

Insights into the feeding behavior
of *Madagascarophis meridionalis*
DOMERGUE, 1987, from Isalo,
Madagascar

Madagascar has a rich and diverse colubrid snake fauna numbering about 80 currently described species. Although recent years have seen major advances in the understanding of Malagasy snake systematics as well as the description of several new taxa (e.g., NAGY et al. 2003, 2007, 2012; GLAW & VENCES 2007; FRANZEN et al. 2009; GLAW et al. 2007, 2009, 2013, 2014; VIEITES et al. 2010), there is still little knowledge about the behavior or ecology of most species. The present note provides insights into the feeding behavior of a little-known lamprophiid species endemic to south-western and south-central Madagascar, *Madagascarophis meridionalis* DOMERGUE, 1987.

The genus *Madagascarophis* MERTENS, 1952, comprises four recognized species (GLAW et al. 2013) of crepuscular and nocturnal snakes with highly varied diets: recorded prey items include frogs, lizards, snakes and birds (CADLE 2003). *Madagascarophis meridionalis* is largely known from the arid spiny forests of south-western Madagascar, but specimens from the Isalo Massif and further east (Andringitra National Park) have also been identified as *M. meridionalis*, using nuclear and mitochondrial markers (NAGY et al. 2007, 2013).

A telemetry study on the spatial ecology of the Rainbow Frog, *Scaphiophryne gottliebii* BUSSE & BÖHME, 1992 (ANDREONE et al. 2013) carried out in the Isalo Massif (Fianarantsoa Province, Antsohy Fivondronona, Ranohira Firaisana) revealed some information on the species' interspecific interactions. One of the radio-tracked individuals was consumed by a juvenile *M. meridionalis* [not *M. colubrinus* (SCHLEGEL 1837), as previously reported; ANDREONE et al. 2013], later captured on 15 February 2011 near Malaso canyon (22°35,49'S; 45°21,44'E) (Fig. 1). The specimen is currently preserved at the Parc Botanique et Zoologique de Tzimbazaza (Antananarivo, Madagascar) under the provisional code FAZC 14788.

On 12 February 2011, an adult individual of *M. meridionalis* was observed

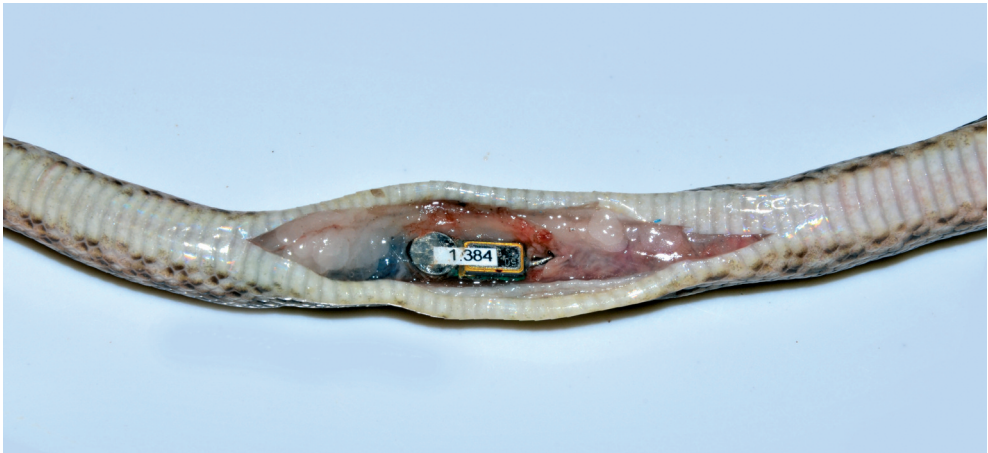


Fig. 1: Juvenile of *Madagascarophis meridionalis* DOMERGUE, 1987, captured after consumption of an adult *Scaphiophryne gottlebei* BUSSE & BÖHME, 1992, being radio-tracked. The figure shows the transmitter that was attached to the frog inside the snake's digestive tract. Photo by P. Eusebio Bergö.

preying on an adult *Mantidactylus* sp. aff. *femoralis* (BOULENGER, 1882) (Fig. 2). This is a locally common water-dwelling frog

species in Anjofo canyon (Andrianomanero), Isalo Massif (22°22,01'S; 45°21,96'E). The snake was spotted already with half of



Fig. 2: *Madagascarophis meridionalis* DOMERGUE, 1987, consuming an adult *Mantidactylus* sp. aff. *femoralis* (BOULENGER, 1882) in Anjofo canyon (Andrianomanero), Isalo Massif, Madagascar. A-B – the snake swallows the frog head first; C – the individual writhes its body to facilitate the passage of the prey to the stomach. Photos by P. Eusebio Bergö.



Fig. 3: *Madagascarophis meridionalis* DOMERGUE, 1987, swimming (A) and foraging (B) in a stream in the Namazaha Valley, Isalo Massif, Madagascar. Photos by L. Jasper.

the frog body in its mouth. The episode subsequently lasted for about five minutes (from 18:36 to 18:41), before the snake had completely swallowed the frog.

On 4 January 2013, at 09:25, another adult individual of *M. meridionalis* was encountered in Namazaha Valley, also within the Isalo Massif (22°32.24'S; 45°22.17'E,

850 m a.s.l.). The snake was actively foraging within a small rocky stream. Upon the first encounter, the animal was entirely submerged and remained underwater for at least 30 seconds, during which time it repeatedly inserted its head between and under rocks in search of prey. When it emerged it continued to move along the

stream for several minutes with its head above water (Fig. 3) until when (perhaps disturbed by our presence) it left the stream and sought refuge under some dense water-side vegetation. It was still present under this vegetation an hour later. The authors presume that the snake was searching for frogs, or perhaps their eggs or tadpoles, because no aquatic lizards are known from this region and these snakes are not known to eat invertebrates.

The diurnal, active foraging observed seems unusual in the genus *Madagascarophis*, which is known to be primarily nocturnal or crepuscular (CADLE 2003; GLAW & VENCES 2007). Interesting to note though that the Namazaha valley is a very narrow, steep-sided canyon, and by this time of the morning had not received any direct sunlight. Amongst other Malagasy snakes, *Liopholidophis sexlineatus* (GÜNTHER, 1882) is semiaquatic and *Thamnosophis lateralis* (DUMÉRIL, BIBRON & DUMÉRIL, 1854) has also been recorded in water (CADLE 2003; GLAW & VENCES 2007). The present observations confirm the preference of *M. meridionalis* for aquatic habitats and, although the genus *Madagascarophis* is known to prey on a range of vertebrate groups, in these canyons on Isalo Massif, *M. meridionalis* may be a specialist predator of frogs, at least in the rainy season (GLAW & VENCES 2007).

ACKNOWLEDGMENTS: The authors are indebted to the University of Antananarivo, Parc Botanique et Zoologique de Tsimbazaza (PBZT), the Direction des Eaux et Forêts, and Madagascar National Parks (MNP) for permission to visit the National Park of Isalo and to conduct research activity (authorization nos. 191/09/MEF/SG/DGF/DCB.SAP/SLRSE of 22. IX.2009, 222/09/MEF/SG/DGF/DCB.SAP/SLRSE of 12.X.2009, and 357/10/MEF/SG/DGF/DCB.SAP/SCB of 17.XII.2010). The team of MNP at Ranohira–Isalo was very helpful, especially its director A. Rajaonarivo and our guide Anicet. The fieldwork was possible with the support of the Mohamed bin Zayed Species Conservation Fund, EDGE, Zoological Society of London, Amphibian Specialist Group, Conservation International, Gondwana Conservation and Research, Regione Piemonte, and the Zurich Zoo. G. M. Rosa holds a doctoral scholarship from the Fundação para a Ciência e a Tecnologia (FCT) (SFRH/BD/69194/2010); A. Crottini is supported by an Investigador FCT contract (IF/00209/2014) under the Programa Operacional Potencial Humano – Quadro de Referência Estratégico Nacional funds from the European Social Fund and Portuguese Ministério da Educação e Ciência. The authors acknowledge the project “Genomics and Evolutionary Biology” cofinanced by North Portugal Regional Operational Programme 2007/2013 (ON.2 – O Novo

Norte), under the National Strategic Reference Framework (NSRF), through the European Regional Development Fund (ERDF).

REFERENCES: ANDREONE, F. & BERGÒ, P. E. & MERCURIO, V. & ROSA, G. M. (2013): Spatial ecology of *Scaphiophryne gottlebei* in the canyons of the Isalo Massif, Madagascar.- *Herpetologica*, Lawrence; 69 (1): 11-21. CADLE, J. E. (2003): Colubridae, Snakes; pp. 997-1004. In: GOODMAN, S. M. & BENSTEAD, J. P. (Eds.): The natural history of Madagascar; Chicago (The University of Chicago Press). FRANZEN, M. & JONES, J. & RASELIMANANA, A. P. & NAGY, Z. T. & D'CRUZE, N. & GLAW, F. & VENCES, M. (2009): A new black-bellied snake (Pseudoxyrhophiinae: *Liophidium*) from western Madagascar, with notes on the genus *Pararhadinaea*.- *Amphibia-Reptilia*, Leiden; 30: 173-183. GLAW, F. & KUCHARZEWSKI, C. & NAGY, Z. T. & HAWLITSCHKE, O. & VENCES, M. (2014): New insights into the systematics and molecular phylogeny of the Malagasy snake genus *Liopholidophis* suggest at least one rapid reversal of extreme sexual dimorphism in tail length.- *Organisms, Diversity & Evolution*, Berlin, Heidelberg; 14 (1): 121-132. GLAW, F. & NAGY, Z. T. & FRANZEN, M. & VENCES, M. (2007): Molecular phylogeny and systematics of the pseudoxyrhophiine snake genus *Liopholidophis* (Reptilia, Colubridae): evolution of its exceptional sexual dimorphism and descriptions of new taxa.- *Zoologica Scripta*, Oxford; 36: 291-300. GLAW, F. & NAGY, Z. T. & KÖHLER, J. & FRANZEN, M. & VENCES, M. (2009): Phylogenetic relationships of a new species of pseudoxyrhophiine snake (Reptilia: Lamprophiidae: *Thamnosophis*) suggest a biogeographical link between western and northern Madagascar.- *Organisms, Diversity & Evolution*, Berlin, Heidelberg; 9: 13-22. GLAW, F. & VENCES, M. (2007): A field guide to the amphibians and reptiles of Madagascar. Third edition. Köln (M. Vences und F. Glaw Verlags GbR), pp. 496. GLAW, F. & VENCES, M. & KUCHARZEWSKI, C. & NAGY, Z. T. (2013): Resolving an enigma by integrative taxonomy: *Madagascarophis fuchsi* (Serpentes: Lamprophiidae), a new opisthoglyphous and microendemic snake from northern Madagascar.- *Zootaxa*, Auckland; 3630 (2): 317-332. NAGY, Z. T. & GLAW, F. & ANDREONE, F. & WINK, M. & VENCES, M. (2007): Species boundaries in Malagasy snakes of the genus *Madagascarophis* (Serpentes: Colubridae *sensu lato*) assessed by nuclear and mitochondrial markers.- *Organisms, Diversity & Evolution*, Berlin, Heidelberg; 7: 241-251. NAGY, Z. T. & JOGER, U. & WINK, M. & GLAW, F. & VENCES, M. (2003): Multiple colonization of Madagascar and Socotra by colubrid snakes: evidence from nuclear and mitochondrial gene phylogenies. - *Proceedings of the Royal Society, London*; (B) 270: 2613-2621. NAGY, Z. T. & SONET, G. & GLAW, F. & VENCES, F. (2012): First large-scale DNA barcoding assessment of reptiles in the biodiversity hotspot of Madagascar, based on newly designed COI primers.- *PLoS One*, Lawrence; 7: e34506. VIEITES, D. R. & RATSOAVINA, F. M. & RANDRIANIAINA, R.-D. & NAGY, Z. T. & GLAW, F. & VENCES, M. (2010): A rhapsody of colours from Madagascar: discovery of a remarkable new snake of the genus *Liophidium* and its phylogenetic relationships.- *Salamandra*, Rheinbach; 46: 1-10.

KEY WORDS: Reptilia: Squamata: Serpentes; *Madagascarophis meridionalis*, feeding behavior, prey, ethology, Madagascar

SUBMITTED: December 15, 2014

AUTHORS: Gonçalo M. ROSA (corresponding author, < goncalo.m.rosa@gmail.com >) ^{1, 2, 3}; Paolo Eusebio BERGÒ ⁴; Franco ANDREONE ⁴; Angelica CROTTINI ⁵; Louise JASPER ⁶; Charlie J. GARDNER ^{1, 7}

¹) Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, Kent, CT2 7NR, UK

²) Institute of Zoology, Zoological Society of London, Regent's Park, NW1 4RY London, UK

³) Centre for Ecology, Evolution and Environmental Changes (CE3C), Faculdade de Ciências da Universidade de Lisboa, Bloco C2, Campo Grande, Lisboa, Portugal

⁴) Museo Regionale di Scienze Naturali, Via G. Giolitti, 36, I-10123, Torino, Italy

⁵) CIBIO Research Centre in Biodiversity and Genetic Resources, InBIO, Universidade do Porto, Campus Agrário de Vairão, Rua Padre Armando Quintas, N^o 7, 4485-661 Vairão, Vila do Conde, Portugal

⁶) BP 639, Toliara 601, Madagascar.

⁷) WWF Madagascar and Western Indian Ocean Programme Office, BP 738, Antananarivo 101, Madagascar