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VARIATION IN NINE STOCKS OF THE DEER-MOUSE, *PEROMYSCUS MANICULATUS*, FROM ARIZONA

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IT is well known that there is much variation from place to place in the characters of most species of animals. As a contribution to a knowledge of the amount of such local variability there are presented in this report the means and their standard errors of several measurements of body dimensions and of the tint photometer readings of pelage color for nine stocks of deer-mice from the state of Arizona.

There are two subspecies of the deer-mouse in Arizona. *Peromyscus maniculatus rufinus* occurs at moderately high elevations in the northern and eastern parts. The subspecies *sonoriensis* in Arizona inhabits the semiarid lower mountains and some of the semiarid plains of the southern and central parts, and occurs along rivers in the western parts (Osgood, 1909, Pl. 1). No mice of this species live in the desert parts of southwestern Arizona.

STOCKS

The following stocks from the state were available for this study.

Little Spring. The station is at an elevation of 8500 feet, in Coconino County, two miles south of Little Spring, and

eighteen miles by road northwest of Flagstaff (Map 1). This is near the base camp of C. H. Merriam at the time he secured the specimens on which the name *rufinus* was later based, so this stock may be assumed to be typical of *rufinus*. The mice were trapped in various habitats.

Deadman Flat A. The trapping station of the A stock is on the southern border of Deadman Flat, in Coconino County, fifteen to twenty miles by road north of Flagstaff. The mice were trapped at the lower edge of yellow-pine slopes in a mixture of junipers and pines.

Deadman Flat D. The D station is in a rabbit-brush habitat near the middle lower portion of Deadman Flat. It is about three miles from the A station, and is at a somewhat lower elevation.

Ice Caves. The mice were taken on black lava rock, on reddish lava rock, and on adjacent black and reddish cinders near the Ice Caves, seventeen miles by road northeast of Flagstaff, in Coconino County.

Winslow. This station is near the Little Colorado River, two miles east of Winslow, in Navajo County. The habitats in which the mice were taken included mesquite forest, cottonwood forest, and cultivated fields.

Rustler Park. The mice were taken in yellow-pine forest in Rustler Park, Chíricahua Mountains, Cochise County.

Miller Canyon. The station is at the base of the Huachuca Mountains near the mouth of Miller Canyon, in Cochise County, nine miles west of Hereford. The elevation is 5000 feet. The mice were trapped in open oak forest and in an adjacent Senecio habitat.

Summerhaven. The collecting station is in yellow-pine forest in Sabino Canyon, Santa Catalina Mountains, three-quarters of a mile east of Summerhaven, Pima County. The elevation is 7700 feet above sea level.

Oracle. The stock was produced by a single pair of mice which were trapped among oaks and shrubs along a sandy wash two miles north of Oracle, Pinal County. The elevation is 4040 feet.

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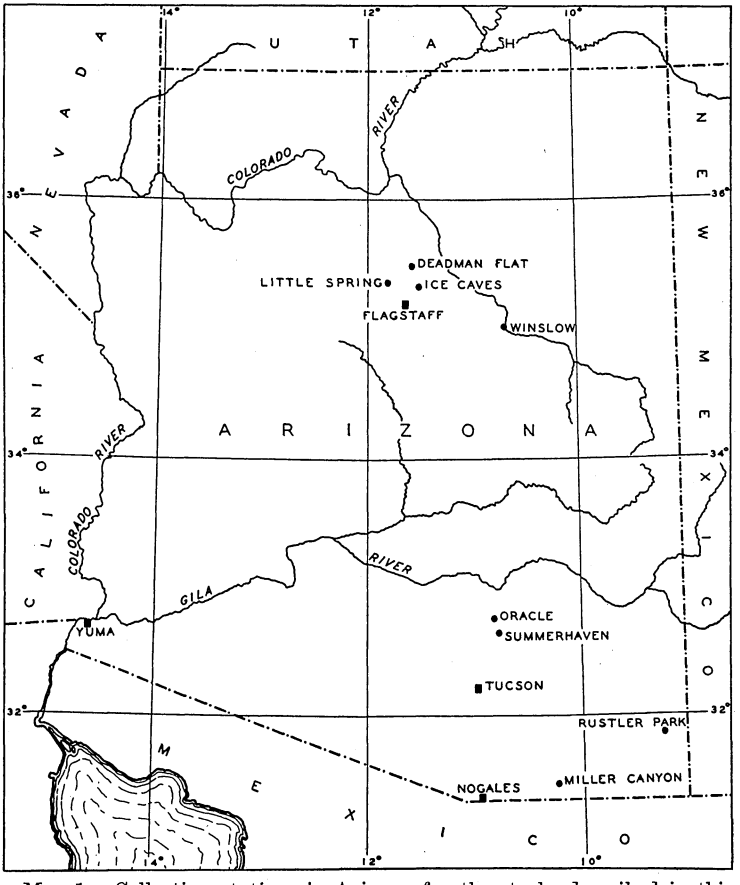
The stocks from Little Spring, Deadman Flat, Ice Caves, and Winslow were secured by G. W. Bradt, A. M. Stebler, and A. J. Nicholson on an expedition from the Museum of Zoology,



MAP 1. Collecting stations in Arizona for the stocks described in this report.

University of Michigan, supported in part by the Carnegie Institution of Washington. The stock from Rustler Park was secured by Victor H. Cahalane on an expedition from the Cranbrook Institute of Science, working in co-operation with

the Desert Laboratory of the Carnegie Institution of Washington. The stocks from Miller Canyon, Summerhaven, and Oracle were taken by myself as a part of a field study supported by the Carnegie Institution of Washington, and conducted in co-operation with the Desert Laboratory. All the breeding stocks were taken in the summer of 1932.

The laboratory expenses of the study have been borne by the Laboratory of Vertebrate Genetics, and the specimens are preserved in the Museum of Zoology, University of Michigan. Federal funds through the National Youth Administration were used to employ several of the assistants who made the measurements of the specimens.

Methods

The methods employed in making the measurements of the mice and in taking the readings of pelage color have been described in a previous paper (Dice, 1932: 5–7, 19, 22).

The specimens described in this report are all from laboratory-bred mice of the one-year age class, and none of the animals were less than 38 weeks nor more than 76 weeks of age when killed. I made all of the external measurements. The measurements of the bones were made by Reeve Bailey and Earl Cady. The tint photometer readings are by John Schwartzman and Raymond Durkee. The statistical calculations are by Earl Cady and Margaret Liebe.

Standard errors rather than probable errors are used throughout this report.

Preauricular Spots

In front of each ear a tuft of white hairs, forming a white preauricular spot, is present in many of the mice of the *Peromyscus maniculatus* group. There is much variation in the occurrence and in the size of these spots among the mice from each locality.

For the designation of the size of the preauricular spots the mice have been arbitrarily grouped into several grades (Table I). In grade 0 there is no trace of a white spot, in grade 1 there are one or two white hairs, in grade 2 a few white hairs,

TABLE I

PREAURICULAR SPOTTING IN *PEROMYSCUS MANICULATUS* FROM ARIZONA
1-year age class; males and females. Arbitrary scale of 4 grades: 0 to 3.

STOCK	NUMBER OF SPECIMENS	MEAN GRADE	STANDARD ERROR
Little Spring	112	1.36	±.06
Deadman Flat A	50	1.52	±.08
Deadman Flat D	96	1.36	±.06
Ice Caves	74	1.66	±.09
Winslow	61	1.95	±.05
Rustler Park	20	0.75	±.12
Miller Canyon	74	1.82	±.06
Summerhaven	12	2.08	±.09
Oracle	14	1.86	±.09

and in grade 3 the spot is of small size. The arrangement of the specimens in grades has been made by Margaret Liebe. In none of our specimens from any of the Arizona localities are there even moderately large preauricular spots, and therefore grade 3 is the highest listed grade in amount of white. Very few of our specimens entirely lack white hairs in front of the ears. Most of the specimens fall into grades 1 and 2.

The average grade of preauricular spotting in the mice ranges from 0.75 for the Rustler Park stock to 2.08 for the Summerhaven stock. The difference is 1.23 ± 0.15 grades, a very significant difference. None of the Rustler Park mice have large enough spots to be placed in grade 3 and most of them fall in grades 0 and 1. All the Summerhaven mice have spots and most of the specimens fall into grade 2, none are placed in grade 1, and only 1 in grade 3. There are, however, only twenty specimens available for the Rustler Park stock and only twelve for the Summerhaven stock, and therefore the statistical difference in spotting between these two stocks is not wholly convincing.

No certain geographical trend in the occurrence of ear spots is indicated by our stocks. It will be noted that the Rustler Park stock, which has the lowest mean grade of spotting, and

the Summerhaven stock, which has the highest mean grade, both come from high mountains in the southern part of Arizona. The Oracle and Miller Canyon stocks, which also come from the southern part of the state, both have relatively high average grades, but both are excelled in grade, although not significantly, by the Winslow stock, and neither differs significantly from the Ice Caves stock.

There does not seem to be any close correlation between the grade of preauricular spotting and the shade of the pelage color. The Rustler Park stock, which has the lowest grade of spotting, also is one of the darkest of the Arizona stocks in pelage color. The Ice Caves stock is nearly as dark in pelage color as the Rustler Park stock and is intermediate among the stocks in amount of preauricular spotting. The Summerhaven stock has the highest average grade in preauricular spotting and is relatively dark in side color but relatively pale on the dorsal stripe. The Winslow stock has the next highest grade of preauricular spotting and is intermediate among the other stocks in pelage color.

The evidence indicates that the amount of white spotting in front of the ears in these mice varies from place to place without any obvious correlation either with geographical position or with the general shade of pelage color of the mice.

Color Phases

Color phases are obvious in the Miller Canyon stock, but in none of the other stocks. In the one-year old mice of the Miller Canyon stock both gray and buff phases are clearly evident, but there is considerable variability in color in both phases, and some specimens are more or less intermediate between gray and buff. The buff specimens are most numerous, there being fifty-seven buff specimens to eleven gray and thirteen intermediate. It has been shown (Dice, 1933: 571–74) for the related subspecies *blandus* that in heredity the gray color is, in general, a single unit recessive to the buff color, but that some individuals show an intermediate character.

The mean tint photometer readings of the mice of the Miller

Canyon stock, divided according to color phase, are given in Table II. No standard errors have been computed, owing to the difficulty of assigning the intermediate specimens.

TABLE II

COLOR PHASES IN THE MILLER CANYON STOCK

Peromyscus maniculatus sonoriensis: 1-year age class. Means of tint photometer readings in per cent.

PHASE	NUMBER OF SPECIMENS	RED	YELLOW	GREEN	PEACOCK	BLUE-VIOLET
Dorsal stripe						
Gray	11	13.64	12.55	11.73	11.27	10.55
Intermediate .	13	13.54	12.15	10.77	9.61	8.15
Buff	57	14.42	12.77	10.77	9.05	7.89
Side						
Gray	11	22.18	20.64	19.27	17.27	16.82
Intermediate .	13	23.38	20.77	19.23	15.08	14.38
Buff	57	22.37	19.79	16.82	13.84	12.32

It will be noted that there are only slight differences between the buff and the gray phases in the mean readings for reflected red and yellow from the dorsal stripe. On the other hand, the mean readings for peacock blue and blue-violet are distinctly less, and the mean readings for green are somewhat less, in the buff than in the gray phase. For side color the mean readings for red and for yellow are not greatly different in the two phases, but the readings for green, peacock blue, and blue-violet are considerably less in the buff phase than in the gray phase.

It is evident then that in the buff phase the readings for red and for yellow are considerably greater than those for the blue end of the spectrum, giving a hue of buff, while in the gray phase the means for all the colors are more nearly alike. The difference in hue between the two phases is very apparent to the human eye.

PELAGE COLOR

Dorsal stripes which are relatively pale in color occur on the mice from Winslow, Summerhaven, Miller Canyon, and Oracle

TABLE III

MEASUREMENTS OF *PEROMYSCUS MANICULATUS* FROM ARIZONA

Means and standard errors of 1-year age class, in millimeters.

STOCK	NUMBER OF SPECIMENS	MEAN AGE WEEKS	NUMBER OF PARENTS	BODY	TAIL	FOOT	EAR
Little Spring	116	48	26	94.56 ± .38	61.67 ± .34	19.684 ± .065	18.355 ± .064
Deadman Flat A	49	48	5	94.61 ± .50	61.27 ± .61	19.935 ± .087	18.412 ± .144
Deadman Flat D	96	56	14	93.57 ± .50	61.04 ± .55	19.953 ± .072	18.917 ± .078
Ice Caves	74	51	10	96.85 ± .41	66.08 ± .56	20.173 ± .070	18.874 ± .094
Winslow	61	50	6	93.34 ± .37	61.02 ± .39	19.749 ± .067	17.803 ± .122
Rustler Park	21	59	4	93.48 ± .67	64.10 ± .93	20.957 ± .176	18.585 ± .238
Miller Canyon	84	56	13	95.79 ± .55	61.58 ± .45	20.220 ± .076	16.936 ± .079
Summerhaven	11	47	4	91.82 ± 1.26	64.50 ± 1.32	20.618 ± .136	18.611 ± .175
Oracle	23	59	2	91.39 ± .75	64.48 ± .82	21.500 ± .140	17.004 ± .093

STOCK	NUMBER OF SPECIMENS	FEMUR	MANDIBLE	CONDYLE-PREMAXILLA	CONDYLE-ZYGOMA	BULLAR WIDTH
Little Spring	111	15.693 ± .063	15.904 ± .038	24.245 ± .055	17.333 ± .039	10.785 ± .022
Deadman Flat A	47	15.817 ± .099	15.560 ± .049	24.209 ± .071	17.315 ± .053	10.870 ± .036
Deadman Flat D	95	15.927 ± .070	15.835 ± .051	24.148 ± .086	17.213 ± .056	10.723 ± .028
Ice Caves	74	16.385 ± .088	16.141 ± .059	24.577 ± .073	17.542 ± .054	10.928 ± .024
Winslow	58	15.798 ± .086	15.700 ± .065	23.938 ± .069	17.169 ± .055	10.673 ± .040
Rustler Park	21	16.170 ± .117	15.962 ± .089	24.486 ± .149	17.210 ± .090	10.688 ± .049
Miller Canyon	79	16.531 ± .082	15.867 ± .055	24.322 ± .083	17.605 ± .055	10.767 ± .029
Summerhaven	10	16.260 ± .264	16.400 ± .135	24.740 ± .273	17.540 ± .253	10.970 ± .109
Oracle	21	16.340 ± .079	15.976 ± .067	24.147 ± .111	17.432 ± .067	10.768 ± .040

(Table III). The Oracle stock has a brighter buff hue than the other three stocks of this pale-colored group. Its mean of the tint photometer readings for red reflected from the dorsal stripe exceeds the corresponding mean of the Miller Canyon stock by $1.00 \pm .45$ units, but its means for peacock blue and for blue-violet are both significantly lower than the corresponding means of the Miller Canyon stock.

The Miller Canyon stock has the highest mean tint photometer readings for dorsal stripe color of all the stocks, except for red and yellow, being exceeded for these colors by the Oracle stock. The means of the Miller Canyon stock exceed those of the Summerhaven stock for all colors, but the differences are statistically significant only for peacock blue and blue-violet. The readings for the Summerhaven stock are, however, close to those of the buff phase of the Miller Canyon stock. Compared to the Winslow stock the Miller Canyon stock has significantly higher mean readings for all colors except, possibly, red. The mean readings of the Summerhaven stock for dorsal stripe colors are all higher than those of the Winslow stock, but the differences are not statistically significant for any color screen. The Winslow stock has considerably higher mean readings for all color screens than has the next darker stock, that from Deadman Flat A, and the differences are significant for red, yellow, green, and possibly also for peacock blue and blue-violet.

The darkest pelage colors for the dorsal stripe of the nine stocks are shown by those from Ice Caves, Little Spring, Rustler Park, and by the two stocks from Deadman Flat. Of these five dark-colored stocks the Deadman Flat A stock has the highest mean readings for all the color screens and has, thus, the palest color of the dark-colored group. The differences in mean color readings between the Deadman Flat A stock and the stocks from Little Spring and Ice Caves are of statistical significance for all color screens. There are differences for particular colors between some of the other stocks of this dark-colored group, but none of the differences are of certain statistical significance.

In color of the side the two stocks from Oracle and Miller Canyon average palest. These two do not differ significantly

from one another for any color screen, but both exceed the next palest stock, Deadman Flat A, by amounts which are statistically significant for all colors. The Deadman Flat stocks A and D and the Winslow stock do not differ significantly from each other, although the Deadman Flat A stock has the highest means of the three. The Deadman Flat A stock significantly exceeds in mean color readings of the side both the Little Spring and Ice Caves stocks. Those from Summerhaven and Rustler Park do not differ significantly from one another for any color screen, neither do either of these differ significantly from the Little Spring nor Ice Caves stocks, except that the Rustler Park stock has a significantly lower mean for red side color than has the Little Spring stock.

In general, therefore, the stocks from Miller Canyon and Oracle are pale in color tone both on the dorsal stripe and on the side. The two stocks differ from each other in hue of the dorsal stripe, but the presence of two color phases in the Miller Canyon stock complicates this comparison. The stocks from Little Spring, Ice Caves, and Rustler Park are rather dark in color. The two stocks from Deadman Flat are intermediate in color tone but are closest to the dark-colored series. The stocks from Summerhaven and Winslow rank among the relatively pale-colored ones in tone of the dorsal stripe and among the relatively dark-colored ones in tone of the side of the body.

Body Dimensions

The measurements of body and skeleton vary considerably in the nine stocks here compared, and for some measurements the differences between certain of the stocks are of high statistical significance (Table IV). On the other hand, two of the skull measurements vary only slightly among the several stocks. There is a difference of only 0.436 millimeter between the largest (Miller Canyon) and the smallest (Winslow) means of condylo-zygomatic skull distance. The difference between the largest mean of bullar width (Summerhaven) and the smallest mean (Winslow) is only 0.297 millimeter, and the difference between these two means is of doubtful statistical significance.

TABLE IV

PELAGE COLOR OF *PEROMYSCUS MANICULATUS* FROM ARIZONA

Mean tint photometer readings and standard errors of 1-year age class, in per cent.

STOCK	NUMBER OF SPECIMENS	RED	YELLOW	GREEN	PEACOCK BLUE	BLUE-VIOLET
Dorsal Stripe						
Little Spring	110	9.57 ± .19	7.99 ± .17	6.68 ± .12	5.46 ± .12	4.64 ± .10
Deadman Flat A .	49	10.49 ± .26	9.20 ± .24	7.55 ± .19	6.37 ± .17	5.47 ± .17
Deadman Flat D .	95	9.65 ± .18	8.42 ± .17	7.04 ± .15	5.86 ± .13	5.05 ± .12
Ice Caves	74	9.36 ± .23	8.00 ± .19	6.55 ± .17	5.35 ± .14	4.66 ± .12
Winslow	59	12.63 ± .43	10.66 ± .35	9.19 ± .37	7.24 ± .29	6.17 ± .25
Rustler Park	21	9.43 ± .51	8.29 ± .46	6.90 ± .43	6.14 ± .40	5.43 ± .38
Miller Canyon ...	81	14.17 ± .38	12.64 ± .35	10.90 ± .34	9.44 ± .32	8.30 ± .29
Summerhaven ...	10	13.70 ± 1.40	11.50 ± 1.19	9.50 ± .78	7.90 ± .57	6.90 ± .62
Oracle	23	15.17 ± .25	12.78 ± .34	10.30 ± .26	8.09 ± .26	6.96 ± .26
Side						
Little Spring	110	19.58 ± .23	16.71 ± .21	14.05 ± .18	11.03 ± .18	9.61 ± .16
Deadman Flat A .	49	21.16 ± .39	17.90 ± .35	15.29 ± .29	12.22 ± .28	10.65 ± .25
Deadman Flat D .	95	20.60 ± .28	17.47 ± .23	14.67 ± .23	11.68 ± .18	10.14 ± .16
Ice Caves	74	19.19 ± .27	16.61 ± .23	13.51 ± .23	10.60 ± .17	9.26 ± .16
Winslow	59	19.90 ± .43	17.46 ± .37	14.29 ± .34	11.93 ± .33	10.63 ± .36
Rustler Park	21	18.00 ± .54	15.76 ± .50	13.67 ± .40	11.10 ± .46	9.57 ± .40
Miller Canyon ...	81	22.51 ± .32	20.03 ± .33	17.54 ± .31	14.51 ± .33	13.26 ± .30
Summerhaven ...	10	18.40 ± 1.18	16.50 ± 1.05	13.80 ± .91	11.30 ± .57	10.10 ± .74
Oracle	23	23.61 ± .54	20.83 ± .49	17.09 ± .49	14.78 ± .46	12.65 ± .41

Because of the slight differences in the means of these two measurements they are omitted from further discussion.

Of the two stocks which are palest in color of pelage the Miller Canyon stock averages small, i.e., it has the smallest mean or does not differ significantly from the smallest, among the nine stocks in tail length and ear length, but in body length, femur length, and skull length, it is among the largest. The Oracle stock averages small in body length, ear length, and skull length, but its means for tail length, hind foot length, and femur length are among the largest means of all the stocks. In length of mandible it is intermediate. These two pale colored stocks, therefore, agree in having short ears and long femurs, but in the other measurements they are quite dissimilar.

The darkest of the Arizona stocks in pelage color are those from Little Spring, Ice Caves, and Rustler Park. In measurements the Little Spring stock averages small among the nine stocks in tail length, hind foot length, and femur length, and is intermediate among the stocks in the other measurements. On the contrary, the Ice Caves stock averages large in all measurements except hind foot length, in which it is intermediate. The stock from Rustler Park, averages small among the stocks in body length, but is large in all the other measurements except length of mandible, in which it is intermediate. The only dimensions in which there is any general agreement among these dark-colored stocks are ear length and skull length. In these measurements the Ice Caves and Rustler Park stocks average large, and the Little Spring stock averages intermediate among the Arizona stocks.

The two Deadman Flat stocks are both intermediate in pelage color between the darkest and the palest of the Arizona mice, but they are closest in mean color tone to the dark-colored group. The Deadman Flat A stock is among the smallest of the stocks in tail length, hind foot length, femur length, length of mandible, and skull length, and is intermediate in body length and ear length. The Deadman Flat D stock is among the smallest in body length, tail length, foot length, femur length, and skull length, is intermediate in length of mandible,

and is among the largest in ear length. It appears that in comparison with the other Arizona stocks the two from Deadman Flat agree in having relatively short tails, short hind feet, short femurs, and short skulls.

The stocks from Summerhaven and from Winslow have pale-colored dorsal stripes and relatively dark-colored sides. The Summerhaven stock has a relatively short body; the hind foot is intermediate in size; the tail, ear, femur, mandible, and skull average relatively long. The Winslow stock averages among the smallest of the stocks in all measurements except ear length, in which it is intermediate. The only agreement in body dimensions, between the Summerhaven and Winslow stocks, therefore, is in body length, which is relatively short in both.

The Rustler Park and Summerhaven stocks of *rufinus* from southern Arizona have relatively short body lengths compared to the other stocks and relatively long tails, ears, femurs, and skulls. This might be taken to indicate that the deer mice living in the high mountain forests of the southeastern part of the state tend to have body proportions of this kind. However, the Little Spring stock from the coniferous forests of northern Arizona has quite different body proportions. Furthermore, the variation in body proportions among all these stocks is so great that it seems unwise to draw conclusions from the slight indication given by these two southern stocks.

Most of the body dimensions vary considerably among the several stocks; only the condylo-zygomatic skull distance and the bullar width of skull are relatively constant in all. Furthermore, the several body dimensions seem to vary quite independently of each other. For instance, a relatively short body may be combined either with a relatively long or with a relatively short tail. These stocks of mice, however, are not greatly different from one another in body size or body proportions.

Nomenclature

The Miller Canyon stock was taken about thirty miles from Santa Cruz, Sonora, the type locality of *sonoriensis*. So far as can be determined from the maps at hand the town of Santa

Cruz lies at an elevation about five hundred feet lower than my collecting station at the mouth of Miller Canyon, but from the description of the vicinity of Santa Cruz given by Mearns (1907 : 105–6) the vegetation there must be somewhat similar to that at Miller Canyon. With the known amount of local variation which occurs in these mice, it is not safe to assume that the characters of the Miller Canyon stock are exactly those of the mice living at the type locality of *sonoriensis*. Moreover, the type locality of *sonoriensis* lies near the extreme southern edge of the range of the subspecies, and the characters of the deer-mice in that area may not be those of the deer-mice of the Great Basin, which is the main home of the race.

In pelage color, both of the dorsal stripe and side, the stocks from Miller Canyon and from Oracle average palest of the Arizona stocks, and on the basis of color both may therefore be assigned to *sonoriensis*. It should be noted that the Oracle stock has a brighter buff hue to the dorsal stripe than has the Miller Canyon stock. A stock of *sonoriensis* from Victorville, Mohave Desert, California, received from Dr. Sumner, is much paler, both on the dorsal stripe and side (Dice, 1935 : Table V), than are either of these Arizona stocks. The Victorville stock, however, was considerably inbred when received by me, and may have been unconsciously selected for pale color in the laboratory.

The darkest pelage colors of the nine Arizona stocks are shown by those from Little Spring, Ice Caves, and Rustler Park. The Little Spring locality may be considered to be practically the type locality of *rufinus*. The subspecies *rufinus* is therefore, as is commonly recognized, typically darker in color than *sonoriensis*. The deer-mice from the upper slopes of Mount Lemmon in the Santa Catalina Mountains are very dark in pelage color (Dice and Blossom, 1937 : 34–35) and must be assigned to *rufinus*. The two stocks from Deadman Flat, although paler in color than typical *rufinus*, are obviously referable to that subspecies.

The two *sonoriensis* stocks from Miller Canyon and Oracle agree in having relatively small ears. They are both signifi-

cantly smaller in this measurement than is the Winslow stock, which has the next smallest ears. The Ice Caves and Rustler Park stocks of *rufinus* both have relatively large ears. Although the Little Spring mice are intermediate among the other stocks in length of ear they average significantly larger in this measurement than the Winslow stock, which is next largest. The Deadman Flat D stock averages large in ear length, and the A stock, while intermediate in ear size, has a significantly larger mean than the Winslow stock.

Four stocks of *rufinus* from Colorado and New Mexico have also relatively large ears (Dice, 1933: Table I), and a stock of *sonoriensis* from Victorville, California, has relatively small ears (Dice, 1935: Table III). There is, therefore, an indication that the subspecies *sonoriensis* has somewhat smaller ears than *rufinus;* however, the number of stocks of both subspecies which have been critically studied is too few for satisfactory generalization. Osgood (1909: 72 and 89) does not indicate that there is an important difference in any body dimension between *rufinus* and *sonoriensis,* but he had available few reliable ear measurements.

We may assign the mice from the San Francisco Mountains, from the adjacent Deadman Flat, and from the highest parts of the Santa Catalina and Chíricahua Mountains to the subspecies *rufinus,* and those from the upper edge of the desert in southern Arizona to *sonoriensis,* but the subspecific assignment of the Summerhaven and Winslow stocks is more difficult.

These two stocks are related to *rufinus* in tone of the color of the side of the body but are closest to *sonoriensis* in color of the dorsal stripe. Neither of these stocks, therefore, can be assigned definitely to either subspecies on the basis of color alone.

It has already been shown that in ear size the *sonoriensis* stocks average small and that the *rufinus* stocks tend to have slightly larger ears. The Summerhaven stock has rather large ears; the ears of the Winslow stock are intermediate in size among the other stocks and are significantly larger than the ears of either the Miller Canyon or Oracle stocks, and significantly smaller than those of any of the stocks assigned to *rufinus.*

The Summerhaven stock may be assigned on the basis of its large ears to *rufinus*. The Winslow stock, however, is intermediate between *rufinus* and *sonoriensis* both in pelage color and in ear size, and it cannot, from the information now at hand, be assigned to either subspecies.

Correlation Between Pelage Color and Soil Color

In order to compare the pelage colors of these mice with the colors of the soils of their habitats, samples were collected of the surface soil at most of the collecting stations. The colors of the soil samples have been analyzed with the tint photometer in the same way as have the pelage colors, except that when making readings of the soil colors the instrument has been thrown out of focus, so that the general color effect of the whole exposed sample has been recorded. For each sample ten to twelve sets of readings were taken, and the soil was stirred up between each set of readings.

The mean readings (Table V) given for the Miller Canyon station are for the oak plain association, where many of these animals occur. However, the species was taken also at the same locality in Senecio association, the surface soil of which is slightly paler in color than that of the oak forest. The readings given for the Ice Caves station are the combined means and extremes from ten readings of each of three soil samples, one of reddish scoria of moderate size, one of small black cinders, and one of small reddish cinders.

The stocks which are pale in pelage color (Miller Canyon and Oracle) come from areas having pale-colored surface soils (compare Tables IV and V). The very high readings for the soil of the Oracle station are due to the occurrence of pale-colored sand in the small wash where the animals were taken.

Likewise, the stocks which are relatively dark in pelage color (Little Spring, Ice Caves, Deadman Flat A, and Deadman Flat D) were taken at stations where the soils are dark in color.

The soil of the Winslow station is very pale in color, as shown by the higher mean tint photometer readings, yet the pelage color of the sides of the mice is about as dark as that of the sides

TABLE V

SURFACE SOIL COLORS

Means and extremes of ten to twelve tint photometer readings of each soil sample, in per cent.

STATION	RED	YELLOW	GREEN	PEACOCK BLUE	BLUE-VIOLET
Little Spring	15.20(14–19)	12.10(10–17)	10.00(8–12)	8.0(7–10)	7.60(7– 9)
Deadman Flat A	15.20(14–17)	12.70(12–14)	11.10(10–12)	10.1(9–11)	9.60(9–10)
Deadman Flat D	14.40(13–17)	12.00(11–13)	10.30(9–12)	8.9(8–10)	8.20(8– 9)
Ice Caves	9.50(7–17)	8.50(6–13)	8.10(6–12)	7.2(6–10)	6.80(5–11)
Winslow	28.30(25–33)	21.80(20–25)	17.90(16–21)	15.4(13–17)	14.70(13–16)
Miller Canyon (Oak Plain)	20.70(16–25)	17.90(14–23)	15.20(12–21)	12.2(9–17)	9.90(7–14)
Oracle (Wash)	29.75(23–34)	26.33(22–30)	22.75(19–25)	19.0(16–22)	17.25(15–19)

of mice from Little Spring and from other stations with dark-colored soils. The dorsal stripes of the Winslow mice average pale, though not so pale as the dorsal stripes of the mice from Miller Canyon or Oracle.

The Deadman Flat A stock is paler in color than the Deadman Flat D stock, as is shown by higher tint photometer readings for every color screen, both for the dorsal stripe and the side (Table IV), but none of the differences are of statistical significance. The soil also of the A station is paler in color than that of the D station (Table V). Station A is somewhat higher in elevation than station D and is in juniper and yellow-pine forest whereas station D is in sagebrush. The explanation for this reversal for the usual relation between soil color and life belt seems to be that station A is located on a slope where humus has little chance to collect, but is washed down and collects on the flat where station D is located. The accumulated humus is presumably the reason why the soil of station D has a darker color than that of station A.

A general trend toward a correlation between the shade of pelage color of a number of species of Arizona mammals and the shade of surface soil color of their habitats has already been pointed out (Dice and Blossom, 1937: 106–8). These laboratory-bred deer-mice give further evidence of the tendency for the pelage color of small mammals to be correlated with the surface soil color of the places where they live.

Summary

The nine stocks of *Peromyscus maniculatus* from Arizona here described vary considerably among themselves in pelage colors and in body dimensions, and no sharp separation into geographic races can be made. The stocks from Miller Canyon and from Oracle are paler in pelage color and have slightly smaller ears than the other stocks; they are assigned to the subspecies *sonoriensis*. The Winslow stock is intermediate between *sonoriensis* and *rufinus*. The other six stocks are assigned to the subspecies *rufinus*.

The preauricular white spots of these mice vary considerably

in size, but there is no obvious correlation between size of spot and either geography or pelage color.

Gray and buff color phases occur in the Miller Canyon stock, but are not obvious in the other stocks.

There is a general trend toward correlation between the pelage color of these mice and the color of the surface soil of their habitats.

LITERATURE CITED

DICE, LEE R.

1932 Variation in a Geographic Race of the Deer-mouse, *Peromyscus maniculatus bairdii*. Occ. Papers Mus. Zool. Univ. Mich., No. 239: 26, 1 fig.

1933 The Inheritance of Dichromatism in the Deer-mouse, *Peromyscus maniculatus blandus*. Amer. Nat., 67: 571–74.

1935 A Study of Racial Hybrids in the Deer-mouse, *Peromyscus maniculatus*. Occ. Papers Mus. Zool. Univ. Mich., No. 312: 1–22.

DICE, LEE R., AND PHILIP M. BLOSSOM

1937 Studies of Mammalian Ecology in Southwestern North America, with Special Attention to the Colors of Desert Mammals. Carnegie Inst. Wash., Publ., No. 485: i–iv, 1–129, 8 pls., 8 figs.

MEARNS, EDGAR A.

1907 Mammals of the Mexican Boundary of the United States. Part I. U. S. Nat. Mus. Bull., 56: i–xv, 1–530, 13 pls., 126 figs.

OSGOOD, WILFRED H.

1909 Revision of the Mice of the American Genus *Peromyscus*. N. Amer. Fauna, No. 28: 1–285, 8 pls., 12 figs.