

# Lizards, A Study In Thermoregulation

J Comp Physiol B (1995) 165: 125–131

Springer-Verlag 1995

ORIGINAL PAPER

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**A radio-telemetric study of the thermoregulation of free living water monitor lizards, *Varanus S. salvator***

Accepted: 21 November 1994

**Abstract** Eight water monitor lizards, *Varanus s. salvator*, were captured: four individuals from an oil palm estate on the Malayan peninsula, and four from fresh water-deficient Tulai Island 65 km off-shore in the South China Sea. They were fitted with a radio transmitter attached to a thermistor which was inserted into the cloaca of the animals and released. The heating rate during basking was measured as 0.117 and 0.118 °C min<sup>-1</sup> while the daily cloacal temperature fluctuated between 29.5–37.5 °C. Cloacal temperature was measured on other individuals, caught at random times during the day, which revealed a considerable daily and individual variation. The average cloacal temperature during activity was 30.4 °C. The peak activity appeared when body temperature was 31 °C. Thermoregulation by behavioural means included cooling in water and reducing heat loss at night by sleeping in burrows. The cooling rate for two individuals when submerged in 29 °C water was 0.308 and 0.340 °C min<sup>-1</sup>. There appeared to be a strong correlation between ambient temperature and cloacal temperature.

**Key words** Thermoregulation · Radiotelemetry · Cooling heating rate · Behaviour · Lizard, *Varanus s. salvator*

**Abbreviations** bw body weight · T<sub>a</sub> ambient temperature · T<sub>b</sub> body temperature · T<sub>c</sub> cloacal temperature · TOP Tumor Oil Palm Estate · TUL Tulai Island

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## Introduction

The water monitor lizard, *Varanus s. salvator*, is considered to be an aquatic species which inhabits an area from India to Flores in the east-Indonesian archipelago (Smith 1932) where it feeds mainly on insects, crustaceans and amphibians (Gaulke 1991; Tracholt 1994a) and occasionally on carrion (Dermayagalis 1931; Harrison and Lim 1957; Vogel 1979; Auffenberg 1981), although only when it is found within their respective home range (Tracholt 1994b). Although considered to be aquatic, it is also found on tiny fresh water-deficient coral islands in the South China Sea, Malacca Strait and in the Nusa Tenggara archipelago of Indonesia where it has adapted to a strictly terrestrial life (Tracholt (1994a); unpubl. data).

Thermoregulation in lizards has been extensively studied and documented (Bogert 1949; Ballinger 1969; Beuchat 1989) but varanids have until recently, despite being common and often very large animals, received little attention. Only the thermoregulation of *V. giganteus*, *V. varius*, *V. gouldii*, *V. griseus*, *V. grayii* and *V. komodoensis* have been studied by radio-telemetric means (Stebbins and Barwick 1968; Sokolov 1975; King 1980; Auffenberg 1981, 1988; Vermet et al. 1988; King et al. 1989) and although reptiles are often considered as cold-blooded, these studies show that varanids tend to keep their body temperature around 35–37 °C while active. Studies of varanids in captivity support these findings (Bartholomew and Tucker 1968; Johnson 1972; Gleeson 1981).

The effect of large body size on the thermoregulation of varanids has been a subject of minor disputes. Bartholomew and Tucker (1968) suggests that the rate of heat production is so low and the conductance so high as to produce minuscule equilibrium differentials with the environment. McNab and Auffenberg (1976) and Auffenberg (1981), however, concluded that the body size of the Komodo dragon, *V. komodoensis*, plays a vital

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