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On the Cover: *Varanus caerulivirens*

Varanus caerulivirens is a poorly-studied member of the *V. indicus* complex, indigenous to the northern Moluccas, Indonesia. To date, few observations of this species have been made by scientists in the field, and documentation of its ecology have been limited until now (Weijola, this issue).

The *V. caerulivirens* depicted on the cover and inset of this issue were photographed by **Valter Weijola**. The specimen to the left was photographed basking on a fallen tree trunk at Air Mangga, Obi Island, at ca. 600 m elev., on 2 January 2009 at ca. 1130 h. The specimen below was photographed around 1000 h on 8 December 2008 near Tetawang, Halmahera.



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Quarterly Journal of Varanid Biology and Husbandry

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The International Varanid Interest Group is a volunteer-based organization established to advance varanid research, conservation, and husbandry, and to promote scientific literacy among varanid enthusiasts. Membership to the IVIG is free, and open to anyone with an interest in monitor lizards and the advancement of varanid research. Membership includes subscription to *Biawak*, a quarterly journal of varanid biology and husbandry, and is available online through the IVIG website.

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Varanus albigularis. Hluhluwe Imfolozi Game Reserve, South Africa. Photograph by **Jo-anne Hounsom**.

ORGANIZATIONAL NEWS

New Web Editor

The International Varanid Interest Group welcomes Ryan Oberto to the editorial board as web editor. A new IVIG website, which will continue to host *Biawak* and an assortment of educational resources, is currently in development and should be online soon.

IVIG Logo Designs

Due to unforeseen complications, decision of the winning insignia design for the IVIG has been delayed, and will be decided shortly, with the winning design announced in the next issue of *Biawak*.

Call for Papers on the Herpetoculture of Varanids

Biawak is currently seeking papers describing the husbandry, breeding, and management of varanids in captivity. Submissions from private hobbyists and zoos are both welcomed. Assistance with manuscript preparation is available to those who inquire. For additional information, please contact submissions@varanidae.org



Varanus gouldii. Ewaninga Rock Carvings Conservation Reserve, Northern Territory, Australia. Photograph by **Ed Loveridge**



Varanus salvator tracks. Teluk Kampi, Penang National Park, Malaysia Photograph by **Chris Liberty** chris@chrisliberty.com

NEWS NOTES

Nile Monitor Hunt to Begin in Florida

A hunt scheduled in the state of Florida aimed at reducing the population of feral pythons will also include the alien Nile monitor (*Varanus niloticus*). The hunt, to take place March 8 through April 17, will occur in three areas: Everglades and Francis S. Taylor, Holey Land and Rotenberger Wildlife Management Areas. Anyone with a valid hunting license and who pays an additional \$26 fee will be able to hunt the reptiles. Unlike previous hunts, this one will be open to the public at large and not just individuals who possess reptile-of-concern permits. Hunters will be allowed to use all legal methods used in taking game animals (excluding centerfire rifles), as well as nets and snares. No live animals are allowed to be removed.

Source: Florida Fish and Wildlife Conservation Commission – 22 February 2010

Indonesian Ranger Attacked by Komodo Dragon

An Indonesian park ranger was attacked and severely wounded by a Komodo dragon on the island of Rinca. Marselinus Sabanhadir was heading for the toilet when a two-meter dragon which had been concealed behind a guard post rushed towards him, grabbing his right foot and causing deep lacerations before other rangers drove the animal away. Sabanhadir was taken to a hospital on Bali where he is recovering.

Source: Jakarta Globe - 23 February 2010; Mercury News - 23 February 2010

Man Arrested with 40 Endangered Monitor Lizards

A 48 year old man from West Delhi, India was arrested and detained for 14 days of judicial custody for the



Combatting *Varanus salvator macromaculatus*. Lumpini Park, Bangkok, Thailand. Photograph by **Tim Cox**.

illegal poaching of endangered monitor lizards (*Varanus bengalensis*). Police seized a total of 40 monitors which were bound within seven gunny bags when they apprehended the subject in a park in Raghur Nagar. The man was planning on selling the animals for their meat, at 2000 Rupees each (ca. \$44 USD). The monitors are planned to be released back into the wild.

Source: *Indian Express.com* - 13 Jan 2010

Cincinnati Zoo to Open New Monitor Lizard Exhibit

The Cincinnati Zoo, Ohio, US, will be opening a new Komodo dragon exhibit on 5 June 2010, after a four year period without a dragon on display at the zoo. The new exhibit will also feature several additional species of monitor lizard, highlighting the largest, longest, smallest, and some of the most colorful species in the genus.

Source: *zandavistor.com* - 29 January 2010



Varanus salvator salvator: Kandy, Sri Lanka.
Photograph by **Lynda Hanwella**.

Invitation to the Second Annual Meeting of the “AG Warane“ of the DGHT

We are pleased to invite all those interested in monitor lizards to the second annual meeting of the DGHT-AG Warane. The meeting will take place on 24 April 2010 in Hanau near Frankfurt. The participation fee for non-members is 10,- €, members are free of charge. The fee will be set against the membership fee for new members who attend the AG-Warane at the meeting. AG-members have to be members of the DGHT (www.dght.de).

Location: Cafe-Restaurant Sandelmühle
Philipp-August-Schleissner-Weg 2a
63452 Hanau

Schedule of talks and presentations:

- 10:30 Begin of the meeting
- 11:00 Welcome: Kay Dittmar and André Koch, leaders of the AG-Warane
- 11:15 Klaus Wesiak (Frankfurt) & André Koch (ZFMK, Bonn): “Successful husbandry and first breeding of *Varanus juxtindicus* Böhme et al., 2002, with remarks on the development of juveniles of this rarely-kept endemic Solomon monitor species” (in German).
See report in Biawak 3(4): 106-121.
- 12:00 Lunch break and group photo shoot
- 13:30 General meeting (inofficial)
- 14:00 Thomas Hörenberg (Stuttgart): “Keeping and breeding of Macrae’s tree monitor (*Varanus macraei*) and caesarean section in *V. (Odatria) tristis orientalis*” (in German).
- 14:45 Monika Labes (Germering): “Report on the Husbandry and Breeding of *Varanus exanthematicus*” (in German).
- 15:30 Coffee break
- 16:00 André Koch (ZFMK, Bonn): “News about Southeast Asian monitor lizards” (in German).
- 16:30 Jochen Meyer (Stuttgart): “Remarks about keeping and breeding of *Varanus rudicollis*” (in German).
- 17:00 Farewell and social gathering

Further information can be found on the AG Warane homepage at www.ag-warane.de, or contact Kay Uwe Dittmar (working group leader) at dittmar@ag-warane.de or André Koch (scientific leader) at a.koch.zfmk@uni-bonn.de.

ARTICLES

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Geographical Distribution and Habitat Use of Monitor Lizards of the North Moluccas

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Abstract: Observations on the ecology and distribution of monitor lizards were made on three different field visits to Halmahera, Morotai, Bacan, Gebe and Obi islands. Data was collected on four species: *Varanus caerulivirens*, *V. rainerguentheri*, *V. cf. salvator* and *V. yuwonoi*. No specimens of *V. zugorum* were observed during the course of the study, and this species also appears to be virtually unknown even among local hunters and animal collectors. *Varanus caerulivirens*, *V. rainerguentheri* and *V. cf. salvator* are reported from Obi for the first time. Additionally, *V. caerulivirens* and *V. rainerguentheri* were recorded from Morotai and Bacan. The different species appear to avoid competition by differences in habitat use, body size, and foraging mode. *Varanus rainerguentheri* is largely restricted to the coasts, while *V. caerulivirens* and *V. yuwonoi* primarily occur in inland forest habitats.

Introduction

Currently, the *V. indicus* species group is, despite the efforts of several workers, quite possibly the least resolved group of varanoid lizards in the world. They occupy a vast and difficult to access geographical region from the Solomon Islands in the east, across New Guinea with its shelf islands and parts of northern Australia, through the Moluccas as far as Talaud in the northwest, as well as some remote Pacific Island groups. This is a region of unparalleled complex geological history consisting of thousands of variously sized islands where isolation and other evolutionary forces have driven populations to diverge and differentiate, resulting in a phylogenetic and ecological diversity that is still poorly understood.

The Moluccan islands (Maluku) of east Indonesia forms part of the biogeographical region known as Wallacea. Traditionally considered a transition zone between the Australian and Asian faunas, many of the islands also hold a considerable number of endemic species and have at least for some animal groups played an important role in speciation processes (How and

Kitchener, 1997, Ziegler *et al.*, 2007b). The number of identified species in the *Varanus indicus* species group in the Moluccas has risen from one to eight during the last decade (of which seven are endemic to this region), and more will inevitably be described (e.g., Weijola and Sweet, in press). Sweet and Pianka (2007) review the reasons for the high diversity of small monitors (less than 130 cm total length) east of Wallace's Line, concluding that the historical absence of predatory placental mammals has played a fundamental role in the radiation of lineages such as *Euprepiosaurus*.

The numerous islands with their different communities provide the ideal natural experiment to study resource partitioning and ecological release in monitors. Since studies on varanid communities have historically been largely restricted to dry and seasonally wet Australian environments, it seemed relevant to compare these "dry communities" with ones in the wet tropics, such as in the Moluccas. It is particularly interesting since most of the species within Moluccan communities are very similar in size and more closely

related than within most Australian communities (where assemblies include species of several subgenera).

Despite the recent discovery boom of new species, there has been very little fieldwork involved, and all the descriptions, except for *V. lirungensis* Koch *et al.* (2009), have been based solely on museum or animal trade specimens. The first ecological observations of many of these species were made during this study on three separate field trips in 2008 and 2009. This paper concerns varanids of the larger islands of the biogeographical northern Moluccas: Halmahera, Morotai, Bacan, Kasiruta, Gebe and Obi. The Sula Islands are also included in the administrative unit, but group biogeographically with Sulawesi and are not considered further here.

Methods and Study Area

Field work was conducted during March 2008, December-February 2008-2009, mid April- mid June, and late October-mid November 2009. Investigations were made in coastal habitats (Fig.4), lowland forests

(Fig.3), swamps (Fig.5), and hill forests (Fig.2) on Halmahera, Bacan, Morotai, Gebe and Obi (Fig.1). These are all climatologically rather similar and are, or have historically been, covered primarily by tropical rain- and evergreen forest. At present, much of the lowland forests are degraded, converted to plantations or even mined for minerals. Annual rainfall varies according to land topography, but averages between 1500 and 2000 mm. (Monk *et al.*, 1997; Bacan Agricultural University, pers. comm. 2009), and lowland temperatures are 25-30 °C year-round. December through March tends to receive the heaviest rainfall, but most of the Moluccas rarely experience prolonged dry periods.

Many of the *V. indicus* group monitors can be observed by searching on foot in suitable habitats. Alternatively, some of the shyer species can be attracted to bait (fish/meat). *Varanus yuwonoi* is particularly difficult to observe, and the author was forced to follow a professional animal collector at work in order to see this species at all. Locating monitor lizards in tropical wet forests presents particular difficulties since it excludes the possibility of using tracks as aid and the

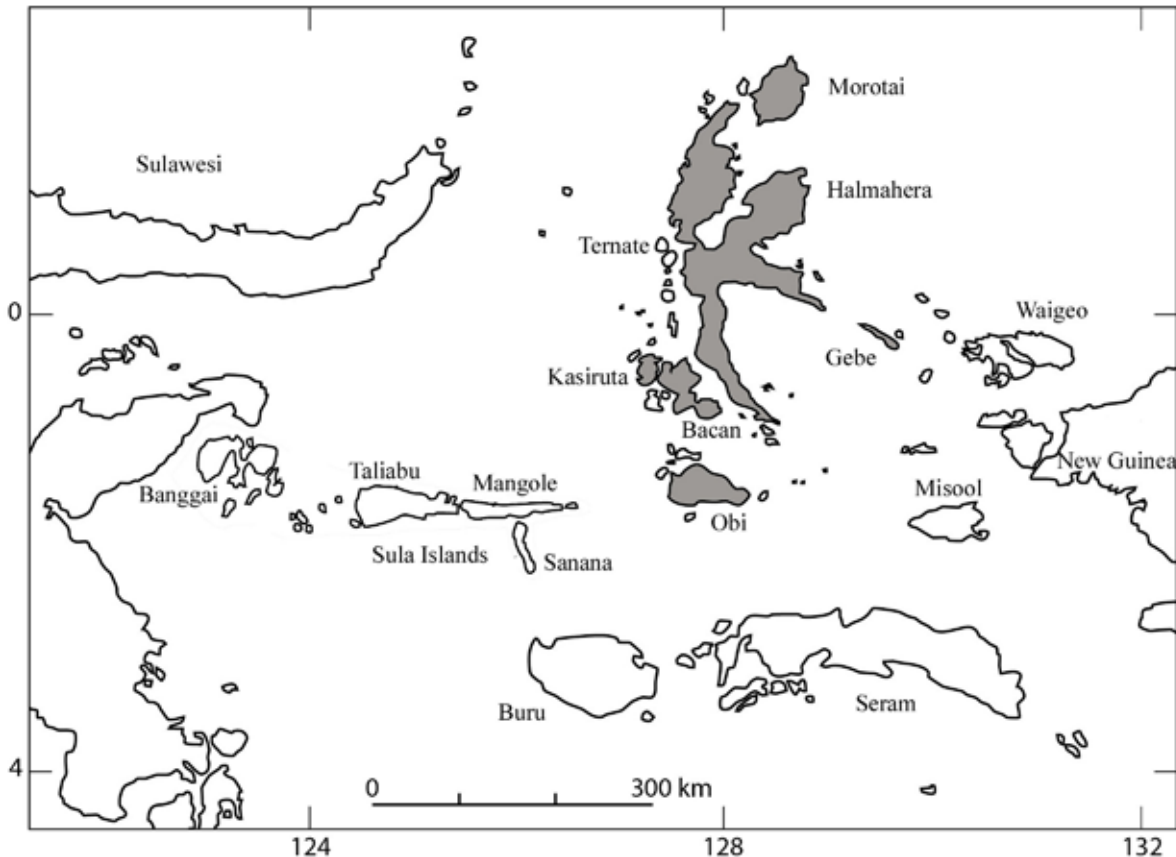


Fig. 1. Map of the Moluccas with the study area darkened.

dense vegetation provides ample cover and places to hide. Recurrent periods of rain and clouds often decrease activity levels of the animals, making observations difficult for days or weeks on end. For each observation, a set of data (most importantly: habitat use, location and activity etc.) were recorded. In a few cases, dead animals were encountered and stomach content and reproductive condition was analyzed.

Abbreviations for museum collections mentioned in this article are: BYU: Brigham Young University, Utah; RMNH: Naturalis, National Museum of Natural History, Leiden; MZB: Museum Zoologicum Bogoriense, Java

Halmahera

Halmahera is the largest and most geologically complex island in the Moluccas (Hall, 1998). It is of composite origin and consists of a younger, volcanic western part and an older eastern part. These collided somewhere between one and three million years ago (Hall, 1999), after having moved westwards for 15-20 million years. Their composite nature and historical proximity to New Guinea probably contributes to the high species diversity of this island. Four species have

been confirmed (*V. caerulivirens*, *V. rainerguentheri*, *V. yuwonoi* and *V. zugorum*), which is more than on any other Moluccan island.

Observations were made around a number of sites on the northwestern, northeastern and eastern peninsulas in a variety of habitats from coastal mangrove swamps, *Nypa* swamps, coastal forests, sago swamps, plantations, secondary forest, disturbed forest, and primary forest, at elevations from 0 to 700 m.

Morotai

Morotai is a part of the East Halmaheran Crustal Fragment (Hall, 1999) and is at present separated from Halmahera by about 10 km of open sea. According to Voris (2000), Morotai would have been connected to Halmahera by land bridges repeatedly during Pleistocene glacial periods. Only one field site was visited on Morotai: the surroundings of Pilowo village on the southern end of the island. There are vast mangrove forests in this area but unfortunately the lowland forests are disturbed or secondary. Most observations were made in the mangroves.



Fig.2. Mangrove forest, Tetewang, Halmahera



Fig. 3. *Nypa*-palm swamp, Kasiruta.



Fig. 4. Freshwater stream and lowland forest, Sumahode, Halmahera.

Bacan Islands

The Bacan islands are geologically a part of western Halmahera (Hall, 1999) and were also periodically connected with southern Halmahera during the Pleistocene (Voris, 2000). Two field sites were based on the island of Kasiruta, one at Dobo (north east coast) and the other at Kasiruta Dalam (southern interior). The site at Dobo was poor since most of the surroundings were heavily converted to nutmeg and clove plantations. Kasiruta Dalam was reached by ascending the Kasiruta River by a small motorized canoe. It is a small village surrounded by sago swamps and disturbed lowland forest.

On the main island of Bacan, observations were made outside of Labuha and Wayamiga. Wayamiga lies at the foothills of the mountain Gunung Sibela, from where a day long excursion into the virgin hill forests was made.



Fig. 5. Hill forest on Gunung Sibela, Bacan; habitat of *V. caerulivirens*.

Gebe

Gebe is situated ca. 40 km southeast of the easternmost tip of Halmahera and 70 km west of Waigeo. The geology is mostly Tertiary limestone (raised reef) and ophiolitic red soils. The western part has been heavily mined for nickel and large areas have been destroyed during the past decades. Thus observations were concentrated in the eastern part where pockets of primary lowland forest, drier limestone forests and mangroves remain.

Obi

Large portions of Obi are composed of raised reef limestone (Monk *et al.*, 1997). Field work was conducted at two sites in the northeastern part of the island. The coasts were heavily forested by mangroves, coconut groves and coastal swamps, with inland areas including cocoa plantations, disturbed hill forest, and limestone forests.



Fig. 6. Limestone forest, Air Mangga, Obi.

Results

Species accounts

Up to nine species have been reported to occur on these islands collectively; *V. caerulivirens*, *V. cerambonensis*, *V. doreanus*, *V. indicus*, *V. melinus*, *V. rainerguentheri*, *V. salvator*, *V. yuwonoi* and *V. zugorum*. Of these, *Varanus melinus* was erroneously reported from Obi (Böhme and Ziegler, 1997), but later omitted by Ziegler and Böhme (1999); the absence of *V. melinus* from Obi is supported by fieldwork (this study). Examination of photographs of voucher material (RMNH 3184) and fieldwork reveals that the record for *V. cerambonensis* from Obi in Philipp *et al.* (1999) is based on a misidentification of *V. rainerguentheri*, and thus Obi should be omitted from the range of this species. Based on four 19th century voucher specimens, Koch *et al.* (2007) included both Seram and Halmahera in the range for *V. salvator*; however, these records are not supported by fieldwork (this study; Edgar and Lilley, 1993; Setiadi and Hamidy, 2006) or interviews with locals and local dealers (T. Baadilla and B. Baadilla, pers. comm. 2009) and should be omitted until more substantial evidence is presented. *Varanus cf. salvator* is however here documented to be native to Obi. Yuwono (1998) mentioned a record of *V. doreanus* from Halmahera, and genetic studies by Ziegler *et al.* (2007b) include a specimen allegedly from that island, but fieldwork does not support such an occurrence. Thus five species are confirmed from within this region: *V. caerulivirens*, *V. rainerguentheri*, *V. cf. salvator*, *V. yuwonoi* and *V. zugorum*.

Varanus caerulivirens

Despite having been described so recently (Ziegler *et al.*, 1999), the turquoise monitor (Figs. 7 and 8) is widely distributed in the northern Moluccas and is actually often quite common in suitable habitats.

Distribution: The type locality for *V. caerulivirens* is the northern Moluccan island of Halmahera, and the only precise locality previously published is Patani at the far eastern tip of that island (Ziegler *et al.*, 2004). A specimen collected on Morotai in 1944 (BYU 7477) confirms its presence on that island. Investigations on Halmahera found the species to be widely distributed throughout the lowlands up to about 700 m elevation in all but the most disturbed forested habitats. Several sightings were also made in primary forests in Gunung Sibela on the island of Bacan, and this species is expected to be widespread

on that island. No observations were made on Kasiruta, a large island just west of Bacan, although considering the close proximity between these islands it is likely that they do occur there.

This species was also recorded in the field on Obi for the first time, an island separated from Halmahera by almost 60 km of open sea. On Obi, they are sympatric with *V. rainerguentheri* and *V. cf. salvator*. Investigations on Gebe strongly suggest that *V. caerulivirens* does not reach that island, most likely making east Halmahera and Morotai the eastern limit for its range.

Ecology: A total of 59 observations of *V. caerulivirens* were made during almost five months of work throughout



Fig. 7. *Varanus caerulivirens*. Tetewang, Halmahera.



Fig. 8. *Varanus caeurulivirens*. Air Mangga, Obi.

its range. This species is a forest generalist and occurs in most non-salt water influenced forest types: from coastal forest and beach vegetation, plantations, primary and secondary lowland forests, limestone-, alluvial-, hill- and mountain forests up to at least 600-650 m elevation. They are often found basking around small clearings. Occasionally, specimens are encountered while patrolling freshwater streams, and on one occasion, two specimens were observed near a lake at over 600 m elevation (Tables 1 and 2).

This species is most often encountered while actively foraging through the leaf litter layer of the forest floor, and stomach content analysis reveals that they consume burrowing animals such as earthworms, mole crickets, etc. They almost invariably seek refuge in trees when frightened by or pursued by humans and use tree cavities as night refuges, and probably for nesting as well. The claws and scales of the feet are well adapted for climbing and they make much use of tree trunks and canopies for basking, sometimes even jumping from one tree to the other.

No significant difference in habitat utilization could be observed between juveniles and adults - both were equally terrestrial and arboreal, though admittedly far fewer sightings were made of small vs. large individuals.

It is possible that younger individuals make more extensive use of tree hollows.

Dissection of sexually mature specimens revealed males to have enlarged testes throughout the year, suggesting that reproduction takes place year-round. The largest adult specimen measured 110 cm in total length, which is probably near maximum size.

Varanus rainerguentheri

Varanus rainerguentheri (Figs. 9-14) was described as a cryptic species within the *V. indicus* complex based on molecular and morphological evidence (Ziegler *et al.*, 2007a). Unfortunately, the genetic comparison of the new species with *V. indicus* in that paper was restricted to a single sequence of mtDNA from a *V. indicus* specimen without specific locality data. Additionally, the type locality of *V. rainerguentheri* (Jailolo, Halmahera) is disputed by the original collector (L. Wagner, pers. comm. November 2008), making the genetic and morphological argumentation a comparison between two unknown localities.

Two of the characteristic morphological features of the holotype were the blunt snout and occurrence of a light postocular stripe. The blunt snout was never



Fig. 9. *Varanus rainerguentheri*. Ibu, Halmahera.



Fig. 10. Head and tongue of *V. rainerguentheri*. Tetewang, Halmahera.



Fig. 11. *Varanus rainerguentheri*. Pilowo, Morotai.



Fig. 12. *Varanus rainerguentheri*. Air Mangga, Obi.



Fig. 13. Adult *V. rainerguentheri*. Gebe Island.



Fig. 14. Juvenile *V. rainerguentheri*. Gebe island.

observed in the field and appears to be unique to that particular specimen. Field investigations of larger sample sizes also show that the postocular stripe is variable among Halmaheran and north Moluccan populations of *V. rainerguentheri*, and usually fades with age. For example, the two specimens depicted in Setiadi and Hamidy (2006) as *V. indicus* and *V. rainerguentheri* appear to only show intraspecific variation, and cannot be allocated to different species based solely on the occurrence of a temporal stripe. The temporal stripe is usually less pronounced on specimens from Obi and Gebe compared to Halmahera and Morotai, though based on external features, the populations on these islands are very difficult to distinguish. Specimens from Obi do appear to have dark pigmentation further back on the tongue.

Despite the potential weaknesses in the original description, I have opted to use the name *V. rainerguentheri* for populations of the *V. indicus*-type monitors in the northern Moluccas included in this paper. A more detailed taxonomic investigation of animals from verifiable localities and with larger sample sizes is much needed to confirm the taxonomy and

specific characteristics of this species, particularly since the description of *V. rainerguentheri* failed to make a comparison with the very similar animals of nearby Waigeo, which were described as *V. chlorostigma* by Gray (1831). This name was synonymized with *V. indicus* by Böhme *et al.* (1994) and earlier authors, but the subsequent redefinition of *V. indicus* (Philipp *et al.* 1999) excludes animals from Waigeo on several characteristics (such as throat markings, tongue color and scalation). The redefinition of *V. indicus* invalidates this earlier synonymization, and makes *V. chlorostigma* a potentially available name for *V. rainerguentheri*.

Distribution: *Varanus rainerguentheri* is widely distributed, particularly around the coastlines, on Halmahera, Ternate (RMNH voucher), Tidore (MZB voucher), Morotai, Bacan, Kasiruta, Gebe and Obi (and probably on many of the smaller islands of this region).

Ecology: One hundred and twelve (112) observations were made during the course of fieldwork. On all islands except Gebe, they are mostly restricted to coastal areas and mangrove swamps (Tables 1 and 2).

Table 1. Habitat use of monitors on Halmahera, Morotai and Bacan.

Habitat	<i>V. caerulivirens</i>	<i>V. rainerguentheri</i>	<i>V. yuwonoi</i>
Mangrove	-	13 (38.2%)	-
Beach, littoral vegetation/swamp	1 (1.8%)	6 (17.7%)	-
<i>Nypa</i> swamp	-	3 (8.8%)	-
Sago swamp	-	-	-
Brackish water river delta	-	6 (17.7%)	-
Freshwater stream and river	5 (8.9%)	3 (8.8%)	-
Inland lake	2 (3.6%)	3 (8.8%)	-
Secondary lowland forest 2-50 m.a.s.	20 (35.7%)	-	2 (66.7%)
Primary lowland forest 2-50 m.a.s	-	-	1 (33.3%)
Hill forest 50-200 m.a.s	11 (19.6%)	-	-
Hill forest over 200 m.a.s	15 (26.8%)	-	-
Plantation	2 (3.6%)	-	-
Total # of observations	56	34	3

Table 2. Habitat use of monitors on Obi.

Habitat	<i>V. caerulivirens</i>	<i>V. rainerguentheri</i>	<i>V. cf. salvator</i>
Mangrove	-	17 (73.9%)	3 (60%)
Beach, littoral vegetation/swamp	-	3 (13.0%)	2 (40%)
<i>Nypa</i> swamp	-	1 (4.4%)	-
Sago swamp	-	-	-
Brackish water river delta	-	-	-
Freshwater stream and river	1 (33.3%)	1 (4.4%)	-
Inland lake	-	-	-
Secondary lowland forest 2-50 m.a.s.	-	-	-
Primary lowland forest 2-50 m.a.s	-	-	-
Hill forest 50-200 m.a.s	-	-	-
Hill forest over 200 m.a.s	1 (33.3%)	-	-
Plantation	1 (33.3%)	1 (4.4%)	-
Total # of observations	3	23	5

High densities are also reached in brackish water river deltas and *Nypa* swamps. Occasionally, individuals are found further inland along freshwater streams, lakes and smaller swamps where they occur syntopically with *V. caerulivirens*. One individual on Bacan was encountered at an elevation of more than 200 m in a small mountain swamp. This species was only once (on Gebe) encountered in sago swamps, despite several searches in that habitat. They heavily utilize trees for basking and nighttime refuges. Diet consists of crabs (Tanner, 1950) as well as other suitable aquatic and terrestrial prey and carrion. One individual was seen chasing aquatic prey in

a small stream, while another individual was observed digging for food in a steep riverbank. On Obi and Gebe, they were also frequently seen foraging around human waste heaps at the margins of villages. The ecology of *V. rainerguentheri* appears to be more generalized on Gebe, where it occurs alone, from that of Halmahera and Obi where they face competition from other monitor species, probably indicating niche release (Weijola, in prep.). The largest specimen measured was 133 cm in total length, however, animals estimated to be nearer to 150 cm were observed on Obi.

Varanus yuwonoi

Distribution: The black-backed mangrove monitor was only observed around the villages of Akesahu and Kao, both in the western part of Teluk Kao (Kao Bay) on Halmahera. The type series was collected near Jailolo (Harvey and Barker, 1998). Interviews with locals and animal dealers suggest that this species is widespread throughout the island. Eyewitness accounts of *V. yuwonoi*-like animals from Morotai, Bacan, and even Obi exist, but still need confirmation.

Ecology: *Varanus yuwonoi* (Figs. 15 and 16) is a difficult species to study. Despite frequent observations by local hunters, specimens are very rarely encountered out in the open. Considering the difference in size, which is presumably also reflected in trophic level, this species probably does not reach population densities as high as *V. caerulivirens*. A less active mode of hunting (sit and wait/ambush) may also result in the fewer encounters with *V. yuwonoi*.

Traps used by locals specifically for this species are always set up around megapode bird (scrubfowl) nests in

inland forests. The unusual pigmentation of the tail, body and neck breaks up the silhouette of the animal very well as they lie on the forest floor. Considering that the smaller and more predator-vulnerable species in the Moluccas have not evolved such an elaborate camouflage, it may have evolved rather as a means to escape detection from potential prey. The head is comparatively powerfully built and the teeth proportionately longer than any of its close relatives (Fig. 16), even in comparison to most other more distantly related varanids. Considering these facts, the author hypothesizes that *V. yuwonoi* is an ambush predator, favoring sites in the forest such as megapode nests, that are frequented by a variety of potential prey items. It is uncertain whether large individuals can kill adult scrubfowl, but the large nest mounds attract a number of smaller birds such as pigeons, and also lizards, snakes, and invertebrates, as well as the frequently hatching megapode chicks. According to local people, this species is also occasionally seen digging into these nests in search of eggs. Additionally, observations of intraspecific aggression within the *V. yuwonoi* and *V. doreanus* clade (Ast, 2001) in captivity would support a hypothesis that *V. yuwonoi* could be an



Fig. 15. Large *V. yuwonoi*. Akesahu, Halmahera.



Fig. 16. Head and teeth of *V. yuwonoi* at a trader in Dumdum, Halmahera.

ambush predator. With few exceptions (Sweet, 1999, 2007), widely foraging monitor (and other scleroglossan lizards) species are not territorial; however, the two species (*V. scalaris* and *V. glebopalma*) known to be territorial are both ambush hunters. For a sit and wait predator favoring prey “hotspots”, a certain degree of territoriality could be expected to evolve.

The largest individual measured 146 cm in total length; this specimen however did not appear to be fully grown, and according to locals they occasionally grow much larger.

Varanus cf. salvator

The distribution of *V. salvator* (Fig. 17) in the Moluccas has been uncertain for a long time, probably starting with what appears to be an erroneous record for Halmahera in de Rooij (1915), widely cited since (for example Bennett, 1995, Harvey and Barker, 1998). Obi, Seram and Bacan were mentioned by Mertens (1930, 1942, 1959), and Buru by Bleeker (1857). Since recent fieldwork, including this study, has not found support for many of these localities, it is suggested that all except Obi be omitted from the range of *V. salvator*.

Since the animals on Obi do not completely correspond with any of the described *V. salvator* group taxa, it is here employed with a cf. (meaning “compare with”).

Distribution (in the north Moluccas): Obi Island, probably also on nearby Bisa, but not confirmed.

Ecology: Five observations were made of this species during two weeks on Obi. The sympatry between members of *Soterosaurus* and *Euprepiosauris* is interesting, since some authors have presumed that they might be ecologically exclusive (Mertens, 1942, Sprackland, 2004, Ziegler *et al.*, 2007b). This proves to be incorrect since this study confirms sympatry of *V. cf. salvator* with *V. rainerguentheri* and *V. caerulivirens* on Obi, as well as two other species in the Sula islands (Weijola and Sweet, in press).

All observations of *V. cf. salvator* on Obi occurred in coastal mangrove forest and periodically flooded littoral vegetation (Table 2), where it is widely syntopic with *V. rainerguentheri*. They most likely also occur in inland forests and around freshwater streams side by side with *V. caerulivirens*. On Obi, they appear less numerous than



Fig. 17. *Varanus cf. salvator*. Air Mangga, Obi.

V. rainerguentheri (5 vs. 22 observations), and similarly on Sanana, many fewer *V. cf. salvator* were observed compared to a sympatric member of the *V. indicus* complex during the course of fieldwork.

Varanus zugorum

This is the only species which was not observed during fieldwork. It appears to be almost completely unknown by locals, and only two reasonably reliable local eyewitness accounts were collected, in Akesahu (lower western side of Kao Bay) and Labi Labi (northeast Halmahera). Searches and interviews around the type locality Pasir Putih were unproductive. The holotype was collected in December 1980 by a villager, so further details from the initial discovery remain unknown (Adam Messer, pers. comm. 2008).

Discussion

Monitor communities and niche segregation by sympatric species have been studied by several workers, including Pianka (1994), Shine (1986), Sweet (1999, 2007) and Philipp (1999). Communities range from simple one species systems up to as many as 11 species

in certain areas of northern Australia (Sweet, 2007). These studies have shown that interspecific competition is typically minimized by differing use of habitat, different body sizes, and foraging mode. Additionally, phylogenetic distance may aid in reducing niche overlap in the most diverse communities of Australia and New Guinea.

A community comparable to the one on Halmahera, though slightly less diverse, was studied by Philipp (1999) in West Papua. He investigated the habitat use of three closely related species of the *indicus*-group (*V. doreanus*, *V. indicus* and *V. jobiensis*), and concluded that competition and interaction is largely avoided by the use of different habitats and/or microhabitats.

This study found that on Halmahera and Obi, *V. rainerguentheri* is similar in habitat use to that of *V. indicus* on New Guinea (Philipp, 1999), while *V. caerulivirens* appears to fill a similar niche to that of *V. jobiensis*. *Varanus yuwonoi* overlaps widely in habitat use with *V. caerulivirens* but grows significantly larger, may use a different hunting strategy, and concentrate on larger prey items. Thus there seem to be clear niche separations in communities of *V. indicus* group animals in Moluccan multi-species communities as well. The ecological separation where members of *Euprepiosaurus*

and *V. salvator* overlap is not equally obvious.

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Varanus spenceri: A Last Supper of Grasshoppers (Acrididae)

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Abstract: The stomach of a road-killed *Varanus spenceri* contained many largely-intact grasshoppers, together with the well-digested remains of a lizard limb, and nematodes, *Abbreviata hastaspicula*.

Spencer's monitor, *Varanus spenceri*, is one of Australia's larger (ca. 1.2 m in total length), ground-dwelling varanid lizards that is found on the Mitchell grass plains of north-western Queensland and the Barkly Tableland in the Northern Territory (Wilson and Swan, 2008). The diets of Australian varanids are not well known, but they tend to swallow their prey whole or, in larger species, in pieces that can be readily identified, and they are capable of catching fast moving prey (Green and King, 1993). Based on an analysis of the stomach contents of preserved museum specimens of nine species (not including *V. spenceri*), James *et al.* (1992) found that most had generalized diets with lizards and orthopterans being the most common prey items, but a variety of other invertebrates were also taken.

Only three reports were found on prey taken by *V. spenceri* and it appears that this species feeds on a broad range of prey items including invertebrates, reptiles, and mammals. Pengilley (1981) found isopods, grasshoppers, reptiles (including single records of an unidentified agamid and an elapid snake, *Pseudonaja ingrami*) and unidentified mammals (probably *Rattus villosissimus*) in the stomachs of eight specimens collected on the Barkly Tableland from September to October, 1976. Valentic and Turner (1997) found three lizards (two *Ctenotus joanae* and one *Tympanocryptis tetraporophora*), and "a large roach (blattodea, approx. 30 mm long) too large

to have been secondarily ingested" in the stomach of a *V. spenceri* found injured on the Barkly Highway in the Northern Territory, 32 km west of the border with Queensland, in October 1996. Jackson and Lemm (2009) identified the tail of an agamid lizard, *Pogona henrylawsoni*, in the stomach of a road-killed *V. spenceri* found on the Landsborough Highway, 110 km south of Winton, Queensland in October 2008.

A fresh road-killed *V. spenceri* was collected near Waterloo Plains (20°57'S; 141°43'E), approximately 33 km south of the town of Julia Creek, Queensland on 22 April 1995. The stomach contained a large number of mostly intact, undigested grasshoppers (Acrididae) as well as the well-digested remains of part of a limb of a small lizard and numerous large nematodes. The appearance of the acridids suggested that they were the last food eaten before the death of the monitor. The acridids, 47 in all, comprised one male Spur-throated locust (*Austracris guttulosa* [Walker]), four male and 11 female Leaping Lagoonia (*Lagoonia* sp. 1) and 13 male and 18 female Speckled Yrrhapta (*Yrrhapta striata* Sjöstedt). *Austracris guttulosa* and *Y. striata* are fully-winged species whereas *Lagoonia* sp. 1 is brachypterous, but known to be a powerful jumper. Rentz *et al.* (2003) give details of size and seasonal occurrence for these grasshoppers.

About 106 nematodes, all *Abbreviata hastaspicula*,

were extracted from the stomach. This is the most common species of *Abbreviata* in the drier inland of Australia, principally in larger species of *Varanus* such as *V. gouldii*, *V. panoptes* and *V. spenceri* (H. Jones, pers. comm.).

These observations and those made by others on the stomach contents of *V. spenceri* indicate that this species, like the nine other varanids studied by James *et al.* (1992), has a generalized diet.

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Parthenogenesis in an Ornate Nile Monitor, *Varanus ornatus*

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Abstract: Parthenogenesis is documented in *Varanus ornatus* for the first time. A ten year old captive female *V. ornatus* laid a clutch of 21 eggs in July 2008 without ever coming into contact with a male. Two of the 21 eggs contained embryos. Information on the history and husbandry of the adult female is given as well as details of the reproductive event.

Introduction

Parthenogenesis was recently described in two varanid lizards, *Varanus panoptes horni* (Lenk *et al.*, 2005) and *V. komodoensis* (Watts *et al.*, 2006). Here, parthenogenesis is described for the first time in a *V. ornatus*, maintained in captivity at the Reptile Village Zoo in Kilkenny, Ireland.

Acquisition and Husbandry

A female *V. ornatus* (Figs. 1 & 2) was obtained from a dealer in 1998 as an unsexed, wild-caught juvenile (11 cm snout to vent length [SVL]). The exact country of origin is unknown.

Since January 2006, the female *V. ornatus* in question has been housed in a glass-fronted enclosure of timber construction measuring 150 x 120 x 140 cm (l x w x h). The female was housed alone her entire life except for three instances when attempts were made to house her with another adult female *V. ornatus* in the collection. All attempts at cohabitation were unsuccessful, with fighting occurring within seconds of introduction. The enclosure is furnished with an artificial rock background with several basking ledges and large climbing branches. A 5 cm deep layer of bark mulch of is used for substrate and a large water tub allows for bathing. A large cork bark tube is provided for refuge. A 300 watt UVB basking lamp



Fig. 1. Female *Varanus ornatus* which reproduced by parthenogenesis.



Fig. 2. Profile of female *V. ornatus*.

fixed to the ceiling of the enclosure provides basking temperatures of up to 45 °C. An ambient temperature of 25 °C (in winter) to 32 °C (in summer) is maintained by a panel heater controlled by a thermostat. As an adult, the female has been fed weekly on a diet of weaned rats, fish, chicks and eggs.

Both *V. ornatus* were proven to be females, evidenced by egg production. The female in question laid 15 eggs on 12 March 2007; the second female laid 12 eggs on 20 April 2007 and 15 eggs on 11 June 2008. Aside from the brief, unsuccessful introductions to each other, both females never came into contact with any other individual. As a result, when eggs were laid by either *V. ornatus*, they were assumed to be non-viable and were immediately discarded.

Oviposition

On 4 June 2008, the *V. ornatus* was given a routine general health assessment, was weighed, and measured. At this time, the female measured 52 cm SVL and 131 cm in total length (TL), and weighed 4.48 kg.

On 16 July 2008, the female deposited 21 eggs in the corner of the enclosure, with oviposition lasting ca. 30 minutes. Eggs were retrieved once the female had finished covering them with substrate. Defensive nest guarding behavior was observed, however the female appeared noticeably fatigued from oviposition.

Up until a few days prior to oviposition, the female's behavior did not change, exhibiting normal basking behavior and activity levels. Gravidity was not suspected

until test digging was first observed on 9 July, eight days prior to oviposition. Test digging occurred in the rear of the enclosure, away from the public-viewing side of the enclosure. During gravidity, the female's feeding patterns did not change, and she consumed two large fish three days prior to oviposition.

Incubation and Parthenogenetic Embryos

Previous *V. ornatus* clutches at the zoo were discarded once retrieved. However, due to the recent reports by Lenk *et al.* (2005) and Watts *et al.* (2006) documenting parthenogenesis in *Varanus*, and the on-site availability of a large incubator, it was decided to artificially incubate the eggs on this occasion. The clutch was split up and placed in three plastic containers each measuring 25 x 18 x 8 cm filled with dampened vermiculite at a water:vermiculite ratio of 1:2 by weight. The containers were then placed inside an incubator converted from a refrigerator, heated by infrared lamps on the bottom connected to a digital thermostat. A small fan circulated air inside the incubator. The eggs were incubated at 27 °C and were inspected every other day by opening each container and visually inspecting each egg. Within a week, some of the eggs had begun to deteriorate. Eggs which collapsed and had begun to grow mold were removed and discarded. On 6 November 2008, after 113 days of incubation, seven eggs remained, of which four appeared healthy. Assuming that all eggs were non-viable after losing the majority of the clutch, it was decided to discard all remaining eggs.

Beginning with the three deteriorating eggs, each was dissected to check its contents. The three deteriorating eggs contained solidified yellow material and showed no signs of vascularization. Upon dissection of the first healthy-looking egg, a partially-developed embryo was discovered (Fig. 3). Coloration and patterning had

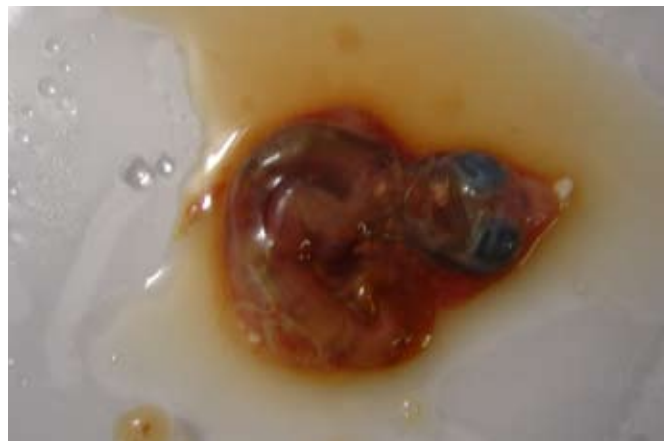


Fig. 3. Parthenogenetic embryo, removed from egg.



Fig. 4. Parthenogenetic embryo, dorsal view.



Fig. 5. Parthenogenetic embryo, ventral view.

begun to develop, and distinct banded markings on the tail were visible (Figs. 4 & 5). All limbs and digits, including the claws were formed. The embryo had a SVL of ca. 5.3 cm and a TL of ca. 13.0 cm. Given this discovery, the remaining three eggs were returned to the incubator, where they were checked on a daily basis for an additional 88 days. During this time another egg began to deteriorate and was removed. Dissection confirmed it was infertile.

On 2 February 2009, after 201 days of incubation, the remaining two eggs started to deteriorate. One of the eggs showed mold growth and was found to be infertile upon dissection. The remaining egg, while slightly

beginning to smell of decomposition, appeared full and turgid. Upon dissection, a dead, fully-developed embryo was discovered (Figs. 6, 7 & 8). It had noticeably been dead for some time and decomposition had begun to set in. The yolk sac was fully absorbed and the embryo appeared fully formed, apart from developing only three digits on the front left foot. The embryo measured 9.3 cm SVL and 22.7 cm TL.

The same female laid another clutch on 2 August 2009. Eleven eggs were retrieved for incubation, though at least three were eaten by the female before they could be collected. All eggs began to decompose within the first week of incubation.



Fig. 6. Full-term parthenogenetic *V. ornatus* embryo. Note the expended yolk sack.



Fig. 7. Parthenogenetic embryo, dorsal view



Fig. 7. Parthenogenetic embryo, ventral view

Outlook

Since *V. ornatissimus* is now the third documented species of *Varanus* to undergo parthenogenesis, with previous reports documenting surviving parthenogenetic offspring (Lenk *et al.*, 2005; Watts *et al.*, 2006), it seems as though this reproductive mode may be more common in captive varanids than realized. Further research is needed to determine how widespread parthenogenesis is in captive varanids, and whether or not it occurs in wild populations. The two parthenogen have been preserved and are currently held at the Reptile Village Zoo awaiting future DNA analysis.

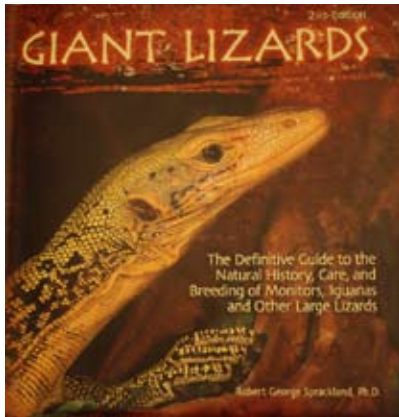
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BOOK REVIEWS

A 21st Century Book Written for 20th Century Herpetoculture



Giant Lizards: The Definitive Guide to the Natural History, Care, and Breeding of Monitors, Iguanas and Other Large Lizards

ROBERT G. SPRACKLAND

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One of my earliest introductions to herpetological literature as a teenage reptile enthusiast was Robert G. Sprackland's (1991a) book entitled *Giant Lizards*, which I came across one day in a local pet store. Back then, as a budding hobbyist who knew absolutely nothing about herpetological natural history, taxonomy, or husbandry, I considered the book to be an excellent resource for educating myself about lizards. But as time went on and my interest in reptiles and knowledge of their biology and husbandry grew, I began to notice a number of mistakes in the book, whether they were outdated and potentially hazardous husbandry advice, mislabeled photographs, or photographs of taxidermied museum displays being used to depict living specimens (see Fig. 1). Today, the book has lost its value, but serves as a slight reminder of my early years as a young reptile enthusiast.

Despite the poor composition of *Giant Lizards*, and my disappointment with the author's (2001) book entitled *Savannah and Grassland Monitors* (very critically reviewed by Bennett, 2002), I was excited to learn that TFH Publications would be publishing a new and completely revised edition of Sprackland's *Giant Lizards* in 2009, this time incorporating written contributions from several successful and esteemed lizard breeders. Would this second edition be as disappointing as the original, or would the author constructively learn from

and build upon its mistakes and errors, and criticisms from others? Would the new book benefit from the input of these invited authors? Subtitled as "*The Definitive Guide to the Natural History, Care, and Breeding of Monitors, Iguanas and Other Large Lizards*", the revised edition of *Giant Lizards* would surely have its work cut out for it just to afford such a designation.

Reading this book has left me with a dissatisfying sense of déjà vu. Despite seeking to present new material on the larger lizard species of the world, this revised edition suffers from many of the same types of mistakes seen in the original 1991 version, but also includes many new mistakes and questionable material; all of which I will discuss in detail below.

The Second Edition

Printed in a smaller size than the original version, the second edition of *Giant Lizards* resembles a coffee table book on account of its square-ish shape. Judging the book by its hard cover, which depicts a beautiful *Varanus melinus*, it would seem as though the publisher invested significant time and resources into producing this publication. Inside, the book's pages are glossy and of high quality, and printed in full color. The book features more than 260 color photographs and hand-



Fig. 1. A taxidermied display of *Varanus komodoensis* at the American Museum of Natural History, New York. A photograph of this display is used on p. 52 in the original 1991 edition of Sprackland's *Giant Lizards* to depict a live dragon eating a wild boar. The same photograph also appears on p. 26 in Coborn (1997).

drawn illustrations, and 13 tables.

The book begins with a brief preface and introduction which explain the motivation for the new edition, offer acknowledgements, and a brief overview of the history of herpetoculture. The book is then divided into two main sections before concluding with a glossary, references, resources section, and index. The first major section is comprised of individual chapters dealing with a number of topics relevant to the biology and husbandry of lizards including anatomy, physiology, taxonomy, acquisition and care, reproduction, veterinary care, laws, and herpetoculture. The following section is comprised of individual species accounts, divided into four chapters highlighting "giant" members (species reaching over .9 m in total length; although some species below the .9 m mark are also included [e.g., *V. prasinus*, *V. keithhornei*, *V. tristis*] and some over the mark aren't [e.g., *V. reisingeri*, *V. spinulosus*]) of the Gekkota (1 species), Iguania (33

species), Scincomorpha (9 species), and Anguimorpha (43 species). Each species account covers etymology, distribution, maximum size, captive suitability, natural history, captive care and breeding, and includes a list of relevant publications. Included within some sections are brief accounts on the captive husbandry and reproduction of certain species written by invited authors. Bert Langerwerf (*Physignathus lesueurii*; *Ophisaurus apodus*), Gunther Kohler, A.J. Gutman and John Binns (*Ctenosaura*), Robyn Markland and Chad Brown (*V. albigularis*), Paul Rodriguez (*V. salvator*), and Ben Aller and Michaela Manago (*V. dumerilii*) contribute information based on their personal experiences with certain species. The glossary defines a total of 90 terms which also appear bold-faced within the text, and the references section provides a bibliography of published works cited throughout the book as well as sources for further reading. The resources section lists a number of

herpetological societies and informational websites, and is followed by an index.

Comments

Knowing the Audience

Before I express my thoughts on this book, I feel it is necessary to point out that since TFH Publications, Inc. identifies itself as “the source for authoritative books on your companion animals” as per the company’s website (<http://tfhpublications.com>), the target audience of this book is most likely beginner and marginally-experienced pet reptile-keeping hobbyists, probably those belonging to younger age groups. These assumptions are further evidenced by the colorful and playful “tribal-like” borders, fonts, and artistic designs used throughout the book, which I feel would deter more serious enthusiasts and herpetological professionals from thumbing through its pages or purchasing.

What immediately stands out when reading the first chapter on lizard anatomy, physiology, and taxonomy, is the author’s “textbook-like” treatment of the material. While this information may be useful and relatable to a more informed audience, I feel that much of it is beyond the comprehension level of the book’s major audience despite the layman’s definitions accompanying technical terminology throughout the chapter. On page 29 the author provides a list of bones found in the lizard skull. While potentially useful to someone with an educational backing in anatomy, I am doubtful that the average pet lizard keeper will retain knowledge that the basioccipital, epipterygoid and septomaxilla bones are part of the upper skull, whereas the prearticular and surangular bones are part of the lower jaw. Another example can be found on the following page, where several bones of the skull are individually sketched. Without a diagram in the book referencing all of the bones found in an articulated lizard skull, an illustration of a lone premaxillary is of no use to an uninformed reader since it can be extremely difficult to visualize where the bone is actually located in the skull. Semi-technical discussions on circulatory physiology, lung function, taxonomy and the rules of zoological nomenclature, and chromosomal sex determination systems (as well as CITES, and other wildlife trade laws presented in a later chapter) are also likely to escape the majority of the book’s readership. Similar to my thoughts on certain sections of Bayless’ (2006) book on *V. exanthematicus* (Mendyk, 2008), I get the impression that the author attempted to create a semi-technical work for the wrong audience. The following

chapters read more in line with what would be expected for a beginning keeper audience; for instance, on page 245, *V. yuwonoi* is said to “resemble the Velociraptors of Jurassic Park in temperament and behavior”.

In addition to material that is likely beyond the comprehension level of most readers, the book also presents material which I find irrelevant to the subject matter. The most obvious example is a full-page table presenting the Greek alphabet system with a pronunciation key (p. 303). Greek terminology, using Greek letters, also appears in some species accounts when considered relevant to a particular taxon’s etymology. While the author states on pages 116-117 that he has received feedback from others interested in herpetological etymology, I wonder how useful could the Greek alphabet be to the average reptile keeping hobbyist, and what proportion of readers will actually take interest in such a resource?

Photographic Quality

One of the more upsetting yet perplexing aspects of this book is its shortage of crisp and brilliant photographs. I would estimate that more than 1/3 of the photos in the book appear to be at least 15 to 20 years old, evidenced by their dull, grainy and faded appearances, with many of them terribly out of focus (e.g., p. 62, 173, 184, 188). Additionally, I recognize several photos from previously published pet hobbyist books and popular pet magazine articles of the 1990s. The book does contain some nice photography (mostly appearing on the title pages of some chapters); however, the abundance of dreadful photos detracts from any real enjoyment or appreciation of the photography in this book.

I consider the overall photographic quality to be highly unacceptable for any contemporary book of this nature, and cannot believe that a publisher would print seemingly decades-old, recycled, faded, and out of focus material given the advent and widespread usage of digital photography. Quality photographs of most lizard species are no longer difficult to come by, thanks to online search engines and photo hosting websites. Today, anyone with a computer and working internet connection can easily access high-quality digital images of reptiles from around the world, and I am confident that most amateur photographers would be delighted to contribute their digital images to a book of this nature, gratis. While I doubt these issues are the fault of the author, since the publisher does have a well-known history of reusing photographs in many of its reptile and amphibian titles, I question whether those responsible for the photographic

content of this book have ever heard of the internet, or if they were just lazy?

Editing

Just like the original edition of *Giant Lizards*, this version has its share of poor editing. In one example in a sidebar discussion on page 25, “1980s Scotsman” should read “1780s Scotsman”, otherwise the entire section is historically incorrect and fails to make any sense. On the title page of chapter two and in all subsequent page headings in the chapter, “acquisition” is misspelled as “aquisition”. Similarly, in all page headings throughout chapter five, “herpetoculture” is misspelled as “heptoculture”. Redundancy is also an issue. For example, the change in coloration of *V. beccarii* from hatchling to adult is mentioned twice in the same species account (p. 231-232); similarly, the long-distance eyesight of *V. giganteus* is also discussed twice in the same account, in successive paragraphs (p. 271).

Editorial mistakes are not limited to proof reading and fact-checking errors; poor layout and design are also common throughout the book. The placement of sidebar discussions, tables, and photographs in a chapter often has nothing to do with their actual content. For example, a sidebar discussion on page 32 discussing a veterinary procedure for extracting blood appears within a section on teeth, limbs, and tails. An illustration depicting head pattern diversity in several varanid taxa appears in a section dedicated to parietal eye and behavioral control (p. 40). A sidebar discussion highlighting the homology of the human hand, bat wing, and whale fin mysteriously appears in a section on skin and scales (p. 45). While these are just a few examples, several additional instances of poorly-placed objects occur throughout the book which might confuse, or be missed by readers.

Taxonomy and Natural History

Natural History Information

There are a number of claims made throughout the book pertaining to varanid natural history which are dubious and lack literature citations to verify their validity. I will focus on just a few that I feel are likely to misinform or mislead readers.

On page 245, the author states that *V. yuwonoi* is “known to forage on the beach and swim in the ocean”. There are no published reports documenting a coastal occurrence or sea-going behavior in this species, and

according to its original description, which remains the only published account on its occurrence to date, *V. yuwonoi* is known only from inland forested areas of Halmahera (Harvey and Barker, 1998). The author also lists several preferred prey items for *V. yuwonoi*, yet no dietary studies of wild or museum specimens have been conducted on the species to date.

A statement which immediately caught my attention is a claim on page 295 that *V. salvadorii* is often referred to as “death from above” by local people because of “the lizards’ tendency to drop from a tree and kill hunting dogs and to sometimes attack people”. I am unaware of any authenticated reports documenting such a behavior, and while this claim is undoubtedly a case of folklore, the way in which it is presented and implied in the text will cause naïve readers to believe that this is indeed a natural habit of *V. salvadorii*.

In the natural history section of the *V. salvator* species account on page 254, the author states that a “well-fed” *V. salvator* may weigh 68 kg (150 lbs). This is almost three times the maximum weight reported for the species (25 kg/ 55 lbs) by Gaulke and Horn (2004). Although specimens of *V. salvator* in captivity frequently become obese, I am unaware of any authenticated report or record which documents a captive specimen weighing anywhere in the vicinity of 68 kg. A photograph in the first edition of *Giant Lizards* (Sprackland, 1991a; p 127; but also included again in the second [2009] edition, p. 104) purportedly depicts a 59 kg (130 lbs) *V. salvator*, however judging by the size of the animal, this is most likely a gross embellishment. Regarding size records, the author also states that *V. komodoensis* holds the maximum length record for any living lizard. While *V. komodoensis* certainly attains longer average lengths than any other species, the current authenticated record for the longest lizard is held by a Sri Lankan *V. salvator* which measured 3.21 m in total length (Randow, 1932).

Taxonomic Conventions

Although this book is intended for pet reptile hobbyists and is by no means a taxonomic treatise, there are a number of taxonomic conventions used by the author which are incorrect or invalid. I fear that these misnomers will cause readers to accept invalid taxa and confuse those who have read other accounts which use different, or conflicting taxonomic conventions.

On page 231, the author refers to the taxonomy of *V. caerulivirens*, *V. cerambonensis*, and *V. juxtindicus* as controversial and suggests that they may represent examples of normal variation within *V. indicus*; however,

no explanations or supportive evidence are given. Several additional statements about the taxonomy of the *V. indicus* complex are equally as dubious. *Varanus cerambonensis* is also incorrectly identified throughout the book as “ceramboensis”.

I am bothered by the author’s use of “Teri’s monitor” as one of the vernacular names of *V. keithhornei*. The name “Teri’s monitor” originates from Sprackland’s (1991b) description of *V. teriae* (named after his wife, Teri), a species which had already been described six years earlier as *V. keithhornei* by Wells and Wellington (1985). Since *V. keithhornei* had taxonomic priority over *V. teriae*, the latter was dropped and deemed invalid; thus, so should its associated vernacular name.

The author fails to acknowledge *V. kordensis* as a distinct taxon from *V. prasinus*, despite its elevation to species status in 2002 (Jacobs, 2002) and widespread recognition and usage of *V. kordensis* in current literature (Jacobs, 2004; Eidenmüller, 2007; Eidenmüller and Philippen, 2007; Böhme, 2003; Ziegler *et al.*, 2007). The author also rejects the validity of subspecies within *V. albigularis*, citing a taxonomic revision of his own published in a non-peer reviewed popular pet hobbyist magazine (Bayless and Sprackland, 2000a,b).

Varanus ocellatus is surprisingly treated as a valid taxon despite its long synonymization with *V. exanthematicus* (Mertens, 1942a,b,c), also citing the same hobbyist magazine revision as before (Bayless and Sprackland, 2000a,b). Modern authorities follow Mertens’ (1942a,b,c) treatment and fail to recognize *V. ocellatus* as a valid species (Böhme, 2003; Pianka and King, 2004).

The most problematic taxonomic treatment in the book is the recognition of *V. rubidus* as a valid species. Cited by the author in the ‘*rubidus*’ species account, Storr (1980) described *rubidus* as a subspecies of *V. panoptes*, not a distinct species. Unless a mistake, the author’s treatment of *rubidus* most likely follows Wells and Wellington’s (1985) controversial taxonomic revision of Australian reptiles which raised *rubidus* to specific rank without providing any supportive evidence or explanation why. Due to a number of problems associated with Wells and Wellington’s (1985) report, many of its proposed taxonomic changes were never adopted, including the elevation of *rubidus*. Interestingly, the author has heavily criticized the Wells and Wellington (1995) report in the past for its taxonomic questionability and lack of adequate research when arguing for the conservation of his *V. teriae* and the suppression of their earlier-described *V. keithhornei* (Sprackland *et al.*, 1997).

Photo Identifications

Much like the original version of *Giant Lizards*, there are several misidentified species in the book’s photographs. On page 14, a *V. salvator* is incorrectly identified as *V. niloticus*. On page 241, a photograph depicting a green and patternless specimen of a presently undescribed species belonging to the *V. indicus* complex (Bayless, unpub. ms.), is labeled as *V. juxtindicus*. On page 252, a “sulphur” water monitor (*Varanus salvator*) is identified as *V. cumingi*. On pages 254 and 255, three of the four photographs are mislabeled or incorrectly identified. Instead of reading *V. s. marmoratus*, *V. s. komaini*, *V. s. togianus*, and *V. s. salvator*, the photographic captions should read *V. cumingi*, *V. togianus*, *V. nuchalis*, and *V. s. salvator*.

Captive Husbandry

I am very disappointed with the captive husbandry and breeding information presented in this book. Although the written contributions from the invited authors are a welcoming addition since they present useful and progressive information based solely on first-hand knowledge and experience, they quickly become overshadowed by the author’s own recommendations. In addition to pushing many of the same outdated standards and practices from some of his earlier herpetocultural publications, there is also an abundance of contradictions, inconsistencies and questionable material presented throughout the text which will undoubtedly misinform, mislead, and confuse readers, and in turn adversely affect captive specimens.

Captive Suitability

For determining the captive suitability of a particular species, the author has devised a numerical rating system purportedly based on the disposition, hardiness, and breeding potential of a species. A suitability rating of 1 represents a species considered to be extremely difficult to keep, potentially aggressive, and unsuitable for captivity, whereas a rating of 5 represents a “beginner’s-level species easy to care for and not difficult to breed”. Suitability ratings for all varanid species presented in *Giant Lizards* are given in Table 1.

I find most of the suitability ratings assigned to varanids in this book to be preposterous, and question the author’s familiarity with the species in captivity. Many of the ratings appear to have been randomly

generated and are not at all representative of species' dispositions, hardiness, or ease of breeding in captivity. For example, *V. exanthematicus* is given the highest possible rating of 5, deeming it a worthy beginner-level species. Since few *V. exanthematicus* live long lives in captivity, with more specimens dying at the hands of inexperienced beginner keepers each year than any other varanid species, it cannot be considered a hardy captive. Captive reproduction of *V. exanthematicus* has also been extremely rare with respect to the sizeable numbers of specimens being kept in captivity. Only a few published reports on its successful breeding exist, most of which report on single hatching events rather than consistent and repeatable success; an indication that *V. exanthematicus* is indeed difficult for most people to breed in captivity. Given this overall lack of success with *V. exanthematicus*, I fail to see how anyone can consider it a species suitable for beginner keepers.

Despite clearly stating that *V. niloticus* is unsuitable for private collections on page 226, the author assigns it a suitability rating of 4 later on in the book. Of the dozens of varanid species currently available in the pet trade, I cannot think of many other species which are less suitable for captivity than *V. niloticus*. Having only been bred a few times in private collections, it is not an easy species to maintain or reproduce in captivity. Furthermore, *V. niloticus* attain very large adult sizes (up to ca. 2 m) and can be extremely defensive, posing serious safety risks to the keeper. Their inexpensiveness and diminutive size as juveniles have led to countless impulse purchases by inexperienced keepers over the past several decades. As a result, most captive *V. niloticus* do not survive to adulthood, and those that do are often dumped off on rescue groups or sometimes released into the wild when they become too large or unmanageable (*V. niloticus* is now established in parts of southern Florida, US [Enge, *et al.*, 2004]). Suggesting that *V. niloticus* is a semi-acceptable species for beginners by ranking it a 4 is ridiculous and also highly irresponsible.

Another rating which disagrees with the species' history in captivity is that given to *V. nebulosus* (*V. bengalensis nebulosus*). Despite the author claiming it to be a beginner-level species (5), captive breeding of *V. bengalensis nebulosus* has been extremely rare with few, if any records documenting successful reproduction or long-term keeping of this species in existence. Also attaining a large adult size (ca. 1.7 m), it is well-known for its defensive nature in captivity (M. Cota, pers. comm; M. Bayless, pers. comm.), and can pose serious safety risks to keepers.

Most shocking of the rankings is that assigned to

Table 1. Suitability ratings of varanid species from Sprackland's (2009) *Giant Lizards*. 1 = least suitable for captivity; 5 = most suitable for captivity

Taxon	Suitability Rating
<i>albigularis</i>	3
<i>exanthematicus</i>	5
<i>ocellatus</i>	4
<i>niloticus</i>	4
<i>ornatus</i>	3
<i>griseus</i>	4
<i>yemenensis</i>	3
<i>beccarii</i>	3
<i>boehmei</i>	3
<i>keithhornei</i>	3
<i>macraei</i>	2
<i>prasinus</i>	2
<i>doreanus</i>	2
<i>finnschi</i>	3, 2
<i>indicus</i>	3
<i>jobiensis</i>	4
<i>melinus</i>	4
<i>yuwonoii</i>	4
<i>caerulivirens</i>	3
<i>cerambonensis</i>	3
<i>bengalensis</i>	4
<i>nebulosus</i>	5
<i>flavescens</i>	3
<i>cumingi</i>	3
<i>salvator</i>	3
<i>dumerilii</i>	5
<i>rudicollis</i>	4,3
<i>mabitang</i>	1
<i>olivaceus</i>	4
<i>giganteus</i>	3
<i>gouldii</i>	4
<i>panoptes</i>	5
<i>rosenbergi</i>	4
<i>rubidus</i>	4
<i>spenceri</i>	4
<i>glebopalma</i>	4
<i>tristis</i>	4
<i>mertensi</i>	3
<i>varius</i>	4
<i>komodoensis</i>	2
<i>salvadorii</i>	1

V. olivaceus (4). As one of only two fruit-eating dietary specialists within the genus, it has proven to be very difficult to maintain and breed in captivity (Card, 1995a), with just two live offspring produced in captivity to date (Card, 1995b; M. Yuyek, pers. comm.). To assign *V. olivaceus*, a large (ca. 2 m) and highly endangered species notoriously difficult to keep and breed, the same suitability rating as *V. tristis*, a small (to 80 cm), easily-manageable species which has been successfully kept in captivity for decades and bred to multiple filial generations (Eidenmüller, 2007; Husband and Bonnett, 2009), is ridiculous.

Inconsistencies in suitability ratings occur between closely related taxa with identical or near-identical husbandry requirements. For example, despite being nearly identical in size, morphology, habit, diet, disposition, husbandry requirements, and breeding biology, members of the *V. prasinus* complex are given different suitability ratings; *V. macraei* and *V. prasinus* are given lower ratings than *V. boehmei*, *V. beccarii*, and *V. keithhornei*. For reasons unknown, *V. prasinus* is ranked as one of the lowest in the group in terms of captive suitability, yet has been kept longer and bred more frequently and consistently than any other member of the complex, to multiple captive generations. Within the *V. indicus* complex, *V. doreanus* is ranked two grades below *V. yuwonoi*, yet both species attain similar sizes, have similar morphologies and dispositions, require similar husbandry parameters, and all known captive specimens originate from the wild. Other members of the *V. indicus* group, whose size, husbandry, and disposition do not differ substantially from one another (e.g., *V. indicus*, *V. finschi*, *V. cerambonensis*, *V. caerulivirens*, *V. jobiensis*, *V. melinus*), are given a range of scores which are not at all representative of their hardiness, disposition, or history of reproduction in captivity.

While I do not think any large lizard species is suitable for beginner keepers, which certainly undermines the concept of this book, I do agree with the author in that *V. panoptes*, *V. gouldii*, and *V. tristis* make hardy captives. Since specimens of all three species maintained in captivity outside of Australia are captive bred, they tend to be hardier, have generally calmer dispositions, and are more likely to reproduce than wild-caught species. I also agree that *V. salvadorii* makes a terrible captive, but since the author's rating for this species is based on its potential dangerousness, why not extend the same rating to *V. komodoensis* and other truly giant species such as *V. salvator*, *V. niloticus*, or *V. giganteus* which are equally as formidable?

These rankings are also disappointing because they

promote and endorse the wild-caught reptile trade. Since successful captive breeding has been absent or extremely limited in *V. exanthematicus*, *V. niloticus*, *V. jobiensis*, *V. melinus*, *V. yuwonoi*, *V. bengalensis*, *V. dumerilii*, *V. rudicollis*, and *V. olivaceus* (level 4 and 5 species according to the author), specimens in the pet trade are almost entirely of wild-caught origin. Promoting these species as easy or relatively-easy to keep will encourage inexperienced, beginner hobbyists to purchase wild-caught specimens, further sustaining the wild-caught trade. I cannot see how anyone can look at the numbers of wild-caught (or "captive-hatched", which is even more ecologically-destructive) *V. exanthematicus* imported into the United States alone each year (ca. 25,000 in 2007, ca. 23,000 in 2008; CITES trade database) and fail to see a problem with recommending the species to inexperienced keepers.

If these wild-caught species were identified and promoted as poor, unsuitable captives, the demand for specimens would decrease, and fewer animals would have to be removed from the wild each year to supply the pet trade. Beginner keepers should be introduced to captive-bred species which are hardier, and where deaths caused by keeper inexperience will not affect wild populations. Wild-caught species should be left to experienced, dedicated keepers and breeders who are more likely to succeed in establishing captive-bred lineages.

Husbandry Recommendations

Prior to reading this book, I assumed that 21st century herpetoculture had advanced well beyond the primitiveness of feeding processed meats and dog food to captive reptiles, and that those days were now a thing of the past. I was wrong. On numerous occasions throughout the book, the author condones feeding beef (p. 54, 187, 241), cooked turkey sausage (p. 133, 139, 201, 211, 219, 234, 241, 246, 260, 270, 274), and dog food (p. 133, 187, 196, 201, 208, 238, 246) to lizards. Also advocated is the feeding of bananas to *V. prasinus*, *V. macraei*, and *V. boehmei*. Improper and lazy dietary items such as these can easily become adopted by beginner hobbyists who don't know any better, and can adversely affect the health of captives. I am not aware of a single report of long-term keeping or reproductive success which documents or advocates the feeding of beef or dog food to varanids. These are potentially hazardous, unnatural dietary items which mainstream herpetoculture has done away with many years ago, for good reasons.

The author's support for a number of unnatural substrates in this book is equally as appalling. Although he does recommend deep soils for *V. albigularis*, *V. exanthematicus* and *V. griseus*, which would seem to be a progressive departure from some of the advice given in his earlier works, these suggestions are negated by his endorsements of bare wood, glass and concrete floors, wood shavings, shredded newspaper, rabbit food pellets (alfalfa), paper towels, and brown butcher paper as acceptable substrates elsewhere in the book (p. 61). These suggestions conflict with advice given by highly successful long-term varanid keepers and breeders such as Vincent and Wilson (1999), Eidenmüller (2007), and Husband and Bonnett (2009), who understand that terrarium substrates serve more purposes than just collecting fecal material. Unnatural substrates serve absolutely no benefit to the physiological or behavioral requirements of lizards and should have no place in herpetoculture.

Another major problem with the book's captive husbandry information is its lack of consistency between species accounts. For some accounts, recommendations for enclosure sizes are outlined, but for others they aren't. Suggested dietary items are given for some taxa, but not for others. Incubation temperatures, humidity levels and durations are given for some, but not for others. What I especially find strange is why many closely related taxa, such as members of the *V. prasinus* complex, have different husbandry guidelines. Why is the recommended diet for *V. macraei* different than *V. prasinus*, considering their near-identical morphological and ecological similarities? Another example is the difference in feeding frequencies recommended for *V. cumingi* and *V. salvator*, two very similar species which were once considered the same species. Why is *V. cumingi* to be fed daily, but *V. salvator* just twice weekly? Inconsistencies and contradictions like these occur for many other species in the book (not just varanids) and give the impression that these sections were hastily assembled in a random, unorganized manner. It also begs the question of where is the information coming from?

Many of the species accounts fail to cite or incorporate important information from published husbandry and breeding reports, and instead present questionable material from outdated or unknown sources. For example, despite a number of detailed and informative publications existing (e.g., Biebl, 1993; Dedlmar, 1994; Bosch, 1999; Polleck, 2004; Baldwin, 2006), the species account for *V. prasinus* does not cite a single report of successful long-term keeping and

breeding of the species. Instead, the author refers readers to dated articles of his own on the keeping of *V. prasinus* in captivity (Sprackland, 1989, 1991c). Even when successful published accounts are cited for a species, the information is sometimes mixed together with and skewed by questionable material from other, unknown sources. An example of this can be found in the *V. boehmei* species account (p. 232), which cites the only published report on the successful husbandry and breeding of the species (Reisinger and Reisinger-Raweyi, 2007). Nowhere in Reisinger and Reisinger-Raweyi (2007) do the authors report or advocate the feeding of bananas, yet they are included by the author as a suggested dietary item in the book's species account. Another example demonstrating a poor grasp of herpetocultural literature can be seen in the *V. macraei* species account, which states that there are no published reports on captive bred offspring of *V. macraei*, yet two such reports (Jacobs, 2002b; Dedlmar, 2007) are cited in the account's references section.

Occasionally, the author compares the husbandry requirements of one species to a non-related species originating from an entirely different environment. For example, little information is given on the husbandry of *V. varius* (p. 287); instead, the author suggests that its husbandry should mimic that of *V. salvator*. *Varanus varius* and *V. salvator* inhabit vastly different environments, have different habits (e.g., *V. salvator* is semi-aquatic; *V. varius* is semi-arboreal), and differ in their reproductive biology (e.g., *V. salvator* often nests in the ground; *V. varius* in termite nests). In another example, the author recommends that the husbandry of *V. nebulosus* (*V. bengalensis nebulosus*), an inhabitant of open forests and disturbed environments of southeast Asia, should be the same as that for the African grassland-dwelling *V. albigularis*.

On more than one occasion, the author recommends dangerously high ambient temperatures which can be deadly to any reptile maintained under such conditions. For example, on page 271, he claims that captive *V. giganteus* "do best if kept at temperatures above 43.3 °C and given several options to escape the heat". In virtually every conceivable captive situation, particularly indoor enclosures, cool areas to escape extreme heat would be extremely difficult if not impossible to provide if the enclosure's ambient temperature was being maintained near or above 43.3 °C. Unless the author is wrongly referring to basking temperatures of 43.3 °C, extended exposure to these excessive ambient temperatures will quickly kill a reptile. Similarly, on page 249 the author recommends seasonal increases in "daytime temperature" to 39.7-45 °C for *V. bengalensis*. Like

the excessive ambient temperatures recommended for *V. gigatneus*, these markedly high temperatures will quickly kill captive reptiles when cool temperatures are unable to be provided. Beginner keepers can easily misunderstand the concept or importance of cool refuge sites when providing hot ambient temperatures, and will quickly overheat and kill their captives if they follow these suggestions.

Many of the book's photographs depict outdated husbandry practices and inadequate enclosure designs. To use the expression, "a picture is worth a thousand words", I fear that beginner hobbyists flipping through this book's pages will see some of the pictured lizard enclosures, substrates, hide spots, and furnishings, and adopt them for their own captives. There are several photos which depict lizards housed in screen cages or enclosures with large wire ventilation areas (p. 59, 62, 108, 239, 247). Since most keepers do not live in tropical regions with consistently high humidity levels, these types of enclosures promote low humidity levels and can cause chronic dehydration, related illnesses, and eventually death. Although the author briefly discusses the importance of proper humidity levels and hydration in the text, he does not address the humidity issues wire screening will cause. Moreover, the photos of inadequate enclosures are more likely to be noticed by readers, and can be devastating to the health of captives. On page 61, a young *V. komodoensis* is pictured in its enclosure. The image's caption discusses the importance of shelter in reducing stress levels in varanids; however, the half log-type hide depicted in the photo is too large and vacuous to provide any real sense of security for the animal. Inappropriately-sized hide areas occur in several photographs (p. 60, 65) and may give readers the wrong impression about what suitable refugia should look like and provide.

Non-Varanid Material

Though I have clearly focused my attention on the varanid-related content of the book since this review is appearing in a varanid-specific publication and because its varanid content makes up almost half of the book's species account section, I did find some errors in non-varanid related sections as well. One of the more noticeable mistakes occurs in the chapter on agamids where the author repeatedly refers to *Hydrosaurus pustulatus* incorrectly as "pustulosus" (p. 135-137). *Hydrosaurus "pustulosus"* is also claimed to be the most heavily-exported member of the genus based on United States CITES records (p. 136); however, no members of

Hydrosaurus are listed in any of the CITES appendices, therefore, the source for this statement is incorrect and the claim dubious. Many of my concerns regarding the husbandry advice given for varanids also apply to other taxonomic groups discussed in this book. Given the poor quality and accuracy of information in sections pertaining to *Varanus*, I have no reason to believe that other areas of the book do not suffer in similar ways.

Conclusions

To be blunt, I feel that *Giant Lizards* 2nd ed. is one of the worst books of the last two decades to cover the natural history and captive husbandry of varanid lizards. My criticisms outlined in this review, although numerous, do not represent frivolous or trivial mistakes, but serious flaws which affect the accuracy, credibility and educational value of the book, and are indicative of its overall quality. Its poor composition, careless mistakes, informational inconsistencies and contradictions, unsupported statements, questionable taxonomic conventions, dreadful photography, and appalling captive husbandry advice render this book the antithesis of anything worthy of being considered a "definitive guide".

Of my many criticisms, I consider the biggest disappointment to be the information and advice given on captive husbandry and breeding. From the information presented in this book, I am convinced that the author has very little, if any practical experience with varanids in captivity, much less the 41 species he has provided husbandry and breeding advice on. Admittedly having no experience or interest in breeding lizards (p. 7), the author clearly lacks the qualifications necessary to be offering recommendations on their long-term care and reproduction in captivity.

Although lacking the product placements which were rampant throughout the first edition that undoubtedly helped boost reptile product sales in pet shops worldwide, the second edition of *Giant Lizards* is destined to become a new personal favorite of pet shop owners if their customers can afford its \$79.95 USD suggested retail price (I have been told this price has recently been lowered to around \$50 USD). Not only does it encourage readers to purchase wild caught species, which have a much higher retail markup value than captive-bred species, but inexperienced keepers are also likely to return to the pet shop to purchase a replacement animal once his or her current specimen dies as a result of some of the poor husbandry advice outlined in this book. Lastly, one mustn't forget the

book's dietary recommendations of canned dog food for lizards, which will also require returning trips to the pet shop.

Sadly, instead of improving herpetoculture, as any new book on the subject should, *Giant Lizards* sets varanid keeping back more than a decade with its outdated and potentially harmful husbandry recommendations, some of which will kill captives if adopted. The author ignores many of the significant advancements and breakthroughs made in varanid herpetoculture over the past decade which have enabled specimens to live longer, healthier lives and possibly reproduce in captivity. This is now the author's third poorly-written book reporting on the captive husbandry of varanid lizards, which I consider to be a great disservice to the progression and advancement of herpetoculture.

Due to its poor educational value and overall quality, I cannot in good conscience recommend this book to anyone, not even for its photographs, as I have done for others in the past (Mendyk, 2008) since a sizeable percentage of them are poor in quality. For current and progressive information on the keeping and breeding of varanids in captivity, I recommend *Monitor Lizards: Natural History, Captive Care and Breeding* by Eidenmüller (2007), *The Savannah Monitor Lizard: The Truth About Varanus exanthematicus* by Bennett and Thakoordyal (2003), and *Keeping and Breeding Australian Lizards*, edited by Swan (2007). For detailed information on the biology and natural history of varanids, I recommend Pianka and King's (2004) *Varanoid Lizards of the World*.

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Varanus albigularis. Tarangire National Park, Tanzania. Photograph by **Daniel Virella**.