

A new species of colubrid snake (*Liopholidophis*) from northern Madagascar

FRANK GLAW, MICHAEL FRANZEN & MIGUEL VENCES

Abstract. We describe a new species of the colubrid snake genus *Liopholidophis* from the far north of Madagascar. *Liopholidophis marta* sp. n. from the dry forest of the limestone massif Montagne des Français belongs to the *L. stumpffi* group and is characterized by 19 dorsal scale rows, 185 ventrals, 109 subcaudals, and colouration (lack of well defined, continuous light dorsolateral stripes, presence of extensive dark spots and stripes on venter, postocular bar extends diagonally across the ultimate supralabial). We emphasize the importance of Montagne des Français as a center of endemism for reptiles and strongly suggest including this massif into the network of nature reserves in Madagascar.

Key words. Squamata: Serpentes: Colubridae: *Liopholidophis*, new species; Madagascar.

Introduction

Liopholidophis MOCQUARD, 1904 is a genus of colubrid snakes endemic to Madagascar (GUIBÉ 1954, DOMERGUE 1973). The genus was recently revised by CADLE (1996, 1998) who recognized nine species in two species groups. The *Liopholidophis sexlineatus* group contains *L. sexlineatus* (GÜNTHER, 1882), *L. varius* (FISCHER, 1884), *L. doliocercus* (PERACCA, 1892), *L. grandidieri* (MOCQUARD, 1904), and *L. rhadinaea* CADLE, 1996. These species have 17 rows of dorsal scales and are characterized (with the exception of *L. varius*) by an extreme sexual dimorphism in tail length, the tails of the males being much longer. Accordingly, the number of subcaudals is much higher and the total length is longer in males than in females (CADLE 1996). The species in this group mainly occur in mid- and high-altitude habitats of eastern and central Madagascar but have not yet been recorded from the far north of the island.

The *Liopholidophis stumpffi* group contains *L. stumpffi* (BOETTGER, 1881), *L. lateralis* (DUMÉRIL, BIBRON & DUMÉRIL, 1854), *L. infra-signatus* (GÜNTHER, 1882), and *L. epistibes* CADLE, 1996. These species have 19 rows of

dorsal scales and do not show an extreme sexual dimorphism in tail length. They are distributed throughout eastern Madagascar from Montagne d'Ambre in the north to Andohahela in the south, ranging from sea level to about 1600 m altitude (ANDREONE & RANDRIAMHAZO 1997, RAXWORTHY & NUSSBAUM 1994, CADLE 1996, NUSSBAUM et al. 1999). In addition, *L. lateralis*, *L. stumpffi*, and *L. epistibes* are also known from less humid localities in western Madagascar (e. g. CADLE 1996, ANDREONE et al. 2001).

In his review of *Liopholidophis* CADLE (1996) confirmed the two species groups already recognized by PARKER (1925), but was not able to confirm the monophyly of *Liopholidophis* as a genus. The *L. sexlineatus* group (especially *L. rhadinaea*) shows remarkable similarities to species of the genus *Liophidium* in morphology and colouration, which makes a clear definition and delimitation of these two genera partly difficult (CADLE 1996). A recent molecular phylogenetic analysis of Madagascan colubrids (NAGY et al. 2003) included only the type species, *L. sexlineatus*, but no representative of the *Liopholidophis stumpffi* group, and therefore could not resolve the question about the monophyly of *Liopholidophis*.

During recent surveys in northern Madagascar we discovered a single individual of a new *Liopholidophis* species which we describe in the following. Additionally, we examined material of the *L. stumpffi* group housed in the herpetological collections of the Museum Alexander Koenig (Bonn) and Zoologische Staatssammlung (München).

Material and Methods

The snakes were collected by hand, euthanised by injection with chlorobutanol, fixed in formalin, and stored in 70% ethanol. Muscle tissue samples were taken from freshly killed specimens in the field and preserved in 98% ethanol. Snout-vent length (SVL) and tail length (TL) were measured to the nearest millimeter with a caliper. We follow CADLE (1996) regarding the terminology of meristic and mensural data. Counts of ventral scales are ventrals without preventrals.

Geographical coordinates of localities were determined by global positioning receiver (GPS). Institutional abbreviations are: Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK), and Zoologische Staatssammlung München (ZSM).

Material used for comparison: *Liopholidophis epistibes*: ZSM 230/2002, Vohidrazana; ZSM 112/2004, Andohahela; ZFMK 14153, Andasibe [= Périnet]; ZFMK 59788, An'ala. *Liopholidophis infrasignatus*: ZSM 726/2003 and ZSM 801/2003, Ranomafana National Park; ZSM 118/2004, Andohahela; ZFMK 14697 and ZFMK 59786, Andasibe [= Périnet]. *Liopholidophis lateralis*: ZSM 577/2001, Ankarafantsika (Ampijoroa); ZFMK 17739, Andasibe [= Périnet]; ZFMK 27682, Moramanga; ZFMK 50440-50444 and ZFMK 54183-54184, Mananjary; ZFMK 18966-18967, Mananjary: Kianjavato; ZFMK 54182, Tolagnaro [= Fort Dauphin]; ZFMK 8917 and ZFMK 33428, Toliara [= Tuléar]. *Liopholidophis stumpffi*: ZSM 579/2001 and ZFMK 53157, Nosy Be; ZSM 986/2003, Manongarivo.

Results

Liopholidophis martaе sp. n.

Holotype: ZSM 253/2004 (field number FGZC 0492), adult male (Figs. 1-3), collected at Montagne des Français (12°19'34"S, 49°20'09"E, ca. 300 m above sea level), Antsiranana Province, northern Madagascar, by F. GLAW, M. PUENTE, R.D. RANDRIANIAINA, and several employees of the hotel "King's Lodge" on 23 February 2004.

Diagnosis: A species of the *Liopholidophis stumpffi* group that differs from all species of the *L. sexlineatus* group (*L. rhadinaea*, *L. doliocercus*, *L. grandidieri*, *L. sexlineatus*, *L. varius*) by 19 rows of dorsal scales (vs. 17), more ventrals (185 vs. 139-179), colouration, and the presence of apical pits (absent in all species of the *L. sexlineatus* group).

Liopholidophis martaе sp. n. differs from all species of the *Liopholidophis stumpffi* group (*L. stumpffi*, *L. epistibes*, *L. lateralis*, *L. infrasignatus*) by a higher number of ventrals (185 vs. 141-169), and from *L. epistibes*, *L. lateralis*, *L. infrasignatus*, and the males of *L. stumpffi* by a higher number of subcaudals (109 vs. 62-104). Moreover, it differs from *L. stumpffi* by a larger maximum size (847 mm vs. 711 mm total length). The new species differs distinctly from *L. lateralis* by the lack of a well defined continuous light dorsolateral stripe.

The general dorsal colouration of *L. martaе* sp. n. resembles those of most individuals of *L. stumpffi* and *L. epistibes* in having narrow but more or less distinctive light dorsolateral stripes on the neck and anterior body which gradually fade posteriorly (see Figs. 4-5). However, it differs from *L. stumpffi* by its extensive dark spots and stripes on the venter (vs. immaculate) and by the position of the postocular bar, which diagonally crosses the ultimate supralabial in *L. martaе* (vs. restricted to upper edge of ultimate supralabial: Fig. 4; see also CADLE 1996: Fig. 8B). From *L. epistibes* it differs by its short postocular bar which ends on the ultimate

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	Sex	Dorsals	Ventrals	Subcaudals	Total length [SVL] (mm)	Tail length/ total length	Eye diameter/ eye-nostril distance
<i>Liopholidophis stumpffi</i>							
ZSM 579/2001	♂	19	151	101	456 [309]	0.32	1.24
ZFMK 53157	♂	19	152	102	293 [198]	0.32	1.18
ZSM 986/2003	♀	19	146	*80	436 [314]	*0.28	1.24
<i>Liopholidophis epistibes</i>							
ZSM 230/2002	♂	19	155	92	650 [452]	0.30	1.27
ZSM 112/2004	♀	19	150	88	520 [355]	0.32	1.20
ZFMK 14153	♀	19	158	89	768 [543]	0.29	1.25
ZFMK 59788	♀	19	162	96	*917 [636]	0.31	1.23
<i>Liopholidophis infrasignatus</i>							
ZSM 726/2003	♂	19	152	68	722 [547]	0.24	1.00
ZSM 801/2003	♂	19	149	76	616 [456]	0.26	1.03
ZSM 118/2004	♀	19	144	62	615 [471]	0.23	1.00
ZFMK 14697	♀	19	151	68	694 [534]	0.23	1.17
ZFMK 59786	♀	19	149	64	760 [584]	0.23	1.21
<i>Liopholidophis lateralis</i>							
ZSM 577/2001	♂	19	157	92	687 [475]	0.31	1.10
ZFMK 8917	♂	19	152	99	677 [454]	*0.33	1.25
ZFMK 27682	♂	19	150	88	765 [523]	0.32	0.97
ZFMK 50441	♂	19	154	97	659 [452]	0.31	1.15
ZFMK 50443	♂	19	159	96	686 [490]	0.29	1.15
ZFMK 50444	♂	19	166	94	501 [353]	0.30	1.23
ZFMK 54182	♂	19	146	84	578 [412]	0.29	1.08
mean±sd			154.9±6.5	92.9±5.3	–	0.31±0.02	1.13±0.09
ZFMK 17739	♀	19	161	86	694 [503]	0.28	1.12
ZFMK 18966	♀	19	163	93	736 [524]	0.29	–
ZFMK 18967	♀	19	159	85	701 [512]	0.27	1.00
ZFMK 33428	♀	19	169	83	828 [605]	0.27	0.97
ZFMK 50440	♀	19	163	92	689 [495]	0.28	1.04
ZFMK 50442	♀	19	161	86	737 [525]	0.29	1.15
ZFMK 54183	♀	19	156	81	579 [427]	0.26	1.16
ZFMK 54184	♀	19	161	82	658 [473]	0.28	1.11
mean±sd			161.6±3.7	86.0±4.4	–	0.28±0.01	1.08±0.07

Tab. 1. Meristic and mensural data of comparative specimens of the *Liopholidophis stumpffi* group housed in the collections of ZFMK and ZSM. Asterisks (*) indicate major range extensions compared to the data of CADLE (1996: Tab. 2) and discussed in the text. For *L. lateralis* mean value and standard deviation (mean ± sd) are given for both sexes.

supralabial (vs. usually confluent with dark lower lateral stripe on side of neck; CADLE 1996: Fig. 8A).

Description of holotype: Male, hemipenes not extruded (sex determination based on the slightly expanded tail base). Total length 847 mm, tail length 272 mm (32% of total length). Dorsal scales smooth, usually with two tiny apical pits. Dorsals in 19-19-17 rows. Scale row reduction from 19 to 17 rows at the level of the ventral 103. Two preven-

trals, 185 ventrals. Anal plate divided. Subcaudal pairs 109. Upper labials 8/8, with 4-5 touching the eye. Lower labials 10/10, the first pair in contact behind the mental, 1-5 touching an anterior genial, 5-6 touching a posterior genial. Right anterior genial shorter than posterior; left anterior genial as long as posterior. Preocular single, two postoculars. Loreal present, wider than high (ratio height / width 0.59). Temporals 2+2+3 on right side; 2+1+3 on left side (fusion of secondary lower temporal with penultimate



Fig. 1. Portrait of the holotype of *Liopholidophis martae* sp. n.

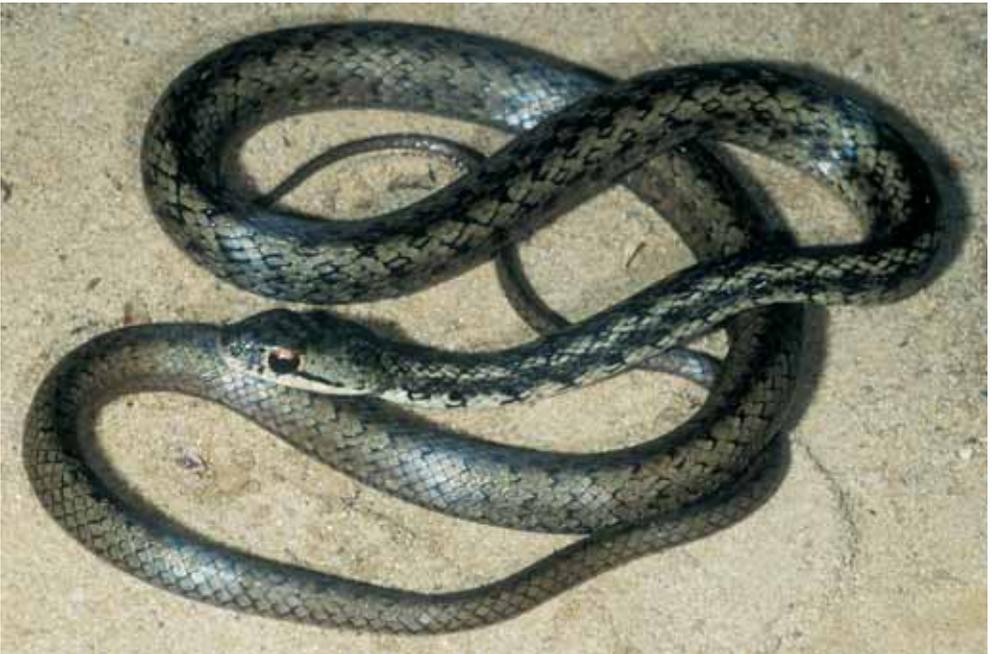


Fig. 2. Dorsolateral view of the holotype of *Liopholidophis martae* sp. n.

supralabial). Body approximately as high as wide. Greatest head width (parietal region) 14.5 mm, head length (tip of snout to end of mandibles) 26.0 mm. Head wider than neck. Pupil round. Eye large, diameter 4.6 mm, equal to the distance between eye and posterior edge of nostril.

Life colouration (based on slides taken in the field, see also Figs. 1-3): Ground colouration of head light brown, dorsally and laterally dusted with dark brown and black, forming an indistinct dark head cap. The head cap covers the supralabials 1-3, internasals, nasals, loreals, upper portions of preoculars, prefrontals, the frontal, supraocular, and the parietals. The remaining portions of the head are mostly immaculate, with the exception of the sutures of supralabials 1-3, and a black postocular bar. The postocular bar extends from the lower half of the lower postocular into the mouth angle and covers the lower half of the lower primary temporal, the upper half of supralabial 7, and the center of supralabial 8.

Ground colouration of dorsal scale rows 1-5 (neck and anterior body) and 1-3 (posterior body) medium to dark brown, of dorsal scale rows 6-7 (neck and anterior body) and 4-7 (posterior body) light brown. Middorsal area is medium to dark brown. The light stripe on dorsal scale rows 6-7 starts a few dorsal scales behind the head and is narrowest and most distinctive on the anterior part of the body, becoming gradually broader and more diffuse posteriorly. Entire dorsal side of the body mottled with black markings, which concentrate in the middorsal area and partly form a diffuse zig-zag band and/or indistinct reticulation. The markings are most dense and partly confluent on the anterior third of the body and almost lacking on the posterior third of the tail.

Ground colouration of ventral surfaces of the head, neck, and anterior third of body creamish-white to grey, slightly iridescent. The light ground colouration is gradually suffused with grey to black mottlings on the posterior thirds of the body and tail. Ventral surface of head immaculate. Anterior third of



Fig. 3. Ventral view of the holotype of *Liopholidophis martae* sp. n.

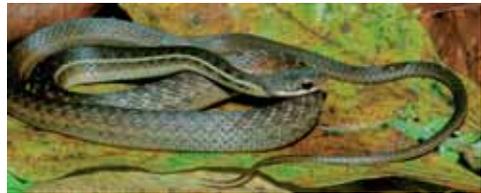


Fig. 4. *Liopholidophis stumpffi* from the type locality Nosy Be (ZSM 579/2001).



Fig. 5. *Liopholidophis epistibes* from Andasibe.

venter with three rows of longitudinal dark spots, gradually forming three distinct lines on the posterior two thirds of the venter. Spots/lines are situated midventrally and ventrolaterally. The ventrolateral rows begin on first ventral (preventrals immaculate), the midventral row on ventral 9.

After approximately ten months of preservation, the dorsal ground colouration has faded considerably and changed to a more or less homogenous grey-brown, making the

	<i>L. stumpffi</i>	<i>L. epistibes</i>	<i>L. lateralis</i>	<i>L. infrassignatus</i>	<i>L. marta</i> sp.n.
Dorsals	19-19-17	19-19-17	19-19-17	19-19-17	19-19-17
Ventrals					
♂♂	149-153 (8)	155-166 (9)	144-166 (35)	141-156 (19)	185 (1)
♀♀	145-157 (8)	150-167 (20)	151-169 (28)	144-161 (38)	–
Subcaudals					
♂♂	89-104 (8)	91-104 (8)	80-99 (29)	66-81 (17)	109 (1)
♀♀	80-109 (8)	83-96 (19)	76-97 (23)	62-73 (33)	–
Maximum total length [SVL] (mm)					
♂♂	627 [416]	709 [471]	765 [523]	727+ [606]	847 [575]
♀♀	711 [475]	917 [636]	828 [605]	920 [712]	–
Tail length / total length					
♂♂	0.29-0.34 (8)	0.28-0.34 (8)	0.27-0.33 (29)	0.23-0.27 (18)	0.32 (1)
♀♀	0.28-0.34 (8)	0.27-0.32 (18)	0.25-0.29 (23)	0.21-0.24 (32)	–
Eye diameter / eye-nostril distance	1.13-1.31 (10)	1.16-1.69 (16)	0.97-1.30 (38)	1.0-1.44 (24)	1.0 (1)

Tab. 2. Variation in basic meristic and mensural data of the species in the *Liopholidophis stumpffi* group, based on Table 1 and CADLE (1996). Data are given as ranges followed by the number of specimens in parentheses. SVL = snout-vent-length.

alternating light and dark longitudinal zones nearly invisible, especially on the posterior two thirds of the body.

Etymology: This species is dedicated to MARTA PUENTE MOLINS in recognition for her invaluable help in the field.

Habitat and habits: The holotype was captured during the day on the ground by a local assistant close to pitfall lines which were placed between limestones within dry forest. The collection site is close to the highest altitude of the Montagne des Français massif.

Distribution and conservation: *Liopholidophis marta* is only known from Montagne des Français which is a classified dry forest in a limestone massif but hitherto not formally protected as nature reserve. As Montagne des Français is an important center of endemism for Madagascan reptiles it seems likely that also *L. marta* is endemic to this northernmost Malagasy limestone massif. Recent surveys have revealed a remarkable number of new reptile species which are only known

from Montagne des Français and possibly represent locally endemic species (e. g. GLAW et al. 2001, GLAW et al. in press). This high number of potentially local endemics of reptiles strongly suggests that this area might be of extraordinary importance for other groups of the fauna and flora as well. A survey of succulent plants revealed remarkable diversity and endemism in this massif (LAVRANOS et al. 2001). We therefore strongly suggest including Montagne des Français into the network of Madagascar's nature reserves.

Remarks: Available names in the *L. stumpffi* group include *Dromicus baroni* BOULENGER, 1888 (type locality "Madagascar"). This taxon was recognized by CADLE (1996) as a synonym of *L. infrassignatus* and the scale counts of the female holotype (158 ventrals, 69 subcaudals) are within the variation of this species (see CADLE 1996: 429-430).

The syntypes of *Liophidium gracile* MOCQUARD, 1908 (an adult male from Montagne d'Ambre and one juvenile from Nossi-Be) were both examined by CADLE (1996: 416) and were found to be synonymous with

L. stumpffi. The scale counts of the types of *L. gracile* are therefore within the range of *L. stumpffi* (see CADLE 1996: 416, 418).

Discussion

Mensural and meristic data of the new *Liophilidophis* species and of additional material (Tab. 1 & 2) confirm the morphological variation within the *Liophilidophis stumpffi* species group as defined by CADLE (1996). Minor differences regard *L. epistibes* and *L. lateralis*, i.e. +/- one to three ventral and subcaudal scales and slightly larger total lengths. In *L. stumpffi* the ranges of subcaudal counts and relative tail length are considerably lowered by a presumed female from Manongarivo (ZSM 986/2003), with only 80 subcaudals and a tail length / total length ratio of 0.28 (vs. a minimum of 91 subcaudals and a tail length / total length ratio of 0.31 for females according to CADLE 1996). However, the specimen is subadult and sex determination is not certain. At least the tail length / total length ratio of the individual is near to those given for males by CADLE (1996). Moreover, the maximum total length of 917 mm in *L. epistibes* is attained by a female from An'ala (ZFMK 59788). Previously reported maximum length was 829+ mm (CADLE 1996). In males of *L. lateralis* the variation of relative tail length is extended by two specimens from Toliara (ZFMK 8917: tail length/total length 0.33), and Moramanga (ZFMK 27682: tail length/total length 0.32). Previously reported maximum relative tail length was 31% of total length (CADLE 1996).

Regarding the similarities in pholidosis and colouration, *L. martaе* appears to be most closely related to *L. stumpffi* and *L. epistibes*. Both latter species seem to be distributed allopatrically throughout most of their range, but both occur in the region of Montagne d'Ambre (CADLE 1996) which is not far from Montagne des Français, the type locality of *L. martaе*. The occurrence of these three species in the extreme north of Mada-

gascar is remarkable and might indicate that this species complex evolved in that area.

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Author's addresses: FRANK GLAW, MICHAEL FRANZEN, Zoologische Staatssammlung, Münchhausenstraße 21, D-81247 München, Germany, E-Mail: frank.glaw@zsm.mwn.de; MIGUEL VENCES, Institute for Biodiversity and Ecosystem Dynamics, Zoological Museum, Mauritskade 61, NL-1092 AD Amsterdam, The Netherlands.