

An enigmatic new *Scaphiophryne* toadlet from the rainforests of north-eastern Madagascar (Amphibia: Microhylidae)

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Abstract

A new species of *Scaphiophryne* is described from north-eastern Madagascar. The new toadlet species is probably at least partly fossorial as can be judged from its large and sharp metatarsal tubercle, and seems to lead a secretive or strictly seasonal life since very few adult specimens were collected despite intensive field surveys in the region. The new species differs from all other *Scaphiophryne*, among other characters, by the absence of a tarsal tubercle and reminds the genus *Paradoxophyla* in its strongly marbled ventral pattern on belly and hindlimbs, and by its triangular head shape with pointed snout.

Key words

Anura; Microhylidae; *Scaphiophryne*; *Scaphiophryne matsoko* sp. n.; Marotondrano Special Reserve; tarsal tubercle.

Introduction

Madagascar harbors an extraordinary diversity of amphibians, with currently about 290 described species, and many others (at least 130) still waiting to be described (VIEITES *et al.*, 2009). Over 40 new species have been described since 2010. Contrasting with its high species diversity, the Malagasy amphibian fauna is characterised by a considerable paucity of families (GLAW & VENCES, 2007), represented by five major phylogenetic clades (ANDREONE *et al.*, 2005; VIEITES *et al.*, 2009; CROTTINI *et al.*, 2012): (1) the family Mantellidae which is endemic to Madagascar and Mayotte, (2) the microhylid subfamily Dyscophinae, (3) the microhylid subfamilies Cophylinae and Scaphiophryninae which together probably form an

endemic clade (VAN DER MEIJDEN *et al.*, 2007), (4) the hyperoliid genus *Heterixalus*, and (5) the Ptychadenid species *Ptychadena mascareniensis* (GLAW & VENCES, 2007; CROTTINI *et al.*, 2012). In addition, a frog native to India (*Hoplobatrachus tigerinus*, belonging to the family Dicroglossidae) has been introduced to Madagascar (KOSUCH *et al.*, 2001).

Species-level endemism in Madagascar's amphibians is complete if considering the entire island and if ignoring human introductions (100% of the island's amphibians naturally only occur in Madagascar), but is also high considering smaller regions within Madagascar. This high rate of microendemism clearly represents a major

challenge for conservation strategies because it is difficult to establish efficient conservation strategies for narrowly distributed taxa (KREMEN *et al.*, 2008). The north-eastern (NE) portion of Madagascar represents one of the most interesting centers of amphibian diversity and microendemism (e.g., WOLLENBERG *et al.*, 2008b). Factors contributing to this situation might be the heterogeneity of the landscape, and the geographic situation, with connections to the northernmost parcels of the eastern rainforest belt, to the Sambirano rainforest, as well as to areas of transitional and dry forest.

Despite the intensive biological inventories carried out within different forest blocks in NE Madagascar, the species inventory of this area is far from complete, as indicated by the discovery of many new species over the last 10 years. These include, for example, *Boophis ulftunni*, *Gephyromantis tahotra*, *G. ranjomavo*, *G. salogy* and *Blommersia variabilis* (ANDREONE *et al.*, 2003; WOLLENBERG *et al.*, 2008a; ANDREONE *et al.*, 2010; PABIJAN *et al.*, 2011; GLAW & VENCES, 2011; GLAW *et al.*, 2011).

The genus *Scaphiophryne*, together with *Paradoxophyla*, represent the endemic subfamily Scaphiophryninae within the Microhylidae (BLOMMERS-SCHLÖSSER & BLANC, 1991). Scaphiophrynines probably form a clade with the equally Madagascar-endemic Cophylinae (VAN DER MEIJDEN *et al.*, 2007; KURABAYASHI *et al.*, 2011) although other studies placed them with African Hoplophryninae (PYRON & WIENS, 2011), and they are not particularly species rich: *Paradoxophyla* currently contains two and *Scaphiophryne* eight nominal species (GLAW & VENCES, 2007), plus two dubious species, *S. obscura* and *S. verrucosa* which are probably valid due to nomenclatural priority, but were not yet assigned to any of the known species.

The toadlets of the genus *Scaphiophryne* are mainly characterised by the morphology of their psammonektonic tadpole which is intermediate between the ranoid and the microhylid type (BLOMMERS-SCHLÖSSER, 1975; WASSERSUG, 1984; MERCURIO & ANDREONE, 2006; GROSJEAN *et al.*, 2007, 2009). *Scaphiophryne* typically reproduce in lentic, often temporary waters, and deposit a large number of small eggs (BLOMMERS-SCHLÖSSER, 1975; VENCES *et al.*, 2002a).

Our field research in NE Madagascar revealed at several sites the presence of an undescribed but morphologically highly distinct species that can be ascribed to the genus *Scaphiophryne*. In this paper we provide the formal description of this new species and discuss its possible relationships to other scaphiophrynine species.

Materials and Methods

Specimens were collected by opportunistic searches during day and night and by pitfall traps with drift fences.

Vouchers specimens were euthanized in chlorotone solution and fixed in 5% formalin. Subsequently they were soaked in water to remove formalin before being preserved in 70% ethanol. Specimens examined are deposited in the herpetological collections of the Museo Regionale di Scienze Naturali, Torino (MRSN), the Université d'Antananarivo, Département de Biologie Animale (UADBA), and the University of Michigan, Museum of Zoology (UMMZ). Comparative material was examined from the Zoologisches Forschungsmuseum A. Koenig, Bonn (ZFMK), the Zoologische Staatssammlung München (ZSM), and the Zoological Museum Amsterdam (ZMA).

The following measurements were taken with a caliper to the nearest 0.1 mm: SVL (snout-vent length), HW (head width at the maxillary rictus), HL (head length, from the maxillary commissure to the snout tip), ED (horizontal eye diameter), END (eye-nostril distance), NSD (nostril-snout tip distance), NND (nostril-nostril distance), TD (horizontal tympanum diameter), HAL (hand length, from the carpal-metacarpal articulations to the tip of the longest finger), FORL (forelimb length, from the axil to the tip of the longest finger), HIL (hindlimb length, from the cloaca to the tip of the longest toe), FOL (foot length, from the tarsal-metatarsal articulations to the tip of the longest toe), FOTL (foot length including tarsus, from the tibiotarsal articulation to the tip of the longest toe), IMTL (maximum length of inner metatarsal tubercle). The sex and maturity of preserved specimens were determined by dissection and gonad examination.

Scaphiophryne matsoko sp. nov.

Figs. 1–4

Holotype. UADBA 29301 (field number APR 6090), probably an adult male, collected on 28 November 2004 in the Special Reserve of Marotondrano, Mandritsara Fivondronana, Mahajanga Province, Madagascar, – 16.285, 48.81500, 850 m above sea level, by A. P. RASELIMANANA.

Paratypes. Three specimens, UADBA 29300 and UADBA 29302–29303 (field numbers APR 6055, 6091 and 6131) with same collection locality and date as holotype (except UADBA 29303 collected on 30 November 2004). UMMZ 191168, adult male, from Ambatovaky Special Reserve, Soanierana-Ivongo Faritany, Toamasina Fivondronana, eastern Madagascar, 600 m above sea level, collected by C. J. RAXWORTHY on 22 February 1990, approximately at – 16.74, 49.25. UMMZ 211519, adult male, from a site recorded as Ankarana River, Antalaha Faritany, Antsiranana Fivondrona, 70–100 m above sea level, collected by C.J. RAXWORTHY, ANGELIN RAZAFIMANANTSOA and ANGELUC RAZAFIMANANTSOA on 11 January 1993 (coordinates not recorded). MRSN A1849 (FN 6367), juvenile, from Tsararano Forest, Campsite 1, (Antsarahana'ny Tsararano), Andapa Fivondronana, Antsiranana Faritany (Diego Suarez Province), – 14.90667, 49.68667, on

5 December 1996, collected by F. ANDREONE and J. E. RANDRIANIRINA; [MRSN A2270](#), juvenile, from Besariaka Forest, Campsite 1 (Ambinaninimiakamidina), Andapa Fivondronana, Antsiranana Faritany (Diego Suarez Province), at Besariaka forest, Campsite 1, Andapa Fivondronana, Antsiranana (Diégo Suarez Province), –14.82167, 49.05417, about 940 m a.s.l., on 28 April 1996, collected by J. E. RANDRIANIRINA.

Diagnosis. A microhylid toad assigned to the genus *Scaphiophryne* based on combination of (a) absence of vomerine teeth; (b) rudimentary webbing between toes; (c) large and sharp inner metatarsal tubercle; (d) broad, posteriorly free tongue; (e) apparent dark subgular vocal sac. See comments below for a distinction from all other microhylid genera in Madagascar. Distinguished from all other species of *Scaphiophryne* by absence of a tarsal tubercle and a distinctly pointed snout tip. Further distinguished from all *Scaphiophryne* except *S. calcarata* by longer hindlimbs (TIBL/SVL ratio 0.46–0.52 vs. less than 0.43) and a distinct dorsolateral fold; from all *Scaphiophryne* except some *S. marmorata* and *S. boribory* by the strongly contrasted dark-light marbling ventrally on belly and hindlimbs; from *S. boribory*, *S. gottlebei*, *S. madagascariensis*, *S. marmorata*, *S. menabensis*, and *S. spinosa* by the uniformly brown reddish dorsal color without green elements except on the upper surface of hindlimb; and from *S. boribory*, *S. gottlebei*, *S. marmorata*, *S. menabensis*, and *S. spinosa* by absence of expanded terminal discs on fingers and toes (vs. distinctly triangular expanded discs). Most similar to *S. calcarata* from which it differs by larger size (adult SVL up to 35–36 vs. 28–33 mm), a much more pointed (vs. rounded) snout, a more strongly marked dorsolateral fold, and the absence of the tarsal tubercle.

Description of the holotype. Specimen in good state of preservation. For measurements see Table 1. A longitudinal cut along both flanks applied for gonad examination. Body stout; head slightly wider than long, distinctly narrower than body; snout tip pointed in dorsal and lateral views, with a distinct rostral projection beyond mouth opening ca. 2 mm in length. Nostrils directed laterally; slightly protuberant, nearer to tip of snout than to eye; canthus rostralis distinct; loreal region flat; tympanum not clearly visible; supratympanic fold visible, straight; tongue ovoid and broad, posteriorly free and not bifid; maxillary teeth not recognizable; vomerine teeth absent; choanae rounded. Forelimbs slender; subarticular tubercles single and distinct; metacarpal tubercles not recognizable; fingers without webbing; relative length of fingers $1 < 2 < 4 < 3$, fourth finger clearly longer than second finger; finger disks not expanded; nuptial pads absent. Hindlimbs relatively slender and short but longer than in most other *Scaphiophryne*; tibiotarsal articulation almost reaches the tympanal region when hindlimb is adpressed along the body; lateral metatarsalia strongly connected; large and sharp inner metatarsal tubercle present, no outer metatarsal tubercle; no tarsal tubercle; traces of webbing between toes; relative length of toes $1 < 2 < 5 < 3 < 4$;



Fig. 1. Living holotype of *Scaphiophryne matsoko* (UADBA 29301) from Marotondrano in dorsolateral view. Photo by A. P. RASELI-MANANA.

third toe distinctly longer than fifth toe; terminal disks of toes not expanded.

Skin on dorsal and ventral surface, including throat, smooth. A distinct dorsolateral fold runs from the posterior corner of the eye to the hindlimb insertion. In preservative, dorsally uniformly dark brown, gradually becoming lighter in the inguinal region. Dorsolateral fold of beige coloration in the inguinal region, constituting a distinct border of coloration. A very thin light vertebral line is present. The flanks below the fold are of a darker tone of brown than the dorsum. The lateral area from just anterior to the tympanal region to the forelimb insertion, including also the upper surface of the forelimb, is beige with a few minute brown spots. The hindlimbs are dark brown with some very indistinct markings and cross-bands. A few small beige dots on the posterior part of the dorsum and above the eye. Ventrally, the throat is brown with a faint and incomplete central line of white dots. The chest is dirty yellowish with indistinct brown marbling. The belly and hindlimbs have a distinct vermiculated marbling in yellowish and dark brown.

In life (Fig. 1), the color was generally similar. The dorsum was brown with a somewhat reddish tone and the flanks darker brown. The dorsolateral fold was white colored. The hindlimbs had distinct and extended green markings dorsally and a reddish brown background coloration. The iris was light brown with some darker markings. The belly was yellow with dark markings, the throat was orange.

Variation. The paratypes agree largely with the holotype in morphology. Measurements of five paratypes are included in Table 1. [UMMZ 191168](#) (Fig. 3–4) and [UMMZ 211519](#) are adult males as ascertained by gonad inspection. [UMMZ 191168](#) has a visible tympanum which however is not very distinct; its diameter is 77% of horizontal eye diameter. In this specimen we also noted rudimentary maxillary teeth and a slightly rugged skin on the throat, probably indicating the presence of a subgular



Fig. 2. Preserved holotype of *Scaphiophryne matsoko* (UADBA 29301) in dorsal and ventral views.

vocal sac. The left side of the head of UMMZ 211519 is damaged so that a number of measurements could not be taken, and additionally transversal and longitudinal ventral cuts were made in this specimen to examine gonads and shoulder girdle. The tibiotarsal articulation reaches the eye. As far as recognizable, also the coloration agrees with that of the holotype (after several years preserved in alcohol): brown ground color, light posterior head sides and tympanic region, distinct brown-white marbling on belly. The two MRSN paratypes are juvenile specimens in mediocre state of preservation, being in ethanol since 15 years. The tibiotarsal articulation of MRSN A2270 reaches the eye. The overall coloration is rather darkened, but it appears substantially similar to the adults, with a blackish mottled belly. MRSN A1849 is comparatively smaller, with a less dehydrated body. The tibiotarsal articulation reaches the eye. In this specimen whitish light spots (in life almost greenish-yellowish) are visible at the level of the fore-arm insertion. The right foot is amputated, with tarsus and metatarsus, but without any visible toe.

Etymology. The species epithet is a noun in apposition to the genus name, derived from the Malagasy adjective „*matsoko*“, used as to indicate something pointed forward. It is used in this context to indicate to the pointed shape of the head of this species.

Natural history. The holotype was found jumping on leaf litter at the edge of the rainforest at the campsite at 18:00, in almost closed canopy forest. UADBA 29302 was caught under a rotten log after jumping on the ground in a degraded rainforest in a valley along the Riamalandy river at 11:00 am. The two other specimens from Marotondrano SR were caught in pitfall traps dur-

ing the afternoon checking of the traps. This pitfall line was set in a valley with almost closed canopy rainforest near the campsite. Hence all these specimens were collected from roughly the same habitat, during a period (7 days) without rainfall, and the hand-caught individuals were active during daylight. The other traps and the surveys carried out at other places in the Marotondrano reserve did not result in additional records of the species. This observation suggests that *S. matsoko* might have a localized distribution within its range or highly seasonal habits. The two MRSN paratypes were captured in pitfall traps during morning surveys.

Distribution. The new species is known from (1) the type locality, Marotondrano Special Reserve, (2) Ambatovaky Special Reserve, (3) Ankarana River near Antalaha, (4) Tsararano and (5) Besariaka (see Fig. 5). All collecting sites are located at low to mid-altitudes (70–850 m asl) in north-eastern Madagascar.

Available names. Besides the nominal species of *Scaphiophryne* and *Paradoxophyla* listed in the diagnosis above, several names are currently considered as either junior synonyms of *Scaphiophryne calcarata*, or as dubious names, or as valid species by some authorities (e.g., AMPHIBIAWEB, 2013). These are: *Pseudohemismus granulatus* GUIBÉ, 1952; *Pseudohemismus longimanus* ANGEL, 1930; *Pseudohemismus longimanus* var. *melanopleura* ANGEL, 1934; *Hemismus obscurus* GRANDIDIER, 1872; *Pseudohemismus verrucosus* ANGEL, 1930. The type specimens on which these names are based (more details in BLOMMERS-SCHLÖSSER & BLANC, 1991; FROST, 2013) are partly in extremely bad state of preservation, and will be discussed in detail in a forthcoming revision of the *S. calcarata* complex which consists of several cryptic species



Fig. 3. Preserved paratype (UMMZ 191168) of *Scaphiophryne matsoko*: dorsal and ventral view, lateral view of head, and ventral views of hand and foot.



Fig. 4. Ventral views of the tarsus of *Scaphiophryne matsoko* (left; paratype UMMZ 191168), *S. brevis* (center; ZFMK 53714) and *S. marmorata* (right; ZMA 6877), showing the tarsal tubercle (as indicated by arrows) in the latter two species which is absent in *S. matsoko*.

(see GLAW & VENCES, 2007). Here we only state that upon our own examination of all type specimens, none of these names is available as earlier name for *Scaphiophryne matsoko* due to the presence of a tarsal tubercle in all of them. Furthermore, the type localities (where known) of these taxa all are in the dry areas of western or north-western Madagascar, thus not agreeing with the distribution range and habitat requirements of *S. matsoko*.

Comments. The new species described herein is assigned to the genus *Scaphiophryne* based on a number of phenetic characters, but it lacks the most unequivocal external synapomorphy of this genus within the scaphiophrynine/cophyline clade: the tarsal tubercle, a distinct rounded protuberance on the ventral side of the tarsus close to the tibiotarsal articulation. The small number of specimens of *Scaphiophryne matsoko* available for analysis led us to the decision to avoid the clearing and staining of one of them for osteological examination. We therefore here shortly review the external differences of the new species to other Malagasy microhylids (according to BLOMMERS-SCHLÖSSER & BLANC, 1991; GLAW &

VENCES, 2007). The Dyscophinae contain a single genus, *Dyscophus*, with three species. These are characterized by vomerine teeth and moderate webbing between toes (both absent in *S. matsoko*). The Cophylinae, in contrast, are a large radiation comprising almost 40 nominal species in seven genera. Of these, *Anodonthyla*, *Cophyla* and *Platypelis* are arboreal forms with widely expanded disks of fingers and toes (not expanded in *S. matsoko*). *Madecassophryne* and *Stumpffia* are small to miniaturized forms of less than 30 mm SVL without enlarged inner metatarsal tubercles (vs. >30 mm and enlarged inner metatarsal tubercle in *S. matsoko*). The fossorial species of *Plethodontohyla* and *Rhombophryne* are characterized by a snout that is usually rounded in dorsal view (pointed in *S. matsoko*), their internal metatarsal tubercle is distinctly smaller and not sharp as in *S. matsoko*, and many species have vomerine teeth. The second scaphiophrynine genus, *Paradoxophyla*, shares a distinct, vermiculated ventral marbling with the new species but has partly aquatic habits and lacks an enlarged metatarsal tubercle.

Discussion

Recent years have seen an enormous increase of new species descriptions in the Malagasy amphibian fauna. Many of these, however, refer to cryptic species that are morphologically very similar to already described forms. Among microhylids, for example, this is true for *Plethodontohyla mihanika* (VENCES *et al.*, 2003a) which is morphologically similar to *P. notosticta*, or *Rhombophryne coronata* that is similar to *R. serratopalpebrosa* (VENCES & GLAW, 2003). Most of the still undescribed candidate species of Malagasy frogs do not show highly distinct morphological and behavioural features, and their distinction from related siblings is possible only with an integrative combination of morphological, acoustic, and molecular analyses (e.g., VIEITES *et al.*, 2009). Notwithstanding, several species newly described in the last decades are very distinct, including *Tsingymantis antidra* (GLAW *et al.*, 2006), from the tsingy karst of the Ankarana reserve, of a peculiar small *Blommersia* with previously unknown breeding strategy (ANDREONE *et al.*, 2010), and two extremely colorful species of *Scaphiophryne* (BUSSE & BÖHME, 1992; VENCES *et al.*, 2003b). The species described herein is another such example because its unique combination of characters makes a confusion with any other *Scaphiophryne* unlikely and even sheds some doubts on its generic attribution. Actually, the lack of a tarsal tubercle, and the overall similarity (pointed snout, marbled venter) to *Paradoxophyla palmata* and *P. tiarano* may qualify the new species to phylogenetically bridge the large morphological and evolutionary gap between these two genera that were first tentatively placed in one subfamily Scaphiophryninae by BLOMMERS-SCHLÖSSER & BLANC (1991) and confirmed

Table 1. Morphometric measurements (all in mm) of holotype (HT) and seven paratypes (PT) of *Scaphiophryne matsoko* sp. n. For abbreviations of morphometric measurements and collection acronyms, see Materials and Methods. Additional abbreviations: n.a., not applicable; n.m., not measured; M, male; J, juvenile.

Catalogue number	sex	Status	SVL	HW	HL	Eye	Tym	END	NSD	NND	FORL	HAL	HIL	FOTL	FOL	TIBL	IMTL	IMTH
UADBA 29301	M?	HT	35.1	11.4	10.2	2.9	n.a.	2.3	1.8	3.0	49.2	19.8	49.2	22.5	16.2	15.5	2.5	1.7
UADBA 29303	?	PT	34.2	10.0	9.9	2.9	1.4	2.1	1.7	3.1	50.3	20.1	50.3	23.4	16.6	16.2	3.0	1.6
UADBA 29300	?	PT	24.0	7.4	7.3	2.8	1.3	2.0	1.4	2.6	34.8	14.2	34.8	16.6	11.3	11.4	1.7	1.3
UADBA 29302	J	PT	18.6	6.0	6.5	1.7	n.a.	1.8	1.2	2.1	26.2	10.8	26.2	12.2	7.9	8.4	1.3	1.0
UMMZ 191168	M	PT	34.6	10.7	10.1	3.0	2.3	2.4	1.5	2.5	21.5	10.2	52.9	24.2	17.5	16.2	2.5	n.m.
UMMZ 211519	M	PT	36.4	n.a.	n.a.	3.0	n.a.	n.a.	n.a.	n.a.	23.8	11.7	59.0	27.4	19.4	18.8	2.6	n.m.
MRSN A2270	J	PT	21.2	8.3	7.6	2.7	1.3	2.1	1.5	2.3	11.1	5.5	27.0	13.5	10.3	9.3	1.5	1.1
MRSN A1849	J	PT	18.7	6.9	6.5	2.5	1.2	1.6	1.7	2.2	10.9	4.8	24.7	12.2	9.1	9.2	1.3	n.m.

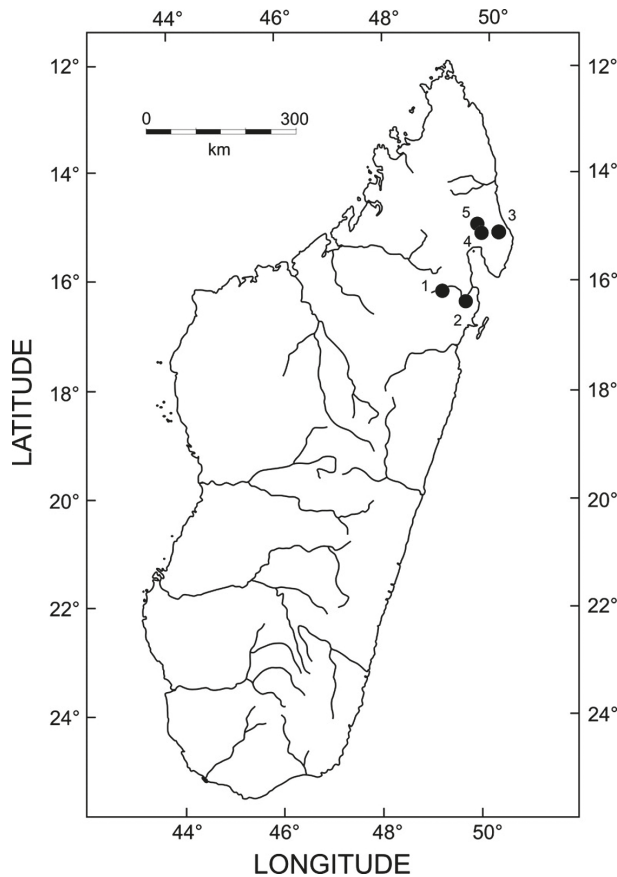


Fig. 5. Map of Madagascar with localities of *Scaphiophryne matsoko*. (1) Marotondrano Special Reserve, (2) Ambatovaky Special Reserve, (3) Ankarana River near Antalaha (approximative location), (4) Tsararano and (5) Besariaka.

as a clade by VAN DER MEIJDEN *et al.* (2007).

The new species is remarkable also regarding its combination of morphological and natural history characters. Within *Scaphiophryne*, two major groups can be distinguished based on general external appearance (VENCES *et al.*, 2003b): the *Scaphiophryne marmorata* complex (*S. marmorata*, *S. menabensis*, *S. boribory* and *S. spinosa*), plus *S. madagascariensis* and *S. gottlebei*, which are characterized by greenish dorsal color patterns and (except for *S. madagascariensis*) by expanded terminal finger disks. These species all live in the rainforests or montane regions of east and central Madagascar, or in forest relicts in western Madagascar (*S. gottlebei*, *S. menabensis*). In contrast, *Scaphiophryne calcarata* and *S. brevis* are largely restricted to arid environments of western Madagascar. The new species *Scaphiophryne matsoko* shows the strongest similarity to *S. calcarata*, yet it seems restricted to the humid rainforests of north-eastern Madagascar. Awaiting molecular or osteological data on the relationships among these taxa, we hypothesize that *S. matsoko* may represent an independent lineage of scaphiophrynine microhylids restricted to north-eastern Madagascar, not closely related to any other *Scaphiophryne*.

Despite intensive fieldwork in the north-eastern Madagascar (e.g., ANDREONE, 2005) only few specimens of

Scaphiophryne matsoko have been collected so far. Two of these were juveniles collected in pitfalls (MRSN A2270 and MRSN A1849). Almost no data on the natural history of this species are available. This could be interpreted as indication of *S. matsoko* being rare or localized, or restricted to special environments, but we rather suspect that it parallels other *Scaphiophryne* in being strongly seasonal. *Scaphiophryne* usually reproduce in temporary stagnant water (BLOMMERS-SCHLÖSSER, 1975; VENCES *et al.*, 2002b), and often the reproduction is limited to a period of a few days or weeks. Outside the reproductive period these toads are encountered only sporadically. In the Andasibe area, one of the best and most frequently studied rainforests of Madagascar, until recently it was unknown when and in which ponds the relatively common marbled toads, *Scaphiophryne marmorata*, actually reproduce, although adults and especially juveniles are frequently encountered (GROSJEAN *et al.*, 2007, 2009).

The new species is known from at least two protected areas (Ambatovaky Special Reserve and Marotondrano SR) and might occur in one further area that has recently received legal protection (Makira Reserve). Additionally, its general distribution pattern makes its occurrence in the Masoala National Park likely, so that no immediate threats for its survival are apparent, and we suggest a Red List status of Least Concern for this species.

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