A new species of *Mantidactylus* from northeastern Madagascar with resurrection of *Mantidactylus blaini* (Guibé, 1974)

(Anura, Ranidae)

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*Mantidactylus* sp., sp. nov. is described from the Moroany massif in northeastern Madagascar. Voles of the new frog species are characterized by a distinct colouration of the head: a yellow area along the upper lip which is bordered by a black band, very long hands, and a small snout-vent length (males 27-29 mm). In addition, *M. blaini* differs from all similar *Mantidactylus* species by advertisement calls. The new species is tentatively included in the subgenus *Gephyromantis*. *Gephyromantis* blaini Guibé, 1974 is resurrected as *Mantidactylus blaini* from the synonymy of *Mantidactylus decorus* (Angiel, 1920). Both species are redefined and advertisement calls of *M. decorus* are described.

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Introduction

Madagascar harbours an enormous diversity of amphibian species of which a large number still remains to be described. 182 valid species were scientifically named until the end of the 20th century, but a total of at least 224-250 species have already been discovered and identified (Glaw & Vences in press). The most speciose amphibian genus in Madagascar is *Mantidactylus* (Ranidae; Mantellinae), which is classified in 12 subgenera (Glaw & Vences, 1994). Phylogenetic relationships between these subgenera are largely unknown. In the present paper we describe a new species of *Mantidactylus* from northeastern Madagascar and resurrect another one, which bears similarities to the new species in a number of characters.

Material and methods

Vocalisations were recorded using portable tape recorders with an external microphone (Sony ECM-228) and were analyzed with the MEDAN sound analysing system Spirele 3.2. Song grams were edited with high frequency resolution (FFT 512). Morphological measurements were taken by the same person (FC) with a calliper to the nearest 0.1 millimetre. For definition of external and internal colors of several glands, see Glaw et al. (in press). weighting formula is given according to Bensch & Schliewen (1979). Institutional abbreviations are as follows: MNHN (Muséum national d'Histoire naturelle, Paris), UAMZ (University of Antananarivo, Département de Biologie Animale), ZFMK (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn), ZSM (Zoologische Staatssammlung, München). SVL is used to abbreviate snout-vent length.
Fig. 1a. Holotype of *Mantidactylus schuift*, spec. nov. (ZFMK 58855) from the Manjapyr massif in dorsal-lateral view.

Fig. 1b. Holotype of *Mantidactylus schuift*, spec. nov. Drawing by K. Kubbandor (Photo: M. Müller).

Fig. 2. Holotype of *Mantidactylus schuift*, spec. nov. in ventral view.

Fig. 3. Paratype of *Mantidactylus schuift*, spec. nov. (ZFM 5871999) in dorsal-lateral view.
Results and Discussion

Mantellaria schiffi, spec. nov. Figs 1-5


Diagnosis. M. schiffi is characterized as a member of the genus Mantellaria by the lack of nuptial pads in males and by its general similarity to other species of the genus. Males differ from all other members of this genus by a combination of the following characters: (1) Colouration of the head (a distinct pinkish brown), which is bordered by a black band from the snout tip to the insertion of the hindlimbs; (2) very long toes (longer than the hindlimbs); (3) large and long black lateral metatarsus; (4) advertisement call (see below). It differs from M. granulatus (which can be very similarly coloured and has a long tail) by (1) large, well-developed lateral gland, (2) less webbing between toes and (3) smaller SVL, males up to 20 mm in M. schiffi versus up to 42 mm in M. granulatus; (4) lack of black vocal sac folds along the lower jaw in males. (5) Advertisement calls and (6) by the calling habitat (arising in breaks in M. granulatus versus independent from water bodies in M. schiffi).

Description. Type (Figs 1-5). SVL 45 mm, body slender, head longer than wide, slightly wider than body; snout pointed in dorsal and lateral view, nostrils directed laterally, slightly protuberant; no snout tip to eye; canthus rostralis distinct, slightly concave; lateral region weakly concave; tympanum distinct, rounded; horizontal tympanum diameter (1.4 mm) is 60% of eye diameter (3.8 mm); supratympanic fold recognizable (appears distinct by the strong colour border), rather straight; tongue broad, distinctly bilobed posteriorly; song thin, not distinctly bilobed posteriorly, posterior half of the fold, mesotympanic fold, rather indistinct; fingers without webbing; relative length of fingers: 1: 2: 3: 4: 5:1; relative length of toes 1: 2: 3: 4: 5:1; skin on the snout smooth, covered with small, thin, granulated scales on the ventral side; lateral metatarsus covered with large, granulated scales; no distinct markings on the head region. Colouration in life (Figs 1-2) is light grey-brown, very poorly delimited and very variable in both external and internal view (not referable to the plumage types described by Glaw et al. in press). After more than four years in alcohol, dorsum grey-brown, more beige posteriorly. A brown band between eyes, bordering more or less triangular beige patch which covers the head surface. Arms light brown without distinctive ridges and bands. Hindlimbs light brown with indistinct dark crossbands. Head colouration very characteristic: a highly distinct white band along the upper lip from outer tip to the insertion of the arm, sharply bordered by a black band from snout tip to the insertion of the arm. This is interrupted by the eye. Ventral surface well defined, with small dark spots on the ventrum and a more differentiated pattern on the top. Note the presence of a brown band along the upper lip. Colouration in life (Figs 1-2) generally similar to that in preserved. However, the dorsal surface is slightly more colourful in life, being more orange-brown. The ventral surface is more yellowish than in alcohol.

Paratypes. ZFMK 567/1979 is morphologically very similar to the holotype. SVL 27.1 mm. Tympanum diameter (2.0 mm) is 50% of eye diameter (4.0 mm). The dorsal scales are more distinct than in the holotype. Ventral glands very poorly delimited and very indistinct from both external and internal view. Webbing formula is identical to the holotype. The paratype from UADCA was not available for morphological comparison. The holotype is approximately 45 mm in length. The plastron of the two male paratypes is shown in Figs 3-5. Morphology and colouration of MNHN 1973/391 is largely similar to ZFMK 567/1979 and ZFMK 567/1979, except for its distinctly larger size (SVL 31.5 mm) and the fact that the head is as wide as the body (which may be due to a different mode of preservation). The skin on the external clade region of the shoulder is similar to the male paratypes. Ventral articulation of the head is present, tympanum diameter (2.3 mm) is 55% of eye diameter (4.4 mm); the dorsal pods are distinct; the articulation reaches much beyond snout tip, webbing formula of the foot: 1(1), 2(1.157), 3(1), 4(1.25), 5(1.25); 4(1.25); 5(1.25); lateral metatarsus partially connected. Dorsal articulation large with black lateral sides and distinct white tips. Two very small black dots between the eyes. Ventral articulation with somewhat webbing. The stomach contained one baby, and the length of the tail is 3 mm. Three males are distinctly smaller than MNHN 1973/391, (75-94% of the female SVL) and that such a distinct sexual size dimorphism is unusual in both the M. granulatus group and the M. bougainvillii group (see "Relationships" below).

Distribution. Mantellaria schiffi is only known from 1250-1300 m altitude in the Marojejy Reserve in northeastern Madagascar. Numerous amphibians and reptile species appear to be endemic to this massif, and the same may be true for the new species. Except for MNHN 1973/391, no additional voucher specimens of M. schiffi were found in the MNHN collection which harbours a large collection from the Marojejy mountains. This may indicate that M. schiffi is a rare species. However, it appears more likely that it is simply difficult to discover by opportunistic searching, since all recently collected specimens were found only by locating calling males.

Habitat. Calling males were seen sitting at mid-day in bushes ca. 1.5 m above the bottom. No water body was recognized in the vicinity of the calling males. Therefore, it appears likely that M. schiffi has a reproductive mode which is independent of water bodies. It probably has direct development (as is known for several species of the subgenus Gephyromantis). (Brunner-Schleif 1979, Glaw & Vences 1991).

Advertisement calls (Fig. 10). Vocalizations were recorded at the type locality in the Marojejy Reserve on 28 February 1993, 11:30 h, at 22.3 °C air temperature. Notes are unharmonious, distinctly pulsed, and generally emitted in regular series. One completely analyzed note series consisted of 21 notes and had a duration of about 40 seconds. Temporal parameters (given as range followed by mean ± standard deviation and number of measurements) are as follows: Note duration is 426-638 ms (504 ± 97 ms, n = 22); interval duration 1047-1397 ms (1212 ± 274 ms, n = 22). Intervals between the first note of a note series are the longest and become shorter with the number of notes in the series. The number of notes in a consistent series ranges from 80 to 280 notes. Note series consists of 46-61 pulses (54.1 ± 8.1), the pulse rate is 136-155/s (142 ± 7.5, n = 7). Frequency range is 2400-3500 Hz (dominant frequency 2800-3300 Hz).

Etymology. Mantellaria schiffi, spec. nov. is dedicated to Mrs. Margot Schiff (Augsburg) to her son Prof. Dr. Wolfgang Schiff on the occasion of his 50th Birthday.

Relationships. The relationships of M. schiffi are of special interest, because it shows a mosaic of characters which are typical either for the Mantellaria granulata group of the subgenus Pipaphona or for the Mantellaria bougainvillii group of the subgenus Gephyromantis. Other characters are intermediate between both groups. M. schiffi therefore seems to represent a connecting link between both species groups that may indicate close phylogenetic relationships between them. The contrasting coloration of the hypertrophic region of the body and the long legs are typical for M. granulata. However, most species of the Mantellaria bougainvillii group (subgenus Gephyromantis) can have a blackish temporal region and a long leg along the upper lip, although this is less distinct and often disrupted by small dark spots.

The lateral metatarsus is largely or completely connected in all species of the Mantellaria bougainvillii group and partially or completely separated in the species of Pipaphona.
Fig. 4. Paratype of *Monticola spadix*, spec. nov. (ZSM 387/1999) in ventral view.

Fig. 5. Paratype of *Monticola spadix*, spec. nov. (ZADBA) in dorsolateral view.

Fig. 6. *Monticola spadix* (Calde) from the Andringitra massif (male in dorsolateral view).

Fig. 7. *Monticola spadix* (Calde) from the Andringitra massif (male in ventral view).
Accordingly, webbing on the fourth toe is generally absent in the *Mantisbilla* brevirostrus group, but present in all *Phrynogomphus* species.

- The range of SVL is 25.33 mm in the *Mantisbilla brevirostrus* group and 31.50 mm in the subgenus *Phrynogomphus*. The size of *M. schiffi* (27.34 mm) is therefore intermediate between the *Mantisbilla* group and the subgenus *Phrynogomphus*.

- Black spots between the eyes occur in species of both the *M. brevirostrus* group (*M. hageni*) and the subgenus *Phrynogomphus* (*M. rutilans, M. cinctus*).

Indistinct terminal glands of males (from external view) occur in species of the *M. brevirostrus* group (*M. schiffi* and the subgenus *Phrynogomphus* (*M. rutilans, M. cinctus*).

- The distinct sexual size dimorphism of *M. schiffi* is neither typical for the *Mantisbilla brevirostrus* group nor for *Phrynogomphus* species.

- Diurnal calling activity away from water bodies is typical for the species of the *M. brevirostrus* group, whereas calling activity is mainly nocturnal in *Phrynogomphus* and it diurnal – concentrated along brooks. The calling activity of *M. schiffi* is therefore in agreement with the *M. brevirostrus* group.

- The unlimited series of small typical call structure of numerous *Mantisbilla* species with diurnal calling activity (including the species of the *M. brevirostrus* group) whereas *Phrynogomphus* species tend to produce long series of notes.

**Summary:** The available data do not allow an unambiguous attribution of *Mantisbilla schiffi* either to *Gomphogomphus* or *Phrynogomphus*. The main argument to erect the subgenus *Phrynogomphus* was the observation of free-swimming and feeding habits in *Mantisbilla Orion* and M. pohonok, whereas *Gomphogomphus* was thought to have direct development (Gliew & Vences 1994). Unfortunately, nothing is known about the reproduction of *M. schiffi*. However, the calling activity far away from water bodies may indicate that direct development is much more common in this species than reproduction with free-flying larvae. We therefore propose the tentative classification of a member of the *Mantisbilla brevirostrus* group (Vences et al. 1997) in the subgenus *Phrynogomphus*.

**Available names:** All valid *Mantisbilla* species can be clearly distinguished from *M. schiffi* by the character combination given in the diagnosis. However, synonyms of valid taxa are to be excluded as earlier available names. Among others, *M. schiffi* is characterized by a small SVL, by very long hindlegs, and by large, but not completely divided lateral metasternum. Two available names which may fit into the description of *M. schiffi* are *M. decaryi* and *M. plana*, the latter being considered as a junior synonym of the former. However, as will be demonstrated below, both taxa are reclassified into valid species which are clearly different from *M. schiffi*.

**Identity of *Mantisbilla blanda* (Gliew, 1974) and *M. decaryi* (Angel, 1930)**

*Mantisbilla blanda* was originally described as *Gomphogomphus blanda* from the Andringitra mountains, without providing any explicit characters to distinguish it from other *Mantisbilla* species. Monograph on Madagascar frogs, Gliew (1978) considered the species again, mostly repeating the original description, but provided an identification key. In 1999, Blommers-Schönhuber & Blank designated a lectotype of *Gomphogomphus decaryi* and synonymized all *blanda* with *Mantisbilla decaryi* without any discussion, although these authors obviously studied the type material of both taxa.

In his identification key (Gliew 1995: 46) characterized *M. decaryi* by (1) "la barbe sombre entre les yeux", (2) "le museau, pas de mâchoire blanche", (3) "le museau, pas de mâchoire blanche", (4) "la barbe sombre entre les yeux", (5) "la barbe sombre entre les yeux", (6) "la barbe sombre entre les yeux", and (7) "la barbe sombre entre les yeux".

Character 1 is 3/1 to identify *M. blanda* agree with our material of both species from near Ambalamanara in the Andringitra mountains (ZFMK 62234, 62235, 62236, 62237, see also Figs. 8-9), although character 1 approaches the state of *M. blanda* in ZFMK 62234. Character 3 is less clear since partial dorsal-follicles are recognisable in both specimens. Character 6 can not be confirmed at all since somewhat teeth are virtually absent in ZFMK 62236 and 62237. Summarized, according to the key of Gliew (1978), there remains little doubt that our material from the Ranomafana region is referable to *M. decaryi*, whereas the specimens from Andringitra belong to the taxon *M. blanda*.

**Mantisbilla blanda** (Gliew, 1974), bona species

**Figs. 6-7:**

**Identity:** A recent re-examination of the *blanda* type specimen confirmed that this taxon is referable to specimens collected in the Andringitra mountains which were described and figured under the name *M. decaryi* (Gliew & Vences 1994). On the other hand, the type material of *M. decaryi* closely resembles the species from the Ranomafana region, which is clearly different from *M. blanda* in morphology, colouration and advertisement calls. *Mantisbilla decaryi* must therefore be considered as a valid species.

**Diagnosis:** *M. decaryi* is characterized by the presence of a distinctly elongated metatarsus, a virtually no webbing between toes, larger, smooth, subterminal, terminal, calling habitat (independent from water bodies), and its similarity with the other species of the *Mantisbilla brevirostrus* group. It differs from the other species of this group as follows: from *M. hageni*, *M. schiffi*, *M. cinctus*, and *M. plana* by larger hindlegs, by larger hindlegs and wider body and head, by longer hindlegs (bilateral articulation reaches beyond stout tip) from *M. decaryi*, *M. hageni*, *M. cinctus*, *M. plana*, *M. rutilans*, *M. cinctus* and *M. schiffi* by advertisement calls and colouration; and from *M. rutilans* by colouration and terrestrial habits. Males of *M. decaryi* differ from those of *M. cinctus*, *M. plana*, and *M. rutilans* by the presence of distinct and well defined femoral glands which are easily visible from the external view. *M. decaryi* differs from *M. cinctus* in the call of Gliew (1979) as described above, and in addition by smaller stout vent length (males 21.29-22.82 mm versus 26.3-26.5 mm in the ZFMK material). The advertisement calls and colouration (bilateral articulation reaches slightly beyond stout tip versus beyond stout tip) are different (see Figs. 6-9). The advertisement calls (see Figs. 10-12) and the only available female of *M. rutilans* (ZFMK 57422) is similar to the males, but slightly larger (SVL 21.5 mm) and without black bands on the vocal sac folds.

**Distribution:** *M. decaryi* is known from two localities in the Andringitra mountains, the forest of Ambalamanara at 1700 m altitude (Gliew 1974) and the forest around Ambalamanara at the same altitude (Gliew & Vences 1994). In addition, a specimen from the Ranomafana area (photographed by L. Kohler in 1995) should be considered as *M. decaryi* as well, since it has distinct femoral glands and recognizable black bands on the vocal sac folds. The calls here referred to *M. blanda* were recorded at Vohiapano (ca. 1000 m altitude). The four localities (1) Komata, (2) Andringitra, (3) Fianarantsoa, and (4) Analamanga, listed in Blommers-Schönhuber & Blank (1999) may refer either to *M. decaryi* or to *M. blanda*.

**Habitat:** Calling males were found during the day on the ground in primary rainforest of the Andringitra massif (in January) and heard in second-order scrub at Vohiapano (in February). In both cases, calling males were not found around water bodies.

**Advertisement calls** (Fig. 11): Vocalizations from *Andringitra* have been briefly described by Gliew & Vences (1994) under the name *M. decaryi*. New recordings from Vohiapano (Ranomafana region) recorded 29 February 1998 at 12:15 h were similar to those from Andringitra, but unfortunately the calling specimens could not be located in the dense forest. Since *M. decaryi* was already recorded from the Ranomafana region by photographs (see above) it is nevertheless likely that the following description refers to the calls of *M. decaryi*. Vocalizations were emitted in series of 11-14 (12.7 ± 1.0, n = 7) melodic notes. Interval duration between two notes was up to several minutes. The duration of note series was 10.24-15.25 s (12.9 ± 9.9, n = 7), the note repetition rate 9.8 ± 1.8 s. Note duration was 21.2-31.2 ms (29.2 ± 1.2 ms, n = 13), duration of intervals between two notes 30-103 ms (32 ± 11 ms, n = 12). The interval between the two last notes of a series was longer than between the other notes. Fundamental frequency was between 2000-2200 Hz and dominant frequency between 450-570 Hz. The note series from Vohiapano are similar to *M. hageni* (especially in the number of notes per series) but the note repetition rate is higher in *M. decaryi*. The note series from Vohiapano differ from those of Andringitra by a higher number of notes.
Fig. 8. *Mantidactylus decurtus* (Angel) from Ranomafana (male in dorsolateral view).

Fig. 9. *Mantidactylus decurtus* (Angel) from Ranomafana (male in ventral view).

Fig. 10. Sonagram and oscillogram of one note of *Mantidactylus decurtus* (Angel) from the type locality.

Fig. 11. Sonagram and oscillogram of a section of a note series of *Mantidactylus nitidus* (Grul.) from Vohilava.

Fig. 12. Sonagram and oscillogram of a section of a note series of *Mantidactylus decurtus* (Angel) from Ranomafana.
Identity. The type material of *M. devraji* is in a bad state of conservation. In the lectotype MNHN 1900.435 (designated by Blommers-Schösser & Blanc 1991) the left hindleg is completely separated from the body and the right hindleg is only loosely linked with the body (foot and tarsus are completely lacking from the right limb). The SVL is 22.5 mm. Although the original colouration is largely faded and the condition of the lectotype is very bad, several characters agree with that of the unidentified species from the Ramamonana region: (1) There is a slightly converging, dark dorsal ridge on each side of the neck, that is followed dorsolaterally by a further ridge. (2) A brown spot is present below the canthus oculi between eyes and nostril. (3) Two further brown spots are present between eye and nostril. About four brown irregularly dispersed spots on a light background are recognizable on each side of the lower jaw. A brown bar is present between the eyes. (4) In contrast to the original description (Angelo 1930) vomerine teeth are rather indistinct. These characters of the lectotype are nearly identical in our specimens from the Ramamonana region, except that the colour of the spots in life is black instead of brown. Only the black tympanic region of the living specimen is not (more) recognizable in the lectotype. Paralectotype MNHN 1900.438 is a juvenile of about 14.5 mm SVL. Paralectotype MNHN 1900.437 is an adult male of 23.4 mm SVL with very long limbs (more measurements were not taken because of the poor conservation state), with distinct elongated femoral glands (6.0-6.3 mm × 1.5 mm), and with distinct skin folds along the lower jaw (oral sac). In contrast to the lectotype brown spots on the head or folds on the back are less or not recognizable. Paralectotype MNHN 1900.436 was not received from the MNHN. It may represent the specimen that was exchanged with the Museum of Comparative Zoology in 1932 and probably corresponds to MCF 17439 (Barbour & Lovett 1916).

Angelo (1930) mentioned four specimens collected 500-1100 m above sea level. Our records are virtually in the same altitudinal range and from the southern half of eastern Madagascar, regarding the absence of morphological similarity between the type material of *M. devraji* and our specimens from the Ramamonana region we conclude that both are conspecific.

Distribution. Reliable records of *M. devraji* series saxicae are Malagasy du Sud, 300-700 m altitude (lectotype MNHN 1900.435) and Pic d'ivoile, 1100 m altitude (MNHN 1900.436 to 438, paralectotypes). Personal records are from Ramamonana (CH185, 47°24'E, 450-600 m alt, ZMHK 62294), from above Vohiperina (ca. 1000 m alt, ZMHK 62289), and from several places along the street between both localities (no voucher specimen). The four localities: (1) Kandiatra, (2) Andraninany, (3) Viphafy, and (4) Chains Anonyineri, listed by Blommers-Schösser & Blanc (1941), may refer either to *M. devraji* or to *M. bianki*. Near Vohiperina *M. devraji* apparently occurs in sympathy with *M. bianki*.

Habitat. Calling males were found in February and March during the day. They were sitting on or near the ground in primary rain forest and in secondary vegetation, far away from water bodies.

Advertisement calls (Fig 12). Calls were recorded on 25 February 1986 at Ramamonana during the day. The frogs emitted rather long series of notes. The duration of a note series with 44 notes was 4970 ms. Note duration was 65-120 ms (82±11 ms, n=44); interval duration 1-275 ms (15±13 ms, n=44). Both note-duration and interval-duration did tend to become shorter from the first to the last note of a series. Fundamental frequency was 1455-1650 Hz, dominant frequency 2980-3350 Hz. The intensity of each note had a peak at its beginning, decreasing toward its end.

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