

BODY TEMPERATURES OF A DESERT POPULATION OF THE STRIPE-NECKED TERRAPIN, *MAUREMYS CASPICA*

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SUMMARY

Measurements have been made on the body temperatures of a population of *Mauremys caspica leprosa* Schweigger, in a desert habitat in North Africa. The results indicate that *M. caspica* employs heliothermy to only a limited degree and generally operates at body temperatures which are lower than air and substrate temperatures and only slightly higher than water temperatures.

INTRODUCTION

Heliothermy in reptiles is a behavioural strategy principally evolved to enable the elevation of body temperatures above the temperatures of the environment. This thermoregulatory strategy is found amongst all the major reptilian groups but is most prevalent and perhaps developed to its highest degree in species from the temperate regions where daily environmental temperatures may be low. When the temperatures of the habitat are high, heliothermy may be employed to only a limited degree or even become a seasonal phenomenon. Such a situation has been found in desert reptiles (Gauthier, 1967; Cloudsley-Thompson, 1971) where very high summer temperatures may alternate with cool winters. This paper reports on the body temperatures and basking behaviour of the stripe-necked terrapin *Mauremys caspica*. This chelonian is semi-aquatic and during the summer months the populations inhabiting the pools and streams of North West Africa frequently encounter environmental temperatures above those that may be lethal for reptiles.

Thermoregulation and thermoregulatory behaviour in semi-aquatic chelonians have been mainly investigated in North American species (see Boyer, 1965; Cloudsley-Thompson, 1971; Avery, 1982 for reviews). In the Mediterranean region there are only two species of terrapin *Emys orbicularis* and *M. caspica*. Cherchi (1958) has studied thermoregulation in *E. orbicularis* in the laboratory but there have been no such studies on *M. caspica* other than general observations on basking (e.g. Stubbs, Hailey, Tyler & Pulford, 1981).

MATERIALS AND METHODS

Body (cloacal) temperatures were recorded from basking terrapins during a two day period in May 1980

and one day's field work in September 1981 at an irrigation channel running through a desert region in Southern Morocco. The irrigation channel was approximately 2 m wide and had a concrete perimeter with a base of fine sand. The water running through the channel was slow moving and clear. Measurements on the body temperatures of basking terrapins are perhaps more difficult to obtain than in other reptile groups. The method used in this study was by entering the water and approaching the animals from this direction. Nets with adjustable handle lengths (up to 3m) were then used to capture the animals when they dived. This method produced the best results, the initial method of approaching from the bank was largely unsuccessful. A total of 30 captures were made; 6 in May (carapace lengths from 44-88 mm) and 24 in September (carapace lengths from 39-168 mm).

Temperatures were recorded in May with a mercury bulb thermometer, in September with a Whitley digital thermometer. The Whitley thermometer was battery operated and had a range from -50°C to 150°C and an error of $\pm 0.5^{\circ}\text{C}$. Substrate temperatures were measured by inserting the probes 8 mm into the soil, water temperatures to a depth of 15 cm and air temperatures 30 cm above the ground with the probe shaded. Environmental temperatures were recorded simultaneously with body temperatures or every 30 mins or so. Body temperatures were tested for correlation with associated air and water temperatures and with carapace lengths. When appropriate a *t*-test with *n*-2 degrees of freedom has been used to test the levels of significance of the *r* value when *n* is low (Bailey, 1959).

RESULTS

During the period that body temperatures were gathered, sand temperatures around the channel varied from $45-55^{\circ}\text{C}$ in May and $55-60^{\circ}\text{C}$ in September, water temperatures from $24-25.2^{\circ}\text{C}$ in May and $25.9-31^{\circ}\text{C}$ in September, air temperatures from $30-33^{\circ}\text{C}$ in May and $33-39^{\circ}\text{C}$ in September. Only relatively few *M. caspica* were observed basking at either time of year. Basking took the form of the terrapins hauling themselves onto the concrete perimeter of the channel, at most a few centimeters clear of the water line and occasionally with the rear of their shells submerged.

Table I summarizes the results recorded between

TABLE I. Summary of *Mauremys caspica* body temperatures ($^{\circ}\text{C}$) at two periods in the year

Period	n	Range	Mean	1.96 SD
May	6	24–26.5	25.4	1.84
September	24	24.8–29.5	26.8	2.54
Pooled	30	24–29.5	26.4	2.63

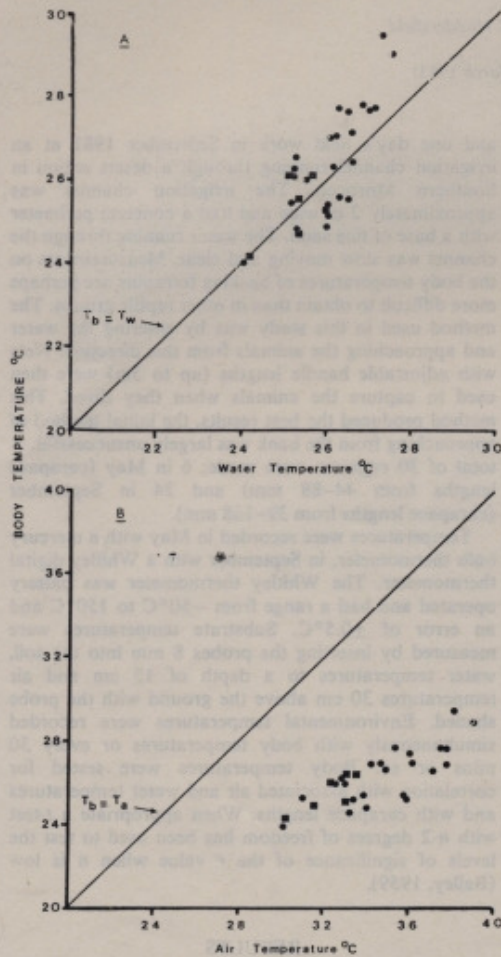


FIG. 1. Graphs showing *Mauremys caspica* body temperatures plotted against water temperature (A) and air temperature (B). Slanting lines indicate where body temperatures equal air or water temperature. September = ●, May = ■.

1200–1327 h in May and 1000–1800 h in September. In September, body temperatures were generally higher in mid-afternoon, the time when environmental temperatures were also highest. Figure 1 shows *M. caspica* body temperatures in relation to associated air and water temperatures. There was a significant correlation between air temperature and body temperature in

September ($r = 0.70$, $P < 0.001$), but not in May ($r = 0.62$, 4 d.f., $P > 0.10$). Body temperatures were significantly lower than air temperatures (May: $t = -18.0$, 5 d.f., $P < 0.001$; September: $t = -27.1$, 29 d.f., $P < 0.001$). The majority of terrapins (70%) had body temperatures higher than or equal to water temperatures but there was no significant difference between mean body temperature and mean water temperature (May: $t = 1.53$, $P > 0.10$; September: $t = 1.58$, $P > 0.10$). Body temperatures were positively correlated with water temperature (May: $r = 0.76$, 4 d.f., $P < 0.10$; September: $r = 0.72$, 23 d.f., $P < 0.001$). Body temperatures were tested for correlation with carapace length. The results were not significant (May: $r = 0.53$ 4 d.f., $P > 0.10$; September: $r = 0.21$, 23 d.f., $P > 0.10$).

The mean body temperatures of males ($\bar{x} = 26.4^{\circ}\text{C}$) and females ($\bar{x} = 26.8^{\circ}\text{C}$) in September were not significantly different ($t = 0.74$, 15 d.f., $P > 0.10$) nor was the difference between the overall means of the May and September samples, $t = 1.02$, 28 d.f., $P > 0.10$ (See Table I).

DISCUSSION

In the desert areas of North Africa *Mauremys caspica* is regularly confronted with environmental temperatures that surpass the known critical maximum of chelonians (Hutchison, Vinegar & Kosh, 1966). However, by adopting a behavioural strategy of limited heliothermy and a large degree of thermoconformity with environmental temperatures *M. caspica* effectively maintains stable body temperatures to within a narrow range. Thermoconformity with water temperatures has been recorded in *Sternotherus oderatus*. Edgren and Edgren (1955) found that in this species body temperatures closely follow water temperatures when they are in the region of 28–30 $^{\circ}\text{C}$ but that body temperatures are elevated above water temperature when these are low (17–19 $^{\circ}\text{C}$). They concluded that since this differential is not maintained in the laboratory it is presumably achieved by behavioural thermoregulation. The concrete basking areas used by *M. caspica* may also be influencing their thermoregulatory behaviour since Boyer (1965) noted that terrapins basking on concrete, which has high conductivity, did not remain emergent for long in contrast to those basking on logs, which spent long periods basking.

Thermoregulatory behaviour is believed to influence the presence of algal growth, flaking scutes and leeches on the shells of terrapins (Boyer, 1965). It has been suggested that basking and drying the body helps to keep the terrapins free of such animal and plant parasites and that non-basking terrapins in clear water would be the most subject to attack (Cagle, 1950; Neill & Allen, 1954). This hypothesis appears to be in good agreement with the limited basking of *M. caspica* since algal growth, flaking scutes and leeches have been found on the shells of over 20% of the terrapins examined at this study area (Meek, in preparation).

The maximum body temperature of 29.5 $^{\circ}\text{C}$ attained by *M. caspica* is several degrees below the critical maxi-

mum body temperature of 41.5°C found for emydids by Hutchison *et al.* (1966) and the 37.4°C at which the loss of righting response begins. It is of interest to note also that *M. caspica* does not appear to elevate body temperatures as high as those found for two species of amphibian at this study area (Meek, 1983) and are also lower than the maximum body temperatures found in North African *Testudo graeca* from a cooler coastal habitat (Meek & Jayes, 1982).

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