WEIGHT AND MEASUREMENT DATA ON THE GROOVED TORTOISE *TESTUDO SULCATA* (MILLER) IN CAPTIVITY

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INTRODUCTION

The relationship between linear dimensions and weight is of prime importance in biological studies since it yields valuable information on the general well-being and growth rates of individuals, populations and species. This relationship has been studied in several species of Chelonia including *Testudo* (=*Geochelone*) *sulcata* (Cloudsley-Thompson, 1970), *Testudo hermanii* (Jackson, 1978, 1980; Lawrence, 1981; Meek and Inskeep, 1981; Stubbs, Hailey Tyler and Pullford, 1981). *Testudo graeca* (Jackson, 1978, 1980 and Lawrence, 1981), *Chrysemys* (=*Pseudemys*) *scripta elegans* and *Emys orbicularis* (Lawrence 1981 and Meek, 1982).

Meek (1982) quantified the relationship between length and weight and produced a single mathematical formula for each of the above species (*T. sulcata* not included) as well as a comprehensive equation obtained by combing all data sets, in the form of an allometric equation which can be used to compare growth relationships between species or populations.

The work reported here compares the relationship between shell-length, body weight and some linear measurements in two populations of captive *T. sulcata* Miller.

MATERIAL AND METHODS

T. sulcata held in captivity in the Sudan Natural History Museum (Group A) and Khartoum (Group B) were used in this study. For each individual the total weight was recorded to the nearest gram. The shell length (carapace length) from the notch in the nuchal scute to that in the supra caudal scute, shell height and shell width (measured at the point of greatest diameter) and head length were measured to the nearest mm.

RESULTS

RELATIONSHIP BETWEEN LENGTH AND WEIGHTS

According to Meek (1982) the shell length of a chelonian is related to its weight in accordance with the following equation:

$$L = aW^b \qquad (1)$$

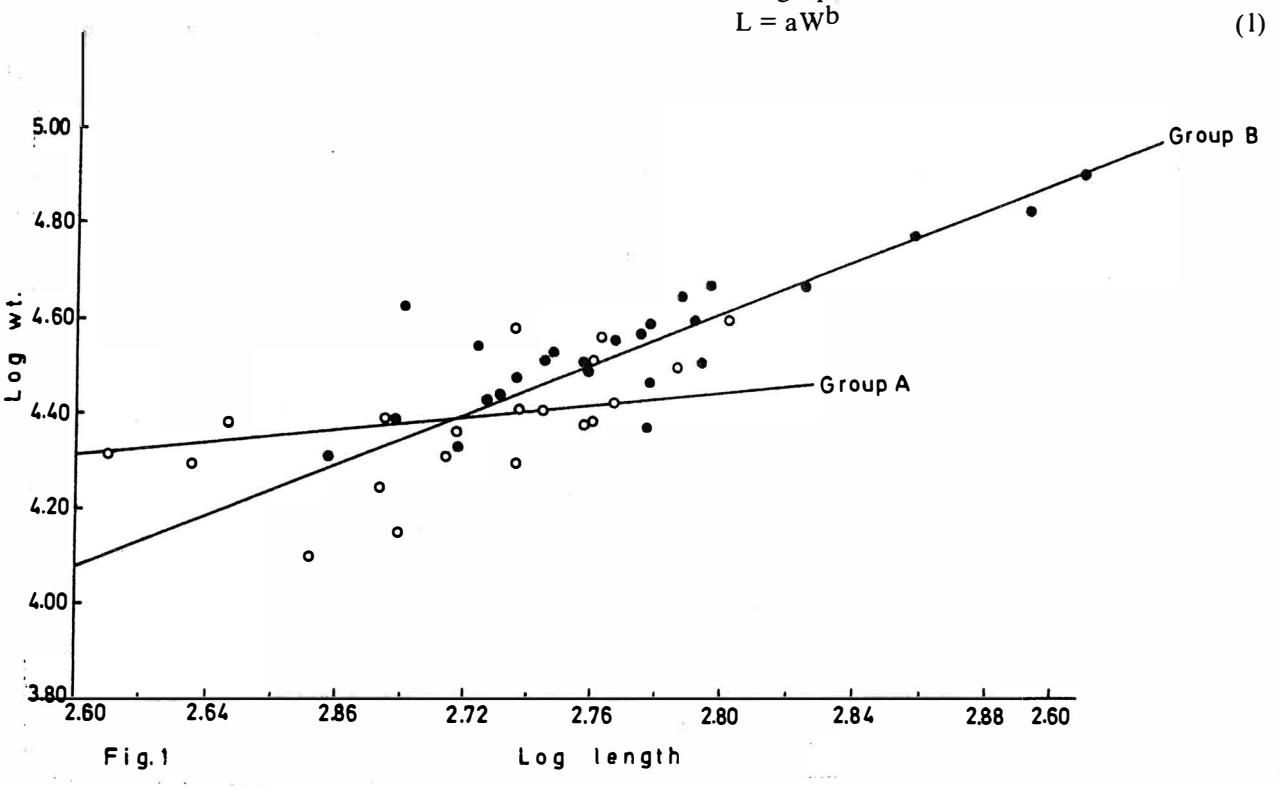

Fig. 1 Logarithmic relationship between shell length and weight in *T. sulcata*. The symbols are (o) for Group A and (•) for Group A and B.

Where

L = shell length in mm, a = the intercept and b an exponent of the mass W in g. The reliability of using shell length in standard growth measurements of *T. sulcata* was tested by plotting the shell length against weight for the two groups. For Group A this gave,

$L = -18.4748\ W^{0.815}$ ($r = 0.671$, $n = 22$)

and for Group B

$L = -62.7605\ W^{1.6674}$ ($r = 0.935$, $n = 25$)

While group A showed a poor correlation ($r^2 = 0.45$), group B showed a good correlation ($r^2 = 0.86$).

Analysis of data following the logarithmic form of Equation 1,

$$\text{Log } L = \text{Log } a + b \text{ Log } W \qquad (2)$$

yielded points lying about straight line (Fig. 1) and when regression was calculated, the two parameters were found to be related to each other by the following regression equations (Table 1).

Log L = 0.815 Log W — 18.4748 for Group A and

Log L = 1.6674 Log W — 62.7603 for Group B.

The correlation significance (r) was assessed for n-1 degree of freedom and it was found that in both groups r is significant. This is indicative of the reliability of the equation which was a good fit for Group B ($r^2 = 0.86$) as compared with Group A ($r^2 = 0.45$) suggesting some change in the two parameters during growth in Group A. This is true in view of the fact that weight increased relatively more than length in Group A than it did in Group B, which showed a higher exponent than Group A. As the value of the exponent b (the regression coefficient) was less than 3 in both groups it was concluded that growth is allometric in *T. sulcata*.

Species	No.	Exponent b	Regression equation Log L = Log a + b Log W	Size range g	Reference
T. gracea	28	0.30	Log L = 2.43 + 0.30 Log W	78-2381	Meek, 1982
T. hermanii	9	0.35	Log L = 11.87 + 0.35 Log W	796-2198	Meek and Inskeep, 1981; Stubbs *et al* 1981
C. scrupta	26	0.36	Log L = 15.25 + 0.36 Log W	25-1276	Meek, 1982
E. orbicularis	7	0.41	Log L = 10.84 + 0.41 Log W	60-595	Meek, 1982
T. sulcata	7	0.91	Log L = 0.91 Log W — 20.6844	3500-42600	Cloudsley-Thompson, 1970
T. sulcata	22	0.81	Log L = 0.81 Log W — 18.4748	12400-39100	Present work (Group A)
T. sulcata	25	1.66	Log L = 1.66 Log W — 62.7603	21000-80000	Present work (Group B)

TABLE 1: Results for the regression analyses of linear relationship between shell length (mm) and body weight (g) in different Chelonian species.

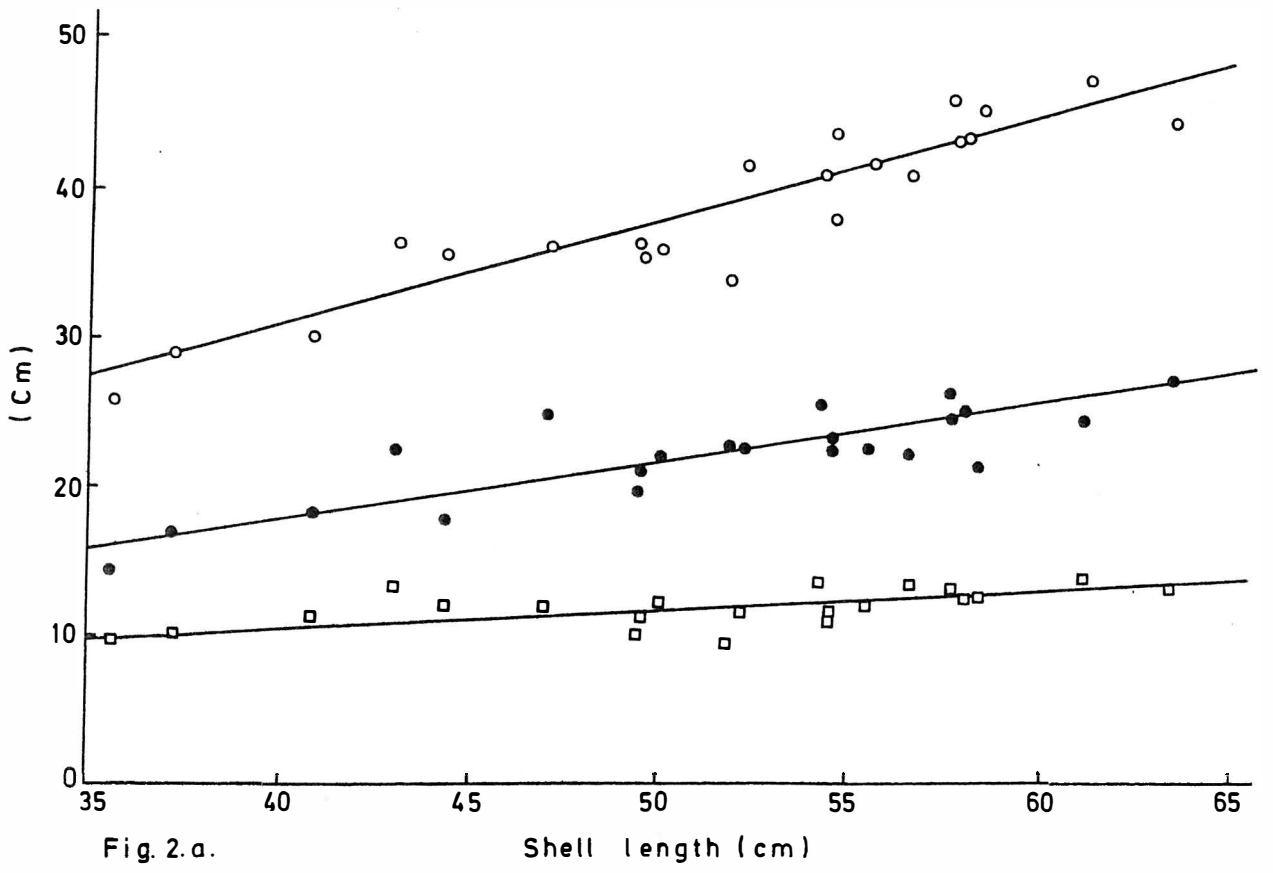

Fig. 2.a.

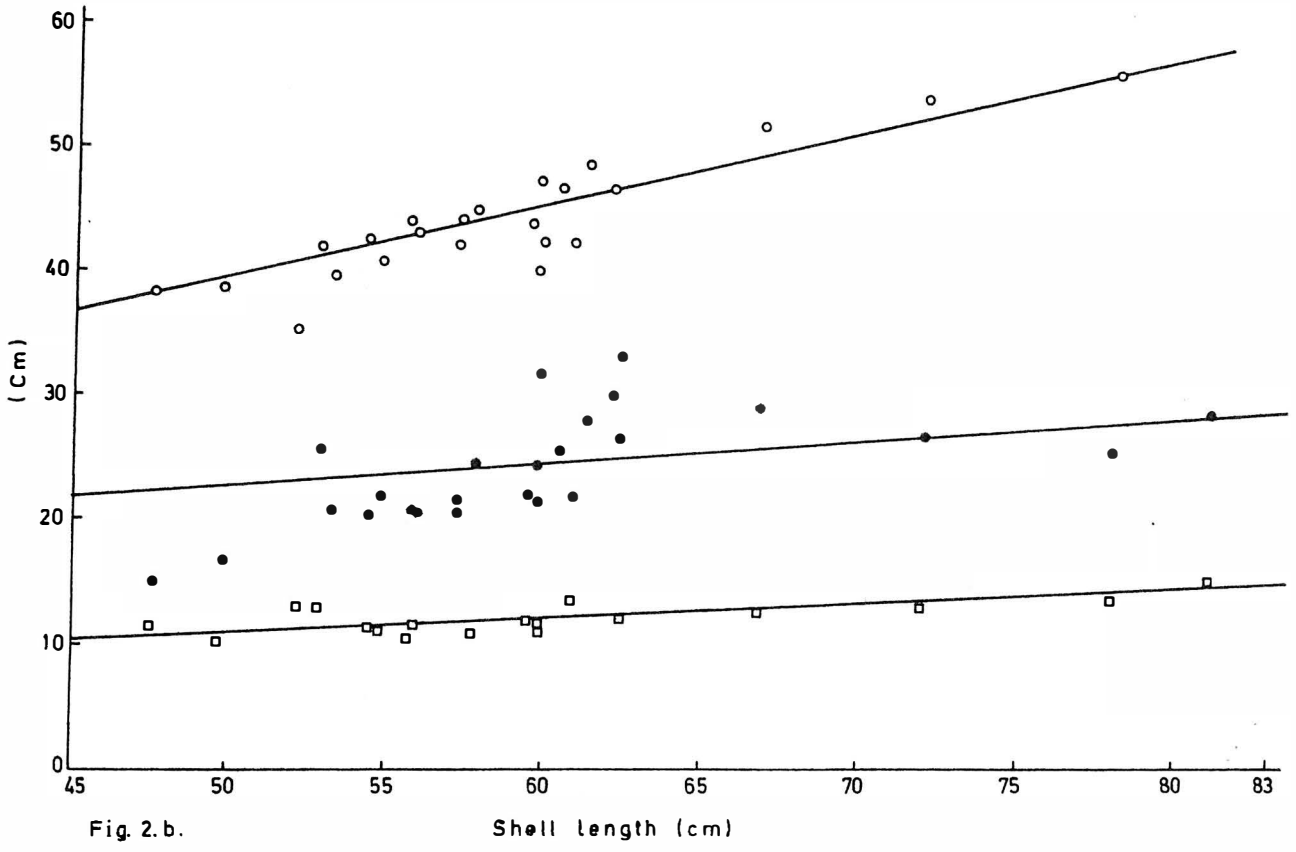

Fig. 2 Relationship between shell length and shell height (●) shell width (o) and head length (□) in *T. sulcata*. Fig. 2a (Group A) and 2b (Group B).

Source*	Intercept (a)	Regression coefficient (b)	Regression Equation Log X = Loga + b Log L	Correlation coefficient (r)
			GROUP A	
SL/SH	7.27	0.29	Log X = 7.27 + 0.29 Log L	0.71
SL/SW	4.21	0.67	Log X = 4.21 + 0.67 Log L	0.90
SL/HL	7.38	0.09	Log X = 7.38 + 0.091 Log L	0.46
			GROUP B	
SL/SH	3.65	0.33	Log X = 3.64 + 0.33 Log L	0.57
SL/SU	3.65	0.64	Log X = 5.84 + 0.64 Log L	0.83
SL/HL	4.33	0.21	Log X = 0.21 Log L — 4.33	0.29

TABLE 2: Results for the regression analyses of linear relationship between shell length (mm) of *T. sulcata* and some morphometric dimensions (mm).

* SL (shell length), SH (shell height), SW (shell width), HL (Head length).

Relationship Between Body-length Proportions

When the relationships between shell length and other body proportions were tested using regression analysis (Equation 1) in its logarithmic transformation for a straight line relationship (Equation 2) using X instead of W as a morphometric parameter in mm (Fig. 2, Table 1). It was found that the shell height, width and head length all grew relatively slower than shell length. The grooved tortoise tended, therefore, to become longer and flatter with relatively smaller heads.

DISCUSSION

The main findings of the present work and of published data is derived from regression analysis. The study showed that the two groups of captive *T. sulcata* exhibit allometric growth. Cloudsley-Thompson (1970)

demonstrated a close correlation between shell length and body weight in *T. sulcata* but did not quantify the relationship. However, from his data the following regression equation was calculated:

Log L = 0.9106 Log W — 20.6844 (r = 0.9611, n = 7)

This equation, which was a good fit to the data ($r^2 = 0.94$) is indicative to allometric growth and is closer to that shown in Group A (see Table 1).

The exponents for *T. sulcata* are higher than the exponents given for other tortoises (Table 2). According to Meek (1982), lower exponents are indicative of a relatively greater increase in body weight in relation to increase in shell length. Such differences in growth rates between species or populations might be attributed to differences in quantity and quality of food and/or climatic factor. But these remain to be investigated, as does any relationship with reproductive activity and age.

The growth in other morphometric dimensions was investigated against shell length and showed varying degrees of correlation (Table 1). The coefficient of determination (r^2) indicates that predictive equations (Table 1) are good fit for shell length and shell width relationship for both groups. This agree well with the calculated relationship for wild *T. sulcata* from the data given by Cloudsley-Thompson (1970).

Log L = 0.7658 Log X — 0.3583

($r = 0.97$, $r^2 = 0.94$, $n = 7$)

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