

Remarks on the genital morphology of the Malagasy snake genus *Liophidium* (Reptilia, Serpentes, Colubridae)

Beitrag zur Genitalmorphologie der madagassischen Schlangengattung *Liophidium* (Reptilia, Serpentes, Colubridae)

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ZUSAMMENFASSUNG: Der Hemipenis von *Liophidium torquatum* wird erstmalig beschrieben und bildlich dokumentiert. Bislang unentdeckte Unterschiede in der Hemipenisornamentierung von *Liophidium apperti* und *Liophidium trilineatum* werden vorgestellt. Nach bisherigem genitalmorphologischen Kenntnisstand innerhalb der Gattung *Liophidium* erscheint der Hemipenis von *L. therezieni* als weitgehend ursprünglich. Während die Hemipenes von *L. torquatum* und *L. vaillantii* bereits einen etwas komplizierteren Aufbau erkennen lassen, sind *L. apperti* und *L. trilineatum* als genitalmorphologisch hoch abgeleitet einzustufen. Abschließend wird die außergewöhnliche Hemipenisstruktur der letzteren Arten im Hinblick auf funktionelle Aspekte diskutiert.

DOMERGUE (1983) described three new species of the genus *Liophidium*: *L. apperti*, *L. therezieni* and *L. chabaudi*, in which the description of the former was mainly based on hemipenis morphology (DOMERGUE, C. A., 1983: Bull. Mus. natn. Hist. nat., Paris, 4e sér., 5, section A(4), 1109-1122). Within the framework of our genital morphology investigations on Malagasy snakes we re-examined the remarkable hemipenes of *Liophidium apperti* (MHNP 1982-442) and *L. trilineatum* (MHNP 1982-443), which were illustrated by DOMERGUE (l.c., 1113).

In accordance with DOMERGUE (l.c.) the hemipenes of *L. apperti* are characterized by a very short, unpaired pedicel and two extremely long and slender lobes, which are entirely covered with spines („...épineuses sur toute leur surface...“). According to DOMERGUE (l.c.) the only differences in hemipenis morphology of *L. apperti* and *L. trilineatum* are the relatively longer lobes of *L. apperti*, which furthermore are not asymmetrically formed as in *L. trilineatum*.

These observations were largely confirmed by our examinations. In fact the tips of the lobes of the hemipenes do not seem to be fully everted, but the shortening of the inner lobe of *L. trilineatum* is obvious. However this is not the only distinctive feature between the hemipenes of *L. apperti* and *L. trilineatum*. The hemipenes of *L. apperti* show relatively longer and more slender spines, which do not cover the entire hemipenis as in *L. trilineatum*. In the hemipenis of *L. apperti* merely the lateral surface is covered with spines, the surrounding area of the sulcus spermaticus and the corresponding area on the asculate surface are spineless. This important distinctive feature, which was not mentioned by DOMERGUE (l.c.), makes a (hemipenial) distinction of the externally very similar species possible even if hemipenis lobes are only partially everted.

Furthermore we are able to describe the fully everted hemipenis of *Liophidium torquatium* for the first time, using a method for preparing the hemipenes of preserved specimens (PESANTES, O. S., 1994: J. Herpetol. **28**(1), 93-95; for revised method see also ZIEGLER, T., 1996: Unpubl. MSc thesis, Bonn, 246 pp.). The only available hemipenes of *Liophidium rhodogaster* merely were partially everted and poorly preserved (ZFMK 62235: Périnet [= Andasibe]; SVL: 20,7; TL: 7,8 cm), so that some better preparations are required for conclusive statements; because of the delicateness of the organs and the high probability of destruction, a later preparation of the hemipenes has not been tried. However an undivided pedicel and sulcus spermaticus including some occasional, delicate and elongate spines were discernible at the base. No data on the hemipenes of *L. chabaudi* were available.

For terminology see KLAVER, C. J., BÖHME, W., 1986: Bonn. zool. Monogr. **22**, 1-64 and BÖHME, W., 1988: Bonn. zool. Monogr. **27**, 1-176. Abbreviations used in the text are SVL (snout-vent length, measured from tip of snout to vent), TL (tail length, measured from vent to tail tip) and HPL (hemipenis length, measured from cloacal base point to apex).

Hemipenial morphology of *Liophidium torquatium* ZFMK 50445 (Fig. 1.) from Madagascar, 15 km W Mananjary (SVL: 33,5; TL: 13,5; HPL: 1,7 cm):

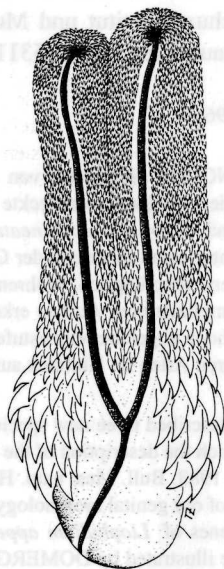


Fig. 1: Sulcal view of the left hemipenis of *Liophidium torquatium* (ZFMK 50445).

Abb. 1: Sulcalansicht des linken Hemipenis von *Liophidium torquatium* (ZFMK 50445).

Fully everted hemipenis elongate, deeply bilobed from the lower truncus on and largely covered with spines. The relatively small and slender, slightly recurved spines of the elongate lobes gradually become smaller towards the tips of the lobes. On the upper pedicel and lower truncus there are lateral curves, which are covered with strong and elongate spines. At the base especially the asulcate surface is slightly covered with tiny spines. The sulcus spermaticus is bifurcate for about 2/3 of its length, with the branches terminating at the tips of the lobes. The distal depression at the tips of the fully everted lobes is caused by the insertion of the musculus retractor penis magnus. The lobes, from which the inner one appears to be a little bit shorter, are slightly curved towards the sulcate surface. The hemipenis of ZFMK 50445 corresponds to the retracted and dissected hemipenes of another specimen (ZFMK 14699: Madagascar; SVL: 46; TL: 16 cm).

According to the drawings by DOMERGUE (l.c.) the hemipenis of *L. therezieni* appears to be relatively primitive within the genus *Liophidium*, because of the largely regular, strong spines and the simple shape of the lobes. In the hemipenis of *L. vaillanti* the arrangement of the small spines and the (terminal) shape of the lobes seem to be more complicated. On the one hand the hemipenis of *L. apperti* with its extremely long and slender lobes and the special arrangement of the small spines and on the other hand the hemipenis of *L. trilineatum* with its conspicuously asymmetrical lobes seem to be the most derived. Comparing the hemipenis of *L. torquatum* with the hemipenis drawings by DOMERGUE (l.c.), there are close relationships to *L. therezieni*, but in the hemipenis of *L. torquatum* the arrangement of the spines seems to be more complicated. Further it has to be mentioned that the corresponding lobes of the hemipenis drawings by DOMERGUE (l.c.) and both lobes of the hemipenis of *L. torquatum*, which is documented here for the first time, show somewhat different lengths. This can be interpreted as a preliminary stage to the exceptionally asymmetrical formation of the lobes in the hemipenis of *L. trilineatum*. But for conclusively clarifying the systematic situation within *Liophidium* and related genera (e.g. *Liopholidophis*) further (hemipenis morphology) studies are needed (see also CADLE, J. E., 1996: Bull. Mus. Comp. Zool. **154**, 369-464).

DOMERGUE (l.c.) emphasizes the diverse and partly extreme shape of the hemipenes within the genus *Liophidium*: „La diversification des hémipénis est remarquable et l'on ne peut réprimer un certain étonnement en constatant que l'organe de *L. apperti* (...) est identique à celui d'une forme ophidienne, combien éloignée tant dans la classification que dans la géographie, le *Crotaliné Trimeresurus albolabris* Gray, 1842“; because of the different hemipenis morphology he considers a revision of the genus to be necessary. But merely different thickness and length of the hemipenis lobes alone do not necessarily justify higher systematic categories, especially as important hemipenis ornaments (e.g. spines, shape of the sulcus etc.) essentially show the same principle.

The hemipenis morphology situation of the African colubrids *Mehelya poensis* and *Mehelya guirali* also is comparable to the phenomenon in the genus *Liophidium* discussed before (DOUCET, J., 1963: Acta Tropica **20**). So the hemipenis of *M. guirali* corresponds to the hemipenis of *L. therezieni* (DOMERGUE l.c., 1116) to a large extent, whereas the hemipenis of *M. poensis* is characterized by extremely long and slender lobes, corresponding to the situation in *L. apperti*. Likewise within the genera *Pseudaspis* (COPE, E. D., 1900: Rept. U. S. Natl. Mus., Washington 1898, 151-1294, plate 22) and *Bitis* (DOUCET l.c.) there are hemipenes with conspicuously long and slender lobes. So it has still to be clarified whether these phenomena are phylogenetically relevant features between closely related species, or whether functional aspects are of significance and thus the character is adaptive and subject to selective pressure under certain eco-ethological conditions. In view of the obviously multiple origin of such remarkable hemipenes it could be possible, that it concerns the (extreme) formation of an effective copulatory apparatus, which has to be understood in connection with an optimized fertilization success (see also BÖHME, W., SIELING, U., 1993: herpetofauna **15**: 15-23; ZIEGLER l.c.).

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