Journal of Herpetology, Vol. 33, No. 4, pp. 639–647, 1999

Resurrection and Redescription of *Mantidactylus tricinctus* from Eastern Madagascar

FRANK GLAW[1] AND MIGUEL VENCES[2]

[1]*Zoologische Staatssammlung, Münchhausenstr. 21, D-81247 München, Germany*
[2]*Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 160, D-53113 Bonn, Germany*

ABSTRACT.—*Gephyromantis tricinctus* Guibé, 1947 (Anura: Ranidae: Mantellinae) known only from the type series and currently considered as a synonym of *Mantidactylus biporus*, is resurrected as *Mantidactylus tricinctus*, and included in the subgenus *Brygoomantis*. A detailed redescription, based on specimens recently collected in central eastern Madagascar, notes on natural history, and a description of advertisement calls are provided. The species is distinguished from all other named species of the subgenus *Brygoomantis* by its short in snout–vent length and reduced webbing.

The endemic Malagasy genus *Mantidactylus* Boulenger, 1895 comprises 12 subgenera (Dubois, 1992; Glaw and Vences, 1994) and currently contains 63 species (Andreone et al., 1998). The subgenus *Brygoomantis* Dubois, 1992 (formerly the *Mantidactylus ulcerosus* group) consists of seven species (Blommers-Schlösser and Blanc, 1991; Glaw and Vences, 1994). Morphological definitions of several of these taxa are rather poor, and inconsistencies between morphological diagnoses and bioacoustic data have been recognized (Glaw and Vences, 1992a). Species of *Brygoomantis* are distinguished from representatives of other subgenera of *Mantidactylus* by a specialized karyotype (reduced chromosome number 2n = 24 as compared to 2n = 26 in most *Mantidactylus* and other ranids; see Blommers-Schlösser and Blanc, 1991) and a combination of femoral gland structure (gland with an external median depression in males, rudimentary glands present in females), sexual dimorphism in tympanum size (males having a larger tympanum than females) and in snout–vent length (females larger than males), slightly distensible single subgular vocal sac in males, only slightly enlarged finger and toe disks, semiaquatic and partly diurnal habits, tadpoles with generalized mouthparts and distinct spiral-shaped intestine visible through ventral skin, and advertisement call structure (pulsed notes of low intensity).

During recent field surveys we discovered additional species of the subgenus *Brygoomantis* that are distinguishable by morphological and bioacoustic characters. Unfortunately, the nomenclatural situation is rather difficult due to the existence of several junior synonyms attributed to the species of *Brygoomantis*. More field observations, especially at the type localities of the described taxa, are necessary before a comprehensive revision of this subgenus can be provided. However, one of the recently discovered species is easily distinguished by several morphological characters from all other seven species currently included in the subgenus. We found this form to be conspecific with the type specimens of *Gephyromantis tricinctus* Guibé,

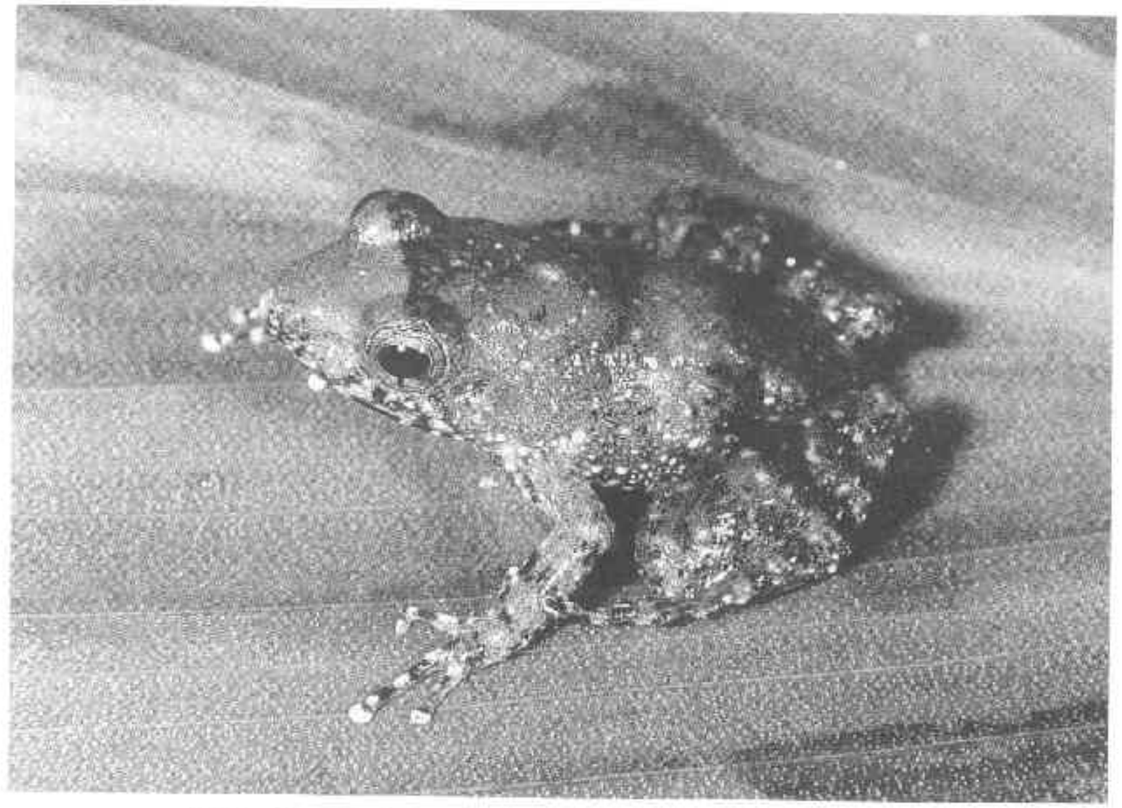

FIG. 3. Dorsolateral view of *Mantidactylus tricinctus* (ZFMK 62251) in life.

femoral glands consisting of four equally sized, prominent granules. These are either arranged cross-like (MNHN 1931.27) or as a rounded structure (the granules being more or less triangular as in MNHN 1994.611 and 1994.613), but their internal borders are always confluent, forming a central median depression in external view (Fig. 2).

All paralectotypes are in bad to very bad states of preservation. The pattern is largely faded, but the alternating light and dark spots on the lower lip are visible in all four males. A light snout tip is visible in all males except for MNHN 1931.27. In contrast to the observations of Guibé (1947), the lateral metatarsalia of all type specimens are separated. Measurements of lectotype and paralectotypes are included in Table 1.

New Material.—ZFMK 62251 and 62255-62257, four adult males, ZFMK 62252–62254, three adult females, all collected in rainforest near An' Ala (18°56' S, 48°28' E, 840 m above sea level), Toamasina province, eastern Madagascar, on 3 February 1996 by F. Glaw. Several uncatalogued specimens (same locality, date and collector as ZFMK specimens) were deposited in the herpetological collection of the University of Antananarivo, Madagascar.

Diagnosis.—A species of the genus *Mantidactylus* as indicated by the presence of distinct femoral glands, and by the absence of nuptial pads in males. A member of the subgenus *Brygoomantis* as indicated by sexual dimorphism in tympanum size (tympanum diameter is 81–105% of eye diameter in males, 68–87% in females, mean values 94% versus 76%; data from Table 1) and snout–vent length (male SVL = 16.7–19.2 mm, female SVL = 18.0–20.3 mm; data from Table 1), presence of femoral glands in males and females, only slightly enlarged finger disks, single subgular vocal sac in males, separated lateral metatarsalia, semiaquatic and partly diurnal habits, and advertisement call structure (series of pulsed notes of low intensity).

Mantidactylus tricinctus is distinguished from all other valid species of the subgenus *Brygoomantis* (*M. alutus, M. ambohimitombi, M. betsileanus, M. biporus, M. curtus, M. madecassus, M. ulcerosus*) by its shorter snout–vent length (males and females ≤20 mm in *M. tricinctus* versus ≥25 mm in the other species) and the reduced webbing between the toes (four phalanges of fourth toe free of web, versus a maximum of three free phalanges in the other species, according to the webbing formula notation of Savage and Heyer [1967]). *Mantidactylus tricinctus* is further distinguished from *M. alutus, M. betsileanus, M. curtus,* and *M. ulcerosus* by advertisement calls (not known in *M. ambohimitombi, M. biporus,* and *M. madecassus*), and from *M. madecassus* by the presence of vomerine teeth.

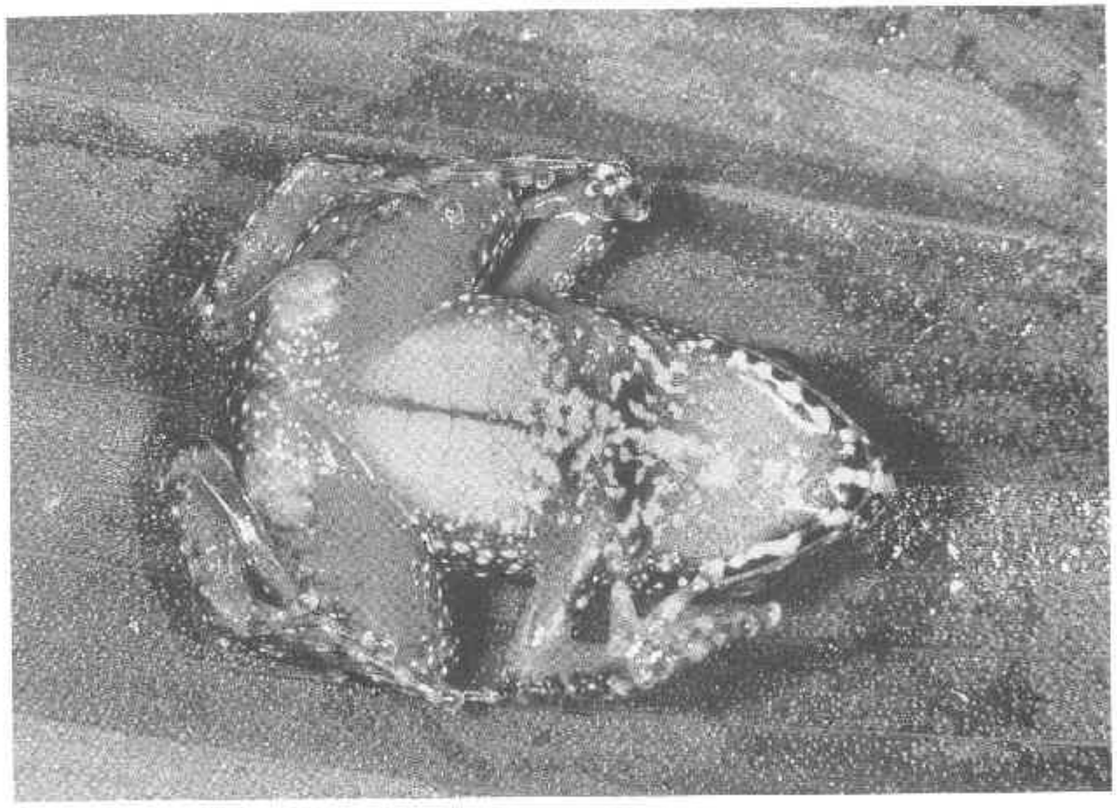

FIG. 4. Ventral view of *Mantidactylus tricinctus* (ZFMK 62251) in life.

Redescription.—The following redescription is based on ZFMK 62251 (measurements in Table 1). Body slender; head longer than wide, as wide as body; snout pointed in dorsal and lateral views; nostrils directed laterally, slightly protuberant; canthus rostralis weak, slightly concave; loreal region weakly concave; tympanum distinct, large, rounded, diameter about 90% of eye diameter; supratympanic fold distinct, beginning straight, with a rather distinct bend midway towards insertion of forelimb; tongue ovoid, distinctly bifid posteriorly; vomerine teeth small but distinct, positioned posterolateral to choanae; choanae small, rounded. Forelimbs slender; subarticular tubercles single; outer metacarpal tubercle not recognizable, inner metacarpal tubercle small; fingers without webbing; relative length of fingers: I < II < IV < III; finger disks slightly enlarged; nuptial pads absent. Hindlimbs slender; tibiotarsal articulation reaches nostril; foot as long as tibia; lateral metatarsalia separated (although this state is difficult to verify due to the rather intensive fixation of the specimen); inner metatarsal tubercle small; outer metatarsal tubercle present, large, but only weakly prominent; webbing greatly reduced, only traces of web, mainly between toes III–IV, and IV–V; webbing formula: I 2-3 II 2-3^{-} III 3 IV 4-2^{+} V; relative length of toes: I < II < V < III < IV.

Skin on the upper surface smooth, with few scattered granules on flanks; ventral side smooth, more tubercles in anal region. Femoral glands prominent, in external view not consisting of single, sharply delimited granules but having a rather irregular tubercular surface with median depression.

In preservative, dorsum grey-brown, with irregular, poorly defined darker markings. A dark brown band between eyes, sharply bordering a more or less triangular beige patch which covers the head surface. Forelimbs light brown with distinct dark crossbands on upper forelimb and hands. Hindlimbs light brown with indistinct dark crossbands. Inguinal region with a short light longitudinal lateral stripe and few scattered whitish spots. Snout tip with a whitish spot. Venter beige, with some brown mottling on the thorax and a dark midventral line. A longitudinal white median line is faintly recognizable on thorax and throat. Lower lip with distinct alternating white and brown spots.

TABLE 1. Measurements (in mm) of available adult specimens of *Mantidactylus tricinctus*. See Materials and Methods section for abbreviations of characters. LT = lectotype, PLT = paralectotypes.

	MNHN 1931.26	MNHN 1931.27	MNHN 1994.611	MNHN 1994.612	MNHN 1994.613	ZFMK 62251	ZFMK 62252	ZFMK 62253	ZFMK 62254	ZFMK 62255	ZFMK 62256	ZFMK 62257
Status	LT	PLT	PLT	PLT	PLT	—	—	—	—	—	—	—
Sex	F	M	M	M	M	M	F	F	F	M	M	M
SVL	18.0	17.1	17.1	19.2	18.1	16.7	20.3	19.2	19.7	17.6	17.8	17.8
HW	6.9	6.3	6.4	7.2	6.7	6.0	7.0	6.5	6.9	6.3	6.5	6.5
HL	7.8	7.3	7.1	7.6	7.6	6.7	8.2	7.7	7.9	7.4	7.3	7.2
TD	1.5	2.3	2.2	2.3	2.5	2.2	2.1	2.0	1.9	2.5	2.4	2.1
ED	2.2	2.2	2.2	2.3	2.7	2.5	2.6	2.3	2.8	2.7	2.6	2.6
END	1.7	1.7	1.6	1.9	2.0	1.8	1.8	1.8	2.2	1.9	1.6	2.1
NSD	1.3	1.2	1.4	1.7	1.7	1.4	1.3	1.3	1.4	1.4	1.3	1.4
NND	2.2	2.4	2.2	2.7	2.5	2.0	2.3	2.5	2.5	2.1	2.1	2.2
IAL	5.5	4.8	5.0	5.4	4.8	4.8	6.0	5.5	6.1	5.5	5.5	5.3
FORL	12.6	9.6	10.0	10.5	11.4	11.1	13.5	12.7	13.1	11.5	11.7	11.6
HIL	30.3	26.6	26.1	26.7	—	27.4	32.7	30.8	32.0	27.5	29.4	28.0
FOL	9.1	8.2	7.1	8.7	—	8.4	10.0	8.7	10.4	9.0	8.6	8.6
FGL	—	2.1	2.3	2.7	2.2	2.5	—	—	—	2.9	2.6	2.5
FGW	—	1.6	1.5	1.8	1.8	1.8	—	—	—	1.7	1.7	1.8
FGD	—	2.8	2.0	2.3	2.1	1.7	—	—	—	1.6	1.8	2.3

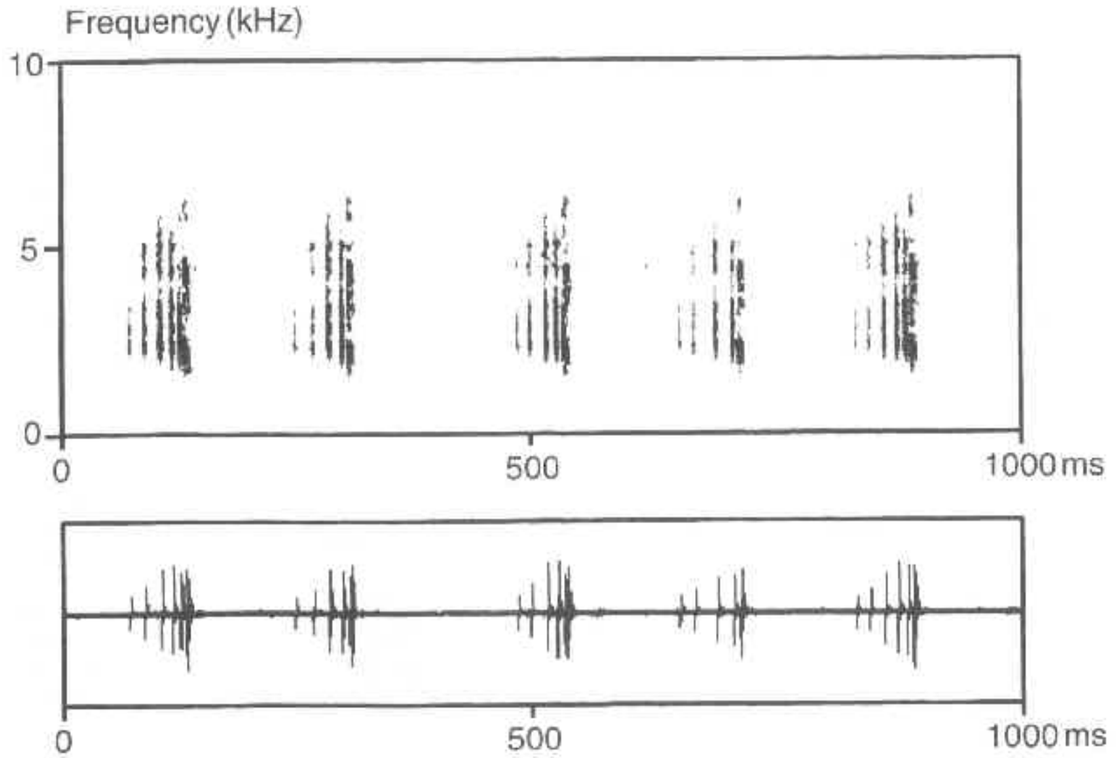

FIG. 5. Sonagram (top) and oscillogram (bottom) of a section of an advertisement call of *Mantidactylus tricinctus* (ZFMK 62251), recorded on 3 February 1996 at 26.9 C air temperature.

In life, dorsum brown, similar to color in preservative except the whitish spots on the flanks were more distinct and bright. Fingers with alternating dark brown and white crossbands; fingertips white. Spot on snout tip yellow. Belly beige to yellowish, ventral side of throat, forelimbs and hindlimbs transparent pinkish. Thorax with dark brown marbling on bright white background. Femoral glands yellowish.

Variation.—Among all newly collected specimens (ZFMK 62252-62257), only traces of web are present, mainly between the toes III–IV and IV–V, and the lateral metatarsalia are separated. The tibiotarsal articulation reaches between eye and nostril in all specimens except ZFMK 62254, in which it reaches the nostril. Tympanum diameter is 81–93% of eye diameter in the males and 68–87% of eye diameter in the females. In external view, the four separate large granules of the male femoral glands are less evident than in the type series (probably due to a different fixation method), but are clearly recognizable after dissection (verified in ZFMK 62256). Small rudiments of femoral glands are recognizable in preservative in the female ZFMK 62254, and very faintly in ZFMK 62252 and 62253. After dissection it could be recognized (in ZFMK 62252) that the glands consist of four small granules, thus resembling miniature copies of the male structures.

The distinct dark brown ventral mottling on the thorax alternates with white, and extends onto the anterior venter and the throat. The white band on the throat, although mostly not continuous, is visible in all specimens. In life, several of the collected males had a yellowish lower lip, spotted with black.

Natural History.—Calling males were observed during daytime in a shallow, partly sun-exposed swamp with dense vegetation in primary forest. They were sitting on leaves, fallen branches and similar structures, generally only 0–2 cm above the water level. Calling behavior of one individual male was observed for several minutes. This specimen moved forward during its vocalizations, in a conspicuously jerky, disrupted way. The function of this behavior is not known.

Advertisement Call.—Vocalizations were recorded on 3 February 1996 from 1200–1300 h at 26.9 C air temperature. Sonagram and oscillogram of a section of a call of ZFMK 62251 are shown in Fig. 5. The following data refer to calls of ZFMK 62251. Calls are series of about 20 pulsed notes and last up to 4 sec. Note repetition rate is 5/sec. One note consists of 5–6 (N = 5) separated pulses. Intervals between pulses are variable, but are always shorter between the last 2–3 pulses of one note as compared to the first 2–3 pulses of the same note. Intensity in-

creases from the first to the third pulse of a note. Temporal call parameters (in milliseconds), given as range followed by mean ± standard deviation in parentheses are as follows: note duration 63–75 (69 ± 4, N = 5); duration of intervals between notes 106–165 (123 ± 28, N = 4). The frequency ranged from 1.5–6.25 kHz, dominant frequency from 1.9–4.5 kHz. Each note corresponds to one expiration. The vocal sac is single and subgular; it was only slightly extended during the call, and did not remain partly inflated between calls. Intensity of the calls, evaluated by subjective impression, was low.

The general call structure of the species (unharmonious, pulsed notes of low intensity) corresponds well with other species of the subgenus *Brygoomantis*, but temporal patterns are different from the calls of the remaining species as described by Blommers-Schlösser (1979) and Glaw and Vences (1992a, 1994). *Mantidactylus betsileanus*, which is morphologically most similar to *M. tricinctus*, has calls consisting of a single long note with a large number of pulses (60–120). The notes in calls of *M. ulcerosus*, *M. alutus*, and *M. curtus* also consist of more pulses (8–45) than in *M. tricinctus*.

Distribution.—The species is known only from Befotaka, Vondrozo, and An' Ala. All three localities are located in mid-altitudes (750–900 m) of the rainforest belt of central-eastern Madagascar. Guibé (1947) mentioned specimens attributed to *tricinctus* from Tsianovoha, but did not mention their catalogue numbers. We were unable to locate these specimens in the MNHN and, since Guibé (1947) mentioned morphological differences to the types, we consider their specific appartenance as dubious. We also do not consider Guibé's (1978) statement that "*M. tricinctus* est connue de la forêt de l'est, du massif de l'Andringitra et des chaines Anosyennes" since the lack of additional informations does not allow to verify this statement.

Available Names in Brygoomantis.—Several available names in the subgenus are considered as junior synonyms of valid species names, or as dubious names, according to Blommers-Schlösser and Blanc (1991). Some of these names need to be considered as possible earlier names for *Mantidactylus tricinctus*.

The three taxa *Rhacophorus fumigatus* Mocquard, 1895, *Mantidactylus multiplicatus* Boettger, 1913, and *Mantidactylus brunneus* Ahl, 1929 are currently considered as synonyms of *M. betsileanus*. *Rana inaudax* Peracca, 1893, and *Mantidactylus bellyi* Mocquard, 1895 are currently considered as synonyms of *M. curtus*. *Mantidactylus laevis* Angel, 1929 is considered as synonym of *Mantidactylus alutus*. Beside these synonyms two dubious species exist which can not be attributed to any valid taxon with certainty (Blommers-Schlösser and Blanc, 1991): *Mantidactylus tripunctatus* Angel, 1930 and *Mantidactylus brauni* Ahl, 1929. According to the respective original descriptions, size and extension of webbing in the types is as follows: *Rana inaudax*: SVL of largest syntype 30 mm, toes nearly fully webbed; *Rhacophorus fumigatus*: SVL of holotype 35 mm, toes half webbed; *Mantidactylus bellyi*: SVL of holotype 40 mm, toes 3/4 webbed; *Mantidactylus multiplicatus*: SVL of holotype 36 mm, toes 2/3 webbed; *Mantidactylus brauni*: SVL 37 mm (two syntypes), toes 2/3 webbed; *Mantidactylus brunneus*: SVL of holotype 32 mm, toes 2/3 webbed; *Mantidactylus laevis*: SVL of the holotype 32 mm (holotype lost according to Blommers-Schlösser and Blanc, 1991), toes half webbed; *Mantidactylus tripunctatus*: SVL of the largest syntype 30 mm, toes half webbed, fifth toe 4/5 webbed. Therefore, the types of all these earlier names can be clearly distinguished from *M. tricinctus* by combination of their larger size and more webbing between the toes. We examined all type specimens except *Rana inaudax* and *Mantidactylus laevis* and confirm the presence of important morphological differences to *M. tricinctus*.

Acknowledgments.—We are grateful to Annemarie Ohler and Alain Dubois (MNHN, Paris) Rainer Günther (ZMB, Berlin) and Gunther Köhler (SMF, Frankfurt) for making type material accessible. The fieldwork of FG was financially supported by the German Foreign Exchange Service (Deutscher Akademischer Austauschdienst, DAAD). The research in Madagascar was made possible by cooperation between the University of Antananarivo and the Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn. We are indebted to the Madagascan authorities for research permission and the permit to export voucher specimens.

Literature Cited

Andreone, F., F. Glaw, M. Vences, and D. Vallan. 1998. A new *Mantidactylus* from south-eastern Madagascar, with a review of *Mantidactylus pericae* (Ranidae: Mantellinae). Herpetol. J. 8:149–159.

Blommers-Schlösser, R. M. A. 1979. Biosystematics of the Malagasy frogs. I. Mantellinae (Ranidae). Beaufortia 29(352):1–77.

———. 1985. *In* D. R. Frost (ed.), Amphibian Species of the World. Ass. Syst. Coll., Lawrence, Kansas.

———, and C. P. Blanc. 1991. Amphibiens (première partie). Faune de Madagascar 75:1–379.

Dubois, A. 1992. Notes sur la classification des Ranidae (Amphibiens Anoures). Bull. Mens. Soc. Linn. Lyon 61:305–352.

Glaw, F., and M. Vences. 1992a. Zur Kenntnis der Gattungen *Boophis*, *Aglyptodactylus* und *Mantidactylus* (Amphibia: Anura) aus Madagaskar, mit Beschreibung einer neuen Art. Bonner zool. Beitr. 43: 45–77.

———, and ———. 1992b. A Fieldguide to the Amphibians and Reptiles of Madagascar. Vences und Glaw Verlag, Köln, Germany.

———, and ———. 1994. A Fieldguide to the Amphibians and Reptiles of Madagascar, 2nd ed. Vences und Glaw Verlag, Köln, Germany.

Guibé, J. 1947. Trois *Gephyromantis* nouveaux de Madagascar (Batraciens). Bull. Mus. Natur. Hist. Nat., Paris, ser. 2. 19:151–155.

———. 1978. Les Batraciens de Madagascar. Bonn. Zool. Monogr. 11:1–140.

Leviton, A. E., R. H. Gibbs, Jr., E. Heal, and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985:802–832.

Myers, C. W., and W. E. Duellman. 1982. A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama. Amer. Mus. Novitates 2752:1–32.

Savage, J. M., and W. R. Heyer. 1967. Variation and distribution in the tree frog genus *Phyllomedusa* in Costa Rica, Central America. Beitr. Neotrop. Fauna 5:111–131.

———, and ———. 1997. Digital webbing formulae for anurans: a refinement. Herpetol. Rev. 28:131.

Accepted: 18 July 1999.