

A NEW SPECIES OF *CALLULOPS* FROM NEW GUINEA AND COMMENTS ON THE STATUS OF *C. HUMICOLA COMPTUS* (ZWEIFEL) (ANURA: MICROHYLIDAE: ASTEROPHRYINAE)

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Summary

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Callulops sagittatus sp. nov. from the summit of Mt Binnie, Western Province, Papua New Guinea is described. It is a moderately large species (males 44.1-47.8 mm, a female 56.3 mm S-V) distinguished from congeners by the presence of an orange stripe from the tip of the snout dorsally across each eyelid, forming an arrow-shaped mark on the crown. The advertisement call is a series of 11-12 deep croaks uttered from the entrance to, or deep within, crevices between rocks. The female paratype contains large (4.5 mm diameter) unpigmented eggs indicating that, like other Australopapuan microhylids, larval development is completed within the egg capsule. Among the Asterophryinae, *Callulops sagittatus* and *C. h. humicola* share a unique condition of the mandibular branch of the trigeminal nerve suggesting that *C. sagittatus* and not *C. h. comptus* is the closest relative of *C. h. humicola*. This and a number of other consistent morphological differences indicate that *C. h. comptus* warrants elevation to specific status.

KEY WORDS: Anura, Microhylidae, Asterophryinae, frog, new species, *Callulops sagittatus* sp. nov., *Callulops humicola*, *Callulops comptus*, New Guinea.

Introduction

Microhylid frogs of the subfamily Asterophryinae are restricted to the New Guinea mainland and nearby islands (Zweifel & Tyler 1982). This ecologically and morphologically diverse group occurs from sea level to subalpine meadows high in the central cordillera (Zweifel 1972). In a review of the Asterophryinae Burton (1986) recognised eight genera and 43 species. Blum & Menzies (1988) subsequently described nine new species of *Xenobatrachus* and *Xenorhina*, and Richards *et al.* (1994) described a new species of *Asterophrys*, bringing the total to 53. Additional undescribed species occur in museum collections, and field work continues to reveal unnamed taxa.

During a survey of the fauna of Mt Binnie, Western Province, Papua New Guinea (Dennis *et al.* 1995)¹ three of us (SR, AD, MC) collected an undescribed species of the asterophryine genus *Callulops*. The discovery of this new species necessitates a reassessment of the relationships of the taxa currently recognised as subspecies of *Callulops humicola*. Here

we describe the new species and demonstrate that *Callulops humicola comptus* warrants elevation to specific status.

Materials and Methods

Specimens are deposited in the Biology Department, University of Papua New Guinea, Port Moresby (UPNG) and the Queensland Museum, Brisbane (QM).

Recordings of mating calls were made in the field with a Sony Professional Walkman tape recorder with an Electret Condenser Microphone ECM-Z200 and were analysed using the sound analysis program "Canary" (Cornell Ornithology Laboratory, 1994).

Measurements were made to the nearest 0.05 mm with dial callipers or to the nearest 0.1 mm using a binocular microscope with an ocular micrometer. Methods of measurement follow Zweifel (1985) except the snout-naris measurement, taken from the tip of the snout to the centre of the naris. Measurements (mm) were: snout-vent length (S-V); tibia length (TL); eye diameter (EYE); eye-naris distance (EN); internarial distance (IN); snout-naris distance (SN); head width at angle of the jaws (HW); head length from tip of snout to angle of the jaws (HL); horizontal diameter of tympanum (EAR); hand length (HD); foot length (FT). The rather featureless palmar and plantar surfaces of the hands and feet, and the poorly defined tympanic annulus made measurement of the hands, feet and tympanum difficult, and the measurements should be treated with caution. One of us (TCB) dissected the superficial throat and jaw musculature under a Wild M3Z microscope with the aid of topical application

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¹ DENNIS, A., RICHARDS, S. & CUNNINGHAM, M. (1995) Preliminary survey of mammals, birds, reptiles and frogs on the summit of Mt Binnie, Western Province, PNG, 20-23 November, 1994. Report to Ok Tedi Mining Limited (unpubl.)

of the iodine-potassium iodide solution of Bock & Shear (1972). The squamosal bone was also examined.

Systematics

Callulops Boulenger is applied to asterophryine microhylid frogs formerly referred to *Phrynomantis* Peters, following the recommendation of Dubois (1988). *Callulops* is distinguished by two skull characters: two supplementary slips to the M. intermandibularis arise from the dentary; one via a tendon and the other directly, and run together, more or less parallel to the mandible, to insert upon the ventral fascia of the M. submentalis and sometimes also upon the adjacent medial aponeurosis of the M. intermandibularis (Burton 1986). The second character is that the otic ramus of the squamosal bone is about the same length as the zygomatic ramus, and it is not twisted i.e. the postero-lateral surface of the otic ramus is continuous with the lateral surface of the zygomatic ramus (Burton 1986).

In his revision of the asterophryines, Zweifel (1972) described *Callulops h. humicola* and *C. h. comptus*. These taxa resemble each other superficially apart from relatively longer legs in *C. h. humicola*, and an orange postocular stripe in adult *C. h. comptus* which is only 'somewhat developed in young *humicola*' (Zweifel 1972 p. 476). The geographic ranges of these taxa abut. Zweifel reported only one instance of sympatry, and was reluctant to assign the taxa to species status in the absence of evidence of reproductive isolation.

Burton (1986) added two further characters to distinguish the taxa. First, in *C. h. humicola* the M. depressor mandibulae arises from the dorsal fascia, with some fibres from the otic ramus of the squamosal and the posterior surface of the adjacent prootic; in *C. h. comptus* and all other *Callulops*, additional fibres arise from the entire posterior and ventral surfaces of the tympanic ring. Second, in *C. h. humicola* the mandibular branch of the trigeminal nerve passes directly ventro-laterally through the M. adductor mandibulae posterior longus on its way to the mandibular musculature; in *C. h. comptus* and all other asterophryines this nerve passes antero-laterally between the M. a. m. posterior longus and the M. m. anterior longus, and then postero-ventrally across the lateral surface of the M. a. m. posterior longus before plunging towards the mandibular musculature. Burton (1986) made no taxonomic recommendation regarding the status of these taxa.

Callulops sagittatus sp. nov. (FIGS 1-5)

Holotype: UPNG 9051 an adult male collected by S. J. Richards, M. Cunningham and A. J. Dennis on

20.xi.1994 at an altitude of 2200 m on the summit of Mt Binnie, Western Province, Papua New Guinea (141° 7' 30" E, 5° 12' S).

Paratypes: UPNG 9052 (adult female), QMJ 60231 (adult male), same data as holotype.

Definition

A moderately large and robust species (males 44.1-47.8 mm S-V, a female 56.3 mm S-V) distinguished from congeners by a combination of the following characters: fingers and toes without expanded discs, a distinct orange stripe dorsally on the head from the snout extending across each eyelid, tympanum indistinct, advertisement call a series of deep 'crawks' with a dominant frequency of 609 Hz, a note repetition rate of 1.85-2.2/s and a pulse rate of 11.89-14.02/ms.



Fig. 1. *Callulops sagittatus* sp. nov. in life (S-V 56.3 mm).

Description of holotype

Body robust, almost pear shaped (Fig. 1), head broader than long (HW/HL 1.23) with nares closer to tip of snout than to eye (SN/EN 0.6) and directed laterally. Internarial distance greater than distance from eye to nares (EN/IN 0.78), eyes large (EYE/S-V 0.119). Snout blunt, broadly rounded in dorsal view and rounded in lateral view (Fig. 2). Canthus rostralis rounded, loreal region steep, slightly concave. Tympanum indistinct, annulus barely visible. Dorsal and ventral surfaces minutely granular, a weak supratympanic fold. Anterior palatal ridge long, smooth, posterior palatal ridge with 11 distinct denticles.

Limbs short (TL/S-V 0.38), relative lengths of fingers 3 > 4 > 2 > 1, fourth finger only marginally longer than second. Fingers unwebbed, tips without expanded discs, subarticular tubercles low, rounded. Palm smooth except for a low inner metacarpal tubercle. Relative lengths of toes 4 > 3 > 5 > 2 > 1. Toes

unwebbed, tips without expanded discs, subarticular tubercles low, rounded. A low, oval inner metatarsal tubercle; no outer tubercle (Fig. 3).

Colour in life uniform deep red-brown dorsally on body and limbs, grading laterally into a uniform lighter brown ventral surface. Throat slightly darker brown than rest of venter. Head deep red-brown with an orange stripe dorsally from tip of snout along canthus and over eye, forming distinct arrow shape on crown. Slight orange tinge on upper surface of thigh. No other markings dorsally or ventrally. In preservative brown with a mauve tinge dorsally, brown ventrally, stripes on head very pale pink.

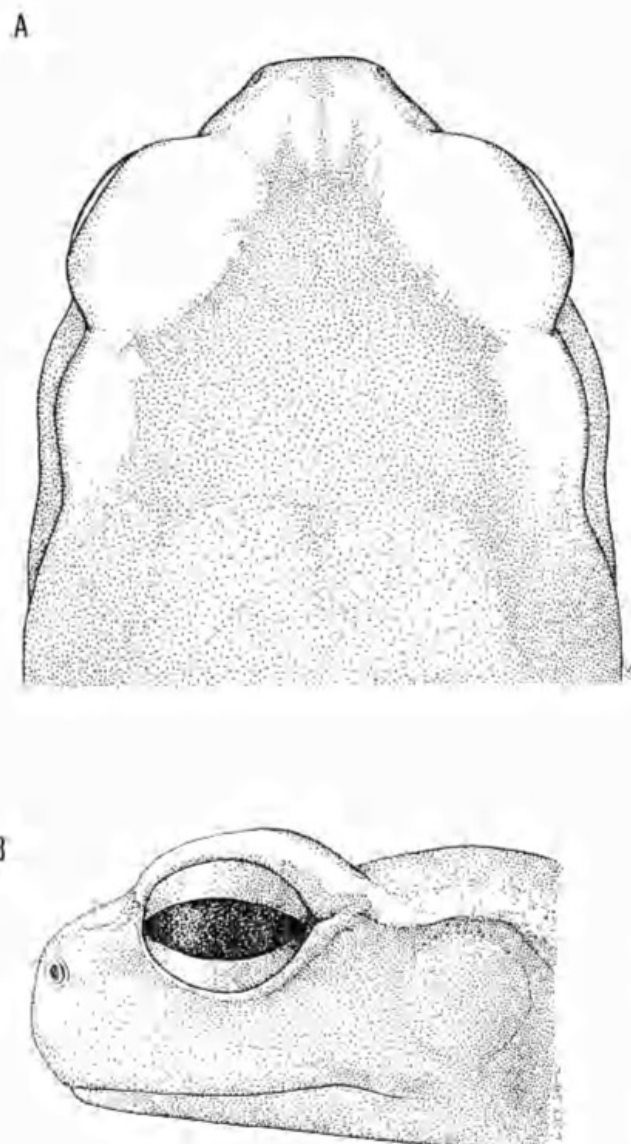


Fig. 2. Views of head of *Callulops sagittatus* sp. nov. holotype (UPNG 9051). A. Dorsal view. B. Lateral view. Scale bar = 10 mm.

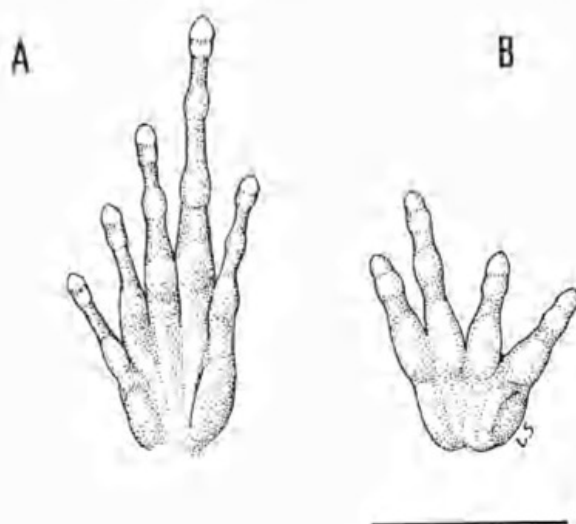


Fig. 3. Hand and foot of *Callulops sagittatus* sp. nov. holotype (UPNG 9051). A. Plantar view of foot. B. Palmar view of hand. Scale bar = 10 mm.

Dimensions of holotype

S-V 47.8; TL 18.2; EN 3.3; SN 2.0; IN 4.2; EYE 5.7; HW 17.0; HL 13.8; HD 12.5; FT 19.3; EN/IN 0.785; TL/S-V 0.38; HW/HL 1.23; EYE/S-V 0.119; HW/S-V 0.355; width of toe tip on fourth toe 1.0 (width of penultimate phalanx 0.8); width of toe tip on third finger 0.9 (1.0).

Musculature

The superficial throat musculature and squamosal form conform to the definition of *Callulops*. The M. depressor mandibulae arises predominantly from the dorsal fascia, but also receives substantial contributions from the otic ramus and the posterior and ventral margins of the tympanic ring. The mandibular branch of N. trigeminalis passes directly ventro-laterally from the brain case and penetrates the M. adductor mandibulae posterior longus on its way to the mandibular musculature (Fig. 4).

Advertisement call

We recorded two call sequences but only one of these is of sufficient quality for detailed analysis. The mating call is a series of deep, guttural croaks "cawk, cawk, cawk...". The recordings contained 11 and 12 notes lasting a total of 5.57 and 5.186 seconds respectively (note repetition rate = 1.85/s and 2.2/s). Both calls had a dominant frequency of 609 Hz. Individual notes in the 11-note call lasted 118.9-182.3 ms (mean = 154.2), contained 10-13 pulses (mean = 11.63) at a rate of 11.89-14.02/ms (mean = 13.23). Fig. 5 illustrates the first four notes of an 11-note call recorded at the type locality on 20.xi.94 at an air temperature of 13.5 °C.

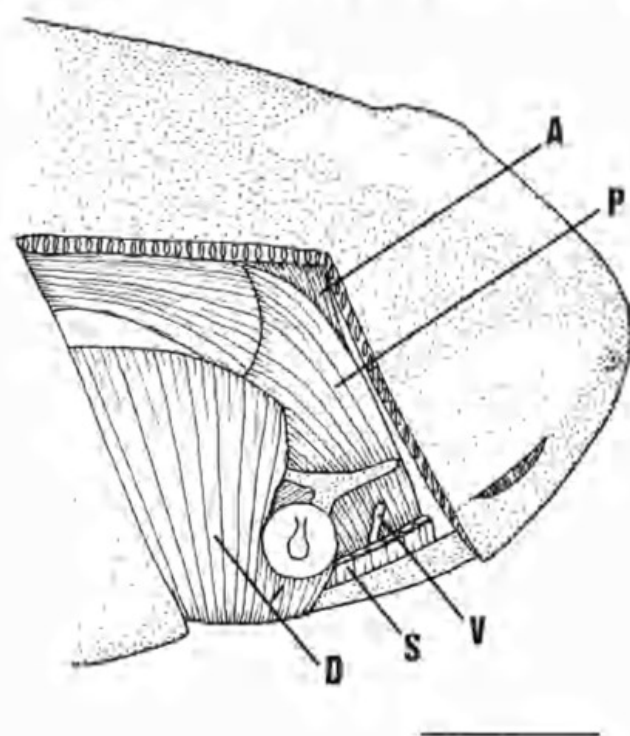


Fig. 4. Dorsolateral view of musculature of right jaw of *Callulops sagittatus* sp. nov. A, M. adductor mandibulae anterior longus; D, M. depressor mandibulae; P, M. adductor mandibulae posterior longus; S, M. adductor mandibulae externus superficialis (severed); V, mandibular branch of trigeminal nerve. Scale bar = 5 mm.

The calls were uttered at irregular intervals, with long periods (often over five minutes) between calls. On several occasions we heard a melodious, dove-like "coo coo..." vocalisation uttered immediately following, or from the same vicinity as, one of the call types described above but we were unable to confirm whether it was part of the vocal repertoire of this species.

Natural history

The type series was collected in disturbed rainforest and secondary regrowth at altitudes over 2000 m along the access road to the summit of Mt Binnie. One male was calling from the entrance to a deep crevice between rocks in a vertical road cutting, and the other was calling from deep within a labyrinth of crevices among large rocks in the road cutting. The female was collected on the surface and appeared to be approaching the latter male. Additional males were heard calling within crevices adjacent to the road but we were unable to trace them due to the sporadic nature of calling and their subterranean habitats.

The female contains large, unpigmented eggs indicating that development occurs within the egg capsule like other Australopapuan microhylids (Zweifel & Tyler 1982). Two mature eggs measured in the ovary were 4.5 mm in diameter.

The skin of this species is thick and glandular (Fig. 4) and the animals exuded a slimy mucus when handled, apparently as a defensive mechanism.

Variation

The colour pattern is consistent in the three available specimens, all of which exhibit the distinctive orange stripes on the head. Some of the fingers and toes of each specimen are dehydrated making accurate measurement difficult, but none has expanded discs; some fingers and toes have faint, vestigial grooves on the tips. Measurements and proportions of the two paratypes (UPNG 9052/QMJ60231) are: S-V 56.3/44.1; TL 19.8/14.6; EN 3.4/3.3; SN 2.1/2.0; IN 4.6/3.9; EYE 6.0/5.2; HW 19.0/17.7; HL 16.0/16.1; ET 21.0/19.0; HD 13.2/11.7; EN/IN 0.76/0.846; TL/SV 0.35/0.33; HW/HL 1.18/1.09; EYE/S-V 0.106/0.118; HW/S-V 0.337/0.401; width of toe tip on fourth toe (width of penultimate phalanx) 1.1 (0.9)/0.8 (0.7); width of toe tip on third finger 1.0 (1.0)/1.0 (1.0).

Comparison with other species

Callulops (sensu Dubois (1988)) now includes 15 species. Morphologically they are rather conservative, and there is extensive overlap in most body proportions among species (Zweifel 1972 Table 6). The comparisons below are based largely on the detailed descriptions of taxa presented by Zweifel (1972).

The presence of orange stripes dorsally on the head distinguishes *C. sagittatus* from known congeners. *Callulops boettgeri*, *C. eurydactylus* and *C. slateri* further differ from *C. sagittatus* in having greatly expanded finger and toe discs (vs no discs). *Callulops doriae*, *C. dubius*, *C. fuscus*, *C. humicola humicola* and *C. h. comptus*, *C. kopsteini*, *C. personatus* and *C. robustus* have small grooved discs on the fingers and toes. *Callulops doriae* (100 mm), *C. personatus* (72.5 mm) and *C. robustus* (73 mm) are much larger species and *C. dubius* appears to be a much smaller species (maximum S-V = 24 mm). Although sample-size is small, there appear to be differences between the mating calls of *C. sagittatus* and those of both *C. personatus* and *C. robustus*. Two calls of *C. personatus* have a dominant frequency of about 1000–1500 Hz (vs 609 Hz) and contained 5 notes (vs 11–12). Calls of *C. robustus* from Misima Island (the type locality) have a dominant frequency of about 800 Hz (J. Menzies unpubl. data). *Callulops h. comptus* is the only other species in which adults have orange stripes on the head, but in this species the orange markings are restricted to a short lateral post-ocular stripe. *Callulops sagittatus* shares with *C. h. humicola* the condition of the mandibular branch of the trigeminal nerve. As this condition is unique among the asterophryines it appears to be a synapomorphy indicating a close phylogenetic relationship between these taxa. However, *C. h. humicola* differs from *C. sagittatus* in the possession

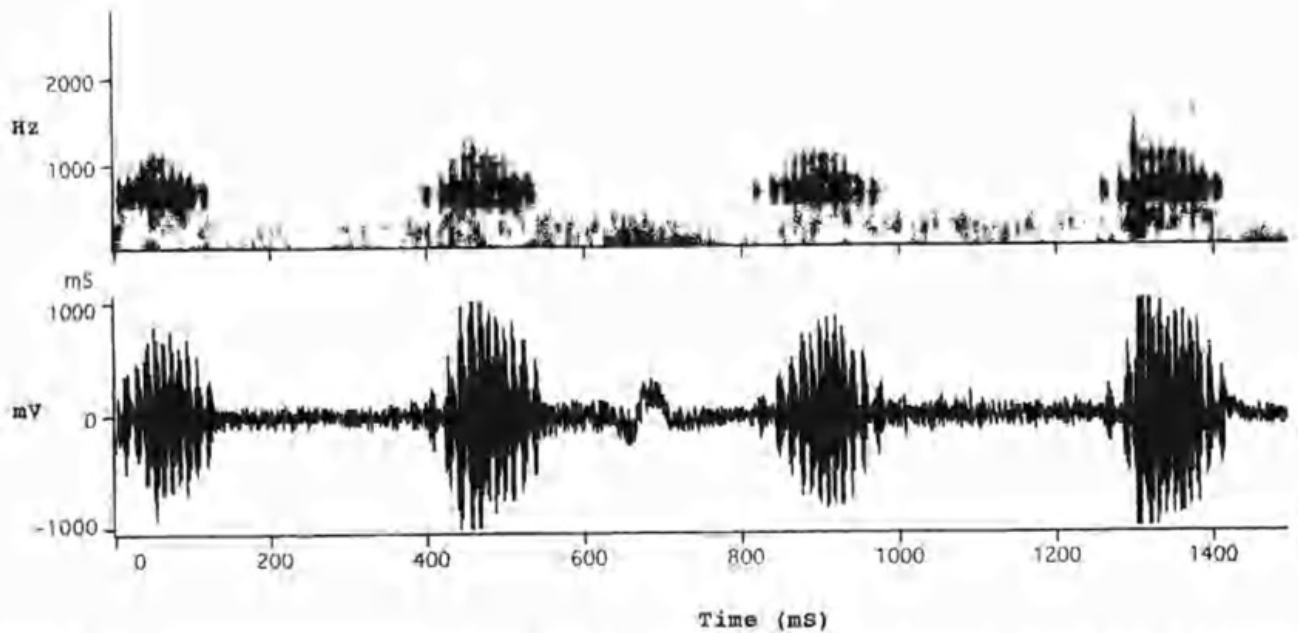


Fig. 5. Audiospectrogram (top) and wave form (bottom) of first four notes of an H-note call sequence of *Callulops sagittatus* sp. nov. recorded at the type locality. Air temperature 13.5°C.

of grooved discs on the fingers, and lack of orange stripes on the head. Three species, namely *C. glandulosus*, *C. stictogaster* and *C. wilhelmanus* share with *C. sagittatus* the lack of finger and toe discs. *Callulops glandulosus* differs from *C. sagittatus* in having a coarsely mottled ventral surface (vs uniform) and in having a well-developed glandular area behind the ear, whereas *C. stictogaster* is a larger species (to 80 mm) and has a distinct tubercle between the eye and the nostril (lacking in *C. sagittatus*). *Callulops wilhelmanus* closely resembles *C. sagittatus* and has a similar call (J. Menzies unpubl. data), size and colour pattern. It is distinguished predominantly by the absence of orange markings on the crown and the condition of the mandibular branch of the trigeminal nerve.

Zweifel (1972) discussed four specimens of *Callulops* from Busilmin on the northern slopes of the Star Mountains that he tentatively assigned to *C. robustus*. This population is geographically close to the type locality and is at a similar altitude. The frogs are within the size range of *C. sagittatus* but none exhibits the orange stripes typical of this species and their identification remains uncertain.

Status of Callulops h. humicola and C. h. comptus

Although we still lack calls or other reproductive data for these taxa, their classification as a single species is no longer tenable, given the evidence that the taxon most closely related to *C. h. humicola* is not *C. h. comptus* but *C. sagittatus*. In light of this and

previously reported consistent morphological differences (Burton 1986; Zweifel 1972) we propose that *C. humicola comptus* be elevated to specific status as *Callulops comptus* (Zweifel) new combination. Zweifel (1972) presented a thorough description of these two taxa and a detailed comparison with each other and all other *Callulops* except *C. sagittatus*, with which they are compared above.

Etymology

From the *L. Sagitta* (= arrow) with reference to the arrow-shaped orange markings on the crown.

Acknowledgments

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