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Notes on the tropical Andean genus *Disceratus* (Orthoptera, Tettigoniidae, Pseudophyllinae), the probable male of *D. nubiger*, and its calling song

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Abstract

A male *Disceratus* specimen found in cloud forest of Podocarpus National Park in southernmost Ecuador is apparently conspecific with *Disceratus nubiger* Scudder 1869, known only from the female holotype, collected one and a half centuries ago on slopes of the volcano Antisana. The song of this male could be recorded, confirming the identification of field recordings as well as additional acoustic records with an ultrasound detector at the same site. This incessant calling song, a series of steadily repeated short clicks with a sharp peak at 20 kHz, easily reveals the presence of this short-legged and brachypterous katydid – it lives in bamboo thickets within cloud forest, where individuals are very difficult to find. More fieldwork and nocturnal acoustic monitoring in the tropical Andes will be essential to shed light on the distribution and life history of this practically forgotten genus and its species, some of them probably still undiscovered. *Disceratus* is recognized as full genus rather than a subgenus of *Gnathoclita*.

Introduction

The neotropical genus *Disceratus* Scudder 1869 comprises five species of yellowish or reddish brown, short-legged and brachypterous katydids that are distinguished by two knobs or spiniform processes on the clypeus, and elongated mandibles in males. The name seems to be derived from these hornlets (Greek κέρατος = horned). While *D. karschi* Brunner von Wattenwyl 1895, known from a single female specimen, is supposed to be from Costa Rica, the four other species are from the Andes of Ecuador (listed according to type locality from north to south): *D. anostostoma* (Gorochov 2012) from Pichincha Province (Cordillera Occidental, 1970 m), *D. nubiger* Scudder 1869 from slopes of the volcano Antisana (Cordillera Oriental, at 3000 m), *D. immanis* Hebard 1924 from Chimborazo (Cordillera Occidental, at 3000 m) and *D. festae* Giglio-Tos 1898 from Cañar Province (separation into two distinct cordilleras complicated). All seem to be known from the type specimens only: respectively a unique male, a unique female, a male and female pair, and a female along with two nymphs of both sexes. Male sexual differences include more elongated mandibles and an upcurved rear margin of the pronotum, the latter probably providing space to move the tegmina during stridulation. In the known females the metazona is flat.

In his monograph of the large subfamily Pseudophyllinae, Beier (1960) assigned *Disceratus* to the new tribe Glaphyraspidini, a group of altogether five genera that ultimately needed to be renamed Homalaspidiini (*Homalaspidia* Uvarov 1940 is a new name for the preoccupied name *Homalaspis* Brunner von Wattenwyl 1885, while the unnecessary replacement name *Glaphyraspis* Beier 1960 is preoccupied as well, cf. Eades *et al.*). A recently described species of *Disceratus* was first placed into the new subgenus *Tettohenicus* Gorochov 2012 within the genus *Gnathoclita* Haan 1843, the latter being distinguished by strongly elongated mandibles and clypeus in males, and belonging to the tribe Eucocconotini (Beier 1960). That subgenus turned out to be a synonym of the genus *Disceratus*, which in turn was moved as subgenus under *Gnathoclita*, the respective author criticizing the "erroneous inclusion of two subgenera … in different tribes by Beier" (Gorochov 2014).

In fact, the two genera are quite different. First, *Disceratus* lacks the ventral tubercles at the base of fore and middle coxae, which are considered to be diagnostic for the tribe Eucocconotini and are present in *Gnathoclita* (Beier 1960). As already mentioned, *Disceratus* has a pair of apically rounded spiniform processes on the normally-sized clypeus, which are not present on the protruding mouthparts of *Gnathoclita* with its prolonged clypeus. The mandible tips in *Disceratus* are free, while in *Gnathoclita* they are covered by the labrum. In *Disceratus* the lateral lobes of the pronotum are much longer than high, while in *Gnathoclita* the pronotum is fairly short. *Disceratus* has short and slit-like tympanal openings which are situated laterally on the base of the fore tibiae (about 1/3 of total tibial width removed from the edges of the flat dorsal surface), whereas in *Gnathoclita* the openings seem to be wider and coincide with the dorsal edges of the tibiae. Finally, all *Disceratus* species are brachypterous, with tegmina shorter than the pronotum and hind wings wanting (Scudder 1869, Beier 1960), while in the four real *Gnathoclita* species the tegmina are considerably longer than the pronotum or even projecting beyond the abdomen tip, with hind wings being present (Beier 1960). However, both genera probably should not be kept in two different tribes.

For a long time I thought a *Disceratus* species discovered in 1997 on the Eastern Andean Cordillera in the very south of Ecuador was new (Braun 2002, 2008), but apparently it belongs to *D. nubiger* Scudder 1869, the type species of the originally monotypic genus. It has never been reported again since its original description, based on a female from a place called Salto (perhaps a waterfall) on the slopes of the volcano Antisana, also on the Cordillera Oriental, at 10,000 feet (around 3000 m). The expedition led by naturalist James Orton, during which the specimen was collected, ascended Antisana on its western slope, reaching "a little lake called Mica" (Orton 1870). This is the Laguna de la Mica at over 3900 m (Google Earth). The new locality is 410–420 km further south. There the species seems to live in bamboo thickets in cloud forest (so the name "nubiger", borne by the clouds, is quite appropriate). It requires the aid of an ultrasound detector and the male's distinctive and incessant calling song to detect these cryptic katydids.

Investigation area and methods.—The species was found during extensive fieldwork in Podocarpus National Park and its surroundings between August 1997 and January 2000 (Braun 2002, 2008). At that time a collecting permit was provided by the Instituto Ecuatoriano

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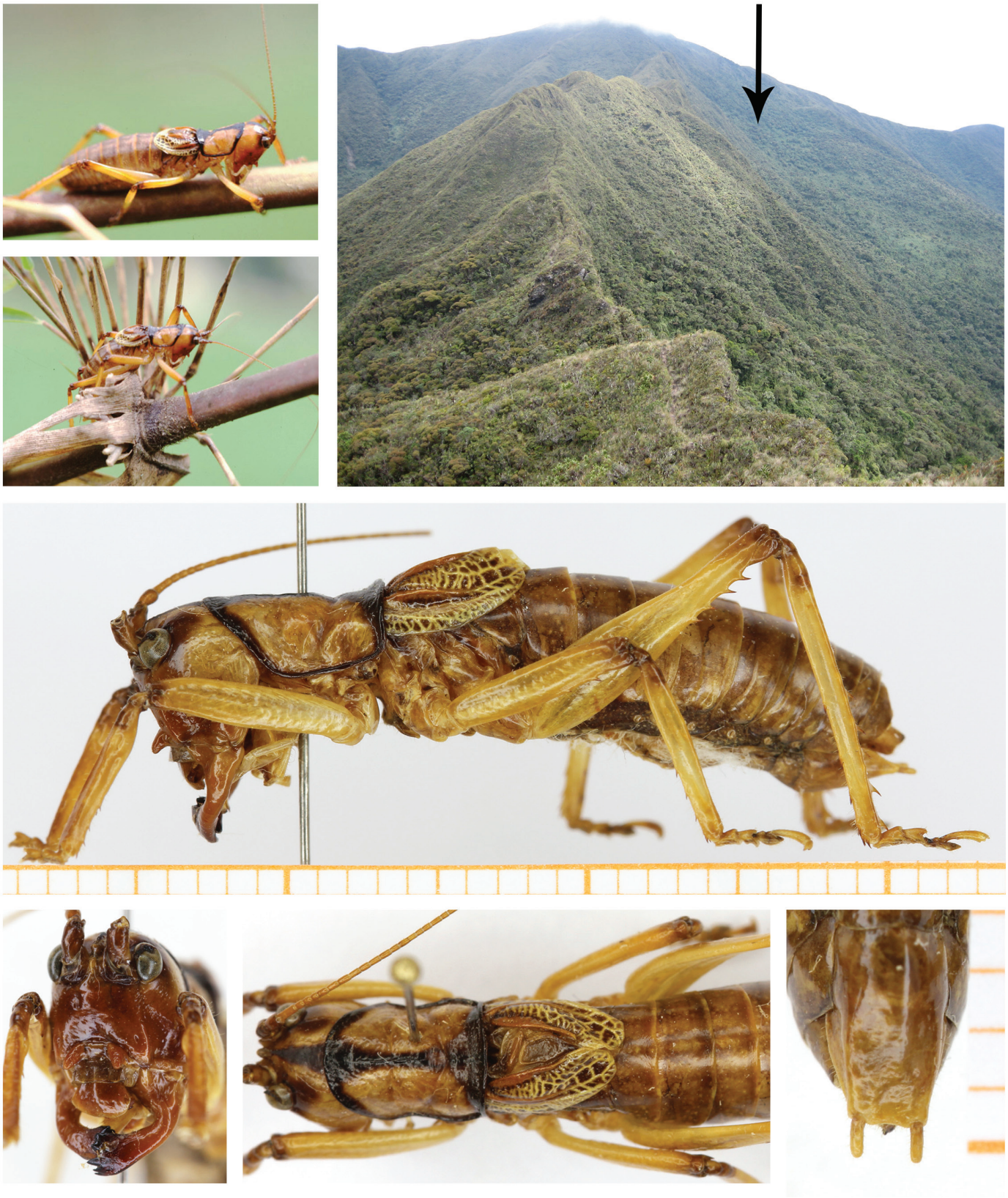


Fig. 1. Male of *Disceratus nubiger*: Two staged photos during day; locality on western slope of Cajanuma ridge at almost 3000 m (photographed in January 2010); specimen in lateral, frontal and dorsal view, and subgenital plate in ventral view (specimen cbt016s01).

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Forestal y de Áreas Naturales y Vida Silvestre (INEFAN), which in 1999 was integrated in the Ministero del Ambiente del Ecuador. The collected individual was accommodated in a dome-shaped gauze cage with a square base of 30 cm side length and a height of 15 cm. It was furnished with plant parts and provided with small cucumber pieces almost every day. Sound recordings of the caged male and of undiscoverable males in the field were made with a Laar Bridge Box XL (BVL von Laar, Klein Görnow) at 400 kHz sampling rate and stored on DAT (digital audio tape) using a Sony Walkman (TCD-D7 and TCD-D100). Temperatures were taken with a simple pocket thermometer. A Mini-3 heterodyne bat detector (Ultrasound Advice, London) was used for acoustic monitoring. Sound analysis was done with Avisoft-SASLab Pro (R. Specht, Berlin). Recordings were also stored as WAV files: originally ten times slowed down on DAT, read in with 22.05 kHz sampling rate in Cool Edit 2000 (Trial Version), and then set to 220.5 kHz. Sound recordings, additional images and a map are available on Orthoptera Species File Online (Eades *et al.*). Photos of type specimens of other *Disceratus* species and the *Gnathoclita* species can also be accessed there.

***Disceratus nubiger* Scudder 1869**
urn:lsid:Orthoptera.speciesfile.org:TaxonName:465472

Examined specimens.— Male cbt016s01, Ecuador, Provincia de Loja, Parque Nacional Podocarpus, Cajanuma (access to park south of Loja), 2990 m, 17 October 1999, leg. H. Braun, in collection of author; another male was destroyed when it drew its powerful mandibles into the finger of a startled field assistant of F. Matt, right after it was caught by the latter in December 1997 at the same site at a slightly lower elevation: this specimen's remains were used for drawings of the cercus (Fig. 2).

Descriptive notes and comparison with holotype.— Most morphological details are illustrated (Figs 1, 2). In comparison with the female holotype, the mandibles are strongly elongated and the rear margin of the pronotum is upcurved (both sexual dimorphisms). On the lateral lobes of the pronotum the blackish coloration of the ventral margin and the upper rear corner is slightly more extensive. The tegmina, bearing the stridulatory apparatus, are only a little shorter than the pronotum. The legs, especially the femora, seem somewhat stouter. Prosternal spines are delicate and short (shorter than the clypeus hornlets), mesosternal lobes are pointed and erected, metasternal ones broadly rounded, and the metasternal pit is transverse, short, and deep (divided by a thin medial ridge). Fore femora bearing two ventral spines, middle femora two, and hind femora four. Only the internal genicular lobes of middle and hind femora are armed. In the female holotype the external lobes of hind femora are rounded and unarmed and "some of the internal genicular lobes are armed" (Hebard 1924).

Measurements.—Length of pronotum 6 mm (same in holotype), tegmina 5 mm, hind femora 11 mm (13 mm in holotype).

Comparison with other species.— The male of *D. anostostoma* has longer and more downcurved clypeus hornlets (length greater than diameter of eye), cerci without dorsal spinule, its subgenital plate has a v-shaped emargination, and the distance between the styli is barely greater than half their length. The *D. immanis* pair each have thinner clypeus hornlets, male cerci and subgenital plate seem to

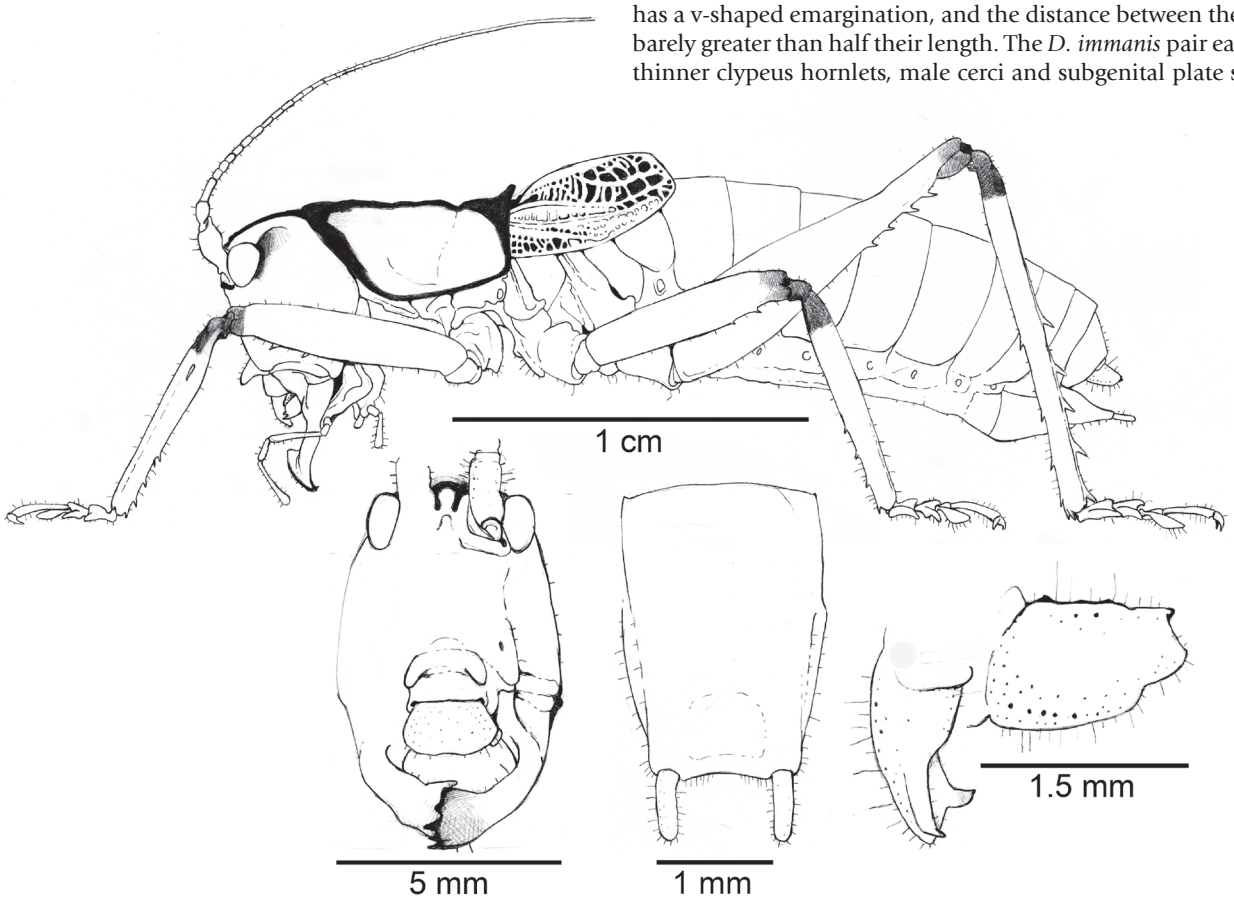


Fig. 2. Male of *Disceratus nubiger*: habitus, head in frontal view, subgenital plate in ventral view (after specimen cbt016s01), dried left cercus in dorsal view (shrunk, originally more cylindrical over entire length) and external lateral view (after destroyed specimen from December 1997, all pencil drawings from October 2003).

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be like in *D. anostostoma*, and the mandibles are also considerably elongated in the female, although less so than in the male. The female of *D. festae* has small clypeus hornlets, pronotum without black median stripe, and distally blackened abdominal tergites. The female of *D. karschi* has very short clypeus knobs and femora with black medial stripes.

Song.— Two males calling from inaccessible bamboo shrubbery were recorded at night in the field and a located and captured individual was later recorded calling caged. The song of this nocturnal species was also discovered subsequently on a recording of the little walking leaf katydid *Typophyllum egregium* (Fig. 3A). It makes long series of very short low-ultrasound clicks at an almost constant repetition rate (Fig. 3). At a temperature of 7 °C at night in the natural habitat one click every 400-500 ms. These clicks have a loud onset and rapidly decay within 10-15 ms. Considering that loud clicks produce echoes, particularly in dense vegetation, the real signal duration might be only 1 ms (Fig. 3C). The frequency spectrogram shows a surprisingly sharp peak for such a short signal at 20 kHz (Fig. 3E). This distinctive song, reminiscent of a clockwork, can readily be detected with a bat detector. At a temperature of 18 °C the caged male called much more rapidly, producing a click about every 150 ms (Fig. 3D). The carrier frequency is independent of temperature.

Distribution and habitat.— Cordillera Oriental in Ecuador, known from western slopes of Antisana around 3000 m and the western slope of the cordillera in Podocarpus National Park 2750 – 3000 m. Living in cloud forest up to tree line, apparently associated with bamboo (including the collected individual 17 calling males were heard with an ultrasound detector in October 1999 – no monitoring occurred below 2750 m, so that the lower limit of altitudinal distribution is uncertain).

Discussion

Species identity and acoustic monitoring.—It cannot be entirely excluded that the female holotype of *Disceratus nubiger* and the newly-discovered male belong to different species. It would be necessary to find a male from the type locality to compare it with both the holotype and the male presented in this paper. At present it seems advisable to treat the latter as conspecific rather than to describe it as new species. A possible search on Antisana and at other montane rainforest areas on the Eastern Andean Cordillera in Ecuador should include listening after dusk with an ultrasound detector tuned to 20 kHz. This is a good example of a species with a cryptic lifestyle that can easily be detected acoustically. Without first noticing its conspicuous calling song and then tracking down the two male individuals, this katydid would have gone unnoticed at the new site. There it apparently occurs only on the western slope of the cordillera, whereas the distinctive song could not be detected on the eastern slope at the same elevation range with similar types of habitat. So the distribution of *D. nubiger* seems to be restricted to the inter-Andean slope.

Elongated mandibles and systematic issues.—The elongated mandibles in males of *Disceratus* as well as *Gnathoclita* could indicate that both

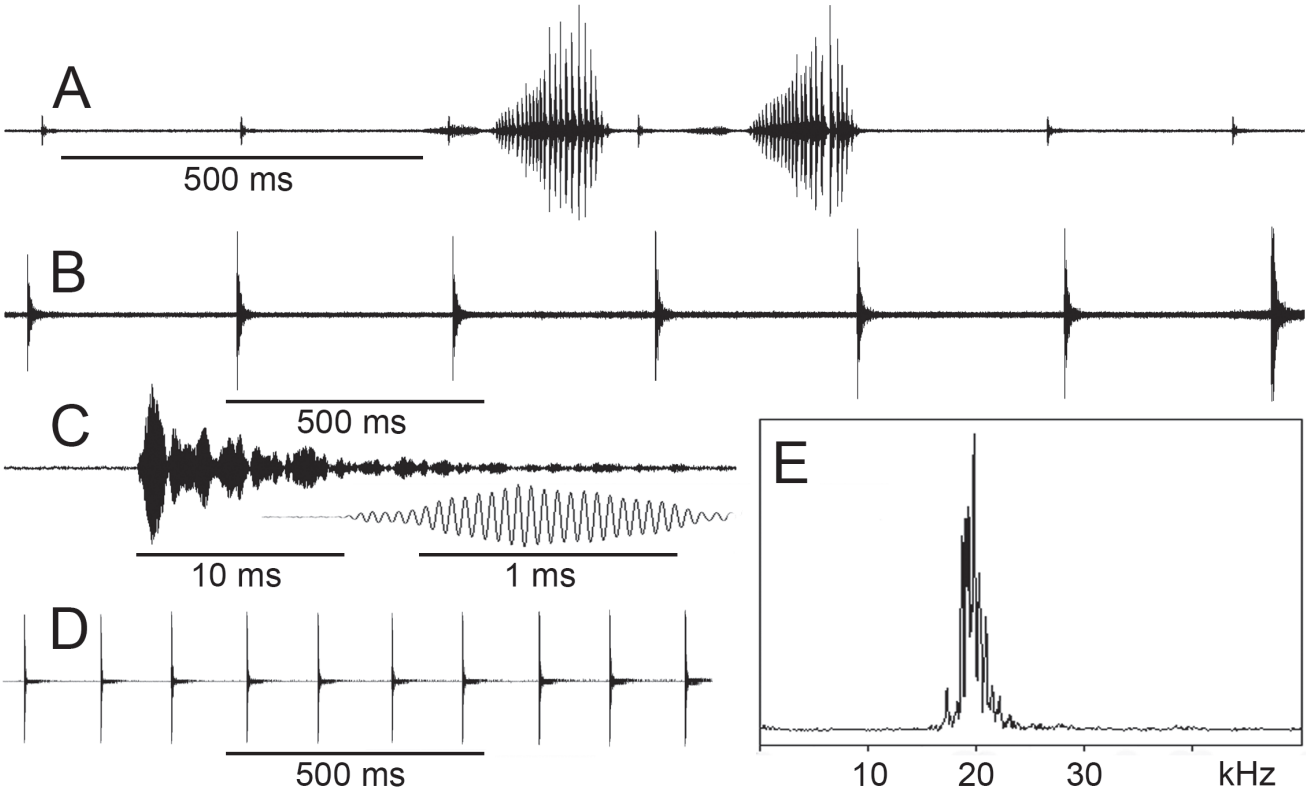


Fig. 3. Song of *Disceratus nubiger*: A. accidental recording with call of the leaf-mimicking katydid *Typophyllum egregium* (two conspicuous syllables in the middle) and *Disceratus* calling in background (six clicks visible, another one hidden by second syllable of *Typophyllum*), 11 °C, October 1997, 2750 m (recording cbt016x01r01); B. undiscoverable male calling continuously from bamboo shrubbery, 7 °C, 17 October 1999 (cbt016x03r01); C. single click from B, below onset in higher resolution; D. collected individual calling like crazy at 18 °C in cage (cbt016s01r01); E. linear spectrogram taken from B.

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genera are closely related (Gorochov 2014), but it could also be the result of convergent evolution. Very similarly elongated mandibles occur in males of the Orthoptera family Anostostomatidae (in particular genus *Anostostoma*). *Henicus monstrosus* (Herbst 1803) from South Africa additionally even sports forward-directed processes on the genae, recalling the clypeal hornlets in *Disceratus*. The similar shape of male cerci is suggested as another indication for the possible relatedness of *Gnathoclita* and *Disceratus* (Gorochov 2014). But such stout cylindrical cerci with broadly rounded tips occur in other genera of Eucocconotini (*Ottotettix* and apparently *Panoploscelis*) and Homalaspidiini (*Arrhenotettix*, *Homalaspidia*, and *Jimenezia*). They appear to be prone to substantial shrinkage: the turgescence seems totally lost in dried specimens (Fig. 2 here, Fig. 1 in Braun 2011, well preserved in Figs 202, 204 in Gorochov 2014). At the moment it is perhaps practical to include *Disceratus* along with *Gnathoclita* in Eucocconotini instead of moving it back to Homalaspidiini, despite the smooth rather than granulated surface of the pronotum in some species (including *D. nubiger*), the obtuse-angled and not square anterior corners of its lateral lobes, and the missing ventral tubercles at the base of fore and middle coxae (also practically absent in specimens of a new *Myopophyllum* species from southern Ecuador, pers. obs.). Including both genera in the not very well defined Homalaspidiini appears less appropriate.

Coming back to the enlarged mandibles: in Anostostomatidae they are used in combat between males, *e.g.* to control tree cavities where females find refuge during the day (*e.g.* Kelly 2004). An adaptation for aggressive behavior was also assumed for *Gnathoclita sodalis* Brunner von Wattenwyl 1895 (Montealegre & Morris 1995). However, males of this species seem to use tremulation signals to chase off smaller rivals (De Souza *et al.* 2011). Apparently there are no observations in the wild. The population density of *Disceratus nubiger* found at the new site, with 17 males calling in one night between 2780 m and 3000 m, is rather low for possible male-male interactions.

Acknowledgements

The bat specialist Felix Matt first noticed the ultrasound song of this katydid and managed to track down and capture the first specimen back in 1997. Klaus-Gerhard Heller and Glenn Morris provided useful comments concerning the song, and Glenn also offered suggestions for improving the wording.

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