

Notes on the diversity and natural history of the snake fauna of Ambodiriana - Manompana, a protected rainforest site in north-eastern Madagascar

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Abstract. Opportunistic encounters of different Malagasy lamprophiid/pseudoxyrhophiine snakes (Squamata: Serpentes: Lamprophiidae) from a small protected area of lowland rainforest named Ambodiriana, located at Madagascar's north-east coast are reported in order to complete the species inventory of this area. These observations provide new locality records for *Compsophis laphystius*, *Ithycyphus goudoti*, *Ithycyphus perineti*, *Langaha madagascariensis*, *Madagascarophis colubrinus*, *Parastenophis betsileanus*, *Phisalixella artifasciata*, and *Pseudoxyrhopus tritaeniatus*. In addition a predation of *Ithycyphus perineti* on a leaf-tail gecko (*Uroplatus sameiti*) and of a *Parastenophis betsileanus* on a leaf chameleon (*Brookesia superciliaris*) is documented. We hope that the results of this report may help to highlight the high species diversity in this forest, and will hopefully contribute to the ongoing protection of this important lowland rainforest site.

Keywords. Lamprophiidae, species inventory, new distribution records, predation, diet.

Introduction

Madagascar harbours a rich snake fauna including about 96 species corresponding to the three families of Typhloidae, Boidae, and Lamprophiidae. While Typhloidae and Boidae include only a comparable low number of species (12 species of Typhlopidae and three or four species of Boidae respectively), lamprophiids are very diverse with about 80 endemic species and almost all of them (except the genus *Mimophis*) can be traced back to a single radiation (Nagy et al. 2003), that of the pseudoxyrhophiines. Within the last decade seven new lamprophiid species were discovered and identified in Madagascar (Nagy, Glaw, Vences 2010). This recent increase in species discoveries is mainly due to increased intensity of field exploration combined with the use of integrative taxonomic approaches that combine molecular genetics and comparative morphology (e.g. Vieites et al. 2010). Nevertheless, the diversity, systematics and phylogenetic relationships amongst Malagasy lamprophiids are still poorly known, as exemplified by the results of Nagy, Glaw, Vences (2010) on the phylogeny of the genus *Stenophis*. These

studies resulted in a split of the genus *Stenophis* in three different monophyletic clades, now recognized as the genera *Lycodyras*, *Phisalixella* and *Parastenophis* (Nagy, Glaw, Vences 2010).

Thus important data on life history aspects for understanding the species ecology, and comprehensive distribution data for biogeographic studies and conservation assessments are still missing for a considerable proportion of Madagascar's serpent fauna. Only limited data are available on the natural history and diet of Malagasy snakes (e.g. Preston-Mafham 1991; Cadle 1996a, 1996b; Burney 2002; Vences et al. 2004; Mercurio et al. 2006; Glaw, Vences 2007; Knoll, Glaw,

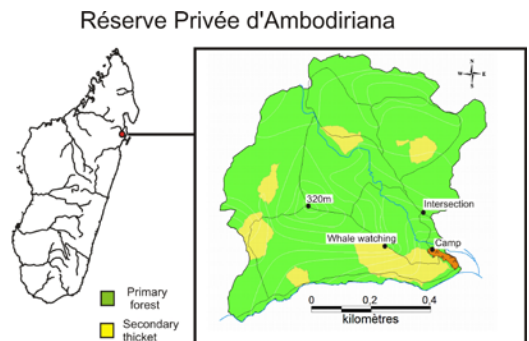


Figure 1. The study area, the protected forest of Ambodiriana - Manompana in north-eastern Madagascar. Green colour indicates primary rainforest, yellow indicates area consisting of secondary thickets, the camp-site is marked in orange, rivers are blue. In the map several distinct landmarks are given.

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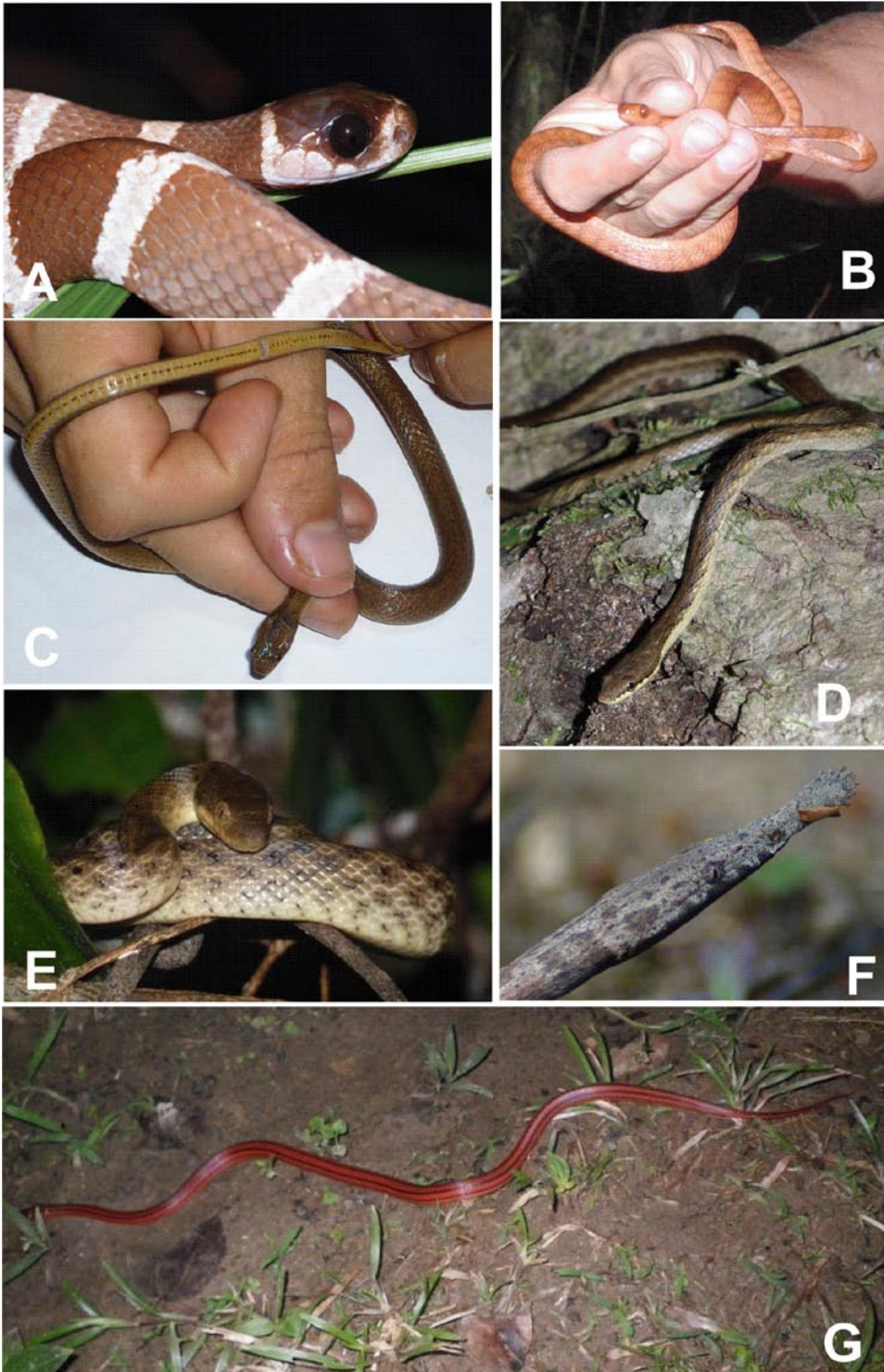


Figure 2. Photographs of different snake species encountered at Ambodiriana. A. *Parastenophis betsileanus*; B. *Phisalixella artifasciata*; C. *Compsophis laphystius*; D. *Ithycyphus goudoti*; E. *Madagascarophis colubrinus*; F. *Langaha madagascariensis*; G. *Pseudoxyrhopus tritaeniatus*. Photographs taken by Florian Bernier (A), Ségolène Beaucent and Marc Fayolle (B,F), Chantal Misandeau (C,E,G), and David Ringler (D).



Figure 3. *Ithycyphus perineti* preying on *Uroplatus sameiti*, Ambodiriana forest, north-east Madagascar. A. The picture shows how the snake was encountered at 15.24h. The *Uroplatus* was still alive. B. At 15.32h the *Uroplatus* was paralyzed and almost entirely swallowed by the *I. perineti*. C. Strangely the snake started to swallow the gecko with its tail first. Photographs taken by Augustin Kaloloha.

Köhler 2009; Jenkins, Rabearivony, Rakotomanana 2009; Crottini et al. 2010). Malagasy lamprophiids mostly prey on amphibians, lizards, and small mammals but also ophiophagous and opportunistic egg-eating snakes have been reported (Domergue 1987; Preston-Mafham 1991; Mercurio et al. 2006; Glaw, Vences 2007, Knoll, Glaw, Köhler 2009; Jenkins, Rabearivony, Rakotomanana 2009; Crottini et al. 2010). During the ongoing conservation work in the Ambodiriana forest that we have been conducting since 1996, we regularly visit the forest guiding tourists and recording data on its biodiversity. Since our work is not only focused on the herpetofauna of this rainforest site, observations of snakes are more of an opportunistic nature. Gehring, Ratsoavina, Vences (2010) published a first rough estimate of herpetofaunal diversity in Ambodiriana forest, reporting on four different snake species that were found during a short survey of three days (*Sanzinia madagascariensis*, *Leioheterodon madagascariensis*, *Pseudoxyrhopus heterurus* and *Thamnosophis lateralis*). Without any doubt this list is far from being complete, therefore we add inhere new information on the snake fauna of Ambodiriana.

Study site and Methods

The Réserve Privée (R.P.) d'Ambodiriana (16°40'28.4"S, 49°42'10.0"E; 53m a.s.l.) is located about 6 km north-west to the Rural Commune of Manompana (16°41'23.3"S, 49°44'40.92"E; 8 m a.s.l.) at Madagascar's eastern coast about 200 km north of Toamasina (Fig. 1). The elevation within the 138 ha of protected area starts from 75 m above sea level and reaches up to 320 m a.s.l.. The R.P. d'Ambodiriana is flanked by the Antsahamanga-

rana River to the south and by the Antsalovana River to the east. The Manompana River divides the sanctuary in two sections. The vegetation consists mainly of low-elevation moist evergreen forest, with small imbedded patches of secondary thickets, resulting from former slash and burn agriculture (Fig. 1). The low-elevation rainforest type often has trees reaching 25–30 m in height with several strata and a diffuse understory. It is very rich in plant species; some of the dominant genera are *Calophyllum*, *Ocotea*, *Dalbergia*, *Anthostema*, and *Pandanus*. This primary lowland forest is connected with the Zahamena-Mananara-Makira rainforest block. The R.P. d'Ambodiriana has been founded and is managed by the NGO "Association de Défense de la Forêt d'Ambodiriana" (ADEFA).

Encountered snakes were photographed in the field and species identification is only based on the photographs by the senior author. Selected photographs are given for each species in Fig. 3. For some individuals selected measurements were taken in the field and are reported in the following species accounts.

Results and Discussion

Compsophis laphystius (Cadle, 1996)

This arboreal nocturnal snake is known to prey on amphibians and their clutches (Glaw, Vences 2007). A putative individual of this species was encountered at night within the primary rainforest (Fig. 2C). Species identification is tentative, due to the fact that important information on scale characters are missing and assured identification just by the photograph is not possible. Nevertheless, due its overall appearance, coloration and the given locality the most likely hypothesis on the species identification is *Compsophis laphystius*. The presence of dark longitudinal lines on the body rules out confusion with the similar *C. infralineatus*, which is

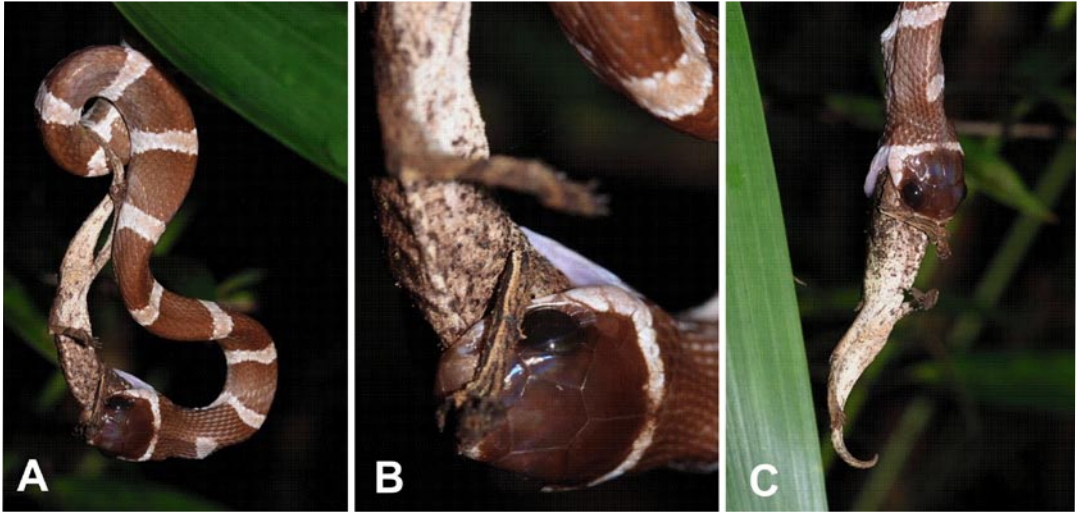


Figure 4. *Parastenophis betsileanus* preying on *Brookesia superciliaris*, Ambodiriana forest, north-east Madagascar. Photographs taken by Florian Bernier.

characterized by diagonal lines on the body. Confusion with the other similar species *C. fatsibe* from localities north of the Bay of Antongil is also unlikely, due to the absence of a vertebral line from mid-body to tail tip.

Ithycyphus goudoti (Schlegel, 1837)

The genus *Ithycyphus* comprises five medium-sized and arboreal Madagascan species (Glaw, Vences 2007). They have opisthoglyphous dentition and mild envenomation is known (Domergue 1986, 1989; Mori, Mizuta 2006). *Ithycyphus* is diurnal and known for preying on different lizard species (e.g. chameleons: Domergue 1987; Crottini *et al.* 2010). A specimen of this taxon was found on a tree trunk about 1 m above the ground, in low-altitude-rainforest at daytime (Fig. 2D). It had a total length of 770 mm (snout-vent length: 470 mm; tail length 300 mm). Due to its coloration, its overall appearance, and its locality along the east coast it is most likely that this specimen belongs to *I. goudoti*, since the other two similar species *I. oursi* and *I. blanci* are only known from the far south and the north, respectively. Gehring, Ratsavina, Vences (2010) found *I. goudoti* as well in secondary vegetation at Antanambe approximately 60 km north of Ambodiriana.

Ithycyphus perinetti Domergue, 1986

With a total length of more than 150 cm *I. perinetti* is one of the largest lamprophiids from Madagascar. The dorsal coloration including head, supralabials and flanks is beige to yellow on the anterior part of the body and reddish-brown on the posterior part (Glaw, Vences

2007). When disturbed *I. perinetti* can flatten its neck in a cobra-like fashion, open widely its mouth and start to hiss impressively loud.

I. perinetti inhabits the north and central eastern regions of Madagascar from mid-elevation rainforests (e.g. Andasibe, Ranomafana) to lowland and coastal forests (e.g. Vohibola, Antalaha) (Glaw, Vences 2007, Gehring, Ratsavina, Vences 2010). Between Antalaha at Madagascar's north-east coast and Vohibola at Madagascar's central east coast a large gap exists where the occurrence of this species is still undocumented.

During fieldwork on 12th February 2011 a specimen of *I. perinetti* was found in the afternoon (15.24h; 26°C, humidity 75%) in the rainforest reserve of Ambodiriana by the first author. The snake was observed near a point of view named "Whale-watching" (16°40'30.0 S, 49°42'20.0'E; 175 m a.s.l.; slope 33°) within primary forest close to a path (Fig. 1). The snake had a body length of \pm 120 cm, color beige to yellow on the anterior part and reddish-brown on the posterior part and a brownish coloration on the tail. Species identification was assured by photographs taken by the first author.

The snake was hanging head down from a small tree about 1 m above the ground and was constricting a leaf-tail gecko (*Uroplatus sameiti*). When encountering the snake and the gecko, the *U. sameiti* was still alive and tried to bite the snake (15.25h; Fig. 3A). Only a few minutes later the gecko was paralyzed or dead (15.30h). Since we did not observe the beginning of the predation event, we cannot discriminate if the paralysis of the *Uroplatus* was caused by a possible envenomation as described in Domergue (1987) and Crottini *et al.* (2010)

or by the constriction. Shortly after, the snake started to swallow fast its prey from the tail on (15.32h, Fig. 3B and 3C). Once the gecko was completely swallowed, the *I. perineti* disappeared in the forest along the branches at 1 m above the ground. To our knowledge, this observation describes the first encounter of *I. perineti* preying on a leaf-tail gecko and fills a major distribution gap for *I. perineti* at Madagascar's north-east coast.

Langaha madagascariensis Bonnatere, 1790

Surely, the most conspicuous snake species of Madagascar due to the strange and sexually dimorphic rostral appendage. A single adult female was found foraging on the ground, in a degraded forest patch in the morning (Fig. 2F). The presence of the typical rostral appendage assured the species identification. *L. madagascariensis* is also known from the nearby localities Nosy Boraha and Tampolo, where it inhabits the coastal and littoral rainforests and secondary forest formations (Glaw, Vences 2007; Gehring, Ratsoaivina, Vences 2010).

Madagascarophis colubrinus (Schlegel, 1837)

This snake is probably one of the most common snakes of Madagascar and has one of the widest distribution ranges (Glaw, Vences 2007). *M. colubrinus* occurs in every kind of habitat ranging from closed primary rainforests to houses in big cities. Therefore the encounter of this species in Ambodiriana was expected and not surprising. The vertical pupil and the general appearance of the photographed snake assured species identification (Fig. 2E) as a confusion with the dry habitat adapted similar species *M. meridionalis* and *M. ocellatus* from southern Madagascar in Ambodiriana is very unlikely.

Parastenophis betsileanus (Günther, 1880)

After the revision of the genus *Stenophis* by Nagy, Glaw, Vences 2010, *Stenophis betsileanus* was placed in the monotypic genus *Parastenophis*, due to the molecular and morphological distinctiveness of this species. This nocturnal and partly arboreal species was identified on the photographs due to its distinct coloration, consisting of white cross-bands on a dark brown ground coloration (Fig. 2A). One specimen was observed at night within the primary rainforest of Ambodiriana preying on a leaf chameleon (*Brookesia superciliaris*) (Fig. 4). Preying on the leaf litter inhabiting *Brookesia superciliaris* fits well to the observation that *P. betsileanus* is also a terrestrial

forager and is not completely restricted to an arboreal life-style, like the other exclusively arboreal species of the former genus *Stenophis* (sensu lato). The finding of *P. betsileanus* at Ambodiriana fits into a major gap of the distribution map of this species at Madagascar's north-eastern coast (Glaw, Vences 2007).

Phisalixella artifasciata (Duméril, Bibron & Duméril, 1854)

A single specimen was found at night on a trunk about 1 m above the ground, in low-altitude-rainforest (Fig 2B). It had a total length of 950 mm (snout-vent length: 700 mm; tail length 250 mm) and thereby seems to be the largest reported size for this species. Ground color was reddish-brown with a distinct black cross-band in the neck and several other dark cross-bands on the rest of the body and tail. We largely exclude the possibility that our records refers to *P. variabilis* due to its isolated distribution range in northern and northwestern dry forests, resulting in an allopatric distribution of both species. We cannot surely exclude a possible confusion with *P. iarakaensis*, because we have no information on the number of dorsal scale rows at midbody for this specimen. 19 dorsal scales rows are unique for *P. iarakaensis*, whereas *P. artifasciata* has 21. The tentative finding of *P. artifasciata* at Ambodiriana fulfills a major gap in the distribution map of this species at Madagascar's north-eastern coast (Glaw, Vences 2007).

Pseudoxyrhopus tritaeniatus Mocquard, 1894

A relatively large nocturnal and terrestrial snake with a unique coloration consisting of five separated black stripes on the back on a red ground coloration (Fig. 2G), like it is reported from specimens from Nosy Mangabe (Glaw, Vences 2007). The photographed specimen was found foraging on the forest floor inside the primary rainforest at night. This finding adds another species of the genus *Pseudoxyrhopus* (besides *P. heterurus*) to the snake fauna of the Ambodiriana forest reserve.

Conclusion

Encounters of snakes are usually rare in Malagasy rainforests, except of some common species such as *Madagascarophis colubrinus* or *Thamnosophis lateralis*. Therefore only limited information exists on the distribution and natural history of most Malagasy lamprophiid species. With the presented observation we add eight more serpent species to the

previously published records on the herpetofauna of the Ambodiriana forest by Gehring, Ratsoaivina, Vences (2010), resulting in a total of at least twelve species. Needless to say that even this number is surely an underestimation of the true diversity in this little patch of lowland rainforest. Species inventories are a cornerstone for the justification and the management of conservation activities and can give crucial information on the condition of a protected area. Especially species of high trophic levels (like snakes) are likely sensitive to disruptions in the ecological equilibrium, therefore a high diversity of these predators is a good indicator of the health of this forest.

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