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Genital Morphology and Systematics of *Varanus mabitang* Gaulke & Curio, 2001 (Squamata: Varanidae)

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Abstract: Genital morphology of *Varanus mabitang* is described for the first time, based on the hemiclitoris of the holotype. The formerly invertedly fixed outer genital organs could be brought to subsequent eversion through a slight maceration and a partial reversion of the original fixation effects by storing the dissected and removed organs in 2% potassium hydroxide solution (KOH). Morphological features of the organs, especially the derived structures of the hemibaubella, corroborate the view that *V. mabitang* is presumably sister to another Philippine species, *V. olivaceus*, and this renders the subgenus *Philippinosaurus* polytypic.

Key words: Squamata; Varanidae; *Varanus mabitang*; Hemiclitoris morphology; Systematics

INTRODUCTION

Gaulke and Curio (2001) described a new arboreal varanid species, *Varanus mabitang*, from Panay Island, the Philippines. They assumed that the new species, with its highly secretive habits and fragmented habitats that are confined to some of the remaining rainforest patches on Panay, would be most closely related to *V. olivaceus*. The latter species was formerly known as *Varanus grayi*, for which Mertens (1959) erected the monotypic subgenus *Philippinosaurus*, mainly based on character states presumably adaptive to the

arboreal habitat and the unique frugivorous trophic niche (Auffenberg, 1988; Böhme, 1991). It was Auffenberg (1988), who pointed out that the name *grayi* Boulenger, 1885 is antedated by *olivaceus* Hallowell, 1856. *Varanus olivaceus* is known only from Luzon, Catanduanes and Polillo Islands, all belonging to the same faunal region within the Philippines (Luzon region), whereas Panay Island, where *V. mabitang* occurs, belongs to a different faunal region (West Visayan region: see Gaulke and Curio, 2001).

With *V. olivaceus*, *V. mabitang* shares a number of morphological and ecological characteristics, such as the slit-like nostrils, enlarged head scales, blunt teeth, very large feet, large caecum, and several aspects of the highly specialized feeding habits. However,

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the almost uniform black coloration, the characteristic head shape, the higher midbody scale count, the strongly keeled ventrals, the triangular tail with double keels on its crest, as well as characteristics in trophic ecology (Struck et al., 2002; Gaulke et al., in press) clearly differentiate *V. mabitang* from *V. olivaceus* (Gaulke and Curio, 2001).

To gather more information regarding the systematic relationships of *V. mabitang*, we recently received permission to dissect and evert the invertedly fixed outer genital organs of the holotype (PNM 7272), which was deposited in the Philippine National Museum, Manila. Due to the scarcity of *V. mabitang*, the female holotype was the only collected and preserved specimen of that species at the time, and Gaulke and Curio (2001) correctly advised to refrain from collecting further specimens because the population status must be considered as critically endangered (Gaulke et al., 2002, in press). Based on the preparation of the hemiclitoris of the alcohol-preserved holotype, we are able to describe here for the first time the genital morphology of *V. mabitang*, which in addition enables further statements about its systematic position.

MATERIALS AND METHODS

The invertedly fixed hemiclitoris of the adult female holotype of *Varanus mabitang* (527 mm in snout-vent length, 741 mm in tail length) were removed from the tail base and then were carefully everted based on the method described by Pesantes (1994) for snakes and first successfully applied to male and female varanids by Ziegler and Böhme (1997) as follows:

The inverted female organs have been removed by opening the ventral side of the tail base with a longitudinal incision and by subsequent displacement of the adjoining tail musculature. The inverted outer genital organs including their cloacal base-point were removed with the initial part of the retractor muscle (musculus retractor clitoridis magnus) and then

were stored for about half a day in 2% potassium hydroxide solution (KOH) at 25°C. This storage caused a slight maceration of the tissue and a partial reversion of the original fixation effects. Subsequently, the organs that had been made pliant again could be everted mechanically, using forceps applied to the inverted organ or to the retractor muscle. After almost completing eversion 70% ethanol was injected in order to get maximum turgor. The injected organs were stored in 70% ethanol, because thus they will retain their pliance and flexibility, which facilitates later studies of small or hidden structural details. For more methodological details and terminology, see the materials and methods section of Ziegler and Böhme (1997).

RESULTS

Everted hemiclitoris of the female holotype of *Varanus mabitang* measured 14.1 mm (right outer genital organ) and 18.5 mm (left organ) in length (Figs. 1–3). They were elongated, relatively slender and apically broadened. The sulcus and parts of the bordering truncus area were pigmented. Sulcus spermaticus was oblique at base, but was then more or less straight to the apex where it ended medially on the apical platform between the two hemibaubella and surrounding tissues. The outer sulcal lip was somewhat more developed, and the sulcus remained largely open. The well defined apical platform was asulcally distinctly notched. In both hemiclitoris the larger hemibaubellum was terminally protruded far beyond the apical platform. The smaller hemibaubellum protruded only in the larger, left outer genital organ. As a result of the high pressure used to evert not only the large but also the smaller hemibaubellum, the apex region of this outer genital organ was somewhat distorted and distended. The other hemiclitoris was not inflated to such an extent, so that the smaller hemibaubellum could not be brought to eversion. The larger hemibaubella were shovel-shaped and broadened apically; the single discernible smaller hemibaub-

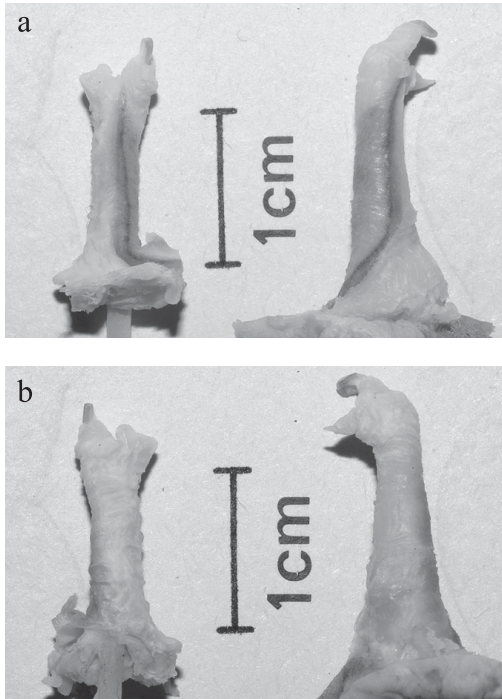


FIG. 1. Everted and fixed hemiclitoris of the holotype of *Varanus mabitang*. Note the artefacts during preparation (i.e., smaller hemibaubellum in the smaller organ not fully everted, and apex of the larger organ somewhat distorted and distended). A, sulcal view. B, asulcal view.

bellum was somewhat knife-shaped: elongated, flattened, ending in a relatively rounded tip. All hemibaubella were elastic and obviously nearly unmineralized with no discernible terminal spikes. In both hemiclitoris the paryphasmata were relatively indistinct (thus, difficult to distinguish from simple tissue folds) and were hardly countable. On the asulcal side, the paryphasmata started at the beginning of the apex as short rows and then stretched along the lateral sides of a v-shaped asulcal apical notch just below the apical platform. Below the asulcal apical notch there were four or five discernible undivided paryphasman rows. In addition, along the lateral sides of the v-shaped apical notch, there were also four or five discernible paryphasman rows. The pedicel was partially covered with micro-spines at its base.



FIG. 2. Sulcal view of the apex of the larger hemiclitoris. Note the difference in size and shape of the two hemibaubella.

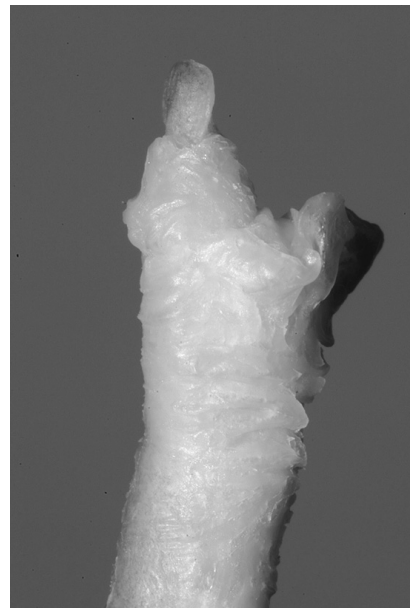


FIG. 3. Asulcal view of the apex of the smaller hemiclitoris. Note the v-shaped apex notch that divides the apical paryphasmata just below the notch of the apical platform.

DISCUSSION

Before discussing the systematic significances of the outer genital structures of *Varanus mabitang*, we would like to briefly review the systematic history and the previous studies on the genital morphology of its presumed sister species, *V. olivaceus*, following Gaulke (2004). Originally, this species was classified with the "slit-nosed group of monitor species", especially close to *V. bengalensis* (Auffenberg, 1988). Böhme (1991) reconstructed shape and ornamentation of the *V. olivaceus* hemipenis by dissection of invertedly fixed organs. Although the results of Böhme's (1991) tentative reconstruction could not completely resolve the species relationships, the hypothesis of a closer relationship with *V. bengalensis* and its relatives (subgenus *Empagusia*) was negated from the structures recognized. In addition, a closer relationship with *V. salvator*, an alternative phylogenetic hypothesis by Auffenberg (see Böhme, 1991), could be also disproved. Based on the asymmetrical and uniquely derived (i.e., autapomorphic) outer genital morphology of *V. salvator*, Ziegler and Böhme (1997) erected the monotypic subgenus *Soterosaurus* for *V. salvator*. Finally, the same authors were able to examine completely everted hemipenes as well as hemiclitoris of *V. olivaceus* for the first time (see also Böhme [1995]) and thus to complete Böhme's (1991) hemipenis description (Ziegler and Böhme, 1997).

Comparing the hemiclitoris morphology of *V. olivaceus* as figured in Böhme (1995) and described in detail in Ziegler and Böhme (1997) with our present findings for *V. mabitang*, we can state that they very much resemble each other. Although the exact structure of the smaller hemibaubellum of *V. olivaceus* is not clearly discernible from the alizarin-stained and cleared hemiclitoris figured by Böhme (1995; see also plate IX in Ziegler and Böhme, 1997), it largely corresponds with the knife-shaped hemibaubellum observed in one of the two hemiclitoris of the holotype of *V. mabitang*. Even so, however,

due to the somewhat rudimentary state of hemiclitoris structure as compared with conspecific hemipenes (Ziegler and Böhme, 1997), examination of male outer genital organs of *V. mabitang* is much desired to learn more about possible differences of this species from *V. olivaceus* in view of the outer genital morphology (e.g., possible slight differences in the shape of the smaller hemibacula). Nonetheless, now we can state that our observations on the hemiclitoris of *V. mabitang* support its close affinity with *V. olivaceus*, as already assumed by Gaulke and Curio (2001), Böhme (2003), and Gaulke (2004). The derived genital morphological structures shared by *V. olivaceus* and *V. mabitang*, especially the asymmetrically shaped supportive structures (see Ziegler and Böhme, 1997), suggest monophyly of these species on the one hand, and their distant phylogenetic status from the other *Varanus* species on the other hand, supporting the validity of the subgenus *Philippinosaurus*, as consisting now of these two species.

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