

**Description of two new frogs of the genus
Mantidactylus from Madagascar,
with notes on *Mantidactylus klemmeri*
(Guibé, 1974) and *Mantidactylus webbi*
(Grandison, 1953)
(Amphibia, Ranidae, Mantellinae)**

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Two new species of the endemic Malagasy frog genus *Mantidactylus* were discovered during recent fieldwork in northeastern Madagascar, and these are formally named and described in this paper. The first one inhabits mossy stone habitats in the Marojezy massif and is mainly characterized by its olive-greenish coloration and a short snout. The second new species is similar but larger and has a copper red iris. It is characterized by a very distinctly protruding inner metatarsal tubercle which is less developed in other known *Mantidactylus*. Both new species are tentatively included in the subgenus *Gephyromantis*, but their relationships with other *Mantidactylus* remain obscure. Morphologically they are most similar to *M. klemmeri* and *M. webbi*; we therefore provide an updated diagnosis of these two species and a detailed description of the call of *M. klemmeri*, as well as first data on its ecology and coloration in life.

INTRODUCTION

The systematics of the frog genus *Mantidactylus* Boulenger, 1895, endemic to Madagascar, has been the subject of several studies during the last 20 years. The biosystematic investigations of BLOMMERS-SCHLÖSSER (1979) showed that the distinction between the genera *Gephyromantis* and *Mantidactylus*, as made by GUIBÉ (1978) and previous workers, was largely artificial. As a conclusion, BLOMMERS-SCHLÖSSER (1979) considered *Gephyromantis* as a junior synonym of *Mantidactylus*. She also described two new species of the genus and assigned 31 *Mantidactylus* species to 10 phenetic species groups. BLOMMERS-SCHLÖSSER & BLANC (1991) assigned all *Mantidactylus* species to these groups and analysed phylogenetic relationships within *Mantidactylus*. The cladogram presented by these authors characterized the species groups by assumed synapomorphies,

and thus suggested that each represents a monophyletic unit. DUBOIS (1992) elevated some of these groups to subgeneric rank. Based on new biosystematic data, GLAW & VENCES (1994) argued that the monophyly of the subgenera within *Mantidactylus* would be more convincing recognizing four additional subgenera. They also noted that no phylogenetic arguments remain to regard *Laurentomantis* Dubois, 1980 as a genus separate of *Mantidactylus*, and thus considered it as a subgenus, transferring the three *Laurentomantis* species to *Mantidactylus*. Following GLAW & VENCES (1994), 12 subgenera within *Mantidactylus* are presently accepted: *Mantidactylus* Boulenger, 1895; *Gephyromantis* Methuen, 1920; *Hylotritachus* Laurent, 1943; *Laurentomantis* Dubois, 1980; *Blommersia* Dubois, 1992; *Brygomantis* Dubois, 1992; *Guibemantis* Dubois, 1992; *Spinomantis* Dubois, 1992; *Chonomantis* Glaw & Vences, 1994; *Ochthomantis* Glaw & Vences, 1994; *Pandanusicola* Glaw & Vences, 1994; *Phylacomantis* Glaw & Vences 1994.

Since 1990, eight new *Mantidactylus* species have been described (BLOMMERS-SCHLÖSSER & BLANC, 1991; GLAW & VENCES, 1992b, 1994), one species was transferred to this genus from the genus *Boophis* (GLAW & VENCES, 1992a) and three species were resurrected from synonymy (BLOMMERS-SCHLÖSSER & BLANC, 1991; RAXWORTHY & NUSSBAUM, 1994; ANDREONE & GAVETTI, 1994). Despite this intensive work on the genus, the species inventory of *Mantidactylus* is far from being complete. The continued discovery of new species even in well studied areas shows that the genus is much more speciose than presently recognized (59 named species according to GLAW & VENCES, 1994).

The subgenus *Gephyromantis* currently contains 10 species which are arranged in two species groups according to GLAW & VENCES (1994): the *M. asper* group with four scansorial primary forest species, which can be found during the day on the forest floor and which call predominantly at night from leaves and branches; and the *M. boulengeri* group with six rather small ground-dwelling frogs which call mainly during the day. Probably closely related subgenera are *Laurentomantis* with three species and *Phylacomantis* with six species. The monophyly of these taxonomic units (subgenera and species groups) must still be verified since the attribution of species to subgenera within *Mantidactylus* is often only based on phenetic similarity, the diagnostic synapomorphies of the groups generally being derived from studies of only a few species.

Two species of the subgenus *Gephyromantis* differ from other species of this subgenus mainly in terms of their coloration which is partly greenish, and their ecology which is associated with mossy rocks along forest brooks. These species are *M. webbi*, and one species which up to now was regarded as *M. klemmeri* (GLAW & VENCES, 1994).

Fieldwork conducted during 1994 and 1995 yielded new data on these two forms, and resulted in the discovery of two additional species which are morphologically similar to *M. webbi* and to the species previously regarded as *M. klemmeri*. After examination of the types of *Mantidactylus klemmeri* and *M. webbi* in the context of the two similar, newly discovered species, we conclude that the four forms studied by us are *M. klemmeri*, *M. webbi*, and two unnamed forms which we will here describe as new species.

MATERIAL AND METHODS

Specimens were captured by hand both during the day and at night with the aid of flashlights. They were fixed for a few minutes in 96 % ethyle alcohol, and stored in 70 % ethyle alcohol. Live animals were photographed to document color and pattern variation. Morphometric measurements were taken by the first author with a ruler to the nearest 0.5 mm or with a precision calliper to the nearest 0.1 mm. Abbreviations used are SVL (snout-vent length) and HW (head width). Tympanum and eye diameter were measured along a horizontal plane.

Calls of *M. klemmeri* were recorded with a Tensai portable tape recorder and an external VIVANCO EM 238 microphone. These were analysed with the sound analyzing system "MEDAV Spekro 3.2".

Type material was examined both in the Natural History Museum, London, United Kingdom (BM) and the Muséum National d'Histoire Naturelle, Paris, France (MNHN). Other abbreviations used in this paper are as follow: MRSN, Museo Regionale di Scienze Naturali, Torino, Italy; ZFMK, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany.

RESULTS

THE IDENTITY OF *MANTIDACTYLUS KLEMMERI*

In 1994, GLAW & VENCES (color plate 101) showed a picture of a brook-dwelling frog from the Marojezy mountains which they considered to be *Mantidactylus klemmeri*. The pictured species occurred along brooks near the *M. klemmeri* type locality and was morphologically similar to that species. Furthermore, its unique character combination separated it clearly from any other described *Mantidactylus*. In 1995, however, F. GLAW collected a second frog species in Marojezy which inhabited the forest floor and showed some important morphological and ecological differences from the species previously assigned to *M. klemmeri*. These differences are summarized in tab. 2, whereas tab. 1 shows the absolute measurements of all specimens considered in the present publication. A direct comparison with the types of *Mantidactylus klemmeri* showed that the species inhabiting the forest-floor should be assigned to this taxon. An updated diagnosis of *M. klemmeri* together with first data on its advertisement call is presented below. The brook-dwelling form is consequently described as a new species.

Tab. 1. - Measurements (all in mm) of the *Mantidactylus* specimens considered in the present study. Number: abbreviation of museum where specimen is held, and its collection number. Holotypes are marked with a * behind the number, paratypes with a + behind the number. Other abbreviations used are: M, male; F, female; J, juvenile; SVL, snout-vent length; HW, head width; Eye, horizontal eye diameter; Tym, horizontal tympanum diameter; E-N, distance between anterior eye margin and nostril; N-ST, distance between nostril and snout tip; HL, hand length; FLIT, foot length including tarsus; TibT, tibiotarsal articulation reaching (1) eye, (2) beyond eye, (3) nostrils, (4) snout tip, (5) slightly beyond snout tip, (6) clearly beyond snout tip; ToeL, relative length of third toe compared with fifth toe; FGS, size of femoral glands, given as length × width; FGD, distance between inner margins of glands on opposite femurs. All specimens are from the type localities of the respective species, except for MNHN 1975.781 (*M. klemmeri*; female from the Chaînes Anosyennes) and MNHN 1975.951-952 (male and female of *M. webbi* from Andohahela).

Species and number	Sex	SVL	HW	Eye	Tym	E-N	N-ST	HL	FLIT	TibT	ToeL	FGS	FGD
<i>Mantidactylus klemmeri</i>													
MNHN 1973.960+	M	20.8	7.3	3.0	1.2	2.0	1.2	6.9	16.5	(5)	3=5	1.5×1.5	2.7
MNHN 1973.959+	M	20.8	7.2	2.6	1.1	2.3	1.5	6.2	17.1	-	3=5	1.7×1.4	2.6
MNHN 1973.957+	M	20.0	6.9	3.0	0.9	2.2	1.3	6.6	17.5	(4)	3=5	1.9×1.2	2.4
MNHN 1973.958+	M	21.2	6.6	2.8	0.9	2.2	1.3	6.5	16.0	(5)	3=5	-	-
ZFMK 59944	M	20.5	7.0	2.7	0.9	2.2	1.5	7.0	16.2	(6)	3=5	2.0×1.4	1.5
ZFMK 59943	M	19.5	6.5	2.5	0.9	2.2	1.5	6.2	15.6	(5)	3=5	2.4×1.7	2.2
ZFMK 59942	M	20.5	6.6	2.5	1.0	2.2	1.5	6.4	17.2	(5)	3=5	1.8×1.5	2.7
MNHN 1973.962+	F	20.8	6.5	2.7	0.9	2.2	1.2	6.5	17.2	(5)	3=5	-	-
MNHN 1973.961+	F	24.0	7.3	3.3	1.2	2.5	1.5	7.7	18.4	(4)	3=5	-	-
MNHN 1973.956+	F	24.0	7.2	3.1	1.0	2.5	1.4	7.0	18.5	-	3=5	-	-
MNHN 1973.955*	F	24.0	7.5	2.8	1.1	2.6	1.4	8.0	18.9	(5)	3=5	-	-
MNHN 1973.963-	J	16.8	-	-	-	-	-	-	-	-	-	-	-
MNHN 1975.781	F	26	8	3.2	1.4	2.5	2.2	8.2	-	(4)	3=5	-	-
<i>Mantidactylus rivicola</i>													
ZFMK 57428*	M	22.5	7.5	2.6	1.0	2.0	1.4	7.8	16.7	(4)	3=5	1.5×1.3	0.8
ZFMK 59898+	M	24.3	8.8	3.4	1.7	2.5	1.7	8.0	18.0	(5)	3=5	-	-
ZFMK 57429+	F	23.8	7.8	3.2	1.2	2.0	1.6	7.5	16.3	(2)	3=5	-	-
ZFMK 59946+	F	24.3	7.7	2.9	1.4	1.9	1.4	7.0	16.5	(4)	-	-	-
ZFMK 59945+	F	24.2	7.5	3.0	1.1	1.9	1.5	7.1	15.5	(2)	3=5	-	-
ZFMK 59947-	J	19.4	5.9	2.5	0.9	1.6	1.1	5.6	14.4	(5)	3=5	-	-
<i>Mantidactylus silvanus</i>													
MRSN A1661*	M	30.5	10.5	3.9	2.2	2.9	2.0	9.5	21.0	(3)	3=5	2.2×1.5	ca. 1.0
<i>Mantidactylus webbi</i>													
MNHN 1975.951	M	22.5	8.0	2.2	1.0	2.3	1.4	7.3	16.0	(3)	3=5	3.7×2.0	1.0
MNHN 1975.952	F	24.9	8.5	2.9	1.3	2.4	1.8	8.8	20.0	(6)	3=5	-	-
ZFMK 52725	M	24.9	8.7	3.0	1.8	2.5	1.5	7.8	19.0	(5)	3=5	3.6×1.5	2.3
ZFMK 52726	F	30.5	10.5	2.7	1.6	3.5	1.7	9.8	22.2	(4)	3=5	-	-

Tab. 2. - Comparison between the four *Mantidactylus* species treated in the present study. Morphometric data from tab. 1. IMT: inner metatarsal tubercle. Other abbreviations as in tab. 1. Values are given as range; mean \pm standard deviation is given in brackets. Significant differences (Mann-Whitney *U* test) were detected between value pairs marked with stars (* $P < 0.05$; ** $P < 0.005$). Values for snout-vent length are given separately for males (M) and females (F). For snout-vent length only specimens from the type localities were considered; other values are based on all specimens listed in tab. 1.

	<i>M. klemmeri</i>	<i>M. rivicola</i>	<i>M. silvanus</i>	<i>M. webbi</i>
SVL (M) [mm]	19.5 - 21.2	22.5 - 24.3	30.5	24.9
SVL (F) [mm]	20.8 - 24.0	23.8 - 24.3	-	30.5
HW:SVL	0.30 - 0.35 (0.32 \pm 0.02)	0.30 - 0.36 (0.33 \pm 0.02)	0.34	0.34 - 0.36 (0.35 \pm 0.01)
HL:SVL	0.29 - 0.34 (0.32 \pm 0.02)	0.29 - 0.35 (0.31 \pm 0.02)	0.31	0.31 - 0.35 (0.33 \pm 0.02)
FLIT:SVL	0.40 - 0.88 (0.77 \pm 0.12)	0.64 - 0.74 (0.71 \pm 0.04)	0.69	0.71 - 0.80 (0.75 \pm 0.04)
Tym:Eye	**0.30 - 0.44 (0.37 \pm 0.05)	0.36 - 0.50 (0.41 \pm 0.06)	0.56	**0.45 - 0.60 (0.52 \pm 0.08)
(Eye N + N-ST):SVL	*0.14 - 0.19 (0.17 \pm 0.01)	*0.14 - 0.17 (0.15 \pm 0.01)	0.16	0.16 - 0.17 (0.17 \pm 0.004)
Eye-N - N-ST	**0.48 - 0.68 (0.60 \pm 0.07)	**0.68 - 0.80 (0.73 \pm 0.05)	0.69	0.49 - 0.75 (0.61 \pm 0.11)
General habitat	forest floor	forest brooks	forest brooks?	forest brooks
Micro-habitat	on leaf litter/roots	on mossy rocks	at night on leaves	on mossy rocks
Habitus	very slender	slender	less slender	less slender
Dorsal skin	finely granular	some large granules	finely granular	coarsely granular
Snout	long, pointed	short	long	long
IMT	small	protruding	strongly protruding	reduced
Color	brownish	olive greenish	olive greenish/brown	olive greenish

Tab. 3. - Parameters of six notes from calls of *Mantidactylus klemmeri*, recorded in the Marojezy Strict Nature Reserve. Notes 1-3 from Camp 3 (26.02.1995; air temperature 23.8°C), notes 4-6 from Camp 4 (28.02.1995; air temperature 22.5°C). All temporal measurements are given in milliseconds (ms).

	1	2	3	4	5	6
Note duration	648	662	769	731	718	626
Number of primary pulses	4	4	4	1	2	1
Duration of primary pulses (range)	17 - 22	16 - 26	20 - 25	-	-	-
Duration of primary pulses (mean)	19.5	20.5	21.5	-	-	-
Interval between primary pulses (range)	24 - 43	25 - 41	19 - 36	-	-	-
Interval between primary pulses (mean)	32	31	28.3	-	-	-
Number of double clicks	1	1	2	0	0	0
Duration of double clicks	20	17	18 - 20	-	-	-
Duration of secondary pulse series	406	419	507	684	575	534
Number of secondary pulses	23	25	31	18	17	17
Repetition rate of secondary pulses	56.7	59.7	61.1	26.3	29.6	31.8

Mantidactylus klemmeri (Guibé, 1974)

Gephyromantis klemmeri Guibé, 1974; GUIBÉ, 1978.

Mantidactylus klemmeri: BLOMMERS-SCHLÖSSER & BLANC, 1991; GLAW & VENCES, 1992b, 1994 (partim).

Mantidactylus (Gephyromantis) klemmeri: DUBOIS, 1992.

Diagnosis. - A small, extremely slender, brownish frog, belonging to the genus *Mantidactylus* as is evident from the presence of femoral glands in males (not recognizable in females). The absence of webbing between the toes, in combination with the small size, connected lateral metatarsalia, and the presence of a subgular vocal sac (laterally blackish) in males allow a distinction to be made from most other *Mantidactylus*. *M. eiselti* and *M. thelenae* are morphologically very similar but their advertisement calls differ distinctly. *M. webbi* and the two new species described below have a different coloration (partly greenish). Additionally, *M. webbi* males can be recognized by the white vocal sac, and the two new species have distinct, protruding inner metatarsal tubercles (small and not protruding in *M. klemmeri*).

The tibiotarsal articulation of *M. klemmeri* reaches at least the tip of snout or beyond as was noted by GUIBÉ (1974) in the original description, not between nostrils and tip of snout as was first stated by BLOMMERS-SCHLÖSSER & BLANC (1991) and subsequently quoted by GLAW & VENCES (1992b, 1994).

Type material. - Holotype MNHN 1973.955, adult female, and paratypes MNHN 1973.956-963, four adult males, three adult females and one juvenile specimen, all collected by C.-P. BLANC in December 1972 in the "Massif du Marojezy" at an altitude of 600 m. Measurements of the types and of three additional ZFMK specimens from the type locality are given in tab. 1.

Color in life. - Based on color slides of ZFMK specimens, the dorsum and flanks are marbled grey or brownish without distinct transversal markings. No specimens with a light median dorsal stripe were found at Marojezy. Indistinct dark crossbands are present on fore- and hindlegs. The lower lip is dark with some rather regularly spaced light spots. Sometimes this pattern also occurs on the upper lip, resulting in transverse dark and light bands. In other specimens a light frenal stripe is faintly recognizable. The tympanic area is brown. This brown patch runs from the eye to the insertion of forelegs. The thorax and throat are marbled brown and white, the marbling on the venter and ventral limb surfaces being lighter and less contrasting. A light median line is sometimes present on the throat. Males have a distinct subgular vocal sac which is laterally blackish, indicating a possible paired or bilobate shape of the inflated sac.

Distribution. - Apart from the type material and our specimens, which were all collected in the Marojezy Strict Nature Reserve (Réserve Naturelle Intégrale) in northeastern Madagascar, one additional specimen from the Anosy mountains ("Chaînes Anosyennes") in southeastern Madagascar is available in the MNHN. This female (MNHN 1975.781) is somewhat larger than the other specimens and has a light median dorsal stripe, but shows no other morphological differences (tab. 1) from the types. We therefore consider it as belonging to the species *M. klemmeri* pending the obtention of more data.

