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Distribution patterns of pocket gophers in the Hobble Creek Area, Utah County

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DISTRIBUTION PATTERNS OF POCKET GOPHERS IN THE HOBBLE CREEK AREA, UTAH COUNTY

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INTRODUCTION

In Utah there are two recognized species of pocket gophers, Thomomys umbrinus usually a low valley form and T. talpoides which inhabits the mountains and high valleys. Within the state the two species reach the northern and southern limits of their ranges. Their pattern of distribution exhibits several areas where the ranges of the two species are adjacent. One such location is along the Wasatch Front where the ranges of T. t. wasatchensis Durrant and T. u. albicaudatus Hall come together.

This study was initiated to investigate patterns of distribution and certain ecological factors which may affect the distribution of these two species of pocket gophers in the area adjacent to Hobble Creek Canyon, Utah County, Utah. This area (Fig. 3) is near the southern end of the Wasatch Front and is representative of those canyons which emerge from the Wasatch mountains and open onto areas once occupied by Lake Bonneville.

Taxonomy and Distribution of Pocket Gophers in the State

The taxonomy of Utah pocket gophers has undergone a history of confusion and changes. The first account of actual

specimens of pocket gophers in Utah was made by Elliot Coues (1875). The specimens were designated as Thomomys talpoides. He mentions that specimens from Provo exhibit such variation that labeling is a matter of indifference and these specimens were designated as T. talpoides bulbivorous. However, a paper dated the same year by Coues and Yarrow (1875) uses the name T. talpoides umbrinus for specimens from Provo. In 1877 umbrinus was again changed to bulbivorous and the pocket gophers from southern Utah were designated as T. umbrinus (Coues, 1877).

Bailey (1915) made a summary of the known information of the genus Thomomys. He lists only four kinds belonging to four different species for Utah. The species and approximate ranges given are: T. fossor Allen, found in the mountains of eastern and southern Utah; T. uinta Merriam, in northern Utah; T. ocius Merriam, found in the Green River Basin northeastern Utah; and T. perpallidus aureus Allen, found in the desert regions of southern Utah.

Since 1930 a great deal of work has been done on the distribution and variation of pocket gophers in Utah. Most noteworthy of these is "The Pocket Gophers of Utah" by Durrant (1946). This work resulted in recognizing only two species, T. talpoides and T. bottae. Since 1946 bottae has been changed to an earlier name, umbrinus (Hoffmeister, 1954), and Durrant (1955) has described one new subspecies for each species, T. t. bridgerii and T. u. powelli. The total kinds of pocket gophers from Utah as presently recognized by Hall

and Kelson (1959) is T. umbrinus with twenty-five subspecies and T. talpoides with twelve subspecies.

The many distinct forms of pocket gophers in the state are surprising. Some of the factors contributing to this display of speciation are: The genetic plasticity of pocket gophers, the varied topography and climate found in Utah and the fact that both species are at the limits of their ranges.

In the state T. talpoides is found in the central mountain ranges and high plateaus and in the Uinta Mountains. East of the Colorado and Green Rivers it is found in the mountains of San Juan and Grand Counties. T. umbrinus typically inhabits the lower valleys of the state but also occupies the mountains west of the central mountain ranges with the exception of the Oquirrh Mountains (Durrant, 1952).

The two subspecies under consideration in this paper, T. t. wasatchensis, and T. u. albicaudatus, were described as new subspecies by Durrant (1946) and Hall (1930) respectively. The approximate range for wasatchensis in the state is the Wasatch Mountains and neighboring high valleys as far south as Spanish Fork Canyon, Utah County. The range of albicaudatus is that area between the Great Salt Lake and the Wasatch Mountains south to the Sevier River in Juab County and west into Tooele County to the Onaqui and Sheeprock Mountains (Durrant, 1952). In the Hobble Creek area, Utah County, the ranges of umbrinus and talpoides are in contact with each other.

Literature Reviewed

Little is known concerning the patterns of distribution for two species of pocket gophers which live in the same area. Several accounts of general distribution are found in the literature but examples which give some analyses of the ecological factors involved are few.

The greatest development of the family Geomyidae is found within a narrow belt extending from sea to sea across the southern end of the table-land of Mexico. This region is characterized by diverse ecological conditions which permit seven genera of pocket gophers to live there. Goldman (1939) indicates that the habitats of the genera are often in close proximity but apparently there is no intermingling.

In southern Texas Kennerly (1959) investigated the biological dynamics of contact between the ranges of two allopatric species of pocket gophers, Geomys personatus fallax Merriam and G. bursarius attwateri Merriam. Indurate soils were thought to constitute the greatest barrier to dispersal and interspecific competition was largely responsible for the separation of the ranges in the area studied.

Hall (1946) concludes that there is no overlapping in the ranges of the four species of pocket gophers which occur in Nevada. Two of these are those considered in this work. Variation in the nature of the soil and conditions associated with climate were claimed to be responsible for the distinct separation of the species.

After a rather extensive study of the ecology and distribution of pocket gophers in Colorado Hansen (1964) concludes that in the regions of contact between the ranges of two or more species the ranges may meet and interdigitate but do not overlap. He states that, "A particular species may be limited by unfavorable soils relative to their ranges of soil tolerance, by climatic factors, or by interspecific competition."

After a series of trappings Durrant (1952) found T. talpoides and T. umbrinus to be living sympatrioally between 5,000 and 6,000 feet elevation in Rose Canyon on the east and Settlement Creek on the west of the Oquirrh Mountains in Salt Lake County, Utah. He observed that in this area umbrinus occupied the more moist soils and talpoides was generally found in the dryer, more rocky soils.

Collections made in Utah County by La Munyon and La Munyon (1949) indicate that the two species, talpoides and umbrinus, are in close proximity of each other but no border or overlap of ranges was established by them.

It was primarily the result of the work just mentioned and those of Durrant (1946 and 1952) that Hobble Creek Canyon and the adjacent areas were chosen as the major area of study by the author.

METHODS

Field collecting took place from the middle of March until the middle of June, 1963 and 1964 with additional trapping being done during September and October, 1963. Traps were set at least once each week. They were generally set in the evening and collected the following morning as this time proved to be the most productive.

Dead trapping was accomplished by the use of California Gopher Traps. Several attempts were made to live trap specimens but only one immature talpoides was taken in this manner.

The entire study area was divided into segments to facilitate the keeping of trapping records and field notes. There was no consistent pattern as to where traps were set. Generally they were scattered throughout most of the study area in freshly dug burrows when these could be found. As each specimen was collected the location, soil type and vegetation were recorded. The place of collection was also plotted on a map of the study area. This information was used to establish different distribution patterns.

Specimens were brought to the laboratory where all the skulls and representative skins were prepared and kept for identification purposes. The reproductive tracts were

excised and records were made of the reproductive stage of each specimen.

Throughout the study 255 traps were set (not trap nights) which resulted in the collection of 74 talpoides and 46 umbrinus specimens. Additional specimens from the Brigham Young University and the University of Utah mammal collections were used in this study.

The field notes taken have been of great assistance in the compilation of this paper. Toward the conclusion of the field work especially, a great deal of time was spent walking over the study area and making rather critical notes on pocket gopher activity, plotting of the vegetation and making correlations concerning the distribution patterns of the two species of pocket gophers.

DIFFERENTIATION OF THE TWO SPECIES

The two species look very much alike externally. In the Hobble Creek area where it is not always certain which species will be trapped it was at first necessary to make determinations by using the morphology of the skulls. After becoming better acquainted with the two species, distinguishing external characteristics were evident. Of those characteristics given by Durrant (1946) and from personal observation the author found the following to be of most value.

Characteristic	T. t. wasatchensis	T. u. albicaudatus
Sphenoidal fissure	absent	present
Incisive foramina	anterior to infra-orbital canal	posterior to infra-orbital canal
Lambdoidal suture	concave posteriorly	not concave posteriorly
Posterior end of nasal	emarginate	straight
Extension of premaxilla past nasals	varies only slightly but distinctly less than albicaudatus	exceeds considerably that of wasatchensis (Table 1)
Color - back	uniform brown mixed with black (No color variation with age.)	prominent dark brown streak down back with lighter color over sides and flanks. (Older specimens lighter; dark streak may be nearly absent.)

Comparative measurements for adult specimens of the two species are given in Table 1. Adult status was recognized according to criteria given by Hisaw (1924) and Hansen (1960). The determination of age was made easier since the majority of specimens were collected in the spring before the young were active. The figures show there is a distinct sexual dimorphism in both species. The males on the average are larger than the females. Umbrinus albicaudatus males are considerably larger than talpoides wasatchensis males. On the average umbrinus albicaudatus females are the same size as talpoides wasatchensis males. It is interesting to note that the tail length of both species is highly variable. If the length of the tail is deducted from the total length, the difference between the maximum and minimum lengths is generally reduced by half. Apparently the selection pressure for tail length is not very great.

Table 1 also includes comparable measurements of type-locality and topotype specimens for both species. Talpoides from the type locality, Midway, Wasatch County, are generally larger in all categories than talpoides from Hobble Creek, Utah County. It should be indicated however that most of the variation in total length is due to the variable length of the tails. Umbrinus specimens (males) from Hobble Creek appear to be larger than the type locality specimens but considering the body size (minus the tail) the specimens from Hobble Creek are smaller. The females from both localities

TABLE 1.--Comparative measurements for T. t. wasatchensis and T. u. albicaudatus from Hobble Creek and type localities. All measurements were made by the author and are in millimeters. The number preceding each group of specimens designates the number measured.

Total length	Length of tail	Length of hind foot	Basilar length	Zygo-matic breadth	Length of nasals	Inter-orbital breadth	Ext. of premaxilla past nasal
(19) T. t. wasatchensis ♂♂ Hobble Creek, Utah County							
Ave. 207	56	28	31.4	21.6	13.6	7.8	.9
Min. 195	50	25	29.6	20.0	12.3	6.4	.3
Max. 225	64	30	33.4	24.0	15.0	8.0	1.9
(9) T. t. wasatchensis ♂♂ Midway, Wasatch County							
Ave. 222	68	28	31.6	21.7	13.4	7.1	1.1
Min. 204	60	26	27.7	19.0	11.8	6.9	.6
Max. 237	75	31	35.0	23.6	15.4	7.6	2.0
(26) T. t. wasatchensis ♀♀ Hobble Creek							
Ave. 196	55	27	30.1	20.3	12.9	7.2	1.0
Min. 180	45	25	27.5	18.9	11.2	6.8	.1
Max. 210	64	29	31.9	21.5	14.2	7.5	1.8
(10) T. t. wasatchensis ♀♀ Midway							
Ave. 207	62	27	33.4	20.8	13.2	7.1	1.1
Min. 180	52	23	29.2	19.8	12.7	6.9	.6
Max. 222	70	30	31.6	22.0	14.0	7.5	1.4

TABLE 1--Continued

Total length	Length of tail	Length of hind foot	Basilar length	Zygo-matic breadth	Length of nasals	Inter-orbital breadth	Ext. of premaxilla past nasal
(5) T. u. albicaudatus ♂♂ Hobble Creek							
Ave. 237	71	30	36.5	26.3	13.9	7.2	3.2
Min. 225	65	28	35.0	25.3	13.2	6.7	2.7
Max. 250	81	31	37.6	27.4	14.6	7.4	3.7
(5) T. u. albicaudatus ♂♂ Provo, Utah County							
Ave. 231	59	30	38.1	27.2	14.8	7.2	3.7
Min. 222	54	29	36.7	26.7	14.4	7.0	3.4
Max. 239	61	31	39.5	27.5	15.5	7.3	3.9
(2) T. u. albicaudatus ♀♀ Hobble Creek							
Ave. 207	56	28	33.1	23.0	12.4	7.0	3.0
Min. 204	55	27	33.1	22.8	12.2	6.9	2.9
Max. 210	56	28	33.1	23.2	12.5	7.0	3.0
(6) T. u. albicaudatus ♀♀ Provo							
Ave. 210	59	28	33.1	23.5	12.4	7.2	3.3
Min. 207	54	26	31.8	22.8	11.6	6.9	2.8
Max. 218	64	30	34.1	24.2	12.8	7.7	3.7

(Provo and Hobble Creek) are similar in the measurements taken. The smaller size of talpoides from Hobble Creek may be the result of living in a habitat which does not allow the growth that is achieved with the more optimum conditions present in the type locality area. Davis (1938) makes mention of this same trend. He indicates that less favorable soils are responsible for the arrested development. However, it is extremely difficult to make meaningful comparisons between umbrinus specimens collected from different habitats. Within the Provo area, which is the type locality, specimens were compared from Ironton, the Bonneville terrace east and north of Provo, Provo City and the area close to Provo Harbor on Utah Lake. Specimens from each type of habitat were different in average size. They ranged from the largest to the smallest in the following order: Provo Harbor, Hobble Creek, Ironton, and Bonneville terrace. It is now very evident what Coues meant when he stated that animals (pocket gophers) from Provo "exhibit among themselves such variations that their labeling becomes a matter of indifference." (Coues, 1877)

DESCRIPTION OF STUDY AREA

The major study area is shown topographically in Fig. 3. The major landmarks are the two canyons which open onto the valley floor and the distinct terraces of Lake Bonneville. Fig. 1 shows the Bonneville terrace as it appears between Hobble Creek and Maple Canyons. This terrace is extensive enough in two locations that the area has been cleared and planted into grass or irrigated crops. Along this terrace are several coves and large gullies which have

Fig. 1. Bonneville terrace. Looking north from the mouth of Maple Canyon.

cut down through and open onto the valley floor. These gullies provide exposures which show patterns of distribution very similar to the north and south exposures on the surrounding mountains. The drier environment of the south exposures allows the sagebrush community to penetrate the mountain brush community to higher elevations than on north exposures. The mountain brush community is more prominent at lower elevations on the north than on the south exposures. These different exposures also provide a very interesting pattern in the distribution of talpoides.

Most of the soil in the valley and on the terraces is a result of alluvial deposits. The soil is generally of a sandy loam type with variations from a rocky or gravelly sandy loam to a silt loam.

The aerial photo (Fig. 2) best illustrates the distribution of vegetation. The more obvious variations in the distribution pattern are: (a) The variation due to land use; (b) extensions of the sage-grassland community into higher elevations on south and west exposures than on north exposures; and, (c) greater density of the mountain brush community on north exposures as compared to south exposures.

The author has divided the Hobble Creek area into agricultural, sage-grassland and mountain brush communities (Fig. 3). Agricultural land occupies most of the actual study area. Generally speaking all of the land that is not too steep or rocky has been put under cultivation. The more rocky soils have been planted to orchards. Soils that are

Fig. 2. Aerial Photo of Hobble Creek and Adjacent Area (USDA, unpublished).

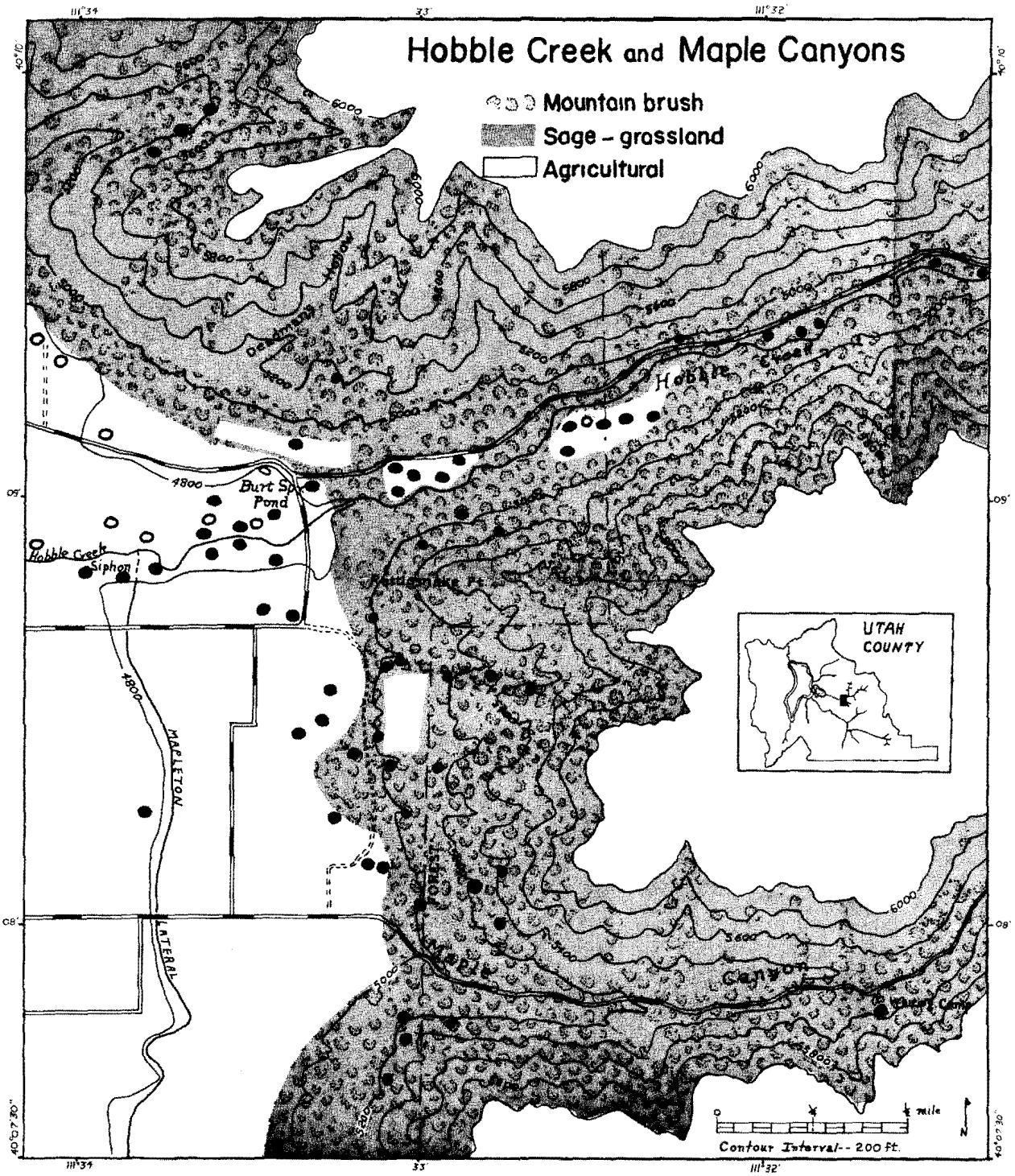

Fig. 3. A topographic map of the major study area showing the distribution of pocket gophers with respect to types of vegetation. The symbols indicate the places of capture or where activity was observed. All specimens collected are not shown. (Map redrawn from U. S. Geologic Survey map--Springville quadrangle--1948)

○ T. u. albicaudatus ● T. t. wasatchensis

most free of rocks are used to grow alfalfa, peas, corn and other grains, or pasture.

The sage-grassland community usually borders the agricultural land. Its most abundant vegetation consists of sagebrush, Artemisia tridentata; small amounts of rabbit brush, Chrysothamnus nauseosus; match brush, Gutierrezia sorothrae; cheat grass, Bromus tectorum, which is very abundant; bluegrass, Poa bulbosa; and blue-bunch wheat grass, Agropyron spicatum. The environment on south and west facing slopes enables this community to grow to higher elevations than on north facing slopes (Fig. 2). On those areas which appear nearly bare, the predominant vegetation is cheat grass with scattered perennial grasses. Perennial species are usually more abundant than the cheat grass on the north facing slopes among the mountain brush.

Mountain brush and sage-grassland communities are very much intermixed. This has been indicated in Fig. 3 by representing the sage-grassland all through the mountain brush. There has been an attempt to indicate differences in the density of mountain brush by having fewer symbols in areas of lesser density such as south and west facing slopes. No attempt was made to show the rock outcrops which are very evident in this area. The predominant vegetation included in the mountain brush community is oak, Quercus gambelii; mountain mahogany, Cercocarpus montanus; squawbush, Rhus trilobata; some bitterbrush, Purshia tridentata; and Rocky Mountain maple, Acer grandidentatum. Box elder, Acer negundo,

and willows, Salix spp. are present but limited to the areas adjacent to the streams. Oak brush is the predominant vegetation on north facing slopes. On south facing slopes oak is less evident than mountain mahogany but both cover less area than the sage-grassland vegetation.

Because of the slope which varies from 10 - 60% most of the area occupied by sage-grassland or mountain brush communities is rather badly eroded. This is especially true on the south and most west facing slopes.

ECOLOGICAL FACTORS AND DISTRIBUTION PATTERNS

Observation and analysis indicate that there are several rather evident variables in the environment which may be responsible for the distributional pattern shown by the two species of pocket gophers in the Hobble Creek area. These are vegetation, land use, soil types, moisture and slope exposure. Other ecological factors that may be considered are hybridization and interspecific competition. Since both species are approaching limits of their ranges in the Hobble Creek area, it is unlikely that the entire area would have characteristics within the physiological tolerance ranges of the species. In such an area the critical factors that determine distribution would be more evident than in the center of the range. In writing this paper the author has correlated the distribution of each species with a particular ecological factor and the possible effects of each on distribution are discussed.

Vegetation and Land Use

Since pocket gophers are strictly herbivorous there is the possibility that the type of vegetation may affect their distribution. Fig. 3 shows the general distribution of the two species with respect to vegetation. It indicates

that all specimens of umbrinus in the Hobble Creek area were taken from agricultural land. This soil is either planted to alfalfa or had been taken out of alfalfa in the fall of 1963 and planted to grain the next spring. It should be noted that over a larger area umbrinus is not so restricted to agricultural land since specimens were also collected in sage-grassland and mountain brush communities on and above the Bonneville terrace east of Provo. Specimens of talpoides are shown to have also been collected from all vegetational communities.

Even though orchards occupy approximately one-fifth of the agricultural area no specimen of either species was collected nor was activity observed in an orchard in the Hobble Creek area. Rather than there being an inhibiting factor associated with the trees themselves the periodic discing and mulching of the soil possibly keeps the pocket gophers out of the orchards.

In sage-grassland and mountain brush communities the only species of pocket gopher found is talpoides. Here the specimens are most often found close to, but not in, clumps of oak brush. There were only two specimens taken from areas where no vegetation of the mountain brush type exists. Several investigations show that as much as 80-90 percent of the food of talpoides consists of forbs (Aldous 1945, Tryon 1947, Ward and Keith 1963). Therefore it is likely that the greater number of specimens associated with oak brush does not indicate a preference for this type of vegetation but

that they are associated more intimately with factors related to moisture and exposure as well as soil.

In areas occupied by both species of gophers the vegetation is entirely alfalfa. Both species were observed to have removed the alfalfa from around the opening of the burrow and cut the stems into pieces one or two inches long. These pieces were often removed from freshly dug burrows while traps were being set. There appears to be a particular preference for nesting material shared by both species in that all nests observed were constructed of grass.

It is unlikely that the variation of the vegetation, in itself, has any appreciable effect upon the distribution of either species.

Soil Types

General soil types for the Hobble Creek area were obtained from the U. S. D. A. Soil Conservation Service. The number of specimens taken from each soil type is given in Table 2.

TABLE 2.--Number of specimens taken from general soil types in Hobble Creek area, Utah County.

Soil type	talpoides	umbrinus
Stony or stony-sand loam	3*	-
Gravelly or gravelly-sandy loam	39*	2
Deep-dark brown loam (well-drained)	19*	7*
Silt loam	-	-

*Observations made of additional activity.

The additional activity, indicated by an asterisk, in Table 2 was judged to be that of talpoides or umbrinus by the following criteria. During the winter some pocket gophers make tunnels in the snow which are used for runways and as a depository for excavated soil. When the snow melts several of these earthen cores can be seen issuing from a common center. (Fig. 4). These earthen cores are very prominent in the spring in areas occupied by talpoides. However, in areas or burrows known to be inhabited by umbrinus earthen cores were observed to be associated with only one burrow. This observation together with previous trapping records enabled the author to determine which species was responsible for the observed activity.

Fig. 4.--An example of the earthen cores which are evidence of the winter activity of T. talpoides. This photo was taken April 4, 1964 in Hobble Creek Canyon.

Distribution according to soil types shows that umbrinus is usually found in well drained, loamy soils but

also occurs in gravelly-sandy loam soils. Talpoides occupies all soil types except silt loam but is more abundant in gravelly or gravelly-sandy loam soils. In analyzing the soils more closely the one soil which seems to inhibit the distribution of both species of pocket gophers more than any other is a silt loam soil. This soil is highly plastic, becoming sticky when too wet, and hard and cloddy when dry (Lyon and Buckman, 1943). Wherever such a soil exists in the study area it is void of pocket gophers. There appears to be a tendency for both species to occupy soils which are loose-sandy or gravelly loam. (The designation "loose" is used here as being opposed to the heavy clay or silty soils.) This is especially evident for umbrinus along the lake terrace east and north of Provo. Here their distribution is spotty but wherever specimens are found the soil is of a loose, sandy or gravelly loam type. This was also the finding of Hayward (1945) in reference to talpoides. He indicated that even though the soil may be rather rocky it is frequently used provided it is loose and not too dry.

Soils such as silty loam types which are sticky when wet and hard when dry may inhibit the distribution of pocket gophers. In the Hobble Creek area any such soils are so limited that they are not a problem to the pocket gophers as far as general distribution patterns are concerned.

Moisture and Exposure

The overall range of umbrinus in the state receives an

average precipitation of 6 - 15 inches annually. The range of talpoides receives an average of 17 - 40 inches a year with some localities in eastern Utah receiving as low as 8 inches. The average precipitation for the Hobble Creek area is approximately 16 inches annually. (Alter, 1941) It would seem that in general talpoides occupies more mesic conditions than does umbrinus.

The most noticeable distribution pattern in the entire study area occurs along the Bonneville terrace between Hobble Creek and Maple Canyons (Fig. 1 and 2). Talpoides is the only species occurring here. As has been previously mentioned large gullies have cut down through the terrace leaving north and south exposures which have environments similar to these same exposures on the surrounding mountains.

It is reasonable to assume that on these north exposures there would be a greater amount of available moisture which would remain in the soil for longer periods of time than on the south exposures. The greater amount of available moisture results from several factors associated with these north exposures. A greater density of vegetation decreases the temperature of the soil and acts as a shelter reducing the amount of evaporation by the wind. The organic matter added to the soil has a great absorptive capacity and tends to retard the rate as well as the magnitude of runoff. North exposures do not receive the radiation from the sun as directly as south facing slopes. This factor also reduces the temperature on north exposures which results in

less water being lost through evaporation and transpiration. The variation in moisture on the north and south exposures along the terrace should reveal whether the amount of available moisture is a factor affecting or limiting the distribution of talpoides.

It was found that talpoides occurred almost invariably on the north facing slopes along the Bonneville terrace. Only on two occasions were specimens found on west and south slopes. Points of capture and/or observation of activity are plotted on Fig. 5. These data tend to indicate a preference of talpoides for the more moist conditions.

Only one pocket gopher was taken from the terrace itself. This specimen was collected in an irrigated field just north of Burt Spring Pond (Fig. 5). The fact that talpoides occurs in irrigated fields but not on the drier areas of the terrace also indicates a preference for more moist conditions. The soil along the terrace is of a uniform type; i.e., loam or gravelly loam.

The author's observations indicate that a lack of available moisture in the Hobble Creek area is a major factor inhibiting the distribution of the vegetation and of talpoides in non-irrigated soils. In irrigated soils where there is plenty of moisture talpoides appears to find a very favorable habitat.

It is shown (Fig. 5) that in the Hobble Creek area umbrinus was collected only in irrigated fields. In other parts of Utah Valley, however, this species occupies the

more moist soils around Provo Bay as well as much drier soils east and north of Provo on the Bonneville terrace and its west slopes. Being so adaptable it is possible that umbrinus is less affected in its distribution by the amount of soil moisture than is talpoides.

Interspecific Relationships

Hybridization

Morphological comparison of talpoides and umbrinus from Hobble Creek with the type or type-locality specimens of each species does not indicate that hybridization is occurring. The comparative measurements are given in Table 1. The measurements of each specimen within a species were similar to each other and no characteristic of one species was observed to be present in the other. However, it is realized that morphological evidence alone is insufficient when determining whether interbreeding occurs or not.

Because there is an area where the ranges of the two species are in actual contact it is theoretically possible that interbreeding occurs since the breeding seasons of the two species overlap. The data given in Fig. 6 and Table 3 are combined from trapping records for 1963 and 1964. All animals represented were collected at an altitude of 4,500 to 5,200 feet. No particular difference in the breeding seasons was attributed to differences in altitude.

Table 3 gives information on the reproductive period

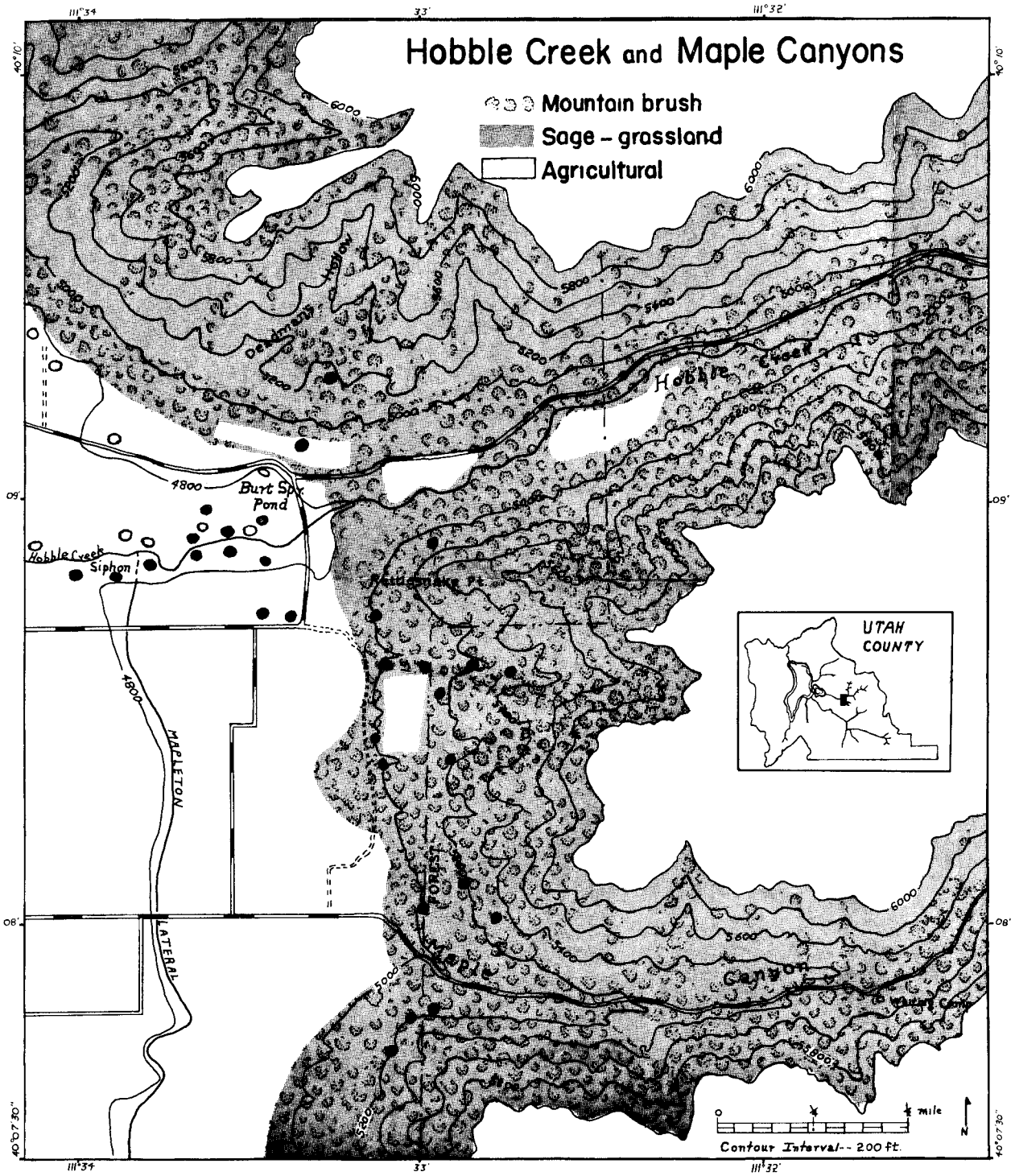

Fig. 5. The red symbols show the area where the ranges of T. umbrinus ○ and T. talpoides ● are in contact. Note that on the south side of Hobble Creek talpoides extend further west than on the north side. The distribution of talpoides along the Bonneville terrace is shown in black.

of females. The available data indicate that the breeding season of female talpoides is from the latter part of April to the middle of May and from the latter part of March to the middle of May for umbrinus. The extent of the breeding seasons was estimated on the basis of information given by Schramm (1961) who observed that the gestation period of captive pocket gophers, T. bottae, was nineteen days.

Fig. 6 shows the seasonal change which occurs in the testes of both species. This change was determined by measuring the dissected testes and then representing their development as a percentage of the total body length. The percentages are averaged for 10 day periods. Hansen (1960) indicates that the maximum size of the testes is reached just before pocket gophers are sexually active and from this time to the end of the breeding season they show a gradual decline. The testes of both species had reached their maximum size prior to March 23 when the first males were collected. These males were assumed to be sexually active. Males of both species were sexually active at least until the latter part of May when the testes showed a rapid decrease in size. The male reproductive periods of the two species are shown to correlate very closely.

Males of both species are sexually active for a longer period of time than are the females. This increases the possibility that interbreeding could occur since females coming into breeding condition early or late could mate with a sexually active male of either species.

TABLE 3.--Reproductive period for female specimens of T. talpoides and T. umbrinus in Hobble Creek area.

Reproductive stage	talpoides	umbrinus
Embryos observed	May 2 to May 29	April 3 to May 26
First lactating females	May 29	May 1

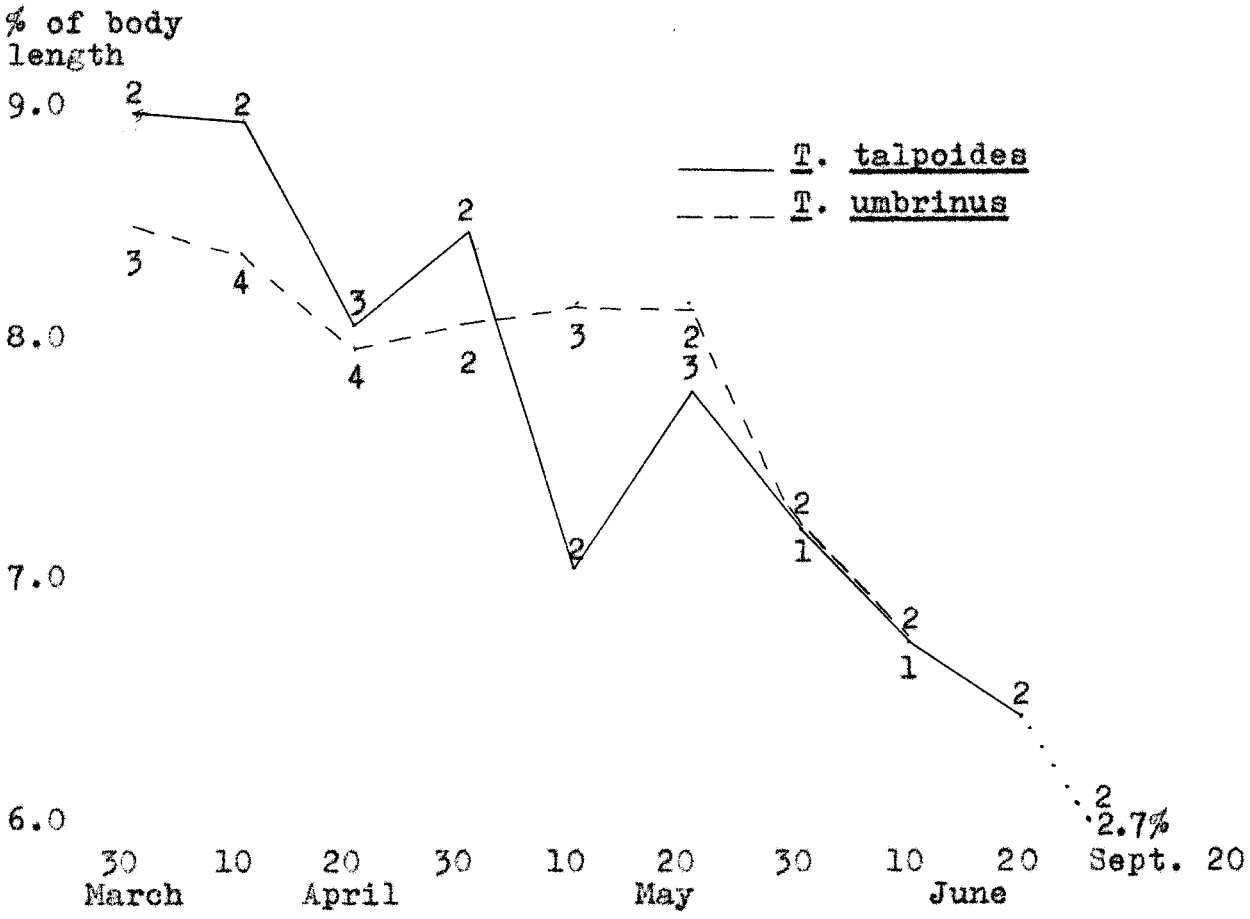

Fig. 6. Graph showing the seasonal change of the testes in T. talpoides and T. umbrinus in Hobble Creek area. The figures on the left represent the length of the testes as percentages of the total body length. The number above or below each point refers to the number of animals averaged in each group.

Despite the ranges being in contact and the close correlation of reproductive periods no specimens were collected which indicated that interbreeding is occurring. If interbreeding is occurring and no viable offspring are produced, interbreeding would be an important factor in distribution patterns since selection would tend to rid the population of those pocket gophers which were interbreeding.

Interspecific Competition

In the irrigated alfalfa field where the ranges of the two species are in actual contact interspecific competition appears to be a limiting factor in the distribution of both species. This can be seen by reference to the plotted trapping records on Fig. 5. On the south side of Hobble Creek the only species present is talpoides. Since the area is not occupied by umbrinus, talpoides has extended its range to the west further than the map shows. On both sides of the creek the soil and vegetation are the same. A similar pattern is evident outside the study area where umbrinus is the only species present. In the Hobble Creek area all specimens collected on the Bonneville and Provo terraces were talpoides. However along the same terraces east and north of Provo no talpoides are present. With no competition from talpoides and conditions otherwise favorable umbrinus has extended its range from the valley up to and above the Bonneville terrace. This is approximately 400 feet higher elevation than the Hobble Creek area where the

two ranges are in contact.

Miller (1964) investigated the factors of distribution for the four species of pocket gophers in Colorado. In the southwest part of the state the ranges of talpoides and umbrinus come together in much the same pattern as along the Wasatch Front in Utah. Where conditions were favorable to both species the presence of talpoides was noted to occur only where umbrinus was absent. Although he does not evaluate the specific factors involved he supposes that interspecific competition is important in the distribution of these pocket gophers.

The general distribution pattern of pocket gophers in the Hobble Creek area is similar to those described by Miller (1964). However no actual competition was observed and the suggested possibility that interspecific competition is a limiting factor in the distribution of both species where their ranges are in contact is based only on observation and trapping records.

FUTURE DISTRIBUTION PATTERNS

Durrant (1952) has discussed the possible effects of Lake Bonneville on pocket gopher distribution. When Lake Bonneville was in existence talpoides probably occupied the higher elevations above the level of the lake and umbrinus occupied the more arid areas to the west and south. As the lake receded more area would have become available for range extension to the west and south than along the steep eastern shore of the Wasatch Front. This pattern of lake recession would have made areas such as Provo the last to be inhabited. As has been indicated in the Provo area umbrinus specimens can be found in nearly every habitat. The high plasticity of umbrinus tends to indicate that this species is living in a rather new or an unstable environment. Talpoides on the other hand appears to be rather restricted in the range extension that took place after Lake Bonneville receded since they occupy only those areas in Hobble Creek which have the greatest amounts of available moisture.

Considering the evidence given within this paper the author suggests the following as a possible trend in the distribution pattern of pocket gophers in Hobble Creek area. In that area where the ranges of the two species are in contact it appears that the range extension of both species is

inhibited by interspecific competition. Even though inhibited, umbrinus should extend its range at the expense of talpoides. Miller (1964) states that wherever the two species occur together that talpoides tends to be displaced to a higher life zone generally into less favorable habitats. He credits umbrinus as being the better competitor in areas which are suitable for both species to live. In those areas which are occupied by only one species the ranges should be extended. Talpoides however will be limited to those areas with the greatest amounts of moisture. Due to its adaptability to soil and moisture conditions umbrinus will undoubtedly continue to increase its range.

SUMMARY AND CONCLUSIONS

This study was initiated to investigate the distribution patterns of two species of pocket gophers, Thomomys talpoides wasatchensis Durrant and T. umbrinus albicaudatus Hall whose ranges come together in the vicinity of Hobble Creek Canyon, Utah County, Utah. The effect of certain ecological factors upon these patterns was considered.

Trapping was accomplished by the use of California Gopher traps and continued from March until the middle of June during 1963 and 1964. As each specimen was collected the area, place of collection, soil, vegetation, and reproductive stage were recorded.

Outside the Hobble Creek Canyon area specimens of umbrinus were collected in the vicinity of Provo and along the Lake Bonneville terrace east and north of Provo. Additional specimens of both species were examined from the Brigham Young University and University of Utah mammal collections.

Trapping locations were plotted on a map and the patterns of distribution for the two species were then correlated with the following ecological factors: vegetation and land use, soil types, moisture and exposure, hybridization and interspecific competition.

Both species were collected in all three vegetation zones: agricultural, sage-grassland and mountain brush. Within the Hobble Creek area umbrinus inhabited only the agricultural zone but its range extends into the other zones outside of this study area. No vegetation preference is shown by either species.

Various soil types do not appear to inhibit the distribution of either species to any noticeable extent. Both species however showed a preference for sandy or gravelly loam soils.

The distribution of talpoides is apparently inhibited by a lack of available moisture in some portions of the study area. This is especially evident along the Bonneville terrace where the terrace is interrupted by deep gullies which cut through and open onto the valley floor. Talpoides was taken or observed consistently on the north exposures of these gullies but very seldom on the south or west facing slopes or on the terrace itself. Umbrinus does not appear to be so affected since it occurs on the terrace and its west exposures to the east and north of Provo.

Morphological examination provided no evidence of the two species interbreeding even though their breeding seasons coincide and there is a small area where the ranges of the two species are in contact.

Interspecific competition appears to be an inhibitor to the distribution of both species in the area of range

contact. However, in those areas not inhabited by umbrinus, talpoides extends past the area of range contact for a considerable distance. In those areas where umbrinus is the only occupant its range has been extended from the valley to the Bonneville terrace, a difference of approximately 400 feet elevation above the area where the ranges of the two species come together.

It is suggested that due to interspecific competition there will be little range extension for either species where the ranges are in contact. In areas inhabited by only one species the ranges should increase with talpoides being limited to those areas having the greatest amounts of moisture. Due to its great adaptability umbrinus appears to be uninhibited in its ability to extend its range except where the ranges of the two species are in contact.

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ABSTRACT

This study was initiated to investigate the distribution patterns of two species of pocket gophers, Thomomys umbrinus albicaudatus Hall and T. talpoides wasatchensis Durrant whose ranges come together in the Hobble Creek area, Utah. The effect of certain ecological factors upon their distribution was determined. The ecological factors included: vegetation and land use, soil, moisture and exposure, hybridization and interspecific competition.

From morphological examination no interbreeding was detected even though the breeding seasons of the two species correspond. A limited area was found where the ranges of the two species are in contact.

A lack of available moisture was determined to be a major factor inhibiting the distribution of talpoides in non-irrigated soils. Umbrinus is very versatile toward moisture and does not appear to be affected.

Both species show a preference for sandy or gravelly-loam soils. Interspecific competition apparently inhibits the distribution of both species where the ranges come together. It is supposed that where only one species occurs that ranges will continue to be extended with talpoides being limited to the more moist areas.

The other ecological factors are of no apparent significance to the distribution of either species except as they relate to the amount of available moisture.