

Description of a striking new *Mantophryne* species (Amphibia, Anura, Microhylidae) from Woodlark Island, Papua New Guinea

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Abstract

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We describe a striking new species of the microhylid frog genus *Mantophryne* from Woodlark Island in Milne Bay Province, Papua New Guinea. It is most similar to *M. lateralis* but is distinguished from that species by its more slender body, longer shanks, larger discs on the toes, and unique advertisement call. Most known specimens had, in life, a striking golden tan mid-dorsum bordered by broad blackish dorsolateral bands. The new species is currently known only from the rainforests of Woodlark Island, where males call from elevated perches up to 4 m above the ground from climbing *Freycinetia* plants, from crevices and hollows in elevated limestone outcrops, and from tree buttresses and on top of fallen logs on the forest floor. It is the most arboreal member of this predominantly terrestrial genus discovered to date.

Introduction

The genus name *Mantophryne* was coined by Boulenger (1897) to accommodate a single frog species (*lateralis*), “similar to *Xenorhina* but with large eyes and ranoid habit”, from the east of New Guinea. The name *Mantophryne lateralis* was retained by Méhely (1901) and Vogt (1911) but treated as a synonym of *Hylophorbus rufescens* Macleay, 1878, by Fry (1913) and Van Kampen (1923). Parker (1934) stated that the five type specimens of *Mantophryne lateralis* were not all conspecific and that the name bearing syntype must be allocated to *Asterophrys rufescens* Parker, 1934 (he treated *Hylophorbus* as a synonym of *Asterophrys* Tschudi, 1838). In his revision of the subfamily Asterophryinae Günther, 1858, Zweifel (1972) included *lateralis* in the genus *Phrynomantis* Peters, 1867, described a similar species as *Phrynomantis infulata*, and also allocated *Asterophrys louisadensis* Parker, 1934 to this genus. However the genus name *Phrynomantis* was subsequently shown by

Dubois (1988) to be preoccupied by an African taxon and it was therefore replaced by *Callulops* Boulenger, 1888. Zweifel (1972) had also resurrected the genus name *Hylophorbus* mainly because members of that genus have an eleutherognathine jaw, in contrast to a symphygnathine jaw in members of the genus *Phrynomantis* (*Callulops*). On the basis of osteological and myological studies Burton (1986) then resurrected the name *Mantophryne* where he accommodated the symphygnathine species *infulata*, *lateralis* and *louisadensis*. These three species were later complemented by *M. axanthogaster* Kraus & Allison, 2009.

In a recent paper Oliver et al. (2013) studied phylogenetic relationships between the closely related genera *Mantophryne*, *Hylophorbus* and *Pherohapsis* Zweifel, 1972. They used three mitochondrial and three nuclear genes and confirmed *M. lateralis*, *M. louisadensis* and *M. axanthogaster* as congeneric; the monotypic *Pherohapsis menziesi* Zweifel, 1972 is also nested within *Mantophryne* and was transferred to that genus; *M. infulata* is

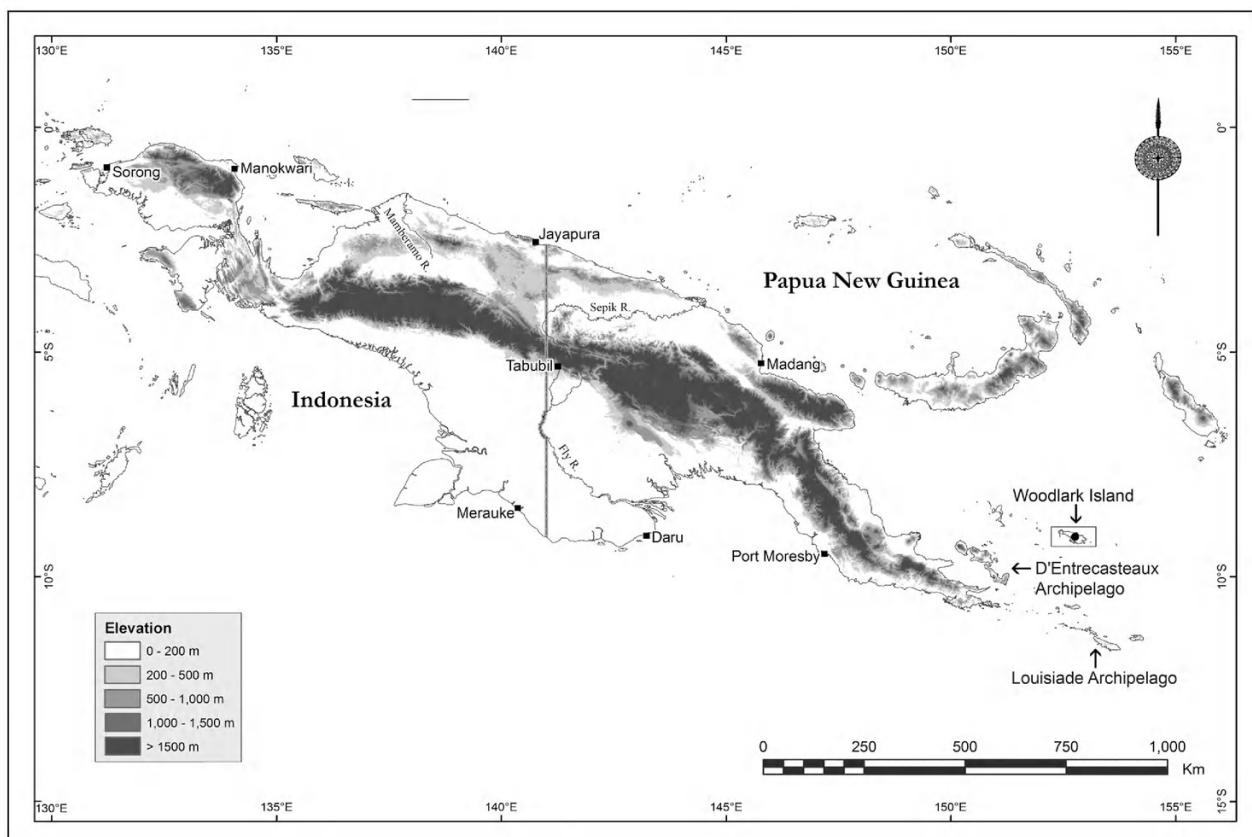


Figure 1. Map of New Guinea showing location of Woodlark Island, type locality of *Mantophryne insignis*.

nested within *Hylophorbus* and was included in that genus as *H. infulatus*. Accordingly *Mantophryne* at present contains four species and quite a number of undescribed forms (Oliver et al. 2013, Frost 2015).

During field work on Woodlark Island, Papua New Guinea (Fig. 1) in April 2011 three strikingly coloured male frogs were encountered that, on the basis of their overall morphology and the symphygnathine condition of the maxillary bones belong to the genus *Mantophryne* but cannot be assigned to any of the known species. We describe and illustrate the new species here.

Material and methods

Frogs were located at night by tracking their advertisement calls, and all specimens were photographed in life prior to preservation. Tissue probes from liver were taken from two of the three collected specimens and stored in about 96% ethanol to enable DNA sequencing. All specimens were fixed in 10% formalin and later transferred to 75% ethanol for permanent storage. Measurements were taken with a digital calliper (> 10 mm) or with a binocular dissecting microscope fitted with an ocular micrometer (< 10 mm) to the nearest 0.1 mm.

SUL snout-urostyle length: from tip of snout to distal tip of urostyle-bone; SUL is subject to lower measurement error than the traditionally used snout-

vent length (SVL) (R. Günther, pers. obs.) so we have used it here. However both measurements are very similar. We therefore directly compare SUL measurements reported here with SVL measurements of congeners presented in the literature;

- TL** tibia length: external distance between knee and ankle;
- TaL** length of tarsus: external distance between tarsal and ankle joints held at a right angle;
- T4L** length of fourth toe: from tip of toe to proximal end of inner metatarsal tubercle;
- T4D** transverse diameter of disc of fourth toe;
- F3L** length of third finger from tip to proximal margin of central palmar tubercle;
- F3D** transverse diameter of disc of third finger;
- F1D** transverse diameter of disc of first finger;
- T1D** transverse diameter of disc of first toe;
- HL** head length: from tip of snout to posterior margin of tympanum;
- HW** head width, taken in the widest point;
- SL** snout length: from an imaginary line that connects the centres of eyes to tip of snout;
- END** distance from anterior corner of orbital opening to centre of naris;
- IND** internarial distance between centres of external nares;
- ED** eye diameter: from anterior to posterior corner of orbital opening;
- TyD** horizontal diameter of tympanum.

Advertisement calls were recorded with a Marantz PMD-660 digital recorder and a Sennheiser ME66 shotgun microphone and analysed with Avisoft-SAS Lab Pro software.

Specimens are stored in the collection of the South Australian Museum, Adelaide (SAMA), the Museum für Naturkunde Berlin (ZMB) and prospectively the Papua New Guinea National Museum (PNGNM), Port Moresby.

Our information concerning features of *Mantophryne* species was taken from original descriptions (Boulenger 1897; Parker 1934; Zweifel 1972; Kraus and Allison 2009), recompiled treatises (Parker 1934; Zweifel 1972; Burton 1986; Menzies 2006; Oliver et al. 2013) and our own observations including direct examination of eight *Mantophryne lateralis* (SAMA R69327–34) specimens from mainland New Guinea.

Results

Mantophryne insignis sp. n.

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Holotype. SAMA R69237 (field number = FN SJR 13920); adult male, collected on the slopes of Talpos Mountain, Woodlark Island (Fig 1), Milne Bay Province, Papua New Guinea (9°09.364'S, 152°46.495'E, 180 m a.s.l.) on 15.IV.2011 by S.J. Richards.

Paratypes. ZMB 83181 (FN SJR 13923), same data as for holotype, and FN SJR 13932 (to be deposited in

the PNG National Museum), Upper Muniai Creek, Woodlark Island, Milne Bay Province, Papua New Guinea (9°07.502'S, 152°44.902'E, 30 m a.s.l.).

Diagnosis. The new species is assigned to the genus *Mantophryne* on the basis of the following characters: body slender, circum-marginal grooves on all finger and toe discs, those on the toes wider than those of fingers; symphygnathine condition of the maxillary bones (anterior processes of the maxillary bones not fused but almost in contact and joined by a ligament); and two protuberances on chin. It differs from all hitherto known congeners by its 1) relatively long legs (TL/SUL 0.55–0.57 vs. <0.51 in males of all congeners; Menzies 2006, Kraus and Allison 2009), 2) more expanded terminal discs on the toes, 3) smooth dorsum, 4) advertisement calls consisting of 38–52 notes and lasting 4.6–6.5 s, and 5) distinct colouration normally comprising a uniformly golden tan dorsum, broad blackish dorsolateral bands edged below with a narrow, slightly undulating white stripe and large, distinct dark brown blotches each encircled by a white border, on the abdomen.

Description of the holotype. In life mid-dorsal band and dorsal surfaces of thighs uniform golden tan, dorsal surfaces of shanks yellow, posterior of thighs, extending partly to dorsal surfaces, orange-red; supra-cantial stripe, extending onto upper eyelids, yellowish; dorsolateral band blackish, ventral boundary of this band delineated by narrow white stripe; axillary region yellowish and inguinal region orange-red. Lateral surfaces



Figure 2. Holotype of *Mantophryne insignis* sp. n., dorsolateral view in life.



Figure 3. Holotype of *Mantophryne insignis* sp. n., ventral view in life.

of shanks and dorsal surfaces of tarsi dark brown, their ventral parts mottled with dark brown. Iris silvery with a few irregular dark lines; anterior and posterior portions of iris more strongly pigmented by dark lines and with an orange hue (Fig. 2). Ground colour of all ventral surfaces whitish. Throat and chest covered by variably intense brown pigmentation and scattered large dark-brown spots especially along the chin and on the bases of the forelegs. Abdomen and lower areas of flanks are covered by a pattern of very conspicuous dark-brown blotches, each encircled by a narrow white line; areas between the spots are less densely pigmented than the throat and chest; brown spots on inferior thighs are smaller than on abdomen and not encircled by white lines (Fig. 3).

Colouration of the preserved holotype: Dorsal surfaces of head, shanks and mid-dorsum uniform light grey; dorsal surfaces of thighs with faint brown mottling; those of upper arm more strongly mottled with brown; anterior of lower arm and dorsal surfaces of hands, tarsi and metatarsi irregularly brown; conspicuous large dark brown spots edged with a white line extend to posterior of lower arm and anterior tarsus and metatarsus; a relatively wide whitish supra-canal stripe extends from snout tip to middle of eyelid. The broad dorsolateral bands begin at the posterior edge of the orbital opening, are widest on middle of flanks, and end with a small tip at cloacal opening. Ground colour of all ventral surfaces is off-white. Mottling is same colour as in life.

Measurements of the holotype are listed in Table 1. There is a longitudinal incision in the abdomen. Head longer than broad (HL/HW 1.06). Snout truncate, with only a slight narrowing at the tip in dorsal view and protruding in lateral view. Canthus rostralis rounded, straight anterior to eyes before bending laterally above the nares; loreal region flat, nares directed laterally, close to end of snout and not visible from above; distance between nares greater than distance between eye and naris (END/IND 0.86). Supratympanic skin fold scarcely pronounced, tympanic annulus clearly visible; horizontal diameter of tympanum more than half that of eye (TyD/ED 0.55). Pupil horizontally oval. Tongue very broad, long and free laterally and posteriorly, its posterior margin not notched. Anterior prepharyngeal ridge with three lobes and posterior ridge with ten denticles. Vocal slits small and near angle of jaws. No webbing between fingers; one well developed subarticular tubercle on finger I and II and two well developed tubercles on fingers III and IV; three less prominent metacarpal tubercles; no other palmar tubercles; all fingers bear small but distinct, grooved discs; disc of third finger clearly smaller than that of fourth toe (F3D/T4D 0.63); relative length of fingers III>IV>II>I (Fig. 4). Legs long and slender (TL/SUL 0.57). Toe discs clearly broader than those of fingers and all with distinct circum-marginal grooves; no webbing between toes; one well-developed subarticular tubercle on toe I and toe II, two prominent subarticular tubercles on toes III, V and three on toe IV; clearly expressed inner



Figure 4. Ventral view of the left hand of the holotype of *Mantophryne insignis* sp. n. in life.

metatarsal tubercle, no outer one; relative length of toes $IV > III > V > II > I$ (Fig. 5). All dorsal and ventral surfaces of legs, body and head smooth except two inconspicuous)(-shaped longitudinal ridges beginning between eyes and reaching to occiput. Two small chin protuberances, clearly visible in the living specimen, disappeared in preservative. There are 3 faint, whitish tubercles on the upper edge of the eyelid.

Variation in the type series. Body size (SUL) of three adult males (including the holotype) varied only slightly, from 35.0 mm to 36.2 mm, mean 35.5 mm, SD (standard deviation) 0.61. Measurements of all types are listed in Table 1. Deviations in colouration of the paratypes from the holotype are insignificant; all share the striking colour pattern of a golden tan dorsum with broad, blackish dorsolateral bands and a heavily spotted venter.

Additional variation. Three additional adult male specimens of this species (BPBM 40135–7) collected on Woodlark Island by F. Kraus are 34.1–35.3 mm SUL and agree closely with the description of the type series in all features except that the dorsal colouration of one of the three specimens (BPBM 40135), including the mid-dorsal band, is creamy tan rather than golden tan.

Vocalisation. The advertisement call of *Mantophryne insignis* sp. n., recorded at an air temperature of 25 °C, is a rattle of several seconds duration (Fig. 6).



Figure 5. Ventral view of the left foot of the holotype of *Mantophryne insignis* sp. n. in life.

Two complete calls of the holotype and two calls of SJR 13932 were analysed. Call duration varied from 4.6 to 6.5 s, mean 5.9 s. Number of notes per call was 38–52, mean 47.5. Note repetition rate was from 8.0 to 8.3/s, mean 8.1 notes/s. Mean note duration of two calls from the holotype was 53.1 ms, SD 15.4, range 30–78 ms, $n=104$; mean internote interval duration was 72.9 ms, SD 12.7, range 41–153 ms, $n=102$. For technical reasons note and internote length from the calls of the second specimen could not be measured exactly and therefore are not considered here. Note and internote interval length and amplitude of notes clearly increased during the course of the call (compare Figs 7 and 8).

In three of the four calls the last internote interval is clearly the longest and in one call the last but one interval was the longest. All notes are composed of pulses, and these mostly cluster into pulse-groups. The first pulse of almost all notes is clearly separated from the following (clustered) pulses. Frequencies scatter mainly from 1.0 to 3.5 kHz with dominant frequency at 2.0 kHz (Fig. 9). There are no harmonics evident and no modulation of frequencies.

Table 1. Body measurements and body ratios of the type series of *Mantophryne insignis* sp. n. Reg-No=registration numbers; FN are the field numbers of Stephen Richards (SJR). SAMA R69237 is the holotype, all three specimens are adult males. All measurements are in mm; SD=standard deviation; all other abbreviations are explained in “Materials and methods”.

Reg-No	SAMA R69237	ZMB 83181	PNGNM	Mean±SD
FN	SJR 13920	SJR 13923	SJR 13932	
SUL	36.2	35.0	35.4	35.5±0.61
TL	20.7	19.8	19.5	
TaL	12.2	12.0	11.5	
T4L	20.1	19.1	18.3	
T4D	1.6	1.5	1.5	
F3L	10.7	9.2	9.1	
F3D	1.0	1.0	1.0	
T1D	1.1	1.0	1.0	
F1D	0.8	0.7	0.7	
HL	12.5	12.2	12.3	
HW	11.8	11.5	11.6	
END	3.0	2.9	3.1	
IND	3.5	3.2	3.4	
ED	3.8	4.1	4.0	
TyD	2.1	2.5	2.3	
SL	5.5	6.0	5.6	
TL/SUL	0.57	0.57	0.55	0.56±0.01
TaL/SUL	0.33	0.34	0.32	0.33±0.01
T4L/SUL	0.56	0.55	0.52	0.54±0.02
T4D/SUL	0.044	0.043	0.042	0.043±0.001
F3L/SUL	0.30	0.26	0.26	0.27±0.02
F3D/SUL	0.022	0.029	0.028	0.026±0.004
T4D/F3D	1.60	1.50	1.50	1.53±0.06
F1D/SUL	0.022	0.020	0.020	0.021±0.001
T1D/F1D	1.38	1.43	1.43	1.41±0.03
HL/SUL	0.35	0.35	0.35	0.35±0.00
HW/SUL	0.33	0.33	0.33	0.33±0.00
HL/HW	1.06	1.06	1.06	1.06±0.00
END/IND	0.86	0.91	0.91	0.89±0.03
ED/SUL	0.105	0.117	0.113	0.112±0.006
TyD/SUL	0.058	0.071	0.065	0.065±0.007
TyD/ED	0.55	0.61	0.58	0.58±0.03
SL/SUL	0.152	0.171	0.158	0.160±0.009

Distribution and ecological remarks. The three type specimens of *M. insignis* were detected by their calls, which were uttered at night from hidden perches 50–80 cm high in a limestone block, a tree buttress and a fallen log, all in lowland rainforest (30–180 m asl) in south-central Woodlark Island. However two of three additional specimens found calling on Woodlark Island by F. Kraus (pers. comm.) were approximately 4 m above the ground, in climbing pandanus (*Freycinetia* sp.) plants. The third specimen was calling from under a leaf on the forest floor. The slender body form, long legs and expanded toe discs (relative to congeners) reflect the unusually arboreal habits of this *Mantophryne* species. Given the uniformity of habitat across the island, and the lack of major topographic relief, it is like-

ly that the species is widespread in lowland rainforest on Woodlark Island. This species has not been reported from any other islands in the region and may be endemic to Woodlark.

Etymology. The name *insignis* is derived from the Latin ‘insignis’ meaning remarkable or conspicuous, and refers to the species’ distinctive colour pattern and unusual (for the genus) ecology.

Comparison with other species. *Mantophryne lateralis*, which is mainly distributed throughout the lowlands of eastern New Guinea (Oliver et al. 2013), is most similar to the new species in having black lateral bands and distinct spotting on the abdomen. Some specimens of this species also have extremely smooth skin, approaching the state in the new species. However it is larger than the new species (males more than 40 mm SUL vs. less than 40 mm SUL in *M. insignis*), has shorter legs (SUL/TL <0.51 vs. 0.55–0.57), smaller toe discs (T4D/SUL <0.034–0.042 vs. 0.042–0.044), lacks the conspicuous golden tan dorsum, and has very long advertisement calls (up to 30 s) at 22–24 °C with a note duration of about 200 ms vs. calls of about 6 s and a mean note length of about 50 ms in the new species (Zweifel 1972, Menzies 2006).

With a snout-vent length up to 82 mm *Mantophryne louisianensis* is substantially larger than the new species; it also has a broader head, a more robust habitus, lacks dark lateral bands and does not exhibit the striking golden tan middorsal area or clearly delimited brown spots on the abdomen (Zweifel 1972, Kraus and Allison 2009).

Mantophryne axanthogaster male is also larger (> 40 mm SVL) than *M. insignis* and further differs from the new species by its flecked (vs. uniform golden tan) dorsum, lack of dark lateral bands, and uniform grey venter (vs. strongly spotted). Moreover, its advertisement call contains 13–18 notes (vs. 38–52 notes) with a mean note duration of 126 ms (vs. about 50 ms) and a mean note repetition rate of 1.8 notes/s (vs. 8.1 notes/s) at 26.5 °C (Kraus and Allison 2009).

With a snout-vent length of 25–31 mm *Mantophryne menziesi* is smaller than the new species, lacks dark lateral bands and a blotched venter, and has a grey- brown (vs. golden tan) dorsum. Its advertisement call is also different, with notes having a length of about 200 ms (temperature not available) (vs. 50 ms). Moreover in *M. menziesi* the squamosal and frontoparietal bones meet to form an arch over the prootic region, a character which is unique for asterophryine microhylid frogs.

Hylophorbus infulatus (until recently *Mantophryne infulata*) is similar to *M. insignis* sp. n. in many body proportions. The species differ, however, in their internarial spacing. The ratio END/IND of 20 specimens of *H. infulatus* ranges from 0.73–0.84 (Zweifel 1972) whereas three specimens of the new species have values of 0.86–0.91. Moreover, the species differ in their colouration. *H. infulatus* has an inconspicuous brown mid-dorsum with some darker markings (vs. uniform golden tan mid-dorsum in most *M. insignis*), the upper margin of its blackish dorsolateral band is poorly defined (vs. well defined

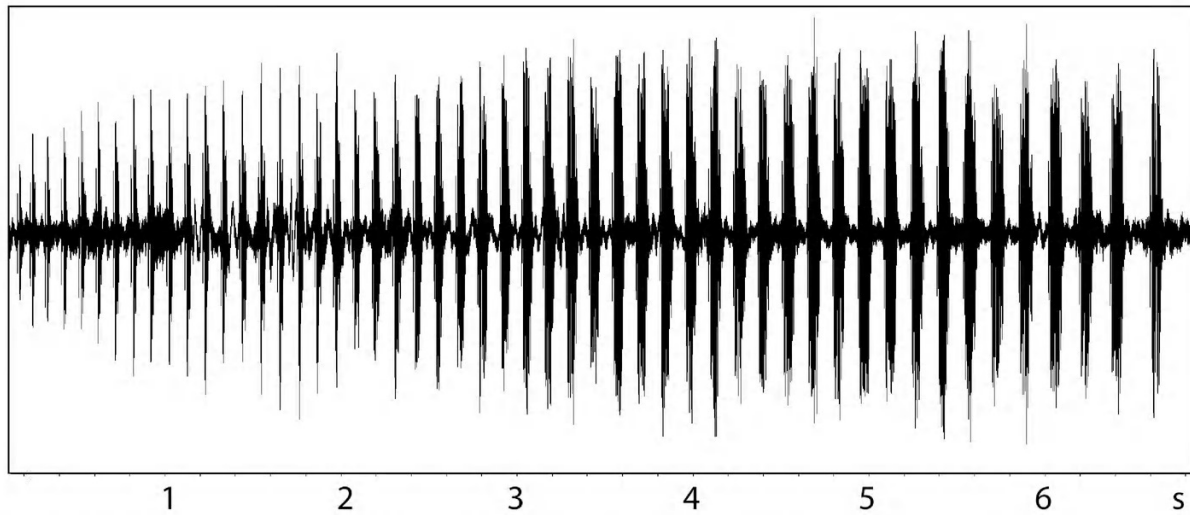


Figure 6. Wave form of a complete advertisement call of the holotype of *Mantophryne insignis* sp. n. with 52 notes.

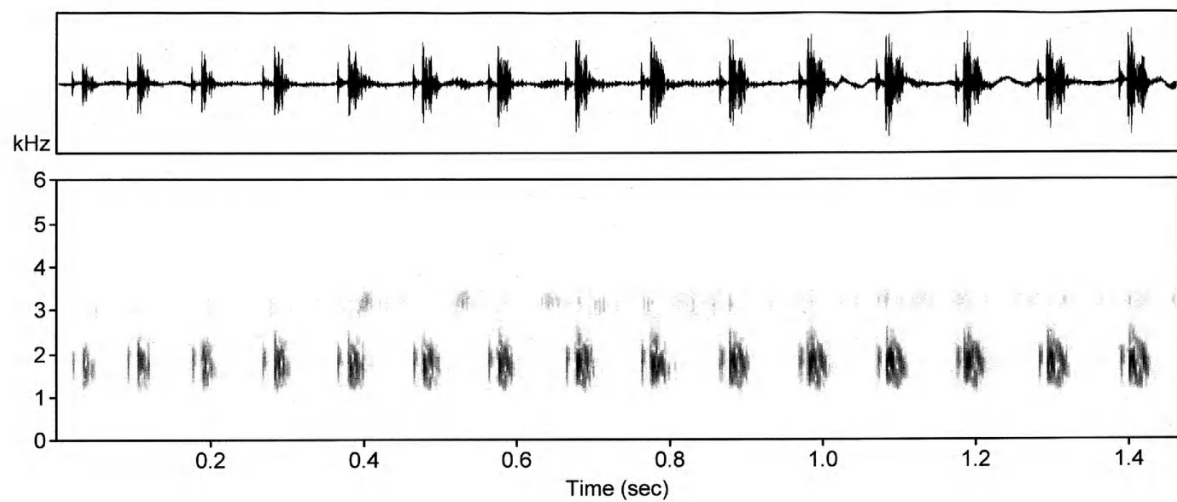


Figure 7. Wave form (above) and spectrogram (below) of a sequence of 15 notes from the first part of an advertisement call of the holotype of *Mantophryne insignis* sp. n.

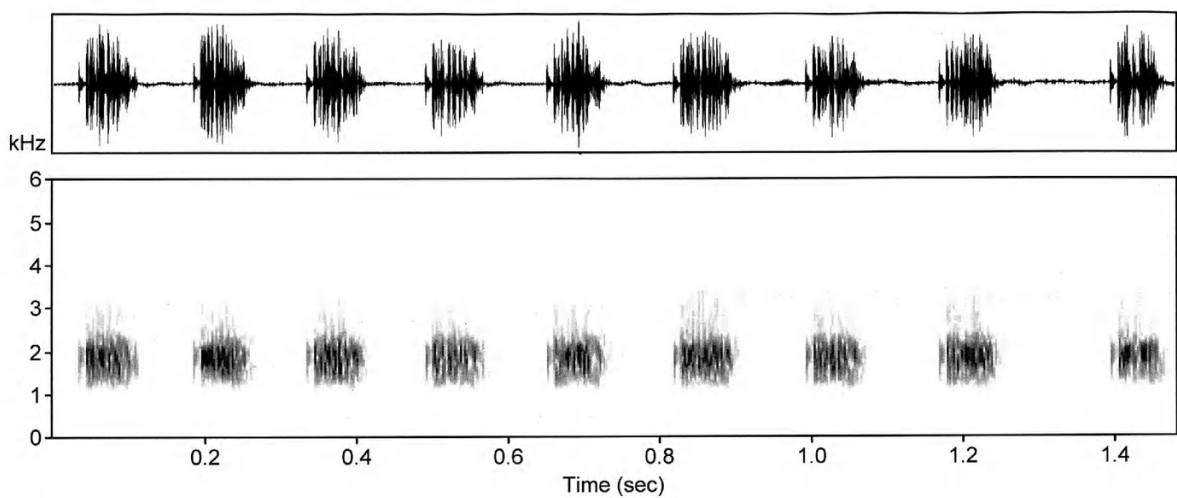


Figure 8. Wave form (above) and spectrogram (below) of a sequence of 9 notes from the last part of an advertisement call of the holotype of *Mantophryne insignis* sp. n.

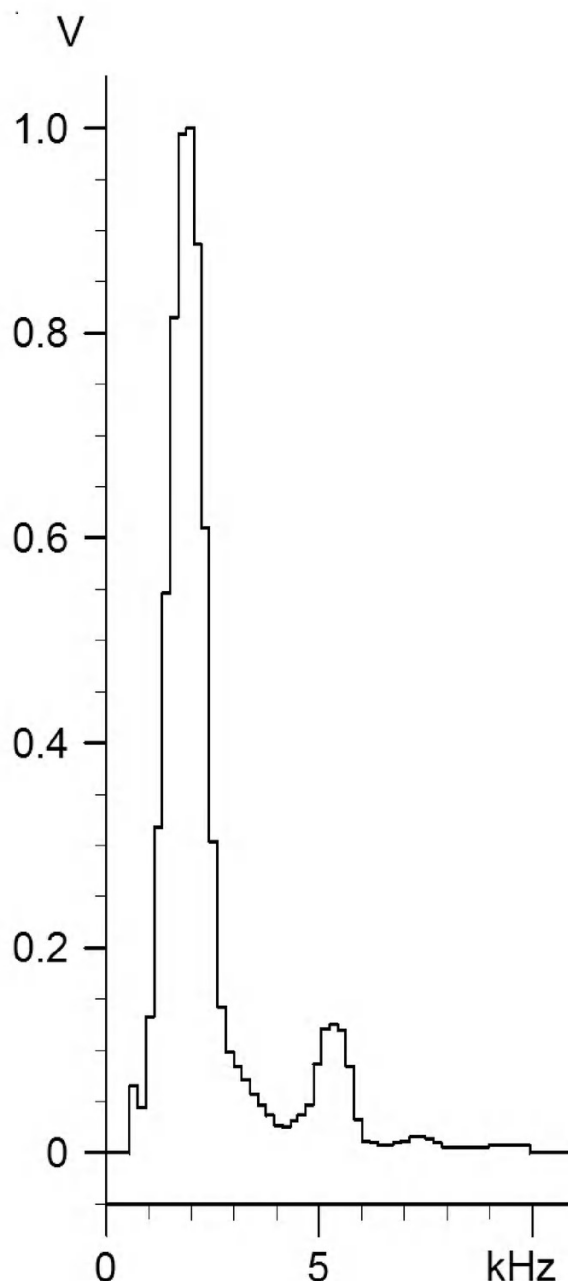


Figure 9. Power spectrum of an advertisement call of *Mantophryne insignis* sp. n.

in *M. insignis*) and its ventral surfaces are mottled with diffuse flecks (vs. covered with well-defined dark brown blotches) (Zweifel 1972).

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