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Pelage Color Variations of Peromyscus Maniculatus Nebrascensis in Western Kansas

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PELAGE COLOR VARIATIONS OF

PEROMYSCUS MANICULATUS NEBRASCENSIS

IN WESTERN KANSAS

being

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THESIS ABSTRACT

An investigation was made to determine the role of pelage color of Peromyscus maniculatus nebrascensis in relation to the type of soil and the vegetation the Nebraska deermouse inhabits. P. m. nebrascensis displays several different shades of pelage coloration which may afford protection from predation. Also, the pelage color of a particular species or subspecies, distinguished mainly by differences in pelage color, tends to be correlated with the color of the soils of their habitats.

Two methods of securing specimens were employed. Snap trapping was done with Museum Special traps to secure specimens in various soil and vegetation types. Eight trap sites were sampled in the western one-third of Kansas, generally a mixed prairie habitat. The trap areas were selected in relation to the type of soil and vegetation. The composition of the soil was described from Soil Conservation Service maps of the various areas. The vegetative composition of the areas was ascertained by estimating the frequency and abundance of forbs and grasses present.

Each animal collected was weighed, measured, sexed, and the pelage color described. Three skins, from a collection representative of western Kansas, were selected as type colors. The lightest was marked number one, the darkest number three and the intermediate was marked number two. Specimens taken were given a number between one minus and three plus by visual comparison with the selected series.

Live traps were used to secure specimens for the breeding study. A breeding program was organized to determine how pelage color of parents was transmitted to the offspring. The number of breedings completed was limited by available time; and no useful data was obtained.

Data were also used from established trap line located in the college relict area. Animals caught were recorded in relation to color and released. Seventy-eight P. maniculatus were caught in a seven month period, with the same individual being captured more than once in some instances.

Data gathered from the investigation may be found in Tables I through V.

The characteristics of P. m. nebrascensis as well as other subspecies of Peromyscus, have a genetic basis, as shown by lack of modifiability even when the habitat is changed. The comparative frequencies of the Mendelian genes for pelage color should afford some measure of the intensity of selection against Peromyscus that are conspicuous on their backgrounds. Natural selection by predators is an important factor in the evolution of pelage color in Peromyscus.

The pelage color of Peromyscus maniculatus nebrascensis in western Kansas showed no significant relationship between pelage color and the type of vegetation in which the trapped specimens lived. The distribution of pelage color did not differ from the distribution of total population in the three vegetative types.

The pelage color of P. m. nebrascensis showed a direct relationship to soil color only in the light colored soil. There was only a slight tendency toward a relationship between pelage color and the medium to dark soils.

In further investigations of pelage color of P. m. nebrascensis, the author would suggest that a more detailed and extensive study would yield valuable information.

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INTRODUCTION

Protective coloration and other adaptations of animals play an important role in evolution by means of natural selection. Only a few measurements have been made of the actual effectiveness of selection under any particular set of conditions. Toleration of heat and radiation by animals through color adjustments indicates that color adaptation is not only a response to selective pressure by predators but is also the result of selection by factors in the physical environment (Cole, 1943; Parker, 1948).

The American rodent genus Peromyscus displays several different shades of pelage coloration which may afford protection from predation. Various studies (e.g. Cott, 1939; Hovanitz, 1940; and Iseley, 1938) have shown that the pelage color of a particular species or subspecies, distinguished mainly by differences in pelage color, tends to be correlated with the color of the soils of their habitats.

Although Peromyscus spp. have been studied extensively throughout the United States and especially in the southwestern United States, the subspecies P. m. nebrascensis has not been studied in relation to pelage color in western Kansas.

Publications which were useful in supplying background and suggesting methods for the present study were those of Apgar (1930), Blair (1947a), Dice (1933; 1933a), and Huestis and Barto (1934). Other studies which were helpful in various ways were those of Dice (1931; 1945), Osgood (1909), and Sumner (1917).

Two obvious limitations to my study were the use of only a single subspecies and the restriction to the mixed prairie habitat. My results, however, may contribute a part of the future picture of the survival value of color variation in mammals. Data unknown to me may modify the conclusions and some conclusions are clearly moot. If these stimulate criticism they will be valuable.

METHODS

Two methods of securing specimens were employed. Snap-trapping was done with Museum Special traps to secure specimens in various soil and vegetation types. The bait used was a mixture of peanut-butter and oatmeal. Eight trap sites were sampled in the western one-third of Kansas, generally a mixed prairie habitat. The trap areas were selected in relation to the type of soil and vegetation. The composition of the soil was described from Soil Conservation Service maps of the various areas. The vegetative composition of the areas was ascertained by estimating the frequency and abundance of forbs and grasses present.

The trapped specimens were placed in the collection of the Zoology Department of Fort Hays Kansas State College, Hays, Kansas. Each animal collected was weighed, measured, sexed, and the pelage color was described.

Three skins, from a collection representative of western Kansas, were selected as type colors. The lightest was marked number one, the darkest number three and the intermediate was marked number two (Fig. 1). Specimens taken were given a number between one minus and three plus by visual comparison with the selected series.

Fig. 1. Pelage colors used to classify the colors of specimens captured in the study.

Live traps, modified from Fitch (1950), were used to secure specimens for the breeding study. A breeding program was organized to determine how pelage color of parents was transmitted to the offspring. The number of breedings completed was limited by available time. Animals used for breedings were trapped between January 20, 1959, and March 15, 1959; no useful data were obtained.

Females were difficult to obtain while the temperature remained low. Males were relatively abundant, and apparently entered the traps more readily than females. Trapping was used only as a means of securing animals; therefore, traps were set at random in areas with suitable habitat.

Data were also used from an established trap line located in the college relict area. Animals caught were recorded in relation to color and released. Seventy-eight P. maniculatus were caught in a seven month period, with the same individual being captured more than once in some instances.

Additional discussion of methods and procedures will appear where appropriate throughout the paper.

Snap Trapping

Seven areas were trapped with Museum Special traps to obtain information on the relation of soil color and vegetation to pelage color. The areas were chosen to exhibit various soil textures and colors in western Kansas. Specimens were trapped on each area and numbers of specimens trapped ranged from two specimens in a short-grass exclosure to 26 specimens trapped in a hillside area. One hundred traps were set in each

area and, in most cases, were maintained for one day. Traps were set within the area wherever it was most probable that deermice might be trapped.

Atwood

The first area to be trapped was 2.4 miles west and 0.7 miles north of Atwood, Rawlins County, Kansas. The area trapped was a moderately grazed hillside with a southwest facing slope; the soil color was ash-grey. The most common forbs were Psoralea tenuiflora, Aster multiflorus, Mentzelia decapetala and Yucca glauca. The major grasses were Buchloe dactyloides, Panicum virgatum, Bouteloua curtipendula, Sporobolus asper, and Bouteloua gracilis. The soil was a loessial type which was called light colored (Fig. 2).

The color of P. m. nebrascensis trapped ranged from one-plus to two-plus (Table II). There were three deermice marked one-plus, six deermice marked two and four marked two-plus, for a total of 13 specimens trapped. The color of the pelts was adapted to the color of the soil in this particular area, in that they were both of a rather light shade. Dice (1931) stated that the pelage color of Peromyscus and other small mammals tended to match the color of the surface of the soil of the habitat. I would seem to be in agreement with Dice on this particular trap area.

Most of the specimens trapped in the Atwood site were caught near the base of the large patches of Yucca glauca (Fig. 2). Panicum virgatum was in close association with the Yucca glauca and seemed to afford some protection in the form of cover in and around the Yucca glauca

patches. The cover of the area was generally fairly abundant. There were rocky out-croppings at the northeast corner of the trap area. The soil around the rocks was loose and subject to erosion. No mice were caught near the rocks, as the rocks probably did not provide protection to the animals within the area.

Sitka

An area was trapped 4.5 miles west and 2.3 miles north of Sitka, Clark County, Kansas. Five specimens were trapped ranging in color from one-plus to two. Of the five specimens trapped in the Sitka area one was a one-plus, three were two-minus and one as a two (Table II). Again, the pelage color was somewhat adapted to the soil color, as the soil type of the Sitka trap area is a typical Permian Red Soil.

The common forbs were Meriolix serrulata, Ambrosia psilostachya, Psoralea tenuiflora, and Erigeron racemosus. The major grasses were Panicum virgatum, Buchloe dactyloides, Andropogon gerardi, Bouteloua curtipendula, Aristida longiseta, and Bouteloua gracilis.

The area trapped was an eroded area with a northeast facing slope (Fig. 3). It was heavily grazed with low cover. There was no apparent difference in communities and it might be described as a short-grass community with broken cover.

The traps were set in rings around a rock dome approximately in the center of the area (Fig. 3). Deermice were trapped in all parts of the area. The vegetation was closely grazed and had a maximum height of four inches.

Fig. 2. Atwood Trap site--General view

"Tufts" are Yucca glauca. Common forbs included were Psoralea tenuiflora, Aster multiflorus, Mentzelia decapetala, and Yucca glauca. The major grasses were Buchloe dactyloides, Panicum virgatum, Bouteloua curtipendula, Sporobolus asper, and Bouteloua gracilis.

Fig. 3. General view of the Sitka trap site

The mound in the center shows the original level of the ground. The area was a slight to moderate west-facing slope. Common forbs included were Meriolix serrulata, Ambrosia psilostachya, Psoralea tenuiflora, and Erigeron racemousus. The major grasses were Panicum virgatum, Buchloe dactyloides, Andropogon gerardi, Bouteloua curtipendula, Aristida longisela, and Bouteloua gracilis.

Smoky Hill

An area was trapped 0.5 miles west of the north side of the Smoky Hill River bridge on Highway 183, which is one mile east of Schoenchen, Ellis County, Kansas. The trap site was a sandy hillside with a sandy light tan soil. The most common forbs were Ambrosia psilostachya, Yucca glauca, Gaura biennis, and Grindelia squarosa. The major grasses were Bouteloua curtipendula, Andropogon gerardi, Sporobolus cryptandrus, and Panicum capillare. There was no appreciable difference in communities.

The specimens trapped ranged in color from one to one-plus. There were three specimens marked one and two specimens marked one-plus for a total of five deermice trapped in the area (Table II). This would seem to be in agreement with Dice (1931), as the soil and the color of the deermice were light. The trap site was a flood plain with a south-facing slope (Fig. 4).

The lower edge of the slope was a disturbed area with a large amount of trash above the ground level (Fig. 4). The river was approximately 200 yards south of the trap area; however, no trees were situated within the trap area.

College Hill

The college hill trap site was on a small open area of Fort Hays limestone surrounded by a midgrass hillside one mile west of the Fort Hays Kansas State College dairy barns. The soil was described by Edward E. Bookless (1953) as an XL soil group. The soil group XL

Fig. 4. General view of Smoky Hill River trap site. Common forbs were Ambrosia psilostachya, Yucca glauca, Gaura biennis, and Grindelia squarosa. The major grasses were Bouteloua curtipendula, Andropogon gerardi, Sporobolus cryptandrus, and Panicum capillare.

includes very thin dark colored soils occurring on steep slopes. These soils have dark brown silt loam surfaces underlain by limestone or shale.

Common forbs included Ambrosia psilostachya, Artemesia kansana, Grindelia squarosa, and Ratibida columnifera. The major grasses were Bouteloua gracilis, Bouteloua hirsuta, Bouteloua curtipendula, Buchloe dactyloides, Andropogon scoparius, and Bromus japonicum. Near the bottom of the break was a Buchloe dactyloides-Bromus japonicus association which was the only definite community that could be ascertained (Fig. 5).

On the upland the outcropping of limestone was more evident than it was on the lowland, it was well drained and didn't appear to be eroded to any extent (Fig. 6). The open area of the site was flat and supported very little vegetation; however, several mice were trapped on the flat surface.

There were 17 specimens trapped on the college hill trap site. They ranged in color from one to three (Fig. 1). There were two specimens marked one, two specimens marked one-plus, five specimens marked two, six specimens marked three-minus and two specimens marked three (Table II). The wide range of pelt color may be explained by the diversity in habitat from the bottom to the top of the area.

Natural Revegetation Exclosure

A trap site was sampled in the Fort Hays Kansas State College pasture 1.5 miles west of Hays, Ellis County, Kansas on a south-facing slope. The soil may be generally described as dark. Vegetation within the 50 by 200 food exclosure consisted of the following most common forbs (Fig. 7): Ambrosia psilostachya, Psoralea tenuiflora and Erigeron

Fig. 5. General view of College Hill trap site.

This area was a moderately sloping south-facing hillside. Common forbs included were Ambrosia psilostachya, Artemesia kansana, Grindelia squarosa, and Ratibida columnifera. The major grasses were Bouteloua gracilis, Bouteloua hirsuta, Bouteloua curtipendula, Buchloe dactyloides, Andropogon scoparium, and Bromus japonicus.

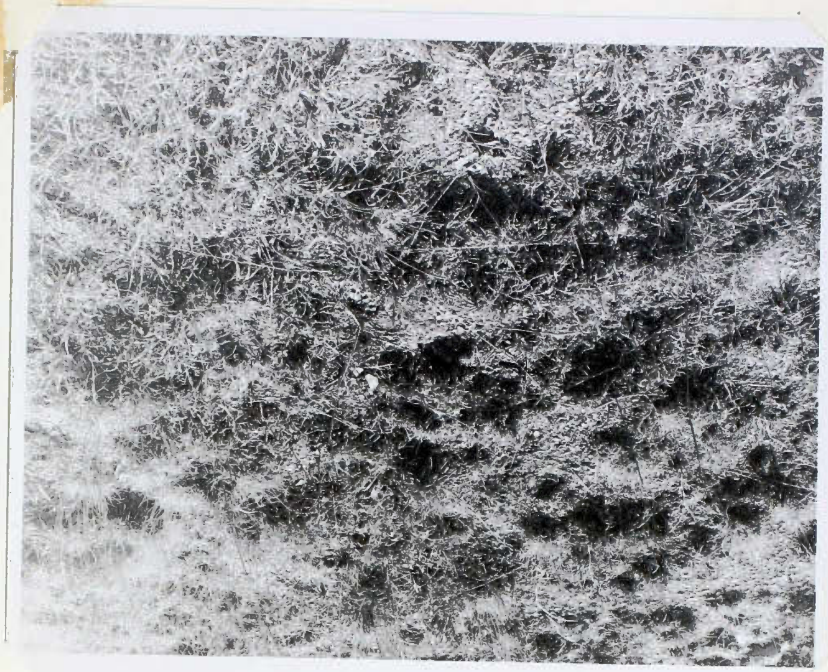

Fig. 6. View of the upland at College Hill showing soil condition. Fort Hays limestone can be seen between vegetation.

Fig. 7. General view of natural revegetation exclosure showing the moderate south-facing slope.

Note Andropogon scoparius communities. Common forbs were Ambrosia psilostachya, Psoralea teniflora, and Erigeron racemosus. The predominant grasses were Andropogon scoparius, Buchloe dactyloides, Bromus japonicus, Sporobolus asper, Bouteloua curtipendula Agropyron smithii, and Aristida longiseta.

racemosus. The predominant grasses were Andropogon scoparius, Buchloe dactyloides, Bromus japonicus, Sporobolus asper, Bouteloua curtipendula, Agropyron smithii, and Aristida longiseta. The vegetation might be described as a midgrass mixture. The differences in communities were evident with Andropogon scoparius, Agropyron smithii, Buchloe dactyloides and Aristida longiseta covering most of the exclosure (Fig. 8).

The deermice trapped seemed to vary in color with communities. The specimens trapped in close proximity with the Andropogon scoparius were light in color; two specimens trapped were marked number one. In the Aristida longiseta, three specimens trapped were number two. A total of five specimens were taken in the area (Table II).

Short-grass Exclosure

Another trap site was chosen in the Fort Hays Kansas State College pasture one mile west of Hays, Ellis County, Kansas, on an upland site, with little or no slope. The soil might be described as generally dark, and the vegetation was a Buchloe dactyloides community. The most common forbs were Ambrosia psilostachya. The major grasses were Buchloe dactyloides and Bouteloua gracilis, with large amounts of Bromus japonicus in the area (Fig. 9). There was an evident difference in communities, with Bromus japonicum and Ambrosia psilostachya comprising a large amount of the vegetation within the exclosure (Fig. 8). Two P. m. nebrascensis were taken; one was marked two-plus and the other three (Table II). This trap area displays again the apparent agreement of soil color and pelt color as they were both dark.

Fig. 8. View showing difference between communities of Andropogon scoparius and Buchloe dactyloides at the Natural Revegetation Exclosure trap site.

Fig. 9. General view of College Pasture Short-grass Exclosure showing flat condition of area. Common forbs included Ambrosia psilostachya, and Helianthus annuus, a weedy forb. The major grasses were Buchloe dactyloides, and Bouteloua gracilis, with large amounts of Bromus japonicus in the area.

Kansas Mammal Census

Three trap nights were sampled in the Fort Hays Kansas State College relict area 1.5 miles west of Hays, Ellis County, Kansas, for the Kansas Mammal Census, on November 25 to November 27, 1948. Twenty-three P. m. nebrascensis were trapped; the colors ranged from one-plus to three minus. Three specimens were marked one, three were marked one-plus, four specimens were marked two-minus. Eight specimens were marked two, three specimens were marked two-plus and two specimens were marked three for a total of 24 specimens (Table II).

The soil was described generally as dark. The more common grasses were Bouteloua gracilis, Buchloe dactyloides, Agropyron smithii, Bouteloua curtipendula, Andropogon gerardi and Sporobolus asper. The common forbs were Liatrus punctatus and Helianthus annuus, a weedy forb (Fig. 10).

The traps were set 50 feet apart in a straight line which runs almost the complete width of the relict area. The trap line covered an east-facing slope and a west facing slope (Fig. 10).

Relict Area

Data were kept from June 17, 1958 to December 23, 1958 on the Fort Hays Kansas State College relict area live-trapping site, 1.5 miles west of Hays, Ellis County, Kansas (Fig. 11). The area contains 100 live traps, as described in the methods section of this work. The traps are set in five lines of 20 traps, 50 feet apart. The traps are run seven nights per month; therefore, 3,500 traps nights were sampled. Seventy-six P. m. nebrascensis were trapped.

Fig. 10. General view showing abundant vegetation in the College Relict Area Kansas Mammal Census trap line. Note the white stakes which are trap stations along the trap line. The more common grasses were Bouteloua gracilis, Bouteloua curtipendula, Agropyron smithii, Andropogon gerardi, and Sporobolus asper. Common forbs included were Liatris punctata, and Helianthus annuus, a weedy forb.

Fig. 11. General view of College Relict Area showing the abundant vegetation of the draw. Five generalized plant communities are included. They are: Andropogon gerardi community, mixed community, weedy community, Agropyron smithii, and Andropogon scoparius community.

Five plant communities have been defined within the trapping area (Martin, 1959). Within the Andropogon gerardi type a total of 21 specimens were trapped. Six specimens, or 25.5 per cent, were marked number one, 13 specimens, or 61.9 per cent, were marked two and two specimens, or 9.5 per cent were marked number three. Within the mixed type, 24 specimens were trapped. Six specimens, or 25.0 per cent were marked number one pelage color, 14 specimens or 58.4 per cent, were marked number two and four specimens, or 16.6 per cent were marked number three pelage color. In the weedy type of vegetation there were 10 specimens trapped; of these, one specimens, or 10.0 per cent, marked number one pelage color and nine specimens, or 90.0 per cent, were marked number two. In the Agropyron smithii type of vegetation, 13 specimens were trapped; of these specimens, three, or 23.0 per cent were marked number one pelage color, eight specimens, or 61.6 per cent were marked number two and two specimens, or 15.4 per cent were marked number three pelage color. In the Andropogon scoparius type of vegetation, eight specimens were trapped, all of them, or 100.0 per cent, being number two pelage color (Table I).

The soil type of the relict area may be generally described as medium to dark in color.

Summary - Snap-trapping Study

A total of 146 P. m. nebrascensis were compared according to pelage color in the duration of the study. Thirty-seven specimens, or 25.34 per cent, were found to be colored one, 90 specimens, or

TABLE I. Vegetative types present in the college relict area and number of specimens trapped in each vegetative type.

Color class of pelts		I		II		III	
Vegetative type	Total animals trapped	Number of specimens	Percentage of total specimens	Number of specimens	Percentage of total specimens	Number of specimens	Percentage of total specimens
Andropogon gerardi	21	6	25.5%	13	61.9%	2	9.5%
Mixed vegetation	24	6	25.0%	14	58.4%	4	16.6%
Weedy vegetation	10	1	10.0%	9	90.0%	0	0.0%
Agropyron smithii	13	3	23.0%	8	61.6%	2	15.4%
Andropogon scoparius	8	0	0.0%	8	100.0%	0	0.0%
Total No. of specimens	76						

61.64 per cent were found to be number two, and 19 specimens, or 13.01 per cent, were found to be three (Table II).

In relation to soil color, light soil was categorized as that of the Smoky Hill River and Atwood trap sites; colored soils were considered as that of the Sitka trap site; and medium to dark colored soils were those of the Fort Hays Kansas State College pasture and relict area trap sites.

Of the 31 deermice marked as being number one in color, eight specimens, or 21.62 per cent, were trapped in light soil, one specimen, or 2.70 per cent, was trapped in the red soil, and 28 specimens or 75.7 per cent, were trapped in the medium to dark type soil (Table III).

Ninety P. m. nebrascensis were marked as being in the number one pelage color category. Ten specimens or 11.11 per cent, were trapped in the light soil, four specimens, or 4.44 per cent were trapped in the red soil and 76, or 84.44 per cent, were trapped in the medium soil (Table III).

Of the 19 specimens in the number three pelage color category, no P. m. nebrascensis was trapped in the light soil. None was trapped in the red soil, and 19 specimens, or 100 per cent, were trapped in the medium to dark soil (Table III).

In regard to vegetation, the trap areas were generalized into three vegetative types. The Buchloe dactyloides type included the Sitka trap area and Short-grass exclosure, the midgrass type included the Atwood, Smoky Hill River, College Hill, trap sites and the Fort Hays Kansas State College natural revegetation exclosure. The Andropogon

TABLE II. A total number of mice caught in all areas and their pelage colors.

Color type of pelts	I-	I	I+	II-	II	II+	III-	III	III+	Total
Trap sites										
Atwood			3		6	4				13
Sitka			1	3	1					5
Smoky Hill		3	2							5
College Hill		2	2		5		6	2		17
Natural Revegetation Exclosure		2			3					5
Short-Grass Exclosure						1		1		2
Mammal Census		3	3	4	8	3		2		23
Relict Area		3	13	8	20	24	5	1	2	76
Totals	0	13	24	15	43	32	11	6	2	146
Total in Each General Category		37			90			19		146

TABLE III. Chart showing number of P. m. nebrascensis trapped in different soil types.

	I		II		III			
	Number of specimens trapped		Number of specimens trapped		Number of specimens trapped		Specimens trapped	
Soil Color*	Total of No. 1 pelage	% of total specimens	Total of No. II pelage	% of total specimens	Total of No. III pelage	% of total specimens	Total	% of total specimens
Light soil	8	44.4	10	55.6	0	0.0	18	12.3
Red soil	1	20.0	4	80.0	0	0.0	5	3.4
Medium soil	28	22.8	76	61.8	19	15.4	124	84.3
Total	37	25.3	90	61.7	19	13.0	148	100.0

*Note: The light-colored soil occurred at the Smoky Hill River and Atwood trap sites.
The red soil occurred at the Sitka trap site.
The medium to dark colored soils occurred in the college pasture relict area trap sites.

gerardi type included the Fort Hays Kansas State College relict area trap sites, which included the live trap lines and Kansas Mammal Census line (Table IV).

Of the 39 specimens marked number one, one, or 2.70 per cent, was trapped in the Buchloe dactyloides type, 14 specimens, or 37.83 per cent, were trapped in the midgrass type and 22, or 59.45 per cent, were trapped in the Andropogon gerardi type vegetation (Table IV).

Of the 19 P. m. nebrascensis marked number three pelage color, one specimen, or 5.26 per cent, was trapped in the Buchloe dactyloides type, eight specimens, or 42.10 per cent, were trapped in the midgrass type and 10 specimens, or 52.63 per cent were trapped in the Andropogon gerardi type vegetation (Table IV).

Color Inheritance

Areas of varied soil color occur in many parts of North America. Some of the ecological associations of these soil types include considerable populations of deermice, and the dynamics and ecological limits of these populations are probably as well known as those of any populations of small mammals.

Several studies have been completed on the inheritance of color in Peromyscus. One such study was by Blair (1947) on the estimated frequencies of the buff and gray genes in adjacent populations of deermice (Peromyscus maniculatus blandus) living in soils of different colors in the Tularosa Basin, New Mexico. Buff and grey soils occur adjacent to one another in many parts of the Tularosa Basin. The two Mendelian genes studied produce

TABLE IV. Vegetation chart showing the number of P. m. nebrascensis trapped in generalized vegetation types.

		I		II		III	
Vegetative type*.	Total specimens trapped	Total No. of specimens	Percentage of total	Total No. of specimens	Percentage of total	Total No. of specimens	Percentage of total
Buchloe dactyloides	7	1	14.3%	5	71.4%	1	14.3%
Midgrass	40	14	35.0%	18	45.0%	8	20.0%
Andropogon gerardi	99	22	22.0%	67	67.8%	10	10.2%
Totals		37	25.3%	90	61.7%	19	13.0%

Note* Buchloe dactyloides type includes the Sitka trap site and the college pasture short-grass exclosure.

Midgrass type includes the Atwood, Smoky Hill River, College Hill, and College Pasture natural revegetation exclosure.

Andropogon gerardi type includes portions of the College Relict Area. (Kansas Mammal Census, and Relict Area Trap sites).

a buff and a grey mouse respectively. The comparative frequencies of these genes for buff and grey pelage on adjacent areas of buff and grey soils should, therefore, afford some measure of the intensity of selection against the mice that are conspicuous on their backgrounds. Blair found that the genes were in equilibrium in the population sampled and gave data to support the hypothesis that a selection against the mice was positive. Differences in the shade and saturation of the buff phenotype that are attributable to the effects of minor additive genes have also been found.

Huestis and Barto (1934) found, in a study of brown and silver deer-mice (Peromyscus maniculatus), that each character of coat color is due to a pair of recessive genes, and that the genes for the respective characters are, as would be expected, nonallelomorphic. The recessive genes are rather variable or readily modified and the brown and silver genes have been shown to be nonallelomorphic although their visual effects are due to some extent supplementary.

Sumner (1932) found that subspecific differences in Peromyscus had a genetic basis because they lacked modifiability when transferred to a common environment and reared there for a number of generations. Intra-racial differences frequently were found to be non-genetic. A number of mulations occurred during the investigations, of which albino, pallid, hairless, and yellow were simple recessives; grizzled seemed to depend on a more complex genetic basis. Correlation studies on pigmentation have lowest values for parental races and F_1, higher for F_2 and highest for F_3 progenies from selected F_2 parents, indicating that the various pigmental features have in part a common genetic basis.

Dice (1933) found, in a study on the inheritance of dichromatism, that two color phases occur, buff and gray. Breeding showed that grey is recessive to buff and that the two colors are allelomorphic. Intermediate colors occurred and were probably due to color modifiers. Several inherited factors modifying color and pattern are known, and it was assumed by Dice that other unknown factors were present.

Dice (1947) in a study of selection by owls of deermice (Peromyscus maniculatus) found, in natural habitation, owls must depend heavily on sight as well as sound to discover prey. The mice which were usually inconspicuous with the shade of the background were taken fewer times by owls than were the mice in discordance with the background.

In every population of Peromyscus much of the variability that exists has a basis in heredity. The variability within populations in pelage color and in other characteristics provides natural selection with an abundance of materials on which to operate. It is impossible to escape the conclusion that natural selection by predators must be an important factor in the evolution of pelage color in the deermice in any region where they are subject to predation by owls or by other Predators with similar visual acuity.

DISCUSSION AND CONCLUSIONS

A total of 18 specimens were trapped in the light colored soils, of these, eight specimens, or 44.4 per cent were marked number one, light pelage color (see Fig. 1), and 10 specimens, or 55.6 per cent, were marked number two, medium pelage color, (see Fig. 1). No specimens taken in light soils were marked number three, dark pelage color, (see Fig. 1).

Five specimens were trapped in the red soil type. Of these, one specimen was marked number one and four specimens were marked number two. No specimen trapped in the red soil was dark enough in color to be marked number three.

In the medium to dark soils, 123 specimens were captured. Of these, 28 specimens, or 22 per cent, were marked number one, 76 specimens, or 61.8 per cent, were marked number two and 19 specimens, or 15.4 per cent, were marked number three. All of the dark colored (number III) specimens were trapped in the medium to dark soils.

The eight trap sites were classified into three types of vegetation. In the buffalo grass type, there was a total of seven specimens trapped. One specimen, or 14.3 per cent, was marked number one, five specimens, or 71.4 per cent, were marked number two and one specimen, or 14.3 per cent, was marked number III. Thus the intermediate pelage color was the most abundant in the short grass, where the amount of bare ground was low and the vegetation was short.

In the midgrass vegetation, a total of 40 specimens was trapped: of these, 14 specimens, or 35.0 per cent, were marked number one, 18

specimens, or 45.0 per cent were marked number two, and eight specimens, or 20.0 per cent were marked number three.

In tall vegetation of big bluestem type, a total of 99 specimens were trapped. Of these, 22 specimens, or 22.0 per cent, were marked number one, 67 specimens, or 67.8 per cent, were marked number two and 10 specimens, or 10.2 per cent, were marked number three. Again the largest number of specimens were marked number three pelage color.

The results of the study regarding relation of pelage to vegetation are not significant. The distribution of pelage color did not differ from the distribution of total population in the three vegetative types (Table V).

In regard to soil color and pelage color, there was a significantly greater number of light-colored specimens than dark-colored specimens taken in the light soil. There were 37 number one mice taken altogether, which made up 25.3 per cent of all the mice trapped. Ninety number two mice were trapped, which was 61.7 per cent of the total number taken in the duration of the study. In the light soil, there were 18 number one mice captured, of which eight, or 44.4 per cent, were number one and 10, or 55.6 per cent, were number two. There were no number three pelts taken in the light soil color (Table V).

The sampling in the red soil was not large enough to validate the findings as only five specimens were secured (Table V).

In the medium to dark soils, there was only a slight tendency toward a greater number of dark-colored specimens than light. There were 123

TABLE V. Distribution of pelage colors in relation to the distribution of animals trapped in the three generalized soil types.

		No. trapped in light soil		No. trapped in Red soil		No. trapped in medium to dark soil	
Total specimens	% of total	Total No. in light soil	% of total in light soil	Total in red soil	% of total in red soil	Total No. in medium to dark soil	% of total in medium to dark soil
Color type							
I 37	25.3	8	44.4	1	20.0	28	22.8
II 90	61.7	10	55.6	4	80.0	76	61.8
III 19	13.0	0	0.0	0	0.0	19	15.4

specimens, or 84.3 per cent of the total number of deermice trapped in the study, taken in the medium to dark soils. Of these 123 pelts, 29 or 22.8 per cent, were found to be number one pelage color, 76, or 61.8 per cent, were found to be number one, and 19, or 15.4 per cent, were found to be number three pelage color. The only number three pelts collected were found in the medium to dark soil color. The pelage colors trapped in the medium to dark soil are in relatively close agreement with the total number of mice caught in the entire study (Table V).

The characteristics of P. m. nebrascensis as well as other subspecies of Peromyscus, have a genetic basis, as shown by lack of modifiability even when the habitat is changed. The comparative frequencies of the mendelian genes for pelage color should afford some measure of the intensity of selection against Peromyscus that are conspicuous on their backgrounds. Natural selection by predators is an important factor in the evolution of pelage color in Peromyscus.

In further investigations of pelage color of P. m. nebrascensis, the author would suggest that a more detailed and extensive study would yield valuable information.

The pelage color of Peromyscus maniculatus nebrascensis in western Kansas showed no significant relationship between pelage color and the type of vegetation in which the trapped specimens lived. The distribution of pelage color did not differ from the distribution of total population in the three vegetative types.

The pelage color of P. m. nebrascensis showed a direct relationship to color only in the light colored soil. There was only a slight

tendency toward a relationship between pelage color and the medium to dark soils.

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