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A study of the Utah pocket mice of the genus perognathus

Merlin L. Killpack
Brigham Young University - Provo

A STUDY OF THE UTAH POCKET MICE OF THE GENUS PEROGNATHUS

A Thesis Submitted to the Department of Zoology and Entomology

In Partial Fulfillment of the Requirements for

The Degree of Master of Science

BRIGHAM YOUNG UNIVERSITY

PROVO, UTAH

By

MERLIN L. KILLPACK

August, 1956

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August, 1956

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INTRODUCTION

The pocket mice treated in this paper belong to the genus Perognathus of the family Heteromyidae. These mice are interesting little mammals found in arid or semi-arid regions of the western half of North America. They are principally nocturnal in habit which makes them unknown to the average individual. Their food consists chiefly of grain and seeds of wild plants found within their habitat. Some of their food is usually stored in their burrows for use during severe weather. It is not known for sure whether or not any of these animals hibernate in the true sense.

The burrows of pocket mice are usually excavated by the animals themselves and the entrances are closed during the day by plugging with soil in a manner similar to the pocket gopher. During the day the wind usually drifts extra soil and removes most of the evidence of their burrows. The burrows made in mellow soil usually run two or three feet in depth and have many branches, winding shafts, storage chambers, and a nest cavity. The animals usually make their burrows in dry brushy areas or along the roadside, where they can find plenty of weed seeds or grain.

Perognathus are small mice ranging in size from a little larger to about half the size of common house mouse. They have elongated hind legs and tail. These mice possess external fur-lined cheek pouches in

which they store food while transporting it to their burrows. They usually molt only once a year which takes place during the late summer.

REVIEW OF LITERATURE

Maximilian, Prince of Wied, (Wied-Neuwied, 1839:369) was the first to discover and describe a pocket mouse from North America. The genus and species name he applied to this animal was Perognathus fasciatus Wied-Neuwied. From the time Maximilian named the first species until 1889 only 5 other kinds had been discovered and named. At that time C. H. Merriam (1889) of the Division of Ornithology and Mammalogy, U. S. Department of Agriculture, saw a need for revising the genus and published a monograph on this group. This constituted the first important paper on the pocket mice of the genus Perognathus.

Although Merriam had less than 200 specimens, he named 12 new species of which 3 were types from Utah. Perognathus olivaceus Merriam was one of the species, collected at Kelton, Box Elder County on October 24, 1889 by Vernon Bailey. It is now known as Perognathus parvus olivaceus Merriam. Another is Perognathus olivaceus amoenus Merriam collected at Nephi, Juab County on November 23, 1888 by Vernon Bailey. It is now considered synonymous with Perognathus parvus olivaceus. The third species was Perognathus formosus Merriam collected on January 2, 1889 at St. George, Washington County by Vernon Bailey. This species still stands as valid without change.

The next and latest revision of this genus was undertaken by

W. F. Osgood in 1900. He had nearly 3,000 specimens on which he based his work. His revision included 34 subspecies belonging to 32 species and making a total of 53 names proposed for this genus up to that time. The latest check list of mammals (Miller and Kellogg, 1955) lists 140 subspecies belonging to 27 species. Five of the 27 species are monotypic and the other 22 are polytypic.

Barnes (1922 and 1927) compiled the first monograph of the mammals occurring in Utah. In his latest publication (1927) he listed 6 species which occurred within the boundaries of the state of Utah. Durrant (1952) published the next monograph of the mammals of Utah. He listed 13 subspecies belonging to 6 species.

The first specimens of the genus Perognathus taken in Utah were collected during the Railroad Survey Projects conducted by the War Department of the United States Government. Baird (1857) obtained a mounted specimen of Perognathus flavus taken on the Grand White River in 1853 by Mr. Kreuzfeldt. The literature is not clear as to the exact location where this specimen was taken, but the Colorado River was formerly known as the Grand River (Cary, 1911). This was probably the first record of the genus Perognathus occurring in Utah. The next person to collect members of this genus within the state was Vernon Bailey, who was working under the direction of Dr. Merriam.

Some of the other noteworthy publications dealing with pocket mice in Utah are Moore (1930), Goldman (1932, 1939), Benson (1935), Hayward (1936, 1941), Hall and Johnson (1938), Huey (1939), Long (1940),

Tanner (1940), Hardy (1945, 1949), Fautin (1946), Bee (1947), Behle and Hansen (1951), and Kelson (1951a, 1951b).

The Brigham Young University mammal collection contains 290 specimens of the genus Perognathus representing 14 subspecies belonging to 7 species. These specimens have been collected since 1931 by staff members, students, and the author.

The family Heteromyidae may be identified by the following characteristics (Durrant, 1952:232):

> Large external fur-lined cheek pouches; rounded ears; large eyes; elongated hind limbs and tail; 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. 1/1, c. 0/0, p. 1/1, m. 3/3.

Osgood's (1900:13) description of the genus Perognathus is as follows:

> Size medium or small; form murine, rather slender; tail nearly as long or longer than head and body; ears small; hind legs and feet rather long; external cheek pouches lined with hair. Skull rather small and light, flattened above; mastoids very large; audital bullae inflated more or less triangular in outline, anteriorly opposed pterygoids; jugals light and thread-like; rostrum attenuate, nasals somewhat tubular anteriorly; infraorbital foramen reduced to a lateral opening in the maxillary. Teeth 20; molars rooted and tuberculate; upper incisors strongly sulcate.

Aims

The objectives of this study were:

1. To make a detailed study of the distribution of the genus Perognathus in Utah.

2. To determine if any species or races not now recorded occur in the state.

3. To bring together notes on life histories of this genus, both from the literature and field studies.

4. To determine habitat preferences of the species represented.

METHODS

Field trips were made to as many parts of the state as possible during the 5 summers allotted to this study. Extensive collections of small mammals were made in all areas visited. The pocket mice, along with other small mammals collected, were weighed, measured, and prepared in the field. Therefore, all skin measurements used in this study were taken from fresh unskinned animals. Standard measuring methods were used which included the total length, length of tail vertebrae, length of hind foot, and length of ear. The system of measuring the skulls used by Durrant (1952:248) was followed. Field notes considered pertinent to this project were kept.

Snap and live traps baited with dry, rolled oats were used in the trapping procedure. The reproductive organs of Perognathus captured in live traps were preserved in Bouins and Worcesters solution. They were

sent to Dr. Kenneth L. Duke, Duke University, for histological analysis.

Miller's and Kellogg's (1955) arrangement was followed in listing the species and subspecies. The numbers of animals listed under specimens examined include all the Perognathus collected regardless of whether skins and skulls were saved. Some specimens were returned to the laboratory in such a condition that it was impossible to save the skins and only a good series was kept where large numbers of animals were taken. Population record sheets which listed all animals trapped, measurements, weights, and ecological notes were kept for all areas. All the specimens that were preserved are in the Brigham Young University collection.

ACCOUNTS OF SPECIES AND SUBSPECIES

Key to the Utah Species of the Genus Perognathus
(Adapted from Osgood, 1900 and Durrant, 1952)

1. Mastoids relatively small, not projecting beyond plane of occiput; audital bullae separated by full width of basisphenoid; fur harsh, often with spiny bristles on rump..... Perognathus intermedius

1'. Mastoids greatly developed, projecting posteriorly beyond plane of occiput; audital bullae nearly meeting anteriorly on ventral surfaces; fur soft with no spines.

2. Antitragus lobed; hind foot more than 20 mm.

3. Side of body with olivaceous line; tail not crested; lateral indentations of mastoid in supraoccipital absent. .....Perognathus parvus

3'. Side of body without olivaceous line; tail crested; lateral indentations of mastoid in supraoccipital present. .....Perognathus formosus

2'. Antitragus not lobed; hind foot 20 mm. or less.

4. Lower first molariform tooth larger than last. .....Perognathus longimembris

4'. Lower first molariform tooth about the same or smaller than last.

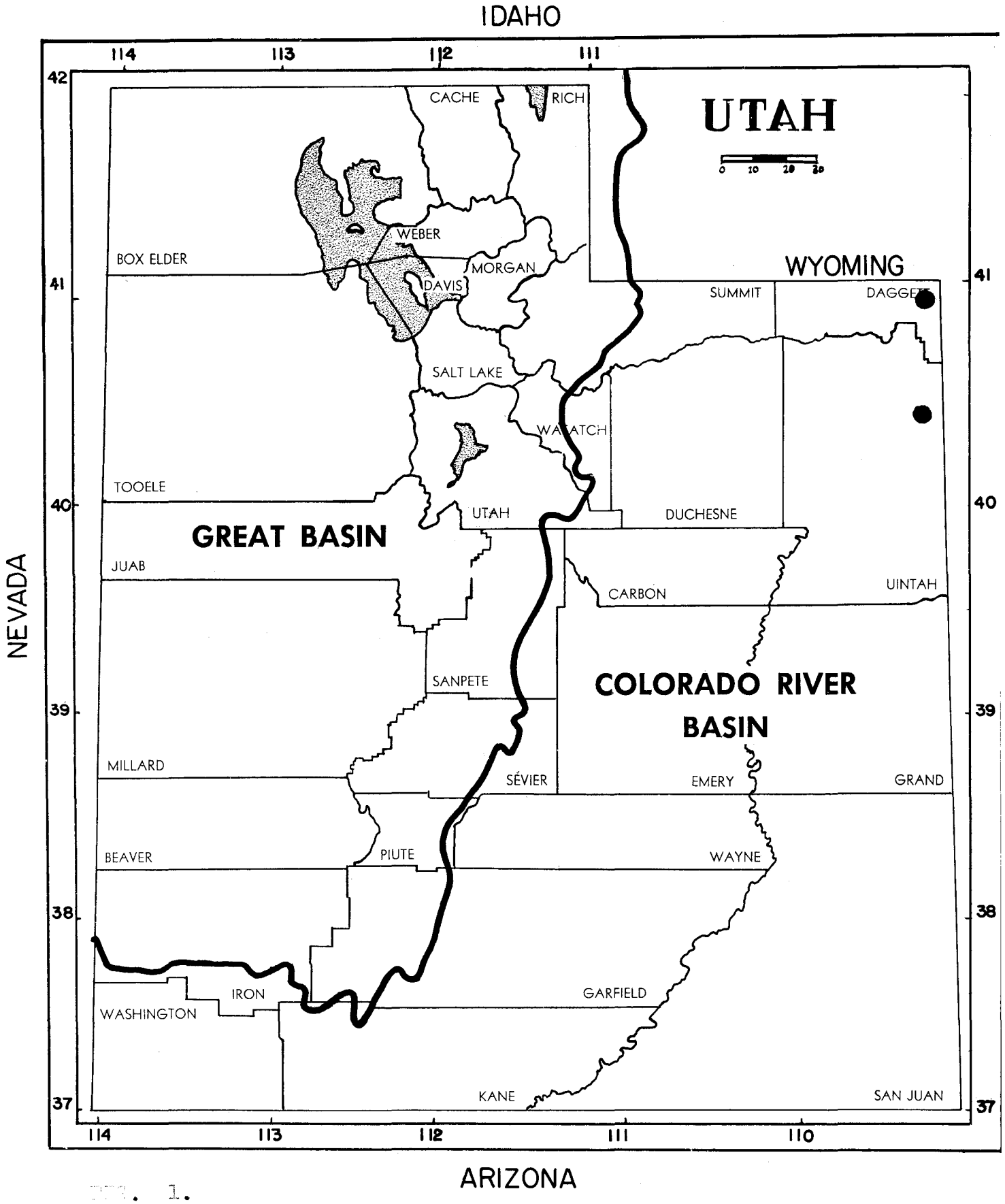
5. Total length less than 130 mm. (115-128); greatest length of skull less than 22 mm. (20.4-21.9); length of nasals 8 mm. or less (7.1-8.0). .....Perognathus flavus

5'. Total length 130 mm. or more (130-160); greatest length of skull 22 mm. or more (22.0-25.7); nasals more than 8 mm. (8.2-9.7).

6. Bullae extending well past the occipital region; tympanic bullae meeting or nearly meeting anteriorly. .....Perognathus apache

6'. Bullae not extending past the occipital or only slightly so; tympanic bullae not meeting at anterior end on ventral side.....Perognathus fasciatus

Fig. 1. Distribution of Perognathus fasciatus callistus.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RICH
WEBER
BOX ELDER
MORGAN
DAVIS
WYOMING
SUMMIT
DAGGETT
SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
GREAT BASIN
JUAB
CARBON
UINTAH
SANPETE
COLORADO RIVER BASIN
MILLARD
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Fig. 1.

PEROGNATHUS FASCIATUS CALLISTUS OSGOOD

Red Desert Pocket Mouse

Perognathus callistus Osgood, North Amer. Fauna, 18:28, Sept. 1900, type from Kinney Ranch, Green River Basin, near Bitter Creek, Sweetwater County, Wyoming.

Perognathus Fasciatus callistus, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:524, Aug. 1, 1953.

RANGE:

This was the first species collected in North America. The first ones were collected in North Dakota. Its range was formerly known to extend from western North and South Dakota west to eastern Wyoming and Montana, north to Manitoba and probably Saskatchewan (Miller and Kellogg, 1955:354), and south into northwestern Colorado. The subspecies found in Utah is Perognathus fasciatus callistus Osgood. The species callistus was first recognized as a subspecies of fasciatus by Jones (1953).

After Osgood (op. cit.) named this pocket mouse it was known only from its type locality until Miller (1928) captured specimens in northwestern Colorado near the junction of the Snake and Bear rivers (the latter is now known as the Yampa River). In the present study the range of this subspecies has been extended about 100 miles south and west into northeastern Utah north of the White River in Uintah County. From northwestern Colorado its range has been extended west into Daggett County, Utah,

north and east of the Green River.

Possibly the White River has served as a barrier to the movements of the genus Perognathus to the north or south. Perognathus fasciatus callistus was found near Bonanza about 10 miles north of the White River and P. apache caryi at Rainbow about 8 miles south of the river in the same kind of habitat. To date apache has not been taken north of the White River or callistus south of the river. The Roan Cliff Mountains extend up into the Canadian Zone in Colorado separating the Colorado River from the head waters of the White River (Cary, 1911). These Mountains possibly have prevented apache from entering this area and crossing the White River at its head waters. The size of the White River at its junction with the Green River may have prevented it from crossing in that area.

The Upper Sonoran Zone, extending from Wyoming down the Snake River across the Yampa River in northwestern Colorado, and southwest into Utah, apparently has been a natural passageway for callistus. The area to the north in Daggett County is similar to that found in northwestern Colorado and has possibly permitted callistus to enter Utah at this point.

COMMENTS ON DESCRIPTION AND VARIATION:

Measurements: Type, total length, 135; tail, 63; hind foot, 18 (Osgood, op. cit.:28). A comparison of the skulls of P. f. callistus and P. apache apache from Wingate, New Mexico by Jones (op. cit.) follows:

Interparietal bone wider in callistus averaging 4.5 (as opposed

to 4. 0) and more pentagonal; lacrimal bone shorter and stouter in callistus; tympanic bullae more inflated in callistus; interorbital foramina larger in callistus; lower premolar approximately the same size as the last lower molar in callistus, approximately half the size of the last lower molar in apache.

In comparing specimens from eastern Utah with those from Wyoming and Colorado, the Utah specimens were larger in body measurements (total length, 142 vs 129; tail, 66. 7 vs 60. 9; hind foot, 18. 8 vs 18. 1). (See Table 1). The interorbital breadth averaged 5. 9 in specimens from Bonanza and 5. 6 in those from Bridgeport as opposed to 5. 3 in the specimens from Colorado. (See Table 2). The interorbital breadth as measured by Jones (op. cit. : 525) taken in Sweet water County, Wyoming, averaged 5. 2. His other skull measurements were very similar to the Utah specimens. Other skull measurements of the specimens collected in Colorado are very similar to those from Utah except in the length of the interparietal which averaged 2. 7 for those in Colorado as opposed to 3. 5 in those from Utah.

Hall (Correspondence) offered the following characteristics by which we might distinguish callistus from P. a. caryi. In caryi the bullae are larger and project farther posteriorly in relation to the occipital region; the tympanic bullae are nearer together at their anterior ends in caryi than they are in callistus; in caryi the lateral line on the skin is broad and buffy, whereas it is narrow and yellow in callistus.

ECOLOGY:

This pocket mouse apparently inhabits flats and gentle slopes in

the Upper Sonoran Zone. Those noted (Warren, 1942:142; and Cary, 1911) and collected (Miller, 1928) in Colorado were on flats and gentle rolling areas containing sage brush, Artemisia tridentata, and greasewood, Sarcobatus vermiculatus. The specimens collected in Daggett County were in a similar habitat. Those taken north of Bonanza were in sage and shadscale, Atriplex sp. The soil in all cases was a gravelly sandy type. In Colorado Warren (op. cit.) and Cary (op. cit.) found callistus burrows under prickley pear, Opuntia sp., or other small shrubs. Miller (op. cit.) caught them in holes along with the pigmy vole, Lagurus curtatus. The specimens from Daggett County were taken in association with Eutamias minimus, Dipodomys ordii, Onychomys leucogaster, and Peromyscus maniculatus.

Of 7 females taken from June 23 to July 8, only 1 taken June 23 at Bonanza, contained 6 embryos, 8 mm. long. None of the 12 specimens taken during the above time was immature.

SPECIMENS EXAMINED:

Total 12 distributed as follows: Daggett County, Bridgeport, 5; Uintah County, 15 miles north of Bonanza, 7.

TABLE 1

SKIN MEASUREMENTS OF PEROGNATHUS FASCIATUS CALLISTUS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Topotype From Kinney Ranch, Sweetwater County, Wyoming					
	131.0	63.0	18.0	-	-
From 2-Bar Springs, West Moffat County, Colorado					
Ave.	129.1	60.9	18.1	-	7
Min.	122.0	56.0	18.0	-	-
Max.	134.0	75.0	19.0	-	-
15 Miles North of Bonanza, Uintah County, Utah					
Ave.	142.7	66.0	18.9	7.7	7
Min.	134.0	62.0	18.0	7.0	-
Max.	148.0	70.0	19.0	9.0	-
Bridgeport, Daggett County, Utah					
Ave.	141.1	67.4	18.8	7.6	5
Min.	133.0	65.0	18.0	7.0	-
Max.	147.0	70.0	20.0	8.0	-

TABLE 2

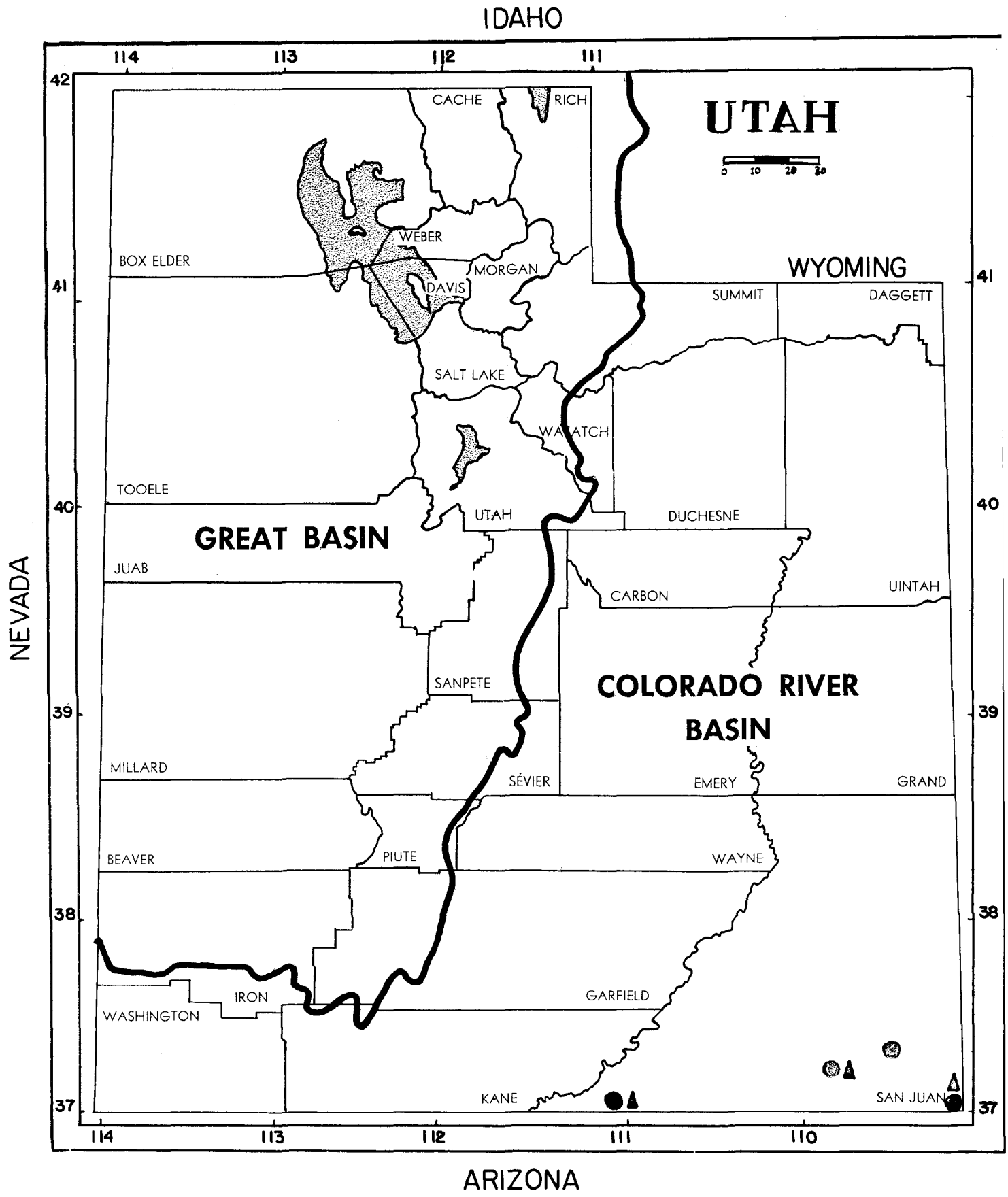
SKULL MEASUREMENTS OF PEROGNATHUS FASCIATUS CALLISTUS

	A	B	C	D	E	F	G	H	I	J	K
Topotype From Kinney Ranch, Sweetwater County, Wyoming											
	23.4	8.5	11.8	12.8	5.8	6.9	7.6	3.4	4.3	3.5	-
From 2-Bar Springs, West Moffat County, Colorado											
Ave.	23.3	8.5	12.5	11.9	5.3	6.7	7.4	2.7	4.4	3.3	6
Min.	22.4	8.0	12.0	11.7	5.0	6.3	6.9	2.2	4.0	3.3	-
Max.	24.3	9.3	12.8	12.6	5.6	6.9	7.8	3.2	4.7	3.4	-
15 Miles North of Bonanza, Uintah County, Utah											
Ave.	23.6	8.8	13.0	12.6	5.9	7.3	8.2	3.5	4.8	3.8	5
Min.	23.2	8.5	12.8	12.2	5.8	7.0	7.9	3.0	4.5	3.5	-
Max.	23.8	9.0	13.2	13.0	6.0	7.6	8.4	4.0	5.0	4.0	-
Bridgeport, Daggett County, Utah											
Ave.	23.7	8.8	12.5	12.4	5.6	6.8	7.4	3.4	5.0	3.5	5
Min.	22.7	8.5	11.6	12.0	5.2	6.5	7.2	3.2	4.8	3.1	-
Max.	24.6	9.3	13.0	12.7	5.8	7.1	7.7	3.7	5.2	3.7	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

Fig. 2. Distribution of Perognathus flavus hopiensis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WYOMING
NEVADA
ARIZONA
GREAT BASIN
COLORADO RIVER BASIN
CACHE
RICH
WEBER
BOX ELDER
MORGAN
DAVIS
SUMMIT
DAGGETT
SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
JUAB
CARBON
UINTAH
SANPETE
MILLARD
SÉVIER
EMERY
GRAND
BEAVER
PIUTE
WAYNE
IRON
WASHINGTON
GARFIELD
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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.

RANGE:

Perognathus flavus is found from eastern Utah and Arizona east to Kansas, north to North Dakota and south into Mexico. Utah has only one representative of this species, Perognathus flavus hopiensis. In Utah this subspecies is apparently confined to San Juan County east of the Colorado River. Specimens have been collected from the San Juan River south to the Utah-Arizona state line. Our present study has extended the collection range north to Montezuma Creek Trading Post which is approximately 15 miles north of the previous records. (See Figure 2).

COMMENTS ON DESCRIPTION AND VARIATION:

Measurements of the type specimen are as follows: Total length, 115; length of tail, 50; length of hind foot, 15 (Goldman, op. cit.). 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; rostrum slender; lower first molariform tooth smaller than last (Durrant, 1952:233).

The specimens (B. Y. U. collection) collected at Bluff and Montezuma Creek Trading Post closely resemble the type specimen. The specimens from the Four Corners are of a larger size resembling Perognathus flavus bimaculatus but the mastoid breadth is smaller as in P. f. hopiensis. Those from the Four Corners have an average total length of 124 (128-120), tail, 59 (61-54), hind foot, 17. (See Tables 3 and 4).

ECOLOGY:

This species seems to be confined to arid regions ranging from 4,500 feet at Bluff to 6,100 feet on the mesa near Navajo Mountain. In Colorado (Warren, 1949:178) P. flavus was taken at 8,000 feet.

In Utah Benson (op. cit.) took hopiensis on the mesa areas only. The ones at the Four Corners were taken on a rocky slope and in sandy bottoms of washes leading into the San Juan River. Those at Bluff were taken on ridges in sandy soil containing fine gravel. Black brush, Coleogyne ramosissima, was the dominant shrub with sparse growths of grass. The area had been heavily grazed.

On the mesa near Navajo Mountain hopiensis was taken in association with Perognathus longimembris arcus and P. apache apache (Benson, op. cit.). Dr. Hayward took only Peromyscus maniculatus in the same area he took flavus. At the Four Corners it was taken along with Peromyscus truei and P. maniculatus. One hundred and seventy-two traps were set at

the Four Corners on August 26, 1953. A total of 20 mammals were caught. Ten of the animals taken were Perognathus, 4 females and 6 males. Four of them were taken in live traps and 6 in snap traps baited with fine rolled oats.

In Colorado Cary (1911:146) caught flavus in sunflower patches. They had sunflower seeds in their pouches and were caught easily using the sunflower seeds for bait. He also found a large amount of seeds stored in their burrows. He seemed to think that flavus were less active on damp nights than on drier nights.

A flavus kept in captivity by Aldous (1930:81) was not observed to drink water. However, it was fond of green foods and stored the grain given to it. Two females put together in the same cage fought, indicating that they may have an intolerance of each other when placed in close proximity. One of the specimens he kept in captivity lived for 5 years.

The young are apparently born between April and June. A female taken in Colorado (Warren, op. cit.) on April 20 contained 4 embryos.

Of the 20 specimens collected by the Brigham Young University 13 were males. None of these animals were immature and none of the females were pregnant. All of the above specimens were collected in June and August except the one taken at the Navajo Trading Post which was a male taken in early May.

SPECIMENS EXAMINED:

Total 22, distributed as follows: San Juan County: Bluff, 2; Montezuma Creek Trading Post, 10; Four Corners, 9; Navajo Mountain

Trading Post, 1.

OTHER RECORDS:

San Juan County: Noland's Ranch, Riverview (Osgood, 1900:25); Bluff, Noland's Ranch, (Goldman, 1932); Navajo Mountain Trading Post (Benson, 1935).

TABLE 3

SKIN MEASUREMENTS OF PEROGNATHUS FLAVUS HOPIENSIS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Type From Oraibi, Hopi Indian Reservation, Navajo County, Arizona					
	115	50.0	15	-	-
From the Four Corners, San Juan County, Utah					
Ave.	125	59.4	17	7.2	5
Min.	120	54.0	17	7.0	-
Max.	128	61.0	17	8.0	-
Montezuma Creek Trading Post, San Juan County, Utah					
Ave.	115	49.0	16	6.0	6
Min.	115	43.0	15	5.0	-
Max.	115	60.0	17	7.0	-
Navajo Mountain Trading Post, San Juan County, Utah					
	117	55.0	16	6.0	-

TABLE 4

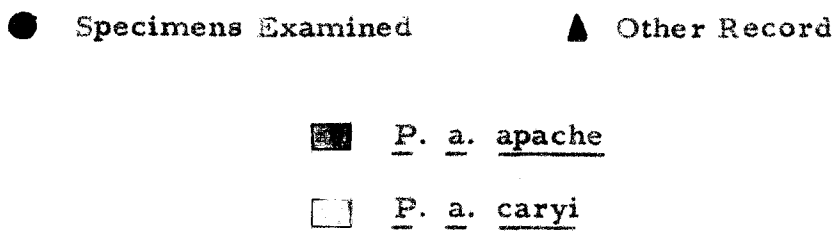
SKULL MEASUREMENTS OF PEROGNATHUS FLAVUS HOPIENSIS

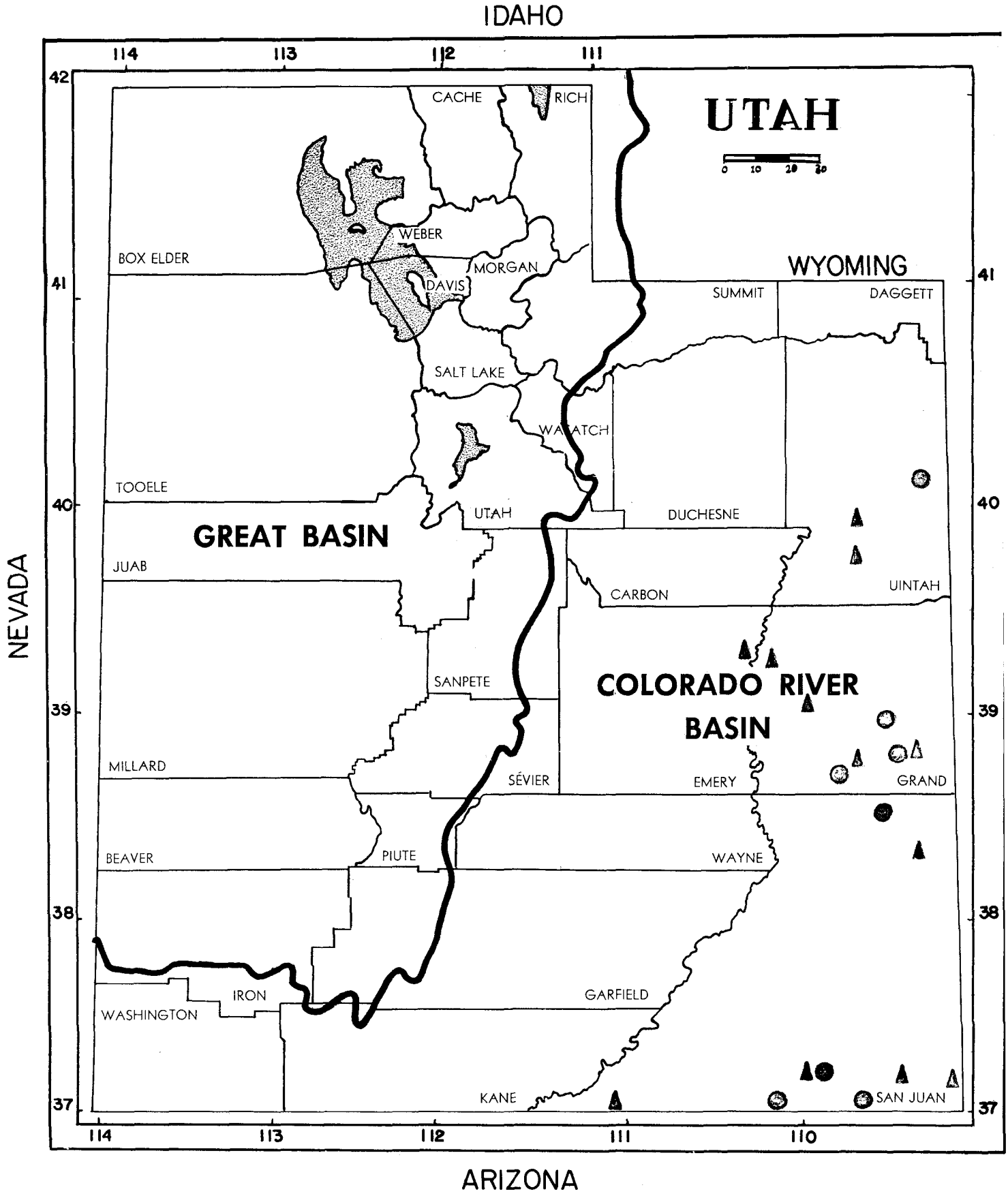
	A	B	C	D	E	F	G	H	I	J	K
Type From Oraibi, Hopi Indian Reservation, Navajo County, Arizona											
	20.4	7.1	10.1	10.9	4.4	5.5	6.9	2.4	3.1	3.0	-
Four Corners, San Juan County, Utah											
Ave.	21.3	7.7	11.4	11.6	4.8	6.0	7.4	3.1	3.4	3.2	5
Min.	21.0	7.5	11.3	11.2	4.6	5.8	6.9	3.0	2.6	3.1	-
Max.	21.9	7.8	11.7	12.0	4.9	6.3	7.7	3.4	3.7	3.4	-
Montezuma Creek Trading Post, San Juan County, Utah											
Ave.	21.1	7.5	11.3	11.3	4.7	6.4	7.0	2.5	3.4	3.3	6
Min.	19.9	7.0	10.4	10.6	4.6	6.1	6.6	2.2	3.0	3.0	-
Max.	21.9	7.9	11.8	11.9	4.9	6.7	7.3	2.9	3.7	3.4	-
Navajo Trading Post, San Juan County, Utah											
	21.6	7.6	11.5	-	4.9	6.4	7.2	2.5	2.9	3.3	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

Fig. 3. Distribution of Perognathus apache.

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ARIZONA
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SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
GREAT BASIN
JUAB
CARBON
UINTAH
SANPETE
COLORADO RIVER BASIN
MILLARD
SÉVIER
EMERY
GRAND
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
WASHINGTON
KANE
SAN JUAN
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PEROGNATHUS APACHE MERRIAM

Apache Pocket Mouse

Perognathus apache apache Merriam

Perognathus apache Merriam, North Amer. Fauna, 1:14, October 25, 1889, type from near Kearns canyon Apache County, Arizona.

Perognathus apache apache, Miller, Bull. U. S. Nat. Mus., 144:275, April 29, 1924.

Perognathus apache caryi Goldman

Perognathus apache Caryi Goldman, Proc. Biol. Soc. Washington, 31:24, May 16, 1918, type from 8 miles west of Rifle, Garfield County, Colorado.

RANGE:

The range of this species extends from west central Colorado and eastern Utah to northern New Mexico and Arizona. With the exception of two records (Kelson, 1951:62 and Stark, 1948:158) all the animals of this species collected in Utah have been east of the Colorado and Green Rivers. Two subspecies are now recognized in Utah.

These two geographical races occupy the eastern side of the state east of the Green and Colorado Rivers. The smaller race, apache, is the population found to the south; while caryi occupies the northern area and the transition between the two is near the San Juan River (Kelson, op. cit.).

Perognathus apache caryi seems to be limited to the north by the White River. As was noted under fasciatus, caryi was found south of the river and callistus north. The East Tavaputs Plateau extends from western Colorado west to the Green River in Utah. This plateau extends into the Canadian Zone in western Colorado and is bounded on the east by the Hudsonian Zone (Cary, 1911). In Utah this plateau has several sections which are around 7,000 feet which would enable apache to move northward to the White River. An interesting project would be a detailed study of the area along the White River to determine the exact extent of the range of these two species, i.e., fasciatus and apache.

COMMENTS ON DESCRIPTION AND VARIATION:

According to Durrant (op. cit.) apache may be distinguished from caryi by being smaller, lighter in color (less cinnamon and black), skull smaller, braincase less inflated, and nasals shorter. The author noted that most of the specimens taken north of the Colorado and east of the Green rivers tended to be more pallid. This is in agreement with Kelson (op. cit.). Contrary to this, however, are the specimens taken by the Brigham Young University at Arches National Monument north of the Colorado River. They are darker and have more buff in the dorsal coloration. All the other specimens taken south of the Colorado River to the Arizona border are also darker with more buff.

The color of the soil in local areas seems to be associated with color variation. The darker specimens were all taken on a darker, reddish sandy soil. Those taken at Cisco and Rainbow were caught on a lighter gravelly

soil and were lighter in color. Hardy (1945:103) and Dice (1937:107, 111), in their studies on effects of soil on coloration of pelage found that the animals tend to be colored in relation to their soil habitat.

One specimen, number 1133, collected at Rainbow contained apparent characters of hybridization. It measured 135 in total length; tail, 60; hind foot, 18; total length of skull, 23.5; and nasals, 9. The average measurements for apache are: total length, 135; tail, 65; hind foot, 18.6; length of skull, 23.6; nasals, 8.6; caryi: 146.2; 71.7; 18.5; 24; and 9.2 (See Tables 5 and 6).

Kelson (op. cit.) and Durrant (op. cit.) noted considerable intergradation in the specimens they examined from the Bluff area and eastward along the San Juan River. They seemed to resemble apache more closely than caryi, therefore, they referred them to the former race. Kelson (op. cit.) also noted some intergradation in the specimens in Uintah County.

Other characteristics of intergradation were noted in the specimens in the Brigham Young University collection. One specimen, number 2451 from Arches National Monument, measured 140 in total length, and 4 other specimens had a total skull length of 24 or more and a nasal length of 9 or more. Although 1 specimen from 22 miles south of Moab measured 146 in total length, the cranial characters resembled apache. The specimens collected at Red Mesa and Monument Valley, San Juan County more closely resemble apache although one measured 141 in total length.

ECOLOGY:

Perognathus apache appear to inhabit more or less sandy areas

from 3,300 feet at Bluff to about 6,500 feet in Uintah County. Those taken at Rainbow were in a sandy wash in the Juniper belt. Sage, Artemisia tridentata, and greasewood, Sarcobatus vermiculatus, were the dominant plants along the bottom and sides of the wash. Those taken ten miles south of Cisco were on a sandy slope containing fine gravel with bunch grass as the dominant vegetation. The more common bunch grasses were Aristida glauca, Oryzopsis hymenoides, and Hilaria jamesii. Some of the other plants were prickly pear, Opuntia sp., shadscale, Atriplex sp., and composites. Out of 700 trap nights, covering three nights of trapping, only 3 animals were taken on this ridge. Two of them were Perognathus which were caught the first night. All other specimens taken were captured in reddish or sandy areas with black brush, Coleogyne ramosissima, greasewood, and joint fir, Ephedra sp. The habitat was very similar to that occupied by Onychomys. Moore (1930:87) and Benson (1935:451) also stated that the specimens they collected were on a sandy soil.

Some of the other animals taken in association with apache were Peromyscus maniculatus, p. truei, P. crinitis (where the ledges and rocky conditions extended into edge of sandy areas), Dipodomys ordii, Reithrodontomys megalotis, and Onychomys leucogaster.

SPECIMENS EXAMINED:

Total of 35 distributed as follows: Uintah County: 1 mile north of Rainbow, 9. Grand County: Arches Nat. Mon., 14; Castle Valley, 3; 10 miles south of Cisco, 4. San Juan County: 22 miles south of Moab, 3; Red Mesa, 1; Monument Valley, 1.

OTHER RECORDS:

(Durrant, 1952:235 unless otherwise noted) Uintah County: Brown's Coral and Willow Creek. Emery County: Pump Station 4 miles north of Green River. Grand County: 1 mile east of Green River; 2 miles east of Highway 160, 6 miles south Valley City; Castle Valley, 18 miles northeast of Moab. San Juan County: John's Canyon, San Juan River 12 miles northwest Mexican Hat; Hatch Crossing, about 30 miles north of Monticello (Moore, 1930:87).

TABLE 5

SKIN MEASUREMENTS OF PEROGNATHUS APACHE

	Total Length	Tail	Hind Foot	Ear	Number Examined
One Mile North of Rainbow, Uintah County, Utah					
Ave.	146.9	69.5	19.1	7.9	9
Min.	135.0	60.0	18.0	7.0	-
Max.	160.0	78.0	20.0	9.0	-
Arches National Monument, Grand County, Utah					
Ave.	133.3	65.3	18.2	-	12
Min.	128.0	62.0	17.0	-	-
Max.	140.0	69.0	19.0	-	-
Ten Miles South of Cisco, Grand County, Utah					
	141.0	76.0	18.0	7.0	-
	150.0	72.0	18.0	8.0	-
Castle Valley, Grand County, Utah					
	142.0	62.0	19.0	-	-
	135.0	70.0	18.0	-	-
Twenty-two Miles South of Moab, San Juan County, Utah					
Ave.	134.0	64.6	18.0	-	3
Min.	126.0	60.0	18.0	-	-
Max.	146.0	71.0	18.0	-	-
Red Mesa and Monument Valley, San Juan County, Utah					
	137.0	65.0	20.0	-	-
	141.0	65.0	19.0	-	-

TABLE 6

SKULL MEASUREMENTS OF PEROGNATHUS APACHE

	A	B	C	D	E	F	G	H	I	J	K
One Mile North of Rainbow, Uintah County, Utah											
Ave.	24.2	9.2	12.9	12.9	5.9	7.0	8.2	3.4	4.8	3.6	9
Min.	22.8	8.6	12.4	12.4	5.6	6.8	7.7	3.3	4.4	3.4	-
Max.	25.7	9.7	13.7	13.5	6.4	7.3	8.6	3.6	5.4	3.9	-
Arches National Monument, Grand County, Utah											
Ave.	23.6	8.9	12.3	12.4	5.9	6.7	7.6	3.4	4.6	3.6	13
Min.	22.0	8.3	11.2	13.3	5.5	6.4	7.2	2.6	4.0	3.3	-
Max.	24.4	9.4	13.1	12.9	6.7	7.0	8.0	4.1	5.0	3.9	-
Ten Miles South of Cisco, Grand County, Utah											
	24.3	9.5	13.1	12.3	5.6	6.5	7.9	3.2	4.6	3.3	-
	23.4	8.6	11.8	11.4	5.5	6.3	7.7	3.3	4.2	3.2	-
Castle Valley, Grand County, Utah											
	24.4	9.1	11.5	12.1	5.0	5.8	6.7	5.0	4.7	3.9	-
	24.0	9.1	12.0	11.9	5.0	5.6	7.4	4.6	4.9	3.2	-
Twenty-two Miles South of Moab, San Juan County, Utah											
	23.7	8.8	12.1	12.0	5.6	6.4	7.7	3.2	5.0	3.7	-
	23.9	8.8	12.6	12.2	5.9	6.5	7.6	3.7	4.6	3.6	-
Red Mesa and Monument Valley, San Juan County, Utah											
	23.3	8.4	10.9	11.9	5.2	6.2	7.3	3.4	4.0	3.5	-
	23.2	8.5	10.7	12.0	5.0	6.7	7.0	3.1	3.9	3.2	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

Fig. 4. Distribution of Perognathus longimembris

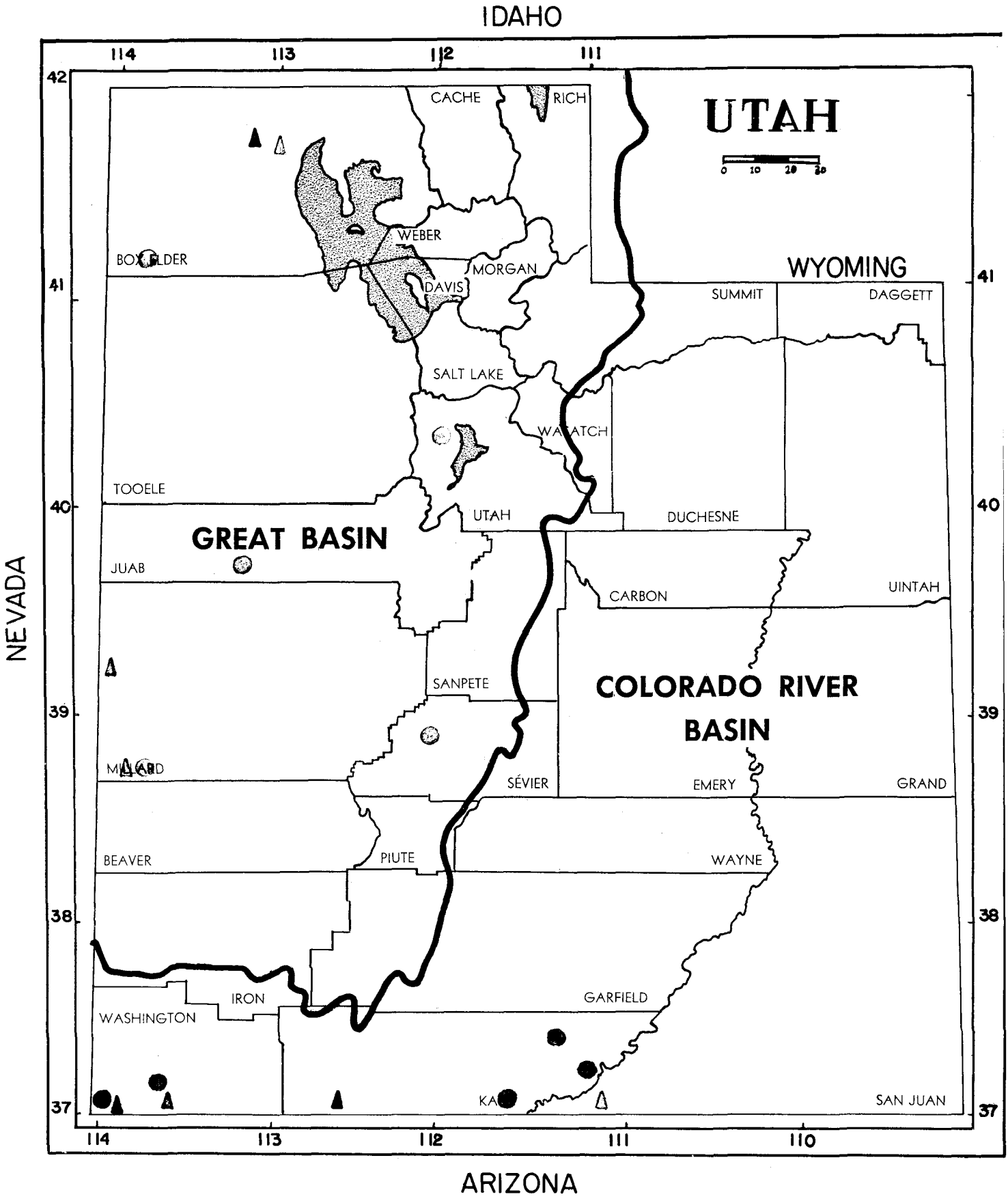
● Specimens Examined ▲ Other Record

P. l. gulosus

P. l. arizonensis

P. l. virginis

P. l. arcus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SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
GREAT BASIN
JUAB
CARBON
UINTAH
SANPETE
COLORADO RIVER BASIN
MILLARD
SÉVIER
EMERY
GRAND
BEAVER
PIUTE
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IRON
WASHINGTON
GARFIELD
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PEROGNATHUS LONGIMEMBRIS (COUES)

Little Pocket Mouse

Perognathus longimembris arizonensis Goldman

Perognathus longimembris arizonensis Goldman, Proc. Biol. Soc. Washington, 44:134, October 17, 1931, type from 10 miles south of the Jacobs Pools, Houserock Valley, north side Marble Canyon of Colorado River, Coconino County, Arizona.

Perognathus longimembris gulosus Hall

Perognathus longimembris gulosus Hall, Proc. Biol. Soc. Washington, 54:55, May 20, 1941, type from one-fourth mile south of Smith Creek, Mt. Moriah, 5,800 feet, White Pine County, Nevada.

Perognathus longimembris virginis Huey

Perognathus longimembris virginis Huey, Trans. San Diego Soc. Nat. Hist., 9:55, August 31, 1939, type from St. George, 2,950 feet, Washington County, Utah.

Perognathus longimembris arcus Benson

Perognathus longimembris arcus Benson, Univ. California Publ. Zool., 40:541, December 31, 1935, type from Rainbow Bridge, 4,000 feet, San Juan County, Utah.

RANGE:

This little pocket mouse is found from southeastern Oregon south to Mexico. It extends east to central Utah and Arizona and west into Nevada and eastern California (Miller and Kellogg, 1955). All but one race, arcus, are found only on the west side of the Colorado River. Four subspecies

occur in Utah.

In Utah longimembris occupies the western portion of the state from the northern to the southern border. In the southern part of the state it extends eastward to the Colorado River with only the subspecies arcus being found on the east side of that river. The population of this subspecies apparently is not very large as it is known only from its type locality and it is the only one of the genus Perognathus not represented in the Brigham Young University collection. See figure 4 for a more detailed description of exact ranges of this species.

P. l. arizonensis is found on the Kaiparowits Plateau and Kane County. It also extends southward into Arizona (Miller and Kellogg, op. cit.). The former known range of gulosus was from Kelton, Box Elder County southward to five miles south of Garrison, Millard County (Miller and Kellogg, op. cit.). The author's study has extended its range east to Cedar Valley, Utah County, and south to Glenwood, Sevier County. Perognathus l. virginis is found in Utah in the Virgin River Valley in the vicinity of St. George and the Beaver Dam Wash area, Washington County.

COMMENTS ON DESCRIPTION AND VARIATION:

Durrant (op. cit.) used the following characters to distinguish the races of longimembris found in Utah:

> P. l. virginis may be distinguished from P. l. gulosus by being darker, black and reddish (buffy as opposed to grayish overall dorsal color); and the skull markedly larger, especially mastoid bullae. P. l. arizonensis can be distinguished from P. l. virginis by total length less; hind foot smaller; occipitonasal length less; nasals longer; mastoids larger. P. l. arcus resembles P. l. arizonensis more closely than any of the other

found in Utah. It may be distinguished from arizonensis by having a longer tail, larger ears, slightly lighter dorsal coloration and smaller interparietal."

In comparing the above characters of P. l. virginis and P. l. gulosus with the specimens examined in the Brigham Young University collection, the following differences were noted: Skull: average longer in virginis (22.4) as compared with gulosus (21.7) breadth of interparietal narrower in virginis being 3.7 and gulosus 4.4; total length of virginis, 146.8; tail, 79.9; hind foot, 19.1 as opposed to 128.2; 68.2; and 18.2 in gulosus. (See Table 8).

The color of longimembris examined seems to fit, in the main, the distinguishing characteristics listed above by Durrant (op. cit.). However, the specimens taken at Cedar Valley, Utah County, Lucin, Box Elder County, and Glenwood, Sevier County, are darker than the ones taken at Joy, Juab County, and the Desert Range Experiment Station, Millard County. The ones at Joy contain the spotted conditions mentioned by Durrant (op. cit.) found in his specimens taken at the Desert Range Experiment Station.

The following differences were noted when the specimens collected at Willow Tank Springs, Kane County, were compared with specimens collected within ranges of virginis and gulosus: Skull--total length about the same as virginis but longer than gulosus (22.5 vs 21.7); nasals longer than virginis (8.7 vs 8.4) or gulosus (8.2); mastoid breadth wider than either virginis (12.5 vs 11.7) or gulosus (11.8); bullae more inflated than in virginis (6.6 vs 6.1) or gulosus (6.2); length of interparietal longer (3.7)

than either virginis (2.9) or gulosus (3.0), but narrower than gulosus (3.6 vs 4.4). The total length of arizonensis (135.1) is between gulosus (128.2) and virginis (146.8); tail longer than gulosus (74.3 vs 68.2) but a little shorter than virginis (79.9); hind foot about same as gulosus (18.7 vs 19.1), but shorter than virginis (18.2). The coloration of arizonensis is a brighter buff tending toward a more pinkish condition than virginis but darker than gulosus.

ECOLOGY:

It seems that longimembris prefers a sandy soil containing fine gravel. Burt (1952:87) states that they are found, "In valleys and on the slopes below the pinyon pine-juniper belt, where the soil is sandy and covered with a desert pavement of small pebbles." Hardy (1945:97) indicated that he found them only at stations where there was less than 10 percent of the top soil particles of granule gravel and at other stations they were absent, which he attributed to a more gravelly condition. He stated also that they seem to favor a soil with a high concentration of sodium sulphate.

The plant association which this species seems to inhabit, varies somewhat with the race and locality. Woodbury (1955:62) found gulosus in only the shadscale community. Hardy (op. cit.) found virginis in the Larrea association, Artemisia filifolea association, and Atriplex confertifolia association. The Larrea association is found on nearly level areas where the drainage is good and the salt content of the soil is low. The dominant shrub is Nevada joint fir, Ephedra nevadensis. Bromus rubens, Astragulus nuttallianus, Erodium circutarium, and Eriogonum inflatum were the

annual plants found in abundant numbers. Other small mammals taken in this association were Citellus leucurus, Dipodomys ordii, Lepus californicus, Sylvilagus auduboni, and a few Perognathus formosus.

The Atriplex confertifolia association is confined to flats which are too salty to support other types of plant life. The dominant shrub is Atriplex confertifolia. Citellus leucurus and Dipodomys microps were some of the other small animals caught in this association (Hardy, op. cit.).

The specimens taken in the Beaver Dam Wash area were in a sandy, clay soil containing fine particles of gravel. The longimembris were caught on the flat areas where black brush, Coleogyne ramosissima, was the dominant shrub. Other shrubs were rabbit brush, Chrysothamnus sp., yucca, Yucca buccata, shadscale, Atriplex sp., and joint fir, Ephedra sp., (Unpublished notes of Travis G. Haws and Gerald E. Bessey).

Perognathus l. gulosus seems to prefer the areas dominated by shadscale, Atriplex sp. The specimens collected at Joy, Cedar Valley, Lucin, and the Desert Range Experiment Station were all in this plant association.

Benson (1935:541) gave the following description of the area where he took P. l. arcus:

> Although the total amount of vegetation is small, there is a considerable variety present. The trees include juniper, pinyon, willow oak, redbud, and ash. The shrubs are common desert species. Ferns, grasses, and spiraea grow about springs and seeps issuing from the bases of the cliffs.

So far the Brigham Young University has been unable to secure any specimens of this subspecies.

Whenever formosus was found in the same area with longimembris, the former preferred rocky slopes adjoining flat sandy sections occupied by longimembris.

Apparently longimembris is more active during the spring and summer months than autumn and winter. In June 1953, 110 animals (9 were longimembris) were caught during 327 trap nights. Out of 375 trap nights in Octover only 7 animals were taken of which 3 were longimembris. During the course of this study the ratio of females to males was a little over two to one. None of the nine females taken during April, June, or October was pregnant. However, during the latter part of May, 1956, 13 females were taken at Wahweep Creek, Kane County, and 7 of these were pregnant. Two specimens taken at Lucin in June were immature.

SPECIMENS EXAMINED:

Total 47, distributed as follows: Box Elder County: Lucin, 8; Utah County: Cedar Valley, 2; Juab County: Joy, 12; Millard County: Desert Range Experiment Station, 4; Sevier County: Glenwood, 2; Washington County: Beaver Dam Wash, 12; Kane County: Willow Tank Springs, 6; Hole-in-Rock, 1; 3 miles west Wahweep Creek 10 miles north of Arizona border, 13.

OTHER RECORDS:

Box Elder County: Kelton (Durrant, 1952:237-38; Osgood, 1900: 31; Hall, 1941); Millard County: 5 miles south of Garrison (Hall and Johnson, 1938:121); Washington County: St. George; Beaver Dam Wash (Durrant, 1952:239); St. George (Huey, 1939:55); Kane County: Willow Tank Springs (Tanner, 1940:104); Kanab (Goldman, 1931:135); San Juan County: Rainbow Bridge (Benson, 1935:541).

TABLE 7

SKIN MEASUREMENTS OF PEROGNATHUS LONGIMEMBRIS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Lucin, Box Elder County, Utah					
Ave.	129.2	68.4	18.6	-	8
Min.	127.0	66.0	18.0	-	-
Max.	133.0	74.0	19.0	-	-
Cedar Valley, Utah County, Utah					
	112.0	65.0	17.0	-	-
	125.0	70.0	18.0	-	-
Joy, Juab County, Utah					
Ave.	132.7	68.5	18.5	-	12
Min.	126.0	60.0	18.0	-	-
Max.	140.0	74.0	19.0	-	-
Great Basin Branch Experiment Station, Millard County, Utah					
Ave.	127.5	67.7	18.5	-	4
Min.	121.0	64.0	18.0	-	-
Max.	134.0	71.0	19.0	-	-

TABLE 7 - Continued

	Total Length	Tail	Hind Foot	Ear	Number Examined
Glenwood, Iron County, Utah					
	132.0	68.0	18.0	-	-
	135.0	70.0	18.0	-	-
Eight Miles North of St. George, Washington County, Utah					
Ave.	146.3	78.7	19.0	-	3
Min.	141.0	75.0	19.0	-	-
Max.	149.0	81.0	19.0	-	-
Beaver Dam Wash, Washington County, Utah					
Ave.	147.4	81.1	19.3	-	10
Min.	138.0	75.0	18.0	-	-
Max.	155.0	89.0	20.0	-	-
Willow Tank Springs, Kane County, Utah					
Ave.	135.1	74.3	18.7	-	7
Min.	126.0	72.0	17.5	-	-
Max.	143.0	84.0	19.3	-	-

TABLE 8

SKULL MEASUREMENTS OF PEROGNATHUS LONGIMEMBRIS

	A	B	C	D	E	F	G	H	I	J	K
Lucin, Box Elder County, Utah											
Ave.	21.8	8.3	10.6	11.4	5.3	6.0	6.6	2.8	4.3	3.1	8
Min.	21.1	8.0	10.4	11.2	5.2	5.4	6.4	2.4	4.0	2.8	-
Max.	22.2	8.7	10.8	11.6	5.8	6.4	7.0	3.3	4.6	3.4	-
Cedar Valley, Utah County, Utah											
	21.4	8.2	11.1	11.7	5.6	6.2	6.5	3.0	4.3	3.4	-
	21.6	8.2	11.1	11.8	5.7	6.4	6.6	3.3	4.5	3.6	-
Joy, Juab County, Utah											
Ave.	21.8	8.4	11.6	11.9	5.8	6.3	6.9	3.1	4.4	3.4	12
Min.	20.9	7.9	11.4	11.5	5.6	5.6	6.4	2.8	3.8	3.1	-
Max.	22.3	8.8	11.8	12.3	6.0	6.6	7.3	3.3	5.1	3.5	-
Great Basin Branch Experiment Station, Millard County, Utah											
Ave.	21.7	8.1	11.5	12.0	5.6	6.1	6.9	2.8	4.4	3.2	4
Min.	21.4	7.9	11.4	11.8	5.5	6.0	6.7	2.5	4.1	3.1	-
Max.	22.1	8.3	11.5	12.3	5.8	6.3	7.3	3.1	4.6	3.3	-
Glenwood, Iron County, Utah											
	21.5	8.0	11.6	11.5	5.9	6.1	6.7	3.3	4.4	3.3	-
	21.9	8.4	12.0	12.0	6.0	6.5	7.0	3.5	4.5	3.4	-

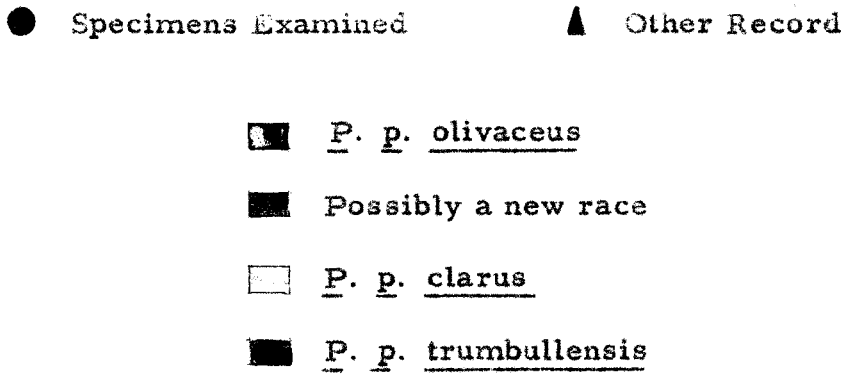
TABLE 8 - Continued

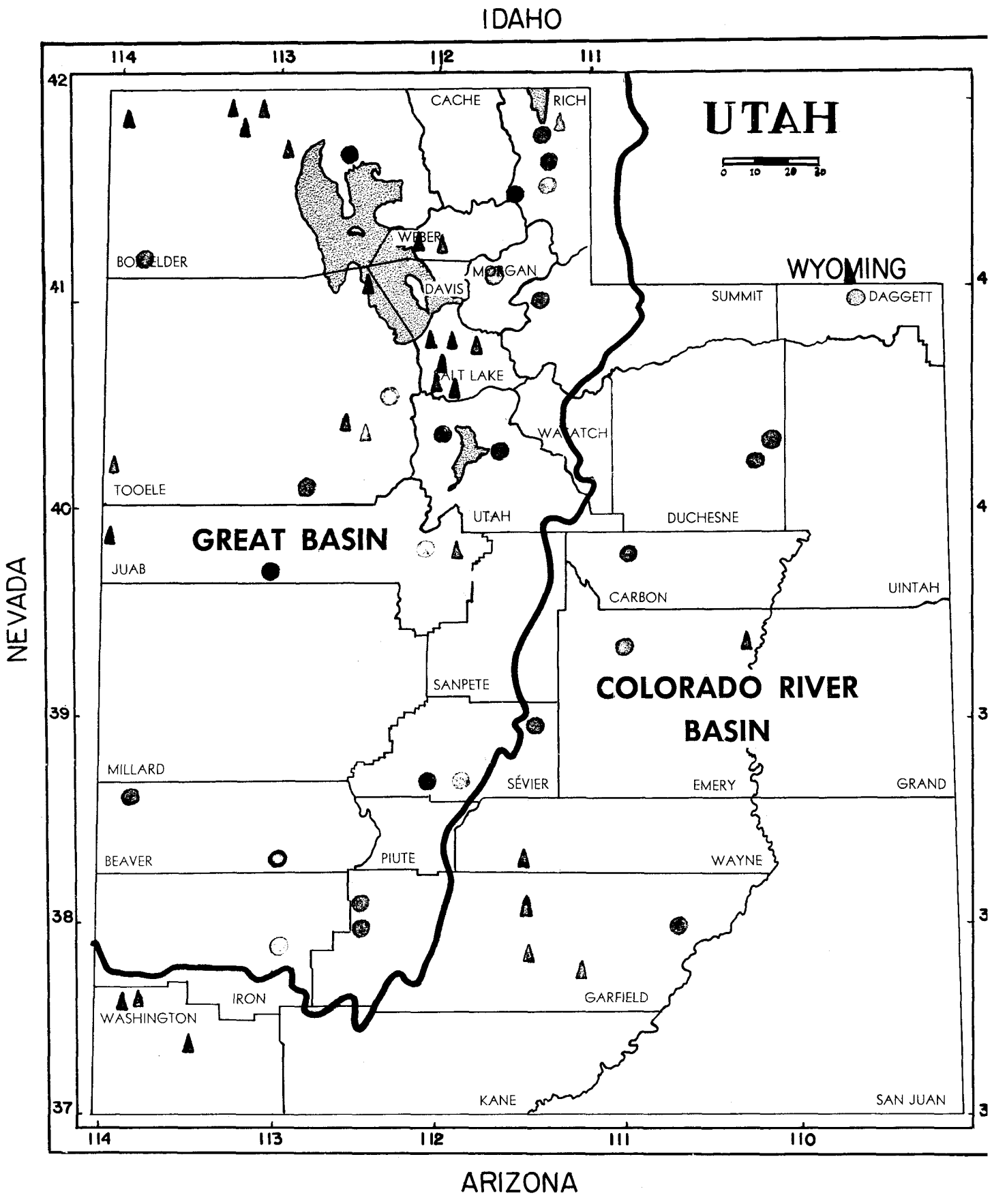
	A	B	C	D	E	F	G	H	I	J	K
Eight Miles North of St. George, Washington County, Utah											
Ave.	22.5	8.6	10.9	11.9	5.4	6.2	7.1	3.1	3.9	3.5	3
Min.	21.5	8.0	10.7	11.6	5.2	6.1	6.9	3.0	3.8	3.3	-
Max.	23.3	9.0	11.0	12.4	5.7	6.3	7.4	3.3	4.1	3.7	-
Beaver Dam Wash, Washington County, Utah											
Ave.	22.4	8.1	10.9	11.6	5.4	6.0	6.8	2.7	3.6	3.3	12
Min.	21.5	7.7	10.6	11.2	5.1	5.8	6.5	2.2	3.3	3.0	-
Max.	22.9	8.6	11.3	12.3	5.7	6.3	7.1	3.3	4.2	3.7	-
Willow Tank Springs, Kane County, Utah											
	22.5	8.7	11.5	12.5	5.5	6.6	8.0	3.7	3.6	3.7	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

Fig. 5. Distribution of Perognathus parvus

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NEVADA
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CACHE
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MORGAN
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SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
GREAT BASIN
JUAB
CARBON
UINTAH
SANPETE
COLORADO RIVER BASIN
MILLARD
SEVIER
EMERY
GRAND
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
WASHINGTON
KANE
SAN JUAN
114
113
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PEROGNATHUS PARVUS (PEALE)

Great Basin Pocket Mouse

Perognathus parvus clarus Goldman

Perognathus parvus clarus Goldman, Proc. Biol. Soc. Washington, 30:147, July 27, 1917, type from Cumberland, Lincoln County, Wyoming.

Perognathus parvus olivaceus Merriam

Perognathus olivaceus Merriam, North Amer. Fauna, 1:15, October 25, 1889, type from Kelton, Box Elder County, Utah.

Perognathus parvus olivaceus, Osgood, North Amer. Fauna, 18:37, Sept. 20, 1900.

Perognathus parvus plerus Goldman

Perognathus parvus plerus Goldman, Journ. Mamm., 20:352, August 14, 1939, type for north end of Stansbury Island, Great Salt Lake, Utah.

RANGE:

Perognathus parvus is the most widely distributed of any of the Perognathus found in Utah. At the time the latest distribution records (Durrant, 1952:242) were published parvus was known to occur principally in the Great Basin area from northern Utah south to Juab County and in Daggett and Emery Counties. This study has extended the range of parvus to nearly every County on the west side of the State as far south as Iron and Garfield Counties. On the east side of the Great Basin specimens have

been taken in Daggett, Duchesne, Carbon, Emery, and the east side of Garfield Counties. Also an extensive collection of specimens have been taken in the Bear Lake region. The collection areas from the east side of the Great Basin are rather scattered but it is felt that these gaps will be filled in as more extensive collections are made. The slow collection of materials may seem to be due to fluctuations in populations as indicated in collections made by Dr. Hayward in Cedar Valley, Utah County. In 1936 trapping was done in this area but not one specimen of Perognathus was taken or on subsequent visits until 1949 when trapping was resumed after the war period. At that time and up to the present, specimens have been taken in abundance in the same locality with the same kind of traps and bait.

At the present time the race found in the north central part of the state and east of the Wasatch Range is considered to be clarus. The notations by Durrant (op. cit.) and the material sent to Dr. E. R. Hall that was collected from these areas was designated as this race. The race from the Great Basin area is considered to be olivaceus. P. p. plerus is only known from its type locality and Durrant (op. cit.:241) considered diagnostic characters inadequate to varify its separation so included it under olivaceus.

COMMENTS ON DESCRIPTION AND VARIATION:

Perognathus parvus olivaceus is distinguished from P. p. clarus by being light ochraceous buffy instead of light buffy as in clarus. The lateral line is less distinct in clarus. In comparing 12 topotypes of clarus

with 7 specimens from Lucin, Box Elder County, it was noted that the body measurements were about the same. The skull was longer in olivaceus (26.2 vs 24.8) due to longer nasals (10.5 vs 9.6). All other skull measurements were not appreciably different. (See Tables 9 and 10). The clarus topotypes did not indicate the difference in the length of the aveolar tooth row as pointed out by Durrant (op. cit.: 244).

The only diagnostic character used by Goldman (1939:352) to separate plerus from olivaceus was that of color. Durrant (op. cit.) did not consider this sufficient evidence to separate them since some specimens taken in areas near Great Salt Lake were pale in color similar to those from the islands. He also pointed out that the islands are not true islands since they are connected with the main land at intervals during the fluctuation of the water level in the Lake. Durrant, therefore, included this subspecies under olivaceus. Miller and Kellogg (1955:366) still retain the name Perognathus parvus plerus in their recent check list of North American Mammals.

Considerable variation was noted among the populations of parvus found throughout the state. The series from the Bear Lake area might be expected to be closest to clarus since the nature of the sage brush plains is more or less continuous from the type locality of clarus. Neither does the relatively low divide separating the Green and Bear River drainages in Wyoming seem to afford a serious barrier. However, the Laketown series is larger on the average in most measurements taken than in clarus topotypes. In the Laketown series the skull has a greater length owing in the

main to longer nasals (10.6 vs 9.6). The body measurements are larger on the average but not significantly so. (See Table 9 and 10).

A striking difference in coloration appears in the Laketown series. The ground color is darker, ranging between cinnamon buff and pinkish cinnamon rather than pinkish buff as in clarus. The lateral stripe is wider and more distinct. The dark hairs of the back are more prominent with a tendency to form black patches on the rump and a distinct black mid-dorsal line. The Laketown series seem to be closer to olivaceus in matters of cranial measurements, body measurements and ground color. They differ from olivaceus in the striking black hairs of the dorsum.

Linwood Series: After comparing the Linwood, Daggett County series with the clarus topotypes considerable intergradation was noted. They resemble clarus more closely in both cranial measurements (see Table 10) and color as might be expected from their continuous range. They have the paler buffy ground color and narrower lateral stripe as in clarus. However, the clarus topotypes have decidedly more dark hairs on the dorsum and in that respect are closer to the Laketown series.

Uintah Basin Series: This series averages smaller in all 3 body measurements than either olivaceus or clarus. The skulls average distinctly longer (27.1 vs 24.8) than clarus and slightly longer than in olivaceus. The interparietals are longer and narrower than either olivaceous or clarus. In coloration they are closer to olivaceus than

to clarus since they have the darker buffy ground color and the wider lateral stripe.

Northwash Series: This series was large enough to make a good comparison with the other series collected in the state. The comparisons indicate significant characters that would warrant separating them into a new race.

This series has a much brighter ground color, being bright cinnamon buff rather than a pinkish buff. The buffy lateral line is also indistinct. A reduction of the dark hairs on the back gives the animal a brighter and more buffy appearance in general and such dark hairs as there are are confined to a rather distinct mid-dorsal stripe which is especially evident between the ears. The subauricular white patches are larger and the tail is more buffy throughout.

The hind foot averaged smaller (21.6 vs 23.8 in clarus and 23.1 in the Lucin series) than either clarus or olivaceus. The ears were shorter (8.9 vs 10.8) than in clarus or olivaceus. The interorbital breadth is slightly narrower than clarus and narrower than olivaceus (5.9 vs 6.4) and in this respect resembles the Woodruff and Laketown series. The mastoid breadth is a little wider than in all the other populations sampled (13.0 vs 12.6).

ECOLOGY:

Hundreds of notations regarding the habitat preferences of parvus have been made throughout the course of this study and collections made by the Brigham Young University Zoological Department. It

inhabits, almost invariably, bench lands and lower slopes of mountains at elevations ranging from 4,500 to 6,500 feet. However, some specimens have been taken at elevations ranging as high as 10,000 feet. Bee (1947: 192) took one specimen at the head of Slide Canyon east of Provo, Utah County, at an elevation of about 8,500 feet. Two other specimens were taken at an elevation of about 9,100 feet near Monte Cristo Forest Camp, Rich County. This is in agreement with Hall's (1946:366) findings in Nevada. He stated that they were found up to 10,000 feet in elevation but were more abundant in arid areas around 4,000 to 6,000 feet.

The great majority of specimens collected were taken in the sage brush association. Even the collections made at the higher elevations were taken in sage brush on south exposed slopes between patches of aspens and conifers. Fautin (1946:280) found parvus only in the sage brush community. Woodbury (1955) found parvus very common in sandy flats in the valley where rabbit brush and Indian rice grass were the predominant plants. They were also common in the juniper community.

Parvus also occurs commonly on rocky soils and often extends well up into the steeper slopes where the ground is strewn with loose boulders or talus materials. They are frequently taken where you would expect to find formosus. At Joy, Juab County, parvus and formosus were taken together on rocky slopes but parvus also extended onto the flats where the shadscale, Atriplex sp., and rabbit brush, Chrysothamnus sp., were predominant on fine gravelly soil. In the vicinity of the Henry Mountains, parvus was taken near sandstone ledges as well as in open sandy flats

vegetated with black brush, Coleogyne ramosissima, and joint fir, Ephedra sp.

Population studies conducted by Gray (1943:192) in Yakima Valley, Washington, found parvus to constitute 73.6 percent of the small mammal population of the dominant sage brush, Artemisia tridentata. They were somewhat less abundant in the black greasewood, Sarcobatus vermiculatus, and downy brome, Bromus tectorum. He also found most of the parvus on the flat areas rather than on the north facing rocky ravines. Hall (1929:301) found parvus on a slightly finer soil than Microdipodops or Dipodomys. In Idaho, Davis (1939:268) indicated that parvus is found in a wide variety of habitats.

Perognathus parvus apparently prefer arid situations and can exist without drinking water. However, Hall (op. cit.) suggested that with the frequency in which he caught them near the edge of small streams, it would indicate that they visit conditions containing water more often than do other species.

Perognathus parvus has been taken in association with two other species of Perognathus. At Joy, Juab County, parvus was taken in the same community as formosus and longimembris. At Lucin, Box Elder County, it was taken with longimembris. Other small mammals taken in the same areas with parvus were Peromyscus maniculatus, P. crinitis, P. truei, Reithrodontomys megalotis, Dipodomys ordii, Eutamias minimus, E. dorsalis, and Lepus californicus.

It seems that the food of parvus consists of a wide variety of plants.

This is probably one of the factors that enables it to adjust to such a variety of habitats. The following is a list of the plant seeds or fruits found in the cheek pouches of the specimens studied in Nevada by Hall (op. cit.: 364-65): Eriogonum sp., Cruciferae gen. et. sp., Polygonum sp., Rosa sp., Cuscata sp., Gilia inconspicua, Descurainia sp., Amsinckia sp., Leptotaenia multifida, and Dactylus glomerata. Burt (1943:412) also listed Astragulus sp., Chenapodium sp., and Phoradendron sp. as part of their food supply. During the course of this study pods of Cruciferae and seeds of Bromus tectorum were the only foods found in their cheek pouches.

The young are born during May, June, and July. Apparently they reach their peak during the month of June. The 12 pregnant females taken during this study were caught during the latter part of June and the embryos ranged from 6 to 22 millimeters in length. Davis (1939:264) took pregnant females in May and June but also indicated that the reproduction cycle reaches its peak in June. Hall's (op. cit.) collections in Nevada tend to substantiate this breeding cycle. The 212 females taken by him are distributed by months as follows: April, 2; May, 59 (11 pregnant); June, 58 (16 pregnant); July, 65 (6 pregnant); August, 19; and September, 9.

The number of young per litter seems to be about five. The 12 pregnant females examined during this study averaged 4.8 per female. The extremes were 3 and 8. Hall (op. cit.) in examining 33 pregnant females found the average number to be 5.5 with the extremes of 3 and 8. The mode was 5 or 6 as equal numbers of females had 5 and 6 embryos each. Hall (op. cit.) also believes that parvus has only 1 molt per year

and this occurs during May, June, and July.

A variety of external parasites were taken from parvus by Beck (1955:27). They are as follows: Ticks, Ixodes sp., and Dermacentor sp.; Fleas, Meringis parkeri, Monopsyilus exilis, M. wagneri wagneri, Opisodasys keeni, Orchopeos sexdentatus, and Catallagia decipiens. Also some species of mites and lice were taken from parvus.

SPECIMENS EXAMINED:

Total 168 distributed as follows: Box Elder County: Lucin, 12; Locomotive Springs, 2. Rich County: Laketown, 31; Randolph, 5; Woodruff, 5; Monte Cristo Forest Camp, 2. Morgan County: 5 miles east on highway in Weber Canyon, 1. Summit County: Echo Junction, 1. Daggett County: Linwood, 28. Duchesne County: Roosevelt, 8; 8 miles southwest of Myton, 1. Utah County: Cedar Valley, 13. Tooele County: Mercur, 3. Juab County: Callao, 10; Joy, 4. Carbon County: Price, 5. Sevier County: Southwest entrance to Fish Lake area, 2; Paradise Valley, 2; 8 miles west of Koosharem, 3. Beaver County: Minersville, 4. Garfield County: Spry, 4; 10 miles northwest of Panguitch, 5; North Wash, 15. Iron County: Heiroglyphic Gap, 2.

ADDITIONAL RECORDS:

(Durrant, 1952:243-44) Box Elder County: George Creek rd. Junction 5 mi. southeast Yost, Raft River Mountains; Pine Canyon, 20 miles northwest of Kelton; Pine Creek, 3 miles north of Rosetta, Raft River Mts.; 17 miles northwest of Kelton; Clear Creek, Raft River Mts. Weber County: Ogden. Tooele County: Carington Island, Great Salt Lake;

Stansbury Island, Great Salt Lake; Clover Creek, Onaqui Mts.; Cliffton Flat, 7 miles southwest of Goldhill; Little Valley, Shiprock Mts. Salt Lake County: East shore Great Salt Lake; Salt Lake City; Millcreek Canyon, 5 miles southwest of Salt Lake City; Bacchus; Butterfield Canyon, 3 miles southwest Butterfield Tunnel; 1 mile west Herriman; Rose Canyon, 3 miles southwest of Herriman; Beef Hollow, 3 miles west of Camp Williams. Juab County: Nephi; Queen of Sheba Canyon, west side Deep Creek Mts. Emery County: 7 miles north of Greenriver. Rich County: Laketown. Washington County: Pine Valley Mountains; Enterprise Reservoir; 19 miles west of Enterprise. Garfield County: Bown's Reservoir; Snow Ranch; Hall Ranch; Steep Creek. Wayne County: Aquarius Guard Station, Aquarius Plateau. (Durrant, Lee, and Hansen, 1955:75).

TABLE 9

SKIN MEASUREMENTS OF PEROGNATHUS PARVUS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Topotypes From Cumberland, Lincoln County, Wyoming					
Ave.	177.1	91.1	23.8	10.8	13
Min.	165.0	75.0	23.0	10.0	-
Max.	188.0	95.0	26.0	11.0	-
Linwood, Daggett County, Utah					
Ave.	179.0	91.0	23.5	10.8	6
Min.	172.0	86.0	22.0	10.0	-
Max.	189.0	95.0	25.0	11.0	-
Roosevelt, Duchesne County, Utah					
Ave.	166.7	84.5	23.0	-	4
Min.	162.0	80.0	21.0	-	-
Max.	175.0	94.0	24.0	-	-
Lake Town, Rich County, Utah					
Ave.	178.0	92.2	23.9	10.3	8
Min.	170.0	85.0	22.0	10.0	-
Max.	195.0	98.0	25.0	11.0	-
Woodruff, Rich County, Utah					
Ave.	186.6	94.6	23.8	10.3	5
Min.	177.0	87.0	22.0	10.0	-
Max.	199.0	102.0	26.0	11.0	-
Price, Carbon County, Utah					
Ave.	178.6	93.6	23.4	-	5
Min.	168.0	82.0	23.0	-	-
Max.	198.0	102.0	24.0	-	-

TABLE 9 - Continued

	Total Length	Tail	Hind Foot	Ear	Number Examined
Paradise Valley, Sevier County, Utah					
	170.0	88.0	23.0	-	-
	181.0	100.0	23.0	-	-
North Wash, Garfield County, Utah					
Ave.	173.6	90.1	21.6	8.9	11
Min.	164.0	82.0	21.0	8.0	-
Max.	185.0	100.0	23.0	10.0	-
Lucin, Box Elder County, Utah					
Ave.	171.1	91.3	23.1	-	6
Min.	164.0	88.0	22.0	-	-
Max.	182.0	96.0	24.0	-	-
Cedar Valley, Utah County, Utah					
Ave.	172.9	90.0	23.1	-	22
Min.	155.0	80.0	21.0	-	-
Max.	185.0	114.0	26.0	-	-
Callao, Juab County, Utah					
Ave.	183.4	96.7	23.8	10.4	7
Min.	171.0	91.0	23.0	10.0	-
Max.	199.0	103.0	25.0	11.0	-

TABLE 9 - Continued

	Total Length	Tail	Hind Foot	Ear	Number Examined
Joy, Juab County, Utah					
Ave.	175.7	93.7	23.5	-	4
Min.	173.0	90.0	23.0	-	-
Max.	179.0	100.0	24.0	-	-
Minersville, Beaver County, Utah					
	169.0	92.0	23.0	-	-
	178.0	95.0	24.0	-	-
Wahwah Springs, Beaver County, Utah					
	168.0	96.0	24.0	-	-
Heiroglyphic Gap, Iron County, Utah					
	181.0	96.0	25.0	-	-
Panguitch, Garfield County, Utah					
Ave.	177.7	91.0	23.6	-	3
Min.	174.0	87.0	23.0	-	-
Max.	183.0	96.0	24.0	-	-

TABLE 10

SKULL MEASUREMENTS OF PEROGNATHUS PARVUS

	A	B	C	D	E	F	G	H	I	J	K
Topotypes From Cumberland, Lincoln County, Wyoming											
Ave.	24.8	9.6	12.6	12.0	6.1	6.5	7.6	3.8	5.6	4.0	12
Min.	24.0	9.3	12.0	11.8	6.0	6.2	7.1	3.5	5.2	3.7	-
Max.	25.7	10.4	13.2	12.3	6.5	6.8	7.8	4.1	6.3	4.5	-
Linwood, Daggett County, Utah											
Ave.	25.7	10.7	13.2	12.6	6.3	6.7	7.7	4.1	5.7	4.2	5
Min.	24.8	10.3	12.6	12.1	6.0	6.5	7.4	3.5	5.2	4.0	-
Max.	26.6	11.0	13.9	12.9	6.4	7.0	7.9	4.7	6.4	4.4	-
Roosevelt, Duchesne County, Utah											
	26.4	11.0	11.0	12.3	6.5	6.5	7.7	4.5	4.9	4.1	-
	27.6	11.3	12.8	13.7	7.5	7.1	8.0	4.8	5.3	4.2	-
Laketown, Rich County, Utah											
Ave.	25.9	10.6	12.5	12.3	5.9	6.1	7.4	4.1	5.9	3.7	10
Min.	25.0	9.6	11.9	11.7	5.5	5.3	6.9	3.5	5.3	3.3	-
Max.	27.8	11.7	14.0	13.0	6.4	6.6	7.9	4.7	6.0	4.2	-
Woodruff, Rich County, Utah											
	26.4	10.7	13.0	12.2	5.9	6.0	6.1	3.2	5.4	3.7	-
	26.4	10.8	13.2	12.3	6.0	6.3	7.2	4.3	5.5	3.7	-
North Wash, Garfield County, Utah											
Ave.	26.1	10.3	13.3	13.0	5.8	6.9	7.9	4.0	5.1	3.9	11
Min.	25.3	9.8	12.7	12.1	5.6	6.4	7.3	3.6	4.5	3.7	-
Max.	28.3	11.5	14.0	13.9	6.1	7.6	8.6	4.4	5.6	4.1	-

TABLE 10 - Continued

	A	B	C	D	E	F	G	H	I	J	K
Lucin, Box Elder County, Utah											
Ave.	26.2	10.5	12.9	12.4	6.2	6.6	7.7	3.8	5.6	4.1	7
Min.	25.4	9.9	12.8	11.8	5.8	6.0	7.3	3.3	5.1	3.6	-
Max.	27.0	11.4	13.1	12.9	6.7	6.9	8.0	4.5	5.8	4.5	-
Cedar Valley, Utah County, Utah											
Ave.	26.7	10.6	12.7	12.9	6.4	6.8	7.6	4.1	5.6	3.7	21
Min.	25.2	9.6	11.6	12.4	5.9	6.4	7.0	3.8	5.1	3.2	-
Max.	28.2	11.9	13.9	13.5	7.0	7.2	8.9	4.5	6.3	4.3	-
Callao, Juab County, Utah											
	29.0	12.2	13.2	13.1	6.1	6.7	8.0	4.2	5.2	4.1	-
Joy, Juab County, Utah											
Ave.	26.6	11.2	11.9	12.5	6.4	6.7	7.0	3.7	5.2	3.8	4
Min.	26.5	11.1	11.0	11.7	6.3	6.4	6.4	3.2	4.4	3.5	-
Max.	27.5	11.4	12.8	12.9	6.5	6.8	7.7	4.2	5.7	4.2	-
Minersville, Beaver County, Utah											
	26.6	10.8	12.8	12.1	6.3	6.4	7.7	3.7	5.8	3.7	-
Wahwah Springs, Beaver County, Utah											
	26.4	10.6	12.2	12.9	6.5	7.1	8.3	4.8	6.0	3.4	-
Heiroglyphic Gap, Iron County, Utah											
	26.6	10.3	13.3	12.9	6.8	7.0	8.7	4.5	6.2	4.6	-

TABLE 10 - Continued

	A	B	C	D	E	F	G	H	I	J	K
Panguitch, Garfield County, Utah											
	27.0 -	10.6 -	13.9 -	12.7 13.1	6.2 6.6	6.9 7.0	8.0 8.5	4.0 4.0	5.4 6.0	4.3 4.4	- -

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

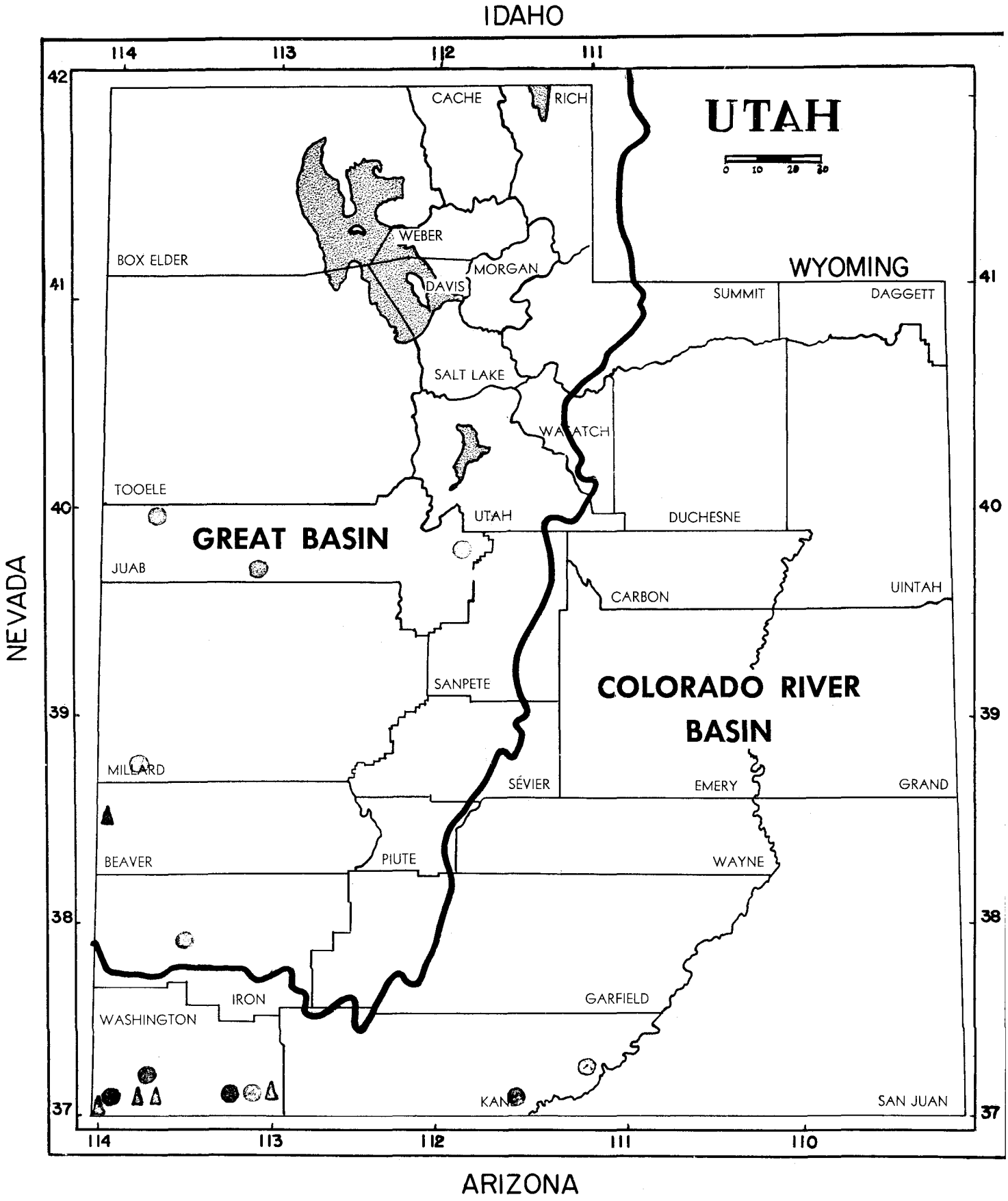
Fig. 6 Distribution of Perognathus formosus

● Specimens Examined ▲ Other Record

P. f. incolatus

P. f. formosus

P. f. mohavensis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PEROGNATHUS FORMOSUS MERRIAM

Long-tailed Pocket Mouse

Perognathus formosus formosus Merriam

Perognathus formosus Merriam, North Amer. Fauna, 1:17, October, 1889, type from St. George, Washington County, Utah.

Perognathus formosus formosus Nelson and Goldman, Proc. Biol. Soc. Washington, 42:106, March, 1929

Perognathus formosus incolatus Hall

Perognathus formosus incolatus Hall, Proc. Biol. 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 mohavensis Huey

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.

RANGE:

The range of Perognathus formosus appears to be confined to the southwestern portion of the state. They have been collected from Juab County south to Washington and Kane Counties. The race considered to occupy the area north of the Pine Valley Mountains is incolatus. P. f. formosus occupies the region south of the Pine Valley Mountains and east of the Beaver Dam Mountains east to the Colorado River. Perognathus

formosus mohavensis is found on the west slope of the Beaver Dam Mountains.

COMMENTS ON DESCRIPTION AND VARIATION:

Perognathus formosus may be distinguished from the other Perognathus by being larger, crested tail, and with coarser body hair. The race found north of the Pine Valley Mountains is lighter in color than the ones east of the Beaver Dam Mountains and south of the Pine Valley Mountains. It is a little paler in color than mohavensis which is found on the west slopes of the Beaver Dam Mountains. P. f. formosus is the darkest of the 3 races found in Utah. These color markings which were noted in the specimens collected in this study are in agreement with Hardy (1945: 104), Hall (1946:366) and Durrant (1952:246). Hardy (op. cit.) indicated the Beaver Dam Mountains were a barrier to the passage of the small rodents and even though Perognathus formosus has crossed it they have become separated into separate races. The darker race is found on the east side and the lighter race on the west side of the Beaver Dam Mountains.

Hall (op cit.) and Durrant (op. cit.) used the shape of the interparietal to distinguish the races of formosus. In P. f. formosus and P. f. mohavensis the suture between the interparietals and parietals has the form of an open inverted "V". In P. f. incolatus the anterior border of the interparietal is nearly straight. In the Brigham Young University collection, however, some intergradation in this character was noted in the specimens examined. One female, number 2873 collected at Fish Springs, and one specimen, number 2777 collected at Joy, Juab County,

posessed the open inverted "V" shaped suture between the interparietal and parietal bones. Those collected at the Desert Range Experiment Station and Antelope Springs, Iron County, tend to have more of an inverted "V" suture but retain the paler coloration of typical incolatus. One specimen taken eight and one half miles north of St. George, tends to have a straighter suture like incolatus but has the darker color of typical formosus.

Durrant (op. cit.) noted that mohavensis differed from formosus in having a more inflated braincase and tympanic bullae and a larger and wider interparietal. The author, in comparing 9 specimens from Beaver Dam Wash with 11 specimens taken from Grafton, Rockville, and 8 miles north of St. George, noted that the skull was a little longer in mohavensis (27.2 vs 26.8). The inflation of the auditory bullae was more apparent with the depth being 10.6 in mohavensis, whereas it was 7.8 in formosus. However, the width of the interparietal did not show any appreciable difference (6.4 vs 6.3). The nasals were slightly longer in mohavensis (11.0 vs 10.6). See Table 12.

Durrant (op. cit.) mentions the following differences between mohavensis and incolatus: "longer hind foot, longer total length, larger interparietal and more inflated braincase and tympanic bullae." The author, in comparing 9 specimens from Beaver Dam Wash with 13 specimens of incolatus, noted that the length of the hind feet appeared to vary only slightly (24.6 vs 24.2). The length of the skull was greater in mohavensis than in incolatus (27.2 vs 26.6). Here again the inflation of the auditory bullae was more apparent (10.6 vs 7.8), and the interparietals did not show any

appreciable variation. (See Table 12).

ECOLOGY:

Perognathus formosus inhabits rocky slopes ranging from 2,800 to 6,300 feet in elevation. Hall (op. cit.) said that in western Nevada, they are closely confined to slopes where there are stones from the size of walnuts up to those eight inches or over partly imbedded in the ground. Hardy (op. cit.) in his ecological study of formosus of southwestern Utah, said formosus was abundant on steep rocky slopes but was less often found on more nearly level areas. He also stated that all of his formosus specimens came from rocky areas or gravelly soils.

The specimens taken near St. George, by the author et al. were from the edge of sandy flats on up the rocky slopes, while longimembris was found on the sandy floor of the valley. Travis G. Haws and Gerald E. Bessey, students at Brigham Young University, noted this same condition while trapping in the Beaver Dam Wash area. The specimens taken at Fish Springs, Joy, and Grafton were also taken on gravelly soils and rocky slopes.

Hardy (op. cit.) lists the following plants as common in the habitats where he collected formosus: Joshua trees, Clistoyucca brevifolia; creosote bush, Larrea tridentata; cheat grass, Bromus rubens; dwarf milkvetch, Astragalus nuttallianus; Plantago scariosa; alfilaria, Erodium cirutarium; small matchweed, Guterezia lucida; black brush, Coleogyne ramosissima; and Hymenoclea salsola. The common plants in the area at Beaver Dam Wash area trapped by Haws and Bessey were black brush, Coleogyne ramosissima; rabbit brush, Chrysothamnus sp.; yucca, Yucca

buccata; joint fir, Ephedra sp.; and shadscale, Atriplex sp. Foutin (1946: 279) listed formosus as a part of the Tetradymia and black sage community but only where it was rocky or gravelly. The specimens taken at Fish Springs by the Brigham Young University were in a shadscale association on a rocky slope.

Other animals captured in the same area with formosus were Neotoma lepida, Peromyscus eremicus, P. maniculatus, P. crinitis, Reithrodontomys megalotis, Onychomys torridus, Perognathus longimembris, Dipodomys microps, and Lepus californicus.

Apparently the food of formosus consists of the various seeds found in their habitat. One specimen taken at Fish Springs on July 15, 1951 had 51 seeds of Bromus tectorum along with rolled oats used for bait, in its cheek pouch. Hall (op. cit.) found seeds of Plantago inserlaris, nutlets and calyxes of Plectocarya limearis, and pods and seeds of Cruciferae in the cheek pouches of two animals taken June 13, 1932. On May 20, 1931 he found one with fruits of Oryctes nevadensis in its cheek pouch.

Apparently the breeding season for formosus is from April to July. Grinnel (1914:245) took pregnant females April 28 and 29 and May 10 and 14. He stated he found no evidence of breeding before April 28. During this study 21 adult females were taken from February to the latter part of July. Only 2 pregnant females were taken on April 16, each containing 6 embryos. On July 15, 1951, 15 immature females and 7 immature males were taken. Only 2 females out of 91 taken in Nevada by Hall (op. cit.) from January to July were pregnant and contained 6 embryos each. They

were taken in July. Fautin (op. cit.) did not take a single pregnant female in his study but 4 immature specimens were taken in July.

SPECIMENS EXAMINED:

Total 79 distributed as follows: Juab County: Fish Springs, 36; Uba Dam Res., 1; Joy, 6. Millard County: Desert Range Experiment Station, 3. Iron County: Antelope Springs, 6. Washington County: 8 1/2 miles north of St. George, 4; Rockville, 5; Grafton, 5; Beaver Dam Wash, 9. Kane County: Hole-in-Rock, 4; 3 miles west of Wahweep Creek, 10 miles north of Arizona border, 1.

ADDITIONAL RECORDS:

(Durrant, 1952:245 unless otherwise noted) Millard County: Warm Cove 55 miles west of Milford; White Valley, 65 miles west of Delta (Fautin, 1946:280). Washington County: Beaver Dam Wash; west side of Black Hill, 1/2 mile west of St. George; Santa Clara Creek, 3 miles southwest of St. George; Springdale (Long, 1940:176); Zion National Park (Presnall, 1938:14).

TABLE 11

SKIN MEASUREMENTS OF PEROGNATHUS FORMOSUS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Fish Springs, Juab County, Utah					
Ave.	192.1	107.1	25.0	-	6
Min.	184.0	104.0	24.0	-	-
Max.	195.0	111.0	26.0	-	-
Joy, Juab County, Utah					
Ave.	189.7	105.8	24.3	-	6
Min.	180.0	95.0	23.0	-	-
Max.	196.0	112.0	25.0	-	-
Great Basin Branch Experiment Station, Millard County, Utah					
Ave.	178.3	103.0	23.3	-	3
Min.	174.0	95.0	22.0	-	-
Max.	185.0	117.0	24.0	-	-
Antelope Springs, Iron County, Utah					
	171.0	92.0	24.0	-	-
	187.0	99.0	25.0	-	-

TABLE 11 - Continued

	Total Length	Tail	Hind Foot	Ear	Number Examined
8 1/2 Miles North of St. George, Washington County, Utah					
Ave.	192.3	102.3	25.0	13.3	3
Min.	183.0	92.0	24.0	13.0	-
Max.	199.0	110.0	26.0	14.0	-
Hurricane, Washington County, Utah					
Ave.	188.6	106.0	23.6	-	3
Min.	176.0	93.0	21.0	-	-
Max.	195.0	110.0	25.0	-	-
Rockville, Washington County, Utah					
Ave.	193.8	107.2	25.0	13.2	5
Min.	180.0	93.0	24.0	13.0	-
Max.	201.0	113.0	26.0	14.0	-
Beaver Dam Wash, Washington County, Utah					
Ave.	190.4	108.6	24.6	-	8
Min.	180.0	102.0	24.0	-	-
Max.	200.0	115.0	26.0	-	-

TABLE 12

SKULL MEASUREMENTS OF PEROGNATHUS FORMOSUS

	A	B	C	D	E	F	G	H	I	J	K
Fish Springs, Juab County, Utah											
Ave.	26.8	10.5	13.9	13.2	6.8	6.7	8.0	3.4	6.3	4.1	5
Min.	26.0	10.0	13.4	13.0	6.6	6.5	7.6	3.3	6.0	3.7	-
Max.	27.2	10.8	14.3	13.5	7.0	6.8	8.5	3.9	6.4	4.4	-
Joy, Juab County, Utah											
Ave.	26.6	10.8	13.9	13.3	6.9	6.5	7.8	3.4	6.3	4.2	6
Min.	25.5	10.4	13.4	12.8	6.8	6.3	7.6	3.2	5.8	3.9	-
Max.	27.3	11.2	14.3	13.6	7.3	6.7	7.8	3.9	6.9	4.6	-
Desert Range Experiment Station, Millard County, Utah											
	26.2	10.4	13.7	14.2	6.7	6.8	7.7	3.3	5.6	3.9	-
Antelope Springs, Iron County, Utah											
	25.9	10.4	13.2	12.8	6.9	6.3	7.0	3.5	6.1	3.6	-
	27.9	11.0	14.6	14.0	7.4	6.9	8.2	4.1	6.9	4.1	-
8 1/2 Miles North of St. George, Washington County, Utah											
Ave.	26.8	10.7	13.7	13.0	7.1	7.0	7.9	4.5	6.4	4.2	4
Min.	26.4	10.1	13.0	12.8	6.8	6.7	7.0	4.0	6.0	3.9	-
Max.	27.3	11.4	14.2	13.1	7.5	7.4	8.3	4.8	7.0	4.4	-

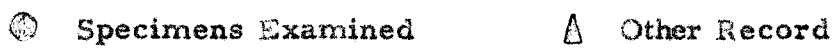
TABLE 12 - Continued

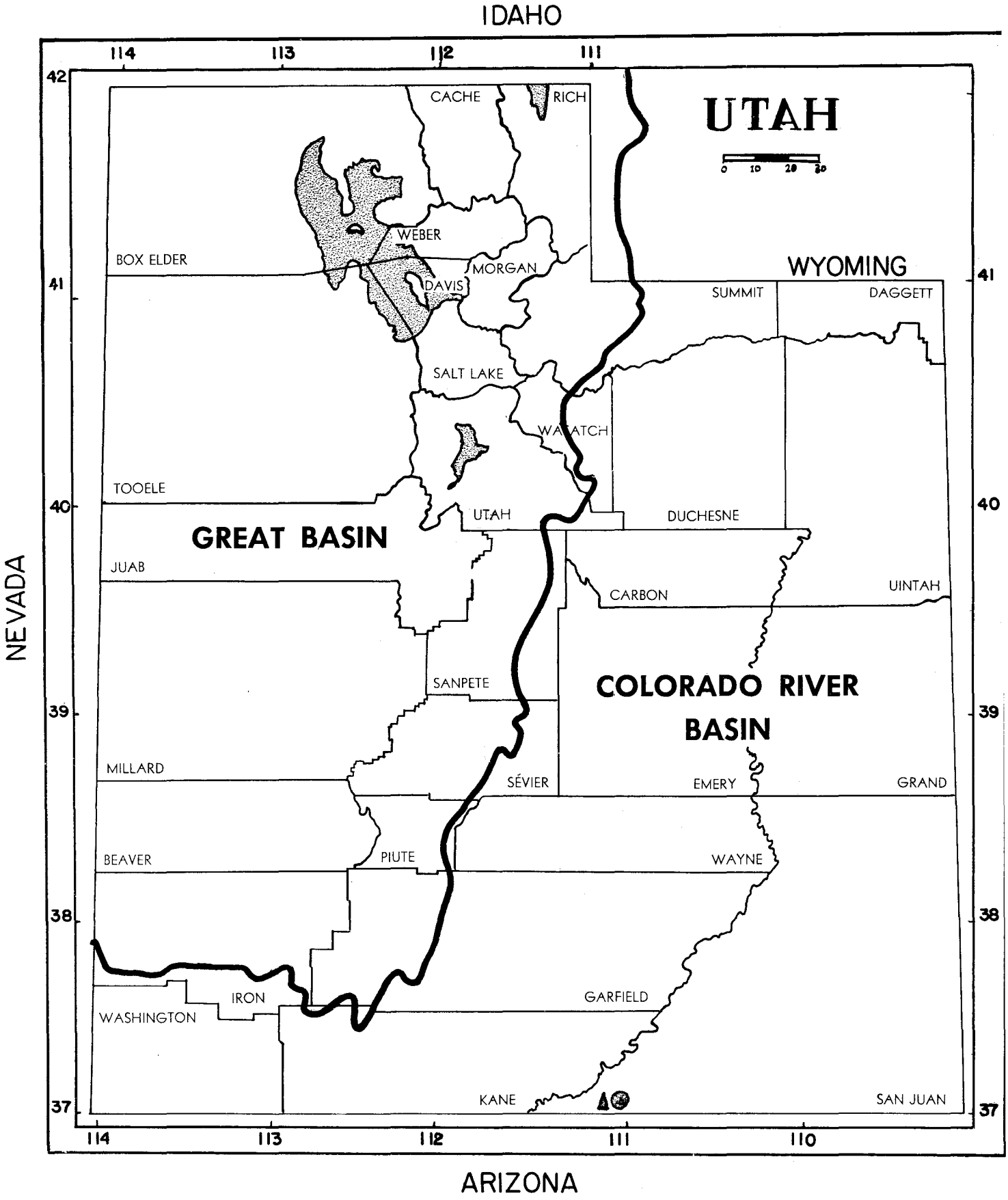
	A	B	C	D	E	F	G	H	I	J	K
Hurricane, Washington County, Utah											
Ave.	26.9	10.7	13.9	13.3	7.1	6.9	8.1	4.1	6.1	3.9	5
Min.	25.8	10.1	13.7	13.2	6.7	6.2	7.5	3.7	5.7	3.7	-
Max.	28.4	11.1	14.3	13.6	7.4	7.5	8.6	4.5	6.6	4.4	-
Rockville, Washington County, Utah											
	26.5	10.5	13.4	12.5	6.8	6.7	7.3	3.6	6.1	4.0	-
	26.8	10.5	13.6	13.1	6.8	6.9	7.9	3.9	6.9	4.4	-
Beaver Dam Wash, Washington County, Utah											
Ave.	27.2	10.9	13.8	13.4	7.0	6.8	10.6	3.8	6.4	4.2	9
Min.	26.4	10.5	13.2	12.8	6.8	6.4	9.5	3.6	5.9	4.0	-
Max.	27.9	11.5	14.4	13.9	7.3	7.3	11.5	4.1	6.8	4.7	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

Fig. 7. Distribution of Perognathus intermedius




IDAHO
UTAH
WYOMING
NEVADA
ARIZONA
CACHE
RICH
WEBER
BOX ELDER
MORGAN
DAVIS
SUMMIT
DAGGETT
SALT LAKE
WASATCH
TOOELE
UTAH
DUCHESNE
GREAT BASIN
JUAB
CARBON
UINTAH
SANPETE
COLORADO RIVER BASIN
MILLARD
SÉVIER
EMERY
GRAND
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
WASHINGTON
KANE
SAN JUAN
114
113
112
111
110
42
41
40
39
38
37

PEROGNATHUS INTERMEDIUS MERRIAM

Rock Pocket Mouse

Perognathus intermedius crinitus Benson

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.

RANGE:

This subspecies is found in northeastern Arizona and southeastern Utah east of the Colorado and south of the San Juan Rivers. Until Dr. Hayward captured a specimen at Rainbow Bridge in 1955, the only specimens of this species taken in Utah were by Benson (1935:451). His specimens were taken at Rainbow bridge and Navajo Mountain Trading Post.

This species has a strongly pinicillate tail and spines on hairs of the rump which distinguishes it from all other species found in Utah.

ECOLOGY:

Perognathus intermedius seems to prefer rocky slopes similar to formosus. Dice (1937:80 wrote that in Arizona it was found in rocky situations and seemed to be almost entirely restricted to this habitat. He stated,

> The rock pocket mouse is almost entirely restricted to the rocky hill association and, therefore, the sandy desert plains are nearly a complete barrier to its distribution. It rarely occurs on rock covered slopes and along rocky arroyos on the desert plains adjacent to its preferred rocky hill habitat.

Grinnell (1914:248-49) and Benson (op. cit.) also are in agreement that they are confined to the rocky hill sides. However, 3 of 82 specimens taken by Grinnell (op. cit.) in Arizona were in a sandy condition. They were along the river but could easily have reached this area from the adjacent rocky hillside. The specimen taken by Dr. Hayward was also found on a rocky hillside.

Grinnell (op. cit.) stated that scattered creosote brush was the conspicuous plant found in the habitat where he collected intermedius. Benson (op. cit.) stated that the dominant plants on the mesa at the Navajo Trading Post were Juniper, pinyon, and sage brush, Artemisia tridentata. He also stated that the area had been heavily grazed by sheep and goats resulting in a thin cover of grasses and herbs. Dice (op. cit.: 81) noted that definite color patterns of light and dark shades corresponded with the color of the rock formation in which they were found.

Some of the other small mammals collected in the same area with intermedius were Neotoma stephensi, Peromyscus maniculatus, and P. truei. Benson (op. cit.) stated there were very few small mammals and birds on the mesa where intermedius were taken by him.

Grinnell (op. cit.) did not take any pregnant females during his collections in Arizona. However, he did take two immature animals on April 24 and 25. He believes that the breeding season would be deferred in the case of this species until the advent of hot weather.

SPECIMENS EXAMINED: San Juan County: Navajo Mountain Trading Post, 1.

OTHER RECORDS: San Juan County: Rainbow Bridge, Navajo Mountain Trading Post (Benson, 1935:443).

TABLE 13

SKIN MEASUREMENTS OF PEROGNATHUS INTERMEDIUS CRINITUS

	Total Length	Tail	Hind Foot	Ear	Number Examined
Navajo Mountain Trading Post, San Juan County, Utah					
	178.0	100.0	27.0	7.0	-

TABLE 14

SKULL MEASUREMENTS OF PEROGNATHUS INTERMEDIUS CRINITUS

	A	B	C	D	E	F	G	H	I	J	K
Navajo Mountain Trading Post, San Juan County, Utah											
	25.1	9.6	12.1	12.0	6.6	6.7	7.6	3.1	7.3	3.7	-

LEGEND

A Greatest length of skull
B Length of nasals
C Zygomatic breadth
D Mastoid breadth
E Interorbital breadth
F Width of bulla
G Depth of bulla
H Length of interparietal
I Breadth of interparietal
J Alveolar length of upper molariform series (tooth row)
K Number examined

GENERAL ECOLOGY NOTES

Perognathus are usually found in arid areas where it would be difficult to obtain water to drink. Lindeborg (1948) was of the opinion that they could subsist on the water obtained by metabolism and in their foods. Aldous (1930:81) kept a Perognathus flavus in captivity making green foods, water, and dry grains available to it. There was no evidence that it drank any water, but it readily ate the green foods and stored the grains.

Table 15 indicates that the reproductive cycle of Utah Perognathus is from April to July reaching its peak in June. Of 121 adult females taken 22 were pregnant. The 2 in April were taken in the Beaver Dam Wash area, Washington County. One pregnant female of parvus was taken June 24 at Monte Cristo Forest Camp at an elevation of 9,000 feet. At about this same time 8 pregnant females of parvus were taken at Laketown, Rich County at an elevation of 6,000 feet.

Duke (1956) in his histological studies examined 26 females and 25 males from Utah. Twelve of the 20 females taken in June were pregnant. The only other two pregnant females were taken on April 18 in the southern portion of the state. Assuming that they have a regular gestation period comparable to other small rodents, this would indicate that the breeding season starts approximately April 1. Duke (op. cit.) stated that there was no histological evidence for activity in the reproductive tracts of females

TABLE 15

NUMBERS OF PEROGNATHUS ACCORDING TO AGE AND SEX

BY MONTHS

Month	I	I	A	A	Total	Preg.
January	--	--	--	--	--	--
February	--	--	1	8	9	--
March	--	--	--	--	--	--
April	--	--	3	36	39	2
May	--	--	16	16	32	7
June	4	4	43	44	95	13
July	26	18	27	31	102	--
August	--	--	30	32	62	--
September	--	--	--	--	--	--
October	--	--	1	2	3	--
November	--	--	--	--	--	--
December	--	--	--	--	--	--
Total	30	24	121	178	342	22

LEGEND

I -- Immature A -- Adult

Preg. -- Pregnant

collected after early July. Only 2 of the females taken in June had 2 sets of corporea lutea in their ovaries, indicating the possibility of two or more litters per year. The average size of each litter was 5.38 with a mode of 5.

Of 685 adult females taken from April through September in Nevada, Hall (op. cit.) found 40 pregnant females in May, 17 in June, and 8 in July. He found the average number per litter to be 5.5 with a mode of 5 or 6 since equal numbers of females had 5 and 6 embryos each. He also noted the extremes to be 3 and 8.

Records indicate longimembris reaches the peak in its reproductive cycle in May. Only 7 pregnant females of longimembris were taken during this study, all in May. Of 40 pregnant females taken in May by Hall (op. cit.), 29 were longimembris.

Twelve of the 13 pregnant females taken in June by the writer et al., were parvus. Hall (ibid.) took more pregnant females of parvus in June than any other month.

Evidence is lacking for the peak in the reproductive cycle in formosus. Of 21 females taken during this study only 2, taken in April, were pregnant. In Nevada, Hall (ibid.) took only 2 pregnant females in July.

Although pocket mice apparently do not harbor many ectoparasites, Beck (1955:26-27) found mites, lice, and ticks on the Perognathus that he examined. Usually the pocket mice were found to be free of ectoparasites.

DISCUSSION

In his recent monograph of Utah Mammals, Durrant (1952) listed 13 subspecies belonging to 6 species of Perognathus as occurring in the state of Utah. The present study has added a new species record to those he listed making 14 subspecies belonging to 7 species now occurring in the state. The new occurrence record is Perognathus fasciatus callistus from north-eastern Utah east of the Green River.

Distribution

Since pocket mice live in arid or semi-arid places, their habitats and distributional movements are greatly influenced by high mountain ranges and large bodies of water. Utah has a varied topography composed of many factors that apparently limit the ranges of Perognathus. Most of the pocket mice in Utah are found at elevations of 6,000 feet, or less, located within two large basin areas separated in the center by high mountainous country (see Figure 8).

Perognathus fasciatus callistus. Formerly this sub-species was not known to occur in Utah. This study has extended its range about 100 miles southwest from western Colorado into Uintah County and west into Daggett County. Since it appears to choose its habitat within the Upper Sonoran Zone, it probably has followed the low terrain southward

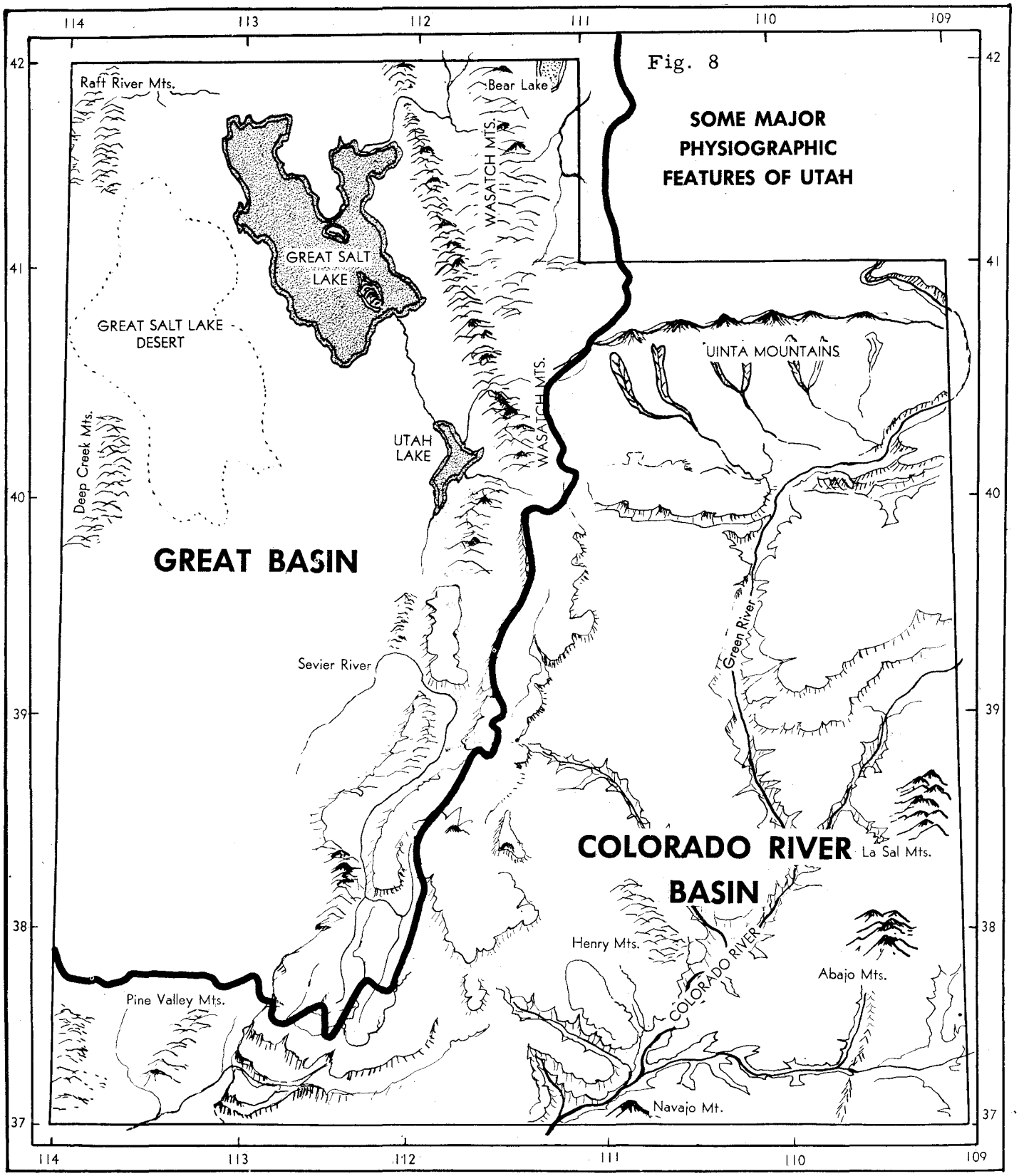


Fig. 8
SOME MAJOR PHYSIOGRAPHIC FEATURES OF UTAH
Raft River Mts.
Bear Lake
WASATCH MTS.
GREAT SALT LAKE
GREAT SALT LAKE DESERT
UINTA MOUNTAINS
Deep Creek Mts.
UTAH LAKE
WASATCH MTS.
GREAT BASIN
Sevier River
Green River
COLORADO RIVER BASIN
La Sal Mts.
Henry Mts.
COLORADO RIVER
Abajo Mts.
Pine Valley Mts.
Navajo Mt.
114
113
112
111
110
109
42
41
40
39
38
37

from Wyoming across northwestern Colorado into northeastern Utah and south along the Green River. Possibly the White River, in Uintah County, has been a barrier to its southward movements below the junction of the White and Green rivers. To date it has not been taken south of the White River. Time did not permit a careful study of the area near the junction of the White and Green rivers and additional collections will be necessary to verify the above assumptions. Evidently the Green River has limited its westward movements since no specimens have been taken on the west side of this river.

Perognathus flavus hopiensis. The present study did not increase the known range of this species to any appreciable extent. Kelson (1951a: 61) felt that there was no definite known barrier to limit its northward movement. The writer is in agreement with him and suggests when more collection records become available it is possible that this species will be found farther north along the Colorado River. The Colorado River is probably a barrier to its westward movements since it is not known to occur on the west side of this river.

Perognathus apache. This species occurs in the Colorado River Basin east of the Green and Colorado rivers. It occurs north of the Colorado River above its junction with the Green River and is found as far north as the White River in Uintah County. P. apache is probably limited to the north by the White River.

There is one interesting record of P. apache occurring on the west side of the Green River (Kelson, op. cit.: 63). This collection was

made near two large bridges, and these structures may have permitted it to cross the stream in recent years.

Perognathus longimembris. One race, P. l. gulosus, occurs in the Great Basin area. The other 3 races found in Utah occur in the Colorado River Basin.

The Great Basin race was formerly known only from the west border of Utah from Box Elder County south to Beaver County. The present study has extended its known range east to the high mountainous country (see Figure 4). Collections were taken in Cedar Valley, Utah County, and at Glenwood, Sevier County. The high mountains are probably an effective barrier to their eastward movements since no specimens have been collected in the Colorado River Basin east of these mountain ranges.

This study has indicated that this species prefers the sandy flats along the valley floors. This is probably why the Pine Valley Mountains have kept the population to the south separated from those in the Great Basin sufficiently long for two distinct races to develop. Even the rough terrain to the east of the Virgin River Valley has apparently kept the Colorado River Basin populations isolated. Distinct races are found on the deserts of the Colorado River Basin and in the Virgin River Valley.

An interesting feature in the distribution of longimembris is the occurrence of a race in the Navajo Mountain area east of the Colorado River. Apparently this species has been able to cross the river in numbers sufficient to survive and has become isolated long enough to develop distinct racial characters. It more closely resembles P. l. arizonensis than any

of the other races of P. longimembris. The population of the race east of the Colorado River is probably small since it is only known from its type locality, Rainbow Bridge, San Juan County.

Perognathus parvus. This species appears to be able to adapt itself to a wider variety of habitats than any of the others found in Utah. It has been collected in nearly all the habitats inhabited by the other species and at elevations ranging up to 9,000 feet on the mountainous areas between the two basins. It is also found in both basins on each side of the mountainous country as far west as Nevada and east to the Colorado and Green rivers.

The writer's study has extended the range of P. parvus in the Great Basin from Juab County south to Iron County. Figure 5 shows collection records from every county in the Great Basin except Piute. Formerly there were only 3 specimens known from the Colorado River Basin. To date specimens have been taken in Duchesne, Carbon, and Garfield Counties. A good series was collected at Laketown, Rich County, and Linwood, Daggett County. The Colorado and Green rivers are apparently barriers to this species since no records are available east of these streams.

Perognathus formosus. One race occurs in the Great Basin and two in the Colorado River Basin. Formerly the Great Basin race was only known from the western border of the state in Beaver County. The present study has extended its range north to Fish Springs and east to Uba Dam Reservoir, Juab County and south to Antelope Springs, Iron County. It appears that the high mountainous region to the east has been an effective barrier. There are no records of this species occurring in the Colorado

River Basin east of these mountains.

The Virgin River Valley race was formerly known only from Washington County. Its range has now been extended east to the Colorado River. The Beaver Dam Mountains separate the two Colorado River Basin races of formosus, but Perognathus longimembris virginis is found on both sides of these mountains.

Perognathus intermedius crinitus. The population of this species is apparently not very large. Prior to the capturing of a specimen by Dr. Hayward in 1955, Benson (1935) collected the only other specimens taken in Utah. This species is a southern group. The subspecies crinitus occurs in northeastern Arizona. Its entrance into Utah has probably been north along the east side of the Colorado River. In Utah it is known only from the Navajo Mountain region. Since P. intermedius inhabits almost exclusively rocky hillsides, the variable terrain has probably caused this species to reach its ecological limits in this region.

Description and Variation

No doubt the variable topography found in Utah has been responsible to a great extent for the variation existing between the populations of the species of Perognathus occurring within its boundaries.

Perognathus fasciatus callistus: The specimens from Utah are larger than those occurring in Wyoming and Colorado. However, the cranial characters vary only slightly. The interorbital breadth is a little wider and the length of the interparietal is a little longer in the Utah speci-

mens (see Tables 1 and 2). The color of the Utah specimens is a little grayer owing to the reduction of light buff on the dorsal parts of the body.

Perognathus flavus hopiensis: All the populations of this species except the ones taken at the Four Corners closely resemble the type specimen. The ones from the Four Corners are larger and in this respect resemble bimaculatus. However, the mastoid breadth is narrower than bimaculatus and more closely resembles hopiensis. The reader is referred to the account of species for a more detailed discussion of hopiensis.

Perognathus apache: Most of the specimens of this species taken north of Moab are lighter in color. This is probably associated with soil conditions found in their habitats since the lighter ones were taken on a light sandy soil and the darker ones on a darker, reddish soil. The exception to the lighter specimens taken north of Moab were those from Arches National Monument and they were on a darker soil.

Durrant (1952) referred all the specimens he examined north of the San Juan River to the subspecies caryi. The writer found considerable intergradation among the specimens near the Moab area. Since a majority of the specimens taken at Arches National Monument and 22 miles south of Moab were shorter in total length, length of skull, and nasals, the writer was inclined to refer them to the subspecies apache. Also their color was similar to the specimens taken south of the San Juan, but the color is perhaps associated with soil conditions rather than genetic factors.

Perognathus longimembris: The author found the color characteristics of the races within this species in agreement with those listed by others.

Durrant (op. cit.) pointed out that the topotypes of virginis differed from gulosus in that the mastoid was markedly larger. Table 6 does not bear this out in the specimens taken 8 1/2 miles north of St. George. It was noted by the author in the specimens he examined that virginis averaged larger than gulosus in total length, longer tail, and the interparietals were smaller.

Perognathus parvus: Considerable variation was noted by the writer in the populations of parvus collected in Utah. Although the specimens of this species from Laketown and Woodruff, Rich County and Roosevelt, Duchesne County were sent to Dr. E. R. Hall and designated as belonging to the race clarus; they are not typical of either clarus or olivaceus. The Laketown series is longer on the average in most measurements taken than in clarus topotypes. The total length of the skull was longer owing in the main to longer nasals (see Table 10).

The ground color in the Laketown series was darker ranging from a cinnamon buff to a pinkish cinnamon rather than a pinkish buff. The lateral stripe was wider and more distinct in the Laketown series than clarus. Darker hairs of the back are strikingly more prominent with a tendency to form black patches on the rump and a distinct black mid-dorsal line. In matters of cranial and body measurements, the writer feels they resemble olivaceus more closely than clarus.

A comparison of the Linwood series with a good series of clarus topotype shows some signs of intergradation between olivaceus and clarus. However, in both cranial measurements and color they are decidedly closer

to clarus as might be expected from their continuous range.

A population of parvus taken on the east slope of the Henry Mountains possesses strikingly different characteristics from either olivaceus or clarus. The ground color is a brighter cinnamon buff rather than a pinkish buff. The buffy lateral stripe on the sides is indistinct as in clarus. The reduction of dark hairs on the back gives the animal a brighter and more buffy appearance in general and such dark hairs as there are are confined to a rather distinct mid-dorsal stripe which is especially evident between the ears. The subauricular white patches are larger and the tail more buffy throughout than in P. p. clarus or P. p. olivaceus.

The hind foot and ears are smaller than P. p. clarus or P. p. olivaceus. The mastoid breadth is wider and the interorbital breadth is narrower. It is the writer's opinion that this series contains sufficient characters to warrant separation into a new race.

Perognathus formosus: In the main the author found agreement in the characteristic differences between the races of formosus as listed by others. In comparing the shape of the suture between the parietal and interparietal bone, the writer noted some intergradation between Perognathus formosus formosus and P. formosus incolatus. The author found a lack of agreement in one cranial character. Durrant (op. cit.) noted that the interparietals were wider in P. formosus mohavensis than P. f. formosus or P. f. incolatus. Table 12 does not indicate any appreciable difference in this respect for the specimens examined.

Perognathus intermedius crinitus: The specimen of this species

examined by the author appears to fit the description listed in the literature for others taken in the same area (Benson, 1935).

Ecology

In general this study has merely added more evidence of the known habitat preferences of the various species of Perognathus. Perognathus formosus and P. intermedius prefer rocky hillsides and slopes. Perognathus apache appears to favor sandy areas with a fine gravel content. Perognathus longimembris is found on flat sandy areas. Perognathus parvus appears to be able to adjust to a wide variety of situations.

Although sufficient data were not available on the reproductive cycles of Perognathus, it appears the Utah animals begin their breeding season in April. It extends over to July and reaches its peak in June. This study has brought out the fact that there is little evidence that Perognathus have more than one litter per year.

Perognathus are relatively free of ectoparasites. However, ticks, mites, lice, and fleas were found on some of the Utah specimens (Beck, 1955).

SUMMARY

1. There are now 14 subspecies belonging to 7 species of Perognathus occurring in Utah.

2. Perognathus parvus is the most widely distributed of any of the pocket mice found in Utah.

3. Four of the species are found only on the east side of the Green and Colorado rivers. An exception to this is one record of a specimen of P. apache taken on the west side of the Colorado (Kelson, 1951a:63).

4. One interesting distribution record is of the Perognathus longimembris arcus found on the east side of the Colorado River. All the other races are found only on the west side.

5. Perognathus are an arid or semi-arid dwelling species usually found at about 6,000 feet, or less, in elevation. In Utah there is a collection record for Perognathus from nearly every county.

6. Perognathus can apparently subsist on the moisture gained through metabolism and their food (Lindeborg, 1948 and Aldous, 1930:81).

7. The breeding season of Perognathus in Utah appears to be from April to July reaching its peak in June.

8. In addition to the published data regarding Perognathus in the state, the following information has been brought out by this study and is considered to be a distinct contribution to our knowledge of this genus:

a. There is a new occurrence record, Perognathus fasciatus callistus, from northeastern Utah east of the Green River.

b. The ranges of Perognathus longimembris, P. parvus, and P. formosus have been extended in Utah.

c. Some variation and differences have been noted in P. parvus, P. formosus, P. flavus, and P. longimembris that have not been reported in the literature.

d. One population of P. parvus from the east slope of the Henry Mountains appears to have sufficient traits to warrant separation into a new race.

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ABSTRACT

A STUDY OF THE UTAH POCKET MICE OF THE GENUS PEROGNATHUS

The objectives of this study were: (1) to make a detailed study of the distribution of the genus Perognathus in Utah; (2) to determine if any species or races not now recorded occur in the state; (3) to bring together notes on life histories of this genus, both from the literature and field studies; and (4) to determine habitat preferences of the species represented.

This paper lists 14 subspecies belonging to 7 species of Perognathus occurring in Utah. One species is a new occurrence record, Perognathus fasciatus callistus, from northeastern Utah east of the Green River. The ranges of Perognathus longimembris, P. parvus, and P. formosus have been extended in Utah.

Most of the pocket mice in Utah are found at an elevation of 6,000 feet or less. Perognathus parvus is the most widely distributed of any of the species and may be found at elevations as high as 10,000 feet. The other species appear to prefer special habitats. One group of P. parvus from the east slope of the Henry Mountains is believed to contain sufficient taxonomic traits to warrant separation into a new race.

The reproductive cycle of the Utah species appears to be from April to July reaching its peak in June. There is little evidence that

pocket mice have more than one litter per year.

As a rule pocket mice are relatively free of ectoparasites. However, ticks, mites, lice, and fleas were taken from some of the Utah specimens.