CARAPACE COLORATION AND LATITUDINAL DISTRIBUTION IN TESTUDINAE

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SUMMARY

Land tortoises from equatorial regions tend to have more extensive black pigmentation in their carapaces than species from sub-tropical regions; while the latter, in turn, are darker than tortoises from regions with Mediterranean climates.

INTRODUCTION

The abdominal cavity of many diurnal alpine and desert lizards is lined with a black peritoneum. It has been postulated that this black lining may be related to the high incidence of shortwave radiation in the desert, and act as a shield preventing damage to the delicate internal organs. Only species with a black peritoneum seem to be capable of marked colour change. It appears not unlikely, therefore, that a black peritoneum may be important in absorbing the extra light which penetrates the body wall as the animal blanches when the radiation head load is increased during the day. (See discussion in Mayhew, 1968). Land tortoises are also day active but do not have black peritoneums, so it seemed possible that species inhabiting equatorial and tropical regions might possess carapaces of darker hue than those from sub-tropical and Mediterranean regions. This hypothesis is tested in the present article.

METHOD

The three authors independently assessed the percentage of black pigmentation (to the nearest 10%) in the carapaces of those land tortoises (Testudinidae) that are adequately illustrated by Wermuth & Mertens (1961). Where differences occurred in the assessment, the mean figure to the nearest 10% was adopted. The animals were then accorded numbers according to their latitudinal distribution as follows:— Equatorial and tropical (1); subtropical (2); Mediterranean (3). Finally, correlations were drawn between pigmentation and species distribution.

RESULTS

The assessments made were as follows (nomenclature updated according to Pritchard, 1979):—

Fig. in Wermuth & Mertens (1961)	Species	Distribution		% blackness of carapace
139	*Chersine angulate*	SW and S Africa	(2)	50
140	*Geochelone carbonaria*	Tropical S America	(1)	80
142	*G. denticulata*	Tropical S America	(1)	80
143	*G. elegans*	India and Ceylon	(2)	70
144	*G. elephantopus*	Galapagos Is	(1)	100
152	*Psammobates geometricus*	S Africa	(2)	50
154	*Geochelone gigantea*	Seychelles and Aldabra	(1)	100
156	*Testudo graeca*	S Europe, SW Asia, N Africa	(3)	40
161	*T. kleinmanni*	N Africa	(3)	30
162	*T. marginata*	SE Europe	(3)	40
163	*Psammobates oculifer*	SW and S Africa	(2)	30
164	*Geochelone pardalis*	Central and S Africa	(1)	40
165	*Acinixys planicauda*	Madagasca	(3)	30
167	*Geochelone radiata*	Madagasca	(2)	70
170	*Psammobates tentorius*	SW Africa	(2)	70
172	*Geochelone travancorica*	India	(1)	40

The results, expressed graphically, are shown in Fig. 1, to which are added Standard Errors of the Means (vertical bars) and a Regression Line. Although the differences between the means are not significant to P = 0.05 (when analysed using the t-test of significance for small samples) there is some indication that species from equatorial regions tend to have more extensive black pigmentations in their carapaces than species from sub-tropical regions which, in turn, are darker than tortoises from Mediterranean habitats.

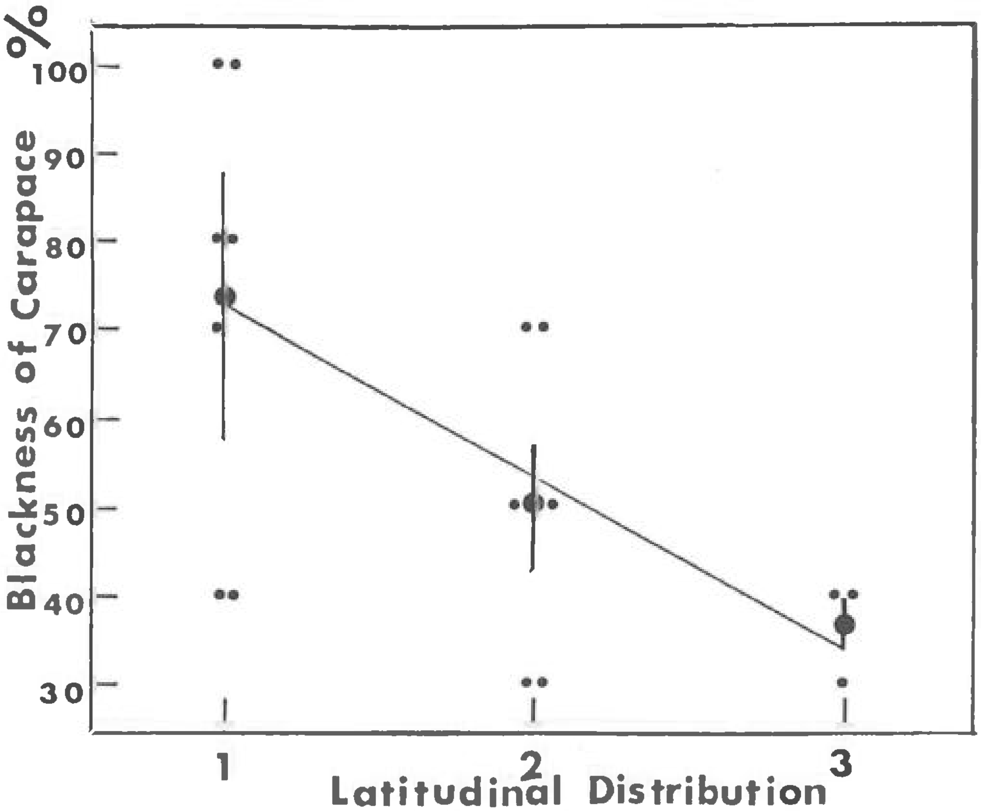

Figure 1. Relationship between colour (% blackness) of carapace and latitudinal distribution of tortoises (1. Equatorial and tropical; 2. Sub-tropical; 3. Mediterranean). Estimates ... • Means ... ● Standard Errors of the Means (vertical bars) and the Regression Line have been inserted.

DISCUSSION

In reptiles that are unable to change colour, the operation of its concealing and thermoregulatory functions are largely synergistic. When the two tend to produce opposing or antagonistic effects, the colour possessing the greater survival value is normally selected (Cloudsley-Thompson, 1979). Land tortoises do not change colour. The pigmentation of their carapaces therefore probably reflects a compromise between the functions of crypsis, the absorption of heat, and of protection from excess ultra-violet light. That aposematic coloration should appear among Testudinidae is improbable, although Hingston (1933) cites examples from the Emydidae and Trionychidae which bite, or forcibly close their shells. Thick-shelled tortoises might, conceivably, have bright colours that would indicate to predators that it would not be worthwhile to attack them. It would be reasonable to expect that cryptic and disruptive coloration should predominate in smaller more vulnerable species while, in giant tortoises which when adult are scarcely exposed to predation, physical factors such as ultra-violet light, are probably of greater adaptive importance. The two totally black species among those listed, *G. elephantopus* and *G. gigantea,* are also the two largest. *G. denticulata,* which was rated at 80% blackness of carapace, is one of the largest of the mainland tortoises. Although *G. carbonaria* whose carapace is as dark or darker, is somewhat, smaller, it may reach as much as 45 cm in length. Apparently exceptional in this context are *G. pardalis* and *G. sulcata,* both of which are large, yet relatively pale. (*G. sulcata* was not included in the survey, because it is not illustrated appropriately by Wermuth & Mertens (1961)). In general, however, there appears to be a general relationship between size and colour although a statistical relationship, even if significant, would not necessarily imply a causal connection. The correlation between colouration and latitudinal distribution although again not statistically significant, may indeed reflect a causal relationship — protection from short-wave radiation.

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