

A new and minute species of *Austrochaperina* (Amphibia: Anura: Microhylidae) from western New Guinea

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> Abstract

A new and extremely small species of the Australopapuan microhylid frog genus *Austrochaperina* is described on the basis of recently collected material from the base of the Wandammen Peninsula, Cenderawasih Bay, neck of Vogelkop, Papua Province, Indonesia. The description is based mainly on morphological, osteological, and bioacoustic data.

> Kurzfassung

Auf der Basis eigener Aufsammlungen in den Jahren 1999 und 2000 im Wondiwoi Gebirge an der Basis der Wandammen Halbinsel, Cenderawasih Bay, westliche Papua Provinz, Indonesien, wird eine neue, sehr kleinwüchsige Art der australopapuanischen Microhylidengattung *Austrochaperina* beschrieben. Die Beschreibung basiert hauptsächlich auf morphologischen, osteologischen und bioakustischen Untersuchungen.

> Key words

Amphibia, Anura, Microhylidae, *Austrochaperina*, new species, morphology, osteology, bioacoustics, ecology, Papua Province, Indonesia, New Guinea.

Introduction

In a recent revision ZWEIFEL (2000) split the Australopapuan microhylid genus *Sphenophryne* sensu PARKER (1934) into four genera, for all of which names were already available, namely *Austrochaperina* FRY, 1912 including 24 species at present; *Liophryne* BOULENGER, 1897 with six species; *Oxydactyla* VAN KAMPEN, 1913 with five species; and *Sphenophryne* PETERS & DORIA, 1878 with one species. The genus *Austrochaperina* was diagnosed by ZWEIFEL (2000) as follows “A genus of genyophrynine microhylid frogs (sensu ZWEIFEL, 1971; BURTON, 1986) with the following combination of morphological characters: clavicles long and slender, reaching from scapula almost to midline of pectoral girdle; tips of fingers and toes (except sometimes the 1st) flattened and disclike with terminal grooves and typically broader than penultimate phalanx, the disc of the 3rd finger narrower or no broader than that on the 4th toe; subarticular elevations low and rounded, almost undetectable in some species”. According to ZWEIFEL (2000) snout-vent lengths of the adults range from 20 to 50 mm. Most species are surface dwell-

ers on and below leaf-litter, and some inhabit riparian habitats along small streams. The genus is distributed from sea level to elevations of approximately 2000 m above sea level (a.s.l.). Most species occur on the main island of New Guinea, some on adjacent islands, and five in northern Australia.

During field work in the Wondiwoi Mountains at the base of the Wandammen Peninsula, Papua Province, Indonesian New Guinea, in various years between 1998 and 2003 the present author together with indigenous helpers found, among others, a tiny species of *Austrochaperina* which could not be allocated to any of the hitherto recognized taxa. This new species is described in the following text.

Materials and methods

Abbreviations

AMNH	American Museum of Natural History, New York, USA
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, USA
MZB	Museum Zoologicum Bogoriense, Bogor/Cibinong, Indonesia
PNG	Papua New Guinea
PPI	Papua Province, Indonesia
RMNH	National Museum of Natural History, Leiden, The Netherlands
mm	millimetre
ms	millisecond
SD	standard deviation
s	second
sp. nov.	species nova
UPNG	University of Papua and New Guinea, Port Moresby, Papua New Guinea
ZMB	Museum für Naturkunde (formerly Zoologisches Museum des Museums für Naturkunde der Humboldt-Universität), Berlin, Germany

Most frogs of the new species were collected at night after locating them by their advertisement calls. One female was found serendipitously. Frogs were anaesthetized with chlorobutanol and most were stored in 2% formalin in the field and transferred to 75% ethanol in the collection of the ZMB. Clearing and double staining of one specimen as an osteological preparation was carried out according to a modified method of DINGERKUS & UHLER (1977).

Measurements of SUL and TL to the nearest 0.1 mm were made with a digital caliper, all others with an ocular micrometer in a dissecting microscope:

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, external distance between knee and heel (caliper gently pressed)
F3D	transverse diameter of third finger disc
T4D	transverse diameter of fourth toe disc
HL	head length, from tip of snout to posterior margin of tympanum
HW	head width, taken in the region of the tympana
END	distance from anterior corner of orbital opening to centre of nares
IND	internarial distance between centres of nares
ED	eye diameter, from anterior to posterior corner of orbital opening
TyD	horizontal diameter of tympanum

All calls were recorded in the field with a Sony Digital Audio Tape (DAT) Walkman TCD-D 100 and a Sennheiser microphone MKE 300 and analysed with Avisoft-SAS Lab software. Specimens are currently housed in the herpetological collection of the Museum für Naturkunde, Berlin (ZMB) and bear registration numbers of this institution. Part of the types will be transferred to the Museum Zoologicum Bogoriense (MZB) at Cibinong (Indonesia).

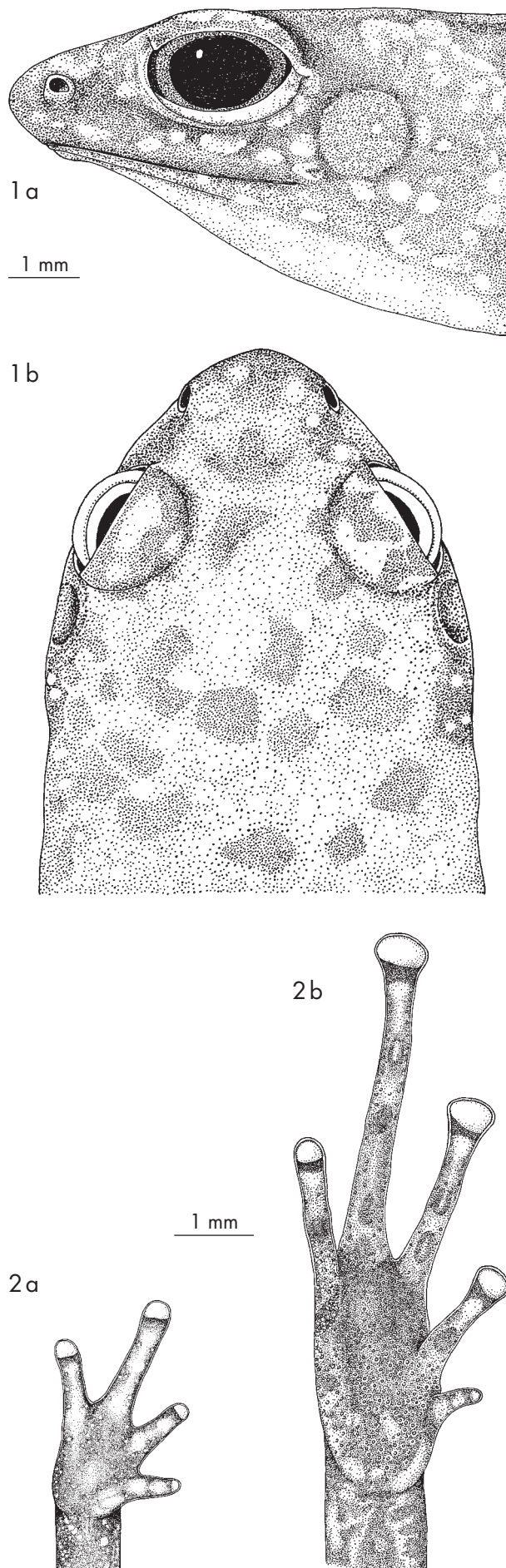
Material compared. *Austrochaperina archboldi*: AMNH 66719 (holotype), 66720, 66722–25 (paratypes), Eastern Highland Province of PNG; *Austrochaperina blumi*: UPNG 9529–31, 9534, 9537, Jayawijaya District, PPI; *Austrochaperina derongo*: MCZ A-132891, A-132913–14, A-132918, A-132978, A-132999 (all of them paratypes), Western Province of PNG near Dorongo; *Austrochaperina guttata*: MCZ A-132843–45 (all of them paratypes), Gulf Province of PNG near Uraru; *Austrochaperina macrorhyncha*: RMNH 4630 (holotype), south-eastern corner of the Vogelkop Peninsula, Manikion area, PPI; *Austrochaperina mehelyi*: MCZ A-28406, Huon Peninsula, PNG; *Austrochaperina novaebritanniae*: MCZ A-73085–86 (paratypes), East New Britain Province, PNG.

Austrochaperina minutissima sp. nov.

Figs. 1–9 and Table 1

Holotype. ZMB 62573 (field number=FN 7264), adult male, collected by R. Günther and S. Marani on 9 May 2000, on the ridge of the Wondiwoi Mountains at the base of the Wandammen Peninsula, elevation 920 m a.s.l., coordinates 2°56'S and 134°36'E, border between Nabire and Manokwari districts, Papua Province, Indonesia. **Paratypes.** ZMB 62069 (FN 6997), adult male, collectors and collection site the same as for the holotype, collection date 25 August 1999; ZMB 62071 (FN 7038) adult female, collection site 700 m a.s.l., eastern slope of the Wondiwoi Mountains at the base of the Wandammen Peninsula, collectors R. Günther and M. Kapisa, collection date 28 August 1999; ZMB 62574 (FN 7281), ZMB 62575 (FN 7282), adult males, all data the same as for the holotype. ZMB 62574 is now an osteological preparation.

Diagnosis. Four adult males measured from 15.0 to 15.8 mm SUL and one adult female 16.6 mm. With this body size, *Austrochaperina minutissima* is the smallest known species of this genus. Only *A. polysticta* with but one known and now destroyed specimen of 16.5 mm SVL is probably of a similar small size. From an illustration of the whole body by MÉHELY (1901),



it can be calculated that *A. polysticta* exhibits a TL/SVL ratio of 0.44. With a TL/SUL-ratio of 0.46–0.49 the new species has somewhat longer hind legs than does *A. polysticta*. Moreover, *A. polysticta* exhibits a dark red-brown stripe from the tip of the snout, passing along the upper eyelid and the upper margin of the tympanum, and extending to the midbody region; such a stripe is missing in *A. minutissima*. The advertisement calls of *A. minutissima* consist of short trains of high-pitched peeps with a mean call length of 0.94 s, a mean number of notes per call of 10, a mean note length of 43 ms, and a mean note repetition rate of 10.8 per s.

Description of the holotype. An adult male with a snout-urostyle length of 15.6 mm. For measurements and body-ratios see Table 1. Head in the region of the tympana as wide as the remaining body. Snout rounded, in profile protruding (Fig. 1a). Nostrils laterally directed and closer to snout tip than to eyes, distance between nares distinctly greater than distance between eye and naris (Fig. 1b). Canthus rostralis straight and gently rounded. Tongue small, elongate, half free posteriorly, and without a posterior indentation. Prepharyngeal ridges scarcely visible. Elongate vocal slit on each side of the tongue. Tympanum clearly expressed, its horizontal diameter slightly more than half eye diameter, no supratympanic skin fold. Eye of middle size (ED/SUL 0.115), with horizontal pupil. Fore limbs short with small hands and short fingers, their tips not (fingers 1 and 2) or only scarcely (fingers 3 and 4) broader than penultimate phalanges (Fig. 2a); terminal grooves present on fingers but weakly expressed; some rugosity on palmar surface, no subarticular tubercles; relative length of fingers $3 > 4 > 2 > 1$. Hind limbs much stronger developed than fore limbs. Discs of toes 2, 3, and 4 clearly broader than penultimate phalanges, that of toe 5 about the same width as penultimate phalanx, all with terminal grooves; toe 1 rudimentary with no clear disc and no clear terminal groove. Metatarsal tubercles and subarticular tubercles absent. Relative length of toes $4 > 3 > 5 > 2 > 1$, no webbing (Fig. 2b). All dorsal and ventral surfaces smooth.

Fig. 1a. Lateral view of the head of the holotype of *Austrochaperina minutissima* sp. nov.

Fig. 1b. Dorsal view of the head of the holotype of *Austrochaperina minutissima* sp. nov.

Fig. 2a. Ventral view of the right hand of the holotype of *Austrochaperina minutissima* sp. nov.

Fig. 2b. Ventral view of the right foot of the holotype of *Austrochaperina minutissima* sp. nov.

Tab. 1. Biometrical values of the holotype (ZMB 62573) and four paratypes of *Austrochaperina minutissima* sp. nov. ZMB 62071 is a female, all others are males. All measurements in mm. Abbreviations are explained in the section Materials and methods.

ZMB-No.	62069	62071	62573	62574	62575	Mean	SD
SVL	15.7	16.6	15.6	15.0	15.8	15.7	0.57
TL	7.3	8.2	7.5	7.3	7.6	7.6	0.37
TaL	7.3	8.2	7.5	7.3	7.6	7.6	0.37
T4D	0.80	0.85	0.70	0.60	0.80	0.75	0.10
F3D	0.3	0.4	0.3	0.2	0.3	0.3	0.07
HL	5.2	5.7	5.5	5.0	5.4	5.36	0.27
HW	5.8	6.0	6.4	5.6	6.0	5.96	0.30
END	1.2	1.3	1.2	1.2	1.2	1.22	0.04
IND	1.9	2.0	2.0	2.0	2.1	2.0	0.07
ED	1.8	2.0	1.8	1.8	1.9	1.86	0.09
TyD	1.0	1.2	1.0	1.0	1.0	1.04	0.09
TL/SUL	0.46	0.49	0.48	0.49	0.48	0.48	0.012
TaL/SUL	0.32	0.34	0.32	0.31	0.32	0.32	0.011
T4D/SUL	0.051	0.045	0.045	0.040	0.051	0.046	0.005
T4D/F3D	2.67	2.13	2.30	3.00	2.67	2.55	0.34
HL/SUL	0.33	0.34	0.35	0.33	0.34	0.34	0.008
HW/SUL	0.37	0.36	0.41	0.37	0.38	0.38	0.02
HL/HW	0.90	0.95	0.86	0.89	0.90	0.90	0.032
END/IND	0.63	0.65	0.60	0.60	0.57	0.61	0.031
ED/SUL	0.115	0.120	0.115	0.120	0.120	0.118	0.003
TyD/ED	0.56	0.60	0.56	0.56	0.53	0.56	0.025



Fig. 3. Dorsal view of the living holotype of *Austrochaperina minutissima* sp. nov.

Snout tip with a transparent whitish cap. Dorsal surface of head, body, and extremities reddish-brown with numerous dark brown spots. Dorsal surface of fore limbs as well as sides of body and head with some whitish flecks. Basic colour of all ventral surfaces light

yellowish; throat, chest, inferior flanks, and hind limbs more or less densely speckled with brown. Tympanum light brown and, in terms of colour, clearly demarcated from its surroundings. Loreal region and upper eyelids with large dark brown flecks. The colouration in life was largely the same, but was more intense and with numerous very small whitish flecks and streaks on all dorsal surfaces (Fig. 3).

Morphological variation in the type series. The type series consists of four adult males and one adult female for which measurements and body ratios are listed in Table 1. Sex was determined by inspection of gonads and of secondary sex characters (presence of vocal slits). There are only minor differences in SUL: males measure 15.0–15.8 mm and the female 16.6 mm. Due to the small sample size it is impossible to decide whether there are real differences in body size between the sexes. The female differs slightly in various body ratios from the males (Table 1) but, as with SUL, there are too few animals for conclusions in this respect. Basic colouration is much the same in all types. There are differences in the extent of spotting of the dorsal and ventral surfaces (Figs. 4a and 4b).

Osteological characteristics (based on a bone and cartilage preparation of ZMB 62574). Long and slender clavicles, reaching from scapula almost to midline of pectoral girdle, and an eleutherognathine condition



Fig 4a. Dorsal view of the preserved holotype and three paratypes of *Austrochaperina minutissima* sp. nov. From left to right: ZMB 62069, ZMB 62071, ZMB 62573 (holotype), and ZMB 62575.



Fig. 4b. Ventral view of the preserved holotype and three paratypes of *Austrochaperina minutissima* sp. nov. Same order as above.

of the upper jaw clearly indicate that the new species belongs to the genus *Austrochaperina* sensu ZWEIFEL (2000). Frontoparietals as long as broad, not fused to one another but fused to exoccipital (Fig. 5a). Prootic separated from frontoparietal and exoccipital by broad and scarcely ossified sutures. Occipital condyles prominent. Nasals sparsely mineralized, sphenethmoid largely covered by frontoparietals. Squamosal with distinct zygomatic ramus; otic ramus fairly short, broader than zygomatic ramus, and overlapping the cartilaginous crista parotica, basal part of ventral ramus greatly expanded (unusual at least in Australopapuan microhylids) and connected with quadratojugal and articulating with dentary. Palatine process of premaxillary relatively long and acuminate. Prevomer and palatine united. There is a bony element with a longitudinal split on the anterior mouth roof whose origin is dif-

ficult to interpret (Fig. 5b). Hyoid apparatus (Fig. 5c) with broad anterolateral and acuminate posterolateral processes; posteromedial processes with dilations; a transverse chasm in the central plate posterior of the posterolateral processes; central cartilaginous plate partly ossified (unstippled areas). Ventral elements of pectoral girdle (Fig. 5d) are: long and slender clavicles that reach from nearly the midline of the girdle to the scapulae, their basal end strongly dilated; slender cartilaginous procoracoids expanded from epicoracoid cartilage up to scapulae; robust and angular-arranged coracoids, their distal ends narrower than their proximal ends; long and partly ossified sternum with anchor-shaped xiphisternum. Vertebral column (Fig. 5e) with eight procoelous, non-imbricate presacral vertebrae, sacral vertebra with expanded transverse processes, urostyle bone and ilia without crests. Radius and ulna

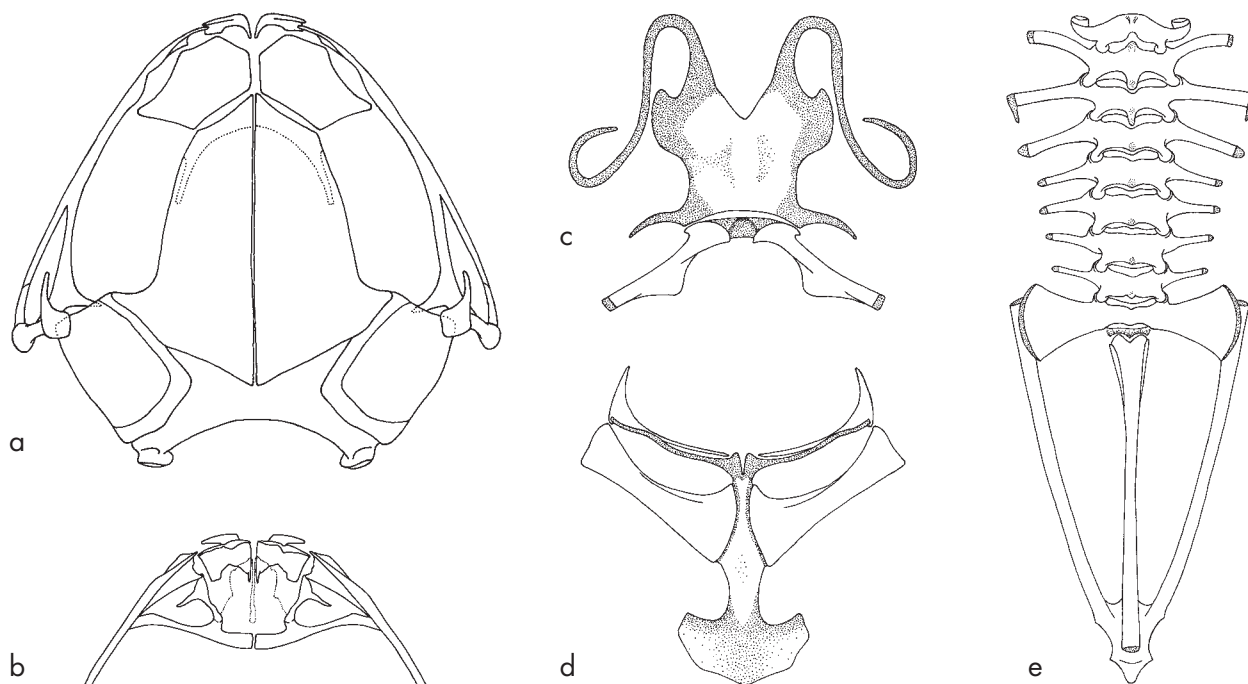


Fig. 5. Skeletal elements of *Austrochaperina minutissima* sp. nov.: (a) dorsal view of the skull, (b) ventral view of the roof of the oral cavity, (c) ventral view of the hyoid apparatus, (d) ventral view of the pectoral girdle, (e) dorsal view of the vertebral column.

fused, no distal carpals, phalangeal formula of hand 3-3-4-4, ultimate phalanx of digit 1 tiny, that of digit 2 clearly expressed, neither T-shaped; ultimate phalanx of digits 2 and 4 T-shaped but transverse element very narrow. Phalangeal formula of foot 2-3-4-5-4 (there is a tiny terminal element on digit 1 that is too small to be considered as a phalanx); digits 2-5 each with T-shaped ultimate phalanx, transverse element of T in all cases small.

Distribution. Wondiwoi Mountains at the base of the Wandammen Peninsula, border between Manokwari District and Nabire District, western Cenderawasih Bay, Papua Province, Indonesian New Guinea.

Habitat and ecology. All males were found on the main ridge of the mountain chain at approximately 900 m a.s.l. in primary mossy rain forest (Fig. 6). They were common. The female was accidentally found at 700 m a.s.l. All specimens were hidden under leaf-litter. Males started to call in the late afternoon or at dusk, and call intensity decreased soon after nightfall; a few call series were heard up to midnight.

Vocalization. Advertisement calls consisted of a series of short and high pitched notes and strongly resembled the songs of crickets. Calls were uttered mostly in long series of up to several minutes in length, whereby length of calls as well as length of intercall intervals varied insignificantly (Fig. 7). The shortest interval

between two consecutive calls was approximately 2 s. Mean call duration of 25 calls from three males was 0.94 s, SD 0.18, range 0.58–1.20 s. Number of notes in these calls: mean 10.0, SD 1.33, range 7–12. Mean length of 224 notes was 43 ms, SD 4.7, range 30–50 ms. Mean length of 199 internote intervals was 56 ms, SD 4.2, range 72–199 ms. Mean note repetition rate in 25 calls was 10.8 notes per s, SD 0.82, range 10.0–12.3 notes per s. Notes are unpulsed, their sound volume oscillates more or less. There are notes which start with the maximum sound intensity, in other notes the maximum sound intensity was at the end, and still others showed a bimodal sound intensity (Fig. 8, above). There is a clear frequency modulation in all notes, and the frequency rises from approximately 5.5 kHz to about 6.5 kHz in the course of the note. Most notes exhibit three frequency bands: a fundamental frequency band reaching from 3 to 4 kHz, a dominant frequency band reaching from 6 to 7.5 kHz, and an upper harmonic band centering at 9.5 kHz. Most energy is concentrated in the dominant band, followed by the fundamental band, and the least energy is expressed in the upper harmonic band (Fig. 8, below, and Fig. 9). All calls were recorded at air temperatures of from 19 to 20 °C.

Etymology. The specific epithet refers to the extreme small size of the new species. *Minutus* (-a, -um) is a Latin adjective in singular and means small, tiny. *Minutissimus* (-a, -um) is the superlative and means



Fig. 6. Rain forest on the top of the Wondiwai Mountains, type locality of *Austrochaperina minutissima* sp. nov., elevation 920 m above sea level.

smallest, tiniest, or extremely small or tiny. The suggested common name is Pygmy Land Frog.

Comparison with other species. Of five specimens in the type series, the largest is a female of 16.6 mm SUL. There are only five other *Austrochaperina* species with a similar size: *A. gracilipes*, *A. mehelyi*, *A. novaebritanniae*, *A. polysticta*, and *A. adelphe*.

A. gracilipes is larger (males up to 20 mm and females up to 23 mm SVL) than *A. minutissima*, and according to ZWEIFEL (2000) inhabits grassy woodlands along small streams in low elevations, and has different calls. Its call notes last 0.14–0.15 s, that of *A. minutissima* 0.03–0.05 s; number of notes per second 1.3–1.7 in *A. gracilipes* and 10–12 notes per second in *A. minutissima*; and dominant frequency is approximately 4000 Hz in *A. gracilipes* and 6000 Hz in *A. minutissima*. Call parameters of the former species are from ZWEIFEL (2000).

According to ZWEIFEL (2000) *A. mehelyi* reaches snout-vent lengths of about 21 mm. Méhely mentioned a specimen with a 24.5 mm length. Thus, *A. mehelyi* can become considerably larger than *A. minutissima*. Specimen MCZ A-28406 of *A. mehelyi*, measured by me, shows the following differences from *A. minutissima*: TL/SUL in the latter is 0.46–0.49, in *A. mehelyi* 0.43; T4D/SUL in *A. minutissima* 0.040–0.051, in *A. mehelyi* 0.027; T4D/F3D in *A. minutissima* 2.13–3.0 (mean 2.67), in *A. mehelyi* 2.00; END/IND in *A. minutissima* 0.57–0.65, in *A. mehelyi* 0.52. Further

differences are in the structure of the anterior mouth roof: there is a bony element of unclear origin with a deep median longitudinal furrow in *A. minutissima* (Fig. 5b), the comparable element in *A. mehelyi* has an anchor-like shape (Fig. 5 in Table 6 in MÉHELY, 1901).

A. novaebritanniae is slightly larger (males up to 19 mm SVL and females up to 21.9 mm SVL) than *A. minutissima* and is endemic to the island of New Britain (ZWEIFEL, 2000). Two specimens measured by me (MCZ A-73085-86) have distinctly shorter tibiae (TL/SUL 0.41 and 0.43) than *A. minutissima* (mean ratio TL/SUL 0.48). There are differences between these taxa also in body ratios TaL/SUL, T4D/SUL, T4D/F3D, HL/SUL, HL/HW, and TyD/ED.

The holotype and sole specimen of *A. polysticta* has been destroyed and no other specimens of that species are known. The holotype had a SVL of 16.5 mm and besides its verbal description by MÉHELY (1901) under the name *Chaperina polysticta*, there is also a colour illustration of its dorsal perspective and a drawing of the ventral elements of its pectoral girdle (MÉHELY, 1901). *A. polysticta* has shorter tibiae (TL/SUL 0.44) than *A. minutissima* (TL/SUL 0.46–0.49, mean 0.48) and a smaller tympanum (TyD/ED 0.40) than *A. minutissima* (TyD/ED 0.53–0.60). *A. polysticta* has a conspicuous dark brown stripe which begins at the posterior corner of the eye, touches the tympanum on its upper edge, and extends about to the middle of the body; no such stripe is present in *A. minutissima*. The

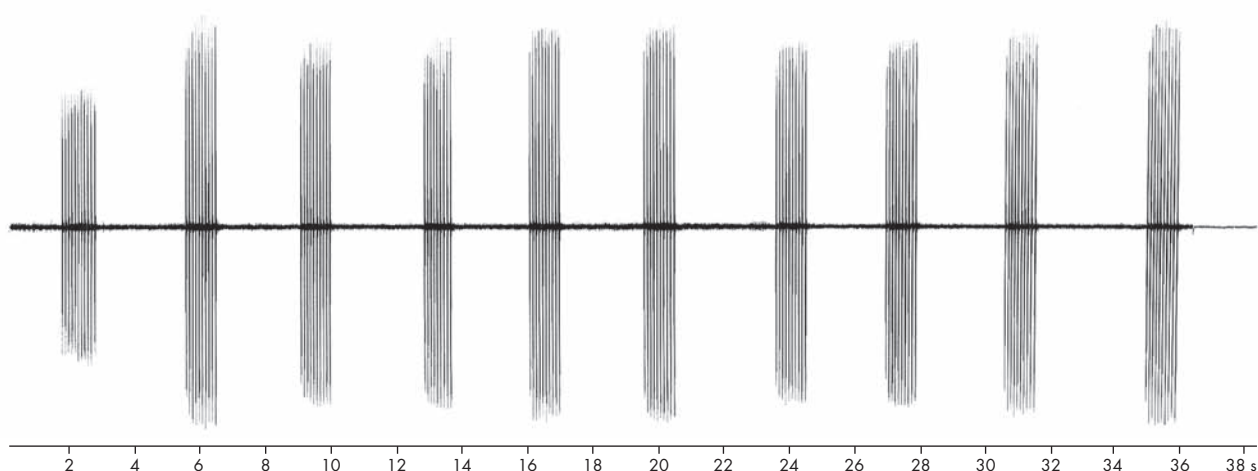


Fig. 7. Wave form of a series of ten advertisement calls of *Austrochaperina minutissima* sp. nov.

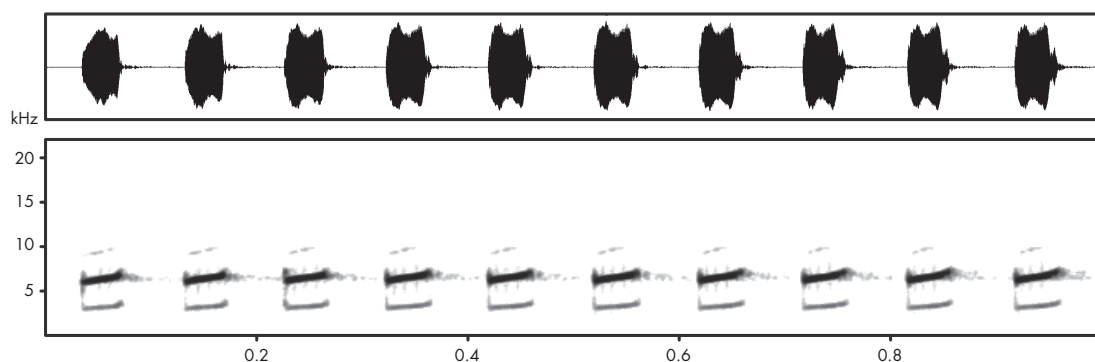


Fig. 8. Above: Wave form of an advertisement call of *Austrochaperina minutissima* sp. nov. with ten notes. Below: Audio-spectrogram of this advertisement call.

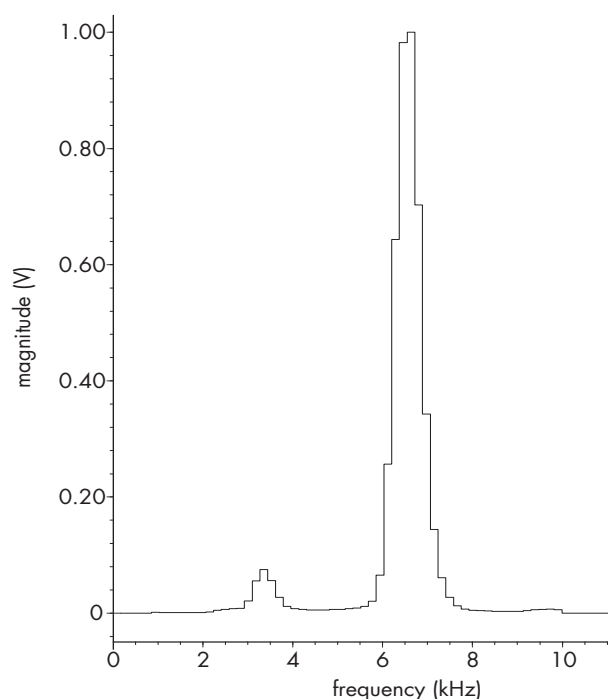


Fig. 9. Frequency distribution of an entire advertisement call of *Austrochaperina minutissima* sp. nov.

latter exhibits many small whitish flecks on all dorsal surfaces, lacking in *A. polysticta*. There is one more obvious difference between these two taxa: the base of the clavicle is strikingly expanded in *A. minutissima* but only scarcely expanded in *A. polysticta*.

A. adelphe is known only from northern Australia. It is larger than *A. minutissima*, has different body ratios, lives in other habitats and has clearly different calls (ZWEIFEL, 2000).

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