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A novel thermoregulatory behavior in a gravid rock lizard, *Psammophilus dorsalis*

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Abstract. A gravid rock lizard, *Psammophilus dorsalis* was seen in a puddle of water. As it was unnatural for this species to be found in water, observations were made on its activity. It was submerging its ventral side in water and making circular movements. Intermittently it rubbed its abdomen with water using forelimbs and the hind limbs against each other. Surface body temperature of the lizard was ~3.8 ºC lower than when it was outside water. This novel thermoregulatory behavior of bathing by a gravid lizard is perhaps to lower the body temperature to protect the oviductal embryos against high ambient temperatures.

Keywords. agamidae, body temperature, reptile, *Psammophilus dorsalis*.

The body temperature of reptiles greatly influences their ability to perform various activities such as digestion, growth, movement, oxygen consumption, reproduction, foraging, escape from predator, social interaction and so on (Kearney 2001). It is widely known that reptiles derive their body heat from external sources and pregnant females actively select the required body temperature rather than passively accepting the available temperature (Mathies and Andrews 1997). The behavioral mechanisms generally involve shuttling between sun and shade, retreating into deep shade or crevices, basking for variable durations, modifying postures to alter surface areas to be exposed to heat and altering their activity with respect to environmental temperature (Castilla and Bouwens 1991; Díaz 1994; Labra, Soto-Gamboa and Bozinovic 2001; Radder, Saidapur and Shanbhag 2005). In the lizard, *Gallotia galloti*, the adult males are darker in color and bask for longer period than females and sub-adult males while juveniles bask least (Díaz 1994). The author correlates body size and color to basking duration. Also, lizards like *Sceloporus undulatus*, *Pogona barbata* and *Varanus varius* may adopt physiological mechanisms for thermoregulation such as alteration in heart beat (Angilletta 2001; Angilletta, Niewiarowski and Navas 2002; Seebacher 2000; Seebacher 2005). The females are known to thermoregulate very precisely when gravid carrying eggs rather than when non-gravid (Mathies and Andrews 1997).

In this study, we report a novel thermoregulatory behavior exhibited by a gravid rock lizard, *Psammophilus dorsalis*. During one of our field visits for behavioral studies on *P. dorsalis*, one gravid individual was seen in a puddle near the guest house of Kannada University, Hampi (15 º16'N, 76º29'E) around 1215 hr on 23rd May 2008. The ambient air temperature was 35.3 ºC. Since it is unusual to find a rock lizard in puddles, we decided to study the focal lizard in detail. The whole episode till the lizard left the spot was videotaped (~40 minutes). 15 minutes after we began our observations, due to disturbance by a human visitor, the focal animal moved out of the puddle and went away to about 5 meters. After ~15 minutes it came to another water pocket near the first one and stayed there for ~13 minutes. When the water in that pocket percolated into the ground the lizard moved to another water pocket and stayed there for 3 minutes. Later the lizard moved to a nearby rocky shelter.

While in water, the lizard was seen moving intermittently in small circles (Figure 1a) with a brief period of rest. It was seen to press its ventral body surface to the ground to dip its abdomen in water and

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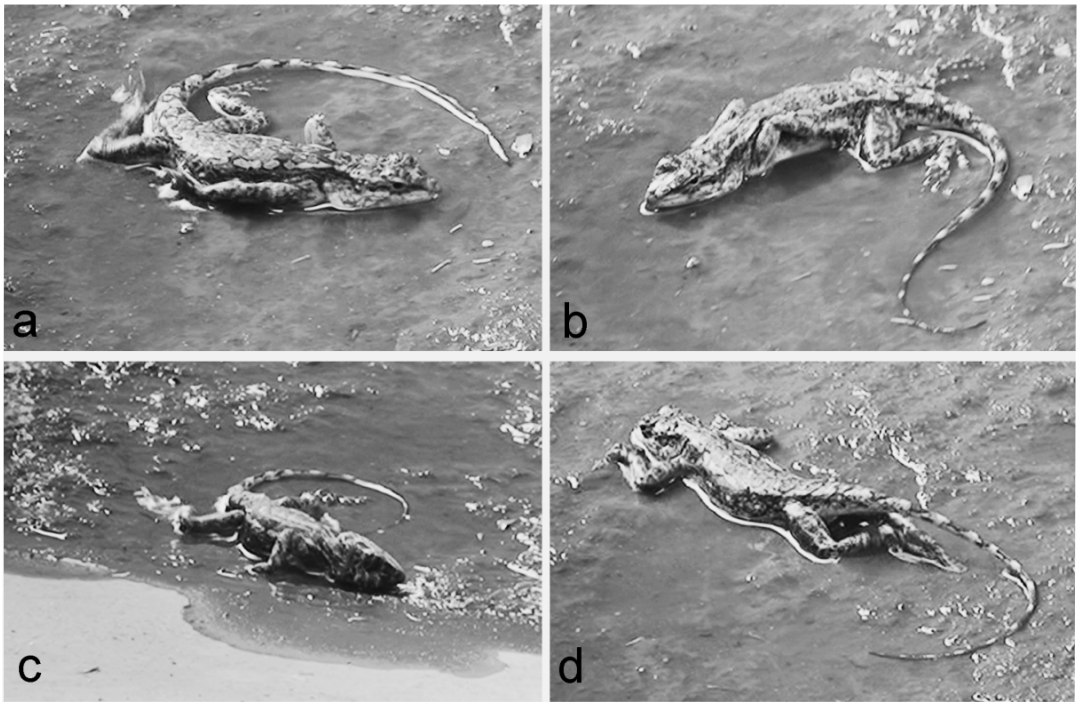

Figure 1. Photographs of gravid *Psammophilus dorsalis* engaged in circular movement (a), splashing water with forelimbs on the abdomen (b), scrubbing head and snout to the ground (c), and rubbing hindlimbs during bathing (d).

rub it with wet forelimbs as if to cool the abdomen with application of water (Figure 1b). It scrubbed its head and snout to the wet ground (Figure 1c) and also scrubbed with hind limbs. At times it rubbed its hind limbs against each other to splash the water (Figure 1d). The whole episode looked as if the lizard was trying to 'bathe' in the small puddle. During this process of 'bathing' the lizard breathed faster as judged by quicker lowering and uplifting of ventral body wall than when it was out of water, and gasping more air. The lizard stayed still intermittently possibly due to exhaustion. During the 'bathing' process, it circled around itself making vigorous movements at intervals. The surface body temperature of the lizard when in water and when out of water in sunny areas was recorded using an infrared thermometer. The body surface temperature of the lizard while bathing was 30.4 ºC and when out of water it was 34.2 ºC.

A previous study on the activity patterns of *P. dorsalis* has shown that they bask for long periods during morning hours (up to 0930 h) when the air temperature rises to 30-36 ºC, they retreat under the rocks or boulders during afternoon hours (1300-1545 h) and again emerge out in early evening hours (1600-1700 h) when the air temperature drops to 31- 33 ºC (Radder, Saidapur and Shanbhag 2005). However, it is not known whether gravid individuals also bask until late morning hours when temperature rises to more than 36 ºC. The presently reported behavior is a novel type and perhaps rare among the lizards. The focal female lizard in question was gravid. Lowering of the body temperature by 3-5 ºC is reported in another gravid agamid lizard, *Calotes versicolor* during prolonged oviductal egg retention phase (Shanbhag, Saidapur and Radder 2003). The gravid *C. versicolor* are known to arrest embryonic growth during prolonged egg retention phase which results following non availability of proper/moist oviposition sites (Radder, Shanbhag and Saidapur 1998). The mechanism of lowering body temperature in these lizards is however unknown at present. The present field observations suggest that gravid *P. dorsalis* lowers body temperatures by bathing in water possibly to ensure embryonic survival using the strategy of cooling abdominal surface.

The annual diurnal temperature of the study area ranges from 20 to 47 ºC and the rock lizards are able to cope up with such extreme temperatures by behavioral thermoregulation i.e. by shuttling between

sun and shade (Radder, Saidapur and Shanbhag 2005). It is possible that in nature, lizards use diverse strategies to overcome extreme changes in the ambient temperature that might not be often noticed by an observer. Extensive field studies are needed to reveal mechanisms of thermoregulation especially in gravid female rock lizards that are exposed to very high temperatures, ordinarily not congenial for the survival of oviductal embryos.

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References

Angilletta, M.J. (2001): Thermal and physiological constraints on energy assimilation in a widespread lizard (*Sceloporus undulatus*). Ecology **82**: 3044-3056.

Angilletta, M.J., Niewiarowski, P.H., Navas, C.A. (2002): The evolution of thermal physiology in ectotherms. J. Therm. Biol. **27**: 249-268.

Castilla, A.M., Bauwens, D. (1991): Thermal biology, microhabitat selection, and conservation of the insular lizard *Podarcis hispanica atrata*. Oecologia **85**: 366-374.

Díaz, J.A. (1994): Field thermoregulatory behavior in the western Canarian lizard *Gallotia galloti*. J. Herpetol. **28**: 325-333.

Kearney, M. (2001): Postural thermoregulatory behavior in the nocturnal lizards *Christinus marmoratus* and *Nephrurus milii* (Gekkonidae). Herpetol. Rev. **32**: 11-14.

Labra, A., Soto-Gamboa, M., Bozinovic, F. (2001): Behavioral and physiological thermoregulation of Atacama desert-dwelling *Liolaemus* lizards. Ecoscience **8**: 413-420.

Mathies, T., Andrews, R.M. (1997): Influence of pregnancy on the thermal biology of the lizard, *Sceloporus jarrovi*: why do pregnant females exhibit low body temperatures?. Func. Ecol. **11**: 498-507.

Radder, R.S., Saidapur, S.K., Shanbhag, B.A. (2005): Population density, microhabitat use and activity pattern of the Indian rock lizard, *Psammophilus dorsalis* (Agamidae). Curr. Sci. **89**: 560-566.

Radder, R. S., Shanbhag, B. A., Saidapur, S. K. (1998): Prolonged oviductal egg retention arrests embryonic growth at stage 34 in captive *Calotes versicolor*. Herpetol. Rev. **29**: 217-218.

Seebacher, F. (2000): Heat Transfer in a Microvascular Network: the Effect of Heart Rate on Heating and Cooling in Reptiles (*Pogona barbata* and *Varanus varius*). J. Theor. Biol. **203**: 97-109.

Seebacher, F. (2005): A review of thermoregulation and physiological performance in reptiles: what is the role of phenotypic flexibility? J. .Comp. Physiol. B **175**: 453-461.

Shanbhag, B.A., Saidapur, S.K., Radder, R.S. (2003): Lowering body temperature induces embryonic diapause during prolonged egg retention in the lizard, *Calotes versicolor*. Naturewissenschaften **90**: 33-35.

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