

New morphological and distributional data on *Varanus rainerguentheri* (Squamata: Varanidae), an endemic and little-known monitor lizard species of the Moluccas, Indonesia

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Abstract. The descriptions of several morphologically cryptic species of the growing *Varanus indicus* species complex in recent years have challenged the taxonomic identities of all previously collected voucher specimens of this wide-ranging group of Indo-Australian monitor lizards. Reexamination of numerous supposed *V. indicus* specimens in various natural history collections revealed that they actually belonged to phenotypically similar but taxonomically distinct species. Several specimens of *V. rainerguentheri* discovered in the collections of various international natural history museums provide further morphological and distribution data on this recently described and still little-known monitor lizard species of the northern Moluccas, Indonesia. Thus, we provide the first record for the island of Buru, where *V. rainerguentheri* co-exists with the closely-related *V. cerambonensis*. Due to the morphological similarity in lepidotic features between both species we encourage further investigations regarding the taxonomy and distribution of these CITES-listed Indonesian monitor lizards as a step towards determining if systematic conservation work is also required. In addition, our own observations from the USA, Thailand and Europe suggest that *V. rainerguentheri* is exploited for the international pet trade although no official exports of this monitor lizard species are documented by CITES. This circumstance highlights the importance of correctly identified voucher specimens in museum collections where they serve as taxonomic references for correct species identifications and sources for the taxonomic training of customs officers and other persons in charge of enforcing CITES regulations.

Key words. Squamata, Varanidae, *Varanus rainerguentheri*, Moluccas, taxonomic identity.

Introduction

The past decade and a half has seen a considerable number of new species descriptions within the mangrove monitor species complex around *Varanus indicus* (DAUDIN, 1802), with several of these being described based on the re-evaluation of museum specimens originally assigned to *V. indicus* (see e.g., PHILIPP et al. 1999, ZIEGLER et al. 1999, BÖHME & ZIEGLER 2005). One such recent discovery was *V. rainerguentheri* ZIEGLER, BÖHME & SCHMITZ, 2007 from Halmahera in the northern Moluccas, Central Indonesia, described in part based on a juvenile voucher specimen collected more than twenty years earlier (ZIEGLER et al. 2007a). Although recent field work shows this species to be ubiquitous on Halmahera and surrounding islands together with other endemic species of the *V. indicus* species complex (WEIJOLA 2010), *V. rainerguentheri* at present appears to be known with certainty in museum collections solely from the original type series that con-

sists of only two voucher specimens. However, reexamination of several mangrove monitor specimens in various natural history collections revealed that they actually represented the recently described and morphologically similar *V. rainerguentheri*, too. The extensive taxonomic restructuring of this species complex (consisting at present of thirteen recognized taxa, see ZIEGLER et al. 2007b and KOCH et al. 2010, in press) has made it likely that many specimens long held in various museum collections may not represent the species originally indicated after all. As many of the newly-described species of the *V. indicus* complex are known with certainty only from their types or the type series, respectively, re-identification of supposed “*Varanus indicus*” specimens held throughout various international natural history museums would be likely to yield additional morphological and distributional information on recently described and little-known monitor lizard species of the Moluccas, Indonesia.

Material and methods

Five supposed *V. indicus* specimens collected on Halmahera in the northern Moluccas, Indonesia, and preserved in the herpetology department of the National Museum of Natural History (USNM) in Washington D.C. were examined by M.S. Additional specimens were examined by A.K. in the collections of the Museum Zoologicum Bogoriense (MZB) in Bogor, Indonesia, Senckenberg Museum (SMF) in Frankfurt, Germany, National Museum of Natural History “Naturalis” (RMNH) in Leiden, The Netherlands, and in the Museum National d’Histoire Naturelle (MNHN) in Paris, France. Specimen details are listed in the appendices.

Comparisons of morphological character states were made with those given in the descriptions of the various *V. indicus* complex species known to inhabit the Moluccas. These are: *V. melinus* (BÖHME & ZIEGLER, 1997), *V. yuwonoi* (HARVEY & BARKER, 1998), *V. caerulivirens* (ZIEGLER et al., 1999), *V. indicus* (DAUDIN, 1802, re-defined by PHILIPP et al., 1999), *V. cerambonensis* (PHILIPP et al., 1999), *V. zugorum* (BÖHME & ZIEGLER, 2005), *V. rainerguentheri* (ZIEGLER et al., 2007a), and *V. obor* (WEIJOLA & SWEET, 2010). Definitions for the characters utilized follow the studies by MERTENS (1942a–c), BRANDENBURG (1983), and BÖHME et al. (1994): SVL – snout-to-vent length measured from snout tip to cloaca, TaL – tail length measured from cloaca to tail tip, Index 1 – relative tail length [SVL/TaL], ToL – total length measured from snout tip to tail tip, A – head length measured from snout tip to anterior margin of ear opening, B – head width measured across maximum width, Index 10 – relative head length [A/B], G – snout length measured from anterior rim of eye to centre of nostril, H – snout length measured from centre of nostril to snout tip, Index 2 – position of nostril on snout [G/H], S – number of midbody scale rows, T – transverse rows of ventral scales measured from gular fold to cloaca, U – enlarged supraocular scales (right/left). Measurements were taken to the nearest millimetre. For juveniles with a small body size, a microscope was utilized so that accu-

rate scale counts could be taken. For comparisons of colour patterns, information on the type specimens was taken from the summarized accounts provided by ZIEGLER et al. (2007a) and the photographs published in the respective species descriptions (see above).

Results and discussion

Identity of supposed *V. indicus* specimens

Our investigations showed that several supposed *V. indicus* specimens from Moluccan islands in various international museum collections were in fact misidentified. Two of the USNM specimens (adults) that had previously been identified as *V. indicus* were found to represent *V. caerulivirens* (M. SOMMA unpubl. data) while three juvenile specimens represented *V. rainerguentheri* (Figs. 1, 2). Taxon identification was based on the comparison of diagnostic characters given in the original descriptions of the various species. Colour and pattern factored principally in our identification, including the presence or absence of blue pigmentation on the tail, dorsum colour, and dorsum pattern (spots, ocelli, or banded). Lepidotic character states appear to widely overlap among species (see Tab. 2). Morphological data are given in Table 1. Tongue colour does not appear to be subjected to any ontogenetic changes in this taxon, a feature that has been observed in certain *V. indicus* complex species, though, i.e., in *V. cerambonensis* and *V. lurungensis* (PHILIPP et al. 1999, KOCH et al. 2009). Compared to photographs of the paratype published by ZIEGLER et al. (2007a), minor differences in colour pattern are also noted in the USNM specimens, such as smaller spots on the neck and dorsum. Whereas the ventral pattern of the paratype appears fairly thick, those of the USNM specimens are thinner and form more of a transverse banded appearance, and in at least one specimen (USNM 306185), does not always fully meet at the midline. This thinner ventral pattern is a feature also seen in imported *V. cf. rainerguentheri* specimens without locality data (Fig. 3; also see



Figure 1. Juvenile *V. rainerguentheri* (USNM 215908) from Halmahera Island, dorsal view. Photo by MATTHEW SOMMA.



Figure 2. Juvenile *V. rainerguentheri* (USNM 215908) from Halmahera Island, ventral view. Photo by MATTHEW SOMMA.

Morphology and distribution of *Varanus rainerguentheri*

Table 1. Morphological data of newly identified *V. rainerguentheri* specimens compared with data of the original type specimens (ZIEGLER et al. 2007). Morphological codes utilized follow MERTENS (1942a–c), BRANDENBURG (1983), and BÖHME et al. (1994). For details see Material and methods section. n.a. – data not available † – Right supraocular region damaged, †† – Tongue damaged anteriorly, * data from BRANDENBURG (1983).

(Paratype)	ZFMK 85404 (Holotype)	USNM 237438	USNM 215907	USNM 215908	USNM 306185	MZB 6145	RMNH 3188*	RMNH 3190a*	RMNH 3190b*	MNHN 5157	SMF 11581	SMF 56469
Locality	Halmahera	Halmahera	Halmahera	Halmahera	Halmahera	Halmahera	Morotai	Ternate	Ternate	Ternate	Ternate	Buru
Measurements												
SVL	291 mm	162 mm	125 mm	130 mm	130 mm	242 mm	n.a.	n.a.	n.a.	121 mm	301 mm	277 mm
TaL	425 mm	224 mm	170 mm	184 mm	192 mm	376 mm	n.a.	n.a.	n.a.	174 mm	436 mm	456 mm
ToL	716 mm	386 mm	295 mm	314 mm	322 mm	618 mm	n.a.	n.a.	n.a.	295 mm	737 mm	733 mm
A	49.9 mm	31.4 mm	25 mm	27 mm	29 mm	44.5 mm	n.a.	n.a.	n.a.	25.8 mm	50.6 mm	49.9 mm
B	29.2 mm	17.9 mm	11 mm	11 mm	10 mm	24.3 mm	n.a.	n.a.	n.a.	13.7 mm	27.5 mm	25.7 mm
G	13.6 mm	9.3 mm	7 mm	7 mm	7 mm	12.2 mm	n.a.	n.a.	n.a.	6.8 mm	13.9 mm	14.3 mm
H	11.7 mm	7.7 mm	5 mm	5 mm	5 mm	10.1 mm	n.a.	n.a.	n.a.	5.8 mm	11.8 mm	10.7 mm
Proportional indices												
Index 1 (= TaL/SVL)	1.46	1.38	1.36	1.42	1.48	1.55	1.50	1.40	1.47	1.43	1.45	1.65
Index 2 (= G/H)	1.16	1.21	1.40	1.40	1.40	1.21	1.32	1.17	1.24	1.17	1.18	1.34
Index 10 (= A/B)	1.71	1.75	2.27	2.46	2.90	1.83	1.81	1.86	1.88	1.88	1.84	1.94
S	139	138	126	122	131	141	151	120	128	131	131	139
T	95	94	88	86	90	97	101	93	90	95	96	101
U	6/5	–	†/5	5/5	5/4	5/5	3/3	5/5	4/5	4/4	5/4	4/4
Colour and Pattern												
Tongue colour	Pink, dark tines and longitudinal medial stripe on anterior half	base pink, with dark longitudinal pigmentation, tines dark	dark dorsally, pink ventrally	dark dorsally, pink ventrally and on tines	pink††	Base pink, remaining parts bluish-grey	Pink	Base light blue-grey, tines pink	Light blue-grey	Pink, with dark longitudinal pigmentation	Dark blue-grey	Base pink, tines dark
Postocular stripe	present	present	present	present	present	absent	present	present	present	present	absent	present
Dorsal pattern	~10 transverse rows of light ocelli	~12 transverse rows of light ocelli	10 transverse rows of light spots (~5–6 scales each)	12 transverse rows of light spots (~4–6 scales each)	12 transverse rows of light spots (~4–6 scales each)							
Neck pattern	Large (~8–10 scales each) light ocelli; faintly visible	Large (~10–12 scales each) light ocelli; distinctly visible	Medium (~6–8 scales each) light spots; distinctly visible	Medium (~6–8 scales each) light spots; distinctly visible	Small (~2–3 scales each) light spots; faintly visible							
Ventral pattern	~18 greyish transverse bands; faintly visible	~20 thick, dark transverse bands	~20 thin, dark transverse bands	~21 thin, dark transverse bands	~17 thin, dark transverse bands							

below). As the paratype and our set of specimens originate from different parts of Halmahera (Tab. 1), some amount of geographic variation is not surprising, as this has likewise been demonstrated for other features in this monitor species, such as the presence of a postocular stripe (WEIJOLA 2010). Some notable differences in the proportion indices were also recorded. Relative length of the tail (= Index 1) for most specimens examined by us was within the range observed in the type series (ZIEGLER et al. 2007a). However, one specimen (SMF 56469, Fig. 4) exhibits a somewhat longer tail (1.65 times the body length vs. 1.46 on average

in all other *V. rainerguentheri* specimens investigated). It should be noted that this specimen from Buru Island, which was identified as *V. rainerguentheri* based on its dorsal colour pattern consisting of ocelli, represents a new geographic locality record for this monitor species well outside of its previously known range (see below). Varying (and in the USNM specimens, higher) values were recorded in proportion indices 2 and 10 (see Tab. 1). A comparison of the original descriptive characters of this taxon was made with our new data (Tab. 2). Colour and dorsal pattern were found to still be the best pointers for quickly identifying

Table 2. Summary of morphological data of *V. rainerguentheri* compared to original diagnostic characters and the taxa it most closely resembles, viz. *V. cerambonensis* and *V. indicus*. Updated diagnostic characters are indicated in bold. † – Descriptive characters from ZIEGLER et al. (2007a), †† – Extended diagnostic characters.

	<i>Varanus rainerguentheri</i> †	<i>Varanus rainerguentheri</i> ††	<i>Varanus cerambonensis</i>	<i>Varanus indicus</i>
Dorsum colour	Greyish	Greyish	Dark (brownish to black)	Dark (brownish to black)
Dorsum pattern (adults)	Ocelli	Ocelli	Banded	Spotted
Dorsum pattern (juveniles)	Not specifically described	Spots (formed of 4–6 scales)	Spots (formed of 5–12 scales)	Spots (formed of 1–3 scales)
Temporal stripe	Present	Variable	Present	Absent
Throat colour/pattern	Light/unpatterned	Light/unpatterned	Light/unpatterned	Light/unpatterned
Blue pigmentation on tail	Absent	Absent	Absent	Absent
Tongue colour (adults)	Pink/dark tips	Pink/dark tips	Pink/dark tips	Dark
Tongue colour (juveniles)	Pink/dark tips	Pink/dark tips	Pink	Dark
Midbody scale rows	138–139	120–151	129–150	106–137
Ventral scale rows	94–95	86–101	90–102	74–107
Hemibaccula tips	> 10	Information not available	> 20	Information not available

this species (i.e., in the field), although for work requiring a higher degree of taxonomic certainty, differences in genital morphology need to be analysed. Unfortunately, time constraints did not allow us to expand our research to genetic differences, even though this would be worth the attention of future researchers.

Distribution in the Moluccas

Varanus rainerguentheri was originally described from Jailolo District, Halmahera, in the northern Moluccas.



Figure 3. A pet-trade juvenile of *V. cf. rainerguentheri* lacking locality data. Photo by FIRDAUS KARIM.

Subsequent research (WEIJOLA 2010), utilizing both field observations and museum voucher specimens, considerably expanded the species' range throughout the northern Moluccas (North Maluku Province) to include the following islands: Halmahera, Morotai, Ternate, Tidore, Gebe, Kasiruta, Bacan, and Obi. Our review of museum specimens previously assigned to *V. indicus* indicates that *V. rainerguentheri* is also present on Buru. SMF 56469 (Fig. 4) represents the first record of this species from the southern Moluccas (Maluku Province) and brings to nine the total number of islands that this species has thus far been recorded from (Fig. 5). The new island record of this historical voucher specimen of *V. rainerguentheri* is confirmed by a recent expedition to Buru, during which one subadult specimen could be collected (Fig. 6). Given that *V. rainerguentheri* represents a relatively newly described species and that there is still some uncertainty surround-



Figure 4. A voucher specimen of *V. rainerguentheri* (SMF 56469) from Buru that confirms the new island record. Photo by ANDRÉ KOCH.

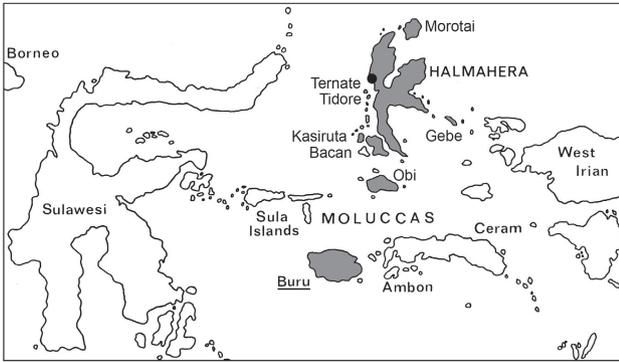


Figure 5. Range of *V. rainerguentheri* in the Moluccas. Shaded areas indicate islands of currently known occurrence; the underlined island name represents new locality data and the black dot points out the type locality on Halmahera.

ing its specific identity due to its partly considerable variation in colour pattern, it is not surprising that new locality data for this monitor species continues to be uncovered. This is particularly important in respect to the overlapping scale counts of *V. rainerguentheri* and *V. cerambonensis* (see PHILIPP et al. 1999 and data presented in this study). Thus, our results suggest, that Buru is inhabited by both monitor species sympatrically. The occurrence of a third species on Buru, viz. the widespread *V. indicus*, could not be confirmed by our investigations. Among eleven voucher specimens examined from that island, none showed the characteristic colour and pattern of that species (A. KOCH, unpubl. data).

Due to the geographic proximity to the new locality record from Buru, it is very likely that *V. rainerguentheri* also inhabits the neighbouring Moluccan islands of Seram



Figure 6. *V. rainerguentheri* from Buru, a new island record for this monitor species. Photo by IQBAL SETIADI.

and Ambon. Future fieldwork or investigations of further museum collection specimens will surely answer this open question.

International pet trade?

The additional descriptive data gathered help to establish that photographs of a number of *Varanus* sp. specimens (in spite of their being without exact locality data) that have been imported for the pet trade to Europe, Thailand, and the U.S. actually might represent *V. rainerguentheri* (Fig. 3) while this monitor species is not (yet) listed in the CITES trade database (CITES 2011). Probably, *V. rainerguentheri* is traded under the established name of *V. indicus*, which is a species that has regularly been exported from Indonesia in recent years and served in the past as a collective name for various other and partly undescribed members of the *V. indicus* species group (e.g., BÖHME & ZIEGLER 1997, ZIEGLER et al. 1999). While photos of these import specimens largely correspond with the examined specimens of *V. rainerguentheri*, certain discrepancies in colour pattern are also noted, including a conspicuously barred throat, which is a feature lacking in both *V. rainerguentheri* and *V. indicus*. Therefore, given this uncertainty, we feel it is necessary to regard these animals as *V. cf. rainerguentheri*. While the exact origins of these monitors are not known, the presence of *V. rainerguentheri* in the pet trade is not surprising given the activity of collectors of wildlife in the northern Moluccas and beyond. It has previously been established that many “*Varanus indicus*” specimens in the international pet trade since the 1990s in fact represented other cryptic members of this varied species complex, such as *V. juxtindicus* from the Solomon Islands (see WESIACK & KOCH 2009).

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Appendix 1

Specimens of *V. rainierguentheri* examined

MZB 6145, an adult from Desa Sofifi, Oba Utara, Halmahera Island, collected by IQBAL SETIADI & AMIR HAMIDY, 3.viii.2006; RMNH 3188, a juvenile from Morotai Island, collected by H. A. BERNSTEIN, 1862; RMNH 3190a–b, two juveniles from Ternate Island, collected by H. A. BERNSTEIN, 1862; RMNH 3184, a subadult from Obi Island, collected by BERNSTEIN, 1863, identified as *V. cerambonensis* by PHILIPP et al. (1999), re-identified by WEIJOLA (2010); MNHN 5157, a juvenile from Ternate Island, collected by A. RAFFRAY, ca. 1876; SMF 11581, a subadult from Ternate Island, collected by W. KÜKENTHAL, 1895; SMF 56469, a subadult from Buru Island, collector unknown, 24.vii.1913, donated by the Museum in Bogor in vii.1957; USNM 215907 (field number HS-A-175), a juvenile from Kampung Loleba, Wasile District, Halmahera Island, collected 25.xi.1978; USNM 215908 (field number HS-A-371), a juvenile from Kampung Loleba, Wasile District, Halmahera Island, collected by P. M. TAYLOR, 14.iii.1978; USNM 306185 (field number 85 B 28), a juvenile from Wasile, Wasile District, Halmahera Island, probably collected by P. M. TAYLOR, 1982.

Appendix 2

Specimens of *V. rainierguentheri* not examined in detail

SMF 11580, a juvenile from Halmahera, collected by W. KÜKENTHAL, 1895; SMF 34437–38, two juveniles from Halmahera, collected by W. KÜKENTHAL, 1895; SMF 56470 (formerly MZB 666), a juvenile from Ternate Island, collector unknown, donated by the Museum in Bogor in vii.1957.