

Three new species of *Austrochaperina* from southern Papua New Guinea (Anura, Microhylidae)

RAINER GÜNTHER^{1,*} & STEPHEN J. RICHARDS²

¹ Museum für Naturkunde, Herpetologie, Invalidenstr. 43, 10115 Berlin, Germany; rainer.guenther@mf.n.berlin — ² Herpetology Department, South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia; steve.richards@samuseum.sa.gov.au — * Corresponding author

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Abstract

We describe three new species in the microhylid frog genus *Austrochaperina* Fry, 1912 from southern Papua New Guinea. All three species are medium sized for the genus (between 23–31 mm SUL) and exhibit no or limited sexual dimorphism. *Austrochaperina beehleri* **sp. nov.** can be distinguished from all congeners by, among other characters, having the dorsal surfaces in life reddish with brown mottling, while the surfaces of the axilla, groin, knee pit and posterior thigh are orange. It produces 50–70 unpulsed advertisement calls in series lasting 8–12 s. *Austrochaperina fulva* **sp. nov.** can be distinguished from all congeners by, among other characters, having the dorsum in life reddish-brown to brown without mottling, the lateral surfaces yellowish to reddish, and the ventral surfaces largely yellow. It utters distinctly pulsed advertisement calls in very long series, one series lasting more than 25 s. *Austrochaperina brachypus* **sp. nov.** can be distinguished from all congeners by, among other characters, having very short legs, having the dorsum in preservative uniform brown becoming lighter on the flanks, and the abdomen, chest and ventral surfaces of the limbs cream with fine brown markings that are most dense on the throat. It utters unpulsed advertisement calls in short series lasting just 1–2 s. Like most other members of the genus these species were encountered most commonly on the forest floor, although two of them appear to be at least partially scansorial. Descriptions of these three species brings the number of *Austrochaperina* known from the New Guinea region to at least 25.

Kurzfassung

Drei neue Froscharten in der Gattung *Austrochaperina* Fry, 1912, Familie Microhylidae, werden vom südlichen Papua Neuguinea beschrieben. Alle drei Arten sind mittelgroß (zwischen 23 und 31 mm Kopf-Rumpf-Länge) und zeigen keinen oder nur einen unbedeutenden Sexualdimorphismus. *Austrochaperina beehleri* **sp. nov.** kann von allen anderen Arten der Gattung unterschieden werden durch ihre im Leben rötliche und mit braunen Flecken durchsetzte Oberseite und die orange gefärbten Achseln, Weichen, Kniekehlen sowie Hinterseiten der Oberschenkel kombiniert mit 50–70 ungepulsten Paarungsrufen, die in 8–12 s dauernden Serien geäußert werden. Die Oberseite von *Austrochaperina fulva* **sp. nov.** ist im lebenden Zustand rotbraun oder braun und ungefleckt, ihre Körperseiten sind gelblich bis rötlich, die Unterseiten weitestgehend gelb, die Paarungsrufe sind deutlich gepulst und werden in mehr als 25 s dauernden Serien geäußert. *Austrochaperina brachypus* **sp. nov.** unterscheidet sich von allen congenerischen Arten durch sehr kurze Beine, eine im fixierten Zustand uniform braune Oberseite, die sich an den Flanken aufhellt und alle ventralen Körperteile cremefarben mit braunen Sprenkeln, die auf der Kehle am dichtesten sind. Die Serien ihrer ungepulsten Paarungsrufe dauern nur 1–2 s. Wie die meisten anderen Arten der Gattung halten sich auch die neuen Arten vorwiegend auf dem Waldboden auf, zwei scheinen auch teilweise zu klettern. Mit der Beschreibung dieser drei neuen steigt die Anzahl der Arten in der Gattung *Austrochaperina* auf mindestens 25.

Key words

Amphibia, Melanesia, systematics, bioacoustics, morphology, rainforest.

Introduction

The Australopapuan microhylid genus *Austrochaperina* currently comprises around 25 small to medium sized frogs (~ 16–50 mm SVL; ZWEIFEL, 2000; GÜNTHER, 2009,

2017; FROST, 2019) that normally occupy litter on the rainforest floor, although several species are found predominantly in riparian habitats (ZWEIFEL, 2000; GÜNTHER

et al., 2014). The genus reaches its greatest diversity on mainland New Guinea and adjacent islands where at least 22 described species occur, one of which (*A. gracilipes* Fry, 1912) is shared with Australia. In contrast just five species occur in Australia, where they are restricted to the tropical northern and north-eastern fringe of the continent (CLULOW & SWAN, 2018).

The genus-level classification of Australopapuan asterophryine microhylid frogs is poorly resolved, and recent molecular studies have revealed paraphyly of many taxa, resulting in a number of taxonomic changes (e.g. PELOSOS *et al.*, 2016; RIVERA *et al.*, 2017). *Austrochaperina* was diagnosed by ZWEIFEL (2000) as having long, slender clavicles that extend from the scapula almost to the midline of the pectoral girdle, tips of the fingers and toes that are typically broader than the penultimate phalanx and normally flattened and disclike with terminal grooves (except sometimes the 1st), the disc of the 3rd finger equal to or narrower than that on the 4th toe, and having subarticular elevations that are low, rounded, and almost undetectable in some species. However recent genetic studies have called into question this morphology-based diagnosis, with three species, *A. derongo* Zweifel, 2000, *A. guttata* Zweifel, 2000 and *A. rivularis* Zweifel, 2000 transferred from *Austrochaperina* to *Copiula* Méhely, 1901 (a genus lacking clavicles altogether) by PELOSO *et al.* (2016), one species of *Copiula* (*C. tyleri* Burton, 1990) found to be nested within *Austrochaperina* (RIVERA *et al.*, 2017), *A. palmipes* (Zweifel, 1956) consistently found to be significantly divergent from other *Austrochaperina* species (e.g. RIVERA *et al.*, 2017), and other studies finding a complex pattern of phylogenetic relationships among *Austrochaperina* and *Copiula* species (KÖHLER & GÜNTHER, 2008; PYRON & WIENS, 2011; RITTMAYER *et al.*, 2012).

Here we describe three new species of *Austrochaperina* from southern Papua New Guinea that conform to the traditional definition of *Austrochaperina* provided by ZWEIFEL (2000). However we accept that, until molecular data are available for type species of the genera discussed here, resolution of their taxonomy is not possible and in future a comprehensive genetic assessment of *Austrochaperina* and *Copiula* may require reconsideration of these species' generic placement.

Material and methods

Male frogs were located at night by their advertisement calls; females were detected on litter and on low foliage along forest trails using a headlamp. Representative specimens were photographed in life, and specimens were anaesthetised and euthanized in an aqueous chlorobutanol solution and subsequently fixed in 5% formalin. Liver samples were taken from some specimens before fixation, and stored in 95% ethanol to enable later DNA sequencing. All specimens were transferred to 70%

ethanol within two days of fixation. The following 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 from preserved specimens only:

SUL – snout-urostyle length from tip of snout to distal tip of urostyle bone; SUL is generally slightly shorter than snout-vent length (SVL). As the measurement error is higher in the latter, we prefer to use the former. Both measurements are sufficiently similar (unpublished data) that, where relevant, we compare our SUL measurements with SVL's presented for members of the genus in some papers; **TL** – tibia length: external distance between knee and tibio-tarsal articulation, herein referred to as 'shanks'; **TaL** – length of tarsus: external distance between tibio-tarsal and tarsal-metatarsal joints when held at right angles; **T4L** – length of 4th toe, from tip of 4th toe to proximal edge of sole; **T4D** – transverse diameter of disc of 4th toe; **T1D** – transverse diameter of disc of first toe; **F3L** – length of 3rd finger, from tip of 3rd finger to proximal edge of palm; **F3D** – transverse diameter of disc of 3rd finger; **F1D** – transverse diameter of disc of first finger; **HL** – head length, from tip of snout to posterior margin of tympanum; **HW** – head width, taken across the tympana; **SL** – snout length, from an imaginary line connecting the centres of the eyes to the tip of the snout; **END** – distance from anterior corner of orbital opening to centre of naris; **IND** – internarial distance between centres of nares; **ED** – eye diameter, from anterior to posterior corner of orbital opening; **TyD** – horizontal diameter of tympanum. Sex was determined mainly by the presence of vocal slits (males) or absence of vocal slits (females); some specimens were dissected in order to inspect their gonads. Ratios did not differ between sexes, so data from males and females of the new species were combined for the comparative studies. Measurements are presented as ranges and/or means $\pm$ standard deviations.

Advertisement calls were recorded under natural conditions with a Sony TCM 5000EV tape recorder or a Marantz PMD-660 digital recorder and a Sennheiser ME66 Microphone with K6 power module, and analysed with Avisoft-SAS Lab Pro software. Air temperatures adjacent to calling males were recorded using a rapid-reading digital thermometer. Terminology and acoustic analysis procedures mostly follow KÖHLER *et al.* (2017). Each of the species described herein produces calls that consist of a single note produced as a mandatory part of a series, in which inter-note duration is distinctly longer than note length. According to the definitions provided by KÖHLER *et al.* (2017) each note therefore represents a single call. We therefore refer to the individual notes as calls, and to the sequence of notes as a call series.

Generic allocation of the new species is mainly based on the presence of long and slender clavicles which, in each species, extend from the scapula almost to the midline of the pectoral girdle.

Specimens compared

- Austrochaperina alexanderi* Günther, Richards & Dahl, 2014: SAMA R65094 (holotype), SAMA R65091-3, ZMB 79520 (paratypes), Muller Range, Western Province, PNG;
- A. archboldi* Zweifel, 2000: AMNH 66719 (holotype), 66720, 66722–25 (paratypes), Eastern Highlands Province, PNG;
- A. basipalmata* (Kampen, 1906): ZMB 25718, 62246–247, upper reaches of the Sepik River, and ZMB 25786 - a series of 10 specimens - also from the Sepik River, northern PNG;
- A. blumi* Zweifel, 2000: UPNG 9529–31, 9534, 9537 (all paratypes), Eipomek, Jayawijaya District, PPI;
- A. laurae* Günther, Richards & Dahl, 2014: SAMA R65097 (holotype), SAMA R65095–6, R65098–100, ZMB 79521–22 (paratypes), Muller Range, Western Province, PNG;
- A. macrorhyncha* (Van Kampen, 1906): RMNH 4630 (holotype), south-eastern corner of the Vogelkop Peninsula, Manikion area; ZMB 62235, 62237, 62238, 62601, 62602, 62603, 70326–28, nine further specimens from Wondiwoi Mountains, all near border of PPI and WPPI;
- A. mehelyi* (Parker, 1934): MCZ A-28406, Huon Peninsula, Morobe Province, PNG;
- A. minutissima* Günther, 2009: ZMB 62573 (holotype), ZMB 62569, 62571, 62574–75 (paratypes), Wondiwoi Mountains, near border of PPI and WPPI;
- A. novaebritanniae* Zweifel, 2000: MCZ A-73085–86 (paratypes), East New Britain Province, PNG;
- Austrochaperina punctata* (Van Kampen, 1913): ZMA 5747, 5750 (Went Mountains), ZMA 5751, 5752 (Heuvelbivak, Lorentz River), ZMA 25754 (Hellwig Mountains), all ZMA specimens are syntypes and originate from PPI; ZMB 85605–85610, near the village of Silimo, 1600 m a.s.l., about 40 km south of Wamena, Jayawijaya Mountains, PPI;
- Austrochaperina rudolfarndti* Günther, 2017: ZMB 63900 (holotype), ZMB 63898–99, ZMB 70324–25 (paratypes), Wondiwoi Mountains, near border of PPI and WPPI;
- Copiula derongo* (Zweifel, 2000): MCZ A-132891, A-132913–14, A-132918, A-132978, A-132999 (all of them paratypes), near Derongo, Western Province, PNG; ZMB 70334, 70335, 70329, Yapen Island, PPI;
- Copiula guttata* (Zweifel, 2000): MCZ A-132843–45 (all of them paratypes), near Uraru, Gulf Province, PNG.
- Comparisons of the newly described species with congeners are based on the above material, on additional material in the collection of the Museum für Naturkunde, Berlin (ZMB), and on data published in original descriptions and in comparative studies (KAMPEN, 1906, 1913, 1923; NIEDEN, 1926; PARKER, 1934; LOVERIDGE, 1948; ZWEIFEL, 2000; MENZIES, 2006; GÜNTHER, 2009, 2017; GÜNTHER *et al.*, 2014).

Abbreviations

- AMNH American Museum of Natural History, New York;
- a.s.l. above sea level;
- FN Field number;
- MCZ Museum of Comparative Zoology, Harvard University, Cambridge, USA;
- PNG Papua New Guinea;
- PNGNM Papua New Guinea National Museum
- PPI Papua Province of Indonesia;
- RMNH Rijksmuseum van Natuurlijke Historie, now Naturalis Biodiversity Center, Leiden, Netherlands;
- SAMA South Australian Museum, Adelaide, Australia;

- UPNG University of Papua New Guinea, Port Moresby;
- WPPI West Papua Province of Indonesia;
- ZMA Zoölogisch Museum Amsterdam, now Naturalis Biodiversity Center, Leiden, Netherlands;
- ZMB Zoologisches Museum Berlin, now Museum für Naturkunde, Berlin, Germany.

Austrochaperina beehleri sp. nov.

ZOOBANK urn:lsid:zoobank.org:act:FFDAF6BC-BD2B-4E2B-B73B-6DAB12B7BBF8

Holotype. SAMA R71444 (FN SJR 14843), adult male, Papua New Guinea, Western Province, upper Strickland River basin, Camp 5 (6.2763°S, 142.1022°E; 110 m a.s.l.), collected on 03 August 2013 by S. J. RICHARDS.

Paratypes. ZMB 89195 (FN SJR 14878), same details as holotype except adult female and collected 05 August 2013; ZMB 89196 (FN SJR 14192), adult female, Papua New Guinea, Western Province, upper Strickland River basin, Camp 6 (6.4355°S, 142.5615°E; 380 m a.s.l.), collected on 10 August 2014 by S. J. RICHARDS; PNGNM, unregistered (FN SJR14822), adult male, SAMA R71445 (FN SJR 14837), adult female, Papua New Guinea, Western Province, Palmer River Catchment, upper Fly River basin, Camp 4 (5.9079°S, 141.8462°E; 125 m a.s.l.), collected on 01 August 2013 by S. J. RICHARDS.

Diagnosis. With a snout-urostyle length of 25.0–25.7 mm in two adult males and 24.2–28.0 mm in three adult females, *A. beehleri* sp. nov. is a moderately-sized species of the genus exhibiting no or only minor sexual size dimorphism. It can be distinguished from all congeners by the following combination of characters: shanks fairly short (TL/SUL 0.40–0.44), head moderately wide (HW/SUL 0.34–0.38), discs with circum-marginal grooves present on all fingers and toes, those on fingers clearly narrower than those on toes (T4D/F3D 1.50–2.00); eye-naris distance shorter than internarial distance (END/IND 0.72–0.81); in life, colour of dorsal surfaces reddish with brown mottling; colour of abdomen, chest and ventral thighs whitish; surfaces of axilla, groin, knee pit and posterior thigh orange; in preservative dorsal surfaces with more or less dense brown mottling on paler background, ventral surfaces of abdomen and chest uniformly off-white, those of throat and limbs off-white with brownish mottling, pale longitudinal stripe posterior to eye; pale rostral pad present in males but not in females; advertisement calls uttered in series lasting 8–12 s and containing 50–70 unpulsed calls; duration of calls 39–46 ms, duration of intercall intervals 99–194 ms, dominant frequency 3.80 kHz.

Description of the holotype. An adult male with a snout-urostyle length of 25.7 mm (Figs 1a–1f). There is a longitudinal cut in the belly. For measurements and body-ratios see Table 1. Snout tip with rounded pad in dorsal view, strongly protruding in profile (Fig. 1d). Nostrils visible from above but not from below, directed laterally, closer to snout tip than to eyes, distance between nares greater than distance between eye and naris (END/IND

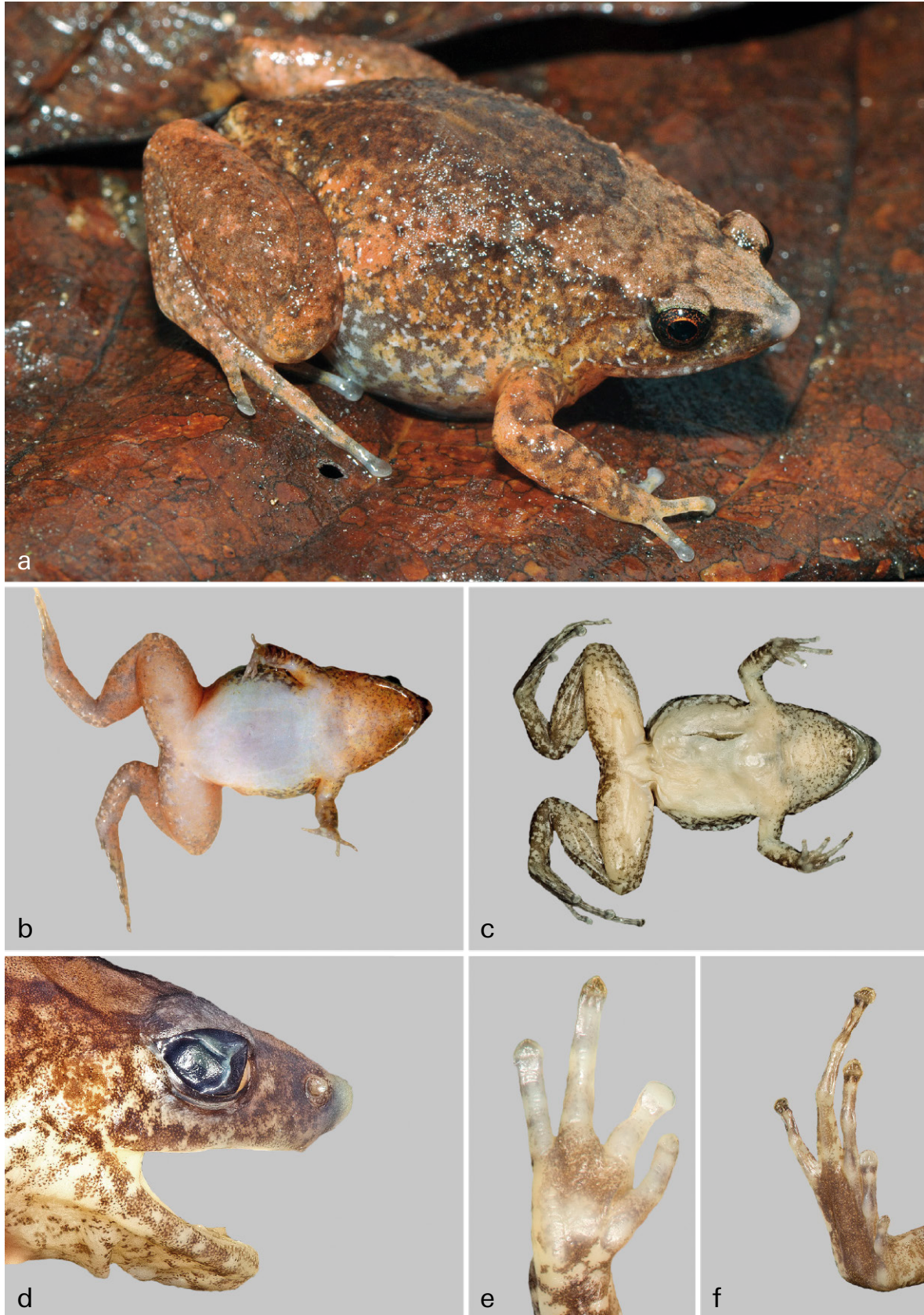


Fig. 1a. Holotype (SAMA R71444) in life of *Austrochaperina beehleri* sp. nov. in dorsolateral view.

Fig. 1b. Living holotype of *Austrochaperina beehleri* sp. nov. in ventral view.

Fig. 1c. Preserved holotype of *Austrochaperina beehleri* sp. nov. in ventral view.

Fig. 1d. Holotype of *Austrochaperina beehleri* sp. nov., lateral view of the head.

Fig. 1e. Lower surface of the right hand of the preserved holotype of *Austrochaperina beehleri* sp. nov.

Fig. 1f. Lower surface of the right foot of the preserved holotype of *Austrochaperina beehleri* sp. nov.

0.80). Canthus rostralis straight and gently rounded, loreal region gently sloping. Tongue large, pear-shaped, half free posteriorly, without posterior notch. Prepharyngeal ridge with 9 denticles. Vocal slits elongate, located on each side of posterior half of tongue. Tympanic annulus partly visible, its horizontal diameter slightly more than half eye diameter, supratympanic skin fold present. Eye small (ED/SUL 0.101), pupil horizontal. Fore limbs moderately robust, fingers rather short, with tips slightly wider than penultimate phalanges; all finger discs with terminal grooves; metacarpal and subarticular tubercles poorly developed; relative lengths of fingers $3 > 4 > 2 > 1$ (Fig. 1e). Hind limbs more robust than fore limbs. Discs of toes 2, 3, 4 and 5 clearly wider than penultimate phalanges, that of comparatively very short toe 1 somewhat wider than penultimate phalanx, discs of all toes with terminal grooves. Inner metatarsal tubercle clearly visible, outer metatarsal tubercle absent, subarticular tubercles adelomorphous; toes without webbing, relative lengths $4 > 3 > 5 > 2 > 1$, (Fig. 1f). Dorsal surfaces in life with some small tubercles, in preservative both dorsal and ventral surfaces smooth.

Colouration in life. Overall impression of dorsal and lateral surfaces reddish-brown with denser brown mottling on back and marginal mottling on pale head (Fig. 1a); a narrow off-white mid-dorsal line was also visible. Iris orange with dark venation. Ground colour of abdomen, chest and inferior thighs whitish without spots, that of throat and inferior limbs light orange with diffuse greyish mottling. Axilla, groin and knee pit orange-red (Fig. 1b).

Colouration in preservative. Dorsal and lateral surfaces off-white with dense brown mottling on middle and posterior dorsum, and less mottling on anterior dorsum; in these regions and on extremities brown colours predominate. Narrow pale mid-dorsal line has almost completely disappeared. Lateral surfaces with mottling darker brown than on dorsum and off-white areas more conspicuous. Conspicuous is also a pale, irregularly shaped stripe from posterior of eye to middle of body, bordered inferiorly by an irregularly shaped dark brown stripe; sides of head largely dark brown. A whitish spot in lumbar region is bordered inferiorly by an irregular dark brown spot reminiscent of an eye spot. Chest, abdomen and proximal parts of upper arms and of thighs off-white without mottling. Throat, forearm, margins of thighs, inferior shanks and tarsi off-white with dark grey mottling (Fig. 1c). Light grey rostral pad visible in preservative as well as in life.

Morphological variation in the type series. Measurements and body ratios of the two adult male and three adult female types are presented in Table 1. There is extensive overlap in body size between the sexes with males measuring 25.0–25.7 mm and females 24.2–28.0 mm. Body ratios of both sexes also do not differ, so both sexes were pooled for calculation of ratios. Four specimens have a roundish snout tip in dorsal view, one (ZMB 89196) has a truncate snout tip. Ground colour is beige in

all preserved specimens. This ground colour is covered by a more or less dense brown pigmentation on all dorsal surfaces. Brown pigmentation consists of flecks and/or blotches which form a reticulum on various body parts and in one specimen (PNGNM, unregistered) dorsal and lateral surfaces are uniformly dark reddish brown with some inconspicuous pale spots. Posterior two-thirds of dorsal surface in three specimens is darker brown than anterior third. A pale postorbital stripe, bordered along its ventral edge by a dark brown area or dark brown spots is seen in all specimens, a pale mid-dorsal line is also bordered by dark brown areas. Belly and chest in all specimens uniform beige, throat with a brown reticulum except (PNGNM, unregistered) which has a brown throat with a few whitish spots. Head laterally varies from uniform brown to more or less speckled, and ventral surfaces of thighs from uniform to strongly mottled.

Distribution and ecological notes. *Austrochaperina beehleri* sp. nov. is known from three locations in lowland rainforest at altitudes between 110 and 380 m a.s.l. along the southern edge of Papua New Guinea's central cordillera (Fig. 12). Males called from within litter on the forest floor at night during rain, while females were found on top of the litter or perched on low vegetation.

Vocalisation. *Austrochaperina beehleri* sp. nov. utters calls (= notes) in long series. Mean duration of six call series from the holotype was 10.7 ± 1.29 s, range 8.7–12.0 s, mean number of calls per series 65.3 ± 8.24 , range 53–73 calls/series. Mean call repetition rate 6.08 ± 0.13 calls/s, range 5.9–6.3 calls/s. Mean interval length between six call series 32.6 ± 10.2 s, range 17.8–43.3 s. There are one or a few short breaks in each call series, longest period without breaks was 7.7 s. Mean call length 42.9 ± 1.90 ms, range 39–46 ms, $n=60$. Mean intercall interval length 118.1 ± 14.2 ms, range 99–194 ms, $n=60$. All calls are unpulsed, amplitude rises quickly to the maximum at the start of the call and immediately thereafter drops more slowly to zero (Fig. 2, top). Calls are frequency modulated with a steep rise at the beginning and a gradual decline in frequency during the course of the call (Fig. 2, bottom). Due to this frequency modulation it is difficult to assess mean values of single bands in spectrograms, but amplitude spectrums clearly show mean values of the fundamental frequency band at 1.90 kHz, of dominant frequency at 3.80 kHz and of a third harmonic band at 5.70 kHz (Fig. 3). All calls were recorded at air temperatures between 20 and 22 °C.

Etymology. The specific epithet is an honorific for DR. BRUCE BEEHLER, in recognition of his extensive contributions to knowledge about New Guinea's biodiversity over many decades.

Comparison with other species. With snout-vent lengths less than 20 mm, six species (*A. gracilipes*, *A. meheli*, *A. minutissima*, *A. novaebritanniae*, *A. polysticta* [Méhely, 1901], and *A. yelaensis* Zweifel, 2000) are clearly

Table 1. Body measurements and body ratios of the type series of *Austrochaperina beehleri* sp. nov. SAMA R71444 is the male holotype; PNGNM, unreg. is a male paratype, SAMA R71445, ZMB 89195 and ZMB 89196 are female paratypes. All measurements in mm; for explanation of abbreviations see “Material and methods”.

Reg.-No.	ZMB 89196	PNGNM unreg.	SAMA R71445	SAMA R71444	ZMB 89195	Mean $\pm$ SD	Range
SUL	26.7	25.0	24.2	25.7	28.0		
TL	11.2	10.8	10.4	11.4	11.3		
TaL	8.1	7.1	7.2	8.1	7.3		
T4L	10.5	10.0	10.1	11.5	10.7		
T4D	0.9	1.0	1.0	1.3	1.0		
T1D	0.5	0.6	0.5	0.6	0.5		
F3L	5.2	5.2	5.1	6.1	5.5		
F3D	0.6	0.6	0.5	0.8	0.8		
F1D	0.5	0.5	0.5	0.6	0.5		
HL	8.0	8.2	7.9	8.0	8.6		
HW	9.1	9.0	9.1	9.1	9.5		
END	2.2	1.9	1.8	2.0	2.1		
IND	2.7	2.6	2.5	2.5	2.8		
SL	4.1	3.8	3.7	4.2	4.1		
ED	2.7	2.5	2.8	2.6	2.7		
TyD	1.5	1.4	1.4	1.5	1.6		
EST	3.5	3.1	2.8	3.2	3.2		
TL/SUL	0.42	0.43	0.43	0.44	0.40	0.42 $\pm$ 0.015	0.40–0.44
TaL/SUL	0.30	0.28	0.30	0.32	0.26	0.29 $\pm$ 0.023	0.26–0.32
T4L/SUL	0.39	0.40	0.42	0.45	0.38	0.41 $\pm$ 0.028	0.38–0.45
T4D/SUL	0.034	0.040	0.041	0.051	0.036	0.040 $\pm$ 0.007	0.34–0.51
T1D/SUL	0.019	0.024	0.021	0.023	0.018	0.021 $\pm$ 0.003	0.018–0.024
F3L/SUL	0.19	0.21	0.21	0.24	0.20	0.21 $\pm$ 0.019	0.19–0.24
F3D/SUL	0.022	0.024	0.021	0.031	0.029	0.025 $\pm$ 0.004	0.021–0.031
F1D/SUL	0.019	0.020	0.021	0.023	0.018	0.020 $\pm$ 0.002	0.018–0.023
T4D/F3D	1.50	1.67	2.00	1.63	2.00	1.76 $\pm$ 0.228	1.50–2.00
T1D/F1D	1.00	1.20	1.00	1.00	1.00	1.04 $\pm$ 0.089	1.00–1.20
HL/SUL	0.30	0.33	0.33	0.31	0.31	0.32 $\pm$ 0.013	0.30–0.33
HW/SUL	0.34	0.36	0.38	0.35	0.34	0.35 $\pm$ 0.017	0.34–0.38
HL/HW	0.88	0.91	0.87	0.88	0.91	0.89 $\pm$ 0.019	0.87–0.91
END/SUL	0.082	0.076	0.074	0.078	0.075	0.077 $\pm$ 0.003	0.074–0.082
IND/SUL	0.101	0.104	0.103	0.097	0.100	0.101 $\pm$ 0.003	0.097–0.104
END/IND	0.81	0.73	0.72	0.80	0.78	0.77 $\pm$ 0.041	0.72–0.81
ED/SUL	0.101	0.100	0.116	0.101	0.096	0.103 $\pm$ 0.008	0.096–0.116
TyD/SUL	0.056	0.056	0.058	0.058	0.057	0.057 $\pm$ 0.001	0.056–0.058
TyD/ED	0.56	0.56	0.50	0.58	0.59	0.56 $\pm$ 0.035	0.50–0.59
SL/SUL	0.154	0.152	0.153	0.163	0.146	0.154 $\pm$ 0.006	0.146–0.163
EST/SUL	0.131	0.124	0.116	0.125	0.114	0.128 $\pm$ 0.010	0.114–0.131

smaller than the new species; and with lengths more than 30 mm nine species (*A. alexanderi*, *A. archboldi*, *A. basipalmata*, *A. hooglandi* [Zweifel, 1967], *A. palmipes* [Zweifel, 1956], *A. punctata* and the former *Austrochaperina* [but now *Copiula*] species *C. derongo*, *C. guttata* and *C. rivularis* Zweifel, 2000) are clearly larger than the new species. These will not be considered further here.

Austrochaperina adamantina Zweifel, 2000 is known from a single adult female measuring 28 mm SVL. It differs from *A. beehleri* by larger eyes (ED/SVL 0.125 vs. 0.096–0.116), smaller eye-naris distance (END/SVL 0.073 vs. 0.074–0.082), smaller internarial distance (IND/SVL 0.098 vs. 0.097–0.104) and broader finger discs (F3D/SVL 0.041 vs. 0.021–0.031).

Austrochaperina aquilonia Zweifel, 2000 is known from two male specimens measuring 31.0 and 23.3 mm SVL. It differs from *A. beehleri* by its more conspicuous mottling on dorsum, greater internarial distance (IND/SVL 0.111–0.118 vs. 0.097–0.104), smaller eye-naris distance (END/SVL 0.069–0.074 vs. 0.074–0.082), smaller ratio END/IND (0.58–0.67 vs. 0.72–0.81) and longer toes (T4L/SVL 0.44–0.48 vs. 0.38–0.45).

Austrochaperina blumi: our measurements of five paratypes (see “Material and methods”) revealed the following differences (*blumi* vs. *beehleri*): TL/SUL 0.47–0.49 vs. 0.40–0.44; F3D/SUL 0.029–0.040 vs. 0.021–0.031; T4D/F3D 1.00–1.43 vs. 1.50–2.00; HL/HW 0.91–0.96 vs. 0.87–0.91; END/SUL 0.086–0.093 vs. 0.074–0.082;

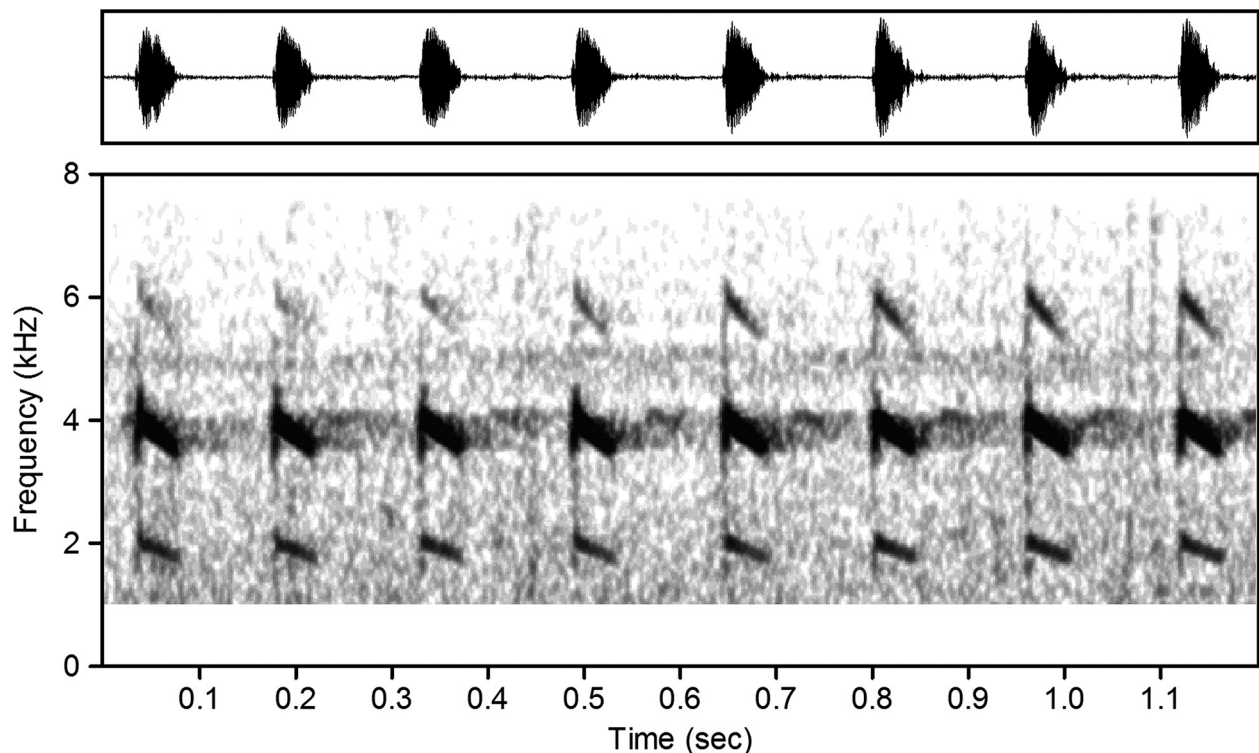


Fig. 2. Oscillogram (above) and spectrogram (below) of a section with 8 calls from a call series of the holotype of *Austrochaperina beehleri* sp. nov. Basic noise was deleted up to 1 kHz. Sampling rate conversion from 24 kHz to 16 kHz. Spectrogram parameters: FFT length 512, Frame size 75 %, Window FlatTop, Bandwidth 157 Hz, resolution 31 Hz, Overlap 93.75 %.

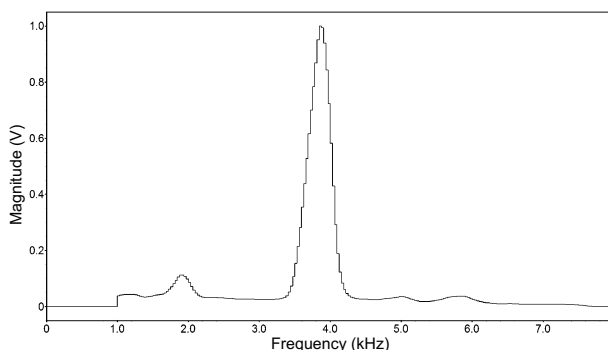


Fig. 3. Amplitude spectrum of five calls from an advertisement call series of the holotype of *Austrochaperina beehleri* sp. nov. Same parameters as in Fig. 2; basic noise was deleted up to 1 kHz.

IND/SUL 0.108–0.115 vs. 0.097–0.104; ED/SUL 0.116–0.129 vs. 0.096–0.116; TyD/SUL 0.036–0.043 vs. 0.056–0.058 and TyD/ED 0.29–0.37 vs. 0.50–0.59.

Austrochaperina brevipes (Boulenger, 1897) has a broader head (HW/SVL 0.38–0.44 vs. 0.34–0.38), bigger eyes (ED/SVL 0.113–0.132 vs. 0.096–0.116), conspicuous and continuous dorsolateral skin fold vs. inconspicuous and interrupted fold, and pulsed calls with repetition rate from 10.1–14.4 calls/s vs. unpulsed with repetition rate of 5.9–6.3 calls/s.

Austrochaperina kosarek Zweifel, 2000 was described on the basis of a single adult female measuring 21 mm SVL, so the available specimen has a smaller body size than *A. beehleri*. This specimen further dif-

fers from the new species by having bigger eyes (ED/SVL 0.121 vs. 0.096–0.116), smaller eye-naris distance (END/SVL 0.071 vs. 0.074–0.082) and narrower toe discs (T4D/SVL 0.031 vs. 0.034–0.051). Moreover only disc of third finger broader than penultimate phalanx in *A. kosarek* vs. discs of fingers 2–4 broader than penultimate phalanges in *A. beehleri*.

Austrochaperina laurae differs from *A. beehleri* by its larger size (males 26.9–29.6 mm, females 28.2–35.2 mm SUL), and further by its uniformly brown dorsal colouration with few whitish dots on all dorsal surfaces and yellow ground colouration of ventral surfaces vs. reddish dorsal ground colouration with dark grey or brown spots and whitish colouration without markings on most ventral surfaces. It has larger eyes than *A. beehleri* (ED/SUL 0.108–0.127, $n=8$ vs. 0.096–0.116, $n=5$; comparisons of medians $p=0.010$), the ratio T1D/F1D is significantly higher (1.00–1.43 vs. 1.00–1.20, $p=0.036$) and the ratio T4D/F3D is lower in *A. laurae* (1.23–1.63 vs. 1.50–2.00, $p=0.021$). Calls of *A. laurae* are distinctly pulsed (vs. unpulsed in *A. beehleri*).

Austrochaperina macrorhyncha is smaller than the new species (22.8–24.9 mm, $n=9$, vs. 24.2–28.0 mm SUL, $n=5$) with longer limbs (TL/SUL 0.47–0.52 vs. 0.40–0.44). It further differs in the following ratios: IND/SUL (0.122–0.140 vs. 0.097–0.104), END/IND (0.56–0.71 vs. 0.72–0.81), ED/SUL (0.124–0.145 vs. 0.096–0.116) and in having pulsed (vs. unpulsed) advertisement calls.

Austrochaperina parkeri Zweifel, 2000 is only known from the holotype, a female of 30.6 mm SVL. It differs from *A. beehleri* by larger internarial distance (IND/SVL 0.105 vs. 0.097–0.104), smaller eye-naris distance (END/SVL 0.070 vs. 0.074–0.082), lower ratio END/IND (0.67 vs. 0.72–0.81) and broader finger discs (F3D/SUL 0.031 vs. 0.021–0.031).

Austrochaperina punctata (five syntypes of this species were examined) is larger than the new species (27.1–33.8 mm vs. 24.2–28.0 mm), has longer limbs (TL/SUL 0.47–0.50 vs. 0.40–0.44), broader discs on fourth toe (T4D/SUL 0.051–0.054 vs. 0.034–0.051), broader discs on third finger (F3D/SUL 0.044–0.054 vs. 0.021–0.031) and differs further by having pulsed vs. unpulsed advertisement calls (GÜNTHER, 2017).

Austrochaperina rudolfarndti has longer limbs, toes, and a longer head (TL/SUL 0.46–0.49, $n=5$ vs. 0.40–0.44, $n=5$; T4L/SUL 0.48–0.51 vs. 0.38–0.45; HL/SUL 0.33–0.36 vs. 0.30–0.33), smaller eye-naris distance (END/SUL 0.071–0.075 vs. 0.074–0.082), greater internarial distance (IND/SUL 0.119–0.122 vs. 0.097–0.104), bigger eyes (ED/SUL 0.130–0.139 vs. 0.096–0.116), it differs also in the following body ratios: T4D/F3D (1.11–1.25 vs. 1.50–2.00) and END/IND (0.59–0.66 vs. 0.72–0.81) and in having distinctly pulsed calls (vs. unpulsed calls).

Austrochaperina septentrionalis Allison & Kraus, 2003 is somewhat larger than *A. beehleri* (28.4–31.6 mm vs. 24.2–28.0 mm) but most body ratios overlap extensively. However advertisement calls differ significantly: calls of *A. septentrionalis* contain 2–11 pulses (ALLISON & KRAUS 2003) vs. unpulsed; call repetition rate ranges from 9.3 to 9.6 calls/s (vs. 5.9 to 6.3 calls/s); dominant frequency is 3.1 kHz (vs. 3.8 kHz).

Austrochaperina fulva sp. nov.

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Holotype. SAMA R71446 (FN SJR 10388), adult male, Papua New Guinea, Western Province, Juha South Camp (5.9018°S, 142.4360°E; 953 m a.s.l.), collected on 18 February 2008 by S. J. RICHARDS.

Paratypes. SAMA R71447 (FN SJR 10431) and ZMB 89197 (FN SJR 10462), adult females, same details as for holotype except R71447 collected on 20 February 2008 and ZMB 89197 collected on 22 February 2008.

Diagnosis. With a snout-urostyle length of 30.4 mm in one adult male and 27.9–31.0 mm in two adult females, *A. fulva* sp. nov. is a moderately-sized species of its genus with no or only minor sexual size dimorphism. It can be distinguished from all congeners by the following combination of characters: shanks fairly short (TL/SUL 0.38–0.42), head moderately wide (HW/SUL 0.35–0.36), discs with circum-marginal grooves present on all fingers and toes and those on fingers clearly narrower than on toes (mean ratio T4D/F3D 1.53), eye-naris distance shorter than internarial distance (mean ratio

END/IND 0.78); in life, lateral surfaces yellowish to reddish, dorsum reddish-brown to brown without mottling, ventral surfaces largely yellow; in preservative, dorsal surfaces basically uniform brown, ventral surfaces including lower flanks predominantly whitish; males with and females without pale rostral pad; advertisement calls uttered in series, one series lasting more than 25 s; calls pulsed and with mean length of 45.4 ms, mean pulse number per call 5.22, call repetition rate 7.52 calls/s, dominant frequency 3.30 kHz.

Description of the holotype. An adult male with a snout-urostyle length of 30.8 mm; there is a longitudinal incision in the right margin of the abdomen (Figs 4a–d). Measurements and body-ratios are presented in Table 2. Tip of snout rounded in dorsal view and covered with a whitish pad, strongly protruding in profile. Nostrils directed laterally, not visible from above or below, closer to snout tip than to eyes, distance between nares greater than distance between eye and naris (END/IND 0.72). Canthus rostralis straight, gently rounded. Loreal region gently sloping. Tongue oval, half free posteriorly and weakly notched. Prepharyngeal ridge with about 10 denticles. Two flat palatal ridges behind choanae. Vocal slits elongate, located on each side of posterior half of tongue. Tympanic annulus entirely visible, its horizontal diameter slightly more than half eye diameter (TyD/ED 0.56), supratympanic skin fold present. Eye small (ED/SUL 0.105), with horizontal pupil. Fore limbs moderately robust with moderately short fingers; tips of all fingers, except finger 1, slightly wider than penultimate phalanges; all finger discs with terminal grooves; two metacarpal tubercles visible, subarticular tubercles scarcely visible; relative length of fingers 3>4>2>1 (Fig. 4c). Hind limbs more robust than fore limbs. Discs of toes 2, 3, 4 and 5 clearly wider than penultimate phalanges, that of comparatively very short toe 1 only somewhat wider than penultimate phalanx, all toes with terminal grooves on discs. Inner metatarsal tubercle clearly visible, outer metatarsal tubercle absent, subarticular tubercles adelmorphic, relative length of toes 4>3>5>2>1, webbing absent (Fig. 4d). Dorsolateral row of tubercles from eye to middle of dorsum; in life other dorsal surfaces with some small tubercles, in preservative both dorsal and ventral surfaces smooth.

Colouration in life. Overall impression of dorsal surfaces reddish-brown, of lateral surfaces red-yellow. Conspicuous is the whitish rostral pad and the blackish dorsolateral tubercle row; other conspicuous markings absent. Iris with inner margin orange, outer surface a mixture of silvery and blackish spots and stripes (Fig. 4a). Ventral surfaces, except grey palms and soles, yellow to reddish with inconspicuous whitish dots and some irregular grey markings on throat. Inguinal region red (Fig. 4b).

Colouration in preservative. In preservative mid-dorsum uniform brown, lateral surfaces pale brown with



Fig. 4a. Holotype (SAMA R71446) of *Austrochaperina fulva* sp. nov. in life, in dorsolateral view.

Fig. 4b. Living holotype of *Austrochaperina fulva* sp. nov. in ventral view.

Fig. 4c. Lower surface of the right hand of the living holotype of *Austrochaperina fulva* sp. nov.

Fig. 4d. Lower surface of the right foot of the living holotype of *Austrochaperina fulva* sp. nov.

darker brown speckles. Dorsal surfaces of limbs light brown with vague darker brown bands. Postocular row of tubercles and ridges is accompanied by an irregular blackish line. Ventral surfaces off-white with irregular brown mottling on throat, chest and limbs.

Morphological variation in the type series. The type series consists of one adult male and two adult females,

for which measurements and body ratios are listed in Table 2. In our admittedly sparse material no size differences between sexes are evident (male 30.4 mm SUL, females 27.9 and 31 mm SUL) and body ratios are similar. Colouration in life of paratype SAMA R71447 (Fig. 5) is very similar to that of the paratype ZMB 89197 (Fig. 6) but lacks the red hues exhibited by the other two types and has a darker iris.



Fig. 5. Female (SAMA R71447) of *Austrochaperina fulva* sp. nov. with yellow-red lateral surfaces and red-brown dorsum.



Fig. 6. Female (ZMB 89197) of *Austrochaperina fulva* sp. nov. with yellow lateral surfaces and brown dorsum.

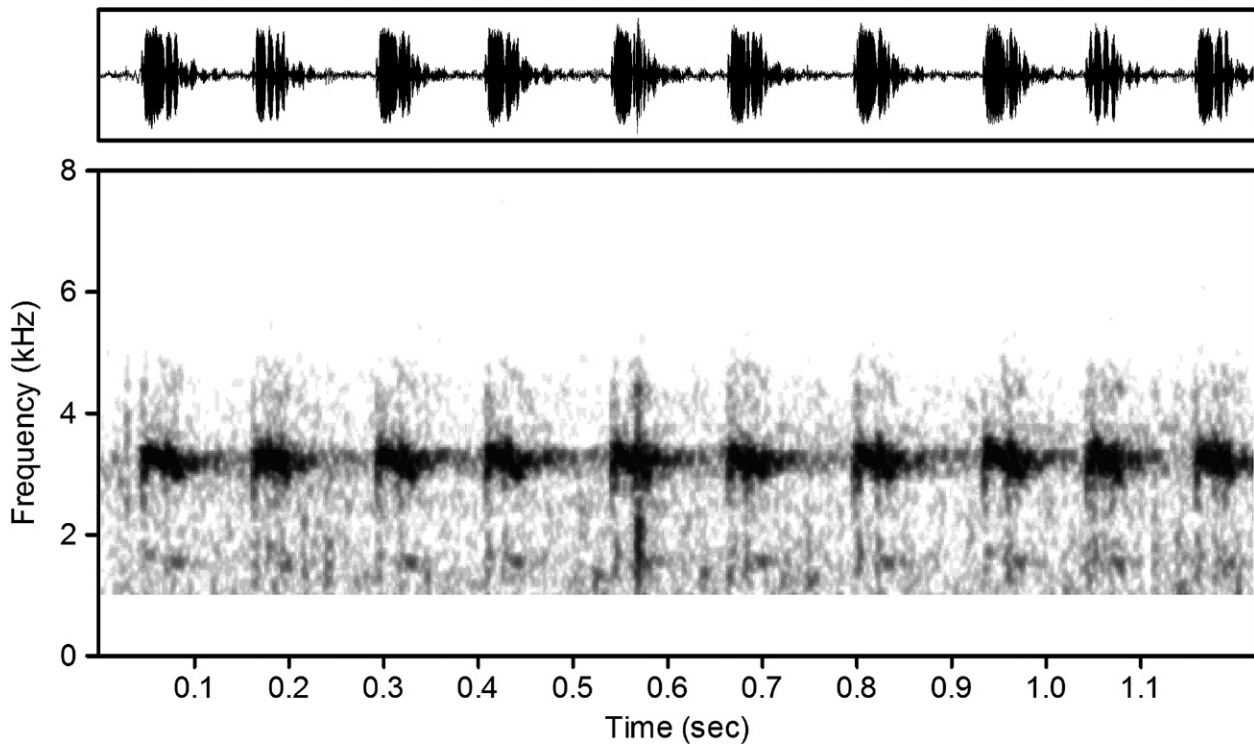


Fig. 7. Oscillogram (above) and spectrogram (below) of a section with 10 calls from a call series of the holotype of *Austrochaperina fulva* sp. nov. Basic noise was deleted up to 1.0 kHz. Sampling rate conversion to 16 kHz. Spectrogram parameters: FFT length 512, Frame size 75 %, Window FlatTop, Bandwidth 157 Hz, resolution 31 Hz, Overlap 93.75 %.

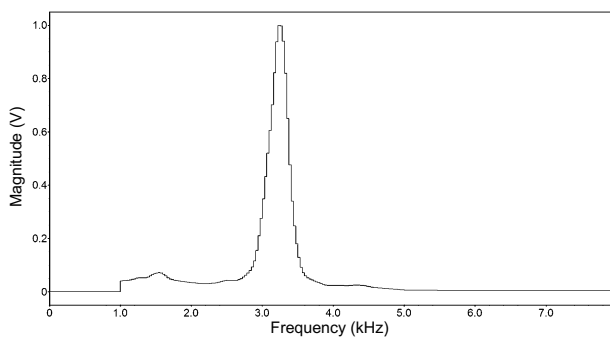


Fig. 8. Amplitude spectrum of five calls from an advertisement call series of the holotype of *Austrochaperina fulva* sp. nov. Same parameters as in Fig. 7; basic noise was deleted up to 1 kHz.

Table 2. Body measurements and body ratios of the type series of *Austrochaperina fulva* sp. nov. SAMA R71446 is the male holotype, SAMA R71447 and ZMB 89197 are female paratypes. All measurements in mm; for explanation of abbreviations see “Material and methods”.

Reg.-No.	SAMA R71446	SAMA R71447	ZMB 89197	Mean $\pm$ SD	Range
SUL	30.4	27.9	31.0		
TL	12.0	11.7	11.9		
TaL	8.4	7.7	8.2		
T4L	11.5	11.6	11.9		
T4D	1.3	1.1	1.1		
T1D	0.6	0.5	0.7		
F3L	6.6	6.0	6.2		
F3D	0.8	0.7	0.8		
F1D	0.7	0.5	0.6		
HL	10.1	9.3	9.9		
HW	10.5	10.0	10.8		
END	2.3	2.4	2.5		
IND	3.2	3.0	3.0		
SL	5.1	4.2	5.2		
ED	3.2	3.0	3.0		
TyD	1.8	1.5	1.7		
EST	4.5	3.9	3.8		
TL/SUL	0.39	0.42	0.38	0.40 $\pm$ 0.021	0.38–0.42
TaL/SUL	0.28	0.28	0.26	0.27 $\pm$ 0.012	0.26–0.28
T4L/SUL	0.38	0.42	0.38	0.39 $\pm$ 0.023	0.38–0.42
T4D/SUL	0.043	0.039	0.035	0.039 $\pm$ 0.004	0.035–0.043
T1D/SUL	0.020	0.018	0.023	0.020 $\pm$ 0.003	0.018–0.023
F3L/SUL	0.22	0.22	0.20	0.21 $\pm$ 0.012	0.20–0.22
F3D/SUL	0.026	0.025	0.026	0.026 $\pm$ 0.0006	0.025–0.026
F1D/SUL	0.023	0.025	0.019	0.022 $\pm$ 0.003	0.019–0.023
T4D/F3D	1.63	1.57	1.38	1.53 $\pm$ 0.130	0.138–0.163
T1D/F1D	0.86	1.00	1.17	1.01 $\pm$ 0.155	0.86–1.17
HL/SUL	0.33	0.33	0.32	0.33 $\pm$ 0.006	0.32–0.33
HW/SUL	0.35	0.36	0.35	0.35 $\pm$ 0.006	0.35–0.36
HL/HW	0.96	0.93	0.92	0.94 $\pm$ 0.021	0.92–0.96
END/SUL	0.076	0.086	0.081	0.081 $\pm$ 0.005	0.076–0.086
IND/SUL	0.105	0.108	0.097	0.103 $\pm$ 0.006	0.097–0.108
END/IND	0.72	0.80	0.83	0.78 $\pm$ 0.057	0.72–0.83
ED/SUL	0.105	0.108	0.097	0.103 $\pm$ 0.006	0.097–0.108
TyD/SUL	0.059	0.054	0.055	0.056 $\pm$ 0.003	0.054–0.059
TyD/ED	0.56	0.50	0.57	0.54 $\pm$ 0.038	0.50–0.57
SL/SUL	0.168	0.151	0.168	0.162 $\pm$ 0.009	0.151–0.168
EST/SUL	0.148	0.140	0.123	0.137 $\pm$ 0.013	0.123–0.148

Distribution and ecological notes. *Austrochaperina fulva* sp. nov. is known from one location at an altitude of 950 m a.s.l. on the southern fringe of Papua New Guinea’s central cordillera (Fig. 12). Males called from litter on the forest floor at night during and after rain, but females were observed perched on low foliage up to 30 cm above the ground on both wet and dry nights.

Vocalisation. *Austrochaperina fulva* sp. nov. utters long series of rasping, pulsed calls (Fig. 7). We analyzed a call series of 26.2 s duration recorded from the holotype at 25 °C. Calls were not uttered evenly during this series but were interrupted by short breaks (stuttering) and struc-

ture of pulses was irregular. First pulse in most calls was longer than following ones. In the series analyzed 197 calls had a repetition rate of 7.52 calls/s and a mean call length of 45.4 $\pm$ 5.08 ms, range 34–61 ms, n=140. Mean intercall interval was 86.5 $\pm$ 19.8 ms, range 65–153 ms, n=140. Mean pulse number per call calculated from 140 calls was 5.22 $\pm$ 1.13, range 3–9 and frequencies scattered between 1 and 5 kHz with a dominant frequency at 3.3 kHz (Fig. 8).

Etymology. Fulva is a feminine Latin adjective, meaning red-yellow and refers to the colouration of this new species.

Comparisons with other species. We restrict our comparisons with *A. fulva* to those species having a similar body size (mean SUL ~ 25–35 mm):

Austrochaperina adamantina is known from a single adult female measuring 28 mm SVL. It differs from *A. fulva* by longer legs (TL/SVL 0.43 vs. 0.38–0.42 and T4L/SVL 0.45 vs. 0.38–0.42.), bigger eyes (ED/SVL 0.125 vs. 0.097–0.108), narrower head (HW/SVL 0.34 vs. 0.35–0.36), smaller eye-naris distance (END/SVL 0.073 vs. 0.076–0.086), smaller internarial distance (IND/SVL 0.098 vs. 0.097–0.108) and broader finger discs (F3D/SVL 0.041 vs. 0.025–0.026).

Austrochaperina aquilonia is known from two male specimens measuring 31.0 and 23.3 mm SVL. It differs from the new species by conspicuous mottling on dorsum (vs. absent), longer legs (TL/SVL 0.41–0.48 vs. 0.38–0.42 and T4L/SVL 0.44–0.48 vs. 0.38–0.42), bigger eyes (ED/SVL 0.110–0.135 vs. 0.097–0.108), smaller eye-naris and larger internarial distance (END/SVL 0.069–0.074 vs. 0.076–0.086 and IND/SVL 0.111–0.118 vs. 0.97–0.108), and lower ratio END/IND (0.58–0.67 vs. 0.72–0.83).

Austrochaperina archboldi is larger (males up to 35 mm, females up to 38 mm SVL), has conspicuous brown mottling on a pale background (vs. no mottling on dorsum), longer shanks (TL/SVL 0.45–0.49 vs. 0.38–0.42), larger finger discs (F3D/SVL 0.026–0.035 vs. 0.025–0.026), and larger toe discs (T4D/SVL 0.041–0.052 vs. 0.035–0.043).

Austrochaperina basipalmata is also larger than the new species (males up to 31.6 mm, females up to 34.4 mm SVL), has webbed toes (vs. no webbing) longer fingers and toes (F3L/SVL 0.23–0.27 vs. 0.20–0.22; T4L/SVL 0.43–0.49 vs. 0.38–0.42), and broader finger discs (F3D/SVL 0.033–0.046 vs. 0.025–0.026).

Austrochaperina beehleri cannot be differentiated from *A. fulva* on the basis of body ratios because most ratios overlap extensively. Only the ratio HL/HW did not show any overlap (HL/HW in *A. beehleri* 0.87–0.91 vs. 0.92–0.96 in *A. fulva*). However the two species can be distinguished by their colouration and advertisement calls: dorsum of *A. fulva* reddish-brown to brown without darker mottling (vs. that of *A. beehleri* pale grey to reddish with brown mottling); ventral surfaces of abdomen and thighs in *A. beehleri* whitish (vs. yellow in *A. fulva*). *Austrochaperina beehleri* utters unpulsed calls (vs. pulsed in *A. fulva*). Mean duration of six call series from *A. beehleri* 10.7 ± 1.29 s (vs. duration of one call series of *A. fulva* 26.2 s), mean length of intercall intervals in *A. beehleri* 118 ± 14.2 ms (vs. 86.5 ± 19.8 ms in *A. fulva*), call repetition rate in *A. beehleri* 6.08 ± 0.13 calls/s, range 5.9–6.3 (vs. 7.52 calls/s in *A. fulva*).

Austrochaperina laurae has dark brown dorsal surfaces (vs. reddish-brown or yellowish-brown), yellow with a reticulum of grey spots ventrally (vs. no mottling), longer shanks (TL/SUL 0.41–0.48 vs. 0.38–0.42), larger eyes (ED/SUL 0.108–0.127 vs. 0.097–0.108), wider discs of third finger (F3D/SUL 0.027–0.041 vs. 0.025–0.026), wider discs of fourth toe (T4D/SUL 0.041–0.053 vs.

0.035–0.043) and a lower ratio HL/HW (0.81–0.91 vs. 0.92–0.96). There are also differences in the advertisement calls; these are pulsed in both species but call series last 0.91–2.45 s in *A. laurae* but more than 25 s in *A. fulva*.

Austrochaperina macrorhyncha is smaller than the new species (22.8–24.9 mm, $n=9$, vs. 27.9–31.0 mm SUL, $n=3$) and its shanks are considerably longer (TL/SUL 0.47–0.52 vs. 0.38–0.42).

Austrochaperina parkeri is only known from the holotype, a female measuring 30.6 mm SVL. It differs from *A. fulva* by: dorsum with white spots (vs. no white spots on dorsum), longer shanks (TL/SVL 0.44 vs. 0.38–0.42), smaller eye-naris distance (END/SVL 0.070 vs. 0.076–0.086), greater internarial distance (IND/SVL 0.105 vs. 0.097–0.104), lower ratio END/IND (0.67 vs. 0.72–0.83), and broader discs on third finger (F3D/SUL 0.031 vs. 0.025–0.026).

Austrochaperina punctata data are mainly based on our measurements of five syntypes of this species (see Material and methods). *A. punctata* has longer shanks (TL/SUL 0.47–0.50 vs. 0.38–0.42), broader head (HW/SUL 0.38–0.41 vs. 0.35–0.36), bigger eyes (ED/SUL 0.131–0.141 vs. 0.097–0.108), broader finger and toe discs (F3D/SUL 0.044–0.054 vs. 0.025–0.026) and smaller toe discs (T4D/SUL 0.051–0.054 vs. 0.035–0.043; T4D/F3D 1.00–1.20 vs. 1.38–1.63).

Austrochaperina rudolfarndti has longer legs (TL/SUL 0.46–0.49, $n=5$ vs. 0.38–0.42, $n=3$; T4L/SUL 0.48–0.51 vs. 0.38–0.42), broader discs on third finger (F3D/SUL 0.030–0.036 vs. 0.025–0.026), smaller toe discs T4D/F3D (1.11–1.25 vs. 1.38–1.63), broader head (HW/SUL 0.37–0.40 vs. 0.35–0.36), bigger eyes (ED/SUL 0.130–0.139 vs. 0.097–0.108), larger internarial distance (IND/SUL 0.119–0.122 vs. 0.097–0.108), and lower ratio END/IND (0.59–0.66 vs. 0.72–0.83). Overall impression of dorsal surfaces of *A. rudolfarndti* in life are different tones of grey, those of *A. fulva* unicoloured brown or reddish.

Austrochaperina septentrionalis differs in the following characters: longer shanks (TL/SVL 0.41–0.46 vs. 0.38–0.42), dorsal surfaces in life mainly greyish-brown (vs. reddish-brown), ventral surfaces cream (vs. yellow), calls with harmonic structure (vs. no harmonic structure) and call series lasting less than 10 s, (vs. more than 25 s with call repetition 9.3–9.6 calls/s (vs. 7.5 calls/s).

***Austrochaperina brachypus* sp. nov.**

ZOOBANK urn:lsid:zoobank.org:act:2B235C53-E6EC-4B71-B8B9-2C5E53287911

Holotype. SAMA R71448 (FN SJR 8503), adult male, Papua New Guinea, Hela Province, Moran Oilfield (6.2390°S, 143.1210°E; 1,700 m a.s.l.) collected on 14 November 2004 by S. J. RICHARDS and C. DAHL.

Paratype. ZMB 89198 (FN SJR 8509), adult female, same data as for holotype.

Diagnosis. With a snout-urostyle length of 23.6 mm in one adult male and 25.3 mm in one adult female, *A. brachypus* sp. nov. is a moderately-sized species of its genus. It can be distinguished from all congeners by a combination of the following characters: shanks short (TL/SUL 0.36–0.37), head wide (HW/SUL 0.38), discs present on all fingers and toes, those of toes scarcely wider than those of fingers, discs of fingers 1 and 4 as well as of toes 1 and 5 not wider than corresponding penultimate phalanges; eyes medium-sized (ED/SUL 0.119–0.123), eye-naris distance clearly shorter than internarial distance (END/IND 0.69–0.73); in preservative (and most probably in life) colour of dorsal surfaces uniform brown becoming lighter on flanks; ground colour of abdomen, chest and ventral limbs cream with fine brown markings, sparse on abdomen and most dense on throat; pale rostral pad present in male but not in female; advertisement calls are uttered in series lasting 1–2 s and contain 11–20 unpulsed calls. Calls have a harmonic structure and a duration of 23–40 ms, duration of intercall intervals 60–94 ms, dominant frequency 3.90 kHz.

Description of the holotype. An adult male with a snout-urostyle length of 23.6 mm (Figs 9a–c). For measurements and body-ratios see Table 3. Snout with an acute tip covered by a whitish rostral pad in dorsal view and strongly protruding in profile. Nostrils visible from above, but not from below, directed laterally, and closer to snout tip than to eyes, distance between nares much greater than distance between eye and naris (END/IND 0.69). Canthus rostralis rounded, loreal region distinctly sloping outwards. Tongue long, pear-shaped, more than half free posteriorly with a barely detectable notch. Prepharyngeal skin ridge with about 12 poorly developed denticles. Elongate vocal slits located near angle of jaws. Tympanum lighter than surrounding skin, clearly visible, its horizontal diameter slightly more than half eye diameter, supratympanic skin fold weakly expressed. Eye of medium size (ED/SUL 0.119), pupil horizontal. Fore limbs moderately robust with moderately short fingers, tips of fingers 2 and 3 with expanded disc, disc of fingers 1 and 4 not expanded; all finger discs with terminal grooves; inner metacarpal tubercle elongate, outer roundish, subarticular tubercles poorly developed; relative lengths of fingers 3>4>2>1. Hind limbs more robust than fore limbs. Discs of toes 2, 3 and 4 clearly wider than penultimate phalanges; those of toes 1 and 5 not wider than penultimate phalanges; all toes with terminal grooves on discs. Inner metatarsal tubercle visible, outer

metatarsal tubercle adelomorphic, subarticular tubercles barely detectable; toes without webbing, relative lengths 4>3>5>2>1. Dorsal and ventral surfaces in preservative smooth.

Colouration in preservative. Dorsal surfaces uniform brown, flanks slightly lighter (Fig. 9a). Ventral surfaces off-white with brown dots and irregular flecks, mottling lesser dense on abdomen and thighs and more dense on lower extremities and throat (Fig. 9b)

Morphological variation in the type series. Besides the male holotype there is only one female paratype in the type series; measurements and body ratios of both are listed in Table 3. The female is slightly larger than the male, but body ratios are similar (Table 3). Differences include: snout of male long, with acute whitish tip (Fig. 9c), that of female short, truncate tip lacking whitish cap. Dorsal surfaces of female lighter brown than male with more traces of mottling; dorsal surfaces of limbs and area below dark line between eye and middle of flank more strongly pigmented than remaining dorsal and lateral surfaces, abdomen off-white with only few small brown marks.

Distribution and ecological notes. *Austrochaperina brachypus* is known from one location on the Agogo Range in Hela Province, Papua New Guinea at an altitude of 1,750 m a.s.l. (Fig. 12). Both specimens were collected in extremely wet, mossy forest on karst terrain where they were found in litter on the forest floor.

Vocalisation. *Austrochaperina brachypus* sp. nov. utters short series of high pitched, unpulsed calls. Mean duration of 15 full call series (nine from the holotype and six from a male that eluded capture) recorded at 19°C was 1.70 ± 0.34 s, range 1.02–2.1 s. Mean number of calls per series 17.0 ± 2.9 , range 11–20 calls/series, mean call repetition rate 10.1 ± 0.51 calls/s, range 9.4–11.0 notes/s; mean interval length between 13 consecutive call series 7.5 ± 2.2 s, range 3.5–11.8 s; mean call length 35.4 ± 3.2 ms, range 23–40 ms, $n=110$; mean intercall length 69.2 ± 6.7 ms, range 60–94 ms, $n=104$. There is a tendency that the first calls of a series are the shortest and the last ones are the longest. The same applies to intercall intervals. Calls are unpulsed, their amplitude rises rapidly to maximum at the beginning, remains at this maximum for a short duration and then decreases more slowly to zero (Fig. 10, top). All calls are frequency modulated with a lower frequency at the beginning of a note and a higher frequency at the end (Fig. 10, below). Due to this frequency modulation it is difficult to assess mean values of single bands in spectrograms, but amplitude spectrums clearly show highest values of the fundamental frequency band at 1.95 kHz, of the dominant frequency at 3.90 kHz and of the third harmonic bands at 5.80 kHz (Fig. 11). There are a few additional upper harmonics in some recordings.



Fig. 9a. Preserved holotype of *Austrochaperina brachypus* sp. nov. (SAMA R71448) in dorsal view.

Fig. 9b. Preserved holotype of *Austrochaperina brachypus* sp. nov. in ventral view.

Fig. 9c. Preserved holotype of *Austrochaperina brachypus* sp. nov., lateral view of the head.

Etymology. *Brachypus* is a composite Greek adjective (*brachys*=short; *pous*=foot, leg) and refers to the extremely short hind legs of this new species.

Comparison with other species. With a mean snout-vent length of less than 20 mm the following seven species are clearly smaller than *Austrochaperina brachypus*: *A. gracilipes*, *A. mehelyi*, *A. minutissima*, *A. novaebritanniae*, *A. polysticta* and *A. yelaensis*; and with a mean

snout-vent length of more than 30 mm the following nine species are obviously larger than *A. brachypus*: *A. alexanderi*, *A. archboldi*, *A. basipalmata*, *A. hooglandi*, *A. palmipes*, *A. punctata* and the former *Austrochaperina* but now *Copiula derongo*, *C. guttata* and *C. rivularis*. These species are not considered further.

Austrochaperina adamantina is known from a single adult female measuring 28 mm SVL. It differs from *A. brachypus* in having longer legs (TL/SVL 0.43 vs.

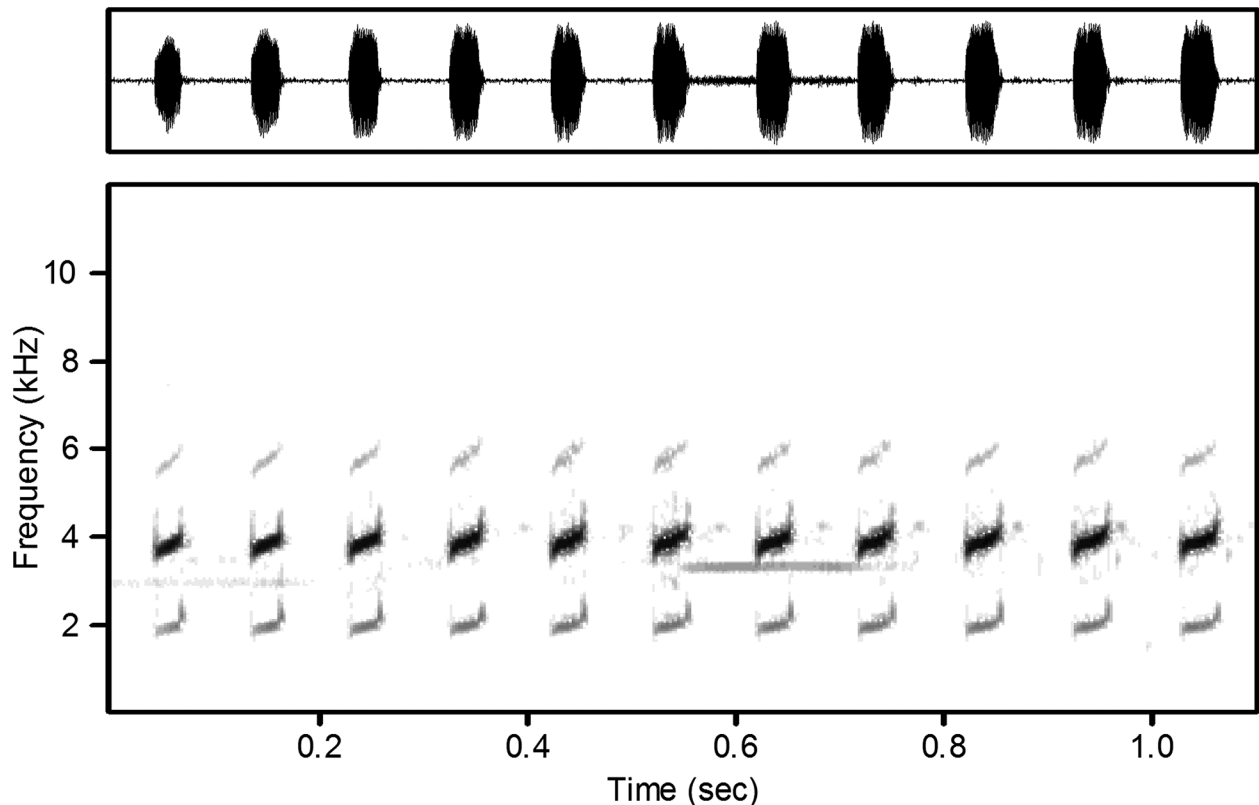


Fig. 10. Oscillogram (above) and spectrogram (below) of a section with 11 calls from a call series of the holotype of *Austrochaperina brachypus* sp. nov. Basic noise was deleted up to 1.0 kHz. Sampling rate conversion from 44 kHz to 16 kHz. Spectrogram parameters: FFT length 512, Frame size 75 %, Window FlatTop, Bandwidth 157 Hz, resolution 31 Hz, Overlap 93.75 %.

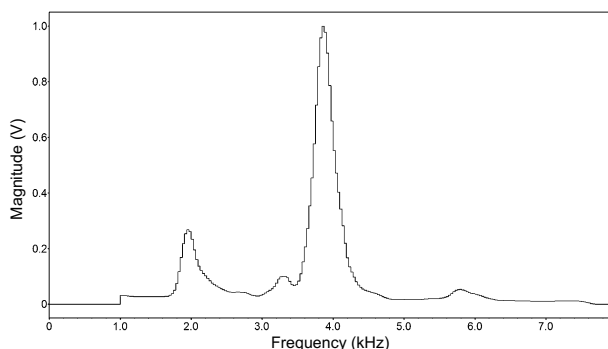


Fig. 11. Amplitude spectrum of five calls from an advertisement call series of the holotype of *Austrochaperina brachypus* sp. nov. Same parameters as in Fig. 10; basic noise was deleted up to 1 kHz.

0.36–0.37; T4L/SVL 0.45 vs. 0.34–0.35), wider finger and toe discs (T4D/SVL 0.043 vs. 0.025–0.032; F3D/SVL 0.041 vs. 0.024–0.025) and a narrower head (HW/SVL 0.34 vs. 0.38–0.39).

Austrochaperina aquilonia was described on the basis of two male specimens measuring 31.0 and 23.3 mm SVL. It differs from the new species by more conspicuous mottling on dorsum, longer hind limbs (TL/SVL 0.42–0.48 vs. 0.36–0.37 and T4L/SVL 0.44–0.48 vs. 0.34–0.35) and broader discs on fourth toe (T4D/SVL 0.035–0.037 vs. 0.025–0.032).

Austrochaperina blumi: our measurements of five paratypes of this species (see “Material and methods”) revealed longer shanks (TL/SUL 0.47–0.49 vs. 0.36–0.37), broader discs on fourth toe and third finger (T4D/SVL 0.38–0.46 vs. 0.25–0.32 and F3D/SUL 0.029–0.040 vs. 0.024–0.025), broader internarial distance (END/SUL 0.086–0.093 vs. 0.075–0.076) and smaller tympana (TyD/SVL 0.036–0.043 vs. 0.067–0.068).

Austrochaperina brevipes is similar to the new species. Both are short-legged frogs with broad heads and dorso-lateral skin ridges from eye to middle of flank. *A. brevipes* has longer toes than *A. brachypus* (T4L/SVL 0.39–0.48 vs. 0.34–0.35). The following body ratios could also be different (*brevipes* vs. *brachypus*): TL/SVL 0.36–0.44 vs. 0.36–0.37; HW/SVL 0.38–0.44 vs. 0.38–0.39; and T3D/SVL 0.016–0.025 vs. 0.024–0.025. However these two species have distinctly different advertisement calls. ZWEIFEL (2000) writes “The call (of *brevipes*) is a series of short, harsh chirps uttered at intervals of one to several minutes”. In contrast calls of *A. brachypus* are series of short melodious peeps and intervals between call series are less than 12 seconds (see above). Moreover, calls of *A. brevipes* contain 9–11 pulses with a dominant frequency at 2.9–3.2 kHz (vs. unpulsed and dominant frequency at 3.9 kHz in *A. brachypus*).

Austrochaperina fulva is larger than *A. brachypus* (27.9–31.0 mm vs. 23.6–25.3 mm SVL), has longer legs and toes (TL/SUL 0.38–0.42 vs. 0.36–0.37 and T4L/SUL

Table 3. Body measurements and body ratios of the type series of *Austrochaperina brachypus* sp. nov. SAMA R71448 is the male holotype, ZMB 89198 is the only female paratype. All measurements in mm; for explanation of abbreviations see “Material and methods”.

Reg.-No.	SAMA R71448	ZMB 89198	Mean
SUL	23.6	25.3	
TL	8.7	9.1	
TaL	6.6	6.7	
T4L	8.3	8.7	
T4D	0.6	0.8	
T1D	0.4	0.4	
F3L	5.0	5.5	
F3D	0.6	0.6	
F1D	0.4	0.4	
HL	8.2	8.8	
HW	9.0	9.8	
END	1.8	1.9	
IND	2.6	2.6	
SL	3.5	3.6	
ED	2.8	3.1	
TyD	1.6	1.7	
EST	3.0	2.8	
TL/SUL	0.37	0.36	0.37
TaL/SUL	0.28	0.26	0.27
T4L/SUL	0.35	0.34	0.35
T4D/SUL	0.025	0.032	0.29
T1D/SUL	0.017	0.016	0.17
F3L/SUL	0.21	0.22	0.22
F3D/SUL	0.025	0.024	0.25
F1D/SUL	0.017	0.016	0.017
T4D/F3D	1.00	1.33	1.17
T1D/F1D	1.00	1.00	1.00
HL/SUL	0.35	0.35	0.35
HW/SUL	0.38	0.39	0.38
HL/HW	0.91	0.91	0.91
END/SUL	0.076	0.075	0.76
IND/SUL	0.110	0.103	0.107
END/IND	0.69	0.73	0.71
ED/SUL	0.119	0.123	0.121
TyD/SUL	0.068	0.067	0.068
TyD/ED	0.57	0.55	0.56
SL/SUL	0.148	0.142	0.145
EST/SUL	0.127	0.111	0.119

0.38–0.42 vs. 0.34–0.35), broader discs on first and fourth toe (T1D/SUL 0.018–0.023 vs. 0.016–0.017 and T4D/SUL 0.035–0.043 vs. 0.025–0.032), broader disc on first finger (F1D/SUL 0.019–0.025 vs. 0.016–0.017), smaller head (HL/SUL 0.32–0.33 vs. 0.35 and HW/SUL 0.35–0.36 vs. 0.38–0.39) and smaller eyes (ED/SUL 0.097–0.108 vs. 0.119–0.123). Furthermore, *A. fulva* utters very long note series (more than 25 s duration vs. 1–2 s in *A. brachypus*) and calls are pulsed with a repetition rate of 7.5 calls/s in *A. fulva* and are unpulsed with a mean repetition rate of 10.1 calls/s in *A. brachypus*.

Austrochaperina kosarek was described on the basis of a single adult female measuring 21 mm SVL and so probably has a smaller body size than *A. brachypus*. It also differs from the new species by having: longer shanks (TL/SUL 0.41 vs. 0.36–0.37), longer toes (T4L/SUL 0.41 vs. 0.34–0.35), broader snout (END/IND 0.64 vs. 0.75–0.76) and smaller finger discs (F3D/SVL 0.021 vs. 0.024–0.025); dorsolateral skin fold absent (vs. present in *A. brachypus*), abdomen with brown spotting (vs. scarcely spotted in *A. brachypus*, and only disc of third finger broader than penultimate phalanx, (vs. discs of fingers two and three broader than penultimate phalanges in *A. brachypus*).

Austrochaperina laurae differs by its larger body size (males 26.9–29.6 mm vs. 23.6 mm SUL in *A. brachypus* and females 28.2–35.2 mm vs. 25.3 mm SUL), longer shanks (TL/SUL 0.41–0.48 vs. 0.36–0.37), broader discs on fourth toe and third finger (T4D/SUL 0.041–0.052 vs. 0.025–0.032 and F3D/SUL 0.027–0.042 vs. 0.024–0.025), and by having distinctly pulsed (vs. unpulsed) calls.

Austrochaperina beehleri has longer shanks (TL/SUL 0.40–0.44 vs. 0.36–0.37), longer fourth toes (T4L/SUL 0.38–0.45 vs. 0.34–0.35), broader discs on fourth toe and first finger (T4D/SUL 0.034–0.051 vs. 0.025–0.032 and F1D/SUL 0.018–0.023 vs. 0.016–0.017), a shorter head (HL/SUL 0.30–0.33 vs. two times 0.35), smaller eyes (ED/SUL 0.096–0.116 vs. 0.119–0.123), smaller tympana (TyD/SUL 0.056–0.058 vs. 0.067–0.068) and a higher ratio T4D/F3D (1.50–2.00 vs. 1.00–1.33). There are also clear differences in the advertisement calls. Calls and intercall intervals are longer in *A. beehleri* and call repetition rate is lower (5.9–6.3 vs. 9.4–11.0 calls/s). Moreover, frequency decreases during individual calls of *A. beehleri* but rises in *A. brachypus*.

Austrochaperina macrorhyncha has much longer limbs (TL/SUL 0.47–0.52 vs. 0.36–0.37), and advertisement calls that are clearly pulsed with low call repetition rate (vs. unpulsed with high call repetition rate in *A. brachypus*).

Austrochaperina parkeri is only known from the holotype, a female measuring 30.6 mm SVL. It differs from *A. brachypus* by longer shanks (TL/SVL 0.44 vs. 0.36–0.37), narrower head (HW/SVL 0.35 vs. 0.38–0.39), smaller eyes (ED/SVL 0.105 vs. 0.119–0.123), broader finger discs and toe discs (F3D/SVL 0.031 vs. 0.024–0.025 and T4D/SVL 0.042 vs. 0.025–0.032), and having white spots on dorsal surfaces and abdomen mottled with darker or lighter brown (vs. no white spots on dorsum and abdomen scarcely spotted).

Austrochaperina rudolfarndti has longer limbs (TL/SUL 0.46–0.49 vs. 0.36–0.37; T4L/SUL 0.48–0.51 vs. 0.34–0.35), broader finger and toe discs (F3D/SUL 0.030–0.036 vs. 0.024–0.026; T4D/SUL 0.034–0.043 vs. 0.025–0.032), bigger eyes (ED/SUL 0.130–0.139 vs. 0.119–0.123), wider internarial distance (IND/SUL 0.119–0.122 vs. 0.103–0.110) and utters harsh, pulsed calls (vs. high pitched, unpulsed calls).

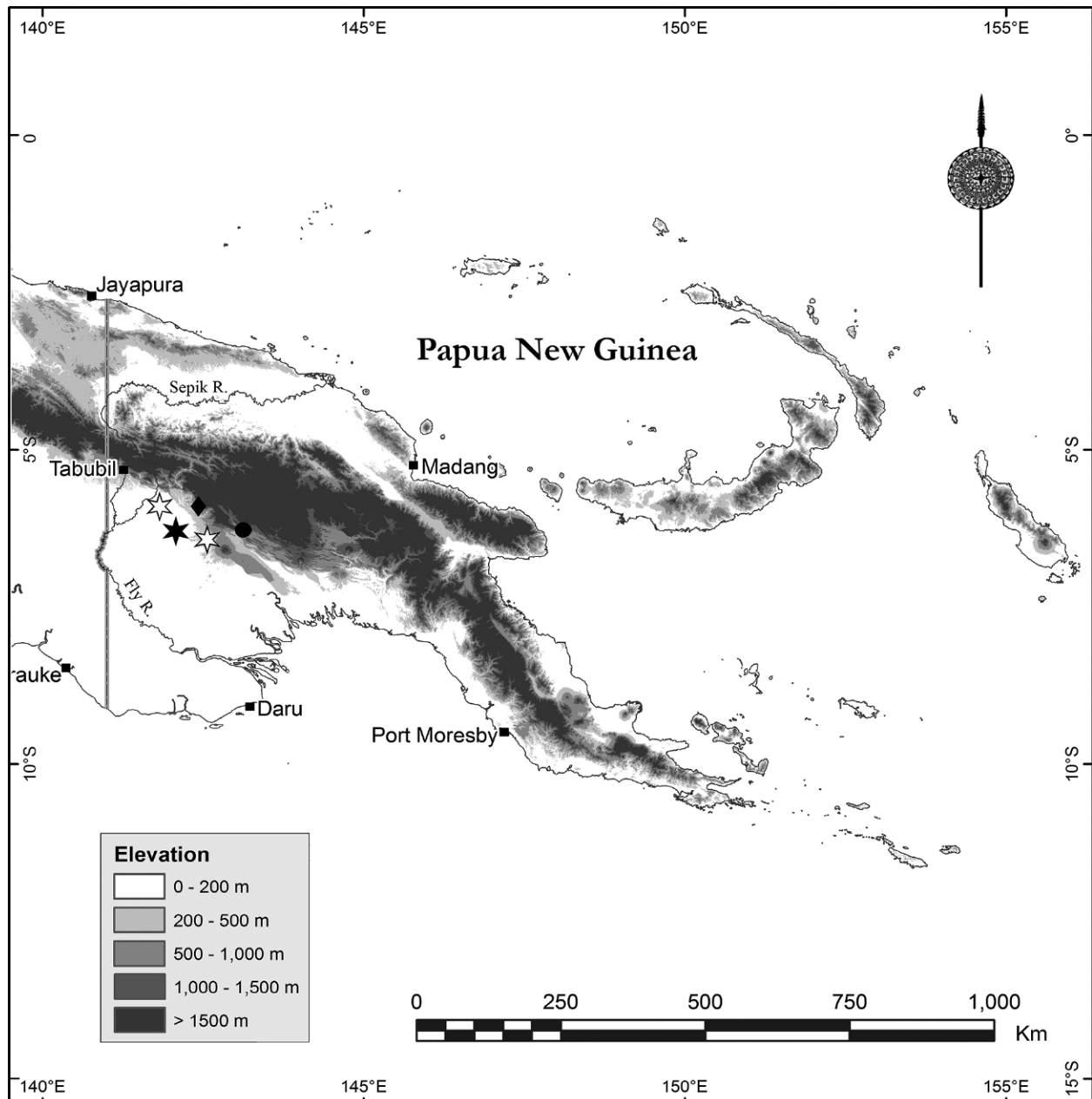


Fig. 12. Map showing the distributions of three new *Austrochaperina* species in Papua New Guinea: star = *Austrochaperina beehleri* sp. nov.; diamond = *A. fulva* sp. nov.; circle = *A. brachypus* sp. nov. Black symbols indicate the type localities for each species.

Austrochaperina septentrionalis is slightly larger than *A. brachypus* (SVL 28.4–31.6 mm vs. 23.6–25.3 mm) and has longer shanks (TL/SVL 0.41–0.46 vs. 0.36–0.37), broader disc on fourth toe (T4D/SVL 0.031–0.040 vs. 0.025–0.032), smaller eyes (ED/SVL 0.098–0.110 vs. 0.119–0.123), smaller tympana (TyD/SVL 0.049–0.055 vs. 0.067–0.068) and advertisement calls with a harsh, rasping quality consisting of 2–11 pulses with a dominant frequency of 3.1 kHz (vs. high pitched, unpulsed calls with dominant frequency at 3.9 kHz).

Copiula tyleri Burton, 1990 which possibly belongs to *Austrochaperina* (see Introduction) differs from *A. brachypus* by longer shanks (TL/SVL 0.45–0.53 vs. 0.36–0.37) and by the absence of clavicalae.

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