An Update on the Ecology of the Pygmy Monitor *Varanus eremius* in Western Australia

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Abstract

Between 1995 and 2003, I collected 68 new specimens of the pygmy monitor *Varanus eremius* at Yamarna in the Great Victoria Desert. Here I update earlier reports using these new data on its anatomy, behavior, diet, and reproduction in Western Australia. I also briefly compare and contrast its anatomy and ecology with that of a sympatric smaller species, *V. brevicauda*.

Key words: Squamata: Varanidae: *Varanus eremius, V. brevicauda*; anatomy, ecology, W Australia, Great Victoria Desert.

Introduction

The pygmy monitor *Varanus eremius* is found throughout the red sandy deserts of interior Australia (Pianka 2004). It is a widely foraging terrestrial specialist on lizards. I have reported on various aspects of its ecology earlier (Pianka 1968, 1982, 1986, 1994). Here I update what is known about this species using data from 68 new specimens collected between 1995 and 2003 near the southern limit of its geographic range at Yamarna in the Great Victoria Desert (hereafter GVD).

Methods

All lizards were collected under Conservation and Land Management (CALM) permits after obtaining the approval of appropriate Animal Ethics Committees. Body temperatures of active lizards were measured with a thin bulb Shultheiss cloacal thermometer at the time of capture. Ambient air temperature at 1.5 m above ground was also recorded. Fresh SVL, tail length, and weight were measured in the field before preservation. Lizards were preserved in 10% formalin and transferred to 70% ethanol after fixation.

Ten body measurements were taken on preserved specimens with mm rulers and/or digital calipers: preserved SVL, preserved tail length, head length, head width, head depth, jaw length, foreleg length, hind leg length, forefoot length, and hind foot length. Lizards were then dissected and reproductive condition and stomach contents examined. Lengths and widths of testes were measured for males, and numbers and sizes of ovarian and oviductal eggs were counted and measured for females. Lengths of fat bodies were also measured. In text and tables, means are given with their plus/minus standard errors.

Results

In the GVD of Western Australia, fresh SVL ranges from 59 to 165 (mean = 129.96 $\pm$ 2.13) with fresh tail lengths ranging from 92 to 293 mm (mean = 215.29 $\pm$ 3.664). Tail length ranges from 140-188% of SVL (mean = 1.661 $\pm$ 0.007) (Fig. 1). Males are slightly larger, heavier, and have longer tails than females, but no sexual dimorphisms in head or limb proportions were detectable.

Activity during the day is bimodal with a peak in the morning and another in the afternoon (Fig. 2).

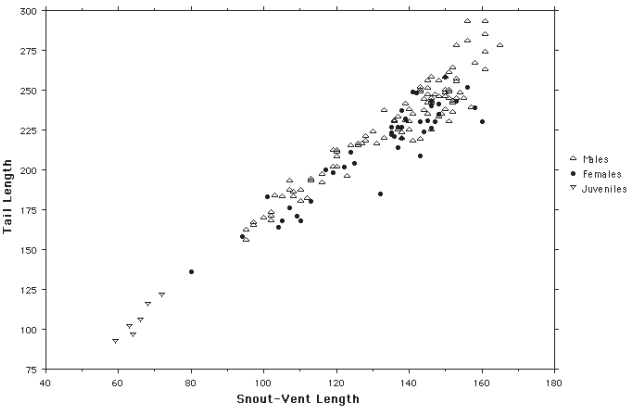

Fig. 1. Tail length plotted against SVL. Females shown with solid circles, males with upright triangles, and juveniles with inverted triangles.

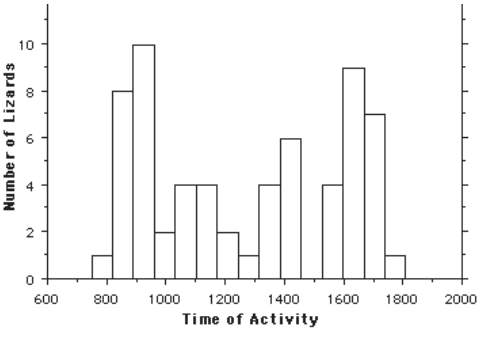

Fig. 2. Histogram showing times of activity.

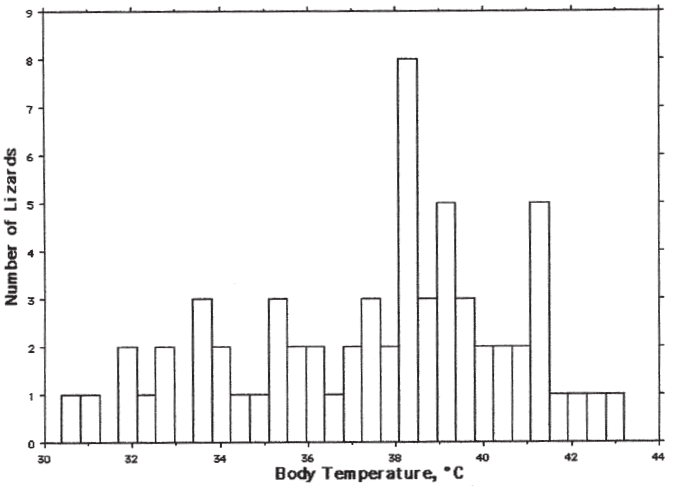

Fig. 3. Histogram of body temperatures of active lizards.

Body temperatures vary from 30.4°C to 43.2°C (mean = 37.5°C ± 0.39, N = 63) (Fig. 3) and are weakly correlated with ambient air temperatures (Fig. 4), with a slope of 0.234, indicating a fairly high degree of thermoregulation.

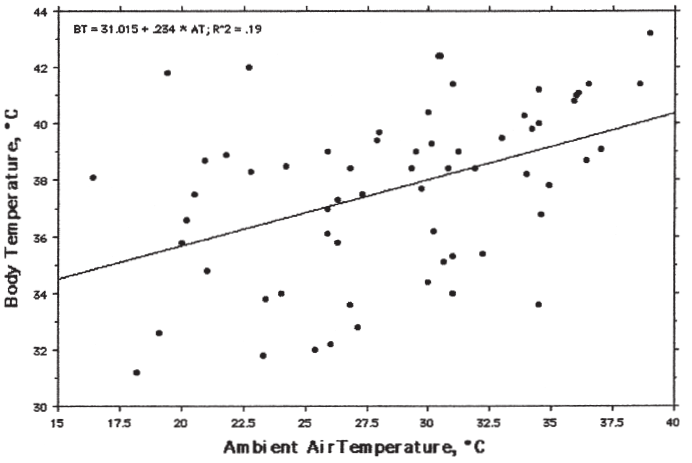

Fig. 4. Body temperature plotted against ambient air temperature.

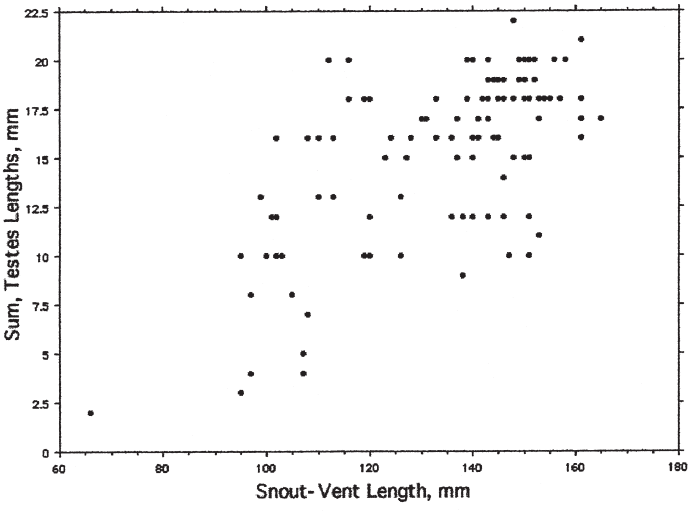

Fig. 5. Testes volume plotted against male SVL.

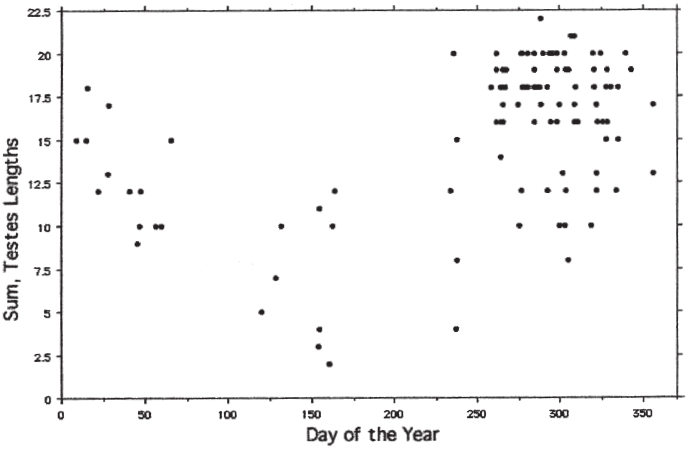

Fig. 6. Testes volume plotted against day of the year.

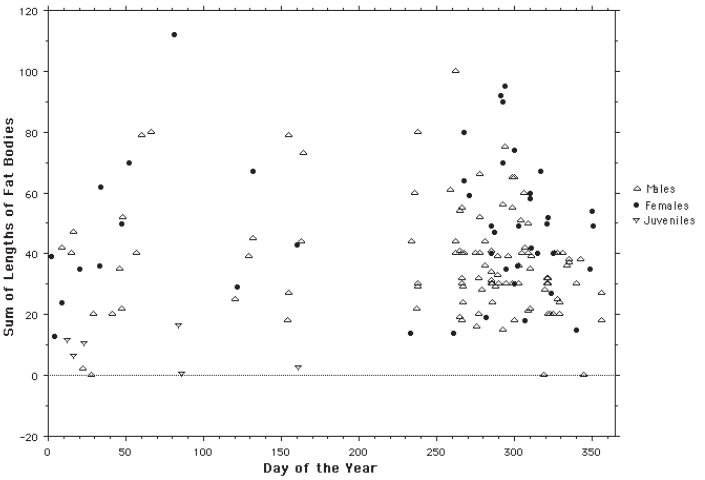

Fig. 7. Fat body lengths of females (solid circles), males (upright triangles), and juveniles (inverted triangles) plotted against day of the year.

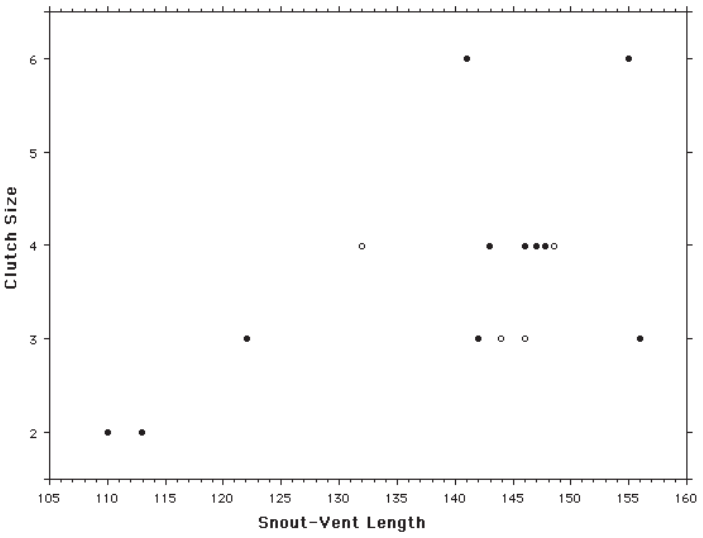

Fig. 8. Clutch size plotted against female SVL. Ovarian eggs are shown with solid circles, oviductal eggs shown with open circles.

Larger males have larger testes than smaller males (Fig. 5). A plot of testes size against day of the year shows a seasonal cycle (Fig. 6), with smaller testes during winter months and enlarged testes during spring and summer.

Fat bodies do not show much of a seasonal cycle (Fig. 7) and they are slightly larger in females (48.73 ± 3.52) than they are in males (37.13 ± 1.72).

Females reach sexual maturity at about 110 mm SVL and males do so at about 116 mm SVL (Pianka 1994). Thirteen females had enlarged yolked ovarian eggs during late September, October, November, and early December. Shelled oviductal eggs were found in four other females from mid October to early January when eggs are presumably laid. Clutch size varies from 2 to 6, with a mode of 3-4 and an average of 3.68 (N=17).

Prey species	Number	Volume (cc.)	% of Total Number	% of Total Volume	Frequency % 128
Centipedes	2	1.0	1.20	0.64	1.56
Spiders	2	0.4	1.20	0.25	1.56
Scorpions	3	2.7	1.81	1.72	2.34
Grasshoppers	38	19.8	22.89	12.59	28.13
Cockroaches	3	3.0	1.81	1.91	2.34
Beetles	2	0.3	1.20	0.19	1.56
Caterpillars	1	0.1	0.60	0.06	0.78
Other Larvae	1	0.2	0.60	0.13	0.78
Pupae	2	0.6	1.20	0.38	0.78
Unidentified Insects	11	3.25	6.63	2.07	8.59
Lizards	89	125.2	53.61	79.62	70.31
Seeds	5	0.5	3.01	0.32	0.78
Unid. Pt. Dig.	7	0.2	4.22	0.13	5.47
Totals	166	157.3	100.0	100.0	

Tab. 1. Summary of the stomach contents of 128 *Varanus eremius* with food in their stomachs (68 other stomachs were empty). Frequencies based on 128 stomachs.

	V. eremius	*V. brevicauda*
SVL	129.96 ± 2.130	88.92 ± 1.325
Tail Length	215.29 ± 3.664	83.26 ± 1.383
Tail Length/SVL	1.661 ± 0.007	0.941 ± 0.007
No. Presacral Vertebrae	29	31-35 (mean 32.3)
No. Postsacral Vertebrae	110	47-67 (mean 56.5)
Weight	31.201 ± 1.271	8.974 ± 0.247
Foraging Mode	Widely Foraging	Ambush
% Grasshoppers by volume	12.6 %	17.2 %
% Lizards by volume	79.6 %	16.8 %

Tab. 2. Comparsion of various aspects of the anatomy and ecology of *Varanus eremius* with *V. brevicauda*.

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Larger females lay larger clutches (Fig. 8). Relative clutch mass (clutch volume) of 4 females with oviductal eggs averaged 20.8 % of female weight. Neonates hatch in January and February at about 59-62 mm SVL and weigh about 2.7-3.3 grams.

Major food items are other lizards, which constitute 79.6 % of the diet by volume. Skinks of the genera *Ctenotus*, *Menetia*, and *Morethia* are eaten, as are the agamids *Ctenophorus inermis, Ctenophorus isolepis*, and *Lophognathus longirostris*, a tail of the gecko *Diplodactylus conspicillatus*, and the pygopodid *Delma butleri*. Grasshoppers were the second most important prey item, found in 28% of stomachs and constituting 12.6% of the diet by volume. Other prey items eaten in considerably smaller proportions include centipedes, spiders, scorpions, cockroaches, beetles, caterpillars, other insect larvae, and pupae (Table 1). Ninety of 128 stomachs (70%) with food contained lizards or parts of lizards. One juvenile (SVL = 69 mm) had eaten a baby *Ctenotus quatuordecemlineatus*. Other skink species eaten include *Ctenotus calurus, Ctenotus colletti, Ctenotus dux, Ctenotus helenae, Ctenotus pantherinus, Ctenotus piankai, Ctenotus schomburgkii, Menetia greyi,* and *Morethia butleri.* Several stomachs contained only *Ctenotus* tails. One individual had eaten a tail of a *Diplodactylus conspicillatus*, a nocturnal gecko. These geckos use abandoned trapdoor spider burrows as diurnal retreats, suggesting that this *Varanus eremius* individual may have gone down into such a burrow during the day and bitten off the gecko's tail. Three other pygmy monitors, *Varanus brevicauda, V. caudolineatus* and *V. gilleni*, are also known to harvest gecko tails (*D. conspicillatus* and *Gehyra*) in their diurnal retreats (Pianka 1969, King and Pianka 2007).

Discussion

Varanus brevicauda and *V. eremius* are both members of the subgenus *Odatria*, and their current geographic ranges are nearly identical corresponding to the red sandy deserts of interior Australia. Both species are primarily terrestrial, and both feed on grasshoppers and other lizards, but prey are captured in fundamentally different ways. *V. brevicauda* are sedentary sit-and-wait ambush predators, whereas *V. eremius* forage widely over extensive areas and eat many more lizards than *V. brevicauda*. The two species also differ dramatically in morphology (Table 2). *V. brevicauda* are long bodied but have short tails, approximately equal to SVLs (mean = 94%), whereas *V. eremius* have considerably longer tails averaging about 166% of SVL. Greer (1989) reports that most Australian varanids, including *V. eremius*, have 29 presacral vertebrae, but *V. brevicauda* possess from 31 to 35 (mean = 32.3) in keeping with their relatively long bodies. Postsacral (tail) vertebral counts for *V. brevicauda* range from 47 to 67 (mean = 56.5), whereas one *V. eremius* examined had 110 postsacral vertebrae. *V. brevicauda* have a pronounced sexual dimorphism in head size (males have relatively larger heads than females), but no such dimorphism exists in *V. eremius*.

Acknowledgments

My research has been supported by grants from the National Geographic Society, the John Simon Guggenheim Memorial Foundation, a senior Fulbright Research Scholarship, the Australian-American Educational Foundation, the University Research Institute of the Graduate School at the University of Texas at Austin, the Denton A. Cooley Centennial Professorship in Zoology at the University of Texas at Austin, the U. S. National Science Foundation, and the U. S. National Aeronautics and Space Administration. I thank the staffs of the Department of Zoology at the University of Western Australia and the Western Australian Museum plus the staffs of the De-

partment of Conservation and Land Management (CALM) at Kalgoorlie and Woodvale.

Zusammenfassung

Zwischen 1993 und 2003 sammelte ich 68 weitere Exemplare des Zwergwarans *Varanus eremius* bei Yamarna in der Victoria Wüste (Great Victoria Desert). Im vorliegenden Beitrag ergänze ich frühere Berichte durch weitere Angaben über Anatomie, Verhalten, Nahrungszusammensetzung und Reproduktion dieser Art in Western Australia. Ebenso vergleiche ich die Anatomie und die Ökologie dieser Art mit der des sympatrisch vorkommenden kleineren Warans, *V. brevicauda.*

Schlüsselwörter: Squamata: Varanidae: *Varanus eremius, V. brevicauda*; Anatomie, Ökologie, Western Australia, Great Victoria Desert.

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