

## Fragmenta Theriologica

### Pelage Coloration of the Old-field Mouse with Comments on Adaptive Coloration

Ubarwienie futerka u *Peromyscus* i uwagi o ubarwieniu adaptatywnym

Donald W. KAUFMAN & Glennis A. KAUFMAN

Kaufman D. W. & Kaufman G. A., 1976; Pelage coloration of the old-field mouse with comments on adaptive coloration. Acta theriol., 21, 11: 165—168. [With 2 Tables].

Pelage coloration in two naturally-occurring pelage phenotypes, dark brown (n=39) and light brown (n=44), of *Peromyscus polionotus* (Wagner, 1843) was examined, using a reflectance spectrophotometer. Phenotype and age had a significant effect on the purity of the light reflected. Differences in brightness and dominant wavelength of the reflected light were affected by phenotype but not age. Adaptive coloration of small mammal pelage is discussed.

[Dept. Biol. Sci. State Univ. N.Y., Binghamton, N.Y. 13901, USA]

Postnatal development, including pelage changes and molting patterns, has been studied extensively in the genus *Peromyscus* (review by Layne, 1968). In general, the juvenile pelages of the different species of *Peromyscus* are gray whereas subadult pelages are more brownish than the juvenile form but less brown than the adult pelage. For quantitative comparison of coloration, visual observation is too crude; however, pelages can now be examined in greater detail using reflectance spectrophotometer measurements. In this way, a series of values can be calculated that characterize the light reflected from the pelage in a more consistent manner than by judging pelage coloration from standards by eye.

We examined pelage coloration in two naturally-occurring pelage phenotypes of the old-field mouse *Peromyscus polionotus* (Wagner, 1843) utilizing a reflectance spectrophotometer. Differences between pelage phenotypes, age groups and interactions between phenotypes and age were determined. Since there are changes in pelage coloration with age (from visual inspection), we were interested in quantitative measurements of this variation relative to the concept of concealing coloration (Cott, 1940).

Reflectance spectrum of the mid-dorsal pelage was analyzed for old-field mice between one and 24 weeks of age. The eight age groups were 1, 2, 3, 4, 5, 6, 7—12 and 13—24 weeks of age. Two pelage phenotypes, dark brown (n=39) and light brown (n=44), of the old-field mouse were

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examined. These mice are described elsewhere (Dawson, Smith & Carmon, 1969; Smith, Carmon & Gentry, 1972; Kaufman, 1974a). Reflectivity from 400—700 m $\mu$  was measured using a Bausch and Lomb Spectronic 505 Recording Spectrophotometer. Mice from a laboratory colony were prepared as flat skins to facilitate reflectance measurements.

Pelage coloration was characterized by excitation purity ( $P_e$ ), brightness ( $B$ ) and dominant wavelength ( $\lambda_d$ ) of the reflected light using the selected ordinate method (Hardy, 1936).

Phenotype and age had a significant effect on the purity ( $P_e$ ) of the light reflected from the dorsal pelage (Table 1). Changes in purity with age for both light and dark brown mice indicate a decrease in purity up to four or five weeks of age with a subsequent increase (Table 2).

Differences in brightness ( $B$ ) between mice were due to pelage phenotype and did not change with age (Table 1). Average brightness values for light and dark brown mice were 13.96 (2 S. E.=0.40) and 8.30 (2 S. E.=0.49), respectively. These values compare favorably with the values of 13.34 (2 S. E.=0.56) and 7.73 (2 S. E.=0.47) reported for adult mice of each phenotype (Kaufman, 1974a).

Dominant wavelength ( $\lambda_d$ ) of the reflected light was also affected by phenotype but not age (Table 1). Values of  $\lambda_d$  were 583.81 (2 S. E.=0.25) and 585.81 (2 S. E.=0.83) for light and dark brown mice, respectively.

Table 1

F<sup>a</sup> — values from ANOVAs for the effects of phenotype and age on dominant wavelength ( $\lambda_d$ ), purity ( $P_e$ ) and brightness ( $B$ ) of the mid-dorsal pelage of the old-field mouse, *Peromyscus polionotus*.

Effect	d.f.	$P_e$	$B$	$d$
Phenotype	1	241.64*	339.06*	25.26*
Age	7	11.74*	1.29	1.41
P $\times$ A	7	2.00	1.21	1.67

\*  $P < 0.0001$ .

The old-field mouse like other *Peromyscus* and many other rodents changes in pelage coloration through a series of molts from birth to adult stage (Golley, Morgan & Carmon, 1966). These changes for most *Peromyscus* result in gray juvenile pelage developing into a more brownish adult pelage (Layne, 1968). However, these differences are difficult to quantify from visual observation since color possesses three basic attributes, hue, saturation and lightness (or brightness), which can be confused (Wyszecki & Stiles, 1967).

We utilized the reflectance spectrum to characterize the mid-dorsal pelage of the mice with respect to dominant wavelength, purity and brightness. Dominant wavelength is the wavelength of the spectrum which mixed with an appropriate amount of white light will match the pelage and correlates approximately to the concept of hue (Wyszecki & Stiles, 1967). Excitation purity relates to amount of white light that is mixed with the dominant wavelength to match the pelage and correlates roughly to saturation under everyday conditions. Finally, brightness is

an attribute of color classed as an equivalent to some intensity of white light and, therefore, can be used to compare relative brightness of different objects.

Differences between phenotypes were due to variation in dominant wavelength, purity and brightness. However, within a phenotype no change occurred in the dominant wavelength or brightness with age. Changes in purity would account for the major differences visually observed by an investigator in the pelages. Therefore, differences that we see would not be due to changes in hue or brightness but rather in the saturation of the pelage color.

Small mammal pelage coloration is adaptive, that is, small, nocturnal mammals tend to match their background (*e.g.*, Benson, 1933; Dice & Blossom, 1937) and predator selection against conspicuous forms has been documented (Dice, 1947; Kaufman, 1974a, 1974b). Since pelage coloration is adaptive in *Peromyscus* it is then of more than passing interest to ask, why are young old-field mice a different color than older

Table 2

Summary of the mean value ( $\pm 2$  S.E.) of excitation purity ( $P_e$ ) in eight age groups for both light and dark brown old-field mice, *Peromyscus polionotus*.

Age (weeks)	Light		Dark	
	n	$P_e$	n	$P_e$
1	3	0.212 $\pm$ 0.010	4	0.153 $\pm$ 0.032
2	3	0.172 $\pm$ 0.012	4	0.076 $\pm$ 0.032
3	4	0.172 $\pm$ 0.023	5	0.068 $\pm$ 0.033
4	4	0.149 $\pm$ 0.012	3	0.085 $\pm$ 0.011
5	5	0.176 $\pm$ 0.018	3	0.063 $\pm$ 0.035
6	3	0.191 $\pm$ 0.019	6	0.092 $\pm$ 0.030
7—12	11	0.175 $\pm$ 0.014	9	0.113 $\pm$ 0.009
13—24	11	0.241 $\pm$ 0.018	5	0.126 $\pm$ 0.041

individuals? One answer is that young mice react to the environment differently than adults and are, therefore, adapted to a different background. However, the results of Kaufman (1974a) suggested that lightness or brightness of the prey relative to background is probably more important to visual, nocturnal predator effectiveness than actual color matching. Brightness of pelage does not vary across age (*i.e.*, at night the different ages of a phenotype would appear as the same shade of gray) and, therefore, from the standpoint of a nocturnal predator the older animals are not darker or lighter than younger ones. Variation in the coloration between young and old mice is probably the result of selection for brightness and color matching of nocturnal small mammals to their background relative to pigment formation of different ages rather than an adaptation to different backgrounds at different ages.

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### Age Determination of the Hare from Annual Layers in the Mandibular Bone

Oznaczenie wieku zająca bielaka na podstawie rocznych warstw kostnych żuchwy

OHTAISHI N., HACHIYA N. & SHIBATA Y.

Ohtaishi N., Hachiya N. & Shibata Y., 1976: Age determination of the hare from annual layers in the mandibular bone. *Acta theriol.*, 21, 11: 168—171. [With Plate II].

To establish of an exact and rapid age-determination technique for hares, the adhesion line on the mandible bones of the 14 known aged ainu hare (*Lepus timidus ainu* Barret-Hamilton, 1900) were examined. In the central part of the medial side of the mandible, the adhesion lines are regularly formed every winter.

[Department of Oral Anatomy, Faculty of Dental Medicine, Hokkaido University, Sapporo, Japan and Hokkaido Branch, Government Forest Experiment Station, Sapporo].

The establishment of an exact age-determination technique for hares and rabbits is of fundamental importance to an analysis of the age structure of a population and an estimate of the birthrate, and in consequence to forecasting population variation. Many methods have been investigated, *i.e.* using the ear length (Tiemeier & Plener t, 1964), the hind foot length (Bujalska, Caboń-Raczyńska & Raczyński, 1965), the closure and thickening of the humeral or ulnar epiphyses (Bujalska *et al.*, 1965; Connolly, Dudziński & Longhurst, 1969), the ossification of the skull and pelvis (Bujalska *et al.*, 1965), the lens weight (Bujalska *et al.*, 1965; Connolly *et al.*, 1969; Rongstad, 1966; Tiemeier *et al.*, 1964), *etc.* But all of the techniques were relative methods and did not exactly define the absolute age. For example, the method usually applied to jack rabbits was a technique using the closure of the humeral epiphysis. According to this method,