8.1
♀	13684 C. M.	35.7	14.5	24.4	21.5	6.2	7.8	2.7	17.1	8.1

TABLE 9.—*Concluded*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		T. t. ocius, ♂ 12 mi. W Linwood, Henrys Fork, Wyoming; ♀, topotypes								
♂	177506 USNM	27.5	11.5	19.9	17.8	6.2	6.8	1.0	13.5	7.0
♀	18854 USNM	30.1	13.6	21.0	18.0	6.2	7.3	1.0	15.3	7.3
♀	18863 USNM	29.9	13.0	19.9	17.5	6.3	7.1	1.0	14.7	7.5
♀	18861 USNM	30.1	14.0	21.5	18.6	6.1	7.3	0.5	15.0	7.3
		T. t. moorei, topotypes								
♂	7 av	32.4	13.9	22.9	19.2	6.5	7.7	1.5	15.9	7.3
♂	Max	34.7	14.5	23.7	20.0	7.0	8.2	2.0	16.3	7.7
♂	Min	31.3	13.0	21.5	18.4	6.0	7.3	0.9	14.8	6.7
♀	5 av	29.9	12.8	21.5	18.4	6.6	7.3	1.3	14.6	6.8
♀	Max	31.2	14.1	22.5	19.1	6.8	7.5	1.6	15.6	7.0
♀	Min	29.0	12.3	21.0	18.0	6.4	7.0	1.0	14.0	6.4
		T. t. durranti, topotypes								
♂	6 av	31.6	13.7	20.2	17.1	6.3	7.1	0.6	15.6	7.3
♂	Max	35.0	14.9	20.8	17.9	6.5	7.6	0.8	17.1	7.8
♂	Min	31.0	13.1	19.7	16.8	6.1	6.8	0.1	15.0	7.0
♀	8 av	30.3	13.0	20.7	17.7	6.3	7.2	0.5	15.4	7.2
♀	Max	31.2	14.1	21.5	18.5	6.5	7.7	0.9	16.2	7.5
♀	Min	28.8	11.9	19.8	16.3	5.8	6.8	0.0	14.8	6.8
		T. t. parowanensis, Britts Meadow, Beaver Mountain								
♂	158601 USNM	34.6	14.8	22.7	18.9	6.2	8.2	1.7	17.3	8.2
♀	4 av	33.2	14.5	22.8	19.0	6.0	7.8	0.9	15.4	7.3
♀	Max	34.8	15.5	23.0	19.6	6.2	8.1	1.5	17.8	7.7
♀	Min	30.5	12.8	22.7	18.6	5.8	7.4	0.5	14.7	7.0
		T. t. levis, topotypes								
♀	158076 USNM	28.2	11.6	19.5	17.9	6.4	7.2	1.0	13.2	7.0
♀	158077 USNM	28.0	10.6	18.9	17.5	5.8	6.6	0.6	12.8	6.6

Thomomys bottae aureiventris Hall

Botta Pocket Gopher

Thomomys perpallidus aureiventris Hall, Univ. California Publ. Zoöl., 32: 444, July 8, 1930, type from Fehlman Ranch, 3 miles north of Kelton, 4,225 ft., Boxelder County, Utah; Hall, Univ. California Publ. Zool., 37:3, April 10, 1931.

Thomomys bottae aureiventris, Goldman, Proc. Biol. Soc. Washington, 48: 156, October 31, 1935; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:28, August 15, 1946.

Range.—Northwestern Utah, and extreme western Utah as far south as the southern end of the Deep Creek Mountains.

Description and comments.—Average and extreme measurements of 4 adult male topotypes are as follows: Total length, 243 (253-232); length of tail, 67 (72-59); length of hind foot, 32 (33-31). Claws on front feet small. Color: Cinnamon on dorsal and ventral surfaces; inguinal region, front and hind feet and distal third to half of tail white; nose, cheeks and postauricular patches grayish black. Skull: Moderately angular and ridged; zygomatic arches nearly parallel with sides of skull; jugals vertical; marked thickening at union of jugal and zygomatic process of maxilla; greatest zygomatic breadth at anterior part of arches; interpterygoid space lyre-shaped; ventral margin of jugal concave dorsally; nasals long and denticulate distally; parietal ridges bowed in at two places, at coronal suture and at middle of interparietal; paroccipital processes extremely well developed; dorsal frontomaxillary suture usually straight.

From near topotypes of *Thomomys bottae centralis, T. b. aureiventris* differs as follows: Size larger; hind foot longer; claws on front feet shorter. Color: Slightly darker on upper parts, but with greater extension of white on ventral surface. Skull: Zygomatic breadth greater; greatest width across zygomatic arches at anterior rather than posterior region; zygomatic arches thicker at union of jugals and zygomatic processes of maxillae; dorsal frontomaxillary suture less convex medially; mastoid breadth greater; extension of premaxillae posterior to nasals less; interpterygoid space lyre-shaped rather than V-shaped.

From topotypes of *Thomomys bottae albicaudatus, T. b. aureiventris* can be distinguished by: Size larger; hind foot longer. Color: Markedly lighter throughout, Cinnamon as opposed to near (13''''*n*) Black. Skull: Larger in all but three measurements taken; extension of premaxillae posterior to nasals less; alveolar length of upper molar series shorter; zygomatic arches widest anteriorly rather than posteriorly; thickening at union of jugal and zygomatic process of maxilla markedly greater; interpterygoid space lyre-shaped as opposed to V-shaped; lacrimal processes more globose at tips.

Thomomys bottae aureiventris can be distinguished from *Thomomys bottae bonnevillei, Thomomys bottae sevieri, Thomomys bottae wahwahensis* and *Thomomys bottae convexus* by larger size

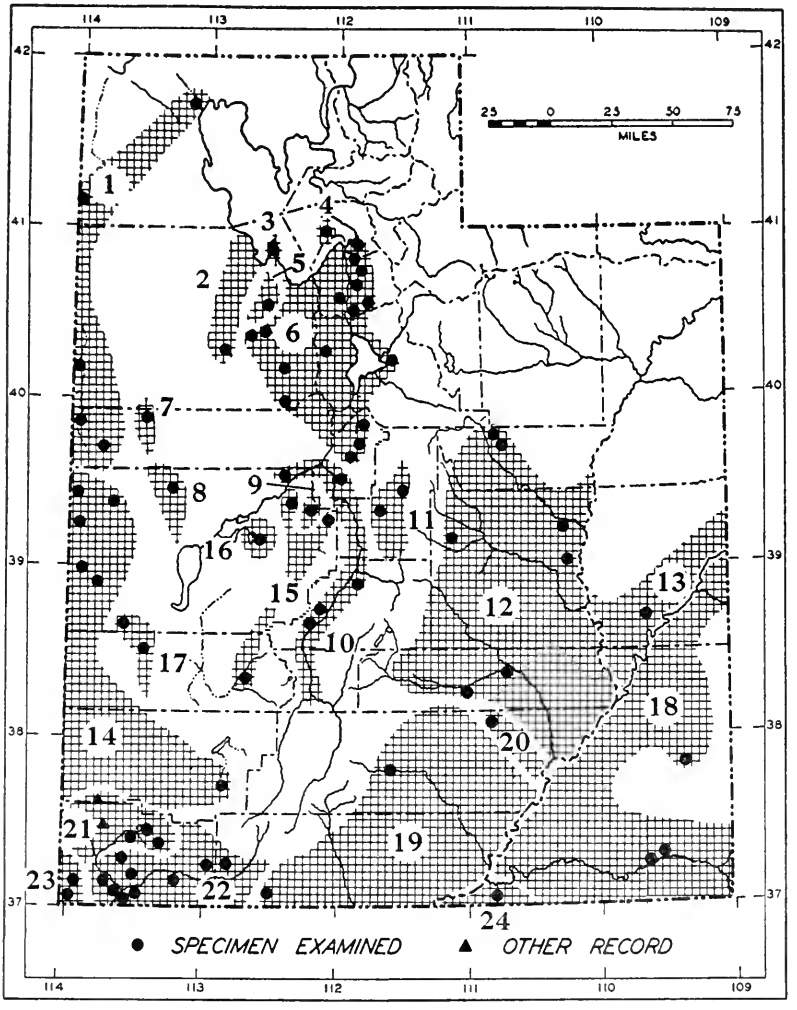

FIG. 38. Distribution of *Thomomys bottae*.

1. *T. b. aureiventris.*
2. *T. b. robustus.*
3. *T. b. minimus.*
4. *T. b. nesophilus.*
5. *T. b. stansburyi.*
6. *T. b. albicaudatus.*
7. *T. b. bonnevillei.*
8. *T. b. sevieri.*
9. *T. b. tivius.*
10. *T. b. lenis*
11. *T. b. levidensis.*
12. *T. b. osgoodi.*
13. *T. b. howelli.*
14. *T. b centralis.*
15. *T. b. contractus.*
16. *T. b. convexus.*
17. *T. b. wahwahensis.*
18. *T. b. aureus.*
19. *T. b. absonus.*
20. *T. b. dissimilis.*
21. *T. b. birdseyei.*
22. *T. b. planirostris.*
23. *T. b. virgineus.*
24. *T. b. alexandrae.*

in all measurements taken and darker coloration. The same differences obtain in comparison with *Thomomys bottae tivius* and *Thomomys bottae stansburyi* except that *T. b. aureiventris* is much lighter colored (see the accounts of those subspecies on succeeding pages).

T. b. aureiventris has one of the most extensive ranges of any subspecies of *T. bottae* occuring in Utah. The range extends from the environs of Kelton, in the northwestern part of the state south along the extreme western margin of the state approximately to the southern end of the Deep Creek Mountains. This ascribed range practically bounds the northwestern and western margins of the great salt desert in Boxelder and Tooele counties. As far as known, this great waste area harbors no members of the *Geomyidae*. Pocket gophers were available from four localities in addition to the type locality. At these four localities all of the animals are intergrades. The three specimens from Queen of Sheba Canyon, Deep Creek Mountains, although smaller than *T. b. aureiventris* in every measurement taken, resemble it in color and general configuration of the skull. The animals from Trout Creek and Ibapah at the southern end of the range, although referred to *T. b. aureiventris* are intermediate between it and *T. b. centralis*. In color and measurements they more closely resemble *T. b. centralis*, but the skulls closely resemble those of *T. b. aureiventris*. The skulls show some slight characteristics of *T. b. bonnevillei*, the subspecies to the east, which indicates relationship of the two. Specimens from the east side of Tecoma Range, adjacent to Pilot Peak, although referred to *T. b. aureiventris*, are intergrades between it and *T. b. centralis*. Although this locality is nearer the type locality of *T. b. aureiventris* than any of the other record stations, the animals show the maximum departure from topotypes in morphological features. In color they approach *T. b. centralis*, and agree with it in one half of the measured characters. The general configuration of the skull and a majority of the critical diagnostic characters, for example, jugal thickening, are more nearly as in *T. b. aureiventris*. From the remarks made immediately above it is readily understood that this subspecies is extremely variable.

Specimens examined.—Total, 62, distributed as follows: *Boxelder County:* Fehlman Ranch, 3 mi. N Kelton, 4,225 ft., 8 (7, M.V.Z.); Utah-Nevada Boundary, E side Tecoma Range, 4,300 ft., 12. *Tooele County:* Ibapah, 5,000 ft., 21. *Juab County:* Queen of Sheba Canyon, W side Deep Creek Mountains, 5,600 ft., 11; Trout Creek, 10.

Thomomys bottae robustus Durrant

Botta Pocket Gopher

Thomomys bottae robustus Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:30, August 15, 1946, type from Orr's Ranch, Skull Valley, 4,300 ft., Tooele County, Utah.

Range.—Skull Valley, Tooele County, Utah.

Description and comments.—Average and extreme measurements of 9 adult male and 11 female topotypes are respectively as follows: Total length, 222 (236-214), 199 (207-191); length of tail, 65 (70-59), 61 (66-56); length of hind foot, 29 (31-28), 27 (29-22). Tail short; hind foot short. Color: In a series of 24 animals, upper parts vary from Pale Smoke Gray (4 specimens) through Cinnamon-Buff (19 specimens) to Dark Mouse Gray (1 specimen). The Cinnamon-Buff color is considered to be typical; grading to lighter on underparts; postauricular patches small and grayish black; front and hind feet and distal part of tail white. Skull: Small, flat and heavily ridged; nasals short; zygomatic arches heavy and widely spreading, widest posteriorly at union of jugal and squamosal; union of jugal and zygomatic process of maxilla thickened, with a ventrally directed process in sixty per cent of the specimens; occasionally there is a second process, also directed ventrally at union of jugal and zygomatic process of squamosal; zygomatic arches convex dorsally; deep dorsal depression present in frontal bones in mature specimens; lacrimal processes prominent, projecting well above arch at anteromedial angle of orbit; interpterygoid space V-shaped; tympanic bullae well inflated ventrally; upper incisors short, and pale; when placed on on a flat plane, dorsal surface of skull nearly parallel to substratum; space enclosed within zygomatic arches nearly quadrangular.

From topotypes of *Thomomys bottae aureiventris*, *T. b. robustus* can be distinguished as follows: Size smaller; tail and hind foot shorter. Color: Lighter throughout. Skull: Smaller, more heavily ridged and more nearly flat; nasals shorter; rostrum relatively wider and shorter; zygomatic arches shorter and relatively more widely spreading, with greatest width posteriorly as opposed to anteriorly; junction of jugal and zygomatic process of maxilla not so prominent; *T. b. aureiventris* shows no spinous process at this junction; lacrimal processes larger and projecting farther dorsally; enclosed space within zygomatic arches roughly quadrangular as opposed to triangular; mastoidal part of tympanic bullae less exposed; sphenoid fissure smaller; interpterygoid space V-shaped rather than lyre-shaped; palatal pits smaller and shallower; tympanic bullae smaller, but more inflated ventrally; basioccipital averaging relatively wider; molars smaller; upper incisors shorter, smaller and cadmium yellow as opposed to orange yellow.

Comparisons of *T. b. robustus* with topotypes of *Thomomys bottae albicaudatus* show the following: Size smaller. Color:

Lighter throughtout; postauricular patches smaller and lighter. Skull: Smaller, more compact and more nearly flat; rostrum shorter and more nearly straight; lacrimal processes larger, projecting higher above anteromedial angle of orbit; parietal ridges uniformly heavier; mastoid width actually as well as relatively wider; zygomatic arches heavier and relatively much wider (males 76.2% of basilar length, females 73.8% as opposed to males 73.8% and females 73.5%); union of jugal and zygomatic process of maxilla uniformly more thickened; spinous process at jugal-maxillary suture present; zygomatic arches much more concave on ventral surface; uniform deep depression present in mature adults, between frontal processes of premaxillae, and anterior interorbital region of frontals; extension of premaxillae posterior to nasals less; sphenorbital fissure more constricted; tympanic bullae more inflated ventrally, extending well ventrad of basioccipital; palatal pits shallower and smaller; molars smaller; upper incisors shorter, narrower and paler (see comparison of *T. b. aureiventris*).

From near topotypes of *Thomomys bottae centralis,* from 1 mile east of Garrison, Utah, *T. b. robustus* differs in: Size smaller; tail and hind foot shorter. Color: Lighter, terminal bands of hairs Cinnamon but, because of more black in underfur, animals appear darker; postauricular patches smaller and lighter. Skull: Shorter, more nearly flat and much more heavily ridged; nasals shorter; rostrum shorter and wider; lacrimal processes larger and projecting higher above anteromedial angle of orbit; zygomatic arches heavier, shorter, more angular and actually as well as relatively wider; jugals thicker; angle between maxillary plate and rostrum less obtuse; spinous process at jugal-maxillary suture present; extension of premaxillae posterior to nasals less; parietal ridges much more pronounced; looked at from above, space enclosed within zygomatic arches more quadrangular in shape as opposed to roughly triangular; tympanic bullae more inflated ventrally; molars smaller; upper incisors shorter, narrower and paler.

The characteristics that distinguish *T. b. robustus from Thomomys bottae wahwahensis* are: Size slightly smaller. Color: Darker throughout. Skull: Rostrum longer and narrower; nasals longer; zygomatic arches wider and longer; lacrimal processes larger and projecting higher above anteromedial angle of orbit; parietal ridges more roughened; tympanic bullae much larger and more inflated ventrally; supraoccipital higher; middorsal depression in frontals present. For comparisons with *Thomomys bottae bonnevillei,* see account of that subspecies.

The remaining subspecies from the Bonneville Basin, namely, *Thomomys bottae sevieri, Thomomys bottae connvexus, Thomomys bottae tivius* and *Thomomys bottae stansburyi* are all easily distinguished from *T. b. robustus.* Specimens of *T. b. sevieri* are paler, smaller in every measurement taken, and the skulls are weaker and less angular. All specimens of *T. b. convexus* are paler, the skulls are more convex dorsally and narrower, with less ridging and angularity. Both *T. b. tivius* and *T. b. stansburyi* are small dark forms, with weak, smooth, small skulls as compared with *T. b. robustus* which is light-colored and has compact, ridged and angular skulls.

Twenty-three specimens were obtained at a small isolated spring. Critical study of animals taken only a few miles to the east prove them to be so different as to be referable to another subspecies, *T. b. albicaudatus. T. b. robustus* is an endemic form in this desert valley. The variable color is noteworthy but difficult to explain in an isolated population as small as this one. All five of the gray animals are females of which four are lactating adults. The affinities of this subspecies are with *T. b. albicaudatus* to the east, but enough time has elapsed since isolation to enable it to differentiate.

Specimens examined.—Total, 23, from the type locality.

Thomomys bottae minimus Durrant

Botta Pocket Gopher

Thomomys bottae minimus Durrant, Proc. Biol. Soc. Washington, 52:161, October 11, 1939, type from Stansbury Island, Great Salt Lake, Tooele County, Utah; Marshall, Journ. Mamm., 21:154, May 16, 1940; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:32, August 15, 1946.

Range.—Known only from the type locality.

Description and comments.—Measurements of topotypes, 2 adult males, numbers 263942 U.S.N.M. and 263945 U.S.N.M. and 2 adult females, numbers 263944 U.S.N.M. and 263941 U.S.N.M., are respectively as follows: Total length, 189, 179, 181, 175; length of tail, 64, 55, 58, 54; length of hind foot, 26, 24, 25, 24. Tail relatively long. Color: Upper parts Pinkish Buff, darker on head; underparts Pale Pinkish Buff; front and hind feet white; nose, chin and postauricular patches black. Skull: Long, slender annd nearly devoid of ridges; braincase moderately inflated; interparietal quadrangular; zygomatic arches weak, widest in temporal region, but neither widely spreading nor angular; nasals straight and truncate posteriorly; extension of premaxillae posterior to nasals relatively great; tympanic bullae moderately inflated; palatal pits deep; rostrum short but narrow; interpterygoid space moderately lyre-shaped; upper incisors narrow; molars light.

From topotypes of *Thomomys bottae albicaudatus, T. b. minimus* differs as follows: Size markedly smaller; claws on front feet shorter

and weaker. Color: Markedly lighter throughout, being Pinkish Buff as contrasted with near (13''''*n*) Black. Skull: Smaller in every measurement taken; slender, smooth weak and nonangular as opposed to ridged, robust, wide and angular; zygomatic arches much weaker and not so widely spreading posteriorly; ascending processes of premaxillae much narrower; extension of premaxillae posterior to nasals less; interpterygoid space moderately lyre-shaped as opposed to V-shaped; dentition lighter.

Topotypes of *T. b. minimus* differ from those of *Thomomys bottae aureiventris* as follows: Size markedly smaller. Color: Lighter dorsally and no "gold color" on underparts. Skull: Markedly smaller in every measurement taken; weak, smooth and slender as opposed to ridged, angular and robust; zygomatic arches weak and widest posteriorly rather than heavy and widest anteriorly; no great thickening at region of union of jugal and zygomatic process of maxilla; jugals more nearly straight rather than concave laterally; interpterygoid space not so markedly lyre-shaped; dentition appreciably lighter.

The subspecies geographically nearest to *T. b. minimus* are *Thomomys bottae nesophilus* and *Thomomys bottae stansburyi.* For comparisons, see accounts of those subspecies.

This subspecies is the smallest of all the kinds of *Thomomys bottae* occurring in Utah. As far as known it is endemic to Stansbury Island, and since the Pleistocene Lake Bonneville attained its highest level has remained on that part of Stanbury Island that was above this high level (see comments under *T. b. nesophilus*). The sandy nature of the soil and the desert conditions of the area that has since been exposed at lowel levels apparently do not constitute a favorable environment. Unlike *T. b. nesophilus* from Antelope Island, the affinities of *T. b. minimus* are not with *T. b. albicaudatus* the valley form of the adjacent mainland, but *T. b. minimus* does show affinities with *T. b. stansburyi,* the nearest montane subspecies on the mainland. This is easily understood when one realizes that Stansbury Island is only an isolated part of Stansbury Mountain that projects northward as a peninsula into Great Salt Lake. The history of Stansbury Island with reference to isolation of *T. bottae minimus* parallels that of *T. bottae nesophilus* on Antelope Island (see discussion under *T. bottae nesophilus*).

Specimens examined.—Five (U. S. N. M.) from *Tooele County,* Stansbury Island in Great Salt Lake.

Thomomys bottae nesophilus Durrant

Botta Pocket Gopher

Thomomys bottae nesophilus Durrant, Bull. Univ. Utah, 27 (no. 2):2, October, 1936, type from Antelope Island, Great Salt Lake, Davis County, Utah; Marshall, Journ. Mamm., 21:156, May 16, 1940; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:34, August 15, 1946.

Range.—Known only from the type locality.

Description and comments.—Average and extreme measurements of 4 adult males and measurements of one adult female, number 900, topotypes, are, respectively, as follows: Total length, 230 (242-220), 210; length of tail, 69 (75-60), 65; length of hind foot, 32 (33-30), 31. Claws on front feet long. Color: Upper parts Cinnamon-Buff; lighter below; sides Pinkish Buff interspersed with gray; pectoral and inguinal regions Cinnamon; nose grayish black; postauricular patches black. Skull: Interparietal wedge-shaped; tympanic bullae small; dorsal surface of lambdoidal prominence 3 mm. wide rather than developed as a crest; jugals nearly straight; zygomatic arches strongly rectangular.

Compared with topotypes of *Thomomys bottae albicaudatus*, *T. b. nesophilus* is of approximately the same size, but differs as follows: Claws on front feet longer. Color: Lighter throughout; tail white terminally, but much darker at base; postauricular patches smaller. Skull: Interparietal wedge-shaped as opposed to roughly quadrangular; lambdoidal eminence more of a crest than a ridge; tympanic bullae smaller; jugals more nearly straight; zygomatic arches more nearly rectangular.

From topotypes of *Thomomys bottae aureiventris*, *T. b. nesophilus* differs in: Size smaller; claws on front feet longer. Color: Darker throughout; postauricular patches larger. Skull: Heavier, more massive; zygomatic arches more robust and convex laterally rather than concave; interparietal wedge-shaped rather than roughly quadrangular; braincase more nearly flat; tympanic bullae markedly smaller; upper molariform series longer; molariform teeth wider and heavier; interpterygoid space V-shaped rather than lyre-shaped.

The subspecies nearest geographically to *T. b. nesophilus* is *Thomomys bottae minimus* from Stansbury Island, Great Salt Lake. It can be easily distinguished from *T. b. minimus* by the following features: Size much larger; claws on front feet longer and thicker. Color darker throughout; postauricular patches larger and with more admixture of buff colored hairs. Skull larger in every measurement taken; wide and robust as opposed to narrow and slender; zygomatic arches more widely spreading and angular; braincase more nearly flat; tympanic bullae actually larger, but relatively

smaller; lambdoidal eminence flat-topped rather than a crest; interparietal wedge-shaped as opposed to quadrangular; teeth larger.

The affinities of *T. b. nesophilus* of Antelope Island are unquestionably with *T. b. albicaudatus* of the eastern and southern mainland. At the time of this writing (1948), Antelope Island is not truly an island, but only the tip of a broad peninsula projecting westward into Great Salt Lake. Nevertheless, the area of occurrence of *T. b. nesophilus* is effectively isolated by the exposed, sandy lake bottom that is unsuited to occupancy by pocket gophers. Fluctuations in the level of the Great Salt Lake have broken and re-established this connection with the mainland many times. Each of the several other kinds of mammals which are known from both the island and the mainland shows no differentiation on the mentioned island. These are kinds (see Marshall, 1940:156), which more freely cross the exposed, sandy lake bottom. I, myself, have noted tracks of coyotes going to and from the island. The pocket gopher, *T. b. nesophilus*, so far as known, is the only mammal which has developed a subspecies endemic to the island. The beach levels of the Pleistocene Lake Bonneville are well marked on both Antelope Island and Stansbury Island which is 15 miles west of Antelope Island. On the eastern side of Antelope Island the lower beach levels of this prehistoric lake are farmed. Although sought for elsewhere on this island, pocket gophers were found only in the farmed land. On Stansbury Island there has been no farming, and the endemic pocket gophers, *T. b. minimus*, although sought for elsewhere on that island were found only above the highest beach levels of the ancient lake. Evidently these pocket gophers still occupy only that part of Stansbury Island that was above water during the period when Lake Bonneville was at its greatest height. Farming on Antelope Island may have developed a more favorable environment for pocket gophers, thus causing them to move down to the lower levels from that part of the island that was above water during Pleistocene times.

Specimens examined.—Total, 5, from the type locality.

Thomomys bottae stansburyi Durrant

Botta Pocket Gopher

Thomomys bottae stansburyi Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:36, August 15, 1946, type from South Willow Creek, Stansbury Mountains, 7,500 ft., Tooele County, Utah.

Range.—Stansbury Mountains, Tooele County, Utah.

Description and comments.—Average and extreme measurements of 5 adult male and 5 adult female topotypes, are respectively, as follows: Total length,

206 (215-198), 202 (210-195); length of tail, 60 (68-58), 57 (63-56); length of hind foot, 28 (31-26), 28 (30-26). Color: Upper parts Saccardo's Umber, darker on head; sides and underparts Pinkish Buff; nose, chin and postauricular patches black; front and hind feet and distal third to half of tail white. Skull: Small, slender, weak and smooth; zygomatic arches light and not widely spreading; zygomatic arches actually as well as relatively short; interparietal generally quadrangular; nasals relatively long and slender; interpterygoid space narrowly V-shaped; basioccipital fairly wide; tympanic bullae moderately inflated ventrally; dentition light.

Topotypical specimens of *T. b. stansburyi* can be readily distinguished from those of *Thomomys bottae centralis, Thomomys bottae aureiventris* and *Thomomys bottae albicaudatus* by being smaller in every measurement taken, particularly those of the skull, which is weaker and smoother. In color *T. b. stansburyi* is like *T. b. albicaudatus* but is much darker throughtout than *T. b. aureiventris* and *T. b. centralis.*

Comparisons of topotypes of *T. b. stansburyi* with those of *Thomomys bottae sevieri* show them to be of approximately the same size, but to differ as follows: Color: Darker throughout. Skull: Zygomatic arches shorter; tympanic bullae less inflated ventrally; zygomatic breadth less; mastoid breadth greater; width across alveolar processes of maxillae greater; alveolar length of upper molar series greater; molariform teeth larger.

From topotypes of *Thomomys bottae minimus, T. b. stansburyi* is seen to be of larger size and darker color throughout, with a skull that is larger in almost every measurement taken, although of the same slender, smooth, nonangular type.

Among named subspecies of *Thomomys bottae, T. b. stansburyi* most closely resembles *Thomomys bottae tivius,* a small, dark, mountain subspecies from central Utah. Size and color are almost the same but *T. b. stansburyi* differs in: Tail shorter; hind foot averaging slightly longer. Skull: Larger in every measurement taken; zygomatic arches shorter; width across alveolar processes of maxillae greater; zygomatic arches more widely spreading, and widest in extreme posterior region rather than in region of jugal-squamosal suture.

The Stansbury Mountains are separated from the Oquirrh Mountains by the Stockton Bar, and from the Onaqui Mountains, which are in reality a continuation of the Stansbury Mountains, by only a low pass. Pocket gophers from Clover Creek, Onaqui Mountains and Little Valley, Sheeprock Mountains, although intergrades between *Thomomys bottae robustus* and *T. b. albicaudatus* are dark in color like *T. b. stansburyi.* These intergrades are large, dark

colored, and have heavy, ridged, angular skulls. It appears that *T. b. stansburyi* is a mountain subspecies derived from *T. b. albicaudatus* of the valley. It would be instructive to transplant gophers from mountains to valleys, and *vice versa,* so as to reveal what effects if any on morphology the environment might have in one or a few generations. Gophers are well known to be very plastic, and such an experiment as suggested might call for modification of the view, held here, that the differential features of gophers from South Willow Creek and say, Bauer, are hereditary.

Specimens examined.—Total, 11, from the type locality.

Thomomys bottae albicaudatus Hall

Botta Pocket Gopher

Thomomys perpallidus albicaudatus Hall, Univ. California Publ. Zoöl., 32:444, July 8, 1930, type from Provo, 4,510 ft., Utah County, Utah; Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931.

Thomomys bottae albicaudatus, Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Durrant, Bull. Univ. Utah, 28 (no. 4):5, August 18, 1937; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:37, August 15, 1946.

Thomomys perpallidus aureiventris Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931.

Range.—From Bountiful, in the area between the Great Salt Lake and the Wasatch Mountains, south along the western margin of the central mountains of the state to the Sevier River, in Juab County, west into Tooele County to the Onaqui and Sheeprock mountains.

Description and comments.—Average and extreme measurements of 7 adult male and 4 adult female topotypes are, respectively, as follows: Total length, 228 (235-223), 211 (219-199); length of tail, 65 (72-59), 64 (70-55); length of hind foot, 31 (32-29), 30 (32-29). Claws on front feet medium. Color: Upper parts near (13''''*n*) Black, grading over sides and flanks to Pinkish Cinnamon on underparts; chin, nose, top of head and postauricular patches black; front feet, hind feet and distal third to half of tail white. Skull: Angular and ridged; zygomatic arches moderately wide-spreading, widest posteriorly; paroccipital processes weak; zygomatic processes of maxillae convex anteriorly; lacrimal processes small and peglike; jugals convex dorsally on ventral surface; nasals short, rounded distally and truncate proximally; parietal crests bowed in, at two places; interpterygoid space broadly V-shaped.

For comparisons of *T. b. albicaudatus* with *Thomomys bottae aureiventris* and *Thomomys bottae centralis,* see accounts of those subspecies.

Topotypes of *T. b. albicaudatus* are dark-colored and can be distinguished from those of *Thomomys bottae birdseyei, Thomomys bottae tivius, Thomomys bottae stansburyi* and *Thomomys bottae contractus* which are also dark-colored subspecies, by larger size and larger, more robust skulls (see accounts of those subspecies).

T. b. albicaudatus can be distinguished from the remainder of the known subspecies of *Thomomys bottae* in Utah by darker color and by cranial details (see accounts of those subspecies).

The range of *T. b. albicaudatus* is larger than that of any other subspecies of *Thomomys bottae* limited to Utah. Specimens are available from thirty localities which represent widely varied habitats and environments. This subspecies consists of many highly variable local populations, and the marginal populations intergrade freely with adjacent subspecies. In many populations, it is really difficult to recognize the relationships on account of the great variation, and the student is frequently tempted to name some of them as distinct. Careful study of the large number of specimens has enabled me to recognize diagnostic characters common to all of these variable populations. The animals range from large and dark at the north to small and light at the south.

The Jordan River bisects Salt Lake County from north to south. Pocket gophers were taken at nine places east of the river, and at three places west of the river. Gophers from Salt Lake City and environs east of the river vary in color from almost black to dark cinnamon. Specimens from Draper, which locality is likewise east of the river, are uniformly lighter, but also vary in color. The skulls of animals from both localities are indistinguishable from each other and closely resemble those of the topotypes. Specimens from the west side of the river, from Riverton, 2 miles west of Murray and Rose Canyon, Oquirrh Mountains, are all lighter in color than topotypes. The color varies from darkest at the north at Murray to lightest at the south at Riverton. This is exactly the reverse of what would be expected since Riverton is the locality geographically nearest to the type locality, Provo. The skulls are quite uniform and are all referable to *T. b. albicaudatus*. The Jordan River may be one factor which causes this lack of uniformity between the animals from the two sides of the river. Davis (1939:56-57) states that a river is not a barrier to movements of pocket gophers where the river completely freezes over and has the ice covered with thick snow. Although the Jordan River does occasionally freeze over, it is never frozen for more than a few days at a time, and snow in this region does not last for long periods. The material at hand indicates that the gophers from both sides of the river are referable to the same subspecies, *T. b. albicaudatus*. The animals from the east side of the river, in the aggregate of characters, resemble topotypes of *T. b. albicaudatus* more closely than do any other specimens. Those from the west side of the river, although

definitely referable to *T. b. albicaudatus,* do show some intergradation with *Thomomys bottae robustus,* the subspecies situated to the west.

The specimens from Bauer, Tooele County, are relatively uniform in color, and are considerably lighter than topotypes of *T. b. albicaudatus.* Their upper parts vary from Sepia to Saccardo's Umber as compared with near (13''' *n*) Black of the topotypes. The sides and underparts are lighter, primarily because of much less black in the underfur. The specimens from Bauer average slightly longer in total length, but shorter in length of hind foot. All cranial measurements are slightly smaller than in topotypes of *T. b. albicaudatus.* The shape of the skull closely resembles that of *T. b. albicaudatus,* although the rostrum, nasals, upper incisors and posterior tongues of the premaxillae tend to be narrower. This narrowness indicates intergradation with *Thomomys bottae stansburyi* the subspecies nearest to the west. In the majority of their characters these animals are referable to the subspecies *Thomomys bottae albicaudatus.*

Bauer is situated in extreme western Tooele Valley at the foot of Stockton Bar, a low pass between the Stansbury and the Oquirrh mountains. This valley lies to the west of the aforementioned Jordan River. While these gophers are definitely referable to *T. b. albicaudatus* they are not so typical as the animals from Riverton.

The specimens from Settlement Canyon, in the Oquirrh Mountains, show the same characteristics as those from Bauer.

In large series of animals from St. John in Rush Valley the upper parts vary from black, even darker than topotypes of *T. b. albicaudatus,* to Tawny-Olive, and the underparts vary from black through Cinnamon-Buff to Pinkish Buff. Most of the animals are Cinnamon-Buff. Although variable they approach *T. b. albicaudatus* in color. The total length, tail and hind foot of males are longer than in topotypes of *T. b. albicaudatus;* females differ in the same direction but only slightly. In both sexes the zygomatic breadth is less, and the mastoid breadth is greater than in *T. b. albicaudatus.* In size and shape of the lacrimal processes, and the great thickening of the jugal at the maxillo-jugal suture, they approach *T. b. robustus.* They are much larger, however, and in the majority of characters are referable to *T. b. albicaudatus.*

What has just been said relative to the animals from St. John applies also to those from Clover Creek in the Onaqui Mountains of Tooele County. At the latter locality the tendencies towards *T. b. robustus* are accentuated. This is to be expected, since this locality is midway between St. John and the type locality of *T. b.*

robustus. All characters considered, these animals are all referable to *T. b. albicaudatus.*

The animals from Little Valley, Sheeprock Mountains, Tooele County, resemble *T. b. albicaudatus* in color. They vary on the upper parts from near(*1*) Sepia to Clay Color, and ventrally from nearly black to Pinkish Buff. They are markedly smaller in every measurement taken, except zygomatic and mastoidal breadths, and extension of premaxillae posterior to nasals. This relatively greater breadth indicates intergradation with *T. b. robustus* to the west. These gophers are smaller in most measurements than any other population referred to *T. b. albicaudatus.* This is understandable because gophers from mountains usually are smaller and have weaker, smoother skulls than animals from lowlands. Although approaching *T. b. robustus* in size and in some aforementioned cranial details, the aggregate of characters, including color, make these animals referable to *T. b. albicaudatus.*

The animals from Fairfield are closer geographically to the type locality of *T. b. albicaudatus* than any other series, but morphologically are the least like topotypes. At first glance one is struck with the differences. They are uniformly Clay Color above, with Cinnamon-Buff sides and flanks and Pinkish Buff underparts. Their color closely approaches that of *T. b. robustus* to the west which has Cinnamon-Buff on the upper parts. Examination of eleven measurements for males and the same number for females shows that the animals are nearest to *T. b. robustus* in two measurements, to *T. b. albicaudatus* in 12, distinct in 7 and intermediate in one. The general appearance of the skull is intermediate between that of the two above mentioned subspecies. The differences from *T. b. albicaudatus* in size and color may be correlated with the differences in soil at Fairfield and Provo. At Fairfield the soil is light-colored clay, but at Provo it is sandy and darker. Although they are intergrades between *T. b. robustus* and *T. b. albicaudatus,* the animals are referred to the latter subspecies. Utah Lake and its outlet, the Jordan River, make a partial barrier between populations at Fairfield and at the type locality at Provo. During Pleistocene times, when Lake Bonneville was present it formed a complete barrier. Enough time has evidently elapsed since the disappearance of this lake to allow *T. b. albicaudatus,* the mainland subspecies, to expand its range to the west. Intergradation has taken place with the result that the animals from Fairfield, although unstable, agree with the mainland form, *T. b. albicaudatus,* in the majority of their characters.

Pocket gophers were taken at four localities from north to south in eastern Juab County. They range in color from Ochraceous-Tawny on the upper parts and Cinnamon-Buff on the underparts to shades that are slightly lighter. All are much lighter than topotypes of *T. b. albicaudatus.* The general configuration of the skull is the same as that of *T. b.. albicaudatus,* and this is especially true of the females. In the narrower rostrum and weaker dentition they approach *T. b. contractus,* but are distinctly lighter colored. Hall (1931:3) referred one specimen from Nephi to *Thomomys bottae aureiventris.* Since that time *Thomomys bottae lenis* which has some affinities with *T. b. aureiventris* has been described (see account of *T. b. contractus*). The large series now available from Nephi and nearby localities do show some intergradation with *T. b. lenis,* in that four characters are more as in *T. b. lenis* and *T. b. contractus* and seven characters are more as in *T. b. albicaudatus.* Although differing markedly in many respects from topotypes of the subspecies *T. bottae albicaudatus* they fit the aforementioned concept of this subspecies, and are being treated as a variable local population of it.

Provo is the locality listed for specimens which were available to naturalists from 1875-1877. To these specimens the following names were applied: *Thomomys talpoides bulbivorus* Coues (1875:256; 1877:627) and *Thomomys talpoides umbrinus* Coues and Yarrow (1875:112). Possibly these names were applied to the animals currently known as *Thomomys bottae albicaudatus* which does occur at Provo. Without the opportunity to examine the actual specimens which so far as I know are no longer in existence, the possibility cannot be excluded that the locality designation "Provo" was used in a general sense to include pocket gophers taken a few miles to the eastward of Provo, where it is known that pocket gophers of only the species *Thomomys talpoides* (current terminology) occur.

Specimens examined.—Total, 248, distributed as follows: *Davis County:* Bountiful, 4,500 ft., 1. *Salt Lake County:* Salt Lake City and environs, 4,300 ft., 58; 2 mi. W Murray, 4,300 ft., 6; Riverton, 4,300 ft., 11; Mouth Little Willow Creek, 5 mi. NE Draper, 5,000 ft., 1; Draper, 4,500 ft., 7; Corner Canyon, "near" Draper Tunnel, 5,000 ft., 1; Rose Canyon, Oquirrh Mountains, 5,650 ft., 4. *Tooele County:* Bauer, 4,500 ft., 30; Settlement Creek, Oquirrh Mountains, 6,500 ft., 1; St. John, 4,300 ft., 28; Clover Creek Onaqui Mountains, 5,500 ft., 15; Vernon, 4,300 ft., 2 (U.S.A.C.); Little Valley, Sheeprock Mountains, 5,500 ft., 20. *Utah County:* Fairfield, 4,800 ft., 24; Provo, 4,400 ft., 20 (1, B.Y.U.; 12, M.V.Z.). *Juab County:* Neff Farm, 4 mi. N Nephi, 5,000 ft., 2 (1, R.H.); Nephi, 5,000 ft., 1 (M.V.Z.); 2 mi. S Nephi, 4,700 ft., 14; 7 mi. SW Nephi, 6,000 ft., 2.

Thomomys bottae bonnevillei Durrant

Botta Pocket Gopher

Thomomys bottae bonnevillei Durrant Univ. Kansas Publ. Mus. Nat. Hist., 1:41, August 15, 1946, type from Fish Springs, 4,400 feet, Juab County, Utah.

Range.—Known only from the type locality.

Description and comments.—Measurements of three male topotypes, numbers 3576, 3582 and 3615, and average and extreme measurements of 7 female topotypes, are respectively, as follows: Total length, 221, 236, 227, 199 (216-184); length of tail, 62, 79, 70, 57 (66-50); length of hind foot, 30, 30, 30, 28 (29-24). Claws on front feet small. Color: Entire dorsal surface Warm Buff; sides near (*e*) Cinnamon-Buff; underparts near (16″) Pale Pinkish Buff; inguinal region, front and hind feet and distal part of tail white; top of head, nose and cheeks grayish black; postauricular patches small and grayish black; ears small, pointed and with heavily pigmented pinnae. Skull: Angular, short but wide; nasals of medium length, narrow proximally but widely flared distally; interparietal small; lambdoidal suture concave towards the interparietal; zygomatic arches uniformly widely spreading; interpterygoid space widely V-shaped; extension of premaxillae posterior to nasals long; lambdoidal crest well developed.

From topotypes of *Thomomys bottae aureiventris*, *T. b. bonnevillei* differs as follows: Size smaller, hind foot shorter. Color: Upper parts and sides lighter; underparts pale buff rather than "gold". Skull: Shorter and relatively wider; rostrum wider and heavier; zygomatic arches relatively wider and more massive, with greatest width posteriorly instead of anteriorly; interpterygoid space widely V-shaped rather than lyre-shaped; thickening at union of jugal and zygomatic process of maxilla less developed; anterior palatine foramina larger; nasals shorter and more markedly flared distally; zygomatic breadth relatively, and mastoidal breadth actually, wider; extension of premaxillae posterior to nasals greater; tympanic bullae more inflated ventrally; upper incisors wider.

From near topotypes of *Thomomys bottae centralis*, from 1 mile east of Garrison, Millard County, Utah, *T. b. bonnevillei* differs as follows: Size smaller; hind foot and tail shorter. Color: Generally darker above and lighter below; top of head darker; postauricular patches smaller and lighter. Skull: Shorter and wider (zygomatic breadth expressed in per cent of basilar length in males being 74.5 in *T. b. bonnevillei* and 71.5 in *T. b. centralis*); interpterygoid space more widely V-shaped; interparietal smaller, and more triangular; nasals shorter and much more dilated distally, as well as more constricted proximally; lacrimal processes smaller and less globose at tips; temporal fossae larger; braincase and en-

tire surface of skull more nearly flat; lambdoidal suture convex posteriorly as opposed to nearly straight; tympanic bullae more inflated ventrally.

Comparisons of *T. b. bonnevillei* with the type and type series of *Thomomys bottae wahwahensis* show them to be of approximately the same size, but to differ as follows: Color: Slightly darker above and lighter below; postauricular patches smaller and lighter. Skull: Larger in every measurement taken, except breadth of rostrum which is smaller; skull not so nearly flat; tympanic bullae more inflated ventrally; nasals and rostrum longer; extension of premaxillae posterior to nasals greater; interparietal smaller and more triangular; zygomatic arches more bowed out laterally; jugals heavier; interpterygoid space more widely V-shaped; upper incisors less massive.

The characters that distinguish *T. b. bonnevillei* from *Thomomys bottae albicaudatus* are: Size smaller. Color: Markedly lighter throughout. Skull: Shorter and wider; mastoid and zygomatic breadths greater; rostrum narrower but shorter; angle between rostrum and zygomatic processes of maxillae less; interparietal smaller and more triangular; extension of premaxillae posterior to nasals greater; upper incisors shorter, narrower and more recurved.

T. b. bonnevillei is indistinguishable in color from *Thomomys bottae convexus*, but differs from it in the following features: Size larger in nearly every measurement taken. Skull: Flattened dorsally as opposed to convex; zygomatic arches longer and weaker; jugals more nearly perpendicular; tympanic bullae larger; upper incisors longer; alveolar length of upper molar series the same, but molars narrower; rostrum longer but nasals shorter; extension of premaxillae posterior to nasals greater.

Topotypes of *T. b. bonnevillei* can be distinguished from those of both *Thomomys bottae tivius* and *Thomomys bottae stansburyi* by being larger in every measurement taken, by markedly lighter color throughout, and by ridged, massive, angular skulls rather than smooth, weak, nonangular skulls.

The subspecies closest geographically to *T. b. bonnevillei* are *Thomomys bottae robustus* and *Thomomys bottae sevieri.* Compared with topotypes of *T. b. robustus, T. b. bonnevillei* differs in: Size larger; color lighter throughout; skull larger, although not so compact; zygomatic arches more widely spreading; jugals lighter; lacrimal processes not so prominent; zygomatic processes of maxillae not so robust; nasals more flared distally; extension of premax-

illae posterior to nasals greater; alveolar length of upper molar series longer; molars larger; upper incisors longer, wide, and color darker; when placed ventral side down on a flat surface, dorsal face of skull of *T. b. robustus* is approximately parallel to surface whereas the skull of *T. b. bonnevillei* dips down in occipital region.

T. b. sevieri can be easily distinguished from *T. b. bonnevillei* by being smaller in every measurement taken, darker in color, and by small, weak, smooth skulls as opposed to large, robust, ridged skulls.

Fish Springs, where *T. b. bonnevillei* occurs is a marshy area south of the barren, salt-desert country of western Utah. The source of water is springs at the base of the north end of the Fish Springs Mountains. Only the moist area supports pocket gophers. Specimens from Trout Creek, 25 miles to the southwest, are intergrades between *T. b. bonnevillei* and *T. b. aureiventris*, and are referred to the latter subspecies. The country between Fish Springs and Trout Creek in 1937 and 1940 lacked pocket gophers; it was of the playa and sand type. Probably *T. b. bonnevillei* was derived from *T. b. aureiventris*, a western mainland form of Pleistocene Lake Bonneville, through isolation and subsequent differentiation morphologically. The moist soils at Cane Springs, 7 miles south of Fish Springs, had no pocket gophers when visited in 1940.

Specimens examined.—Total, 11, from the type locality.

Thomomys bottae centralis Hall

Botta Pocket Gopher

Thomomys perpallidus centralis Hall, Univ. California Publ. Zoöl., 32:445, July 8, 1930, type from 2½ miles east of Baker (1¼ mi. W Nevada-Utah Boundary on 39th parallel), 5,700 ft., White Pine County, Nevada.

Thomomys bottae centralis Hall, Univ. California Publ. Zoöl., 38:333, February 27, 1932; Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:44, August 15, 1946; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Extreme western Utah, in Millard, Beaver and Iron counties.

Description and comments.—Average and extreme measurements of 9 adult male and 17 adult female topotypes are, respectively, as follows: Total length, 237 (250-215), 214 (229-195); length of tail, 75 (83-61), 67 (75-55); length of hind foot, 30 (32-29), 29 (30-27). Tail long; claws on front feet long. Color: Near Cinnamon-Buff on upper parts, darker in middorsal region, grading to Pinkish Buff on underparts, more accentuated in pectoral and inguinal regions; nose, cheeks and postauricular patches grayish black; front and hind feet and distal half of tail white. Skull: Robust and moderately ridged; zygomatic breadth about the same for entire length of arches; jugals vertical posterior to middle; moderate thickening present at region of maxillo-jugal suture; interpterygoid space narrowly V-shaped; dorsal fronto-maxillary sutures

convex medially; lacrimal processes globose and well developed; nasals long and with distal denticulations; paroccipital processes well developed.

From topotypes of *Thomomys bottae albicaudatus, T. b. centralis* differs as follows: Size larger; tail longer; claws on front feet longer. Color: Lighter throughout, Cinnamon-Buff as opposed to near (13'''*n*) Black. Skull: Basilar length and length of nasals greater; zygomatic breadth less; zygomatic arches thicker at region of maxillo jugal sutures; interpterygoid space more broadly V-shaped; dorsal fronto-maxillary sutures convex medially as opposed to straight; paroccipital processes more developed; zygomatic breadth approximately the same for entire length of arches as opposed to greater posteriorly.

For comparison with *Thomomys bottae aureiventris,* see account of that subspecies.

T. b. centralis can be distinguished from *Thomomys bottae bonnevillei, Thomomys bottae robustus, Thomomys bottae sevieri* and *Thomomys bottae convexus* by larger size throughout and generally darker color (see accounts of those subspecies). From *Thomomys bottae stansburyi* and *Thomomys bottae tivius, T. b. centralis* differs in larger size throughout and lighter color (see accounts of those subspecies).

Thomomys bottae centralis has one of the most extensive ranges of any of the subspecies of *T. bottae.* The eastern limits extend into extreme western Utah. Specimens from Utah for the most part are intergrades between *T. b. centralis* and *T. b. aureiventris,* the subspecies to the north. Some slight evidence of intergradation is noted also between the eastern populations of *T. b. centralis* and populations of the more eastern subspecies *T. b. sevieri* and *T. b. bonnevillei.* Intergradation between *T. b. centralis* and *T. b. aureiventris* is to be expected because both occur on the western mainland of the Pleistocene Lake Bonneville, whereas the subspecies to the east, *T. b. sevieri* and *T. b. bonnevillei,* although closest geographically to these far eastern populations of *T. b. centralis* were isolated from the gophers of the western mainland in prehistoric times by this lake. They are still isolated and enough time has elapsed so that only vestiges of morphological intergradation exist between *T. b. centralis* and these eastern forms. Two specimens from Cedar City are intergrades between *Thomomys bottae wahwahensis, T. b. centralis* and *Thomomys bottae planirostris.* Their skulls are slightly convex as in *T. b. planirostris,* and the rostrum is short and wide as in *T. b. wahwahensis.* In shape of the zygomatic arches, length of the nasals and color they resemble *T. b. centralis* to which they are here referred.

Specimens examined.—Total, 49, distributed as follows: *Millard County:* 1 mi. SE Gandy, 5,000 ft., 15 (M.V.Z.); White Valley (Tule Spring), 60 mi. W Delta, 4 (3 in R. W. Fautin Vertebrate Collection); Robison Ranch, 5,300 ft., (on Hendry Creek), 4,596 ft., 2 (M.V.Z.); 1 mi. E Garrison, 5,000 ft., 21; 5 mi. S Garrison, 5,400 ft., 5 (M.V.Z.). *Iron County:* Cedar City, 2 (M.V.Z.).

Thomomys bottae sevieri Durrant

Botta Pocket Gopher

Thomomys bottae sevieri Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:45, August 15, 1946, type from Swasey Spring, House Mountains, 6,500 ft., Millard County, Utah.

Range.—Known only from the type locality.

Description and comments.—Measurements of 3 adult male, numbers 1381, 1383, and 1374, and average and extreme measurements of 7 adult female, topotypes are, respectively, as follows: Total length, 210, 215, 220, 205 (212-199); length of tail, 66, 67, 68, 62 (70-54); length of hind foot, 30, 29, 31, 28 (29-28). Claws on front feet short and weak; ears short; tail relatively long. Color: Upper parts Pinkish Buff, grading over sides to Pale Pinkish Buff on underparts; nose, top of head, chin and cheeks grayish black; postauricular patches small and grayish black; front and hind feet and distal two-thirds of tail white. Skull: Small, weak and smooth; rostrum narrow; nasals narrow, not markedly flared distally; zygomatic arches weak, not angular, and of "graceful" contour; lacrimal processes small; characteristic dorsal depression present in region of sagitto-coronal suture; mastoid nad zygomatic breadths narrow; occiput narrow and high; braincase well inflated; paroccipital processes small and smooth; interpterygoid space narrowly V-shaped; tympanic bullae well inflated ventrally; alveolar length of upper molar series short; molars small; upper incisors short, but narrow.

From topotypes of *Thomomys bottae aureiventris, Thomomys bottae sevieri* differs as follows: Size smaller. Color: Lighter throughout, no "gold" on underparts. Skull: Much smaller in every measurement taken, less massive and not angular; zygomatic arches weaker and widest posteriorly rather than anteriorly; union of jugal and zygomatic process of maxilla not greatly thickened; interpterygoid space narrowly V-shaped rather than lyre-shaped; pterygoid hamulae shorter and weaker; tympanic bullae smaller, but markedly more inflated ventrally; dentition smaller and weaker.

From near topotypes of *Thomomys bottae centralis, T. b. sevieri* can be distinguished by the following features: Size markedly smaller; color lighter throughout; skull markedly smaller in every measurement taken, weaker and smoother; zygomatic arches weaker, less angular and more "graceful;" rostrum shorter but narrower; lacrimal processes smaller; tympanic bullae smaller, but more inflated ventrally, being triangular in shape as opposed to ovate and with anteromedial margin decidedly pointed; pterygoid hamulae smaller and weaker; dentition smaller and weaker.

T. b. sevieri can readily be distinguished from *Thomomys bottae albicaudatus* by the following features: Size smaller in every measurement taken; color markedly lighter throughout; skull smaller, and weaker; rostrum shorter and narrower; ascending processes of premaxillae narrower; extension of premaxillae posterior to nasals shorter; posterior tongues of premaxillae narrower; dentition much lighter.

T. b. sevieri and topotypes of *Thomomys bottae wahwahensis* are of approximately the same size, but *T. b. sevieri* differs as follows: Hind foot longer; ear shorter; color slightly darker; skull smaller, weaker, less ridged; zygomatic breadth less; zygomatic arches markedly less angular; mastoid breadth less; rostrum much longer and narrower, not so blunt nor flattened; tympanic bullae much larger and more inflated ventrally; braincase vaulted as opposed to flattened.

From topotypes of *Thomomys bottae bonnevillei, T. b. sevieri* differs in: Size smaller throughout; skull smaller in every measurement taken, weaker, smoother and less angular; dentition smaller and weaker.

Topotypes of *T. b. sevieri* are easily distinguished from those of *Thomomys bottae robustus* by smaller size, and smaller, markedly weaker skull which is less angular and ridged.

Among named subspecies of *Thomomys bottae, T. b. sevieri* is closest geographically to *Thomomys bottae convexus,* but differs from it as follows: Size larger; hind foot longer; skull smaller in every measurement taken; nasals shorter and not so flaring distally; rostrum weaker, narrower and not so depressed; zygomatic arches markedly weaker and less angular; lacrimal processes smaller; supraoccipital narrower and higher; paroccipital processes weaker; tympanic bullae smaller; dentition markedly weaker.

Topotypical specimens of *T. b. sevieri* can be readily distinguished from those of *Thomomys bottae tivius* by Pinkish Buff instead of Mummy Brown on upper parts. Tympanic bullae larger and markedly inflated; nasals longer; zygomatic and mastoidal breadths greater; rostrum longer and more depressed; upper incisors longer and wider; molariform teeth smaller. The skulls of *T. b. sevieri* resemble those of *T. b. tivius* more closely than those of any other subspecies.

The House Mountains in western Millard County are surrounded by desertlike terrain that is seemingly unsuited to pocket gophers. In these mountains, gophers were sought in vain at several localities,

including Antelope Springs which superficially appeared suitable for the animals. Pocket gophers were found only at the type locality, Swasey Spring, which is well above the highest level of the Pleistocene Lake Bonneville. *T. b. sevieri,* like *Thomomys bottae minimus* on Stansbury Island, Great Salt Lake, appears to remain only on land that was an island when Lake Bonneville was at its highest level.

Specimens examined.—Total, 10, from the type locality.

Thomomys bottae convexus Durrant

Botta Pocket Gopher

Thomomys bottae convexus Durrant, Proc. Biol. Soc. Washington, 52:159, October 11, 1939, type from east side Clear Lake, 4,600 feet, Millard County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:47, August 15, 1946.

Range.—West-central Utah in Delta Valley.

Description and comments.—Average and extreme measurements of 6 adult male and 11 adult female topotypes are, respectively, as follows: Total length, 213 (233-206), 197 (204-182); length of tail, 59 (68-57), 57 (63-43); length of hind foot, 28 (29-27), 27 (28-26). Color: Upper parts and sides Pinkish Buff, purest on sides; underparts Pale Pinkish Cinnamon; inguinal and pectoral regions Pale Pinkish Buff; nearly all specimens have white on perineal region; nose grayish black; front feet, hind feet and distal third to half of tail white; postauricular patches black. Skull: Braincase moderately convex on dorsal surface; rostrum strongly depressed, giving the entire dorsal surface of the skull a "rocker-shape"; zygomatic arches heavy, short and widely spreading, widest posteriorly; upper incisors recurved, short and wide; molariform teeth large; alveolar length of upper molar series long; palatal pits deep; tympanic bullae moderately inflated ventrally; mastoidal breadth actually as well as relatively wide.

Compared with topotypes of *Thomomys bottae wahwahensis, T. b. convexus* is of approximately the same color, but differs as follows: Size smaller; tail, hind foot, and ear shorter. Skull: Rostrum longer, narrower and more depressed; skull convex rather than flat; nasals longer, and convex rather than flat; tympanic bullae larger; zygomatic arches shorter and more massive; molariform teeth larger.

From topotypes of *Thomomys bottae centralis, T. b. convexus* differs in: Size: Smaller; tail and hind foot shorter. Color: Uniformly lighter, more white in perineal region. Skull: Smaller, more convex; rostrum shorter, wider and more depressed; zygomatic arches shorter and heavier; mastoidal breadth actually, as well as relatively wider; tympanic bullae more inflated ventrally; upper incisors shorter and wider.

Topotypes of *T. b. convexus* can be distinguished from those of *Thomomys bottae aureiventris* by: Size smaller; tail and hind foot shorter. Color: Darker on upper parts; no "gold" on underparts. Skull: Smaller and more nearly flat; rostrum shorter and more depressed; zygomatic arches shorter, heavier and widest posteriorly rather than anteriorly; interpterygoid space V-shaped as opposed to lyre-shaped; upper incisors shorter, narrower and more recurved.

When compared with topotypes of *Thomomys bottae albicaudatus, T. b. convexus* shows the following differences: Size smaller; tail and hind foot shorter. Color: Markedly lighter throughout. Skull: Smaller, more convex and compact; rostrum shorter, heavier, more depressed and compact; zygomatic arches shorter and more robust; upper incisors shorter and more recurved.

Thomomys bottae tivius is the closest subspecies geographically to *T. b. convexus.* From it *T. b. convexus* can be readily distinguished by: Size larger, tail shorter; hind foot longer. Color: Markedly lighter throughout. Skull: Much heavier and more compact, weights of skulls of males and females of the two subspecies being 2.4 grs., 1.6; 1.6, 1.2 respectively; rostrum heavier, wider and more depressed; zygomatic arches shorter, and more massive; upper incisors shorter, wider and more recurved; molariform teeth larger.

For comparisons with *Thomomys bottae lenis, Thomomys bottae contractus, Thomomys bottae sevieri, Thomomys bottae bonnevillei* and *Thomomys bottae robustus,* see accounts of those subspecies.

Thomomys bottae convexus is limited to the area around Clear Lake in Millard County. This lake is surrounded by areas of loose, shifting sand and flat areas of barren alkali. The lake is fed by springs which flow from lava outcroppings on its eastern side. As far as discernible, the only area populated by pocket gophers in 1938 was that adjacent to the lake where vegetation had trapped the sand. The factor which limits the extension of range of this subspecies probably is plant food. Also the soil is mechanically poor for burrowing since it caves in easily and burrows were found only in the sand where salt grass (*Distichlis stricta*) had trapped and stabilized it. Burrows were found from the edge of the water back as far as this grass persisted.

Specimens examined.—Total, 17, from the type locality.

Thomomys bottae tivius Durrant

Botta Pocket Gopher

Thomomys bottae tivius Durrant, Bull. Univ. Utah, 28 (no. 4):5, August 18, 1937, type from Oak Creek Canyon, 6 miles east of Oak City, 6,000 ft., Millard County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:49, August 15, 1946.

Range.—Limited to the Cañon Mountains, Millard County.

Description and comments.—Average and extreme measurements of 7 adult male and 5 adult female topotypes are, respectively, as follows: Total length, 208 (227-199), 203 (215-192); length of tail, 69 (70-67), 68 (74-63); length of hind foot, 27 (30-25), 27 (30-26). Color: Upper parts Mummy Brown, grading through Cinnamon on sides to pale Cinnamon on underparts; cheeks Cinnamon; postauricular patches black; distal third to half of tail white. Skull: Small, weak; zygomatic arches weak, not widely spreading, widest posteriorly; tympanic bullae large; interpterygoid space V-shaped; nasals short, usually simple distally, but with some denticulations in some specimens; palatal pits deep; palate narrow; paroccipital processes small; incisors, both upper and lower narrow; molariform teeth small.

Topotypes of *T. b. tivius* differ from those of *Thomomys bottae albicaudatus* as follows: Size markedly smaller in every measurement taken. Color: Lighter, Mummy Brown as opposed to near (13''''*n*) Black. Skull: Smaller, slenderer and weaker; zygomatic arches weak and not widely spreading as opposed to massive and widely spreading; nasals and rostrum narrower and shorter; extension of premaxillae posterior to nasals shorter; tympanic bullae smaller; molariform teeth smaller.

For comparisons with *Thomomys bottae stansburyi* and *Thomomys bottae contractus,* see accounts of those subspecies.

The four aforementioned subspecies are the darkest in color of all the *Thomomys bottae* occurring in Utah.

This small, dark subspecies is restricted to the Cañon Mountains in eastern Millard County. Apparently *T. b. tivius* is a mountain derivative of *Thomomys bottae contractus* which occurs in the valleys to the east and west of these mountains. Intergradation is noted between *T. b. tivius* and animals from the valleys on either side of the Cañon Mountains. For further comments on distributional problems of this type see remarks under *Thomomys bottae stansburyi.*

Specimens examined.—Total, 12, from the type locality.

Thomomys bottae contractus Durrant

Botta Pocket Gopher

Thomomys bottae contractus Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:50, August 15, 1946, type from Scipio, 5,315 feet, Millard County, Utah.

Thomomys perpallidus albicaudatus Hall, Univ. California Publ. Zoöl., 37:3, April 10, 1931.

[*Thomomys bottae*] *albicaudatus*, Durrant, Bull. Univ. Utah, 28 (no. 4):4, August 18, 1937.

Range.—Extreme eastern Millard and Beaver counties, Utah in the valleys west of the high mountains.

Description and comments.—Average and extreme measurements of 8 adult male and 6 adult female topotypes are, respectively, as follows: Total length, 229 (255-209), 219 (225-208); length of tail, 74 (85-63), 68 (73-58); length of hind foot, 31 (33-28), 30 (31-29). Color: Upper parts Cinnamon-Buff, mixed with black giving a color of Dresden Brown; sides between Cinnamon-Buff and Pinkish Buff; underparts Pinkish Buff, purest on inguinnal and pectoral regions; postauricular patches medium and black; ears covered with black hairs; nose, chin, cheeks and top of head dusky; front feet, hind feet and distal third to half of tail white; proximal part of tail covered all around with buff-colored hairs. Skull: Long, slender, moderately ridged and connvex transversely at proximal ends of nasals; nasals long; rostrum long and narrow; posterior ends of nasals truncate or shallowly emarginate; ascending processes of premaxillae slender; extension of premaxillae posterior to nasals long; zygomatic arches neither robust nor widely spreading; interparietal subquadrangular; supraoccipital extending horizontally well behind lamboidal suture instead of dropping off abruptly to the foramen magnum; interpterygoid space moderately V-shaped in some specimens, but somewhat lyre-shaped in others; tympanic bullae large and truncate anteriorly; upper incisors long and narrow; molariform teeth small and light.

From topotypes of *Thomomys bottae albicaudatus*, *T. b. contractus* differs as follows: Tail longer. Color: Lighter throughout. Skull: Slenderer, less ridged and angular; rostrum narrower; zygomatic and mastoidal breadths less; ascending processes of premaxillae narrower; posterior tongues of premaxillae narrower; posterior ends of nasals less truncate; zygomatic arches weaker, less angular, and less widely spreading; interparietal larger; paroccipital processes weaker; interpterygoid space not so widely V-shaped; upper incisors longer and narrower; molariform teeth smaller.

Topotypes of *T. b. contractus* can be distinguished from those of *Thomomys bottae convexus* as follows: Size larger, tail and hind foot longer. Color: Darker throughout. Skull: Longer, narrower and not so massive; top of skull moderately, as opposed to strongly convex; nasals arched rather than straight; zygomatic arches neither so widely spreading, angular nor massive; space enclosed within

zygomatic arches longer; interparietal larger; interpterygoid space more narrowly V-shaped; upper incisors longer and narrower; molariform teeth much lighter.

Comparisons of topotypes of *T. b. contractus* with near topotypes of *Thomomys bottae centralis* show them to be of approximately the same size, but to differ as follows: Color: Darker throughout. Skull: Shorter, but slenderer; rostrum narrower; region between posterior tongues of premaxillae narrower and more convex transversely; nasals more truncate; zygomatic breadth less, but arches relatively more widely spreading posteriorly; interparietal larger; interpterygoid space generally narrower; upper incisors longer and narrower; molariform teeth smaller.

Topotypes of *T. b. contractus* differ from those of *Thomomys bottae aureiventris* as follows: Size smaller; tail longer; hind foot shorter. Color: Darker throughout. Skull: Shorter but slenderer; rostrum narrower; nasals shorter but slenderer, and more truncate posteriorly; extension of premaxillae posterior to nasals longer; zygomatic arches weaker and less angular; zygomatic processes of maxillae weaker and with no marked thickening at union of maxilla and jugal; interparietal larger; interpterygoid space more V-shaped; upper incisors longer and narrower; molariform teeth smaller.

From topotypes of *Thomomys bottae planirostris, T. b. contractus* differs in: Size smaller throughout. Color: Darker, more black and less Cinnamon in pelage. Skull: Smaller in every measurement taken; rostrum narrower; nasals arched instead of flat; zygomatic arches neither angular, massive nor widely spreading; upper incisors narrower; molariform teeth markedly smaller and weaker.

Topotypes of *T. b. contractus* differ from those of *Thomomys bottae levidensis* in larger size, darker color and longer, slenderer skulls.

Among named subspecies of *Thomomys bottae, T. b. contractus* is closest morphologically to *Thomomys bottae tivius.* It differs from it as follows: Size larger throughout. Color: Lighter throughout. Skull: Larger in every measurement taken; rostrum longer and narrower; extension of premaxillae posterior to nasals longer; posterior tongues of premaxillae narrower.

Fifteen animals from Oak City, are intergrades between *T. b. contractus* and *T. b. tivius.* Intergradation with *Thomomys bottae lenis* is shown in some specimens by the widely spreading zygomatic arches. In the majority of characters including the diagnostic, long, slender, narrow rostrum they are more nearly like *T. b. contractus* to which they are here referred.

Nine animals from Beaver were considered by Hall (1931:3) and Durrant (1937:4) to be intergrades between *Thomomys bottae albicaudatus* and *Thomomys bottae centralis.* Restudy of these animals in the light of additional material now shows them to be intergrades between *T. b. centralis, T. b. planirostris* and *T. b. contractus.* The majority of these animals are intermediate in color between *T. b. centralis* and *T. b. contractus,* but a few have the reddish cast of *T. b. planirostris.* The shape of the nasals is characteristic of *T. b. planirostris,* whereas the zygomatic arches are as in *T. b. centralis.* In the remainder of the diagnostic characters they are like *T. b. contractus* to which they are here referred.

Strong affinities exist between *T. b. albicaudatus, T. b. tivius* and *T. b. contractus.* All three of these subspecies probably stemmed from a dark form which formerly inhabited the eastern mainland of the Pleistocene Lake Bonneville. At present, *T. b. tivius* is islolated on the Cañon Mountains in eastern Millard County, and the ranges of *T. b. albicaudatus* and *T. b. contractus* are separated by that of *T. b. lenis. T. b. lenis* more closely resembles *T. b. aureiventris,* which is an inhabitant of the western mainland of this ancient lake, than any other named subspecies. An understanding of the history of the Sevier River Valley will probably clarify the distribution of this pocket gopher.

Specimens examined.—Total, 39, distributed as follows: *Millard County:* Oak City, 5,000 ft., 15; Scipio, 5,315 ft., 15. *Beaver County:* Beaver, 6,000 ft., 9 (M.V.Z.).

Thomomys bottae lenis Goldman

Botta Pocket Gopher

Thomomys townsendii lenis Goldman, Proc. Biol. Soc. Washington, 55:75, June 25, 1942, type from Richfield, 5,308 feet, Sevier County, Utah.
Thomomys bottae lenis, Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:53, August 15, 1946.
Thomomys perpallidus aureus, Moore, Journ. Mamm., 10:259, August 10, 1929.

Range.—Sevier River valley from Piute County north to southwestern Juab and northeastern Millard counties, Utah.

Description and comments.—Measurements of 2 adult male topotypes, numbers 264806 U.S.N.M. and 264807 U.S.N.M., are respectively, as follows: Total length, 255, 248; length of tail, 86, 74; length of hind foot, 32, 31. Color: Upper parts Cinnamon-Buff mixed with black in middorsal region; sides, flanks, forearms, thighs and underparts Pinkish Buff; inguinal region, front feet, hind feet, underpart of tail and end of tail white; postauricular patches small and dusky; chin, cheeks, nose and top of head dusky. Skull: Largest of Utah gophers, massive and angular; nasals long and denticulate distally; rostrum long and relatively narrow; zygomatic arches widely spread-

ing and heavy throughout; jugals nearly vertical; zygomatic processes of maxillae heavy and flaring out abruptly from base of rostrum; union of zygomatic process of maxilla and jugal greatly thickened; extension of premaxillae posterior to nasals long; posterior tongues of premaxillae relatively narrow; lacrimal processes small; pterygoid hamulae long; interpterygoid space moderately V-shaped, tending to be somewhat lyre-shaped in some specimens; tympanic bullae somewhate flattened, only moderately inflated ventrally; upper incisors long and narrow molariform teeth actually large, but relatively small.

Topotypes of *T. b. lenis* can be readily distinguished from those of *Thomomys bottae tivius, Thomomys bottae convexus, Thomomys bottae contractus, Thomomys bottae albicaudatus, Thomomys bottae levidensis, Thomomys bottae centralis* and *Thomomys bottae aureiventris* by the following markedly greater average measurements of males: Total length, 250; length of nasals, 15.5; zygomatic breadth, 28.3; mastoid breadth, 22.5; and lengths of rostrum, 18.3. Other distinguishing characters are: Zygomatic arches more widely spreading; zygomatic processes of maxillae relatively longer; rostrum narrower.

Twenty-one animals obtained from Lynndyl, Millard County, are all intergrades between *T. b. lenis* and *T. b. aureiventris.* They are like *T. b. aureiventris* in the shape of the zygomatic arches, and in the bowing of the parietal crests. Slight intergradation with *T. b. centralis* is indicated by color and the shape of the nasals. The transverse arching of the posterior part of the rostrum is indicative of some relationship with *T. b. contractus.* In six other characters studied they most closely approach *T. b. lenis* to which they are here referred.

Large size is the distinctive feature of *T. b. lenis.* The skulls are the largest of any member of the species *Thomomys bottae* found in Utah. In total length, however, these animals are no longer than the extremes found in other named subspecies. When Goldman (1942:75) named this subspecies as new, he referred it to the species *Thomomys townsendii,* but remarked that the animal from Richfield was different enough from any other named subspecies to merit probably full specific status. I know of no characters other than size to separate *Thomomys townsendii* from *Thomomys bottae,* and since intergradation has been shown to exist between these alleged *Thomomys townsendii* from Richfield and animals from extreme western Utah known to belong to the species *Thomomys bottae, T. b. lenis* is here arranged as a subspecies of *Thomomys bottae.*

The range here ascribed to this subspecies is the Sevier River Valley from Piute County as far downstream as the town of Lynndyl

which is near the eastern mainland of Pleistocene Lake Bonneville. The Sevier River continues farther out into Delta Valley ultimately to empty into Sevier Lake, which at present is adjacent to the area that formerly constituted the western mainland of the aforementioned ancient lake. This water course may have provided a migration route in ancient times, during fluctuations of Lake Bonneville, whereby the animals formerly of the western mainland were able to come far eastward. The characters of the animals from Lynndyl tend to support this hypothesis because they are intergrades between *T. b. lenis,* an eastern mainland form, and *T. b. centralis* and *T. b. aureiventris* which are subspecies of the western mainland of Lake Bonneville.

Specimens examined.—Total, 35, distributed as follows: *Juab County:* U. B. (= Yuba) Dam, 5,000 ft., 1. *Millard County:* Lynndyl, 4,796 ft., 21. *Sevier County:* Salina, 4,375 ft., 1; Richfield, 5,308 ft., 9 (3, U. S. N. M.); ½ mi. NE Elsinore R. R. Depot, 3.

Thomomys bottae levidensis Goldman

Botta Pocket Gopher

Thomomys bottae levidensis Goldman, Proc. Biol. Soc. Washington, 55:76, June 25, 1942, type from Manti, 5,500 feet, Sanpete County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:54, August 15, 1946.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—Sanpitch River Valley, Sanpete County, Utah.

Description and comments.—Measurements of one adult male, number 191959 U. S. N. M., and average and extreme measurements of 4 adult female topotypes are, respectively, as follows: Total length, 222, 205 (223-194); length of tail, 65, 69 (73-61); length of hind foot, 28, 26 (27-26). Color: Upper parts and sides Cinnamon-Buff, finely mixed with black along median line of back; underparts Pinkish Buff; nose, cheeks and chin grayish black; postauricular patches fairly large and grayish black; front and hind feet white (examples from type series badly stained); tail Light Buff but apparently white distally (the color of these specimens has apparently changed with age). Skull: Small, fairly robust; basilar length short; zygomatic arches weak, but widely spreading; tympanic bullae small; nasals short and simple distally; ventral margin of jugals convex dorsally; extension of premaxillae posterior to nasals relatively as well as actually long; posterior tongues of premaxillae relatively wide.

Topotypes of *T. b. levidensis* differ from those of *Thomomys bottae absonus* as follows: Size smaller. Color: Lighter throughout. Skull: Shorter, weaker and less ridged and angular, but relatively wider.

From topotypes of *Thomomys bottae albicaudatus, T. b. levidensis* differs as follows: Size smaller in every measurement taken.

Color: Markedly lighter throughout. Skull: Smaller in every measurement taken; width relatively greater; skull smooth, weak and nonangular as opposed to ridged, robust and angular.

For comparisons with *Thomomys bottae lenis* and *Thomomys bottae contractus,* see accounts of those subspecies.

The range here ascribed to *T. b. levidensis* is the Sanpitch River Valley, which gradually merges southward into the Sevier River Valley. The latter valley in this area is inhabited by pocket gophers that belong to another subspecies, *T. b. lenis.* Nephi Valley to the west of the Sanpitch River Valley is inhabited by animals belonging to the subspecies *T. b. albicaudatus.* No known specimens show intergradation between *T. b. lenis* and *T. b. levidensis,* but intergradation between *T. b. lenis* and *T. b. albicaudatus* is noted in the Nephi Valley animals (see account of *T. b. albicaudatus*). Superficially, *T. b. levidensis* resembles *T. b. absonus* in size and color, but the skulls closely resemble those of *T. b. albicaudatus,* except for size in which they are smaller in all measurements. *T. b. albicaudatus* is the most variable subspecies of *Thomomys bottae* occurring in Utah, and additional material from the Sevier River Valley between Sanpitch River Valley and Nephi Valley may show *T. b. levidensis* to be only a local variant of the highly variable subspecies, *T. b. albicaudatus.*

Specimens examined.—Total, 7, distributed as follows: *Sanpete County:* Spring City, 1; Manti, 5,000 ft., 6.

Thomomys bottae osgoodi Goldman

Botta Pocket Gopher

Thomomys perpallidus osgoodi Goldman, Journ. Washington Acad. Sci., 21:424, October 19, 1931, type from Hanksville, Wayne County, Utah.
Thomomys bottae osgoodi Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:56, August 15, 1946.
Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—Eastern Utah in the valleys of the drainage of the San Rafael, Dirty Devil and Price rivers.

Description and comments.—Measurements of 1 adult male, number 158529 U.S.N.M., and 1 adult female, number 158528 U.S.N.M., topotypes are, respectively, as follows: Total length, 225,203; length of tail, 70, 61; length of hind foot, 29, 27. Color: Upper parts near (3) Pale Ochraceous-Buff, definitely yellow in appearance; sides Pale Ochraceous-Buff; entire underparts white, with wash of Light Buff in the pectoral and inguinal regions; top of head, nose, cheeks, and chin dusky; postauricular patches grayish black; front feet, hind feet and distal part of tail white. Skull: Fairly robust

but narrow; zygomatic arches concave medially in mid-jugal region; skull moderately convex dorsally, because of swelling in region of base of rostrum; lambdoidal suture situated well ahead of posterior margin of skull, with supraoccipital forming a wide shelf at posterior part of skull; interpterygoid space narrowly V-shaped; tympanic bullae well inflated ventrally; basioccipital short; nasals rounded posteriorly; molariform teeth large.

Topotypes of *T. b. osgoodi* differ from those of *Thomomys bottae absonus* as follows: Size generally smaller. Color: Lighter throughout, more yellowish in apperance as opposed to buffy. Skull: Smaller in all measurements, except length of nasals, mastoid breadth, and alveolar length of upper molar series which are larger; rostrum shorter but relatively wider; zygomatic arches more robust, and concave medially; palate wider; supraoccipital more bulging posteriorly; tympanic bullae more inflated ventrally; molariform teeth larger.

For comparisons with *Thomomys bottae aureus* and *Thomomys bottae dissimilis*, see accounts of those subspecies.

The animals here referred to *T. b. osgoodi* are remarkably uniform in color, but vary widely in cranial details. Specimens from Carbon County are not typical and when more material becomes available it may prove that these animals from the northern part of the range of *T. b. osgoodi* will merit separation and naming. The specimens from Emery County are not typical but resemble *T. b. osgoodi* more than do the animals from Carbon County.

The range here ascribed to *T. b. osgoodi* is in that part of the eastern Utah desert that is bounded on the east by the Green and Colorado rivers, on the west by the high mountains of central Utah, on the north by the Book Cliffs and on the south by the north end of the Henry Mountains and Trachyte Creek. The area is an uninviting wasteland in which there are relatively few roads and little water. In addition, it is greatly cut up by washes and gullies which contain water only during a few weeks of the year. The continuation of this area of wasteland southward beyond the Henry Mountains and Trachyte Creek is inhabited by pocket gophers belonging to the subspecies *T. b. absonus*. If specimens were available they probably would show intergradation to exist between *T. b. osgoodi* and *T. b. absonus*.

Specimens examined.—Total, 24, distributed as follows: *Carbon County:* ½ mi. N Spring Glen, 6,150 ft., 2; Spring Glen, 6,200 ft., 2; 2 mi. E Spring Glen, 6,200 ft., 1. *Emery County:* Price River, 2 mi. SE Woodside, 4,600 ft., 2 (C.M.); 5 mi. S Castle Dale, 5,600 ft., 3; Greenriver, 4,080 ft., 5 (M.V.Z.). *Wayne County:* Hanksville, 2 (U.S.N.M.); Notom, 6,200 ft., 7.

Thomomys bottae howelli Goldman

Botta Pocket Gopher

Thomomys bottae howelli Goldman, Journ. Washington Acad. Sci., 26:116, March 15, 1936, type from Grand Junction, 4,600 feet, Mesa County, Colorado; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:57, August 15, 1946.

Range.—In the valleys of eastern Utah, east of the Green River and north of the Colorado River.

Description and comments.—Inasmuch as there is but one specimen, the holotype known, and as it was unavailable, the following diagnoses and comparisons are from Goldman (1936:116).

"*General characters.*—A rather large, pallid subspecies with a broad, flattened cranium. Similar to the palest specimens of *Thomomys bottae aureus* of the San Juan River Valley, southeastern Utah, in color, but underparts more thinly overlaid with buffy white, and cranial characters, especially the broad, flat braincase distinctive. Approaching *Thomomys bottae osgoodi* of the Fremont River Valley, Utah, in color, but much larger and skull widely different."

"*Color.*—Type (winter pelage): Upper parts in general between tilleul buff and pale olive buff (Ridgway, 1912), somewhat darkened on head by a mixture of cinnamon buff and brown; a few inconspicuous dusky-tipped hairs along median line of back; muzzle dusky; ears and postauricular spots deep, contrasting black; underparts thinly overlaid with buffy white, the hairs becoming pure white to roots on inguinal region; thighs pure white to roots all around; feet white; tail buffy whitish, slightly paler below than above."

"*Skull.*—Similar in general to that of *T. b. aureus*, but braincase conspicuously broader and flatter; zygomata more widely spreading; nasals shorter; premaxillae more attenuate posteriorly; interparietal larger; audital bullae more rounded and fully inflated anteriorly; incisors short, as in *T. b. aureus*, but less strongly recurved. Compared with that of *T. b. osgoodi* the skull is much larger, with flatter braincase, shorter nasals, and posteriorly narrower premaxillae."

Average and extreme measurements of 5 adult males and 1 adult female, number 20300 C.M., from 10 miles north of Moab are, respectively, as follows: Total length, 213 (225-205), 202; length of tail, 67 (68-64), 59; length of hind foot, 31 (32-30), 28.

Six specimens, in the Carnegie Museum from 10 miles north of Moab, Grand County, Utah, were available for this study. They are not typical of *T. b. howelli* as it is diagnosed by Goldman (*loc. cit.*). They appear to be intergrades between *T. b. howelli* and *T. b. osgoodi* in cranial characters, but more closely resemble *T. b. howelli*, particularly in the flat, wide, low braincase. In color, some specimens suggest intergradation between *T. b. aureus* and *T. b. howelli*. The range ascribed to this subspecies in Utah seems to be

one of the most natural ranges within the state since the range is bounded by the Green and Colorado rivers which have formed deep rocky gorges in this area.

Specimens examined.—Total, 6, from *Grand County:* 10 mi. N Moab, 6 (C.M.).

Thomomys bottae wahwahensis Durrant

Botta Pocket Gopher

Thomomys bottae wahwahensis Durrant, Bull. Univ. Utah, 28 (no. 4):3, August 18, 1937, type from Wah Wah Springs, 30 miles west of Milford, 6,500 feet, Beaver County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:58, August 15, 1946.

Range.—West-central Utah, in Wah Wah Mountains, and Pine Valley to the west of these mountains.

Description and comments.—Average and extreme measurements of 4 adult male and 8 adult female topotypes are, respectively, as follows: Total length, 228 (250-210), 185 (197-180); length of tail, 66 (78-60), 56 (62-50); length of hind foot, 29 (30-26), 27 (29-26). Color: Upper parts Pinkish Buff; underparts Pale Pinkish Buff with considerable admixture of gray; inguinal and pectoral regions Pale Pinkish Buff; nose and cheeks grayish black; postauricular patches small and black; front feet, hind feet and distal one-third to one-half of tail white. Skull: Flat dorsoventrally; rostrum short and wide; premaxillae broad and heavy; nasals short and straight, with no arching as viewed laterally; tympanic bullae small; space enclosed within zygomatic arches short anteroposteriorly; alveolar length of upper molar series short; molariform teeth small.

From topotypes of *Thomomys bottae centralis, T. b. wahwahensis* differs as follows: Size smaller in every measurement taken. Color: Lighter, Pinkish Buff as opposed to Cinnamon-Buff. Skull: Rostrum wider, shorter and more nearly flat; nasals straight as opposed to moderately convex; tympanic bullae smaller and less inflated ventrally; zygomatic arches more widely spreading and angular; molariform teeth smaller; extension of premaxillae posterior to nasals less.

From topotypes of *Thomomys bottae albicaudatus, T. b. wahwahensis* differs as follows: Hind foot shorter. Color: Lighter throughout, Pinkish Buff as opposed to near (13''''*n*) Black. Skull: Smaller and more nearly flat; rostrum shorter, wider and more nearly flat; nasals straight as opposed to convex; zygomatic breadth less but mastoid breadth greater; tympanic bullae smaller, and less inflated ventrally; extension of premaxillae posterior to nasals less; molariform teeth smaller.

From topotypes of *Thomomys bottae aureiventris, T. b. wahwahensis* differs in the following features: Size smaller; hind foot shorter. Color: Lighter throughout, no "gold" on underparts. Skull: Smaller in nearly every measurement taken; rostrum shorter

and relatively wider; zygomatic arches more angular and relatively more widely spreading; nasals shorter and more nearly flat; thickening at union of jugal and zygomatic process of maxilla less; interpterygoid space V-shaped as opposed to lyre-shaped; tympanic bullae much smaller, and less inflated ventrally; molariform teeth much smaller.

Topotypes of *T. b. wahwahensis* can be easily distinguished from those of *Thomomys bottae tivius* by their markedly larger size in every measurement taken, lighter color, and larger, more robust and more nearly flat skull.

For comparisons of *T. b. wahwahensis* with *Thomomys bottae sevieri, Thomomys bottae robustus, Thomomys bottae bonnevillei,* and *Thomomys bottae convexus,* see accounts of those subspecies.

Among named subspecies of *Thomomys bottae, T. b. wahwahensis* definitely has its affinities with *Thomomys bottae planirostris* from Zion National Park. Both possess flat skulls with wide, short rostra. It differs from the latter in: Size smaller in every measurement taken. Color: Lighter throughout. Skull: Nasals and rostrum shorter and more nearly flat; tympanic bullae markedly smaller; alveolar length of upper molar series shorter; molariform teeth markedly smaller and weaker.

Wah Wah Springs, the type locality of *T. b. wahwahensis* is on the summit of a low pass in the Wah Wah Mountains in the desert of west-central Utah. The surrounding valleys, for many miles, as far as my investigations show are not inhabited by pocket gophers, except at the Desert Range Experiment Station of the United States Forest Service in Pine Valley to the west of these mountains. There, pocket gophers were obtained which are intergrades between *T. b. centralis* and *T. b. wahwahensis.* In five out of seven characters investigated, these gophers resemble *T. b. wahwahensis* to which they are here referred. Study of the topography reveals the probable means by which the animals reached this valley. The long axis of the Wah Wah Mountains is north to south, but a westward arm forms the northern boundary of Pine Valley. Workings of pocket gophers were found around springs in this westward projecting arm of these mountains. With the development of water at the Desert Range Experiment Station, and the subsequent improvement of forage, these animals probably came down into the valley from the springs to the north.

The terrain between the Desert Range Experiment Station in Pine Valley and Snake Creek (where *T. b. centralis* occurs) to the west is not inhabited by pocket gophers at present. This area, how-

ever, forms part of the southwest mainland of Pleistocene Lake Bonneville, which mainland in times past was probably suitable for pocket gophers. Since the close of the Pleistocene, aridity has rendered most of it unfit for pocket gophers, and they remain only in isolated areas where suitable environment still persists.

Specimens examined.—Total, 18, distributed as follows: *Millard County:* Desert Range Experiment Station, United States Forest Service, Sec. 9, T. 25S, R. 17W, Salt Lake Base Meridian, 6. *Beaver County:* Wah Wah Springs, Wah Wah Mountains, 30 mi. W Milford, 6,500 ft., 12 (2, M.V.Z.).

Thomomys bottae dissimilis Goldman

Botta Pocket Gopher

Thomomys perpallidus dissimilis Goldman, Journ. Washington Acad. Sci., 21:425, October 19, 1931, type from East Slope Mount Ellen, Henry Mountains, 8,000 feet, Garfield County, Utah.

Thomomys bottae dissimilis Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:60, August 15, 1946.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—Known only from the type locality.

Description and comments.—Measurements of 1 adult female, number 158524 U.S.N.M., from the type locality are as follows: Total length, 188; length of tail, 61; length of hind foot, 27. Color: Upper parts Light Buff, grading over sides to nearly white on underparts; underparts lightly washed with pale buff, more marked in inguinal and pectoral regions; postauricular patches grayish black; nose, chin, cheeks and top of head dusky; front feet, hind feet and distal half of tail white. Skull: Small and weak; zygomatic arches long, but lying close to skull, giving it a slender appearance; supraoccipital markedly projecting posteriorly from lambdoidal suture; rostrum relatively long and narrow; nasals long; tympanic bullae well inflated ventrally, with a median ventral ridge; pterygoid hamulae weak; interpterygoid space narrowly V-shaped; upper incisors short and light in color; molariform teeth relatively large.

Comparison of one topotype of *T. b. dissimilis* with topotypes of *Thomomys bottae aureus* shows it to differ as follows: Size smaller throughout. Color: Lighter dorsally and on sides, pale buff as contrasted with rich ochraceous; underparts more buffy. Skull: Smaller in every measurement taken; zygomatic arches markedly less widely spreading; braincase narrower and more vaulted; tympanic bullae with a median ventral ridge as opposed to smooth; pterygoid hamulae slenderer; interpterygoid space narrowly V-shaped as opposed to U-shaped; upper incisors smaller and lighter in color.

From topotypes of *Thomomys bottae absonus, T. b. dissimilis* differs as follows: Size smaller in every measurement taken. Color:

Lighter throughout. Skull: Smaller in every measurement taken, except alveolar length of upper molar series which is greater; skull narrower and weaker; zygomatic arches weaker and less widely spreading; tympanic bullae more ridged on ventral surface and shorter (more rounded) in anteroposterior measurement; upper incisors shorter and narrower; molariform teeth larger.

Thomomys bottae dissimilis resembles *Thomomys bottae osgoodi* more than any other subspecies, but differs in: Size smaller throughout. Color: Slightly darker dorsally. Skull: Smaller in every measurement taken, and slenderer; rostrum relatively longer; zygomatic arches weaker, and less widely spreading, more converging anteriorly; tympanic bullae less rounded, more ridged medioventrally; upper incisors shorter but narrower; molariform teeth smaller.

The Henry Mountains, in eastern Garfield County, are in the Colorado River drainage. The surrounding country is desertlike and cut by gullies and washes with sheer escarpments and precipitous draws. The type locality of *T. b. dissimilis* is possibly in an isolated area. Only three specimens were available to Goldman when he named *T. b. dissimilis.* He commented on the close resemblance to *T. b. osgoodi* which inhabits the country to the north. I have examined only one of the three specimens available to Goldman. Although I can see the characters that he mentioned, I am not fully convinced that *T. b. dissimilis* is separable from *T. b. osgoodi.* Two specimens from Escalante are referred to *T. b. absonus,* but they show intergradation with *T. b. dissimilis.*

Specimen examined.—One (U.S.N.M.) from E Slope Mount Ellen, Henry Mountains, 8,000 ft., Garfield County.

Thomomys bottae aureus Allen

Botta Pocket Gopher

Thomomys aureus Allen, Bull. American Mus. Nat. Hist., 5:49, April 28, 1893, type from Bluff City, San Juan County, Utah; Warren, The mammals of Colorado, Knickerbocker Press, p. 79, 1910.

Thomomys bottae aureus, Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Benson, Univ. California Publ. Zoöl., 40:450, December 31, 1935; Warren, The Mammals of Colorado, Univ. Oklahoma Press, p. 158, 1942; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:61, August 15, 1946.

Thomomys fulvus aureus, Goldman, Journ. Washington Acad. Sci., 21:417, August 19, 1931; Goldman, Journ. Washington Acad. Sci. 23:464, October 15, 1933.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—All of San Juan County (except extreme southwestern part) and Grand County east of the Colorado River.

Description and comments.—Measurements of 3 adult male topotypes, numbers 1149, 1151 and 1152, and 3 adult female topotypes, numbers 1147, 1148 and 1150, are, respectively, as follows: Total length, 197 (?), 233, 251, 225, 233, 217; length of tail, 26 (?), 70, 65, 54, 58, 60; length of hind foot, 32, 34, 36, 31, 31, 30. Color: Upper parts Cinnamon-Buff, lighter on sides; underparts generally white or if colored at all with only a faint wash of Light Buff; nose and chin blackish gray; top of head blackish owing to admixture of black hairs; postauricular patches small and dusky; front feet and hind feet white. Skull: Long, narrow but massive; zygomatic arches not widely spreading, but heavy; jugals thick; union of jugals and zygomatic processes of maxillae thickened; rostrum long but wide; top of rostrum convex in lateral view; ascending processes of premaxillae wide and heavy; nasals thin proximally; braincase long and narrow; tympanic bullae well inflated ventrally; alveolar length of upper molar series long; molars large; pterygoid hamulae heavy; interpterygoid space U-shaped; palate arched; upper incisors long and wide.

From topotypes of *Thomomys bottae osgoodi, T. b. aureus* differs as follows: Size larger in every measurement taken, except tail which is shorter. Color: Darker throughout except on ventral surface which is lighter. Skull: Larger, and wider; nasals longer; rostrum wider and longer; zygomatic arches more nearly straight and heavier; ascending processes of premaxillae wider; basioccipital longer; interpterygoid space U-shaped as opposed to V-shaped; tympanic bullae larger; upper incisors longer, wider; molars larger.

Topotypical specimens of *T. b. aureus* can be readily distinguished from those of *Thomomys bottae dissimilis* by: Size larger throughout. Color: A trifle darker on dorsal surface. Skull: Larger in every measurement taken; zygomatic arches heavier and more nearly straight; tympanic bullae larger and more inflated ventrally; interpterygoid space U-shaped as opposed to V-shaped; alveolar length of upper molar series longer; molars larger; upper incisors longer and wider.

Topotypes of *T. b. aureus* differ from those of *Thomomys bottae absonus* as follows: Size larger in every measurement taken. Color: Darker dorsally, light ochraceous as opposed to Cinnamon-Buff; owing to admixture of gray, *T. b. absonus* has more of a grayish cast. Skull: Larger in every measurement taken, longer, narrower and more compact; zygomatic arches heavier; ascending processes of premaxillae wider; jugals heavier; tympanic bullae larger; interpterygoid space U-shaped rather than V-shaped; upper incisors longer and wider; molars larger.

From topotypes of *Thomomys bottae planirostris, T. b. aureus* can be distinguished as follows: Size larger; tail shorter. Color:

Lighter throughout. Skull: Larger in every measurement taken except zygomatic breadth, extension of premaxillae posterior to nasals and length of upper molariform series which are less; rostrum longer, wider and more convex; nasals slightly arched rather than straight; depression absent rather than present in posterior region of nasals; zygomatic arches not so widely spreading, but equally heavy.

For comparison with *Thomomys bottae alexandrae*, see account of that subspecies.

Topotypes of *T. b. aureus* are among the largest of pocket gophers in the state. They are exceeded in total length only by *Thomomys bottae lenis* and are approached by *Thomomys bottae aureiventris* and *T. b. planirostris*. On the average they have the longest hind foot, body and ear. The length of the skull is second only to that of *T. b. lenis* as also is the length and breadth of the rostrum relative to the basilar length.

From the time of the original description of *Thomomys aureus* in 1893 until 1930, only the name *aureus* has been applied to all light colored gophers from Utah. Barnes (1927:100) gives the range of *T. b. aureus* as extending completely across southern Utah and on the west and east sides as far north as central Utah. From this area, since 1930, subspecies have been named by E. R. Hall, W. H. Burt, E. A. Goldman and the writer, and by restriction the range accorded to *T. b. aureus* in Utah now is that part of the state east of the Colorado River.

Specimens examined.—Total, 27, from: *San Juan County:* Monticello, 1; Bluff, 3,300 ft., 25 (15, M.V.Z.); 1.6 mi. SW Bluff, 4,400 ft., 1.

Thomomys bottae birdseyei Goldman

Botta Pocket Gopher

Thomomys bottae birdseyei Goldman, Proc. Biol. Soc. Washington, 50:134, September 10, 1937, type from Pine Valley Mountains, 5 miles east of Pine Valley, 8,300 feet, Washington County, Utah; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:63, August 15, 1946.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—High mountains and plateaus of southwestern Utah.

Description and comments.—Average and extreme measurements of 3 adult male and 3 adult female topotypes are, respectively, as follows: Total length, 227 (243-214), 220 (223-217); length of tail, 64 (81-52), 71 (75-68); length of hind foot, 31 (32-30), 29 (30-28). Color: Upper parts between Cinnamon and Sayal Brown, finely mixed with black in medial dorsal region, grading over sides and flanks to Cinnamon on underparts; front feet, hind feet, and distal part of tail white; postauricular patches, chin, cheeks and top

of head grayish black. Skull: Depressed along median line of frontals and posterior ends of nasals; region of fronto-nasal suture concave ventrally; zygomatic arches heavy and widely spreading, widest posteriorly; posterior ends of nasals straight, tending to be somewhat rounded in some specimens; extension of premaxillae posterior to nasals moderate; tympanic bullae moderately inflated ventrally; basioccipital wide; interpterygoid space widely V-shaped.

Topotypes of *T. b. birdseyei* differ from near topotypes of *Thomomys bottae virgineus,* from Beaverdam Wash as follows: Size larger; tail and hind foot longer. Color: Darker throughout, between Cinnamon and Sayal Brown as opposed to Cinnamon-Buff. Skull: Larger in every measurement taken except extension of premaxillae posterior to nasals, and length and width of rostrum which are less; skull more depressed in naso-frontal region; zygomatic arches more widely spreading; zygomatic processes of squamosals shorter; pterygoid hamulae longer; tympanic bullae smaller and less inflated ventrally.

Among named subspecies of *Thomomys bottae, T. b. birdseyei* most closely resembles *Thomomys bottae trumbullensis* in size, but differs from it as follows: Hind foot and tail longer. Color: Lighter throughout; postauricular patches smaller and lighter. Skull: Larger; mastoid breadth less; zygomatic arches wider and more widely spreading posteriorly; median frontal depression more marked; extension of premaxillae posterior to nasals greater; tympanic bullae less inflated ventrally; molariform teeth larger.

For comparison with *Thomomys bottae planirostris* see account of that subspecies.

T. b. birdseyei is apparently endemic to the mountainous area of southwestern Utah in Washington and Iron counties. It intergrades with *T. b. virgineus* and with *T. b. planirostris,* as described in the account of the latter.

Specimens examined.—Total, 8, distributed as follows: *Washington County:* Pine Valley, 1 (U. S. N. M.); Pine Valley Mountains, 5 mi. E Pine Valley, 8,300 ft., 3 (U. S. N. M.); Pine Valley Campground, 6,800 ft., 1 (R. H.); ¾ mi. E of town of Pine Valley, 6,500 ft., 3 (R. H.).

Additional record (Bailey, 1915:75).—*Washington County:* Hebron; Mountain Meadows.

Thomomys bottae virgineus Goldman

Botta Pocket Gopher

Thomomys bottae virgineus Goldman, Proc. Biol. Soc. Washington, 50:133, September 10, 1937, type from Beaverdam Creek, near confluence with Virgin River, at Littlefield, 1,500 feet, Mohave County, Arizona; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:64, August 15, 1946.

Range.—Extreme southwestern Utah, in Beaverdam Wash, Washington County, Utah.

Description and comments.—Average and extreme measurements of 5 adult males and 4 adult females from Beaverdam Wash, 5 miles north of Utah-Arizona line, are respectively, as follows: Total length, 226 (235-216), 211 (218-202); length of tail, 68 (70-62), 64 (68-60); length of hind foot, 29 (30-27), 29 (30-27). Color: Upper parts Cinnamon-Buff, finely mixed with black; sides and flanks Pinkish Buff; underparts Pale Pinkish Buff; front feet, hind feet and distal part of tail white; nose, cheeks, chin and top of head grayish black. Skull: Robust, with moderately wide zygomatic arches; zygomatic processes of maxillae wide; zygomatic processes of squamosals long; jugals concave laterally, giving zygometic arches appearance of double bowing; nasals long; extension of premaxillae posterior to nasals long; tympanic bullae well inflated ventrally; pterygoid hamulae heavy; interpterygoid space widely V-shaped; molariform teeth large.

For comparisons of *T. b. virgineus* with *Thomomys bottae planirostris* and *Thomomys bottae birdseyei* see accounts of those subspecies.

Topotypical specimens of *T. b. virgineus* can be distinguished from those of *Thomomys bottae trumbullensis* as follows: Size smaller. Color: Lighter throughout. Skull: Zygomatic arches less widely spreading; jugals more bowed medially; zygomatic processes of squamosals longer; extension of premaxillae posterior to nasals greater; tympanic bullae larger and more inflated ventrally; molariform teeth larger.

From topotypes of *Thomomys bottae centralis, T. b. virgineus* differs in: Size smaller; tail shorter; hind foot smaller. Color: Deeper Cinnamon-Buff, thus darker in over-all appearance. Skull: Smaller, but relatively wider; zygomatic processes of maxillae heavier; region of maxillo-jugal sutures thicker; jugals more concave laterally; tympanic bullae more inflated ventrally; molariform teeth larger.

This pocket gopher occupies practically the same range in Utah as the large kangaroo rat *Dipodomys deserti deserti* Stephens. Both are found in Beaverdam Wash. The type locality of *T. b. virgineus* is but a short distance down Beaverdam Creek at Littlefield, Arizona. It intergrades with *T. b. birdseyei,* the mountain form, to the north and east (see remarks under *T. b. birdseyei*). There are evidences of intergradation with *T. b. planirostris* of the Virgin River Valley above the narrows of the Virgin River where it cuts through the Beaverdam Mountains (see the discussion under *T. b. planirostris*). There are intergradational tendencies exhibited toward *T. b. centralis* in some specimens. Some of the animals are

practically indistinguishable in color and there are intergrading cranial characters in the nasals, zygomatic arches and tympanic bullae.

Specimens examined.—Total, 20, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona border, 7; Beaverdam Wash, 5 mi. N Utah-Arizon border, 2,600 ft., 13.

Thomomys bottae planirostris Burt

Botta Pocket Gopher

Thomomys perpallidus planirostris Burt, Proc. Biol. Soc. Washington, 44:38, May 8, 1931, type from Zion National Park, Washington County, Utah.

Thomomys bottae planirostris, Hall and Davis, Proc. Biol. Soc. Washington, 47:52, February 9, 1934; Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938; Long, Journ. Mamm., 21:176, May 16, 1940; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:66, August 15, 1946.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927; Woodbury, Ecol. Monog., 3:193, April, 1933.

Thomomys bottae centralis, Hall and Davis, Proc. Biol. Soc. Washington, 47:52, February 9, 1934; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938.

Thomomys perpallidus centralis Hall, Univ. California Publ. Zoöl., 32:445, July 8, 1930.

Thomomys bottae nicholi Goldman, Journ. Washington Acad. Sci., 28:337, July 15, 1938; Hardy, Ecol. Monogr., 15:98, January, 1945.

Thomomys bottae trumbullensis, Hall and Davis, Proc. Biol. Soc. Washington, 47:52, February 9, 1934.

Range.—Valley of the Virgin River from Zion National Park west to the Beaverdam Mountains.

Description and comments.—Average and extreme measurements of 8 adult male and 8 adult female topotypes are, respectively, as follows: Total length, 238 (261-222), 215 (228-205); length of tail, 76 (83-66), 71 (78-61); length of hind foot, 32 (34-31), 31 (33-30). Tail long. Color: Upper parts Sayal Brown; underparts between Vinaceous-Cinnamon and Cinnamon, grading to Pinkish Cinnamon in some specimens; nose, chin, cheeks, postauricular patches, and top of head grayish black; front feet and hind feet white; tail Pinkish Buff, with distal third white. Skull: Massive and ridged; nasals straight and flat, simple distally; dorsal surface of rostrum slightly concave at proximal end of nasals; zygomatic arches widely spreading, widest posteriorly; zygomatic processes of maxillae heavy; premaxillae broad and extending far beyond posterior end of nasals; rostrum wide and heavy; palate slightly arched; pterygoid hamulae heavy; interpterygoid space V-shaped; tympanic bullae moderately inflated ventrally, somewhat compressed laterally; upper incisors long and heavy; molariform teeth large.

From topotypes of *Thomomys bottae birdseyei, T. b. planirostris* differs as follows: Size larger, except total length which averages slightly less in females. Color: Lighter throughout. Skull: Larger in every measurement taken and more massive; rostrum wider, longer and more nearly flat; nasals straight and not inflated dorsally

on distal end; premaxillae wider at posterior ends; extension of premaxillae posterior to nasals greater; zygomatic arches heavier, especially the zygomatic processes of the maxillae; posterior ends of nasals more nearly truncate as opposed to generally rounded; tympanic bullae more nearly flat and relatively smaller; upper incisors longer and heavier; interpterygoid space more narrowly V-shaped; molariform teeth much heavier.

Topotypes of *T. b. planirostris* differ from near topotypes of *Thomomys bottae virgineus* as follows: Size larger; tail and hind foot longer. Color: Slightly darker dorsally, but markedly darker ventrally; postauricular patches smaller and lighter. Skull: Larger in every measurement taken; skull more massive; nasals flat, neither arched nor swollen distally; rostrum wider; naso-frontal region flattened or concave as opposed to convex; premaxillae relatively narrower; zygomatic arches heavier, especially in the processes of the maxillae; tympanic bullae smaller and less inflated ventrally; interpterygoid space generally more narrowly V-shaped; upper incisors longer and heavier; molariform teeth larger.

From topotypes of *Thomomys bottae trumbullensis, T. b. planirostris* differs in: Size larger throughout; tail longer. Color: Much lighter throughout. Skull: More convex dorsally; rostrum wider and more depressed distally; extension of premaxillae posterior to nasals greater; zygomatic arches shorter, and not so widely spreading posteriorly; interpterygoid space more narrowly V-shaped; tympanic bullae smaller; upper incisors wider and longer; molariform teeth larger.

Topotypes of *T. b. planirostris* can be easily distinguished from those of *Thomomys bottae absonus* by darker color throughout and markedly larger size.

From the synonymy at the beginning of this account one may note that the animals here ascribed to this subspecies have had nearly as many subspecific names applied to them as there have been investigators who have written about them. Although each of the previous writers had but a small amount of material upon which to base his opinion, the diversity of opinion as to subspecific status bespeaks the instability of these animals. The present study is based upon 80 animals including additional comparative material.

All animals from Zion National Park have the characters pointed out by Burt (1931:38) in his description of this subspecies. Farther down the Virgin River Valley, towards St. George, however, some very perplexing problems of intergradation are encountered. St. George and environs may correctly be thought of as a "melting pot."

Each of the 57 animals studied from this region is an intergrade; some specimens combine the characters of three subspecies.

As may be seen on the distribution map, three different subspecies of *Thomomys bottae* occur in Washington County. Down the River, below St. George, the subspecies *T. b. virgineus* inhabits the Virgin River Valley below the narrows of the Beaverdam Mountains. Because these narrows are filled with water from wall to wall during periods of high runoff, they form an effective barrier at present to migration of pocket gophers. The mountains to the north of St. George are inhabited by the dark subspecies *T. b. birdseyei.* The type locality of *T. b. planirostris* is on the middle reaches of the Virgin River, in Zion National Park. In addition, on Mount Trumbull to the south, in northern Arizona, there is another subspecies, *T. b. trumbullensis.*

Unquestionably the easiest route of migration into the St. George area is down the Virgin River from Zion National Park; no barrier to pocket gophers occurs between the Park and St. George. Although the animals from St. George are all intergrades, the majority of their affinities as would be expected are with *T. b. planirostris* from Zion National Park. The river itself is not an impassible barrier for gophers to the north and south of it, since this stream frequently changes its course, and often nearly dries up. The Virgin River Valley in Zion National Park is in the bottom of a relatively deep narrow canyon which has sheer rock escarpments. Land around the upper reaches of the river is inhabited by pocket gophers of another species, *Thomomys talpoides.*

Two specimens from St. George, north of the Virgin River, were identified as *T. b. centralis* by Hall and Davis (1934:52), but were stated to be intergrades between *T. b. centralis, T. b. trumbullensis* and *T. b. planirostris.* Goldman (1938a:338) referred 12 specimens from St. George to *Thomomys bottae nicholi,* but stated that they intergraded with *T. b. planirostris.* Twenty-six other specimens from 3 miles southwest of St. George on the west side of Santa Clara Creek, about one-half mile above its confluence with the Virgin River and on its north side, like the topotypes of *T. b. planirostris* were taken in May and have complete, fresh summer pelage. With the exception of 2 specimens which show the ventral color of *T. b. virgineus,* these animals are indistinguishable in color from the topotypes of *T. b. planirostris.* A study of eleven measurements of the males of this series yield the following data: Like *T. b. planirostris* in four measurements, *T. b. birdseyei* in one, *T. b. virgineus* in one; intergrade between *T. b. planirostris* and *T. b. birdseyei*

in two, *T. b. planirostris* and *T. b. virgineus* in two and *T. b. birdseyei* and *T. b. virgineus* in one. Corresponding measurements of the females show the animals to be: Like *T. b. planirostris* in four measurements, *T. b. birdseyei* in one, *T. b. virgineus* in two; intergrade between *T. b. planirostris* and *T. b. birdseyei* in two, *T. b. planirostris* and *T. b. virgineus* in one, and *T. b. birdseyei* and *T. b. virgineus* in one. In 8 of 11 measurements the males either are like *T. b. planirostris* or intergrade towards it, and the females are similarly allied to *T. b. planirostris* in 7 out of 11 measurements. In none of the measurements was either sex referable to *T. b. trumbullensis.*

Intergradation was noted in still other cranial details. In the heavy, relatively straight zygomatic arches, a majority of the skulls resemble those of *T. b. planirostris,* although some show the elongated zygomatic processes of the squamosals that is characteristic of *T. b. virgineus.* Some skulls show a tendency toward *T. b. birdseyei* in the widely spreading posterior regions of the zygomatic arches. The nasals for the most part are as in *T. b. planirostris.* Intergradation between all three subspecies is shown in the extension of the premaxillae posterior to the nasals. Some skulls show the lateral concavity of the jugals which is characteristic of *T. b. virgineus.* The tympanic bullae are variable but on the average are intermediate between those of *T. b. planirostris* and *T. b. birdseyei,* but more as in the latter. The size of the pterygoid hamulae is like that of *T. b. planirostris,* but the shape of the interpterygoid space is more like that of *T. b. birdseyei.* The size of the molariform teeth is as in *T. b. birdseyei.* The incisors are intermediate between those of *T. b. planirostris* and *T. b. birdseyei,* but more like those of *T. b. birdseyei.*

Eighteen specimens from St. George and its environs, on the north side of the Virgin River, agree with the 26 specimens just described, except that they show more evidence of intergradation with *T. b. birdseyei* in slightly darker color, length of hind foot, length of nasals and alveolar length of upper molariform series.

One specimen from 3 miles south, two from 2 miles southwest, another from 4 miles southeast of St. George, and four immature animals from Short Creek Road, south of the town of Virgin, all on the south side of the Virgin River, are darker than topotypes of *T. b. planirostris* and show intergradation with *T. b. trumbullensis* to the south. In size they are likewise closer to the latter subspecies. They intergrade with *T. b. trumbullensis* in the size and shape of the zygomatic arches and tympanic bullae. In the

majority of cranial details, however, they are like *T. b. planirostris* to which they are here referred.

One specimen, a skin only, from Danish Ranch, 5 miles northwest of Leeds, north of the Virgin River, is an intergrade in size and color between *T. b. birdseyei* and *T. b. planirostris*, but referable to the latter.

Three specimens from the East Entrance, and 3 from near the East Entrance of Zion National Park are much darker than topotypes of *T. b. planirostris*. All of these animals are in worn pelage, thus allowing a great amount of the black underfur to show, which gives a markedly darker color. The unworn hair is only slightly darker than that of the topotypes. The cranial details prove these animals to be intergrades between *T. b. planirostris* and *T. b. trumbullensis*. They resemble *T. b. trumbullensis* in size of tympanic bullae, extension of the premaxillae posterior to the nasals and shape of the nasals. The majority of cranial details are as in *T. b. planirostris* to which they are here referred.

When Goldman (1938a:337) named *Thomomys bottae nicholi* from northern Arizona he referred 12 specimens from St. George, Washington County, Utah, to his newly named subspecies. He noted that the animals from this region intergraded with *T. b. planirostris*. I have had occasion to study one-fourth of the material available to Goldman for his original description of *T. b. nicholi*. For his specimens listed as from St. George, the exact locality of capture, which is so essential in this distributional study, was not given. All of the specimens that I have seen from the Biological Surveys Collections are from the south side of the Virgin River, while St. George itself is on the north side. As noted earlier in this account there are differences between the gophers from the two sides of the Virgin River in this area. Those from the north side are intergrades between *T. b. birdseyei, T. b. planirostris* and *T. b. virgineus*, while those from the south side are intergrades between *T. b. planirostris* and *T. b. trumbullensis*.

Goldman (*loc. cit.*) mentioned several times that the skulls of *T. b.* nicholi were nearly indistinguishable from, or closely resembled, those of *T. b. trumbullensis*. Color was the only truly diagnostic character mentioned by Goldman. My study reveals the same differences and likenesses found by Goldman, but I consider color alone insufficient basis in this instance for establishing a new subspecies, and regard *Thomomys bottae nicholi* as a synonym of the earlier proposed name, *Thomomys bottae trumbullensis*.

The animals from the south side of the Virgin River, labelled as from St. George, Washington County, heretofore referred by Goldman to *T. b. nicholi,* are intergrades between *T. b. trumbullensis* and *T. b. planirostris* and along with other specimens from the same place are referable to the latter subspecies.

Specimens examined.—Total, 85, distributed as follows: *Washington County:* Danish Ranch, 5 mi. NW Leeds, 1; Zion National Park, 2 (M. V. Z.); Grotto Camp, Zion National Park, 4,300 ft., 6 (N. H. M. S. D.); Springdale, 3,400 ft., 4 (K. U.); "near" Short Creek Road, S town of Virgin, 4 (R. H.); St. George, N Virgin River, 2,950 ft., 21 (4, M. V. Z.; 8, R. H.; 9, N. H. M. S. D.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 26; St. George, S. Virgin River, 5 (2, M. V. Z.; 3, U. S. N. M.); 2 mi. SE St. George, 2,950 ft., 2 (N. H. M. S. D.); 3 mi. S St. George, 1 (C. M.); 4 mi SE St. George, S Virgin River, 1 (R. H.); 6 mi. S St. George, 2,700 ft., 6 (K. U.). *Kane County:* East Entrance Zion National Park, 5,725 ft., 3 (N. H. M. S. D.); "near" East Entrance Zion National Park, 5,500 ft., 3 (N. H. M. S. D.).

Thomomys bottae absonus Goldman

Botta Pocket Gopher

Thomomys perpallidus absonus Goldman, Journ. Washington Acad. Sci., 21:425, October 19, 1931, type from Jacobs Pools, Houserock Valley, 4,000 feet Coconino County, Arizona.

Thomomys bottae absonus, Hall and Davis, Proc. Biol. Soc. Washington, 47:52, February 9, 1934; Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:71, August 15, 1946.

Thomomys perpallidus aureus, Bailey, N. Amer. Fauna, 39:74, November 15, 1915; Barnes, Bull. Univ. Utah, 12 (no. 15):85, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):100, June, 1927.

Range.—Southern Utah in Kane and Garfield counties in the drainages of Kanab Creek, Johnson Creek, Paria and Escalante rivers.

Description and comments.—Measurements of one adult male topotype, number 3094, are as follows: Total length, 220; length of tail, 71; length of hind foot, 29. Color: Upper parts Ochraceous-Buff mixed with dusky; sides and underparts Light Ochraceous-Buff; chin, nose, cheeks and top of head grayish black; postauricular patches black mixed with buff; front feet, hind feet, inguinal region and distal third of tail white. Skull: Nasals relatively long; rostrum narrow; ascending processes of premaxillae narrow; extension of premaxillae posterior to nasals short; lambdoidal and sagittal crests poorly developed; zygomatic arches light; jugals nearly straight; palate narrow; molariform teeth small.

Compared with topotypes of *Thomomys bottae trumbullensis, T. b. absonus* differs in: Size smaller. Color: Markedly lighter throughout. Skull: Smoother, less angular; zygomatic arches weak as opposed to robust; nasals more convex as viewed laterally; extension of premaxillae posterior to nasals less; ascending processes of premaxillae narrower; palate narrower; palatal pits shallower; rostrum narrower; cheek teeth smaller. For comparisons of *T. b. absonus* with *Thomomys b. aureus,* see account of that subspecies.

Among named subspecies of *Thomomys bottae*, *T. b. absonus* most closely resembles *T. b. planirostris*, but can be distinguished from the topotypes as follows: Size markedly smaller. Color: Lighter, more buffy throughout. Skull: Smaller, less ridged and more nearly flat; nasals convex as opposed to flat; extension of premaxillae posterior to nasals less; width of ascending processes of premaxillae less; zygomatic arches weaker; palate narrower; alveolar length of upper molar series shorter; tympanic bullae more inflated ventrally; molariform teeth smaller and lighter.

One specimen from Kanab is an intergrade between *T. b. trumbullensis* and *T. b. absonus*. The majority of its characters are with *T. b. absonus* to which it is referred (see Hall and Davis, 1934:52). Two specimens from Escalante are intergrades between *T. b. absonus* and *Thomomys bottae dissimilis*, but are referable to *T. b. absonus*.

Specimens examined.—Total, 5, distributed as follows: *Garfield County:* Escalante, 5,258 ft., 2 (B. Y. U.). *Kane County:* Kanab, 4,925 ft., 1 (M. V. Z.); 1 mi. S Kanab, 4,600 ft., 2.

Thomomys bottae alexandrae Goldman

Botta Pocket Gopher

Thomomys alexandrae Goldman, Journ. Washington Acad. Sci., 23:464, October 15, 1933, type from 5 miles southeast of Rainbow Lodge, 6,200 ft., near Navajo Mountain, Coconino County, Arizona.

Thomomys bottae alexandrae, Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935; Durrant, Univ. Kansas Publ. Mus. Nat. Hist., 1:72, August 15, 1946.

Range.—In extreme southwestern San Juan County, Utah. Known only from Navajo Mountain, probably limited to the area enclosed on the north by the Colorado and San Juan rivers and on the east and west by Navajo and Piute canyons respectively.

Description and comments.—Measurements of one male topotype (Benson, 1935:450), and average and extreme measurements of 3 female topotypes are, respectively, as follows: Total length, 205, 205 (215-195); length of tail, 59, 63 (70-57); length of hind foot, 27, 28 (29-27). Color: Upper parts Cinnamon-Buff, grading over the sides to Pinkish Buff on underparts; nose and top of head grayish black; hind feet and tail white; postauricular patches large and dark. Skull: Small and not heavily ridged; zygomatic arches widely spreading but weak; zygomatic arches nearly parallel; tympanic bullae moderately inflated ventrally; palate not arched; interpterygoid space U-shaped; dentition light.

Compared to topotypes of *Thomomys bottae absonus*, *T. b. alexandrae* differs as follows: Size smaller in every measurement taken. Color: Upper parts Cinnamon-Buff as contrasted with Light Ochraceous Buff. Skull: Smaller in every measurement taken except

interorbital breadth and alveolar length of upper molar series which are larger; molariform teeth larger.

Among named subspecies of *Thomomys bottae* occurring in Utah, *T. b. alexandrae* most resembles *Thomomys bottae aureus* to the northeast. It can be distinguished from topotypes of the latter by: Size smaller in every measurement taken. Color: Darker throughout. Skull: Smaller, slenderer and more nearly flat; palate nearly flat as opposed to arched; zygomatic arches weaker and not so widely spreading; interparietal narrower; tympanic bullae smaller; dentition weaker.

Goldman (1933:464) accorded *T. b. alexandrae* full specific status, because he found no intergradation with other subspecies, from which he thought *T. b. alexandrae* had been isolated perhaps for thousands of years by the barriers of the surrounding terrain. Benson (1935:450) noted resemblance between *T. b. alexandrae* and specimens of *T. b. latirostris* (= *Thomomys bottae aureus*) from Keams Canyon, Zuni Well, and Winslow in Navajo County, Arizona and also between *T. b. alexandrae* and *T. b. absonus* from Houserock Valley, Arizona. He thought that *T. b. alexandrae* is no more differentiated or isolated than each of several kinds of desert pocket gophers, and therefore, accorded *T. b. alexandrae* only subspecific status, as I also, am inclined to do.

The taxonomy of the pocket gophers of the species *Thomomys bottae* from extreme southeastern Utah is incompletely known. This entire area is extremely rocky and is greatly dissected by small tributaries of the San Juan and Colorado rivers. The entrenchment of the streams within their narrow, deep, rocky ravines has formed many isolated or nearly isolated small plateaulike areas which contain soil of sufficient amount and kind for inhabitation by the edaphically restricted pocket gophers. The majority of these small plateaus are inaccessible, or nearly so, and to date, no collecting has been done upon them. Small populations of pocket gophers undoubtedly occur in some of these areas, and owing to their small numbers, high genetic plasticity, and relatively isolated areas of occurrence, they have possibly evolved quite rapidly into recognizable subspecies. This is known to have happened in other areas, and is undoubtedly what has happened in animals now known to belong to *T. b. alexandrae*.

Specimens examined.—One (M. V. Z.) from Soldier Spring, Navajo Mountain, 8,600 ft., San Juan County. Fourteen topotypes from Arizona also were examined.

TABLE 10

Cranial Measurements of Thomomys bottae

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		Thomomys bottae aureiventris, topotypes (Hall, 1930: 446)								
♂	4 av.	36.4	14.7	26.5	21.5	6.6	7.9	2.4	.....	.....
♂♂	Max.	37.1	15.3	27.3	22.3	6.9	8.0	3.4	.....	.....
♂♂	Min.	35.3	14.0	25.5	20.9	6.1	7.8	1.8	.....	.....
♀	2 av.	32.4	12.9	22.9	19.4	6.7	7.4	2.9	.....	.....
♀♀	Max.	33.0	13.1	23.3	19.8	6.8	7.8	3.1	.....	.....
♀	Min.	31.8	12.6	22.5	18.9	6.6	7.0	2.7	.....	.....
		Thomomys bottae centralis, topotypes (Hall, 1930: 446)								
♂	9 av.	36.3	14.6	25.2	20.7	6.6	8.0	3.2	.....	.....
♂♂	Max.	38.0	15.9	26.1	21.9	7.2	8.7	4.5	.....	.....
♂	Min.	34.5	13.9	24.6	19.7	5.8	7.5	2.2	.....	.....
♀	17 av.	31.8	12.6	22.1	19.0	6.6	7.6	2.7	.....	.....
♀♀	Max.	33.0	13.8	23.1	20.1	7.1	7.8	3.4	.....	.....
♀	Min.	30.5	11.9	21.3	18.2	5.9	7.0	2.0	.....	.....
		Thomomys bottae albicaudatus, topotypes (Hall, 1930: 446)								
♂	7 av.	35.4	14.0	26.1	20.5	6.6	8.1	3.2	.....	.....
♂♂	Max.	36.1	15.1	27.8	21.1	6.9	8.4	3.8	.....	.....
♂	Min.	34.9	13.4	24.9	19.8	6.4	7.8	3.0	.....	.....
♀	4 av.	32.5	12.9	22.9	18.8	6.6	7.7	2.7	.....	.....
♀♀	Max.	33.8	13.5	24.0	19.5	6.8	8.0	3.0	.....	.....
♀	Min.	31.7	11.9	21.9	18.2	6.1	7.5	2.0	.....	.....
		Thomomys bottae robustus, topotypes								
♂	9 av.	34.1	13.6	26.0	20.8	6.4	7.8	2.7	15.7	8.4
♂♂	Max.	35.7	14.4	26.7	21.5	6.7	8.2	3.0	17.0	8.8
♂	Min.	32.6	13.0	25.2	20.0	6.1	7.3	2.0	14.7	8.1
♀	11 av.	30.6	11.7	22.6	18.8	6.4	7.6	2.6	13.9	7.4
♀♀	Max.	31.6	12.2	23.6	19.8	6.7	8.0	2.9	14.7	7.9
♀	Min.	29.0	10.6	21.0	18.1	6.2	7.1	2.0	12.0	7.1
		Thomomys bottae stansburyi, topotypes								
♂	5 av.	32.3	12.4	22.4	19.1	6.3	7.6	2.8	14.7	7.5
♂♂	Max.	33.4	13.0	23.1	20.1	6.5	8.0	3.0	15.4	7.8
♂	Min.	30.6	12.0	21.5	18.2	6.2	7.0	2.5	14.1	7.1
♀	5 av.	31.1	12.1	21.9	18.7	6.5	7.7	2.6	14.5	7.4
♀♀	Max.	32.7	12.8	22.4	19.5	6.8	8.0	3.0	15.2	7.7
♀	Min.	29.9	10.6	21.0	17.8	6.2	7.3	2.3	13.4	6.9
		Thomomys bottae nesophilus, topotypes								
♂	4 av.	35.3	14.4	25.5	20.4	6.8	8.4	2.5	17.1	8.2
♂♂	Max.	36.5	14.8	26.2	21.1	7.1	8.7	2.9	18.4	8.6
♂	Min.	33.6	14.1	24.9	19.8	6.5	8.2	2.1	16.4	7.6
♀	900	31.2	12.3	23.2	19.3	6.9	8.2	2.2	15.2	7.3

TABLE 10.—*Continued*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		Thomomys bottae minimus, topotypes								
♂	263942 USNM	32.8	12.5	22.4	19.6	6.4	7.6	2.5	15.0	7.4
♂	263945 USNM	28.7	10.2	20.2	17.8	6.3	7.3	2.5	12.9	7.0
♀	263941 USNM	28.2	10.4	19.6	17.1	6.1	7.0	2.3	13.0	6.5
♀	263944 USNM	28.1	10.8	19.7	17.7	6.1	7.0	2.3	13.2	6.8
		Thomomys bottae lenis, topotypes								
♂	264806 USNM	39.9	16.2	28.4	22.4	6.6	8.2	3.7	18.8	8.6
♂	264810 USNM	39.4	15.8	28.7	22.7	6.9	8.5	3.0	17.9	8.9
		Thomomys bottae contractus, topotypes								
♂	8 av	33.3	12.5	23.7	19.1	6.6	7.6	3.0	15.4	7.3
♂	Max	37.4	14.5	26.4	20.9	6.9	8.0	3.5	18.2	8.0
♂	Min	30.0	10.9	21.4	17.7	6.3	7.2	2.4	13.5	6.5
♀	6 av	33.1	12.6	23.3	19.5	6.5	7.8	2.6	15.5	7.1
♀	Max	34.7	13.3	25.2	20.6	6.7	8.2	3.2	17.0	7.3
♀	Min	32.2	12.0	22.2	18.9	6.4	7.6	2.3	14.2	7.0
		Thomomys bottae levidensis, topotypes								
♂	191959 USNM	33.3	12.7	24.5	19.0	6.5	7.6	3.3	15.1	8.0
♀	4 av	30.5	11.1	21.7	17.5	6.6	7.5	2.9	14.0	7.0
♀	Max	30.8	11.5	21.9	17.9	6.9	7.8	3.2	14.7	7.2
♀	Min	29.3	10.6	21.5	17.3	6.3	7.2	2.8	13.0	6.9
		Thomomys bottae convexus, topotypes								
♂	6 av	33.1	14.3	24.9	21.7	6.6	8.0	2.6	16.2	8.2
♂	Max	35.0	14.6	26.7	22.3	6.8	8.1	2.8	17.2	8.6
♂	Min	31.3	13.9	23.8	21.0	6.5	7.7	2.1	15.2	8.0
♀	11 av	29.9	12.5	21.7	19.3	6.6	7.7	2.6	14.7	7.4
♀	Max	30.9	13.4	22.3	19.8	7.1	7.9	3.1	15.2	7.7
♀	Min	27.9	11.2	21.0	18.8	6.2	7.1	2.1	13.3	7.1
		Thomomys bottae tivius, topotypes								
♂	7 av	31.5	12.2	22.4	18.4	6.4	7.2	2.4	14.0	7.1
♂	Max	34.1	12.8	25.0	19.8	6.6	7.6	3.0	15.0	7.9
♂	Min	29.3	11.9	20.6	17.1	6.0	7.0	2.1	13.2	6.5
♀	5 av	29.5	11.1	21.1	17.8	6.5	7.2	3.4	13.5	6.8
♀	Max	31.3	11.4	22.9	19.0	6.7	7.5	3.0	14.2	7.2
♀	Min	28.0	10.5	20.1	17.3	6.3	7.1	2.0	12.7	6.4
		Thomomys bottae bonnevillei, topotypes								
♂	3576	35.2	13.5	25.4	21.7	6.7	8.1	3.4	16.6	8.2
♂	3582	33.6	13.2	25.8	20.5	6.5	8.1	3.5	16.1	8.7
♂	3615	37.4	14.9	28.0	22.5	6.7	8.1	4.3	18.1	8.7
♀	7 av	31.7	11.8	22.2	19.3	6.6	7.7	3.2	14.9	7.3
♀	Max	34.3	13.6	24.3	20.3	7.0	8.5	4.1	16.6	7.7
♀	Min	29.4	10.1	20.3	18.1	6.4	7.1	2.6	13.5	6.9

TABLE 10.—*Continued*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		Thomomys bottae sevieri, topotypes								
♂	1374	33.5	13.4	23.4	19.3	6.2	7.2	3.0	16.4	7.6
♂	1381	32.9	11.8	23.0	19.0	6.3	7.2	2.6	14.5	7.5
♂	1383	31.7	13.5	22.2	18.0	6.7	7.0	1.8	15.0	7.7
♀	7 av	30.2	11.8	21.6	18.0	6.4	7.0	2.7	14.2	7.1
♀	Max	30.7	12.6	22.1	18.6	6.8	7.4	3.0	14.7	7.6
♀	Min	29.4	11.3	20.6	17.7	6.1	6.6	2.1	13.9	6.6
		Thomomys bottae wahwahensis, topotypes								
♂	4 av	34.7	13.5	25.5	20.7	6.6	7.3	2.3	15.7	8.7
♂	Max	37.6	14.6	27.0	21.4	6.8	8.0	2.5	17.1	9.0
♂	Min	33.0	13.1	24.6	20.1	6.5	7.0	2.2	14.9	8.5
♀	8 av	28.7	11.3	20.6	17.6	6.3	7.1	2.1	12.6	7.1
♀	Max	30.7	12.6	22.0	19.0	6.7	7.8	2.9	14.0	7.6
♀	Min	26.3	10.2	19.0	16.5	5.8	6.9	1.1	10.8	6.4
		Thomomys bottae planirostris, topotypes (Burt, 1931: 39)								
♂	8 av	35.6	13.8	25.5	20.4	6.6	8.5	3.7	.....	8.8
♂	Max	38.7	15.3	27.6	21.3	7.2	8.9	4.5	.....	9.4
♂	Min	33.3	12.5	24.4	19.8	6.2	8.2	3.0	.....	8.3
♀	8 av	32.2	12.4	23.2	18.7	6.5	8.1	3.6	.....	7.9
♀	Max	33.0	12.9	24.1	19.5	6.7	8.6	4.5	.....	8.1
♀	Min	31.5	11.8	22.3	18.1	6.4	7.5	2.8	.....	7.5
		Thomomys bottae birdseyei, topotypes								
♂	3 av	34.9	13.8	26.2	20.9	6.2	8.4	2.6	16.3	8.3
♂	Max	35.2	14.1	27.4	21.5	6.5	8.8	2.8	16.9	8.4
♂	Min	34.5	13.1	26.0	20.1	6.0	8.1	2.2	16.0	8.2
♀	3 av	31.6	11.8	22.7	18.6	6.1	7.4	2.4	14.7	7.5
♀	Max	32.0	12.8	23.0	19.1	6.2	7.4	3.0	15.3	7.5
♀	Min	31.4	11.0	22.4	18.3	6.0	7.3	1.6	13.3	7.4
		Thomomys bottae virgineus, Beaverdam Wash, 5 mi. N Utah-Arizona Line								
♂	5 av	34.6	13.5	25.6	20.7	6.3	8.0	3.0	16.5	8.5
♂	Max	34.9	14.4	26.0	21.1	6.6	8.4	3.5	17.4	8.7
♂	Min	33.5	12.8	25.0	20.0	6.1	7.6	2.4	15.3	8.3
♀	4 av	31.6	12.2	22.6	19.4	5.9	7.5	3.1	15.1	7.3
♀	Max	32.1	12.8	22.7	20.0	6.1	7.8	3.7	15.5	7.6
♀	Min	31.3	11.3	22.4	18.8	5.8	7.3	2.4	14.4	7.2
		Thomomys bottae aureus, topotypes								
♂	1149	35.3	13.8	24.6	20.6	6.4	7.7	2.3	16.7	8.3
♂	1151	37.8	14.9	25.8	21.5	6.8	8.7	2.0	17.9	9.0
♂	1152	36.8	14.3	25.6	22.0	6.7	8.6	2.5	16.9	8.7
♀	1147	34.0	14.2	23.7	19.8	6.8	8.2	2.0	16.4	8.2
♀	1148	32.8	13.0	24.4	19.6	6.9	8.4	1.6	15.1	8.2
♀	1150	32.8	12.5	23.3	19.8	6.4	8.0	2.0	14.5	8.3

TABLE 10.—*Concluded*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Alveolar length of upper molariform tooth-row	Extension of premax. post. to nasals	Length of rostrum	Breadth of rostrum
		Thomomys bottae howelli, 10 mi. N Moab								
♂	5 av.	33.1	13.5	23.2	20.1	6.5	8.3	2.5	16.1	8.8
♂	Max.	35.3	14.3	24.1	20.7	6.8	8.8	2.8	17.5	9.4
♂	Min.	31.8	12.8	22.8	18.9	6.4	8.0	2.3	15.1	8.1
♀	20300 C. M.	32.4	12.3	21.1	19.2	6.4	7.9	2.4	15.8	8.3
		Thomomys bottae absonus, topotype								
♂	3094	32.0	13.9	22.6	19.0	6.4	7.0	1.0	15.1	7.2
		Thomomys bottae osgoodi, topotypes								
♂	158529 USNM	33.8	13.3	22.7	19.6	6.6	8.4	3.2	16.5	8.3
♀	158528 USNM	29.6	11.5	.....	18.3	6.9	7.4	2.0	14.0	7.3
		Thomomys bottae alexandrae, topotypes ♂ (Benson, 1935:450)								
♂	.....	33.9	13.7	24.3	19.7	6.5	8.0	.....	15.8	8.1
♀	3 av.	30.9	11.8	20.8	17.9	6.4	7.6	1.8	14.1	7.5
♀	Max.	31.5	12.1	22.2	18.6	6.5	7.7	2.0	14.7	7.7
♀	Min.	28.7	11.5	20.5	17.2	6.3	7.5	1.5	13.6	7.2

Family HETEROMYIDAE

Pocket Mice, Kangaroo Mice, Kangaroo Rats

The mammals belonging to this family have the following characters in common: Large external fur-lined cheek pouches; rounded ears; large eyes; elongated hind limbs and tail; markedly elongated hind feet; small front feet and legs; greatly enlarged auditory bullae, with mastoid part of bullae well exposed on dorsal surface of skull; upper incisors grooved; zygomata slender; anterior openings of infraorbital foramina situated well forward on sides of rostrum; dental formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{1}{1}$, m.$\frac{3}{3}$.

This family is represented in Utah by the genus *Perognathus* with 13 subspecies belonging to 6 species; the genus *Microdipodops* with 2 subspecies belonging to a single species; the genus *Dipodomys* with 24 subspecies belonging to 4 species.

KEY TO THE HETEROMYIDS OF UTAH

1.–Soles of hind feet densely haired; interparietal less than ¼ of greatest width of skull.
  2.–Tip of tail tufted; hind foot more than 32; dermal gland present on back; occlusal surface of upper premolar elliptical.
    3.–Four toes on hind foot.
      4.–Size large; total length more than 300; color pale; terminal part of tail white ..... *Dipodomys deserti*, p. 280
      4'.–Size medium, total length never more than 250; color dark; terminal part of tail dark ..... *Dipodomys merriami*, p. 278
    3'.–Five toes on hind foot.
      5.–Lower incisors awl-shaped ..... *Dipodomys ordii*, p. 252
      5'.–Lower incisors chisel-shaped .. *Dipodomys microps*, p. 269
  2'.–Tip of tail nontufted; hind foot less than 32; dermal gland absent on back; occlusal surface of upper premolar triangular. *Microdipodops megacephalus*, p. 250
1.'–Soles of hind feet naked, or haired only from heel to plantar surface; width of interparietal more than ¼ of greatest width of skull.
  6.–Mastoids relatively small, not projecting beyond plane of occiput; audital bullae separated by full width of basisphenoid. *Perognathus intermedius*, p. 247
  6'.–Mastoids greatly developed, projecting beyond plane of occiput; audital bullae nearly meeting anteriorly on ventral surfaces.
    7.–Antitragus lobed; hind foot more than 20.
      8.–Side of body with olivaceous line; tail not crested; lateral indentations of mastoid in supraoccipital absent. *Perognathus parvus*, p. 241

8'.–Side of body without olivaceous line; tail crested; indentations of mastoid in supraoccipital present, *Perognathus formosus*, p. 244

7'.–Antitragus not lobed; hind foot less than 20.

9.–Lower premolar larger than last molar. *Perognathus longimembris*, p. 237

9'.–Lower premolar smaller than last molar.

10.–Total length less than 130; mastoid breadth less than 11. *Perognathus flavus*, p. 233

10'.–Total length more than 130; mastoid breadth more than 12. *Perognathus apache*, p. 235

Perognathus flavus hopiensis Goldman

Baird Pocket Mouse

Perognathus flavus hopiensis Goldman, Proc. Biol. Soc. Washington, 45:89, June 21, 1932, type from Oraibi, Hopi Indian Reservation, 6,000 feet, Navajo County, Arizona; Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935.

Cricetodipus flavus, Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871-74, Wheeler's Rep't Expl. W 100th Meridian, 5:109, 1875.

Perognathus flavus bimaculatus, Osgood, N. Amer. Fauna, 18:24, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):87, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):104, June, 1927.

Range.—Southeastern Utah in San Juan County.

Description and comments.—Measurements of the type, a female, are as follows: Total length, 115; length of tail, 50; length of hind foot, 15 (Goldman, 1932c:90). Color: Upper parts, sides and lateral margins of hind limbs Light Ochraceous-Buff, finely mixed with black on crown and dorsal regions; postauricular patches conspicuous and buffy in color; subauricular patches white; ears gray externally, black internally; front and hind feet white; dorsal surface of tail grayish or light brownish; entire underparts white; ventral surface of tail similar to dorsal surface but paler. Skull: Small; bullae well developed; interparietal small, pentagonal in shape; rostrum slender; zygomatic processes of maxillae angular; lower premolar smaller than last molar.

From *Perognathus flavus bimaculatus, P. f. hopiensis* differs in lighter color (less ochraceous and less black dorsally) and from its near geographic neighbor, *Perognathus flavus fuliginosus*, it differs in the same way being pallid as opposed to Ochraceous-Buff heavily overlaid with black.

San Juan County is the only area in Utah from which any member of the species *Perognathus flavus* is known. The Colorado River

probably has acted as a barrier preventing the species from extending farther northwest.

Specimens examined.—Total, 14, distributed as follows: *San Juan County:* ½ mi. NW Bluff, 4,500 ft., 10; 1 mi. SW Bluff, 4,600 ft., 1 (M.V.Z.); Navajo Mountain Trading Post, 5 mi. SE Navajo Mountain, 3 (M.V.Z.).

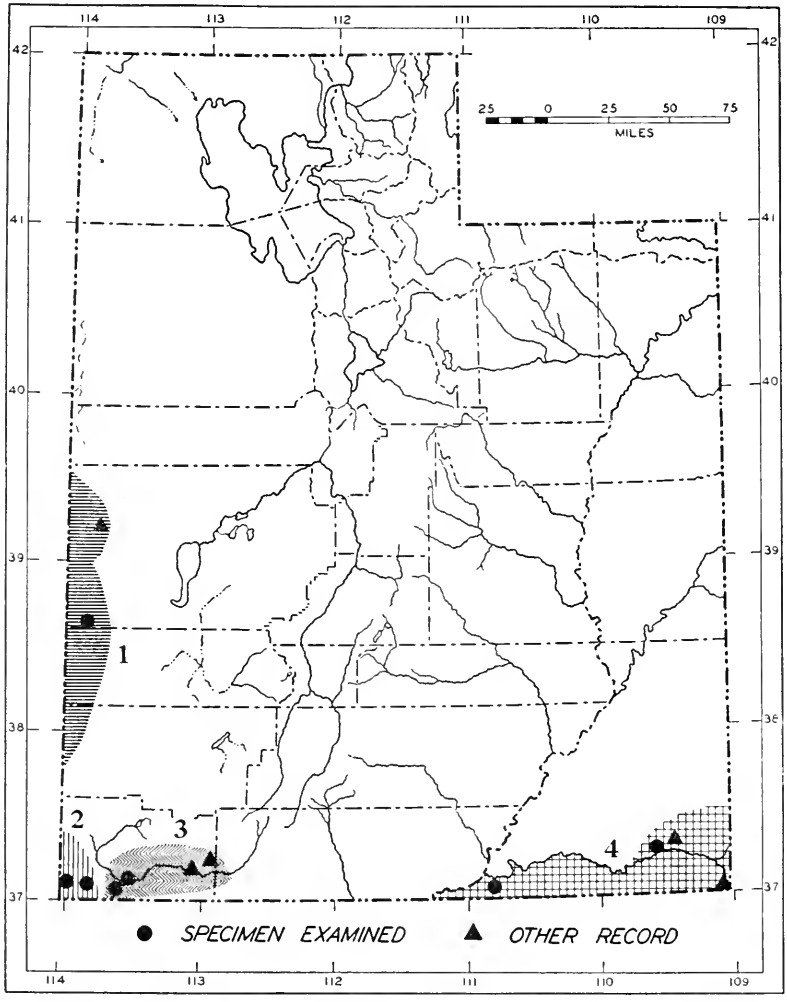

FIG. 39. Distribution of *Perognathus formosus* and *Perognathus flavus*.
1. *P. formosus incolatus.*
2. *P. formosus mohavensis.*
3. *P. formosus formosus.*
4. *P. flavus hopiensis.*

Additional records (Goldman, 1932c:90).—*San Juan County:* Bluff; Nolands Ranch [= N side San Juan River, 1½ mi. N "Four Corners" (Hall, 1931:2)]

Perognathus apache caryi Goldman

Apache Pocket Mouse

Perognathus apache caryi Goldman, Proc. Biol. Soc. Washington, 31:24, May 16, 1918, type from 8 miles west of Rifle, Garfield County, Colorado; Moore, Journ. Mamm., 11:87, February 11, 1930.
Perognathus apache, Warren, The mammals of Colorado, Knickerbocker Press, p. 69, 1910.

Range.—Eastern and southeastern Utah, from southern Uintah County south to the San Juan River. See figure 41.

Description and comments.—Measurements of a male, number 1199, from Johns Canyon are as follows: Total length, 147; length of tail, 70; length of hind foot, 21; length of ear, 8. Color: Upper parts Light Ochraceous-Buff heavily suffused with black; subauricular patches small, white; front feet, hind feet, ventral surface of tail and entire underparts white; conspicuous lateral lines from cheeks to hips pure Light Ochraceous-Buff; ears blackish inside; dorsal surface of tail like rump, darkest distally; Skull: Large; massive; braincase arched; nasals long.

For comparison with *Perognathus apache apache,* see account of that subspecies.

This pocket mouse has practically the same range in Utah as the kangaroo rat *Dipodomys ordii nexilis.* Each occupies practically the entire area east of the Green and Colorado rivers and north of the San Juan River. Intergradation with *P. a. apache* is noted in specimens from Bluff. Further details on geographic distribution are given in the account of *P. a. apache.*

The specimens from Uintah County are the most northerly ones known from Utah. They are paler than those from San Juan County being fawn as opposed to Light Ochraceous-Buff. They possess some minor distinctive cranial characters, and adequate material may prove them to be subspecifically different from *P. a. caryi.*

One specimen, number 6667, is from Emery County, west of the Green River. It is the only animal of this species known from the west side of the river. The locality of capture is only four miles from the highway and railroad bridges which span the river at the town of Greenriver. This animal may have crossed on one of these bridges. Study of this specimen reveals no differences from animals from the east side of the river.

Specimens examined.—Total, 16, distributed as follows: *Uintah County:* Browns Corral, 20 mi. S Ouray, 6,250 ft., 2; Willow Creek, 25 mi. S Ouray, 5,250 ft., 2. *Emery County:* Pump station, 4 mi. N Greenriver, 4,100 ft., 1. *Grand County:* 1 mi. E Greenriver, 4,080 ft., 8 (M. V. Z.); 2 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 1; Castle Valley, 18 mi. NE Moab, 6,000 ft., 1. *San Juan County:* John's Canyon, San Juan River, 12 mi. NW Mexican Hat, 5,150 ft., 1.

Additional record (Moore, 1930:87).—*San Juan County:* Hatch Crossing, about 30 mi. N Monticello.

Perognathus apache apache Merriam

Apache Pocket Mouse

Perognathus apache Merriam, N. Amer. Fauna, 1:14, October 25, 1889, type from near Keams Canyon, Apache County, Arizona; Allen, Bull. American Mus. Nat. Hist., 5:71, April 28, 1893; Osgood, N. Amer. Fauna, 18:26, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):88, April, 1922.

Perognathus apache apache, Miller, Bull. U. S. Nat. Mus., 144:275, April 29, 1924; Barnes, Bull. Univ. Utah, 17 (no. 12):105, June, 1927; Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935.

Range.—Southeastern Utah in San Juan County. See figure 41.

Description and comments.—Measurements of 2 males, numbers 1169 and 1158, from Bluff are, respectively, as follows: Total length, 134, 130; length of tail 68, 60; length of hind foot, 17, 20; length of ear, 7, 7. Color: Upper parts Pinkish Buff, finely mixed with black; subauricular patches small, white; sides Pinkish Buff; front feet, hind feet, ventral surface of tail and entire underparts white; dorsal surface of tail like rump, but more suffused with black in some specimens. Skull: Relatively large; mastoid bullae well inflated; interparietal moderately large, pentagonal in shape; angular process of mandible short and upturned; lower premolar smaller than last lower molar.

From *Perognathus apache caryi*, *P. a. apache* differs as follows: Smaller; color lighter (less cinnamon and black); skull smaller; braincase less inflated; nasals shorter.

Superficially *P. a. apache* is easily confused with some subspecies of *Perognathus longimembris* but can be readily distinguished by shorter tail; longer, more massive skull and by lower premolar being smaller than last lower molar.

This subspecies and *Dipodomys ordii longipes* have almost the same geographic distribution in southeastern Utah. All of the specimens from Bluff are nearly typical but in minor degree are intergrades between *P. a. apache* and *P. a. caryi*. All specimens available for this study from north of the San Juan River, with the exception of those from Bluff, are referable to *P. a. caryi*. One specimen from Johns Canyon, on the north side of the San Juan River is typical *P. a. caryi*. Bluff is likewise on the north side of the San Juan River but farther upstream. As noted by Durrant and Setzer (1945:22) the San Juan River is a barrier downstream towards its confluence with the Colorado River, but in its upper reaches it is not a barrier to dispersal of small mammals. The pocket mouse, *P. a. apache*, from the Painted Desert of Arizona seems to have been able to circumvent the upper reaches of the River; on the north side its range extends as far west as the environs of Bluff.

Specimens examined.—Total, 7, distributed as follows: *San Juan County:* 1 mi. N Bluff, 4,400 ft., 1; ½ mi. N Bluff, 4,400 ft., 1; Bluff, 4,400 ft., 1 (M. V. Z.); Navajo Mountain Trading Post, 1 (M. V. Z.); plain S Navajo Mountain, 3 (M. V. Z.).

Additional records.—San Juan County: Riverview (Allen, 1893b:71); Nolands Ranch [= N side San Juan River, 1½ mi. N "Four Corners" (Hall, 1931:2)] (Osgood, 1900:27).

Perognathus longimembris gulosus Hall

Little Pocket Mouse

Perognathus longimembris gulosus Hall, Proc. Biol. Soc. Washington, 54:55, May 20, 1941, type from ¼ mile south of Smith Creek Cave, Mt. Moriah, 5,800 feet, White Pine County, Nevada.

Perognathus nevadensis, Osgood, N. Amer. Fauna, 18:31, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):88, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):106, June, 1927.

P[erognathus]. nevadensis, Goldman, Proc. Biol. Soc. Washington, 44:135, October 17, 1931.

Perognathus longimembris nevadensis, Hall and Johnson, Proc. Utah. Acad. Sci. Arts and Letters, 15:121, 1938; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Extreme western Utah.

Description and comments.—Average and extreme measurements of 6 males, and measurements of 3 females, numbers 3852, 3880 and 3902, from Desert Range Experiment Station are, respectively, as follows: Total length, 130 (140-124), 125, 131, 120; length of tail, 72 (77-69), 70, 69, 63; length of hind foot, 19 (20-18), 17, 19, 18; length of ear, 6 (7-5), 6, 6, 5. Color: Upper parts Pinkish Buff, uniformly overlaid with dark brown or black; subauricular patches small, white or buffy white; feet white; lower sides pure Pinkish Buff; entire underparts white to base of hairs; tail bicolored, dusky above, darkest distally. Skull: Small; wide across mastoid region; length of mastoid bullae moderate; upper molariform series short.

In Utah, the subspecies geographically closest to *P. l. gulosus* is *Perognathus longimembris virginis.* For comparison see account of that subspecies.

Insofar as known, this subspecies of *P. longimembris* is restricted in Utah to the extreme western part. It inhabits the western area of the region formerly occupied by Pleistocene Lake Bonneville. The Pine Valley Mountains and the Beaverdam Mountains form an effective barrier between the ranges of *P. l. gulosus* and *P. l. virginis.* Like most animals limited to the Lake Bonneville area it is characterized by pallid coloration. It is the palest member of the genus found in the state.

Six animals from the Desert Range Experiment Station in Millard County show an interesting arrangement of dorsal spots. The spots are white all the way to the bases of the hairs. The distribu-

tion of spotting varies from a single spot on the rump to 12 spots distributed from the rump to the mid-orbital region.

Specimens examined.—Total, 26, distributed as follows: *Boxelder County:* Kelton, 4,225 ft., 1 (M.V.Z.). *Millard County:* 5 mi. S Garrison, 5,400 ft., 2 (M.V.Z.); Warm Cove, 55 mi. W Milford, 5,500 ft., 4; Desert Range Experiment Station, 50 mi. W Milford (Desert Range Experiment Station, United States Forest Service, Sec. 33, T. 25S R. 17W, Salt Lake Base Meridian, 5,252 ft.), 19.

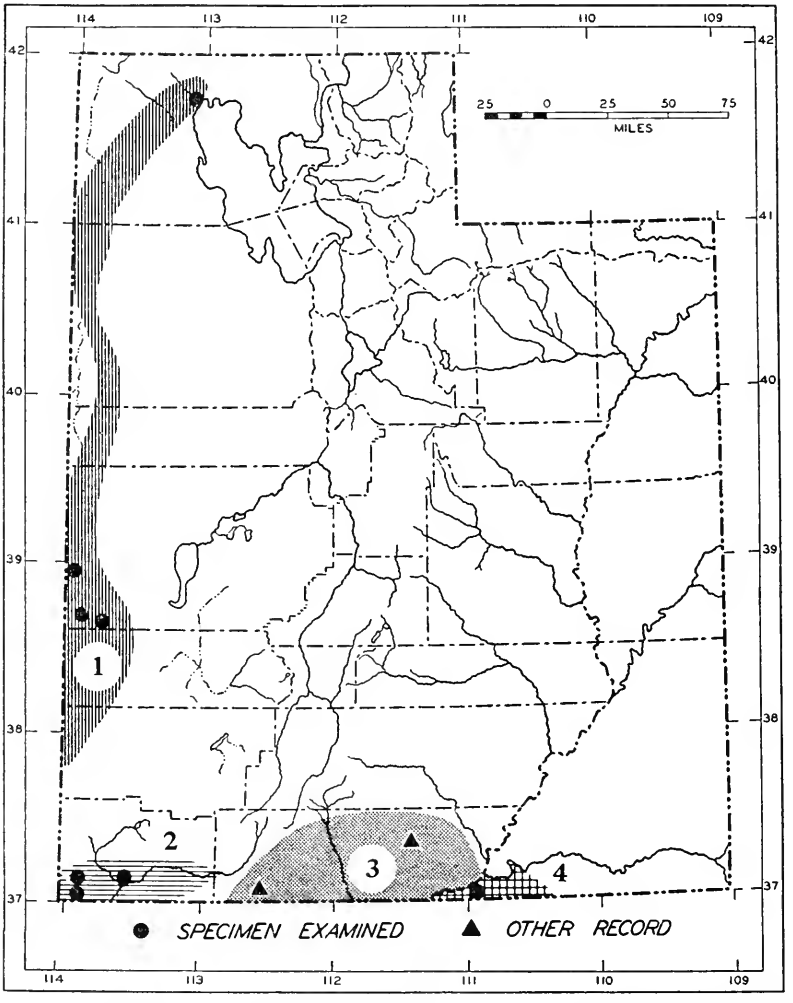

FIG. 40. Distribution of *Perognathus longimembris* and *Perognathus intermedius*.

1. *P. l. gulosus.*
2. *P. l. virginis.*
3. *P. l. arizonensis.*
4. *P. l. arcus* and *P. i. crinitus.*

Perognathus longimembris virginis Huey

Little Pocket Mouse

Perognathus longimembris virginis Huey, Trans. San Deigo Soc. Nat. Hist., 9:55, August 31, 1939, type from St. George, 2,950 feet, Washington County, Utah; Hardy, Ecol. Monogr., 15:86, January, 1945.

Perognathus panamintinus, Osgood, N. Amer. Fauna, 18:28, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):88, April, 1922.

Perognathus panamintinus panamintinus, Barnes, Bull. Univ. Utah, 17 (no. 12):105, June, 1927.

P[erognathus]. l[ongimembris]. panamintinus, Goldman, Proc. Biol. Soc. Washington, 44:135, October 17, 1931.

Range.—Washington County, limits unknown.

Description and comments.—Measurements of a male, number 3230, and a female, number 3231, topotypes are, respectively, as follows: Total length, 132, 131; length of tail, 65, 66; length of hind foot, 19, 18; length of ear, 6, 5. Color: Upper parts Light Pinkish Cinnamon finely mixed with black; purest on sides; subauricular patches white; dorsal surface of tail like back, becoming more hairy and darker on distal third; front feet, hind feet and entire underparts white; ventral surface of tail similar to dorsal surface, but a trifle lighter. Skull: Small; mastoid bullae small, extending well beyond occiput; interparietal pentagonal, nearly as broad as long; lower premolar larger than last lower molar.

The subspecies in Utah geographically nearest to *P. l. virginis* is *Perognathus longimembris gulosus.* Topotypes of *P. l. virginis* may be readily distinguished from *P. l. gulosus* as follows: Color: Darker, black and reddish (buffy as opposed to grayish overall dorsal color). Skull: Markedly larger, especially mastoid bullae.

For comparison with *Perognathus longimembris arizonensis,* see account of that subspecies.

Hardy (1945) showed that the Beaverdam Mountains have exerted considerable effect on speciation of a number of mammals. In these small pocket mice considerable difference exists between those from St. George on one side of the Beaverdam Mountains and those from Beaverdam Wash on the other side, although the two localities are separated by a distance of only 25 miles. Four specimens from Beaverdam Wash are all markedly larger in each external measurement taken. Also the color is slightly lighter and there are some cranial differences. At this time it seems best to refer these animals to *P. l. virginis.*

Specimens examined.—Total, 27, distributed as follows: Washington *County:* St. George, 21 (M.V.Z.); Black Hill, ¼ mi. W St. George, 3,000 ft., 1; 1 mi. W St. George, 2,800 ft., 1; 1½ mi. E Beaverdam Wash, 8 mi. N Utah-Arizona border, 3,200 ft., 3; Beaverdam Wash, 5 mi. N Utah-Arizona border, 2,600 ft., 1.

Perognathus longimembris arizonensis Goldman

Little Pocket Mouse

Perognathus longimembris arizonensis Goldman, Proc. Biol. Soc. Washington, 44:134, October 17, 1931, type from 10 miles south of Jacobs Pools, Houserock Valley, north side Marble Canyon of Colorado River, Coconino County, Arizona; Tanner, Great Basin Nat., 1:104, June 30, 1940.

Range.—Known only from the Kaiparowits Plateau, and Kanab.

Description and comments.—Measurements of the type, a female, are: Total length, 137; length of tail, 79; length of hind foot, 18.5 (Goldman, 1931:135). Color: Upper parts between Ochraceous-Buff and Light Ochraceous-Buff, finely lined with black; postauricular patches small, white; front and hind feet white; tail buffy above, paler below; entire underparts white. Skull: Mastoid bullae large and projecting far beyond occiput; tympanic bullae large; interparietal nearly as long as wide.

P. l. arizonensis can be distinguished from *Perognathus longimembris virginis* by: Total length less; hind foot smaller; occipitonasal length less; nasals longer; mastoids larger. For comparison with *Perognathus longimembris arcus*, see account of that subspecies.

Records of occurrence.—Kane County: Kaiparowits Plateau (Tanner, 1940a:104); Kanab (Goldman, 1931:135).

Perognathus longimembris arcus Benson

Little Pocket Mouse

Perognathus longimembris arcus Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935, type from Rainbow Bridge, 4,000 feet, San Juan County, Utah.

Range.—Known only from the type localtiy.

Description and comments.—Measurements of the type, a female, are as follows: Total length, 145; length of tail, 86; length of hind foot, 19; length of ear, 8 (Benson, 1935:451). Ears large; tail long. Color: Similar to *Perognathus longimembris arizonensis* but slightly lighter on upper parts. Skull: Large; audital bullae well expanded beyond occiput; interparietal small.

Specimens of this subspecies resemble those of *P. l. arizonensis* more closely than any other member of the species *Perognathus longimembris* known to occur in Utah, but *P. l. arcus* differs in longer tail, larger ears, slightly lighter dorsal coloration and smaller interparietal.

In Utah, this subspecies is known from only two specimens from the type locality. This locality is 4 miles north of the southern border of the state and south of the Colorado River. This is the only subspeceis of *Perognathus longimembris* known to occur south of the Colorado River in this region. *Perognathus longimembris*

bombycinus occurs south of the river at its lower end in extreme southwestern Arizona. The range of *P. l. arcus* probably will be found to extend southward and eastward. Like *P. l. arizonensis* and many other mammals, *P. l. arcus* probably reaches the extreme northern limits of its range in southern Utah.

Specimens examined.—Two, from the type locality (M.V.Z.).

Perognathus parvus olivaceus Merriam

Great Basin Pocket Mouse

Perognathus olivaceus Merriam, N. Amer. Fauna, 1:15, October 25, 1889, type from Kelton, Boxelder County, Utah.

Perognathus parvus olivaceus, Osgood, N. Amer. Fauna, 18:37, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):89, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):106, June, 1927; Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Fautin, Ecol. Monogr., 16:304, October, 1946; Hardy, Journ. Mamm., 30:434, November 17, 1949.

Perognathus monticola, Coues and Yarrow, Report upon the collection of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871-74, Wheeler's Rep't Expl. W 100th Meridian, 5:110, 1875.

Perognathus olivaceus amoenus Merriam, N. Amer. Fauna, 1:16, October 25, 1889, type from Nephi, Juab County, Utah.

Perognathus parvus plerus Goldman, Journ. Mamm., 20:352, August 14, 1939, type from north end of Stansbury Island, Great Salt Lake, 4,250 feet, Tooele County, Utah; Marshall, Journ. Mamm., 21:153, May 16, 1940.

Range.—Western Utah; one small population occurs in eastern Emery County.

Description and comments.—Average and extreme measurements of 5 males and 4 females from east shore Great Salt Lake are, respectively, as follows: Total length, 174 (181-160), 172 (190-160); length of tail, 91 (97-85), 88 (90-85); length of hind foot, 23 (24-22), 21 (22-19); length of ear, 8 (9-7), 7.5 (9-6). Tail long, moderately pencillate; antitragus lobed. Color: Upper parts near (*c*) Pinkish Buff, profusely mixed with black, palest on sides; subauricular patches small and white; front and hind feet white; lateral side of upper arm with pale wash of Pinkish Buff; entire underparts white; tail bicolored, white below, like back above, distal one-half to one-third darker. Skull: Large; nasals long; tympanic bullae well inflated; interparietal pentagonal; premaxillae extend posterior to nasals.

For comparison with *Perognathus parvus clarus,* see account of that subspecies.

Most of the range of this animal within the state is that area formerly occupied by the Pleistocene Lake Bonneville.

Goldman (1939b:352) named the pocket mouse from Stansbury and Carrington islands in Great Salt Lake *Perognathus parvus plerus.* The only diagnostic character by which it was separated from *P. p. olivaceus* of the mainland was that of color. The skulls of the two subspecies were considered by Goldman (*loc. cit.*) to be

indistinguishable from each other. I have examined two of the five specimens upon which the name *Perognathus parvus plerus* was based. I concur with Goldman in that although removed by only a distance of a few miles, the specimens from the islands are lighter-

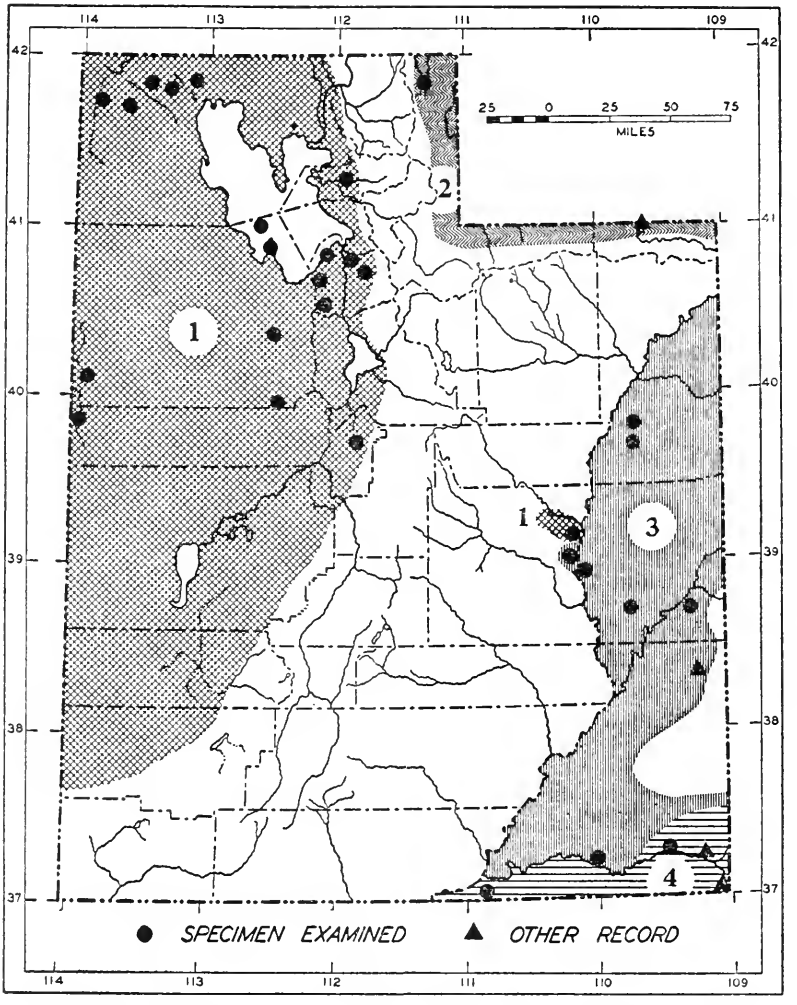

FIG. 41. Distribution of *Perognathus parvus* and *Perognathus apache*.
1. *P. p. olivaceus.*
2. *P. p. clarus.*
3. *P. a. caryi.*
4. *P. a. apache.*

colored, in general, than the majority of the mainland animals. In the several series from Ogden, Sheeprock Mountain, and even from as far west as the Deep Creek Mountains on the Utah-Nevada bor-

der, there are specimens which in this pallid coloration approach the animals from the islands. The darker coloration of the mainland animals is chiefly because of a greater admixture of black and not because of any marked deepening of the lighter color. The animals from the islands are a little more "roseaceus", which may possibly be the result of the reaction of alkaline soils on the hairs, and not to genetic differences.

Furthermore, these islands are not islands in the true sense, since they are periodically connected with the mainland by bars when the level of the lake recedes. Sometimes these periods are of several years duration, and then there is opportunity for exchange of pocket mice between these islands and the mainland.

I can see the differences described in the original description, but do not consider color alone, without diagnostic cranial characters, as sufficient evidence for separation of these insular animals. The name *Perognathus parvus plerus,* therefore, here is placed as a synonym of the earlier named *Perognathus parvus olivaceus.*

Since preparing the manuscript of the original study of *P. p. olivaceus* from Utah, one adult and two immature specimens of *Perognathus parvus* have been obtained from 7 miles north of Greenriver, Emery County. This locality is on the east side of the central mountain ranges of the state and within the drainage of the Colorado River, whereas all previously known localities of occurrence are on the west side of these mountains and in the Great Basin drainage. These specimens from Emery County are inadequate for critical taxonomic study, but resemble *P. p. olivaceus.* Adequate study material from south central Utah and northern Arizona may show *P. p. olivaceus* to have circumvented the southern end of the central mountain ranges of Utah and to have extended its range northward on the east side of these mountains as far as the environs of Greenriver. Larger series of these pocket mice from east central Utah may, however, prove the existence there of an unnamed kind of *P. parvus,* but for the present, I tentatively refer these 3 specimens to *P. p. olivaceus.*

Specimens examined.—Total, 126, distributed as follows: *Boxelder County:* George Creek rd. junction, 5 mi. SE Yost, Raft River Mountains, 1; George Creek, 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 5; Pine Canyon, 20 mi. NW Kelton, 1 (M.V.Z.); Pine Creek, 3 mi. N Rosette, Raft River Mountains, 6,100 ft., 3; 17 mi. NW Kelton, 11 (M.V.Z.); Clear Creek, Raft River Mountains, 5 mi. SW Nafton, 6,500 ft., 2; Grouse Creek, Raft River Mountains, 6,500 ft., 1. *Weber County:* Ogden, 3 (U.S.N.M.). *Tooele County:* Carrington Island, Great Salt Lake, 1 (U.S.N.M.); Stansbury Island, Great Salt Lake, 2 (U.S.N.M.); Clover Creek, Onaqui Mountains, 5,500 ft., 1; Clifton Flat, 7 mi. SW Goldhill, 6,149 ft., 2; Little Valley, Sheeprock Mountains, 5,500 ft., 2. *Salt Lake County:* E shore Great Salt Lake, 4,320 ft., 59; Salt Lake City, 4,300 ft., 4 (U.S.N.M.); Millcreek Canyon, 5 mi. SE Salt Lake City, 4,700 ft., 1; Bacchus, 4,800 ft., 2; Butterfield Canyon, 3 mi. SW Butter-

field Tunnel, 8,000 ft., 1; 1 mi. W Herriman, 5,000 ft., 1; Rose Canyon, 3 mi. SW Herriman, 5,500 ft., 5; Beef Hollow, 3 mi. W Camp Williams, 6,000 ft., 2. *Juab County:* Nephi, 5,059 ft., 8 (M.V.Z.); Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 5. *Emery County:* 7 mi. N Greenriver, 4,100 ft., 3.

Perognathus parvus clarus Goldman

Great Basin Pocket Mouse

Perognathus parvus clarus Goldman, Proc. Biol. Soc. Washington, 30:147, July 27, 1917, type form Cumberland, Lincoln County, Wyoming; Svihla, Journ. Mamm., 12:262, August 24, 1931.

Range.—Extreme northeastern Utah, in Rich County and probably in Summit and Daggett counties.

Description and comments.—Measurements of the type, a male, are: Total length, 181; length of tail, 84; length of hind foot, 22 (Goldman, 1917:147). Color: Upper parts Light Buff finely lined with black; subauricular patches white; lateral line faint and buffy in color; feet and entire underparts white; tail bicolored, brownish above, white below. Skull: Large; nasals long; bullae well inflated; interparietal pentagonal.

Perognathus parvus clarus may be distinguished from *Perognathus parvus olivaceus* as follows: Color of upper parts lighter (less ochraceous); lateral line less distinct; upper molariform series longer.

Osgood (1900:38) referred two specimens from Laketown, Rich County, to *Perognathus parvus olivaceus,* at a time when *P. p. clarus* was as yet unrecognized. My appeal to Doctor Hartley H. T. Jackson and Mr. Stanley P. Young to lend me these two specimens resulted in their finding only one of them, a skin lacking the legs and skull, number 55293, collected on July (26?), 1893, by Vernon Bailey (original number 4132). The external measurements are 175, 93, 25. The faint lateral line and blackish, as opposed to buffy, overcast on the upper parts are points of difference from *P. p. olivaceus* and are points of agreement with *P. p. clarus* to which the specimen is referred.

Specimen examined.—One from *Rich County:* Laketown.

Perognathus formosus incolatus Hall

Long-tailed Pocket Mouse

Perognathus formosus incolatus Hall, Proc. Boil. Soc. Washington, 54:56, May 20, 1941, type from 2 miles west of Smith Creek Cave, Mt. Moriah, 6,300 feet, White Pine County, Nevada.

Perognathus formosus formosus, Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Extreme western Utah. See figure 39.

Description and comments.—Measurements of the single specimen, number 1677, from Utah, are: Total length, 182; length of tail, 104; length of hind foot, 24; length of ear, 11. Color: Upper parts and sides pale grayish (Avellaneous), mixed white, Light Buff and brown; tail like back, darker distally;

subauricular patches small, white; feet and entire underparts white; ventral surface of tail whitish, with faint wash of buff. Skull: Medium in size; tympanic bullae large; interparietal large, markedly wider than long; anterior suture of interparietal nearly straight.

For comparisons with *Perognathus formosus formosus* and *Perognathus formosus mohavensis,* see accounts of those subspecies.

Hall (1941:56) commented upon the fact that the taking of the specimens upon which he based the name *P. f. incolatus* was the first evidence that this species ranged northward into the basin of Pleistocene Lake Bonneville. The type locality is on Mt. Moriah, White Pine County, Nevada, which is on the western mainland of the ancient lake. The speculation of Hall (*loc. cit.*) is borne out by the taking, by the author, of one specimen in western Millard County, Utah, and by Fautin (1946:280) who found these animals to constitute 21.3 per cent of the mammalian population of the black sage (*Artemisia nova*) community within the old lake basin. According to Fautin (*op. cit.*:279) these pocket mice are restricted to the Tetradymia, Black Sage Communities in the Lake Bonneville Basin.

Specimens examined.—One from *Millard County:* Warm Cove, 55 mi. W Milford, 5,500 ft.

Additional record (Fautin, 1946:280).—*Millard County:* White Valley, 65 mi. W Delta.

Perognathus formosus formosus Merriam

Long-tailed Pocket Mouse

Perognathus formosus Merriam, N. Amer. Fauna, 1:17, October 25, 1889, type from St. George, Washington County, Utah; Osgood, N. Amer. Fauna, 18:40, September 20, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):90, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):106, June, 1927; Long, Journ. Mamm., 21:176, May 16, 1940.

Perognathus formosus formosus, Nelson and Goldman, Proc. Biol. Soc. Washington, 42:106, March 25, 1929; Huey, Trans. San Diego Soc. Nat. Hist., 9:36, November 21, 1938; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938.

Perognathus f[ormosus]. Hardy, Ecol. Monogr., 15:84, January, 1945.

Range.—Washington County, as far west as the Beaverdam Mountains. See figure 39.

Description and comments.—Average and extreme measurements of 7 adult female topotypes are as follows: Total length, 185.5 (194-181); length of tail, 99 (105-90); length of hind foot, 24 (25-23); length of ear, 10.2 (11.0-10.0). Tail long, attenuate and sparsely haired. Color: Upper parts, sides and proximal dorsal surface of tail Wood Brown in general tone owing to mixture of Pale Pinkish Cinnamon and Mummy Brown; upper arm like back; subauricular patches small and white; distal hairs on tail long, Mummy Brown; entire underparts white; ventral surface of tail buffy white. Skull: Size medium; mastoid bullae projecting slightly beyond occiput; interparietal large, markedly wider than long, roughly pentagonal; zygomatic arches thickened; lower premolar larger than last lower molar; interorbital region wide.

Topotypes of *P. f. formosus* differ from those of *Perognathus formosus incolatus* as follows: Slightly larger; darker on upper parts, sides and tail, especially distally; anterior border of interparietal shaped like a widely inverted V instead of nearly straight. Differences from *Perognathus formosus mohavensis* are given in the account of that subspecies.

The range of this pocket mouse in Utah so far as known is in the southwesternmost county. As indicated by Hardy (1945a:95) the Beaverdam Mountains tend to isolate this subspecies from *P. f. mohavensis* which occurs in the extreme southwestern corner of the state west of the Beaverdam Mountains.

It is well known that pocket mice are highly responsive and adaptive to color of soil. Specimens from Santa Clara Creek taken on light colored soil are much lighter than those taken on dark soil, from the black hill immediately west of St. George.

Specimens examined.—Total, 61, distributed as follows: *Washington County:* W side Black Hill, ½ mi. W St. George, 3,000 ft., 1; E side Black Hill, ¼ mi. W St. George, 3,000 ft., 1; St. George, 2,850 ft., 41 (M.V.Z.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 18.

Additional records.—*Washington County:* Springdale (Long, 1940:176); Zion National Park (Presnall, 1938:14).

Perognathus formosus mohavensis Huey

Long-tailed Pocket Mouse

Perognathus formosus mohavensis Huey, Trans. San Diego Soc. Nat. Hist., 9:35, November 21, 1938, type from Bonanza King Mine, Providence Mountains, San Bernardino County, California; Hardy, Ecol. Monogr., 15:87, January, 1945; Hardy, Journ. Mamm., 30:435, November 17, 1949.

Range.—Extreme southwestern Utah, west of the Beaverdam Mountains. See figure 39.

Description and comments.—Measurements of one adult male, number 4069 and 2 adult females, numbers 4067a and 4067, from Beaverdam Wash are, respectively, as follows: Total length, 172, 197, 190; length of tail, 86, 107 104; length of hind foot, 24, 25, 25; length of ear, 11, 11, 11. Color: Similar to *Perognathus formosus formosus* but slightly lighter. Skull: Size medium; braincase and tympanic bullae well inflated; interparietal large and pentagonal.

Specimens of *P. f. mohavensis* from Beaverdam Wash in Utah can be distinguished from topotypes of *P. f. formosus* as follows: Slightly lighter color; more inflated braincase and tympanic bullae; larger and wider interparietal.

P. f. mohavensis from Utah is distinguishable from *Perognathus formosus incolatus* by longer hind foot, longer total length, larger interparietal and more inflated braincase and tympanic bullae.

The range of this pocket mouse parallels those of such species as *Dipodomys deserti deserti, Dipodomys merriami merriami* and

others. Many animals common to the fauna of southern Nevada reach their extreme eastern limits in this corner of Utah. The Beaverdam Mountains and the Virgin River Narrows seem to be effective barriers preventing extension of ranges.

When Huey (1938b:35) described *Perognathus formosus mohavensis*, he set it off from *Perognathus formosus formosus* by less inflated braincase and tympanic bullae, and lighter color. Critical examination of specimens from Beaverdam Wash shows them to differ from topotypes of *P. f. formosus* from St. George, Utah, which is removed by only a few miles. However, the differences in size of braincase and bullae are just the reverse of what Huey (*loc. cit.*) found in that in these specimens here referred to *P. f. mohavensis*, the bullae and the braincase are more inflated than in topotypes of *P. f. formosus*.

Specimens examined.—Total, 5, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona border, 2,800 ft., 1; 1½ mi. E Beaverdam Wash, 8 mi. N Utah-Arizona border, 3,200 ft., 4.

Perognathus intermedius crinitus Benson

Intermediate Pocket Mouse

Perognathus intermedius crinitus Benson, Proc. Biol. Soc. Washington, 47:199, October 2, 1934, type from 2.6 miles west of Wupatki Ruins, Coconino County, Arizona; Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935.

Range.—Southeastern Utah in San Juan County. See figure 40.

Description and comments.—Average and extreme measurements of males are as follows: Total length (10 specimens), 175 (179-167); length of tail (10), 99 (101-95); length of hind foot (12), 23 (24-21); length of ear from crown (12), 5 (6-5). See Benson (1934:200). Pelage long and soft; tail strongly penicillate. Color. Upper parts Light Pinkish Cinnamon, hairs tipped with black; hairs Neutral Gray at base; dorsal surface of tail blackish; stripes on flanks Light Pinkish Cinnamon; throat, chest and feet white; belly white, often washed with Pale Pinkish Cinnamon; ventral surface of tail white. Skull: Long, narrow; mastoids relatively small.

Compared with *Perognathus intermedius intermedius*, *P. I. crinitus* may be distinguished as follows: Tail longer and more penicillate; pelage longer, softer and denser; skull relatively narrower; mastoids relatively smaller.

Because of its large size and strongly penicillate tail, *P. i. crinitus* might be confused with *Perognathus formosus*, but can readily be distinguished from the latter by its long, soft, dense pelage; the pelage of *P. formosus* is coarse. In Utah, *P. i. crinitus* is known only from the southeastern part; the Colorado River apparently has been an effective barrier to westward migration.

Specimens examined.—Total, 3, distributed as follows: *San Juan County:* Rainbow Bridge, 4,000 ft., 2 (M. V. Z.); Navajo Mountain Trading Post, 5 mi. SW Navajo Mountain, 1 (M. V. Z.).

TABLE 11

Cranial Measurements of Perognathus

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Width of bulla	Depth of bulla	Length of interparietal	Breadth of interparietal	Alveolar length of upper molariform series (tooth-row)
		Perognathus flavus hopiensis, type									
♀	248014 USNM	20.4	7.1	10.1	10.85	4.35	5.5	6.9	2.4	3.1	3.0
		Perognathus apache caryi, Johns Canyon									
♂	1199.....	24.3	9.5	13.6	12.9	5.4	7.5	8.0	3.2	3.4	3.7
		Perognathus apache apache, Bluff									
♂	1169.....	22.8	8.0	11.7	12.9	5.5	6.8	7.7	2.7	3.5	3.3
♂	1158.....	21.8	7.9	.....	12.4	5.3	6.6	7.7	2.7	3.6	3.4
		Perognathus longimembris gulosus, Desert Range Experiment Station									
♂	6 av.....	21.6	8.1	11.2	12.3	5.3	6.3	7.2	2.5	3.6	2.9
♂	Max.....	22.3	8.5	11.5	12.8	5.4	6.7	7.3	2.8	3.7	3.0
♂	Min.....	21.0	7.7	11.1	12.0	5.1	6.1	7.0	2.3	3.3	2.8
♀	3852.....	21.1	8.1	11.2	12.0	5.1	5.6	7.1	2.1	3.5	2.7
♀	3880.....	21.0	8.1	11.1	12.0	5.3	6.2	7.3	2.6	3.6	2.7
♀	3902.....	21.2	8.3	10.9	11.9	5.4	6.0	7.1	2.5	4.5	2.7
		Perognathus longimembris virginis, topotypes									
♂	3230.....	22.5	8.0	11.0	12.3	5.2	6.9	7.5	2.8	2.7	3.2
♀	3231.....	21.1	7.7	10.5	11.0	4.9	6.4	7.0	3.0	2.9	3.1
		Perognathus longimembris arizonensis, type									
♀	250032 USNM	22.1	8.0	9.9	11.7	4.9	5.75	7.3	3.2	3.1	3.05
		Perognathus longimembris arcus, type									
♀	58624 MUZ...	22.6	8.9	10.5	.....	5.4	6.4	7.6	3.4	.....	2.9
		Perognathus parvus olivaceus, E shore Great Salt Lake									
♂	5 av.....	26.5	10.2	13.0	12.4	5.9	7.3	8.1	4.0	5.0	3.5
♂	Max.....	27.0	10.7	13.6	12.5	6.1	7.6	8.2	4.1	5.1	3.7
♂	Min.....	26.0	9.7	12.5	12.3	5.8	7.1	7.9	3.9	4.8	3.4
♀	4 av.....	25.6	9.8	12.6	12.2	5.8	7.1	7.8	3.4	4.9	3.6
♀	Max.....	27.0	10.8	13.0	12.8	6.0	7.7	8.4	3.6	5.1	3.6
♀	Min.....	25.1	9.3	12.3	11.7	5.7	6.3	7.2	3.3	4.7	3.5
		Perognathus parvus clarus, type									
♂	178939 USNM	25.4	10.0	12.4	12.1	5.7	5.9	8.0	3.9	5.8	3.8
		Perognathus formosus incolatus, Warm Cove									
?	1677.....	26.8	10.6	13.3	13.6	6.9	7.3	8.5	3.0	5.6	3.7

TABLE 11.—*Concluded*

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Width of bulla	Depth of bulla	Length of interparietal	Breadth of interparietal	Alveolar length of upper molariform series (tooth-row)
		Perognathus formosus formosus, topotypes									
♀	7 av.....	27.1	10.4	13.6	13.4	7.2	7.7	8.6	3.2	5.7	3.7
♀	Max.....	27.6	11.0	14.0	13.8	7.4	8.0	8.9	3.6	6.0	4.0
♀	Min.....	26.2	10.1	13.1	13.1	6.8	7.5	8.3	2.8	5.2	3.5
		Perognathus formosus mohavensis, Beaverdam Wash									
♂	4069.....	26.4	10.3	13.9	13.5	7.2	7.8	9.1	3.7	6.5	3.7
♀	4067.....	27.3	10.9	13.5	13.4	6.6	8.1	8.6	3.6	5.1	3.7
♀	4067a.....	26.8	10.3	14.0	13.4	7.2	8.0	8.8	3.5	5.7	3.7
		Perognathus intermedius crinitus, ♂ ♂ Rainbow Bridge, ♀ Navajo Mountain Trading Post									
♂	60897 MUZ...	25.7	10.6	12.4	.....	6.4	6.1	8.0	3.8	.....	3.9
♂	60898 MUZ...	24.5	9.5	12.2	.....	6.6	6.1	7.9	3.0	.....	3.7
♀	58698 MUZ...	25.9	9.7	12.2	.....	6.5	6.4	8.0	3.2	.....	3.8

Microdipodops megacephalus leucotis Hall and Durrant

Dark Kangaroo Mouse

Microdipodops megacephalus leucotis Hall and Durrant, The Murrelet, 22:6, April 30, 1941, type from 18 miles southwest of Orr's Ranch, 4,400 feet, Tooele County, Utah; Hall, Zoöl. Series, Field Mus. Nat. Hist., 27:266, December 8, 1941.

Range.—Known only from the type locality.

Description and comments.—Measurements of the type, a female, are: Total length, 142; length of tail, 75; length of hind foot, 24. Hind foot short; tail relatively long. Color: Upper parts near (*e*) Light Pinkish Cinnamon; underparts with hair everywhere white to base and encroaching on upper parts almost, but not quite, to lower margin of eye; postauricular and supraorbital patches prominent, white; tail bicolored, corresponding to body, without black tip; feet and ears white. Skull: Small; auditory bullae markedly inflated, therefore skull relatively broad posteriorly; rostrum and anterior part of skull relatively small; interorbital region narrow; incisive foramina widest posteriorly.

From topotypes of *Microdipodops megacephalus paululus, M. m. leucotis* differs as follows: Tail longer; upper parts strikingly lighter; white areas on head much more extensive; tail without blackish or darker color on tip; skull smaller in all measurements taken, except width across auditory bullae which is more. The much

greater inflation of the auditory bullae and lesser interorbital breadth are the two most prominent cranial differences between the two subspecies.

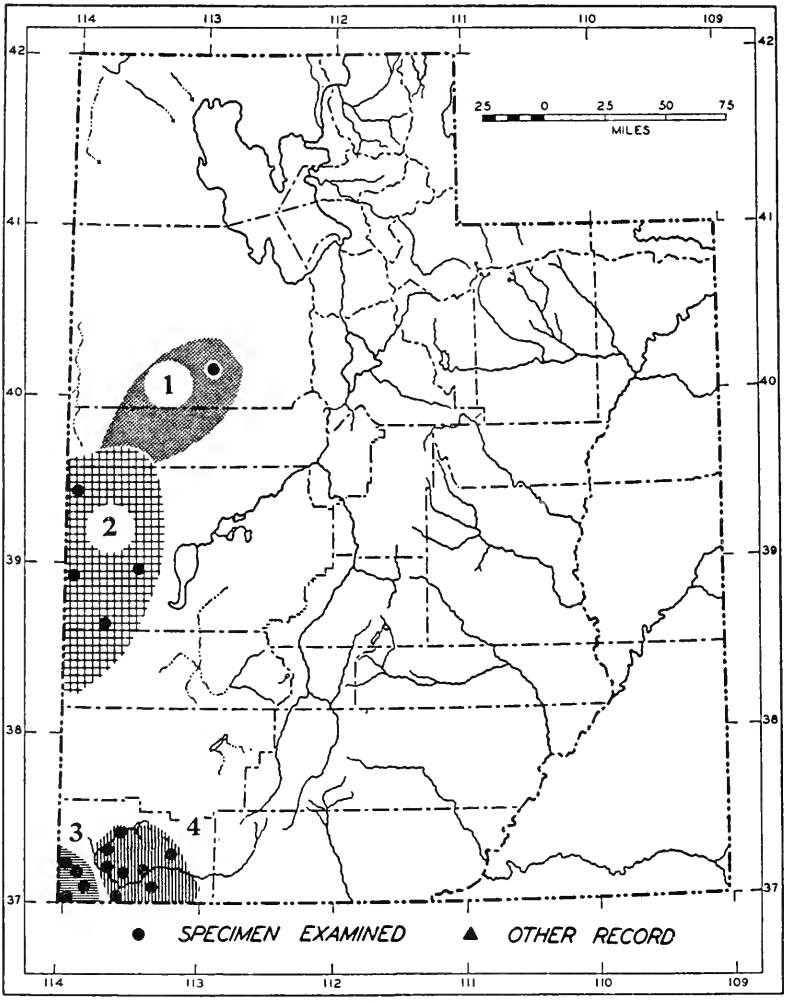

FIG. 42. Distribution of *Microdiopodops megacephalus* and *Dipodomys merriami*.

1. *M. m. leucotis.*
2. *M. m. paululus.*
3. *D. m. merriami.*
4. *D. m. vulcani.*

From *Microdipodops megacephalus megacephalus*, *M. m. leucotis* differs in: Body shorter; color everywhere paler; all light areas more extensive and white rather than buffy or plumbeous; upper

parts of *M. m. leucotis* appear white at first glance in contrast to dark brown or blackish in *M. m. megacephalus.*

This subspecies is one of the palest known for the species and inhabits the bottom of the basin of the Pleistocene Lake Bonneville. The great inflation of the auditory bullae reflects the condition seen in the species *Microdipodops pallidus.* Other cranial details, the short hind foot and the geographic occurrence indicate relationship to the species *Microdipodops megacephalus.*

Specimen examined.—One, the type.

Microdipodops megacephalus paululus Hall and Durrant

Dark Kangaroo Mouse

Microdipodops megacephalus paululus Hall and Durrant, The Murrelet, 22:5, April 30, 1941, type from one half mile east of headquarters building of the Desert Range Experiment Station of the United States Forest Service, Sec. 33, T. 25S, R. 17W, Salt Lake Base Meridian, 5,000 feet, Millard County, Utah; Hall, Zoöl. Series Field Mus. Nat. Hist., 27:264, December 8, 1941; Fautin, Ecol. Monogr., 16:304, October, 1946.

Microdipodops pallidus albiventer Hall and Durrant, Journ. Mamm., 18:357, August 14, 1937; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938.

Range.—Western Utah in Pine, White and Snake valleys.

Description and comments.—Average and extreme measurements of 5 male and 4 female topotypes are as follows: Total length, 136 (148-130); length of tail, 69 (74-64); length of hind foot, 24.6 (25-24). Hind foot and tail short. Color: Upper parts brownish gray lightly mixed with blackish; postauricular patches white; supraorbital patches buffy white; tail bicolored, like back above, distal one-fourth blackish; entire underparts with hair everywhere white to base; feet and ears whitish. Skull: Small; auditory bullae moderately inflated; maxillary breadth across zygomata slight; interorbital constriction moderate; incisive foramina widest posteriorly.

From *Microdipodops megacephalus megacephalus* from eastern Nevada, *M. m. paululus* differs in: Body shorter; tail much shorter; color above slightly lighter; hair on underparts everywhere white to base rather than plumbeous basally and buffy distally; postauricular patches white rather than buffy; skull averaging shorter.

Comparison of *M. m. paululus* with specimens of *Microdipodops megacephalus albiventer* from southeastern Nevada shows it to differ as follows: Tail shorter; upper parts darker; tip of tail with more blackish; skull smaller in all measurements taken except length of nasals which is more.

For comparison with *Microdipodops megacephalus leucotis,* see account of that subspecies.

Snake Valley and White Valley are only provisionally included in the range of this subspecies. One specimen, number 3037, from White Valley has paler upper parts than *M. m. paululus,* a longer

tail and is smaller as regards parts of the broken skull that are measurable. In these features, as well as geographically, it approaches *M. m. leucotis.* Two young specimens from Snake Valley, 5 miles south of Garrison, differ from those of *M. m. paululus* only in longer tail; but one from 35 miles farther north in the same valley (4 miles south of Gandy) has the coloration of the upper parts more as in *M. m. leucotis* although not so light. These specimens from Snake Valley are so young that they do not show diagnostic subspecific characters in either skin or skull.

Specimens examined.—Total, 29, distributed as follows: *Millard County:* 4 mi. S Gandy, 5,000 ft., 2 (M. V. Z.); White Valley, 60 mi. W Delta, 1; 5 mi. S Garrison, 5,400 ft., 2 (M. V. Z.); Desert Range Experiment Station, United States Forest Service, Sec. 33, T. 25S, R. 17W, Salt Lake B. M., 5,000 ft., 24, 1 (M. V. Z.).

TABLE 12

Cranial Measurements of Microdipodops

Sex	Catalog number or number of individuals averaged	Basal length	Length of nasals	Greatest breadth of skull	Maxillary breadth	Interorbital breadth
		Microdipodops megacephalus leucotis, type				
♀	3525	17.5	9.3	19.2	11.3	6.1
		Microdipodops megacephalus paululus, topotypes				
♂ ♀	9 (5 ♂, 4 ♀) av.	17.9	9.8	18.8	11.5	6.5
♂ ♀	Max.	18.5	10.2	19.3	11.8	6.6
♂ ♀	Min.	17.6	9.3	18.5	11.3	6.3

Dipodomys ordii celeripes Durrant and Hall

Ord Kangaroo Rat

Dipodomys ordii celeripes Durrant and Hall, Mammalia, 3:10, March, 1939, type from Trout Creek, 4,600 feet, Juab County, Utah; Hardy, Proc. Biol. Soc. Washington, 55:91, June 25, 1942; Hardy, Proc. Biol. Soc. Washington, 57:54, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):18, June 30, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Dipodomys ordii columbianus, Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938.

Range.—Western Utah, from Utah-Idaho Boundary south to southern Millard County.

Description and comments.—Average and extreme measurements of 4 adult males and the measurements of 3 females, numbers 1961, 1965 and 1967, from Trout Creek are as follows: Total length, 210 (225-203), 223, 205, 195;

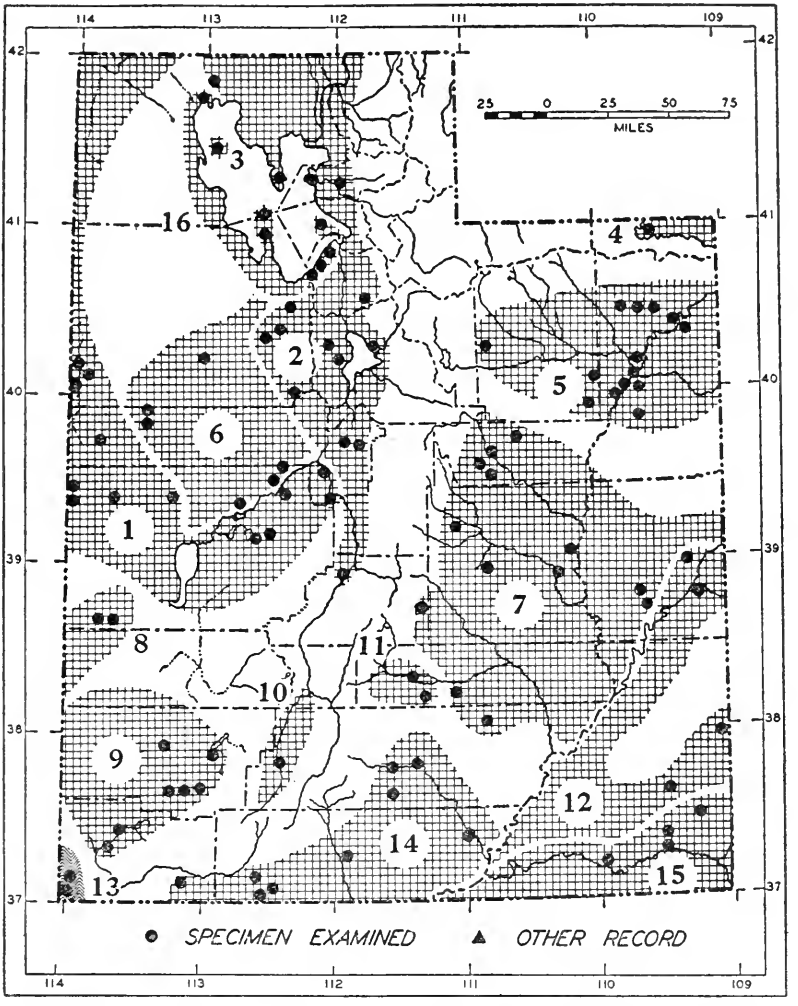

FIG. 43. Distribution of *Dipodomys ordii* and *Dipodomys deserti*.

1. *D. o. celeripes.*	5. *D. o. uintensis*	9. *D. o. cinderensis.*	13. *D. deserti deserti.*
2. *D. o. utahensis.*	6. *D. o. pallidus.*	10. *D. o. panguitchensis.*	14. *D. o. cupidineus.*
3. *D. o. cineraceus.*	7. *D. o. sanrafaeli.*	11. *D. o. fremonti.*	15. *D. o. longipes.*
4. *D. o. priscus.*	8. *D. o. fetosus.*	12. *D. o. nexilis.*	16. *D. o. marshalli.*

length of tail, 111.25 (121-100), 120, 115, 100; length of hind foot, 40 (41-39), 40, 41, 38. Color: Pale, approaching that of *Dipodomys deserti deserti;* upper parts Pinkish Buff with slight suffusion of black; sides Pinkish

Buff; ears, plantar surfaces of hind feet, dorsal and ventral surfaces of tail light brown; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Nasals short and dilated anteriorly; external auditory meatus small and elliptical in shape; styloid processes project anteriorly on bullae beyond middle of external auditory meatus; upper incisors large.

From topotypes of *Dipodomys ordii marshalli*, *D. o. celeripes* differs in: Smaller size, longer hindfoot, shorter tail, lighter color, smaller skull, narrower interorbital breadth, shorter rostrum, smaller lacrimal processes, larger pterygoid processes, and shorter palate.

From topotypes of *Dipodomys ordii cinderensis*, *D. o. celeripes* differs in smaller size, shorter tail, lighter color, shorter rostrum and nasals, less inflated auditory bullae, less ovoid pterygoid fossae and narrower interorbital region.

Topotypes of *D. o. celeripes* differ from *Dipodomys ordii columbianus* known to occur to the west, in Nevada, in smaller size, lighter color, wider and shorter rostrum, wider interparietal, longer and more robust upper incisors and larger pterygoid fossae.

For comparisons with *Dipodomys ordii pallidus* and *Dipodomys ordii fetosus*, see accounts of those subspecies.

This subspecies from the western part of the state appears to be a resident of the foothills of desert mountains as contrasted with its near neighbor *D. o. pallidus* which inhabits the valley floors of the former basin of the Pleistocene Lake Bonneville. The range of *D. o. celeripes* as formerly understood extended east to include Lynndyl and Hinckley. Additional material reveals that the animals at these two localities are intergrades between *D. o. pallidus* and *D. o. celeripes*, and referable to the former. Two specimens from 20 miles southwest of Nephi, and 10 specimens from U.B (Yuba) Dam of *D. o. celeripes* show intergradation with *Dipodomys ordii utahensis*. One specimen of *D. o. celeripes* from 35 miles, and another from 60 miles, west of Delta show intergradation with *D. o. pallidus*.

Specimens examined.—Total, 76, distributed as follows: *Tooele County:* Parrish Ranch, 5 mi. N Ibapah, 1; Clifton Flat, 7 mi. SW Gold Hill, 6,149 ft., 4; Ibapah, 5,000 ft., 23. *Juab County:* 20 mi. SW Nephi, 2; Trout Creek, 4,600 ft., 20 (1, U.S.A.C.); U. B. (Yuba) Dam, Sevier River, 5,000 ft., 10. *Millard County:* 4 mi. S Gandy, 5,000 ft., 1 (M.V.Z.); Smith Creek, 6 mi. S Gandy, 5,400 ft., 2 (M.V.Z.); Oak City, 5,000 ft., 1; White Valley, 60 mi. W Delta, 1; 35 mi. W Delta, 1; Hendry Creek, 5,000 ft., 17 mi. S Gandy, 4 (M.V.Z.); 2 mi. E Clear Lake, 4,600 ft., 2; E side Clear Lake, 4,600 ft., 4 (1, U.S.A.C.).

Dipodomys ordii utahensis (Merriam)

Ord Kangaroo Rat

Perodipus montanus utahensis Merriam, Proc. Biol. Soc. Washington, 17:143, July 14, 1904, type from Ogden, Weber County, Utah; Barnes, Bull. Univ. Utah, 12 (no. 15):86, April, 1922.

Dipodomys ordii utahensis, Grinnell, Journ. Mamm., 2:96, May 2, 1921; Barnes, Bull. Univ. Utah, 17 (no. 12):107, June, 1927; Marshall, Journ. Mamm., 21:155, May 16, 1940; Hardy, Journ. Mamm., 57:54, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):29, June 30, 1945; Hardy, Journ. Mamm., 30: 434, November 17, 1949.

Dipodomys ordii columbianus, Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Durrant and Hall, Mammalia, 3:13, March, 1939.

Range.—North of Great Salt Lake to southern Idaho, south along east margin of Pleistocene Lake Bonneville to northern Sevier County, west to west side of Onaqui Mountains, Tooele County, Utah.

Description and comments.—Measurements of 3 adult males, numbers 695, 698, and 699 (B.Y.U.), and 2 adult females, numbers 700 and 701 (B.Y.U.), from the type locality are, respectively, as follows: Total length, 245, 255, 235, 238, 245; length of tail, 138, 150, 135, 137, 140; length of hind foot, 38.9, 39.8, 37.8, 39.8, 37.8. Color: Upper parts between Cinnamon-Buff and Clay Color, heavily suffused with black; sides and flanks Cinnamon-Buff; ears, plantar surfaces of hind feet, arietiform markings, dorsal and ventral stripes of tail blackish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Small; rostrum short and narrow; interparietal large, spatulate anteriorly; braincase vaulted; lacrimal processes large; zygomatic arches straight and robust; auditory bullae well inflated.

From *Dipodomys ordii celeripes*, *D. o. utahensis* differs in larger size, longer tail, darker color, shorter skull, wider interorbital region, larger lacrimal processes, more ventrally inflated auditory bullae and longer narrower palate.

From *Dipodomys ordii columbianus*, *D. o. utahensis* differs in darker color, darker and wider dorsal and ventral stripes of tail, larger lacrimal processes, larger interparietal, and wider cutting edge of upper incisors.

For comparisons with *Dipodomys ordii pallidus*, *Dipodomys ordii panguitchensis*, *Dipodomys ordii marshalli*, *Dipodomys ordii fremonti*, *Dipodomys ordii cineraceus* and *Dipodomys ordii cinderensis*, see accounts of those subspecies.

The use of the name *Dipodomys ordii utahensis* for the animals from along the Wasatch front has been questioned by several workers, who considered it a synonym of *Dipodomys ordii columbianus*. In their work on the kangaroo rats of Utah, Durrant and Setzer (1945) recognized differences between topotypes of *D. o. utahensis* and *D. o. columbianus* and re-established the name *D. o. utahensis* for the animals from the Wasatch front.

Specimens are not available from the northwestern part of the state where animals referable to *D. o. columbianus* might occur. In addition, none of the available specimens shows intergradation between *D. o. utahensis* and *D. o. columbianus*. For the present, at least, I am not using the name *D. o. columbianus* for any specimens from Utah.

Specimens examined.—Total, 82, distributed as follows: *Boxelder County:* 15 mi. E Park Valley, Raft River Mountains, 5,500 ft., 2; Promontory Point, 1 (U.S.N.M.). *Weber County:* Little Mountain, 1 (U.S.N.M.); Ogden, 20 (7, B.Y.U.) (7, M.V.Z.) (4, U.S.N.M.). *Tooele County:* Bauer, 4,500 ft., 6; St. John, 4,300 ft., 4; Clover Creek, Onaqui Mountains, 5,500 ft., 1; Little Valley, Sheeprock Mountains, 5,500 ft., 1. *Davis County:* Antelope Island, Great Salt Lake, 4,250 ft., 5 (U.S.N.M.). *Salt Lake County:* plain, 4 mi. N Draper, 4,500 ft., 1; 1 mi. N Draper, 4,700 ft., 4. *Utah County:* Fairfield, Cedar Valley, 4,800 ft., 15 (9, B.Y.U.); sand dunes, W Curtis Station, 4 (B.Y.U.); W Lake Mountains, 9 (B.Y.U.). *Juab County:* Nephi, 1 (U.S.N.M.); 4 mi. W Nephi, 1 (R.H.). *Sevier County:* 1 mi. W Aurora, 5,190 ft., 6 (1, U.S.N.M.).

Dipodomys ordii marshalli Goldman

Ord Kangaroo Rat

Dipodomys ordii marshalli Goldman, Proc. Biol. Soc. Washington, 50:223, December 28, 1937, type from Bird Island, Great Salt Lake, 4,300 feet, Tooele County, Utah; Marshall, Journ. Mamm., 21:152, May 16, 1940; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):22, June 30, 1945.
Dipodomys ordii columbianus, Midgley, Journ. Mamm., 19:304, August 18, 1938.

Range.—Bird, Carrington, Badger and Stansbury islands, probably around the western margin of Great Salt Lake north to Kelton, also around southern and southeastern margin of the lake to the mouth of the Jordan River.

Description and comments.—Measurements of 2 adult males, numbers 2969 and 2968, and 2 adult females, numbers 2971 and 2972, from Stansbury Island are, respectively, as follows: Total length, 241, 238, 245, 245; length of tail, 136, 128, 135, 135; length of hind foot, 40, 40, 40, 40. Color: Upper parts pale near Pinkish Buff with slight admixture of black; sides, flanks and cheeks Pinkish Buff; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail brownish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Of medium size; rostrum long and narrow; pterygoid fossae ovoid; external auditory meatus round and small; cutting edge of upper incisors narrow.

From topotypes of *Dipodomys ordii utahensis, D. o. marshalli* differs in smaller size, lighter color, smaller skull, except interorbital breadth and depth of auditory bullae which are greater, nasals less flaring distally and cutting edge of upper incisors narrower.

For comparisons of *D. o. marshalli* with *Dipodomys ordii pallidus, Dipodomys ordii celeripes* and *Dipodomys ordii cineraceus,* see accounts of those subspecies.

Many specimens referable to *D. o. marshalli,* which was thought to be isolated on Bird Island, Great Salt Lake (Marshall, 1940:144-159) have been obtained in the 15 years (1933-1948) from various localities on the eastern and southeastern shores of the lake by students from the University of Utah. No typical specimens were taken on the adjacent mainland, however; all of these animals show intergradation between *D. o. marshalli* and *D. o. utahensis.* Two specimens from Kelton are intergrades between *D. o. celeripes* and *D. o. marshalli;* the darker color and majority of cranial characters show them to be referable to the latter.

Of the 12 kinds of mammals which Goldman (1937, 1939b) named from the islands in Great Salt Lake, he thought that 11 were endemic. Now, however, only *Dipodomys microps alfredi, Peromyscus maniculatus inclarus* and *Neotoma lepida marshalli* are definitely known to be restricted to the islands. Of the remainder, *Dipodomys microps subtenuis, Dipodomys ordii marshalli, Onychomys leucogaster utahensis, Reithrodontomys megalotis ravus* and *Peromyscus crinitus pergracilis* are known to occur on both the islands and the mainland. *Dipodomys microps russeolus* and *Dipodomys ordii cineraceus* are of questionable subspecific status and *Perognathus parvus plerus* and *Peromyscus maniculatus gunnisoni* are indistinguishable from subspecies named earlier from the mainland.

Specimens examined.—Total, 51, distributed as follows: *Boxelder County:* Kelton, 4,300 ft., 2. *Tooele County:* Bird Island, Great Salt Lake, 4,300 ft., 1 (U. S. N. M.); Carrington Island, Great Salt Lake, 4,300 ft., 1 (U. S. N. M.); Stansbury Island, Great Salt Lake, 4,300 ft., 10 (4, U. S. N. M.). *Salt Lake County:* 18 mi. W Salt Lake City, 4,320 ft., 26; 17 mi. W Salt Lake City, 4,320 ft., 7; 16 mi. W Salt Lake City, 4,300 ft., 3; 14 mi. W Salt Lake City, 4,300 ft., 1.

Dipodomys ordii cineraceus Goldman

Ord Kangaroo Rat

Dipodomys ordii cineraceus Goldman, Journ. Mamm., 20:352, August 14, 1939, type from Dolphin Island, Great Salt Lake, 4,250 feet, Boxelder County, Utah; Marshall, Journ. Mamm., 21:151, May 16, 1940; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):19, June 30, 1945.

Range.—Known only from the type locality.

Description and comments.—Measurements of 2 adult females, numbers 263893 and 263894 (U.S.N.M.), from the type locality, are as follows: Total length, 230, 228; length of tail, 132, 129; length of hind foot, 39, 38. Color: Pale; upper parts near Pale Pinkish Buff, lightly washed with black; sides Pale Pinkish Buff; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail light brown; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Of medium size; rostrum and nasals short; interparietal region relatively wide.

From topotypes of *Dipodomys ordii marshalli, D. o. cineraceus* differs in smaller size, darker (more reddish) color and larger skull in all parts measured.

From topotypes of *Dipodomys ordii pallidus, D. o. cineraceus* differs in smaller size, darker (more reddish) color, smaller skull with less inflated auditory bullae and shorter rostrum and nasals.

From topotypes of *Dipodomys ordii utahensis, D. o. cineraceus* differs in smaller size, markedly lighter color and larger skull with longer nasals and more inflated auditory bullae.

This subspecies with *Dipodomys microps russeolus* occurs insofar as known, only on Dolphin Island, Great Salt Lake. Specimens from Kelton, Boxelder County, while closer geographically to *D. o. cineraceus,* are referable in a majority of their characters to *D. o. marshalli.* No available mainland specimens are referable to *D. o. cineraceus,* although the island, as mentioned by Goldman (1939b: 353), is connected to the mainland by a bar which could be a means of communication with the nearby shore. Trapping is necessary on the bar and mainland near Dolphin Island before the degree of isolation, if any, of *D. o. cineraceus is known.*

Specimens examined.—Two from the type locality.

Dipodomys ordii priscus Hoffmeister

Ord Kangaroo Rat

Dipodomys ordii priscus Hoffmeister, Proc. Biol. Soc. Washington, 55:167, December 31, 1942, type from Kinney Ranch, 21 miles south of Bittercreek, 7,100 feet, Sweetwater County, Wyoming; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):28, June 30, 1945.

Range.—Extreme northeastern Daggett County, north of the Green River.

Description and comments.—Average and extreme measurements of 4 adult males and 4 adult females, topotypes are, respectively, as follows: Total length, 258 (265-251), 256 (264-249); length of tail, 148 (152-144), 145 (152-138); length of hind foot, 44 (45-43), 42 (45-40). Color: Upper parts between Light Ochraceous-Buff and Ochraceous-Buff, lightly suffused with black; sides and flanks Light Ochraceous-Buff; ears, plantar surfaces of hind feet, arietiform markings, dorsal and ventral stripes of tail grayish to blackish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Of medium size; rostrum long and narrow; nasals long; width across auditory bullae relatively narrow; zygomatic arches weak; upper incisors moderately wide at cutting edge.

Among named subspecies of *Dipodomys ordii* known to occur in Utah, *D. o. priscus* most closely resembles *Dipodomys ordii uintensis,* for comparison see account of *D. o. uintensis.*

Durrant and Setzer (1945:28) had no specimens of *D. o. priscus* from Utah, but they did have specimens from Vernal, Uintah

County, which were intergrades between *D. o. priscus* and *D. o. uintensis;* they predicted that animals belonging to *D. o. priscus* would be found in the extreme northeastern part of Daggett County. These now have been obtained from that locality by both the University of Utah and the Carnegie Museum, and proved to be referable to *D. o. priscus.* The Green River in this region acts as a barrier to the extension of range southward of *D. o. priscus.*

Specimen examined.—One, from *Daggett County:* N (E) side Green River, 1 mi. E Hideout Trail Bridge, Hideout Canyon, 6,400 ft.

Dipodomys ordii pallidus Durrant and Setzer

Ord Kangaroo Rat

Dipodomys ordii pallidus Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):24, June 30, 1945, type from Old Lincoln Highway, 18 miles southwest of Orr's Ranch in Skull Valley, 4,400 feet, Tooele County, Utah.

Range.—Low valleys of west-central Utah in Juab, Tooele and Millard counties.

Description and comments.—Average and extreme measurements of 7 adult males and measurements of 2 adult females, numbers 3541 and 3528, from Old Lincoln Highway are, respectively, as follows: Total length, 231 (240-208), 251, 229; length of tail, 125 (138-104), 141, 132; length of hind foot, 41 (43-40), 45, 40. Color : Upper parts Light Pinkish Cinnamon; sides and flanks Light Pinkish Cinnamon with great suffusion of white; postorbital and postauricular spots, dorsal surface of hind feet, front legs, hip stripes, base of tail, lateral stripes of tail and entire underparts white; dorsal and ventral stripes of tail light brown. Skull: Large; auditory bullae long, wide and well inflated; dorsal border of external auditory meatus with an evagination; nasals long and flared out distally.

From *Dipodomys ordii celeripes, D. o. pallidus* differs as follows: Size: Larger. Color: Slightly darker, although some specimens are lighter; hairs of dorsal stripe of tail tipped with brown instead of black. Skull: Larger; nasals longer and more flared out distally; interorbital breadth greater; auditory bullae larger; external auditory meatus larger.

From *Dipodomys ordii fetosus, D. o. pallidus* differs in markedly lighter color, wider hip stripes, less distinct ventral stripe of tail, nasals longer and more flared distally, larger auditory bullae, larger external auditory meatus and shorter, broader palate.

From *Dipodomys ordii marshalli, D. o. pallidus* differs in longer hind foot, lighter color, less conspicuous arietiform markings, less pronounced dorsal and ventral stripes on tail, slightly larger skull, narrower and longer palate, heavier jugals, external auditory meatus larger and more deeply evaginated on the anterior border; cutting edge of upper incisors wider and nasals more expanded distally.

Specimens from Clover Creek, Onaqui Mountains, are intergrades between *D. o. pallidus* and *Dipodomys ordii utahensis*, but on the basis of darker color and the majority of the cranial features are referable to the latter. Animals from Lynndyl and Hinckley are intergrades between *D. o. celeripes* and *D. o. pallidus*. Specimens from the area west of Delta are intergrades between *D. o. celeripes* and *D. o. pallidus*, but are referable to the former.

Specimens examined.—Total, 34, distributed as follows: *Tooele County:* Old Lincoln Highway, 18 mi. SW Orr's Ranch in Skull Valley, 4,400 ft., 9. *Juab County:* Fish Springs, 4,400 ft., 4; 7 mi. S Fish Springs, 4,400 ft., 4. *Millard County:* 1 mi. N Lynndyl, 4,768 ft., 5; Lynndyl, 4,768 ft., 1; Hinckley, 4,600 ft., 11.

Dipodomys ordii uintensis Durrant and Setzer

Ord Kangaroo Rat

Dipodomys ordii uintensis Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):27, June 30, 1945, type from Red Creek, 6,700 feet, 2 miles north of Fruitland, Duchesne County, Utah.

Perodipus longipes, Allen, Bull. American Mus. Nat. Hist., 8:246, November 25, 1896.

Dipodomys ordii luteolus, Moore, Journ. Mamm., 11:88, February 11, 1930.

Range.—Uinta Basin drainage of the White, Green and Duchesne rivers in Uintah, Duchesne and eastern Wasatch counties.

Description and comments.—Measurements of 3 adult males, numbers 11631, 11634 and 11640 (C.M.), from 2 miles north of Fruitland are as follows: Total length, 260, 253, 260; length of tail, 145, 140, 150; length of hind foot, 40, 40, 41. Color: Upper parts near (*c*) Cinnamon-Buff, faintly overlaid with dusky, giving a general tone of (16 *a*) Clay Color; sides paler with great suffusion of white; supraorbital and postauricular spots, dorsal surface of hind feet, front legs, hip stripes, lateral stripes of tail and entire underparts white; dorsal and ventral stripes of tail brownish. Skull: Large; fronto-maxillary suture convex medially; lacrimal processes large; styloid processes project on ventral surface of auditory bullae beyond middle of external auditory meatus; nasals flared distally.

From *Dipodomys ordii priscus*, *D. o. uintensis* differ as follows: Hind foot shorter. Color: More cinnamon in upper parts; arietiform markings more distinct; dorsal stripe of tail wider and darker, extending to tip of the pencil rather than being absent for distal one-third; plantar surfaces of hind feet darker; postauricular and supraorbital spots less pronounced. Skull: Styloid processes project farther forward on ventral surface of auditory bullae; depth of foramen magnum expressed in percentage of width across posterior margin of occipital condyles greater (86 instead of 81); fronto-maxillary suture convex medially as opposed to nearly straight; lacrimal processes larger; nasals slightly more flared out distally.

From *Dipodomys ordii luteolus*, *D. o. uintensis* differs as follows:

Size: Larger; hind foot shorter. Color: Dorsal and ventral stripes of tail wider and darker; plantar surfaces of hind feet darker. Skull: Nasals shorter; fronto-maxillary suture convex medially as opposed to nearly straight; width across auditory bullae less; foramen magnum smaller and more nearly round; external auditory meatus more nearly ovoid; width across zygomatic processes of maxillae less; width across posterior margin of occipital condyles less (averaging 6.1 as opposed to 6.8), paroccipital breadth less.

From *Dipodomys ordii nexilis, D. o. uintensis* differs as follows: Hind foot shorter. Color: Lighter in all respects. Skull: Interorbital breadth greater; fronto-maxillary suture convex medially as opposed to concave; lacrimal processes larger; nasals more flared distally; width across auditory bullae less; basal length greater; zygomatic arches bowed out laterally as opposed to straight.

For comparison with *Dipodomys ordii sanrafaeli,* see account of that subspecies.

This large, rather dark subspecies inhabits the desert valleys of the White, Green and Duchesne rivers in northeastern Utah. The nearest subspecies geographically, as well as morphologically, is *D. o. priscus.* Animals from Vernal are intergrades between *D. o. uintensis* and *D. o. priscus,* but are referable to the former subspecies on the basis of color and cranial measurements. Slight intergradation with *D. o. nexilis* is noted in animals from the southeastern part of the range.

Specimens examined.—Total, 76, distributed as follows: *Duchesne County:* Red Creek, 6,700 ft., 2 mi. N Fruitland, 4 (C.M.); 10 mi. S Myton, 1; 20 mi. S Myton, 1 (R.H.). *Uintah County:* 15 mi. W Vernal, 1; 4 mi. W Vernal, 1; Vernal, 4 (1, B.Y.U.); Jensen, 5 (B.Y.U.); E side Green River, 3 mi. S Jensen, 4 (C.M.); W side Green River, 3 mi. N Ouray, 4,800 ft., 25; E side confluence Green and White rivers, 1 mi. SE Ouray, 4,700 ft., 1; junction Green and White rivers, 4,800 ft., 2 mi. S Ouray, 5 (C.M.); Pariette Bench, 5,000 ft., 8 mi. S Ouray, 8 (C.M.); Desert Springs, 10 mi. S Ouray, 4 (C.M.); Pariette Bench, 12 mi. S Ouray, 2 (C.M.); Browns Corral, 20 mi. S Ouray, 6,250 ft., 10.

Dipodomys ordii sanrafaeli Durrant and Setzer

Ord Kangaroo Rat

Dipodomys ordii sanrafaeli Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):26, June 30, 1945, type from 1½ mi. N Price, 5,567 feet, Carbon County, Utah.

Dipodomys ordii longipes, Stanford, Journ. Mamm., 12:360, November 11, 1931.

Range.—The desert of east-central Utah north of the Colorado River, from Carbon County south to northeastern Garfield County.

Description and comments.—Measurements of 1 adult male, number 15649 (C.M.), and 1 female, number 15647 (C.M.), from 12 miles southwest of Green-

river are, respectively, as follows: Total length, 265, 253; length of tail, 144, 138; length of hind foot, 41, 42. Color: Entire dorsal surface Cinnamon-Buff, lighter on sides and flanks; supraorbital and postauricular spots, dorsal surface of hind feet, front legs, hip stripes, lateral stripes of tail and entire underparts white; dorsal stripe of tail with brown and black-tipped hairs. Skull: Large; auditory bullae large; diastema short; lacrimal processes small.

From *Dipodomys ordii longipes, D. o. sanrafaeli* differs in smaller size, more cinnamon color, lighter ears, smaller skull, smaller auditory bullae, ovoid rather than round pterygoid fossae, greater breadth across occipital condyles and narrower zygomatic breadth.

From *Dipodomys ordii uintensis, D. o. sanrafaeli* differs in longer hind feet, lighter color, lighter ears, lighter dorsal and ventral stripes of tail, lighter plantar surfaces of hind feet, larger skull, noticeably larger auditory bullae and smaller lacrimal processes.

From *Dipodomys ordii priscus, D. o. sanrafaeli* differs in lighter color, shorter nasals, longer, deeper and wider auditory bullae, shorter diastema, shorter maxillary tooth-row and greater breadth across paroccipital processes.

From *Dipodomys ordii cupidineus, D. o. sanrafaeli* differs in larger size, lighter color and larger skull.

From *Dipodomys ordii nexilis, D. o. sanrafaeli* differs in lighter color, larger skull, noticeably larger auditory bullae and greater breadth across zygomatic porcesses of maxillae.

Animals from southern Wayne and northern Garfield counties are intergrades between *D. o. sanrafaeli* and *D. o. cupidineus;* their larger size and lighter color are basis for referring them to the former subspecies. Intergradation between *D. o. sanrafaeli* and *D. o. nexilis* occurs in animals from 16 miles northwest of Moab; the larger size and lighter color are the basis on which these specimens are referred to *D. o. sanrafaeli.*

In places where they have high vertical walls, large, permanent streams such as the Green River, which transects the range of *D. o. sanrafaeli,* act as barriers to distribution of kangaroo rats. It is possible that Durrant and Setzer (1945:27) misinterpreted the effect of the Green River since additional information has shown that the deep canyons of the Green River have been formed in relatively late geologic time, and therefore, have only recently become a barrier, dividing what may have been previously a continuous range.

Specimens examined.—Total, 45, distributed as follows: *Carbon County:* 12 mi. NE Price, 2 (C.M.); 3 mi. NE Price, 1 (R.H.); Price, 5,567 ft., 2 (R.H.); Wellington, 1 (R.H.). *Sevier County:* 4 mi. E Mt. Alice, between Emery and Loa, 7,450 ft., 3. *Emery County:* 5 mi. S Castledale, 5,600 ft., 3; pump station, 4 mi. N Greenriver, 4,100 ft., 1; San Rafael, "21 miles out", 1 (U.S.A.C.); 12 mi. SW Greenriver, 2 (C.M.). *Grand County:* 1 mi. E High-

way 160, 6 mi. S Valley City, 4,500 ft., 12; 1 mi. E Highway 160, 10 mi. S Valley City, 4,000 ft., 1; Highway 160, 3 mi. W entrance Arches National Monument, 3; 14 mi. N Moab, 4,500 ft., 4; 16 mi. NW Moab, 2 (C.M.). *Wayne County:* Notom, 6,200 ft., 4 (1, B.Y.U.). *Garfield County:* King Ranch, 4,800 ft., 3 (1, U.S.A.C.).

Dipodomys ordii nexilis Goldman

Ord Kangaroo Rat

Dipodomys ordii nexilis Goldman, Journ. Washington Acad. Sci., 23:470, October 15, 1933, type from 5 miles west of Naturita, Montrose County, Colorado; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):23, June 30, 1945.

Perodipus montanus richardsoni, Warren, The mammals of Colorado, Knickerbocker Press, p. 76, 1910.

Range.—Grand County and San Juan County largely between the Colorado and San Juan rivers.

Description and comments.—Measurements of one adult male, number 149940 (U.S.N.M.), from Naturita, Colorado, are as follows: Total length, 261; length of tail, 156; length of hind foot, 44. Color: Upper parts dark, between (*a*) Cinnamon-Buff and Clay Color, mixed with black; sides, flanks and cheeks Cinnamon-Buff; ears, plantar surfaces of hind feet, areitiform markings, dorsal and ventral stripes of tail blackish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Large; rostrum and nasals long and narrow; auditory bullae strongly inflated; pterygoid fossae ovoid; braincase not inflated.

From *Dipodomys ordii longipes, D. o. nexilis* differs in smaller size, darker color, wider rostrum, greater interorbital breadth, wider cutting edge of upper incisors and lighter and more nearly straight zygomatic arches.

For comparisons with *Dipodomys ordii sanrafaeli* and *Dipodomys ordii uintensis,* see accounts of those subspecies.

Goldman remarked at the time of the original description of this subspecies that it probably intergraded with *D. o. longipes* in Utah. Specimens from near Bluff, do show characters intermediate between *D. o. longipes* and *D. o. nexilis,* but are referable to the latter. The animals from Grand County are intergrades between *D. o. nexilis* and *D. o. sanrafaeli,* and on the basis of darker color and less inflated bullae are assigned to the former.

In this desert area of Utah, rivers are only partial barriers to the distribution of kangaroo rats; the rivers appear to be efficient barriers in their lower reaches where water is permanent, but in their middle reaches, and especially in the headwaters which dry up at times, the kangaroo rats cross from one side to the other.

Specimens examined.—Total, 7, distributed as follows: *Grand County:* Cisco, 4 (C.M.); 18 mi. NE Moab, 6,000 ft., 1. *San Juan County:* Snyders Pond, 22 mi. (air) ENE Monticello, 5,650 ft., 1; Blanding, 1.

Dipodomys ordii fetosus Durrant and Hall

Ord Kangaroo Rat

Dipodomys ordii fetosus Durrant and Hall, Mammalia, 3:14, March, 1939, type from 2 miles north of Panaca, 4,800 feet, Lincoln County, Nevada; Hardy, Proc. Biol. Soc. Washington, 57:53, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):20, June 30, 1945.

Range.—Southwestern Millard and western Beaver counties.

Description and comments.—Average and extreme measurements of 6 adult males and 10 adult females from Panaca, Nevada, are, respectively, as follows: Total length, 237 (249-220), 229.6 (237-224); length of tail, 133 (140-126), 126.5 (134-122); length of hind foot, 42 (43-40), 40.5 (41.5-39.0). Color: Upper parts near Cinnamon-Buff, with heavy admixture of black; sides and flanks near Cinnamon-Buff; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail blackish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Rostrum wide and short; lacrimal processes large; zygomatic arches bowed laterally; external auditory meatus small, rounded with dorsal evagination; pterygoid fossae large and subcircular.

From *Dipodomys ordii celeripes, D. o. fetosus* differs as follows: Total length greater; tail longer. Color: Darker; arietiform markings present. Skull: Upper incisors smaller; nasals less inflated distally; interorbital region wider.

For comparisons with *Dipodomys ordii cinderensis* and *Dipodomys ordii pallidus,* see accounts of those subspecies.

This subspecies ranges from south central Lincoln County, Nevada, northeast into Utah where it is restricted to the low desert of western Millard and northwestern Beaver counties. The animals from Utah are not typical and are intergrades between *D. o. fetosus* and *D. o. celeripes.* They are intermediate in color, but darker than *D. o. celeripes;* the cranial characters are more as in *D. o. fetosus* and they are referred to that subspecies.

Specimens examined.—Total, 28, distributed as follows: *Millard County:* Pine Valley, sec. 33, T. 25S, R. 17W, Salt Lake B.M., 5,000 ft., 16; Warm Cove, sec. 34, T. 25S, R. 18 W, Salt Lake B.M., 5,500 ft., 2; Desert Range Experiment Station, 50 mi. W Milford, 5,252 ft., 10 (1, B.Y.U.).

Dipodomys ordii fremonti Durrant and Setzer

Ord Kangaroo Rat

Dipodomys ordii fremonti Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):21, June 30, 1945, type from Torrey, 7,000 feet, Wayne County, Utah.

Range.—Known only from Wayne County.

Description and comments.—Measurements of 2 adult females, numbers 15660 and 15661 (C.M.), topotypes, are as follows: Total length, 253, 246; length of tail, 142, 132; length of hind foot, 38, ––. Color: Upper parts near (16) ''Tawny-Olive; sides Cinnamon-Buff slightly suffused with white; postorbital and postauricular spots, dorsal surface of hind feet, front legs,

hip stripes, base of tail, lateral stripes of tail and entire underparts white; dorsal and ventral stripes of tail brownish. Skull: Small; upper incisors long; rostrum deep; temporal processes of zygomatic arches bowed laterally; diastema long; upper molariform series long.

From *Dipodomys ordii panguitchensis, D. o. fremonti* differs as follows: Color: Lighter, particularly the ears (light brown in *D. o. fremonti* as opposed to black in *D. o. panguitchensis*). Skull: Larger in all measurements taken; upper incisors longer; rostrum deeper; depth of bullae greater; temporal processes of zygomatic arches bowed out laterally rather than straight; upper molariform series longer; diastema longer.

From *Dipodomys ordii utahensis, D. o. fremonti* differs as follows: Size: Body longer; tail shorter. Color: Lighter, particularly the ears (light brown as opposed to black). Skull: Foramen magnum larger and with a deeper dorsal evagination; width across occipital condyles greater; temporal processes of zygomatic arches bowed out laterally rather than straight; rostrum generally deeper; upper incisors longer; anterior palatine foramina longer.

From *Dipodomys ordii cinderensis, D. o. fremonti* differs in lighter color, brown rather than black ears, smaller skull, smaller bullae, wider supraoccipital and larger foramen magnum.

D. o. fremonti can be readily distinguished from *Dipodomys ordii cupidineus, Dipodomys ordii nexilis, Dipodomys ordii uintensis* and *Dipodomys ordii sanrafaeli* by smaller size and generally darker color.

D. o. fremonti is known only from the upper reaches of the Fremont River in west-central Wayne County and probably represents an isolated population derived from the dark-colored stock characterized by *D. o. utahensis.* The subspecies which is nearest geographically to *D. o. fremonti* is *D. o. sanrafaeli* whose range is immediately to the east. Further collecting is needed in the Fremont River Valley to determine accurately the geographic range of *D. o. fremonti* and to determine whether or not it intergrades with *D. o. sanrafaeli.*

Specimens examined.—Total, 11, from: *Wayne County:* Torrey, 7,000 ft., 6 (5, C.M.); ¼ mi. N Grover, 5.

Dipodomys ordii cinderensis Hardy

Ord Kangaroo Rat

Dipodomys ordii cinderensis Hardy, Proc. Biol. Soc. Washington, 57:53, October 31, 1944, type from about 4,000 feet on sandy soil immediately north of the northern of two large cinder cones in Diamond Valley, ten miles north of St. George, Washington County, Utah; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):18, June 30, 1945.

Range.—From Diamond Valley, Washington County north through Moun-

tain Meadows, thence east as far as Cedar City, Iron County, north through the Escalante Desert to Lund, Iron County, and west to the Utah-Nevada line.

Description and comments.—Average and extreme measurements of 8 adult males and measurements of 2 adult females, numbers 2704 and 2689 (R.H.), from the type locality are, respectively, as follows: Total length, 237.8 (250-227), 240, 222; length of tail, 128.5 (139-120), 134, 118; length of hind foot, 40 (43-38), 41, 40. Color: Upper parts Buffy Brown with heavy suffusion of black; sides Buffy Brown; plantar surfaces of hind feet, dorsal and ventral stripes of tail nearly black; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Rostrum narrow; external auditory meatus small; auditory bullae well inflated; interparietal region narrow.

Topotypes of *D. o. cinderensis* differ from topotypes of *Dipodomys ordii panguitchensis* in smaller size, lighter color, larger auditory bullae, longer molariform tooth-row and an otherwise smaller skull.

D. o. cinderensis closely resembles *Dipodomys ordii fetosus,* but differs from it in darker color and smaller size in all measurements taken.

From *Dipodomys ordii utahensis, D. o. cinderensis* differs in: Tail relatively, to body, longer; auditory bullae more inflated; foramen magnum round as opposed to ovoid; paroccipital breadth narrower.

This subspecies inhabits the deserts in northern Washington County and in most of Iron County. The only subspecies with which *D. o. cinderensis* is known to intergrade is *D. o. fetosus,* its near neighbor to the north. This intergradation is noted in animals from Lund. Intergradation of *D. o. cinderensis* with *Dipodomys ordii cupidineus* which occurs to the south, and with *D. o. panguitchensis* which occurs to the east is impossible as high mountains are interposed between the range of *D. o. cinderensis* and that of each of the two aforementioned subspecies.

Specimens examined.—Total, 74, distributed as follows: *Iron County:* 4½ mi. NW Summit and 6 mi. W Parowan, 9 (R.H.); Escalante Desert, 11 mi. SE Lund, 50 (R.H.); Cedar City, 2 (B.Y.U.); 5 mi. W Cedar City, 1 (U.S.A.C.); 10 mi. W Cedar City, 1 (U.S.A.C.). *Washington County:* Diamond Valley, 9 (R.H.); N end Mountain Meadows, 2 (R.H.).

Dipodomys ordii panguitchensis Hardy

Ord Kangaroo Rat

Dipodomys ordii panguitchensis Hardy, Proc. Biol. Soc. Washington, 55:90, June 25, 1942, type from 1 mile south of Panguitch, 6,666 feet, Garfield County, Utah; Hardy, Proc. Biol. Soc. Washington, 57:54, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):25, June 30, 1945.

Range.—Known only from the type locality.

Description and comments.—Measurements of 2 adult males, numbers 2151 and 2152, and one adult female, number 2153 (R.H.), from Panguitch are, respectively, as follows: Total length, 257, 252, 240; length of tail, 145, 135, 132; length of hind foot, 41, 40, 38. Color: Upper parts dark nearly Olive-Brown, heavily suffused with black; sides and flanks Olive-Brown; ears, plantar surfaces of hind feet, arietiform markings, dorsal and ventral stripes of tail blackish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Small; rostrum short and wide; interorbital and interparietal regions wide; foramen magnum elongated dorsoventrally; pterygoid fossae ovoid.

Among named subspecies of *Dipodomys ordii, D. o. panguitchensis* most closely resembles *Dipodomys ordii utahensis,* but differs from it in larger size, darker color, dorsoventrally elongated rather than nearly round foramen magnum, ovoid rather than nearly round pterygoid fossae, and wider interparietal region.

For comparisons with *Dipodomys ordii cinderensis* and *Dipodomys ordii fremonti,* see accounts of those subspecies.

This subspecies is restricted to the upper reaches of the Sevier River Valley in the vicinity of Panguitch. Natural barriers such as the Cedar Mountains, to the west, high plateau country to the south, the Paunsaugunt Plateau to the east and the narrow canyons of the Sevier River to the north apparently prevent this subspecies from extending its range.

Specimens examined.—Total, 3, from: *Garfield County:* 1 mi. S Panguitch, 6,666 ft., 3 (2, R. H.).

Dipodomys ordii cupidineus Goldman

Ord Kangaroo Rat

Dipodomys ordii cupidineus Goldman, Journ. Washington Acad. Sci., 14: 372, September 19, 1924, type from Kanab Wash at southern boundary of Kaibab Indian Reservation, Arizona; Long, Journ. Mamm., 21:176, May 16, 1940; Tanner, Great Basin Nat., 1:104, June 30, 1940; Hardy, Proc. Biol. Soc. Washington, 55:91, June 25, 1942; Hardy, Proc. Biol. Soc. Washington, 57:54, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):20, June 30, 1945.

Range. — Southeastern Washington County, most of Kane County and southern Garfield County.

Description and comments.—Measurements of 1 adult male, number 4382, and 2 adult females, numbers 2044 and 2045 (B. Y. U.), are as follows: Total length, 227, 239, 239; length of tail, 136, 138, 121; length of hind foot, 40, 41, 38. Color: Upper parts between Pinkish Cinnamon and Pinkish Buff washed with black; sides Pinkish Cinnamon; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail, blackish brown; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Large; rostrum long and narrow; nasals long and flared distally; external auditory meatus small and ovoid; jugals straight; auditory bullae well inflated.

Topotypes of *D. o. cupidineus* differ from those of *Dipodomys ordii panguitchensis, Dipodomys ordii fremonti* and *Dipodomys ordii cinderensis* in lighter color (more rufescent), and by larger skull in nearly every measurement taken.

From *Dipodomys ordii longipes, D. o. cupidineus* differs in slightly darker color and smaller size in all measurements taken.

For comparison with *Dipodomys ordii sanrafaeli,* see account of that subspecies.

This large, rather reddish subspecies occurs in the sandy areas of south-central Utah. Animals from Kanab closely resemble topotypes while those from farther north at Escalante are intergrades between *D. o. cupidineus* and *D. o. sanrafaeli.* The animals from Escalante are paler than *D. o. cupidineus* and the majority of the cranial characters are more as in *D. o. sanrafaeli,* to which they are here referred.

The Colorado River separates the ranges of *D. o. cupidineus* and *D. o. longipes.* The river in this region is in a deep canyon with precipitous walls and serves as a barrier to disperal of these animals. This river prevents intergradation between *Dipodomys ordii nexilis* and *D. o. cupidineus* in the northeastern part of the range of the latter subspecies.

Specimens examined.—Total, 54, distributed as follows: *Garfield County:* Mouth of Calf Creek, Escalante River, 3 (B. Y. U.); Ten mile Spring, 3 (B. Y. U); Escalante, 5 (B. Y. U). *Washington County:* "near" Short Creek Road, S Virgin, 18 (R. H.). *Kane County:* "near" Sand Dunes, 7 (R. H.); Kanab, 7 (2, B. Y. U.); 1 mi. S Kanab, 4,200 ft., 2; Cottonwood Canyon, 8 mi. NW Kanab, 4,800 ft., 1; near Paria, 1; Willow Tank Springs, 7 (B. Y. U.).

Dipodomys ordii longipes (Merriam)

Ord Kangaroo Rat

Dipodops longipes Merriam, N. Amer. Fauna, 3:72, September 11, 1890, type from foot of Echo Cliffs, Painted Desert, Arizona.

Dipodomys ordii longipes, Grinnell, Journ. Mamm., 2:96, May 2, 1921; Barnes, Bull. Univ. Utah, 17 (no. 12):108, June, 1927; Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 183, 1942; Hardy, Proc. Biol. Soc. Washington, 57:54, October 31, 1944; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):22, June 30, 1945.

Perodipus ordii, Allen, Bull. American Mus. Nat. Hist., 5:71, April 28, 1893.

Perodipus longipes, Warren, The mammals of Colorado, Knickerbocker Press, p. 77, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):87, April, 1922.

Range.—Southern San Juan County.

Description and comments.—Measurements of 2 adult males, numbers 1205 and 1204, and average and extreme measurements of 5 adult females, from Johns Canyon are, respectively, as follows: Total length, 252, 250, 241.8 (251-227); length of tail, 148, 136, 130 (136-113); length hind foot, 43, 42, 40.4 (42-38). Color: Upper parts Cinnamon-Buff slightly suffused with black; sides Cinnamon-Buff; ears, plantar surfaces of hind feet, dorsal and

ventral stripes of tail brownish; supraorbital and postauricular spots, front legs, lateral stripes of tail, base of tail, hip stripes and entire underparts white. Skull: Large; rostrum and nasals long and narrow; auditory bullae well inflated; styloid processes project on ventral surface of auditory bullae beyond middle of external auditory meatus.

For comparisons with *Dipodomys ordii cupidineus, Dipodomys ordii sanrafaeli, Dipodomys ordii nexilis,* and *Dipodomys ordii fremonti,* see accounts of those subspecies.

In Utah, this large, reddish subspecies from the Painted Desert of northern Arizona occurs in only the extreme southeastern part of the state. All specimens examined were from the north side of the San Juan River, San Juan County, Utah, and were intergrades between *D. o. longipes* and *D. o. nexilis* the subspecies the nearest geographically to the north and east. The reddish color and larger cranial measurements show these animals to be more nearly like *D. o. longipes* to which they are referred. The lower reaches of the San Juan River near its confluence with the Colorado River is a barrier to dispersal of these animals. The middle and upper parts of the San Juan River have been known to become dry periodically, which would afford opportunity for kangaroo rats to cross from one side to the other. Animals belonging to *D. o. longipes* from the south side of the river have been able by this means to intergrade on the north side of the river with *D. o. nexilis,* as indicated by the aforementioned specimens.

Specimens examined.—Total, 16, distributed as follows: *San Juan County:* Hatch Trading Post, Montezuma Creek, 25 mi. SE Blanding, 4,500 ft., 1; 1 mi. N Bluff, 3,500 ft., 1; ½ mi. N Bluff, 3,300 ft., 7; ½ mi. NW Bluff, 4,500 ft., 3; Bluff, 2; Johns Canyon, San Juan River, 5,150 ft., 2.

Dipodomys microps bonnevillei Goldman

Chisel-toothed Kangaroo Rat

Dipodomys microps bonnevillei Goldman, Proc. Biol. Soc. Washington, 50:222, December 28, 1937, type from Kelton, 4,300 feet, Boxelder County, Utah; Hall and Dale, Occ. papers Mus. Zoöl. Louisiana State Univ., 4:58, November 10, 1939; Hardy, Proc. Biol. Soc. Washington, 55:90, June 25, 1942; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26): 12, June 30, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Dipodomys microps levipes, Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938; Midgley, Journ. Mamm., 19:304, August 18, 1938.

Range.—Western Utah from the Utah-Nevada Boundary south to northern Iron County; from the western border of Utah east as far as the western edge of Sevier County.

Description and comments.—Average and extreme measurements of 17 adult males and 15 adult females, from Desert Range Experiment Station are, respectively, as follows: Total length, 252 (275-222), 253 (283-236); length

of tail, 146 (160-110), 147.5 (170-135); length of hind foot, 41.5 (43-40), 41 (43-40). Color: Upper parts Pinkish Buff mixed with black; external surface of ears generally white (anterior margin brownish black); supraorbital and postauricular spots, dorsal surface of hind feet, front legs, hip stripes, base

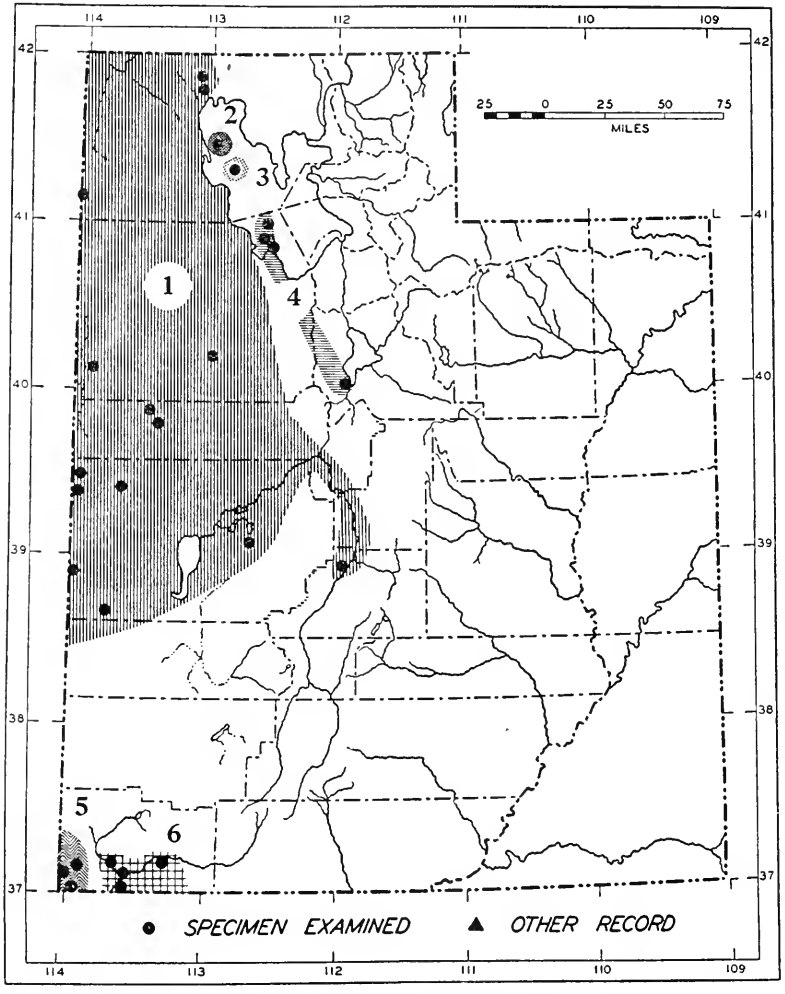

FIG. 44. Distribution of *Dipodomys microps*.

1. *D. m. bonnevillei.*
2. *D. m. russeolus.*
3. *D. m. alfredi.*
4. *D. m. subtenuis.*
5. *D. m. woodburyi.*
6. *D. m. celsus.*

of tail, lateral stripes of tail and entire underparts white; brush on tail reduced, hairs white basally and black distally; dorsal and ventral srtipes of tail pronounced and with a mixture of brown and black hairs. Skull: Of medium size; orbit small; interparietal narrow; incisors broad.

D. m. bonnevillei differs from *Dipodomys microps subtenuis, Dipodomys microps celsus* and *Dipodomys microps woodburyi* in smaller size in all measurements taken. The interorbital region of *D. m. bonnevillei,* however, is relatively broader.

Among named subspecies of *Dipodomys microps, D. m. bonnevillei* more closely resembles *Dipodomys microps russeolus,* but differs from it in darker color, longer tail and wider skull.

For comparison with *Dipodomys microps alfredi,* see account of that subspecies.

Animals from Fish Springs, from 18 miles southwest of Orr's Ranch and from the area east of Clear Lake (on the margins of the geographic range of the subspecies) differ from other samples of *D. m. bonnevillei* in being lighter-colored and in having a wide variation in the shape and length of the nasals. The lighter color may result from fading of the hairs owing to the action of the highly alkaline soils on, and in, which the rats live. Some specimens approach *D. m. subtenuis* in the narrowness and straightness of the nasals, but most of the specimens possess the wide, flared nasals of *D. m. bonnevillei;* the characters of the specimens as a group are more as in *D. m. bonnevillei,* to which they are here referred.

These animals are primarily inhabitants of sandy soils in the desert valleys of western Utah where they are closely associated with the vegetation typical of the desert, such as shadscale (*Atriplex*), greasewood (*Sarcobatus*), inkweed (*Sueda*), and other genera, as well as with the non-saline sage brush (*Artemisia*).

Specimens examined.—Total, 119, distributed as follows: *Boxelder County:* Hardup, 1 (U.S.A.C.); Kelton, 4,225 ft., 10 (3, U.S.N.M.; 7, M.V.Z.); Utah-Nevada border, E side of Ta[=e]coma Range, 4,300 ft., 2. *Tooele County:* Old Lincoln Highway, 18 mi. SW Orr's Ranch in Skull Valley, 4,400 ft., 10; Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 1; Clifton Flat, 7 mi. SW Gold Hill, 6,149 ft., 2; Ibapah, 5,000 ft., 21. *Juab County:* Fish Springs, 4,400 ft., 3; 7 mi. S Fish Springs, 4,400 ft., 3. *Millard County:* 4 mi. S Gandy, 5,000 ft., 2 (M.V.Z.); White Valley, 60 mi. W Delta, 2; 1 mi. SE Gandy, 5,000 ft., 2 (M.V.Z.); Smith Creek, 5,400 ft., 6 mi. S Gandy, 7 (M.V.Z.); 2 mi. E Clear Lake, 4,600 ft., 1; 5 mi. S Garrison, 5,400 ft., 1 (M.V.Z.); Warm Cove, 55 mi. W Milford, 5; Desert Range Experiment Station, Sec. 9, T. 25S, R. 17W, Salt Lake B.M., 37 (4, B.Y.U); Pine Valley, Sec. 33, T. 25S, R. 17W, Salt Lake B.M., 50 mi. W Milford, 5,500 ft., 8. *Sevier County:* Aurora, 1 (B.Y.U.).

Dipodomys microps russeolus Goldman

Chisel-toothed Kangaroo Rat

Dipodomys microps russeolus Goldman, Journ. Mamm., 20:353, August 14, 1939, type from Dolphin Island, Great Salt Lake, 4,250 feet, Boxelder County, Utah; Hall and Dale, Occ. papers Mus. Zoöl. Louisiana State Univ., 4:62, November 10, 1939; Marshall, Journ. Mamm., 21:151, May 16, 1940; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):14, June 30, 1945.

Range.—Known only from the type locality.

Description and comments.—The type is the only known specimen, and as it was unavailable for study the following is from Goldman (1939b:353). Measurements are: Total length, 248; length of tail, 136; length of hind foot, 41. Color: Upper parts near Pinkish Buff moderately mixed with black on top of head and back; cheeks sides and flanks near Pinkish Buff; postauricular and supraorbital spots, forelimbs, dorsal surface of hind feet, hip stripes, tail all around at base and entire underparts white; dorsal and ventral stripes of tail brownish; lateral stripes of tail white; soles of hind feet blackish to toes which are white; ears black crossed with median band of white; cheek pouches black anteriorly. Skull: Small and elongate; rostrum and nasals long; outer angles of maxillary arches rounded.

From the data given by Goldman (*loc. cit.*), *D. m. russeolus* is distinguished from all other subspecies of *Dipodomys microps* known to occur in Utah, with the exception of *Dipodomys microps bonnevillei,* by smaller size in all measurements and more rufescent color. For comparison with *D. m. bonnevillei,* see account of that subspecies.

Goldman (1937 and 1939b) described 5 kinds of kangaroo rats from the islands of Great Salt Lake of which 3 were of the species *D. microps* and 2 were of the species *D. ordii.* He considered each of the kinds to be insular even though he was aware that most of these islands were connected periodically with the mainland by low bars (Goldman, 1939b:351), which he considered to be unattractive to kangaroo rats (1939:353). Later work by Durrant and Setzer (1945:15, 23) showed that both *Dipodomys microps subtenuis* from Carrington Island and *Dipodomys ordii marshalli* from Bird and Stansbury islands ranged also onto the adjacent mainland. Dolphin Island, where *D. m. russeolus* occurs, is periodically connected with the mainland by a low bar of the same type as those which connect Bird, Carrington and Stansbury islands with the mainland, and it therefore, seems probable that the populations on Dolphin Island and the mainland are not isolated; probably crossbreeding occurs between them. It is natural, therefore, that in the original description of *D. m. russeolus* Goldman (*loc. cit.*) commented on the close affinities in both color and cranial characters of *D. m. russeolus* and *D. m. bonnevillei* of the mainland. The features given as diagnostic and "beyond the usual range of individual variation" were solely those of more rufescent upper parts and more elongated skull. I have not seen the only known specimen (holotype) of *D. m. russeolus,* but the diagnostic characters as given by Goldman in the original description are not beyond the range of individual variation in *D. m. bonnevillei* as noted in my large series of specimens from the Desert Range Experiment Station.

Consequently, I strongly suspect that when a sufficient number of specimens of *D. m. russeolus* are available, it will be found to be indistinguishable from *D. m. bonnevillei.*

Record of occurrence (Goldman, 1939b:353).—*Boxelder County:* Dolphin Island, 4,250 ft.

Dipodomys microps alfredi Goldman

Chisel-toothed Kangaroo Rat

Dipodomys microps alfredi Goldman, Proc. Biol. Soc. Washington, 50:221, December 28, 1937, type from Gunnison Island, Great Salt Lake, 4,300 feet, Boxelder County, Utah; Hall and Dale, Occ. papers Mus. Zoöl. Louisiana State Univ., 4:59, November 10, 1939; Marshall, Journ. Mamm., 21:152, May 16, 1940; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):12, June 30, 1945.

Range.—Known only from Gunnison Island, Great Salt Lake.

Description and comments.—Measurements of 2 males, numbers 3002 (C.M.N.H.) and 2999 (C.M.N.H.) and 2 females, numbers, 2996 (C.M.N.H.) and 3003 (C.M.N.H.), topotypes are, respectively, as follows: Total length, 299, 250, 277, 270; length of tail, 175, 150, 155, 150; length of hind foot, 47.5, 42, 48, 45. Color: Upper parts Pinkish Buff finely mixed with black; cheeks, thighs and flanks Pinkish Buff; postauricular and supraorbital spots, dorsal surface of hind feet, hip stripes, front legs, base of tail and entire underparts white; dorsal and ventral stripes of tail brown mixed with gray; lateral stripes of tail white (entire tail becoming light brown distally); cheek pouches dusky; ears white externally, mixed with black on anterior fold, and blackish internally. Skull: Large; massive; zygomatic arches widely spreading; jugals thick; rostrum heavy; incisors wide.

Topotypes of *D. m. alfredi* may be distinguished from topotypes of *Dipodomys microps bonnevillei* by markedly lighter color and larger size.

From topotypes of *Dipodomys microps subtenuis,* topotypes of *D. m. alfredi* differ in lighter color and larger, more massive skull.

From the type of *Dipodomys microps russeolus, D. m. alfredi* differs in larger size, paler color (less rufescent), larger skull and wider incisors.

Among named subspecies of *Dipodomys microps, D. m. alfredi* most closely resembles *Dipodomys microps celsus* and *Dipodomys microps woodburyi,* but differs from both in paler color, more angular skull, broader rostrum, heavier jugals and wider incisors.

This subspecies is the lighest in color of any *Dipodomys microps* known to occur in Utah, and supports Marshall's (1940:144-159) generalization that animals from the islands of Great Salt Lake all tend to be pale colored.

Gunnison Island is one of the few islands in Great Salt Lake that has not been periodically connected with the mainland in

historic times. Of all the kinds of mammals obtained from the islands in Great Salt Lake, *D. m. alfredi* is the most differentiated and best exhibits the effects of isolation. This subspecies is remarkably constant in proportions of the body and its appendages and in cranial features; *D. m. alfredi* is clearly distinct from any other known kind of *Dipodomys microps*. In spite of the fact that these animals from Gunnison Island (*D. m. alfredi*) are thought not to intergrade with any other kind of *Dipodomys*, I feel that the degree of their morphological differentiation from *D. microps* is so slight that their relationships are best indicated by treating them as a subspecies of *D. microps* instead of as a distinct species.

Specimens examined.—Total, 11 (1, U.S.N.M.; 10, C.M.N.H.), from the type locality.

Dipodomys microps subtenuis Goldman

Chisel-toothed Kangaroo Rat

Dipodomys microps subtenuis Goldman, Journ., Mamm., 20:354, August 14, 1939, type from Carrington Island, Great Salt Lake, 4,250 feet, Tooele County, Utah; Hall and Dale, Occ. papers Mus. Zoöl. Louisiana State Univ., 4:62, November 10, 1939; Marshall, Journ. Mamm., 21:153, May 16, 1940; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):15, June 30, 1945.

Range.—Badger, Carrington and Stansbury islands, Great Salt Lake; south through Rush Valley to Cedar Valley west of Utah Lake, Utah County.

Description and comments.—Measurements of the type are: Total length, 267; length of tail, 157; length of hind foot, 40 (Goldman, 1939:354). Color: Upper parts near Pinkish Buff moderately mixed with black; supraorbital and postauricular spots, front legs, hip stripes, dorsal surface of hind feet, lateral stripes of tail, base of tail and entire underparts white; dorsal and ventral stripes of tail, arietiform markings, plantar surfaces of hind feet to base of toes, blackish; toes white. Skull: Rostrum and nasals long and slender; maxillary arches long anteroposteriorly with hooklike external angles.

Topotypes of this subspecies can be distinguished from all other subspecies of *Dipodomys microps*, known to occur in Utah, by the long slender skull with long, slender rostrum and nasals.

The islands where this subspecies occurs are periodically interconnected by low bars when the level of the lake fluctuates, and Stansbury Island has been connected with the mainland for many years. These land connections would permit animals from these islands to cross to the mainland and *vice versa*. A single specimen, number 1772 (B. Y. U.), from Chimney Rock Pass, is referable to *D. m. subtenuis*. It is a subadult but does have the long, slender skull with long, thin nasals which are characteristic of *D. m. subtenuis*. Insofar as known, this animal from Chimney Rock Pass is

the only mainland specimen, all others being from the islands. It is noteworthy that no specimens of *Dipodomys microps* have ever been taken on the eastern and southern shores of Great Salt Lake. In the past 15 years students from the University of Utah have collected hundreds of kangaroo rats in this area, but all were of the species *Dipodomys ordii.*

Specimens examined.—Total, 4, distributed as follows: *Tooele County:* Carrington Island, Great Salt Lake, 4,250 ft., 1 (U. S. N. M.); Badger Island, Great Salt Lake, 4,250 ft., 1 (U. S. N. M.); Stansbury Island, Great Salt Lake, 4,250 ft., 1 (U. S. N. M.). *Utah County:* Chimney Rock Pass, 40°04′ N Lat. 111°56′ W Long., Cedar Valley, 1 (B. Y. U.).

Dipodomys microps celsus Goldman

Chisel-toothed Kangaroo Rat

Dipodomys microps celsus Goldman, Journ. Washington Acad. Sci., 14:372, September 19, 1924, type from 6 miles north of Wolf Hole, 3,500 feet, Mohave County, Arizona; Moore, Journ. Mamm., 11:88, February 11, 1930; Hall and Dale, Occ. papers Mus. Zoöl., Louisiana State Univ., 4:60, November 10, 1939; Hardy, Proc. Biol. Soc. Washington, 55:90, June 25, 1942; Hardy, Ecol. Monogr., 15:86, January, 1945; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):13, June 30, 1945.

Range.—Washington County, in the Virgin River Valley; also possibly in southern Kane County.

Description and comments.—Measurements of 3 adult males, numbers 3181, 3182 and 3185, and of 3 adult females, numbers 3183, 3184 and 3186, from 1 mile west of St. George are, respectively, as follows: Total length, 263, 268, 280, 281, 268, 276; length of tail, 150, 155, 156, 160, 150, 160; length of hind foot, 40, 42, 42, 42, 40, 41. Color: Upper parts near Pinkish Buff; dark dorsal hairs black-tipped; supraorbital and postauricular spots, hip stripes, dorsal surface of hind feet, front feet, base of tail, lateral stripes of tail and entire underparts white; arietiform markings, dorsal stripe of tail and ventral surface of shank of hind legs blackish; ventral stripe of tail and plantar surfaces of hind feet brownish black. Skull: Large; massive; mastoid bullae well inflated.

Near topotypes of *D. m. celsus* differ from the types of *Dipodomys microps russeolus* in less rufescent color and larger size in all measurements taken.

From *Dipodomys microps subtenuis, D. m. celsus* differs in larger size, darker color and larger, more angular skull.

For comparisons with *Dipodomys microps woodburyi, Dipodomys microps bonnevillei* and *Dipodomys microps alfredi,* see accounts of those subspecies.

Intergradation between *D. m. celsus,* the subspecies east of the Beaverdam Mountains, and *D. m. woodburyi* from west of the Beaverdam Mountains is indicated by a series of 10 animals from the western slope of these mountains. No intergrades between these 2 subspecies are known from any but the aforementioned locality, and the Beaverdam Mountains are interposed between this

area of intergradation and the main range of *D. m. celsus*. Moreover, these mountains are known to be an effective barrier to dispersal of mammals which are much less restricted environmentally than are kangaroo rats, and one wonders how these 2 kinds of *D. microps* happen to intergrade on the western slope of these mountains. A single specimen of *D. m. celsus* from 1½ miles northwest of Diamond Valley, which locality is north and east of the northern end of the Beaverdam Mountains, indicates that *D. m. celsus* may have gained access to the western slope by extending its range around the northern end of the mountains.

Specimens examined.—Total, 29, distributed as follows: *Washington County:* 1½ mi. NW Diamond Valley, 1 (R.H.); 5 mi. NW St. George, 2 (1, R.H.; 1, D.J.C.); Gould's Ranch, Hurricane, 1 (B.Y.U.); 1 mi. W St. George, 2,800 ft., 5; W side Black Hill, approx. 1 mi. W St. George, 3,300 ft., 1; St. George, 5 (R.H.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 13; 3 mi. S St. George, 1 (R.H.).

Dipodomys microps woodburyi Hardy

Chisel-toothed Kangaroo Rat

Dipodomys microps woodburyi Hardy, Proc. Biol. Soc. Washington, 55:89, June 25, 1942, type from Clistoyucca area on Beaverdam Slope west of Beaverdam Mountains, 3,500 feet, Washington County, Utah; Hardy, Ecol. Monogr., 15:87, January, 1945; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):16, June 30, 1945; Hardy, Journ. Mamm., 30:435, November 17, 1949.

Range.—Known only from the west slope of the Beaverdam Mountains, in extreme southwestern Washington County, Utah.

Description and comments.—Average and extreme measurements of 4 adult male topotypes are: Total length, 288 (302-282); length of tail, 166.5 (177-164); length of hind foot, 43.25 (44-43). Color: Upper parts a mixture of Buffy Brown, Fawn and black; cheeks, sides and flanks Light Vinaceous-Cinnamon; postauricular spots, supraorbital spots, hip stripes, lateral stripes of tail; forelimbs, dorsal surface of hind feet and entire underparts white; dorsal and ventral stripes of tail light brown. Skull: Large; cutting edge of upper incisors wide; nasals long.

Among named subspecies of *Dipodomys microps*, *D. m. woodburyi* closely resembles *Dipodomys microps celsus*. Comparison of topotypes with specimens of *D. m. celsus* from the environs of St. George shows *D. m. woodburyi* to differ in: Tail longer; dark stripes of tail brownish as opposed to blackish; skull averaging larger in all measurements taken; cutting edge of upper incisors wider.

Specimens are unavailable to determine whether the diagnostic characters of *D. m. woodburyi* are beyond the range of individual

variation of *D. m. celsus*. Topotypes of *D. m. woodburyi* have a wide range of individual variation and the characters separating them from *D. m. celsus* are mainly quantitative in nature. These characters appear to be fairly adequate when topotypes of the two subspecies are compared; it is, however, difficult to separate topotypes of *D. m. woodburyi* from specimens of *D. m. celsus* from St. George. *Dipodomys microps leucotis, D. m. celus* and *D. m. woodburyi* form a group of large animals occupying the Arizona Strip in northwestern Arizona and the Virgin River Valley in Utah. This whole group is distinct morphologically and is well removed geographically from the smaller *Dipodomys microps occidentalis* which occurs to the west in Nevada, and from *Dipodomys microps bonnevillei* from the Lake Bonneville area (see Hall and Dale, 1939:51). The range of *D. m. woodburyi* is separated from that of *D. m. celsus* by the Beaverdam Mountains and the narrows of the Virgin River, both of which are known to be barriers to the extension of ranges of other kinds of small mammals, such as pocket mice, pocket gophers and woodrats. Furthermore, its area of occurrence is characterized by a distinctive flora (characterized by *Clistoyucca*) not found in the range of *D. m. celsus* or *D. m. leucotis*. In view of the above, I feel that *D. m. woodburyi* is a subspecies in the process of differentiation. Although the diagnostic characters are not well marked and although the range of individual variation is extensive, differentiation seems to have proceeded far enough to warrant subspecific recognition.

These animals are found in the Joshua Tree (*Clistoyucca*) area of extreme southwestern Utah. The flora is dominated in this region by creosote (*Larrea*), blackbrush (*Coleogyne*) and mesquite (*Prosopis*) and is almost at the northeastern limit of the Lower Sonoran Life-Zone. The mounds of these animals are usually built at the bases of bushes of blackbrush and creosote, and are approximately a foot high and appear to be composed of soil excavated from the burrows. The vegetation around the mounds is usually trimmed closely and the bushes themselves, under which these mounds are built, are practically stripped of leaves and new shoots.

Specimens examined.—Total, 16, distributed as follows: *Washington County:* Beaverdam Slope, 10 (R.H.); 1½ mi. E Beaverdam Wash, 8 mi. N Utah-Arizona Border, 3,200 ft., 3; W slope Beaverdam Mountains, 3,300 ft., 5 mi. N Utah-Arizona Border, 1; "near Ed Terry Ranch", Beaverdam Wash, 2 (R.H.).

Dipodomys merriami vulcani Benson

Merriam Kangaroo Rat

Dipodomys merriami vulcani Benson, Proc. Biol. Soc. Washington, 47:181, October 2, 1934, type from lower end of Toroweap Valley (about ½ mi. E Vulcans Throne), Mohave County, Arizona; Hardy, Ecol. Monogr., 15:86, January, 1945; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):31, June 30, 1945.

Dipodomys merriami merriami, Moore, Journ. Mamm., 11:88, February 11, 1930; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938.

Dipodomys merriami frenatus Bole, Sci. Publ. Cleveland Mus. Nat. Hist., 5:1, January 17, 1936, type from Toquerville, Washington County, Utah; Long, Journ. Mamm., 21:176, May 16, 1940.

Range.—Virgin River drainage in Washington County east of the Beaverdam Mountains. See figure 42.

Description and comments.—Average and extreme measurements of 6 adult males and measurements of 3 adult females, numbers 3189, 3198 and 3203, from 3 miles southwest of St. George are, respectively, as follows: Total length, 243 (256-232), 240, 255, 250; length of tail, 138 (148-130), 134, 145, 138; length of hind foot, 38 (40-32), 36, 39, —. Color: Upper parts near Pinkish Buff, heavily suffused with black, dorsal hairs Slate-Gray basally; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail, brownish black; supraorbital and postauricular spots, front feet, dorsal surface of hind feet, hip stripes, lateral srtipes of tail and entire underparts white. Skull: Similar to that of *Dipodomys merriami merriami* (see account of that subspecies).

For comparison with *D. m. merriami*, see account of that subspecies.

Animals from the Virgin River drainage, east of the Beaverdam Mountains, were named *Dipodomys merriami frenatus* by Bole (1936:1). Durrant and Setzer (1945:32) referred these animals to *D. m. vulcani*, and placed the name *D. m. frenatus* as a synonym of *D. m. vulcani*. Recomparison of topotypes of *D. m. merriami* and *D. m. vulcani* with the animals from the range formerly ascribed to *D. m. frenatus* shows the latter animals to have characters that are intermediate between those of the two first mentioned subspecies. Since these specimens are dark colored and have wide supraoccipitals and a narrow space between the paroccipital processes they more closely resemble *D. m. vulcani* to which they are here referred.

Specimens examined.—Total, 63, distributed as follows: *Washington County:* Veyo, 1 (D.J.C.); Diamond Valley, 1 (R.H.); Toquerville, 1; 5 mi. NW St. George, 1 (D.J.C.); 7 mi. E St. George, 2; Washington, 1 (B.Y.U.); St. George, 23 (16, R.H.; 3, D.J.C.; 3, B.Y.U.); 1 mi. W St. George, 2,800 ft., 3; ¼ mi. W St. George, 2; 4 mi. SW Hurricane, 9; 3 mi. S St. George, 18 (2, R.H.); "near" Bloomington, 1 (R.H.).

Dipodomys merriami merriami Mearns

Merriam Kangaroo Rat

Dipodomys merriami Mearns, Bull. American Mus. Nat. Hist., 2:290, February 21, 1890, type from New River, Maricopa County, Arizona.
Dipodomys merriami merriami, Hardy, Ecol. Monogr., 15:96, January, 1945; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):31, June 30, 1945.

Range.—Extreme southwestern Washington County, in Beaverdam Wash. See figure 42.

Description and comments.—Average and extreme measurements of 6 adult males and measurements of 2 females, numbers 420 (D.J.C.) and 2206 (R.H.), from Beaverdam Slope are, respectively, as follows: Total length, 253 (266-240), 263, 255; length of tail, 152.5 (161-145), 159, 147; length of hind foot, 38 (40-36), 38, 38. Color: Upper parts near Pinkish Buff, lightly suffused with dusky; dorsal hairs Deep Gull Gray basally; ears, plantar surfaces of hind feet, dorsal and ventral stripes of tail dusky; supraorbital and postauricular spots, front feet, dorsal surface of hind feet, hip stripes, lateral stripes of tail and entire underparts white. Skull: Of medium size; supraoccipital bone narrow; pterygoid fossae large; width across paroccipital processes actually and relatively great.

From *Dipodomys merriami vulcani, D. merriami merriami* differs in much larger size, lighter color, narrower supraoccipital bone, larger pterygoid fossae and much greater width across paroccipital processes.

In Utah, animals belonging to this species occur only in Washington County. The Beaverdam Mountains and the narrows of the Virgin River have acted to separate the animals from Beaverdam Wash from those of the St. George area. Evidently sufficient time has elapsed since this separation to permit the two populations to become distinct from each other. All of the animals from the Beaverdam Wash area belong to *D. merriami merriami*, whereas all of those from the St. George area belong to the subspecies *D. merriami vulcani*.

Although the subspecies *Dipodomys merriami merriami* has a small geographic range in Utah, the subspecies as a whole has a large geographic range outside of the state and in these more western and southern areas is subject to considerable geographic variation.

Specimens examined.—Total, 53, distributed as follows: *Washington County:* 1½ mi. E Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 13; "near Ed Terry Ranch, Beaverdam Wash," 7 (R.H.); Beaverdam Wash, W Side Beaverdam Mountains, 11 (6, R.H.; 5, D.J.C.); 1½ mi. E Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,800 ft., 22.

Dipodomys deserti deserti Stephens

Desert Kangaroo Rat

Dipodomys deserti Stephens, Amer. Nat., 21:42, January, 1887, type from Mojave River, San Bernardino County, California; Durrant, Journ. Mamm., 24:404, August 18, 1943.

Dipodomys deserti deserti, Hardy, Ecol. Monogr., 15:103, January, 1945; Durrant and Setzer, Bull. Univ. Utah, 35 (no. 26):9, June 30, 1945.

Range.—Known only from Beaverdam Wash in extreme southwestern Washington County. See figure 43.

Description and comments.—Average and extreme measurements of 4 adult males and measurements of 2 adult females, numbers 4015 and 4100, from Beaverdam Wash are, respectively, as follows: Total length, 331 (332-328), 318, 307; length of tail, 196 (201-193), 182, 166; length of hind foot, 55 (57-53), 51, 58. Color: Upper parts Pinkish Buff with slight suffusion of light brown; sides and flanks Pinkish Buff; tail brush brown, tipped with white "flag"; dorsal stripe of tail light brown, ventral stripe of tail nearly obliterated, being noticeable in only 3 of the 15 skins examined; middorsal skin gland prominent; cheeks, supraorbital and postauricular spots, hip stripes, front legs, dorsal surface of hind feet, lateral stripes of tail and entire underparts white. Skull: Large.

These animals can be easily distinguished from all other kinds of kangaroo rats known to occur in Utah by markedly larger size and long tail with a white "flag".

These large, pallid kangaroo rats remained undetected for a long time in Utah and were first reported upon by Durrant (1943: 404). Their distribution is of interest in that they have never been taken above the narrows of the Virgin River, where the river traverses the Beaverdam Mountains. This restriction of range was suspected by Durrant (*loc. cit.*) and was substantiated by later trapping above the narrows by Ross Hardy. Within their limited range in Utah, these animals are found only in the bottoms of the washes in areas of loose, shifting sand. This restriction of habitat is interesting when one considers that the bottom of the wash is sometimes inundated. As observed on May 5, 1941, the wash was inundated from bank to bank. During such periods the habitat would be completely devoid of animals. Undoubtedly many of these kangaroo rats perish, while some escape to higher ground during these floods. This flooding, at least annually, probably accounts for the paucity of these kangaroo rats in Beaverdam Wash.

Specimens examined.—Total, 15, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 1; "near" Ed Terry Ranch on Beaverdam Wash, 5 (R.H.); Beaverdam Wash, 4 (R.H.); Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,600 ft., 5.

TABLE 13

Cranial Measurements of Dipodomys

Sex	Catalog number or number of individuals averaged	Basilar length	Occipitonasal length	Length of nasals	Interorbital breadth	Length of bulla	Width of bulla	Depth of bulla
		Dipodomys ordii celeripes, topotypes						
♂	4 av.	24.5	31.5	12.65	11.45	14.1	9.6	11.9
♂	Max.	24.5	31.5	14.1	12.4	15.4	10.0	12.5
♂	Min.	.....	.....	11.0	10.7	14.0	9.2	11.5
♀	1954	24.0	30.9	13.2	12.3	15.3	10.3	.....
♀	1957	22.3	29.0	12.0	11.8	15.0	9.8	12.0
		Dipodomys ordii utahensis, topotypes						
♂	699 BYU	22.7	30.0	13.1	11.0	14.3	9.5	11.8
♂	698 BYU	24.5	32.2	14.0	12.1	15.0	10.1	12.0
♂	695 BYU	23.7	31.0	14.1	11.9	14.3	9.3	11.7
♀	700 BYU	23.0	.....	.....	11.4	13.9	9.4	11.9
♀	701 BYU	22.8	29.8	12.8	11.2	14.5	9.9	11.7
		Dipodomys ordii marshalli, Stansbury Island						
♂	2968	23.4	30.5	13.1	12.0	14.6	9.0	12.0
♂	2969	23.0	30.1	13.0	.....	14.9	10.2	12.2
♀	2971	22.8	30.2	13.6	11.9	15.1	9.9	12.2
♀	2972	23.1	30.2	13.2	11.9	15.1	9.9	12.2
		Dipodomys ordii cineraceus, Dolphin Island						
♀	263893 USNM	23.0	30.6	13.7	11.5	14.6	10.2	11.8
♀	263894 USNM	23.6	30.8	13.5	12.0	15.0	10.2	12.0
		Dipodomys ordii priscus, topotypes						
♂	89109 MVZ	24.4	31.4	13.4	13.0	15.3	10.8	12.8
♂	89115 MVZ	25.0	32.3	14.5	13.1	15.5	10.5	12.7
♂	89117 MVZ	25.1	32.5	14.5	12.4	15.9	10.5	13.1
♀	4 av.	25.1	32.4	14.5	12.9	15.9	10.4	12.9
♀	Max.	25.6	32.8	15.0	13.1	16.4	10.8	13.0
♀	Min.	24.7	32.1	14.4	12.2	15.4	10.1	12.8
		Dipodomys ordii pallidus, topotypes						
♂	7 av.	23.1	30.4	13.5	11.9	15.2	9.7	12.1
♂	Max.	23.4	31.0	13.9	12.0	15.7	10.1	12.3
♂	Min.	22.6	29.4	12.8	11.7	14.8	9.0	11.9
♀	3528	.....	.....	12.6	12.1	15.1	10.0	12.2
♀	3541	23.5	30.7	13.0	11.5	14.8	9.6	12.0
		Dipodomys ordii uintensis, topotypes						
♂	11631 CM	24.7	32.1	14.1	.....	15.9	10.1	12.3
♂	11634 CM	24.0	31.2	13.8	12.9	15.1	9.9	12.2
♂	11640 CM	24.2	31.3	13.2	.....	15.5	10.1	12.5

TABLE 13.—*Continued*

Sex	Catalog number or number of individuals averaged	Basilar length	Occipitonasal length	Length of nasals	Interorbital breadth	Length of bulla	Width of bulla	Depth of bulla
		Dipodomys ordii sanrafaeli, 12 mi. SW Greenriver						
♂	15649 CM	25.1	33.0	14.1	.....	16.4	10.7	13.1
♀	15647 CM	25.1	32.2	13.5	.....	16.9	10.5	13.1
		Dipodomys ordii nexilis, Naturita, Colorado						
♂	149940 USNM	24.5	31.6	13.9	11.4	16.0	10.6	12.9
		Dipodomys ordii fetosus, Panaca, Nevada						
♂	6 av.	23.8	30.9	13.6	11.8	15.2	10.2	12.3
♂	Max.	24.0	31.1	14.3	12.2	15.7	10.5	12.4
♂	Min.	23.5	30.6	12.8	11.6	14.9	10.0	12.1
♀	10 av.	22.5	29.4	12.9	11.6	14.7	9.9	12.0
♀	Max.	23.4	30.3	13.5	12.8	15.4	10.6	12.3
♀	Min.	21.6	28.3	12.2	10.9	14.1	9.3	11.2
		Dipodomys ordii fremonti, topotypes						
♀	15660 CM	23.5	30.6	13.8	.....	15.0	9.8	.....
♀	15661 CM	23.1	30.3	13.4	12.1	14.7	9.6	12.1
		Dipodomys ordii cinderensis, topotypes						
♂	8 av.	22.9	30.0	13.2	11.5	15.0	9.8	12.2
♂	Max.	23.4	31.3	14.0	11.7	15.5	10.2	12.7
♂	Min.	22.0	29.0	12.6	11.3	14.3	9.0	11.6
♀	2689 RH	22.0	28.9	12.7	.....	14.5	9.1	11.7
♀	2704 RH	.....	.....	12.8	.....	14.7	9.2	12.0
		Dipodomys ordii panguitchensis, topotypes						
♂	2151 RH	23.0	30.2	13.3	12.0	14.4	9.7	12.2
♂	2152 RH	23.0	30.4	13.5	11.9	14.3	9.5	12.0
♀	2153 RH	22.8	29.6	12.7	11.3	14.0	9.0	11.9
		Dipodomys ordii cupidineus, 1 mi. S Kanab						
♂	4382	23.6	31.2	12.7	12.0	15.4	10.0	12.7
♀	2044 BYU	24.2	31.5	13.6	12.0	16.0	10.2	12.7
♀	2045 BYU	23.5	30.4	13.1	12.3	15.7	10.4	12.3
		Dipodomys ordii longipes, Johns Canyon ♂♂; 1 mi. N Bluff ♀♀						
♂	1204	.....	.....	13.9	.....	17.1	10.6	13.6
♂	1205	24.4	32.1	13.8	12.1	16.0	10.4	12.6
♀	5 av.	23.9	31.3	13.9	12.84	16.5	10.2	12.9
♀	Max.	24.5	31.7	15.0	13.4	16.8	10.6	13.0
♀	Min.	23.4	31.0	13.2	12.5	16.1	10.0	12.8

TABLE 13.—*Concluded*

Sex	Catalog number or number of individuals averaged	Basilar length	Occipitonasal length	Length of nasals	Interorbital breadth	Length of bulla	Width of bulla	Depth of bulla
		Dipodomys microps bonnevillei, Desert Range Experiment Station						
♂	17 av.	24.1	29.6	12.05	11.6	14.6	9.9	12.15
♂	Max.	25.3	31.1	13.1	12.3	15.7	10.5	12.8
♂	Min.	22.3	27.7	10.8	10.6	13.4	9.2	11.5
♀	15 av.	24.1	29.7	12.0	11.4	14.7	9.8	12.25
♀	Max.	25.0	30.5	12.8	12.3	15.6	10.1	12.9
♀	Min.	23.2	28.7	11.3	10.8	13.5	9.2	11.6
		Dipodomys microps alfredi, topotypes						
♂	2999 CMNH	24.0	29.6	11.8	11.5	14.8	10.0	12.3
♂	3002 CMNH	27.5	33.6	13.9	12.8	16.7	11.0	13.0
♀	2996 CMNH	25.7	32.0	12.8	12.0	15.7	10.5	12.5
♀	3003 CMNH	25.7	32.0	13.0	12.9	16.1	10.7	12.6
		Dipodomys microps celsus, 1 mi. W St. George						
♂	3181	23.8	29.9	11.9	11.3	15.0	10.2	12.5
♂	3182	24.0	30.0	12.9	10.6	15.1	10.0	12.0
♂	3185	25.6	31.4	13.4	12.2	15.6	10.2	12.5
♀	3183	24.9	30.8	12.6	11.4	15.2	10.2	12.6
♀	3184	24.1	30.1	12.4	11.6	15.4	10.0	12.4
♀	3186	.....	.....	13.0	11.0	14.5	9.7	11.9
		Dipodomys microps woodburyi, topotypes						
♂	4 av.	25.4	31.7	13.45	12.05	15.4	10.4	12.45
♂	Max.	26.1	32.3	14.4	12.6	15.5	10.7	12.8
♂	Min.	25.1	31.1	13.0	11.5	15.2	10.1	12.0
♀	2168 RH	26.4	32.5	13.5	13.0	16.1	11.1	13.1
		Dipodomys merriami vulcani, 3 mi. SW St. George						
♂	6 av.	22.5	29.5	13.3	13.05	15.1	10.0	11.8
♂	Max.	23.0	30.1	13.9	14.0	15.4	10.4	11.8
♂	Min.	22.0	29.0	12.6	12.6	14.6	9.6	11.8
♀	3189	.....	.....	13.4	13.2	14.7	9.6	11.0
♀	3198	.....	.....	13.9	13.8	16.1	10.2	12.0
♀	3202	22.4	29.6	13.4	13.0	15.0	10.1	11.7
		Dipodomys merriami merriami, Beaverdam Slope						
♂	6 av.	22.6	29.7	13.2	13.2	15.2	10.1	11.8
♂	Max.	22.9	29.9	13.6	13.9	15.8	10.2	12.0
♂	Min.	22.4	29.4	12.9	13.0	14.8	9.9	11.5
♀	420 DJC	22.9	29.9	13.5	13.4	15.6	10.3	12.0
♀	2206 RH	21.5	29.0	12.7	12.7	15.2	10.2	11.9
		Dipodomys deserti deserti, Beaverdam Wash						
♂	4 av.	28.9	38.9	16.5	13.5	18.9	13.9	14.5
♂	Max.	29.0	41.0	17.0	14.1	19.5	14.0	14.9
♂	Min.	28.7	36.8	16.3	12.7	18.1	13.2	14.2
♀	4015	28.6	37.1	16.1	14.3	19.7	13.6	14.9
♀	4100	29.0	37.2	16.1	14.0	19.9	13.6	14.8

Family CASTORIDAE

Beavers

The beaver is the largest living rodent of North America, and a valuable fur bearer. Characteristic anatomical features are: Pelage with dense underfur sharply distinct from overhairs; ears small, valvular and hidden in pelage; eyes small; hind feet large and fully webbed; tail paddle-shaped, scaly, and flattened dorsoventrally; rostrum broad and deep; postorbital processes lacking; infraorbital foramina smaller than incisive foramina; braincase angular and narrow; basioccipital with deep depression on ventral surface; auditory bullae large; auditory tube long; angular process of mandible rounded; cheek teeth hypsodont with alternating bands of enamel and dentine on occlusal surface; dental formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{1}{1}$, m.$\frac{3}{3}$.

This family is represented in Utah by four subspecies of *Castor canadensis.*

Castor canadensis pallidus Durrant and Crane

Beaver

Castor canadensis pallidus Durrant and Crane, Univ. Kansas Publ. Mus. Nat. Hist., 1:409, December 24, 1948, type from Lynn Canyon, 7,500 feet, Boxelder County, Utah.

Range.—Raft River Mountains, in extreme northwestern Utah.

Description and comments.—Measurements of the type, a female, are as follows: Total length, 1040; length of tail, 380; length of hind foot, 157; length of ear, 35. Size small, tail and hind feet short. Color: Pale; upper parts uniformly Light Buff, grading to Light Ochraceous-Buff at base of tail; underfur Light Drab; front and hind feet Light Ochraceous-Buff. Skull: Rostrum short; nasals broad (breadth averaging 54 per cent of length), constricted posteriorly and not extending posteriorly beyond the premaxillae; zygomatic arches robust and not widely flaring (zygomatic breadth 77 per cent of basilar length); mastoid breadth averaging 73 per cent of zygomatic breadth; anterolateral margin of orbit narrow, 6.2; occipital condyles visible from dorsal view; condylobasal length greater than occipitonasal length; coronoid process high and wide; upper incisors narrow and Orange Chrome in color; cheek teeth narrow.

From topotypes and near topotypes of *Castor canadensis taylori, C. c. pallidus* differs as follows: Size smaller, tail and hind foot shorter. Color: Markedly lighter throughout. Skull: Nasals shorter and wider (breadth of nasals averages 54 per cent of length of nasals as opposed to 46 per cent); posterior ends of nasals not projecting beyond premaxillae; rostrum shorter; zygomatic breadth relative to basilar length less; mastoid breadth actually as well as relatively greater; interorbital breadth greater; occipitonasal length

shorter rather than longer than condylobasal length; tympanic bullae smaller; coronoid process higher and wider; cheek teeth narrower.

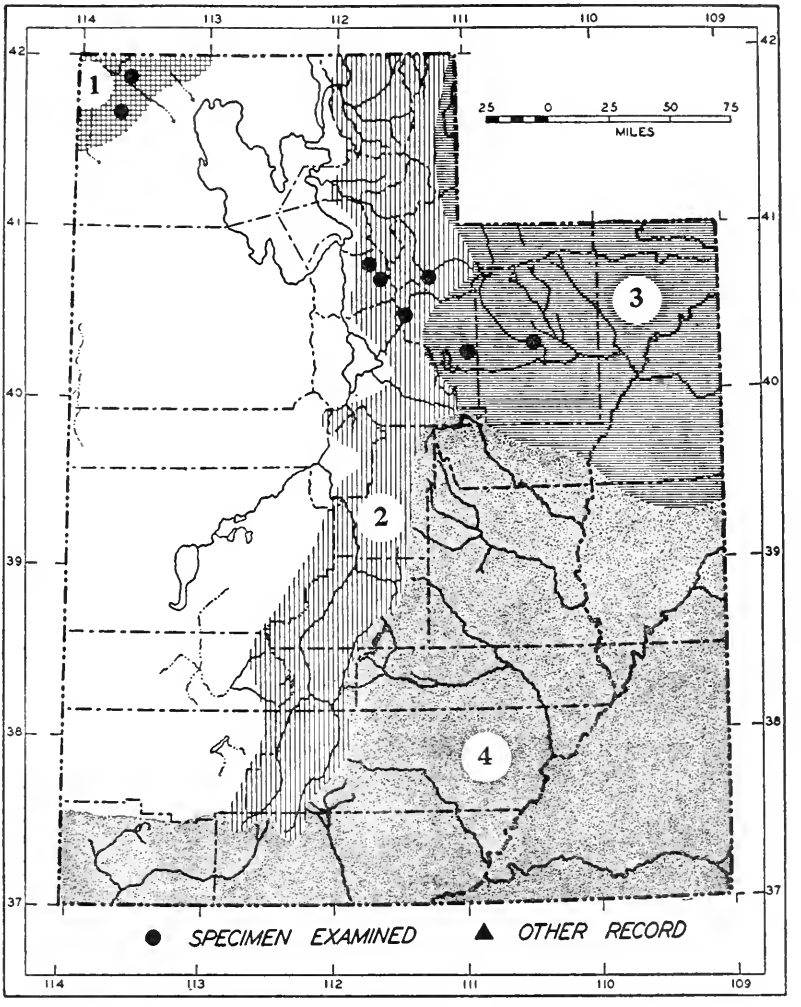

FIG. 45. Distribution of *Castor canadensis*.
1. *C. c. pallidus*.
2. *C. c. rostralis*.
3. *C. c. duchesnei*.
4. *C. c. repentinus*.

From specimens of *Castor canadensis baileyi* from 20 miles north northwest of Elko, Elko County, Nevada, *C. c. pallidus* differs as follows: Size smaller; tail longer; hind foot shorter; ear shorter. Color: Markedly lighter throughout. Skull: Larger; nasals shorter

and broader (breadth of nasals averages 54 per cent of length of nasals as opposed to 41 per cent); posterior ends of nasals not projecting beyond premaxillae; rostrum broader; zygomatic breadth relative to basilar length less; mastoid breadth actually as well as relatively greater; occipitonasal length less rather than greater than condylobasal length; tympanic bullae smaller; coronoid process higher and wider; cheek teeth narrower.

From one topotype and two other specimens from the Colorado River, at Yuma County, Arizona, of *Castor canadensis repentinus*, *C. c. pallidus* differs as follows: Tail and hind foot shorter. Color: Lighter throughout. Skull: Narrower; nasals shorter and wider (breadth of nasals averages 54 per cent of length of nasals as opposed to 47 per cent); posterior ends of nasals not projecting beyond premaxillae; rostrum shorter; zygomatic breadth relative to basilar length less; mastoid breadth actually as well as relatively greater; tympanic bullae narrower and smaller; coronoid process higher and wider; cheek teeth narrower.

From one specimen from Trappers Lake, Garfield County, Colorado, and from the original description (Warren and Hall, 1939: 358) of *Castor canadensis concisor*, *C. c. pallidus* differs as follows: Size smaller. Color: Markedly lighter throughout. Skull: Smaller, narrower; nasals shorter and broader (breadth of nasals averages 54 per cent of length of nasals as opposed to 48 per cent); rostrum shorter; zygomatic breadth relative to basilar length less; mastoid breadth relative to zygomatic breadth greater; tympanic bullae narrower and smaller; jugals narrower; distal end of meatal tube smaller; coronoid process shorter and wider; angular process of mandible shorter and rounded rather than nearly pointed; cheek teeth narrower.

From the type and near topotypes of *Castor canadensis rostralis*, *C. c. pallidus* differs as follows: Size smaller; tail and hind foot shorter. Color: Markedly lighter throughout. Skull: Smaller, and narrower; rostrum shallower and narrower; posterior ends of nasals more constricted and not projecting beyond premaxillae; zygomatic breadth relative to basilar length less; mastoid breadth actually as well as relatively greater; dorsal end of lacrimal larger; tympanic bullae narrower; coronoid process higher and wider; angular process not projecting so far caudad; cheek teeth narrower.

From the type and near topotypes of *Castor canadensis duchesnei*, *C. c. pallidus* differs as follows: Size smaller; tail and hind foot shorter. Color: Lighter throughout. Skull: Narrower and less

massive; nasals shorter and broader (breadth of nasals relative to length of nasals averages 54 per cent as opposed to 46 per cent); posterior ends of nasals not projecting beyond premaxillae; rostrum shorter and narrower; zygomatic breadth relative to basilar length less; mastoid breadth actually as well as relatively greater; tympanic bullae narrower and smaller; coronoid process higher and wider; angular process not projecting so far caudad; cheek teeth narrower.

The Raft River Mountains of extreme northwestern Utah, where *C. c. pallidus* occurs, are the only mountains of the state within the drainage of the Snake River. The Snake River proper lies 50 miles to the northward in Idaho and contains another kind of beaver, *C. c. taylori* (Davis, 1939:273). Although occurring within the same drainage as *C. c. taylori, C. c. pallidus* is as distinct from it as from any other named kind. The relationships of *C. c. pallidus,* as indicated by the short rostrum and short, wide nasals, are rather with *C. c. rostralis* of the Wasatch Mountains, than with *C. c. taylori.*

The pale color of the animals belonging to *C. c. pallidus* was noted at the time of capture and is the same in mature and young individuals.

Specimens examined.—Total, 2, distributed as follows: *Boxelder County:* Raft River, 5 mi. S Yost, Raft River Mountains, 6,000 ft., 1; Lynn Canyon, Raft River Mountains, 7,500 ft., 1.

Castor canadensis rostralis Durrant and Crane

Beaver

Castor canadensis rostralis Durrant and Crane, Univ. Kansas Publ. Mus. Nat. Hist., 1:411, December 24, 1948, type from Red Butte Canyon, Fort Douglas, 5,000 feet, Salt Lake County, Utah.

Castor fiber, Allen, Bull. Essex Inst., 6:65, 1874.

Castor (*Fiber* var. ?) *canadensis,* Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:123, 1875.

Castor canadensis frondator, Barnes, Bull. Univ. Utah, 12 (no. 15):61, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):108, June, 1927.

Castor canadensis subsp., Long, Journ. Mamm., 21:177, May 16, 1940.

Range.—Known from western streams of Wasatch Mountains, probably occurs in all streams draining westward into the Bonneville Basin.

Description and comments.—Measurements of the type, a male, are as follows: Total length, 1330; length of tail, 470; length of hind foot, 170; length of ear, 34. Size large, tail and hind foot long. Color: Upper parts Snuff Brown, purest on head; underfur Blackish Brown (2); base of tail Cinnamon-Buff; hind feet Carob Brown; ears Blackish-Brown (2); under-

parts Auburn, grading posteriorly to Cinnamon-Buff; underfur Light Drab. Skull: Large, massive; nasals short and broad (breadth averaging 54 per cent of length) and moderately convex transversely; rostrum deep and broad; dorsal end of lacrimal bone (between frontal and jugal) small; frontal region generally flat; zygomatic arches heavy and widely spreading (zygomatic breadth averaging 82 per cent of basilar length); ventral surface of rostrum moderately concave dorsally.

From topotypes and near topotypes of *Castor canadensis taylori*, *C. c. rostralis* differs as follows: Color: Darker dorsally owing to darker underfur, guard hairs actually lighter. Skull: Longer; nasals shorter and wider (breadth of nasals relative to length of nasals averages 54 per cent as opposed to 47 per cent); extension of nasals posterior to premaxillae less; rostrum shorter, broader and deeper; dorsal end of lacrimal bone smaller; zygomatic breadth relative to basilar length greater; mastoid breadth relative to zygomatic breadth less; coronoid process shorter; space between coronoid and condyloid processes wider and shallower.

From one topotype and two specimens from the Colorado River, at Yuma, Yuma County, Arizona, of *Castor canadensis repentinus*, *C. c. rostralis* differs as follows: Size larger; tail longer. Color: Darker throughout. Skull: Longer; nasals shorter and wider (breadth of nasals relative to length of nasals averages 54 per cent as opposed to 47 per cent); extension of nasals posterior to premaxillae less; rostrum shorter, deeper and wider; zygomatic breadth relative to basilar length greater; mastoid breadth actually as well as relatively greater; dorsal end of lacrimal bone smaller; space between coronoid and condylar processes wider and shallower.

From specimens of *Castor canadensis baileyi* from 20 miles north northwest of Elko, Elko County, Nevada, *C. c. rostralis* differs as follows: Size larger; tail and hind foot longer. Color: Darker throughout. Skull: Larger in all measurements taken; nasals markedly broader (breadth of nasals relative to length of nasals averages 54 per cent as opposed to 41 per cent); extension of nasals posterior to premixallae less; dorsal end of lacrimal bone smaller; mastoid breadth relative to zygomatic breadth less.

From one specimen from Trappers Lake, Garfield County, Colorado, and from the original description of *Castor canadensis concisor*, *C. c. rostralis* differs as follows: Color: Guard hairs lighter; dorsal underfur darker (blackish as opposed to brownish). Skull: Longer and narrower; nasals broader and shorter (breadth of

nasals relative to length of nasals averages 54 per cent as opposed to 48 per cent); dorsal end of lacrimal bone smaller; distal end of meatal tube smaller; distal end of angular process rounded rather than pointed; coronoid process shorter; space between coronoid and condylar processes wider and shallower.

Among known kinds of *Castor canadensis, C. c. rostralis* is more like *C. c. duchesnei* from which the former differs as follows: Tail and hind foot longer. Color: Darker throughout. Skull: Nasals shorter and broader (breadth of nasals relative to length of nasals averages 54 per cent as opposed to 46 per cent); nasals less arched transversely; rostrum shorter, deeper and broader; ventral surface of rostrum less concave dorsally; dorsal end of lacrimal bone smaller.

For comparison of *C. c. rostralis* with *Castor canadensis pallidus,* see account of the latter subspecies.

Animals from Kamas in the drainage of the Weber River are intergrades between *C. c. rostralis* and *C. c. duchesnei,* but their short, wide nasals and wide rostra make them referable to *C. c. rostralis.*

The available specimens of *C. c. rostralis* are all from streams which ultimately empty into Great Salt Lake which is in the northern part of the basin of Pleistocene Lake Bonneville. No animals are available from streams which drain into the Bonneville Basin, but which do not empty into Great Salt Lake. I suspect, however, that when they become known they will prove to be related to this subspecies.

Specimens examined.—Total, 17, distributed as follows: *Salt Lake County:* Red Butte Canyon (Creek), Fort Douglas, 5,000 ft., 2; Millcreek Canyon, 6 mi. above mouth, 7,000 ft., 1. *Summit County:* Kamas, 5,500 ft., 6. *Wasatch County:* Charleston, Heber Valley, 5,500 ft., 8.

Castor canadensis duchesnei Durrant and Crane

Beaver

Castor canadensis duchesnei Durrant and Crane, Univ. Kansas Publ. Mus. Nat. Hist., 1:413, December 24, 1948, type from Duchesne River, 10 miles northwest of Duchesne, 5,600 feet, Duchesne County, Utah.

Castor canadensis frondator, Barnes, Bull. Univ. Utah, 12 (no. 15):61, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):108, June, 1927, Svihla, Journ. Mamm., 12:262, August 24, 1931.

Range.—Drainage of the Duchesne and White rivers and the Green River north of the Tavaputs Plateau.

Description and comments.—Measurements of the type, a young male, are as follows: Total length, 1176; length of tail, 458; length of hind foot, 165;

length of ear, 33. Size large, tail long. Color: Upper parts Sayal Brown, purest on head, grading to Cinnamon-Buff at base of tail; underfur Fuscous; hind feet Burnt Umber; ears Fuscous-Black; underparts Tawny-Olive; underfur Smoke Gray. Skull: Large, massive; nasals long, slender (breadth averaging 46 per cent of length) and markedly convex transversely; rostrum long and attenuate; zygomatic arches heavy and widely spreading (zygomatic breadth averaging 81:5 per cent of basilar length); ventral surface of rostrum markedly concave dorsally; posterior ends of nasals extend posterior to premaxillae.

From topotypes and near topotypes of *Castor canadensis taylori*, *C. c. duchesnei* differs as follows: Color: Guard hairs lighter; underfur darker. Skull: Nasals narrower and rostrum narrower; mastoid breadth relative to zygomatic breadth less; zygomatic breadth relative to basilar length greater; tympanic bullae narrower and smaller; cheek teeth narrower.

From specimens of *Castor canadensis baileyi*, from 20 miles north northwest of Elko, Elko County, Nevada, *C. c. duchesnei* differs as follows: Size larger; tail and hind foot longer. Color: Guard hairs lighter; underfur darker. Skull: Larger in all measurements taken; nasals broader and longer (breadth of nasals relative to length of nasals averages 46 per cent as opposed to 41 per cent); rostrum broader and longer; mastoid breadth relative to zygomatic breadth less; tympanic bullae larger.

From one specimen from Trappers Lake, Garfield County, Colorado, and from the original description of *Castor canadensis concisor*, *C. c. duchesnei* differs as follows: Color: Lighter throughout. Skull: Nasals more convex transversely; rostrum narrower; ventral border of rostrum more concave dorsally; distal end of meatal tube smaller; angular processes shorter and rounded rather than pointed; cheek teeth smaller.

Among named subspecies of *Castor canadensis*, *C. c. duchesnei* is most like *C. c. repentinus*, but differs from the latter as follows: Size larger, hind foot shorter. Color: Darker throughout. Skull: Basilar length less; mastoid breadth greater; nasals shorter and narrower; extension of nasals posterior to premaxillae less; nasals more convex transversely; cheek teeth smaller.

For comparisons of *C. c. duchesnei* with *Castor canadensis pallidus* and *Castor canadensis rostralis*, see accounts of those subspecies.

The extent of the range of *C. c. duchesnei* within the drainage of the White River is not definitely known. Three animals from 9½ miles southwest of Pagoda Peak, Rio Blanco County, Colorado, from the drainage of the White River, appear to be intergrades between *C. c. concisor* and *C. c. duchesnei*. They are like the latter in shape and length of the nasals, less expanded distal end of

the meatal tube and the rounded angular process, and it appears best pending the acquisition of more material to refer them to *C. c. duchesnei.* Another specimen, number 2090 (K. U.), from Trappers Lake, Garfield County, Colorado, at the headwaters of the White River, and only 16 miles distant from the locality of capture of the three aforementioned animals, however, is referable to *C. c. concisor.* Relying upon the original description (Warren and Hall, 1939:358) this animal is like *C. c. concisor* in size and shape of the jugals, in size of the distal end of the meatal tube and in the pointed end of the angular process. Warren and Hall (*loc. cit.*) noted that animals assignable to *C. c. concisor* occurred throughout the mountainous parts of Colorado, and recorded them from the headwaters of nearly all of the major rivers in the state. Apparently *C. c. concisor* also occurs in the headwaters of the White River, while the main part of the river is inhabited by animals referable to *C. c. duchesnei.*

Specimens examined.—Total, 12, distributed as follows: *Wasatch County:* Currant Creek, Strawberry Valley, 6,000 ft., 11. *Duchesne County:* Duchesne River, 10 mi. NW Duchesne, 5,600 ft., 1.

Castor canadensis repentinus Goldman

Beaver

Castor canadensis repentinus Goldman, Journ. Mamm., 13:266, August 9, 1932, type from Bright Angel Creek, Grand Canyon of the Colorado River, 4,000 feet, Arizona; Presnall, Zion-Bryce Mus. Bull., 2:14, January, 1938.
Castor canadensis frondator, Barnes, Bull. Univ. Utah, 12 (no. 15):61, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):108, June, 1927; Tanner and Hayward, Proc. Utah Acad. Sci. Arts and Letters, 11:215, 1934.

Range.—Drainage of the Colorado and Green Rivers south of the Tavaputs Plateau.

Description and comments. — Measurements of an adult female, number 111614 (U. S. N. M.), from the type locality are as follows: Total length, 1000; length of tail, 390; length of hind foot, 176. Color: Upper parts yellowish cinnamon purest on rump and base of tail; underfur Mars Brown; sides and cheeks Pinkish Cinnamon; underparts pale Cinnamon-Buff; midventral region Mikado Brown; anal region Hazel. Skull: Nasals long; extension of nasals posterior to premaxillae long; jugal nearly verical at postorbital region; occipitonasal length less than condylobasal length.

For comparisons with other subspecies of *Castor canadensis* known to occur in Utah, see accounts of those subspecies.

I know of no specimens of this subspecies from Utah. The sole reference is that of Presnall (1938:14). Since the type locality is but a short distance south of Utah in Arizona and on the Colorado River, its appears logical that the part of Utah in the Colorado River drainage is inhabited by animals referable to *C. c. repentinus.*

TABLE 14

Cranial Measurements of Castor

Sex	Catalog number	Occipitonasal length	Basilar length	Mastoid breadth	Interorbital breadth	Length of nasals	Zygomatic breadth	Width of nasals	Alveolar length of upper molariform tooth-row
		Castor canadensis pallidus, type							
♀	719.....	129.1	116.6	65.6	23.6	43.3	89.7	23.4	30.4
		Castor canadensis rostralis, type, topotype							
♂	5199 type.....	128.2	112.4	62.5	27.9	44.9	91.3	24.7	28.3
♂	2563.....	136.6	119.6	66.9	24.0	50.2	95.1	25.1	30.1
		Castor canadensis duchesnei, type							
♂	4625.....	123.6	98.6	60.4	23.0	46.1	88.3	20.5	28.9
		Castor canadensis repentinus, topotype							
♀	111614 USNM	129.1	118.0	61.3	24.0	51.0	97.5	24.1	30.4

Family CRICETIDAE

Native Rats and Mice

Small to medium-sized rodents, highly diversified morphologically, and exhibiting a wide range of adaptive radiation. Features common to all members are broad, oblique zygomatic plates; lack of postorbital processes of the frontals; infraorbital foramina slitlike, V-shaped, wider at top than bottom; one division of masseter muscle traverses the infraorbital foramina to insert on side of rostrum; tooth formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{0}{0}$, m.$\frac{3}{3}$.

In Utah, this family is represented by two subfamilies, namely, Cricetinae and Microtinae. The subfamily Cricetinae is represented by the genus *Reithrodontomys* with 3 subspecies belonging to one species; the genus *Peromyscus* with 14 subspecies belonging to 6 species; the genus *Onychomys* with 4 subspecies belonging to 2 species and the genus *Neotoma* with 13 subspecies belonging to 5 species. The subfamily Microtinae is represented by the genus *Clethrionomys* with a single kind; the genus *Ondatra* with 2 kinds belonging to one species; the genus *Phenacomys* with one kind; the genus *Microtus* with 11 kinds belonging to 5 species and the genus *Lagurus* with 2 kinds belonging to a single species.

KEY TO THE NATIVE RATS AND MICE OF UTAH

1.–Cheek teeth cusped, occlusal areas devoid of dentine lakes surrounded by enamel.

2.–Tail never more than 60 per cent of length of head and body; coronoid process of mandible high.

3.–Tail less than ½ length of body; upper third molar as long as broad; upper first molar less than ½ length of tooth-row, *Onychomys leucogaster*, p. 324

3′.–Tail usually more than ½ length of body; upper third molar broader than long; upper first molar more than ½ length of tooth-row ..... *Onychomys torridus*, p. 329

2′.–Tail always more than 60 per cent of length of head and body; coronoid process of mandible low.

4.–Length of head and body never more than 80; upper incisors grooved ..... *Reithrodontomys megalotis*, p. 295

4′.–Length of head and body generally more than 80; upper incisors not grooved.

5.–Total length 185 or less.

6.–Tail usually tufted; more than 90 per cent of length of head and body; fur long and soft; maxillary breadth no more than 11..... *Peromyscus crinitus*, p. 299

6′.–Tail not tufted; less than 90 per cent of length of head and body; fur of average length; maxillary breadth more than 11.... *Peromyscus maniculatus*, p. 307

5′.–Total length 185 or more.

7.–Length of ear less than hind foot.

8.–Plantar surface of hind foot naked; mammae inguinal; premaxillae extend proximad of posterior ends of nasals.. *Peromyscus eremicus*, p. 305

8′.–Plantar surface of hind foot haired; mammae inguinal and pectoral; premaxillae never extend proximad of ends of nasals, *Peromyscus boylii*, p. 317

7′.–Length of ear greater than hind foot.

9.–Bullae large and inflated; color fulvous or grayish above..... *Peromyscus truei*, p. 320

9′.–Bullae medium, not markedly inflated; color blackish and grayish above, *Peromyscus nasutus*, p. 323

1′.–Cheek teeth non-cusped; occlusal areas consist of dentine lakes surrounded by enamel.

10.–Hair on ears sparse; ear 65 per cent as long as hind foot; posterior margins of upper first and second molars rounded.

11.–Tail bushy, not bicolored..... *Neotoma cinerea*, p. 344

11′.–Tail round, never bushy; usually bicolored.

12.–Anterointernal re-entrant angle of first upper molar extending more than half way across anterior lobe, *Neotoma mexicana*, p. 336

12′.–Anterointernal re-entrant angle of first upper molar never extending more than half way across anterior lobe.

13.–Hair on throat and chest completely white; not everywhere plumbeous basally ..... *Neotoma albigula*, p. 334

13'.–Hair on throat and chest not completely white; usually plumbeous basally.

14.–Color usually pinkish buff; tail sharply bicolored; hair on tail short ..... *Neotoma lepida*, p. 337

14'.–Color ochraceous or yellowish; tail not sharply bicolored; hair on tail of moderate length, *Neotoma stephensi*, p. 344

10'.–Hair on ears dense; ear 65 per cent as long as hind foot; posterior margins of upper first and second molars not rounded.

15.–Size large; tail scaly and compressed laterally, *Ondatra zibethica*, p. 356

15'.–Size small; tail haired and round.

16.–Outer re-entrant angles of molars shallower than inner, *Phenacomys intermedius*, p. 360

16'.–Outer and inner re-entrant angles of nearly equal depth.

17.–Molars rooted; middorsal region reddish, *Clethrionomys gapperi*, p. 355

17'.–Molars rootless; middorsal region not reddish.

18.–Tail short, approximately same length as hind foot; tympanic bullae cancellous; color light grayish; lower third molar with 4 prisms, *Lagurus curtatus*, p. 379

18'.–Tail always markedly longer than hind foot; tympanic bullae noncancellous; color brown or black; lower third molar with 3 prisms.

19.–Tail long, more than 30 per cent of head and body.

20.–Size large; hind foot approximately 25 ..... *Microtus richardsoni*, p. 376

20'.–Size medium; hind foot approximately 22 ..... *Microtus longicaudus*, p. 371

19'.–Tail short, less than 30 per cent of head and body.

21.–Upper second molar with 4 closed angular sections and a rounded posterior loop; color blackish brown above, *Microtus pennsylvanicus*, p. 362

21'.–Upper second molar with 4 closed angular sections, but no posterior loop; color gray, brown or grayish brown above.

22.–Incisive foramina not constricted posteriorly, *Microtus mexicanus*, p. 375

22'.–Incisive foramina constricted posteriorly, *Microtus montanus*, p. 363

Reithrodontomys megalotis megalotis (Baird)

Western Harvest Mouse

Reithrodon megalotis Baird, Mamm., N. America, p. 451, 1858, type from between Janos, Chihuahua, and San Luis Springs, Grant County, New Mexico.

Reithrodontomys megalotis megalotis, Howell, N. Amer. Fauna, 36:26, June 5, 1914 (part); Barnes, Bull. Univ. Utah, 12 (no. 15):67, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):113, June, 1927; Stanford, Journ. Mamm., 12:360, November 11, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:122, 1938; Presnall, Zion-Bryce Mus.

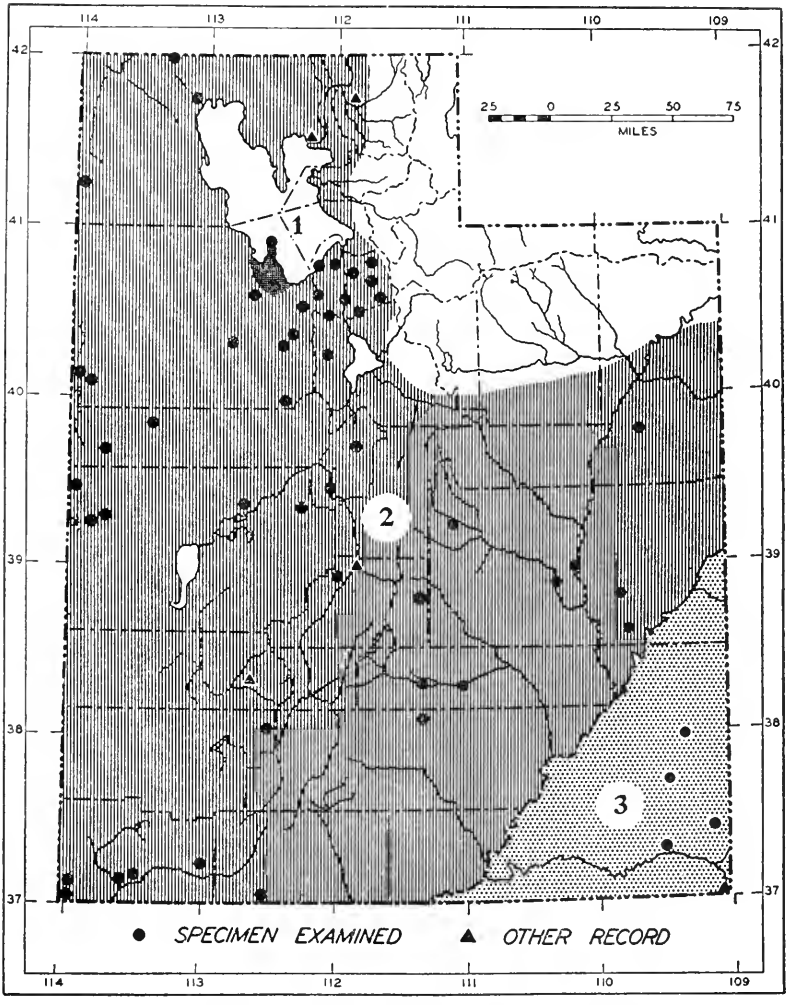

FIG. 46. Distribution of *Reithrodontomys megalotis*.
1. *R. m. ravus*. 2. *R. m. megalotis*. 3. *R. m. aztecus*.

Bull., 2:15, January, 1938; Long, Journ. Mamm., 21:177, May 16, 1940; Hardy, Ecol. Monogr., 15:84, January, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—All of Utah except that area occupied by *Reithrodontomys megalotis ravus,* and that area east of the Colorado River.

Description and comments.—Average and extreme measurements of 7 adult males and 4 adult females from St. John, Tooele County, are, respectively, as follows: Total length, 135 (143-126), 137 (155-128); length of tail, 62 (68-53), 62 (63-57); length of hind foot, 17 (19-16), 17 (18-17); length of ear, 14 (15-13), 15 (16-14). Color: Upper parts Pinkish Buff or Cinnamon-Buff, purest on cheeks, outer side of upper arms and flanks, moderately mixed with dark brown on top of head and middorsal region; ears brown, narrowly margined with white; sides of nose and chin white to base of hairs; remainder of underparts white, hairs plumbeous at base; hind feet, front feet and forearms, white; tail bicolored, dark brown above, white below. Skull: Small, delicate; interorbital constriction narrow; zygomatic arches weak and not widely spreading; palatal shelf approximately same length as incisive foramina; braincase well inflated but relatively narrow; tympanic bullae actually as well as relatively large (well inflated ventrally); alveolar length of upper molar series long.

Specimens of *R. m. megalotis* from Utah may be distinguished from topotypes of *Reithrodontomys megalotis ravus* as follows: Pelage with less admixture of gray; skull larger and relatively narrower; braincase more inflated; zygomatic arches weaker and less widely spreading; interorbital constriction narrower; tympanic bullae markedly larger; alveolar length of upper molar series longer.

Compared with specimens of *Reithrodontomys megalotis aztecus* from San Juan County, the above mentioned specimens of *R. m. megalotis* differ in lighter dorsal color and slightly smaller skull with shorter incisive foramina and palatal bridge.

With the exception of the range ascribed to *R. m. ravus, R. m. megalotis* occurs throughout the state west of the Colorado River. *R. m. megalotis* is extremely variable throughout this area and shows tendencies to form local populations.

Goldman (1939b:355) named *Reithrodontomys megalotis ravus* from animals from Stansbury Island, Great Salt Lake, and from limited areas of the adjacent mainland. I have seen part of the material upon which the original description was based. Unfortunately only one complete skull was available. This, however, is the skull of the specimen from Grantsville, the measurements of which were given by Goldman (*loc. cit.*). This single individual is readily distinguishable from the one hundred odd specimens of *R. m. megalotis* available for this study. Specimens from Salt Lake County were also placed with the subspecies *R. m. ravus* (Goldman, *loc. cit.*). Large series were available from the east shore of Great

Salt Lake and elsewhere in Salt Lake County. In contradiction to Goldman's observations, I can readily distinguish all these latter specimens from the skull of the single aforementioned individual of *R. m. ravus* from Grantsville. There are no discernible differences in the animals from northern Utah from those from elsewhere throughout the intrastate range. Color was also given as a diagnostic character. The specimens of *R. m. ravus*, as Goldman pointed out, are slightly more pallid because of greater admixture of gray. In almost every series taken throughout the entire range there are some variable individuals which exhibit this pallid coloration. I am not convinced, however, that more material would not show the animals described as *R. m. ravus* to be only a local varying population of *R. m. megalotis*. Therefore tentatively, owing to the lack of sufficient material, *R. m. ravus* is here retained as a subspecies.

Specimens from east of the Green River are intergrades between *R. m. megalotis* and *R. m. aztecus*. They are intermediate in color, but the shorter palatal bridge and incisive foramina show them to be more closely related to *R. m. megalotis* to which they are here referred.

Specimens examined.—Total, 204, distributed as follows:—*Boxelder County:* Standrod, Raft River Mountains, 5,500 ft., 2; Kelton, 4,225 ft., 1 (M.V.Z.); Utah-Nevada Line, E side Tecoma Range, 4,300 ft., 2. *Tooele County:* South Willow Creek, Stansbury Mountains, 7,500 ft., 2; Bauer, 4,500 ft., 3; St. John, 4,300 ft., 12; Clover Creek, Onaqui Mountains, 5,500 ft., 7; Orr's Ranch, Skull Valley, 4,300 ft., 2; Clifton Flat, 7 mi. SW Goldhill, 6,149 ft., 1; Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 6; Ibapah, 5,000 ft., 5; Little Valley, Sheeprock Mountains, 5,500 ft., 4. *Salt Lake County:* Lakeshore, 17 mi. W Salt Lake City, 4,320 ft., 24; 3 mi. W Salt Lake Airport, Salt Lake Valley, 4,250 ft., 8; alkali flat, 1½ mi. W S. L. Airport, U. S. Highway 40, 4,200 ft., 1; ½ mi. W S. L. Airport, U. S. Highway 40, 4,200 ft., 3; Salt Lake City, 5,000 ft., 3; Utah Copper Club, Salt Lake Valley, 4,250 ft., 2; 1½ mi. above mouth Parleys Canyon, 4,900 ft., 1; Emigration Canyon, 5 mi. E Salt Lake City, 1; 1 mi. W Herriman, 5,000 ft., 2; Rose Canyon, Oquirrh Mountains, 5,650 ft., 4; mouth Little Willow Creek, 5 mi. NE Draper, 5,000 ft., 2; seventh east st., 2 mi. N Draper, 4,500 ft., 1; 1 mi. W Draper, 4,500 ft., 1; 1½ mi. SW Draper, 4,500 ft., 2; 2 mi. SW Draper, 4,100 ft., 1; 3 mi. SW Draper, 4,400 ft., 3; Corner Canyon, near Draper Tunnel, 5,000 ft., 1; Beef Hollow, 3 mi. W Camp Williams, 6,000 ft., 2. *Utah County:* Fairfield, 4,800 ft., 2. *Uintah County:* Willow Creek, 25 mi. S Ouray, 5,250 ft., 5. *Juab County:* Fish Springs, 4,400 ft., 1; Nephi, 5,095 ft., 2 (M.V.Z.); Trout Creek, 4,600 ft., 1; 20 mi. SW Nephi, 1. *Millard County:* 1 mi. S Gandy, 5,000 ft., 4 (M.V.Z.); Oak Creek Canyon, 6 mi. E Oak City, 6,000 ft., 1; Hinckley, 4,600 ft., 3; White Valley, 60 mi. W Delta, 1; Robison Ranch, 17 mi. S Gandy, 5,300 ft., 3 (M.V.Z.); 5 mi. S Garrison, 5,400 ft., 13 (M.V.Z.). *Sevier County:* 1 mi. W Aurora, 5,190 ft., 1; Richfield, 2; 4 mi. E Mt. Alice, between Emery and Loa, 7,450 ft., 2. *Emery County:* 5 mi. S Castle Dale, 5,600 ft., 9; pump station, 4 mi. N Greenriver, 4,100 ft., 7; San Rafael River, 15 mi. SW Greenriver, 4,200 ft., 1. *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 5; Highway 160, 14 mi. N Moab, 4,500 ft., 1. *Wayne County:* Torrey, 6,800 ft., 2; 2 mi. SE Torrey, 5,800 ft., 6; Notom, 6,200 ft., 4. *Iron County:* Lower Bear Valley, 3 (M.V.Z.). *Garfield County:* Wildcat

R. S., Boulder Mountain, 8,700 ft., 1. *Washington County:* Zion National Park, 2; Springdale, 3 (K.U.); Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 1; 1 mi. W St. George, 2,800 ft., 1; St. George, 2,850 ft., 2 (M.V.Z.); Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,600 ft., 2. *Kane County:* Kanab, 5,200 ft., 2 (M.V.Z.).

Additional records.—Boxelder County: Mouth of Bear River, Duckville Gun Club (Goldman, 1939:355). *Cache County:* Logan (Stanford, 1931:360). *Sevier County:* Salina (Stanford, 1931:360). *Beaver County:* Beaver (Long, 1940:177).

Reithrodontomys megalotis ravus Goldman

Western Harvest Mouse

Reithrodontomys megalotis ravus Goldman, Journ. Mamm., 20:355, August 14, 1939, type from north end of Stansbury Island (sandbar at springs on lakeshore), 4,250 feet, Great Salt Lake, Tooele County, Utah; Marshall, Journ. Mamm., 21:154, May 16, 1940.

Range.—Type locality and adjacent mainland of Great Salt Lake.

Description and comments.—Measurements of one male topotype, number 263960 (U.S.N.M.) and one male near topotype, number 263961, from Grantsville are: Total length, 138, 142; length of tail, 66, 72; length of hind foot, 16, 14; length of ear, 13, 10. Color: Slightly lighter than in *Reithrodontomys megalotis megalotis* owing to admixture of gray; skull wide; braincase flattened; zygomatic arches heavy; tympanic bullae small.

For comparison with *Reithrodontomys megalotis megalotis,* see account of that subspecies.

Topotypes of *R. m. ravus* differ from Utah-taken specimens of *Reithrodontomys megalotis aztecus* in markedly lighter color, smaller skull in almost all parts measured; shorter palatal bridge and incisive foramina, heavier zygomatic arches and smaller tympanic bullae.

This subspecies of doubtful status is limited to Stansbury Island, Great Salt Lake, and the adjacent mainland in Tooele Valley.

Specimens examined.—Total, 2, distributed as follows: *Tooele County:* Stansbury Island, Great Salt Lake, 1 (U.S.N.M.); Grantsville, 1 (U.S.N.M.).

Reithrodontomys megalotis aztecus Allen

Western Harvest Mouse

Reithrodontomys aztecus Allen, Bull. American Mus. Nat. Hist., 5:79, April 28, 1893, type from La Plata, San Juan County, New Mexico.

Reithrodontomys megalotis aztecus, Howell, N. Amer. Fauna, 36:30, June 5, 1914; Barnes, Bull. Univ. Utah, 12 (no. 15):69, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):115, June, 1927; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 196, 1942.

Range.—Southeastern Utah, east of the Colorado River.

Description and comments.—Average and extreme measurements of 7 adult males and 5 adult females from ½ mile north of Bluff, San Juan County, Utah, are, respectively, as follows: Total length, 135 (141-127), 140 (146-130); length of tail, 62 (66-58), 65 (68-58); length of hind foot, 17 (18-17), 17.5

(18-17); length of ear, 14 (15-12), 14 (15-13). Color: Upper parts Cinnamon-Buff, heavily suffused with dark brown; inner margin of ear dark brown; cheeks, sides, flanks and outer side of upper arm Cinnamon-Buff; nose and entire underparts white, hairs white to roots on chin, plumbeous at base elsewhere; tail bicolored, dark brown above, white below. Skull: Large, palate long; incisive foramina long.

For comparison with *Reithrodontomys megalotis megalotis* and *Reithrodontomys megalotis ravus*, see accounts of those subspecies.

This subspecies, in Utah, seems to be limited to the southeastern corner of the state in San Juan and Grand counties; dispersal to the westward seems to be limited by the Colorado River.

Specimens examined.—Total, 43, distributed as follows: *San Juan County:* Monticello, 1; Blanding, 2; Hatch Trading Post, Montezuma Creek, 25 mi. SE Blanding, 4,500 ft., 3; ½ mi. N Bluff, 3,300 ft., 20; ½ mi. NW Bluff, 4,500 ft., 17.

Additional record (Howell, 1914:30).—*San Juan County:* Nolands Ranch, San Juan River.

Peromyscus crinitus pergracilis Goldman

Canyon Mouse

Peromyscus crinitus pergracilis Goldman, Journ. Mamm., 20:356, August 14, 1939, type from south end of Stansbury Island, Great Salt Lake, 4,250 feet, Tooele County, Utah; Marshall, Journ. Mamm., 21:155, May 16, 1940; Hall and Hoffmeister, Journ. Mamm., 23:58, February 14, 1942; Fautin, Ecol. Monogr., 16:304, October, 1946.

Peromyscus crinitus peridoneus Goldman, Journ. Mamm., 18:92, February 11, 1937.

Range.—Western Utah, in area formerly occupied by Pleistocene Lake Bonneville.

Description and comments.—Average and extreme measurements of 9 adult males and 11 adult females from Nevada are, respectively, as follows: Total length, 172 (186-165), 173 (186-164); length of tail, 89 (97-82), 90 (96-86); length of hind foot, 20.1 (21-19), 19.6 (21-18); ratio of tail to head and body, 107, 108; length of ear, 19.6 (21-18), 19.6 (21.5-18) (Hall and Hoffmeister, 1942:54). Color: Upper parts near (16′) Light Ochraceous-Buff overlaid with dusky; ears blackish, narrowly margined with white; tufts at anterior margin of ears buffy white; tail bicolored, dusky dorsally; sides, flanks and outer surface of front legs near (16′) Light Ochraceous-Buff; front feet, hind feet, ventral surface of tail and entire underparts white. Skull: Size medium; braincase flattened; frontals narrow; alveolar length of upper molar teeth short.

From *Peromyscus crinitus auripectus, P. c. pergracilis* differs as follows: Slightly smaller; hind foot smaller. Color: Much paler (less rufescent and more grayish); tail less hairy, with shorter pencil. Skull: Shorter; braincase narrower; diastema and incisive foramina longer; palatal bridge relatively longer.

From *Peromyscus crinitus stephensi, P. c. pergracilis* differs in: Body longer; tail shorter and more heavily haired; color slightly

lighter (near 16', instead of near 14' Light Ochraceous-Buff); skull larger in all measurements taken; palatal bridge relatively longer.

For comparison with *Peromyscus crinitus doutti*, see account of that subspecies.

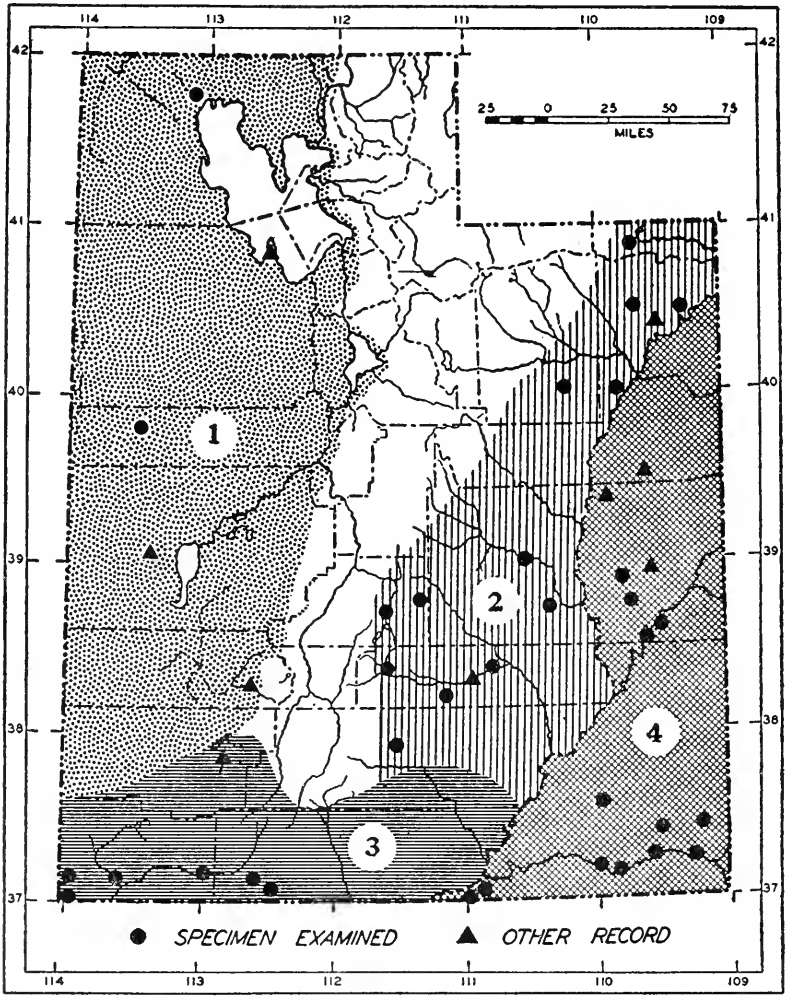

FIG. 47. Distribution of *Peromyscus crinitus*.

1. *P. c. pergracilis.*
2. *P. c. doutti.*
3. *P. c. stephensi.*
4. *P. c. auripectus.*

Like several other kinds of mammals, this subspecies of *Peromyscus crinitus* is limited in distribution, in Utah, to that area formerly occupied by the Pleistocene Lake Bonneville. The area of

distribution is bounded to the east by the high central mountains of the state. The southern limits of occurrence are roughly the Pine Valley and Beaverdam mountains. Northward there is no barrier, and the two specimens from Kelton from the northern limits of the range of the subspecies show intergradation with the dark northern subspecies, *Peromyscus crinitus crinitus,* of which there are no known specimens from Utah.

Specimens examined.—Total, 3, distributed as follows: *Boxelder County:* Kelton, 4,225 ft., 2 (M.V.Z.). *Juab County:* 7 mi. S Fish Springs, 4,400 ft., 1.

Additional records (Hall and Hoffmeister, 1942:59).—*Tooele County:* Stansbury Island, Great Salt Lake. *Millard County:* White Valley. *Beaver County:* Beaver River (near Fort Cameron).

Peromyscus crinitus doutti Goin

Canyon Mouse

Peromyscus crinitus doutti Goin, Journ. Mamm., 25:189, May 26, 1944, type from Antelope Canyon, 20 miles southeast of Duchesne, 7,200 feet, Duchesne County, Utah.

Peromyscus crinitus auripectus, Osgood, N. Amer. Fauna, 28:231, April 17, 1909; Svihla, Journ. Mamm., 12:262, August 24, 1931; Svihla and Svihla, Journ. Mamm., 12:315, August 24, 1931; Hall and Hoffmeister, Journ. Mamm., 23:65, February 14, 1942.

Range.—That part of Utah situated between the Colorado and Green rivers on the east and the Wasatch Mountains and the Fishlake Plateau on the west and from Wyoming south to Wayne and Garfield counties.

Description and comments.—Average and extreme measurements of 9 adult male and 5 adult female topotypes are, respectively, as follows: Total length, 175 (185-162), 176 (183-167); length of tail, 91 (97-80), 89 (96-84); ratio of tail to head and body 108 per cent (120-94), 102 (110-99); length of hind foot, 21.5 (23-21), 21 (23-21); length of ear, 21 (22-20), 21 (21-20). Color: Upper parts vary between Light Pinkish Cinnamon and Light Ochraceous-Salmon, with slight admixture of dark brown, mostly on hind part of back; ears light brown, nearly naked, faintly margined with white; tufts at anterior margin of ear Pale Ochraceous-Salmon; dorsal surface of tail Bister proximally, Warm Sepia distally; sides, flanks and outer surface of front legs Light Ochraceous-Salmon; front feet, hind feet, ventral surface of tail and entire underparts white (some few specimens have buffy pectoral spot); chin white to base of hairs, base of under hair elsewhere Neutral Gray. Skull: Large; braincase wide and deep; interorbital region wide; nasals slender; incisive foramina short.

Among named subspecies of *Peromyscus crinitus, P. c. doutti* most closely resembles *Peromyscus crinitus auripectus.* Topotypes and near topotypes of *P. c. doutti* differ from those of *P. c. auripectus* as follows: Color lighter dorsally, Light Ochraceous-Salmon as opposed to Ochraceous-Buff; pectoral spot usually absent. Skull: Nasals average slightly shorter; braincase wider; incisive foramina shorter; palatal bridge longer; braincase averages slightly deeper;

interparietal wider and longer (10.5 × 2.6 as opposed to 9.3 × 2.4).

P. c. doutti differs from *Peromyscus crinitus stephensi* and *Peromyscus crinitus pergracilis* in much the same way that these two last named subspecies differ from *P. c. auripectus.*

Hall and Hoffmeister (1942:65) referred all specimens of *Peromyscus crinitus* from the area here ascribed to *P. c. doutti* to the subspecies *P. c. auripectus.* Goin (1944:189) restudied the same materials available to the two aforementioned authors, plus additional material, and described the northern animals as a new subspecies, *P. c. doutti.* Hall and Hoffmeister (*loc. cit.*) recognized color differences and some minor cranial variations in the northernmost specimens, but did not consider them significant enough to merit separation from *P. c. auripectus.* Goin (*loc. cit.*) could find no osteological differences, but named *P. c. doutti* on the basis of color and a natural range. I have had occasion in this study to examine practically all of the material available to the aforementioned authors, and recognize the subspecies *Peromyscus crinitus doutti* as a valid one. My study of the skulls reveals constant average differences (see comparisons and measurements). Without doubt the subspecies *P. c. doutti* is closely related to *P. c. auripectus* and is apparently undergoing differentiation. The importance of the presence or absence of the pectoral spot probably has been overemphasized. Although present in the animals west of the Green and Colorado rivers, the spot most certainly has undergone considerable reduction.

Intergradation of *P. c. doutti* with *P. c. stephensi* occurs in the southern part of the range of *P. c. doutti.* Two specimens from 8 miles north of Escalante are intergrades. They are intermediate in color, but in most of their cranial characters are like *P. c. doutti* to which they are here referred. Specimens from Kanab, also are intergrades, but the small skulls make them referable to *P. c. stephensi.* The ranges of *P. c. doutti* and *P. c. stephensi* meet in Kane and Garfield counties.

Specimens examined.—Total, 37, distributed as follows: *Daggett County:* 7 mi. S Sheep Creek, 7 (U. M.). *Duchesne County:* Antelope Canyon, 20 mi. SE Duchesne, 7,200 ft., 3 (C. M.). *Uintah County:* Ashley Canyon, 10 mi. NW Vernal, 6,200 ft., 2 (C. M.); Dinosaur Quarry, 6 mi. N Jensen, 5,500 ft., 5 (C. M.); along Green River, 15 mi. SW Ouray (air line), 4,500 ft., 4 (C. M.); ¼ mi. up Sand Wash, near Green River, 15 mi. SW Ouray, 4,600 ft., 1 (C. M.). *Sevier County:* Summit E Sevier County, 1 (M. V. Z.); Fishlake Mountains, 19 mi. SW Emery, 7,500 ft., 1 (C. M.). *Emery County:* San Rafael River, 15 mi. SE Huntington, 5,200 ft., 4; "21 mi. out of San Rafael," 2 (M. V. Z.). *Wayne County:* Sun View Forest Camp, 3 mi. E Bicknell, 6,900 ft., 2; Fremont River, 12 mi. W Hanksville, 2 (C. M.); 7 mi. SE Fruita, 1 (C. M.). *Garfield County:* 8 mi. N Escalante, 6,500 ft., 2.

Additional records.—Uintah County: Vernal (Goin, 1944:191). *Wayne County:* Caineville (Hall and Hoffmeister, 1942:65).

Peromyscus crinitus auripectus (Allen)

Canyon Mouse

Sitomys auripectus Allen, Bull. American Mus. Nat. Hist., 5:75, April 28, 1893, type from Bluff City, 4,500 feet, San Juan County, Utah.

Peromyscus crinitus auripectus, Osgood, N. Amer. Fauna, 28:231, April 17, 1909; Warren, The mammals of Colorado, Knickerbocker Press, p. 133, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):66, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):116, June, 1927; Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935; Hall and Hoffmeister, Journ, Mamm., 23:64, February 14, 1942; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 204, 1942; Goin, Journ. Mamm., 25:191, May 26, 1944.

Peromyscus auripectus Allen, Bull. American Mus. Nat. Hist., 7:226, June 29, 1895; Allen, Bull. American Mus. Nat. Hist., 8:251, November 25, 1896.

Range.—That part of the state east of the Colorado and Green rivers.

Description and comments.—Average and extreme measurements of 6 adult male topotypes and near topotypes and measurements of one adult female topotype, number 804, are, respectively, as follows: Total length, 173 (185-166), 167; length of tail, 88 (95-84), 85; ratio of length of tail to length of head and body, 104 (119-100), 103; length of hind foot, 22 (25-21), 21; length of ear, 20 (23-19), 21. Tail short, averaging 104 per cent of length of head and body; hind foot long. Color: Upper parts near (*c*) Ochraceous-Buff, slightly mixed with dark brown; ears light brown, narrowly margined with white; dorsal surface of tail like back, darkest (dark brown) distally; sides, flanks and outer sides of front legs pure Ochraceous-Buff; pectoral spot (Ochraceous-Buff) present; front feet, hind feet, ventral surface of tail and remainder of underparts white. Skull: Large (largest of *P. crinitus* in Utah); palatal bridge actually as well as relatively short.

For comparisons with *Peromyscus crinitus stephensi, Peromyscus crinitus pergracilis* and *Peromyscus crinitus doutti,* see accounts of those subspecies.

This subspecies, formerly thought to occur on both sides of the Colorado River in Utah, is now known to be restricted to that region east of the Colorado and Green rivers. These rivers act as barriers separating the range of *P. c. auripectus* from that of *P. c. doutti, P. c. auripectus* is the easternmost subspecies of the species. In Utah, the ranges of occurrence of both *P. c. doutti* and *P. c. stephensi* are to the west of the Colorado and Green rivers, while that of *P. c. auripectus* is to the east of the rivers. Nevertheless, *P. c. doutti* is more closely related to *P. c. auripectus* than it is to its near neighbor *P. c. stephensi.*

Specimens examined.—Total, 57, distributed as follows: *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 2; Highway 160, 14 mi. N Moab, 4,500 ft., 1; Colorado River, 5 mi. E Moab, 4,000 ft., 8; Moab, 4,000 ft., 3. *San Juan County:* Edwin Natural Bridge, 5,725 ft., 2 (M. V. Z.); Hatch Trading Post, Montezuma Creek, 25 mi. (air), SE Blanding, 1; Cottonwood Wash, 8 mi. N Bluff, 4,700 ft., 1 (M.V.Z.); 1 mi. N Bluff, 3,500 ft., 1; ½ mi. NW Bluff, 4,500 ft., 6; Bluff, 4,400 ft., 19 (16, M. V. Z.); Aneth, 4,650 ft., 2 (M. V. Z.); Lime Wash, 5 mi. NE Mexican Hat, 4,500 ft., 1 (M. V. Z.); Johns Canyon, San Juan River, 5,150 ft., 3; Goose Necks, San Juan River, 4,500

ft., 2; Colorado River, Red Rock Canyon, 1; Rainbow Bridge, 4,000 ft., 3 (M. V. Z.); Navajo Mountain Trading Post, 5 mi. SE Navajo Mountain, 1 (M. V. Z.).

Additional records (Goin, 1944:191).—*Uintah County:* Hill Creek 40 mi. S Ouray, 6,000 ft. *Grand County:* mouth Florence Canyon, 35 mi. N Greenriver, 4,306 ft.; 4 mi. N Thompsons.

Peromyscus crinitus stephensi Mearns

Canyon Mouse

Peromyscus stephensi Mearns, Proc. U. S. Nat. Mus., 19:721, July 30, 1897, type from 3 miles east of Mountain Spring, Imperial County, California.

Peromyscus crinitus stephensi, Osgood, N. Amer. Fauna, 28:232, April 17, 1909; Barnes, Bull. Univ. Utah, 17 (no. 12):117, June, 1927; Hall and Hoffmeister, Journ. Mamm., 23:59, February 14, 1942; Hardy, Ecol. Monogr., 15:85, January, 1945.

Peromyscus crinitus peridoneus Goldman, Journ. Mamm., 18:93, February 11, 1937, type from Bright Angel Trail, 4,800 feet, south side Grand Canyon, Coconino County, Arizona.

Peromyscus crinitus auripectus, Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938.

Peromyscus crinitus crinitus, Hardy, Journ. Mamm., 22:90, May 14, 1941.

Range.—Largely restricted to southwestern Utah in Iron, Washington and Kane counties.

Description and comments.—Average and extreme measurements of 6 adult males and 6 adult females from Washington County are, respectively, as follows: Total length, 167 (171-164), 172 (178-167); length of tail, 88 (94-82), 85 (92-76); ratio of tail to length of head and body, 110 per cent (122-82), 105 (112-104); length of hind foot, 19.5 (20-18), 19.5 (20-19); length of ear, 18 (21-16), 17.5 (20-15). Color: Upper parts near (14′) Light Ochraceous-Buff, mixed with dark brown and black; ears dark brown, narrowly margined with white; eye ring dark brown; dorsal surface of tail dark brown, darkest distally; sides, flanks and outer surface of front legs near (14′) Light Ochraceous-Buff; front feet, hind feet, ventral surface of tail and entire underparts white. Skull: Small; zygomatic breadth slight anteriorly.

Utah-taken specimens of *P. c. stephensi* may be readily distinguished from topotypes of *Peromyscus crinitus auripectus* as follows: Size smaller, tail longer and less haired; hind foot smaller. Color: Upper parts much lighter; buffy pectoral spot absent. Skull: Smaller in all measurements taken; anterior zygomatic breadth relatively less; length of palatal bridge relatively longer. *P. c. stephensi* differs from *Peromyscus crinitus doutti* in much the same manner that *P. c. stephensi* differs from *P. c. auripectus.*

P. c. stephensi differs from *Peromyscus crinitus pergracilis* in: Body shorter; tail longer and less heavily haired; color much less gray (*P. c. pergracilis* has quite a grayish cast); skull smaller in all measurements; length of palatal bridge relatively shorter.

Peromyscus crinitus stephensi is a southern subspecies that attains its most northeastern limits in Utah. Intergradation is noted wherever its range contacts that of another subspecies. Specimens

from Kanab are intergrades between *P. c. stephensi* and *P. c. doutti*. One specimen is typical of *P. c. doutti* in color, whereas 4 others are intermediate. The skulls, however, are all small like those of *P. c. stephensi* to which they are here referred. Intergradation of *P. c. stephensi* with *P. c. pergracilis* is also indicated by two specimens from Parowan, Iron County (Hall and Hoffmeister, 1942:59).

The specimens from St. George and environs are of two colors. Those from the red-colored soils are typical of *P. c. stephensi* and those from dark-colored soils are highly melanistic. Cranial details are the same in the two color phases.

Specimens examined.—Total, 47, distributed as follows: *Washington County:* Top of Lady Mountain, Zion National Park, 7,000 ft., 1; Springdale, 1 (K.U.); 3 mi. NE St. George, 1 (K.U.); St. George, 2,850 ft., 19 (M.V.Z.); Black Hill, ¼ mi. W St. George, 3,000 ft., 6; Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 2; Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 1; S side Virgin River, St. George, 2,800 ft., 7 (M.V.Z.); Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,600 ft., 3. *Kane County:* Hamblin Ranch, Cave Lake Canyon, 5 mi. NW Kanab, 5,500 ft., 1; Kanab, 5,200 ft., 5 (M.V.Z.).

Additional record (Hall and Hoffmeister, 1942:61).—*Iron County:* Parowan.

Peromyscus eremicus eremicus (Baird)

Cactus Mouse

Hesperomys eremicus Baird, Mamm., N. Amer., Pac. R. R. Repts., 8:479, 1858, type from Old Fort Yuma, California, opposite Yuma, Arizona.

Peromyscus eremicus, Allen, Bull. American Mus. Nat. Hist., 7:226, June 29, 1895; Osgood, N. Amer. Fauna, 28:239, April 17, 1909.

Peromyscus eremicus eremicus, Barnes, Bull. Univ. Utah, 17 (no. 12):117, June, 1927; Long, Journ. Mamm., 21:178, May 16, 1940; Hardy, Ecol. Monogr., 15:84, January, 1945.

Range.—Limited to extreme southwestern Utah in Washington County.

Description and comments.—Average and extreme measurements of 5 adult males and measurements of 3 adult females, numbers 4160, 4007 and 4159, from Washington County, are, respectively, as follows: Total length, 185 (187-183), 184, 171, 182; length of tail, 96 (100-87), 100, 87, 93; length of hind foot, 21 (21-20), 21, 21, 20; length of ear, 18 (19-17), 17, 16, 17. Tail longer than head and body, annulated, covered with short hairs, little or no pencil at tip. Color: Upper parts Ochraceous-Buff (Cinnamon-Buff in some specimens) finely mixed with dusky; top of head with considerable gray; ears nearly naked, brownish and narrowly margined with white; sides and outer surface of front legs pure Ochraceous-Buff; chin white; underparts white, fur plumbeous at base; tail bicolored, brownish above, white beneath. Skull: Size medium; braincase well inflated; extension of premaxillae posterior to nasals well marked; accessory loph on upper M1 and M2 absent; interorbital breadth wide; nasals usually concave near posterior end.

Superficially, specimens of *P. e. eremicus* might be confused with some specimens of *Peromyscus crinitus stephensi* from the same locality. They differ from *P. c. stephensi* as follows: Size larger; tail longer, more naked and never with well marked pencil; hind foot approximately 20.5 (instead of 19.5); premaxillo-frontal

suture exceeds posterior end of nasals, instead of usually ending at same plane; interorbital breadth usually greater.

These animals are limited to extreme southwestern Utah, and occur mostly in the Lower Sonoran Life-Zone, where they seem to be more or less restricted to the cactus vegetation.

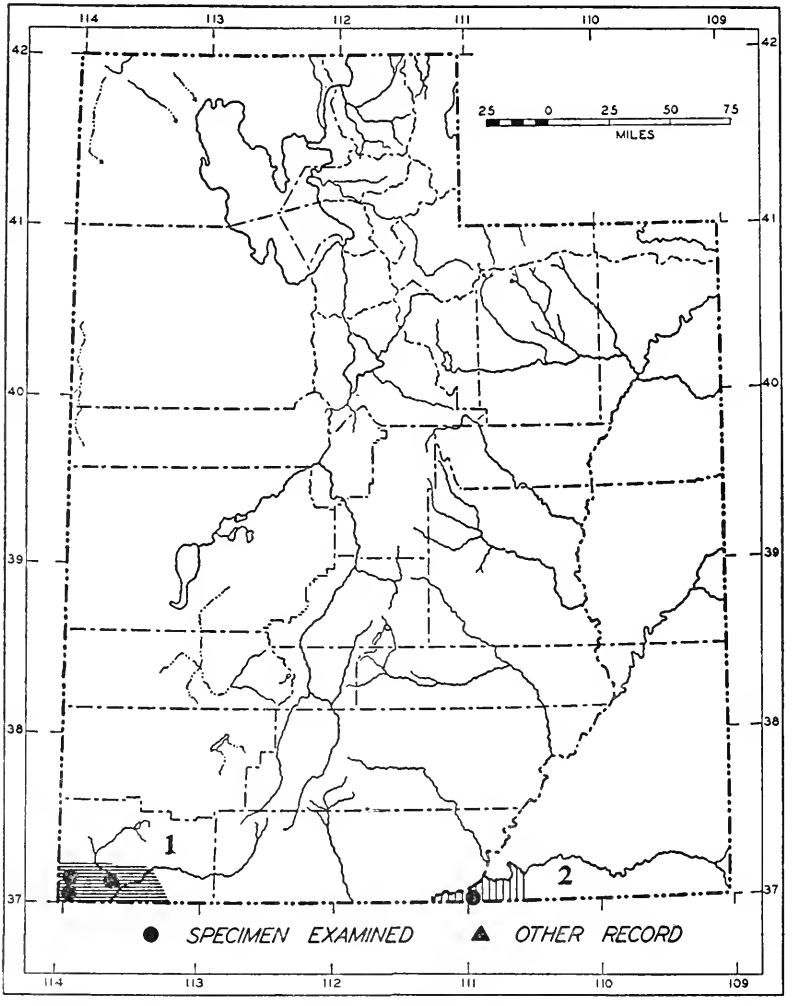

FIG. 48. Distribution of:
1. *Peromyscus eremicus eremicus.* 2. *Peromyscus nasutus nasutus.*

Specimens examined.—Total, 16, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona Border, 3,200 ft., 5; St. George, 2,880 ft., 4 (M.V.Z.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 2; Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,600 ft., 5.

Additional record (Osgood, 1909b:242).—*Washington County:* Santa Clara.

Peromyscus maniculatus sonoriensis (Le Conte)

Deer Mouse

Hesperomys sonoriensis Le Conte, Proc. Acad. Nat. Sci. Philadelphia, 6:413, 1853, type from Santa Cruz, Sonora, Mexico.

Peromyscus maniculatus sonoriensis, Osgood, N. Amer. Fauna, 28:89, April 17, 1909; Barnes, Bull. Univ. Utah, 17 (no. 12):118, June, 1927; Moore, Journ. Mamm., 10:81, February 11, 1929; Stanford, Journ. Mamm., 12:360, November 11, 1931 (part); Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:122, 1938; Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938; Marshall, Journ. Mamm., 21:152, May 16, 1940; Long, Journ. Mamm., 21:177, May 16, 1940; Tanner, Great Basin Nat., 1:104, June 30, 1940; Hardy, Ecol. Monogr., 15:103, January, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946; Hardy, Journ. Mamm., 30:434, November 17, 1949.

Hesperomys leucopus, var. *sonoriensis,* Allen, Bull. Essex Inst., 6:65, 1874.

Sitomys sonoriensis, Allen, Bull. American Mus. Nat. Hist., 5:74, April 28, 1893.

Peromyscus texanus nebrascensis, Allen, Bull. American Mus. Nat. Hist., 8:251, November 25, 1896.

Peromyscus maniculatus gunnisoni Goldman, Proc. Biol. Soc. Washington, 50:224, December 28, 1937, type from Gunnison Island, Great Salt Lake, Boxelder County, Utah.

Range.—All of western Utah as far east as the Wasatch, Fishlake, and Beaver mountains; the area east of the aforementioned mountains, as far east as the Colorado and Green rivers and north to Carbon County; extreme southeastern Utah as far north as the San Juan River.

Description and comments.—Average and extreme measurements of 31 adult males and 23 adult females from Parrish Ranch, 5 miles north of Ibapah, Tooele County, Utah, are, respectively, as follows: Total length, 152 (162-137), 156 (166-148); length of tail, 62 (72-46), 62 (72-55); length of hind foot, 20 (23-17), 20 (21-18); length of ear, 17 (18-15), 17.5 (19-16). Color: Slightly dimorphic. Pale phase: Upper parts between Pale Ochraceous-Buff and Ochraceous-Buff (Pale Ochraceous-Buff predominating), finely mixed with dusky; ears dusky, fairly broadly margined with white; posterior part of auricular tufts like upper parts, anterior part of tufts white; eye ring dusky when present; markings at base of vibrissae absent or pale dusky when present; tail sharply bicolored, white below, brownish above; sides and flanks like back, except clearer (no dusky); front feet and legs, hind feet and entire underparts white or faintly washed with buff. Dark phase: Like light phase except darker owing to more dusky and darker tones of Ochraceous-Buff. Many of these animals approach the dark mountain subspecies *Peromyscus maniculatus rufinus* in color. Skull: Similar to that of *Peromyscus maniculatus osgoodi;* averaging slightly larger in topotypes. Size medium; nasals narrow; braincase narrow; zygomatic arches not widely spreading; palatine slits relatively long and parallel.

From topotypes and near topotypes of *Peromyscus maniculatus rufinus,* Utah-taken specimens of *P. m. sonoriensis* from the western part of the state differ as follows: Color: Markedly lighter (less rufescent). Skull: Zygomatic breadth greater; braincase wider; interorbital breadth greater; nasals shorter and narrower;

premaxillary tongues usually extending farther posteriorly beyond proximal end of nasals.

From topotypes of *Peromyscus maniculatus inclarus, P. m. sonori-*

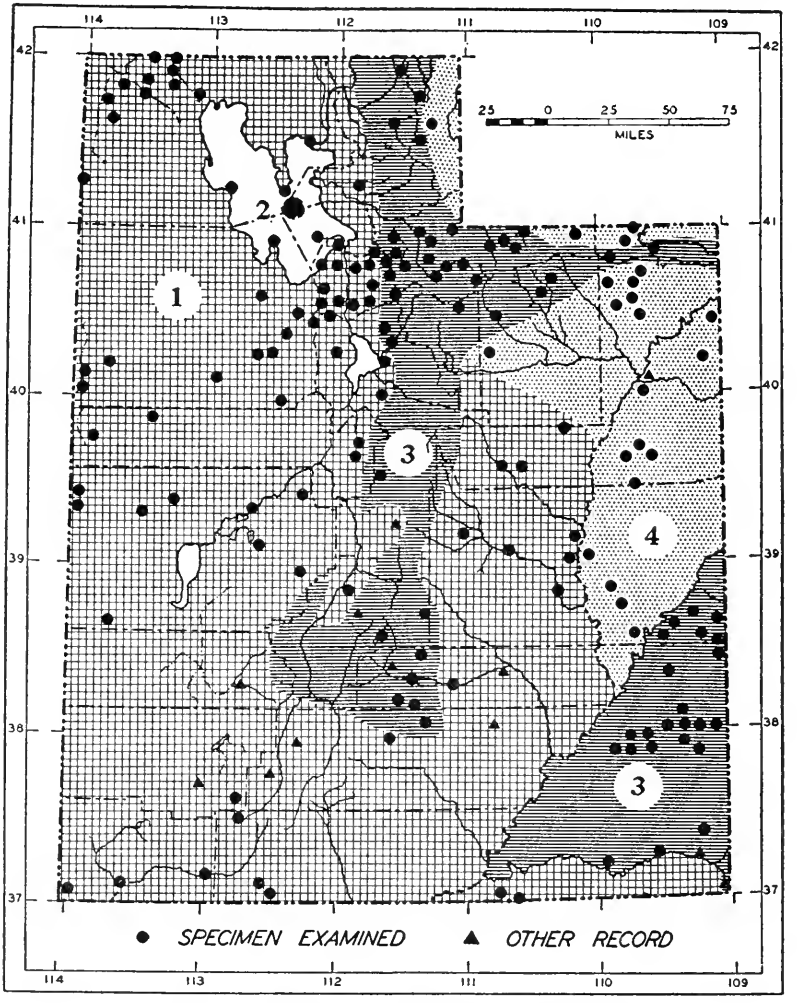

FIG. 49. Distribution of *Peromyscus maniculatus.*

1. *P. m. sonoriensis.*
2. *P. m. inclarus.*
3. *P. m. rufinus.*
4. *P. m. osgoodi.*

ensis differs in much the same manner as *P. m. inclarus* does from *Peromyscus maniculatus osgoodi.*

For comparison of *P. m. sonoriensis* with *P. m. osgoodi,* see account of that subspecies.

This subspecies, like others in the state, intergrades freely wherever its range contacts that of another. I concur wholeheartedly with Osgood's statement (1909b:91) that although there are characters sufficient to separate the various subspecies of *Peromyscus maniculatus,* the great range of individual variation makes the assignment of intergrades a more or less arbitrary operation which is "like dividing the spectrum" (Osgood, 1909b:17).

Within the state of Utah, intergradation between *P. m. sonoriensis* and *P. m. rufinus,* an inhabitant of the high mountains, occurs over large areas, as for example along the western front of the Wasatch, Fishlake, and Beaver mountains. Several hundred specimens are available from Salt Lake City and environs which show that intergradation begins at the edge of the valley floor and continues to the top of the high Wasatch Mountains. Animals collected in the vicinity of the Great Salt Lake are definitely referable to *P. m. sonoriensis.* From the lake eastward to Salt Lake City proper, a distance of 18 miles, the increase in elevation is roughly one foot per mile. All animals from this intervening area are also clearly referable to *P. m. sonoriensis.* In specimens from the piedmont area east of the city, the degree of approach towards *P. m. rufinus* is progressively more as the elevation increases up to the foot of the mountains proper, although all of the animals are referable to *P. m. sonoriensis.* Beginning at the foot of the mountains proper, the approach is definitely closer to *P. m. rufinus* the higher the elevation until the mountain area proper is reached where all of the animals show the characters of *P. m. rufinus.* According to my arrangement, animals in the west lowlands definitely are *P. m. sonoriensis;* the piedmont is an area of intergradation and the animals there are assigned to *P. m. sonoriensis;* the range of *P. m. rufinus* begins at the mountain proper. Southward into the Fishlake, Beaver mountain area, the animals which are referable to *P. m. sonoriensis* occur at higher elevations than they do farther north. The animals from the Fishlake Plateau at an elevation of 8,730 feet resemble somewhat the intergrades from the piedmont area of the Wasatch Mountains at Salt Lake City at an elevation of approximately 4,500 feet, but all characters considered, are referable to *P. m. rufinus.* This encroachment of *P. m. sonoriensis* on the mountains is apparently complete in the Cedar Mountains and Escalante Mountains. Animals from 20 miles north of Escalante, at 9,500 feet elevation, and those from Duck Creek, Cedar Mountains, at 9,000 feet are clearly referable to *P. m. sonoriensis,* as are all animals in this southern part of the state, at least to the Arizona boundary.

Another area where intergradation of *P. m. sonoriensis* with *P. m. rufinus* appears to take place is extreme southeastern Utah. Animals from Bluff and Johns Canyon (both localities in San Juan County and on the north side of the San Juan River) are intergrades referable to *P. m. rufinus*. Osgood (1909b:73) arrived at the same conclusions. Benson (1935:452) concluded after examining animals from various habitats and different elevations from Navajo Mountain and environs, south of the San Juan River, that his material was referable to *P. m. sonoriensis* and not *P. m. rufinus*. I have examined part of the material available to Benson and am inclined at this time to concur in his findings.

Animals from the western part of the state are of two color phases, light and dark, but most of them are of the light phase. In all mountainous areas within the range of this subspecies, the animals from the high elevations mostly are of the dark phase.

Goldman (1937:224) described *Peromyscus maniculatus gunnisoni* from Gunnison Island in the northern part of the Great Salt Lake. The only character mentioned by him as separating *P. m. gunnisoni* from *P. m. sonoriensis* of the mainland was lighter color. On the basis of difference in color alone, it is possible to name local populations from a number of localities in Utah. Specimens from several localities in western Utah are as light as the animals from Gunnison Island. I can see the lighter color mentioned by Goldman, but feel that color alone is not, in this species, sufficient basis for naming a new subspecies. *Peromyscus maniculatus gunnisoni*, therefore, is regarded as a synonym of the earlier named *Peromyscus maniculatus sonoriensis*.

Specimens examined.—Total, 963, distributed as follows: *Boxelder County:* flat, 3 mi. NW Yost, Raft River Mountains, 5,700 ft., 4; ½ mi. S Standrod, Raft River Mountains, 5,650 ft., 2; summit One Mile Canyon, 4½ mi. SW Standrod, Raft River Mountains, 7,500 ft., 3; George Creek rd. junction, 5 mi. SE Yost, Raft River Mountains, 6; S Fork George Creek, SE Yost, Raft River Mountains, 6,700 ft., 1; George Creek, 7 mi. SE Yost, Raft River Mountains, 6,500 ft., 6; George Creek, 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 13; Pine Creek, 3 mi. N Rosette, Raft River Mountains, 6,100 ft., 7; South Fork Raft River, 7,500 ft., 1; Dove Creek, Raft River Mountains, 6,500 ft., 10; Lynn Canyon, 7,500 ft., 3; Kelton, 4,225 ft., 5 (M. V. Z.); Grouse Creek, 6,500 ft., 7; Utah-Nevada Line, E side Tecoma Range, 4,300 ft., 5; mouth of Bear River, 4,200 ft., 1; Gunnison Island, Great Salt Lake, 1; Promontory Point, 2. *Weber County:* Ogden, 4,400 ft., 9 (1, M. V. Z.). *Tooele County:* Stansbury Island, Great Salt Lake, 7; South Willow Creek, Stansbury Mountains, 7,500 ft., 28; Bauer, 4,500 ft., 1; Settlement Creek, Oquirrh Mountains, 6,500 ft., 21; St. John, 4,300 ft., 8; Clover Creek, Onaqui Mountains, 6,500 ft., 16; Orr's Ranch, Skull Valley, 4,300 ft., 8; Clifton Flat, 7 mi. SW Goldhill, 6,149 ft., 16; Old Lincoln Highway, 18 mi. SW Orr's Ranch in Skull Valley, 4,400 ft., 23; Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 94; Ibapah, 5,000 ft., 11; Little Valley, Sheeprock Mountains, 5,500 ft., 19. *Davis County:* Antelope Island, Great Salt Lake, 4,500 ft., 31. *Salt Lake County:* Lake shore, 17 mi. NW Salt Lake City, 4,200 ft., 18; Salt Marshes, 3 mi. NW Salt Lake Airport, 4,400 ft., 6;

Lake shore, 17 mi. W Salt Lake City, 4,300 ft., 22; 1½ mi. W S. L. Airport, U. S. Highway 40, 4,200 ft., 6; Foothills, 14th Ave. and I St., Salt Lake City, 5,000 ft., 5; Salt Lake City, 4,400 ft., 6; E Stadium, University of Utah Campus, 4,400 ft., 9; Ft. Douglas Reservation, 41; ¾ mi. E Mt. Olivet Cemetery, Salt Lake City, 4,500 ft., 6; Foothills Wasatch Mountains, N Parleys Canyon, 4,500 ft., 4; 19th E & 13 S, Salt Lake City, 4,500 ft., 7; Sugarhouse, 4,300 ft., 1; Country Club, Salt Lake City, 4,400 ft., 2; Utah Copper Club, 4,250 ft., 4; Parleys Canyon, 2 mi. below mouth, 4,500 ft., 3; Foothills head 45th South, 4,500 ft., 2; 8 mi. W Salt Lake City, on 33rd S, 1; Jordan River, 2 mi. W Murray, 4,500 ft., 3; Taylorsville, 2 mi. W Murray, 4,300 ft., 3; 8 mi. S Salt Lake City, 2; Bacchus, 4,800 ft., 45; 15 mi. SE Salt Lake City, 6; 12 mi. S Magna, 5,400 ft., 2; Mouth Little Willow Creek, 5 mi. NE Draper, 5,000 ft., 4; 7th East St., 2 mi. N Draper, 4,500 ft., 1; 1 mi. N Draper, 4,700 ft., 5; Draper, 4,500 ft., 1; Jordan River, 2 mi. W Draper, 4,500 ft., 2; 1 mi. W Draper, 4,500 ft., 2; 1 mi. SW Draper, 4,500 ft., 2; 2 mi. SW Draper, 4,100 ft., 5; 3 mi. SW Draper, 4,400 ft., 6; Hillside, 1 mi. E Draper, 5,000 ft., 1; Corner Canyon, near Draper Tunnel, 5,000 ft., 6; 1 mi. W Herriman, 5,000 ft., 2; Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 7,000 ft., 16; Rose Canyon, Oquirrh Mountains, 5,650 ft., 37; Beef Hollow, 3 mi. W Camp Williams, 6,000 ft., 4. *Utah County:* Fairfield, 4,800 ft., 3; E shore Utah Lake, 7 mi. NE Spanish Fork, 3; upper Spring Creek, ½ mi. S Payson, 4,600 ft., 6. *Juab County:* Fish Springs, 4,400 ft., 17; Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 59; 7 mi. SW Nephi, 6,000 ft., 9; 20 mi. SW Nephi, 4. *Carbon County:* Price, 1; Christensen Ranch, Nine Mile Canyon, 10 mi. E of summit, 6,300 ft., 4; 2 mi. E Price, 5,500 ft., 2. *Millard County:* 4 mi. S Gandy, 5,000 ft., 2 (M. V. Z.); Oak Creek Canyon, 6 mi. E Oak City, 6,000 ft., 9; Swasey Spring, House Mountain, 6,500 ft., 7; Smith Creek, 6 mi. S Gandy, 5,400 ft., 6 (M. V. Z.); Hinckley, 4,600 ft., 4; White Valley, 60 mi. W Delta, 6; 2 mi. E Clear Lake, 4,600 ft., 11; W Meadow, 2; Desert Experiment Station, U. S. Forest Service, 50 mi. W Milford, 5,252 ft., 35. *Sevier County:* 10 mi. SE Sigurd, 1 (M. V. Z.). *Emery County:* 5 mi. S Castle Dale, 5,600 ft., 13; 7 mi. N Greenriver, 4,100 ft., 1; San Rafael River, 15 mi. SE Huntington, 5,200 ft., 4; Gunnison Butte, Green River, 4,700 ft., 7; Pump Station, 4 mi. N Greenriver, 4,100 ft., 16; San Rafael River, 15 mi. SW Greenriver, 4,200 ft., 9. *Wayne County:* Notom, 6,200 ft., 3. *Iron County:* Cedar Breaks, 10,000 ft., 1 (M. V. Z.). *Garfield County:* 20 mi. N Escalante, 9,500 ft., 2. *Washington County:* Zion National Park, 6,500 ft., 15; 2 mi. W St. George, 1 (K. U.); Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 5. *Kane County:* Duck Creek, Cedar Mountains, 9,000 ft., 2; Cottonwood, 8 mi. NW Kanab, 4,800 ft., 2; Kanab, 4,400 ft., 5 (4, M. V. Z.). *San Juan County:* Near Summit, Navajo Mountain, 10,000 ft., 3 (M. V. Z.); War God Spring, Navajo Mountain, 8,400 ft., 7 (M. V. Z.); Navajo Mountain Trading Post, 5 mi. SE Navajo Mountain, 1 (M. V. Z.).

Additional records (unless otherwise indicated after Osgood, 1909b:94).—*Sanpete County:* Manti. *Sevier County:* Glenwood. *Beaver County:* Beaver Valley. *Piute County:* Marysvale. *Wayne County:* Hanksville. *Garfield County:* Panguitch; Panguitch Lake; Lyman (Stanford, 1931:360). *Iron County:* Cedar City (Long, 1940:177). *Washington County:* St. George; Santa Clara.

Peromyscus maniculatus rufinus (Merriam)

Deer Mouse

Hesperomys leucopus rufinus Merriam, N. Amer. Fauna, 3:65, September 11, 1890, type from San Francisco Mountain, 9,000 feet, Coconino County, Arizona.

Peromyscus maniculatus rufinus, Osgood, N. Amer. Fauna, 28:72, April 17, 1909; Warren, The mammals of Colorado, Knickerbocker Press, p. 128, 1910; Barnes, Bull. Univ. Utah, 17 (no. 12):118, June, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Stanford, Journ. Mamm., 12:360,

November 11, 1931; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 199, 1942.
Peromyscus rufinus, Barnes, Bull. Univ. Utah, 12 (no. 15):65, April, 1922.
Peromyscus maniculatus ssp., Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—High Wasatch, Uinta, Fishlake and Beaver mountains as far south as northwestern Garfield County; Grand and San Juan counties, north of the San Juan River and east of the Colorado River.

Description and comments.—Average and extreme measurements of 9 adult male and 4 adult female topotypes and near topotypes are, respectively, as follows: Total length, 155 (161-149), 156 (167-150); length of tail, 64 (69-56), 63 (70-57); length of hind foot, 19.8 (21.0-18.5), 19.5 (20.5-18.5). Color: Upper parts near (14′) Ochraceous-Tawny, heavily mixed with fine dusky hairs; ears dusky, narrowly margined with white; auricular tufts Ochraceous-Buff (white in some specimens); eye ring dusky; dark spot at base of vibrissae dusky (black in some specimens); tail sharply bicolored, blackish brown above, white below; sides and flanks clear Ochraceous-Tawny; hind legs dusky to tarsal joints; hind feet, front feet and legs and entire underparts white or creamy white. Skull: Size medium; nasals long; interorbital region and braincase narrow; zygomatic arches neither widely spreading nor robust; proximal end of nasals usually conterminous with or extending slightly beyond proximal ends of premaxillary tongues.

Comparison of topotypes and near topotypes of *P. m. rufinus* with topotypes of *Peromyscus maniculatus inclarus* shows *P. m. rufinus* to differ in darker color (more rufescent and less gray) and skull smaller in most all measurements.

For comparisons with *Peromyscus maniculatus sonoriensis* and *Peromyscus maniculatus osgoodi*, see accounts of those subspecies.

This subspecies intergrades freely with all others whose ranges are contiguous. Specimens from eastern Rich County, northwestern Summit County, the high Uinta Mountains in Daggett County and the southern Uinta Mountains in Duchesne and Uintah counties all intergrade in varying degree with *P. m. osgoodi* (see account of *P. m. osgoodi*). For remarks on intergradation with *P. m. sonoriensis*, see account of that subspecies.

Specimens examined.—Total, 802, distributed as follows: *Cache County:* Beaver Creek, Logan Canyon, 1 (M.V.Z.); Anderson Ranch, Blacksmiths Fork, 5,700 ft., 4. *Rich County:* 5 mi. SW Laketown, 6,500 ft., 8; Monte Cristo, 18 mi. W Woodruff, 8,000 ft., 6. *Morgan County:* East Canyon, 18 mi. NW Park City, 7. *Salt Lake County:* City Creek, 4 mi. above Forks, 5,000 ft., 20; 6 mi. NE Salt Lake City, 4,700 ft., 1; City Creek, ¾ mi. above Forks, 4,400 ft., 42; City Creek, at Forks, 4,400 ft., 2; 1 mi. N Salt Lake City, 4,500 ft., 2; 1 mi. N Veterans Hospital, Salt Lake City, 2; 1 mi. up Dry Canyon, 4,500 ft., 18; Emigration Canyon, 3 mi. E Salt Lake City, 4,500 ft., 98; Red Butte Canyon, Ft. Douglas, 4,750 ft., 5; above reservoir, Red Butte Canyon, 5,500 ft., 4; 1 mi. above zoo, Emigration Canyon, 1; Emigration Canyon, 5 mi. above mouth, 4,400 ft., 8; Emigration Canyon, 8 mi.

above mouth, 6,000 ft., 10; 2 mi. E Salt Lake City, 4,500 ft., 1; Parleys Canyon, 5 mi. E Salt Lake City, 4,400 ft., 57; Parleys Canyon, 7 mi. above mouth, 5,200 ft., 3; City Farm, Mountain Dell, 17 mi. E Salt Lake City, 5,000 ft., 2; Parleys Canyon, 10 mi. E Salt Lake City, 4,700 ft., 7; between Millcreek and Parleys Canyon, 7½ mi. SE Salt Lake City, 2; Millcreek Canyon, 2 mi. above mouth, 4,700 ft., 26; Millcreek Canyon, 5 mi. above lower power station, 18; 12 mi. SE Salt Lake City, 4,700 ft., 1; Millcreek Canyon, Smith Fork, 1; The Firs, Millcreek Canyon, 8,500 ft., 5; mouth of Big Cottonwood Canyon, 4,350 ft., 4; Brighton, Silver Lake P. O., Big Cottonwood Canyon, 9,000 ft., 12; 18 mi. SE Salt Lake City, 4,500 ft., 2; mouth of Hughes Canyon, between Big and Little Cottonwood Canyons, 4,800 ft., 2; mouth of Little Cottonwood Canyon, 4,350 ft., 3; 1 mi. above Alta, 7. *Summit County:* Along Chalk Creek, 19 mi. NE Coalville, 2 (C.M.); Echo Canyon, 26 mi. SW Evanston, Wyoming, 1 (C.M.); Junction East Fork and Blacks Fork, 25 mi. SW Ft. Bridger, Wyoming, 1 (C.M.); Chalk Creek, E Coalville, 5; Junction of Bear River and East Fork, 1 (C.M.); 2 mi. S junction Bear River and Haydens Fork, 2 (C.M.); East Fork of Black Fork, 31 mi. SW Ft. Bridger, Wyoming, 2 (C.M.); Smith and Morehouse Canyon, 7,000 ft., 2; Wolf Creek Pass, 9,400 ft., 3; Weber Canyon, 11 mi. NE Oakley, 6,500 ft., 1; 2 mi. W Park City, on Highway 40, along bank of Kimball Creek, 7,200 ft., 2; SW slope Bald Peak, 10,500 ft., 2 (M.V.Z). *Daggett County:* Green Lake, 60 mi. N Vernal, 5 (C.M.); 4 mi. W Green Lake, 7,500 ft., 5 (C.M.); Beaver Creek, 19 mi. S Manila, 5 (U.M.); Beaver Creek, 21 mi. S Manila, 1 (U.M.); Junction Deep and Carter creeks, 7,900 ft., 11 (2, C.M.); Hoop Lake, Ashley National Forest, 8,000 ft., 2; Hideout Canyon, Ashley National Forest, 5,800 ft., 2; E side Green River, opposite Hideout Spring, 1; NE Bank Green River, Hideout Canyon, Ashley National Forest, 2; Hideout Spring, Hideout Canyon, 6,400 ft., 3; N (E) side Green River, 1 mi. E Hideout Trail Bridge, Hideout Canyon, 6,400 ft., 1. *Utah County:* Mt. Timpanogos, 1 mi. N Aspen Grove, 7,500 ft., 6; Aspen Grove, E Provo, 1 (M.V.Z.). *Duchesne County:* S slope Mt. Emmons, 11,700 ft., 5 (C.M.); Petty Mountain, 15 mi. N Mountain Home, 9,500 ft., 5 (C.M.); Stockmore, 3. *Wasatch County:* 10 mi. SE Kamas, Log Hollow, 7,800 ft., 2; Pine Canyon, 2½ mi. N Midway, 6,000 ft., 11; Midway Fish Hatchery, 5,450 ft., 6. *Sanpete County:* Maple Canyon, 1. *Sevier County:* Fishlake, 8,730 ft., 5; 4 mi. E Mt. Alice, between Emery and Loa, 7,450 ft., 13. *Grand County:* Castle Valley, 18 mi. NE Moab, 6,000 ft., 6; mouth Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 3,995 ft., 8; La Sal Mountains, 15 mi. SE Moab, 6,000 ft., 10; Moab, 4; Warner R. S., La Sal Mountains, 9,750 ft., 3. *Wayne County:* Elkhorn G. S., 14 mi. N Torrey, Fishlake Plateau, 9,400 ft., 6; Torrey, 6,800 ft., 6; 2 mi. SE Torrey, 5,800 ft., 7; Donkey Lake, Boulder Mountain, 10,000 ft., 3. *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 13. *San Juan County:* Quaking Aspen, La Sal Mountains, 1 mi. SE Mesa R. S., 9,200 ft., 18; 3 mi. W Geyser Pass, La Sal Mountains, 10,000 ft., 2; Block Canyon, 19 mi. SE Moab, 5,400 ft., 4; Range, 15 mi. N Monticello, 6,000 ft., 1 (M.V.Z.); 12 mi. N Monticello, 1; Range, 6 mi. N Monticello, 7,000 ft., 1 (M.V.Z.); Abajo Mountains, 8 mi. W Monticello, 9,200 ft., 1; Dalton Spring, 5 mi. W Monticello, Abajo Mountains, 8,300 ft., 31; Baker R. S., 1½ mi. W Monticello, 7,000 ft., 2; 1 mi. W Baker R. S., 1; Range, 3 mi. E Monticello, 7,000 ft., 1 (M.V.Z.); Synders Pond, 22 mi. (air) ENE Monticello, 5,650 ft., 15; 18 mi. E Monticello, 6,720 ft., 1; 18½ mi. E Monticello, 6,720 ft., 27; Jackson Camp, 21 mi. N Blanding, Abajo Mountains, 8,600 ft., 21; Devil Canyon, 14 mi. S Monticello, 6,800 ft., 15; Johnson Creek, 14 mi. N Blanding, 7,500 ft., 27; 8 mi. N Blanding, 6,000 ft., 15; Gooseberry R. S., Elk Ridge, 8,300 ft., 7; Duck Lake, 1 mi. S Gooseberry R. S., Elk Ridge, 8,400 ft., 5; Hatch Trading Post, Montezuma Creek, 25 mi. SE Blanding, 4,500 ft., 4; ½ mi. NW Bluff, 4,500 ft., 10; Bluff, 3,300 ft., 6; Johns Canyon, San Juan Rivers, 5,150 ft., 9.

Additional records (Osgood, 1909b:74).—*San Juan County:* Riverview; Noland Ranch.

Peromyscus maniculatus osgoodi Mearns

Deer Mouse

Peromyscus maniculatus osgoodi Mearns, Proc. Biol. Soc. Washington, 24:102, May 15, 1911, type from Calf Creek, Custer County, Montana; Svihla, Journ. Mamm., 12:262, August 24, 1931; Leraas, Contr. Lab. Vert. Genetics, Univ. Michigan, 6:1, April, 1938.

Peromyscus texanus arcticus, Allen, Bull. American Mus. Nat. Hist., 8:252, November 25, 1896.

Peromyscus texensis subarcticus, Barnes, Bull. Univ. Utah, 12 (no. 15):65, April, 1922.

Range.—North slopes of Uinta Mountains in Summit and Daggett counties; Rich County east of Wasatch Mountains; Uinta Basin and that area east of the Green River and north of the Colorado River.

Description and comments.—Average and extreme measurements of 8 adult male and 5 adult female near topotypes are, respectively, as follows: Total length, 157 (165-146), 168 (173-154); length of tail, 62 (70-56), 63 (68-56); length of hind foot, 20 (21-20), 20 (21-19). Color: Upper parts between Pale Ochraceous-Buff and Ochraceous-Buff, uniformly but lightly mixed with dusky, slightly lighter on sides and flanks; ears brownish dusky, fairly widely margined with white; auricular tufts usually white anteriorly, buffy posteriorly; eye ring poorly marked; tail sharply bicolored, white below, brownish black above; feet and forelegs white; hind legs dusky white, or buffy to tarsal joints; entire underparts white, sometimes creamy owing to slight admixture of buff. Skull: Size medium; nasals long, narrow and convex dorsally; braincase narrow; interorbital breadth narrow; incisive foramina parallel sided.

Among named subspecies of *Peromyscus maniculatus* known to occur in Utah, *P. m. osgoodi* most closely resembles *Peromyscus maniculatus sonoriensis* from which it is separated with difficulty. From specimens of the latter subspecies from extreme western Utah, *P. m. osgoodi* differs as follows: Size slightly larger. Color: Nearly indistinguishable in worn pelage, but slightly darker in fresh pelage. Skull: Slightly larger; nasals longer, narrower and more convex; zygomatic breadth greater; length of diastema greater; incisive foramina longer, narrower and more nearly parallel-sided.

Comparisons of topotypical and near topotypical specimens of *P. m. osgoodi* and *Peromyscus maniculatus rufinus* show the former to differ in: Size slightly larger. Color: Much lighter (less rufescent); auricular tufts with more white, dusky less extensive. Skull: Similar, averaging slightly larger in most all measurements; zygomatic breadth greater; nasals narrower; looked at from directly in front, more of zygomatic processes of maxillae are visible owing to greater lateral torsion.

Comparison of topotypes and near topotypes show *P. m. osgoodi* to differ from *Peromyscus maniculatus inclarus* in the following manner: Color: Much lighter; tail markedly lighter. Skull:

Heavier; nasals longer and wider; rostrum heavier; palatal bridge longer; incisive foramina longer.

The first mention in the literature of *P. m. osgoodi* from Utah, was by Svihla (1931:262). However, Osgood in his revision did include northeastern Utah within its range, although he had no actual specimens upon which to base this conclusion (Osgood, 1909b: frontispiece). From the material at hand, it appears that the range of this subspecies within the state is discontinuous. On the north its range includes eastern Rich County, northeastern Summit County and northern Daggett County. Its largest encroachment into the state is in the eastern part, roughly the Uinta Basin. and the area east of the Green River and north of the Colorado River. This latter larger area, joins that part of Colorado which Warren (1942: 202) indicates is occupied by *P. m. osgoodi.*

Intergradation occurs freely everywhere within the state where the range of this subspecies contacts that of another. Few of the animals here assigned to *P. m. osgoodi* are really typical, and with the exception of the specimens from Uintah County, east of the Green River, all are intergrades of varying degree with the contiguous subspecies, *P. m. rufinus* and *P. m. sonoriensis.* Some specimens combine the characters of all three of the aforementioned subspecies, as for example those from Red Creek, 2 miles north of Fruitland, Duchesne County. A series of 12 animals from Daggett County, in the collections of the University of Michigan, collected by A. and R. D. Svihla show a gradual transition from *P. m. osgoodi* to *P. m. rufinus.* They were taken at four localities: near Manila at the north at the lowest elevation, thence southeastward at successively higher elevations to the high mountains. Svihla (1931: 262) referred all these to *P. m. osgoodi.* My study leads me to refer the specimens from near Manila, in the sagebrush country, to *P. m. osgoodi,* although they show some minor intergradation with *P. m. rufinus* from the high mountains. Those from 7 miles south of Manila, at a higher elevation, are nearly intermediate between the two subspecies. Svihla's animals from 19 and 21 miles south of Manila, respectively, are progressively more like *P. m. rufinus* to which they are here referred.

Specimens (not seen by Svihla) from Henrys Fork, in northern Summit County are clearly referable to *P. m. osgoodi.* It would appear that the northern slopes of the Uinta Mountains are inhabited by *P. m. osgoodi* up to about the 7,800 foot level and that above this elevation the mice, intergrades to be sure, are referable to *P. m. rufinus,* the mountain subspecies in this region. Specimens from west of the Colorado River in Grand County are likewise

intergrades between *P. m. osgoodi* and *P. m. rufinus*. They are somewhat darker than typical *P. m. osgoodi* but resemble it more than they do *P. m. rufinus*.

In the Uinta Basin drainage, bordered on the north by the Uinta Mountains, *P. m. osgoodi* ranges upward to higher elevations than it does on the north side of the Uinta Mountains in Daggett and Summit counties. Animals from Paradise Park at 10,500 feet, although intergrades, are definitely referable to *P. m. osgoodi*. To the west, in Duchesne County, animals from the same elevation as Paradise Park, although unquestionably intergrades, seem best referred to *P. m. rufinus*.

Specimens examined.—Total, 176, distributed as follows: *Rich County:* 8 mi. W Randolph, 1 (M. V. Z.). *Summit County:* Henrys Park, Henrys Fork, 9,000 ft., 4 (2, C. M.). *Daggett County:* Sheep Creek, near Manila, 1 (U. M.); Sheep Creek, 7 mi. S Manila, 5 (U.M.) *Duchesne County:* Red Creek, 2 mi. N Fruitland, 6,700 ft., 5 (C. M.). *Uintah County:* Paradise Park, 45 mi. NW Vernal (by road), 10,500 ft., 9 (5, C. M.); Taylor Mountain, 16 mi. (air line) NW Vernal, 1 (C. M.); Junction Trout Creek and Ashley Creek, 9,700 ft., 5; Ashley Creek, 10 mi. (air line) NW Vernal, 1 (C. M.); 4 mi. W Vernal, 5,600 ft., 3 (C.M.); Powder Springs, 25 mi. E Vernal, 3 (C.M.); Powder Wash, 15 mi. SE Jensen, 2 (C. M.); E side confluence Green and White rivers, 1 mi. SE Ouray, 4,700 ft., 27; Browns Corral, 20 mi. S Ouray, 6,250 ft., 26; Willow Creek, 25 mi. S Ouray, 5,250 ft., 14; Willow Creek, 29 mi. S Ouray, 5,400 ft., 5; P. R. Springs, 43 mi. S Ouray, Uintah-Grand County line, 7,950 ft., 36. *Grand County:* Rock Canyon Corral, 5 mi. SE Valley City, 4,500 ft., 4; 1 mi. E Highway 160. 6 mi. S Valley City, 4,500 ft., 18; Highway 160, 14 mi. N Moab, 4,500 ft., 4; Brush Flat, 6 mi. N Moab Bridge, Highway 160, 4,200 ft., 1; Sand dunes, W Side Colorado River, 1 mi. N Moab Bridge, 3,395 ft., 1.

Peromyscus maniculatus inclarus Goldman

Deer Mouse

Peromyscus maniculatus inclarus Goldman, Journ. Mamm., 20:355, August 14, 1939, type from Fremont Island, Great Salt Lake, Weber County, Utah.

Range.—Known only from the type locality.

Description and comments.—Measurements of 3 adult male topotypes, numbers 264115, 264116 and 264118 (U. S. N. M.), and of one adult female topotype, number 264117 (U. S. N. M.) are, respectively, as follows: Total length, 162, 164, 159, 169; length of tail, 67, 62, 63, 64; length of hind foot, 20, 21, 20, 20; length of ear, 16, 17, 16, 17. Color: Upper parts near Light Drab, heavily mixed with black; ears dusky, narrowly margined with white; auricular tufts white; eye ring dusky; tail sharply bicolored, nearly black above, white below; sides and flanks Light Cinnamon-Drab; dorsal part of thighs like upper parts; front feet and legs, hind feet and entire underparts white. Skull: Large, heavy; zygomatic arches widely spreading and robust; rostrum and nasals broad; palate long; nasals extend posteriorly well beyond premaxillary tongues; dentition heavy.

For comparisons with other subspecies, see accounts of those subspecies.

These mice are the most distinctive of all the *Peromyscus maniculatus* group known to occur in Utah. They are easily recognizable by their gray color, black tails and robust skulls. There are no evidences of intergradation in the material available. This subspecies seems to be endemic to Fremont Island, but the close relationship to *P. maniculatus* argues for subspecific as opposed to full specific status.

Specimens examined.—Four from Fremont Island, Great Salt Lake, Utah.

Peromyscus boylii utahensis Durrant

Brush Mouse

Peromyscus boylii utahensis Durrant, Proc. Biol. Soc. Washington, 59:167, December 23, 1946, type from one half mile [not five miles as given in original description] above lower power station, Millcreek Canyon, 5,800 feet, Salt Lake County, Utah.

Peromyscus boylei rowleyi, Osgood, N. Amer. Fauna, 28:145 (part), April 17, 1909; Svihla, Journ. Mamm., 12:263, August 24, 1931.

Range.—That part of Utah bounded on the east by the Colorado and Green rivers and on the west by the area formerly occupied by Pleistocene Lake Bonneville; north and south limits unknown.

Description and comments.—Average and extreme measurements of 5 adult females from the type locality and near vicinity are as follows: Total length, 194 (200-188); length of tail, 104 (109-95); ratio of length of tail to head and body length, 118 per cent (133-100); length of hind foot, 19.6 (22-17); length of ear, 18 (19-16). Tail long; ears and hind feet short (see measurements). Color: Upper parts a mixture of Fuscous, Light Ochraceous-Buff and gray giving a ground color of Hair Brown; ears dusky, faintly margined with white; nose and postorbital regions grayish; eye ring black; arietiform markings at base of vibrissae black; hind legs dusky to tarsal joints; dorsal surface of tail like middorsal region; lower sides, flanks, cheeks and outer surface of front legs Light Ochraceous-Buff; front feet, hind feet, ventral surface of tail and entire underparts white. Skull: Large; nasals long; depression at proximal end of nasals present; interparietal actually as well as relatively narrow; braincase wide and moderately inflated; diastema long; tympanic bullae well inflated ventrally.

Among the named subspecies of *Peromyscus boylii*, *P. b. utahensis* most closely resembles *Peromyscus boylii rowleyi*. Topotypical specimens of *P. b. utahensis* can be distinguished from topotypes and near topotypes of *P. b. rowleyi* as follows: Size smaller; hind foot and ear shorter; tail relatively longer, averaging 118 per cent of length of head and body as opposed to 106 per cent in *P. b. rowleyi*. Color: Markedly darker on upper parts (much more black and gray and less ochraceous); tail markedly darker. Skull: Larger in eleven of thirteen cranial measurements; length of palatal bridge and upper tooth-row (alveolar length) shorter; interparietal

longer and narrower, extending laterad nearly to temporal suture in *P. b. rowleyi* (9.1 × 2.9 as opposed to 9.6 × 2.8 in *P. b. rowleyi*); infraorbital foramina slightly narrower dorsally.

Since 1909 when Osgood revised the genus *Peromyscus* until 1946 when *P. b. utahensis* was named, all specimens of *Peromyscus boylii*

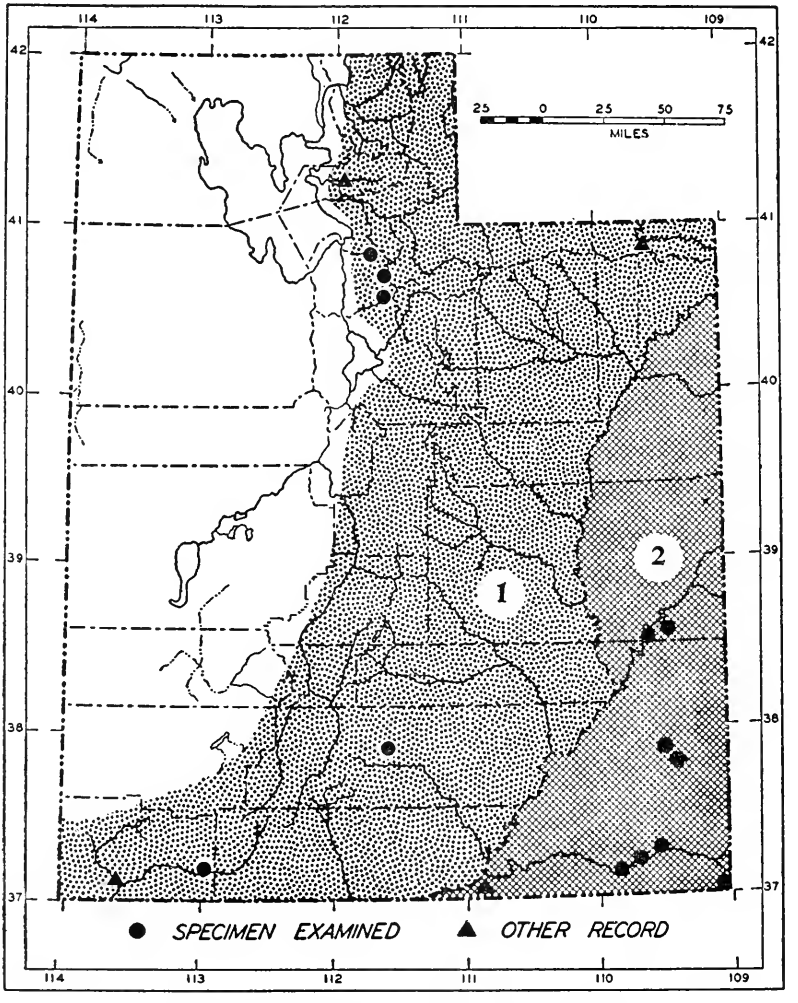

FIG. 50. Distribution of *Peromyscus boylii*.
1. *P. b. utahensis*. 2. *P. b. rowleyi*.

from Utah were referred to the subspecies *P. b. rowleyi*. In his revision, Osgood (1909b:147) referred specimens from southeastern Utah, southwestern Utah and from Ogden in northern Utah to

P. b. rowleyi, the type locality of which is in extreme southeastern Utah east of the Colorado River. At that time there was, and there still is, a discontinuity in the known distribution of this species within the state, since no specimens are known from the central part of Utah. Although there has been no really intensive collecting in the central part of the state, considerable work has been done there and it seems that the mice, if present, are rare.

Material available for this study indicates that *P. b. rowleyi* occurs only east of the Colorado and Green rivers; all specimens studied from elsewhere in the state are referable to *P. b. utahensis*.

Specimens from Zion National Park are intergrades between *P. b. utahensis* and *P. b. rowleyi*. They are intermediate in color but have the darker cast and dark tail typical of *P. b. utahensis*. Moreover, they resemble *P. b. utahensis* in the proportion of length of tail to length of head and body. The majority of the cranial characters are like those of *P. b. utahensis*. One specimen from 8 miles north of Escalante, Garfield County is also an intergrade. The two specimens reported from the eastern end of the Uinta Mountains, west of the Green River, by Svihla (1931:263) seem to have been lost. They are provisionally placed under this subspecies on a distributional basis only. *Peromyscus boylii* is a southern species that in the Great Basin reaches the northernmost limits of its range in Utah.

Specimens examined.—Total, 35, distributed as follows: *Salt Lake County:* 1 mi. above Forks, City Creek Canyon, 4,800 ft., 4; 2 mi. above mouth Millcreek Canyon, 4,800 ft., 2; 0.5 mi. above lower power station, Millcreek Canyon, 3; Mouth Little Willow Creek, 5 mi. NE Draper, 5,000 ft., 2; Corner Canyon, "near" Draper Tunnel, 5,000 ft., 1. *Garfield County:* 8 mi. N Escalante, 6,500 ft., 1. *Washington County:* Zion National Park, 22.

Additional records.—*Weber County:* Ogden (Osgood, 1909b:147). *Daggett County:* Hide Out (Svihla, 1931:263). *Washington County:* Santa Clara Creek (Osgood, 1909b:147).

Peromyscus boylii rowleyi (Allen)

Brush Mouse

Sitomys rowleyi Allen, Bull. Amer. Mus. Nat. Hist., 5:76, April 28, 1893, type from Nolands Ranch (N side San Juan River, 1½ mi. N "Four Corners", Hall, 1931:2), San Juan County, Utah.

Peromyscus boylii rowleyi, Mearns, Proc. U. S. Nat. Mus., 19:139, December 21, 1896; Barnes, Bull. Univ. Utah, 17 (no. 12):119, June, 1927; Tanner, Great Basin Nat., 1:146, June 30, 1940.

Peromyscus boylei rowleyi, Osgood, N. Amer. Fauna, 28:145, April 17, 1909; Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935.

Peromyscus boyleii rowleyi, Warren, The mammals of Colorado, Knickerbocker Press, p. 134, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):66, April, 1922; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 205, 1942.

Range.—Eastern Utah, east of the Colorado and Green rivers.

Description and comments.—Average and extreme measurements of 5 adult female near topotypes are as follows: Total length, 204 (210-191); length of tail, 103.6 (114-100); ratio of tail to length of head and body, 106 per cent (109-104); length of hind foot, 22 (24-21.5). Color: Upper parts Wood Brown; nose and postorbital region grayish; ears dusky, narrowly margined with white; dorsal surface of tail brownish; eye ring narrow, dark brown; sides, flanks and outer surface of front legs Ochraceous-Buff; front feet, hind feet, ventral surface of tail and entire underparts white. Skull: Large; zygomatic arches narrowest anteriorly; interparietal wide extending almost to temporal suture on each side.

For comparison and remarks on distribution, see account of *Peromyscus boylii utahensis.*

Specimens examined.—Total, 36, distributed as follows: *Grand County:* Mouth Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 3,995 ft., 14; Moab, 4,500 ft., 2; 5 mi. E Moab, 4,000 ft., 4. *San Juan County:* Jackson Camp, 21 mi. N Blanding, Abajo Mountains, 8,600 ft., 1; Devil Canyon, 14 mi. S Monticello, 1; Bluff, 4 (A. M. N. H.); Mouth of Aztec Creek, 5 (4, A. M. N. H.); Colorado River, Red Rock Canyon, 1; San Juan River, 1 (A. M. N. H.); Nolands Ranch [= N side San Juan River, 1½ mi. N "Four Corners" (Hall, 1931:2)], 3 (A. M. N. H.).

Additional record (Benson, 1935:452).—*San Juan County:* Rainbow Bridge.

Peromyscus truei nevadensis Hall and Hoffmeister

Piñon Mouse

Peromyscus truei nevadensis Hall and Hoffmeister, Univ. California Publ. Zoöl., 42:401, April 30, 1940, type from one half mile west of Debbs Creek, Pilot Peak, 6,000 feet, Elko County, Nevada.
Peromyscus truei, Osgood, N. Amer. Fauna, 28:165, April 17, 1909 (part).
Peromyscus truei truei, Stanford, Journ. Mamm., 12:360, November 11, 1931; Long, Journ. Mamm., 21:178, May 16, 1940.

Range.—Western Utah in area formerly occupied by Pleistocene Lake Bonneville.

Description and comments.—Average and extreme measurements of 4 topotypes and 2 near topotypes of both sexes are as follows: Total length, 201 (212-191); length of tail, 93 (97-88); length of hind foot, 23.2 (24.0-22.0); length of head and body, 108 (115-102) (Hall and Hoffmeister, 1940:404). Ear long; body actually as well as relatively long. Color: Upper parts Pinkish Buff mixed with black (considerable gray present on head in Utah-taken specimens); dorsal surface of tail brownish; sides and flanks like back except less admixture of black; cheeks and outer surface of front legs Pinkish Buff; front feet, hind feet and entire underparts white (hairs plumbeous at base). Skull: Large; rostrum long; tympanic bullae moderately inflated.

From specimens of *Peromyscus truei truei* from Grand County, *P. t. nevadensis* differs as follows: Body longer; tail relatively shorter; color lighter dorsally; skull larger; rostrum longer; tympanic bullae smaller (less inflated ventrally); external auditory meatus smaller.

Specimens examined.—Total, 5, distributed as follows: *Boxelder County:* Raft River Mountains, 1. *Salt Lake County:* Draper, 5,000 ft., 1. *Juab County:* Nephi, 5,095 ft., 1 (M. V. Z.); Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 1. *Millard County:* Desert Range Experiment Station of the U. S. Forest Service, 50 mi. W Milford (Beaver County), 5,252 ft., 1.

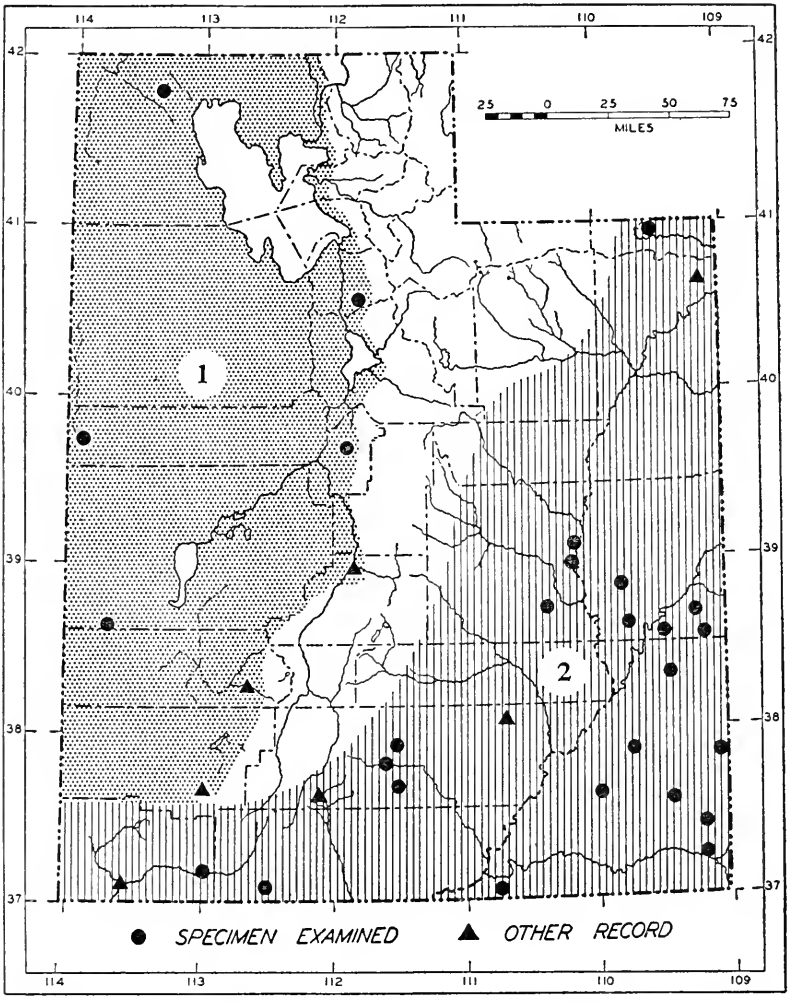

FIG. 51. Distribution of *Peromyscus truei.*
1. *P. t. nevadensis.* 2. *P. t. truei.*

Additional records.—Sevier County: "Near Salina" (Stanford, 1931:360). *Beaver County:* Beaver River, near Fort Cameron (Osgood, 1909b:169). *Iron County:* Cedar City (Long, 1940:178).

Peromyscus truei truei (Shufeldt)

Piñon Mouse

Hesperomys truei Shufeldt, Proc. U. S. Nat. Mus., 8:407, September 14, 1885, type from Fort Wingate, McKinley County, New Mexico.

P[eromyscus]. Truei, Thomas, Ann. and Mag. Nat. Hist., (ser. 6) 14:364, November, 1894.

Peromyscus truei truei, Barnes, Bull. Univ. Utah, 17 (no. 12):120, June, 1927; Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935; Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938.

Peromyscus truei, Allen, Bull. American Mus. Nat. Hist., 8:251, November 25, 1896; Osgood, N. Amer. Fauna, 28:165, April 17, 1909; Warren, The mammals of Colorado, Knickerbocker Press, p. 135, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):67, April, 1922; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 205, 1942.

Range.—From Washington County eastward through south-central to eastern Utah (mostly in Colorado River drainage), limits unknown.

Description and comments.—Average and extreme measurements of 6 adult females from Grand County are as follows: Total length, 183 (186-177); length of tail, 89 (94-83); length of hind foot, 22 (23-20); length of ear, 24 (26-22). Color: Upper parts Cinnamon-Buff, mixed with black, heaviest in middorsal region; ears brown, narrowly margined with white; tail bicolored, brownish above; sides, flanks, cheeks and outer sides of front legs Cinnamon-Buff; front feet, hind feet, and entire underparts white (hairs plumbeous at base). Skull: Large; rostrum long; tympanic bullae large and well inflated ventrally.

For comparison with *Peromyscus truei nevadensis,* see account of that subspecies.

The most typical specimens of *P. t. truei* from Utah, are from San Juan and Grand counties to the east of the Colorado River. A series of 12 animals from these two counties agrees closely with topotypes of *P. t. truei.* Three specimens were available from west of the Colorado River, from Escalante and environs, which appear to be intergrades between *P. t. truei* and *P. t. nevadensis.* They are intermediate in color, but more nearly resemble *P. t. nevadensis.* In total length they are like *P. t. truei.* The proportion of length of tail to length of head and body agrees with that of *P. t. nevadensis* in 2 specimens and with that of *P. t. truei* in one. The skulls are like those of *P. t. truei* in the measureable characters. Furthermore, they resemble *P. t. truei* in size of tympanic bullae and size of the external auditory meatus. From the above data and on distributional grounds these specimens are referred to *P. t. truei.* Only 2 subadult specimens were available from Washington County, and they are provisionally placed with *P. t. truei* on distributional grounds, as, also, are the three specimens, not seen by me, from Beaver County recorded by Osgood (1909b:169) under the name *P. t. truei.*

Specimens examined.—Total, 43, distributed as follows: *Daggett County:* N (E) bank Green River, Hideout Canyon, 5,800 ft., 1. *Emery County:* 14 mi. N Greenriver, 4,037 ft., 2; 7 mi. N Greenriver, 4,100 ft., 7; "21 mi. out of San Rafael", 1 (M.V.Z.). *Grand County:* 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 2; Castle Valley, 18 mi. NE Moab, 6,000 ft., 3; 3 mi. W entrance Arches National Monument, 1; Moab "up the Colorado River", 1; La Sal Mountains, 15 mi. SE Moab, 6,000 ft., 6. *Garfield County:* 8 mi. N Escalante, 6,500 ft., 1; 5 mi. W Escalante, 6,000 ft., 1; 8 mi. S Escalante, 5,200 ft., 1. *Washington County:* Zion National Park, 6,500 ft., 2. *Kane County:* Kanab, 5,200 ft., 1 (M.V.Z.). *San Juan County:* Block Canyon, 19 mi. SE Moab, 5,400 ft., 2; 18½ mi. E Monticello, 6,720 ft., 1; Blanding, 6,000 ft., 3 (1, M.V.Z.); Hatch Trading Post, Montezuma Creek, 25 mi. (air line) SE Blanding, 4,500 ft., 3; Edwin Natural Bridge, 5,725 ft., 2 (M.V.Z.); Aneth, 4,650 ft., 1 (M.V.Z.); Navajo Mountain Trading Post, 5 mi. SE Navajo Mountain, 1 (M.V.Z.).

Additional records.—Uintah County: Browns Park (Osgood, 1909b:169). *Garfield County:* Swamp Canyon, Bryce National Park (Presnall, 1938:15); E slope Mt. Ellen, Henry Mountains (Osgood, 1909b:169). *Washington County:* St. George (Osgood, 1909b:169).

Peromyscus nasutus nasutus (Allen)

Long-nosed Deer Mouse

Vesperimus nasutus Allen, Bull. American Mus. Nat. Hist., 3:299, June, 1891, type from Estes Park Colorado.
Peromyscus nasutus, Osgood, N. Amer. Fauna, 28:176, April 17, 1909.
Peromyscus nasutus nasutus, Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935.

Range.—Known only from extreme southeastern Utah. See figure 48.

Description and comments.—The following measurements are taken from Osgood (1909b:261 and 266). Total length, 195 (210-180); length of tail, 99 (105-91); length of hind foot, 23.2 (24-22); length of ear from notch (dry), 19.7 (20.5-18.5). Color: Upper parts Wood Brown or Isabella Color mixed with gray, clearest on sides; nose and postorbital regions gray; ears dusky, narrowly margined with white; orbital ring blackish; upper surface of tail brownish; entire underparts, feet and ventral surface of tail white. Skull: Large; rostrum long; nasals long and narrow; tympanic bullae spherical and large; zygomatic arches compressed anteriorly; braincase relatively wide and shallow.

Animals belonging to this species can be distinguished from those of *Peromyscus boylii rowleyi* as follows: Size larger, ears longer. Color: Similar but more grayish; annulations on tail narrower. Skull: Rostrum longer and narrower; tympanic bullae actually larger.

Peromyscus n. nasutus may be distinguished from *Peromyscus truei truei* as follows: Size smaller; ears shorter. Color: Darker, more grayish. Skull: Smaller throughout; tympanic bullae smaller; rostrum longer; nasals narrower, longer and less flattened; zygomatic arches more constricted anteriorly; braincase relatively broader and shallower.

I have seen the specimen reported by Benson (1935:452) and

know of no other from Utah. *P. n. nasutus* like many other mammals is known only from the part of the state east and south of the Colorado River. Inasmuch as it occurs far northward in Colorado, the type locality being Estes Park, further collecting may reveal its presence in suitable habitat in all that part of Utah east of the Colorado and Green rivers.

Specimen examined.—One from Rainbow Bridge, 4,000 ft., San Juan County, Utah (M.V.Z.).

Onychomys leucogaster utahensis Goldman

Northern Grasshopper Mouse

Onychomys leucogaster utahensis Goldman, Journ. Mamm., 20:354, August 14, 1939, type from south end Stansbury Island, Great Salt Lake, 4,250 feet, Tooele County, Utah; Marshall, Journ. Mamm., 21:154, May 16, 1940.

Onychomys leucogaster brevicaudus, Hollister, Proc. U. S. Nat. Mus., 47: 441, October 29, 1914; Barnes, Bull. Univ. Utah, 17 (no. 12):111, June, 1927; Hall, Univ. California Publ. Zoöl., 37:5, April 10, 1931; Stanford, Journ. Mamm., 12:360, November 11, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:122, 1938; Fautin, Ecol. Monogr., 16:304, October, 1946.

Onychomys melanophrys, Barnes, Bull. Univ. Utah, 12 (no. 15):64, April, 1922.

Onychomys leucogaster aldousi Goldman, Proc. Biol. Soc. Washington, 55: 77, June 25, 1942, type from Desert Range Experiment Station, U. S. Forest Service, 50 miles west of Milford, Millard County, Utah.

Range.—Western Utah, approximately the area formerly occupied by the Pleistocene Lake Bonneville.

Description and comments.—Measurements of 2 adult males, numbers 3637 and 3638, and 2 adult females, numbers 3636 and 3715, from Ibapah are, respectively, as follows: Total length, 140, 129, 142, 132; length of tail, 35, 32, 34, 31; length of hind foot, 20, 19, 19, 19; length of ear, 20, 19, 20, 17. Color: Upper parts between Avellaneous and Vinaceous-Buff; ears light brown margined with silvery white; anterior tufts of ears white; upper surface of tail light brown with varying amounts of white; entire underparts, under surface of tail, muzzle, forearms, front and hind feet, white. Skull: Short; relatively broad; rostrum short; braincase moderately inflated.

From topotypes of *Onychomys leucogaster melanophrys*, *O. l. utahensis* differs in smaller size, longer ears, paler, grayer, more Avellaneous color, lighter ear tufts (white as opposed to Pale Buff), and smaller skull with shorter rostrum and lighter dentition.

Among named subspecies of *Onychomys leucogaster*, *O. l. utahensis* most closely resembles *Onychomys leucogaster brevicaudus*. It may be distinguished from the latter by lighter color (with less black and brown) and uniformly more convex skull in dorsal outline. The dorsal outline of skulls of topotypes and near topotypes of *O. l. brevicaudus* is straight from the coronal suture to the distal

end of the nasals, whereas that of *O. l. utahensis* is slightly convex. For comparison with *Onychomys leucogaster pallescens,* see account of that subspecies.

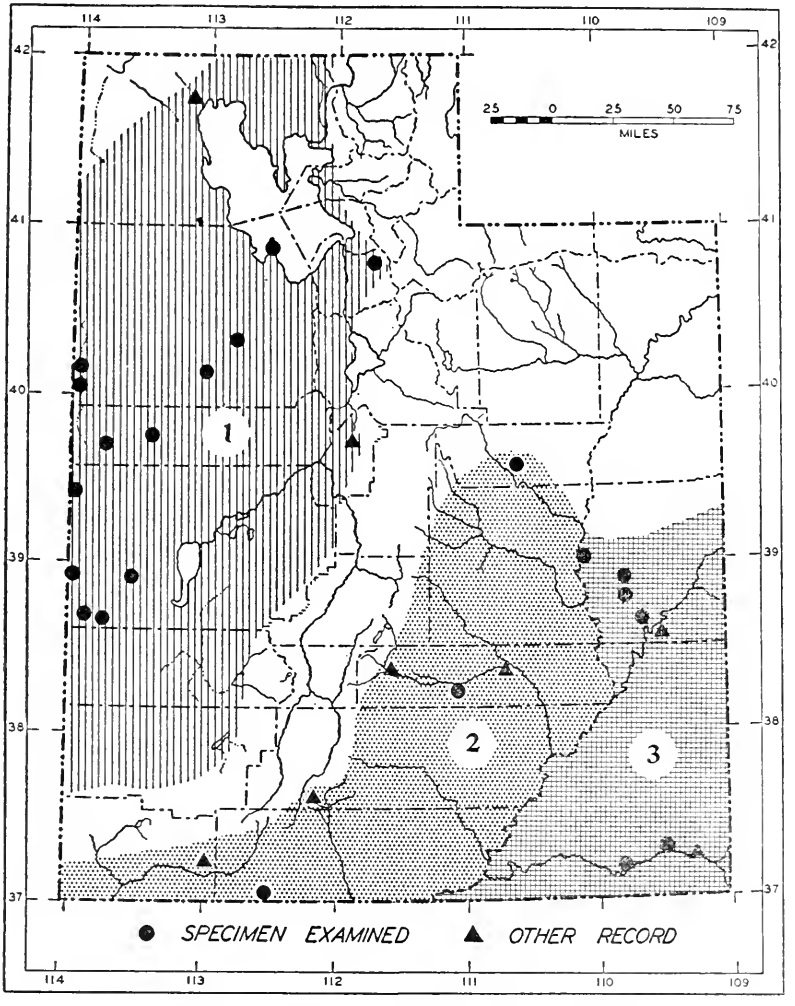

FIG. 52. Distribution of *Onychomys leucogaster.*
1. *O. l. utahensis.* 2. *O. l. melanophrys.* 3. *O. l. pallescens.*

When Goldman (1939b:354) named *O. l. utahensis,* from Stansbury Island in Great Salt Lake, he, like others referred the mainland animals to *O. l. brevicaudus,* but specimens from as far west as Nevada are indistinguishable from specimens of *O. l. utahensis*

from Stansbury Island. This distribution closely parallels that of *Peromyscus crinitus pergracilis* (see Hall and Hoffmeister, 1942: 58), the type locality of which is also the south end of Stansbury Island at the extreme eastern margin of the geographic range; actually, Stansbury Island is no longer an island, but a peninsula that projects into the southwestern part of the Great Salt Lake.

Three years after he named *O. l. utahensis*, Goldman (1942:77) named another subspecies, *Onychomys leucogaster aldousi*, from western Utah, with the type locality at the Desert Range Experiment Station, 50 miles west of Milford. Goldman (*loc. cit.*) compared *O. l. aldousi* with *O. l. brevicaudus* and *O. l. melanophrys* but not with *O. l. utahensis*. My own comparison of one topotype of *O. l. aldousi* with topotypes of *O. l. utahensis* shows them to be indistinguishable, and the published cranial measurements of *O. l. aldousi* and *O. l. utahensis* are almost identical. Accordingly the name *Onychomys leucogaster aldousi* is placed as a synonym of the earlier proposed *Onychomys leucogaster utahensis*.

No specimen of *Onychomys leucogaster brevicaudus* from Utah has been seen.

Specimens examined.—Total, 34, distributed as follows: *Tooele County:* Stansbury Island, Great Salt Lake, 4,250 ft., 4 (1, U.S.N.M.); Orr's Ranch, Skull Valley, 4,300 ft., 1; Old Lincoln Highway, 18 mi. SW Orr's Ranch in Skull Valley, 4,400 ft., 1; Parrish Ranch, 5 mi. N Ibapah, 5,175 ft., 2; Ibapah, 5,000 ft., 15. *Salt Lake County:* 24 mi. E Salt Lake City, 6,500 ft., 3 (M.V.Z.). *Juab County:* 7 mi. S Fish Springs, 4,400 ft., 1; Trout Creek, 4,600 ft., 1. *Millard County:* 4 mi. S Gandy, 4,000 ft., 1 (M.V.Z.); 5 mi. S Garrison, 5,400 ft., 2 (M.V.Z.); White Valley, 60 mi. SW Delta, 1; Warm Cove, 55 mi. W Milford, 5,500 ft., 1; Desert Range Experiment Station, 50 mi. W Milford, 5,252 ft., 1.

Additional records (Hollister, 1914:443).—*Boxelder County:* Kelton. *Juab County:* Nephi.

Onychomys leucogaster melanophrys Merriam

Northern Grasshopper Mouse

Onychomys leucogaster melanophrys Merriam, N. Amer. Fauna, 2:2, October 30, 1889, type from Kanab, 4,295 feet, Kane County, Utah; Hollister, Proc. U. S. Nat. Mus., 47:444, October 29, 1914; Barnes, Bull. Univ. Utah, 17 (no. 12):112, June, 1927; Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938; Long, Journ. Mamm., 21:177, May 16, 1940.

Onychomys melanophrys, Barnes, Bull. Univ. Utah, 12 (no. 15):64, April, 1922.

Range.—Southwestern and south-central Utah.

Description and comments.—Measurements of one adult male, number 56167 (M.V.Z.), and one adult female, number 56168 (M.V.Z.), topotypes, are, respectively, as follows: Total length, 144, 134; length of tail, 44, 40; length of hind foot, 20, 20; length of ear, 14, 14. Color: Upper parts between

Avellaneous and Wood Brown, finely mixed with dark brown, darkest on nose, top of head, lower back and rump; ears blackish, margined with white; ear tufts pale buffy with considerable white at base; eye ring blackish; dorsal surface of proximal two thirds of tail grayish brown; sides and hips pure Pinkish Cinnamon; front feet, hind feet, ventral surface of tail, dorsal surface of distal one third of tail and entire underparts white. Skull: Large; braincase narrow and long; zygomatic arches wide and widely flared posteriorly; infraorbital foramina slitlike.

For comparisons with other subspecies of *Onychomys leucogaster* occurring in Utah, see accounts of those subspecies.

In Utah, the Colorado River and the Green River seem to act as efficient barriers in separating the range of *O. l. melanophrys* from that of *Onychomys leucogaster pallescens* (see account of *O. l. pallescens*). Heretofore, the name *O. l. melanophrys* was applied to all short tailed grasshopper mice in southern Utah. As a result of the study now reported on, the name *O. l. melanophrys* is restricted, in Utah, to those animals occurring in southern and south-central Utah, west of the Colorado and Green rivers, and east of the main central north-south mountain ranges.

Specimens examined.—Total, 10, distributed as follows: *Carbon County:* 2 mi. E Price, 1. *Wayne County:* Notom, 6,200 ft., 4. *Kane County:* 2 mi. N Kanab, 5,200 ft., 1 (K.U.); Kanab, 5,200 ft., 4 (3, M.V.Z.).

Additional records.—*Wayne County* (Hollister, 1914:446): Thurber; Hanksville. *Garfield County* (Presnall, 1938:15): Bryce National Park. *Washington County* (Presnall, 1938:15): Zion National Park.

Onychomys leucogaster pallescens Merriam

Northern Grasshopper Mouse

Onychomys melanophrys pallescens Merriam, N. Amer. Fauna, 3:61, September 11, 1890, type from Moki Pueblos, Navajo County, Arizona.
Onychomys leucogaster pallescens, Benson, Univ. California Publ. Zoöl., 40:451, December 31, 1935.
Onychomys leucogaster melanophrys, Hollister, Proc. U. S. Nat. Mus., 47:444, October 29, 1914; Tanner and Hayward, Proc. Utah Acad. Sci. Arts and Letters, 11:212, 1934; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 193, 1942.

Range.—Southeastern Utah, east of the Colorado and Green rivers.

Description and comments.—Measurements of 2 adult males, numbers 44031 and 95138 (M.V.Z.) and of 3 adult females, numbers 44030, 44029 (M.V.Z.) and 806, from San Juan County, are, respectively, as follows: Total length, 152, 143, 141, 144, 141; length of tail, 40, 42, 42, 44, 40; length of hind foot, 23, 22, 21, 21.5, 21; length of ear, 18, 15, 13, 13, 18. Color: Upper parts Avellaneous, lightly mixed with brownish in middorsal region; darkest on top of head and lower back; nose lighter than head; ear tufts pale buffy; ears blackish margined with white; eye ring dark brown; proximal dorsal two-thirds of tail grayish brown; sides and hips Vinaceous-Cinnamon; front

feet, hind feet, ventral surface of tail, dorsal surface of distal third of tail and entire underparts white. Skull: Large; braincase well inflated; postpalatal part long; cheek teeth large.

Specimens from Utah of this subspecies may be distinguished from topotypes and near topotypes of *Onychomys leucogaster utahensis* as follows: Size larger; tail longer; hind foot longer. Color: Darker (much less gray, rufescent colors much brighter); ear tufts darker (pale buff as opposed to white). Skull: Longer; braincase more inflated; cheek teeth larger.

Among named subspecies of *Onychomys leucogaster, O. l. pallescens* most closely resembles *Onychomys leucogaster melanophrys.* Specimens of *O. l. pallescens* from Utah may be distinguished from topotypes of *O. l. melanophrys* as follows: Hind foot longer. Color: A trifle lighter. Skull: Zygomatic arches not so flared out posteriorly; braincase much wider; postpalatal length greater; braincase deeper; alveolar length of upper molar series greater; teeth larger; infraorbital foramina wide (especially dorsally) as opposed to slitlike.

In Hollister's (1914:444) revision of the grasshopper mice, the name *O. l. pallescens* was arranged as a synonym of *O. l. melanophrys,* but Benson (1935:451) revived the name *O. l. pallescens* for animals from the Painted Desert in Arizona and the vicinity of Navajo Mountain, Utah. Superficially, animals from Utah from both sides of the Colorado River are similar, but cranial characters readily separate the two populations. Two of these characters that are remarkably constant are those of size of the braincase and shape of the infraorbital foramina (see comparisons). I, therefore, agree with Benson (*loc. cit.*) and refer the animals from Utah, east of the Green and Colorado rivers to the subspecies *Onychomys leucogaster pallescens.* A specimen from one mile east of Green River is an intergrade between *O. l. pallescens* and *O. l. melanophrys;* it resembles *O. l. pallescens* in color but in some cranial characters it resembles *O. l. melanophrys.* The width of the braincase and the shape of the infraorbital foramina are more as in *O. l. pallescens* to which the specimen is here referred.

Specimens examined.—Total, 24, distributed as follows: *Grand County:* 1 mi. E Green River, 4,080 ft., 1 (M.V.Z.); 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., 4; 1 mi. E Highway 160, 10 mi. S Valley City, 4,000 ft., 1; Highway 160, 14 mi. N Moab, 4,500 ft., 10; brush flat, Highway 160, 6 mi. N Moab, 4,200 ft., 2. *San Juan County:* Bluff, 4,400 ft., 4 (3, M.V.Z.); 1.6 mi. SW Bluff, 4,400 ft., 1; Lime Wash, 5 mi. NE Mexican Hat, 4,500 ft., 1 (M.V.Z.).

Additional records.—Grand County (Tanner and Hayward, 1934:212): Moab. *San Juan County* (Hollister, 1914:446): Riverview.

Onychomys torridus longicaudus Merriam

Southern Grasshopper Mouse

Onychomys longicaudus Merriam, N. Amer. Fauna, 2:2, October 30, 1889, type from St. George, 2,750 feet, Washington County, Utah; Barnes, Bull. Univ. Utah, 12(no. 15):64; April, 1922.

Onychomys torridus longicaudus Merriam, Proc. Biol. Soc. Washington, 17:123, June 9, 1904; Hollister, Proc. U. S. Nat. Mus., 47:463, October 29. 1914; Barnes, Bull. Univ. Utah, 17 (no. 12):112, June, 1927; Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938; Long, Journ. Mamm., 21:177, May 16, 1940; Hardy, Ecol. Monogr., 15:87, January, 1945; Hardy, Journ. Mamm., 30:435, November 17, 1949.

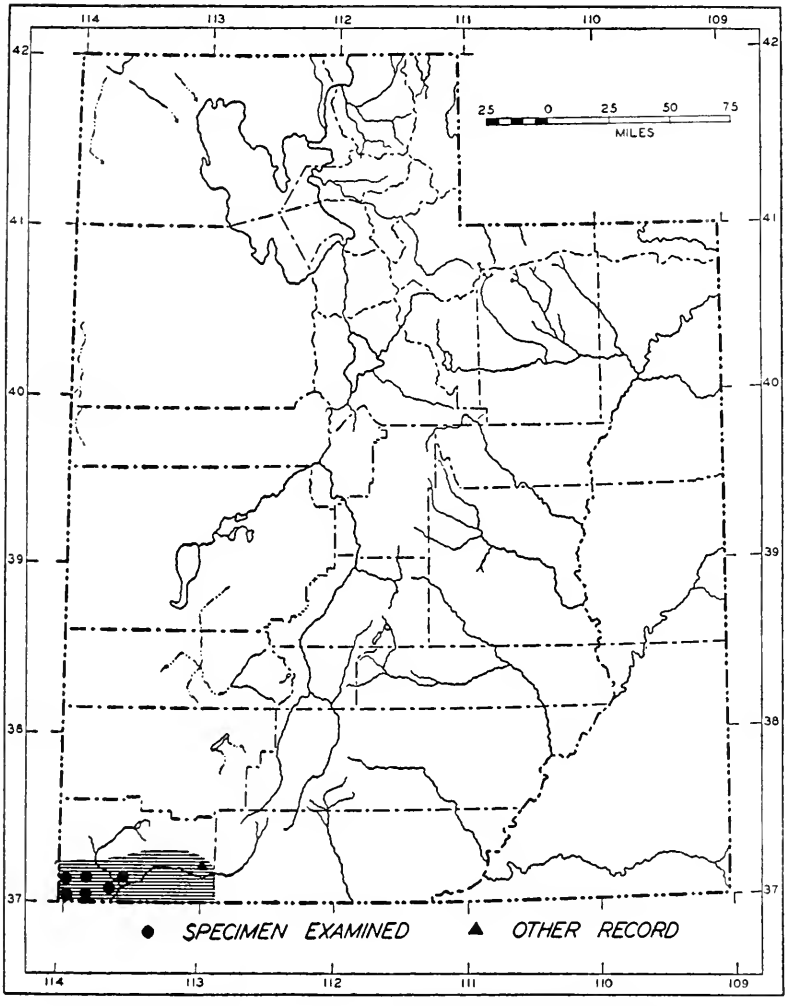

FIG. 53. Distribution of *Onychomys torridus longicaudus*.

Range.—Southwestern Utah.

Description and comments.—Measurements of one male, number 3261, and average and extreme measurements of 7 female near topotypes are, respectively, as follows: Total length, 136, 139 (147-133); length of tail, 46, 46 (51-39); length of hind foot, 20, 20 (21-18); length of ear, 16, 16 (17-15). Tail relatively long. Color: Upper parts Avellaneous grading to Vinaceous-Buff on lower sides; ears margined with silvery white; tufts at anterior base of ear buffy white; dorsal surface of tail like back, with more admixture of brown; front feet, hind feet, muzzle, cheeks, ventral surface of tail and entire underparts white, slightly washed with pale buff in some specimens. Skull: Small; interorbital region relatively wide; posterior margin of palate truncate never with spine; first molar usually more than half the length of tooth-row; incisive foramina small, rarely reaching anterior margin of first molar.

In color, *Onychomys torridus longicaudus* might be confused with members of the species *Onychomys leucogaster,* but is easily distinguished from the latter by longer tail, and by markedly smaller skull.

Onychomys torridus is a southern and western species which ranges northward into extreme southwestern Utah where the subspecies *O. t. longicaudus* occurs.

Specimens examined.—Total, 27, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 2; 1½ mi. E Beaverdam Wash, 8 mi. N Utah-Arizona Border, 3,200 ft., 4; St. George, 2,880 ft., 5 (M.V.Z.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 6; Beaverdam Wash, 5 mi. N Utah-Arizona Border, 2,600 ft., 7; W slope Beaverdam Mountains, 5 mi. N Utah-Arizona Border, 3,300 ft., 3.

Additional record (Presnall, 1938:15).—S Boundary Zion National Park.

TABLE 15

Cranial Measurements of Cricetid Mice

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Greatest breadth of braincase	Zygomatic breadth	Interorbital breadth	Length of palatal shelf	Length of incisive foramina	Length of diastema	Postpalatal length	Alveolar length of maxillary tooth-row
		Reithrodontomys megalotis megalotis, St. John									
7 av.	♂	20.3	7.7	10.2	10.6	3.1	3.5	3.6	4.4	6.5	3.0
Max.	♂	22.0	8.5	10.5	11.0	3.2	3.8	3.9	4.8	6.8	3.3
Min.	♂	20.0	7.1	10.0	10.3	3.0	3.1	3.1	4.1	6.1	2.9
4 av.	♀	21.3	8.1	10.2	11.0	3.1	3.6	3.6	4.4	6.7	3.0
Max.	♀	22.4	8.7	10.6	11.8	3.2	4.0	4.0	4.6	7.1	3.1
Min.	♀	19.8	7.4	9.7	10.5	3.0	3.1	3.1	4.2	6.4	3.0
		Reithrodontomys megalotis rarus, Grantsville									
263961 USNM	♂	20.6	7.8	10.2	10.6	3.4	3.2	3.7	.....	.....	2.8

TABLE 15.—*Continued*

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Greatest breadth of braincase	Zygomatic breadth	Interorbital breadth	Length of palatal shelf	Length of incisive foramina	Length of diastema	Postpalatal length	Alveolar length of maxillary tooth-row
		Reithrodontomys megalotis aztecus, ½ mi. N Bluff									
♂♂♂	7 av.	21.3	8.3	10.3	10.8	3.3	3.8	3.9	4.7	7.1	3.2
♂♂♂	Max.	21.7	8.6	10.4	11.0	3.5	4.0	4.0	4.9	7.3	3.4
♂♂♂	Min.	21.1	8.0	10.1	10.4	3.0	3.5	3.6	4.6	6.8	3.1
♀	5 av.	21.4	8.2	10.3	10.8	3.2	3.7	3.9	4.7	7.1	3.2
♀	Max.	22.0	8.8	10.6	11.2	3.3	4.0	4.1	4.9	7.4	3.3
♀	Min.	20.9	7.8	10.0	10.5	3.0	3.4	3.8	4.6	6.8	3.0
		Peromyscus crinitus pergracilis, (Hall and Hoffmeister, 1942: 54)									
♂	9 av.	24.9	9.4	11.8	.....	4.3	3.8	5.0	6.1	8.6	3.5
♂♂♂	Max.	25.5	9.9	12.1	.....	4.9	4.2	5.4	6.3	8.8	3.6
♂♂♂	Min.	24.4	8.7	11.5	.....	4.1	3.5	4.6	5.8	8.4	3.3
♀	11 av.	25.0	9.5	11.9	.....	4.3	3.8	5.0	6.1	8.7	3.5
♀	Max.	25.5	9.9	12.2	.....	4.5	3.9	5.3	6.5	9.2	3.6
♀	Min.	23.5	8.6	11.5	.....	4.1	3.5	4.7	5.7	8.2	3.2
		Peromyscus crinitus doutti, topotypes									
♂♂♂	9 av.	25.6	9.4	12.5	.....	4.6	4.1	4.4	5.7	8.4	3.45
♂♂♂	Max.	26.2	10.0	12.7	.....	4.8	4.5	4.7	6.0	8.7	3.5
♂♂♂	Min.	25.1	9.0	12.0	.....	4.3	3.9	4.1	5.3	8.0	3.3
♀	5 av.	25.6	9.5	12.4	.....	4.5	4.1	4.4	5.9	8.5	3.5
♀	Max.	26.2	10.0	12.7	.....	4.6	4.2	4.5	6.1	8.8	3.5
♀	Min.	25.2	9.2	12.3	.....	4.5	4.0	4.1	5.7	8.3	3.4
		Peromyscus crinitus auripectus, San Juan County									
♂♂♂	6 av.	25.5	9.6	12.1	12.4	4.5	3.7	4.4	5.7	8.4	3.5
♂♂♂	Max.	26.0	10.6	12.4	12.5	4.7	3.7	4.7	6.0	8.5	3.7
♂♂♂	Min.	25.1	9.0	12.0	12.3	4.2	3.5	4.2	5.5	8.3	3.5
♀	804	26.2	10.8	12.4	12.7	4.4	4.2	4.8	5.9	8.4	4.1
		Peromyscus crinitus stephensi, Washington County									
♂♂♂	6 av.	24.7	9.4	11.7	11.9	4.2	3.8	4.3	5.4	8.1	3.4
♂♂♂	Max.	25.6	10.0	12.2	12.5	4.4	4.0	4.7	5.7	8.8	3.7
♂♂♂	Min.	24.0	8.4	11.5	11.5	3.8	3.5	4.0	5.2	7.7	3.2
♀	6 av.	24.3	9.0	11.6	11.8	4.2	3.8	4.2	5.3	8.2	3.4
♀	Max.	24.8	9.3	11.7	12.0	4.4	4.0	4.3	5.6	8.3	3.5
♀	Min.	23.6	8.8	11.5	11.6	4.1	3.6	4.1	5.2	8.1	3.2

TABLE 15.—*Continued*

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Greatest breadth of braincase	Zygomatic breadth	Interorbital breadth	Length of palatal shelf	Length of incisive foramina	Length of diastema	Postpalatal length	Alveolar length of maxillary tooth-row
		Peromyscus eremicus eremicus, Washington County									
♂	5 av.	24.5	8.9	12.0	12.4	3.9	4.4	4.1	5.4	8.5	3.9
♂	Max.	25.7	9.4	12.3	12.8	4.1	4.7	4.4	5.6	8.7	4.0
♂	Min.	23.3	8.6	11.6	12.1	3.6	4.0	4.0	5.2	8.2	3.8
♀	4007	24.8	8.6	11.9	12.0	3.9	4.3	4.0	5.1	8.7	4.0
♀	4159	.....	.....	.....	.....	3.9	4.0	4.2	5.4	.....	3.8
♀	4160	24.3	9.2	.....	.....	3.9	4.0	4.0	5.6	8.5	3.7
		Peromyscus maniculatus sonoriensis, Parrish Ranch									
♂	31 av.	25.1	9.9	11.7	12.6	4.0	4.0	4.8	5.9	8.5	3.55
♂	Max.	26.2	10.6	12.3	13.5	4.2	4.3	5.2	6.4	9.0	3.7
♂	Min.	24.0	9.3	11.2	11.8	3.7	3.5	4.4	5.5	7.9	3.3
♀	23 av.	25.3	9.9	11.9	12.8	4.1	3.9	4.9	6.0	8.7	3.5
♀	Max.	26.3	10.7	12.2	13.3	4.2	4.3	5.2	6.5	9.0	3.7
♀	Min.	24.0	8.8	11.2	12.0	3.8	3.3	4.3	5.3	8.1	3.3
		Peromyscus maniculatus rufinus, topotypes and near topotypes									
♂	9 av.	25.2	10.3	11.6	12.4	3.8	3.8	4.9	6.0	8.6	3.5
♂	Max.	26.0	10.8	12.2	12.9	4.2	4.5	5.1	6.2	9.0	3.8
♂	Min.	24.7	9.6	11.2	11.1	3.7	3.4	4.7	5.7	8.2	3.3
♀	4 av.	25.1	10.1	11.5	12.1	4.0	3.9	4.9	6.2	8.7	3.5
♀	Max.	25.6	10.3	12.1	13.3	4.1	3.9	5.0	6.3	8.9	3.7
♀	Min.	24.4	9.7	11.0	11.3	3.8	3.8	4.8	6.1	8.2	3.4
		Peromyscus maniculatus osgoodi, near topotypes									
♂	8 av.	25.4	10.3	11.6	13.1	3.9	4.0	5.1	6.4	8.4	3.5
♂	Max.	26.2	10.6	12.0	13.5	4.3	4.1	5.4	6.6	8.8	3.5
♂	Min.	24.8	10.1	11.5	12.5	3.8	3.7	4.6	6.1	8.3	3.4
♀	4 av.	25.5	10.7	11.8	13.0	3.9	4.0	5.0	6.4	8.7	3.6
♀	Max.	25.7	11.4	12.1	13.3	4.0	4.6	5.4	6.7	8.9	3.7
♀	Min.	25.2	10.1	11.5	12.8	3.7	3.7	4.7	6.3	8.5	3.6
		Peromyscus maniculatus inclarus, topotypes									
♂	264115 USNM	27.0	10.6	12.1	13.5	4.1	4.7	5.0	6.3	8.7	3.6
♂	264116 USNM	.....	10.6	.....	.....	4.4	4.5	5.1	6.2	.....	3.9
♂	264118 USNM	.....	10.1	12.2	13.3	4.2	4.2	4.7	5.8	.....	3.8
♀	264117 USNM	.....	10.9	12.0	13.9	4.3	4.3	5.7	6.5	.....	3.9
		Peromyscus boylii utahensis, topotypes									
♀	5 av.	27.9	11.1	13.3	13.9	4.5	4.4	5.2	7.0	9.5	4.05
♀	Max.	28.3	11.2	13.4	14.0	4.5	4.5	5.4	7.1	9.7	4.1
♀	Min.	27.6	10.8	13.2	13.7	4.4	4.2	4.1	6.8	9.1	4.0

TABLE 15.—*Concluded*

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Length of nasals	Greatest breadth of braincase	Zygomatic breadth	Interorbital breadth	Length of palatal shelf	Length of incisive foramina	Length of diastema	Postpalatal length	Alveolar length of maxillary tooth-row
		Peromyscus boylii rowleyi, San Juan County									
♂	5116	28.1	11.0	13.0	13.6	4.5	4.6	5.2	6.8	9.3	4.0
♀	4 av	27.1	10.3	12.7	13.4	4.3	4.5	4.9	6.6	9.2	4.1
♀	Max	27.8	10.6	13.4	14.1	4.7	4.7	5.1	7.1	9.5	4.2
♀	Min	26.5	9.7	12.3	13.0	4.1	4.2	4.7	6.0	8.9	3.9
		Peromyscus truei nevadensis (Hall and Hoffmeister, 1940: 404), ♂ & ♀									
	6 av	29.3	10.9	13.4	.....	4.5	4.3	6.0	7.2	10.5	4.3
	Max	31.1	11.5	13.6	.....	4.7	4.5	6.2	7.8	11.0	4.4
	Min	28.7	10.6	13.1	.....	4.3	4.1	5.8	7.0	9.9	4.2
		Peromyscus truei truei, Grand County									
♂	908	27.6	10.0	12.6	13.2	4.5	3.9	5.3	6.5	9.5	4.1
♂	964	27.7	10.2	12.7	13.3	4.4	4.3	4.7	5.7	9.5	4.2
♀	6 av	27.9	10.4	12.8	13.4	4.4	4.1	5.0	6.4	9.5	4.1
♀	Max	29.2	11.0	13.5	14.1	4.6	4.3	5.1	6.7	9.9	4.2
♀	Min	27.2	10.1	12.1	13.1	4.3	4.0	5.0	6.2	9.2	4.0
		Peromyscus nasutus nasutus, (Osgood, 1909b: 266)									
?		29.4	11.2	.....	14.5	4.4	4.2	5.5	7.4	10.1	4.3
?		28.7	11.1	.....	13.5	4.3	4.3	5.6	7.4	9.5	4.2
		Onychomys leucogaster utahensis, Ibapah									
♂	3637	26.3	10.0	12.6	14.6	5.0	5.1	4.5	6.9	9.4	3.8
♂	3638	25.9	10.1	12.3	14.1	4.8	4.8	4.2	6.8	9.3	3.7
♀	3636	26.8	10.2	12.0	14.0	4.5	5.0	4.5	7.0	9.1	3.9
♀	3715	27.0	10.1	12.3	14.0	4.7	5.0	4.7	7.0	10.0	3.7
		Onychomys leucogaster melanophrys, topotypes									
♂	56167 MVZ	27.7	11.1	12.5	14.5	4.8	5.3	4.6	6.4	9.8	4.4
♀	56168 MVZ	26.8	11.1	12.2	14.5	4.7	5.0	4.6	6.1	9.0	4.4
		Onychomys leucogaster pallescens, San Juan County									
♂	44031 MVZ	28.9	11.5	12.9	14.7	4.7	5.3	4.9	6.8	10.2	4.8
♂	95138 MVZ	27.1	10.5	13.0	.....	4.8	5.0	4.7	6.5	9.2	4.7
♀	44029 MVZ	26.2	10.5	13.0	14.0	4.8	5.5	4.1	5.9	8.9	4.7
♀	44030 MVZ	26.3	9.5	12.6	.....	4.8	4.8	4.5	6.2	9.3	4.5
♀	806	26.7	10.3	12.5	14.0	5.0	5.1	4.3	6.1	9.7	4.4
		Onychomys torridus longicaudus, Washington County									
♂	3261	25.1	9.5	.....	.....	5.2	4.9	4.8	6.0	8.5	3.7
♀	7 av	24.4	9.3	11.5	12.7	4.9	4.8	3.7	5.8	8.4	3.8
♀	Max	25.0	10.1	11.6	13.1	5.1	5.1	4.1	6.1	8.7	4.0
♀	Min	24.1	8.8	11.4	12.2	4.5	4.6	3.4	5.5	8.2	3.6

Neotoma albigula brevicauda Durrant

White-throated Wood Rat

Neotoma albigula brevicauda Durrant, Journ. Mamm., 15:65, February 15, 1934, type from Castle Valley, approximately 15 miles northeast of Moab, Grand County, Utah; Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935; Vorhies and Taylor, Univ. Arizona Tech. Bull. Ag. Exp. Stat., 86:461, June 1, 1940.

Range.—Known only from the type locality.

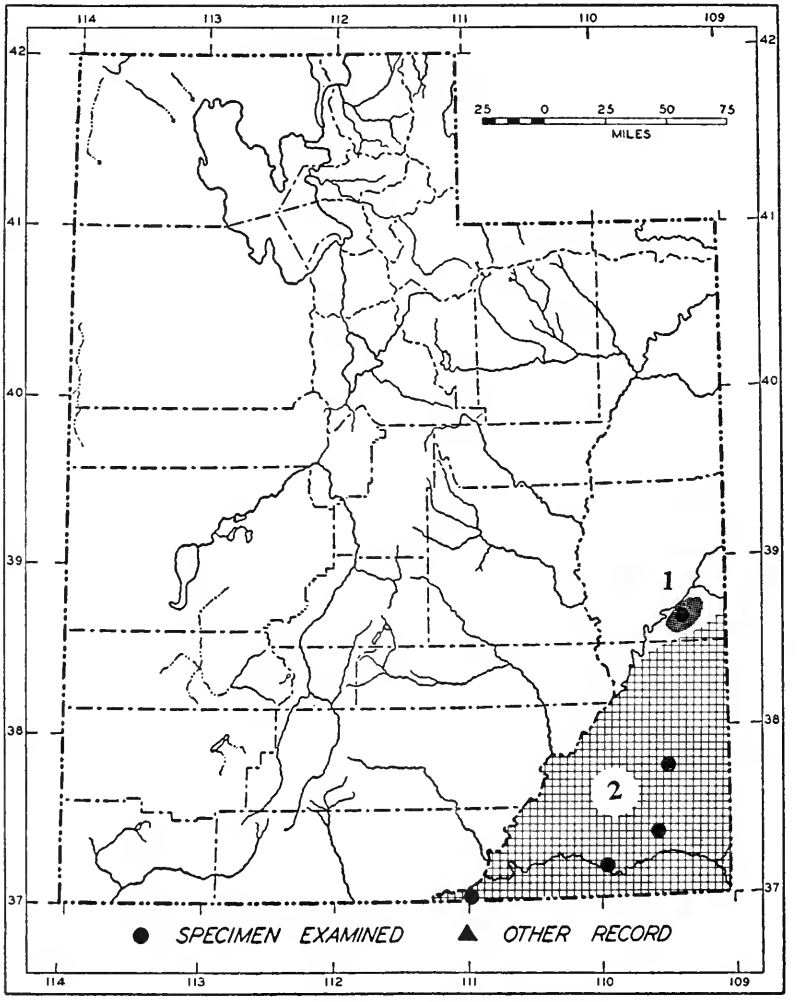

FIG. 54. Distribution of *Neotoma albigula*.
1. *N. a. brevicauda.* 2. *N. a. laplataensis.*

Description and comments.—Average and extreme measurements of 5 adult males and 5 adult females (all topotypes) are, respectively, as follows: Total length, 311 (316-295), 312 (319-305); length of tail, 128 (135-123), 128 (133-118); length of hind foot, 32.7 (36-30), 31.3 (32-30). Ears large; tail and hind foot short. Color: Upper parts near Saccardo's Umber, owing to mixture of Pinkish Buff, dark brown and grayish, heaviest in middorsal region; ears sparsely haired and light brown; orbital ring indistinct; tail bicolored, dorsal stripe of tail distinct, dark brown in color; sides and flanks near (16″) Pinkish Buff; thighs grayish, overlaid with light wash of Pinkish Buff; vibrissae dark basally; front feet, hind feet, ventral surface of tail and entire underparts white; hair of chin, throat and anterior pectoral region white to base, elsewhere plumbeous at base. Skull: Large; robust; interpterygoid space so narrowly concave as to be nearly V-shaped, with the apex of the "V" extending forward almost to level of anterior border of third molar; incisive foramina long; palatal bridge short.

Comparison of topotypes of *N. a. brevicauda* with the type and three topotypes of *Neotoma albigula laplataensis* shows the former to differ as follows: Size larger; hind foot smaller; tail actually as well as relatively shorter. Skull: Decidedly larger; incisive foramina actually as well as relatively longer; rostrum heavier and longer; infraorbital foramina more slitlike.

From near topotypes of *Neotoma albigula albigula* and *Neotoma albigula warreni*, *N. a. brevicauda* differs in: Tail and hind foot shorter; ear longer; interpterygoid space V-shaped as opposed to U-shaped; incisive foramina relatively as well as actually longer; palatal bridge relatively as well as actually shorter.

Neotoma albigula is a southern species and *N. a. brevicauda* is the northernmost subspecies. The Colorado River may have prevented the species from extending its range westward in this latitude.

Specimens examined.—Total, 23, from the type locality (1, M.V.Z.).

Neotoma albigula laplataensis Miller

White-throated Wood Rat

Neotoma albigula laplataensis Miller, F. W., Proc. Colorado Mus. Nat. Hist., 12:2, July 22, 1933, type from "near" Bondad, La Plata County, Colorado; Benson, Univ. California Publ. Zoöl., 40:452, December 31, 1935.

Range.—Southeastern Utah, in San Juan County.

Description and comments.—Measurements of one adult male, number 1216, and one adult female, number 1219, from Johns Canyon are, respectively, as follows: Total length, 302, 282; length of tail, 125, 130; length of hind foot, 32, 32; ratio of length of tail to length of head and body 70.6 and 85.5 per cent. Color: Similar to *Neotoma albigula brevicauda* but lighter, owing to less admixture of black. Skull: Size medium; palatal bridge long; alveolar length of upper molar series long.

For comparison with *Neotoma albigula brevicauda,* see account of that subspecies.

Specimens of *N. a. laplataensis* from Utah differ from those of *Neotoma albigula albigula* from northern Arizona in paler color (fewer black hairs), and longer and wider upper molars.

Insofar as indicated by the available material, *N. a. laplataensis* has the largest range within the state of any subspecies of *Neotoma albigula.* Its range includes practically all of San Juan County. Animals from Utah are not typical of *N. a. laplataensis,* but are intergrades between it and *N. a. albigula.* Benson (1935:452-453) provisionally referred animals from Navajo Mountain to *N. a. laplataensis,* and pointed out that they were intergrades with *N. a. albigula* which occurs in northern Arizona. Little or no intergradation occurs with *N. a. brevicauda* of Grand County to the north. The areas where intergradation might be expected to occur have not yet been thoroughly collected. Additional specimens from southern Grand and northern San Juan counties may yet disclose intergrades between *N. a. brevicauda* and *N. a. laplataensis.*

Specimens examined.—Total, 8, distributed as follows: *San Juan County:* Recapture Canyon, 12 mi. N Blanding, 6,000 ft., 1 (M.V.Z.); 8 mi. N Bluff, 4,700 ft., 1 (M.V.Z.); Johns Canyon, San Juan River, 5,150 ft., 5; Rainbow Bridge, 4,000 ft., 1 (M.V.Z.).

Neotoma mexicana inopinata Goldman

Mexican Wood Rat

Neotoma mexicana inopinata Goldman, Journ. Washington Acad. Sci., 23:471, October 15, 1933, type from Chuska Mountains, 8,000 feet, New Mexico; Benson, Univ. California Publ. Zoöl., 40:453, December 31, 1935.

Range.—Southeastern Utah, east of the Colorado River. See figure 55.

Description and comments.—Measurements of 3 adult males, numbers 943, 944 and 1220, and one adult female, number 919 from southeastern Utah are, respectively, as follows: Total length, 295, 320, 310, 290; length of tail, 105, 145, 130, 130; length of hind foot, 32, 34, 33, 31; length of ear, 22, 19, 27, 26. Color: Upper parts Cinnamon-Buff, heavily mixed with dark brown in middorsal region, purest on sides, flanks and cheeks; ears light brown, narrowly margined with white; vibrissae long, mixed white and dark brown; tail sharply bicolored, dark brown above, white below; front feet, hind feet and entire underparts white (Cinnamon-Buff present occasionally in pectoral and midabdominal regions). Skull: Large and angular; rostrum heavy; tympanic bullae actually as well as relatively small; interpterygoid space wide; braincase wide and well inflated; depth of anterior re-entrant angle of first upper molar usually more than one half width of tooth; exterolateral re-entrant angle occasionally present in last lower molar; maxillary tooth-row actually as well as relatively long; molars massive.

Of this species, *N. m. inopinata* is the only subspecies known to occur in Utah, and when examined superficially it may be confused with *Neotoma lepida* or *Neotoma stephensi,* but can be distinguished from these two species by the following cranial characters: Zygomatic arches more widely spreading; jugals heavier; rostrum heavier; tympanic bullae markedly smaller; braincase wider and more inflated; molars actually as well as relatively much larger; interpterygoid space markedly wider.

From the material at hand, it appears that the animals from Utah are intergrades combining the characters of *Neotoma mexicana inopinata, Neotoma mexicana fallax* and *Neotoma mexicana pinetorum.* Benson (1935:453) critically examined the animals from Utah and assigned them to *N. m. inopinata,* and I agree with his assignment.

Specimens examined.—Total, 22, distributed as follows: *Grand County:* Mouth of Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 3,995 ft., 2; Colorado River, 5 mi. E Moab, 4,000 ft., 3. *San Juan County:* Devil Canyon, 14 mi. S Monticello, 6,800 ft., 1; 14 mi. N Blanding, Johnson Creek, 7,500 ft., 1; Recapture Canyon, 12 mi. N Blanding, 6,000 ft., 1 (M.V.Z.); Bluff, 4,400 ft., 8 (M.V.Z.); Johns Canyon, San Juan River, 5,150 ft., 1; War God Spring, Navajo Mountain, 8,400 ft., 5 (M.V.Z.).

Neotoma lepida lepida Thomas

Desert Wood Rat

Neotoma lepida Thomas, Ann. and Mag. Nat. Hist. (Ser. 6), 12:235, September, 1893, type from along 39th parallel somewhere between Camp Floyd, Utah and Genoa, Nevada.

Neotoma desertorum, Allen, Sci. Bull. Brooklyn Inst., Arts and Sci., 1:121, March 31, 1905; Goldman, N. Amer. Fauna, 31:76, October 19, 1910; Warren, The mammals of Colorado, Knickerbocker Press, p. 115, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):71, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):120, June, 1927; Stanford, Journ. Mamm., 12:360, November 11, 1931.

Neotoma lepida lepida, Barnes, Bull. Univ. Utah, 17 (no. 12):122, June, 1927; Goldman, Journ. Mamm., 13:61, February 9, 1932; Marshall, Journ. Mamm., 21:156, May 16, 1940; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 216, 1942; Fautin, Ecol. Monogr., 16:304, October, 1946.

Neotoma l[epida]. lepida, Hardy, Ecol. Monogr., 15:87, January, 1945.

Neotoma lepida subsp. (part), Long, Journ. Mamm., 21:178, May 16, 1940.

Range.—Entire western half of state in area formerly occupied by Pleistocene Lake Bonneville; in Washington County west of the Beaverdam Mountains.

Description and comments.—Measurements of 3 adult males, numbers 4032, 4023 and 4021 and average and extreme measurements of 4 adult females from Beaverdam Wash are, respectively, as follows: Total length, 295, 292, 280, 269 (290-232); length of tail, 123, 122, 126, 113 (122-96); length of hind foot, 32, 32, 31, 30.5 (33-28); length of ear, 27, 30, 28, 25.5 (26-25). Color: Upper parts between Pinkish Buff and Cinnamon-Buff interspersed

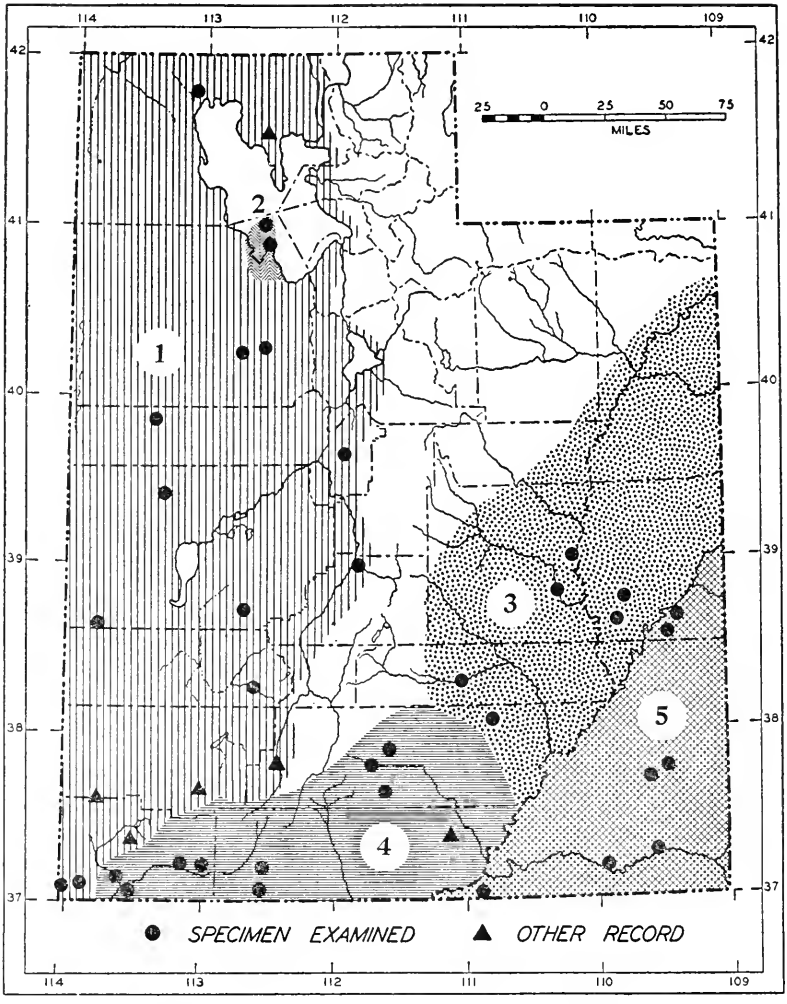

FIG. 55. Distribution of *Neotoma lepida* and *Neotoma mexicana*.
Guide to subspecies 2. *N. l. marshalli.* 4. *N. l. monstrabilis.*
1. *N. l. lepida.* 3. *N. l. saurafaeli.* 5. *N. m. inopinata.*

with gray and dark brown, darkest in middorsal region; sides and flanks Pinkish Buff; ears sparsely haired, Saccardo's Umber; outer margin of front legs and lower margins of cheeks Pale Ochraceous-Buff; front and hind feet white; dorsal surface of tail grayish brown; ventral surface of tail light; entire underparts white, hairs plumbeous at base everywhere except pectoral and inguinal regions where white to base (occasional specimens show buffy wash on underparts, many specimens have buffy spots in pectoral region). Skull: Large; tympanic bullae well inflated; interpterygoid space wide posteriorly.

Utah-taken specimens of *N. l. lepida* can be distinguished from those of *Neotoma lepida monstrabilis* by: Size larger. Color: Lighter owing to less intense Pinkish Buff and less admixture of black. Skull: Larger in almost all measurements taken; braincase less rounded and less inflated proportionally.

From *Neotoma lepida marshalli, N. l. lepida* differs as follows: Size slightly smaller. Skull: Palatal bridge longer; tympanic bullae less inflated; interparietal more nearly truncate laterally; foramen magnum less emarginate dorsally; infraorbital foramina more slitlike; interpterygoid space wider posteriorly.

Hall (1946:529) shows the range of *N. l. lepida* in Nevada to extend the entire length of the western boundary of Utah. Davis (1939:296) shows the range of *Neotoma lepida nevadensis* in Idaho as extending to the northwestern border of Utah. Therefore, animals from northwestern Utah would be expected to be intergrades between *N. l. lepida* and *N. l. nevadensis.* However, all specimens are patently *N. l. lepida.*

The more southern the origin of the specimen, the more resemblance there is to *Neotoma lepida monstrabilis.* Animals are available from Millard County and from several localities south thereof. Specimens from Swasey Spring and Paxton's Ranch are readily referable to *N. l. lepida.* Those from Warm Cove have cranial characters of both *N. l. lepida* and *N. l. monstrabilis.* The shape of the posterior border of the palate is like that of *N. l. monstrabilis.* These specimens resemble *N. l. lepida* in the shape of the interparietal, length of the extension of the premaxillae posterior to the nasals and in the size of the cheek teeth. These specimens are all referred to *N. l. lepida.* A single specimen available from Sevier County is somewhat darker than other *N. l. lepida,* but as adequate material is lacking from this area between the Pah-Vant and Wasatch mountains, this single specimen is referred provisionally to *N. l. lepida* which it resembles more than it does *N. l. monstrabilis.*

In extreme southwestern Utah, in Washington County, intergradation between the two aforementioned subspecies becomes complex. With the exception of the specimens from Zion National Park which are definitely *N. l. monstrabilis,* the remainder of the specimens from Washington County are all intergrades of varying degree between *N. l. lepida* and *N. l. monstrabilis.* Goldman (1932:63) recognized that the animals from the Virgin Mountains and Littlefield, barely over the state line in Arizona, were intergrades between *N. l. monstrabilis* and *N. l. lepida.* Hardy (1945:

95) assigned the animals from east of the Beaverdam Mountains, in Utah to *N. l. monstrabilis*, and those from west of these mountains, in Beaverdam Wash to *N. l. lepida* but gave no detailed reasons for his assignments. Specimens from St. George, although having some characters of *N. l. lepida*, are readily referable to *N. l. monstrabilis* in the majority of characters studied. Animals from the general area of Beaverdam Wash and Castle Cliffs vary considerably in size, color and cranial characters and could be referred either to *N. l. lepida* or *N. l. monstrabilis* with equal propriety. Among others, Durrant (1943), Durrant and Setzer (1945) and Hardy (*loc. cit.*) have pointed out that the Beaverdam Mountains are an effective barrier to the distribution of other rodents in the region concerned. In general, however, the animals mentioned by these authors are kinds which are closely limited to certain types of soil or vegetation. The ubiquitous wood rat, however, finds suitable habitat throughout this entire region. Influenced by Hardy's (*loc cit.*) previous assignment of the specimens from the general area of Beaverdam Wash and Castle Cliffs to *N. l. lepida*, the specimens are here likewise assigned although they could with equal propriety be referred to *N. l. monstrabilis*.

Specimens examined.—Total, 74, distributed as follows: *Boxelder County:* Kelton, 4,225 ft., 4 (M.V.Z.). *Tooele County:* Skull Valley, 3 mi. W Willow Springs, 5,000 ft., 1; Orr's Ranch, Skull Valley, 4,300 ft., 2. *Juab County:* Fish Springs, 4,400 ft., 2; 7 mi. SW Nephi, 6,000 ft., 1. *Millard County:* Swasey Spring, House Mountain, 6,500 ft., 3; Paxton's Ranch, 1; Warm Cove, 55 mi. W Milford, 5,500 ft., 3. *Sevier County:* Salina, 1. *Beaver County:* Beaver, 6,000 ft., 2 (M.V.Z.). *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona border, 2,800 ft., 22; Terry's Ranch, Beaverdam Wash, 2; Beaverdam Wash, 5 mi. N Utah-Arizona border, 3,300 ft., 28; Castle Cliffs, 1 mi. N Beaverdam Wash, 2,500 ft., 2.

Additional records.—*Boxelder County:* Promontory (Goldman, 1910:78). *Iron County:* Cedar City (Long, 1940:178). *Washington County:* Near Hebron (Goldman, *loc cit.*); Pine Valley (Goldman, *loc cit.*).

Neotoma lepida marshalli Goldman

Desert Wood Rat

Neotoma lepida marshalli Goldman, Journ. Mamm., 20:357, August 14, 1939, type from Carrington Island, Great Salt Lake, 4,250 feet, Tooele County, Utah; Marshall, Journ. Mamm., 21:153, May 16, 1940.

Range.—Known only from Carrington and Stansbury islands, Great Salt Lake.

Description and comments.—Measurements of 2 adult males, numbers 263983 and 263985 (U.S.N.M.), and 2 adult females, numbers 263978 and 263979 (U.S.N.M.) from the type locality are, respectively, as follows: Total length, 298, 269, 301, 280; length of tail, 132, 112, 173, 91; length of hind foot, 34, 32, 33, 32; length of ear, 30, 27, 28, 27. Color: Resembles that of *Neotoma lepida lepida*, but usually slightly lighter, with fewer dark hairs

dorsally. Skull: Large; palatal bridge actually as well as relatively short; tympanic bullae well inflated; infraorbital foramina wide (less slitlike); foramen magnum deeply emarginate dorsally.

For comparisons, see accounts of other subspecies of this species.

In naming this subspecies (Goldman, 1939b:357), separated it from *N. l. lepida* only on the basis of paler color and larger skull. I have studied approximately half of the material available to Goldman and in comparing it with *N. l. lepida,* from the adjacent mainland of Great Salt Lake, find no diagnostic differences in coloration, or size of skull. There are, however, cranial differences which readily separate this subspecies from the animals of the mainland (see account of *N. l. lepida*).

Goldman (*loc. cit.*) thought that *N. l. marshalli* occurred only on Carrington and Stansbury islands. Actually for the past 15 years Stansbury Island has been connected with the mainland and in this time vegetation has established itself on the now exposed lake bottom. Collecting now might reveal intergrades between *N. l. marshalli* and the subspecies, *N. l. lepida,* on the mainland.

Specimens examined.—Total, 4, distributed as follows: *Tooele County:* Carrington Island, Great Salt Lake, 3 (U.S.N.M.); Stansbury Island, Great Salt Lake, 1 (U.S.N.M.).

Neotoma lepida sanrafaeli Kelson

Desert Wood Rat

Neotoma lepida sanrafaeli Kelson, Journ. Washington Acad. Sci., 39:418, December 15, 1949, type from Rock Canyon Corral, 5 miles southeast of Valley City, 4,500 feet, Grand County, Utah.

Range.—Eastern Utah between the Colorado River and the High Plateaus, north to Jensen and Vernal, south to northern Garfield County.

Description and comments.—Average and extreme measurements of 5 adult males and the measurements of one adult female, number 6429, all from the type locality, are, respectively, as follows: Total length, 288 (312-267), 300; length of tail, 119 (128-115), 129; length of hind foot, 31 (34-28), 31. Color: Upper parts Light Buff to Light Ochraceous-Buff overlaid with blackish; cheeks, shoulders and flanks Light Ochraceous-Buff; feet white; tail distinctly bicolored, white beneath, hairs with buffy basal band, dusky above owing to mixture of black and buffy hairs; underparts white, hairs plumbeous as base except in pectoral, inguinal and narrow mid-belly strip. Skull: Large, ridged and angular; frontonasal region arched, distinctly concave ventrally; supraorbital ridges well developed; temporal ridges well developed; sphenopalatine vacuities moderate in size; palatal bridge long; upper molars long and wide.

From *Neotoma lepida lepida, N. l. sanrafaeli* differs in slightly larger size, generally buffier color, larger skull, more heavily ridged and deeper furrowed frontonasal region and more rounded and inflated braincase.

From *Neotoma lepida monstrabilis,* the nearest subspecies geographically and the one having the closest resemblance morphologically, *N. l. sanrafaeli* differs as follows: Color: Generally much lighter in ground color (certain specimens of *N. l. monstrabilis* in the light phase resemble *N. l. sanrafaeli*). Skull: Larger in every measurement taken except the breadth of the braincase in which they are equal; frontonasal region more heavily ridged and more deeply furrowed; palatal bridge markedly longer (all adult males of *N. l. sanrafaeli* measure more than 7.1 whereas none of 28 adult males of *N. l. monstrabilis* exceeded 6.9); upper molar series longer and wider (8.2×2.3 as opposed to 7.8×2.1).

The area of occurrence of this subspecies within the state of Utah is the same as that ascribed to the kangaroo rat, *Dipodomys ordii sanrafaeli,* by Durrant and Setzer (1945:26).

Garfield County in south-central Utah appears to be the area of intergradation between *N. l. sanrafaeli* and *N. l. monstrabilis.* Specimens in the collection of the Museum of Zoology of the University of Utah from the environs of Escalante in southern Garfield County are referable to *N. l. monstrabilis,* but they do have some characters of *N. l. sanrafaeli.* Two specimens, numbers 308 and 309, from King's Ranch at the western base of the Henry Mountains in northern Garfield County are also intergrades between the aforementioned subspecies. In color they resemble *N. l. monstrabilis,* but the majority of the diagnostic cranial characters, especially the larger molars, show them to be referable to *N. l. sanrafaeli.* These last mentioned specimens are the southernmost ones known of the subspecies *N. l. sanrafaeli.*

On the basis of 4 specimens from Rangely, Colorado, and 4 from the Henry Mountains, Garfield County, Utah, Goldman (1910:77) extended the geographic range of occurrence of *Neotoma desertorum,* now known as *Neotoma lepida lepida* (Goldman, 1932a:62), north along the Colorado and Green rivers as far as northeastern Utah and northwestern Colorado. Later, Goldman (1932a:62) named *N. l. monstrabilis* and ascribed to it a range in southern Utah and northwestern Arizona, west of the Colorado River. While he did include the specimens from the Henry Mountains of Utah in his newly named subspecies, he made no mention of those from Rangely, Colorado. This probably caused Warren (1942:216) to retain these Coloradan specimens in the subspecies *N. l. lepida.* While it is not the purpose of this study to report upon mammals of Colorado, I am of the definite opinion that animals from Colorado of the species *N. lepida,* do not belong to the subspecies *N. l.*

lepida. My reasons for the aforementioned opinion are that the known range of *N. l. lepida* in Utah is the western half of the state in the Great Basin drainage, and that part of eastern Utah, adjacent to Colorado which has animals of the species *N. lepida,* is populated by those of the subspecies *N. l. monstrabilis* and *N. l. sanrafaeli.* I suspect that these Coloradan animals are either referable to *N. l. sanrafaeli,* or represent an unnamed kind.

Specimens examined.—Total, 28, distributed as follows: *Emery County:* 7 mi. N Greenriver, 4,100 ft., 2; pump station, 4 mi. N Greenriver, 4,100 ft., 6; San Rafael River, 15 mi. SW Greenriver, 4,200 ft., 6. *Grand County:* Rock Canyon Corral, 5 mi. SE Valley City, 4,500 ft., 4; 1 mi. E Highway 160, 6 mi. S Valley City, 4,500 ft., [= Rock Canyon Corral], 6. *Wayne County:* Notom, 6,200 ft., 2. *Garfield County:* King's Ranch, 5,000 ft., 2.

Neotoma lepida monstrabilis Goldman

Desert Wood Rat

Neotoma lepida monstrabilis Goldman, Journ. Mamm., 13:62, February 9, 1932, type from Ryan, Kaibab National Forest, 6,000 feet, Coconino County, Arizona; Woodbury, Ecol. Monogr., 3:208, 213, April, 1933; Presnall, Zion-Bryce Mus. Bull., 2:15, January, 1938.
Neotoma l[epida]. monstrabilis, Tanner, Great Basin Nat., 1:109, June 30, 1940; Hardy, Ecol. Monogr., 15:98, January, 1945.
Neotoma lepida subsp. (part), Long. Journ. Mamm., 21:178, May 16, 1940.
Neotoma desertorum, Goldman, N. Amer. Fauna, 31:76, October 19, 1910.

Range.—Known from Washington, Kane and southern Garfield counties.

Description and comments.—Average and extreme measurements of 4 adult males and the measurements of 2 adult females, numbers 3240 and 3232, from Washington County, are, respectively, as follows: Total length, 266 (300-225), 260, 241; length of tail, 122.5 (150-115), 110, 95; length of hind foot, 32 (40-28), 31, 28; length of ear, 25 (26-24), 28, 23. Color: Similar to *Neotoma lepida lepida* but Pinkish Buff richer (more Cinnamon); upper parts contrastingly darker. Skull: Size medium; braincase large, rounded and well inflated.

From topotypes of *Neotoma lepida marshalli, N. l. monstrabilis* differs in smaller size, darker (more intense Pinkish Buff) color, and smaller skull in all measurements taken. For comparison with *Neotoma lepida lepida,* see account of that subspecies.

Intergradation of this subspecies with *Neotoma lepida sanrafaeli* occurs in Garfield County; it intergrades also with *N. l. lepida.* For comments on intergradation, see accounts of those subspecies.

Specimens examined.—Total, 35, distributed as follows: *Garfield County:* 7 mi. N Escalante, 6,500 ft., 1; 5 mi. W Escalante, 6,000 ft., 1; 8 mi. S Escalante, 5,200 ft., 1. *Washington County:* Zion National Park, 4,300 ft., 9 (1, M.V.Z.); Springdale, 3,900 ft., 3 (K.U.); St. George, 2,850 ft., 3 (M.V.Z.); Santa Clara Creek, 3 mi. SW St. George, 2,800 ft., 9; S side Virgin River, St. George, 2 (M.V.Z.). *Kane County:* 6 mi. N Kanab, 5,600 ft., 1 (K.U.) 1½ mi. N Kanab, 5,300 ft., 1 (K.U.); Kanab, 5,200 ft., 3 (M.V.Z.); Tinney Canyon, 4 mi. N Kanab, 5,000 ft., 1.

Additional record.—Kane County: Kaiparowits Plateau (Tanner, 1940:109).

Neotoma stephensi relicta Goldman

Stephens Wood Rat

Neotoma stephensi relicta Goldman, Journ. Mamm., 13:66, February 9, 1932, type from Keam Canyon, Navajo County, Arizona; Benson, Univ. California Publ. Zoöl., 40:454, December 31, 1935.

Range.—Extreme southeastern Utah; known only from the region of Navajo Mountain. See figure 56.

Description and comments.—Measurements of the type, a female, are: Total length, 312; length of tail, 141; length of hind foot, 28 (Goldman, 1932:67). Tail slightly bushy. Color: Upper parts Light Ochraceous-Buff, with admixture of black in middorsal region, purest on sides, flanks, cheeks and lateral surface of forearms; ears grayish brown; tail bicolored, grayish brown above, white below; front feet, hind feet and entire underparts white. Skull: Interparietal relatively small; anterior internal re-entrant angle of first upper molar shallow or absent; incisors small; alveolar length of upper molar series short.

When examined superficially, this subspecies may be easily confused with *Neotoma lepida,* but differs from it as follows: Tail longer haired, less sharply bicolored. Color: Lighter (more ochraceous). Skull: interorbital region broader and more nearly flat (supraorbital ridges less upturned); nasals broader proximally; interpterygoid space broader; enamel loops of anterior molars less oblique; upper incisors more recurved; outer re-entrant angles of first upper molar narrower; molars wider.

Specimens examined.—Total, 5, distributed as follows: *San Juan County:* Rainbow Bridge, 4,000 ft., 1 (M. V. Z.). Navajo Mountain Trading Post, 5 mi. SE Navajo Mountain, 4 (M. V. Z.).

Neotoma cinerea alticola Hooper

Bushy-tailed Wood Rat

Neotoma cinerea alticola Hooper, Univ. California Publ. Zoöl., 42:409, May 17, 1940, type from Parker Creek (= Shields Creek, U. S. Forest Service Map, edit. 1932), Warner Mountains, 5,500 feet, Modoc County, California.

Neotoma cinerea acraia, Hooper, Univ. California Publ. Zoöl., 42:413, May 17, 1940.

Range.—Extreme northwestern Utah.

Description and comments.—Measurements of 2 males (one subadult), numbers 733 and 732, from Grouse Creek, are: Total length, 400, 360; length of tail, 172, 148; length of hind foot, 44, 42; length of ear, 34, 34. Tail actually as well as relatively short, averaging 75 per cent of length of body in Utah specimens; hind foot large. Color: Upper parts a mixture of Pinkish Buff, dark brown and gray giving an over-all color of Hair Brown, darkest middorsally; sides, flanks, axillae and outer surface of forelegs Light Pinkish Buff; top of head like upper parts but with markedly more gray; eye ring black; vibrissae very dark proximally; dorsal surface of hind legs grayish buff; tail sharply bicolored, dark brown above, white beneath; front feet, ventral surface of front

legs, hind feet, ventral surface of hind legs and entire underparts white. Skull: Large, angular; rostrum long and deep; sphenopalatine vacuities absent; tympanic bullae well inflated; molar teeth large; alveolar length of upper molar series long; zygomatic arches moderately wide-spreading.

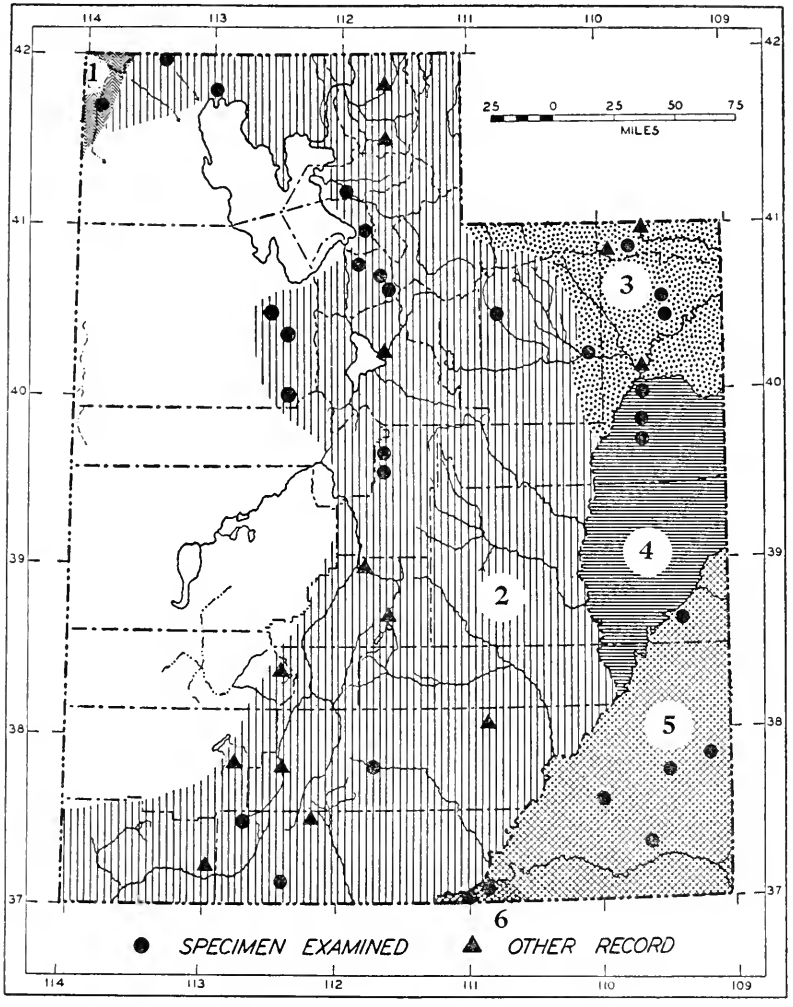

FIG. 56. Distribution of *Neotoma cinerea* and *Neotoma stephensi*.
1. *N. c. alticola.* 3. *N. c. orolestes.* 5. *N. c. arizonae.*
2. *N. c. acraia.* 4. *N. c. macrodon.* 6. *N. s. relicta.*

Relying on specimens from Utah, comparisons yield results as foot smaller; tail actually as well as relatively shorter; upper parts follows: *N. c. alticola* differs from *Neotoma cinerea acraia* in hind

darker; upper molars longer and wider; nasals actually as well as relatively shorter; lateral excavations on ventral surface of basioccipital deeper; anterointernal re-entrant angle of first upper molars deeper; palatal bridge shorter; incisive foramina extending farther posteriorly; squamosal root of zygoma weaker and at an obtuse rather than a right angle with jugals; tympanic bullae larger. *N. c. alticola* differs from *Neotoma cinerea orolestes* and *Neotoma cinerea arizonae* as follows: Larger in every measurement taken, including those of the skull; upper parts darker; sphenopalatine vacuities absent.

Hooper (1940:414) distinguished *N. c. acraia* from *N. c. alticola* by smaller size, smaller hind foot, lighter color, less angular skull, greater zygomatic breadth, smaller tympanic bullae and less massive molars. On this basis he referred 2 specimens from Pine Canyon, Raft River Mountains, in extreme northwestern Utah, to *N. c. acraia,* noting, however, that they were darker than were specimens of *N. c. acraia* from Nevada and California. He noted also that these 2 specimens might be intergrades between *N. c. acraia* and *N. c. orolestes.* I have studied 3 specimens from Standrod, on the north slopes of the Raft River Mountains, and like Hooper (*loc. cit.*), find them to be referable to *N. c. acraia.* These specimens, like those reported upon by Hooper, are darker in color than typical specimens of *N. c. acraia* from elsewhere within the range of that subspecies. Cranial details, however, show my 3 specimens to be intergrades between *N. c. acraia* and *N. c. alticola;* none possesses characters of *N. c. orolestes.*

With reference to characters mentioned by Hooper (*loc. cit.*), 2 specimens from Grouse Creek, in the vicinity of the Raft River Mountains, agree with *N. c. alticola* in color, size of molars and length of hind foot, but to my eye, agree with *N. c. acraia* only in zygomatic breadth. Neither specimen from Grouse Creek possesses characters of *N. c. orolestes,* which is a dark subspecies with large sphenopalatine vacuities occurring in Utah, only, so far as now known, in the extreme northeastern part of the state.

This study indicates that in Utah, the geographic ranges of *N. c. alticola* and *N. c. acraia* meet in extreme northwestern Boxelder County. The range of the former subspecies appears to be restricted in Utah to that area bounded by the Grouse Creek Mountains and the state lines of Nevada and Idaho.

Specimens examined.—Total, 2, from *Boxelder County:* Grouse Creek, 6,000 ft.

Neotoma cinerea acraia (Elliot)

Bushy-tailed Wood Rat

Teonoma cinerea acraia Elliot, Field Columb. Mus., Publ. 87, zoöl. ser. 3:247, January 7, 1904, type from Hot Springs, Long Canyon, Mount Whitney, Inyo County, California.

Neotoma cinerea acraia, Burt, Trans. San Diego Soc. Nat. Hist., 7:418, May 31, 1934; Hooper, Univ. California Publ. Zoöl., 42:413, May 17, 1940; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Neotoma cinerea, Allen, Bull. Essex Inst., 6:65, 1874; Goldman, N. Amer. Fauna, 31:95, October 19, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15): 73, April, 1922.

Neotoma cinerea cinerea, Barnes, Bull. Univ. Utah, 17 (no. 12):123, June, 1927; Tanner, Journ. Mamm., 8:251, August 9, 1927; Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Stanford, Journ. Mamm., 12:361, November 11, 1931; Presnall and Hall, Utah Acad. Sci. Arts and Letters, 13:212, September 15, 1936; Presnall, Zion-Bryce Mus. Bull., 2:16, January, 1938; Long, Journ. Mamm., 21:178, May 16, 1940; Tanner, Great Basin Nat., 1:111, June 30, 1940; [*Neotoma cinerea*] *cinerea,* Hooper, Journ. Mamm., 25:415, December 12, 1944.

Range.—Occurs generally throughout the state in mountainous areas, except the extreme northwestern corner and east of the Colorado and Green rivers.

Description and comments.—Measurements of 2 adult males, numbers 2962 and 2299, and 3 adult females, numbers 1275, 2405 and 1128, from Salt Lake and Davis counties are, respectively, as follows: Total length, 450, 368, 345, 360, 380; length of tail, 223, 158, 145, 175, 170; length of hind foot, 45, 41, 39, 40, 40; length of ear, 35, 33, 33, 30, 30. Color: Upper parts Ochraceous-Buff, finely mixed with dark brown; sides, flanks, cheeks and outer surface of front legs Pinkish Buff; ears brown, narrowly margined with white; tail sharply bicolored, mixture of gray, buff above, tail white beneath; front feet, ventral surface of front legs, hind feet, ventral surface of hind legs and entire underparts white (sometimes faintly washed with buff). Skull: Sphenopalatine vacuities absent; relatively broad across zygomata; molars of medium size; upper molar series short.

From *Neotoma cinerea orolestes, N. c. acraia* differs in lighter color (less buffy and less blackish or dark brownish), sphenopalatine vacuities absent rather than present, zygomatic processes of squamosals join jugals at a lesser angle, shorter upper molar series.

From *Neotoma cinerea arizonae, N. c. acraia* differs in slightly darker color (more rufescent and less ochraceous), bushier tail, longer hind foot, larger skull in most measurements taken, and sphenopalatine vacuities absent rather than present.

The bushy-tailed wood rats from the Great Basin (*N. c. acraia*) were first recognized by Elliot (1904:247-248) as being distinct from *Neotoma cinerea cinerea.* In his revision of the wood rats, Goldman (1910) regarded animals previously assigned to *N. c. acraia* as indistinguishable from those assigned to *N. c. cinerea,* and arranged the name *Neotoma cinerea acraia* as a synonym of

Neotoma cinerea cinerea. A study of the animals from the Charleston Mountains of southern Nevada led Burt (1934:418) to agree with the earlier findings of Elliot (*loc. cit.*). In a later and more comprehensive work on the geographic variation in the bushy-tailed wood rats, Hooper (1940:414) agreed with Elliot and Burt. In my own work on the bushy-tailed wood rats from the state of Utah, I have found no animals from anywhere in the Great Basin area or from any other part of the state that are, in my opinion, referable to *N. c. cinerea.*

One adult male, number 503, from Stockmore, is an intergrade between *N. c. acraia* and *N. c. orolestes;* it is lighter in color than the latter and has the cranial characters more like those of *N. c. acraia,* to which it is referred.

The few specimens of *N. c. acraia* available for this study show a wide range of individual variation. The ratio of the length of the tail to the length of the head and body varies from 98 per cent in animals from the northern part of the state to 70 per cent in animals from the south. The length of the hind foot also varies, ranging from 45 in the northern animals to 35 in the southern animals. Color is likewise variable being darkest in animals from the Wasatch, Raft River and Sanpitch mountains, somewhat lighter in animals from the mountains of the west desert and palest in animals from the extreme south.

The altitudinal range of the specimens that are available from Utah is from as low as 4,350 feet in Salt Lake County up to as high as 9,000 feet in Kane County.

Specimens examined.—Total, 30, distributed as follows: *Boxelder County:* Standrod, Raft River Mountains, 5,500 ft., 3; Statehouse, Locomotive Springs, 5,500 ft., 1. *Weber County:* 1 mi. E Ogden, 4,400 ft., 1. *Tooele County:* South Willow Creek, Stansbury Mountain, 7,500 ft., 1; Clover Creek, Onaqui Mountains, 5,500 ft., 1; Little Valley, Sheeprock Mountain, 5,500 ft., 2. *Davis County:* Bountiful, 1. *Salt Lake County:* City Creek Canyon, 1½ mi. above forks, 4,350 ft., 2; ¼ mi. N Parleys Canyon, 4,400 ft., 1; mouth Parleys Canyon, 4,400 ft., 1; 1 mi. above second power station, Millcreek Canyon, 5,500 ft., 1; Millcreek Canyon, entrance to Wasatch National Forest, 1; The Firs, Millcreek Canyon, 7,000 ft., 1; Millcreek Canyon, 5,000 ft., 2. *Duchesne County:* Stockmore, 1. *Sanpete County:* Maple Canyon, 5; Wales, 1. *Garfield County:* North Creek, 5 mi. W Escalante, 6,000 ft., 1. *Kane County:* Duck Creek, 9,000 ft., 1; Cottonwood, 8 mi. N Kanab, 4,800 ft., 1.

Additional records.—Cache County: Logan Canyon (Stanford, 1931:361); Blacksmith Fork (Goldman, 1910:98). *Utah County:* Provo (Goldman, *loc. cit.*). *Sevier County:* Salina (Stanford, *loc. cit.*); Fishlake Plateau (Goldman, *loc. cit.*). *Beaver County:* Beaver Mountains, Britts Meadow (Goldman, *loc. cit.*) *Iron County:* Parowan (Goldman, *loc. cit.*). *Garfield County:* Henry Mountains (Goldman, *loc. cit.*); Panguitch (Long, 1940:178). *Washington County:* Zion National Park (Presnall, 1938:16). *Kane County:* Bryce National Park (Presnall, *loc. cit.*).

Neotoma cinerea orolestes Merriam

Bushy-tailed Wood Rat

Neotoma orolestes Merriam, Proc. Biol. Soc. Washington, 9,128, July 2, 1894, type from Saguache Valley, 20 miles west of Saguache, Saguache County, Colorado.

Neotoma cinerea orolestes, Warren, Colorado College Publ. (Gen. Ser. 19), Sci. Ser. (no. 46), 11:248, January, 1906; Goldman, N. Amer. Fauna, 31:104, October 19, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):74, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):125, June, 1927; Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Svihla, Journ. Mamm., 12:263, August 24, 1931; Hooper, Journ. Mamm., 25:415, December 12, 1944.

Neotoma cinnamomea Allen, Bull. American Mus. Nat. Hist., 7:331, November 8, 1895.

Range.—Northeastern Utah in Uintah and Daggett counties.

Description and comments.—Measurements of one adult female, number 1221, from Daggett County are: Total length, 340; length of tail, 141; length of hind foot, 41. Color: Upper parts Cinnamon-Buff, purest on sides, cheeks, flanks and outer surface of front legs; middorsal region darkest owing to admixture of dark brown; ears light brown, faintly margined with white; tail bicolored, upper surface a mixture of light brown, buff and gray, under surface white (buffy wash in some specimens); front feet, ventral surface of front legs, hind feet, and ventral surface of hind legs and entire underparts white. Skull: Size medium; sphenopalatine vacuities present; zygomatic processes of squamosals join jugals at a wide angle.

From *Neotoma cinerea arizonae*, *N. c. orolestes* differs in larger size, markedly larger hind foot, darker color (Cinnamon-Buff as opposed to Ochraceous-Buff), larger skull, except sphenopalatine vacuities and tympanic bullae which are smaller; upper molariform tooth-row shorter.

For comparison of *N. c. orolestes* with *Neotoma cinerea alticola*, *Neotoma cinerea macrodon* and *Neotoma cinerea acraia*, see accounts of those subspecies.

Available specimens from Utah, referable to *N. c. orolestes* are few and nontypical. Four from Daggett County are intergrades between *N. c. orolestes* and *N. c. acraia*. In having the sphenopalatine vacuities (absent in *N. c. acraia* from Utah), and the darker, richer buff color, they show greater resemblance to *N. c. orolestes* to which they are referred.

Hooper (1944:415) considered the animals from south of Manila, on the north slopes of the Uinta Mountains to be intergrades between *Neotoma cinerea cinerea* and *N. c. orolestes*, but referable to the latter. Although I have not studied the animals available to Hooper, I do have specimens taken at a place only 5 miles distant from his, and mine are intergrades between *N. c. acraia* and *N. c. orolestes*, referable to the latter. In the same paper Hooper (*loc.*

cit.) revived the name *Neotoma cinerea cinnamomea* for the animals of the arid country of southwestern Wyoming, stating that the geographic range of that subspecies was roughly the area between the Wind River Mountains of Wyoming and the Uinta Mountains of Utah. It does not, therefore, seem reasonable to me, that the animals from northeastern Utah, known to be intergrades referable to *N. c. orolestes,* could intergrade with *N. c. cinerea* as indicated by Hooper, since the range of *N. c. cinnamomea* is interposed between the range of *N. c. cinerea* and northeastern Utah. The present knowledge of the geographic ranges of the bushy-tailed wood rats show the range of *N. c. orolestes* in Utah to contact only those of *N. c. acraia* and *N. c. macrodon* and perhaps that of *N. c. cinnamomea.* From the material at hand, I find no animals from Utah that are referable to *N. c. cinnamomea* as characterized by Hooper.

Specimens examined.—Total, 8, distributed as follows: *Daggett County:* Junction of Deep and Carter creeks, 8,000 ft., 4. *Duchesne County:* Myton, 1. *Uintah County:* Moore's Ranch, Ashley Creek, 5 mi. N Vernal, 1 (M.V.Z.); Vernal, 2.

Additional records.—*Daggett County* (Svihla, 1931:263): Hideout; Beaver Creek; Carter Creek; Granite Park. *Uintah County* (Allen, 1895:332): Uncompahgre Indian Reservation.

Neotoma cinerea macrodon Kelson

Bushy-tailed Wood Rat

Neotoma cinerea macrodon Kelson, Journ. Washington Acad. Sci., 39:417, December 15, 1949, type from east side of confluence of Green and White rivers, one mile southeast of Ouray, 4,700 feet, Uintah County, Utah.

Range.—Northern edge of the East Tavaputs Plateau, Uintah County, Utah.

Description and comments.—Average and extreme measurements of 4 adult males and measurements of 2 adult females, numbers 6660 and 5893 are, respectively, as follows: Total length, 348.5 (372-333), 330, 292; length of tail, 146 (158-139), 140, 120; length of hind foot, 38.3 (40-36), 39, 37. Hind foot small; tail short averaging 74.7 per cent of length of head and body in males. Color: Upper parts Pale Ochraceous-Buff, grading to Light Ochraceous-Salmon on cheeks and sides; upper parts overlaid with blackish; feet white; tail distinctly bicolored, dusky above, white beneath, hairs with basal buffy band, hairs of distal two-thirds narrowly edged with buffy; underparts white. Skull: Small, angular; frontonasal region slightly arched and moderately concave ventrally; temporal ridges widely separated; interparietal broad, but relatively short; sphenopalatine vacuities large; auditory bullae moderately inflated; alveolar length of upper molar series long; individual molars long and wide; upper incisors narrow and weak.

From *Neotoma cinerea acraia, N. c. macrodon* differs as follows: Tail shorter; hind foot shorter. Color: Generally lighter. Skull:

Less angular and smaller; frontonasal region less deeply concave ventrally; squamosal roots of zygomata more lightly constructed; sphenopalatine vacuities large as opposed to absent; interparietal shorter; auditory bullae less inflated ventrally; alveolar length of upper molar series longer; upper incisors weaker.

From *Neotoma cinerea orolestes, N. c. macrodon* differs in slightly smaller size, markedly lighter color, less deeply furrowed frontonasal region, slightly larger sphenopalatine vacuities, longer upper molar tooth-row, heavier zygomatic arches and more arched frontonasal region.

From *Neotoma cinerea arizonae, N. c. macrodon* differs as follows: Color: Markedly lighter, buffy rather than tawny; tail bushier and duskier. Skull: Sphenopalatine vacuities larger; upper molar series 16 per cent longer in comparable males.

The geographic range of this subspecies seems to be limited to the east Tavaputs Plateau. The geographic range may include also that part of the Uinta Basin to the east of the Green River. This is indicated by two specimens from Vernal, in the collections of the U. S. National Museum and one unsexed skull, number 7089, from Myton, Duchesne County, Utah. Both of these localities are west of the Green River in the Uinta Basin, and these specimens show no intergradation with *N. cinerea macrodon,* and are referable to *N. cinerea orolestes.*

Specimens examined.—Total, 7, distributed as follows: *Uintah County:* E side confluence of Green and White rivers, 1 mi. SE Ouray, 4,700 ft., 4; Willow Creek, 25 mi. S Ouray, 5,250 ft., 2; Willow Creek, 29 mi. S Ouray, 5,400 ft., 1.

Neotoma cinerea arizonae Merriam

Bushy-tailed Wood Rat

Neotoma arizonae Merriam, Proc. Biol. Soc. Washington, 8:110, July 31, 1893, type from Keam Canyon, Apache County, Arizona; Warren, The mammals of Colorado, Knickerbocker Press, p. 120, 1910.

Neotoma cinerea arizonae, Goldman, N. Amer. Fauna, 31:106, October 19, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):74 (*Neotoma cinera* (*sic.*) *arizonae*), April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):126, June, 1927; Hooper, Univ. California Publ. Zoöl., 42:422, May 17, 1940; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 219, 1942.

Range.—Southeastern Utah, east of the Colorado River.

Description and comments.—Measurements of an adult male, number 951, from Castle Valley, Grand County, Utah, and of 2 adult females, numbers 53517 (U.S.N.M.) and 161179 (U.S.N.M.), from Winslow and Lees Ferry, Arizona are, respectively, as follows: Total length, 363, 315, 358; length of tail, 154, 138, 160; length of hind foot, 35, 38, 40. Upper parts Ochraceous-Buff moderately mixed with black, purest on sides, cheeks, flanks and outer sides of front legs; ears brown narrowly margined with white; tail bicolored,

mixed gray, brown and buff above, white below; front feet, ventral surface of front legs, hind feet, ventral surface of hind legs and entire underparts white (all white parts with pinkish suffusion in some specimens). Skull: Size medium; sphenopalatine vacuities large; temporal ridges widely separated; tympanic bullae large.

For comparisons see accounts of other subspecies.

The northern limits of the range of *N. c. arizonae* within the state have heretofore been unknown since all available material was from the extreme southeastern part of San Juan County. Specimens now in the collections of the University of Utah show the range to extend at least as far northward as Castle Valley in Grand County.

One animal, number 951, from the extreme northern part of the range in Utah is noteworthy because it differs so much from any other specimen of *N. c. arizonae* from elsewhere within Utah. The over-all pinkish color exceeds even that in animals from Arizona and grades from Light Ochraceous-Buff on the upper parts through Salmon-Buff on the sides to Seashell Pink on the feet and underparts. This specimen also differs from animals typical of *N. c. arizonae* in greater overall length, shorter hind feet, greater zygomatic breadth, longer incisive foramina and shorter maxillary toothrow. Adequate material from the northern part of Grand County, east of the Colorado River, may prove the existence there of an unnamed kind of bushy-tailed wood rat. Since I have but a single specimen, I am provisionally referring it to *N. c. arizonae*. This single specimen also differs from topotypes of *N. c. macrodon* in greater over-all length, longer tail, shorter hind foot, greater basilar length, greater zygomatic breadth, shorter nasals, longer incisive foramina, shorter palatal bridge and lesser alveolar length of upper molars. Castle Valley is an isolated valley situated between the La Sal Mountains to the east, and the Colorado River to the west. It is further isolated from the Colorado River by badlands and highly colored reddish cliffs. It was in these cliffs, on the west side of the valley, that I obtained this single, reddish, seemingly unique, specimen of the bushy-tailed wood rat. The floor of this valley is the type locality of another species of wood rat, *Neotoma albigula brevicauda*. *Neotoma albigula* is a species of, in general, southern distribution, whereas the species *Neotoma cinerea* is, in general, northern in geographic distribution.

Specimens examined.—Total, 9, distributed as follows: *Grand County:* Castle Valley, 18 mi. NE Moab, 6,000 ft., 1. *San Juan County:* Range 25N Monticello, 5,000 ft., 1 (M.V.Z.); Recapture Canyon, 12 mi. N Blanding, 6,000 ft., 1 (M.V.Z.); Edwin Natural Bridge, 5,725 ft., 2 (M.V.Z.); Cottonwood Wash, 8 mi. N Bluff, 4,400 ft., 2 (M.V.Z.).

TABLE 16

Cranial Measurements of Neotoma

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Interorbital breadth	Length of palatal bridge	Length of incisive foramina	Alveolar length of maxillary tooth-row
		Neotoma albigula brevicauda, topotypes						
♂	5 av.	37.3	16.5	23.0	5.9	7.1	9.5	8.0
♂	Max.	39.3	17.7	24.0	6.3	7.3	10.4	8.6
♂	Min.	36.5	15.9	22.1	5.7	6.7	9.0	7.6
♀	5 av.	35.8	15.8	22.1	5.8	7.1	8.7	8.1
♀	Max.	37.7	16.2	23.7	6.0	7.8	10.1	8.3
♀	Min.	34.3	15.3	21.1	5.5	6.6	8.8	7.7
		Neotoma albigula laplataensis, Johns Canyon						
♂	1216	34.5	15.0	21.6	5.7	7.2	8.7	8.2
♀	1219	34.0	15.0	21.5	5.4	7.0	8.5	8.0
		Neotoma mexicana inopinata, Grand County						
♂	943	33.0	16.5	21.9	5.2	8.5	8.5	8.8
♂	944	34.9	.....	21.8	5.3	8.5	8.8	9.5
♂	1220	33.8	16.8	21.5	5.3	8.3	8.7	9.5
♀	919	33.1	15.6	21.0	5.1	8.3	8.3	9.1
		Neotoma lepida lepida, Beaverdam Wash						
♂	4032	34.6	15.3	20.7	5.3	7.2	8.6	7.9
♂	4023	35.1	16.1	21.4	5.5	7.8	8.6	7.3
♂	4021	33.0	14.5	20.1	5.3	7.2	8.4	7.7
♀	4 av.	32.9	15.0	20.1	5.0	6.8	8.4	7.9
♀	Max.	33.5	15.2	20.5	5.1	7.1	8.7	8.2
♀	Min.	32.4	14.3	19.4	4.9	6.5	8.2	7.6
		Neotoma lepida marshalli, topotypes						
♂	263983 USNM.	34.3	15.2	21.1	5.7	7.5	8.0	8.8
♂	263985 USNM.	.....	15.0	20.0	5.4	7.2	7.4	8.3
♀	263978 USNM.	34.8	15.7	21.1	5.1	7.7	8.7	.....
♀	263979 USNM.	36.3	16.3	22.3	5.2	8.4	8.2	8.2
		Neotoma lepida sanrafaeli, topotypes						
♂	4 av.	33.9	14.7	20.9	5.3	7.45	8.5	8.2
♂	Max.	35.1	15.1	21.7	5.4	7.7	9.1	8.5
♂	Min.	32.7	14.5	20.3	5.1	7.1	8.2	8.0
♀	6429	32.8	14.7	20.7	5.3	7.7	8.3	8.3
		Neotoma lepida monstrabilis, Washington County						
♂	4 av.	29.7	14.4	18.95	5.1	6.5	7.5	7.7
♂	Max.	31.0	14.8	19.9	5.5	6.8	8.7	7.9
♂	Min.	27.1	14.1	17.4	4.8	6.1	6.5	7.5
♀	3240	30.7	13.8	19.5	5.1	6.5	7.6	7.75
♀	3232	28.9	13.2	18.0	5.0	6.35	7.1	7.6

TABLE 16.—*Concluded*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Interorbital breadth	Length of palatal bridge	Length of incisive foramina	Alveolar length of maxillary tooth-row
		Neotoma stephensi relicta, type						
♀	67780 USNM.....	33.3	14.8	20.1	5.4	7.1	9.0	7.7
		Neotoma cinerea alticola, Grouse Creek						
♂	732.....	39.7	16.8	23.9	6.0	8.3	11.0	10.0
♂	733.....	43.8	19.3	26.7	6.1	9.1	11.5	10.9
		Neotoma cinerea acraia, Salt Lake and Davis counties						
♂	2962.....	45.6	20 9	26.2	5.6	9.7	12.5	10.1
♂	2299.....	41.5	19.4	.....	5.7	9.6	11.4	9.8
♀	1275.....	39.9	18.7	24.4	5.6	8.5	10.6	9.5
♀	2405.....	42.0	18.9	25.4	5.7	9.1	11.7	9.1
♀	1128.....	40.8	.....	25.0	6.0	9.2	10.6	9.4
		Neotoma cinerea orolestes, Daggett County						
♀	1221.....	39.4	18.3	24.9	5.6	8.4	11.0	9.0
		Neotoma cinerea macrodon, topotypes						
♂	4 av.....	39.2	18.3	24.1	5.8	9.0	10.5	9.8
♂♀	Max.....	42.1	20.6	26.2	6.4	9.4	11.6	10.1
♂♀	Min.....	37.6	17.1	22.5	5.4	8.5	9.7	9.6
♀	5893.....	35.8	16.4	21.0	6.0	7.7	10.1	9.4
♀	6660.....	37.4	16.9	23.2	6.1	8.4	9.9	9.7
		Neotoma cinerea arizonae, ♂ Castle Valley; ♀ Keams Canyon, Arizona						
♂	951.....	40.7	17.9	25.7	5.9	8.8	11.1	8.8
♀	5366/5074 USNM...	38.7	16.9	24.2	5.4	8.0	10.5	9.7

Clethrionomys gapperi uintaensis Doutt

Red-backed Mouse

Clethrionomys gapperi uintaensis Doutt, Proc. Biol. Soc. Washington, 54:161, December 8, 1941, type from Paradise Park, 45 miles northwest of Vernal (by road), 10,500 feet, Uintah County, Utah.

Clethrionomys gapperi galei, Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Svihla, Journ. Mamm., 12:263, August 24, 1931; Hayward, Great Basin Nat., 6:91, November 15, 1945.

Range.—Mountains of northern Utah.

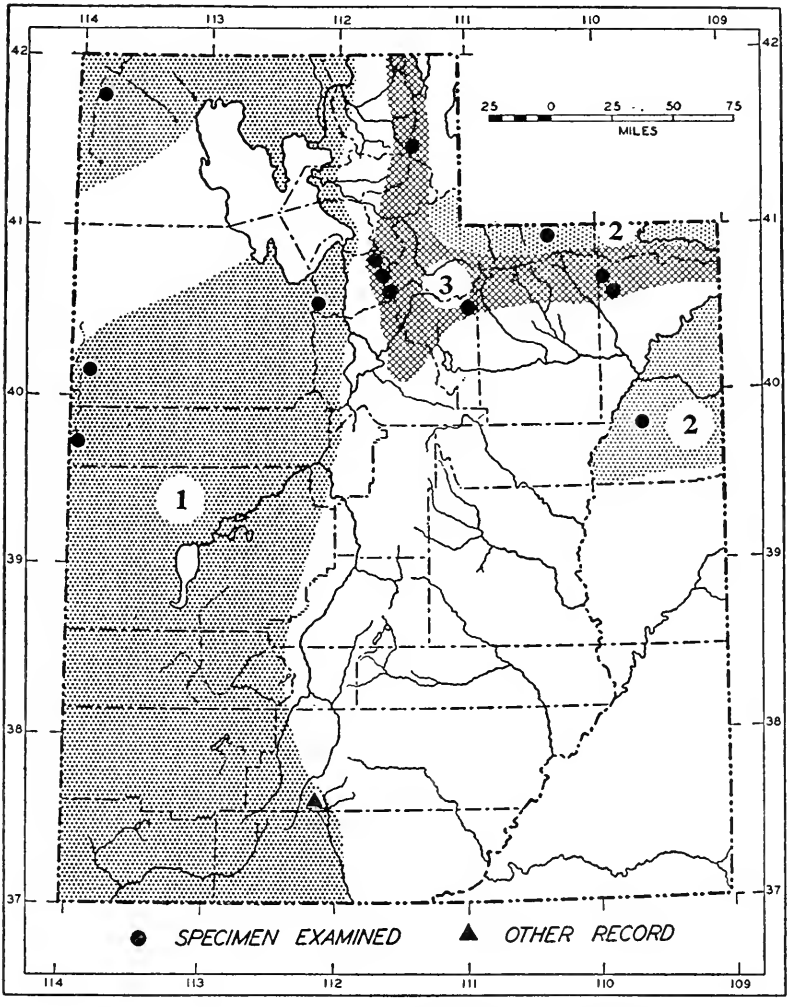

FIG. 57. Distribution of *Clethrionomys* and *Lagurus*.

Guide to subspecies

1. *L. curtatus intermedius.*
2. *L. curtatus levidensis.*
3. *C. gapperi uintaensis.*

Description and comments.—Measurements of 2 adult males, numbers 5282 and 5298, and 3 adult females, numbers 5283, 5287 and 5288, from head of Lambs Canyon are, respectively, as follows: Total length, 136, 142, 145, 136, 141; length of tail, 35, 44, 39, 39, 38; length of hind foot, 18, 17, 19, 17, 19; length of ear, 14, 13, 14, 12, 14. Color: Middorsal region and top of head Auburn; head between eyes and cheeks Smoke Gray; dorsal surface of tail Clove Brown; base of vibrissae dark brown; feet Pale Drab Gray; sides Pinkish Buff, underfur Plumbeous; entire underparts white. Skull: Small, slender; palate with posterior projection; incisive foramina long and parallel sided; auditory bullae well inflated ventrally; zygomatic arches slender; molars rooted; outer and inner re-entrant angles of molars equal.

The small size, red back and rooted molars separate these animals from all other microtines known to occur in Utah. The only known specimens have been obtained in the Uinta and Wasatch mountains. These animals are definitely montane in this southern part of their range.

The specimens from Salt Lake County differ from animals from the Uinta Mountains in paler color.

Specimens examined.—Total, 31, distributed as follows: *Rich County:* Monte Cristo, 18 mi. W Woodruff, 8,000 ft., 1. *Salt Lake County:* Emigration Canyon, 8 mi. above forks, 6,000 ft., 1; Head of Lambs Canyon, 9,000 ft., 10; Silver Lake Post Office (Brighton), 9,500 ft., 11. *Summit County:* Bald Peak, Uinta Mountains, 10,500 ft., 1 (M.V.Z.). *Wasatch County:* Wolf Creek Summit, 9,800 ft., 1. *Uintah County:* 9 mi. NW Paradise Park, Ashley National Forest, 1; Paradise Park, Uinta Mountains, 10,100 ft., 5.

Additional records.—Daggett County: Beaver Dams, 10,500 feet (Svihla, 1931:263). *Duchesne County:* 15 mi. N Mountain Home (Doutt, 1941:162).

Ondatra zibethicus osoyoosensis (Lord)

Muskrat

Fiber Osoyoosensis Lord, Proc. Zoöl. Soc. London, p. 97, 1863, type from Lake Osoyoos, British Columbia (see Hollister, 1911:25).

Fiber zibethicus osoyoosensis, Hollister, N. Amer. Fauna, 32:24, April 29, 1911; Barnes, Bull. Univ. Utah, 12 (no. 15):78, April, 1922.

Fiber zibethicus, Allen, Bull. Essex Inst., 6:65, 1874; Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rep't Expl. W 100th M. 5:108, 1875.

Ondatra zibethica osoyoosensis, Barnes, Bull. Univ. Utah, 17 (no. 12):130, June, 1927; Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Svihla, Journ. Mamm., 12:264, August 24, 1931; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Range.—Northern and central Utah, possibly southeastern Utah, limits unknown.

Description and comments.—Measurements of 3 adult males, numbers 1914, 1916 and 4274, and 3 adult females, numbers 570, 1915 and 1917, from Davis County are, respectively, as follows: Total length, 620, 600, 553, 590, 617, 585; length of tail, 280, 270, 274, 250, 272 262; length of hind foot 84, 78, 76, 75, 79, 78; length of ear, 23, 22, 31, 20, 22, 21. Color: Upper parts Mummy Brown grading to Tawny or Russet on sides; feet Mouse Gray; under-

parts overlaid with Cinnamon; tail long, scaly, laterally compressed, dark brown in color. Skull: Large, robust; ridged; nasals broad; tympanic bullae small; least interorbital breadth narrow; rostrum and nasals long.

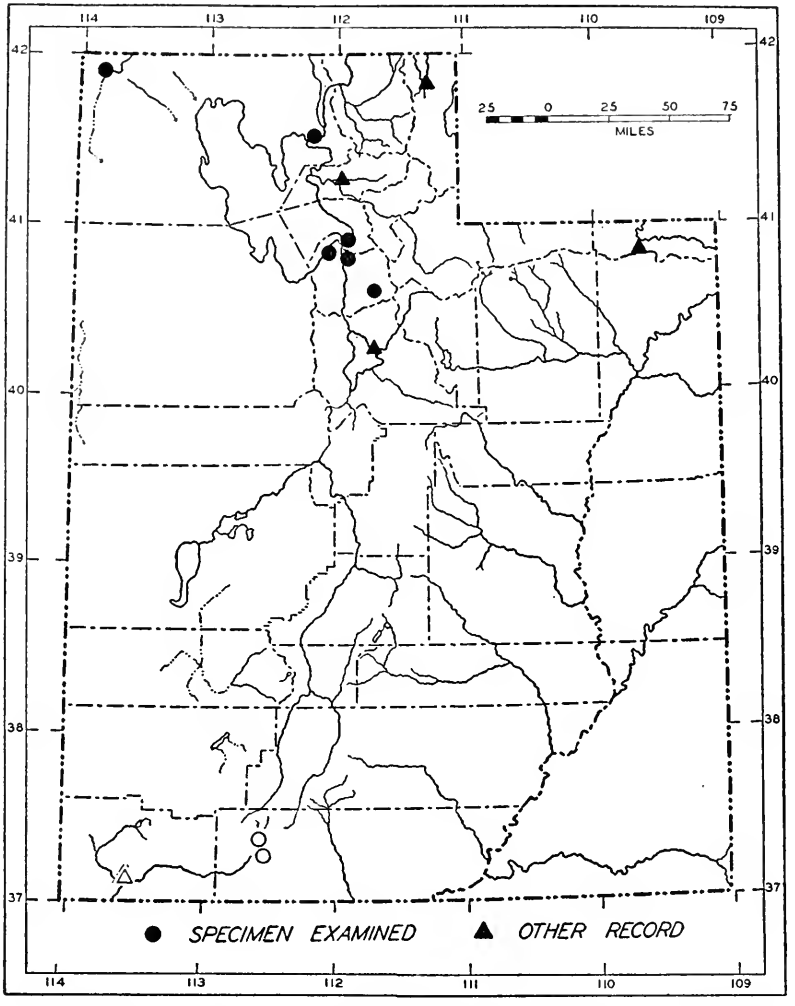

FIG. 58. Known localities of occurrence of *Ondatra zibethicus*. Solid symbols, *O. z. osoyoosensis*. Open symbols, *O. z. goldmani*.

From near topotypes of *Ondatra zibethicus goldmani*, *O. z. osoyoosensis* may be distinguished by: Size generally larger. Color: Slightly darker. Skull: Longer; nasals less expanded distally; interpterygoid space less constricted dorsally; tympanic bullae larger; molars larger.

The status of muskrats from Utah is not clearly understood. The material available for study is neither sufficient nor representative. Muskrat farms in several areas have been stocked with introduced, non-native animals. The inevitable escapees from these enterprises may have bred with the indigenous animals. Mr. John B. Van den Akker of the U. S. Fish and Wildlife Service, stationed at the Bear River Migratory Bird Refuge wrote that one introduction with animals from Missouri was made in the present refuge area approximately 20 years ago by a Mr. Spires. His (Mr. Spires) rat farm was on the northern boundary of the present refuge. At my request, Mr. Van den Akker sought information relative to the results of this introduction. Since he is concerned with a muskrat harvest involving approximately 4,000 animals annually, each of which is checked, as to sex and size by a government employee, he is in an advantageous position to obtain data. His observations and reports from conversations with the veteran trapper Mr. Joseph Hansen of Brigham City, who has participated in the trapping and skinning of more than 65,000 animals from this area, indicate that up to 1947 only 7 cross rats had been taken which were considered to be the result of interbreeding of the native and introduced animals from Missouri. Four additional cross rats were taken during the trapping season of 1948. According to Mr. Hansen, the black rats when first introduced were larger than the native animals, but the few black cross rats which have been trapped since the introduction are smaller than the native animals. The pelts, however, are of better quality than those of the native animals. One such specimen, taken on March 10, 1946, was obtained by the University of Utah. This specimen, a skin only, is nearly black all over, and the guard hairs are greatly reduced, making a very dense, soft pelage. In 1946 and again in 1947, Mr. Van den Akker reported the presence of some cream-colored mutants, which are being sought for breeding purposes. In general, however, he and the trappers are of the opinion that the introduced animals have affected the native population only slightly. The questions as to whether these color mutations are inherent within the native stock or are expressions of the cross with the outside stock are unanswerable at present. No cranial or other osteological materials of these crosses are available. The animals from northern Utah are, however, referable to *O. z. osoyoosensis.*

Almost nothing is known with reference to animals from the eastern part of Utah—Colorado River drainage—nor of animals

from the central part of the state. The only record of muskrats from southeastern Utah, insofar as I know, was a report upon one skull from Bluff, San Juan County (Hall, 1931:6). It was referred at that time to *O. z. osoyoosensis*. I have examined this skull, number 44090 (M.V.Z.), and although it resembles *O. z. osoyoosensis* in almost all characters, it differs from it in shorter incisive foramina and length of molar series and narrower, smaller interparietal. Adequate material from eastern and southeastern Utah may prove that the animals from there belong to the subspecies *Ondatra zibethicus bernardi*.

Hall and Johnson (1938:122) referred animals from extreme western Millard County to *Ondatra zibethicus mergens*. They questioned this designation since muskrats had been introduced into the Snake Creek area. Western Utah, which is in the Great Basin, and which has a fauna closely paralleling that of eastern Nevada, may be inhabited by animals of this subspecies. Water is scarce in this vast region, and amounts adequate for muskrat habitats are localized in only a few localities. One such area is Fish Springs in western Juab County. I have been told, however, that muskrats have been introduced at this locality from elsewhere At this writing I have no specimens of *O. z. mergens* from Utah but recognize that this subspecies may well occur in the state.

Specimens examined.—Total, 27, distributed as follows: *Boxelder County:* Raft River, 5 mi. S Yost, Raft River Mountains, 6,000 ft., 1; Bear River Migratory Bird Refuge, 2. *Davis County:* 3 mi. W Woods Cross, 10; Jordan River, ¾ mi. N 35th North Bridge, 6. *Salt Lake County:* 5 mi. NW Salt Lake Airport, 4,200 ft., 5; Salt Lake City, 2; spring fed creek running into Big Cottonwood river [Creek], 4,400 ft., 1.

Additional records (Hollister, 1911:26).—*Rich County:* Laketown. *Weber County:* Ogden. *Utah County:* Utah Lake. *Daggett County:* Sheep Creek; Beaver Creek (Svihla, 1931:264).

Ondatra zibethicus goldmani Huey

Muskrat

Ondatra zibethica goldmani Huey, Trans. San Diego Soc. Nat. Hist., 8:409, January 18, 1938, type from St. George, Washington County, Utah; Hardy, Ecol. Monogr., 15:84, January, 1945.

Ondatra zibethica mergens, Barnes, Bull. Univ. Utah, 17 (no. 12):132, June, 1927.

Fiber zibethicus mergens Hollister, N. Amer. Fauna, 32:27, April 29, 1911; Barnes, Bull. Univ. Utah, 12 (no. 15):81, April, 1922.

Range.—Virgin River Valley, limits unknown.

Description and comments.—Measurements of one adult male, number 4767, from Kane County, are: Total length, 595; length of tail, 245; length of hind foot, 80; length of ear, 21. Color: Similar to *Ondatra zibethicus osoyoosensis* but a trifle lighter, more grayish. Skull: Size medium; robust; heavily ridged; nasals widely expanded distally; anterior projections of squa-

mosals large; jugals well thickened dorsoventrally; palatal bridge long; interpterygoid space strongly constricted dorsally; molars medium.

For comparison with *O. z. osoyoosensis,* see account of that subspecies.

The range of *O. z. goldmani* in Utah is limited to the Virgin River drainage. It does, however, extend into Nevada on the Virgin River as far as Muddy Creek (Hall, 1946:568). Down stream from this locality the stream is inhabited by animals belonging to *Ondatra zigethicus bernardi* (Hall, *loc. cit.*). The explanation of the occurrence of the two subspecies *O. z. goldmani* and *O. z. bernardi* in the Virgin River may lie in the effects upon distribution of these animals of the rocky, chasmlike narrows of the river.

Specimens examined.—Total, 2, as follows: *Kane County:* Between Mount Carmel and Big Meadow Creek, 1; Orderville, 1.

Additional record.—*Washington County:* St. George (Huey, 1938:410).

Phenacomys intermedius intermedius Merriam

Heather Vole

Phenacomys intermedius Merriam, N. Amer. Fauna, 2:32, October 30, 1889, type from a basaltic plateau, about 20 miles NNW of Kamloops, 5,500 feet, British Columbia, Canada.

Phenacomys intermedius intermedius, Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—Known only from the high Uinta and Wasatch mountains.

Description and comments.—Measurements of an adult male, number 5224, from one mile above Alta and of an adult female, number 4649, from Mt. Timpanogos are, respectively, as follows: Total length, 146, 150; length of tail, 34, 40; length of hind foot, 17, 20. Color: Upper parts buffy grayish; tail bicolored, light brown above, white beneath; front and hind feet and entire underparts white. Skull: Size medium; zygomatic processes of squamosals heavy; incisive foramina parallel sided; auditory bullae small; molars rooted in adults and with very deep re-entrant angles.

Phenacomys is the only microtine in Utah with the inner re-entrant angles of the lower molars much deeper than the outer angles.

Specimens examined.—Total, 8, distributed as follows: *Salt Lake County:* Silver Lake, Brighton, 9,000 ft., 3; 1 mi. above Alta, 9,500 ft., 3. *Utah County:* Mt. Timpanogos, 10,200 ft., 1. *Wasatch County:* Provo River, 3 mi. N Soapstone G. S., Wasatch National Forest, 1.

Additional record.—*Summit County:* Bald Peak, 10,500 feet (Hall, 1931:6).

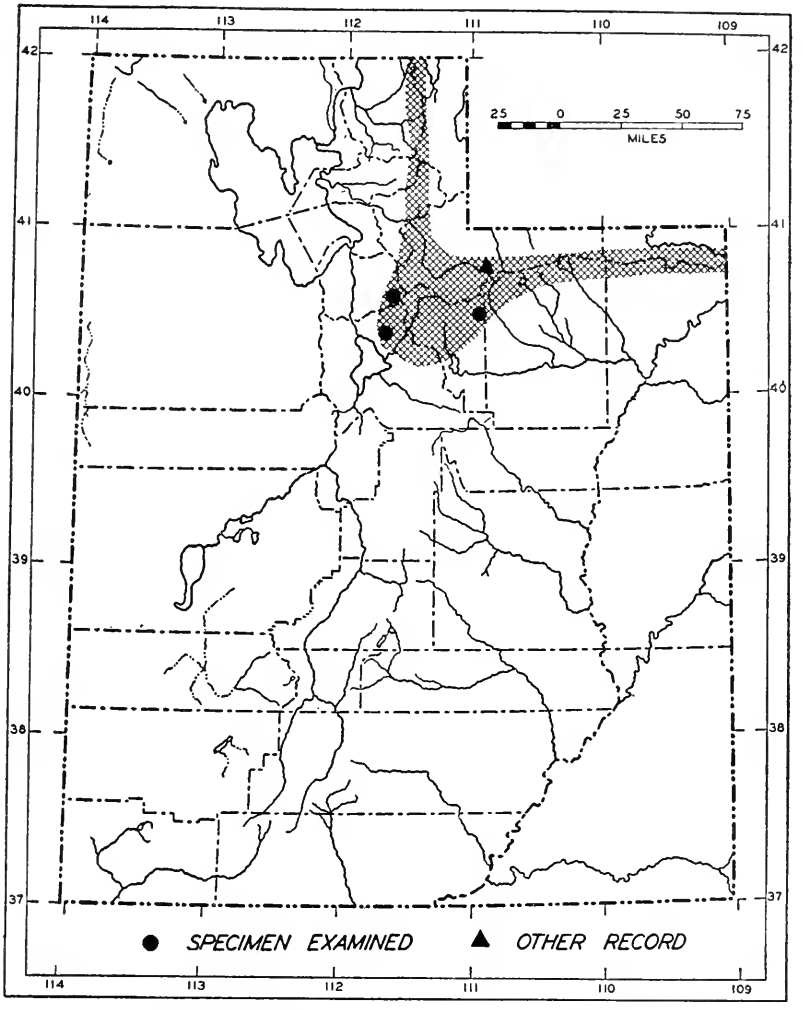

FIG. 59. Geographic distribution of the Heather Vole, *Phenacomys intermedius intermedius.*

Microtus pennsylvanicus modestus (Baird)

Pennsylvanian Meadow Mouse

Arvicola modesta, Baird, Mamm. N. America, 535; 1858, type from Sawatch Pass [= Saguache Pass, Cochetopa Hills], Saguache County, Colorado.

Microtus pennsylvanicus modestus, Bailey, N. Amer. Fauna, 17:20, June 6, 1900; Warren, The mammals of Colorado, Knickerbocker Press, p. 95, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):76, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):126, June, 1927; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 226, 1942.

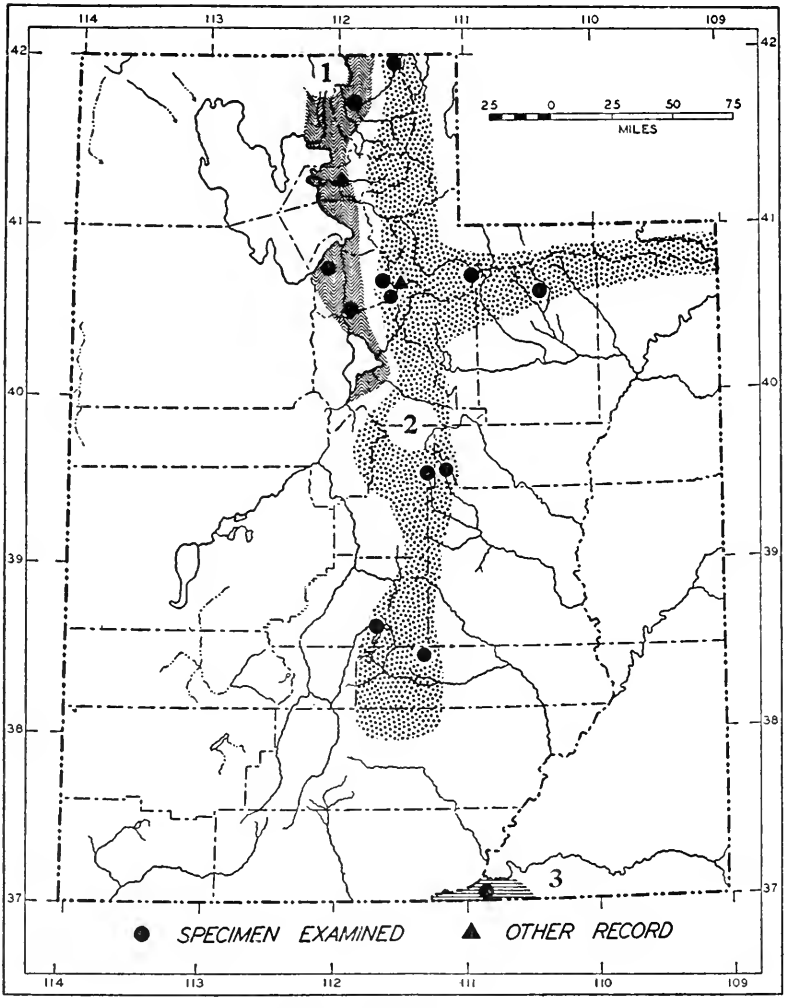

FIG. 60. Distribution of:

Guide to subspecies

1. *Microtus pennsylvanicus modestus.*
2. *Microtus richardsoni macropus.*
3. *Microtus mexicanus navaho.*

Range.—Valleys of central northern Utah.

Description and comments.—Measurements of an adult male, number 4684, from Logan and of an adult female, number 5226, from Draper are, respectively, as follows: Total length, 160, 181; length of tail, 45, 56; length of hind foot, 21, 21. Color: Upper parts dark, a mixture of blackish and reddish giving a general tone of dark Bister; tail bicolored, like upper parts above, grayish white beneath; entire underparts washed with white. Skull: Long, weakly ridged; M2 with 4 closed triangles and a rounded posterior loop; incisive foramina long and relatively narrow; upper incisors moderately procumbent; auditory bullae rounded and moderately inflated ventrally.

Animals belonging to this species can be readily distinguished from all other members of the genus from Utah by generally darker, more intense Bister color of upper parts, by long, unridged skulls and by an accessory (fifth) closed triangle in the enamel pattern of the second upper molar.

The few specimens known from Utah are all from the valleys of the northern part of the state along the western front of the Wasatch Mountains.

Specimens examined.—Total, 11, distributed as follows: *Cache County:* Logan, 1. *Salt Lake County:* ½ mi. W Salt Lake Airport, U. S. Highway 40, 4,200 ft., 6; 1 mi. W Draper, 4,500 ft., 1; 3 mi. SW Draper, 4,400 ft., 3.

Additional record.—Weber County: Ogden (Bailey, 1900:21).

Microtus montanus nanus (Merriam)

Montane Meadow Mouse

Arvicola (Mynomes) nanus Merriam, N. Amer. Fauna, 5:63, July 30, 1891, type from Pahsimeroi Mountains, 9,350 feet, Custer County, Idaho.

Microtus montanus nanus, Hall, Proc. Biol. Soc. Washington, 51:133, August 23, 1938; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Microtus nanus, Bailey, N. Amer. Fauna, 17:30, June 6, 1900; Warren, The mammals of Colorado, Knickerbocker Press, p. 98, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):76, April, 1922.

Microtus nanus nanus, Barnes, Bull. Univ. Utah, 17 (no. 12):128, June, 1927; Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Svihla, Journ. Mamm., 12:263, August 24, 1931; Stanford, Journ. Mamm., 12: 361, November 11, 1931; Whitlow and Hall, Univ. California Publ. Zoöl., 40:266, September 30, 1933.

Range.—Northern Utah in Raft River, Wasatch and Uinta mountains.

Description and comments.—Average and extreme measurements of 6 adult male near topotypes, and the measurements of 3 adult female near topotypes, numbers 24020, 211782 and 211783 (U.S.N.M.), are, respectively, as follows: Total length, 142 (152-130), 160, 160, 149; length of tail, 37 (39-35), 37, 40, 30; length of hind foot, 19 (20-18), 19, 21, 19. Tail and hind foot short. Color: Entire upper parts grayish, little or no black or red; tail bicolored, like back above, or slightly darker with under surface grayish; entire underparts grayish, hairs tipped with white or pale buff. Skull: Small (smallest of the Utah *Microtus montanus* group); auditory bullae relatively large; cheek teeth small.

From topotypes of *Microtus montanus nexus, Microtus montanus amosus* and *Microtus montanus rivularis, M. m. nanus* differs in smaller size, gray over-all coloration as opposed to brownish and blackish, and smaller, weaker skull.

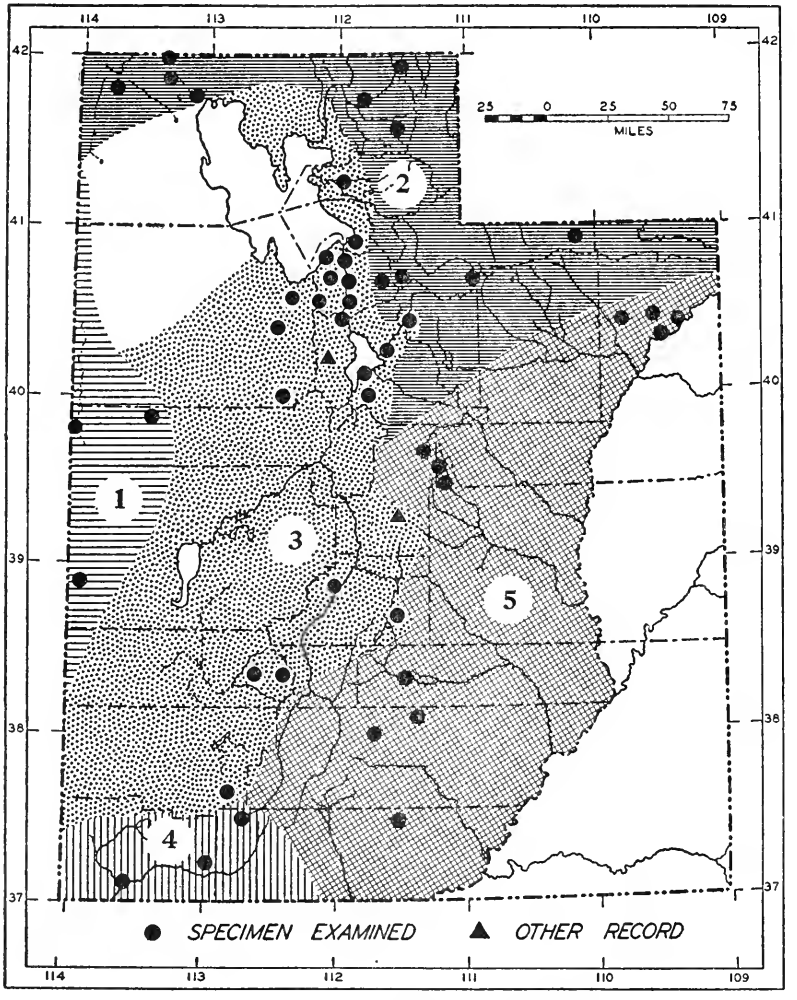

FIG. 61. Distribution of *Microtus montanus.*

Guide to subspecies
1. *M. m. micropus.*
2. *M. m. nanus.*
3. *M. m. nexus.*
4. *M. m. rivularis.*
5. *M. m. amosus.*

Intergradation with surrounding subspecies occurs freely in specimens from marginal localities. Animals from the Raft River Moun-

tains, in extreme northwestern Utah, are slightly darker and have slightly larger skulls than animals from elsewhere and are reminiscent of *M. m. micropus,* the adjacent subspecies to the south, but taking into account all of the characters the specimens from the Raft River Mountains seem best referred to *M. m. nanus.* Intergradation with *M. m. nexus* of the Bonneville Basin is indicated in the animals from Lambs Canyon, in the Wasatch Mountains east of Salt Lake City. Five specimens from the high, mountainous country of extreme northwestern Emery County show intergradation with *M. m. amosus* of the Colorado River drainage to the east.

M. m. nanus attains the southern limits of its distribution in northern Utah where, with the exception of a few specimens from Valleys in Boxelder and Cache counties, it occurs mostly in the mountains. Farther northward in Idaho, these meadow mice, although known to occur infrequently at higher elevations (9,000 feet), occur mostly in the valleys (Davis, 1939:318). Like other kinds of mammals of more northern occurrence known to occur mostly in the valleys, *M. m. nanus* gradually becomes montane as the southern limits of distribution are approached.

Specimens examined.—Total, 29, distributed as follows: *Boxelder County:* Standrod, Raft River Mountains, 5,500 ft., 9; George Creek, 7½ mi. SE Yost, Raft River Mountains, 6,500 ft., 3; Lynn Canyon, 2; Kelton, 4,225 ft., 2 (M. V. Z.). *Cache County:* 12 mi. W Garden City, 1 (M.V. Z.); Logan and environs, 5 (4, M. V. Z.); Anderson Ranch, Blacksmith Fork, 5,500 ft., 1. *Summit County:* Henrys Park, Henrys Fork, 9,000 ft., 1; 4 mi. NE Snyderville, 5,600 ft., 2; Bald Mountain, 25 mi. NE Kamas, 1 (C. M.); 5 mi. E Park City, 2 (C. M.).

Microtus montanus nexus Hall and Hayward

Montane Meadow Mouse

Microtus montanus nexus Hall and Hayward, Great Basin Nat., 2:106, July 20, 1941, type from West Canyon, Oquirrh Mountains, Utah County, Utah.

Microtus montanus, Bailey, N. Amer. Fauna, 17:27, June 6, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):75, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):127, June, 1927.

Microtus montanus montanus, Stanford, Journ. Mamm., 12:361, November 11, 1931.

Range.—Valleys and mountains of western and west-central Utah, south to Fishlake Plateau.

Description and comments.—Average and extreme measurements of 4 adult males and 5 adult females from Salt Lake County are, respectively, as follows: Total length, 161 (185-150), 160 (167-154); length of tail, 39 (44-34), 38 (44-34); length of hind foot, 18 (21-17), 18 (20-15); length of ear, 12 (15-11), 13 (15-11). Color: Upper parts blackish, with moderate admixture of reddish; tail bicolored, dark brown above, grayish below; entire underparts washed with white. Skull: Size medium; palate short; mastoid breadth relatively narrow;

postpalatal length relatively long; tympanic bullae well inflated; basioccipital narrow.

Topotypes and near topotypes of this subspecies can be readily distinguished from *Microtus montanus amosus* by smaller size throughout, and by smaller, less angular skull.

For comparisons with other subspecies of *Microtus montanus* known to occur in Utah, see accounts of those subspecies.

The limits of the range of *M. m. nexus* roughly coincide with the margins of the Pleistocene Lake Bonneville, but also include the drainages of streams which drain westward into the basin of the ancient lake. In addition, specimens are known from 10 miles north of Fishlake and from Midway. Midway is well within the range ascribed to *M. m. nanus,* but is in the lush, moist Heber Valley, of the Wasatch Mountains, which drains westward into the Bonneville Basin by means of the Provo River. In all characters examined the specimens show little or no evidence of intergradation with *M. m. nanus* and are referable to *M. m. nexus* as it is at present understood. Three animals from Salamander Lake, Lambs Canyon, and 2 from one mile above Alta, are from mountain localities at elevations of more than 9,000 feet. They are intergrades between *M. m. nanus* and *M. m. nexus.* Their darker (less grayish) color and larger skulls show them to be referable to *M. m. nexus.* Four animals, intergrades between *M. m. nexus* and *M. m. amosus,* from 10 miles north of Fishlake are referable to the former. Hall and Hayward (1941:107) studied these animals and arrived at the same conclusions, but they noted that the occurrence was within the drainage of the Colorado River supposedly occupied by *M. m. amosus.* The east side of the Fishlake Mountains is within the drainage of the Colorado River, whereas the west side is within the drainage of the Sevier River, which flows westward into Lake Bonneville Basin to end in Sevier Lake. It is not known whether the locality of capture of these 4 animals (10 miles north of Fishlake) is within the drainage of the Colorado River or the Sevier River, but, I suspect, since these intergrades are referable to *M. m. nexus,* that it is on the Sevier River side of the watershed. Since the species *Microtus montanus* is definitely associated with water and moist environments in this semiarid country, the habitats bordering the Provo and Sevier rivers appear to have furnished the migration routes into the Wasatch and Fishlake mountains respectively for these animals from the Bonneville Basin.

For further comments on the distribution of microtines in this western part of the state, see the account of *Microtus montanus micropus.*

Specimens examined.—Total, 75, distributed as follows: *Weber County:* Ogden, 4,293 ft., 4 (M.V.Z.). *Tooele County:* Tooele, 3; St. Johns, 4,300 ft., 3; Little Valley, Sheeprock Mountains, 5,500 ft., 1. *Davis County:* Bountiful, 3. *Salt Lake County:* Lakeshore, 17 mi. W. Salt Lake City, 4,320 ft., 5; 3 mi. W Salt Lake Airport, 1; 1½ mi. W Salt Lake Airport, U. S. Highway 40, 4,200 ft., 1; ½ mi. W Salt Lake Airport, U. S. Highway 40, 4,200 ft., 8; Salt Lake City, 4,320 ft., 1; Utah Copper Gun Club, 4,250 ft., 3; Taylorsville, 2 mi. W Murray, 4,300 ft., 2; Draper and environs, 4,500 ft., 18; Butterfield Canyon, 1½ m. above Butterfield Tunnel, 6,300 ft., 3. *Utah County:* West Canyon, Oquirrh Mountains, 1; Provo, 4,510 ft., 1 (M.V.Z.); 7 mi. W Spanish Fork, 4,563 ft., 2; 1 mi. W Payson, 4,600 ft., 1. *Wasatch County:* Midway, 4. *Sevier County:* Richfield, 3; 10 mi. N Fishlake, Fishlake Mountains, 10,000 ft., 4 (M. V. Z.).

Additional records (Bailey, 1900:29).— *Utah County:* Fairfield. *Sanpete County:* Manti.

Microtus montanus micropus Hall

Montane Meadow Mouse

Microtus montanus micropus Hall, Univ. California Publ. Zoöl., 40:417, October 25, 1935, type from Cleveland Ranch, 6,000 feet, Spring Valley, White Pine County, Nevada; Hall and Johnson, Proc. Utah Acad. Arts Sci. and Letters, 15:122, 1938.

Range.—Western Utah, generally along the western margins of Pleistocene Lake Bonneville.

Description and comments.—Average and extreme measurements of 4 adult males and 4 adult females from 5 miles south of Garrison are, respectively, as follows: Total length, 163 (185-145), 160 (172-146); length of tail, 47 (52-43), 42 (45-38); length of hind foot, 23 (25-21), 23 (24-22); length of ear, 13.5 (15-12), 13.5 (15-12). Color: Entire upper parts and sides blackish mixed with gray and red; tail bicolored, upper surface blackish, under surface grayish; entire underparts gray, tips of hairs actually white or very pale buff. Skull: Size medium; robust; occiput inclined anteriorly exposing condyles in dorsal view; auditory bullae large.

From topotypes and near topotypes of *Microtus montanus nanus,* specimens of *M. m. micropus* from 5 miles south of Garrison differ in larger size in all measurements taken, darker (more blackish) color and relatively smaller auditory bullae.

Compared with one topotype and several near topotypes of *Microtus montanus nexus,* the aforementioned specimens of *M. m. micropus* differ in larger size in most all measurements taken, darker (more blackish) color, larger skull with longer palate, longer nasals and actually as well as relatively larger auditory bullae.

These specimens of *M. m. micropus* differ from *Microtus montanus amosus* in generally smaller size, darker (less reddish) color, smaller skull and smaller auditory bullae.

The differences separating *M. m. micropus* from *Microtus montanus rivularis* are essentially the same as those separating *M. m. micropus* from *M. m. amosus.* One exception is the size of the auditory bullae in which *M. m. rivularis* approximates that of *M. m. micropus.*

The distribution of *M. m. micropus* in Utah closely parallels that of *Dipodomys ordii celeripes* and *Thomomys bottae centralis.* The ancient Lake Bonneville operated importantly in establishing the easternmost limits of the geographic range of each of the three subspecies. The easternmost occurrences of *M. m. micropus* are in the western part of the state of Utah, but this subspecies has the largest range of any within the Great Basin.

Specimens from Utah referred to *M. m. micropus* closely resemble topotypes. Animals from Fish Springs suggest intergradation with the adjacent, eastern subspecies, *M. m. nexus,* in that they are as dark as, if not darker than, typical specimens of *M. m. micropus* (the young and subadults of which are nearly pure black), but have the smaller size of *M. m. nexus.* The cranial characters are more like those of *M. m. micropus* to which the animals are here referred. The material available from the basin of the Lake Bonneville is too scanty to permit definite assignment of the animals from this region as to subspecies; unnamed subspecies probably exist in the area which is poorly represented by specimens. A cursory glance at the distribution map and list of specimens examined will show the dearth of material.

Intergradation with *M. m. nanus* is indicated in specimens referred to *M. m. nanus,* from the Raft River Mountains in extreme northwestern Utah (see account of *M. m. nanus*).

Specimens examined.—Total, 15, distributed as follows: *Juab County:* Fish Springs, 4,400 ft., 4; Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 1. *Millard County:* 5 mi. S Garrison, 5,400 ft., 10 (M.V.Z.).

Microtus montanus amosus Hall and Hayward

Montane Meadow Mouse

Microtus montanus amosus Hall and Hayward, Great Basin Nat., 2:105, July 20, 1941, type from Torrey, Wayne County, Utah.

Range.—Fremont River drainage, probably occurs throughout the western drainage of the Colorado River in Utah.

Description and comments.—Measurements of an adult male, near topotype, number 4687, and 2 adult female topotypes, numbers 4688 and 4686 are, respectively, as follows: Total length, 179, 176, 174; length of tail, 44, 49.5, 51; length of hind foot, 20.5, 20.5, 21.5. Color: Upper parts brownish, with great admixture of reddish; tail bicolored, dark brown above, whitish below; entire underparts washed with white. Skull: Large, robust; braincase wide; zygomatic arches widely spreading; palate short; nasals short.

These animals are the largest of the species *Microtus montanus* known to occur in Utah. They are closest morphologically to *Microtus montanus rivularis,* but differ as described in the account of *M. m. rivularis.*

For comparisons with other subspecies of *Microtus montanus,* see accounts of those subspecies.

The few specimens at hand indicate that the range of this subspecies includes the entire western drainage of the Colorado River in Utah with the exception of the drainage of the Virgin River (see remarks under *M. m. rivularis*).

Five specimens from extreme northwestern Emery County, from high mountainous areas, show intergradation with *Microtus montanus nanus,* but their large size, large bullae and massive skulls make them referable to *M. m. amosus.*

Only five specimens, from the vicinity of Vernal and Jensen, were examined from the entire Uinta Basin. Four of the five have the reddish suffusion of *Microtus montanus fusus,* but are darker, larger, have broader braincases and more robust skulls; their affinities are with *M. m. amosus* as it is at present understood. The remaining specimen from two miles south of Jensen resembles *M. m. fusus.* It is smaller than the other four and has a rich reddish color, both features being characters of *M. m. fusus.* Since all five specimens are from the same general area, and since four of the five are known to be intergrades referable to *M. m. amosus,* I am, pending the acquisition of more material, tentatively assigning this smaller, more reddish animal from two miles south of Jensen, to *M. m. amosus.* Hall (1938:132) and Hall and Hayward (1941:106) likewise indicated that other material from Jensen showed characters indicative of intergradation between *M. m. amosus* and *M. m. fusus* from Colorado. No specimens of *Microtus montanus* are available from the vast area east of the Green and Colorado rivers; possibly *M. m. fusus* occurs there.

Specimens examined.—Total, 15, distributed as follows: *Uintah County:* Vernal, 5,300 ft., 2 (C.M.); La Point, 1; 7 mi. SE Vernal, 2 (C.M.); Ashley Creek, 2 mi. S Jensen, 1 (C.M.). *Sanpete County:* Mammoth R. S., 3. *Wayne County:* Torrey, 6,800 ft., 3. *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 4; 20 mi. N Escalante, 9,500 ft., 1. *Kane County:* Steep Creek, Aquarius Plateau, 1.

Microtus montanus rivularis Bailey

Montane Meadow Mouse

Microtus nevadensis rivularis Bailey, Proc. Biol. Soc. Washington, 12:87, April 30, 1898, type from St. George, Washington County, Utah.

Microtus montanus rivularis Bailey, N. Amer. Fauna, 17:29, June 6, 1900; Allen, Brooklyn Inst. Mus. Sci. Bull., 1:121, March, 1905; Barnes, Bull. Univ. Utah, 12 (no. 15):75, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):127, June, 1927; Hall, Proc. Biol. Soc. Washington, 51:133, August 23, 1938; Hardy, Ecol. Monogr., 15:83, January, 1945.

Microtus montanus micropus, Presnall, Zion-Bryce Mus. Bull., 2:16, January, 1938.

Microtus montanus subsp. Long, Journ. Mamm., 21:178, May 16, 1940.

Range.—South-central and southwestern Utah.

Description and comments.—Measurement of a single adult female topotype, number 190797 U. S. N. M., are as follows: Total length, 163; length of tail, 43; length of hind foot, 21. Color: Upper parts and sides blackish with admixture of reddish; tail bicolored, blackish above, grayish below; entire underparts washed with white. Skull: Large, well arched dorsally; nasals narrow; basioccipital narrow anteriorly.

Topotypes of *M. m. rivularis* can be readily distinguished from *Microtus montanus nexus* and *Microtus montanus nanus* by larger size and darker coloration.

Comparison of topotypes of *M. m. rivularis* with *Microtus montanus micropus* from the western part of the state shows *M. m. rivularis* to differ in larger size, slightly more reddish upper parts, larger skull, actually as well as relatively narrower nasals, and anteriorly more constricted basioccipital.

Among subspecies of *Microtus montanus* known to occur in Utah, *M. m. rivularis* shows greatest resemblance to *Microtus montanus amosus* from which *M. m. rivularis* differs in smaller size, darker color (more blackish), narrower nasals, anteriorly, more constricted basioccipital, narrower rostrum and smaller auditory bullae.

A specimen from Cedar Breaks National Monument, referred by Presnall (1938:16) to *M. m. micropus,* on restudy proves to be an intergrade between *M. m. rivularis* and *M. m. nexus* to which it is here referred. Other specimens from Zion National Park, also referred by Presnall (*loc. cit.*) to *M. m. micropus,* are likewise intergrades between *M. m. rivularis* and *M. m. nexus.* They are paler than topotypes of *M. m. rivularis* and in this they approach *M. m. nexus.* Cranial details such as narrow rostrum, smaller auditory bullae and narrowed basioccipital anteriorly make it seem advisable to refer them to *M. m. rivularis.* A single specimen from Duck Creek, a skin without a skull, is tentatively assigned to *M. m. rivularis.*

The material at hand indicates that the western drainage of the Colorado River is inhabited by two subspecies of *Microtus montanus,* namely *M. m. amosus* and *M. m. rivularis. M. m. rivularis* is restricted to the drainage of the Virgin River and environs. The Virgin River Valley of southwestern Utah is separated from the remainder of the drainage of the Colorado River by the Beaverdam Mountains, and in addition to *M. m. rivularis,* the Virgin River Valley has several other endemic subspecies of mammals.

Specimens examined.—Total, 6, distributed as follows: *Washington County:* Blue Springs, Zion National Park, 3 (M. V. Z.); St. George, 2 (U. S. N. M.). *Kane County:* Duck Creek, 8,500 ft., 1.

Microtus longicaudus latus Hall

Long-tailed Meadow Mouse

Microtus mordax latus Hall, Univ. California Publ. Zoöl., 37:12, April 10, 1931, type from Wisconsin Creek, Toyabe Mountains, 8,500 feet, Nye County, Nevada.

Microtus longicaudus latus, Goldman, Journ. Mamm., 19:491, November 14, 1938.

Microtus mordax mordax, Presnall, Zion-Bryce Mus. Bull., 2:16, January, 1938; Long, Journ. Mamm., 21:178, May 16, 1940.

Range.—Western and south-central Utah.

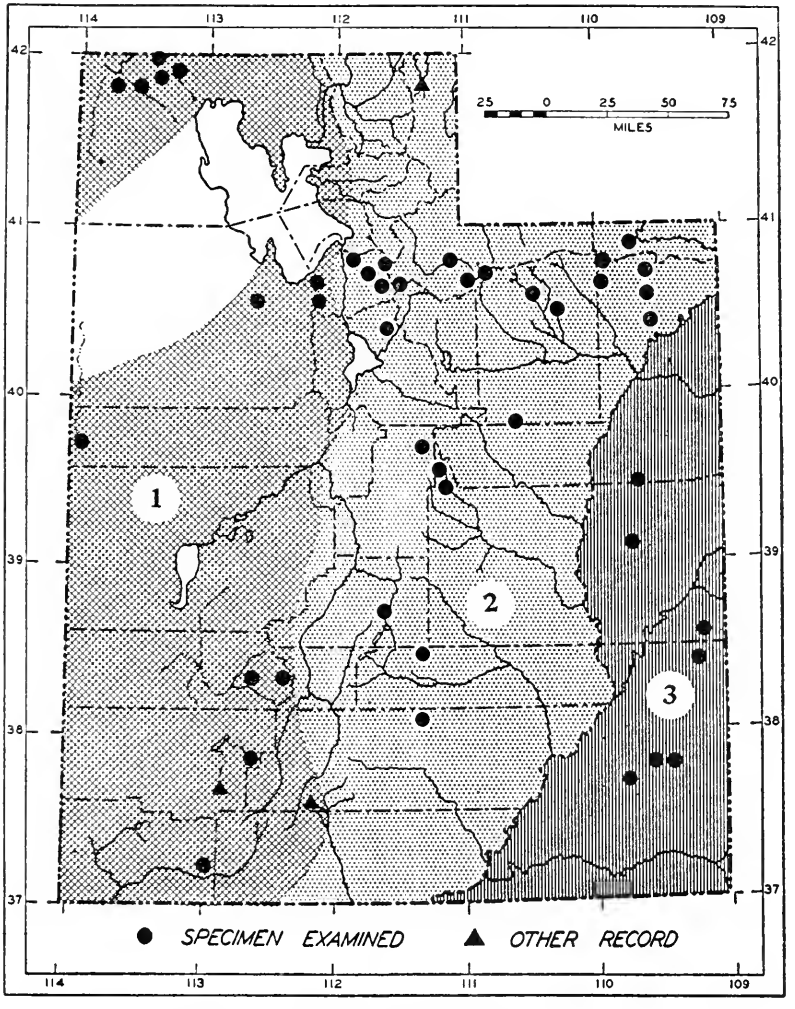

FIG. 62. Distribution of *Microtus longicaudus*.
1. *M. l. latus.* 2. *M. l. mordax.* 3. *M. l. alticola.*

Description and comments.—Average and extreme measurements of 5 adult males and 4 adult females from western Utah are, respectively, as follows: Total length, 164 (178-156), 170 (186-164); length of tail, 54 (59-50), 56 (66-50); length of hind foot, 21 (22-20), 18 (19-17); length of ear, 13.5 (14-13), 14 (15-13). Color: Upper parts pale grayish, moderately washed with Buckthorn Brown; tail bicolored, upper surface slightly darker than back; under surface white; cheeks and sides Mouse Gray; feet brownish; entire underparts white, appearing gray owing to exposure of plumbeous base of hairs. Skull: Size medium; braincase relatively broad; rostrum depressed at tip; anterior margins of frontals rounded; lateral palatal pits relatively shallow; molars weak.

From *Microtus longicaudus mordax* from the Uinta Mountains, Utah-taken specimens of *M. l. latus* differ as follows: Size smaller; tail shorter; hind foot and ear averaging smaller. Color: Lighter on upper parts (more gray, less brown). Skull: Averaging slightly smaller in all measurements taken, except interorbital breadth, in which larger; tip of rostrum more depressed; anterior tongues of frontals more nearly truncate.

Utah-taken specimens of *M. l. latus* can be distinguished from those of *Microtus longicaudus alticola* by the following features: Size slightly smaller; color paler (more gray, less reddish); rostrum more depressed distally; zygomatic arches weaker; nasals neither so uniformly nor so narrowly rounded proximally.

Specimens from the Queen of Sheba Canyon are nearly typical of *M. l. latus*. The animals from the Raft River Mountains, in the extreme northwestern corner of the state, are intergrades between *M. l. latus* and *M. l. mordax*. In color they are approximately midway between the two subspecies. There is, however, a certain pallor reminiscent of *M. l. latus*. The cranial characters are those of *M. l. latus*, to which the specimens are here referred. A single specimen from Stansbury Mountain resembles the animals from the Raft River Mountains. Of the animals from Beaver and Iron counties, those from the high mountains east of Beaver and Parowan are dark like *M. l. mordax*. Their tails are shorter than in *M. l. mordax* from the Uinta and Wasatch mountains, hence more nearly like those of *M. l. latus*, and their skulls show characters of both subspecies. The specimens from three miles east of Beaver at a lower elevation are closer to *M. l. latus* in color, length of tail and cranial details. The animals from Beaver and Iron counties could with almost equal propriety be referred to either *M. l. latus* or *M. l. mordax*. Here they are referred to *M. l. latus* on distributional grounds. Goldman (1938:492) thought that animals from southern Utah appeared to be best assigned to *M. l. latus*.

It would appear from this study, and the distribution assigned to

M. l. latus in Nevada by Hall (1946:551), that this subspecies from the Great Basin attains its easternmost limits along the mountain front in central Utah. The present distribution of *M. l. latus* within Utah closely parallels that of the Pleistocene Lake Bonneville, which has affected the distribution of many mammals in Utah.

Specimens examined.—Total, 44, distributed as follows: *Boxelder County:* Standrod, Raft River Mountains, 5,500 ft., 2; S Fork, Raft River, Raft River Mountains, 1; George Creek, 7 mi. SE Yost, Raft River Mountains, 6,500 ft., 1; Dove Creek, Raft River Mountains, 1; Lynn Canyon, Raft River Mountains, 11. *Tooele County:* South Willow Creek, Stansbury Mountains, 7,500 ft., 1. *Salt Lake County:* Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 8,000 ft., 18; Rose Canyon, 3 mi. SW Herriman, 5,500 ft., 1; Beef Hollow, 3 mi. W Camp Williams, 6,000 ft., 1. *Beaver County:* Britts Meadow, near Delano Ranger Station, 14 mi. E Beaver, 4 (C.M.); along Beaver River, 3 mi. E Beaver, 2 (C.M.). *Iron County:* SW Little Creek Peak, 9 mi. E Parowan, 1 (C.M.). *Washington County:* Blue Springs, Zion National Park, 2 (M.V.Z.).

Additional records.—Iron County: 11 mi. E Cedar City (Long, 1940:178). *Garfield County:* Bryce National Park (Presnall, 1938:16).

Microtus longicaudus mordax (Merriam)

Long-tailed Meadow Mouse

Arvicola (Mynomes) mordax Merriam, N. Amer. Fauna, 5:61, July 30, 1891, type from Sawtooth (or Alturus) Lake, East base of Sawtooth Mountains, Blaine County, Idaho.

Microtus longicaudus mordax, Goldman, Journ. Mamm., 19:491, November 14, 1938.

Microtus mordax, Bailey, N. Amer. Fauna, 17:48, June 6, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):77, April, 1922; Tanner, Great Basin Nat., 1:112, June 30, 1940.

Microtus mordax mordax, Barnes, Bull. Univ. Utah, 17 (no. 12):128, June, 1927; Svihla, Journ. Mamm., 12:263, August 24, 1931; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—Uinta Mountains, Wasatch Mountains and Wasatch Plateau as far south as Fishlake.

Description and comments.—Average and extreme measurements of 11 adult males and 8 adult females from the Uinta Mountains are, respectively, as follows: Total length, 183 (192-165), 182 (199-173); length of tail, 66 (73-57), 64 (69-60); length of hind foot, 21 (22-20), 20.5 (21-20); length of ear, 14.5 (15-14), 15 (16-13). Tail long. Color: Upper parts and sides Bister owing to admixture of black and Dresden Brown; tail bicolored, upper surface like back, white beneath; feet grayish white; entire underparts white, appearing grayish owing to plumbeous base of hairs, tips of hairs white. Skull: Size medium; rostrum slender; nasals slender; condyloid ramus long; incisive foramina long.

Comparison of specimens of *M. l. mordax* from the Wasatch and Uinta mountains, with those of *Microtus longicaudus alticola* from extreme eastern Utah show *M. l. mordax* to differ in the following manner: Size larger; tail longer; ear longer. Color. Darker, Bister as opposed to Dresden Brown. Skull: Averages larger in all measurements taken; incisive foramina actually as well as relatively larger; tympanic bullae larger.

For comparison with *Microtus longicaudus latus,* see account of that subspecies.

In Utah, the most typical animals of this subspecies occur in the eastern part of the Wasatch Mountains and in the Uinta Mountains. No close study is required to note intergradation of *M. l. mordax* with *M. l. latus* in animals obtained along the western front of the Wasatch Mountains and from the Fishlake area. All animals from Salt Lake County are also intergrades of this type. They have the short tail characteristic of Utah representatives of *M. l. latus,* but have the dark color typical of *M. l. mordax.* The cranial characters are likewise intermediate between the two subspecies. In the majority of characters, they are closer to *M. l. mordax* to which they are here assigned. Animals from the Park City area, although intergrades, more closely resemble *M. l. mordax* than do specimens from Salt Lake County. Three specimens from southeast of Salina closely resemble those from Salt Lake County. For further comments, see account of *M. l. latus.*

Specimens examined.—Total, 80, distributed as follows: *Salt Lake County:* City Creek Canyon, 4,700 ft., 4; Emigration Canyon, 6 mi. E Salt Lake City, 5,500 ft., 5; Mt. Dell Canyon, 12 mi. E Salt Lake City, 3 (C.M.); Lambs Canyon, 13 mi. SE Salt Lake City, 3 (C.M.); Salamander Lake, Lambs Canyon, 9,000 ft., 3; head of Lambs Canyon, 9,000 ft., 2; Silver Lake Post Office (Brighton), 8,750 ft., 1; 1 mi. above Alta, 10,000 ft., 2. *Summit County:* Smith and Morehouse Creek, 6,700 ft., 1; Bald Mountain, 10,500 ft., 1 (C.M.); 5 mi. E Park City, 3 (C.M.). *Daggett County:* Junction Deep and Carter creeks, 9 mi. S Manila, 7 (3, C.M.); Vernal-Manila Road, 8 mi. W Greens Lake, 7,800 ft., 1 (C.M.). *Utah County:* Aspen Grove, Provo, 1 (M.V.Z.). *Duchesne County:* Mirror Lake, 10,000 ft., 1; Petty Mountain, 15 mi. N Mountain Home, 9,000 ft., 3 (C.M.); S slope Mt. Emmons, 11,500 ft., 2 (C.M.); Indian Canyon, 20 mi. SW Duchesne, 8,000 ft., 2 (C.M.). *Uintah County:* 9 mi. NW Paradise Park, Ashley National Forest, 11,000 ft., 1; 19 mi. N Vernal, 1 (C.M.); Paradise Park, 45 mi. NE Vernal (by road), 10,050 ft., 1 (C.M.); Ashley Creek, 10 mi. N Vernal, 6,200 ft., 2 (C.M.); Vernal, 5,300 ft., 1 (C.M.). *Sanpete County:* Mammoth R. S., 8,700 ft., 1. *Sevier County:* Seven Mile Creek, 20 mi. SE Salina, 3 (C.M.). *Emery County:* Lake Creek, 11 mi. E Mt. Pleasant, 1 (C.M.); Seeley Mountain, 21 mi. NE Ephraim, 1 (C.M.). *Wayne County:* Elkhorn G. S., 14 mi. N Torrey, Fishlake Plateau, 9,400 ft., 8. *Garfield County:* Wildcat R. S., Boulder Mountain, 8,700 ft., 14.

Additional record (Bailey, 1900:49).—*Rich County:* Laketown.

Microtus longicaudus alticola (Merriam)

Long-tailed Meadow Mouse

Arvicola (Mynomes) alticolus Merriam, N. Amer. Fauna, 3:67, September 11, 1890, type from Little Spring, San Francisco Mountain, 8,200 feet, Coconino County, Arizona.

Microtus longicaudus alticola, Goldman, Journ. Mamm., 19:491, November 14, 1938.

Range.—Southeastern Utah in Uintah, Grand and San Juan counties.

Description and comments.—Average and extreme measurements of 4 adult males and 6 adult females from San Juan County, are as follows: Total length, 175 (179-169), 172 (180-164); length of tail, 56.5 (60-52), 57 (60-56); length of hind foot, 20.5 (21-20), 20 (21-19); length of ear, 14 (15-13), 14 (15-13). Tail short. Color: Upper parts Dresden Brown owing to mixture of black and Ochraceous-Tawny; sides like back with less tawny; tail bicolored, like back above, white beneath; entire underparts white, appearing hoary because of plumbeous base of hairs. Skull: Size medium; extension of premaxillae posterior to nasals averages long; posterior margins of frontals at region of coronal and sagittal sutures generally square; anterior dorsal tongues of parietals rounded and short; incisive foramina relatively as well as actually short.

For comparison of *M. l. alticola* with *Microtus longicaudus mordax* and *Microtus longicaudus latus*, see accounts of those subspecies.

The available material from Utah, from east of the Green and Colorado rivers shows some characters of *M. l. mordax*, but is more like *M. l. alticola* as at present understood. Adequate material from critical areas in this part of Utah may prove the existence there of an unnamed kind of *Microtus longicaudus*.

Specimens examined.—Total, 27, distributed as follows: *Uintah County:* P. R. Springs, 7,950 ft., 43 mi. S Ouray, Uintah-Grand County line, 3. *Grand County:* Pioche Springs, W Fork Willow Creek, 14 mi. N Thompson, 2 (C.M.); Warner R.S., La Sal Mountains, 9,750 ft., 7. *San Juan County:* Geyser Pass, 18 mi. SE Moab, 5 (C.M.); 1 mi. E Geyser Pass, La Sal Mountains, 9,700 ft., 2; Cooley Pass, 8 mi. W Monticello, 3 (C.M.); 5 mi. W Monticello, 4 (C.M.); Duck Lake, 1 mi. S Gooseberry R.S., 8,400 ft., Elk Ridge, 1.

Microtus mexicanus navaho Benson

Mexican Vole

Microtus mexicanus navaho Benson, Proc. Biol. Soc. Washington, 47:49, February 9, 1934, type from Soldier Spring, east slope of Navajo Mountain, approximately 8,000 feet, San Juan County, Utah; Benson, Univ. California Publ. Zoöl., 40:454, December 31, 1935.

Range.—Southeastern Utah, known only from San Juan County. See figure 60.

Description and comments.—Measurements of 3 adult males, numbers 58805, 58806 and 58811 (M.V.Z.), and average and extreme measurements of 5 adult females from Navajo Mountain are, respectively, as follows: Total length, 124, 122, 136, 135 (141-130); length of tail, 26, 27, 33, 30 (34-25); length of hind foot, 18, 19, 18, 19 (20-18); length of ear, 12, 14, 12, 13 (14-11). Tail short. Color: Upper parts pale grayish buff, giving a general tone of Buffy Brown; tail bicolored, like upper parts above, whitish beneath; entire underparts washed with white. Skull: Short; broad; zygomatic arches broadly flattened at union of jugals and zygomatic processes of maxillae; upper incisors strongly recurved; incisive foramina broad and nearly parallel sided; auditory bullae large; molars robust.

Members of this species are readily recognizable from all other members of the genus known to occur in Utah by small size, buffy grayish coloration, short tail, broad short skull, widely flattened zygomatic arches and wide, parallel-sided incisive (anterior palatine) foramina.

Specimens examined.—Total, 10, from *San Juan County:* War God Springs, Navajo Mountains, 8,400 ft.

Microtus richardsoni macropus (Merriam)

Big-footed Meadow Mouse

Arvicola (Mynomes) macropus Merriam, N. Amer. Fauna, 5:60, July 30, 1891, type from Pahsimeroi Mountains, 9,700 feet, Custer County, Idaho.
Microtus richardsoni macropus, Bailey, N. Amer. Fauna, 17:61, June 6, 1900; Barnes, Bull. Univ. Utah, 12 (no. 15):78, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):129, June, 1927; Hall, Univ. California Publ. Zoöl., 37:6, April 10, 1931; Hayward, Great Basin Nat., 6:111. November 15, 1945.

Range.—The high Uinta and Wasatch mountains, as far south as Fishlake Mountains. See figure 60.

Description and comments.—Average and extreme measurements of 4 adult females and the measurements of one adult male, number 11993 (C.M.), are, respectively, as follows: Total length, 225 (232-221), 225; length of tail, 72 (77-69), 67; length of hind foot, 25.5 (27-24), 26; length of ear, 15.5 (16-14), 17. Color: Upper parts blackish with moderate suffusion of reddish (quite red in some specimens); tail bicolored, dark brown above, white below; entire underparts washed with white. Skull: Large and robust; upper incisors markedly procumbent; zygomatic arches widely spreading; nasals relatively short, rounded posteriorly and dilated anteriorly; auditory bullae actually as well as relatively small; incisive (anterior palatine) foramina constricted posteriorly.

The Big-footed Meadow Mouse is the largest of all the meadow mice known to occur in Utah, and this species can be readily distinguished from all others by its large size and by the other characters set forth in the description.

This species reaches the southern limits of its range in Utah, but the limits of its geographic range within the state are incompletely known.

Specimens examined.—Total, 35, distributed as follows: *Cache County:* 12 mi. W Garden City, 1 (M.V.Z.). *Salt Lake County:* Lambs Canyon, 13 mi. SE Salt Lake City, 1 (C.M.); Salamander Lake, Lambs Canyon, 9,000 ft., 10; Silver Lake Post Office (Brighton), 8,750 ft., 8; 1 mi. above Alta, 10,000 ft., 1. *Summit County:* SW Slope Bald Mountain, 10,500 ft., 3 (2, C.M.; 1, M.V.Z.). *Duchesne County:* Petty Mountain, 15 mi. N Mountain Home, 9,000 ft., 1 (C.M.). *Sanpete County:* 3 mi. NE Mammoth R.S., 8,700 ft., 4; Mammoth R.S., 1. *Sevier County:* Fishlake Mountains, 1 (M.V.Z.). *Emery County:* Lake Creek, 11 mi. E Mt. Pleasant, 2 (C.M.). *Wayne County:* Elkhorn G.S., 14 mi. N Torrey, Fishlake Plateau, 9,400 ft., 2.

Additional record (Bailey, 1900:61).—*Summit County:* Park City.

TABLE 17

Cranial Measurements of Clethrionomys, Ondatra, Phenacomys and Microtus

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of palatal bridge	Length of incisive foramina	Postpalatal breadth	Alveolar length of maxillary tooth-row
		Clethrionomys gapperi uintaensis, Lambs Canyon								
♂	5282	21.0	6.7	13.3	11.2	3.7	4.4	4.7	10.0	5.3
♂	5298	21.2	7.0	13.3	11.1	3.7	4.5	4.8	10.0	5.3
♀	5283	20.5	6.1	.....	10.9	3.5	4.6	4.9	.....	5.6
♀	5287	20.6	7.6	12.8	10.4	3.5	4.5	4.5	9.5	5.1
♀	5288	20.5	7.1	12.6	10.7	3.7	4.2	4.6	9.5	5.2
		Ondatra zibethicus osoyoosensis, Davis County								
♂	1914	59.0	22.6	40.9	26.8	6.5	14.0	13.6	23.6	14.7
♂	1916	59.4	21.9	39.7	27.2	6.5	12.6	13.5	23.2	16.0
♂	4274	61.0	22.7	39.7	28.1	5.9	13.8	13.0	23.0	16.1
♀	570	56.8	21.5	40.6	26.6	6.6	13.9	13.2	21.2	15.6
♀	1915	59.1	22.5	41.1	29.3	6.3	14.1	13.4	22.2	15.5
♀	1917	58.0	21.0	38.2	26.3	6.5	14.0	11.8	23.0	16.0
		Ondatra zibethicus goldmani, Orderville								
♂	4767	58.6	21.1	39.7	27.1	6.6	16.1	11.9	23.2	13.4
		Penacomys intermedius intermedius, ♂ 1 mi. above Alta; ♀ Mt. Timpanogos								
♂	5224	33.0	8.6	15.4	11.8	3.4	6.4	4.1	10.1	6.5
♀	4649	22.7	8.2	15.0	11.9	3.6	6.5	4.6	9.3	6.7
		Microtus pennsylvanicus modestus, ♂ Logan; ♀ 3 mi. SW Draper								
♂	4684	23.6	6.7	14.1	.....	3.6	6.4	4.9	9.5	7.1
♀	5226	26.7	8.1	16.0	12.5	3.5	6.8	5.5	10.7	7.4
		Microtus montanus nanus, near topotypes								
♂	6 av	22.2	6.7	14.0	11.4	3.6	5.6	4.4	9.2	6.3
♂	Max	22.8	7.2	14.3	11.8	4.0	6.1	4.5	9.4	6.5
♂	Min	21.3	6.1	13.6	10.7	3.3	5.2	4.1	9.0	6.1
♀	24020 USNM	23.3	7.3	15.4	11.7	3.5	5.8	4.7	10.0	6.2
♀	211782 USNM	23.7	7.2	15.2	12.3	3.5	5.6	4.9	9.7	6.6
♀	211783 USNM	22.3	7.2	14.6	12.0	3.3	5.7	4.4	9.1	6.1
		Microtus montanus nexus, Salt Lake County								
♂	4 av	24.9	7.8	15.2	12.1	3.4	6.0	5.0	10.1	6.8
♂	Max	25.7	8.3	15.9	12.8	3.6	6.7	5.2	10.5	7.4
♂	Min	23.7	7.5	14.5	11.7	3.2	5.3	4.7	9.7	6.4
♀	5 av	24.4	7.5	15.5	12.4	3.4	5.9	4.9	10.0	6.6
♀	Max	25.0	7.9	15.8	12.7	3.6	6.3	5.1	10.1	6.8
♀	Min	23.4	7.0	14.5	12.0	3.2	5.6	4.4	9.7	6.3

TABLE 17.—*Continued*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of palatal bridge	Length of incisive foramina	Postpalatal breadth	Alveolar length of maxillary tooth-row
		Microtus montanus micropus, 5 mi. S Garrison								
♂	4 av.	24.1	7.7	15.6	12.3	3.8	7.1	4.9	9.4	6.9
♂	Max.	27.0	8.5	17.3	13.6	4.0	7.7	5.1	10.8	7.3
♂	Min.	22.4	7.0	14.7	11.8	3.5	6.3	4.2	8.6	6.6
♀	4 av.	23.9	7.6	15.5	12.1	3.7	6.8	5.0	9.5	6.8
♀	Max.	25.3	8.1	16.4	12.7	3.9	7.2	5.3	10.2	7.2
♀	Min.	22.4	7.0	14.8	11.5	3.5	6.4	4.6	8.8	6.6
		Microtus montanus amosus, topotypes								
♂	4687	26.1	8.3	17.2	13.5	3.7	5.6	6.0	10.2	7.5
♀	4688	.....	8.2	16.2	13.1	3.7	6.0	5.5	.....	7.5
♀	4686	26.6	7.9	16.5	12.9	3.8	6.0	5.7	11.0	7.3
		Microtus montanus rivularis, topotype								
♂	190797 USNM	25.5	7.8	16.2	12.2	3.5	6.0	5.6	10.3	7.3
		Microtus longicaudus latus, ♂ ♂ Queen of Sheba Mine; ♀ ♀ Raft River Mountains								
♂	5 av.	23.3	7.2	14.6	12.1	3.7	5.9	4.7	10.0	6.45
♂	Max.	23.5	7.3	15.5	12.2	4.0	6.1	5.1	10.1	6.5
♂	Min.	23.0	6.9	14.0	12.0	3.5	5.8	4.1	9.9	6.4
♀	4 av.	23.4	7.7	14.6	11.9	3.9	5.7	4.6	9.9	6.6
♀	Max.	24.0	7.8	14.9	12.2	4.1	6.3	4.8	10.1	6.9
♀	Min.	22.8	7.6	14.3	11.5	3.7	5.3	4.5	9.8	6.3
		Microtus longicaudus mordax, Uinta Mountains								
♂	11 av.	24.0	7.9	15.0	12.4	3.65	6.0	5.0	10.2	6.6
♂	Max.	24.7	8.2	16.2	12.7	3.9	6.2	5.1	11.5	7.1
♂	Min.	23.3	7.2	14.1	11.6	3.5	5.6	4.4	9.5	6.2
♀	8 av.	23.6	7.9	15.0	12.2	3.6	6.1	5.2	10.1	6.7
♀	Max.	24.4	8.4	15.4	12.5	4.0	6.8	5.8	10.6	6.9
♀	Min.	22.7	7.2	13.5	11.8	3.0	5.3	4.4	9.5	6.2
		Microtus longicaudus alticola, San Juan County								
♂	4 av.	23.4	7.9	14.6	12.2	3.7	5.9	4.7	10.0	6.5
♂	Max.	24.4	8.2	15.3	13.0	3.8	6.2	5.8	10.7	6.8
♂	Min.	22.2	7.6	13.6	11.6	3.5	5.8	4.1	9.5	6.1
♀	6 av.	22.9	7.5	14.4	11.8	3.6	5.8	4.5	9.6	6.3
♀	Max.	23.4	7.8	14.7	12.2	3.8	6.1	4.8	10.1	6.5
♀	Min.	21.5	7.0	13.4	11.3	3.5	5.4	4.1	9.0	6.1

TABLE 17.—*Concluded*

Sex	Catalog number or number of individuals averaged	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of palatal bridge	Length of incisive foramina	Postpalatal breadth	Alveolar length of maxillary tooth-row
		Microtus mexicanus navaho, Navajo Mountain								
♂	58805 MVZ	20.1	7.1	13.6	11.0	3.1	6.0	4.3	8.2	6.8
♂	58806 MVZ	22.7	7.2	14.5	11.6	3.1	5.1	4.3	9.9	6.8
♂	58811 MVZ	22.0	7.0	14.7	11.8	3.6	5.2	4.1	9.3	6.4
♀	5 av	22.3	7.4	14.8	11.7	3.4	5.9	4.3	9.2	7.0
♀	Max	23.7	7.6	15.2	12.0	3.6	6.1	4.6	9.3	7.1
♀	Min	21.1	7.1	14.3	11.5	3.3	5.7	4.0	8.9	6.5
		Microtus richardsoni macropus, Uinta and Wasatch mountains								
♂	11993 CM	31.4	9.3	21.1	14.8	5.0	7.5	5.8	12.4	8.1
♀	4 av	30.6	9.4	20.2	14.9	4.7	7.5	5.7	11.8	8.3
♀	Max	31.5	9.8	21.0	15.3	5.0	7.8	6.1	12.5	8.5
♀	Min	29.7	9.0	19.5	14.7	4.5	7.0	5.3	11.3	8.1

Lagurus curtatus intermedius (Taylor)

Sagebrush Vole

Microtus (*Lagurus*) *intermedius* Taylor, Univ. California Publ. Zoöl., 7:253, June 24, 1911, type from head of Big Creek, Pine Forest Mountains, 8,000 feet, Humboldt County, Nevada.

Lagurus curtatus intermedius, Borell and Ellis, Journ. Mamm., 15:35, February 15, 1934.

Lagurus curtatus pauperrimus, Presnall, Zion-Bryce Mus. Bull., 2:16, January, 1938.

Range.—Western Utah. See figure 57.

Description and comments.—Measurements of 2 adult males, numbers 771 and 3798, and average and extreme measurements of 4 adult females, from western Utah, are, respectively, as follows: Total length, 113, 110, 111.5 (115-108); length of tail, 18, 17, 17.5 (18-16); length of hind foot, 17, 16, 17 (18-16); length of ear, 11, 10, 10 (11-9). Tail short, rarely exceeding that of hind foot; feet hairy. Color: Upper parts vary from Clay Color in some specimens to Drab in others; tail bicolored, like back above, white beneath; feet grayish or buffy; entire underparts white. Skull: Small; braincase wide and flat, top of skull flat or moderately concave ventrally in interorbital region; auditory bullae large, cancellous and well inflated ventrally; rostrum short; zygomatic arches widely spreading; molars light; lower third molar with 4 prisms; stapedial canal complete.

From *Lagurus curtatus levidensis*, *L. c. intermedius* differs in: Body smaller; color lighter, Clay Color or Drab as opposed to Wood Brown; skull similar in all measurements taken except mastoid breadth, basicranial depth and interorbital breadth which average larger in both sexes.

These animals can be readily distinguished from all other microtines from Utah by small size, grayish coloration, short tail, hairy feet, flat wide skull; and third lower molar with 4 prisms.

With the exception of three animals from Uintah County, referable to *L. c. levidensis* and four others reported from the high Uinta Mountains, all others known from the state are from the Great Basin region of western Utah. The animals from Utah are paler and smaller than typical *L. c. intermedius,* but of the known subspecies they more closely approach it and are here so referred. Individual variation is great, and the genus is in need of revision before the assignment of animals to subspecies can be adequately undertaken.

Specimens examined.—Total, 13, distributed as follows: *Boxelder County:* Grouse Creek, Raft River Mountains, 6,500 ft., 1. *Tooele County:* Clifton Flat, 7 mi. SW Gold Hill, 6,149 ft., 1. *Salt Lake County:* Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 7,000 ft., 1. *Juab County:* Queen of Sheba Canyon, W side Deep Creek Mountains, 8,000 ft., 10.

Additional record (Presnall, 1938:16).—Daves Hollow, Bryce National Park.

Lagurus curtatus levidensis (Goldman)

Sagebrush Vole

Lemmiscus curtatus levidensis Goldman, Proc. Biol. Soc. Washington, 54:70, July 31, 1941, type from sandhills, 5 miles east of Canadian River, west base of Medicine Bow Range, east of Walden, North Park, 8,000 feet, Jackson County, Colorado; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 232, 1942.

Microtus pauperrimus, Bailey, N. Amer. Fauna, 17:69, June 6, 1900; Warren, The mammals of Colorado, Knickerbocker Press, p. 100, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):78, April, 1922.

Lagurus pauperrimus, Barnes, Bull. Univ. Utah, 17 (no. 12):130, June, 1927.

Range.—Eastern and northeastern Utah. See figure 57.

Description and comments.—Measurements of an adult male, number 6663, and of an adult female, number 6662, from Browns Corral, are, respectively, as follows: Total length, 119, 125; length of tail, 17, 18; length of hind foot, 17, 16; length of ear, 9, 10. Color: Upper parts Wood Brown suffused with Cinnamon-Buff, darker on head and middorsal region owing to admixture of dark-tipped hairs; underparts dull whitish; feet white; tail bicolored, brownish above, white beneath. Skull: Small, slender, flattened; frontal region depressed; auditory bullae small; dentition relatively heavy.

For comparison with *Lagurus curtatus intermedius,* see account of that subspecies.

Animals from Utah belonging to this subspecies are known only from the High Uinta Mountains (Bailey, 1900:69; Goldman, 1941: 71), and southern Uintah County. The clarification of the taxonomic status of these animals in Utah, must await the collection of specimens from that part of Utah east of the Green and Colorado rivers, and a revisionary study of the genus.

Specimens examined.—Total, 5, as follows: *Summit County:* Blacks Fork, 10,000 ft., 2. *Uintah County:* Browns Corral, 20 mi. S Ouray, 6,250 ft., 3.

TABLE 18

Cranial Measurements of Lagurus

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Condylobasal length	Basicranial depth over bullae	Zygomatic breadth	Interorbital breadth	Mastoid breadth	Alveolar length of maxillary tooth-row	Length of nasals
		Lagurus curtatus intermedius, ♂ 771, Raft River Mountains, ♂ 3798 and ♀ ♀, Deep Creek Mountains							
♂	3798	22.1	21.9	8.2	13.1	3.3	12.3	5.4	6.1
♂	771	24.0	23.8	8.2	13.3	3.5	11.9	6.1	6.3
♀	4 av.	22.0	21.9	8.5	13.3	3.3	11.3	5.5	5.8
♀	Max.	23.1	23.0	8.5	13.5	3.5	11.5	5.7	6.1
♀	Min.	20.9	20.7	8.5	13.0	3.3	11.0	5.4	5.1
		Lagurus curtatus levidensis, Browns Corral							
♂	6663	22.9	22.9	8.1	13.3	3.3	12.0	6.1	5.9
♀	6662	23.2	23.1	8.4	13.6	3.4	11.5	6.1	5.6

Family MURIDAE

Non-native Rats and Mice

These animals are characterized by nearly naked or naked ears; long scaly tails; coarse pelage; criticine-like skulls with rooted, tuberculate molars; molars of upper jaw with three longitudinal rows of tubercles; upper incisors thicker (anteroposteriorly) than wide; tooth formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{0}{0}$, m.$\frac{3}{3}$.

This family is represented in Utah by the genus *Rattus* with two species and the genus *Mus* with one species. The animals are omnivorous and almost everywhere in North America are regarded as a pest. They are non-native and were introduced from the Old World.

KEY TO RATTUS AND MUS IN UTAH

1.–Hind foot more than 25; first upper molar shorter than combined lengths of second and third upper molars.

2.–Tail as long as or longer than head and body; length of parietal measured along temporal ridge less than distance between temporal ridges ..... *Rattus rattus alexandrinus*, p. 382

2'.–Tail no longer than head and body; length of parietal measured along temporal ridge not less than distance between temporal ridges ..... *Rattus norvegicus*, p. 383

1'.–Hind foot less than 25; first upper molar longer than combined lengths of second and third upper molars ..... *Mus musculus*, p. 384

Rattus rattus alexandrinus (Geoffroy)

Alexandrine Rat

Mus alexandrinus Geoffroy, Catal. Mammif. du Mus. d'Hist. Nat., Paris, p. 192, 1803, type from Alexandria, Egypt.
R [attus]. rattus alexandrinus, Hinton, Journ. Bombay Nat. Hist. Soc., 26:63, December 20, 1918.
Mus rattus, Barnes, Bull. Univ. Utah, 12 (no. 15):62, April, 1922.
Rattus rattus rattus, Barnes, Bull. Univ. Utah, 17 (no. 12):132, June, 1927.

Range.—Known only from Salt Lake City; probably occurs in cities and towns of north-central Utah.

Description and comments.—Measurements of an adult male, number 7013 and of an adult female, number 7015, from Salt Lake City are, respectively, as follows: Total length, 415, 359; length of tail, 210, 189; length of hind foot, 38, 34; length of ear (dry), 21, 19. Color: Upper parts mixed brown, gray and black, darkest in middorsal region; ears dark brown; tail uniformly dark brown or black; soles and palms black; underparts whitish. Skull: Large, robust; temporal ridges bowed laterally, developed as crests extending from supraorbital region to lambdoidal crest; molars with three longitudinal rows of cusps; incisors thicker than wide.

Judging from specimens from Salt Lake City, *R. r. alexandrinus* differs from *Rattus norvegicus* in: Size smaller; tail relatively longer; ear larger. Color: Upper parts darker; tail darker and with narrow annulations; soles and palms darker; ears darker. Skull: Smaller; slenderer; braincase more inflated; temporal ridges bowed out laterally rather than parallel; incisive foramina relatively longer and narrower; tympanic bullae larger and more expanded ventrally.

The only specimens of *R. r. alexandrinus* from Utah, known to me are from Salt Lake City. All were obtained from buildings within the downtown area of the city. Whereas *R. norvegicus* is ubiquitous, *R. r. alexandrinus* appears to be restricted to buildings.

Barnes (1927:132) listed the black rat *Rattus rattus rattus* as occurring in Utah. Earlier (1922:62), he employed the name *Mus rattus* for animals from Utah, but used the common name "black rat". I know of no criterea other than color to separate the Alexandrine rat (*R. r. alexandrinus*) from the black rat (*R. r. rattus*). Since the specimens available to me are grayish above and whitish below, I consider them to more closely answer the description of *R. r. alexandrinus* than they do that of *R. r. rattus.* I suspect that color is not a good diagnostic character in *Rattus rattus* since the other species, *Rattus norvegicus,* in Utah is known to vary widely in color (see account of *R. norvegicus*).

Specimens examined.—Total, 3, from: *Salt Lake County:* Salt Lake City.

Rattus norvegicus norvegicus (Berkenhout)

Norway Rat

Mus norvegicus Berkenhout, Outl. Nat. Hist. Great Britain, 1:5, 1769, type from Norway.

Rattus norvegicus, Hollister, Proc. Biol. Soc. Washington, 29:126, June 6, 1916; Silver, Journ. Mamm., 8:58, February 9, 1927; Barnes, Bull. Univ. Utah, 17 (no. 12):134, June, 1927.

Range.—Sevier County northward in central Utah; may occur in all larger settlements.

Description and comments.—Measurements of one male, number 3000, and of 2 females, number 2993 and 2995, from Salt Lake City, are, respectively, as follows: Total length, 393, 418, 376; length of tail, 193, 199, 173; length of hind foot, 40, 41, 40; length of ear, 16, 21, 19. Color: Upper parts and sides dark brownish; feet and underparts grayish. Skull: Large, robust; temporal ridges developed as crests, extending from supraorbital region to lambdoidal crest; incisors thicker than wide.

For comparison with *Rattus rattus alexandrinus*, see account of that subspecies.

According to Allen (1874:65) neither *Rattus rattus* nor *Rattus norvegicus* was present in Utah in 1874 and Silver (1927:60) reported none there as late as 1888.

This rat (*R. norvegicus*) is found throughout the central part of the state in larger settlements as far south as Sevier County. Mr. Fred C. Harmston of the U. S. Public Health Service informs me that they are found as far south as Richfield, but are not found in the eastern and western parts of the state. These animals seem favorably located wherever they can find humans, rubbish and filth. I have observed them in semiaquatic environments along Millcreek, Salt Lake County, downstream from Jensen's slaughter house, and in chicken coops, slaughter houses, garbage dumps, grocery stores, restaurants, hotels, steam tunnels and shrubbery around buildings.

Studies of the available material show *R. norvegicus* to vary in color from gray to brown to black and even to "pinto".

The Norway rat extensively damages stored grain, food-stores of man in general, and even kills young poultry. The surest means of preventing damage is to rat-proof buildings. Where rats are present, trapping permits of disposing of the bodies of the rats so that objectionable odors from decay are avoided. Red squill is the poison safest to use; persons and most domestic animals vomit and expel the red squill that may be taken accidentally. Rats can not vomit and they are killed by the squill. Natural enemies of rats

should be protected where they are not themselves destructive of man's property.

Specimens examined.—Total, 22, from: *Salt Lake County:* Salt Lake City and environs.

Mus musculus subsp.? Linnaeus

House Mouse

Mus musculus Linnaeus, Systema Naturae, 10 ed., 1:62, 1758, type from Upsala, Sweden; Allen, Bull. Essex Inst., 6:65, 1874; Barnes, Bull. Univ. Utah, 12 (no. 15):63, April, 1922.

Mus musculus musculus, Barnes, Bull. Univ. Utah, 17 (no. 12):135, June, 1927; Moore, Journ. Mamm., 10:260, August 10, 1929.

Range.—State-wide.

Description and comments.—Average and extreme measurements of 5 adult males and the measurements of 3 adult females, numbers 1503, 2378 and 2447, from Salt Lake City are, respectively, as follows: Total length, 166 (188-148), 135, 162, 160; length of tail, 79 (93-70), 72, 77, 78; length of hind foot, 17 (19-14), --, 19, 19; length of ear, 11 (13-10), 7, 14, 9. Color: Upper parts grade through light brown to nearly black; tail not sharply bicolored, lighter beneath; feet whitish or grayish; underparts light, usually whitish with a light buffy wash. Skull: Small; nasals and premaxillae terminate proximally at approximately the same level; rostrum short; upper incisors notched (occlusal view); incisive foramina large, extending posteriorly to middle of first molar; first molar markedly enlarged.

No serious attempt has been made by me to identify specimens to subspecies. Specimens in the collection of the University of Utah vary in color more than I would expect if all were of one subspecies. I have wondered if our animals were hybrids of two or more kinds. Mr. and Mrs. Stanley Mulaik of the Division of Biology at the University of Utah have by selective breeding from wild stock produced a great many color types in these mice.

Allen (1874) reported mice in Utah in early pioneer times. They occur throughout the state in buildings, but are adaptable and live far from buildings. I have taken them in the desert, in meadows, and at the mouths of some of the canyons. My observations, suggest that there is a movement away from buildings with the onset of summer and a return in the fall. Under favorable climatic conditions they may remain in fields the year around.

Specimens examined.—Total, 45, distributed as follows: *Weber County:* Ogden, 4,430 ft., 2. *Davis County:* Farmington, 4,500 ft., 1; Antelope Island, Great Salt Lake, 4,500 ft., 1. *Salt Lake County:* Salt Lake City and environs, 30; Taylorsville, 4,300 ft., 1; 1 mi. W Draper, 1. *Summit County:* 4 mi. NE Snyderville, 4,500 ft., 1; Park City, 7,000 ft., 2. *Utah County:* 1 mi. W Payson, 4,600 ft., 2; 8 mi. W Spanish Fork, 4,503 ft., 2. *Uintah County:* Willow Creek, 29 mi. S Ouray, 5,400 ft., 1. *Carbon County:* ½ mi. N Spring Glen, 1.

TABLE 19

Cranial Measurements of Rattus and Mus

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of palatal shelf	Length of incisive foramina	Alveolar length of maxillary tooth-row
		Rattus rattus alexandrinus, Salt Lake City							
♂	7013	45.0	15.7	21.2	15.4	6.9	8.8	7.1	6.6
♀	7015	39.0	14.1	18.1	.....	6.1	7.1	6.3	6.3
		Rattus norvegicus norvegicus, Salt Lake City							
♂	3000	42.7	16.4	20.0	16.7	6.3	9.3	6.7	7.3
♀	2993	46.2	17.1	23.8	17.4	6.9	10.6	7.1	7.7
♀	2995	45.2	17.7	21.7	17.0	6.5	10.4	7.3	7.4
		Mus musculus, Salt Lake City							
♂	5 av.	21.6	8.0	11.2	9.6	3.7	4.0	4.6	3.35
♂	Max.	22.9	8.5	11.9	9.9	3.9	4.5	4.9	3.4
♂	Min.	20.4	7.1	10.6	9.4	3.5	3.4	4.4	3.3
♀	1503	20.2	7.1	10.8	9.4	3.7	3.6	3.9	3.3
♀	2378	22.8	8.8	11.3	9.4	3.8	3.8	4.9	3.5
♀	2447	21.5	8.2	11.5	9.8	3.7	3.8	4.7	3.3

Family ZAPODIDAE

Jumping Mice

Animals of this family are characterized by elongated five-toed hind feet; extremely elongated, scaly tail; blackish middorsal region separated by Ochraceous-Buff lateral stripes from white underparts; broad, tapered rostrum; small infraorbital foramen situated at bottom of large false infraorbital foramen; tooth formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{1}{0}$, m.$\frac{3}{3}$.

This family is represented in Utah by two subspecies of *Zapus princeps*.

Zapus princeps cinereus Hall

Big Jumping Mouse

Zapus princeps cinereus Hall, Univ. California Publ. Zoöl., 37:7, April 10, 1931, type from Pine Canyon, 6,600 feet, Raft River Mountains, 17 miles northwest of Kelton, Boxelder County, Utah; Whitlow and Hall, Univ. California Publ. Zoöl., 40:268, September 30, 1933; Davis, The Recent mammals of Idaho, Caxton Printers Ltd., Caldwell, Idaho, p. 342, April 5, 1939.

Range.—Raft River Mountains.

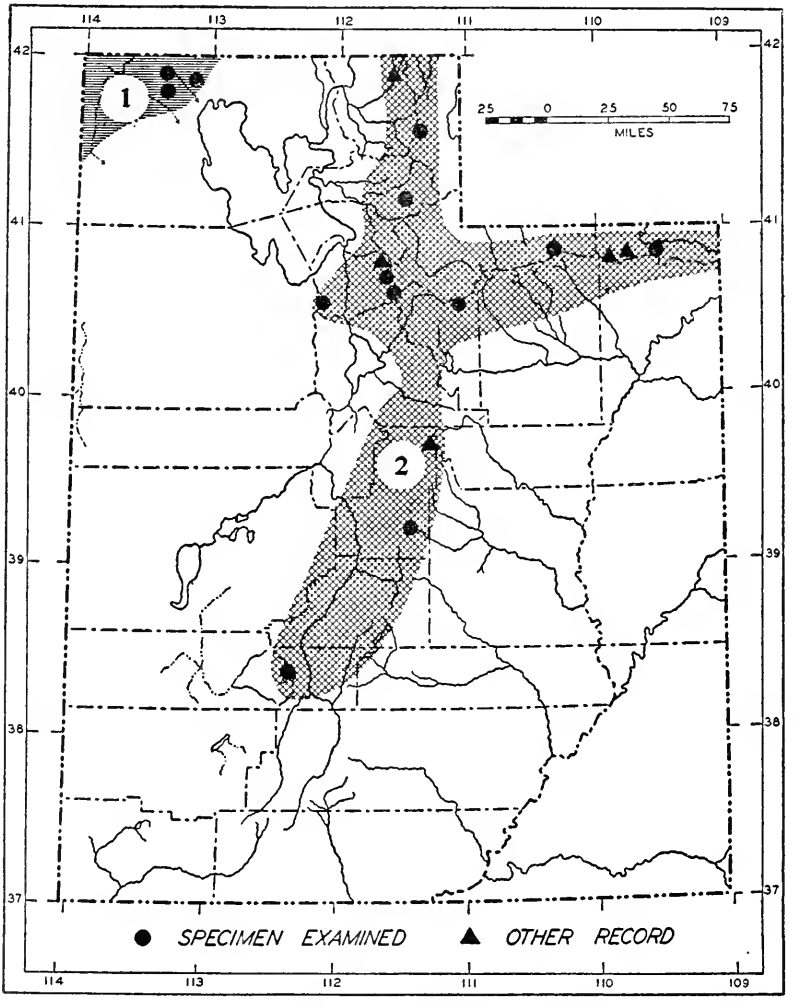

FIG. 63. Distribution of *Zapus princeps*.
1. *Z. p. cinereus.* 2. *Z. p. utahensis.*

Description and comments.—Measurements of 2 adult males, numbers 5029 and 5031, and of 2 adult females, numbers 5030 and 5032, from George Creek are, respectively, as follows: Total length, 232, 240, 270, 241; length of tail, 138, 140, 159, 138; length of hind foot, 33, 35, 35, 33; length of ear, 15, —, 15, 15. Color: Upper parts brownish mixed with Pinkish Buff; sides Pinkish Buff; tail scaly, Brownish above, whitish beneath; front and hind feet and entire underparts white. Skull: Small; palate relatively as well as actually long; upper teeth moderately divergent anteriorly.

For comparison with *Zapus princeps utahensis,* see account of that subspecies.

The gray color of the type of Z. *p. cinereus* is not a good character as gray animals are also found in the darker *Zapus princeps utahensis.* The specimens available to me differ from Z. *p. utahensis* in color only by being Pinkish Buff as opposed to Cinnamon Buff. Davis (1939:343) pointed out that the smaller measurements given by Hall (1931:7) might not be characteristic, but our near topotypes, with one exception, agree closely with the measurements given by Hall. From what is known, this subspecies is limited, in Utah, to the extreme northwestern part of the Raft River Mountains. The type locality is on the southern limits of the range and is in the Great Basin drainage of these mountains. The northern slopes of these mountains are in the Snake River drainage, and the greater part of the geographic range of this subspecies is in Idaho south of the Snake River (see Davis, 1939:338).

Specimens examined.—Total, 10, distributed as follows: *Boxelder County:* George Creek, 7 mi. SE Yost, Raft River Mountains, 6,500 ft., 7; S fork George Creek, 5 mi. SE Yost, Raft River Mountains, 6,700 ft., 1; Clear Creek, N Slope Raft River Mountains, 5 mi. SW Nafton, 6,500 ft., 1; Pine Creek, 3 mi. Rosette, Raft River Mountains, 6,100 ft., 1.

Zapus princeps utahensis Hall

Big Jumping Mouse

Zapus princeps utahensis Hall, Occ. papers, Mus. Zoöl. Univ. Michigan, 296:3, November 2, 1934, type from Beaver Creek, 19 miles south of Manila, Daggett County, Utah; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Jaculus Hudsonius, Allen, Bull. Essex Inst., 6:65, 1874.

Zapus princeps princeps, Wolfe, Journ. Mamm., 9:154, May 9, 1928; Moore, Journ. Mamm., 9:154, May 9, 1928; Svihla, Journ. Mamm., 12:264, August 24, 1931; Stanford, Journ. Mamm., 12:362, November 11, 1931.

Range.—Uinta and Wasatch mountains, south to Beaver Mountains, also found in the Oquirrh Mountains.

Description and comments.—Measurements of 3 adult males, numbers 5307, 5310 and 5314, and average and extreme measurements of 5 adult females from Salamander Lake are, respectively, as follows: Total length, 241, 248, 253, 250 (253-246); length of tail, 145, 151, 148, 152 (155-145); length of hind foot, 32, 33, 34, 34 (35-33); length of ear, 17, 14, 16, 15.4 (16-15). Color: Upper parts brownish mixed with Cinnamon-Buff; sides Cinnamon-Buff; tail

scaly, brownish above, whitish beneath; front and hind feet and entire underparts white. Skull: Large, broad; palate short and wide; upper tooth-rows divergent anteriorly.

From near topotypes of *Zapus princeps cinereus, Z. p. utahensis* differs in: Size larger; tail relatively longer. Color: Darker (Cinnamon-Buff as opposed to Pinkish Buff). Skull: Averages larger; palate wider but shorter; upper tooth-rows generally more divergent anteriorly; nasals longer; incisive foramina wider posteriorly.

The southernmost known record of this animal from Utah is Puffer Lake in the Beaver Mountains. Judging from the terrain, I suppose that they exist at higher elevations still farther south.

Specimens examined.—Total, 34, distributed as follows: *Rich County:* 12 mi. W Woodruff, 1 (M.V.Z.). *Morgan County:* 1. *Salt Lake County:* Salamander Lake, Lambs Canyon, 9,000 ft., 11; head of Lambs Canyon, 9,000 ft., 4; The Firs, Millcreek Canyon, 2; Brighton, Big Cottonwood Canyon, 9,000 ft., 2; 1 mi. above Alta, 10,000 ft., 4; Butterfield Canyon, 1½ mi. above Butterfield Tunnel, 6,300 ft., 4. *Summit County:* Henrys Fork, Uinta Mountains, 3. *Daggett County:* Junction Deep and Carter creeks, Uinta Mountains, 7,500 ft., 2. *Wasatch County:* Provo River, 3 mi. N Soapstone G. S., Wasatch National Forest, 1. *Sanpete County:* Baldy R. S., 2. *Beaver County:* Puffer Lake, 1.

Additional records.—Cache County (Stanford, 1931:362): Head of Logan Canyon. *Salt Lake County* (Wolfe, 1928:154): Pine Crest, Emigration Canyon. *Daggett County* (Hall, 1934:6): Elk Park, 20 mi. S Manila; Beaver Creek, 19 mi. S Manila; Carter Creek; Granite Park, 24 mi. S Manila. *Sanpete County* (Moore, 1928:154): Mammoth Ranger Station, Manti National Forest.

TABLE 20

Cranial Measurements of Zapus

Sex	Catalog number or number of individuals averaged	Occipitonasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of palatal shelf	Width of palate at M3	Width of palate at P4	Alveolar length of maxillary tooth-row
		Zapus princeps cinereus, George Creek								
♂	5029	24.6	9.5	12.4	11.2	5.0	3.3	2.7	3.9	4.2
♂	5031	.....	9.6	.....	.....	4.7	3.2	3.1	3.7	4.1
♀	5030	25.8	10.2	12.8	11.5	5.0	3.6	3.0	4.0	4.5
♀	5032	.....	9.9	12.0	.....	4.7	3.3	2.8	3.8	4.1
		Zapus princeps utahensis, Salamander Lake								
♂	5307	24.7	10.2	12.7	11.3	4.8	3.4	2.7	3.7	4.3
♂	5314	25.6	10.2	13.1	11.3	4.4	3.6	2.8	3.7	4.4
♀	5 av.	25.2	10.4	12.7	11.3	4.9	3.4	2.8	3.7	4.4
♀	Max.	25.7	10.8	13.3	11.5	5.1	3.5	3.0	3.9	4.5
♀	Min.	24.6	10.1	12.3	11.3	4.5	3.2	2.7	3.5	4.3

Family ERETHIZONTIDAE

Porcupines

These animals are characterized by moderately large size (second largest North American rodent); body covered with quills, except on underside of body, chin, throat and cheeks behind the level of the eyes and nose; soles naked; front feet with four toes, hind feet with five toes; nasals extend far posterior to proximal end of premaxillae; diastema longer than maxillary tooth-row; infraorbital foramen larger than foramen magnum; tooth formula, i.$\frac{1}{1}$, c.$\frac{0}{0}$, p.$\frac{1}{1}$, m.$\frac{3}{3}$.

This family is represented in Utah by two subspecies of *Erethizon dorsatum.*

Erethizon dorsatum epixanthum Brandt

Porcupine

Erethizon epixanthus Brandt, Mem. Acad. Imp. Sci., St. Petersbourg, ser. 6, vol. 3 (Sci. Nat., vol. 1), p. 390, 1835, type from California.
Erethizon dorsatum epixanthum, Anderson and Rand, Canadian Journ. Res., 21:293, September 24, 1943.
Erethizon dorsatus var. *epizanthus,* Allen, Bull. Essex Inst., 6:52, 1874.
Erethizon epixanthum, Barnes, Bull. Univ. Utah, 12 (no. 15):90, April, 1922; Tanner, Journ. Mamm., 8:251, August 9, 1927.
Erethizon epixanthum epixanthum, Barnes, Bull. Univ. Utah, 17 (no. 12): 135, June, 1927; Svihla, Journ. Mamm., 12:264, August 24, 1931; Stanford, Journ. Mamm., 12:362, November 11, 1931; Woodbury, Ecol. Monogr., 3:192, April, 1933; Keller, Journ. Mamm., 16:232, August 12, 1935; Presnall, Zion-Bryce Mus. Bull., 2:18, January, 1938; Long, Journ. Mamm., 21:179, May 16, 1940; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Range.—State-wide except southeastern part in Grand and San Juan counties.

Description and comments.—Measurements of an adult male, number 316, from "near Tooele" are as follows: Total length, 775; length of tail, 175; length of hind foot, 100. Similar to *Erethizon dorsatum couesi;* for diagnostic features and comparison, see account of that subspecies.

The subspecies *E. d. epixanthum* has a wide distribution in the foothills and mountains. Occasional animals visit the valley floors, being found in the city parks in Salt Lake City. Towards the southern limits of its range it intergrades with *E. d. couesi* (see account of that subspecies).

Specimens examined.—Total, 16, distributed as follows: *Boxelder County:* Raft River Mountains, 1; George Creek, 7½ mi. SE Yost, Raft River Mountains, 2. *Tooele County:* "near Tooele," 2. *Salt Lake County:* Salt Lake City, 4; Big Cottonwood Canyon, 2 mi. W Brighton, 1; Butterfield Canyon, 3 mi. SW Butterfield Tunnel, 7,000 ft., 1; Beef Hollow, 3 mi. W Camp Williams,

6,000 ft., 1. *Juab County:* Four Mile Canyon, 10 mi. SE Nephi, 1. *Sanpete County:* Baldy R. S., 1. *Iron County:* 2 mi. E Cedar City, 1. *Kane County:* 1 mi. W Kanab, 5,000 ft., 1.

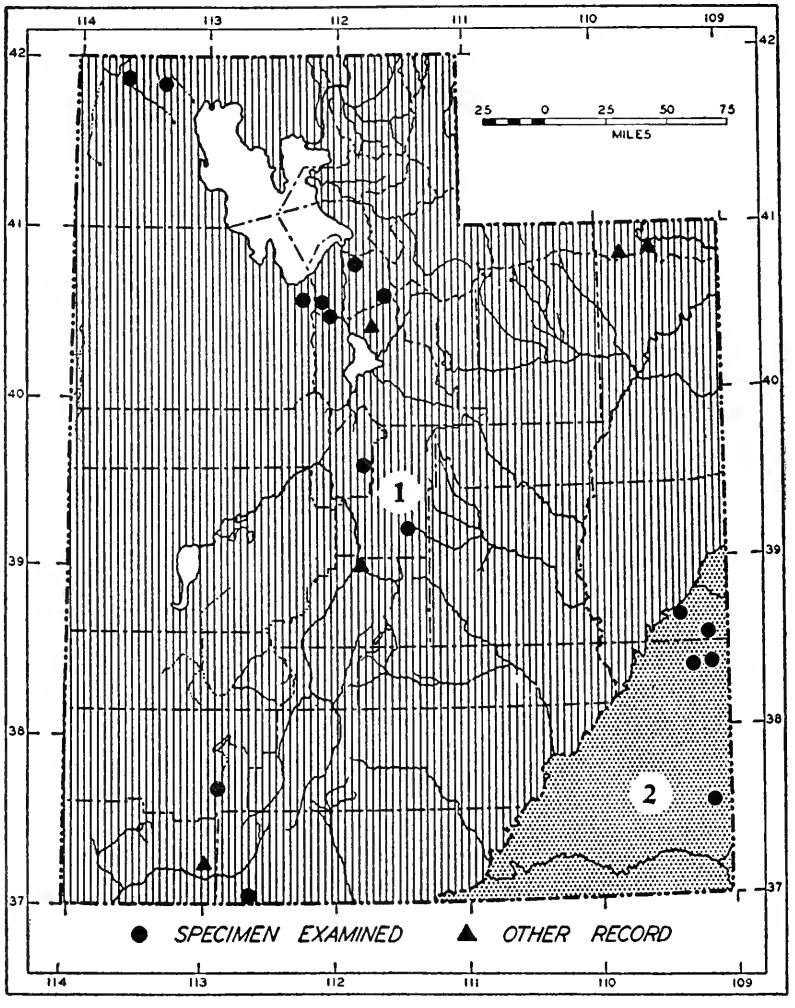

FIG. 64. Distribution of *Erethizon dorsatum.*
1. *E. d. epixanthum.* 2. *E. d. couesi.*

Additional records.—Daggett County (Svihla, 1931:264): Carter Creek; Long's Park; Sheep Creek. *Utah County* (Tanner, 1927:250): Mt. Timpanogos. *Sevier County* (Stanford, 1931:362): Ivie Farm, Salina. *Washington County* (Woodbury, 1933:192): Zion National Park.

Erethizon dorsatum couesi Mearns

Porcupine

Erethizon epixanthus couesi Mearns, Proc. U. S. Nat. Mus., 19:723, July 30, 1897, type from Fort Whipple, Yavapai County, Arizona.
Erethizon dorsatum couesi, Hall, Mammals of Nevada, Univ. California Press, Berkeley, Calif., p. 649, July 1, 1946.
Erethizon epixanthus, Barnes, Bull. Univ. Utah, 12 (no. 15):90, April, 1922.
Erethizon epixanthum epixanthum, Barnes, Bull. Univ. Utah, 17 (no. 12): 135, June, 1927.

Range.—Southeastern Utah in Grand and San Juan counties.

Description and comments.—Measurements of 2 adult females, numbers 2956 and 2955, from San Juan County, are as follows: Total length, 715, 686; length of tail, 170, 180; length of hind foot, 90, 83; length of ear, 30, 25. Pelage consisting of quills, hair and fur; quills yellowish white, tipped with black; hair long extending well beyond quills, white basally, black subterminally, yellowish or greenish-yellow distally; fur white basally, black distally. Color: Upper parts blackish with yellowish or greenish cast owing to terminal bands of guard hairs; nose dark brown; vibrissae black. Skull: Large, heavily ridged; infraorbital foramina large (larger than foramen magnum); nasals extending well posterior to premaxillae; tympanic bullae well inflated ventrally; diastema longer than row of cheek-teeth.

From specimens of *Erethizon dorsatum epixanthum* from Utah, *E. d. couesi* differs in: Infraorbital foramina averaging larger; tympanic bullae more inflated ventrally; jugals narrower dorsoventrally, and nearly straight rather than moderately bowed out; external nares larger; molariform teeth smaller; pterygoid hamulae narrower and more nearly perpendicular; space between pterygoid hamulae and anterior face of tympanic bullae narrower. No significant differences in size or color were detected in the material at hand.

One specimen, number 4718, a skull only, from Kanab, appears to be an intergrade between *E. d. epixanthum* and *E. d. couesi*. This specimen is like *E. d. couesi* in small tympanic bullae and straightness and width of jugals. In other diagnostic characters it more closely resembles *E. d. epixanthum* to which it is here referred. Another specimen, number 4716, from east of Cedar City also shows some characters of *E. d. couesi*, but a larger number of characters of *E. d. epixanthum* to which it is here referred.

Animals from that part of the state east of the Colorado River are referable to *E. d. couesi*. I do not know which subspecies occurs in the Virgin River Basin; no specimens have been seen from that part of the drainage of the Colorado River. Hall (1946:586) guessed that the southern drainage of the Virgin River, in Nevada, was

within the range of *E. d. couesi.* Warren (1942:244) reported one specimen from Chromo, Archuleta County, Colorado, which at that time was the most northerly known record of occurrence of *E. d. couesi.* The northern records of *E. d. couesi* from Utah extend the known range of this subspecies northward a distance of 150 miles.

Specimens examined. — Total, 7, distributed as follows: *Grand County:* Creek bottom, head of Nigger Bill Canyon, E side Colorado River, 4 mi. above Moab Bridge, 3,995 ft., 1; Clark Lake, La Sal Mountains, 2. *San Juan County:* 5 mi. NE La Sal P. O., 8,000 ft., 2; Block Canyon, 19 mi. SE Moab, 5,000 ft., 1; 14 mi. E Blanding, 1.

TABLE 21

Cranial Measurements of Erethizon

Sex	Catalog number	Occipitonasal length	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Palatilar length	Alveolar length of maxillary tooth-row
		Erethizon dorsatum epixanthum, "near Tooele"							
♂	316.....	101.3	97.0	49.1	72.4	44.5	34.4	53.3	27.9
		Erethizon dorsatum couesi, San Juan County							
♂	4719.....	104.5	99.1	49.0	73.9	43.8	32.8	57.7	27.2
♀	2955.....	89.5	80.2	36.8	62.8	39.6	30.6	43.7	27.0
♀	2956.....	88.2	82.7	30.6	67.6	40.7	32.6	45.2	23.7

Order CARNIVORA

Flesh-eaters

In Utah, carnivores vary in size from the grizzly bear to the ermine. With the exception of bears and raccoons, which are omnivorous, the carnivores of Utah are chiefly flesh-eaters. Except for the two aforementioned kinds all others in Utah have the fourth upper premolar and the lower first molar enlarged and modified into carnassial shears. Other characters common to all members are: Incisors small and pointed, arranged in a transverse row, usually consisting of three pairs, the median pair being the smallest; canines large, conical, recurved and sharp; premolars pointed, compressed with one or two roots; lower mandible capable only of vertical movement because of deep glenoid fossae, transversely arranged condyloid processes and interlocking canines; postorbital processes usually well developed on frontals and jugals; orbit open behind; radius and ulna separate; tibia and fibula separate; digits

usually five and clawed (hallux and pollex frequently reduced); cerebral hemispheres convoluted.

KEY TO FAMILIES OF CARNIVORES IN UTAH

1.–Hind foot five toed; teeth 42-34.
2.–Size 47 inches or more; tail shorter than hind foot; teeth 42; upper carnassial not trenchant ..... Ursidae, p. 406
2'.–Size less than 47 inches; tail longer than hind foot; teeth fewer than 42; upper carnassial trenchant.
3.–Tail with conspicuous rings; teeth 40 ..... Procyonidae, p. 415
3'.–Tail without rings; teeth fewer than 40 ..... Mustelidae, p. 416
1'.–Hind foot four toed; teeth 28-32 or 42.
4.–Muzzle long and attenuate; teeth 42; claws non-retractile ..... Canidae, p. 393
4'.–Muzzle blunt and broad; teeth 30 or 28; claws retractile ..... Felidae, p. 438

Family CANIDAE

Foxes, Coyotes and Wolves

Medium sized, digitigrade, cursorial carnivores possessing non-retractile claws, five digits on forefeet, four digits on hind feet, long and usually bushy tails, elongated muzzles, sebaceous glands on dorsum of tail, narrow rostrum, large tympanic bullae with closely appressed paroccipital processes, well defined alisphenoid canals, both trenchant and cutting cheek teeth, anterior openings of infraorbital foramina above interspace between third and fourth upper premolars, anterior cusp of upper carnassial larger than posterior and directed posteriorly, os penis grooved; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{2}{3}$.

This family is represented in Utah by three genera, consisting of five full species with a total of six subspecies.

KEY TO THE CANIDS IN UTAH

1.–Postorbital processes thin and concave dorsally; basilar length of skull less than 147.
2.–Back of ears black or grayish brown; tail without conspicuous dorsal black stripe; inferior margin of lower mandible without prominent step.
3.–Tip of tail white; ears black on outside; distance between orbit and anterior end of infraorbital canal more than height of foramen magnum ..... *Vulpes fulva*, p. 399
3'.–Tip of tail black or dark brown; ears grayish brown on outside; distance between orbit and anterior end of infraorbital canal less than height of foramen magnum ..... *Vulpes macrotis*, p. 402
2'.–Back of ears red; tail with continuous dorsal black stripe; inferior margin of lower mandible with decided step, *Urocyon cinereoargenteus*, p. 404

1'.–Postorbital processes thickened, convex dorsally; basilar length of skull more than 147.

4.–Rostral measurement across canines less than 1¾ of length of tympanic bullae ..... *Canis latrans*, p. 394

4'.–Rostral measurement across canines more than 1¾ of tympanic bullae ..... *Canis lupus*, p. 397

Canis latrans lestes Merriam

Coyote

Canis lestes Merriam, Proc. Biol. Soc. Washington, 11:25, March 15, 1897, type from Toyabe Mountains, near Cloverdale, Nye County, Nevada; Barnes, Bull. Univ. Utah, 12 (no. 15):117, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):61, June, 1927.

Canis latrans lestes, Nelson, Proc. Biol. Soc. Washington, 45:223, November 26, 1932; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938; Marshall, Journ. Mamm., 21:151, May 16, 1940; Hayward, Great Basin Nat., 6:110, November 15, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Canis latrans, Allen, Bull. Essex Inst., 6:62, 1874; Allen, Bull. Amer. Mus. Nat. Hist., 8:258, November 25, 1896; Cahalane, Journ. Mamm., 29:250, August 31, 1948.

Canis lestes lestes, Svihla, Journ. Mamm., 12:259, August 24, 1931.

Range.—State-wide except extreme southern and southeastern parts.

Description and comments.—Measurements of an adult male, number 2560, from Grantsville, Tooele County are: Total length, 1233; length of tail, 358; length of hind foot, 190; length of ear, 120. Ears large; tail bushy. Color: General color grayish with heavy admixture of black and buff, black heaviest in middorsal region; top of head, muzzle, front and sides of forelegs, shoulders, flanks, and lateral sides of hind legs Ochraceous-Buff; forehead grizzled; upper lips, cheeks, throat and most of underparts white. Colors variable and in some series, on upper parts ranging from heavy black to buffy white; tail black tipped. Skull: Size medium; rostrum long and slender; postorbital processes well developed, convex dorsally; sagittal crest well developed in mature specimens; inion well developed; carnassials large; trigonid more than twice as long as talonid.

In Utah, coyotes exhibit a wide range of individual variation both in color and cranial characters. Comparison of specimens of *C. l. lestes* from western Utah with those of *Canis latrans estor* from San Juan County (near topotypes) shows the former to differ as follows: Size larger. Color: Less rufescent, especially on head and neck; underfur of back less ochraceous. Skull: Averages larger in most measurements; tympanic bullae proportionately larger; zygomatic breadth relative to basilar length less; braincase slightly less inflated.

Hall (1946:265) pointed out that in Nevada, he was able to differentiate *C. l. lestes* from *C. l. estor* by the extension of black on the upper parts and less ochraceous underfur. For the animals

from Utah, color in itself is not a reliable character, since on the one hand, animals from Rich County in the extreme north central part of the state, referable to *C. l. lestes,* are nearly as rufescent as near topotypes of *C. l. estor,* and one large animal from Millard

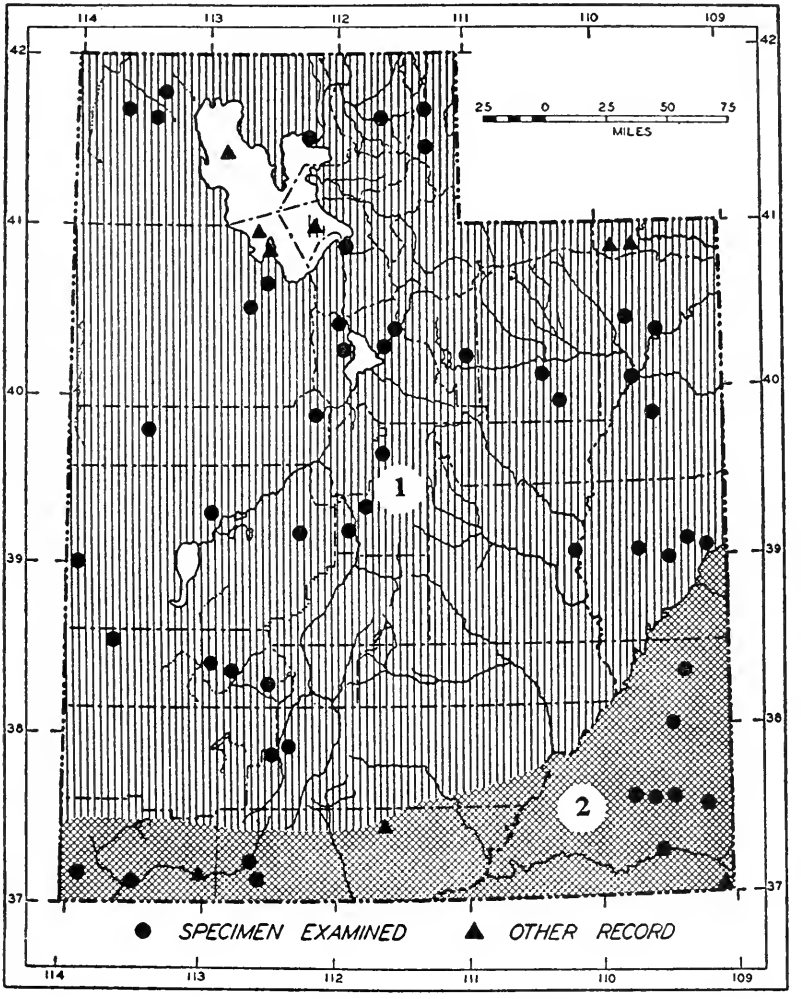

FIG. 65. Distribution of *Canis latrans.*
1. *C. l. lestes.* 2. *C. l. estor.*

County is pale gray. On the other hand, specimens from southern Utah, and especially one small specimen from Kane County, all referable to *C. l. estor,* are nearly as dark as the darkest specimens

studied of *C. l. lestes.* Clinal variation is exhibited from north to south in cranial measurements. Six skulls from Boxelder County and nine from Utah County are larger than those from the middle of the state, and are markedly larger than those, here referred to *C. l. estor,* from Beaverdam Wash, Washington County. Those from Beaverdam Wash are the smallest of any studied, averaging smaller even than near topotypes of *C. l. estor* from San Juan County. The specimens from that part of the state formerly occupied by the Pleistocene Lake Bonneville are patently *C. l. lestes.* Those from Beaver County are intermediate towards *C. l. estor,* but are referable to *C. l. lestes.* Nine animals from Uintah County, and especially those from south of White River, are intermediate in measurements between *C. l. lestes* from the western part of the state and near topotypes of *C. l. estor.* The measurements of these nine animals are closer to those of the first mentioned kind to which they are here referred. Five animals from Grand County are intergrades between *C. l. lestes* and *C. l. estor.* In size, as judged from the tanned, unmeasured pelts, they are like *C. l. estor,* as they are also in the more ochraceous tone of the underfur of the upper parts. They resemble *C. l. lestes* in the distribution of black on the upper parts and in the majority of the cranial characters, and are here assigned to that subspecies. The taxonomic account of the coyotes, that is being prepared by H. H. Jackson, may alter the classification adopted here.

Specimens examined.—Total, 82, distributed as follows: *Boxelder County:* Clear Creek, 1; Dove Creek, 1; Park Valley, 1; mouth of Bear River, 4,300 ft., 9. *Cache County:* Millville Canyon, 3 mi. E Millville, 6,000 ft., 1. *Rich County:* Frazier Ranch, 1; L. B. Johnson Ranch, 1. *Tooele County:* Grantsville, 4,300 ft., 1; Rush Valley, 2. *Davis County:* Rudy-Halloran Gun Club, 4,300 ft., 1. *Utah County:* Cedar Valley, 1; S Fork, Provo River, 13 mi. above Provo, 1 (M.V.Z.); Provo Canyon, 1 (M.V.Z.); W side Utah Lake, 4,800 ft., 9. *Wasatch County:* 5 mi. W Fruitland, 7,000 ft., 1. *Duchesne County:* Eight Mile Flat, S Duchesne, 1; Gilsonite Wells Draw, S Duchesne, 3. *Uintah County:* La Point, 1; Robert Crook's range, S Vernal, 1; Dog Valley, 10 mi. S Vernal, 1; W side confluence Green and White rivers, 3 mi. N Ouray, 4,800 ft., 3; between Book Cliffs and White River, 4. *Juab County:* Tintic Valley, 2; Cane Springs, 4,400 ft., 1. *Sanpete County:* Maple Canyon, 1; Dry Canyon, 1; Round Valley, 1; South Hollow, 1. *Millard County:* 6 mi. W Deseret, 4 (M.V.Z.); Michigan Farm, 1; vicinity of Garrison, 5 (M.V.Z.). *Emery County:* Pump station, 4 mi. N Greenriver, 4,100 ft., 1. *Grand County:* "near" Thompson, 3; Salt Valley, "near" Thompson, 1; Harley Dome, 2. *Beaver County:* Wah Wah Springs, 30 mi. W Milford, 6,500 ft., 3; Rock Corral, E Milford, 1; N Adamsville, 3; 5 mi. E Beaver, 4. *Garfield County:* "near" Panguitch, 1; W Panguitch, 1.

Additional records.—Boxelder County (Marshall, 1940:151): Dolphin Island, Great Salt Lake. *Tooele County* (Marshall, 1940:152): Stansbury and Carrington islands, Great Salt Lake. *Davis County:* Antelope Island, Great Salt Lake (personal observation). *Daggett County* (Svihla, 1931:259): Hideout; Beaver Creek; Granite Park.

Canis latrans estor Merriam

Coyote

Canis estor Merriam, Proc. Biol. Soc. Washington, 11:31, March 15, 1897, type from Nolands Ranch [N side San Juan River, 1½ mi. above "Four Corners" (Hall, 1931:2)], San Juan County, Utah; Warren, The mammals of Colorado, Knickerbocker Press, p. 246, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):117, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):61, June, 1927; Hall, Univ. California Publ. Zoöl., 37:2, April 10, 1931; Tanner, Great Basin Nat., 1:104, June 30, 1940.

Canis latrans estor, Nelson, Proc. Biol. Soc. Washington, 45:224, November 26, 1932; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 95, ("San Juan County, Arizona [= Utah]"), 1942; Hardy, Ecol. Monogr., 15:86, January, 1945.

Canis lestes, Keller, Journ. Mamm., 16:232, August 12, 1935.

Canis latrans lestes, Presnall, Zion-Bryce Mus. Bull., 2:9, January, 1938.

Range.—Extreme southern Utah and southeastern Utah, east of the Colorado River.

Description and comments.—Measurements of an adult male, number 4770, from Kane County are as follows: Total length, 1079.5; length of tail, 355.5; length of hind foot, 152.6. Color similar to *Canis latrans lestes,* but more rufescent, especially on head and neck; averaging smaller in almost all measurements taken.

For remarks on taxonomy and intergradation, see the account of *C. l. lestes.* The subspecies *C. l. estor* is limited to the southern part of the state, in the drainage of the Colorado River. It has practically the same distribution within the state as does *Mephitis mephitis estor* and *Taxidea taxus berlandieri.*

Specimens examined.—Total, 30, distributed as follows: *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona border, 2,800 ft., 3; St. George, 2 (M.V.Z.). *Kane County:* Barracks Ranch, E Fork Virgin River, 2 mi. W Mount Carmel Junction, Highway 89, 1; 10 mi. NW Kanab, 5,000 ft., 5. *San Juan County:* La Sal, 1; Dalton Spring, 5 mi. W Monticello, Abajo Mountains, 8,300 ft., 1; Butler Wash, 20 mi. SW Blanding, 5; 8 mi. W Blanding, 6,500 ft., 1; Blanding, 6,000 ft., 1; Montezuma Creek, 2; Ruin Canyon, 12 mi. E Hatch Trading Post, 5,100 ft., 2; Bluff, 4,500 ft., 6 (5, M.V.Z.).

Additional records.—*Washington County* (Presnall, 1938:9): Zion National Park. *Kane County* (Tanner, 1940:104): Kaiparowits Plateau. *San Juan County* (Merriam, 1897:31): Nolands Ranch.

Canis lupus youngi Goldman

Wolf

Canis lupus youngi Goldman, Journ. Mamm., 18:40, February 11, 1937, type from Harts Draw, north slope Blue Mountains, 20 miles northwest of Monticello, San Juan County, Utah; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 91, 1942; Young and Goldman, The wolves of North America, American Wildlife Inst., Monumental Printing Co., p. 460, 1944.

Canis lupus occidentalis, Coues and Yarrow, Report upon collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept., Expl. W of 100th Meridian, 5:43, 1875.

Canis occidentalis, Barnes, Bull. Univ. Utah, 12 (no. 15):114, April, 1922.
Canis nubilis, Barnes, Bull. Univ. Utah, 17 (no. 12):63, June, 1927; Svihla, Journ. Mamm., 12:260, August 24, 1931.

Range.—Formerly state-wide, except west desert region; now thought to be extinct.

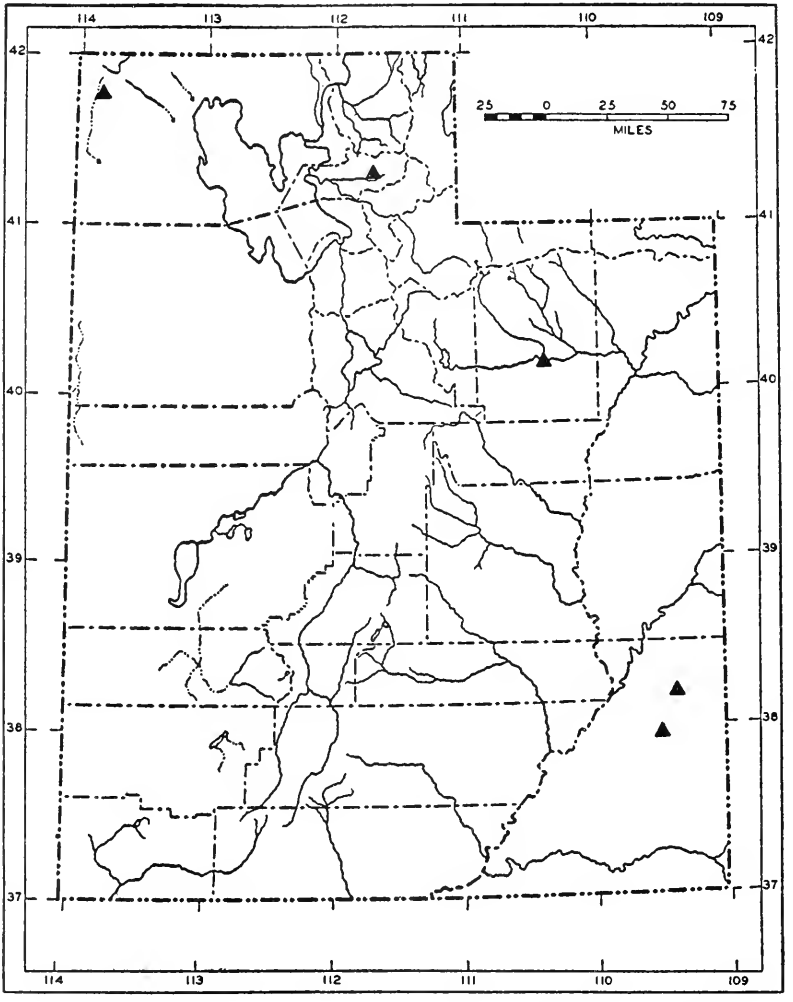

FIG. 66. Known localities of occurrence of *Canis lupus youngi*.

Description and comments.—Measurements of the type, according to Young and Goldman (1944:461-62), are as follows: Total length (from tanned skin), 1800; length of tail, 470; length of hind foot, 225. Color: Upper parts grayish mixed with black and buffy; underparts white tinged with buff. Skull:

Rostrum and palate long; supraoccipital shield broad, rising steeply, with little projection of its apex.

Wolves differ from coyotes in larger size, carriage of tail above line of back rather than below; heavier skull, more inflated frontal sinuses, and proportionately broader rostrum with reference to length. Also, in the first lower molar: talonid proportionately narrower than trigonid; cusps of talonid unequal; protoconid and paraconid subconic rather than bladelike.

According to Young and Goldman (1944:413), wolves formerly occurred throughout the state except in the Great Salt Lake Desert. In the past several years there have been reports of wolves being captured in the state, but in each instance where it was possible to examine the animal concerned, it turned out to be a large coyote or a dog. Possibly an occasional wolf wanders into the state and goes unnoticed in the remote sections.

Records of occurrence (Young and Goldman, 1944:463).—*Boxelder County:* Grouse Creek, 1. *Weber County:* South Eden, 1. *Duchesne County:* Duchesne, 3. *San Juan County:* Greasewood Valley, 10 mi. SE La Sal, 1; Harts Draw, N slope Blue Mountains [Abajo Mountains], 10 mi. NW Monticello, 2.

Vulpes fulva macroura Baird

Red Fox

Vulpes macrourus Baird, Stansbury's Exploration and Survey of the valley of the Great Salt Lake of Utah, p. 309, May, 1852, type from Wasatch Mountains bordering Great Salt Lake, Utah; Baird, General report upon the zoology of the several railroad routes, Pt. I, Mammals, p. 130, 1857; Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:55, 1875; Merriam, Proc. Washington Acad. Sci., 2:663, December 28, 1900; Warren, The mammals of Colorado, Knickerbocker Press, p. 237, 1910.

Vulpes fulva macroura, Barnes, Bull. Univ. Utah, 12 (no. 15):118, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):52, June, 1927; Presnall, Zion-Bryce Mus. Bull., 2:8, January, 1938.

Vulpes Utah, Audubon and Bachman, Proc. Acad. Nat. Sci. Philadelphia, 5:115, July, 1852; Audubon and Bachman, The Quadrupeds of North America, 3:255, 1854.

Vulpes vulgaris var. *macroura,* Allen, Bull. Essex Inst., 6:62, 1874.

Vulpes fulva argentata, Barnes, Bull. Univ. Utah, 12 (no. 15):120, April, 1922.

Vulpes fulva decussatus, Barnes, Bull. Univ. Utah, 12 (no. 15):121, April, 1922.

Vulpes macroura (?), Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935.

Vulpes macroura, Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 87, 1942.

Range.—Limits unknown, may occur sparingly throughout the mountainous sections of the state, with greater numbers in the southern part of the state.

Description and comments.—Hall (1946:228) gives the following average and extreme measurements for 3 males and 5 females, respectively, of a related

subspecies, *V. f. necator* from the Sierra Nevada of California: Total length, 993 (1,022-937), 947 (1003-881); length of tail, 361 (365-349), 348 (373-311); length of hind foot, 166 (171-162), 154 (168-145). Color: Variable; at several places within the geographic range of the species four phases recog-

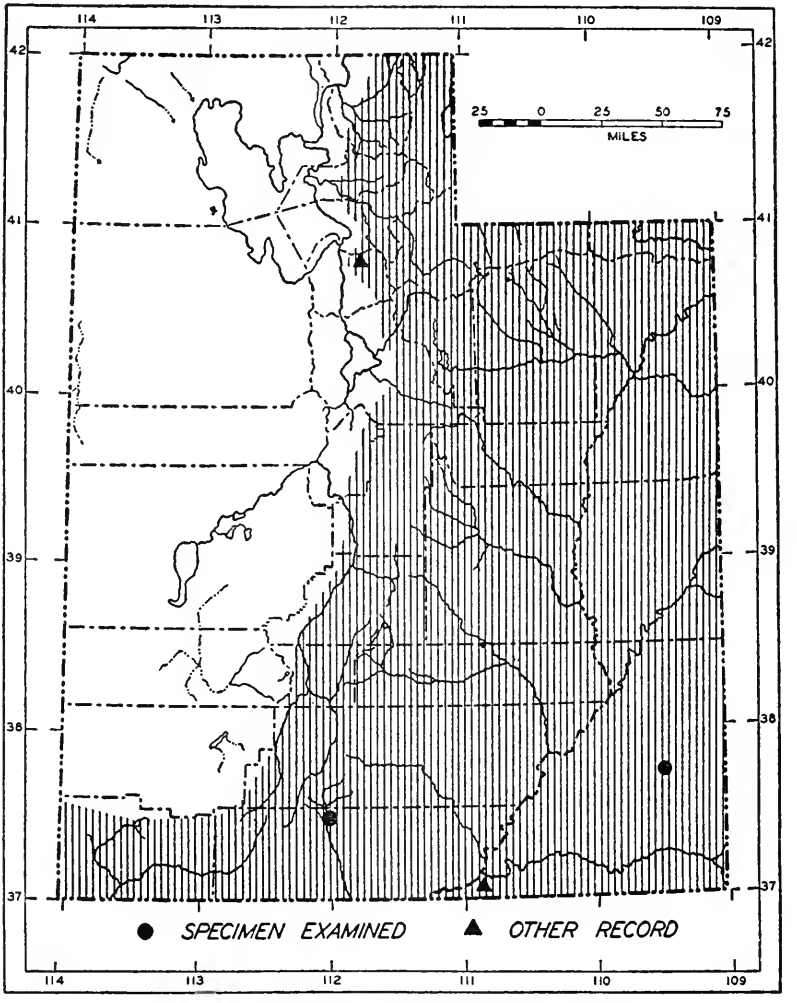

FIG. 67. Distribution of *Vulpes fulva macroura.*

nized, namely, red, cross, silver and black. A specimen from Kane County, Utah, in the red phase has: Neck, shoulders and middorsal line Ochraceous-Tawny, underfur in this region Deep Quaker Drab; sides of neck and sides of

back Pinkish Buff, underfur in this region Light Mouse Gray; rump and dorsal base of tail with admixture of white-tipped guard hairs; tail circular, bushy, dorsally a mixture of Ochraceous-Tawny, gray, black and dark brown, tipped with white; ears Ochraceous-Tawny at base, black-tipped, buff rim, white inside; crown like back with admixture of much white; sides of nose dusky; all tactile hairs jet black; front legs Ochraceous-Tawny proximally, black distally; hind legs white on front side proximally, black distally, Ochraceous-Tawny on sides and backs; lips and chin white mixed with dusky; throat, pectoral, midventral and inguinal regions white medially, Ochraceous-Tawny laterally. Skull: Size medium; light; parietal crests parallel; postorbital processes weak, concave dorsally; rostrum long and slender; auditory bullae well inflated.

This fox differs from *Vulpes macrotis nevadensis* in larger size, reddish as opposed to grayish over-all, general coloration, white-tipped as opposed to black-tipped tail, and larger skull in all measurements taken. From *Urocyon cinereoargenteus scottii, V. f. macroura* differs in larger size, reddish as opposed to grayish over-all, general coloration, lack of black dorsal stripe of tail, larger skull in almost all measurements taken, V-shaped rather than lyre-shaped space between the parietal crests, and lack of a "step" in lower mandible.

Red foxes are rare in Utah, and are not well represented in collections. The exact locality of capture of the type of *V. f. macroura* is not known (Baird, 1853:309); the animal was obtained from hunters who were supposed to have taken it in the Wasatch Mountains. Owing to fox farms having been established in Utah of late years, foxes captured in the wild now may not all be native; some probably have escaped from fox farms of which there are several in the mountainous parts of the state.

The largest number of native red foxes appears to be in the southern and southeastern part of the state. According to the Indian traders at Montezuma Creek and at Bluff, both in San Juan County, the annual take of red foxes there is rapidly falling off. Possibly the red fox of the Colorado is an undescribed subspecies. The two specimens available to me are from Kane County and San Juan County, and I tentatively refer them to *V. f. macroura.*

Specimens examined.—Total, 2, distributed as follows: *Kane County:* Wa Weep Creek, 15 mi. S Henrieville, 1. *San Juan County:* Between Blanding and Monticello, 1.

Additional records.—*Salt Lake County* (Baird, 1852:309): Wasatch Mountains bordering Great Salt Lake. *San Juan County* (Benson, 1935:448): Canyon, N side Navajo Mountain.

Vulpes macrotis nevadensis Goldman

Kit Fox

Vulpes macrotis nevadensis Goldman, Journ. Washington Acad. Sci., 21:250, June 4, 1931, type from Willow Creek Ranch, near Jungo, Humboldt County, Nevada.
Vulpes velox, Barnes, Bull. Univ. Utah, 12 (no. 15):124, April, 1922.
Vulpes velox velox, Barnes, Bull. Univ. Utah, 17 (no. 12):58, June, 1927.
Vulpes macrotis arsipus, Hardy, Ecol. Monogr., 15:85, January, 1945.
Vulpes macrotis spp., Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Western Utah.

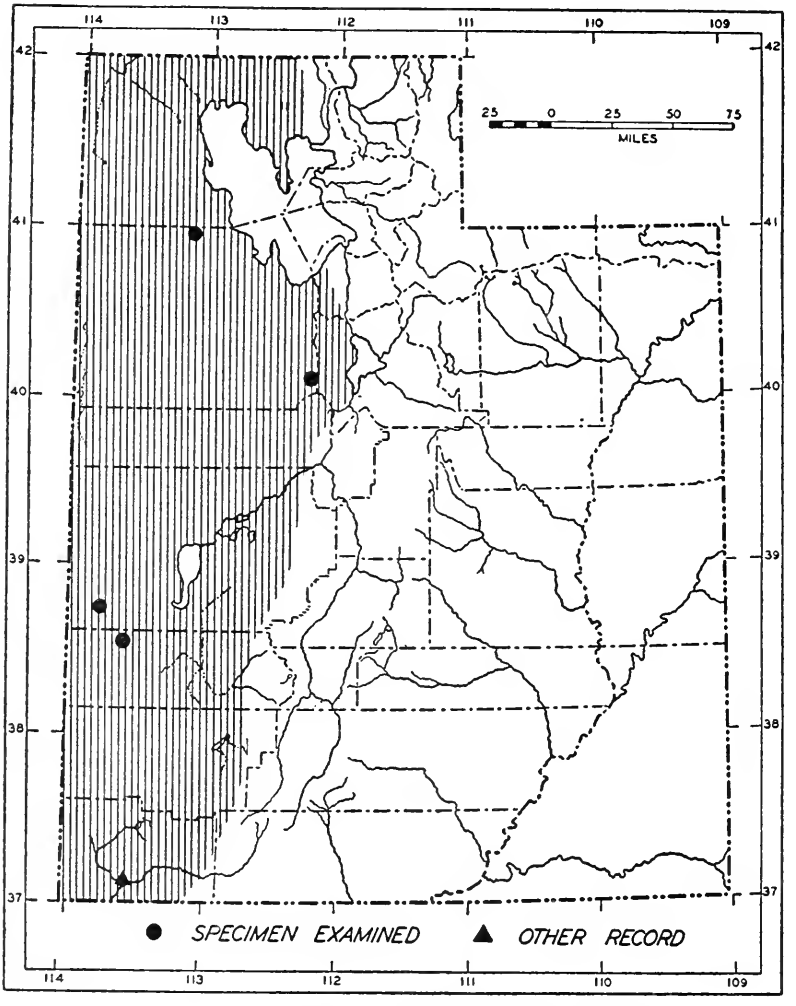

FIG. 68. Distribution of *Vulpes macrotis nevadensis*.

Description and comments.—According to Hall (1946:236) the measurements of a male and female from 5 miles northeast of Hazen, Nevada, are, respectively as follows: Total length, 699, 768; length of tail, 230, 284; length of hind foot, 132, 122; length of ear, 93, 86. Ears long. Color: Upper parts grayish, darkest in middorsal region owing to heavy admixture of black-tipped hairs; underfur of dark dorsal stripe Light Mouse Gray proximally, Ochraceous-Tawny distally; sides of neck, shoulders, sides, anterior faces of front legs, back and sides of hind legs Ochraceous-Tawny; feet white; upper surface of tail a mixture of grayish, buff and black; tip black; under surface of tail light buff proximally; sides of nose black; vibrissae black; ears Ochraceous-Tawny on posterior sides, white rimmed and white inside; top of head Ochraceous-Tawny, heavily sprinkled with white; entire underparts, back side of front legs and front side of hind legs white. Skull: Small, delicate; post-orbital processes thin, concave dorsally; rostrum long and narrow; tympanic bullae large and well inflated.

Comparisons of the two specimens from western Utah (one lacking a skull) with four specimens of *Vulpes macrotis arsipus* from the Colorado River, 29 miles south of Needles, San Bernardino County, California (K.U.), show the animals from Utah to differ in darker dorsal coloration (less silver), darker forehead, black as opposed to brown on sides of muzzle, darker tip of tail, less buffy underparts, larger skull, less abruptly tapering posterior ends of nasals, wider basioccipital and actually as well as relatively smaller tympanic bullae. In the majority of these features, the two animals from Utah agree with *V. m. nevadensis* and differ from *V. m. arsipus* in the same manner as did animals from Nevada reported upon by Hall (1946:236-238).

Since the only specimens available to me were from western Utah and are referable to *V. m. nevadensis,* I am unable to say whether other subspecies occur here or not. Hardy (1945a:85) referred animals from extreme southwestern Utah to *V. m. arsipus* without qualification. This is logical in view of the range assigned by Hall (1946:239) to *V. m. arsipus* in Nevada. In his comments on *V. m. nevadensis,* Hall (*loc. cit.*), however, stated that the diagnostic characters separating *V. m. arsipus* and *V. m. nevadensis* were slight and implied that the two subspecies are possibly only one. If further studies prove *Vulpes macrotis nevadensis* and *Vulpes macrotis arsipus* to be synonyms, then the animals from western Utah would be referable to *V. m. arsipus* Elliot, 1907, because that name has priority over *Vulpes macrotis nevadensis* Goldman, 1931.

Specimens examined.—Total, 4, distributed as follows: *Tooele County:* Grassy Mts., 15 mi. N Knolls, 1; 12 mi. Pass, 2 mi. S Topliff, 1. *Millard County:* North Pine Valley, Desert Range Experiment Station, 1. *Beaver County:* Wah Wah Springs, 30 mi. W Milford, 6,500 ft., 1.

Additional record (Hardy, 1945:85).—*Washington County.*

Urocyon cinereoargenteus scottii Mearns

Gray Fox

Urocyon virginianus scotti Mearns, Bull. American Mus. Nat. Hist., 3:236, June 5, 1891, type from Pinal County, Arizona.

Urocyon cinereo-argenteus scottii, Allen, Bull. American Mus. Nat. Hist., 7:253, June 29, 1895; Barnes, Bull. Univ. Utah, 12 (no. 15):123, April, 1922.

Urocyon cinereoargenteus scottii, Barnes, Bull. Univ. Utah, 17 (no. 12):60, June, 1927; Hall; Univ. California Publ. Zoöl., 37:2, April 10, 1931;

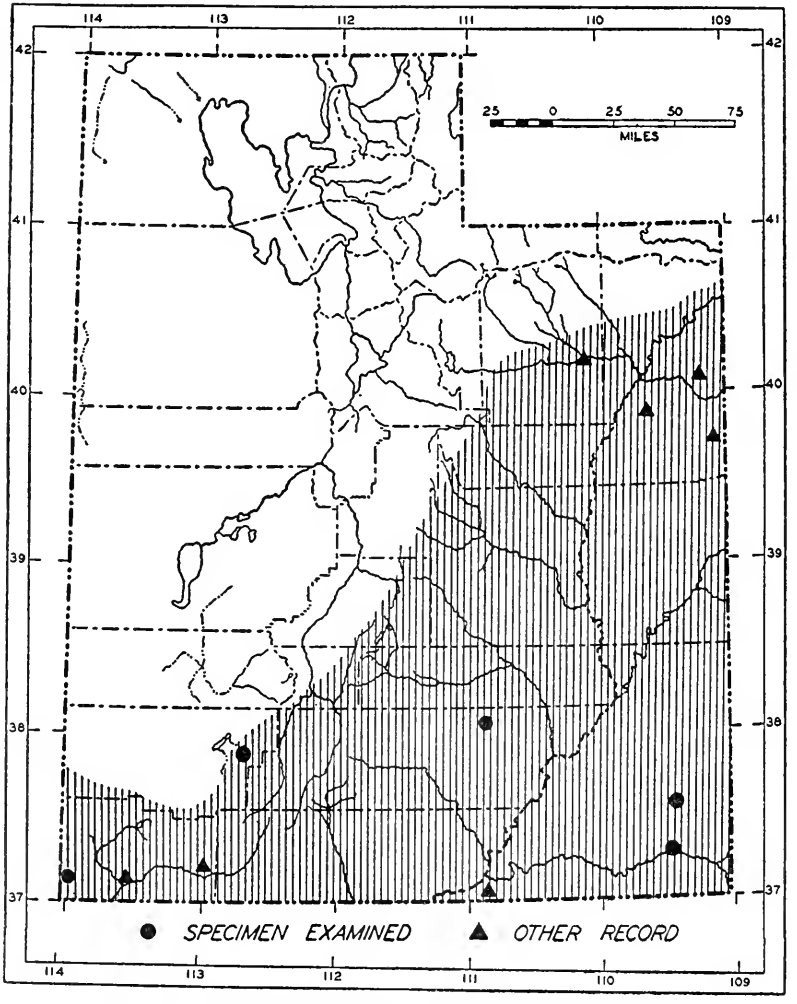

FIG. 69. Distribution of *Urocyon cinereoargenteus scottii*.

Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935; Presnall, Zion-Bryce Mus. Bull., 2:8, January, 1938; Hardy, Ecol. Monogr., 15:86, January, 1945.

Range.—Southern and eastern Utah.

Description and comments.—For specimens from southern Nevada, Hall (1946:239) gives the following average and extreme measurements of 4 males and the measurements of one female, respectively: Total length, 978 (1,030-935), 930; length of tail, 419 (435-405), 405; length of hind foot, 135 (145-133), 132. Color: Upper parts grayish black, grading to nearly pure black on middorsal region; postauricular region and sides of neck Ochraceous-Tawny; underfur on back Mouse Gray subterminally, between Warm Buff and Pinkish Buff terminally; ears dusky, rimmed with white; ears white inside; tactile hairs black; tail with continuous black middorsal stripe, tip black (white hairs present in some specimens); under surface of tail Pinkish Buff; throat, midline of belly, back side of front legs and front side of hind legs white. Skull: Size medium; postorbital processes thin, concave dorsally; temporal ridges widely separated; space between temporal ridges lyre-shaped; lower mandible with distinct "step" on lower margin between angular process and anterior border of coronoid process.

This fox is easily distinguished from other kinds known to occur in Utah, by its long tail (averaging more than 400) with the black dorsal stripe and tip and by the lyre-shaped space between the temporal ridges and by the "step" in the lower margin of the lower mandible.

Gray foxes occur sparingly in all mountainous regions of the eastern and southern parts of the state but there are few in collections. I know of none from the west desert country.

Hall (1946:242), records specimens, however, from localities in eastern Nevada immediately adjacent to the Utah-Nevada border, and also others from localities as far north as north-central White Pine County, Nevada. These Nevadan localities are on the western margin of the basin of Pleistocene Lake Bonneville. Carnivores inhabiting the basin of Lake Bonneville have been heavily trapped for a great many years, but the only foxes I know to have been obtained belong to the species *Vulpes macrotis*. It is possible that some few gray foxes may yet be found to occur in this area in Utah.

Specimens examined.—Total, 13, distributed as follows: *Iron County:* "near" Parowan, 2. *Washington County:* Beaverdam Wash, 8 mi. N Utah-Arizona border, 2,800 ft., 2. *Garfield County:* Henry Mountains, 2. *San Juan County:* Blanding, 4 (M.V.Z.); Bluff, 4,400 ft., 3 (M.V.Z.).

Additional records.—*Duchesne County:* 12 mi. W Roosevelt (Carnegie Museum, correspondence J. K. Doutt). *Uintah County* (Carnegie Museum, correspondence J. K. Doutt): Bitter Creek, 40 mi. SE Vernal; Hill Creek, about 25 mi. S Ouray; Vacuation Creek, 3 mi. W Dragon; 1 mi. W Dragon; Dragon. *Washington County:* Zion National Park (Presnall, 1938:8); vicinity of St. George (Hardy, 1945:86). *San Juan County:* "Near" War God Spring, Navajo Mountain (Benson, 1935:448).

TABLE 22

Cranial Measurements of Canidae

Sex	Catalog number or number of individuals averaged	Greatest length of skull	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Palatilar length	Alveolar length of maxillary tooth-row
		Canis latrans lestes, W side Utah Lake								
?	6 av.	192.0	173.8	76.1	92.3	59.7	29.7	34.6	95.2	85.1
?	Max.	206.7	188.4	83.7	101.5	63.9	32.5	35.8	104.4	92.3
?	Min.	179.6	162.7	70.1	85.7	57.1	26.5	33.7	89.6	80.3
		Canis latrans estor, Butler Wash								
?	5 av.	180.5	164.3	68.1	90.4	57.7	29.1	32.4	90.4	79.9
?	Max.	185.4	169.0	73.4	96.1	59.0	30.0	34.3	93.0	82.1
?	Min.	173.9	162.0	64.5	86.8	55.7	28.0	30.8	87.1	78.5
		Canis lupus youngi, type (Young and Goldman, 1944: 461)								
♂	224001 USNM.	258.5	.....	.....	136.7	.....	44.3	40.6	.....	107.8
		Vulpes fulva macroura, Kane County								
♂	3981.	142.0	124.1	53.0	67.2	42.3	25.2	25.6	70.8	63.2
		Vulpes macrotis nevadensis, Wah Wah Springs								
♂	1621.	112.8	102.5	39.0	60.0	38.6	21.6	21.0	57.3	50.5
		Urocyon cinereoargenteus scottii, Beaverdam Wash								
?	4271.	119.5	106.5	39.2	57.3	41.8	20.7	27.6	55.7	48.0
?	4272.	119.1	106.1	.....	62.3	43.6	22.6	29.0	55.8	49.6

Family URSIDAE

Bears

Bears are the largest carnivores known to occur in Utah. They may be characterized as follows: Tail short; lips loose and protrusible; feet five-toed, plantigrade; digits clawed, longer on front feet; soles naked; eyes and ears small; skull massive; tympanic bullae flattened dorsoventrally; paroccipital processes large, broad and independent of bullae; postorbital processes well developed; alisphenoid canal present; os penis cylindrical; intestinal caecum absent; teeth bunodont, carnassials not developed; anterior premolars small and frequently lost; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{2}{3}$.

In Utah, this family is represented by *Ursus americanus* with two subspecies and by *Ursus horribilis* now thought to be extinct.

KEY TO BEARS IN UTAH

1.–Claws on front feet approximately 75; mane present; skull flattened; last upper molar more than 1½ times length of first upper molar.
Ursus horribilis, p. 407

1'.–Claws on front feet approximately 40; mane absent; skull arched; last upper molars not more than 1½ times length of first upper molar.
Ursus americanus, p. 408

Ursus horribilis utahensis Merriam

Grizzly Bear

Ursus utahensis Merriam, Proc. Biol. Soc. Washington, 27:193, August 13, 1914, type from North Fork, Salina Creek, 10-12 miles southeast of Mayfield, Sanpete County, Utah; Merriam, N. Amer. Fauna, 41:62, February 9, 1918; Barnes, Bull. Univ. Utah, 12 (no. 15):126, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):31, June, 1927; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938.

Ursus arctos, Allen, Bull. Essex Inst., 6:63, 1874 (part).

Ursus arctos horribilis, Coues and Yarrow, Report upon the collection of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:65, 1875.

Ursus horribilis horriaeus, Merriam, Proc. Biol. Soc. Washington, 10:75, April 13, 1896 ("probably southern Utah").

Ursus horribilis, Merriam, Proc. Biol, Soc. Washington, 10:74, April 13, 1896; Svihla, Journ. Mamm., 12:259, August 24, 1931.

Ursus horribilis bairdi, Barnes, Bull. Univ. Utah, 12 (no. 15):127, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):28, June, 1927.

Range.—Probably extinct in Utah at present.

Description and comments.—Size large. Color: Muzzle pale brown; face and throat, except pale edges of lips and long hairs of median line of throat, dark brown becoming grizzled posteriorly; top of head grizzled posteriorly by brown-tipped hairs. Skull: Long, narrow and high, not arched; frontonasal region high and narrow (Merriam, 1918:64).

I recognize that many of the kinds of bears named as full species are, on the criterion of intergradation, only subspecies. In the absence of specimens for study, the name combination *Ursus horribilis utahensis* for the animals from Utah is chosen. Since the grizzly bears are low in numbers and entirely extinct over a great part of their former range, it is doubtful if enough material can ever be obtained to clarify all the questions pertaining to their nomenclature.

Records of occurrence (Merriam, 1918:63).—*Sanpete County:* North Fork, Salina Creek, 10-12 mi. SE Mayfield. *Washington County:* Pine Valley Mountains.

Ursus americanus cinnamomum Audubon and Bachman

Black Bear

Ursus americanus Var. Cinnamomum Audubon and Bachman, Quad. N. Amer. 3:125, 1854, type from northern Rocky Mountains.
Ursus americanus cinnamomum, Hall, Univ. California Publ. Zoöl., 30:232, March 2, 1928.
Ursus arctos, Allen (part), Bull. Essex Inst., 6:63, 1874.
"The bear," Simpson, Report of explorations across the Great Basin of the Territory of Utah for a direct wagon-route from Camp Floyd to Genoa, in Carson Valley, in 1859, Engineer Department, U. S. Army, p. 142, 1876.

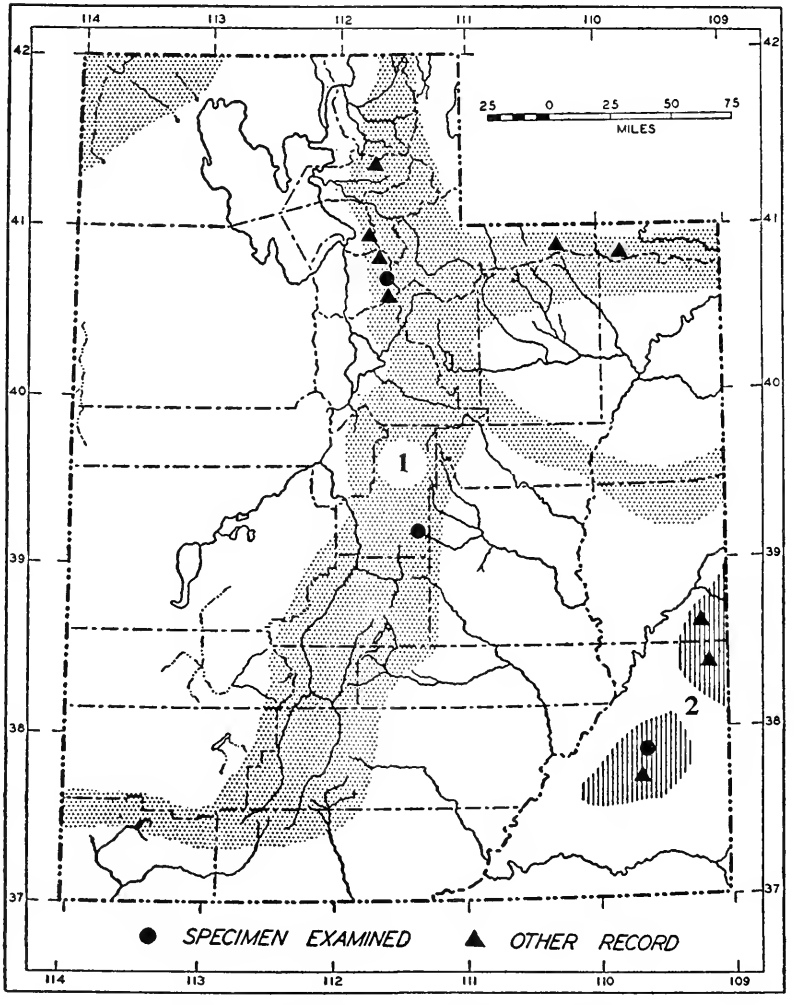

FIG. 70. Distribution of *Ursus americanus*.
1. *U. a. cinnamomum*. 2. *U. a. amblyceps*.

Euarctos americanus, Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 44, 1942.
Euarctos americanus ssp., Hayward, Great Basin Nat., 6:110, November 15, 1945.
Ursus americanus, Barnes, Bull. Univ. Utah, 12 (no. 15):130, April, 1922.
Euarctos americanus americanus, Barnes, Bull. Univ. Utah, 17 (no. 12):26, June, 1927; Svihla, Journ. Mamm., 12:259, August 24, 1931.

Range.—In nearly all of the high mountains, except in southern and southeastern areas.

Description and comments.—Audubon and Bachman (1854 vol. 3:125) give the following measurements: Total length, 68 inches (1727); length of tail, 1.5 (39); height at shoulder, 37 (939). Color: Two phases, black and cinnamon (brown); nose tan. Skull: Moderately arched in dorsal outline; frontal shield arched; zygomatic arches heavy and widely spreading; cheek teeth bunodont; last upper molars small.

In attempting to assign the black bears from Utah to subspecies, I have had occasion to study the following skulls of *Ursus americanus: Ursus americanus amblyceps:* one male, number 1978 (K.U.), Harvey's Ranch, Pecos National Forest, New Mexico; one male, number 4721, Abajo Mountains, San Juan County, Utah; one female number 3987 (K.U.), Truchas Peak, Mora County, New Mexico; one female, number 7586 (K.U.), Ghoiokai [Choiskal?] Mountain, Tohatchi, McKinley County, New Mexico; and 3 female intergrades referable to this subspecies, numbers 1981, 1982 and 1983 (K.U.), Dotsero, Eagle County, Colorado; *Ursus americanus cinnamomum:* one male, number 21881 (K.U.), area 14 miles east and 7 miles south of Livingston, Park County, Montana; one female, number 21883 (K.U.), 1 mile west of Yellowstone National Park, Gallatin and Park counties, Montana; one female, number 4786, 6 miles above mouth of Nine Mile Canyon, Sanpete County, Utah, and 5 unsexed, from Lambs Canyon, Salt Lake County, Utah. From the above material, and with the original descriptions in hand, I find *U. a. amblyceps* to differ from *U. a. cinnamomum* as follows: Skull more convex dorsally; frontal region wider and more bulged out laterally; face steeper and shorter; palate wider; zygomatic breadth averages wider with reference to condylobasal length; nasals shorter; orbit more nearly circular as opposed to roughly ovoid; cheek teeth smaller.

Black bears occur sparingly throughout all the high, unfrequented areas of the state, where a few are killed each year. Occasionally, however, even at present (1946-47), concentrations of black bears occur. Eleven animals were trapped and killed in Lambs Canyon, 15 miles southeast of Salt Lake City; skeletal remains of 5 of these 11 animals are in the collections of the University of Utah. With the exception of animals from the extreme southern and south-

eastern localities, I am referring all other records of occurrence to the subspecies *U. a. cinnamomum.*

Specimens examined.—Total, 6, distributed as follows: *Salt Lake County:* Middle Fork, Lambs Canyon, 7,800 ft., 3; S Fork, Lambs Canyon, 7,800 ft., 2. *Sanpete County:* 6 mi. above mouth Nine Mile Canyon, 1.

Additional records.—*Weber County:* North Ogden Canyon (dead bear observed by writer). *Davis County:* canyon above Bountiful (Barnes, 1927:27); Hardscrabble Canyon, near head of City Creek Canyon (Barnes, *loc. cit.*). *Salt Lake County:* City Creek Canyon, 12 mi. above Salt Lake City (Barnes, *loc. cit.*); Big Cottonwood Canyon (tracks observed by writer). *Summit County:* Henrys Fork, 1 mi. N Dollar Lake (tracks observed by writer). *Daggett County:* Elk Park; Five Parks (tracks observed) (Svihla, 1931:259).

Ursus americanus amblyceps Baird

Black Bear

Ursus amblyceps Baird, Report U. S. and Mex. Boundary Surv., pt. 2:29, January, 1859, type from Copper mines, near Rio Mimbres (near Georgetown), Grant County, New Mexico.

Ursus americanus amblyceps, Bailey, N. Amer. Fauna, 25:187, October 24, 1905; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938.

Euarctos americanus americanus, Barnes (part), Bull. Univ. Utah, 17 (no. 12):26, June, 1927.

Range.—High mountains of southern and southeastern areas.

Comments.—Color like that of *Ursus americanus cinnamomum.* For comparisons and cranial features, see the account of *U. a. cinnamomum.*

Specimen examined.—One from Indian Creek, Abajo Mountains, 10 mi. W Monticello, San Juan County, Utah.

Additional records (Barnes, 1927:27).—*Grand County:* Castle Creek. *San Juan County:* Mill Creek; Park Creek; Shay Mountain; North Cottonwood Creek.

TABLE 23

Cranial Measurements of Bears in Utah

Sex	Catalog number	Basal length	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Length of nasals	Length of palate
		Ursus horribilis utahensis, type (Merriam, 1918: 64)					
♂	180193 USNM..	337.0	226.0	.....	79.0	.....	194.0
		Ursus americanus cinnamomum, Lambs Canyon					
♂	7028.....	261.0	175.0	138.0	64.4	76.5	149.9
♀	7029.....	.....	157.0	116.0	64.8	62.0	136.7
		Ursus anericanus amblyceps, Abajo Mountains					
♂	4721.....	291.0	210.0	149.0	68.5	69.5	150.0

Family PROCYONIDAE

Racoons and Ring-tailed Cats

Semiplantigrade, small to medium-sized, arboreal carnivores; tail having alternate rings of dark and light color; feet with five toes, each toe with a claw; rostrum short; braincase rounded and well inflated; paroccipital processes separate from bullae; os penis cylindrical; cheek teeth somewhat bunodont; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{2}{2}$.

KEY TO PROCYONIDS IN UTAH

1.–Dark rings on tail complete; hard palate extends far posterior to posterior end of tooth-row ..... *Procyon lotor*, p. 413

1'.–Dark rings on tail incomplete; hard palate does not extend markedly posterior to posterior end of tooth-row ..... *Bassariscus astutus*, p. 411

Bassariscus astutus nevadensis Miller

Ring-tailed Cat

Bassariscus astutus nevadensis Miller, Proc. Biol. Soc. Washington, 26:159, June 30, 1913, type from El Dorado Canyon, Clark County, Nevada; Woodbury, Ecol. Monogr., 3:197, April, 1933; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938; Hardy, Ecol. Monogr., 15:85, January, 1945.
Bassariscus astutus, Barnes, Bull. Univ. Utah, 12 (no. 15):131, April, 1922.
Bassariscus astutus flavus, Barnes, Bull. Univ. Utah, 17 (no. 12):34, June, 1927.

Range.—Generally west of the Colorado and Green rivers.

Description and comments.—Measurements of a male, number 4747, from Kane County and of a female, number 4626, from Sevier County, are, respectively, as follows: Total length, 616, – – –; length of tail, 388, 370; length of hind foot, 63, 62; length of ear, 50, 44. Tail extremely long and annulated with 7 white and 8 black rings, black rings incomplete ventrally. Color: Upper parts Pinkish Buff with admixture of dark brown-tipped hairs; nose, arietiform markings and eye ring dark brown, nearly black; subauricular, suborbital and supraorbital spots Pinkish Buff; feet and legs buffy white; entire underparts white, washed with pale buff. Skull: Small, light, delicate; zygomatic arches light; braincase flattened but well expanded laterally; palate extends slightly posterior to posterior margin of molars; tympanic bullae well inflated.

Compared with *Bassariscus astutus arizonensis, B. a. nevadensis* differs as follows: Color: Generally lighter throughout. Skull: Rostrum narrower; tympanic bullae narrower anteriorly; foramen magnum smaller.

The status of the ring-tailed cats in Utah is little known. Specimens are few and from widely separated places. They are, apparently, more numerous in the extreme southern part of the state than elsewhere, but are reported from as far north as Weber Canyon, Weber County, and I have one specimen (skull only) from the

Deep Creek Mountains in western Juab County and one skin from Duchesne County.

Of two complete specimens available, the male, from Kane County in the extreme southern part of the state, is definitely refer-

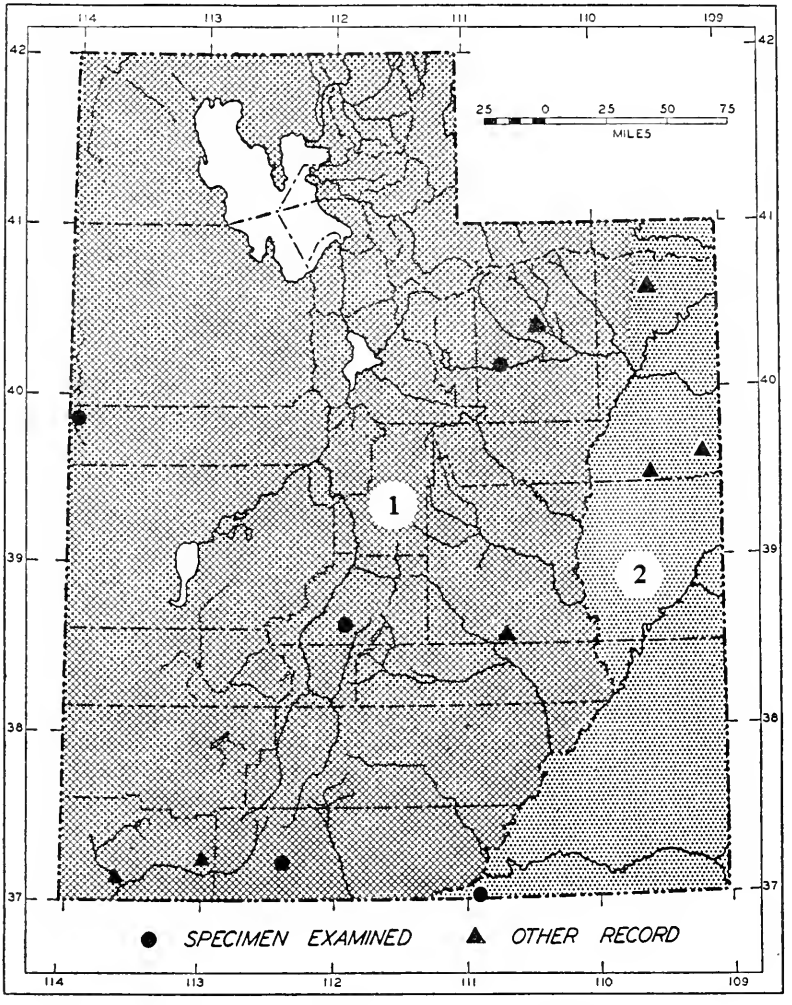

FIG. 71. Distribution of *Bassariscus astutus*.
1. *B. a. nevadensis.* 2. *B. a. arizonensis.*

able to *B. a. nevadensis.* The female from Sevier County in the central part of the state is darker and the annulations of the tail are wider. Both are referred to the subspecies *B. a. nevadensis.*

Specimens examined.—Total, 4, distributed as follows: *Duchesne County:* Junction Strawberry River and Currant Creek, 1. *Juab County:* Birch Creek Canyon, Deep Creek Mountains, 6,000 ft., 1. *Sevier County:* Monrovian Park, Monroe Canyon, 1. *Kane County:* 12 mi. SW Orderville, 1.

Additional records.—Duchesne County: "near" Mountain Home (Carnegie Museum, correspondence J. K. Doutt). *Emery County:* Sinbad approximately 50 mi. SW Greenriver (Carnegie Museum, correspondence J. K. Doutt). *Washington County:* Zion National Park (Presnall, 1938:7); ¾ mi. SW St. George (Hardy, 1945:85).

Bassariscus astutus arizonensis Goldman

Ring-tailed Cat

Bassariscus astutus arizonensis Goldman, Proc. Biol. Soc. Washington, 45:87, June 21, 1932, type from Cosper Ranch, Blue River, about 12 miles south of Blue, Greenlee County, 5,000 feet, Arizona; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935.

Range.—Eastern Utah, generally east of the Green and Colorado rivers.

Description and comments.—According to Goldman (1932b:88) the measurements of the type, a male, are: Total length, 775; length of tail, 390; length of hind foot, 70. Color: As in *B. a. nevadensis,* but darker. Skull: Small, rostrum broad; auditory bullae broadest anteriorly; foramen magnum large.

The only specimen (skin only) referable to *B. a. arizonensis* from Utah that I have seen is that reported by Benson (1935:448). One specimen (skin only), number 6468, from Duchesne County, here referred to *B. a. nevadensis,* is darker than animals referred to that subspecies from elsewhere in the state. It was thus referred on distributional concepts only, and seems to indicate that *B. a. nevadensis* and *B. a. arizonensis* intergrade in northeastern Utah.

Specimen examined.—One, from Rainbow Lodge, San Juan County, Utah.

Additional records (Carnegie Museum, correspondence J. K. Doutt).—*Uintah County:* Dry Fork, 12 mi. NW Vernal; Bitter Creek, 16 mi. SW Dragon; Willow Creek, 42 mi. S Ouray.

Procyon lotor pallidus Merriam

Racoon

Procyon pallidus Merriam, Proc. Biol. Soc. Washington, 13:151, June 13, 1900, type from New River, Colorado Desert, Imperial County California.

Procyon lotor pallidus, Grinnell, Univ. California Publ. Zoöl., 40:99, September 26, 1933; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938.

Procyon lotor, Allen, Bull. Essex Inst., 6:63, 1874.

Procyon lotor mexicanus, Barnes, Bull. Univ. Utah, 12 (no. 15):133, April, 1922.

Procyon lotor lotor, Barnes, Bull. Univ. Utah, 17 (no. 12):32, June, 1927.

Range.—Southern Utah.

Description and comments.—Merriam (1900:152) gives the following measurements of the type, a female: Total length, 855; length of tail, 295; length of hind foot, 128. Color: Face with black mask; tail with 6 black and

5 white complete rings; tip of tail black; body grayish. Skull: Rostrum short; braincase well inflated; palate extends far posterior to molars; cheek teeth bunodont.

Inasmuch as Utah is mostly a semiarid country, there is, in most parts of the state, insufficient water to meet the requirements of racoons. Angus M. Woodbury orally reports them as fairly common in St. George when he was a youth [1895-1900]. Ranchers from Beaverdam Wash reported killing 8 animals around 1935. Possibly a few still live in Utah; Presnall (1938:7) reported tracks in Zion National Park as late as 1936. Ranchers from northwestern Box-elder County report seeing racoons in the Raft River Mountains and residents of Uinta Basin report them from the Uinta Mountains. If racoons do inhabit these two localities, they are probably referable to the subspecies *Procyon lotor excelsus.*

Records of occurrence.—Insofar as I am informed, there are no recent specimens of racoons from Utah. I have substantiated the following records to my own satisfaction: *Washington County:* Zion National Park (Presnall, 1938:7); St. George (conversation with Angus M. Woodbury); Beaverdam Wash (conversation with Mr. Eardley, rancher in Beaverdam Wash).

TABLE 24

Cranial Measurements of Procyonids in Utah

Sex	Catalog number	Condylobasal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Length of palate
		Bassariscus astutus nevadensis, ♂ 12 mi. SW Orderville; ♀ Monrovian Park						
♂	4747	74.3	22.4	46.7	32.4	13.9	17.0	33.0
♀	4626	75.6	21.1	44.4	32.9	14.4	15.9	33.0
		Bassariscus astutus arizonensis, type (Goldman, 1932: 88)						
♀	205388 USNM	75.8	.....	47.4	.....	14.5	.....	.....

Family MUSTELIDAE

Weasels and Allies

Highly diversified carnivores, exhibiting considerable adaptive radiation into terrestrial, arboreal and aquatic kinds. Features common to all are: Neck nearly of same diameter as head; rostrum short; facial angle slight; paroccipital processes well developed; hard palate extends well posterior to posterior end of molars; skull

smooth; braincase rounded; inner moiety of first upper molar larger than outer; molars $\frac{1}{2}$, carnassials well differentiated; os penis cylindrical; intestinal caecum lacking.

This family is represented in Utah by 15 kinds belonging to 7 genera and 10 full species.

KEY TO MUSTELIDS IN UTAH

1.–Feet broad and round; toes completely webbed; upper molar enlarged and nearly square ..... *Lutra canadensis*, p. 434
1'.–Feet round, broad or elongated; toes not completely webbed; upper molar variable in shape.
2.–Feet elongated; toes long; claws non-retractile, blunt, longer on front feet than hind feet.
3.–Claws on forefeet usually longer than 30; greatest length of skull more than 100; posterior nares open far caudad of last molar; color grayish ..... *Taxidea taxus*, p. 426
3'.–Claws on forefeet usually 20 or less; greatest length of skull less than 80; posterior nares open near posterior border of last molars; color black and white.
4.–Upper parts with continuous longitudinal white stripes, *Mephitis mephitis*, p. 429
4'.–Upper parts spotted; white stripes not continuous, *Spilogale gracilis*, p. 432
2'.–Feet rounded; toes short, partially webbed; claws sharp, curved, often semiretractile, nearly equal on front and hind feet.
5.–Greatest length of skull more than 65; tail bushy.
6.–Tail short, thick and bushy, equalling less than one third the length of head and body, *Gulo luscus*, p. 425
6'.–Tail long, equalling one half the length of head and body ..... *Martes caurina*, p. 422
5'.–Greatest length of skull less than 65; tail not bushy or only slightly so ..... genus *Mustela*, p. 416

KEY TO SPECIES OF MUSTELA

1.–Greatest length of tooth-rows more than 20 in males and 17.8 in females; hind foot more than 60.
2.–Color brown, including head; tail unicolored, not distinctly tipped, *Mustela vison*, p. 420
2'.–Color light buff but head with black mask on face; tail tipped with black ..... *Mustela nigripes*, p. 421
1'.–Greatest length of tooth-rows less than 20 in males and 17.8 in females; hind foot less than 60; bullae inflated.
3.–Total length more than 325; hind foot more than 31; ventral color yellowish (summer); length of articulated lower mandibles more than postglenoidal length of skull ... *Mustela frenata*, p. 417
3'.–Total length less than 325; hind foot less than 31; ventral color whitish (summer); length of articulated lower mandibles less than postglenoidal length of skull ..... *Mustela erminea*, p. 416

Mustela erminea muricus (Bangs)

Ermine

Putorius (Arctogale) muricus Bangs, Proc. New England Zool. Club, 1:71, July 31, 1899, type from Echo, 7,500 feet, El Dorado County, California.
Mustela erminea murica, Hall, Journ. Mamm., 26:77, February 27, 1945.
Mustela erminea, Hayward, Journ. Mamm., 30:436, November 17, 1949.

Range.—Limits unknown, probably occurs throughout the state in the high mountains.

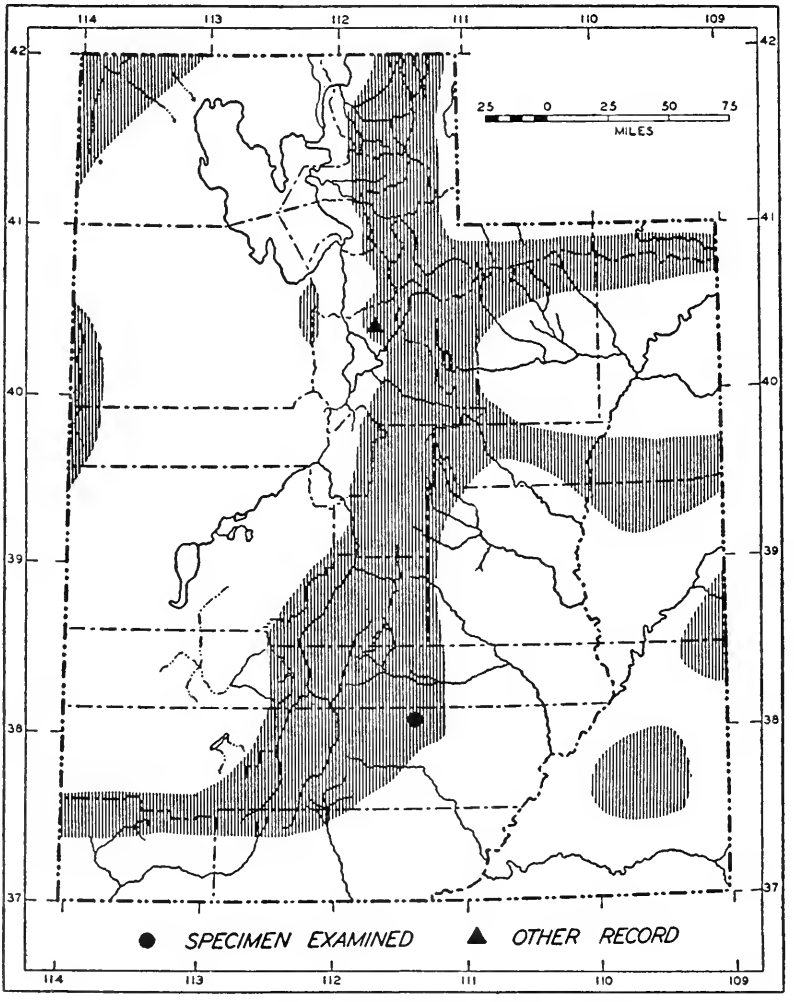

FIG. 72. Distribution of *Mustela erminea muricus*.

Description and comments.—Measurements of a female, number 6661, from Wildcat Ranger Station, Boulder Mountain, are: Total length, 197; length of tail, 48; length of hind foot, 28; length of ear, 15. Tail short. Color (*summer pelage*): Upper parts brown; tail black-tipped; underparts white; undersides of legs white; dorsal surface of legs and feet like upper parts; toes white on front feet, mostly white on back feet. In *winter pelage,* white everywhere except tip of tail which is black. Skull: Small, delicate; length of articulated lower jaws as measured from the symphysis to a line across the condyloid processes less than postglenoidal length of skull; anterior part of tympanic bullae flattened; sagittal crest lacking; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{1}{2}$.

This weasel differs from *Mustela frenata nevadensis* by smaller size, tail shorter than body (averaging 31% of length of body, as opposed to more than 50%), and postglenoidal length of skull more than length of articulated lower mandibles.

I know of only four specimens of *M. e. muricus* from Utah. Hayward (1949:436, 437) reported one taken on September 6, 1947, and another on June 10, 1948, from Mt. Timpanogos. K. R. Kelson and I obtained one on September 17, 1948, from Boulder Mountain. An adult female was reported to me as taken on June 14, 1939, from Strawberry Valley, Wasatch County, Utah, by Lloyd Gunther. The specimen caught by Kelson and me, was in a museum-special mouse trap baited with rolled oats, in a moist mountain meadow, in long grass (knee deep), in heavy stands of willow (*Salix*). In the same line of traps shrews (*Sorex obscurus*) and meadow mice (*Microtus montanus* and *M. longicaudus*) were obtained.

Specimen examined.—One, from Wildcat R. S., Boulder Mountain, 8,700 ft., Garfield County, Utah.

Additional records.—Utah County (Hayward, 1949:436-437): N end Mt. Timpanogos; E slope Mt. Timpanogos. *Wasatch County:* Strawberry Valley (Lloyd Gunther).

Mustela frenata nevadensis Hall

Long-tailed Weasel

Mustela frenata nevadensis Hall, Carnegie Inst. Washington, Publ., 473:91, November 20, 1936, type from three miles east of Baker, White Pine County, Nevada; Presnall, Zion-Bryce Mus. Bull., 2:7, January, 1938; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 57, 1942; Hayward, Great Basin Nat., 6:110, November 15, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Putorius ermineus, Allen, Bull. Essex Inst., 6:62, 1874.

Putorius arizonensis, Merriam, N. Amer. Fauna, 11:22, June 30, 1896; Allen, Brooklyn Inst. Mus. Sci. Bull., 1:122, 1905; Barnes, Bull. Univ. Utah, 12 (no. 15):144, April, 1922.

Mustela arizonensis, Barnes, Bull. Univ. Utah, 17 (no. 12):38, June, 1927; Tanner, Journ. Mamm., 8:250, August 9, 1927; Stanford, Journ. Mamm., 12:363, November 11, 1931; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935.

Range.—State-wide.

Description and comments.—Average and extreme measurements of 5 adult males, and measurements of 2 adult females, numbers 3352 and 2129, from Salt Lake County, are, respectively, as follows: Total length, 388 (431-370), 391, 356; length of tail, 138 (162-122), 120, 110; length of hind foot, 42 (48-35), 42, 30; length of ear, 20 (25-15), 23, 17. Color (*summer pelage*): Entire upper parts Sayal Brown or Snuff Brown; tip of tail black or dark brown;

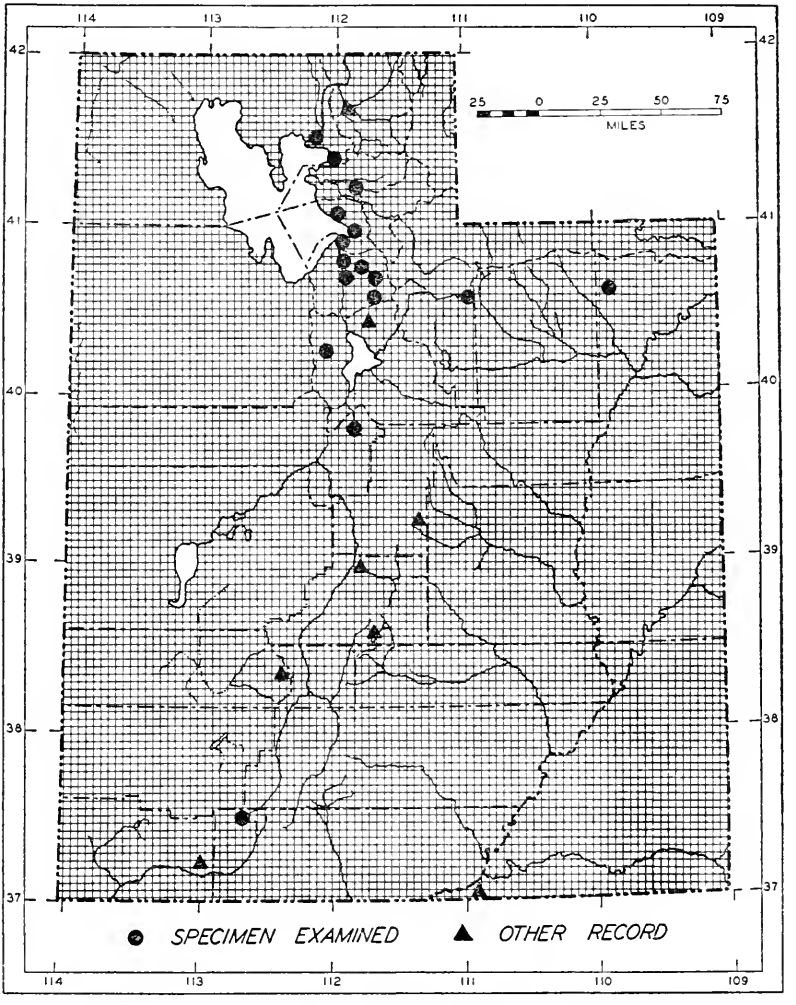

FIG. 73. Distribution of *Mustela frenata nevadensis*.

chin, lower lips, and sometimes upper lips white; entire underparts, medial sides of legs, part of feet and proximal fourth of ventral surface of tail usually Buff Yellow (varying from Straw Yellow to Ochraceous-Yellow); toes white. In *winter pelage*, all white, except tip of tail which is black. Skull: Length of articulated lower mandibles greater than postglenoidal length; tympanic bullae

well inflated, projecting below squamosal anterior to bullae; palate extending posteriorly beyond upper molars; skull with sagittal crest.

Only one other weasel, *Mustela erminea muricus,* occurs in the state. The two species are readily distingiushed by several characters. For comparisons see the account of *M. e. muricus.*

The long-tailed weasel is probably the most widely distributed carnivore in the state. It occurs from elevations of more than 10,000 feet in the mountains down to the lowest elevations in the state on the floors of the valleys. The animals are relatively common in irrigated areas, but seem to be scarce in the most arid desert. They inhabit even cities and are found on the campus of the University of Utah, where they have been taken in the heating tunnels, and underneath the shrubbery.

One of their chief sources of food is pocket gophers. My experience in Utah corroborates that of Hall (1946:191) in Nevada in that more weasels are taken in traps set for pocket gophers than in sets of any other kind. Almost invariably when I have seen a weasel with a rodent in its possession, the rodent has been a pocket gopher. On two occasions in the summer of 1948 I saw weasels with pocket gophers on the walk between the upper and lower campuses of the University of Utah.

Specimens examined.—Total, 22, distributed as follows: *Boxelder County:* Bear River Migratory Bird Refuge, 4,300 ft., 1; Willard, 1. *Weber County:* Wheeler Creek Canyon, 3 mi. from junction Ogden Canyon, 1. *Davis County:* Kaysville, 4,305 ft., 1; entrance to Farmington Bay Refuge, 4,210 ft., 1; 3 mi. W Woods Cross, 4,343 ft., 1. *Salt Lake County:* Jordan River, NW Salt Lake City, 4,300 ft., 1; Ft. Douglas Reservation, 1; Millcreek Canyon, 1; 2 mi. above mouth Millcreek Canyon, 1; 39th South and 13th East, Salt Lake City, 4,266 ft., 1; 5 mi. SW Salt Lake City, 4,300 ft., 1; 7½ mi. SE Salt Lake City, 4,200 ft., 1; 90th South and N Fork Little Cottonwood Road, 4,600 ft., 1. *Utah County:* Fairfield, 1. *Wasatch County:* Summit Wolf Creek, 9,800 ft., 1. *Uintah County:* Ranger Station, Paradise Park, 7 mi. SW Marsh Peak, 10,050 ft., 4. *Juab County:* Between Santaquin and Starr, 1. *Kane County:* Duck Creek, Cedar Mountain, 9,000 ft., 1.

Additional records.—Cache County: Logan (Stanford, 1931:363). *Utah County:* Mt. Timpanogos (Tanner, 1927:250). *Sanpete County:* U. S. Forest Service Experiment Station (Stanford, *loc. cit.*). *Sevier County:* Salina (Ivie Farm); Fishlake (Stanford, *loc. cit.*). *Beaver County:* Briggs Meadow, Belknap Peak, 11,000 feet (Allen, 1905:122). *Washington County:* Zion National Park (Presnall, 1938:7). *San Juan County:* Rainbow Lodge (Benson, 1935:448).

Mustela vison energumenos (Bangs)

Mink

Putorius vison energumenos Bangs, Proc. Boston Soc. Nat. Hist., 27:5, March, 1896, type from Sumas, British Columbia, Canada.

Mustela vison energumenos, Miller, Bull. U. S. Nat. Mus., 79:101, December 31, 1912; Barnes, Bull. Univ. Utah, 17 (no. 12):40, June, 1927; Svihla, Journ. Mamm., 12:259, August 24, 1931; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Putorius vison, Baird, Mammals, App. C. Stansbury's Expl. and Survey of the Valley of the Great Salt Lake of Utah, U. S. Eng. Dept., p. 311, 1852; Coues and Yarrow, Report on collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:60, 1875.

Putorius lutreolus var. *vison*, Allen, Bull. Essex Inst., 6:62, 1874.

Putorius vison lutreocephalus, Barnes, Bull. Univ. Utah, 12 (no. 15):147, April, 1922.

Range.—Occurs sparingly in the high Uinta and Wasatch mountains, southeast to La Sal Mountains. Also reported in southern part of state in Dixie and Fishlake National forests.

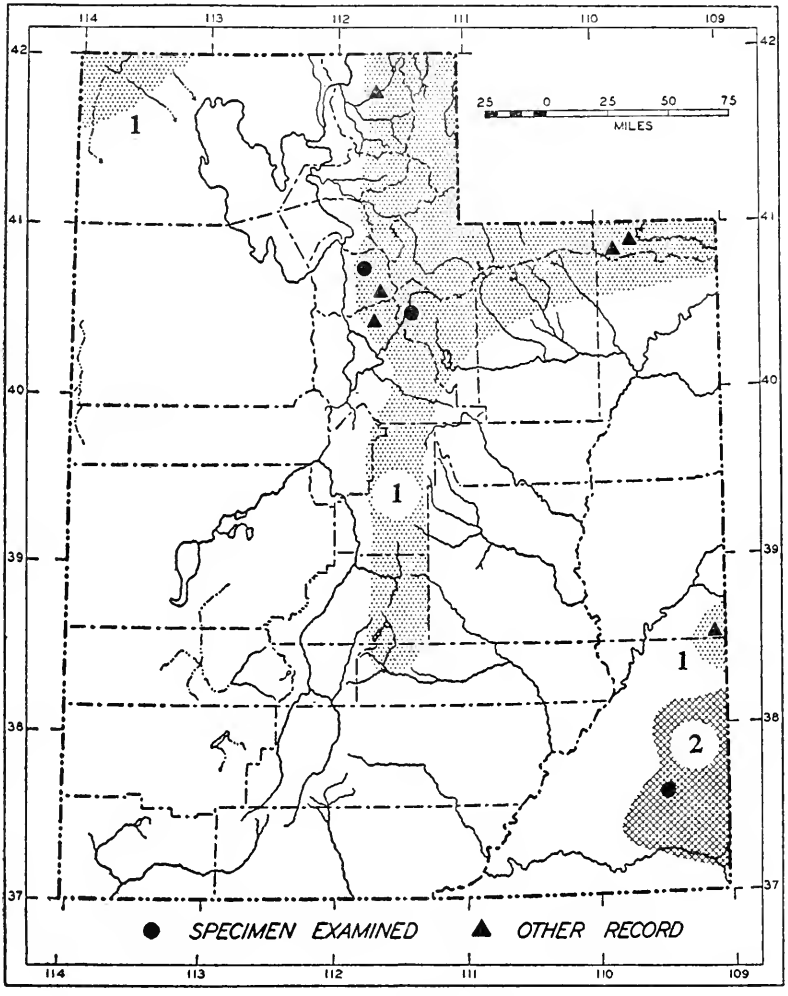

FIG. 74. Distribution of:
1. *Mustela vison energumenos.* 2. *Mustela nigripes.*

Description and comments.—Measurements of an adult male, number 3990, from Wasatch County, are: Total length, 635; length of tail, 184; length of hind foot, 69; length of ear, 25. Color: Upper parts brown, underfur Buffy Brown, guard hairs Verona Brown or Bister, darkest in middorsal region; tail bushy and grading through dark brown to nearly black at tip; underparts light brown, underfur Wood Brown, guard hairs Sayal Brown; white spots present on chin and throat in some specimens. Skull: Weasellike, auditory bullae flattened; greatest length of articulated lower mandibles greater than post-glenoidal length of skull; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{1}{2}$.

Mink can be easily distinguished from all other species of the genus *Mustela* from Utah by large size, dark brown coloration, and flattened auditory bullae.

Since Utah is a semiarid state with relatively little surface water, the mink, a semiaquatic mustelid, is restricted in distribution. Early writers commented particularly on their abundance in the Provo River. This stream, in the Wasatch Mountains, at present probably harbors the largest numbers of the greatly diminished wild mink population. I know of no actual specimens of them save from the Wasatch and Uinta mountains.

The taxonomic status of this animal within the state may never be adequately understood, since the wild population is low in numbers and introduced mink escape and probably interbreed with the native stock. Most of the mink farms are within the range of the native mink.

Specimens examined.—Total, 2, distributed as follows: *Salt Lake County:* Small cave, S slope, mouth Emigration Canyon, 4,800 ft., 1. *Wasatch County:* Below Murdock Power Plant, Provo River, 1.

Additional records.—*Cache County:* Logan River (Barnes, 1927:40). *Salt Lake County:* Big and Little Cottonwood canyons (Barnes, *loc. cit.*). *Daggett County:* Sheep Creek, Beaver Creek (Svihla, 1931:259). *Utah County:* Mt. Timpanogos (Hayward, 1945:110). *Grand County:* La Sal National Forest (Barnes, 1927:40).

Mustela nigripes (Audubon and Bachman)

Black-footed Ferret

Putorius nigripes Audubon and Bachman, Quad. N. America, 2:297, 1851, type from Fort Laramie, Laramie County, Wyoming.
Mustela nigripes, Miller, Bull. U. S. Nat. Mus., 79:102, December 31, 1912.

Range.—Known only from San Juan County. See figure 74.

Description and comments.—Measurements of an adult male, number 77840 (M. V. Z.), from San Juan County, are as follows: Total length, 418.8; length of tail, 114.3; length of hind foot, 63.4; length of ear, 31.7. Soles and palms haired. Color: Upper parts Cinnamon-Buff with heavy admixture of dark (Prout's Brown) guard hairs in posterior one half of back, grading over sides to Light Buff on underparts; chin, nose, cheeks and ears white; facial mask through eyes and across nose dark brown; tail on all surfaces Cinnamon-Buff proximally, white medially and blackish distally; front legs, front feet, hind

legs and hind feet dark brown to black. Skull: Large, robust; lacrimal processes peglike and well developed; lambdoidal and sagittal crests well developed; postorbital constriction markedly narrow; postorbital processes massive; zygomatic arches heavy, widely spreading and bowing markedly dorsad; palate extending caudad to a point midway between orbital fissure and optic foramen; auditory bullae large, flattened and truncate laterally; condyloid processes well developed; coronoid processes large, sagittiform and perpendicular; last lower molar actually as well as relatively to first molar greatly reduced; lower incisors usually 2-ranked (i2 posterior to i1 and i3); tooth formula, $i.\frac{3}{3}$, $c.\frac{1}{1}$, $p.\frac{3}{3}$, $m.\frac{1}{2}$.

This large weasellike animal is readily distinguished from all other members of the genus known to occur in Utah by its pale buffy, whitish color with blackish feet and legs.

Insofar as I know, the occurrence here reported is the first for this animal from the state of Utah. The black-footed ferret is usually credited with preying on prairie dogs. San Juan County has an abundance of these rodents and intensive collecting may prove that the ferret is present there in greater numbers than at present is supposed. The presence of the black-footed ferret in San Juan County, along with other characteristic mammals of the area is further indication that this southeastern region of Utah harbors a mammalian fauna not met with elsewhere within the state. I know of no occurrence of the black-footed ferret north of the Colorado River in Utah, and I would not expect them to occur there.

Specimen examined.—One, from D. Bayliss Ranch, 2 mi. S Blanding, San Juan County, Utah (M.V.Z.).

Martes caurina origenes (Rhoads)

Marten

Mustela caurina origenes Rhoads, Proc. Acad. Sci. Philadelphia, 54:458, September 30, 1902, type from Marvine Mountain, Garfield County, Colorado; Barnes, Bull. Univ. Utah, 12 (no. 15):143, April, 1922.

Martes caurina origenes, Miller, Bull. U. S. Nat. Mus., 79:93, December 31, 1912; Barnes, Bull. Univ. Utah, 17 (no. 12):36, June, 1927; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Martes caurina caurina, Davis, The Recent mammals of Idaho, Caxton Printers, Caldwell, Idaho, p. 130, April 5, 1939.

Range.—Occurs sparingly in the high mountains of the northern and north-central part of the state, and probably in the central part of the state.

Description and comments.—Measurements of an adult female, number 6606, from Wasatch County, are as follows: Total length, 560; length of tail, 180; length of hind foot, 82; length of ear, 42. Soles of feet haired, pads naked; claws semiretractile. Color: Upper parts brown, darkest in middorsal region; sides paler; tail like back proximally, but grading to black at tip; top of head, face and chin grayish brown; throat, pectoral and inguinal regions

orange; feet and legs dark brown; underparts pale brown except midventral line which is orange. Skull: Rostrum short; facial angle slight; auditory bullae well inflated, but not in contact with paroccipital processes; palate extends far posterior to last upper molar; inner half of upper molar larger than outer half;

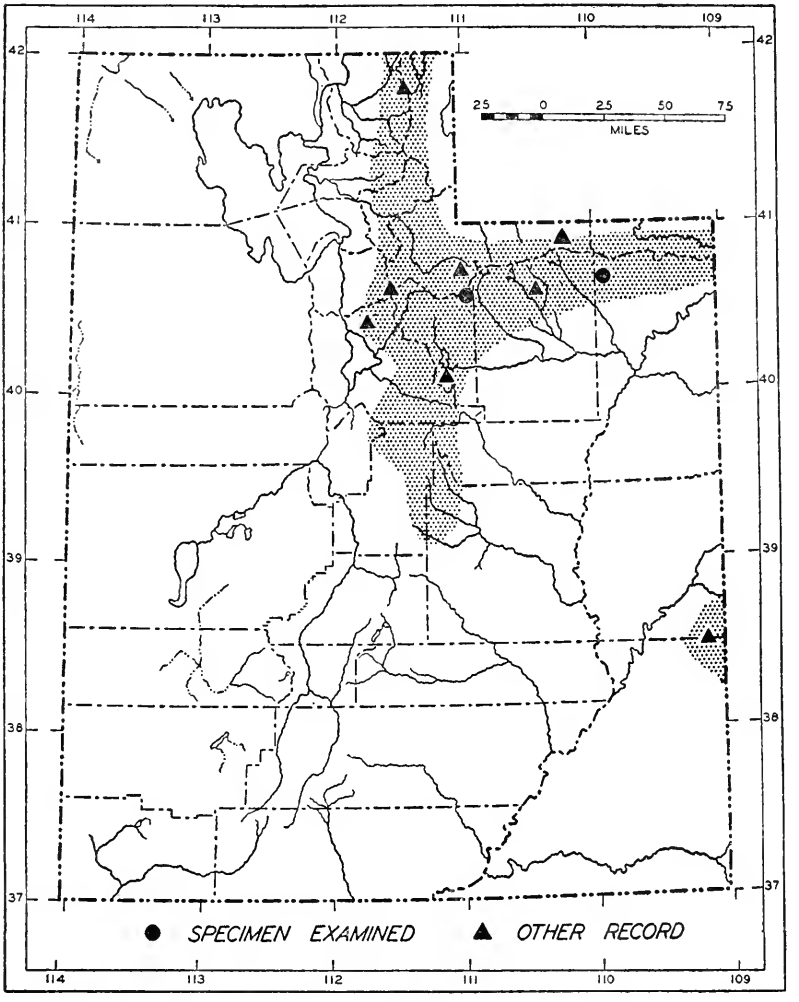

FIG. 75. Distribution of *Martes caurina origenes.*

deuterocone of upper carnassial simple; in lower first molar, trigonid larger than talonid; metaconid appressed to protoconid; talonid semibasined; hypoconid large; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{1}{2}$.

This arboreal mustelid is readily distinguished from other members of the family *Mustelidae* known to occur in Utah by its

long ears, long bushy tail, midventral orange stripe, semiretractile claws and four premolars in each jaw.

Davis (1939:130) thinks that the subspecies *Martes caurina caurina* may extend as far south as Utah. Warren (1942:52) employed the name *Martes caurina origenes* for all animals from Colorado. The material available to me from Utah for this study, consisted of three skulls only and one skin with skull from the Uinta Mountains of Wasatch and Uintah counties. Comparisons of this material with specimens of *M. c. caurina* from Washington and British Columbia (K.U.), and with those of *M. c. origenes* from Las Vegas Mountains, New Mexico (K.U.), show these animals from Utah, insofar as cranial features are concerned, to be intergrades between *M. c. caurina* and *M. c. origenes,* but referable to the latter. Resemblance to *M. c. caurina* is indicated in the shape of the zygomatic arches and in the extension of the palate posterior to the last molar, whereas the shape of the foramen magnum, size of the upper molar, size of the inner cusp of the upper carnassial shear and the shape of the interpterygoid space are more as in *M. c. origenes.* In breadth of the rostrum, the skulls are intermediate between the two subspecies.

I have retained the specific name *Martes caurina* for animals from Utah in keeping with the current usage. My studies of martens cause me to doubt that *M. caurina* is distinct from *Martes americana.*

In Utah, insofar as I am aware, martens are found only in the high parts that support coniferous forests (Canadian and Hudsonian life-zones).

Specimens examined.—Total, 4, distributed as follows: *Wasatch County:* 1½ mi. W Lost Lake, Highway 150, 9,500 ft., 1. *Uintah County:* Paradise Park, 10,000 ft., 3.

Additional records.—*Cache, Salt Lake, Summit, Wasatch, Grand* and *San Juan* counties (no exact localities given, Barnes, 1927:36). *Summit County:* Henrys Fork, N slope Uinta Mountains (observation of writer).

Martes pennanti columbiana Goldman

Fisher

Martes pennanti columbiana Goldman, Proc. Biol. Soc. Washington, 48:176, November 15, 1935, type from Stuart Lake, near headwaters of Fraser River, British Columbia, Canada.

Range.—Known only from Uinta Mountains.

Description and comments.—Goldman (1935:176) gives the following measurements of an adult male from Alturus Lake, Sawtooth Range, Idaho: Total length, 1,013; length of tail, 395; length of hind foot, 128. Structurally similar to the marten, but larger. Color: Upper parts brownish black; underparts lighter. Skull: Size large; massive; zygomatic arches bowed dorsally;

facial angle slight; postorbital processes small; length of auditory bullae less than rostral breadth; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{1}{2}$.

This animal is included in the fauna of Utah on the basis of photographs of its tracks taken by William H. Marshall. In a letter accompanying the photographs, dated March 30, 1948, he stated "I am enclosing two photographs of Fisher tracks which were taken at Trial Lake on the Wasatch Forest [Summit County] on March 27, 1938. The background to them is that I spent about ten days in the last part of March, 1938, at the Ranger Station at Mirror Lake and also at a private cabin on Trial Lake. During this period we covered much of the basin around Mirror Lake and much of the Trial Lake basin area. On this day, the 27th, we picked up the Fisher tracks near the Mirror Lake Ranger Station, followed them across the pass that the road goes through to Trial Lake and on over towards the basin of the north fork of the Provo River. During this time the Fisher . . . traveled always in one general direction but frequently diverting for some reason usually unknown or else to investigate some particularly dense tree. I was back up at Mirror Lake again in May for a seven day period, unfortunately I have forgotten the exact dates. On one of these days the Fisher tracks again appeared by the Mirror Lake Station and we followed them through Trial Lake well over into the north fork of the Provo basin. The animal in general covered the same route that he had in the previous March. Quite frankly I had never seen Fisher tracks before but I have seen them since that time on the Flathead River in Montana and I am sure that these were Fisher tracks we were dealing with. Each foot print was approximately the size of a silver dollar and the animal proceeded through the country in much the same fashion that a Marten would have."

I have examined the tracks as shown in the photograph and have compared them with figures of tracks of marten from various sources. My findings lead me to concur with Marshall.

Record of occurrence.—Summit County: Trial Lake area (photographs of tracks).

Gulo luscus luscus (Linnaeus)

Wolverine

[*Ursus*] *luscus* Linnaeus, Syst. Nat., ed. 12, 1:71, 1766, type locality, Hudson Bay.

Gulo luscus, Sabine, Franklin's Narr. Journ. to Polar Sea, p. 650, 1823; Baird, Appendix C in Howard Stansbury's exploration and survey of the valley of the Great Salt Lake of Utah, U. S. Engineers Dept., p. 311, 1852; Baird, General report upon the zoology of the several railroad routes: Pt. I, Mammals, p. 181, 1858; Coues, Amer. Nat., 1:352, 1867; Allen, Bull. Essex Inst., 6:63, 1874; Coues and Yarrow, Rep't upon the collec-

tion of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept., Expl. W 100th Meridian, 5:61, 1875; Coues, U. S. Geol. Surv. of Territories (Hayden) Misc. Publ., 8:34, 1877; Barnes, Bull. Univ. Utah, 12 (no. 15):139, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):43, June, 1927; Svihla, Journ. Mamm., 12:259, August 24, 1931.

Range.—High Wasatch and Uinta mountains; possibly extinct.

Description and comments.—Seton (1929:406) gives the following measurements for males: Total length, 1,051; length of tail, 212.5; length of hind foot, 198.5. Color: Upper parts dark brown, fulvous bands along sides meeting at base of tail; tail like upper parts; face brown; head grizzled; underparts brown, white patch on throat. Skull: Large, massive; palate extends far posterior to last molar; inner half of first upper molar larger than outer; talonid of lower first molar longer than trigonid; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{1}{2}$.

This large mustelid is readily distinguished from all others by the combination of large size, short bushy tail, fulvous dorsal stripes, large feet with semiretractile claws and by its tooth formula.

The wolverine was never common in Utah. According to D. Irvin Rasmussen of the U. S. Forest Service, it no longer occurs in the state. Like other forms now thought to be extinct, an occasional one might be found in the remote montane areas of the state. William H. Behle of the Biology Department of the University of Utah reported seeing one near Brighton, Salt Lake County, in 1924.

Records of occurrence.—Boxelder County: Bear River (Coues and Yarrow, 1875:62). *Salt Lake County:* "near" Brighton (Behle, conversation). *Millard County:* Fillmore (Coues and Yarrow, *loc. cit.*). *Piute County:* Mt. Baldy (Barnes, 1927:43). *Garfield County:* Boulder Mountains (Barnes, *loc. cit.*).

Taxidea taxus taxus (Schreber)

Badger

Ursus taxus Schreber, Säugethiere, vol. 3, p. 250, 1778, type said to be from Labrador and Hudson Bay, but probably southwest of Hudson Bay (Hall, 1946:225).

Taxidea taxus, Rhoads, Amer. Nat., 28:524, June, 1894; Barnes (part), Bull. Univ. Utah, 12 (no. 15):135, April, 1922.

Taxidea taxus ssp., Hayward, Great Basin Nat., 6:110, November 15, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Taxidea taxus taxus, Barnes (part), Bull. Univ. Utah, 17 (no. 12):50, June, 1927; Tanner, Journ. Mamm., 8:250, August 9, 1927; Svihla, Journ. Mamm., 12:259, August 24, 1931; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938; Marshall, Journ. Mamm., 21:154, May 16, 1940.

Taxidea americana, Newberry, Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean made under the direction of the Secretary of War in 1854-55, 6:45, 1857; Allen, Bull. Essex Inst., 6:63, 1874; Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:63, 1875; Coues, Fur bearing mammals, Monogr. N. Amer. Mustelidae, U. S. Geol. Surv. of the Territories (Hayden), Misc. Publ., 8:263, 1877.

Range.—State-wide except southern and southeastern parts.

Description and comments.—Measurements of an adult male, number 3993, from Tooele County, are as follows: Total length, 712.6; length of tail, 133.7; length of hind foot, 127.4; length of ear, 51. Body flattened; legs short; front feet with long claws for digging; neck thickset; ears short. Color: Upper parts silver gray in prime skins, more buffy in summer pelage; guard hairs long,

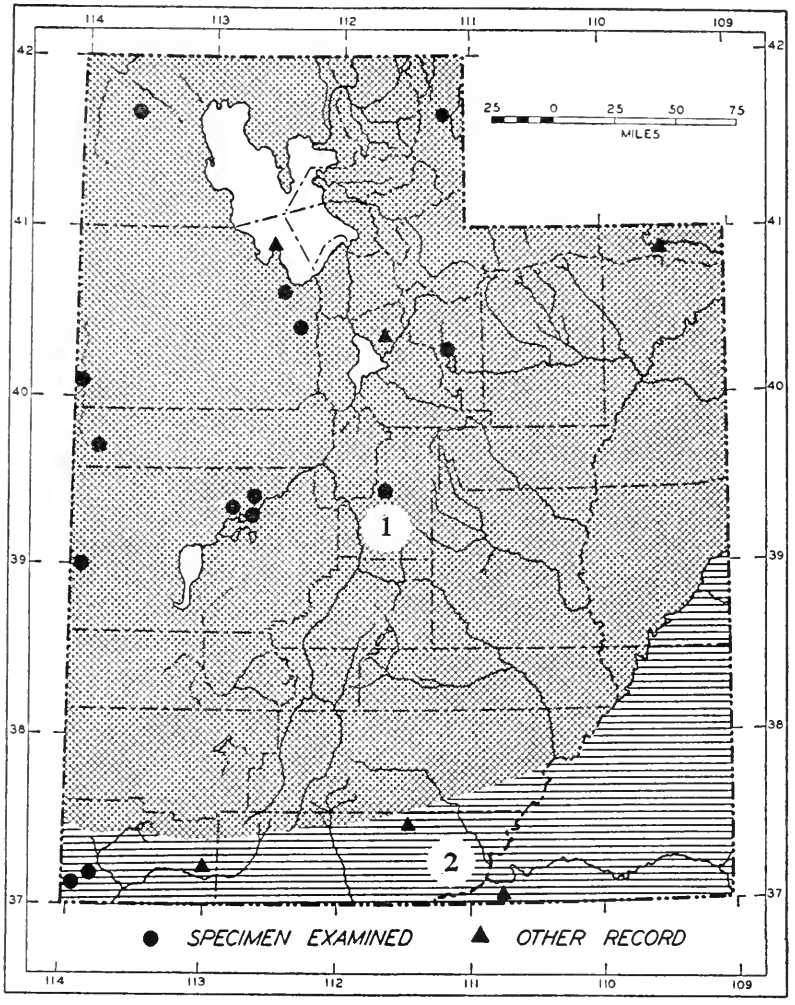

FIG. 76. Distribution of *Taxidea taxus*.
1. *T. t. taxus*. 2. *T. t. berlandieri*.

white-tipped, then a band of black followed by long proximal buffy band; guard hairs longest on sides, like a mantle; underfur Pale Pinkish Buff in winter pelage, Ochraceous-Buff in summer pelage; white stripe present from nose to shoulders; nose, top of head, pre- and post-auricular spots black or dark brown;

inner rim of ear, suborbital and postorbital regions white with buffy margins; feet black or dark brown; chin and throat and midventral region white; remainder of underparts Warm Buff with a sprinkling of black-tipped hairs; chin spot dark brown. Skull: Large, massive; zygomatic arches heavy and widely spreading; tympanic bullae actually as well as relatively large; palate extends posterior to upper molars; skull widest and highest at occiput; paroccipital processes not in contact with tympanic bullae; first upper molar triangular with transversely arranged cusps; upper carnassial with accessory cusp behind deuterocone; talonid smaller than trigonid in lower first molar; metaconid, hypoconid and entoconid large; talonid bears two or three accessory cusps in addition to hypoconid and entoconid; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{1}{2}$.

In Utah, *T. t. taxus* differs from *Taxidea taxus berlandieri* as follows: Size larger. Color: Underfur lighter, much less rufescent; middorsal white stripe shorter. Skull: Larger and more massive throughout; zygomatic arches heavier and more widely spreading; tympanic bullae larger; palate extended farther behind upper molars; cranium less vaulted immediately anterior to junction of coronal and sagittal sutures; dentition heavier.

In all specimens available for this study, which includes young of both sexes, the characters are clear cut, and the animals show no evidence of intergradation. This subspecies is known to intergrade with *T. t. berlandieri* in other localities (Hall, 1946:227). Since no intergrades were found in the specimens from Utah, it is difficult to establish the limits of the distribution of the two kinds within the state. The material at hand indicates that the subspecies *T. t. taxus* ranges over all of the state except the extreme southern and southeastern parts. I have seen badgers in relatively high areas, but they appear to be scarce there, and live mostly in foothills and valleys.

Specimens examined.—Total, 16, distributed as follows: *Boxelder County:* Foot of Black Hill, 9 mi. W Rosette, Raft River Mountains, 6,000 ft., 1. *Rich County:* 1 (no exact locality). *Tooele County:* Grantsville, 4,500 ft., 2; 11 mi. S Tooele, 1; Ibapah, 5,000 ft., 2. *Wasatch County:* Strawberry Valley, 7,600 ft., 1. *Juab County:* 2 mi. W Trout Creek, Deep Creek Mountains, 5,000 ft., 2. *Sanpete County:* Wales, 5,000 ft., 1. *Millard County:* W Delta, 4,500 ft., 1; 4 mi. W Deseret 2 (M.V.Z.); Deseret, 1 (M.V.Z.); "near" Garrison, 1 (M.V.Z.).

Additional records.—Utah County: Mt. Timpanogos (Tanner, 1927:250). *Daggett County:* Hideout, Green River (Svihla, 1931:259). *Tooele County:* Stansbury Island (Marshall, 1940:154).

Taxidea taxus berlandieri Baird

Badger

Taxidea berlandieri Baird, Mamm. N. America, p. 205, 1858, type from Llano Estacado (now Cochran, Hockley, Yoakum and Terry counties, Poole and Schantz, 1942:78), Texas.

Taxidea taxus berlandieri, Allen, Bull. Amer. Mus. Nat. Hist., 7:256, June 29, 1895; Woodbury, Ecol. Monogr., 3:197, April, 1933; Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935; Tanner, Great Basin Nat., 1:109, June 30, 1940.

Taxidea taxus, Barnes (part), Bull. Univ. Utah, 12 (no. 15):135, April, 1922.

Taxidea taxus taxus, Barnes (part), Bull. Univ. Utah, 17 (no. 12):50, June, 1927; Presnall, Zion-Bryce Mus. Bull., 2:8, January, 1938.

Range.—Extreme southern and southeastern Utah in drainage of the Colorado River.

Description and comments.—Hall (1946:227) gives the following measurements for a male and female from Clark County, Nevada: Total length, 673, 591; length of tail, 115, 115; length of hind foot, 105, 102; length of ear, 49, 42. Color: Similar to *Taxidea taxus taxus* except that underfur on upper parts more reddish (Ochraceous-Buff); dorsal white stripe continues farther down back; underparts more reddish (Cinnamon-Buff). Skull: Size medium; zygomatic arches weak and not widely spreading; tympanic bullae well inflated ventrally; palate extended farther behind molars; cranium highest immediately anterior to junction of coronal and sagittal sutures.

As noted in many other mammals of Utah, this subspecies is limited to the drainage of the Colorado River. This river in its southern and northern reaches is not the effective barrier that it is in its middle part, where the river runs between steep canyon-walls. The animals of this subspecies occur on both sides of the river and attain the northern limits of their range in southern and southeastern Utah.

Specimens examined.—Total, 5, distributed as follows: *Washington County:* 3 mi. NW Castle Cliffs, Beaverdam Slope, 3,300 ft., 1; Beaverdam Wash, 8 mi. N Utah-Arizona Boundary, 2,800 ft., 4.

Additional records.—*Washington County:* Zion National Park (Presnall, 1938:8). *Kane County:* Kaiparowits Plateau (Tanner, 1940:109). *San Juan County:* Navajo Mountain Trading Post (Benson, 1935:448).

Mephitis mephitis major (Howell)

Striped Skunk

Chincha occidentalis major Howell, N. Amer. Fauna, 20:37, August 31, 1901, type from Fort Klamath, Klamath County, Oregon.

Mephitis mephitis major, Hall, Univ. California Publ. Zoöl., 37:2, April 10, 1931; Hall, Carnegie Inst. Washington, Publ., 437:66, November 20, 1936; Marshall, Journ. Mamm., 21:156, May 16, 1940.

Mephitis mephitis var. *occidentalis*, Merriam, Report on the mammals and birds of the Expedition, sixth annual report of U. S. Geol. Surv. of Terr. embracing portions of Montana, Idaho, Wyoming and Utah; . . . report of progress for the year 1872, p. 662, 1873.

Mephitis mephitica, Allen, Bull. Essex Inst., 6:63, 1874; Allen, Bull. Geol. and Geol. Surv. of Terr., 2:334, 1876.

Mephitis bicolor, Allen, Bull. Essex Inst., 6:63, 1874.

Mephitis occidentalis major, Barnes, Bull. Univ. Utah, 12 (no. 15):136, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):49, June, 1927; Hayward, Great Basin Nat., 6:110, November 15, 1945.

Range.—State-wide except extreme southern and southeastern part of state, and northern slopes of the Uinta Mountains.

Description and comments.—Hall (1946:212) gives the following measurements of four males from Nevada: Total length, 780, 710, 685, 695; length of

tail, 317, 340, 263, 267; length of hind foot, 83, 78, 79, 75; length of ear, 33, 35, —, 36. Color: Upper parts black with considerable white; white usually begins as a single band at occiput, bifurcating in scapular region and continuing as two white stripes down onto lateral margins of tail; amount and distribution of white highly variable; small white stripe present between eyes; entire under-

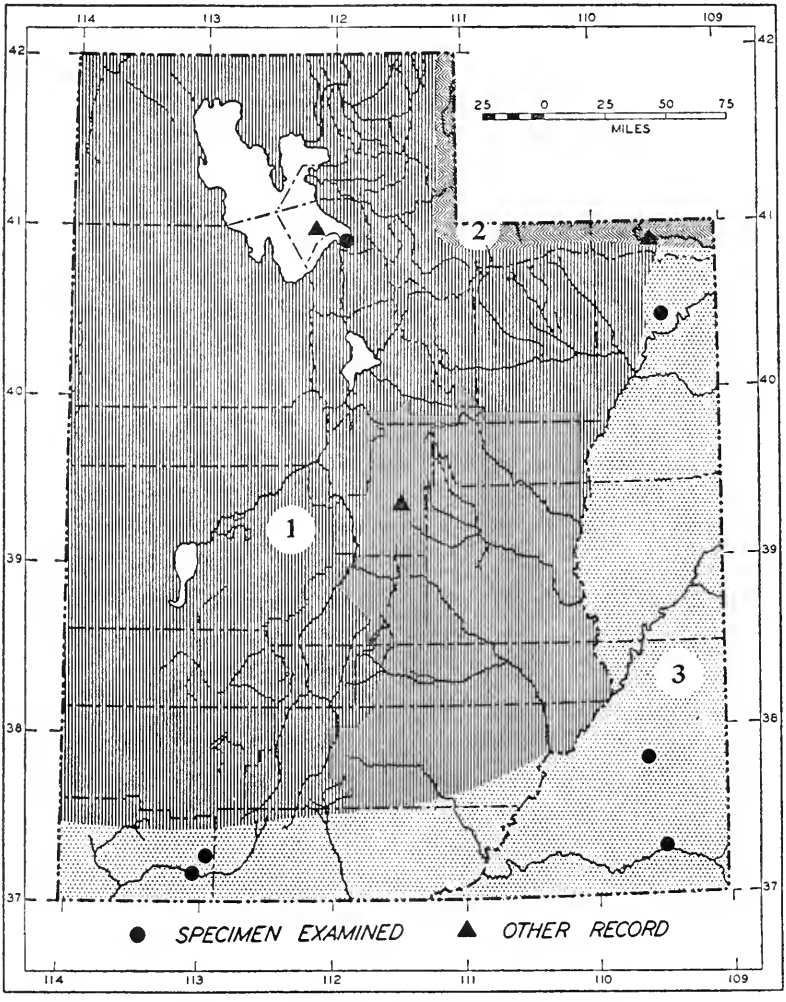

FIG. 77. Distribution of *Mephitis mephitis*.
1. *M. m. major.* 2. *M. m. hudsonica.* 3. *M. m. estor.*

parts black with exception of white pectoral spot. Skull: Robust, ridged; highly arched, deepest in frontal region; zygomatic arches widely spreading and robust; palate without median spine; palate not extending behind upper molars; tympanic bullae flattened; coronoid process at right angles to ramus;

decided step present at posterior ventral margin of mandible; upper molars massive with practically equal measurements of width and length; osseus auditory canal long. In first lower molar: Trigonid longer than talonid, metaconid large and distinct from protoconid, hypoconid and entoconid well developed, and entoconid separated from protoconid; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{1}{2}$.

From *Mephitis mephitis estor*, *M. m. major* differs in: Larger; tail proportionally shorter; less white dorsally; zygomatic arches more widely spreading; interpterygoid fossa narrower; mastoid inflation less marked. *M. m. major* is said to differ from *Mephitis mephitis hudsonica* in larger size, longer tail, white stripes diverging on shoulders rather than on neck, and less widely spreading zygomatic arches.

Although this subspecies has a large range in Utah, and although the striped skunk is not uncommon throughout this range the animal is poorly represented in collections. This paucity of specimens probably is the result of a certain reluctance on the part of collectors to prepare specimens of skunks. Undoubtedly many persons do not agree with Hall (1946:209) and find the odor of the musk of skunks to be unpleasant even in small amounts.

Specimens examined.—One, from 3 mi. W Woods Cross, 4,343 ft., Davis County, Utah.

Additional records.—*Davis County:* Antelope Island, Great Salt Lake (Marshall, 1940:156). *Sanpete County:* Ephraim (Hall, 1931:2).

Mephitis mephitis hudsonica Richardson

Striped Skunk

Mephitis americana var. *hudsonica* Richardson, Fauna Boreali-Americana, 1:55, 1829, type from plains of Saskatchewan, Canada.
Mephitis mephitis hudsonica, Hall, Univ. California Publ. Zoöl., 40:368, November 5, 1934.
Mephitis hudsonica, Svihla, Journ. Mamm., 12:259, August 24, 1931.

Range.—North slopes of Uinta Mountains, probably also in Rich County and eastern Cache County.

Comments.—This subspecies was recorded by Svihla (1931:259), who obtained one specimen from Sheep Creek, Daggett County, Utah, that was identified by Arthur H. Howell.

Mephitis mephitis estor Merriam

Striped Skunk

Mephitis estor Merriam, N. Amer. Fauna, 3:81, September 11, 1890, type from San Francisco Mountain, Coconino County, Arizona.
Mephitis mephitis estor, Hall, Univ. California Publ. Zoöl., 37:1, April 10, 1931; Presnall, Zion-Bryce Mus. Bull., 2:8, January, 1938.
Mesphitis occidentalis major, Woodbury, Ecol. Monogr., 3:197, April, 1933.

Range.—Extreme southern and eastern Utah.

Description and comments.—Measurements of an adult female, number 656, from Zion National Park are as follows: Total length, 681; length of tail, 301; length of hind foot, 62. Tail relatively long. In color similar to *Mephitis mephitis major* but with more white. Skull: Size medium, ridged, highly arched, deepest in frontal region; zygomatic arches moderately wide-spreading; mastoid swellings prominent.

This subspecies appears to be limited in Utah to the Colorado River drainage in southern Utah and in eastern Utah generally to the region east of the Green and Colorado rivers.

Intergradation is noted in two immature specimens from Vernal. They resemble *M. m. estor* in the shape of the interpterygoid space and the bowing of the zygomatic arches. They are intermediate between *M. m. estor* and *M. m. major* in the mastoidal swellings. I tentatively refer them to *M. m. estor.*

Specimens examined.—Total, 7, distributed as follows: *Uintah County:* Vernal Game Bird Refuge, Vernal, 5,200 ft., 2. *Washington County:* Rockville, 1; Zion National Park, 2 (1, M.V.Z.). *San Juan County:* 1 mi. W Baker R. S., 7,000 ft., 1; Bluff, 4,400 ft., 1 (M.V.Z.).

Spilogale gracilis saxatilis Merriam

Spotted Skunk

Spilogale saxatilis Merriam, N. Amer. Fauna, 4:13, October 8, 1890, type from Provo, Utah County, Utah.

Spilogale gracilis saxatilis, Howell, N. Amer. Fauna, 26:23, November 24, 1906; Warren, The mammals of Colorado, Knickerbocker Press, p. 217, 1910; Barnes, Bull. Univ. Utah, 12 (no. 15):137, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):47, June, 1927; Tanner, Journ. Mamm., 8:250, August 9, 1927; Presnall, Zion-Bryce Mus. Bull., 2:8, January, 1938; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 80, 1942; Hardy, Ecol. Monogr., 15:85, January, 1945; Fautin, Ecol. Monogr., 16:304, October, 1946.

Spilogale sp., Svihla, Journ. Mamm., 12:259, August 24, 1931.

Range.—State-wide except southeastern area.

Description and comments.—Measurements of a male, number 2869, from Salt Lake County are as follows: Total length, 400; length of tail, 131; length of hind foot, 45; length of ear, 26. Color: Upper parts with from 4 to 6 white lines broken into segments, remainder black; tail black, tipped with white; underparts black except white spots on chin. Skull: Small, flattened; parietal and frontal regions of equal depth; mastoidal bullae large; palate ends nearly on line of posterior margin of upper molars; metaconule indistinct in upper first molar; inferior margin of lower mandible relatively straight; trigonid larger than talonid in lower first molar; metaconid high and separate from protoconid; entoconid and hypoconid low, the latter being well separated from protoconid; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{1}{2}$.

Members of this subspecies may be distinguished from those of *Spilogale gracilis gracilis* as follows: Size larger. Color: Lateral

white stripes not so pronounced. Skull: Slightly larger; postorbital processes larger; mastoids more ridged; braincase broader.

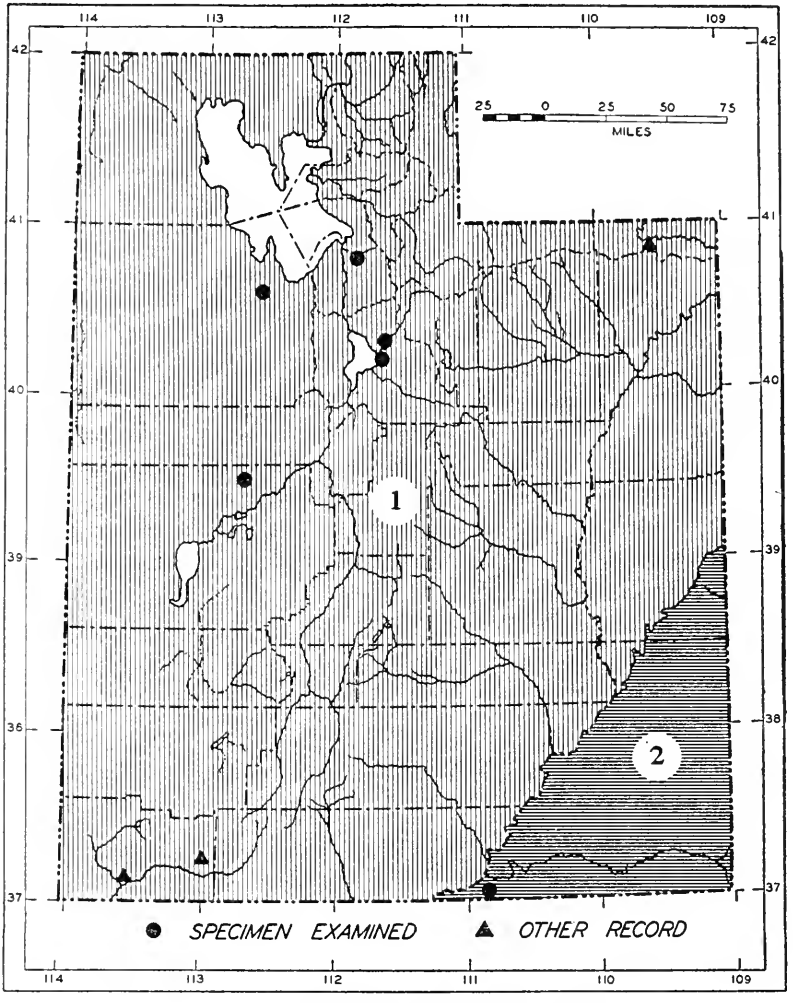

FIG. 78. Distribution of *Spilogale gracilis*.
1. *S. g. saxatilis.* 2. *S. g. gracilis.*

Specimens examined.—Total, 8, distributed as follows: *Tooele County:* 3½ mi. W Grantsville, 5,000 ft., 1. *Salt Lake County:* Mouth of Dry Canyon, 4,500 ft., 1. *Utah County:* 8 mi. NE Provo, 1 (M. V. Z.); Provo Canyon, near Provo, 2 (M. V. Z.); Nun's Station, Provo Canyon, 2 (M. V. Z.) *Millard County:* 16 mi. N Deseret, 1 (M.V.Z).

Additional records.—Daggett County: Sheep Creek (Svihla, 1931:259). *Washington County:* Zion National Park (Presnall, 1938:8); St. George (Howell, 1906:24).

Spilogale gracilis gracilis Merriam

Spotted Skunk

Spilogale gracilis Merriam, N. Amer. Fauna, 3:83, September 11, 1890, type from Grand Canyon of the Colorado, north of San Francisco Mountain, Coconino County, Arizona.
Spilogale gracilis gracilis, Benson, Univ. California Publ. Zoöl., 40:448, December 31, 1935.

Range.—Known only from extreme southeastern Utah.

Description and comments.—Howell (1906:22) gives the following measurements of 5 adult males from Grand Canyon, Arizona, and Panamint Mountains, California, and of one adult female, from Inyo Mountains, California, respectively: Total length, 400-334, 330; length of tail, 160-130, 120; length of hind foot, 46-41, 37. In color and cranial characters similar to *Spilogale gracilis saxatilis*, but differs as indicated under account of the latter subspecies.

This subspecies is definitely known to occur in Utah in San Juan County. Specimens are not available at this time from farther north. I am of the opinion, however, that once they become available they will prove to be intergrades between S. *g. saxatilis* and S. *g. gracilis*, but referable to the latter subspecies, because subspecies of other species from this area usually occur to the south in Arizona. Many kinds of mammals whose ranges are mostly east and south of the Colorado River attain their northernmost limits of distribution in this area.

Specimens examined.—Total, 2, from N Navajo Mountain Trading Post, San Juan County, Utah.

Lutra canadensis nexa Goldman

River Otter

Lutra canadensis nexa Goldman, Proc. Biol. Soc. Washington, 48:182, November 15, 1935, type from near Deeth, Humboldt River, Elko County, Nevada.
Lutra canadensis, Allen, Bull. Essex Inst., 6:63, 1874.
Lutra canadensis sonora, Barnes, Bull. Univ. Utah, 12 (no. 15):150, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):46, June, 1927.

Range.—Known to occur in the Raft River, Wasatch and Uinta mountains, and in the Colorado River.

Description and comments.—Hall (1946:196) gives the following measurements for a subadult female from Bull Head Ranch, 45 miles north of Golconda, Nevada: Total length, 1,006; length of tail, 393; length of hind foot, 121. Toes fully webbed; ears short; tail long and at base nearly as thick as body. Color: Brown, lighter than mink. Skull: Large, robust, flattened; tympanic bullae flattened and not in contact with paroccipital processes; palate extending far caudad of upper molars; infraorbital foramen large; upper first molar rhombic in shape and large; upper carnassial with basined deuterocone; trigonid and talonid of lower first molar nearly of equal length; metaconid large; talonid basined; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{3}$, m.$\frac{1}{2}$.

This mustelid can be readily distinguished from other members of the family Mustelidae known to occur in Utah by its large size, long tapering tail, being nearly as thick as the body at its base, fully webbed toes and premolars $\frac{4}{3}$.

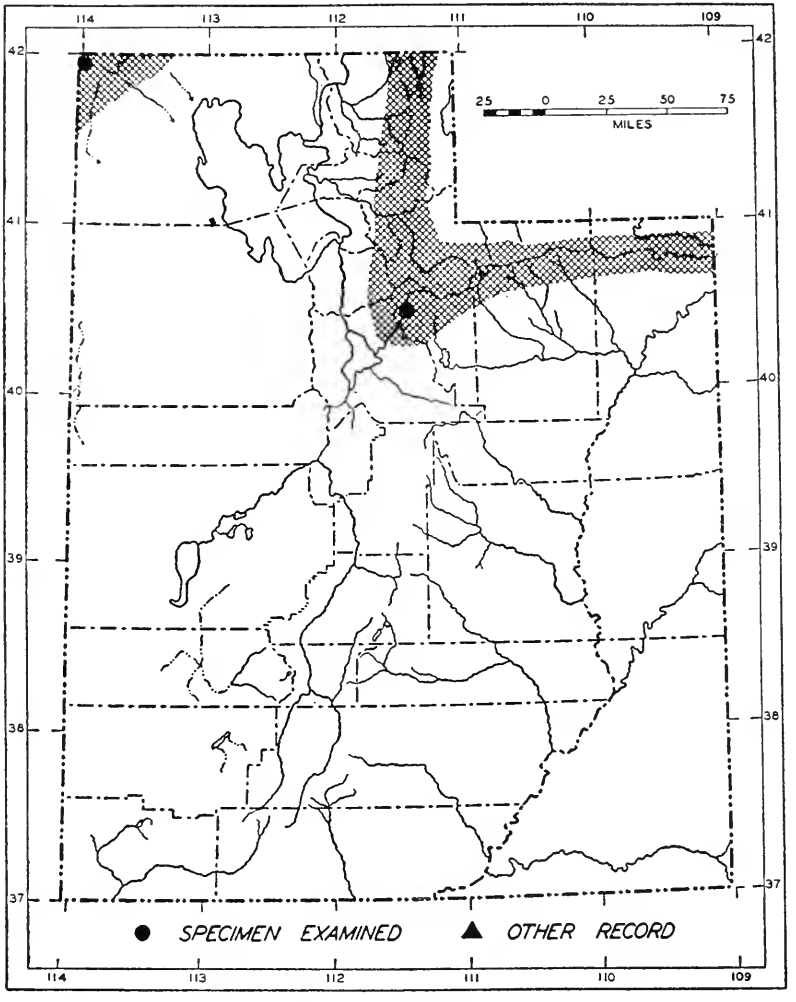

FIG. 79. Distribution of *Lutra canadensis nexa*.

Otters are more abundant in the Raft River Mountains than elsewhere in Utah. Goldman (1935:183) assigned animals from the Humboldt River in Nevada and the Snake River in Idaho to *L. c. nexa*, hence, on geographic grounds, otters from the Raft River

Mountains are assigned to that subspecies. One specimen (mounted) is displayed in the offices of the Utah Fish and Game Department. It was obtained from the Provo River in the Wasatch Mountains, and superficially agrees with the published description of *L. c. nexa.* At present there are no water connections between the Raft River Mountains and the Wasatch Mountains; the intervening area of 100 miles is for the most part semidesert.

Gregory (1938:26) observed otters (1927?) on the Colorado River at Glen Canyon, San Juan County. Presumably these belong to the subspecies *Lutra canadensis sonora.* The Colorado River and its main tributary the Green River may harbor otters throughout their entire course. The lack of records is understandable since man seldom visits the river which mostly flows through steep-walled canyons.

I have reports that otters occur in the Uinta Mountains, and on October 23, 1949, at the Ute Indian Reservation, at Ouray, Uintah County, I saw an Indian who had strips of otter fur braided into his hair. He reported capturing the animal along the Green River, north of Ouray, during the winter of 1948. Both the north and south slopes of the Uinta Mountains are drained by the Green River and its tributaries, and when specimens of otters become available from this area, they will probably be found to be referable to *L. c. sonora.* Intergradation between animals belonging to *L. c. nexa* and *L. c. sonora* probably occurs in the western part of the Uinta Mountains. This area contains the headwaters of the Provo, Weber and Bear rivers which flow westward into the Great Basin, and these headwaters are in close proximity to those of the Green River. Otters from the several drainages might interbreed freely in the area.

Specimens examined.—Total, 2, distributed as follows: *Boxelder County:* ½ mi. E Utah-Nevada Line, 4,900 ft., 1 (imperfect, young skull, M. V. Z.). *Wasatch County:* Provo River "near Heber" (Utah Fish and Game Department).

TABLE 25

Cranial Measurements of Mustelids

Sex	Catalog number or number of individuals averaged	Basilar length	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Palatilar length	Postglenoidal length	Extension of palate posterior to upper molars	Alveolar length of maxillary tooth-row
		Mustela erminea muricus, Boulder Mountain							
♀	6661.....	28.6	16.7	15.7	6.5	10.7	16.8	2.4	8.3
		Mustela frenata nevadensis, Salt Lake County							
♂	1391.....	43.7	28.4	25.2	10.3	22.0	21.3	5.3	14.6
♂	2866.....	.....	25.8	.....	10.7	20.0	.....	3.7	14.2
♀	2129.....	40.7	24.3	22.7	9.3	21.0	20.4	5.1	13.3
♀	3352.....	39.5	24.5	21.5	9.1	19.1	19.5	3.5	13.4
		Mustela vison energumenos, Wasatch County							
♂	3990.....	56.9	38.5	33.0	13.0	27.8	28.1	6.7	19.5
		Mustela nigripes, San Juan County							
♂	77840 MVZ....	63.8	46.4	38.3	18.3	29.0	28.2	.....	16.2
		Martes caurina origenes, Wasatch County							
♀	6606.....	68.7	44.0	35.4	18.0	36.0	27.5	6.1	28.2
		Taxidea taxus taxus, Tooele County							
♂	3993.....	112.3	75.5	77.5	27.9	65.4	39.5	17.9	39.7
		Taxidea taxus berlandieri, Beaverdam Wash							
?	5 av.....	101.4	68.4	65.6	25.2	59.1	35.3	13.6	38.2
?	Max.....	105.3	69.3	69.8	28.0	61.5	36.9	14.6	40.1
?	Mim.....	98.7	67.8	62.3	22.4	56.8	34.3	12.0	36.6
		Mephitis mephitis major, Davis County							
♂	2310.....	65.2	46.7	37.7	20.6	27.5	25.5	00.0	22.3
		Mephitis mephitis estor, Zion National Park							
♀	656.....	63.5	45.7	39.5	20.7	28.0	26.2	00.0	22.3
		Spilogale gracilis saxatilis, Salt Lake County							
♂	2869.....	46.1	32.4	29.1	13.5	20.1	21.4	00.0	17.3
		Lutra canadensis nexa, Goldman (1935: 183)							
♂	210572 USNM	.....	75.0	71.2	.....	.....	.....	.....	37.7
♀	?.....	.....	70.7	69.0	23.6	.....	.....	.....	37.6

Family FELIDAE

Cats

Medium-sized to large animals, semi-arboreal, digitigrade; ears of medium size, sometimes tufted; eyes large; claws sharp, recurved and retractile; feet rounded; toes four on hind feet, five on front feet; skull rounded; frontal region highly arched; rostrum short; carotid canal short or lacking; alisphenoid canal lacking; tympanic bullae large, thin-walled and divided into two chambers; palate extending posterior to upper molars; upper carnassial well developed, deuterocone absent; talonid and metaconid lacking on lower carnassial; glans and os penis rudimentary; caecum small.

This family is represented in Utah by *Felis concolor* with two subspecies; *Lynx canadensis* with one subspecies; and *Lynx rufus* with two subspecies.

KEY TO FELIDS IN UTAH

1.–Tail more than 30 per cent of length of body; 3 upper premolars present on each side; basilar length more than 132. . *Felis concolor*, p. 444

1'.–Tail less than 30 per cent of length of body; 2 upper premolars present on each side; basilar length less than 132.

2.–Tail tipped with black; hypoglossal canal separate from, rather than confluent with, foramen lacerum posterius. . *Lynx canadensis*, p. 438

2'.–Tail tipped with white; hypoglossal canal confluent with foramen lacerum posterius ..... *Lynx rufus*, p. 441

Lynx canadensis canadensis Kerr

Canada Lynx

Lynx canadensis Kerr, Anim. Kingd., vol. 1, systematic catalogue inserted between pages 32 and 33 (description, p. 157), 1792, type from eastern Canada; Allen, Bull. Essex Inst., 6:62, 1874.
Felis canadensis, Barnes, Bull. Univ. Utah, 12 (no. 15):110, April, 1922.
Lynx canadensis canadensis, Barnes, Bull. Univ. Utah, 17 (no. 12):69, June, 1927.

Range.—Uinta Mountains and central mountains of the state probably as far south as Iron County.

Description and comments.—Seton (1929:62) gives the external measurements as follows: Total length, 915; length of tail, 102; length of hind foot, 242. Legs long; feet large; pads well furred. Color: Upper parts a mixture of Ochraceous-Tawny, dark brown and black sprinkled with white; all guard hairs white subterminally and black terminally and darkest middorsally; underfur Cinnamon Brown; top of head like back, but heavily suffused with white-tipped hairs; eyelids white; ears buffy brown at base, with central white spot; dorsal margin of ears brown, terminating in a long, slender black tuft; ears white inside; ruff well developed, consisting of white, black, and brown and white hairs; sides and flanks Ochraceous-Buff, sprinkled with white, guard hairs white subterminally, black terminally; tail Cinnamon above, white be-

neath, black-tipped; feet and legs buffy white; chin and throat white; underparts buffy white sparsely mottled with light brown. Skull: Large; postorbital processes of frontals small; presphenoid wide transversely, but constricted anteroposteriorly; posterior palatine foramina situated near orbital rim of palate; anterior margin of interpterygoid fossa semicircular; anterior condyloid foramen separate from foramen lacerum posterius; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{1}{1}$.

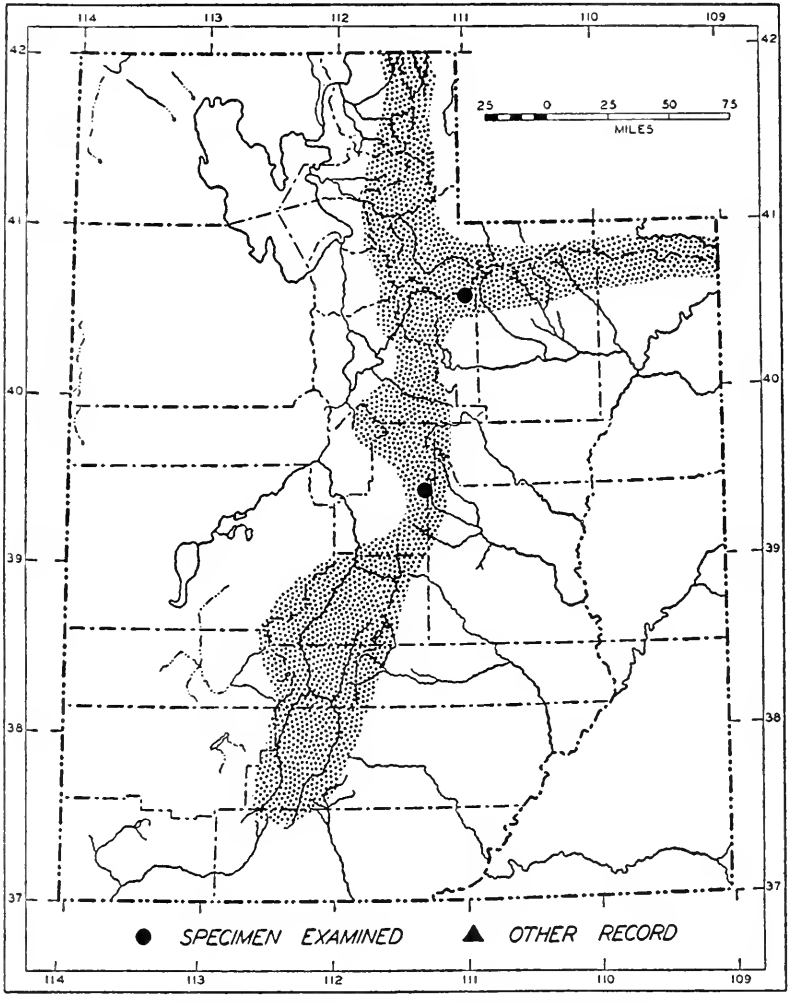

FIG. 80. Distribution of *Lynx canadensis canadensis*.

Lynx canadensis differs from *Lynx rufus* as follows: Size larger; legs longer; feet larger; pads more heavily furred. Color: Black spots on underparts less marked; tail tipped with black instead of white. Skull: Larger; postorbital processes of frontals smaller;

auditory bullae smaller; posterior palatine foramina nearer orbital rim of palate; presphenoid wider and shorter (ventral view); anterior condyloid foramen separate from, rather than confluent with, foramen lacerum posterius; anterior margin of interpterygoid fossa semicircular rather than squared; condylar process of mandible shorter transversally; coronoid process shorter; distance between posterior margin of lower molar and condyle less; angular process less developed; teeth larger.

In the Wildlife Census of Region Four of the U. S. Forest Service for 1945, it was estimated that there were one hundred *L. c. canadensis* in the National Forests of Utah, distributed as follows: Ashley National Forest, 30; Minedoka National Forest, 10; Uinta National Forest, 40 and Wasatch National Forest, 25. I am informed by the officials in charge of big game on Region Four that these figures are too large, and that if *L. c. canadensis* occurs at all in Utah at present, there are only a few animals in the Uinta Mountains. Barnes (1922 and 1927) stated that in the high mountains of the state, excepting those in the southeastern part, 61 lynxes were taken in Utah in 1915, and 42 in 1916. Bobcats (*Lynx rufus pallescens*) are known to occur throughout this area, and large individuals are larger than some *L. c. canadensis*, and are known in the fur trade as lynx cats. Since the only differences in the skins are those of size of feet and color of the tip of the tail (both frequently removed from pelts), some extra large bobcats may have been mistaken for true lynxes, and I am of the opinion that fewer lynxes than the numbers recorded were taken.

I know of only two lynxes from Utah which have been saved as scientific specimens. One is from the western part of the Uinta Mountains and the other is from the Wasatch Plateau in the central part of the state. Lynxes seem to live only in the high Canadian Life-Zone of the mountains. Since the high central mountains of the state are continuous from north to south, the lynx probably has a large area of natural range, but I suppose that the species is more numerous in the eastern Wasatch and Uinta mountains than elsewhere.

Ecologically the lynx is restricted to the Canadian Life-Zone in Utah, while the bobcat ranges from the Lower Sonoran Life-Zone into the Canadian Life-Zone.

Specimens examined.—Total, 2, distributed as follows: *Wasatch County:* North Fork of Provo River, 1 (U.S.N.M.). *Sanpete County*(?): Bald Ridge, near top of Manti Forest Range, W Joes Valley, about 25 miles W and a little north of Orangeville in Emery County, and about the same distance NE Ephraim in Sanpete County (as near as I can plot this locality from the above data it appears to be in extreme eastern Sanpete County), 1 (U.S.N.M.).

Lynx rufus pallescens Merriam

Bobcat

Lynx faciatus pallescens Merriam, N. Amer. Fauna, 16:104, October 28, 1899, type from south base Mount Adams, near Trout Lake, Skamania County, Washington.

Lynx rufus pallescens, Borell and Ellis, Journ. Mamm., 15:23, February 15, 1934; Hall and Johnson, Proc. Utah Acad. Sci. Arts and Letters, 15:121, 1938.

Lynx rufus, Allen, Bull. Essex Inst., 6:62, 1874; Fautin, Ecol. Monogr., 16:304, October, 1946.

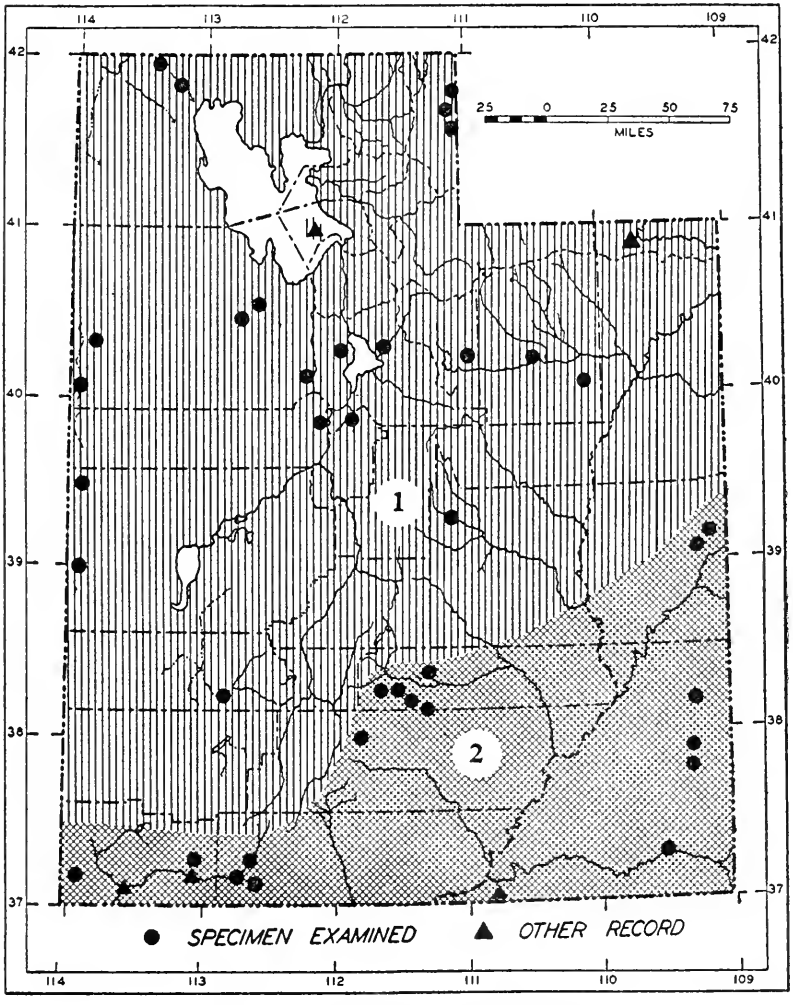

FIG. 81. Distribution of *Lynx rufus*.
1. *L. r. pallescens.* 2. *L. r. baileyi.*

Lynx uinta Merriam, Proc. Biol. Soc. Washington, 15:71, March 22, 1902, type from Bridger Pass, Carbon County, Wyoming; Warren, The mammals of Colorado, Knickerbocker Press, p. 255, 1910; Barnes, Bull. Univ. Utah, 17 (no. 12):72, June, 1927; Svihla, Journ. Mamm., 12:260, August 24, 1931; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 108, 1942; Hayward, Great Basin Nat., 6:110, November 15, 1945.
Felis uinta, Barnes, Bull. Univ. Utah, 12 (no. 15):111, April, 1922.
Lynx ruffus pallescens, Grinnell and Dixon, Univ. California Publ. Zoöl., 21: 350, January 24, 1924.
Lynx rufus uinta, Marshall, Journ. Mamm., 21:156, May 16, 1940.

Range.—Practically all of state except southern and southeastern parts.

Description and comments.—Hall (1946:278) gives the measurements of an adult male from Kleckner Creek, Nevada, and of an adult female from 9 miles east of Eastgate, Nevada, and of another adult female from Millett Post Office, Nevada, respectively, as follows: Total length, 878, 857, 753; length of tail, 187, 161, 150; length of hind foot, 162, 180, 170. Tail short, ears tufted. Color: Upper parts a mixture of gray, buff and black, black color more concentrated in middorsal region, buff color (approaching Ochraceous-Tawny) more concentrated on rump and hind legs; tail with indistinct black rings and usually tipped with white; face grizzled; postorbital and infraorbital stripes light brown or black merging into black spot posterior to angle of jaw; upper and lower eyelids white; ears with black tufts; tactile hairs of face mostly white; sides of neck, throat, chest, belly, inside of front and hind legs white with irregular black spots; feet buffy above, dusky beneath. Skull: Large, robust; sagittal crests lyrate; lambdoidal crest and external occipital protuberance well developed; tympanic bullae large; two premolars present in upper jaw; postorbital processes prominent; presphenoid elongate; tooth formula, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{2}{2}$, m.$\frac{1}{1}$.

Utah representatives of this subspecies are readily distinguished from those of *Lynx rufus baileyi* as follows: Size larger. Color: Less rufescent. Skull: Larger; sagittal and lambdoidal crests more developed in specimens of comparable age and sex; tympanic bullae actually larger.

Members of this large pallid subspecies are referred to in the fur trade as lynx cats. The status of *Lynx uinta* described from Bridger Pass, Carbon County, Wyoming, and thought to occur in southern Wyoming and northern Utah is unsettled. The name might apply to skins from Rich County which are large and rufescent with considerable black in the pelage, being much darker than either *L. r. pallescens* or *L. r. baileyi.* Until such time as adequate material becomes available, I am referring these skins to *L. r. pallescens.* Grinnell and Dixon (1924:350) intimated that *Lynx uinta* was inseparable from *L. r. pallescens,* and Hall (1946:279) mentioned their view when writing of Nevadan bobcats, implying that lack of typical *L. uinta* prevented him from deciding whether the name applied to bobcats of Nevada. After seeing a few specimens from the possible geographic range of

L. uinta, I am not entirely convinced that *L. uinta* is a synonym of *L. r. pallescens.* Additional material might establish its validity.

In Utah, bobcats vary greatly, especially in color. While animals here referred to *L. r. pallescens* are generally more pallid than those referred to *L. r. baileyi,* it is possible to find individuals of *L. r. pallescens* that closely approach the color of *L. r. baileyi,* and the reverse is also true. Greater intrasubspecific constancy is noted in cranial characters than in color. Intergradation is apparent in the animals wherever the ranges of the two kinds come into contact. Animals from Emery County are intergrades between *L. r. pallescens* and *L. r. baileyi.* They are reddish and large and are referred to the former on the basis of size. Specimens from Wayne and Garfield counties also are intergrades of the type described above, but are smaller cranially than typical *L. r. pallescens* and are referred on that basis to *L. r. baileyi.* All of these mentioned intergrades are from areas west of the Colorado and Green rivers. These rivers have not been the effective barriers to dispersal in the case of bobcats that they have been in some other kinds of mammals. This is indicated by a series of 8 animals from Grand County, east of the rivers. All animals that I have studied from Grand County are intergrades between *L. r. pallescens* and *L. r. baileyi.* The majority of the characters show them to be more closely allied to the latter subspecies to which they are here referred.

Specimens examined.—Total, 39, distributed as follows: *Boxelder County:* Yost, 1; Park Valley, 1. *Rich County:* Along Bear River, 1; Crawford Mountain, 5; Bear River, 10 mi. NE Woodruff, 1. *Tooele County:* Johnson Pass, 1; Skull Valley, 4,300 ft., 2; Gold Hill, 1; Boulder Pass, 1; Ibapah, 5,000 ft., 1. *Utah County:* W side Utah Lake, near Pelican Point, 4,300 ft., 6; Lake Mountains, 1; Provo Canyon, 1 (M.V.Z.). *Wasatch County:* 5 mi. W Fruitland, 7,000 ft., 1. *Duchesne County:* W Duchesne, 2; Wells Draw, S Myton, 1; Five Mile S Myton, 1. *Juab County:* S end Goshen Valley, 2; E Jericho, 1. *Millard County:* 4 mi. S Gandy, 1 (M.V.Z.); "near" Garrison, 2 (M.V.Z.). *Emery County:* Joes Valley, 3. *Beaver County:* W reservoir, Minersville, 2.

Additional records.—Davis County: Antelope Island, Great Salt Lake (Marshall, 1940:156). *Daggett County:* Carter Creek (Svihla, 1931:260).

Lynx rufus baileyi Merriam

Bobcat

Lynx baileyi Merriam, N. Amer. Fauna, 3:79, September 11, 1890, type from Moccasin Spring, Coconino County, Arizona; Barnes, Bull. Univ. Utah, 12 (no. 15):111, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):70, June, 1927.

Lynx rufus baileyi, Burt, Trans. San Diego Nat. Hist. Soc., 7:402, May 31, 1934; Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935; Presnall, Zion-Bryce Mus. Bull., 2:10, January, 1938; Hardy, Ecol. Monogr., 15:86, January, 1945.

Lynx rufus uinta, Presnall, Zion-Bryce Mus. Bull., 2:10, January, 1938.

Lynx rufus, Cahalane, Journ. Mamm., 29:252, August 31, 1948.

Range.—Generally all of southern Utah and southeastern Utah east of the Colorado River.

Description and comments.—Hall (1946:282) gives the following measurements of an adult female from Wilson Canyon, Lyon County, Nevada: Total length, 810; length of tail, 155; length of hind foot, 155. Color: Similar to *Lynx rufus pallescens,* but more reddish (one specimen from Kane County is nearly uniformly Ochraceous-Tawny). Skull: Like *L. r. pallescens* but smaller and with relatively smaller tympanic bullae.

For comparison with *L. r. pallescens,* see account of that subspecies.

This small reddish bobcat inhabits southern and southeastern Utah. The material at hand indicates that its range practically coincides with that of *Mephitis mephitis estor, Taxidea taxus berlandieri* and *Canis latrans estor* among the carnivores. Many rodents also show nearly identical areas of geographic distribution.

As in the coyote, the bobcat from Beaverdam Wash in extreme southwestern Utah is the smallest in the state. For remarks on intergradation, see account of *L. r. pallescens.*

Specimens examined.—Total, 28, distributed as follows: *Grand County:* Harley Dome, 5; Salt Valley, 2; Moab, 1. *Wayne County:* Thousand Lake Mountain, 1; Big Hollow, W Bicknell, 1; Boulder Pass, 1; Boulder Mountain, 1; Pine Creek, Boulder Mountain, 1. *Garfield County:* Sanford Canyon, 1. *Washington County:* W Kolob Peak, 3; "near" Kolob Peak, 1; Beaverdam Wash, 8 mi. N Utah-Arizona Border, 2,800 ft., 1. *Kane County:* 8½ mi. SW Orderville, 5,000 ft., 1; 10 mi. NW Kanab, 5,000 ft., 1; vicinity of Kanab, 1. *San Juan County:* La Sal, 3; Indian Wash, between La Sal Junction and Monticello, 6,500 ft., 1; Perkins Cattle Range, between Blanding and Monticello, 1; Bluff, 4,400 ft., 1 (M.V.Z.).

Additional records.—Washington County: St. George (Hardy, 1945:86); Zion National Park (Presnall, 1938:10). *San Juan County:* "near Navajo Mountain Trading Post" (Benson, 1935:449).

Felis concolor hippolestes Merriam

Mountain Lion

Felis hippolestes Merriam, Proc. Biol. Soc. Washington, 11:219, July 15, 1897, type from Wind River Mountains, near head of Big Wind River, Fremont County, Wyoming; Warren, The mammals of Colorado, Knickerbocker Press, p. 256, 1910.

Felis concolor hippolestes, Nelson and Goldman, Journ. Mamm., 10:347, November 11, 1929; Young and Goldman, The Puma mysterious American cat, Amer. Wildlife Inst., p. 209, 1946.

Felis concolor, Allen, Bull. Essex Inst., 6:62, 1874; Coues and Yarrow, Report upon the collections of mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871-74, Wheeler's Rept. Expl. W 100th Meridian, 5:39, 1875.

Felis hippolestes, Barnes (part), Bull. Univ. Utah, 12 (no. 15):107, April, 1922.

Felis oregonensis hippolestes, Barnes (part), Bull. Univ. Utah, 17 (no. 12): 66, June, 1927; Svihla, Journ. Mamm., 12:260, August 24, 1931; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 101, 1942; Hayward, The Great Basin Nat., 6:110, November 15, 1945.

Range.—Northern and north-central Utah.

Description and comments.—Measurements of an adult male, number 4717, from Duchesne County are as follows: Total length, 2112; length of tail, 835; length of hind foot, 280; length of ear, 90; weight, 143 pounds.

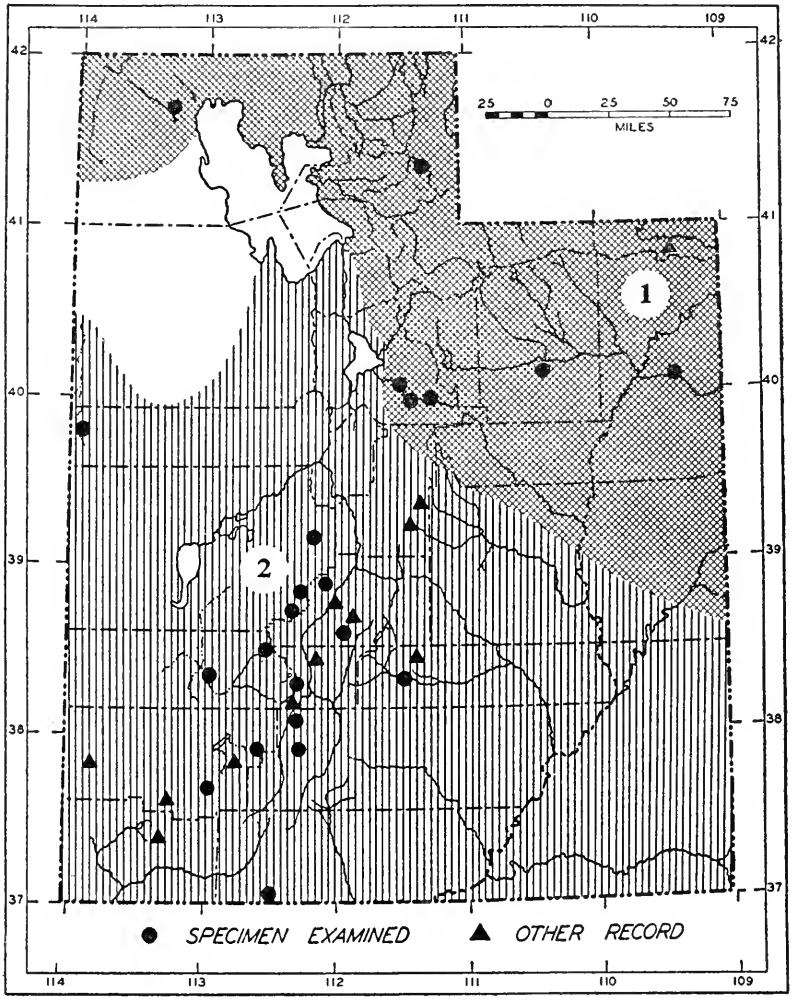

FIG. 82. Distribution of *Felis concolor.*
1. *F. c. hippolestes.* 2. *F. c. kaibabensis.*

Tail long; claws long, retractile and curved; soles haired; pads naked. Color: Upper parts Tawny, grading through Ochraceous-Buff on sides and legs to white beneath; middle of back with indistinct darker area; top of head like back but with some gray; ears grayish-brown posteriorly but white inside; tail

with blackish-brown dorsal stripe and black tip; upper lips, supraorbital patches and cheeks white. Skull: Large, massive; rostrum short, blunt and wide; sagittal crest, lambdoidal crest and external occipital protuberance well developed; nasal sinuses well inflated; tympanic bullae actually as well as relatively large and well inflated ventrally.

In Utah, *F. c. hippolestes* may be distinguished from *Felis concolor kaibabensis* by being larger throughout and darker colored. Also the zygomata are more widely spreading and the sagittal and lambdoidal crests are more developed.

Young and Goldman (1946:10) include the Uinta and Wasatch mountains of northern and northeastern Utah in the range of this subspecies and the specimens at hand bear them out. The geographic ranges of *F. c. hippolestes* and *F. c. kaibabensis* meet in Utah, and as noted in many other kinds of mammals whose ranges meet in Utah, intergradation between the two kinds occurs where the ranges come into contact with each other. A female from Monroe Canyon, Sevier County, appears to be an intergrade between *F. c. hippolestes* and *F. c. kaibabensis.* It has the small bullae of *F. c. kaibabensis* and is here referred to it. A series of 9 animals from Park Valley, Boxelder County, shows intergradation between the aforementioned subspecies to exist in this northwestern corner of the state. In color, these animals are darker than *F. c. kaibabensis* and are like *F. c. hippolestes.* While the skulls are not so large and ridged as those of animals from the Uinta and Wasatch mountains, they are larger, more ridged and have larger tympanic bullae than do those animals from the southern part of the state. The majority of diagnostic characters prove these animals from Boxelder County to be referable to *F. c. hippolestes.*

Specimens examined.—Total, 15, distributed as follows: *Boxelder County:* Park Valley, 9. *Morgan County:* Head of Lost Creek, 1. *Utah County:* Spanish Fork Canyon, 1; Thistle, 1; Spanish Fork Canyon, 4 mi. from mouth of Lake Fork, 6 mi. SE Thistle, 1. *Duchesne County:* Sawmill, Wild Strawberry Canyon, near junction Strawberry and Red creeks, S Duchesne, 8,000 ft., 1. *Uintah County:* White River, 1.

Additional record.—Daggett County (Svihla, 1931:260): Dowd's Hole.

Felis concolor kaibabensis Nelson and Goldman

Mountain Lion

Felis concolor kaibabensis Nelson and Goldman, Journ. Washington Acad. Sci., 21:209, May 19, 1931, type from Powell Plateau, Grand Canyon National Park, 8,700 feet, Coconino County, Arizona; Presnall, Zion-Bryce Mus. Bull., 2:9, January, 1938; Young and Goldman, The Puma mysterious American cat, Amer. Wildlife Inst., p. 223, 1946.

Felis hippolestes, Barnes (part), Bull. Univ. Utah, 12 (no. 15):107, April, 1922.

Felis oregonensis hippolestes, Barnes (part), Bull. Univ. Utah, 17 (no. 12): 66, June, 1927.

Felis concolor hippolestes, Woodbury, Ecol. Monogr., 3:174, April, 1933.

Felis concolor (subsp?), Benson, Univ. California Publ. Zoöl., 40:449, December 31, 1935.

Felis concolor, Cahalane, Journ. Mamm., 29:251, August 31, 1948.

Range.—Includes most of Utah except northern Utah in the Raft River, Wasatch and Uinta mountains and possibly the extreme southeastern part of the state.

Description and comments.—No trustworthy body measurements are available. As described for *Felis concolor hippolestes* but generally lighter-colored, smaller, with narrower skull, less inflated frontal sinuses and lighter dentition.

I know of no mountain lions from San Juan County in extreme southeastern Utah which have been saved as scientific specimens. I know, however, that they do occur there; they may be *Felis concolor aztecus.*

Specimens examined.—Total, 29, distributed as follows: *Juab County:* Deep Creek Mountains, 3. *Millard County:* NE Holden, 1; Chalk Creek Canyon, 1; Corn Creek Area, 7 mi. SE Kanosh, 1. *Sevier County:* Cove Mountain, 8 mi. NW Richfield, 1; Monroe, 2; Monroe Canyon, 8,000 ft., 1. *Beaver County:* Fish Creek, 10 mi. SE Cove Fort, 2; Beaver Mountain on road to Milford, 1. *Piute County:* Wade Canyon, W Circleville, 1; W Circleville, 1. *Wayne County:* Bicknell, 6,000 ft., 3. *Iron County:* Parowan, Paragonah area, 1; Fiddlers Canyon, 1; Cedar City, 4. *Garfield County:* Sandy, 1; Lost Creek, S Circleville, 2; NE Panguitch, 1. *Kane County:* Kanab, 1.

Additional records (Young and Goldman, 1946:225).—*Sanpete County:* Antelope, near Manti; Bull Valley. *Sevier County:* Richfield; Willow Creek, near Richfield. *Piute County:* SE of Marysvale; SE of Circleville. *Wayne County:* Thousand Lake Mountain. *Iron County:* Parowan; Modena; 8 mi. E Kanarraville. *Washington County:* Steamboat Mountain, Pine Valley Mountains.

TABLE 26

Cranial Measurements of Felids

Sex	Catalog number	Greatest length of skull	Condylobasal length	Basilar length	Length of nasals	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Postorbital breadth	Alveolar length of maxillary tooth-row
		Lynx canadensis canadensis, Manti Forest								
? imm.	250110 USNM	120.0	110.0	98.3	26.5	87.9	51.1	27.8	39.6	38.9
		Lynx rufus pallescens, ♂ Utah County; ♀ 10 mi. NE Woodruff								
♂	4257.....	133.0	121.5	106.2	33.7	88.0	56.0	25.1	40.1	38.8
♀	6513.....	130.0	119.5	109.8	33.1	93.7	59.0	26.2	39.9	39.7
		Lynx rufus baileyi, ♂ Kane County; ♀ Salt Valley								
♂	4641.....	121.1	112.2	101.0	31.0	87.3	54.0	24.6	36.4	37.6
♀	6525.....	109.0	102.2	90.1	30.0	74.2	48.3	20.7	38.0	36.8
		Felis concolor hippolestes, ♂ Duchesne County; ♀ Spanish Fork Canyon								
♂	4717.....	220.0	185.0	180.0	64.7	148.1	91.0	45.4	44.2	66.3
♀	4705.....	200.0	176.1	160.0	60.0	126.6	80.4	39.4	45.1	60.0
		Felis concolor kaibabensis, Bicknell								
♂	3166.....	197.7	182.0	160.1	61.9	130.0	85.7	40.6	40.3	61.9
♀	3164.....	190.0	171.6	145.6	54.9	122.3	78.6	39.3	41.7	59.6

Owen W. Morris, District Agent, Utah District, Predator and Rodent Control, U. S. Fish and Wildlife Service, provided the following tabular information, prepared by R. Scott Zimmerman:

TABLE 27

Carnivores Taken by U. S. Fish and Wildlife Service

Date	Wolf	Bear	Bobcat	Coyote	Mt. Lion	Total
1917	33	3	406	3,031	30	3,503
1918	48	4	461	3,300	11	3,824
1919	18	7	494	2,865	15	3,399
1920	17	11	479	3,246	6	3,759
1921	26	13	521	3,831	22	4,413
1922	1	4	303	2,569	10	2,887
1923	1	.....	281	1,982	5	2,269
1924	7	2	207	1,662	5	1,883
1925	1	1	144	1,673	6	1,825
1926	8	3	180	2,139	7	2,337
1927	.....	8	238	2,425	14	2,685
1928	.....	7	276	1,587	18	1,888
1929	1	16	315	1,851	28	2,211
1930	1	10	287	1,608	32	1,938
1931	.....	16	286	1,856	25	2,183
1932	.....	7	223	1,928	57	2,215
1933	.....	11	242	2,283	57	2,593
1934	.....	.....	131	1,506	22	1,659
1935	.....	5	415	3,711	95	4,226
1936	.....	8	1,266	6,416	64	7,754
1937	.....	20	1,378	9,836	58	11,292
1938	.....	15	1,280	9,960	83	11,338
1939	.....	18	1,513	12,559	69	14,159
1940	.....	26	2,124	14,513	56	16,719
1941	.....	28	1,637	14,428	64	16,157
1942	.....	23	1,620	14,213	53	15,909
1943	.....	22	1,120	10,729	25	11,896
1944	.....	7	717	6,657	48	7,429
1945	.....	11	465	5,077	61	5,614
1946	.....	.....	.....	.....	.....	.....
1947	.....	3	78	1,465	14	1,560
1948	.....	14	292	3,731	49	4,086
1949	.....	23	376	3,296	29	3,624
Total,	162	346	19,755	157,933	1,138	179,334

TABLE 28

Methods Used to Obtain the Above Animals

Date	Traps	Poison	Denned	Shot	Cyanide gun	Dogs	Total
1917	.....	.....	.....	.....	.....	.....	3,515
1918	3,328	277	103	97	.....	19	3,824
1919	2,876	345	81	80	.....	17	3,399
1920	.....	.....	.....	.....	.....	.....	3,759
1921	.....	.....	.....	.....	.....	.....	4,413
1922	.....	.....	.....	.....	.....	.....	2,320
1923	1,125	199	84	63	.....	6	2,269
1924	.....	.....	.....	.....	.....	.....	1,883
1925	.....	.....	.....	.....	.....	.....	1,904
1926	.....	.....	.....	.....	.....	.....	2,337
1927	.....	.....	.....	.....	.....	.....	2,685
1928	.....	.....	.....	.....	.....	.....	1,889
1929	.....	.....	.....	.....	.....	.....	2,211
1930	.....	.....	.....	.....	.....	.....	1,938
1931	.....	.....	.....	.....	.....	.....	2,183
1932	1,285	499	338	40	.....	53	2,215
1933	1,583	384	508	64	.....	54	2,593
1934	1,035	436	164	17	.....	7	1,659
1935	2,817	610	669	38	.....	92	4,226
1936	5,778	506	1,330	104	.....	36	7,754
1937	9,193	359	1,467	204	.....	69	11,292
1938	9,823	350	938	94	.....	133	11,338
1939	11,598	680	1,590	200	.....	91	14,159
1940	13,783	876	1,780	228	.....	52	16,719
1941	12,031	1,086	2,507	372	.....	161	16,157
1942	12,054	705	2,655	400	14	81	15,909
1943	9,382	578	1,415	223	236	62	11,896
1944	5,778	510	782	106	189	64	7,429
1945	3,933	598	739	77	214	53	5,614
1946	.....	.....	.....	.....	.....	.....	.....
1947	469	157	394	43	490	7	1,560
1948	1,080	210	689	76	2,015	16	4,086
1949	741	98	649	56	2,060	20	3,624
Total,	109,692	9,430	18,882	2,582	5,218	1,093	178,759

TABLE 29

Tabulation of Bounties Paid by State of Utah Since 1913‡

Year	Coyote	Bobcats	Bear	Lion	Wolf	Total	Total cash
1913	18,849	2,340	77	44	29	21,339	$54,472.50
1914	12,938	1,968	188	62	80	15,236	27,309.00
1915	16,110	2,012	193	50	72	18,437	31,908.00
1916	18,515	3,133	146	34	79	21,907	36,357.00
1917	15,078	2,619	124	44	60	17,925	30,171.00
1918	13,750	2,488	70	48	55	16,411	44,997.00
1919	11,150	2,319	60	17	57	13,603	38,431.00
1920	14,100	3,277	86	27	29	17,519	69,914.00
1921	11,669	2,615	55	21	45	14,405	59,613.50
1922	13,779	2,560	63	17	27	16,446	68,883.50
1923 *	3,712	1,072	7	6	2	4,789	18,579.00
1924 *	5,419	1,861	6	16	6	7,308	29,670.48
1925	No bounty paid, funds exhausted, 1924 with deficit.						
1926	1,128	230	14	1	1	1,347	7,693.00
1927	4,248	305	17	24	3	4,597	28,178.00
1928	4,171	751	26	49	0	4,997	29,274.00
1929	No funds available for bounties.						
1930	14,122	3,055	62	122	5	17,366	96,422.00
1931	11,790	2,983	58	86	0	14,917	81,559.00
1932	Funds exhausted and overdrawn.						
1939	State law amended to cooperate with Federal Government. Following copied from the Utah State Department of Agriculture report—by calender year.						
1943	October 1, bounty payments were again commenced.						
1944	41,374	4,980	0	349	†5	46,708	283,344.00
	State report for 1943, 1944, 1945 consolidated—average 15,569 predators per year.						
1946	18,081	1,612	0	161	†3	19,791	118,697.00
1947	10,960	1,130	0	121	†3	12,214	74,700.00
1948	6,159	941	0	162	0	7,262	54,580.00
1949	2,968	1,002	0	126	0	4,096	26,970.00
Total	270,004	45,253	1,252	1,587	561	318,656	$1,309,722.98

* Funds insufficient to pay all bounty claims presented.
† Probably extra large coyotes.
‡ Animals on which bounties were paid are additional to those reported in above chart as taken by hunters on federal payroll.

Order ARTIODACTYLA

Even-toed Ungulates

Large to medium sized, cursorial, digitigrade ungulates; toes even, usually 4 (2 in *Antilocapra,* occasionally a third "false hoof"); astragalus forms a pullylike joint at both ends permitting the animal to get up rear end first; clavicle absent; in Utah, all native members of this order lack upper incisors; molars complete; entepicondylar foramen lacking in humerus; horns or antlers present (in Utah the species that possess antlers normally have antlers only in the males).

In Utah, this order is represented by six species belonging to three families, they are: *Cervidae* with three species belonging to three distinct genera; *Antilocapridae* with one species, and *Bovidae* with two species belonging to two distinct genera.

KEY TO UNGULATES IN UTAH

1.–Frontal appendages consist of bony core covered with horn sheath (both sexes).
  2.–Horns not branched; 4 hooves (2 false) on each foot....Bovidae.
    3.–Horns smooth, not transversely ridged, curving out and up, *Bison bison,* p. 464
    3'.–Horns rough, transversely ridged, curving back and out, *Ovis canadensis,* p. 466
  2'.–Horns branched; 2 hooves (rarely a false hoof) on each foot. Antilocapridae ..... *Antilocapra americana,* p. 462
1'.–Frontal appendages consist of antlers; females normally antlerless. Cervidae.
    4.–Size large, antlers palmate; nose inflated and pendulous; pendulous growth of skin on throat (bell); nasals short measuring less than half the distance from their anterior ends to anterior ends of the premaxillae, *Alces americanus,* p. 461
    4'.–Size large or medium; antlers not palmate; nose neither inflated nor pendulous; bell on throat absent; nasals measuring more than half the distance from their anterior ends to the anterior ends of the premaxillae.
      5.–Tail black tipped; brow tines only short upward-directed spikes; canines absent; posterior nares separated by median vomer ..... *Odocoileus hemionus,* p. 455
      5'.–Tail not black tipped; brow tines large, forward-projecting spikes; canines present; posterior nares not separated by median vomer..... *Cervus canadensis,* p. 453

Cervus canadensis nelsoni Bailey

Wapiti

Cervus canadensis nelsoni Bailey, Proc. Biol. Soc. Washington, 48:188, November 15, 1935, type from Yellowstone National Park, Wyoming; Presnall, Zion-Bryce Mus. Bull., 2:18, January, 1938.

Cervus canadensis, Allen, Bull. Essex Inst., 6:65, 1874.

Cervus canadensis, Barnes, Bull. Univ. Utah, 12 (no. 15):12, April, 1922; Cahalane, Journ. Mamm., 29:253, August 31, 1948.

Cervus canadensis canadensis, Barnes, Bull. Univ. Utah, 17 (no. 12):156, June, 1927; Svihla, Journ. Mamm., 12:265, August 24, 1931; Hayward, Great Basin Nat., 6:111, November 15, 1945.

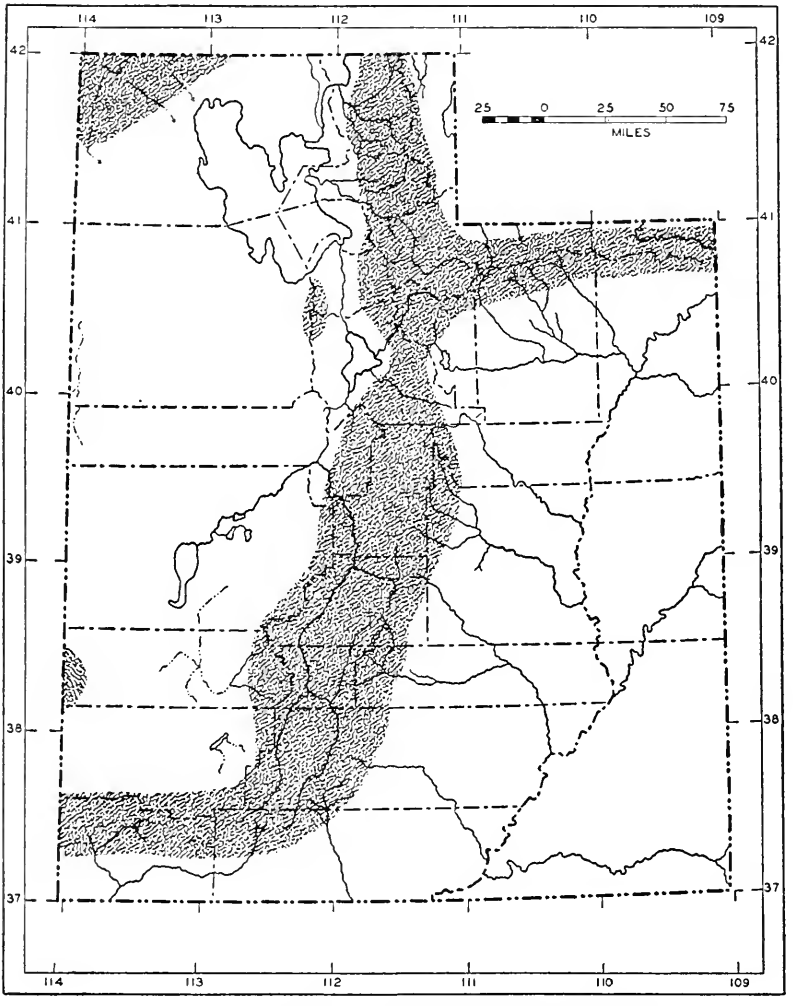

FIG. 83. Distribution of *Cervus canadensis nelsoni*.

Range.—Found in all National Forests within the state with the exception of the La Sal in the southeastern part of the state.

Description and comments.—Hall (1946:618) gives the following measurements of a male and female from Rocky Mountain National Park, Colorado: Total length, 2,464, 2,032; length of tail, 83, 171; length of hind foot, 660, 464; length of ear from notch, 216, 203; weight of male, 762 pounds. Size large; males antlered, females antlerless; antlers large, commonly 5 to 7 points; brow- and bez-tines well developed; antorbital facial gland present; neck with mane; metatarsal gland oval, situated in proximal half of metatarsus; nose rough and naked. Color: Head and neck dark brown; back and sides brownish gray; rump and tail straw colored; front and hind legs dark brown; underparts blackish; area between hind legs white. Skull: Large; antorbital gland openings large; incisive foramina large; posterior nares not separated by median vomer; upper canines present; tooth formula, i.$\frac{0}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

This large deer is easily distinguished from all other mammals known to occur in Utah by its large size (weights up to 600 pounds are common), large, heavy, curving antlers which may measure as much as 66 inches along the curve, and 60 inches in spread, with heavy brow- and bez-tines, and by the presence of upper canine teeth.

That the wapiti was a member of the native fauna of Utah is attested by the report of Allen (1874:65) who stated that it was common in the mountains bordering Salt Lake Valley. According to Barnes (1922:14), Marcus Jones stated, that in 1888, elk were so numerous at La Motts Peak in the Uinta Mountains that they "trampled down the grass in the subalpine basin." In his reports on the mammals of Utah, Barnes (1922:14; 1927:156) stated that only 7 indigenous animals remained in the state prior to 1912, and were in the Uinta Mountains, but that possibly another 6 indigenous animals were in Cache County. In the period 1912-16 a total of 181 animals were transplanted into the state from Jackson Hole, and Yellowstone National Park, Wyoming. Other transplants took place and finally in 1924 the last transplant of 200 animals was made. The success of these introductions is attested by the fact that by 1917 the herds had increased to 327 animals and to 1,564 by 1925. With the increase, hunting of either sex (later bulls only), was started in 1924 (100 taken on Mount Nebo), and of late years hunting of both sexes has been allowed. This controlled cropping of the herds for the past 23 years has accounted for many hundreds of animals (854 in 1946, 1,066 in 1947 and 788 in 1948). In spite of this hunting pressure, the herds have increased until there are, according to the Utah State Fish and Game Department (1948), 4,450 animals in the state distributed in the following districts:

Minadoka, 15; Cache, 1,000; Wasatch, 500; Heaston, 250; Farm Creek, 20; Ashley, 400; Nebo, 600; Manti, 775, Fishlake, 600; Cedar Mountain, 150; Dixie, 100; Indian Peaks, 40.

In certain areas, the increase of these animals has been so great that they have become detrimental to farming, livestock and horticultural interests. In these areas of concentration where they have proven to be detrimental, the Utah State Fish and Game Department has provided supplementary food in winter and has caught some and moved them to areas that did not contain them previously. Damage to man's interests is increased in areas close to the preserves, where farming is carried on at high elevations or on marginal lands. Some marginal lands have been purchased to provide additional winter range.

As a result of the aforementioned introductions of animals into the state, the native wapiti, if different originally, has probably, through interbreeding with the introduced animals, been swamped out, until at present all animals in Utah are the same as those from Yellowstone National Park and Jackson Hole.

Specimen examined.—One from *Juab County:* Four Mile Canyon, 10 mi. SE Nephi. I have observed many animals in the Cache, Heaston, Ashley and Nebo districts.

Odocoileus hemionus hemionus (Rafinesque)

Mule Deer

Cervus hemionus Rafinesque, Amer. Monthly Mag., 1:436, October, 1817, type from Sioux River, South Dakota.

Odocoileus hemionus, Merriam, Proc. Biol. Soc. Washington, 12:100, April 30, 1898; Wright and Dixon, Dept. of Interior Fauna Series, 1:97, May, 1932; Cahalane, Journ. Mamm., 29:255, August 31, 1948.

Odocoileus hemionus hemionus, Barnes, Bull. Univ. Utah, 17 (no. 12):159, June, 1927; Svihla, Journ. Mamm., 12:265, August 24, 1931; Marshall, Journ. Mamm., 21:154, 156, May 16, 1940.

Cervus macrotis, Allen, Bull. Essex Inst., 6:65, 1874.

Odontocoelus hemionus, Barnes, Bull. Univ. Utah, 12 (no. 15):19, April, 1922.

Odocoileus hemionus canus, Barnes, Bull. Univ. Utah, 12 (no. 15):20, April, 1922; Barnes, Bull. Univ. Utah, 17 (no. 12):160, June, 1927.

Odocoileus hemionus macrotis, Presnall, Zion-Bryce Mus. Bull., 2:19, January, 1938; Rasmussen, Fourth N. A. Wildlife Conf. Trans. (1939), p. 236, 1939; Long, Journ. Mamm., 21:180, May 16, 1940; Hayward, Great Basin Nat., 6:111, November 15, 1945.

Range.—State-wide above upper limits of Upper Sonoran Life-zone.

Description and comments.—Hall (1946:622) gives the following measurements of a male and three females, from Nevada, respectively: Total length, 1,710, 1,555, 1,574, 1,540; length of tail, 134, 180, 170, 145; length of hind foot, 585, 480, 465, 455. Size large; males with dichotomously branching antlers; females antlerless; antorbital facial gland present; metatarsal, tarsal and interdigital glands present. Color (winter pelage): Brownish gray on upper parts and sides, darkest dorsally; belly, rump and inside of legs white;

face, sides of head to eye and throat white; dark brownish patch on forehead; lower lips with two black spots, forming darker bar on chin; tail white, except tip and top which are black; tail naked below proximally; brisket dark brown; lower legs brown. In summer pelage: Pattern same as in winter but general color of upper parts yellowish or reddish brown. Skull: Large, lacrimal bone pitted for antorbital gland; posterior nares separated by median vomer; tooth formula, i.$\frac{0}{3}$, c.$\frac{0}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

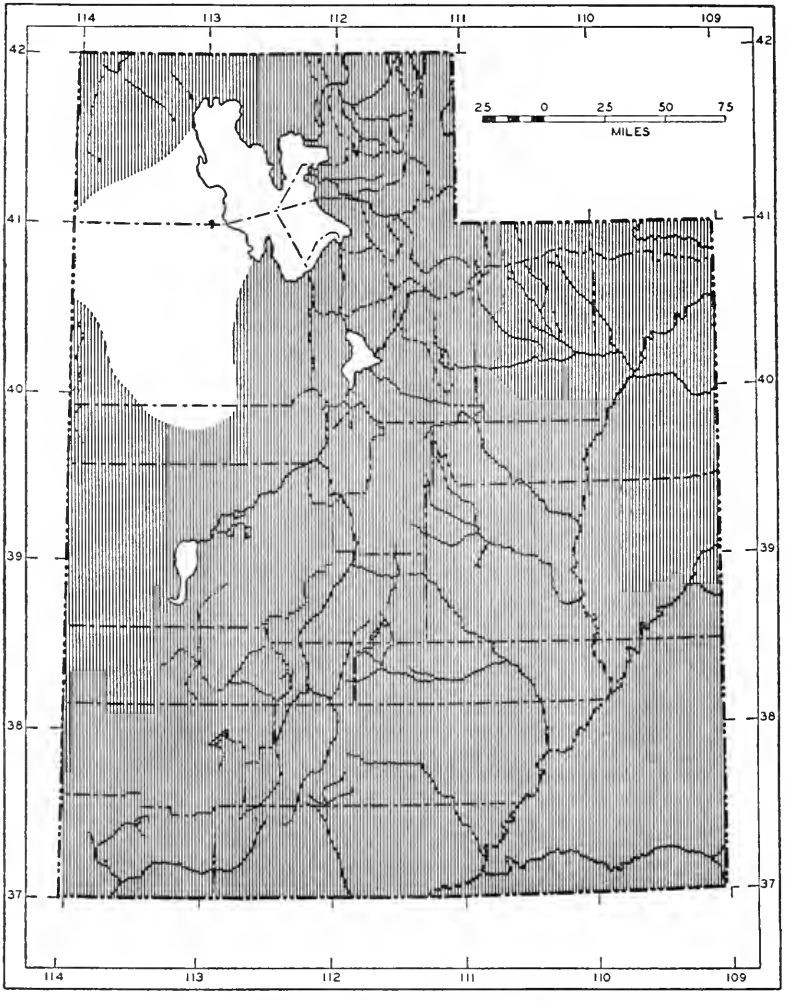

FIG. 84. Distribution of *Odocoileus hemionus hemionus.*

Since whitetailed deer *Odocoileus virginianus,* have been reported in the literature as occurring in Utah, and since some persons think they occasionally see them, it is perhaps worth while to set

forth here the distinguishing features of the two species. *O. h. hemionus* may be distinguished from *O. virginianus* by: Size larger; tail shorter and black on tip and top rather than brownish above and white on tip; ears longer; antlers dichotomous rather than having tines branching from a main beam; metatarsal gland larger (approximately 5 inches in length as opposed to about one inch in length).

The mule deer is the principal large game animal in Utah and it is abundant. Deer are present in Utah today in greater numbers than any "old timer" ever remembers. It is of interest to review the writings from the diaries of the early explorers of the region now known as Utah. The earliest written account of the game was that of Father Escalante, a Franciscan Friar, who with a party of explorers and missionaries traversed the region in 1776. This party entered the state near the present locality of the town of Jensen, from whence they proceeded west to Utah Lake and then south to the Virgin River area, from whence, by following a circuitous route to the southeast, they ultimately crossed the Colorado River at the "Crossing of the Fathers". It is noteworthy that Father Escalante made no mention of deer, although the route traversed by him and his party went through areas which today contain some of the largest herds of deer within the state. Furthermore, it is a matter of record that these explorers endured tremendous hardships and were obliged to kill some of their horses for food. The next accounts in the chronology of the big game of Utah are from the letters, journals and diaries of the "mountain men" who began investigating the region as early as 1820. They uniformily agreed that the western part of the state was devoid of game, and that the northern valleys abounded in antelope and buffalo. Their comments as regards deer are largely confined to the obtaining of deer hides from the Indians. One account of significance was that of W. A. Ferris who in September, 1834 camped near the present town of Moroni. He stated that the scarcity of game forced the Sanpich Indians to live in separate families, and that the women were occupied gathering insects, roots and grass seeds, while the men hunted for prairie dogs, squirrels and mice. The camp site of Ferris was close to an area which today is one of the best for deer hunting.

The "Mormon" pioneers entered the Great Salt Lake Valley in July, 1847, and Captain Stansbury reported that the first winter they were on the verge of starvation and utilized roots, and hides from their dwellings for food. He specifically mentioned that game

was scarce. There are no known records of the numbers of deer present at the time of settlement of Utah, but unquestionably they were scarce in comparison with the number now present. With the expansion of settlement, the increase in domestic herds and the unrestricted hunting, deer were threatened with extinction in many places, and probably reached their lowest numbers at the end of the last century and the beginning of the present one.

A realization of the acuteness of the deer situation is noted in the formation of the first fish and game department by law in 1893, followed by a 5 year moratorium on deer hunting (1908-13). In 1914, the hunting of deer was again permitted, but only of bucks during an open season. These aforementioned events were followed by the beginning of predator control by the then United States Biological Survey in 1915, and the establishment of nearly a million acres of game preserves by the legislature of the state during the period 1917-1925.

Under the protection provided by the buck law, predator control, game preserves and increased law enforcement, deer increased from an estimated 8,400 in 1916 to more than a quarter of a million at present. This does not include more than half a million animals which have been harvested by hunters during the period 1925-48. This increase in deer, now thought to be enhanced by previous overgrazing by livestock, entailing an ecological plant succession from grass to brushy (browse types) of vegetation, and direct competition between deer and domestic animals for the browse, soon proved detrimental to plant cover. It became necessary to harvest part of the does. The first legal hunting of does was in 1934. With the exception of 1936 and 1937 when no hunting of them was allowed, the hunting of does has been permitted to the present time. The removal of antlerless deer reached the peak in 1942 when 26,822 animals were accounted for under 34,519 permits. The following tabular data was obtained from the biennial report (1948) of the Utah State Fish and Game Department.

Inasmuch as livestock raising is one of the major enterprises of Utah, and since sheep, cattle and big game animals utilize the same ranges and are in competition for forage, difficulties frequently arise between the livestock operators and those persons primarily interested in big game animals. These difficulties are enhanced where overgrazing occurs and control, or reduction of the herds becomes mandatory. While the size of the herds of deer have been reduced in the areas of extreme overgrazing, and permits to graze livestock have been reduced, it is the opinion of most of the soil conservationists and wildlife managers that still greater reduction

TABLE 30

Year	Estimated deer population	Number of hunters	Special permits sold	Special hunt kill	Buck kill	Total deer kill
1925	18,421	5,650	.....	.....	1,400	1,400
1926	24,891	7,000	.....	.....	2,000	2,000
1927	32,147	9,000	.....	.....	3,200	3,200
1928	40,574	11,300	.....	.....	4,400	4,400
1929	45,729	12,800	.....	.....	5,000	5,000
1930	54,749	15,600	.....	.....	6,400	6,400
1931	65,164	19,500	.....	.....	7,800	7,800
1932	67,000	16,600	.....	.....	7,113	7,113
1933	74,600	17,700	.....	.....	8,019	8,019
1934	80,800	21,485	728	620	11,271	11,891
1935	87,400	23,000	2,598	2,008	9,640	11,648
1936	89,300	29,500	.....	.....	13,800	13,800
1937	98,000	38,900	.....	.....	21,000	21,000
1938	116,000	50,000	4,500	2,428	25,572	28,000
1939	124,000	60,000	10,612	9,448	28,552	38,000
1940	138,000	60,000	14,437	11,700	32,300	44,000
1941	150,000	60,000	21,461	15,540	34,464	50,000
1942	175,000	65,000	34,519	26,822	36,787	63,609
1943	150,000	75,000	21,242	15,556	40,140	55,696
1944	148,000	64,600	16,320	11,034	40,843	51,777
1945	200,000	71,734	16,160	12,654	37,236	49,890
1946	200,000	89,753	16,689	11,729	41,580	53,309
1947	200,000	88,401	17,560	13,837	46,940	60,813
1948	300,000	95,073	19,704	15,274	52,526	67,800

of the herds of both domestic and wild animals is necessary to reduce the numbers of the animals to the carrying capacity of the range. Naturally this can happen only by the reduction of the size of the herds of game animals, or by limiting grazing permits for domestic stock, or by both. Since Utah is a semidesert state, water is of immediate critical importance. Water and runoff are directly controlled by the conditions of the top soil, which are directly correlated with plant cover. The loss of top soil and hence its water retaining capacities through overgrazing is prevalent over practically the entire state, both in mountain and valley. These conditions are critical in certain areas throughout the state. Water loss through loss of top soil because of overgrazing is not solely the concern of livestock and big game operators, but is of vital concern to all of the citizens of the state because of its direct bearing upon the future of the total economy of this semiarid country. History indicates that no great civilization has ever

maintained itself in semiaridity. If the condition arises where because of overgrazing the benefits to the total citizenry become jeopardized, then the curtailment of all herds is a definite necessity. The control of domestic animals is relatively easy, but control of deer, since they are wild animals, to date has been largely through the increase of hunting, and natural causes such as starvation, winterkill and disease. In certain areas, hunting as permitted at present is not adequate to keep the herds of deer in check. Late fall hunting, as now permitted by the Utah State Fish and Game Department, can never control the herds of deer in such areas as the Abajo Mountains and Elk Ridge in San Juan County because of the rough topography of this area. Perhaps restricted summer hunting would aid in keeping these herds under control.

I do not know whether all mule deer in Utah are of the same subspecies. Museum material is insufficient to decide this question. Hunters are of the opinion that deer from the southern part of the state are lighter in color and smaller than those from the northern part. I have killed deer in both areas, but have noted no significant differences. Deer from the Sanpete Mountains, west of Wales, Utah, do, however, appear to be of two types as regards color and build. In one type the color is fawn, the antlers are narrow and the legs are long. The other type is bluish in color, the antlers are heavy and the legs are shorter, causing a chunkier, heavier appearance. I suspect that this range of variation among the deer of these mountains is not beyond that of the subspecies *O. h. hemionus*.

The older literature lists the whitetailed deer *O. virginianus* as occurring in Utah, and some hunters report that they have taken them. Every case that I have had occasion to investigate has proven erroneous and the animals without exception have been mule deer. Over a period of years, I have examined hundreds of dead deer in deer camps in various parts of the state. To date, I have never seen a whitetailed deer from Utah. Officials of the U. S. Forest Service and of the Utah State Department of Fish and Game who have charge of big game do not consider whitetailed deer to be present in Utah. It is possible that whitetailed deer were present in pioneer times and some may yet exist in remote areas. Until such time as the evidence becomes conclusive, I am not considering them as belonging to the fauna of Utah.

Specimens examined.—Total, 6 skulls, distributed as follows: *Utah County:* Springville, 4,252 ft., 2. *Sanpete County:* Wales, 7,500 ft., 1. *Millard County:* Dry Creek Canyon, 7 mi. SE Fillmore, 7,000 ft., 2. *San Juan County:* Deer Valley, 5 mi. W Elk Ridge, La Sal National Forest, 1.

Additional records.—The author has seen mule deer in the mountainous country of every county in the state.

Alces americanus shirasi Nelson

Moose

Alces americanus shirasi Nelson, Proc. Biol. Soc. Washington, 27:72, April 25, 1914, type from Snake River, 4 miles south of Yellowstone National Park, Lincoln County, Wyoming; Barnes, Bull. Univ. Utah, 17 (no. 12):166, June, 1927.

Alces americanus, Barnes, Bull. Univ. Utah, 12 (no. 15):10, April, 1922.

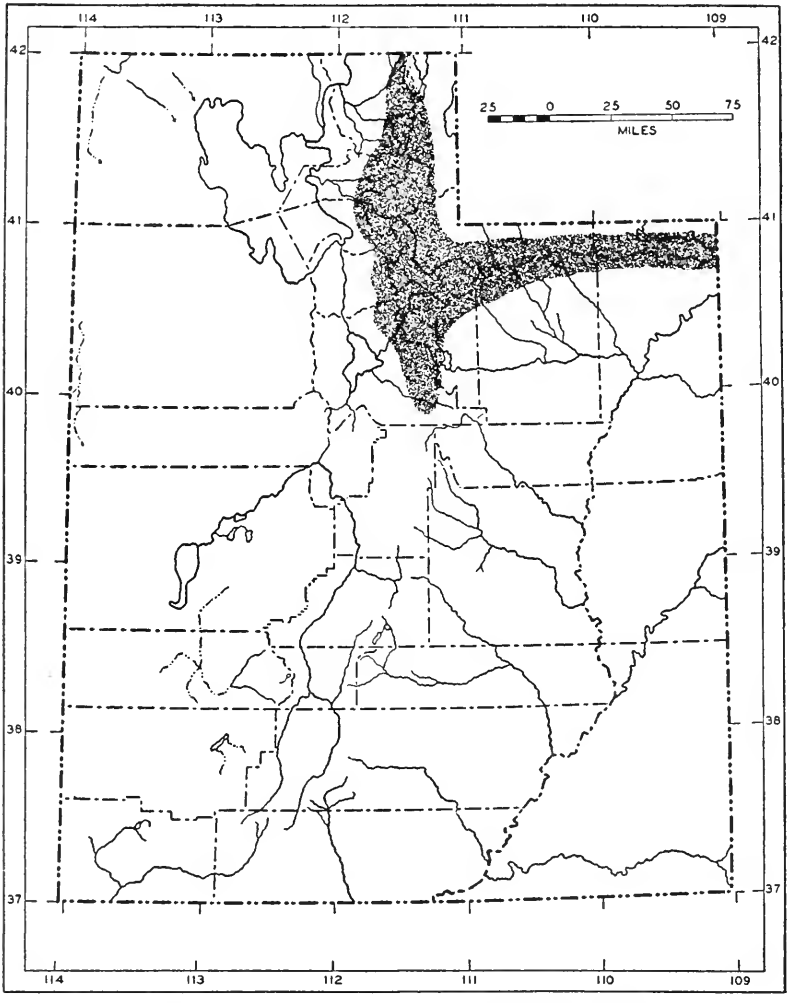

FIG. 85. Distribution of *Alces americanus shirasi*.

Range.—Accidental in Utah, known to occur in the Uinta Mountains and in the Wasatch Mountains as far south as Utah County.

Description and comments.—Largest of the American Cervidae. Antlers broad; palmate; muzzle broad and pendulous; bell present on throat; body higher at withers than at rump; tail short; dewclaws well developed. Color: Upper parts light to dark brown; sides, underparts and upper parts of legs blackish; lower belly and inguinal region buffy. Skull: Size large; nasals short, measuring less than one half the distance from their anterior tips to the anterior tips of the premaxillae; tooth formula, i.$\frac{0}{3}$, c.$\frac{0}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

Accidental animals have been seen in the Logan Canyon area above Logan, Cache County, and in the Uinta Mountains. During the winters of the past three years (1946-48), from one to three animals have been observed at Lewiston, Cache County. A bull was killed in 1947 at Pine View Reservoir, Ogden Canyon, Weber County, and another was killed during the deer hunting season (1948) in Farmington Canyon, Davis County. A bull was observed as far south as American Fork Canyon, Utah County, in 1948. Barnes (1922:6) reported one seen near Kaysville, Davis County, and again (1927:166) reported that two animals were killed, one between Kaysville and Farmington, in Davis County, and another in Spanish Fork Canyon, Utah County.

Antilocapra americana americana (Ord)

Prong-horned Antelope

Antilope americana Ord, Guthries' Geography, 2nd Amer. ed., 2:292 (described on page 308), 1815, type locality "plains and highlands of the Missouri."

Antilocapra americana Ord, Journ. de Phys., 87:149, 1818; Allen, Bull. Essex Inst., 6:64, 1874; Simpson, Report of Expl. across the Great Basin of the Territory of Utah for a direct wagon-route from Camp Floyd to Genoa, in Carson Valley in 1859, Engineer Dept., U. S. Army, p. 46, 1876; Barnes, Bull. Univ. Utah, 12 (no. 15):24, April, 1922; Nelson, U. S. Dep't Agriculture, Dep't Bull., 1364:1 (Utah treated on pp. 56-57), August, 1925.

Antelope, Dale, The Ashley-Smith Explorations, and the discovery of a central route to the Pacific, . . . Arthur H. Clark Co., Cleveland, p. 187, 1918.

Antilocapra americana americana, Barnes, Bull. Univ. Utah, 17 (no. 12):169, June, 1927; Svihla, Journ. Mamm., 12:265, August 24, 1931; Presnall, Zion-Bryce Mus. Bull., 2:20, January, 1938; Marshall, Journ. Mamm., 21:155,156, May 16, 1940; Fautin, Ecol. Monogr., 16:304, October, 1946.

Range.—Western Utah, Daggett County, San Rafael Swell in Emery and Wayne counties, and probably in Uinta Basin.

Description and comments.—Measurements of one adult male, number 4766, from Daggett County, are: Total length (tip of nose to base of tail), 54 inches; heel to toe, 17½ inches; length of ear, 7 inches. Horns forked in both sexes; sheath shed annually; core bony; hair coarse, erectile, brittle; foot consisting of only two hooves (no dew claws). Color: Between Vinaceous-Buff and Avellaneous; darkest on mane, lightest on legs; rump patch large, composed

of long white hairs capable of being erected for "flash"; muzzle, supraorbital spots, edges of ears and eyelashes black; forehead grayish brown; cheeks, lips, two bands on throat and underparts white. Skull: Frontal sinuses open to outside by two large, longitudinal openings in dorsal surface of frontal bone; orbital fossae large and situated ventral to horn cores; bones of skull light; teeth narrow; dental formula, i.$\frac{0}{3}$, c.$\frac{0}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

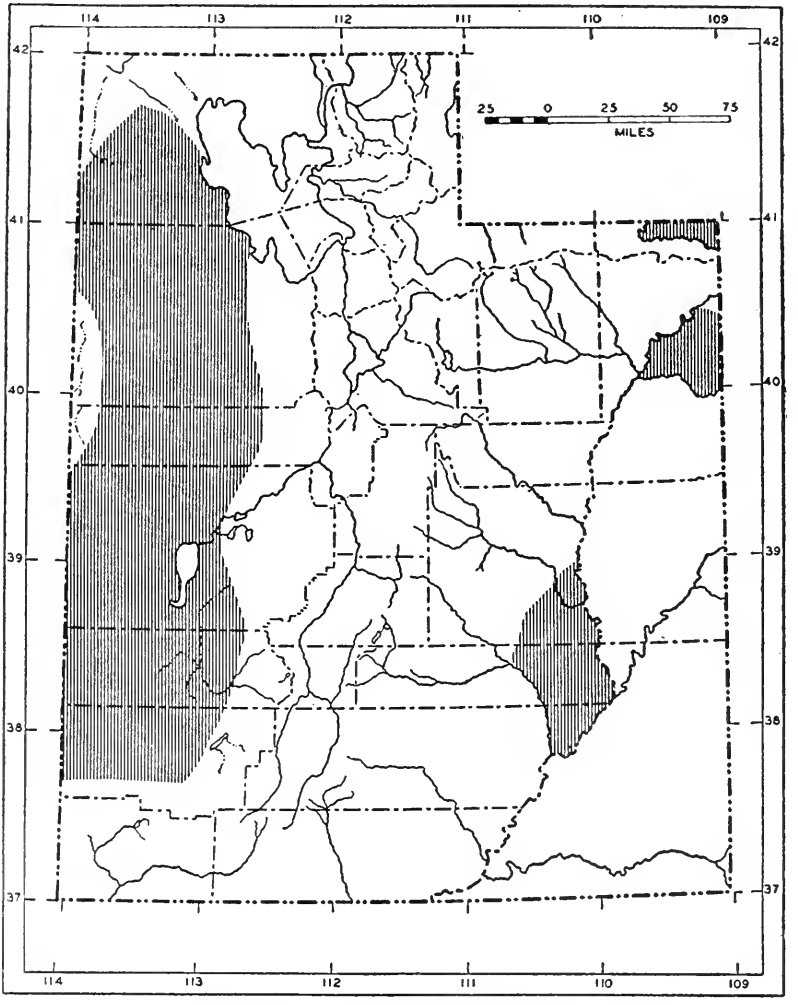

FIG. 86. Distribution of *Antilocapra americana americana*.

Barnes (1922:24 and 1927:170) reported prong-horned antelope from every county in the desert wastes of western Utah. He reported them also from Wayne and Emery counties in the San

Rafael Swell area of east-central Utah. Nelson in his paper on the status of the prong-horned antelope (1925:56) practically reiterated the reports of Barnes. Information obtained from Jay R. Udy, in charge of studies on the prong-horned antelope for the Utah State Fish and Game Department indicates that the total number of animals in Utah in 1948 is about the same as at the time of Nelson's paper (*op. cit.*). The distribution is, however, different. Neither Barnes nor Nelson listed any animals from Daggett County, where at present the largest herd is located. This Daggett County herd was so large that limited hunting has been permitted during the past few years. Mr. Udy also informed me that as of November 9, 1948, there are 190 animals in Iron County of which 60 were transplanted from the herd in Daggett County on November 7, 1948, and that 9 were transplanted there from the same herd in 1947. Furthermore, he reported that 35 animals were transplanted from Laramie, Wyoming, into western Boxelder County, in 1947, and that approximately 16 animals have drifted into western Boxelder County from a herd introduced into southern Idaho by the Idaho State Fish and Game Department. Occasional animals are still found throughout their former range as indicated by Barnes (*loc. cit.*). The drastic reduction in range is undoubtedly because the range of the prong-horned antelope constitutes the bulk of the winter range of domestic sheep, where several million winter annually. This invasion of the range of prong-horned antelope and resultant forage competition, plus poaching, predators and lack of nearby water have reduced them over their former range and removed them entirely in many areas. Prong-horned antelope are extremely inquisitive and in Idaho, Don M. Rees and myself decoyed one from a considerable distance to within 30 feet by waving a white handkerchief.

Specimen examined.—One, from The Glade, 10 mi. E Lynnwood, 6,000 ft., Daggett County.

Bison bison bison (Linnaeus)

Bison

[*Bos*] *bison* Linnaeus, Syst. Nat., ed. 10, 1:72, 1758, type from Mexico.
B[ison]. bison, Jordan, Manual of Vert. animals of northern U. S., ed. 5:337, 1888.
Bison bison bison, Barnes, Bull. Univ. Utah, 17 (no. 12):172, June, 1927; Svihla, Journ. Mamm., 12:265, August 24, 1931; Tanner, Great Basin Nat., 1:39, January 28, 1940.
Bison Americanus, Allen, Bull. Essex Inst., 6:63, 1874; Allen, Memoirs Mus. Comp. Zoöl., Harvard College, 4:119, 1876.
Bison bison, Barnes, Bull. Univ. Utah, 12 (no. 15):31, April, 1922; Presnall, Zion-Bryce Mus. Bull., 2:20, January, 1938.

Range.—Antelope Island, Great Salt Lake, and in eastern Utah from the San Rafael Swell south to the Henry Mountains.

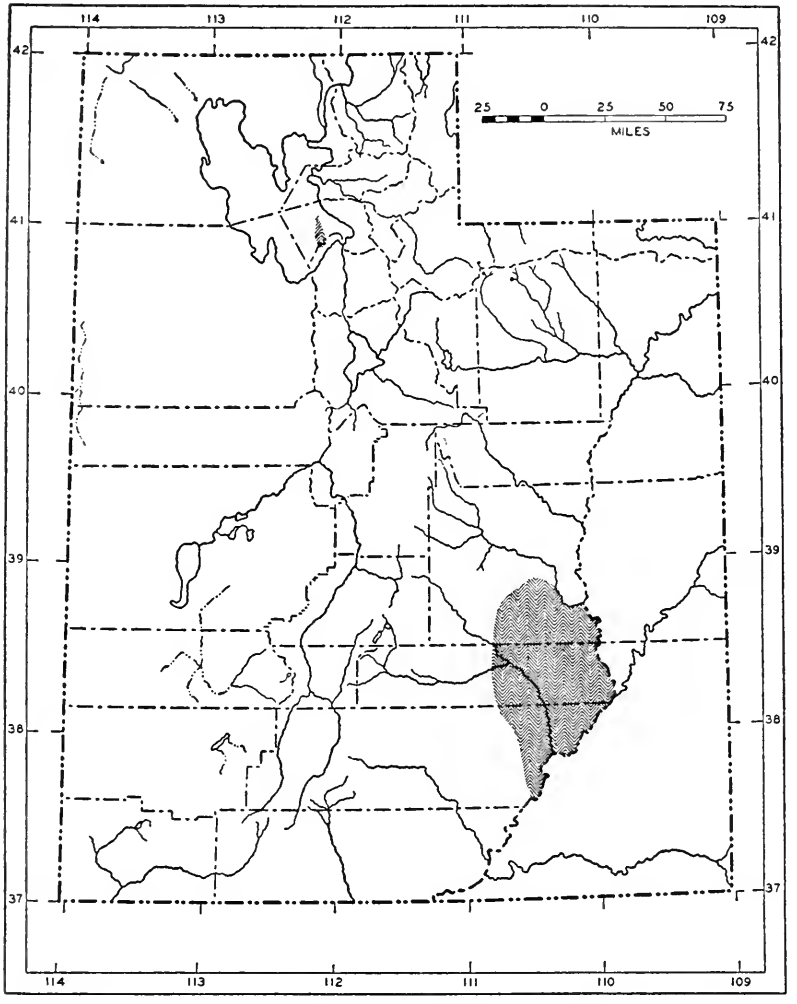

FIG. 87. Distribution of *Bison bison bison.*

Description and comments.—Largest American artiodactyl; both sexes with cylindrical horns curved upward; body highest at withers owing to the presence of a hump, supported by the elongated neural spines of the thoracic vertebrae; tail short with terminal tuft of long hairs; hair long and wooly especially on forequarters; chin with a beard. Color: Brownish or blackish brown, palest on shoulders and hump. Skull: Large, massive, premaxillae do not contact nasals; tooth formula, i.$\frac{0}{3}$, c.$\frac{0}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

By the time of the arrival of the Mormon pioneers in Utah (1847), buffalo were practically extinct in this part of their former range. Allen (1874:64) remarked that as late as 1836 large numbers of buffalo were in the Salt Lake Valley, but were nearly exterminated by an extremely severe winter. Occasional skulls and fragments of skulls, which attest their former presence are still found in Salt Lake Valley. At this writing (1948), only two herds are in the state. One, a small privately owned herd, is on Antelope Island in Great Salt Lake. The other, the result of a transplant from Yellowstone National Park, is in the San Rafael Swell in eastern Emery County. Mr. D. M. Gaufin of the Utah State Fish and Game Department recently informed me that this latter herd has drifted south and is actually on Butt's Point, 20 miles south of Hanksville, Wayne County. The animals range between the Colorado River and the east slope of the Henry Mountains. Two cows still remain at Texas Spring, San Rafael Swell (area of initial introduction). This herd totals, at present, 42 animals. Occasional animals from this herd have drifted onto the National Forests and have caused difficulty in cattle handling and have been killed.

Specimens examined.—Total, 2, distributed as follows: *Boxelder County:* Promontory Point, 1. *Davis County:* 4 mi. W Farmington Bay Refuge, 1.

Ovis canadensis canadensis Shaw

Mountain Sheep

Ovis canadensis Shaw, Naturalists Miscell., 15: text to plate 610, 1804, type locality, mountains on Bow River, near Ershaw, Alberta, Canada; Warren, The mammals of Colorado, Knickerbocker Press, p. 9, 1910.

Ovis canadensis canadensis, Barnes, Bull. Univ. Utah, 17 (no. 12):175, June, 1927; Svihla, Journ. Mamm., 12:265, August 24, 1931; Wright and Dixon, U. S. Dept. of Interior Fauna Series, 1:98, May, 1932; Cowan, Amer. Midland Nat., 24:532, November, 1940; Warren, The mammals of Colorado, Univ. Oklahoma Press, p. 301, 1942.

Ovis montana, Baird, Mammals, appendix C in Howard Stansbury's exploration and survey of the valley of the Great Salt Lake of Utah, U. S. Engineers Dept., Spec. session, March, 1851, Senate, Executive No. 3, p. 312, 1853; Allen, Bull. Essex Inst., 6:64, 1874.

Ovis cervina, Barnes, Bull. Univ. Utah, 12 (no. 15):26, April, 1922.

Ovis canadensis nelsoni, Presnall, Zion-Bryce Mus. Bull., 2:20, January, 1938.

Ovis, Cahalane, Journ. Mamm., 29:257, August 31, 1948.

Range.—With the exception of one small band in the high Uinta Mountains, they are limited to the inaccessible breaks of the Green, San Juan and Colorado rivers, and Zion National Park; they have been reported on the mountains of the southern Utah-Nevada Boundary.

Description and comments.—Hall (1946:640) gives the following measurements of a male and a female from Glacier County, Montana, respectively: Total length, 1,726, 1,433; length of tail, 95, 121; length of hind foot, 482, 406. Both sexes with heavily transversely ridged horns; horns in male curve

backward, downward and outward in a spiral; glands situated between toes and under eyes. Color: Upper parts brownish, Avellaneous or Wood Brown, darker on sides, chest, neck, legs and tail; middorsal line divides yellowish rump patch; face brown; brow yellowish; sides of face, nose, inside of ears and underparts grayish. Skull: Large, massive; tooth formula, i.$\frac{0}{3}$, c.$\frac{0}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$.

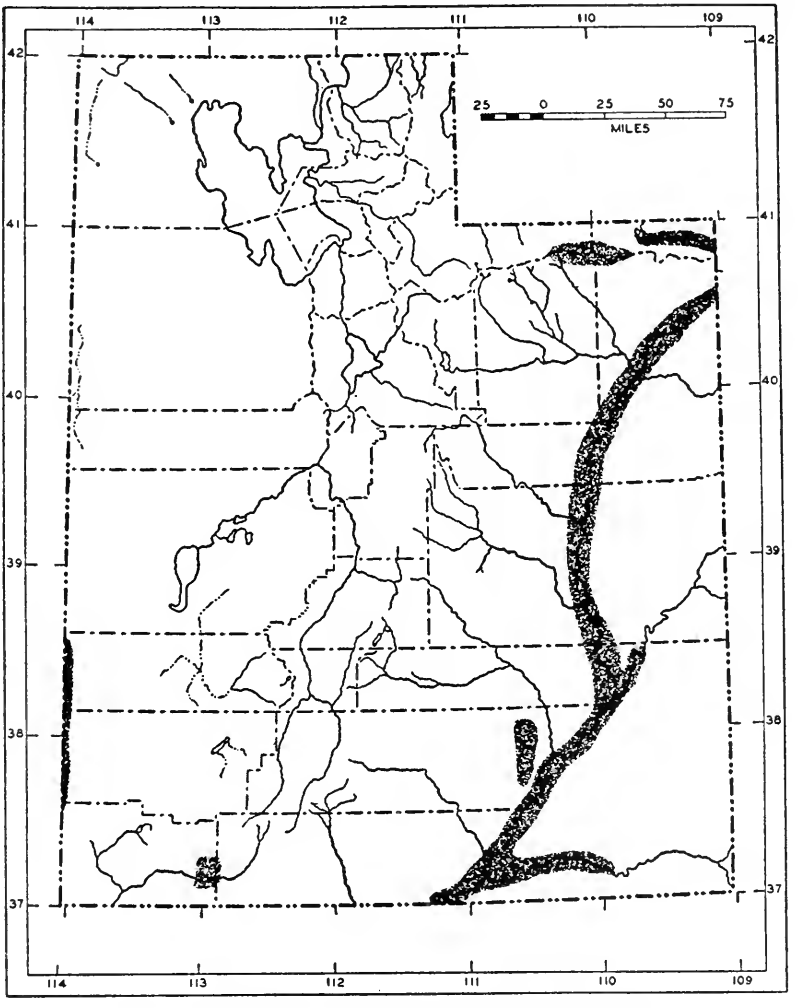

FIG. 88. Distribution of *Ovis canadensis canadensis.*

As early as 1874, Allen (1874:64) mentioned the rapid decrease in the numbers of mountain sheep. Barnes (1927:177) reported 400 animals in the Uinta Mountains. The following statements, made in 1949, regarding mountain sheep in Utah are from D. M.

Gaufin of the Utah State Fish and Game Department. There are at present 25 animals in the Uinta Mountains, and 25 in Zion National Park. Mountain sheep from southern Nevada are at present on the mountains of the southern Utah-Nevada Boundary. Some animals were reported on the Henry Mountains as late as 1947. Roy Musselman, of Monticello, reported 125 animals at the junction of the Dirty Devil and Colorado rivers in 1946. Arthur Chaffin, of Hite, occasionally sees animals at Hite, but they are fast disappearing.

Concerning the taxonomic status of mountain sheep in Utah, I am following Cowan's paper (1940). He referred all specimens from Utah to the subspecies *O. c. canadensis*. He did mention that specimens from 35 miles north of Greenriver while well within the range of variation of *O. c. canadensis* did reflect intergradation toward *Ovis canadensis mexicanus* in the small size of the nasals, and also possibly toward *Ovis canadensis nelsoni* in the slender horns. I suspect that adequate material from extreme south central Utah would prove the animals to be referable to *O. c. mexicanus*, while those from southwestern Utah would be referable to *O. c. nelsoni*.

Records of occurrence. (Cowan, 1940:541).—Uinta Mountains; Mouth of Florence Canyon, 35 mi. north of Green River [= Greenriver].

TYPE LOCALITIES IN UTAH

BOXELDER COUNTY

1. Pine Canyon, 17 miles northwest of Kelton, 6,600 feet.
   Thomomys quadratus gracilis Durrant [*Thomomys talpoides gracilis*], p. 155.
   Zapus princeps cinereus, p. 386.
2. Lynn Canyon, 7,500 feet.
   Castor canadensis pallidus, p. 284.
3. Kelton, 4,300 feet.
   Tamias minimus pictus Allen [*Eutamias minimus pictus*], p. 137.
   Thomomys perpallidus aureiventris Hall [*Thomomys bottae aureiventris*] (Fehlman Ranch, 3 miles north of Kelton, 4,225 feet), p. 180.
   Perognathus olivaceus Merriam [*Perognathus parvus olivaceus*], p. 241.
   Dipodomys microps bonnevillei, p. 269.
4. Dolphin Island, Great Salt Lake, 4,250 feet.
   Dipodomys ordii cineraceus, p. 257.
   Dipodomys microps russeolus, p. 271.
5. Gunnison Island, Great Salt Lake, 4,250 feet.
   Dipodomys microps alfredi, p. 273.

WEBER COUNTY

6. Ogden.
   Eutamias dorsalis utahensis, p. 149.
   Perodipus montanus utahensis Merriam [*Dipodomys ordii utahensis*], p. 255.
7. Foot of Wasatch Mountains, near Ogden.
   Citellus grammurus utah Merriam [*Citellus variegatus utah*], p. 118.
8. Fremont Island, Great Salt Lake, 4,250 feet.
   Peromyscus maniculatus inclarus, p. 316.

TOOELE COUNTY

9. Bird Island, Great Salt Lake, 4,300 feet.
   Dipodomys ordii marshalli, p. 256.
10. Carrington Island, Great Salt Lake, 4,250 feet.
    Dipodomys microps subtenuis, p. 274.
    Neotoma lepida marshalli, p. 340.
11. Stansbury Island, Great Salt Lake, 4,250 feet.
    Thomomys bottae minimus, p. 185.
    Reithrodontomys megalotis ravus (north end Stansbury Island), p. 298.
12. South end of Stansbury Island, Great Salt Lake, 4,250 feet.
    Peromyscus crinitus pergracilis, p. 299.
    Onychomys leucogaster utahensis, p. 324.

13. South Willow Creek, Stansbury Mountains, 7,500 feet.
    Thomomys bottae stansburyi, p. 188.
14. Settlement Creek, Oquirrh Mountains, 6,500 feet.
    Thomomys talpoides oquirrhensis, p. 161.
15. Orr's Ranch, Skull Valley, 4,300 feet.
    Thomomys bottae robustus, p. 183.
16. Old Lincoln Highway, 18 miles southwest of Orr's Ranch in Skull Valley, 4,400 feet.
    Dipodomys ordii pallidus, p. 259.
    Microdipodops megacephalus leucotis, p. 250.

DAVIS COUNTY

17. Antelope Island, Great Salt Lake.
    Thomomys bottae nesophilus, p. 187.

SALT LAKE COUNTY

18. Red Butte Canyon, Fort Douglas, 5,000 feet.
    Castor canadensis rostralis, p. 287.
    Vulpes macrourus Baird [*Vulpes fulva macroura*] (Wasatch Mountains bordering Great Salt Lake), p. 399.
19. Near Barclay, Parleys Canyon, Wasatch Mountains.
    Tamias minimus consobrinus Allen [*Eutamias minimus consobrinus*], p. 132.
    Peromyscus boylii utahensis (½ mile above lower power station, Millcreek Canyon), p. 317.

SUMMIT COUNTY

20. Blacks Fork, Uinta Mountains, 9,500 feet.
    Tamias umbrinus Allen [*Eutamias quadrivittatus umbrinus*], p. 142.
21. North base of Gilbert Peak, Uinta Mountains, 10,000 feet.
    Thomomys uinta Merriam [*Thomomys talpoides uinta*], p. 163.
22. Uinta Mountains, near head of East Fork of Bear River.
    Ochotona uinta Hollister [*Ochotona princeps uinta*], p. 67.
23. Park City.
    Tamias castanurus Merriam [*Citellus lateralis castanurus*], p. 128.
24. 12 miles east of Kamas.
    Glaucomys sabrinus lucifugus, p. 151.

DAGGETT COUNTY

25. Beaver Creek, 19 miles south of Manila.
    Zapus princeps utahensis, p. 387.

UTAH COUNTY

26. West Canyon, Oquirrh Range.
    Microtus montanus nexus, p. 365.
27. Camp Floyd, near Fairfield.
    Spermophilus mollis Kennicott [*Citellus townsendii mollis*], p. 111.
28. Provo, 4,510 feet.
    Thomomys perpallidus albicaudatus Hall [*Thomomys bottae albicaudatus*], p. 190.
    Spilogale saxatilis Merriam [*Spilogale gracilis saxatilis*], p. 432.

WASATCH COUNTY

29. Midway, 5,500 feet.
Thomomys talpoides wasatchensis, p. 159.

DUCHESNE COUNTY

30. Duchesne River, 10 miles northwest of Duchesne, 5,600 feet.
Castor canadensis duchesnei, p. 289.
31. Red Creek, 2 miles north of Fruitland, 6,700 feet.
Dipodomys ordii uintensis, p. 260.
32. Antelope Canyon, 20 miles southeast of Duchesne, 7,200 feet.
Peromyscus crinitus doutti, p. 301.

UINTAH COUNTY

33. Paradise Park, 45 miles northwest of Vernal (by road), 10,050 feet.
Clethrionomys gapperi uintaensis, p. 355.
34. 19 miles north of Vernal, 8,000 feet.
Thomomys talpoides ravus, p. 166.
35. Kennedys Hole, Uncompahgre Indian Reservation, 20 miles northeast of Ouray.
Spermophilus tridecemlineatus parvus Allen [*Citellus tridecemlineatus parvus*], p. 115.
36. East side of confluence of Green and White rivers, 1 mile southeast of Ouray, 4,700 feet.
Neotoma cinerea macrodon, p. 350.

JUAB COUNTY

37. Fish Springs, 4,400 feet.
Thomomys bottae bonnevillei, p. 195.
38. Trout Creek, 4,600 feet.
Dipodomys ordii celeripes, p. 252.

SANPETE COUNTY

39. 1 mile south of Fairview, 6,000 feet.
Thomomys fossor moorei Goldman [*Thomomys talpoides moorei*], p. 170.
40. Manti, 5,500 feet.
Thomomys bottae levidensis, p. 208.
41. North Fork Salina Creek, 10-12 miles southeast of Mayfield.
Ursus utahensis Merriam [*Ursus horribilis utahensis*], p. 407.

CARBON COUNTY

42. Price, 5,567 feet.
Dipodomys ordii sanrafaeli, p. 261.

MILLARD COUNTY

43. Swasey Spring, House Mountains, 6,500 feet.
Thomomys bottae sevieri, p. 199.
44. Oak Creek Canyon, 6 miles east of Oak City, 6,000 feet.
Thomomys bottae tivius, p. 203.
45. Scipio, 5,315 feet.
Thomomys bottae contractus, p. 204.

46. East side of Clear Lake, 4,600 feet.
Thomomys bottae convexus, p. 201.

47. ½ mile east of Headquarters Building of the Desert Range Experiment Station of the U. S. Forest Service, Sec. 33, T 25 S, R 17 W, Salt Lake B. M., 5,000 feet.
Microdipodops megacephalus paululus, p. 251.

SEVIER COUNTY

48. Richfield, 5,308 feet.
Thomomys townsendii lenis Goldman [*Thomomys bottae lenis*], p. 206.

49. Seven Mile Flat, 5 miles north of Fishlake, 10,000 feet.
Thomomys fossor levis Goldman [*Thomomys talpoides levis*], p. 176.

GRAND COUNTY

50. Rock Canyon Corral, 5 miles southeast of Valley City, 4,500 feet.
Neotoma lepida sanrafaeli, p. 341.

51. Castle Valley, about 15 miles northeast of Moab.
Neotoma albigula brevicauda, p. 334.

BEAVER COUNTY

52. Wah Wah Springs, 30 miles west of Milford, 6,500 feet.
Thomomys bottae wahwahensis, p. 212.

53. Briggs (Britts) Meadow, Beaver Mountains, 10,000 feet.
Marmota engelhardti Allen [*Marmota flaviventer engelhardti*], p. 103.
Eutamias adsitus Allen [*Eutamias quadrivittatus adsitus*], p. 147.
Ochotona cinnamomea Allen [*Ochotona princeps cinnamomea*], p. 69.

54. Beaver River, approximately 3 miles east of Beaver.
Sorex leucogenys Osgood [*Sorex merriami leucogenys*], p. 31.

WAYNE COUNTY

55. Hanksville.
Thomomys perpallidus osgoodi Goldman [*Thomomys bottae osgoodi*], p. 209.

56. Torrey, 7,000 feet.
Dipodomys ordii fremonti, p. 264.
Microtus montanus amosus, p. 368.

IRON COUNTY

57. Buckskin Valley.
Cynomys parvidens, p. 108.

58. Brian Head, Parowan Mountains, 11,000 feet.
Ochotona schisticeps fuscipes Howell [*Ochotona princeps fuscipes*], p. 70.
Thomomys fossor parowanensis Goldman [*Thomomys talpoides parowanensis*], p. 174.

GARFIELD COUNTY

59. East slope of Mount Ellen, Henry Mountains, 8,000 feet.
Thomomys perpallidus dissimilis Goldman [*Thomomys bottae dissimilis*], p. 214.
60. 2 miles west of Deer Lake.
Ochotona princeps utahensis, p. 71.
61. 1 mile south of Panguitch, 6,666 feet.
Dipodomys ordii panguitchensis, p. 266.

WASHINGTON COUNTY

62. Near Further Water, Dixie National Forest, Pine Valley Mountains, 9,500 feet.
Tamiasciurus fremonti dixiensis Hardy [*Tamiasciurus hudsonicus dixiensis*], p. 99.
Thomomys bottae birdseyei (5 miles east of Pine Valley, 8,300 feet), p. 217.
63. Diamond Valley.
Dipodomys ordii cinderensis, p. 265.
64. Zion National Park.
Thomomys perpallidus planirostris Burt [*Thomomys bottae planirostris*], p. 220.
65. St. George.
Perognathus longimembris virginis, p. 239.
Perognathus formosus Merriam [*Perognathus formosus formosus*], p. 245.
Onychomys longicaudus Merriam [*Onychomys torridus longicaudus*], p. 329.
Ondatra zibethica goldmani Huey [*Ondatra zibethicus goldmani*], p. 359.
Microtus nevadensis rivularis Bailey [*Microtus montanus rivularis*], p. 369.
66. Clistoyucca area on Beaverdam Slope, west of Beaverdam Mountains, 3,500 feet.
Dipodomys microps woodburyi, p. 276.

KANE COUNTY

67. Kanab, 4,925 feet.
Onychomys leucogaster melanophrys, p. 326.

SAN JUAN COUNTY

68. Harts Draw, north slope Blue Mountains, 20 miles northwest of Monticello.
Canis lupus youngi, p. 397.
69. Johnson Creek, 14 miles north of Blanding, 7,500 feet.
Thomomys talpoides durranti, p. 172.
70. 1 mile east of Kigalia Ranger Station, 30 miles west of Blanding, Natural Bridges National Monument Road, 8,000 feet.
Sciurus aberti navajo, p. 94.
71. Bluff, 4,500 feet.
Thomomys aureus Allen [*Thomomys bottae aureus*], p. 215.
Sitomys auripectus Allen [*Peromyscus crinitus auripectus*], p. 303.

72. Rainbow Bridge, 4,000 feet.
    Perognathus longimembris arcus, p. 240.
73. Soldier Spring, east slope of Navajo Mountain, approximately 8,000 feet.
    Microtus mexicanus navaho, p. 375.
74. Nolands Ranch, north side of San Juan River, 1½ miles above Four Corners.
    Canis estor Merriam [*Canis latrans estor*], p. 397.
    Sitomys rowleyi Allen [*Peromyscus boylii rowleyi*], p. 319.

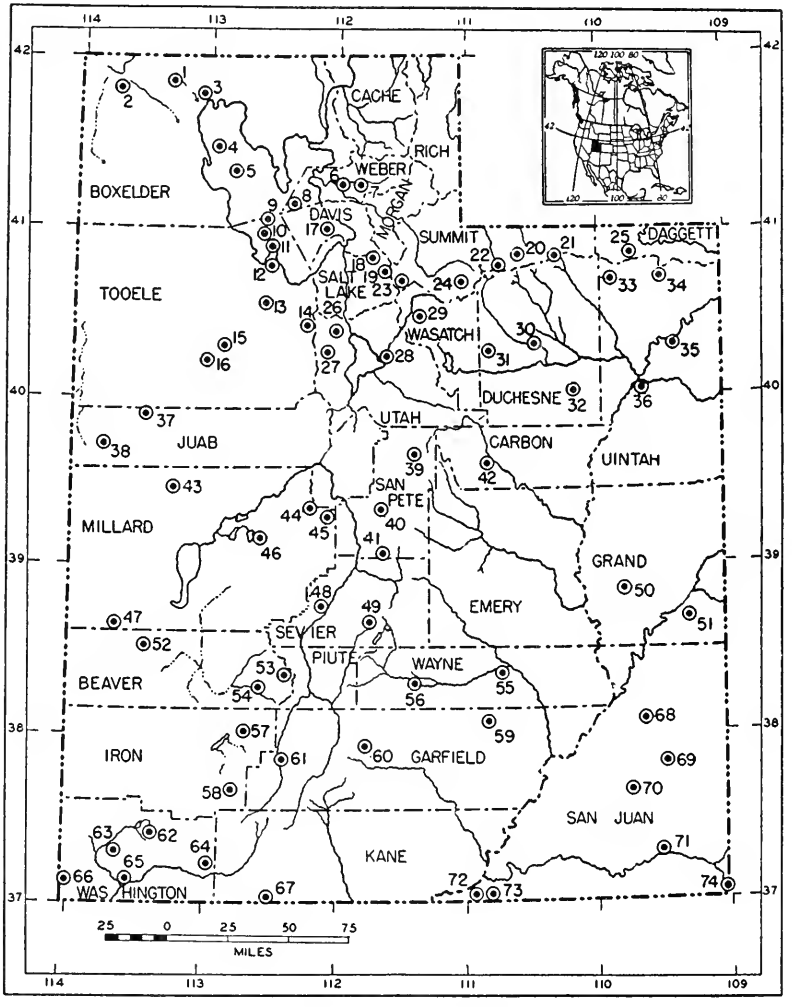

FIG. 89. Type localities.

HYPOTHETICAL LIST

MAMMALS POSSIBLY OCCURRING IN UTAH OF WHICH SATISFATORY RECORD IS LACKING.

1. *Sorex cinereus cinereus* Kerr, Cinereous Shrew.—In his revision of the long-tailed shrews, Jackson (1928:39) included northeastern Utah in the range of this shrew. He did not, however, have any specimens from the state. He did have specimens from Colorado, Idaho and from Wyoming as close to Utah as Evanston, five miles from the Utah-Wyoming boundary. S. *c. cinereus* may be expected to occur in suitable habitat in extreme northeastern Utah.
2. *Notiosorex crawfordi crawfordi* (Coues), Crawford Shrew.—Hall (1946:127) reported one specimen from Nye County, Nevada. This is, insofar as I know, the northernmost known record of occurrence of this shrew. This locality is essentially at the same latitude as the southern boundary of Utah. Inasmuch as the major part of the range of this species is to the south and east of Utah, and inasmuch as animals of this subspecies are now known to occur to the west of Utah, they might be expected to occur also in extreme southern Utah.
3. *Macrotis californicus* Baird, California Leaf-nosed Bat.—Hall (1946: 129) reported the occurrence of this bat from the Lower Sonoran Life-Zone in Clark County, Nevada. This life-zone extends northeastward from Clark County into extreme southwestern Utah, and this bat may also occur there.
4. *Myotis yumanensis sociabilis* H. W. Grinnell, Yuma Myotis.—Miller and Allen (1928:69) listed specimens from Payette Valley, Idaho, and from Fremont Peak, Wyoming, and stated (p. 67) that evidently intergradation between this form and *Myotis yumanensis yumanensis* occurred in Utah and Nevada. Their distribution map (p. 62) shows the range of *M. y. sociabilis* as impinging on Utah. This form may occur sparingly in northern Utah.
5. *Myotis thysanodes thysanodes* Miller, Fringe-tailed Myotis.—Miller and Allen (1938:122) included Utah within the range of this form, but had no specimens from the state, and to date I know of none.
6. *Myotis californicus californicus* (Audubon and Bachman), California Myotis.—Tanner (1927:250) reported this bat from Mount Timpanogos, Utah County, Utah. I requested these specimens for study, but was informed on December 12, 1947, that they no longer exist in the collection of Brigham Young University (personal communication, V. M. Tanner). Davis (1939:116) reported this bat from Washington County, Idaho, and Warren (1942:21) reported it from west-central Colorado. The bat may occur in northern Utah.
7. *Corynorhinus rafinesquii intermedius* H. W. Grinnell, Long-eared Bat.—Davis (1939:124) reported specimens from Bingham and Bannock counties in southern Idaho, and Hall (1946:160) thought the range of this subspecies extended as far eastward as northwestern Utah. This bat may occur in northwestern Utah.

8. *Sciurus kaibabensis* Merriam, White-tailed Squirrel.—Presnall (1938:13) reported an introduction of this squirrel onto the Markagunt Plateau, and that animals had been seen there since; no specimens, however, are known from Utah. Some animals resulting from this transplant may still occur in the aforementioned area.
9. *Citellus richardsoni elegans* (Kennicott), Richardson Ground Squirrel.—Howell (1938:77) listed specimens belonging to this subspecies from Evanston and Fort Bridger, Wyoming. These localities are only 5 and 30 miles, respectively, from the Utah-Wyoming boundary. Barnes (1927:83) thought that these animals occurred in northeastern Utah, and I believe they may be along the northern foothills of the Uinta Mountains.
10. *Citellus richardsoni nevadensis* Howell, Richardson Ground Squirrel.—These animals are known to occur in the central part of Elko County, Nevada (Hall, 1946:304). Since no fundamental changes in types of terrain and vegetation exist between the known localities of occurrence in Nevada and extreme northwestern Utah, I think that these animals may be expected in the Goose Creek and Grouse Creek areas in northwestern Boxelder County, Utah.
11. *Citellus tereticaudus tereticaudus* (Baird), Round-tailed Ground Squirrel.—Howell (1938:187) reported animals from Bunkerville, Nevada, only 15 miles from the Utah boundary. This squirrel, which inhabits the Lower Sonoran Life-zone, may occur in the same life-zone in the Beaverdam Wash area of Utah.
12. *Citellus lateralis wortmani* (Allen), Golden-mantled Ground Squirrel.—Howell (1938:195) listed specimens from Utah from the Uncompahgre Indian Reservation, but did not show their range (p. 192) as reaching Utah. The former Uncompahgre Indian Reservation was in both Utah and Colorado, and I question the locality of capture of these specimens as being in Utah. I have seen 8 specimens of golden-mantled ground squirrels from the area in Utah that was formerly in this reservation and they are all referable to *Citellus lateralis lateralis*. This Coloradan subspecies may have extended its range into the extreme eastern part of the East Tavaputs Plateau in Utah.
13. *Eutamias quadrivittatus quadrivittatus* (Say), Say Chipmunk.—This chipmunk is known to occur in Colorado and New Mexico. Say chipmunks, other than those belonging to *Eutamias quadrivittatus hopiensis*, are rare it seems in eastern Utah, and I know of only one specimen which is from the East Tavaputs Plateau, and it is referable to *Eutamias quadrivittatus umbrinus*. This specimen is not typical and appears to be an intergrade between *E. q. umbrinus* and *E. q. quadrivittatus*. Probably animals referable to *E. q. quadrivittatus* occur in extreme eastern Utah.
14. *Thomomys talpoides bridgeri* Merriam, Northern Pocket Gopher.—This pocket gopher occurs in deep soils in southwestern Wyoming, and will probably be found to occur also in extreme northern Utah.
15. *Perognathus penicillatus sobrinus* Goldman, Desert Pocket Mouse.—Hall (1946:376) reported this pocket mouse from along the Virgin

River, only 10 miles southwest of Utah. They may be expected to occur in the Beaverdam Wash area of extreme southwestern Utah.

16. *Perognathus parvus trumbullensis* Benson, Great Basin Pocket Mouse.—Animals belonging to this subspecies are known from extreme northwestern Arizona (Benson, 1937:182). Inasmuch as other kinds of heteromyids known to occur in this part of Arizona are also found in the Virgin River Valley in Washington County, Utah, *P. p. trumbullensis* also may be expected to occur there.
17. *Perognathus callistus* Osgood, Beautiful Pocket Mouse.—This pocket mouse is reported to occur in Moffatt County, Colorado (Warren, 1942: 176). Moffatt County is adjacent to Uintah County, Utah, and since no appreciable difference in terrain or environment exists between these two counties where they are in contact, *P. callistus* may be found to occur in northeastern Uintah County, Utah.
18. *Dipodomys ordii columbianus* (Merriam), Ord Kangaroo Rat.—Hall (1946:412) thought that the range of this subspecies extended in Nevada to the northwestern boundary of Utah, and Davis (1939:270) reported specimens from Twin Falls County, Idaho. Animals from extreme northwestern Utah, when known, may be referable to this subspecies.
19. *Peromyscus crinitus crinitus* (Merriam), Canyon Mouse.—Davis (1939: 288) listed specimens from Idaho, from only 30 miles northwest of Utah. Animals referable to this subspecies may occur in northwestern Utah.
20. *Onychomys leucogaster brevicaudus* Merriam, Northern Grasshopper Mouse.—Hall (1946:492) and Davis (1939:279) show the range of this subspecies as impinging upon the western and northern boundaries of Utah respectively. When animals become available from extreme northwestern Utah they may be found to belong to this subspecies.
21. *Neotoma lepida nevadensis* Taylor, Desert Wood rat.—Davis (1939: 297) reported animals belonging to this subspecies from the southern part of Twin Falls County, Idaho, and thought (p. 296) that the range of this subspecies extended to the northwestern boundary of Utah. Animals are unknown from northwestern Utah, but this subspecies may occur there.
22. *Neotoma cinerea cinnamomea* Allen, Bushy-tailed Wood Rat.—Hooper (1944:415) revived this name combination for animals which occur in southwestern Wyoming. If this name is valid, animals from the northern slopes of the Uinta Mountains in Utah may be expected to belong to this subspecies.
23. *Ondatra zibethicus mergens* (Hollister), Muskrat.—Animals from western Millard County, Utah, reportedly introduced, were referred with reservation to this subspecies by Hall and Johnson (1938:122).
24. *Ondatra zibethicus bernardi* Goldman, Muskrat.—Animals from the Colorado River drainage of eastern Utah probably are referable to this subspecies.

25. *Microtus montanus fusus* Hall, Montane Meadow Mouse.—Animals from south of Jensen, Uintah County, have the reddish suffusion characteristic of this subspecies, and I think that if, and when, animals from the East Tavaputs Plateau are taken, they will be of this subspecies.
26. *Procyon lotor excelsus* Nelson and Goldman, Raccoon.—I have reports of the occurrence of raccoons, probably of this subspecies, in the Raft River Mountains of northwestern Boxelder County, Utah.
27. *Lutra canadensis sonora* Rhoads, River Otter.—On October 22, 1949, at Ouray, Uintah County, I saw an Indian who had strips of untanned otter fur braided into his hair. He informed me that he had trapped the animal a few years previously on the Green River above Ouray. Gregory (1938) reported otters from Dark Canyon on the Colorado River. River otters from the Colorado River and its tributaries in Utah probably are referable to *L. c. sonora.*
28. *Felis concolor aztecus* Merriam, Mountain Lion.—It seems that no mountain lions from San Juan County, Utah, have been preserved as scientific specimens. I know, however, that mountain lions occur in this part of Utah south of the Colorado River, and suppose that they are of the subspecies *F. c. aztecus.*
29. *Odocoileus virginianus macrourus* (Rafinesque), White-tailed Deer.—The older literature records the white-tailed deer in Utah. I know of no uncontestable record of their occurrence at present. D. M. Gaufin of the Utah State Department of Fish and Game informed me recently (1949) of what he felt was an authentic report of one animal having been seen along the Green River in Daggett County.
30. *Ovis canadensis mexicanus* Merriam, Mountain Sheep.—Cowan (1940) found evidence of intergradation between *O. c. mexicanus* and *O. c. canadensis* in animals from Greenriver, Utah. Mountain sheep have been reported from the gorge of the San Juan River, in extreme southeastern Utah, and I suspect that they are referable to *O. c. mexicanus.*
31. *Ovis canadensis nelsoni* Merriam, Mountain Sheep.—D. M. Gaufin of the Utah State Department of Fish and Game informed me (1949) that mountain sheep from extreme southeastern Nevada have drifted into the mountainous country of the Utah-Nevada boundary in this region. Hall (1946:642) considered mountain sheep from this area to be referable to *O. c. nelsoni.*

ADDENDA

Since the preparation of this manuscript, the new name *Tamiasciurus hudsonicus wasatchensis* has been published as applying to the red squirrels from central Utah (Hardy, Proc. Biol. Soc. Washington, 63:13, April 26, 1950). I have not seen the specimens from central Utah reported by Hardy, but judging from the published account of *T. h. wasatchensis,* the measurements do not appear to be beyond the range of individual variation of *T. h. dixiensis.* Moreover, the description of color, set forth as being characteristic of *T. h. wasatchensis,* coincides with that of specimens from east of Salt Lake City and from Smith and Morehouse Canyon, in the Uinta Mountains, which A. H. Howell (personal communication), Kelson (MS) and I consider to be intergrades between *T. h. ventorum* and *T. h. fremonti.* Furthermore, the range now assigned to the new subspecies is the area in central Utah where the ranges of *T. h. ventorum, T. h. fremonti* and *T. h. dixiensis* formerly were considered to meet, and whence the specimens were considered to be intergrades. In addition, specimens from 14 miles north of Torrey, and at the southern end of the range now ascribed to *T. h. wasatchensis,* are intergrades between *T. h. fremonti* and *T. h. dixiensis.*

At the time this manuscript was finished, the pikas from the Wasatch Plateau of central Utah were considered as being intergrades between *Ochotona princeps uinta* and *Ochotona princeps cinnamomea,* but referable to the latter subspecies. Since that time, they have been described as new and are now known under the name of *Ochotona princeps moorei* Gardner (Journ. Washington Acad. Sci., 40 (10):344, October 23, 1950. The type locality of this new subspecies is 1 mile northeast of Baldy Ranger Station, Manti National Forest, 10,000 feet, Sanpete County, Utah. The Station is 17 miles east and 2 miles south of the town of Gunnison, Sanpete County, Utah.

When I terminated the manuscript, I knew of no raccoons from Utah which had been preserved as scientific specimens. Goldman (N. Amer. Fauna, 60:55, 1950) lists 2 specimens, one from Pine Valley (skull only) and one from St. George. Both of these specimens are referred to the subspecies *Procyon lotor pallidus* Merriam.

FAUNAL AREAS

Any attempt to account for the present distribution of the several kinds of mammals in Utah leads to the realization that their geographic ranges may be readily grouped into specific areas, here referred to as "faunal areas." Nearly all of these faunal areas and

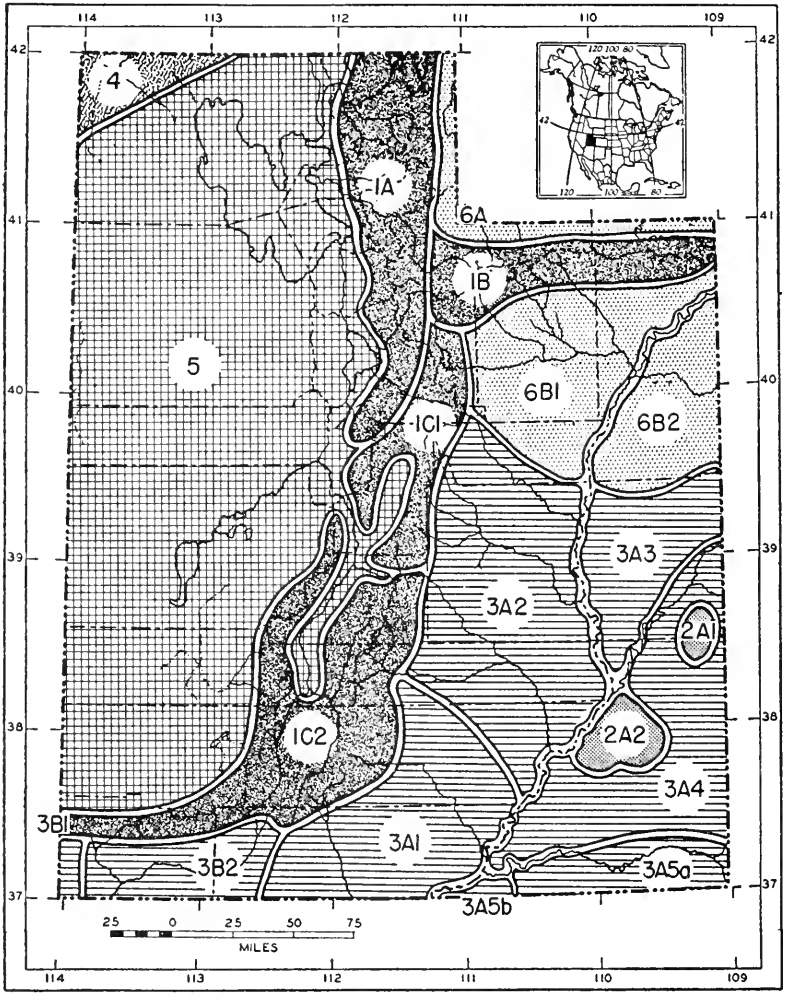

FIG. 90. Faunal divisions of Utah.

their subdivisions show a high degree of coincidence with the major physiographic regions. As concerns the kinds of mammals and their occurrence, each faunal area is distinctive because certain species are restricted to it, and in most instances it has acted as a

center of differentiation for subspecies. As this study progressed, attention was given to the Life-zone concept of Merriam (1890, 1898) with its indicators, based on the range of mean temperatures (1898:54) and the Biotic Provinces of Dice (1943), based on ecological situations within a continuous geographic area. To account for, and explain, the distribution of mammals locally, in Utah, I felt the need of some other system which contained more categories. Since Utah possesses an extremely varied topography, and since the distributions of mammals mostly coincide with the topographic areas, and inasmuch as I consider speciation in mammals in Utah to be directly influenced by, and correlated with, the topography, I have outlined faunal areas and have employed the current terminology of the physiographers for the faunal areas and their subdivisions. The "faunal area" as here employed is not meant to include the total fauna of a region, nor the plant relationships, but is arbitrarily based upon the presence or absence of mammals. The faunal subdivisions of Utah are as follows:

I. Middle Rocky Mountain Faunal Area
   A. Wasatch Mountain Province
   B. Uinta Mountain Province
   C. High Plateau Province
      1. Northern High Plateau Subcenter
      2. Southern High Plateau Subcenter
II. Southern Rocky Mountain Faunal Area
   A. Coloradan Province
      1. La Sal Mountain Subcenter
      2. Abajo Mountain Subcenter
III. Colorado Plateau Faunal Area
   A. Canyon Lands Province
      1. Kaiparowits Subcenter
      2. San Rafael Subcenter
      3. Grand Valley Subcenter
      4. San Juan Subcenter
      5. Painted Desert Subcenter
         a. Monument Valley District
         b. Navajo Mountain District
   B. Virgin River Valley Province
      1. Beaverdam Wash Subcenter
      2. St. George Subcenter
IV. Columbia Plateau Faunal Area
V. Great Basin Faunal Area
VI. Northern Great Plains Faunal Area
   A. Bridger Basin Province
   B. Uinta Basin Province
      1. Duchesne Subcenter
      2. Uintah Subcenter

The Middle Rocky Mountain Faunal Area, consisting generally of the Wasatch Mountains, Uinta Mountains and the north-south central high plateaus of the state, is distinct from others in that the genera *Glaucomys, Clethrionomys, Phenacomys* and *Alces* are restricted to it. Furthermore, it is characterized by the full species *Lepus americanus, Microtus richardsoni, Mustela erminea* and *Lynx canadensis* which do not occur elsewhere within the state. *Citellus armatus* is also practically limited to it. In addition, there are 24 subspecies which are restricted or nearly so to the Middle Rocky Mountain Faunal Area. This faunal area has acted as a center of differentiation in that 10 full species (one lagomorph and 9 rodents), known to occur elsewhere within the state, have evolved 19 subspecies which are known only from the area.

The aforementioned faunal area consists of three provinces, namely, Wasatch Mountain Province (Wasatch Mountains), Uinta Mountain Province (Uinta Mountains) and High Plateau Province (High central plateaus from the Wasatch Plateau southward). Of the 33 kinds restricted in Utah to this faunal area, four (red squirrel, golden-mantled ground squirrel and 2 northern pocket gophers) occur only in the Wasatch Mountain Province, three (northern pocket gophers) occur only in the Uinta Mountain Province, and eight (3 pikas, red squirrel, marmot, Say chipmunk and 2 northern pocket gophers) occur only in the High Plateau Province. Five others (pika, Say Chipmunk, red-backed mouse, heather vole and moose) occur both in the Wasatch Mountain and Uinta Mountain provinces; another (golden-mantled ground squirred) occurs in both the Uinta Mountain and High Plateau provinces; two others (rock squirrel, and northern pocket gopher) occur only in the Wasatch Mountain and High Plateau provinces, and ten (snowshoe rabbit, Uinta ground squirrel, northern flying squirrel, least chipmunk, long-tailed meadow mouse, big-footed meadow mouse, jumping mouse, black bear, ermine and Canada lynx) occur throughout all three provinces.

Those kinds common to the Wasatch Mountain and Uinta Mountain provinces, but not found in the High Plateau Province, are known to occur also to the north in Idaho and Wyoming. They attain the southern limits of their distribution in Utah in the two first mentioned provinces. In this, they parallel the lodge pole pine (*Pinus contorta*) which also attains its southern limits in the Wasatch Mountain and Uinta Mountain provinces. *Citellus variegatus utah* which occurs in both the Wasatch Mountain and High Plateau provinces is known also from Idaho, while *Thomomys talpoides*

moorei, also occurring in these provinces has apparently evolved *in situ.* The Uinta Mountain and High Plateau provinces, however, have mammals in common, such as *Tamiasciurus hudsonicus fremonti* and *Citellus lateralis lateralis,* which are known from Colorado and are thought to have migrated into Utah from the east. The Wasatch Mountain Province has their counterparts in *Tamiasciurus hudsonicus ventorum* and *Citellus lateralis castanurus,* which also occur to the north in Idaho. The Wasatch Mountain Province is distinctive in that, with rare exception, mammals which have migrated into it are of northern and not eastern origin; the Uinta Mountain and High Plateau provinces, on the contrary, have in common mammals of eastern origin. These facts seem to indicate that the high plateaus of central Utah, while appearing to be continuous with the Wasatch Mountains, actually have closer affinities with the Uinta Mountains, and that the Wasatch Mountains are physiographically distinct. The evidence from mammals of this distinctiveness is further corroborated in that western yellow pine (*Pinus ponderosa*), although not occurring in the Wasatch Mountains, is common to both the Uinta Mountains and the high plateaus. The Uinta Mountain Province is further characterized in its easternmost reaches by containing certain mammals which occur also in the Uinta Basin and Wyoming Basin provinces. Examples are *Citellus tridecemlineatus parvus, Peromyscus maniculatus osgoodi* and *Neotoma cinerea orolestes.*

Two subcenters (Northern High Plateau Subcenter and Southern High Plateau Subcenter) are recognizable in the High Plateau Province. These subcenters are roughly separable from each other physiographically by the valleys to the north of Fishlake Plateau. The northern subcenter is characterized by the occurrence of *Thomomys talpoides moorei* and *Eutamias quadrivittatus umbrinus,* and the southern subcenter by *Ochotona princeps cinnamomea, O. p. fuscipes, O. p. utahensis, Eutamias quadrivittatus adsitus, Tamiasciurus hudsonicus dixiensis, Thomomys talpoides levis, T. t. parowanensis, Thomomys bottae birdseyei,* and to lesser degree by *Peromyscus maniculatus sonorensis, Marmota flaviventer* and *Citellus armatus.*

The Southern Rocky Mountain Faunal Area is small in geographic extent, consisting of two isolated mountains (La Sal and Abajo) situated in eastern Grand County and central San Juan County. This faunal area has the genus *Sciurus* endemic to it and has acted as a center of differentiation in that three species, which occur in other parts of the state, have here evolved three endemic subspecies.

The occurrence within the area of *Sorex palustris navigator, Sorex obscurus obscurus, Ochotona princeps saxatilis, Marmota flaviventer luteola, Sciurus aberti navajo, Tamiasciurus hudsonicus fremonti, Thomomys talpoides durranti, Microtus longicaudus alticola* and *Ursus americanus amblyceps* signifies the relationship of these mountains to those of Colorado. The La Sal Mountain Subcenter is closer geographically to Colorado than is the Abajo Mountain Subcenter, and the presence of the navigator shrew, pika and marmot unknown from the Abajo Mountains, is evidence of the closer approach faunistically of the La Sal Mountain Subcenter than of the Abajo Mountain Subcenter to the Colorado fauna. The Abajo Mountain Subcenter is distinct in possessing *Sciurus aberti navajo* and a red squirrel, which while tentatively referred to *Tamiasciurus hudsonicus fremonti,* is rather aberrant and may be an unnamed kind.

The Colorado Plateau Faunal Area consists generally of all the lowland drainage of the Colorado River in Utah with the exception of the Uinta Basin. Some of the mammals of the Uinta Basin are closely related to those of the Northern Great Plains. Fifteen full species and 64 subspecies are restricted to the Colorado Plateau Faunal Area in Utah. This area has acted as a center of differentiation; 42 subspecies (of 26 species), which occur wholly or partly, within Utah occur only within this area.

The Virgin River Province and the Canyon Lands Province are the two major divisions of the Colorado Plateau Faunal Area. Only three (bats) of the 15 full species, and 13 of the 64 subspecies restricted to this faunal area occur in both provinces. The Virgin River Province is subdivided into the St. George Subcenter and the Beaverdam Wash Subcenter. This province is characterized by having the species *Dipodomys merriami, Dipodomys deserti, Peromyscus eremicus* and *Onychomys torridus,* and the subspecies *Thomomys bottae planirostris, T. b. virgineus* and *Perognathus longimembris virginis* restricted to it. The St. George Subcenter consists of the Virgin River Drainage in Utah, east of the Beaverdam Mountains, while the Beaverdam Wash Subcenter is limited to extreme southwestern Washington County, consisting of the Beaverdam Wash and the Beaverdam Slope. The St. George Subcenter is distinguished from the Beaverdam Wash Subcenter as concerns the mammals in possessing *Thomomys bottae planirostris, Perognathus formosus formosus, Dipodomys merriami vulcani, Dipodomys microps celsus, Ondatra zibethicus goldmani* and *Microtus montanus rivularis,* while the Beaverdam Wash Subcenter has *Thomomys*

bottae virgineus, Perognathus formosus mohavensis, Dipodomys deserti deserti, Dipodomys merriami merriami and *Dipodomys microps woodburyi,* restricted to it. These two subcenters are further differentiated by other subspecies which also occur elsewhere in the state. The St. George Subcenter has *Citellus leucurus cinnamomeus* and *Neotoma lepida monstrabilis,* while *Citellus leucurus leucurus* and *Neotoma lepida lepida* occur in the Beaverdam Wash Subcenter. The relationship of these two subcenters is indicated botanically in that both possess plants such as mesquite (*Prosopis chilensis*), creosote bush (*Larrea tridentata*) and desert willow (*Chilopsis linearis*), which are characteristic of the Lower Sonoran Life-Zone. The Beaverdam Wash Subcenter is distinct, however, in having cats claw (*Acacia greggii*) and Joshua tree (*Yucca brevifolia*) restricted to it.

The Canyon Lands Province is one of the most extensive in Utah. Topographically it is greatly diversified consisting of a large plateau area mostly of highly colored rock in which the Colorado, Green and San Juan rivers, and their tributaries, have entrenched themselves, forming tremendously deep canyons with precipitous walls and sheer escarpments. These canyons are U-shaped almost to their headwaters. The diversification physiographically of the province is no more remarkable than the variation exhibited in the mammals which occupy the region. The impact of the barriers, both physical and ecological, caused by the entrenchment of these streams is markedly reflected in the restriction of movement, limitation of range and evidences of evolution *in situ* of many kinds of mammals. This is especially noticeable in those kinds that are sedentary in habits or that are narrowly restricted edaphically. Furthermore, the geographic ranges of many kinds of mammals, known from outside the state, stop at or in this province without extending across or beyond it.

This province is subdivided into the Kaiparowits, San Rafael, Grand Valley, San Juan and Painted Desert subcenters. The first two are situated on the west side of the Colorado and Green rivers, and the last three are on the east side. The Kaiparowits Subcenter is south of the San Rafael Subcenter and the two are indistinctly separated by the Capitol Reef-Water Pocket Flexure. The mammals restricted in Utah to the Kaiparowits Subcenter are essentially the same as those from northern Arizona. They are *Perognathus longimembris arizonensis, Thomomys bottae absonus* and *Dipodomys ordii cupidineus. Peromyscus crinitus stephensi* and *Neotoma lepida monstrabilis,* although not restricted in Utah

to this subcenter, do have the greater part of their range in Utah within this area. The major extent of this subcenter is in Arizona.

The San Rafael Subcenter is one of the more distinctive subcenters of the province because it has acted as a center of differentiation for *Thomomys bottae dissimilis, T. b. osgoodi, Dipodomys ordii sanrafaeli, D. o. fremonti* and *Neotoma lepida sanrafaeli* which have evolved there. This subcenter is not only closer geographically to the Kaiparowits Subcenter than to any other of the province, but certain mammals which occur there also indicate close faunal relationships between them. Wood rats of the species *Neotoma lepida* occur in both western subcenters and in the Grand Valley Subcenter, but are unknown from the San Juan and Painted Desert subcenters. The subspecies *N. l. sanrafaeli* of the San Rafael and Grand Valley subcenters is closely related to *N. l. monstrabilis* of the Kaiparowits Subcenter, and apparently differentiated from an ancestral type which formerly occupied the latter subcenter. The first mentioned subspecies is at present the most northerly recognizable subspecies of the species in eastern Utah. Kangaroo rats of the species *Dipodomys ordii* show similar evidence of relationship of the western subcenters. The subspecies *D. o. cupidineus* inhabits the Kaiparowits Subcenter, and another, *D. o. sanrafaeli,* occurs in the San Rafael and Grand Valley subcenters. These kangaroo rats, as do the wood rats, indicate a close relationship between the western subcenters, because *D. o. sanrafaeli* is closer morphologically to *D. o. cupidineus* than to any other subspecies of *Dipodomys ordii.* Mammals occurring throughout both the Kaiparowits and San Rafael subcenters are *Eutamias quadrivittatus hopiensis, Peromyscus maniculatus sonoriensis* and *Onychomys leucogaster melanophrys.* The occurrence of these subspecies of mammals in both subcenters does not necessarily indicate only close faunal relationship between them, but signifies also that both western subcenters are related faunistically to faunal areas in Arizona.

The Painted Desert Subcenter lies to the east of the Colorado River and comprises that part of San Juan County south of the San Juan River, and the north side of the river as far west as Johns Canyon. Considering the Navajo Mountains and Monument Valley districts of this subcenter collectively, it is distinct in that in Utah, the full species *Perognathus flavus, Perognathus intermedius, Peromyscus nasutus, Neotoma stephensi* and *Microtus mexicanus* are restricted to it. Moreover, certain subspecies, such

as *Thomomys bottae alexandrae, Perognathus apache apache, Perognathus intermedius crinitus* and *Dipodomys ordii longipes,* known to occur to the south in Arizona, have attained the northern limits of their distribution in this subcenter. This region has acted as a center of differentiation; *Perognathus longimembris arcus* has apparently evolved *in situ,* and Mexican voles, while referred to *Microtus mexicanus navaho,* are apparently undergoing differentiation (Benson, 1935:454). In Utah, *Peromyscus maniculatus sonoriensis* reaches its northern limits east of the Colorado River in this subcenter. The Navajo Mountain District, in the extreme western part of this subcenter, merits nominal rank because in Utah, *Thomomys bottae alexandrae, Perognathus intermedius, Peromyscus nasutus, Neotoma stephensi* and *Microtus mexicanus* are endemic to it.

The San Juan Subcenter consists generally of the lowland region of southeastern Utah between the Colorado River, San Juan River and the Utah-Colorado boundary. In its northern reaches, it does include, however, both sides of the Colorado River. Full species limited in Utah to this subcenter are *Cynomys gunnisoni* and *Mustela nigripes.* Endemic subspecies are *Citellus spilosoma cryptospilotus, Dipodomys ordii nexilis* and *Neotoma albigula brevicauda.* The San Juan Subcenter is closely related geographically to the Painted Desert Subcenter, both being east of the Colorado River. This relationship is also indicated faunistically in that both have the following mammals in common: *Sylvilagus nuttallii pinetis, Citellus spilosoma cryptospilotus, Thomomys bottae aureus, Peromyscus boylii rowleyi, Neotoma albigula laplataensis, Neotoma cinerea arizonae,* and *Neotoma mexicana inopinata.* No area in Utah is more distinctive, as concerns mammals, than that east of the Colorado River. Collectively the two subcenters have 10 full species restricted to them; also, nine other species, known to occur elsewhere in Utah, have nine subspecies limited to this area.

The Grand Valley Subcenter is the area south of the Roan Cliffs between the Green and Colorado rivers. Only one kind of mammal, *Thomomys bottae howelli,* is restricted to this area; moreover, this area is distinct in being the only subcenter within the Colorado Plateau Faunal Area which contains *Peromyscus maniculatus osgoodi.* This subcenter is peculiar and merits nominal rank in that it is a "melting pot," containing characteristic mammals from all adjoining areas. *Dipodomys ordii sanrafaeli* and *Neotoma lepida sanrafaeli,* common to the San Rafael Subcenter, from the west side of the Green River, occur also on the east side of the river in the

Grand Valley Subcenter. Mammals characteristic of the southern subcenters such as *Citellus leucurus cinnamomeus, Citellus variegatus grammurus* and *Onychomys leucogaster pallescens* also occur here, as do *Cynomys leucurus, Thomomys talpoides durranti, Thomomys bottae howelli, Perognathus apache caryi* and *Peromyscus maniculatus osgoodi* which are known from more northern and eastern areas.

The Columbia Plateau Faunal Area is extremely restricted in Utah, consisting mainly of the Raft River Mountains in extreme northwestern Boxelder County. Physiographically the area is distinct because it is the only part of Utah within the drainage of the Snake River. Faunistically it is distinct from other areas in Utah in possessing the full species *Citellus beldingi* and *Eutamias amoenus* whose distributional ranges are chiefly in Nevada, Idaho and Oregon. In addition, in Utah, the subspecies *Thomomys talpoides gracilis, Castor canadensis pallidus, Neotoma cinerea alticola* and *Zapus princeps cinereus* are limited to this area. This faunal area is interesting as concerns the Sciuridae, because in addition to the above mentioned sciurids, four full species of chipmunks also occur there. Certain mammals which occur there and also in the Great Basin Faunal Area, such as *Sylvilagus idahoensis, Citellus lateralis trepidus, Eutamias minimus pictus* and *Eutamias quadrivittatus inyoensis,* indicate relationship between the areas. Relationship to the Middle Rocky Mountain Faunal Area is noted also by the occurrence in both areas of *Marmota flaviventer nosophora, Citellus armatus, Neotoma cinerea acraia, Microtus montanus nanus* and *Lutra canadensis nexa.*

The Great Basin Faunal Area is the largest in the state, being made up of nearly all of the western half of Utah. More specifically, the area is bounded on the east by Salt Lake City, on the west by Nevada, on the north by Idaho and on the south by Iron County. Mammalogically speaking, this area is distinct in having the genus *Microdipodops* restricted to it. Moreover, it contains the full species *Sylvilagus idahoensis, Cynomys parvidens, Citellus townsendii* and *Microtus pennsylvanicus* which are not found anywhere else in the state. Furthermore, 16 species known to occur also in other parts of the state, have evolved 42 subspecies which are wholly or nearly restricted to this area. Of the 47 kinds, limited or nearly so, to this faunal area, 14 are subspecies of *Thomomys bottae,* 8 are subspecies of *Dipodomys ordii* and 4 are subspecies of *Dipodomys microps.* The subspecies of these three species appear to have evolved *in situ.* The influence exerted by Pleistocene Lake

Bonneville on speciation in these rodents, which are sedentary and narrowly restricted edaphically is clearly recognizable.

I was tempted during this study to give nominal rank of subcenter to Great Salt Lake and its islands. These islands do have rodents like *Thomomys bottae nesophilus, Dipodomys microps alfredi* and *Peromyscus maniculatus inclarus* which are strictly insular and appear to have evolved *in situ*. I feel, however, that inasmuch as Great Salt Lake is a remnant of Pleistocene Lake Bonneville, and because this ancient lake has operated so importantly in speciation of mammals within the eastern part of the Great Basin, that better understanding of the problems of speciation and distribution would be attained by not considering Great Salt Lake and its islands as distinct from the remainder of the faunal area. The influence of Lake Bonneville, including Great Salt Lake, on speciation is discussed in another section of this report.

The Northern Great Plains Faunal Area attains its western limits in northeastern Utah. That part of Utah within this faunal area is eastern Rich County, northern Summit and Daggett counties, north of the Uinta Mountains, and Uinta Basin, including the greater part of Uintah and Duchesne counties and eastern Carbon County. One full species, *Citellus tridecemlineatus* and 11 subspecies are endemic in Utah to this area. That part of this faunal area involving Rich, Summit and Daggett counties is placed in the Bridger Basin Province. This province is distinct in having *Eutamias minimus minimus, Thomomys talpoides pygmaeus, Perognathus parvus clarus, Dipodomys ordii priscus* and *Mephitis mephitis hudsonica* restricted to it. The Uinta Basin is placed in a province of the same name. Mammals restricted in Utah to this province are *Sylvilagus audubonii baileyi, Citellus tridecemlineatus parvus, Thomomys talpoides ocius,* and *Dipodomys ordii uintensis.* Three other mammals, *Cynomys leucurus, Peromyscus maniculatus osgoodi* and *Lagurus curtatus levidensis* occur throughout the faunal area. The Uinta Basin Province is divided into an eastern (Uintah) and a western (Duchesne) subcenter, which are separated by the Green River. The eastern subcenter has more mammals of the Great Plains Faunal Area than does the western. It is further distinguished from the western subcenter because it possesses mammals such as *Eutamias minimus operarius* and *Peromyscus crinitus auripectus,* which are common to areas farther south, east of the Green and Colorado rivers. The southern elements of the Duchesne Subcenter are, however, those common to southern areas west of the Green River.

PHYSIOGRAPHY AND SPECIATION

Reference to the preceding sections informs the reader that Utah has a varied mammalian fauna (247 kinds), also a varied topography (valleys, mountains, deeply entrenched rivers and rocky deserts), and that the area of occurrence of nearly every kind of mammal coincides with some physiographic province.

To geologists the so-called "everlasting hills" of the poets are but highly transitory structures, and most students of physiography consider the present topographic details as phenomena of the Pleistocene Epoch. Many of the changes in physiography in Utah have occurred in the period of time since the beginning of Pleistocene. Blackwelder (1948:10) who writes ". . . the scenic details of today are mostly of late Pleistocene age,—not only in the Great Basin but the world over," thinks that even less time was required. The thesis of Deevey (1949:1317), in his report upon the biogeography of the Pleistocene, is that "there has been sufficient time, and sufficient transfiguration of geography, for the pre-Pleistocene distribution pattern [of animals] to be completely transformed in a very large number of cases." If the above mentioned tenets are valid, and I consider them to be, then the distribution of Recent mammals in Utah must have been considerably influenced by topographic changes since the beginning of the Pleistocene Epoch. Hubbs and Miller (1948) on fishes, and Dobzhansky (1947) on fruit flies (*Drosophila pseudo-obscura*), have pointed out how the lower taxonomic units of these animals have been influenced during the Pleistocene, and the present study presents corroborative evidence of such influence on the mammals.

My study has lead me to formulate the following thesis:

1.—Pleistocene Lake Bonneville, of great size, and fluctuating level, has importantly affected the distribution and subspeciation of small mammals of both the mainland and the now exposed basin.

2.—The major mountain ranges of Utah have enabled boreal mammals to extend, or retain, their ranges far southward, and have acted as barriers that have prevented many kinds of mammals of the lowlands from crossing to the opposite side.

3.—The Colorado River, and its large tributary the Green River, have markedly influenced the distribution and speciation of mammals, and the influence has been progressively greater down stream to the southern boundary of the state.

4.—Because of secular changes in each of the three physiographic features mentioned above, populations of mammals which are at the limits of their ecological tolerances, and also at the limits of their geographic ranges, have divided into small, terminal populations, which, under semi-isolation, have rapidly evolved into recognizable subspecies.

5.—Sewall Wright's theory of random fixation of nonadaptive characters is supported by the kind and amount of morphological variation of the numerous endemic subspecies, especially those that are semi-isolated or that have linear ranges.

Evidence in support of the thesis stated above is summarized under the following accounts of the three major physiographic features of Utah: (1) Pleistocene Lake Bonneville; (2) central and other mountain ranges; and (3) Colorado River.

PLEISTOCENE LAKE BONNEVILLE

Lake Bonneville formerly occupied the greater part of the western half of the state, an area now referred to as the west desert. At its greatest height, this lake extended from the Wasatch Mountains on the east, to slightly beyond (west of) the Nevadan boundary on the west, and from extreme southern Idaho on the north, to southern Iron County, Utah, on the south.

Almost everyone who perceives the mute evidence of existence of the lake, in the shore lines which still rim its former basin, speculates on, or attempts to understand, the history of this ancient lake. If the bedrock of the Great Basin were to become exposed, it probably would be found not to be a basin at all. It is a basin at present because outlets of its many drainage basins have been closed by sediments resulting from erosion. Bonneville Basin, like the Great Basin of which it is a part, is not a basin in the exact sense, but consists of a group of basins. These smaller basins have different elevations and are separated by mountains and low hills. Geologists generally agree that the mountains between these basins in this region, are types of block mountains, caused by faulting. Sudden elevation of mountains, especially block mountains, results in immediate rejuvenation of the streams and in rapid erosion. This rapid erosion would be further enhanced during periods of aridity by flash floods and cloudbursts, which are characteristic of the region even today. Rapid deposition of sediments into the troughs between these block mountains would soon close the outlets of these valleys and form catch basins. During extremely wet periods, like the Pluvials, these basins filled and overflowed into others, and formed larger lakes that in turn formed still larger lakes. If Bonneville Basin is a group of basins, then Lake Bonneville was formed by the union of many smaller lakes. It is important to have clearly in mind how the lake was formed because its effects upon land mammals are different from what they would have been if there had been but a single body of water.

Physiographic evidence, such as deposits and shore line features, now indicates that Lake Bonneville, with which we are here concerned, was the last of four major lakes which occupied that area within the Great Basin. The first comprehensive report upon the history of Lake Bonneville, was by Gilbert (1890), which was

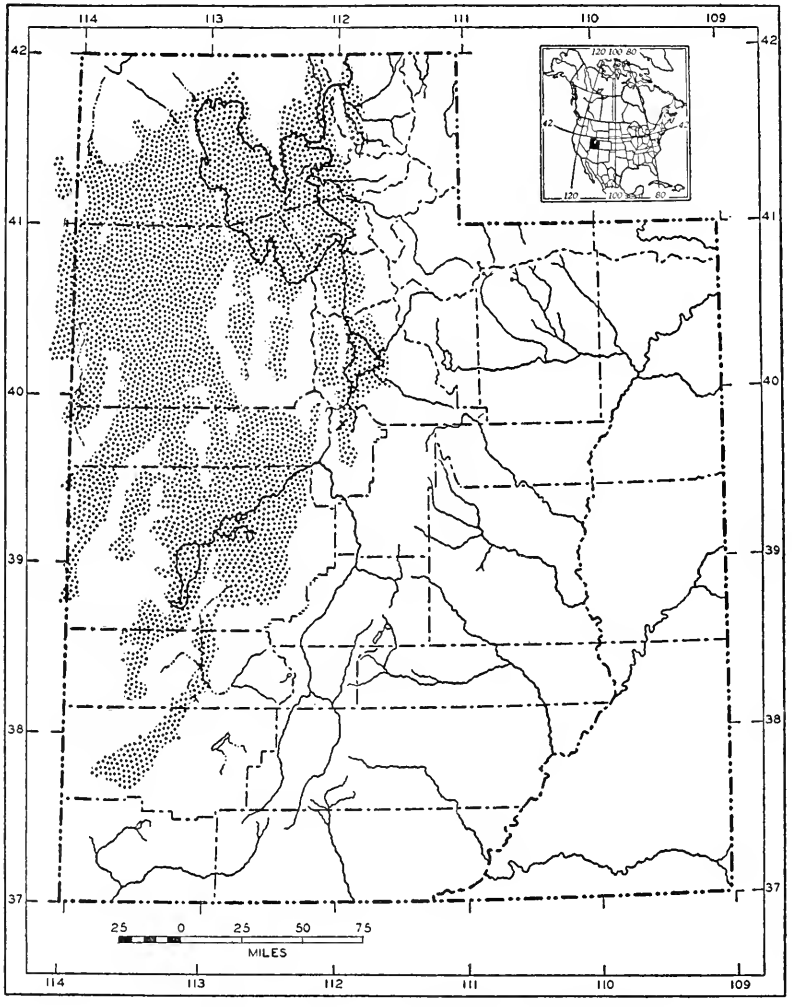

FIG. 91. Pleistocene Lake Bonneville at its greatest height.

reiterated in popular style by Pack (1939). Gilbert thought that Lake Bonneville was a single body of water which overflowed through Red Rock Gap, cut a channel there that lowered the water

to the Provo Level, subsequently, as a result of evaporation, receded still more to the Stansbury Level, and finally to its present level, that of Great Salt Lake. Antevs (1948), however, considers the Bonneville Level to have been followed by a long period of dessication during which the lake receded nearly to the Stansbury Level. This stage was followed by a second pluvial stage in which the water again came back up to the Provo Level, and has since through dessication gone down to the Stansbury Level and then to the level of present Great Salt Lake. Ray E. Marsell, of the Department of Geology, University of Utah (personal communication), as a result of extensive work on the deposits of these Pleistocene lakes, has the following concepts: First, about 70,000 years ago, Lake Bonneville stood at the Bonneville Level for a long period of time, and then receded rapidly to a level even lower than that of the present Great Salt Lake. Second, the lake rose to the Provo Level about 25,000 years ago, then again receded. Third, it yet again came back up to the Provo Level, from whence, during the past 12,000 years, it has receded to the present Great Salt Lake. Furthermore, he does not consider the so-called Stansbury Level as pertaining to any part of the history of Lake Bonneville, but considers it to belong to a more ancient lake. He reasons thus because of its highly eroded shore line, its lack of demonstrable shore lines throughout the basin and because that much of its supposed area is overlaid with deposits of lakes which were older than Lake Bonneville.

The occurrence of these great lakes in western Utah are phenomena of the Pleistocene Epoch, and are considered to have been formed during pluvial periods which are correlated with the Pleistocene glaciations. Antevs (1948) names them the Bonneville Pluvial and the Provo Pluvial, and considers them as corresponding to the Iowan and Mankato glaciations, respectively, and both being parts of the Wisconsin glaciation. When at the Bonneville Level, the lake had an elevation of 5,135 feet (approximately 1,000 feet above the zero level of Great Salt Lake), and covered 19,750 square miles. At the Provo Level, it was 625 feet above the zero level of Great Salt Lake and covered 13,000 square miles.

Unfortunately, it is rarely possible to give as precise data on past physiographic events from studies on distribution of mammals as it is from studies of physiography. Biogeographers have been criticized for the paucity of evidence unearthed by them in support of the findings of the physiographers. I believe, however, that the

present study, especially on pocket gophers, with reference to the impact of Lake Bonneville on their present distribution and speciation, will help somewhat in repaying this debt. I have evidence from the field of mammalian distribution which substantiates the findings of Antevs and Marsell and shows Gilbert to be not wholly correct in his interpretation of the history of Lake Bonneville.

Without doubt Lake Bonneville exerted tremendous effects throughout its entire history upon all mammals within the area. It is understandable that these effects would be more pronounced in mammals of sedentary habits or those narrowly restricted ecologically. The most marked and clearly discernable effects are those demonstrated in the pocket gophers. My attention was first directed to this problem when Hall (1930) named three new kinds of pocket gophers from Utah and Nevada. One kind, *Thomomys perpallidus centralis* [*T. bottae centralis*] was from the western side of the ancient lake, another *T. p. aureiventris* [*T. b. aureiventris*] was from the northwestern side and the third *T. p. albicaudatus* [*T. b. albicaudatus*] was from the eastern side. Later investigations by myself and others disclosed the presence of several endemic kinds of pocket gophers within the basin of Lake Bonneville (see distribution map no. 38). The following discussion of the effects of Lake Bonneville on pocket gophers may be best considered under three phases, pluvial, interpluvial and postpluvial.

During the Bonneville Pluvial, when Lake Bonneville was at its greatest height, the distribution of the two species *Thomomys bottae* and *Thomomys talpoides*, or their immediate respective ancestors, was undoubtedly considerably different than at present. At present, *T. bottae* occurs throughout the entire basin in valleys and on mountains, as well as in the valleys on the adjacent mainland of the ancient lake, excepting those on the northern and northeastern sides; *T. talpoides* occurs on the mountains of the mainland on the northern, western and eastern sides, as well as in the aforementioned northern and northeastern valleys. *Thomomys bottae* is a southern kind, which attains its northern limits in the Great Basin, within the area formerly occupied by Lake Bonneville, whereas *T. talpoides* is a northern kind, which approaches its southern limits in the central mountain ranges of Utah. Pocket gophers of the species *T. bottae* may have occurred as far north as the western and southern mainland of Lake Bonneville in the Bonneville Pluvial, but not this far north, I think, on the eastern mainland. My reasons for this view are that the eastern shore at that time was against the steep face of the Wasatch Mountains, which con-

tained valley glaciers and these mountains were probably already populated by *T. talpoides.* Moreover, the major part of the present geographic range of *T. bottae* on the eastern side was submerged during the Bonneville Pluvial. At present, on the west side, the range of *T. b. aureiventris* extends as far north as Kelton, Boxelder County, whereas on the east side the range of *T. b. albicaudatus* extends only as far north as Farmington, Davis County. North of these mentioned localities, all valleys and mountains are inhabited by *T. talpoides.* During the wet, cold Bonneville Pluvial, all the area surrounding Lake Bonneville as far south as approximately the 39th parallel probably was inhabited by pocket gophers of the species *T. talpoides.* The mountains in Bonneville Basin which were islands during the Bonneville Pluvial were probably for the most part uninhabited by pocket gophers, because the then exposed areas were small, and seem to have been unsuitable for pocket gophers. At present, pocket gophers belonging to *T. talpoides* occur in the colder, wetter habitats, and those belonging to *T. bottae* are found in the hotter, drier environments. Therefore, I consider the major effects of the Bonneville Pluvial to have been the restriction of the northern extension of range of *T. bottae* and to have aided the southern extension of range of *T. talpoides.*

Following the Bonneville Pluvial, the immediate effects of Lake Bonneville on pocket gophers were on populations of the species *Thomomys bottae* only. The major interpluvial was that time between the Bonneville Pluvial and the first Provo Pluvial. The time interval was so short between the two Provo Pluvials that its effect on mammalian distribution was probably minimal. The Bonneville-Provo Interpluvial was of longer duration than the entire subsequent history of Lake Bonneville, and the rapid reduction in the size of the lake and the long exposure of the greater part of its former basin undoubtedly greatly affected the distribution and speciation of pocket gophers. If we can judge events of this interpluvial, as concerns pocket gophers, by what we know to have happened during the Postpluvial, then there must have been considerable extension of ranges of the marginal subspecies, and development of many endemic subspecies on the mountains and in the valleys within the basin of the lake. The Provo Pluvial, at the end of the interpluvial, re-established Lake Bonneville at a level only 335 feet below the Bonneville Level, and would have inundated much land occupied by pocket gophers. While the history of most interpluvial events are obscure or lacking completely, some do remain.

The topography of the basin of Lake Bonneville is such that at the onset of reduction of the lake following the Bonneville Pluvial, a considerably greater area would have been exposed on the western margin than on the eastern. The less precipitous, more gently sloping western margins would have become more quickly available environmentally for pocket gophers than the steeper, rocky eastern margins would have. Pocket gophers then would have been able to extend their ranges faster and farther along the western margins than on the eastern. Consequently, those of the western margins would have been able to become morphologically stabilized long before those of the estern mainland. This greater stability is reflected today in the western kinds. The range of individual and subspecific variation in *T. b. aureiventris* and *T. b. centralis,* from the west is much narrower than in *T. b. albicaudatus* from the east (see Durrant, 1946:38). My study of pocket gophers in Utah indicates that the greatest range of morphological variation is in animals from the least stable environments.

Study of relationship and areas of occurrence of *T. b. lenis* and *T. b. aureiventris* present evidence which substantiates the physiographic findings of Antevs and Marsell on the history of Lake Bonneville and the existence of a Bonneville-Provo Interpluvial. *Thomomys b. lenis* occurs in the Sevier River Valley, on the eastern margins of Lake Bonneville, and *T. b. aureiventris,* its closest relative morphologically, occurs on only the opposite (western) margin of the lake. At present the Sevier River flows southwestward from Lynndyl and empties into Sevier Lake, but formerly flowed northwestward and emptied into the northwestern part of the basin of Lake Bonneville. This latter portion of the basin is at present occupied by pocket gophers belonging to *T. b. aureiventris.* During the Bonneville-Provo Interpluvial, the then exposed valley of this old Sevier River was probably populated by pocket gophers from the western margin of the lake. With the advent of the Provo Pluvial, and the re-establishment of Lake Bonneville, the intervening populations of pocket gophers in this old river valley disappeared, leaving two segments, one in the upper reaches of the Sevier River Valley and the other on the western mainland. Since then, enough time has elapsed to permit these two segments of the population to evolve into distinct subspecies. It might be argued that the development of these two kinds could have taken place during the Postpluvial. My reasons for assigning an Interpluvial origin to these animals are based upon the degree of their morphological differentiation. When Goldman (1942:75) named the kind

now known as *T. b. lenis,* he placed it in the species *Thomomys townsendii* and thought that it possibly merited recognition as a new species. *Thomomys b. lenis* is more widely differentiated from *T. b. tivius, T. b. contractus, T. b. levidensis* and *T. b. albicaudatus,* all subspecies of the eastern margin of Lake Bonneville, than any of the latter are from each other. Here then is noted the existence on the eastern margin of Lake Bonneville of a highly distinctive pocket gopher, the affinities of which are with those of the western margins of the lake. This marked degree of morphological differentiation of *T. b. lenis* probably is the result of a much longer period of time than the Postpluvial, and the gopher probably was isolated from its western relatives at the end of the Bonneville-Provo Interpluvial. Moreover, the four aforementioned subspecies from the eastern margin probably evolved during the Postpluvial.

The Postpluvial, the last period of Lake Bonneville, has endured from the second Provo Pluvial until the present. It is thought to be approximately 12,000 years in duration. Antevs (1948) divides this period into ten millenia and places them in three divisions. The earliest division he names the Anathermal, and thinks that its climate was about the same as that of today. The second, Altithermal, division had a much warmer and drier climate than exists today. The last, the Medithermal, division was somewhat more humid than the Altithermal, and for the past 2,000 years has been becoming drier and warmer. The history of the Postpluvial is the best understood of all and its effects upon pocket gophers are the clearest. With the cessation of the wet, cold climate, at the end of the Provo Pluvial, and the onset of the hot, dry climate of the Postpluvial, the lake receded rapidly. During the Altithermal, which is known to have been the hottest and driest, Great Salt Lake was possibly even lower than at present. These semiarid conditions were favorable to southern mammals such as *Thomomys bottae,* and animals of this species extended their northern limits of occurrence. All valleys and mountains within the basin of Lake Bonneville, except the Oquirrh Mountains, have pocket gophers belonging to the species *Thomomys bottae.* The Oquirrh Mountains, situated in the extreme eastern part of the basin, adjacent to the Wasatch Mountains are populated above the 6,000 foot elevation by pocket gophers of the species *Thomomys talpoides* (see account of *T. t. oquirrhensis*). The retreat of the lake and the subsequent arid conditions over the major part of its former basin, isolated many pocket gophers in localized areas, and enabled them to undergo considerable evolution. Within the basin of Lake Bonneville, nearly every mountain and valley

that has adequate ecological conditions, possesses a population of pocket gophers. Many of them have differentiated sufficiently to be recognized as subspecies. Considerable minor endemism is noted in the numerous local populations. It might be said that the pocket gophers of each mountain and valley within the basin of Lake Bonneville is a recognizable kind. It is extremely difficult at times to decide whether or not the differentiation of these populations has progressed far enough to warrant recognizing them by subspecies names. Several of these local populations are discussed in the account of *T. b. albicaudatus* and *T. b. planirostris.* Undoubtedly many ecological factors, such as water, the amount and texture of the soil and plant cover, are operative in producing an adequate environment for pocket gophers, but, in this western desert, water seems to be the limiting factor. I invariably found pocket gophers where there was water and never found them where it was lacking. Unquestionably, pocket gophers migrate out from these widely separated sources of water during seasonal periods of moisture, such as winter and early spring. These humid areas, however, are widely separated, and distance, in addition to the intense heat and aridity of summer, practically preclude the possibility of regular interbreeding between pocket gophers from these isolated humid areas. Huey (1941:383) pointed out that pocket gophers were enabled to extend their ranges into desert regions by the increased humidity of areas paralleling surfaced highways. I am convinced that these small populations of pocket gophers, which are restricted to these isolated humid areas are relicts, and parallel the fishes of this region (see Hubbs and Miller, 1948).

Study of the morphology and geographic occurrence of the several kinds of pocket gophers of the basin of Lake Bonneville, cause me to think that, following the onset of the Postpluvial, events significant for the pocket gophers were in the following sequence. As aridity of the region increased and the level of the lake receded, animals of the species *Thomomys bottae* advanced northward and established themselves on the now exposed eastern and western margins of the lake. The previously isolated *T. b. lenis* remained essentially *in situ* possibly for ecological reasons. The northern and northeastern margins are inhabited by pocket gophers of the species *Thomomys talpoides.* Those of the eastern margin are of the species *T. bottae;* all four subspecies (*T. b. contractus, T. b. levidensis, T. b. tivius* and *T. b. albicaudatus*) are dark-colored. The subspecies of the western margin, *T. b. centralis* and *T. b. aureiventris,* are light-colored. As the lake gradually receded,

pocket gophers moved into the recently exposed soils as rapidly as environmental situations permitted, and probably occurred entirely around the southern end of the lake. The subsequent increased aridity and the development of desert conditions ultimately permitted them to remain only where there were favorable environments; *T. b. bonnevillei* and *T. b. convexus* are examples. Many of the populations thus isolated around springs and other localized humid areas evolved into distinct subspecies. Their closest affinities are with the marginal stocks to which they are the closest geographically. Consequently *T. b. wahwahensis,* from Wah Wah Springs in the Wah Wah Mountains, is closest to *T. b. planirostris* to the south, and *T. b. sevieri,* from Swasey Spring in the House Mountains, and *T. b. bonnevillei,* from Fish Springs, are closest morphologically to the western marginal stocks, namely *T. b. aureiventris* and *T. b. centralis. T. b. convexus,* from Clear Lake, *T. b. robustus,* from Skull Valley, *T. b. stansburyi,* from Stansbury Mountain, *T. b. minimus,* from Stansbury Island, Great Salt Lake, and *T. b. nesophilus,* from Antelope Island, Great Salt Lake, have their affinities with *T. b. albicaudatus,* the stock on the eastern margin of the lake. Judging from the affinities of these isolated subspecies, it seems to be indicated that migrations into the basin of Lake Bonneville were from east to west and west to east of representatives of the respective marginal stocks. Following these migrations, the terminal populations became isolated in the basin. The effects of Great Salt Lake, a remnant of Lake Bonneville, on speciation in pocket gophers is to be seen in the presence of *T. b. minimus* on Stansbury Island and *T. b. nesophilus* on Antelope Island.

Although the effects of Lake Bonneville upon speciation and distribution of mammals are best seen among the pocket gophers, the effects are seen also in other kinds of mammals. Kangaroo rats (*Dipodomys*) are narrowly restricted edaphically and have been affected nearly as much as have pocket gophers. Unlike pocket gophers, kangaroo rats are not dependent on the presence of free water, but the rats are weak burrowers and are restricted to loose or sandy soil in which they can burrow. Inasmuch as kangaroo rats are inhabitants of hot, semiarid regions, it is questionable whether or not they were present in western Utah during the cold, wet Bonneville Pluvial. In western Utah, during the Pleistocene, the distribution and speciation of both *Dipodomys ordii* and *Dipodomys microps* were affected by the extremes of climate and the concomitant fluctuations of Lake Bonneville. Both the Interpluvial and the Postpluvial exerted considerable effect on *D. ordii,* but

the effects upon *D. microps* are phenomena of the Postpluvial. The rapid establishment of semidesert conditions during the Bonneville-Provo Interpluvial was followed by an influx of *Dipodomys ordii* from the south and west. If we can judge the events of the Interpluvial, by what happened during the Postpluvial, there was considerable isolation of populations, followed by rapid subspeciation. Following the Interpluvial, the cold, humid climate of the Provo Pluvials and the re-development of Lake Bonneville, at the Provo Level, eliminated the animals from the lower part of the basin, now submerged, and caused those of the mainland to retreat southward. This retreat probably was not so far as it was in the Bonneville Pluvial because the lake was smaller. At this time, *D. o. panguitchensis* of the upper Sevier River Valley, and *D. o. fremonti* of the upper Fremont River Valley (formerly of the drainage of the Great Basin) (Gregory, 1947), were isolated. There are two reasons for considering these two kinds as being older and of Interpluvial origin. First, they are completely isolated on the outskirts of the drainage of Lake Bonneville. Second, no other kind within the drainage concerned differs so much morphologically from all other kinds as do these two. By other kinds I am thinking of those of Postpluvial origin. When *D. o. fremonti* was named and described by H. W. Setzer and myself, we at first considered full specific rank for the animal because it differed so much from its relatives. The pocket gopher, *Thomomys bottae lenis,* from the Sevier River valley was initially given specific rank by its describer because the animal differed so greatly from related kinds. Furthermore, *D. o. utahensis,* a subspecies of postpluvial origin is now interposed between the ranges of *D. o. fremonti* and *D. o. panguitchensis* and those of the subspecies which occur in the now exposed bottom of the Lake Bonneville Basin. The history of *D. o. fremonti* and *D. o. panguitchensis,* as now understood, support the view of the physiographers that there was a Bonneville Interpluvial period.

The arid conditions of the Postpluvial period permitted *D. ordii* to repopulate the basin and margins of Lake Bonneville. Reference to the distribution map (page 254), will help the reader to visualize the three categories of subspecies that exist in the Postpluvial period with reference to Lake Bonneville. They are the kangaroo rats of the mainland, those of the exposed margins of the lake, and those of the exposed bottom of the basin. The subspecies of the mainland are the dark-colored *D. o. columbianus, D. o. fetosus* and *D. o. cinderensis,* which occur to the west, southwest and south, respec-

tively. The margins of the lake became exposed as the lake receded and *D. o. utahensis* evolved from the aforementioned complex of dark mainland animals. *Dipodomys ordii utahensis* occupied the now exposed eastern and northern margins of the lake. On the now exposed western and southern margins, which were more extensive than the eastern because of their topography, *D. o. celeripes* evolved from the ancestral mainland type of which *D. o. columbianus,* the present subspecies of the western mainland, is a modern representative. The margins of the present geographic ranges of *D. o. utahensis* and *D. o. celeripes* coincide closely with the margins of Lake Bonneville at its level during the Provo Pluvials. When the lake receded to the present level of Great Salt Lake, the major part of the bottom of the basin became exposed. The ensuing arid climate soon rendered most of the exposed floor environmentally suitable for kangaroo rats, and three subspecies, *D. o. marshalli, D. o. pallidus* and *D. o. cineraceus* have evolved there. Speciation in these kangaroo rats apparently requires a relatively shorter period of time than usually has been supposed. Comparative morphological studies indicate that *D. o. marshalli,* which now occupies the western, southern and southeastern shores of Great Salt Lake has been derived from *D. o. utahensis* or its immediate ancestor, which inhabited the mainland along the eastern margin of the lake. In turn, *D. o. cineraceus* appears to have then differentiated from the ancestor of *D. o. marshalli.* Also *D. o. pallidus,* the range of which occupies the western bottom land of the ancient lake, and is adjacent to that of *D. o. marshalli,* is more closely related morphologically to *D. o. marshalli* than to any other subspecies.

As already noted, Lake Bonneville markedly influenced the distribution and speciation within the species *D. ordii,* both during the Interpluvial and Postpluvial periods. The effects of the lake upon the other species of kangaroo rat (*Dipodomys microps*), the chisel-toothed kangaroo rat, which inhabits the area, are limited to the Postpluvial period. The easternmost record of occurrence is on the west side of Utah Lake. *D. microps* seems to have entered the Bonneville Basin from the west, and only recently, since they do not occur in nearly all of the habitat that seems suitable for them. Consequently, in the basin, there has been less subspeciation in *D. microps* than in the more widely distributed *D. ordii.* Nevertheless, some differentiation of the terminal populations into subspecies has occurred along the extreme eastern limits of the species and this appears to be correlated with the presence of Great Salt Lake and

its islands. *Dipodomys microps russeolus* occurs on Dolphin Island, *D. m. alfredi* occurs on Gunnison Island, and *D. m. subtenuis* occurs on Carrington Island and also on the mainland as far south as the west side of Utah Lake. The entire remainder of the basin of Lake Bonneville, inhabited by animals of this species, is populated by those referable to *D. m. bonnevillei.* It is noteworthy, that Dolphin Island and Carrington Island are periodically connected with the mainland, but this is not true of Gunnison Island. Also the endemic subspecies (*D. m. alfredi*) on Gunnison Island is considered the best differentiated of any of the species.

Other heteromyid rodents such as kangaroo mice (*Microdipodops*) and pocket mice (*Perognathus*) have also been affected by Lake Bonneville. No evidence exists with reference to their history before the Postpluvial. With the last recession of Lake Bonneville, kangaroo mice (*M. megacephalus*) entered the area and differentiated. The southwestern mainland is inhabited by *M. m. paululus,* and the now exposed southwestern part of the basin contains the pallid *M. m. leucotis.*

Three species of pocket mice, *Perognathus parvus, Perognathus longimembris* and *Perognathus formosus,* occur within the basin of Lake Bonneville. Only *P. p. olivaceus* occurs everywhere within the basin. *Perognathus l. gulosus* is restricted to the western margins, where it apparently evolved, and *P. f. incolatus* is an endemic kind of the southwestern part of the basin.

Throughout the existence of Lake Bonneville, changes in its level probably changed the distribution of all mammals of the region. The families Geomyidae and Heteromyidae were affected more in this respect than other families of mammals. The main effects of the lake on the Sciuridae was prevention of migration into the area. Although some suitable habitats exist on mountains within the basin of the lake, no members of the genera *Glaucomys* or *Tamiasciurus* occur there. Only one sciurid, *Eutamias minimus pictus,* is endemic to the basin. Say chipmunks (*Eutamias quadrivittatus*) occur on mountains at the margin of the basin, but not on those within the basin. *Citellus townsendii mollis, Citellus leucurus leucurus* and *Citellus lateralis trepidus,* of western Nevada, possibly were excluded from the basin when the lake was present, but since its disappearance probably entered the basin and certainly occur throughout it now. The effects on the Cricetidae, are similar to those on the Sciuridae, except that more subspeciation occurred. *Onychomys leucogaster utahensis, Neotoma lepida marshalli, Peromyscus maniculatus inclarus* and *Microtus montanus*

nexus are restricted to the basin and seem to have evolved there. No families of mammals, other than those already mentioned, have endemic kinds within the basin of the lake. When it was present, the lake acted as a barrier restricting their dispersal. Since its disappearance, they have invaded the basin and established themselves in suitable habitats.

GREAT SALT LAKE

No account of the history of Lake Bonneville and its effects upon mammals would be complete without some comments on its surviving remnant, Great Salt Lake. Studies of this lake, as they pertain to mammals, have a two-fold significance: first, the effects of Great Salt Lake on distribution and speciation and second, the vista it unfolds in miniature of the effects of the large parent, Lake Bonneville. Five papers have appeared on mammals of Great Salt Lake and environs, Durrant (1936, 1939b), (Goldman, 1937, 1939b) and Marshall (1940). In all 15 new kinds were described from the islands in the lake and from the surrounding mainland. Although some are placed in synonymy in the present paper, and although some others are of questionable validity, seven distinctive subspecies appear to have evolved in this region. They are: *Thomomys bottae nesophilus, T. b. minimus, Dipodomys microps alfredi, D. m. subtenuis, Dipodomys ordii marshalli, Neotoma lepida marshalli* and *Peromyscus maniculatus inclarus.* Great Salt Lake belongs to the late Postpluvial, and according to Antevs (personal communication) is no older than 2,000 years. Consequently, these subspecies of mammals now recognized as being endemic to the islands in the lake are no older. Those subspecies of mammals that have evolved on the islands in Great Salt Lake, and especially those on islands that have emerged only recently, give us a time scale on how long it takes some kinds of mammals to undergo subspeciation. Moreover, they enable us, in part at least, to interpret some of the effects of Lake Bonneville.

CENTRAL AND OTHER MOUNTAIN RANGES

There are several kinds of mountains in Utah that have importantly influenced the present distribution and speciation of mammals. The main mountains are the high north-south central chain, consisting of the Wasatch, San Pitch, Pavant, Wasatch Plateau, Fishlake, Tuchar, Canyon, Markagunt Plateau, Pine Valley and others, which generally separate the two large drainage basins

(Colorado River and Great Basin) of the state from each other, and divide the state into nearly equal halves east and west; and the Uinta Mountains which are the largest mountains on the North American continent that have their long axis in an east-west direction. In addition to those already mentioned, several isolated mountains, such as the La Sal, Abajo, Henry and Navajo, have acted as centers of differentiation and contain endemic subspecies of mammals.

In Utah, mountains have influenced mammals by restricting the dispersal of the lowland kinds, and by enabling northern kinds to extend or retain their ranges far southward. Also, the constantly changing physiography and temporary nature of the mountains have enhanced their function as barriers, enabling terminal segments of populations to undergo differentiation.

With the exception of Navajo Mountain and the Henry Mountains, all others discussed here comprise the Middle Rocky Mountain Faunal Area and the Southern Rocky Mountain Faunal Area. The Wasatch Mountains, Uinta Mountains and the north-south directed central high plateaus make up the Middle Rocky Mountain Faunal Area. The Wasatch Mountains and the central high plateaus comprise a chain that has enabled such northern mammals as the vagrant shrew (*Sorex vagrans*), dusky shrew (*Sorex obscurus*), snowshoe rabbit (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), flying squirrel (*Glaucomys sabrinus*), northern pocket gopher (*Thomomys talpoides*), red-backed mouse (*Clethrionomys gapperi*), heather vole (*Phenacomys intermedius*), big-footed meadow mouse (*Microtus richardsoni*), jumping mouse (*Zapus princeps*), ermine (*Mustela erminea*), mink (*Mustela vison*), marten (*Martes caurina*), Canada lynx (*Lynx canadensis*) and moose (*Alces americanus*), to extend their areas of occurrence far southward in this area. Moreover, they have been operative as centers of differentiation, particularly in kinds having linear ranges. In addition, they have been operative in connection with the Colorado River, in forming a troughlike area, between their eastern slopes and the river, into which many mammals of southern occurrence have been funnelled in their northward extension of ranges (Kelson, MS).

The Uinta Mountains have prevented the dispersal of lowland mammals in north and south directions. These mountains have isolated some kinds of mammals of the Bridger Basin from those in the Uinta Basin. Like the Wasatch Mountains and the central high plateaus, the Uinta Mountains contain the aforementioned

northern kinds and are centers of differentiation for certain subspecies.

The Wasatch Mountains proper, which comprise the Wasatch Mountain Province, extend from Alexander, Idaho, south to Mount Nebo in eastern Juab County, Utah. They are separated from the Uinta Mountains by a high nonglaciated mountain valley, and from the central high plateaus by Sanpete Valley and the Sevier River.

Geologists disagree as to the stratigraphic and chronological relationships of the Wasatch Mountains with the Uinta Mountains and the central high plateaus. It is obvious that the Wasatch Mountains are physiographically distinct from the others. Fenneman (1931) considered the Wasatch Mountains to be chronologically related to the Uinta Mountains, but, at a later date gave it as his opinion that the Wasatch Mountains were younger. Judging from the erosional features, the Wasatch Mountains are younger than the others. The occurrence and distribution of mammals, sheds but little light on the age of these mountains. Subspecies of *Tamiasciurus hudsonicus* and *Citellus lateralis*, nevertheless, signify that the Wasatch Mountains differ faunistically from the Uinta Mountains and the central high plateaus. Among the plants, evidence of the difference between the Wasatch Mountains and the Uinta Mountains and the central high plateaus is the absence of western yellow pine (*Pinus ponderosa*) in the Wasatch Mountains and its presence in both the Uinta Mountains and the central high plateaus. The mammals, *Tamiasciurus hudsonicus ventorum* and *Citellus lateralis castanurus*, occur in the Wasatch Mountains and also to the north in Idaho, whereas *T. h. fremonti* and *C. l. lateralis* occur in both the Uinta Mountains and the central high plateaus, as well as to the east in Colorado.

The northern reaches of the Wasatch Mountains are barriers to lowland mammals of the Great Basin and the Bridger Basin, and separate the ranges of such subspecies as *Perognathus parvus olivaceus* and *P. p. clarus*, and *Peromyscus maniculatus sonoriensis* and *P. m. osgoodi*. The southern reaches of these mountains separate *Thomomys bottae levidensis* of the deep, narrow Sanpete Valley, of the eastern drainage of the Great Basin from *T. b. albicaudatus* of the broad, open Bonneville Basin.

The Oquirrh Mountains, now practically isolated topographically from the Wasatch Mountains, are related to them faunistically. Structurally, the two mountain masses are connected by the low Transverse Range which is considered by geologists as a down

drop block, through which the Jordan River has cut a narrow, deep channel, referred to as the Jordan Narrows. Both mountain masses contain closely related subspecies of northern mammals. *Thomomys talpoides wasatchensis* occurs on the Wasatch Mountains and *T. t. oquirrhensis* occurs on the Oquirrh Mountains, and *Zapus princeps utahensis* occurs on both mountains. It is difficult to explain the occurrence of representatives of these montane species, especially that of *Zapus princeps utahensis,* because the intervening area between the mountains is uninhabitable to them and the Jordan River has deeply entrenched itself in the Transverse Range. The problem becomes more perplexing in trying to account for the present distribution of the ground squirrel *Citellus armatus.* This species, which occurs on the Wasatch Mountains, is unknown from the Oquirrh Mountains, although suitable habitats appear to exist on the interconnecting Transverse Range. The narrowly restricted jumping mouse, and the northern pocket gopher probably gained access to the Oquirrh Mountains before these mountains became isolated topographically. Except for a few marginal occurrences, the species *Citellus armatus* is in general restricted to the Wasatch Mountain Province, and only recently began extending its range beyond the province. Many northern mammals occur in all three provinces of the Middle Rocky Mountain Faunal Area, and the sciurids, subspecies *Tamiasciurus hudsonicus ventorum* and *Citellus lateralis castanurus* and the species *Citellus armatus,* although occurring farther north than Utah, in that state are practically restricted to the Wasatch Mountains. These animals are late arrivals in the area. Kelson (MS) arrived at the same conclusions with reference to the first two aforementioned subspecies. The foregoing data on mammalian distribution and the data on the youth of erosional details of the Wasatch Mountains proper indicate that they are distinct from, and of more recent origin than, the Uinta Mountains and the central high plateaus.

The Oquirrh and Wasatch mountains have functioned in speciation in that each mountain mass has an endemic subspecies of northern pocket gopher. Kelson (MS) considers the Wasatch Mountains to be the center of differentiation for the "wasatchensis" complex of northern pocket gophers. This complex contains *T. t. wasatchensis* of the Wasatch Mountains, *T. t. uinta* of the Uinta Mountains, *T. t. gracilis* of the Raft River Mountains and *T. t. oquirrhensis* of the Oquirrh Mountains.

The Uinta Mountains, the long axis of which lies east and west,

are a simple uplift arch, approximately 150 miles long and 30 miles wide. These mountains parallel the southern Wyoming-Utah boundary and break off into Split Mountain to the east. Although they attain heights in excess of 13,000 feet, their topography, gently rolling crests and high plateaus, bespeak maturity. In this maturity, they resemble the central high plateaus, but differ markedly from the greatly dissected Wasatch Mountains proper.

The Uinta Mountains are barriers separating the ranges of lowland mammals like *Dipodomys ordii priscus* of the Bridger Basin in southern Wyoming from *D. o. uintensis* of the Uinta Basin in northeastern Utah. Furthermore, the Uinta Mountains have also enabled the previously mentioned boreal mammals to extend their ranges southward. Evidence that the Uinta Mountains are a center of differentiation is that *Thomomys talpoides ravus* appears to have evolved *in situ*. Kelson (MS) has pointed out that the Uinta Mountains constitute an area in which northern pocket gophers of three complexes converge. In fact the different "complexes" of gophers meet here. They are *T. t. uinta* of the "wasatchensis" complex, *T. t. ravus* of the "bridgeri" complex, and *T. t. ocius* of another complex. *T. t. pygmaeus,* closely allied to *T. t. ocius* also enters this area. As pointed out by Kelson (MS), each subspecies of pocket gopher within the Uinta Mountains is morphologically closest to a subspecies the geographic range of which is outside the mountain area, and each range lies in a different direction from the mountains.

The High Plateau Province consists of the Northern High Plateau Subcenter and the Southern High Plateau Subcenter. The former contains the Wasatch Plateau and the Sanpich Mountains, and the latter contains all central mountains south of the Sevier River, to the southern boundary of the state. Like the Uinta Mountains, these central high plateaus have a gently rolling topography indicative of Pliocene derivation. The great uplift began in Pliocene time and was so rapid that these already mature mountains were elevated to considerable heights without much obvious alteration. The flanks of these mountains are deeply dissected, and at their southern ends cliffs have formed with the result that these mountains break off to the desert floor in a series of escarpments, each approximately one thousand feet high.

These central highlands separate several kinds of mammals in the Great Basin from closely related kinds in the drainage basin of the Colorado River. Examples are *Citellus leucurus leucurus* and *Cynomys parvidens* of the Great Basin, and *Citellus l. pennipes* and *Cynomys leucurus* of the Colorado River drainage. Many

boreal mammals of this area attain their southern limits of distribution within this province. The High Plateau Province, being the southern terminal province of the Middle Rocky Mountain Faunal Area, has functioned more importantly in speciation of mammals of essentially northern occurrence, than have the other provinces of this faunal area. Considered together, both subcenters of this province have 9 endemic subspecies of montane mammals of which 8 are in the Southern High Plateau Subcenter. They are *Ochotona princeps cinnamomea, O. p. fuscipes, O. p. utahensis, Tamiasciurus hudsonicus dixiensis, Marmota flaviventer engelhardti, Eutamias quadrivittatus adsitus, Thomomys talpoides moorei, T. t. parowanensis* and *T. t. levis.*

In considering the time factor involved in speciation of the aforementioned subspecies, and the impact of physiography upon them, it must be remembered that this province consists of disjunct mountains. In attempting to account for the endemism to which montane mammals have been subjected in this area, the evidence lends itself to at least two interpretations. As the mountain masses rose in Pliocene time and as ecological changes ensued, boreal mammals, that is to say those of more northerly occurrence, may have extended their ranges far southward. The several endemic subspecies of boreal mammals on the now disjunct mountains may have resulted from the isolation of populations by the eroding out of the intervening valleys. To my mind, another, alternate interpretation, which precludes the necessity of going as far back in time as the Pliocene for the origin of the subspecies of montane mammals on the disjunct mountains, is better. It is that during the cold, wet pluvials and their concomitant ecological changes, when large bodies of water like Lake Bonneville were formed, these montane mammals probably were able to descend to lower elevations and cross over from one mountain to another. With the onset of dessication and the development of desertlike conditions during the interpluvials, these mammals ascended the mountains and the previously more or less continuous population became divided into smaller segments. These segments of the population became comparatively isolated on the several mountains when the intervening areas became deserts during the interpluvials. With the onset of another pluvial period, the isolated, terminal populations became reunited and their generic differences resulting from endemism were probably swamped out in the general population. This pluvial period was followed by another dry period and events would be repeated, admittedly not always in the same way or degree.

My reasons for considering the present endemism among these montane subspecies as having occurred during the past 2,000 years (Medithermal, Antevs, 1948), are based upon the degree of morphological differentiation exhibited between them. The degree of morphological distinction among the present mammals of these highlands, and especially pocket gophers, is no greater than it is among those of the exposed margins and the basin of Lake Bonneville, which are known to be of Medithermal time (see discussion of Lake Bonneville).

The High Plateau Province is the most significant area in Utah in which to observe speciation in mammals having essentially linear distributions, and also one in which opportunity is afforded to evaluate the worth of subspecific characters as concerns natural selection. Some investigators, notably Grinnell (1927:353), consider *all* characters which distinguish subspecies as being adaptive and functional in existence. I cannot agree that subspecific characters are *always* adaptive. Genetic stability results in species characters which are undoubtedly under selective pressure. Personally, I doubt, however, that any measure of the ecological components of the environment, say, between those of the northern pocket gophers *Thomomys talpoides moorei* of the Wasatch Plateau, *T. t. parowanensis* of Iron Mountain and *T. t. levis* from the Fishlake Plateau would reveal any significant differences which could be correlated with the distribution of the respective subspecies. The wide range of phenotypic variation exhibited by members of the aforementioned subspecies bespeak a lack of stability within their gene complexes, because several variations appear to be equally successful within their microgeographic ranges. Wright (1940: 172) states that the possibility of nonadaptive differentiation increases much more rapidly in animals having "one-dimensional" ranges than in those having more extensive ranges. The ranges of the aforementioned subspecies of *T. talpoides* and those of *Tamiasciurus hudsonicus* are examples of the "one-dimensional" ranges of which Wright (*loc. cit.*) speaks. Further, owing to partial physiographic discontinuity of the High Plateaus where these subspecies occur, the ranges of the several subspecies are partially isolated from each other and are arranged in a linear series. Dependent upon the differences in their genetic plasticity, and the distance to which they are removed from the parental stock, the terminal (southern) populations have undergone the greatest amount of differentiation and formed small populations with limited, nearly "insular," ranges. Moreover, most of the distinguishing characters

are, to my eye, nonadaptive. This confirms Wright's (*loc. cit.*) concept that random variation and genetic fluctuations are to be expected in small populations. It is of further interest to note that Timofeeff Ressovsky (1940), who is known for his concept of harmonious and stable conditions within gene complexes, in commenting upon fluctuations of small populations, said (p. 118) "They may lead to total disappearance of many genotypes present in low concentrations (irrespective of their selective value), while other rare genotypes may also irrespective of their selective value reach rather high concentrations." It appears also, that the principle of the "biological tension" proposed by Huxley (1939:415) is not applicable to the aforementioned subspecies which have nearly isolated ranges and are few in numbers.

The La Sal and Abajo (Blue) mountains are in southeastern Utah and together comprise the Southern Rocky Mountain Faunal Area. Structurally, they are highly eroded laccoliths of Eocene derivation. Furthermore, they are separated both from each other and from any other mountains. Faunistically, they are related to the Rocky Mountains of Colorado. Because of their isolation within the rocky basin of the Colorado River drainage, they have not functioned as barriers to lowland species. They have been operative, however, like the central mountain ranges of the state, in permitting such montane mammals as *Sorex obscurus, Ochotona princeps, Tamiasciurus hudsonicus, Sciurus aberti, Ursus americanus* and *Martes caurina* to persist in this part of Utah. Indeed, it is signally important that all mammals restricted to these mountains are markedly differentiated, but some of them not sufficiently so as to merit subspecific recognition, at least as judged by the available specimens. *Sciurus aberti navajo* of the Abajo Mountains is one of the most distinctive subspecies of the species. The red squirrels of these mountains, although referred tentatively to *T. h. fremonti,* are in some respects more unlike animals belonging to *T. h. fremonti* from the Uinta Mountains and from Colorado than are those referred to *T. h. dixiensis* from the terminal subcenter of the High Plateau Province. Marmots and pikas from the area, although tentatively referred to *Marmota flaviventer luteola* and *Ochotona princeps saxatilis,* respectively, are among the most characteristic of any found within the state, and also differ considerably from animals from farther east in Colorado, which are referred to the same two subspecies.

Inasmuch as these mountains have always been independent laccoliths, the occurrence upon them of montane mammals which

are most closely related to those found to the east in the Rocky Mountains of Colorado, could not have resulted from a continuous mountainous connection between the La Sal, Abajo and Rocky mountains. The occurrence of these mammals on these isolated mountains resulted not from physiography, but from past climatic factors and their ensuing ecological changes. The best example is the present occurrence of the endemic, relict *Sciurus aberti navajo* on the Abajo Mountains. Durrant and Kelson (1947:81) and Kelson (MS) state that inasmuch as these squirrels are restricted ecologically to yellow pine (*Pinus ponderosa*), more humid climatic conditions in the past must have enabled these trees to occur over a much wider area than at present, and to bridge the now intervening desertlike areas. As aridity ensued, culminating in the present climate of the area, the intervening lowlands became devoid of yellow pines and, consequently, of squirrels, both being reduced to relict populations on the now isolated mountains. I consider neither the "insularity" of these montane mammals nor their degree of morphological distinction, in this instance, to be indicative of great antiquity as concerns isolation. Both Antevs (1948) and Flint (1947:487) are in essential agreement that the maximum warmth of the earth was approximately 4,000 to 6,000 years ago, which would be in the Altithermal (Postpluvial) of Antevs, and of late Pleistocene time. This period of warmth and aridity, as judged from known events in the Great Basin, was of sufficient intensity and duration to cause ecological isolation of montane mammals on the physiographically isolated La Sal and Abajo mountains. Moreover, among others, Blackwelder (1934: 558) considers that the Colorado River is possibly no older than the Pleistocene Epoch, and infers (1948) that the present physiographic features of these mountains are no older. Inasmuch as some subspecies of mammals are completely isolated in the Southern Rocky Mountain Faunal Area, and others are nearly so, and all have small restricted ranges, and all are of small population size, we are again afforded the opportunity of evaluating the kind, amount and significance of the variations exhibited by mammals under these conditions. As I interpret these subspecific variations found in the mammals of these small isolated and semi-isolated populations, they are for the most part nonadaptive. Wright (1940), on purely mathematical probability, has pointed out, that dependent upon gene frequency and the inherent ability to mutate (mutation pressure), the rate of mutation and the fixation of random nonadaptive

variations are more rapid in animals from small semi-isolated populations than in those of large non-isolated ranges.

Navajo Mountain is a laccolith, located just north of the Utah-Arizona boundary, immediately east of where the Colorado River leaves Utah. Unlike the other isolated mountains of the area, it has retained its sedimentary mantle. According to Benson (1935: 446) the mammalian fauna is limited, but shows some affinities with that of the Chuska Mountains and the Mogollon Plateau. The only kind of montane mammal found on both the Navajo Mountain and the Mogollon Plateau was *Microtus mexicanus.* He especially noted (p. 445), that although suitable habitats existed, no montane sciurids were present on Navajo Mountain, whereas they occur on the Chuska Mountains and the Mogollon Plateau, and thought (p. 446) that the absence of squirrels indicated that Navajo Mountain had been isolated for a long time. I have no way of knowing what Benson meant by long time isolation. I do not, however, consider the isolation of the mountain or the mammals to be of longer duration than the Pleistocene, and possibly no longer than late Pleistocene. Piute, Forbidding and Navajo canyons, which at present isolate Navajo Mountain, are parts of the Colorado River complex, which is thought by Blackwelder (1934:558) to be no older than Pleistocene time. The closest relative of *Perognathus longimembris arcus* of Navajo Mountain is *P. l. arizonensis* (Benson, 1935:451), from the other, north, side of the Colorado River, which in this area, is deeply entrenched. If the river is of greater antiquity than the Pleistocene, Navajo Mountain would have been isolated from territory to the north for a longer period of time than the Pleistocene. Under those circumstances, I would expect the mentioned pocket mice to differ from each other more than they do. The endemic vole, *Microtus mexicanus navaho,* of Navajo Mountain closely resembles *M. m. mogollonensis* of the Mogollon Plateau. The pocket gopher, *Thomomys bottae alexandrae,* of Navajo Mountain is no better differentiated than are other subspecies of *T. bottae* which occur within the basin of Lake Bonneville, and which are known to have evolved within the last 4,000 years. The evidence from distribution and speciation in mammals from this area indicates that the present Colorado River is a young stream no older than the Pleistocene, and possibly is even of late Pleistocene origin.

The isolated Henry Mountains also are independent laccoliths, adjacent to the Colorado River and on its western side, whereas the Abajo Mountains are on the east side of the river at the same latitude. From the little that is known of the mammals of the Henry

Mountains, it seems that the same isolating mechanisms functioned here as in the other isolated mountains of the area. The only endemic mammal is *Thomomys bottae dissimilis,* which so closely resembles *T. b. osgoodi* of the adjacent lowlands as to suggest that *T. b. dissimilis* has undergone differentiation only recently. Northern pocket gophers (*Thomomys talpoides*) do not occur on the Henry Mountains, but are found on Boulder Mountain, only 25 miles to the west of the Henry Mountains, and also on the Abajo Mountains, just across the Colorado River to the east of the Henry Mountains. I doubt that the Henry Mountains have ever been accessible to northern pocket gophers, because the surrounding lowlands probably were already populated by *T. bottae* or its immediate ancestor. Perhaps only recently have the soils of the mountain proper become available and suitable to animals from the surrounding lowlands belonging to *T. bottae.*

The Raft River Mountains in extreme northwestern Utah are the only part of the Columbian Plateau Faunal Area within the state. Like the Uinta Mountains, they lie in an east- west direction. These northwestern mountains have functioned in separating the fauna of the lowlands north and south of them. For example *Citellus beldingi crebrus* and *Eutamias amoenus amoenus* of the Columbian Plateau are separated from *Citellus townsendii mollis* and *Eutamias minimus pictus* of the Great Basin. These mountains seem to have been more important in determining the limits of distribution than as a center of differentiation, since only one endemic subspecies of mammal (*Castor canadensis pallidus*) occurs there. The history of the mammals of these mountains is directly correlated with the history of the Pleistocene Lake Bonneville, since that ancient lake bathed the southern slopes of the Raft River Mountains (see account of Lake Bonneville).

COLORADO RIVER

From the east flank of Boulder Mountain on a clear day, it is possible to see a panorama of nearly the entire basin of the Colorado River in Utah. This is, to my thinking, the most spectacular scenic view of the western United States, and one which enables the mammalogist to appreciate how this river has influenced the present distribution of mammals. As a person gazes over the multicolored rock-desert, the isolated mountains stand in bold relief, and the physiographic effects of the deep entrenchment of the river system are clearly discernible. The Colorado River has entrenched itself in deep canyons which have sheer walls. These canyons are

U-shaped to their headwaters, and the stream occasionally follows a meandering course in the bottom of its gorge. This river system is unusual in that it is superimposed on, and is discordant with, the topography of the region. An adequate description is that of Blackwelder (1934:554) in which he states:

"The Colorado River is in many ways an anomalous stream, but perhaps in no respect more so than in the course it pursues. Rising in the high mountains of Wyoming and Colorado, it traverses a series of wide basins, each of which seem to be an entity almost unrelated to the others. It cuts through the Uinta Mountains and the Colorado Plateau in deep canyons and repeats the act on a smaller scale several times between the mouth of the Grand Canyon and the Gulf of California. It runs south for hundreds of miles, and then for no obvious reason turns abruptly west, crosses northern Arizona, and again turns due southward in an erratic course. It enters the long Salton trough, the southern part of which is occupied by the Gulf of California, not at the upper end of the trench but at one side; and shows its lack of genetic relation thereto by building a delta out into the trough, thus forming the basin which is now occupied by the Salton Lake."

Kelson (MS) has pointed out that beginning at the southern end of the state, the effects of the Colorado River on mammalian distribution and speciation becomes progressively less marked northward. Nowhere throughout the river's course in Utah, are different genera limited to only one side of it; the river has been operative in restricting distribution only of species and subspecies.

Comparisons of the most southern subcenter (Kaiparowits) west of the river, with the most southern subcenter (Painted Desert) east of the river, reveal that the Kaiparowits Subcenter has two species not found in the Painted Desert Subcenter; the Painted Desert Subcenter has 11 species not found in the Kaiparowits Subcenter and 12 species are common to both. With respect to subspecies in these subcenters, the Kaiparowits has 20 not found in the Painted Desert, the latter has 10 not found in the former, and 4 are found in both. Upstream where the San Rafael Subcenter is on the west side of the river and the San Juan Subcenter is on the east side, there is less differentiation in the mammals. The San Juan Subcenter has 8 species and 14 subspecies not found in the San Rafael Subcenter, whereas the latter has 2 species and 10 subspecies not found in the former. Two species and two subspecies occur in both subcenters.

In the area north of the junction of the Green and Colorado

rivers and south of the Book Cliffs, the effects of the rivers upon mammals becomes complex, because two large rivers and 3 subcenters are involved (see map of faunal areas). The San Rafael Subcenter is west of the Green River, the Grand Valley Subcenter is between the Green and Colorado rivers and the San Juan Subcenter is east of the Colorado River. At this latitude, no species occur in the San Rafael Subcenter that are lacking in the Grand Valley Subcenter. Both subcenters have 11 species common to them, of which 10 are found also in the San Juan Subcenter. The San Juan Subcenter has also 5 others which occur only east of the Colorado River and 11 species in common with the Grand Valley Subcenter. Concerning subspecies, the San Rafael Subcenter has 3 in common with the Grand Valley Subcenter, and 5 which do not occur east of the Green River. The Grand Valley Subcenter has 5 subspecies not found in the San Rafael Subcenter, and 2 not found outside the Grand Valley Subcenter. The San Juan Subcenter contains 6 subspecies not found in the other two subcenters and 8 that occur also in the Grand Valley Subcenter. One subspecies (*Sylvilagus audubonii warreni*) occurs in all three subcenters.

It is evident from the aforementioned data that there is progressively less distinction up the river between mammals on its two sides; upstream, the river is less of a barrier to movements of mammals than is the case downstream. Kelson (MS) has pointed out, and I think correctly, that there is a difference in the barrier effects of the Green and Colorado rivers above their confluence. He thought this difference a result of the difference in direction of flow of the rivers. The Green River continues upstream above its confluence with the Colorado River in a north-south direction, paralleling the central mountains, whereas the Colorado River continues upstream in a northeasterly direction. Mammals of northern and southern origin, in extending their ranges south and north respectively, would be impeded by a river at a right angle with the direction of movement, but not by a river which paralleled it.

Within the Uinta Basin, north of the Book Cliffs, the effects of the Green River as a barrier are little evident. The mammalian fauna of this basin is such a mixture of montane and lowland types that the effects of the river, if it had any, are obscured. At this latitude the river is in more open terrain and frequently freezes over. During February, 1950, such large ice jams formed in the river, both at Jensen and Ouray, that for a time the United States Army Air Force contemplated breaking them up by bombing.

One of the most interesting areas within the drainage of the

Colorado River, as concerns mammals, is the drainage basin of the Virgin River. In Utah, this drainage is practically restricted to Washington County. Tributaries such as La Verkin Creek, and the North Fork and East Fork of the Virgin River extend slightly into Iron and Kane counties, respectively. The mammalian fauna of the watershed of the Virgin River is so distinct that the territory is given nominal rank as the Virgin River Valley Province of the Colorado Plateau Faunal Area. It is of additional interest, that within this small province, the mammals of Beaverdam Wash are sufficiently distinct from those from the environs of St. George, that both areas have been given the nominal rank of subcenters (see map of faunal areas). Physiographically, these two subcenters are separated by the Beaverdam Mountains. These mountains and the narrow gorge of the Virgin River (Virgin River Narrows), which traverses them, have functioned importantly with reference to the distribution and speciation of the mammals of the two subcenters. The province is characterized by containing terminal populations of mammals of more generally southern and western occurrence. Furthermore, these terminal populations have differentiated *in situ* into recognizable subspecies. One species (*Dipodomys deserti*), in Utah, is restricted to the Beaverdam Wash Subcenter. The Beaverdam Mountains and the rocky Virgin River Narrows are barriers beyond which *D. deserti* has not extended its range to the seemingly suitable habitats that exist to the east in the St. George Subcenter. Montane meadow mice (*Microtus montanus*) occur in the St. George Subcenter, but to date are unknown from the Beaverdam Wash Subcenter. The terminal population of these meadow mice has evolved *in situ* into a distinct subspecies within the St. George Subcenter. Some subspecies such as *Thomomys bottae planirostris* and *T. b. virgineus,* which occur within the province, are clearly recognizable, but others, such as *Neotoma lepida lepida, N. l. monstrabilis, Dipodomys microps woodburyi, D. m. celsus, Perognathus formosus formosus, P. f. mohavensis, Citellus leucurus cinnamomeus* and *C. l. leucurus,* although recognizable in this area are, at present, undergoing differentiation (see accounts of these subspecies). The Beaverdam Mountains are unquestionably not complete barriers separating the mammals of the St. George Subcenter and the Beaverdam Wash Subcenter. Some kinds undoubtedly cross over the mountains or circumvent them to the north. To the south they would be prevented from going around these mountains by the Virgin River and the Virgin River Narrows. This exchange of animals from the two subcenters, slight to be true, would

permit a trickle of gene flow between these semi-isolated populations of some species. These highly variable populations of closely related subspecies of rodents (see account of *D. m. woodburyi* and *N. l. monstabilis*), demonstrate in nature, the same findings as concerns variation that Wright (1940) postulated from a purely mathematical basis. He demonstrated that in terminal populations which were nearly isolated, but between which some exchange of genes still occurred, that there was a rapid shift in the peaks of random fixation of nonadaptive characters, and that differentiation was rapid. Study of kangaroo rats of the species *D. microps* in this area indicate that the highly variable and poorly differentiated *D. m. woodburyi* is a subspecies *in statu nascendi*, probably as a result of single mutations or combinations of mutations. A consideration of this subspecies causes a person to speculate on how stability might be attained, and whether or not the taxonomic term subspecies may not often denote simply the phenotypic expression of a certain degree of stability within the gene complex of animals of a given geographic range. Furthermore, he must speculate when considering those animals of the population whose phenotypes are not characteristic enough to enable him to be sure of their taxonomic assignments. Some geneticists consider these "non-characteristic" animals as genetic "mosaics", but I do not. Undoubtedly many of these non-characteristic animals are intergrades resulting from interbreeding between animals of the different subspecies of a species at, or near, the margins of their respective ranges. I think also that many others of these animals, both on the periphery and within the range, might be those that are still in the process of genetic fluctuation, and have not as yet evolved or stabilized the diagnostic characters of the subspecies. They may be relatively unmodified representatives of the ancestral stock, or they may be members of the recent population that have not as yet attained sufficient genetic stability to develop the phenotype which is characteristic of the subspecies. Looked at in another manner, if we visualize the entire syngameon of the species as a plateau, and the scattered peaks rising from it as the characteristic gene frequencies of the subspecies (adaptive peaks of Sewall Wright), then these aforementioned subspecifically unstabilized ("non-characteristic") animals would be in the gene frequency valleys between the peaks. Thus they would be more generalized and probably represent the ancestral type. Perhaps this genetic instability in some kinds of mammals has further meaning. It has been my observation in studies of subspecies of *Thomomys talpoides* that

the greatest range of morphological variation within a subspecies was always evident in animals from the least stable environments. For example animals belonging to *T. t. wasatchensis* from the steep sides of Mount Timpanogos, in areas where the soil was poorly anchored were far more variable in details of the skin and skull than were those from the deep stable soils of Heber Valley. It appears to me that this instability of the environment would place a premium on genetic plasticity in contradistinction to genetic stabilization.

The mammals of the Virgin River area, as judged from their great degree of genetic plasticity, which is reflected in their wide range of morphological variation, bespeak no greater antiquity than the Pleistocene and possibly even late Pleistocene.

Throughout this section of the report, I have attempted to present evidence that the many kinds of mammals found in Utah at present are the result of the effects of the highly varied topography upon their distribution and speciation. Also, that the number of subspecies has been increased because the physical barriers have restricted many mammals and they have attained their distributional limits in Utah, and furthermore, their terminal populations have become broken up into smaller populations which under the impact of semi-isolation have undergone rapid differentiation. Moreover, I have attempted to establish a range of time in which the aforementioned phenomena occurred. I consider the present distribution and speciation, as evidenced by the mammals of Utah, to be no older than the Pleistocene, and that the majority of the subspecies are of late Pleistocene origin. For the chronological data, I have utilized those concerning the Pleistocene Lake Bonneville, and have interpreted the data from the other areas from them. Physiographers are generally agreed that the present major topographic features of Utah can be correlated with the Pleistocene Epoch and with the Pluvial and Interpluvial periods. I have, in addition, presented evidence from the study of distribution and speciation of mammals, which will possibly be of assistance to physiographers in evaluating and dating their findings. For example, the present geographic occurrence and the degree of morphological differentiation of mammals support the opinions of the physiographers concerning Lake Bonneville and the Colorado River, but contradict their findings concerning the relationships of the Wasatch Mountains proper, and the central high plateaus of the state.

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