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Oninia senglaubi, another new genus and species of frog (Amphibia, Anura, Microhylidae) from New Guinea

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Key Words

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Abstract

Based on morphological, anatomical and molecular traits, a new monotypic genus of the Microhylidae is described. One new species of the new genus was discovered in the Fakfak Mountains, northwestern corner of the Bomberai Peninsula, Papua Province, Indonesia. The new taxon, *Oninia senglaubi*, is a symphignathine member of the subfamily Asterophryinae and differs from all other symphignathine species of the Australopapuan herpetofauna by its extremely small size (snout-urostyle length less than 20 mm). The advertisement call of the new taxon consists of a series of short peeps and these were uttered from small holes in the ground. According to external morphology and osteological characters, it is most closely related to *Xenorhina*, but according to molecular data (mitochondrial DNA), it is most closely related to the genera *Asterophrys, Metamagnusia*, and *Pseudocallulops*.

Introduction

The first author recently (Günther 2009) described two new genera of frogs from Papua Province, Indonesia (PPI), western New Guinea. These new genera, *Metamagnusia* and *Pseudocallulops*, belong to the subfamily Asterophryinae of the family Microhylidae and have been differentiated on the basis of morphological, osteological, behavioural and molecular features.

During field work in the Fakfak Mountains on the Onin Peninsula, northwestern corner of the Bomberai Peninsula, in September 2008, the first author and local helpers found a small microhylid frog that could not be allocated to any known species or genus. Like *Metamagnusia* and *Pseudocallulops*, the new genus is also a symphignathine member of the Asterophryinae and is formally described in the following text.

Material and methods

All voucher specimens were collected after locating them by their advertisement calls. Some living specimens were photographed. Thigh muscle tissue was taken from some and stored in 96 % ethanol for subsequent DNA sequencing. All specimens were preserved in 2 % formalin in the field, and each was assigned a field number (FN). All were later transferred to 75 % ethanol in the collection of the Museum für Naturkunde Berlin (ZMB), and all were given registration numbers from this museum. Two specimens (ZMB 74606 and ZMB 74609) were cleared and double stained as bone-cartilage preparations using a modified method from Dingerkus & Uhler (1977). Snout-urostyle length was taken with a digital calliper, all other measurements, to the nearest 0.1 mm, were made with a binocular dissecting microscope fitted with an ocular micrometer:

SUL	snout-urostyle length from tip of snout to distal tip of urostyle bone (SUL and snout-vent length differ insignificantly, but SUL is more accurately measured)
TL	tibia length
TaL	length of tarsus
T4L	length of fourth toe
T4D	transverse diameter of disc of 4th toe
F3L	length of third finger
F3D	transverse diameter of disc of third finger
L1T	length of first toe, distal of the metatarsal tubercle
Lcint	length of inner metatarsal tubercle
HL	head length, from tip of snout to posterior margin of tympanum
HW	head width, taken in the region of the tympana
SL	snout length, from tip of snout to an imaginary line connecting centres of eyes
END	distance from anterior margin of orbital opening to centre of naris
IND	internarial distance between centres of nares

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ED eye diameter, from anterior to posterior margin of orbital opening
TyD horizontal diameter of tympanum

Advertisement calls were recorded in the field with a Sony Digital Audio Tape (DAT) Walkman TCD-D 100 and a Sennheiser microphone MKE 300 and later analysed with Avisoft-SASLab Pro software. After completion of the study, some types will be transferred to the Museum Zoologicum Bogoriense (MZB), formerly in Bogor and now located in Cibinong, Java, Indonesia.

Genomic DNA was isolated from thigh muscle using a CTAB extraction protocol. The tissue was dried, cut into small pieces and macerated in CTAB buffer containing proteinase K. Fragments of the mitochondrial 12S rRNA (ca. 680 bp) and 16S rRNA (ca. 480 bp) genes were amplified and sequenced by polymerase chain reaction (for details see Köhler & Günther 2008).

Forward and reverse strands were aligned using CodonCode Aligner v. 3.0.3 (CodonCode Corporation, Dedham, MA, USA) and corrected by eye. The sequences were aligned using MAFFT (Katoh & Toh 2008). In addition, ALISCORE (Misof & Misof 2009) was used to identify and delete ambiguous regions in the 12S rRNA alignment (remaining bp: 610, ca. 80.4 %). Substitution models were obtained from MrModeltest v. 2.3 (Nylander 2004; 12S rRNA: GTR + G, 16S rRNA: GTR + I + G).

Phylogenetic analyses of the combined dataset (12S + 16S) were performed using maximum parsimony (MP) as implemented in PAUP* v. 4.0b010 (Swofford 2002), maximum likelihood (ML) using TREEFINDER v. October 2008 (Jobb et al. 2004) and Bayesian inference (BI; Huelsenbeck et al. 2001) using MrBayes v. 3.1.2 (Ronquist & Huelsenbeck 2003). MP parameters: heuristic search with 10 random additions (maximum number of saved trees), tree bisection and reconstruction (TBR) branch swapping, no. of bootstrap replicates = 10,000 (multrees = no). ML parameters: search depth = 2, no. of bootstrap replicates = 1,000; BI parameters: 5,000,000 generations, samplefreq = 100, no. of chains = 4, burnin value = 35,001.

Photographs of specimens and habitat as well as wave forms, audiospectrograms and power spectrograms are by the first author, drawings in Figure 2 are by Elisa Forster and in Figure 4 by Vera Heinrich.

Abbreviations

CCA Christopher Austin Collection, Louisiana State University, Baton Rouge, USA
gen. n. new genus
FN Field number
ms millisecond(s)
MZB Museum Zoologicum Bogoriense, Cibinong, Java, Indonesia
PNG Papua New Guinea
PPI Papua Province, Indonesia
RG Rainer Günther, ZMB
s second(s)
SD Standard deviation
sp. n. new species
ZMB Museum für Naturkunde (formerly Zoologisches Museum des Museums für Naturkunde der Humboldt-Universität, Berlin, Germany)

Specimens examined

The investigated specimens of the genera *Asterophrys, Callulops*, *Metamagnusia* and *Pseudocallulops* are listed by Günther (2009). The Herpetological Collection of the ZMB also contains material of the genera *Hylophorbus* and *Xenorhina* (including the recently synonymised *Xenobatrachus*). Material of these genera was studied and listed in former papers (Günther 2001, Günther & Richards 2005, Günther & Knop 2006).

Sources of DNA material are given by Köhler & Günther (2008). Moreover, samples of the following specimens were analysed:

Asterophrys turpicola, ZMB 70537 (FN: RG 7898), Fakfak Mountains, Bomberai Peninsula, PPI;
Callulops sp., *robustus* complex, ZMB 62566 (FN: RG 7350), Waira Mountain, Yapen Island, PPI;
Callulops sp., *robustus* complex, ZMB 70532 (FN: RG 7877), Fakfak Mountains, Bomberai Peninsula, PPI;
Callulops sp., *robustus* complex, ZMB 70533 (FN: RG 7924), ditto;
Hylophorbus picoides, ZMB 74637 (FN: RG 7840), ditto;
Hylophorbus sextus, MZB Amph. 6918, Wapoga Exploration Camp in the headwaters of the Wapoga River, PPI;
Hylophorbus tetraphonus, ZMB 74636 (FN: RG 7990), eastern end of Yapen Island, PPI;
Hylophorbus wondiwoi, ZMB 61994 (FN: RG 6753), Wondiwoi Mountains at base of Wandammen Peninsula, PPI;
Mantophryne lateralis, CCA 3024, Saundan Province, Utai Village, PNG;
Mantophryne lateralis, CCA 4086, Milne Bay Province, Halowia Village, PNG;
Oninia senglaubi, ZMB 74608 (FN: RG 7940), Fakfak Mountains, Bomberai Peninsula, PPI;
Oninia senglaubi, ZMB 74609 (FN: RG 7942), ditto;
Pseudocallulops eurydactylus, ZMB 70534 (FN: RG 7819), ditto;
Pseudocallulops eurydactylus, ZMB 70535 (FN: RG 7896), ditto;
Xenorhina cf. *oxycephala* ZMB 74628 (FN: RG 7886), ditto;
Xenorhina cf. *oxycephala*, ZMB 74635 (FN: RG 7984), eastern end of Yapen Island, PPI;
Xenorhina cf. *oxycephala*, ZMB 74640 (FN: RG 7953), Fakfak Mountains, Bomberai Peninsula, PPI;
Xenorhina sp. ZMB 74631 (FN: RG 7875), ditto.

Systematics

Oninia gen. n.

Diagnosis. A member of the symphignathine group of the Australopapuan Microhylidae, subfamily Asterophryinae, with the following combination of characters:

Vertebral column diplasiocoelous; no sagittal crest on cranium; frontoparietals conjoined; nasals weakly calcified; vomero-palatines are small rod-shaped elements that lack anterior extensions; cultriform process of parasphenoid terminates broadly; lateral surface of zygomatic ramus of squamosal sharp edged, arched upward and projecting over otic ramus; otic ramus of squamosal cartilaginous and broadly attached to otoccipital; dorsal crest present on ilium and urostyle; terminal phalanges pointed; all finger and toe discs with terminal grooves; discs on fingers as wide or smaller than penultimate phalanges, those on toes 2, 3 and 4 slightly wider than penultimate phalanges and those on toes 1 and 5 of the same width as penultimate phalanges; subarticular tubercles absent; eye medium-sized, ratio of eye diameter/snout-urostyle length more than 1.10; body size very small for a symphignathine species; advertisement call consists of a series of short peeps; mode of life subterrestrial.

Type species. *Oninia senglaubi* sp. n.

Other included species. None are known at present.

Distribution. *Oninia senglaubi* sp. n. is known only from the Fakfak Mountains on the Onin Peninsula, neck of the Vogelkop, western New Guinea, PPI (Fig. 1).

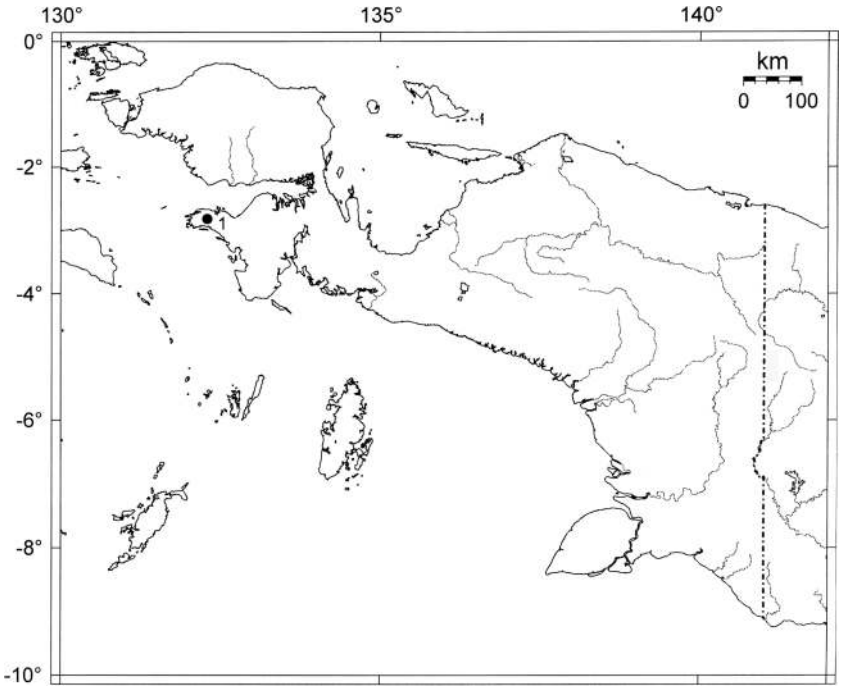

Figure 1. Map of the west of New Guinea (Papua Province, Indonesia) with collection site (1) of *Oninia senglaubi* gen. et sp. n. in the Fakfak Mountains on the Onin Peninsula.

Discrimination from other symphignathine genera. According to Zweifel (1972), Burton (1986) and personal observations, other genera of the Asterophryinae with a symphignathine state of both jaws are *Asterophrys, Callulops, Metamagnusia, Pherohapsis, Pseudocallulops, Mantophryne* (according to Burton [1986] not all species of this genus), and *Xenorhina* (including the recently synonymised *Xenobatrachus*). The genus *Barygenys* has symphignathine lower jaws but its upper jaws are eleutherognathine (Burton 1986), and, based on studies of mitochondrial DNA (Köhler & Günther 2008), it is only distantly related to the above genera and will not be further treated in the following.

The most obvious differences between *Asterophrys* and *Oninia* are a sagittal crest present in the former, absent in the latter; strongly calcified nasals in the former versus weakly calcified nasals in the latter; otic ramus of squamosal ossified versus cartilaginous; vertebral column procoelous versus diplasiocoelous; vomeropalatines robust with anterior extensions versus delicate and rod-shaped and without anterior extensions; terminal phalanges T-shaped versus pointed; body size relatively large (more than 40 mm) versus small (less than 20 mm).

Conspicuous differences between *Oninia* and *Callulops* are weakly calcified nasals in the former versus strongly calcified ones in the latter; lateral surface of zygomatic ramus of squamosal sharp edged and projecting over basis of otic ramus versus not sharp edged and not projecting over otic ramus; otic ramus of squamosal cartilaginous versus ossified; vertebral column diplasiocoelous versus procoelous; ilium with dorsal crest versus no crest; terminal phalanges pointed versus T-shaped; advertisement calls peeping versus croaking; body length less than 20 mm in *Oninia*, more than 20 mm in all 14 *Callulops* species.

The most obvious differences between *Oninia* and *Metamagnusia* are a sagittal crest present in the latter, absent in the former; otic ramus cartilaginous in the former and calcified in the latter; vertebral column diplasiocoelous versus procoelous; dorsolateral skin folds missing versus present; strongly broadened digital discs with T-shaped terminal phalanges in all fingers and toes in *Metamagnusia*, terminal discs of fingers and toes in *Oninia* not or only barely broadened and terminal phalanges not T-shaped; mode of life subterrestrial in *Oninia* but arboreal in *Metamagnusia*. There are also considerable differences in body length: it is less than 20 mm in *Oninia* and more than 40 mm in *Metamagnusia*.

Pherohapsis differs from *Oninia* in having the squamosal and frontoparietal bones meeting to form an arch over the prootic region, in having extensive rugosity of all dermal roofing bones of the skull, in fusion of the nasals, and in development of a broad sheet of bone continuous with the maxilla (Zweifel 1972). SUL of adult *Pherohapsis* is more than 25 mm.

Oninia differs from *Pseudocallulops* by *Oninia* having a broadly- versus narrowly-ending cultriform process of the parasphenoid; a cartilaginous versus ossified otic ramus of the squamosal; a sharp-edged and upward-arched zygomatic ramus of the squamosal versus a zygomatic ramus which does not project beyond the basis of the otic ramus; fragile rod-shaped vomero-palatines without anterior extensions versus more solid vomero-palatines with anterior extensions; postero-medial processes of the hyoid apparatus with broad dilatations versus processes without such dilatations; pointed terminal phalanges versus T-shaped terminal phalanges; scarcely or not enlarged terminal discs of fingers and toes versus conspicuously enlarged terminal discs; a subterrestrial versus a terrestrial mode of life; and a

peeping versus a croaking advertisement call. SUL of adult *Pseudocallulops* is more than 25 mm.

Mantophryne (from which we do not posses osteological preparations and for which characters are mentioned by Zweifel 1972 and Menzies 2006) differs from *Oninia* by the presence of two white-tipped warts on the chin; well-developed subarticular tubercles; anterior extensions of the robust vomero-palatine bones; its larger body size (maximum in the known species *Mantophryne infulata* 40 mm, *M. lateralis* 55 mm and *M. louisiadensis* 82 mm); and, most notably, by strong differences in the DNA sequences of mitochondrial genes.

Species of the genus *Xenorhina* including the former *Xenobatrachus* (Frost et al. 2006, Köhler & Günther 2008) differ from *Oninia* mainly by a pointed versus a rounded snout (see fig. 5 by Günther & Knop 2006); smaller eyes (mean ratio ED/SUL less than 0.090 versus 1.113); strongly expanded anteriorly directed median processes of the vomero-palatines; missing or only weakly developed flanges on the posteromedial processes of the hyoid; and a smooth skin.

Etymology. The new genus is named after the geographic region Onin in the northwestern corner of the Bomberai Peninsula in western New Guinea where this taxon was first discovered. The name was formed by adding the Latin derivative suffix "-ius" in its feminine form "-ia" to the uninflected substantive Onin. Gender of the new genus is feminine.

Oninia senglaubi gen. et sp. n.

Holotype. ZMB 74611 (Field Number = FN 7944); adult male (Figs 2a–d), collected by R. Günther and A. Piahar on 13 September 2008 near the Fakfak Town-Kokas road, at 860 m a.s.l. about 16 km north of Fakfak Town, Fakfak Mountains, Onin Peninsula (part of the Bomberai Peninsula), western New Guinea, PPI, 2°47′ S and 132°16′ E.

Paratypes. ZMB 74606 (FN 7938), ZMB 74607 (FN 7939), ZMB 74608 (FN 7940), ZMB 74609 (FN 7942), and ZMB 74610 (FN 7943). The collection date for ZMB 74606–608 was 12 September and for ZMB 74609–610 was 13 September, 2008. The collection site for all paratypes was the same as for the holotype. Collectors were R. Günther, M. Kapisa, and A. and F. Piahar.

Diagnosis. Snout-urostyle length of six adult males 17.2 mm to 18.8 mm (with this size range the new species and genus is the smallest among all circa 50 symphignathine microhylid species in New Guinea). Ratio of eye diameter/snout-urostyle length more than 1.10. Terminal discs in toes 2, 3 and 4 slightly wider than the penultimate phalanges, other toe discs and all finger discs of the same width or smaller than penultimate phalanges. Finger discs clearly narrower than toe discs. Terminal phalanges pointed. No subarticular tubercles and no outer metatarsal tubercle. Skin of the dorsal and lateral surfaces tubercular, that of the ventral surfaces smooth. Osteological features as for the genus. Mode of life subterrestrial, the advertisement call consists of a series of short peeping notes. Other diagnostic features are given in the diagnosis of the genus.

Description of the holotype. For measurements see Table 1. Head in relation to body small, broader than long (HL/HW 0.83), canthus rostralis flattened, loreal region oblique, snout sloping in profile (Fig. 2a) and rounded in dorsal view (Fig. 2b), snout tip projects over the lower jaw in profile, nostrils laterally oriented and closer to tip of snout than to eye, eye-naris distance the same

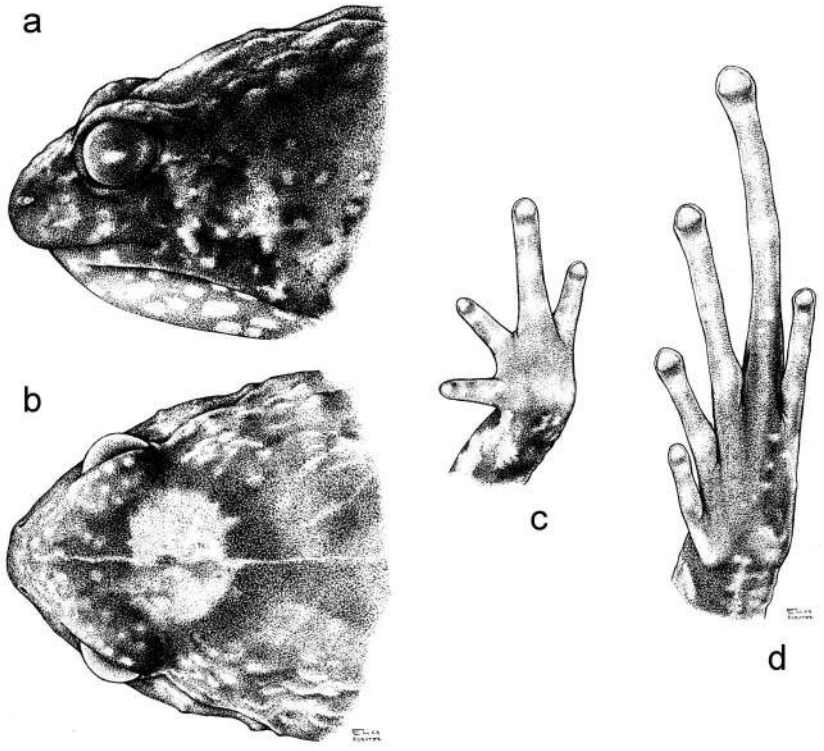

Figure 2. Preserved holotype of *Oninia senglaubi* gen. et sp. n. **a.** Lateral view of the head; **b.** Ventral view of the head; **c.** Dorsal view of the left hand; **d.** Ventral view of the left foot.

Table 1. Body measurements and body ratios of the type series of *Oninia senglaubi* gen. et sp. n. ZMB-No are the inventory numbers of the Museum für Naturkunde Berlin, FN are the first author's field numbers, and SD indicates the standard deviation. ZMB 74611 is the holotype, ZMB 74606 and 74609 are now osteological preparations. All specimens are adult males. All measurements are in mm; abbreviations are explained in "Material and methods".

ZMB-No	74606	74607	74608	74609	74610	74611	mean	SD
FN	7938	7939	7940	7942	7943	7944		
SUL	17.8	18.4	18.1	17.2	18.8	18.7	18.2	0.60
TL	8.1	7.8	7.9	7.8	8.1	8.1		
TaL	5.9	5.2	5.5	5.3	5.6	5.6		
T4L	8.6	8.1	8.8	8.5	8.6	8.4		
T4D	0.6	0.5	0.5	0.5	0.7	0.55		
F3L	3.5	3.2	3.3	3.3	3.6	3.2		
F3D	0.4	0.3	0.35	0.3	0.35	0.3		
HL	5.0	6.1	5.8	5.0	6.0	5.8		
HW	7.2	7.0	7.3	6.8	7.1	7.0		
END	1.2	1.4	1.3	1.3	1.5	1.5		
IND	1.4	1.3	1.5	1.5	1.6	1.5		
ED	2.0	2.1	2.0	1.9	2.1	2.2		
TyD	1.2	1.2	1.1	0.9	1.1	1.1		
SL	2.4	2.7	2.1	2.4	2.6	2.5		
L1T	0.9	1.2	1.3	1.2	1.3	1.25		
LCint	0.6	0.6	0.7	0.8	0.7	0.75		
TL/SUL	0.46	0.42	0.44	0.45	0.43	0.43	0.44	0.015
TaL/SUL	0.33	0.28	0.30	0.31	0.30	0.30	0.30	0.016
T4L/SUL	0.48	0.44	0.49	0.49	0.46	0.45	0.47	0.021
T4D/SUL	0.034	0.027	0.028	0.035	0.037	0.029	0.032	0.004
F3L/SUL	0.20	0.17	0.18	0.19	0.19	0.17	0.18	0.012
F3D/SUL	0.022	0.016	0.019	0.017	0.019	0.016	0.018	0.002
F3D/T4D	0.67	0.60	0.70	0.60	0.50	0.55	0.60	0.074
HL/SUL	0.28	0.33	0.32	0.29	0.32	0.31	0.31	0.019
HW/SUL	0.40	0.38	0.40	0.40	0.38	0.37	0.39	0.013
HL/HW	0.69	0.87	0.79	0.73	0.85	0.83	0.79	0.071
END/IND	0.86	1.07	0.87	0.87	0.94	1.00	0.94	0.085
ED/SUL	0.112	0.114	0.110	0.110	0.112	0.118	0.113	0.003
TyD/ED	0.60	0.57	0.55	0.47	0.52	0.50	0.54	0.048
SL/SUL	0.135	0.147	0.116	0.140	0.138	0.134	0.135	0.010
Lcint/T1L	0.67	0.50	0.54	0.67	0.54	0.60	0.59	0.072

as internarial distance, tympanum diameter half of eye diameter, tympanum partly covered by skin and its margins obscure, no supratympanic fold. Head narrower than body, widest in the region of the tympana. Legs moderately long, hand plus fingers conspicuously smaller than foot plus toes (Figs 2c–d). Eyes middle-sized (ED/SUL 0.118), pupil horizontal, internarial distance equals that from eye to naris. Fore limbs slender with short fingers, all finger discs with a terminal groove and discs more narrow than penultimate phalanges. Relative length of fingers $3 > 4 = 2 > 1$. No palmar and no subarticular tubercles, no nuptial pad. Hind limbs sturdy with fairly long toes. Tibia relatively short (TL/SUL 0.43), heels do not meet one another with legs folded in right angles to body, relative length of toes $4 > 3 > 5 > 2 > 1$. Toes 1 and 5 more delicate than the other toes and their discs not wider than penultimate phalanges, discs of toes 2, 3 and 4 slightly wider than penultimate phalanges, all toe discs with a terminal groove, no subarticular tubercles, inner metatarsal tubercle rather large (Lcint/L1T 0.60), no outer one. Roundish tubercles on all dorsal and lateral surfaces, most numerous on body sides and on dorsum. Some paravertebral skin ridges between insertion of fore and hind limbs. Skin of all ventral surfaces smooth. All dorsal and lateral surfaces brown with irregular blackish spots, a light brown spot on the nape and some light spots on the anterior surfaces of the forearm, tarsus and metatarsus. Iris dark brown with many small golden spots and/or undulating stripes, its inner margin an orange circle. A fine whitish line extends from tip of snout to anal opening, and along the posterior thighs,

the anterior shanks and the posterior tarsi. Ventral surfaces brown with numerous irregular whitish spots and blotches, these spots most dense on legs and abdomen, less dense on throat and chest.

Morphological variation in the type series. Measurements of all types are given in Table 1. SUL of six adult males (sex was inferred from advertisement calls that were heard before collecting the frogs) is 17.2–18.8 mm, mean 18.2, SD 0.60. Shape of body, head and extremities of all paratypes is very similar to that of the holotype. Basic colour of dorsal surfaces varies from light brown to dark brown and intensity and shape of dark and light flecks varies considerably (Figs 3a, c). A larger pale patch on the nape, a single or a group of dark patches above or posteriorly of the arm insertion and in the lumbar region, a pattern of light and dark spots on the extremities, and a light spot around the tympanum are invariable. Tubercles are more expressed in some and less expressed in other specimens. A whitish mid-dorsal line which continued on hind legs up to distal end of tarsus was present in four of the six specimens. In

Figure 3. Paratypes of *Oninia senglaubi* gen. et sp. n. in life. **a.** Dorsolateral view of ZMB 74608 with overall lighter colouration; **b.** Ventral surface of ZMB 74608; **c.** Dorsolateral view of ZMB 74607 with overall darker colouration.

one paratype (ZMB 74610) without such a middorsal line there is a light dorsolateral stripe on each body side. Basic pattern of ventral surfaces is the same in all types, colour of the coloured parts was blackish in the living animals (Fig. 3b) but brown in the preserved specimens.

In order not to damage the skull of the holotype, some anatomical details of the mouth cavity were studied in a paratype (ZMB 74606): tongue broad and roundish, its lower median part longitudinally adherent to mouth floor and its lateral and posterior margins free, prepharyngeal ridge with 10 denticles, apertures of vocal sac relatively small and situated laterally on both sides of the mouth floor.

Osteological characteristics (based on two bone-cartilage preparations, ZMB 74606 and 74609). The main

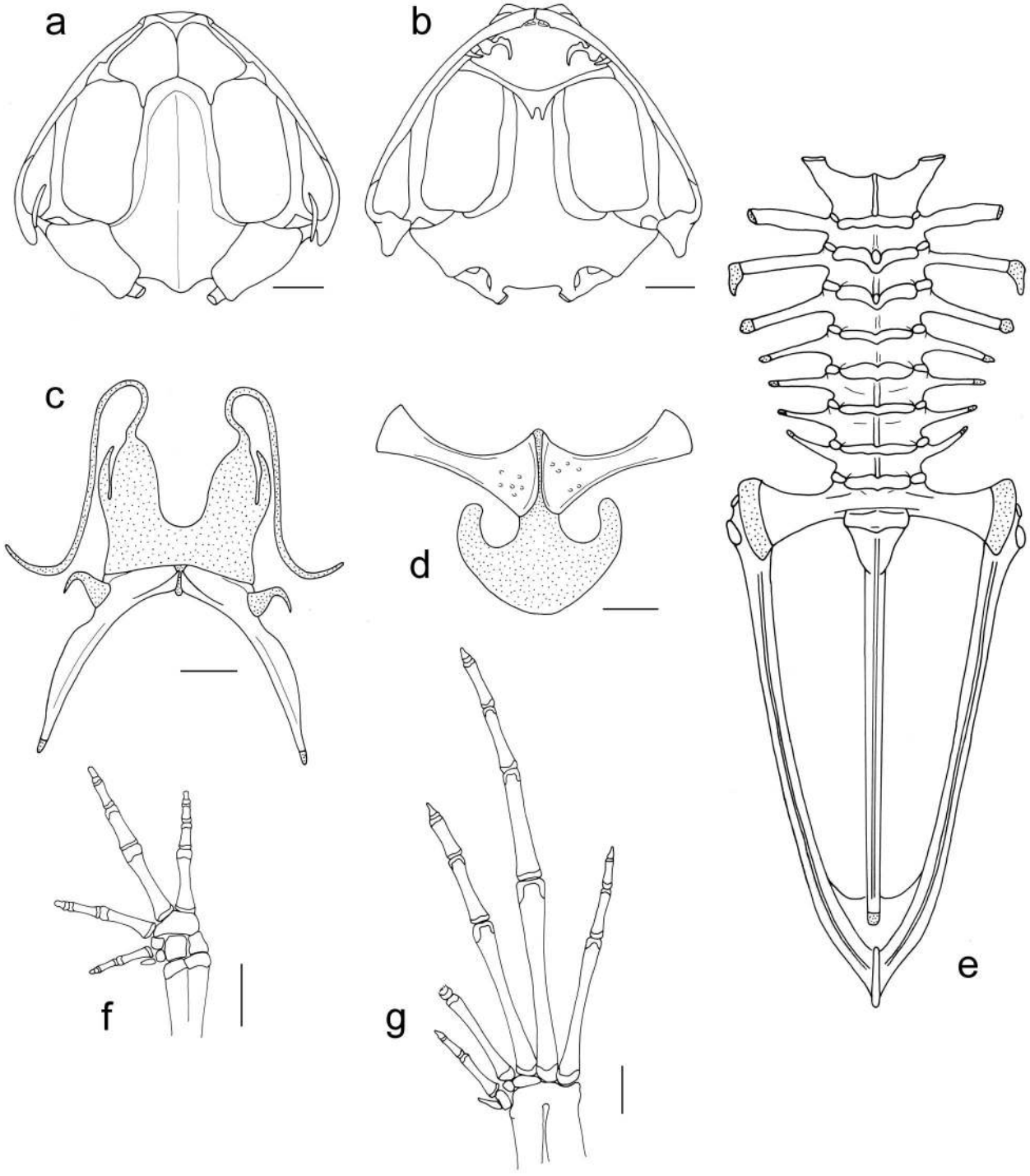

Figure 4. Skeletal elements of *Oninia senglaubi* gen. et sp. n. **a.** Dorsal view of skull; **b.** Ventral view of skull with mandibles removed; **c.** Ventral view of the hyoid apparatus; **d.** Ventral view of pectoral girdle; **e.** Dorsal view of the vertebral column including ilia and urostyl; **f.** Dorsal view right hand; **g.** Dorsal view of right foot, second toe was partly cut off. **White** – bone, **stippled** – cartilage; scale bar = 1 mm.

skeletal features are shown in Figure 4. Skull clearly broader than long, frontoparietals fused, longer than broad, and without a sagittal crest (Fig. 4a). Nasals poorly ossified; based on our two preparations it remains unclear whether the nasals are fused to one another. Squamosal also scarcely ossified, with well developed zygomatic ramus; its outer (distal) surface sharp-edged and projects beyond the base of the otic ramus; occurrence of a posteriad extension of the zygomatic ramus is unclear. Otic ramus cartilaginous and broadly attached to crista parotica. Quadratojugal is ossified. Anterior ends of maxillaries meet in front of very small premaxillaries (symphignathine condition). Cultriform process of parasphenoid terminates rather broadly and meets the posterior processes of the vomero-palatines (Fig. 4b) which are fused with each other and do not show a median suture or median anterior processes. Dentary and mentomeckelian fused. Anterolateral (alary) processes of completely cartilaginous hyoid plate present, posterolateral processes separated from hyoid plate by a narrow chiasm; ossified posteriomedial processes with expanded flanges (Fig. 4c). Eight nonimbricate presacral vertebrae, first seven procoelous, eighth diplasiocoelous. Except vertebra number one, all with broad diapophyses; those of vertebra 8 oriented anteriad, those of number 2, 6 and 7 straight, and those of 3, 4 and 5 directed posteriad. Sacral diapophyses only slightly expanded. Urostyle and ilia with dorsal crests (Fig. 4d). Coracoids robust with distal ends directed slightly anteriad and more broadly expanded than proximal ends. Sternum large, completely cartilaginous and anchor-shaped (Fig. 4e). Procoracoids, claviculae, and omosternum absent. Bones of hands (Fig. 4f) and feet (Fig. 4g) show no peculiarities except that all terminal phalanges are pointed and not T-shaped as in most other microhylids of the region.

Vocalisation. Males began to call in the late afternoon and called up to midnight (we were not in the forest later in the night or in the morning and therefore have no information on calling behaviour at that time). Frogs uttered their calls from small holes beneath the ground surface. The shortest distance between two calling males was about 2 m. Up to five calling males could be heard at one time from one area.

Advertisement calls of four males were analysed (Tab. 2). Calls consisted of series of short peeps (Fig. 5a). Duration of calls was from 1–7 seconds (s); 31 calls lasted on average 3.7 s (SD 1.13). Calls were uttered in series which lasted several minutes; the shortest intervals between two successive calls were about 4 s. Mean note length in the four analysed males was 50 milliseconds (ms), mean internote interval length was 103 ms, and mean note repetition rate was 6.75 notes per s (Tab. 2).

In the course of many calls, some notes were noted to be missing, making such calls stuttering. Many calls start, like the stuttering one on Figure 5b, with a slow and very short introductory note, followed by some notes with increasing sound volume. After this initial phase all following notes have about the same volume. Many but not all notes have a very short and very low introductory part, then sound volume rises abruptly to maximum power. Volume slowly decreases in the course of the note showing some slight modulations and ending rather quickly (Fig. 5c). The introductory part may be part of the main note but may also be more or less separated from the main note (Fig. 5c). Notes are unpulsed and finely tuned with a fundamental frequency band at 2 kHz, a dominant frequency band at 4 kHz and two upper harmonic bands at 6 and 8 kHz (Figs 5a, d). All calls were recorded at temperatures of between 19 and 21 °C.

Distribution and ecological notes. Based on bioacoustics evidence, *Oninia senglaubi* is a common species along the Fakfak Town-Kokas road in the Fakfak Mountains, northwestern corner of the Bomberai Peninsula (Fig. 6). It inhabits elevations between 600 m and 1000 m, on the top and on both sides of a mountain ridge. The new species is certainly an inhabitant of primary rain forest but now also occurs in secondary forest habitats. Shrubs and/or trees seem to be important for its occurrence. All frogs were found beneath shrubs or trees, at 5–20 cm below the surface of the soil, sitting in small holes between humus, living and dead roots, rotting leaves and rotting wood. The intestine of one specimen contained insect remains and much earth.

Table 2. Note length, internote interval length and note repetition rate of four males of *Oninia senglaubi* sp. n.

Number of male	I	II	III	IV
Number of notes	92	71	140	102
Mean note length	54 ± 5.6	47 ± 5.5	49 ± 4.5	50 ± 3.1
Min. note length	44	32	34	42
Max. note length	66	58	62	63
Number of internote intervals	88	68	137	100
Mean interval length	102 ± 8.3	108 ± 11.8	99 ± 10.6	102 ± 7.1
Min.	82	80	64	87
Max.	125	142	118	127
Mean repetition rate, notes/s	6.6 ± 0.33	6.8 ± 0.29	7.1 ± 0.19	6.5 ± 0.32

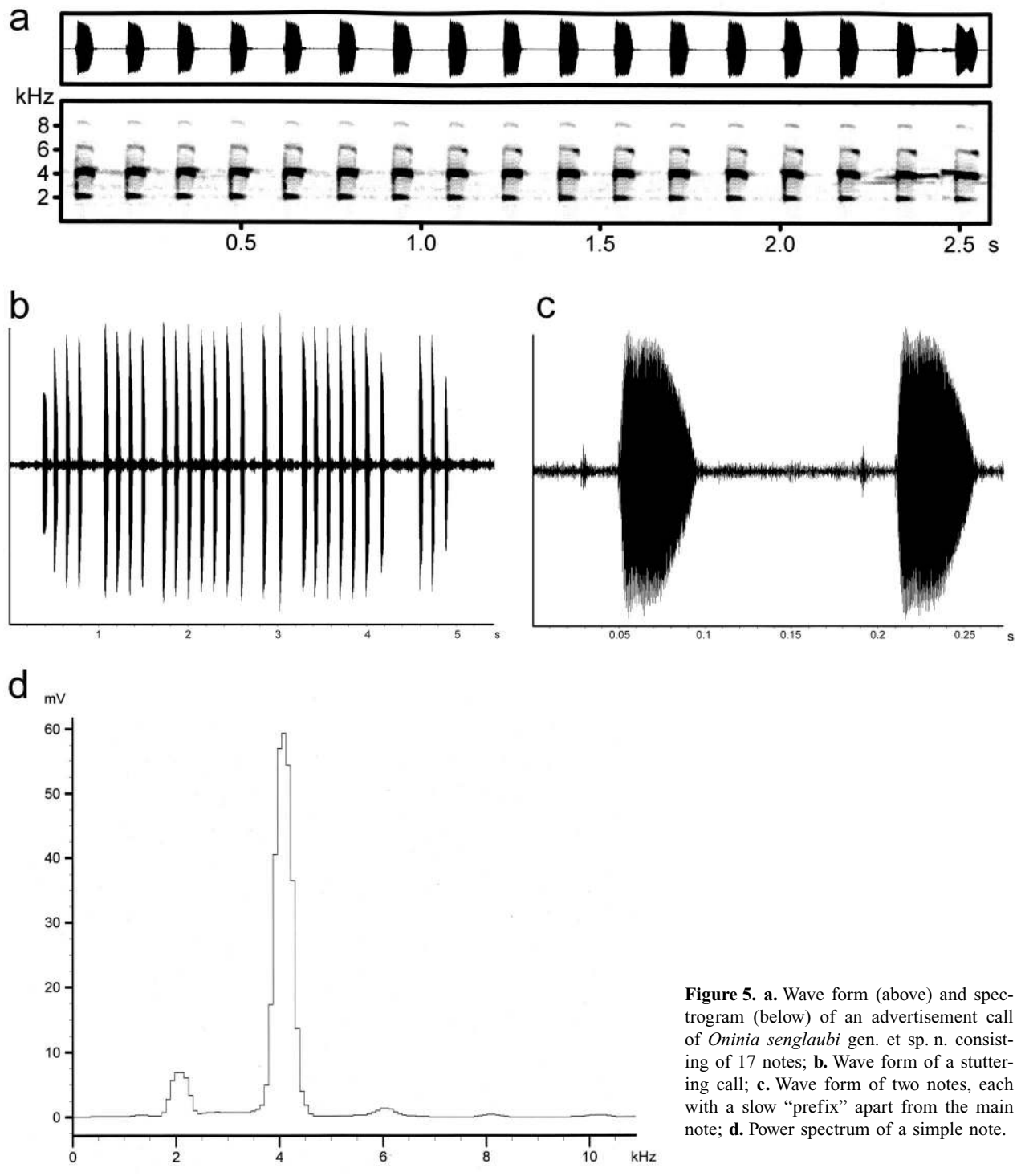

Figure 5. a. Wave form (above) and spectrogram (below) of an advertisement call of *Oninia senglaubi* gen. et sp. n. consisting of 17 notes; **b.** Wave form of a stuttering call; **c.** Wave form of two notes, each with a slow "prefix" apart from the main note; **d.** Power spectrum of a simple note.

Molecular evidence. Genetically, *Oninia* is part of a large and well-supported clade also comprising *Asterophrys, Metamagnusia*, *Pseudocallulops and Xenorhina*. Within this clade, *Oninia* groups with a moderately-supported subclade consisting of *Asterophrys, Metamagnusia*, *Pseudocallulops*. The position of *Oninia* within this subclade remains unresolved (Fig. 7). It is apparently not most closely related to *Xenorhina* although it is morphologically most similar to this genus. *Oninia* is clearly distinct genetically, with minimum genetic distances (p-distance) between it and any of the other three genera in its subclade of 9.0 % (12S) and 20.1 % (16S) (Tab. 3), while the minimum distance between *Oninia* and *Xenorhina* is 12.3 % (12S) and 22.7 % (16S). In comparison, the intrageneric maximum distances in all other genera analysed here range from 0–13.1 % (12S) and 0–18.9 % (16S). Clearly, genetic distance alone does not provide evidence for taxonomic distinctness at any level, particularly if only mitochondrial DNA is considered. However, in combination with the level of morphological distinctness observed in *Oninia senglaubi*, the degree of its genetic dissimilarity to other genera supports its separate generic status.

Figure 6. Habitat of *Oninia senglaubi* gen. et sp. n. in the Fakfak Mountains at 750 m a.s.l.

The present dataset also includes the species *Mantophryne lateralis*; this genus had not yet been studied by Köhler & Günther (2008). The molecular phylogenetic analyses show the representatives of this genus as a sister group to the *Hylophorbus* clade, which is well supported by ML and BI (87 and 100, respectively). Interestingly, the intraspecific genetic distance for 12S (2.8 %) and 16S (5.0 %) between both *Mantophryne* specimens is relatively high. The observed low genetic p-distance in 12S could be attributed to the ALISCORE algorithm, which possibly discards phylogenetically valuable information within the sequence. Further studies are necessary to solve the question whether both *Mantophryne* populations (from Saundan and Milne Bay provinces of PNG) are conspecific.

Table 3. Inter- and intra-generic genetic p-distance range for both markers studied. *A. d.* (*Austrochaperina derongo*), *C. o.* (*Copiula obsti*), *O. s.* (*Oninia senglaubi*), *P. e.* (*Pseudocallulops eurydactylus*), *P. p.* (*Pseudocallulops pullifer*), *M. m.* (*Metamagnusia marani*), *A. t.* (*Asterophrys turpicola*), *X. b.* (*Xenorhina bouwensi*), *X. l.* (*Xenorhina lanthanites*), *X. v.* (*Xenorhina varia), X.* sp. (*Xenorhina* sp.), *X.* cf. *o.* (*Xenorhina* cf. *oxycephala*), *C.* sp. (*Callulops* sp., *robustus complex*), *M. l.* (*Mantophryne lateralis*), *H. n.* (*Hylophorbus nigrinus*), *H. w.* (*Hylophorbus wondiwoi*), *H. p.* (*Hylophorbus picoides*), *H. s.* (*Hylophorbus sextus*), and *H. t.* (*Hylophorbus tetraphonus*).

12S	*A. d.*	*C. o.*	*O. s.*	*P. e.*	*P. p.*	*M. m.*	*A. t.*	*X. b.*	*X. l.*	*X. v.*
O. s.	15.5	16.4	0.0	12.5–12.9	12.7	9.0	11.2–12.9	12.3	12.3	12.3–12.5
M. l.	13.1–14.4	14.7–15.1	11.6–12.7	11.4–11.8	11.8–12.0	8.5–9.2	10.5–12.3	13.6–14.0	12.0–12.5	12.3–12.5

16S	*A. d.*	*C. o.*	*O. s.*	*P. e.*	*P. p.*	*M. m.*	*A. t.*	*X. b.*	*X. l.*	*X. v.*
O. s.	21.5	26.5	0.0	20.1–20.6	20.9–21.2	21.5	22.4–23.0	23.6–25.1	22.7	26.8
M. l.	18.9–21.5	21.5–23.0	21.2–22.1	18.6	19.2–19.5	18.6–19.8	18.9–21.5	20.6–21.8	20.4–21.8	18.6–20.1

Table 3. continued.

12S	*X.* sp.	*X.* cf. *o.*	*C.* sp.	*M. l.*	*H. n.*	*H. w.*	*H. p.*	*H. s.*	*H. t.*
O. s.	12.5	11.6–13.6	10.5–11.4	11.6–12.7	12.0	14.0–14.2	12.7–13.3	12.7	13.8–15.5
M. l.	11.4–11.6	11.6–13.6	8.5–10.5	2.8	9.8–10.9	10.7–10.9	10.1–10.7	10.1–11.2	10.5–13.3

16S	*X.* sp.	*X.* cf. *o.*	*C.* sp.	*M. l.*	*H. n.*	*H. w.*	*H. p.*	*H. s.*	*H. t.*
O. s.	24.8	23.3–25.7	23.9–26.3	21.2–22.1	21.5	21.2	21.5–23.6	21.8	21.8–22.7
M. l.	17.7–19.8	17.1–21.8	15.9–18.0	5.0	16.2–16.8	11.8–12.7	13.9–14.5	14.2–15.0	14.7–18.9

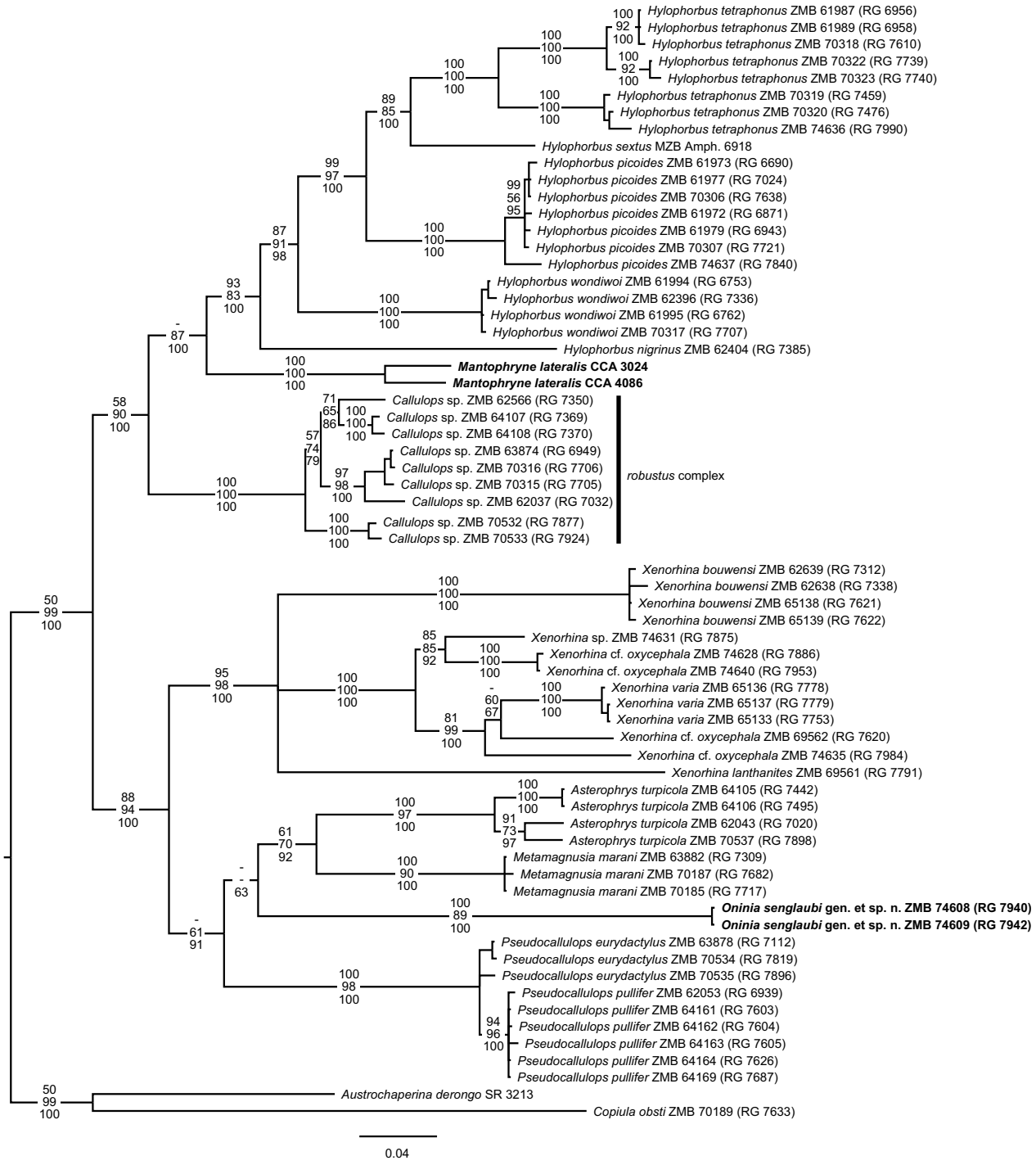

Figure 7. Bayesian phylogram of the concatenated data set (12S rRNA and 16S rRNA). The numbers on branches are maximum parsimony bootstrap values, maximum likelyhood bootstrap values and posterior probabilities of Bayesian inference (from top to bottom).

Etymology. The specific epithet is a patronym in genitive singular. It honours a former director of the Museum für Naturkunde, Berlin, Prof. Dr. Konrad Senglaub, who was also the Ph.D. supervisor of the first author exactly 40 years ago and who was of great importance in his scientific career.

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