# Acanthodasys caribbeanensis sp. n., a new species of Thaumastodermatidae (Gastrotricha, Macrodasyida) from Belize and Panama 

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Academic editor: Antonio Todaro| Received 21 July 2010 | Accepted 30 August 2010 | Published 13 October 2010
urn:lsid:zoobank.org:pub:E249DCOB-8B28-4484-97F3-6E7A8F354B3C
Citation: Hochberg R, Atherton S (2010) Acanthodasys caribbeanensis sp. n., a new species of Thaumastodermatidae (Gastrotricha, Macrodasyida) from Belize and Panama. ZooKeys 61: 1-10. doi: 10.3897/zookeys.61.552


#### Abstract

We describe one new species of Acanthodasys (Gastrotricha, Macrodasyida, Thaumastodermatidae) collected from sublittoral sites around Carrie Bow Cay, Belize and Isla Colón in the Bocas del Toro archipelago, Panama. Though eight species of Acanthodasys are currently recognized, no species has yet been reported from the Caribbean. Acanthodasys caribbeanensis sp. n. is characterized by the lack of lateral adhesive tubes, the presence of ventrolateral adhesive tubes, and with cuticular armature in the form of both spineless and spined scales. The spineless scales are not elliptical as in other species of Acanthodasys, but are instead variable in shape and closely resemble the spineless scales of species of Diplodasys. Spined scales bear uniancres up to $50 \mu \mathrm{~m}$ long and are the largest reported in the genus. Uniancres are arranged dorsally around the mouth rim and distributed in five distinguishable columns. Adult size varies from 325-625 $\mu \mathrm{m}$ long.


## Keywords

Meiofauna, Caribbean, Panama, Belize, gastrotrich, taxonomy

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## Introduction

The phylum Gastrotricha contains some of the smallest ( $0.1 \mathrm{~mm}-3 \mathrm{~mm}$ ) benthic marine invertebrates. In general, marine gastrotrichs are restricted to the interstitial pore spaces between sand grains, making them overlooked in most tropical biodiversity investigations. Knowledge of gastrotrich biodiversity in the Tropical Northwestern Atlantic (aka wider Caribbean) is almost entirely limited to species lists or descriptions of novel taxa from only a handful of sites in the five Caribbean ecoregions: the Gulf of Mexico (Todaro 1994; Todaro et al. 1995), South Florida ecoregion (Thane-Fenchel 1970; Schoepfer-Sterrer 1974; Decho et. al. 1985; Evans and Hummon 1991; Evans 1994), Bahamanian ecoregion (Renaud-Debyser 1963), Lesser Antilles ecoregion (Kisielewski 1984; Hummon 2010) and Central Caribbean ecoregion including Colombia (Hummon 1974) and Panama (Hochberg 2008). Additional unpublished records of marine gastrotrich diversity and biogeography can be found in Hummon (2009).

Here, we document a new species of Acanthodasys (Macrodasyida, Thaumastodermatidae) from two Central Caribbean islands, Carrie Bow Cay on the Belizean barrier reef complex and Isla Colón in the Bocas del Toro archipelago, Panama. Investigations on both islands were conducted as part of a Smithsonian sponsored biodiversity project to barcode the local marine meiofauna.

## Methods

Gastrotrichs were collected from a variety of sublittoral sites around Carrie Bow Cay, Belize (Jan.13-28, 2010) and Bocas del Toro, Panama (June 6-19, 2010). Research was performed at the Smithsonian field station on Carrie Bow Cay, Belize and Smithsonian Tropical Research Institute, Bocas del Toro, Panama, respectively. Sediments were collected by SCUBA in bags and buckets and brought back to the field stations for subsampling. Extraction of gastrotrichs was performed with the following protocol: 1) approximately $100 \mathrm{~cm}^{3}$ of sediment was combined with ca. $900 \mathrm{~cm}^{3}$ of $7.5 \%$ $\mathrm{MgCl}_{2}$ in a 1 L Erlenmeyer flask and allowed to rest for 15 mins; 2) the flask was gently shaken and the supernatant was decanted over a $48 \mu \mathrm{~m}$ mesh; and 3) the mesh was gently washed with seawater into a petri dish. Specimens were sorted with a Leica EZ4 stereomicroscope, transferred to a glass slide, and viewed with a Zeiss A1 compound microscope equipped with DIC (differential interference contrast). Light micrographs were captured with a Sony Handycam digital camera. Measurements of individual specimens were performed with an ocular micrometer. Lengths and positions of organ systems are described in terms of percentage body units, where total body length from anterior (U00) to posterior (U100) is 100 units.

Specimens were prepared for museum archival using the following protocol: fix in $2.5 \%$ gultaraldehyde in 0.1 M phosphate buffer saline (PBS; pH 7.4 ) for at least one week; rinse with PBS for 1 hr ; expose to $1 \% \mathrm{OsO}_{4}$ in 0.1 M PBS for 1 min (to increase constrast); rinse in PBS for 15 min ; dehdryate through an ethanol series;
transferr to propylene oxide for 30 min ; and embed in epon on a glass microscope slide (coverslipped and placed in an oven at $60^{\circ} \mathrm{C}$ for 24 hrs ). Type specimens are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC.

Abbreviations: PIJ, pharyngeointestinal junction; TbA, anterior adhesive tubes below mouth rim; TbL, lateral adhesive tubes; Tb , posterior adhesive tubes on caudal pedicles; TbVL, ventrolateral adhesive tubes.

## Results

Order Macrodasyida Remane, 1925 [Rao \& Clausen, 1970]
Family Thaumastodermatidae Remane, 1927
Subfamily Diplodasyinae Ruppert, 1978
Genus Acanthodasys Remane, 1927

## Acanthodasys caribbeanensis sp. n .

 urn:lsid:zoobank.org:act:2ED007EB-D7F8-4E0D-9DC4-37BAFA49B247Figs 1-3

Type locality. Station CBC10.19, Carrie Bow Cay Reef, coarse sand patches on ridge, 15 m depth, $16^{\circ} 48.127 \mathrm{~N}, 88^{\circ} 04.607 \mathrm{~W}$. Sediments collected by Cheryl Thacker on January 23, 2010.

Holotype. Adult specimen, reproductively mature, $625 \mu \mathrm{~m}$ long, resin preparation: specimen in dorsoventral orientation. USNM \#1145897

Other localities. Station BRS2010-104, Wild Cane Rock, Bocas del Toro, Pana$\mathrm{ma}, 14 \mathrm{~m}$ depth, medium coarse sand plain, $9^{\circ} 21.016 \mathrm{~N}, 82^{\circ} 10.335 \mathrm{~W}$. Sediment collected by Daniel Gouge on June 8, 2010.

Paratypes. Cat. No. USNM 1145898, Adult specimen, minimum $425 \mu \mathrm{~m}$ long (curled), resin preparation: specimen on side. Cat. No. USNM 1145899, Adult specimen, minimum $450 \mu \mathrm{~m}$ long (curled), resin preparation: specimen in dorsoventral orientation.

Material examined. Ten specimens. Three prepared for archival.
Diagnosis. Acanthodasys with an adult body length from $375 \mu \mathrm{~m}$ to $625 \mu \mathrm{~m}$ long. Maximum body width at mouth/PIJ/midpoint of body is $30 / 62 / 100 \mu \mathrm{~m}$. Pharynx to $238 \mu \mathrm{~m}$ long. Cuticle of spineless and spined scales. Spineless scales of various shape. Spined scales bear uniancres to $50 \mu \mathrm{~m}$ long, distributed as one dorsal column flanked by two dorsolateral columns and two lateral columns. Uniancres also extend dorsally across mouth rim. Ten epidermal glands per side. Up to nine TbA per side inserting directly on body surface at mouth rim. TbL absent. At least 43 TbVL per side beginning at PIJ and extending onto the outer edges of the caudal lobes. Two TbP insert terminally on caudal lobes, two insert medially. Hermaphroditic, with paired testes and single glandular caudal organ. Rosette organ on left dorsolateral side of body; single ovary present.


Figure I. Acanthodasys caribbeanensis sp. n. from Carrie Bow Cay, Belize A Dorsal view, transmitted light $\mathbf{B}$ Closeup of anterior end, dorsal view, DIC optics $\mathbf{C}$ Closeup of posterior end, dorsal view, DIC optics. Abbreviatons: cu caudal uniancres, du dorsal uniancre, dlu dorsolateral uniancre, eg egg, lu lateral uniancre, ou oral unianre, TbP posterior adhesive tubes.


Figure 2. Acanthodasys caribbeanensis sp. n. A Habitus, drawn in dorsal view. B Habitus, drawn in ventral view. C Closeup of head region showing the distribution of TbA $\mathbf{D}$ Examples of different shapes of uniancres on the body $\mathbf{E}$ Examples of different scale shapes on dorsal and ventral sides. Abbreviatons: co caudal organ, cu caudal uniancres, dlu dorsolateral uniancre, du dorsal uniancre, ep epidermal gland, lu lateral uniancre, ou oral unianre, ro rosette organ, TbA anterior adhesive tube, TbP posterior adhesive tubes, TbVl ventrolateral adhesive tubes, te testis.

Etymology. Named after the region of origin, referring to the Caribbean (Latin adjectival ending: ensis, caribbeanensis).

Description. The description is based on the holotype (adult, $625 \mu \mathrm{~m}$ long), with ranges given from specimens measured in vivo. Body strap-shaped and 425-625 $\mu \mathrm{m}$ long (Fig. 1A). Mouth region narrow; body inflates at U04, narrows again at U08, and widens toward the trunk. Widths of mouth at U04/pharynx region at U08/PIJ at U36/trunk at U50/caudal base at U92 are 30/67/105/125/20 $\mu \mathrm{m}$. Pharynx 238


Figure 3. Acanthodasys caribbeanensis sp. n. from Carrie Bow Cay, Belize (A, B) and Bocas del Toro, Panama (C) A Closeup of dorsal cuticle showing dorsal uniancres, dorsolateral uniancres and spineless dorsal scales B Closeup of dorsal uiancres C Paratype (Cat. No. USNM 1145899) of Panamanian specimen showing the rosette organ (gland). Abbreviations: du dorsal uniancres, ep epidermal gland, lu lateral uniancre, ro rosette organ, TbVL ventrolateral adhesive tubes.
$\mu \mathrm{m}$ long with pharyngeal pores at U32. Dorsal rim of oral hood, ca. $10 \mu \mathrm{~m}$ wide, free of cuticular spines and fringed with numerous mobile cilia and few stiff sensory hairs to $10 \mu \mathrm{~m}$ long. Epidermal glands to $18 \mu \mathrm{~m}$ diameter and to 10 per side. Ventral locomotory cilia present as a complete field beginning at ca. U08 and extending to the caudum (Fig. 2B).

Cuticular armature. Cuticular spines evident at low magnification and arranged around the periphery of the head, along the trunk and on the caudal lobes (Figs 1, 2). Spined- and spineless scales present. Approximately 10-12 oral uniancres line the dorsal periphery of the head behind the "naked" region of the oral hood (Fig. 1B). Uninacres slightly staggered in position; uniancres increase in size from medial position (10 $\mu \mathrm{m}$ long) to a lateral position along head (U06, $23 \mu \mathrm{~m}$ long). Uniancres in lateral and dorsolateral positions continue along the trunk as individual columns. The trunk contains a total of five columns of uniancres: one dorsal, two dorsolateral, and two lateral columns (Figs 1A, 2A). Sixteen uniancres in dorsal column begin at U08 and extend to U80, increasing in size from $20-50 \mu \mathrm{~m}$ long down the length of the body, and with a slight bend or posterior curvature at the apex (Fig. 3B). Dorsolateral columns of ca. 14-16 spines that increase in length along the trunk, from 17-35 $\mu \mathrm{m}$ long and with a slight posterior curvature or distinguishable bend (Fig. 2D); column ends at U85. Lateral columns of 23-26 spines that increase in length along the trunk, from 20-35 $\mu \mathrm{m}$, and mostly with a straight shape but oriented in a slight posterior direction; column ends at U87. Five small uniancres present on each caudal lobe, $8-20 \mu \mathrm{~m}$ long, in somewhat dorsolateral position (Fig. 1C). Cuticle between uniancres present as spineless scales. Scales of various shape; most dorsal scales have an obtuse triangular shape with the apex pointed posteriorly; some ventral scales same shape as dorsal scales; others of varying shapes (Figs 1B, 2E, 3A). Center of each scale with a triangular or eye-shaped depression. Scales ca. $15 \mu \mathrm{~m}$ wide and arranged in 5 columns on dorsal surface; ventral surface also with scales but the number of columns was undetermined.

Adhesive tubes. Anterior adhesive tubes ( TbA ), 8 per side to $12 \mu \mathrm{~m}$ long, distributed along the mouth margin in a single row (Fig. 2B,C). TbL are absent. TbVL arranged in bilateral columns, to $23 \mu \mathrm{~m}$ long, begin at PIJ and extend posteriorly on to the lateral edge of the caudal lobes; tubes on caudal lobe edges each ca. $15 \mu \mathrm{~m}$ long (Fig. 2B). TbP distributed on caudal lobes as two terminal tubes to $16 \mu \mathrm{~m}$ long and two medial tubes on the inner edge of the caudal lobes to $12 \mu \mathrm{~m}$ long.

Digestive tract. Mouth terminal to $30 \mu \mathrm{~m}$ wide. Pharynx to $238 \mu \mathrm{~m}$ long with pharyngeal pores at base around U32. Intestine narrow and tapering toward posterior end. Anus at U88.

Reproductive system. Hermaphroditic, with paired testes at PIJ. Vasa deferentia extend posteriorly, but their point of termination was not observed. Glandular caudal organ, ca. $30 \mu \mathrm{~m}$ long, at U90 (Fig. 2A). Rosette organ, ca. $27 \mu \mathrm{~m}$ diameter, present at U42 on left, dorsolateral surface. Glands of the rosette organ stain intensely with $\mathrm{OsO}_{4}$ (Fig. 3C). Single egg present, ca. $57 \mu \mathrm{~m} \times 100 \mu \mathrm{~m}$ (Fig. 1C).

## Taxonomic remarks

At present, there are eight valid species of Acanthodasys described globally: Acanthodasys aculeatus Remane, 1927; A. algarvensis Hummon, 2008 (see Hummon and Todaro 2010); A. arcassonensis Kisielewski, 1987; A. carolinensis Hummon, 2008; A. fibro-
sus Clausen, 2004; A. flabellicaudus Hummon \& Todaro, 2009; A. lineatus Clausen, 2000; and A. silvulus Evans, 1992. Five species mentioned by Ruppert (1978) are not described and considered nomina nuda (Kisielewski 1987; Hummon 2008). Among described species, $A$. aculeatus, the type species, has the widest geographic distribution with conspecifics reported from the coasts of Europe (Kisielewski 1987) and the Mediterranean and Black Seas (reviewed in Todaro et al. 2003) to as far south as the coastlines of India (Naidu and Rao 2004), the Maldive Islands (Gerlack 1961), and the Atlantic coast of Florida, USA (Evans 1992). Hummon (2009) has reported $A$. aculeatus from a variety of other locales. However, to date, no species of Acanthodasys are reported from the Caribbean.

Among the eight described species, only $A$. aculeatus Remane, 1927 and $A$. arcassonensis Kisielewski, 1987 possess spineless scales distributed among their uniacres as found in $A$. caribbeanensis sp. n. However, the new species differs from both described species in several significant ways: the head profile differs between $A$. caribbeanensis sp. n . and $A$. arcassonensis; the uniancres are arranged in distinguishable columns in the new species (Figs 1, 2); the uniancres are larger in A. caribbeanensis sp. nov (up to 50 $\mu \mathrm{m}$ long) compared to all other species (e.g, A. arcassonensis to $11 \mu \mathrm{~m}$ long; $A$. fiborosus to $20 \mu \mathrm{~m}$ ); the spineless scales are not elliptical in the new species but instead variously shaped; and the new species possesses adhesive tubes in a ventrolateral ( TbVL ) as opposed to a lateral ( TbL ) position. This latter characteristic is noteworthy because the arrangement of TbVL of $A$. carribeanensis sp . n . is more similar to the arrangement observed in species of Diplodasys, the sister taxon of Acanthodasys within the Diplodasyinae (Ruppert 1978), than to other species of Acanthodasys (e.g., compare to A. Alabellicaudus Hummon \& Todaro, 2009 and D. sanctimariae Hummon \& Todaro, 2009).

Interestingly, there are several aspects of the cuticle of $A$. caribbeanensis sp. n . that appear unique and worth further mentioning. First, the uniancres of the new species are the largest described spines (see Fig 1A; up to $50 \mu \mathrm{~m}$ long on an adult specimen $625 \mu \mathrm{~m}$ long) in the genus and the largest spines known from any species of Macrodasyida. Second, the spineless scales of $A$. caribbeanensis sp. n. are more similar in appearance to the spineless scales of species of Diplodasys than they are to the scales descibed for other species of Acanthodasys. For example, the scales of D. minor Remane, 1936 have a similar shape to those of A. caribbeanensis sp. n., and several species have scales with a wide depressed region in their center like the scales of $A$. caribbeanensis (e.g., see D. ankeli ssp. pacifica Schmidt, 1974; comparison of species' scales in Kisielewski 1987). Note, however, that the scales of $A$. caribbeanensis sp. n. appear to lack any obvious ribbing or texture (Fig. 3A) that often characterizes the scales of species of Diplodasys.

Another peculiar feature of Acanthodasys caribbeanensis sp. n. is the relatively wide size distribution of reproductive adults. We found specimens ranging from $325 \mu \mathrm{~m}$ long in Panama to $625 \mu \mathrm{~m}$ long in Belize, and all specimens showed clear evidence of reproductive maturity i.e., paired testes and/or a solitary rosette organ were present (Fig. 3C). According to Ruppert (1978), the rosette organ is a glandular ring around the female gonopore, but whether it is present in specimens prior to the maturation
of female gametes is not mentioned. According to our surveys, specimens of $A$. caribbeanensis sp. n. may have a rosette organ but no obvious ova or testes. As evidence, we have prepared a paratype (Cat. No. USNM 1145898) of a smaller adult specimen, ca. $400 \mu \mathrm{~m}$ long (slightly curled), with a clear rosette organ but without evidence of eggs or testes. Unfortunately, the rosette organ can be difficult to see in live specimens, but becomes apparent if animals are fixed briefly in $\mathrm{OsO}_{4}$ (see methods); the $\mathrm{OsO}_{4}$ greatly enhances the contrast of many tissues including the epidermal glands (see Fig. 3C).

## Acknowledgements

We thank Dr. M. Antonio Todaro and two anonymous reviewers for their helpful comments on this manuscript. The first author thanks Dr. Jon Norenburg (Smithsonian Institution) for inviting him to participate in the sampling conducted on Carrie Bow Cay, Belize. Both authors also thank Dr. Norenburg and Dr. Rachel Collins (Smithsonian Tropical Research Institute) for their invitation to participate in the Meiofauna Workshop at STRI. Thanks are also extended to Daniel Gouge, Cheryl Thacker and Katrine Woorsae for their assistance with SCUBA collection of samples. This material is based upon work supported by the National Science Foundation under Grant No. DEB 0918499 . This research received partial support from a Marine Science Network award to Jon Norenburg and an award from the Encyclopedia of Life Biodiversity Synthesis Group to Rachel Collin and Jon Norenburg.

## References

Clausen C (2000) Gastrotricha Macrodasyida from the Tromso region, northern Norway. Sarsia 85: 357-384.
Clausen C (2004) A new species of Acanthodasys (Gastrotricha: Thaumastodermatidae) from the west coast of Norway. Sarsia 89: 137-141.
Decho AW, Hummon WD, Fleeger JW (1985) Meiofauna - Sediment interactions around tropical seagrass sediments using factor analysis. Journal of Marine Research 43: 237-255.
Evans WA (1992) Five new species of marine Gastrotricha from the Atlantic coast of Florida. Bulletin of Marine Science 51: 315-328.
Evans WA (1994) Morphological variability in warm-temperate and subtropical populations of Macrodasys (Gastrotricha: Macrodasyida: Macrodasyidae) with description of seven new species. Proceedings of the Biological Society of Washington 107: 239-255.
Evans WA, Hummon WD (1991) A new genus and species of Gastrotricha from the Atlantic coast of Florida, U.S.A. Transactions of the American Microscopical Society 110: 321-327.
Gerlach SA (1961) Über Gastrotrichen aus dem Meeressand der Malediven (Indischer Ozean). Zoologischer Anzeiger 167: 471-475.
Hochberg R (2008) Gastrotricha of Bocas del Toro, Panama: A preliminary report. Meiofauna Marina 16: 101-107.

Hummon WD (1974) Intertidal marine Gastrotricha from Colombia. Bulletin of Marine Science 24: 396-408.
Hummon WD (2008) Gastrotricha of the North Atlantic Ocean: 1. Twenty four new and two redescribed species of Macrodasyida. Meiofauna Marina 16: 117-174.
Hummon WD (2009) Global database for marine Gastrotricha (Taxonomic, Geographic, Bibliographic and Video). [http://132.235.243.28] or [http://hummon-nas.biosci.ohiou.edu].
Hummon WD (2010) Marine Gastrotricha of the Caribbean Sea: A review and new descriptions. Bulletin of Marine Science 86: 661-708.
Hummon WD, Todaro MA (2007) A new species of Xenotrichulidae (Gastrotricha) from southern and southeastern USA. Cahiers de Biologie Marine 48: 297-302.
Hummon WD, Todaro MA (2009) Italian marine Gastrotricha: VI. Seven new species of Macrodasyida. Zootaxa 2278: 47-68.
Hummon WD, Todaro MA (2010) Analytic taxonomy and notes on marine, brackish-water and estuarine Gastrotricha. Zootaxa 2392: 1-32.
Kisielewski J (1984) Xenotrichula guadelupense sp. n., a new marine gastrotrich from Guadeloupe. Bulletin du Museum D'Histoire Naturelle, Paris 6A(1): 37-40.
Kisielewski J (1987) New records of marine Gastrotricha from the French coasts of Manche and Atlantic I. Macrodasyida, with descriptions of seven new species. Bulletin du Museum D'Histoire Naturelle, Paris 9: 837-877.
Naidu KV, Rao GC (2004) The Fauna of India and the Adjacent Countries-Gastrotricha. Director, Zoological Survey of India, Kolkata, 169 pp.
Remane A (1927) Neue Gastrotricha Macrodasyoidea. Zoologische Jahrbuecher Abteilung fuer Systematik Oekologie und Geographie der Tiere 54: 203-242.
Remane A (1936) Gastrotricha. In: Bronns HG (Ed) Klassen Ordnungen des Tierreichs, Band 4, Abteilung II, Buch I, Teil 2, Liefrungen 1-2. Akademie Verlagsgesellschaft, Berlin.
Renaud-Debyser J (1963) Recherches écologiques sur la faune interstitielle des sables: Bassin d'Arcachon et île de Bimini, Bahamas. Vie Milieu Supplement $15: 1-157$.
Ruppert EE (1978) The reproductive system of gastrotrichs. III. Genital organs of Thaumastodermatinae subfam. n. and Diplodasyinae subfam. n. with discussion of reproduction in Macrodasyida. Zoologica Scripta 7: 93-114.
Schmidt P (1974) Interstitielle Fauna von Galapagos. IV. Gastrotricha. Mikrofauna des Meeresbodens 26: 1-76.
Schoepfer-Sterrer C (1974) Five new species of Urodasys and remarks on the terminology of the genital organs in Macrodasyids (Gastrotricha). Cahiers de Biologie Marine 15: 229-259.
Thane-Fenchel A (1970) Interstitial gastrotrichs in some south Florida beaches. Ophelia 7: 113-137.
Todaro MA (1994) Chaetonotus triacanthus and Heteroxenotrichula texana, two new chaetonotid gastrotrichs from the Gulf of Mexico. Transactions of the American Microscopical Society 113: 15-21.
Todaro MA, Matinato L, Balsamo M, Tongiorgi P (2003) Faunistics and zoogeographical overview of the Mediterranean and Black Sea marine Gastrotricha. Biogeographia 24: 131-160.
Todaro MA, Fleeger JW, Hummon WD (1995) Marine gastrotrichs from the sand beaches of the northern Gulf of Mexico: Species list and distribution. Hydrobiologia 310: 107-117.

# The genus Nelcyndana Stål (Hemiptera, Cicadidae, Taphurini) with description of three new species from Borneo 

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#### Abstract

The type species of Nelcyndana, Nelcyndana tener (Stål, 1870) from the Philippines, is redescribed and illustrated. The taxonomic position of the genus Nelcyndana in the tribe Taphurini is discussed. Three new species from Borneo are described and illustrated: Nelcyndana borneensis sp. n., N. vantoli sp. n., and $N$. mulu sp. n. Distributions maps for the three Borneo species are presented and a key for the identification of the four Asian species of the genus is provided.


## Keywords

Nelcyndana, Taphurini, Cicadidae, taxonomy, new species, Borneo

## Introduction

The genus Nelcyndana was described by Stål (1870) as the new subgenus Nelcynda of the genus Tibicen Latreille, 1825. The new subgenus was erected for Nelcynda tener, a species from the Philippines also described by Stål in the same paper. In 1905, Distant elevated Nelcynda to genus rank and added a new species, $N$. madagascariensis, to the genus. The new name Nelcyndana was proposed by Distant (1906) since Nelcynda Stål proved to be preoccupied by Nelcynda Walker, 1862 used in Lepidoptera.

[^1]In his classic work "Cicadas of Malaysia", Moulton (1923) assigned to N. tener the distinction of being the smallest cicada of the Malaysian region (Malay Peninsula, Sumatra, Borneo and Java). The expansion of tegmina of males and females of $N$. tener is $25-31 \mathrm{~mm}$ (Stål, 1870), but Moulton (1923) recorded three even smaller specimens from Borneo with an expansion of $20-25 \mathrm{~mm}$. The Borneo specimens differed from $N$. tener in the relative width of head and pronotum, but in spite of this, Moulton (l.c.) regarded these specimens inseparable from $N$. tener. Nelcyndana is separated from the other genera of the tribe Taphurini from Sundaland (Malayan Peninsula, Sumatra, Borneo and Java) by its small size and the four apical areas in the wings. Other genera of small cicadas in Sundaland of other tribes, like e.g., Muda Distant, 1897, have the normal number of six apical areas in the wings.

In the last two decades, cicada inventories in the Malaysian and Indonesian parts of Borneo and in Peninsular Malaysia have been strongly intensified. Zaidi and coworkers of Universiti Kebangsaan Malaysia recorded N. tener from Sabah and Sarawak, Borneo (Zaidi and Ruslan 1998, Zaidi et al. 2000a, Zaidi et al. 2000b; Zaidi et al. 2004: 131-133, 137) and from Peninsular Malaysia (Zaidi and Ruslan 1997).

This study aims to contribute to a better taxonomic knowledge of the cicadas of Borneo anticipating a larger publication on the Bornean cicada fauna. The descriptions of the three new species of Nelcyndana from Borneo presented here are preceded by a discussion on the taxonomic position of the genus and a description of Nelcyndana tener from the Philippines, the type species of the genus. Several more undescribed species of Nelcyndana are awaiting description until more material comes available viz., three new species from Borneo, one from the Malay Peninsula and two from the Philippines.

## Material and methods

The institutions listed below are the depositories of the material studied. The abbreviations have been used in the lists of material and throughout the text.
BMNH Natural History Museum, London (former British Museum (Natural History))
NHRS Naturhistoriska Riksmuseet, Stockholm
NMWC National Museum of Wales, Cardiff
RMNH Nationaal Natuurhistorisch Museum (former Rijksmuseum voor Natuurlijke Historie), Leiden
ROM Royal Ontario Museum, Toronto
ZMAN Zoölogisch Museum, Universiteit van Amsterdam, Amsterdam
Data on the distribution of the species were derived from the author's "Biodiversity Database of the Cicadas of South East Asia and the West Pacific", and plotted on maps of ADC-Worldmap version 2.0 vol. 4 Southern Asia \& Australia with the program MapInfo for Power Mac, version 4.03. The localities and other data from the specimen
labels in the database are filed in the program File-Maker Pro 4.0. The information about geographical co-ordinates has been retrieved from the following sources: "Atlas van Tropisch Nederland" (Anonymous 1938), "The Times Comprehensive Atlas of the World" (Anonymous 1999), and the GEOnet Names Server of the U.S. Defense Mapping Agency (http://www.nima.mil/gns/html/index.html).

The terminology adopted in this paper for external features of the body and the male genitalia follows that of Duffels (Duffels 1977, 1983; Duffels and Turner 2002) and Moulds (2003, 2005).

## Taxonomy

The genus Nelcyndana was traditionally placed in the tribe Taphurini (Metcalf, 1963; Duffels and Van der Laan 1985; Chou et al. 1997; Moulds 2005). Lee (2010) recently transferred Nelcyndana to the tribe Cicadettini. According to Lee (l.c.), Nelcyndana '..... is allied to Cicadetta Amyot, the type genus of the Cicadettini, considering the similarities in the male genitalia, especially the presence of a well-developed median lobe on the uncus'. Lee did not cite the publication of Moulds (2005) on the higher classification of cicadas. According to Moulds (l.c.) Cicadetiini can be separated from Taphurini by the presence of a pair of pseudoparameres branching off from the theca, the duck-bill shaped, very broad and flat uncus and the ventral rib of the aedeagus which is completely fused with the basal plate. In Taphurini the theca has no pseudoparameres, the uncus is absent and the ventral rib of the aedeagus is rod-like and suspended with attachments only at ends (Moulds 2005). The present study demonstrates that Nelcyndana has no thecal pseudoparameres but either one strong, chitinized appendage, apically divided in two stems, or a pair of more or less similar appendages, and a ventral rib of the aedeagus which is rod-like and suspended with attachments only at ends, which are both characters of the tribe Taphurini. Nelcyndana has no well-developed median uncus lobe as stated by Lee (2010). The uncus is absent, basal parts of the claspers extend to the basis of the anal lobe. The absence of the uncus is another character of the tribe Taphurini. This all means that Nelcyndana belongs to the tribe Taphurini.

## Nelcyndana Distant, 1906

Tibicen (Nelcynda) Stål, 1870: 716
Nelcynda; Distant 1905: 35
Nelcyndana Distant 1906: 130 (nom. nov. pro Tibicen (Nelcynda) Stål [nec Nelcynda Walker 1862], Moulton 1923: 156, 157, 166; Metcalf 1963: 233-234; Duffels \& Van der Laan 1985: 245; Chou et al. 1997: 80, 86; Moulds 2005: 393, 437; Lee 2010: 14, 26. [For further references before 1980 see: Metcalf 1963 and Duffels \& Van der Laan 1985].

Type species: Tibicen (Nelcynda) tener Stål 1870 by monotypy.
Diagnosis. Small cicadas: body length male: $8.1-11.7 \mathrm{~mm}$, female: $9.0-12.4 \mathrm{~mm}$. Head slightly wider than pronotum collar. Vertex black, or reddish brown with a pair of paramedian, squarish, black markings or a pair of spots next to the paired ocelli. Postclypeus protruding weakly to fairly strongly with glabrous nose. Rostrum reaching beyond posterior margin of middle coxae or to anterior margin of hind coxae or beyond. Pronotum slightly wider than mesonotum. Mesonotum with a pair of paramedian, juxtaposed, black, obconical spots and a pair of black to black-brown lateral sigillae. Fore femora with four spines along lower ridge. Tegmina and wings hyaline, wings with four apical areas. Male operculum sickle-shaped and with adjacent setae, margins and apical third with long setae. Timbal with 6-7 ribs and faint intercalary ribs. Pygofer with about equitriangular dorsal beak with long and narrow apex; basal pygofer lobes very long reaching either to about apex of anal segment; upper pygofer lobes mostly distinctly separated from, but sometimes fused with, basal pygofer lobes. Uncus absent. Claspers juxtaposed and different in shape. Theca either with one strong, chitinized appendage, apically divided in two stems, or a pair of more or less similar appendages. Aedeagal basal plates in ventral view triangular to oval. Ventral rib of aedeagal basal plate rod-like and suspended with attachments only at ends.

## Key to the males of Nelcyndana

1. Anterior and ventral parts of postclypeus yellowish to reddish brown. Philippines
N. tener

- Anterior and ventral parts of postclypeus black with either a yellowish to reddish brown glabrous nose or an oblong area of the same colour reaching from nose toward clypeal suture. Borneo 2

2. Head width: $3.8-4.0 \mathrm{~mm}$. Abdominal tergite 2 with a black transverse fascia along anterior margin, a reddish brown fascia at about half-length and a yellow-brown fascia along posterior margin. Borneo N. mulu

- Head width: 2.8-3.3 mm. Abdominal tergite 2 black with a pair of paramedian yellow-brown spots at posterior margin. Borneo 3

3. Male genitalia as in fig. 6 ....................................................... N. borneensis

- Male genitalia as in fig. 9.............................................................N. vantoli


## Nelcyndana tener (Stål, 1870)

Figs 1-2
Tibicen (Nelcynda) tener Stål 1870: 716. Lectotype ở: "Ins. / Philipp", "Semper", "Tibicen / tener / ơ Stål", "Typus" [printed in black cadre; red paper], "NHRSHEMI 000000009" [examined].
Tibicen tener; Distant 1890: Pl. vi, figs 5, 5a-b; Distant 1892: 130.
Nelcyndana tener; Distant 1906: 139 (Equals Tibicen (Nelcynda) tener Stål); Moulton 1923: 157; Metcalf 1963: 234-235; Duffels \& Van der Laan 1985: 245; Lee 2010:


Figures I-2. Nelcyndana tener, male lectotype. I pygofer in ventral view $\mathbf{2}$ appendage of theca. at appendage of theca; $\mathbf{c l}$ clasper; $\mathbf{d b}$ dorsal beak; $\mathbf{I c l}$ lateral clasper lobe.

14, 26 [For further references before 1980 see: Metcalf 1963 and Duffels \& Van der Laan 1985].
Not: Nelcyndana tener; Zaidi and Ruslan 1997: 232 [The specimen mentioned here from Pahang, Rompin probably belongs to a new undescribed species endemic to the Malayan Peninsula]; Zaidi and Ruslan 1998: 369; Zaidi et al. 2000b: 217; Zaidi et al. 2000a: 331; Zaidi et al. 2004: 131-133, 137. [The specimens mentioned in these publications come from Borneo (Sabah and Sarawak), and belong to one of the species from Borneo described here as new to science or to another new species.]

General. The identity of Nelcyndana tener is established by the description given below. I have tried to find more specimens of Nelcyndana tener in various collections, but did not find one.

Nelcyndana tener can be distinguished from the other species of the genus from Borneo described here by the yellowish to reddish brown anterior and ventral parts of the postclypeus and the unpaired appendage of the theca. The Borneo species have a differently coloured postclypeus and a pair of more or less similar thecal appendages.

Lectotype designation for Nelcyndana tener (Stål). Dr Gunvi Lindberg, curator of the Swedish Museum of Natural History, Stockholm, kindly sent me the type specimens of Nelcyndana tener for examination, viz., one male labelled holotype and
two females labelled paratype. She also wrote me: ...' all curators seem to agree that the [type] labels are from the 20th century (thus not from Stål)'. In order to establish the identity of $N$. tener, I designate here the male type specimen as the lectotype of $N$. tener and the female type specimens as paralectotypes.

The lectotype is very fragile and partly damaged: the apical half of the wings is missing and the right tegmen is somewhat glued together; sternite 8 is partly damaged; the abdomen is glued to the head and thorax. The pygofer is taken out for the greater part. It is most likely that this damage to the lectotype was caused by an earlier student attempting to pull out the pygofer. The most characteristic feature of the genus Nelcyndana, viz., the four instead of five apical areas of the wing, already mentioned by Stål (1870) in his original description of the genus and the species, is not visible anymore in the lectotype.

The two paralectotypes are in good condition. One paralectotype bears the following labels: "Ins. / Philipp", "Semper", "Tibicen / tener Stål", "Allotypus" [printed in black cadre; red paper], "NHRS-HEMI 000000010". The other paralectotype bears the labels: "Ins. / Philipp", "Semper", "Tibicen / tener Stål / Q", "Paratypus" [printed in black cadre; red paper], "NHRS-HEMI 000000011"

Description of male lectotype. Ground colour reddish brown.
Head. Vertex reddish brown with a pair of comma-shaped dark brown markings next to paired ocelli, a faint brownish ring around each of the ocelli, and dark brown colouration along mediodistal margin of eye. Postclypeus protruding weakly, yellowish to light reddish brown, dorsally with a pair of lateral dark brown spots, anterior and ventral parts of postclypeus with two paramedian series of 7 dark reddish brown transverse grooves. Anteclypeus light reddish brown without marking. Rostrum yellowish brown with brown apex reaching beyond posterior margin of middle coxae. Lorum black but anterior third reddish brown. Gena light reddish brown with a black line along posterior eye margin. Antenna, supra-antennal plate and vertex lobe yellowish brown to reddish brown.

Thorax. Pronotum with a pair of large, rounded rectangular, dark reddish brown to black brown markings that are enclosed by the reddish brown anterior margin of pronotum, the light reddish brown pronotum collar, and a broad median, light reddish brown fascia that strongly widens to anterior margin of pronotum and to pronotum collar. A lanceolate black-brown marking connects the broadly black-brown anterior and posterior oblique fissures.

Mesonotum with a pair of paramedian, black-brown, obconical spots, those are fused at anterior margin of mesonotum and reach to one fourth of mesonotum disk. Scutal depressions in front of cruciform elevation with light brownish suffusion. Lateral sigillae clouded with dark brown and anteriorly slightly wider than anterior part of paramedian obconical spots, gradually narrow to their distal ends near anterior angles of cruciform elevation. Cruciform elevation yellowish.

Legs. Yellow-brown to brownish. Fore femora with four yellow-brown spines with brown apices: a long spine at proximal end of lower ridge of femur, a second spine, half as long as proximal spine, at half-length of lower ridge, a third spine, one third as
long as proximal spine, at three fifths of lower ridge, and a tiny spine near distal end of lower ridge.

Tegmina and wings. Hyaline. Venation of tegmina and wings brownish to reddish brown variegated with dark brown.

Operculum. Sickle-shaped with narrowly rounded apex reaching to almost anterior margin of abdominal segment 2 , strongly narrowed from base to one fourth of its length, and gradually narrowing from one fourth of length to apex. Apical half with sparse long setae, especially along operculum margins.

Abdomen. Timbal with 7 evenly spaced long ribs and very faint intercalary ribs. Tergite 1 dark reddish brown, tergites 2-7 with a laterally widening, dark reddish brown fascia along anterior margin, medially reaching to half-length or two thirds of tergite, and a laterally narrowing reddish brown fascia; tergite 3 also with a narrow yellowish fascia along posterior margin. Tergite 8 with a laterally narrowing dark reddish brown fascia along anterior segment margin and a laterally narrowing reddish brown fascia, both two fifths as long as tergite and a yellowish fascia along posterior margin, one fifth as high as the tergite. Sternite 2 yellowish, sternites 3 to 6 and anterior half of sternite 7 reddish brown, posterior half of sternite 7 and whole sternite 8 yellowish.

Genitalia (Figs 1-2). Pygofer with convex lateral sides. Dorsal beak about equitriangular, brownish and with somewhat darker brown, fairly long and narrow apex. Basal pygofer lobe long and weakly convex, narrowed to acute apex, that is incurved and reaches to half-length of anal segment. Upper pygofer lobe very short, rounded and widely separated from basal pygofer lobe. Claspers juxtaposed, fairly narrow, incurved; lateral margin distinctly concave at base and weakly convex to narrow and slightly outcurved apex; medial margin very weakly convex; lateral clasper lobes protruding and spherical. Theca with one strongly chitinized appendage (Fig. 2), which is apically divided in a long, curved, dagger-shaped stem with a strong spine at base and a shorter, more widened, dagger ending in an acute spine. Aedeagal basal plates in ventral view triangular.

Description of female paralectotypes. There are two female paralectotypes, one fully coloured and one with obsolete marking. A description of the fully coloured female follows here:

Head. As in male lectotype but anteclypeus black-brown with light brownish anterior margin and keel, and vertex with additional dark brown marking between paired ocelli and eyes.

Thorax. Pronotum as in male lectotype. Mesonotum as in male lectotype but paramedian obconical spots reaching to one third of mesonotum disk and lateral sigillae black-brown.

Legs, tegmina and wings. As in male lectotype.
Operculum. Basal half broad, narrowed at half its length to two thirds of basal width; apical part curved mediad with narrowly rounded apex reaching to just beyond anterior margin of sternite 2.

Abdomen. Tergite 1 light reddish brown. Tergite 2 reddish brown with laterally narrowing, black fascia along anterior margin medially reaching to two fifths of seg-
ment length. Tergites 3-7 with a laterally widening, black fascia along anterior margin, medially reaching to half or three fifths of segment length, a slightly narrower reddish brown fascia at about half-length of tergite and a narrow yellowish green fascia along posterior margin. Tergite 8 with laterally narrowing, black fascia along anterior margin medially reaching to one fourth of segment length, a broad reddish brown fascia and a fairly narrow, yellowish green fascia along posterior margin. Sternite 2 with dark brown transverse marking, sternites 3 to 6 with dark brown transverse band, which is a little less than half as wide as sternite and reaches from anterior sternite margin to two thirds or three fourths of sternite length. Sternite 7 medially dark brown. Segment 9 dorsally with a pair of oblong, paramedian, black-brown markings reaching from anterior margin of segment to three fourths of its length, and laterally with a pair of, round, black-brown spots.

The female paralectotype with the more obsolete marking has no marking on anteclypeus, no additional brown marking on vertex, very light brown lateral sigillae on mesonotum, light reddish brown abdominal tergites with much narrower black marking along their anterior margins, and only small brown median spots on sternites 5 and 6 .

Measurements (in mm; 1 $\widehat{\lambda}, 2 q$ ). -Body length $\delta: 10.2 q: 11.5$; tegmen length $\delta^{\lambda}: 10.9, q: 12.9-13.5$; head width $\delta^{\lambda}: 3.2, q: 3.7-3.8$; pronotum width $\delta^{\lambda}: 3.1, q$ : 3.6-3.7.

Distribution. The type specimens of Nelcyndana tener bear a label with the unspecified locality "Ins. / Philipp". I have tried to find more specimens of this species in various collections, but did not find one. Lee (2010) recorded $N$. tener from Mindanao, Philippines, but this record needs confirmation since several undescribed species of Nelcyndana occur in the Philippines.

## Nelcyndana borneensis Duffels, sp. n.

urn:lsid:zoobank.org:act:EF857435-0490-41F5-B69C-C8A62CA07F93
Figs 3, 5-7
Type material. $24 \circlearrowleft^{\lambda} 23 q$. Holotype $\circlearrowleft^{\lambda}:$ Malaysia: Sabah: "RMNH Leiden E SABAH / Lahad Datu, 60 km W of: / Danum Valley Field Centre / at junction Sg Segama and / Sg Palum Tambun, $150 \mathrm{~m} / 4^{\circ} 58^{\prime N} 117^{\circ} 48^{\prime} \mathrm{E}^{\prime}$, "At light. Bridge of Segama. / 19 Mar 1987, 18.30-21.30. / Clearing, edge of untouched / evergr. lowl. rainforest / leg. Van Tol \& Huisman" (RMNH). Paratypes: Malaysia: Sabah: same data as holotype, 3 ( RMNH ), same data as holotype but: $17 \& 18 . \mathrm{iii} .1987$,
 clearing nr E trail, 21.ii.1987, 18.30-20.30, 1 q (RMNH); 60 km W Lahad Datu, DVFC, nr Segama bridge, $4^{\circ} 58^{\prime} \mathrm{N} 117^{\circ} 43$ 'E, 20.x.1987, 150 m , J. Huisman \& R. de Jong, $1 \circlearrowleft^{\top}(\mathrm{RMNH}) ; 60 \mathrm{~km}$ W of Lahad Datu, road Kg Silam - DVFC, km $68.5,4^{\circ} 58^{\prime} \mathrm{N} 117^{\circ} 48^{\prime} \mathrm{E}, 150 \mathrm{~m}, 24 . i i i .1987$, ML-light, J. Huisman, $1 \delta^{\top}$ (RMNH); Danum Valley, $5^{\circ} 01^{\prime} \mathrm{N} 117^{\circ} 47^{\prime} \mathrm{E}, 10 . \mathrm{ix} .1987,100 \mathrm{~m}$, A.H. Kirk-Spriggs, NMW


Figures 3-4. Nelcyndana spec., male body in dorsal view. $\mathbf{3}$ N. borneensis, paratype, Sarawak, Gunung Mulu, site 74 N . vantoli, holotype.

Sabah (Borneo) Expedition, NMW. Z 1987, 094, light trap sample roadside, secondary forest, $2 \circlearrowleft^{\lambda}$ (NMWC), same data but: 11.ix.1987, $1 \delta^{\top} 2 q$ (NMWC), 14.x.1987, 1 q (NMWC); Danum Valley, $5^{\circ} 01^{\prime} \mathrm{N} 117^{\circ} 47^{\prime} \mathrm{E}$, 30.ix.1987, 200 m , A.H. Kirk-Spriggs, NMW Sabah (Borneo) Expedition, NMW., Z 1987, 094, lowland mixed dipterocarp forest, Grid EZ, light trap sample, understory forest, $1 \sigma^{\AA}$ $2 q$ (NMWC); Danum Valley, 70 km W Lahad Datu, Field Centre, Main Trail West 0 North 5, 150 m, 15.xii.1989, sample Sab. 69, secondary vegetation/canopy/primary forest margin, at light, M.J. \& J.P. Duffels, $1 \delta^{\text {§ }}$ (ZMAN); Bettotan, nr. Sandakan, 17.viii.1927, C.B.K. \& H.M.P. F.M.S. Museums, ex. F.M.S. Museum, B.M. 1955-354, 1 ठ (BMNH), same data but 24.vii.1927, $1 \overbrace{\text { (BMNH); Sungai Dar- }}$ ling, 60 m W Sandakan, 26.xi.1989, sample Sab. 43, secondary forest understorey, at light, M.J. \& J.P. Duffels, 1 Q (ZMAN). Sarawak: Foot of Mt. Dullit, junction of rivers Tinjar \& Lejok, 25.viii.1932, Light trap, Oxford Univ. Exp. B.M. Hobby \& A.W. Moore B.M. 1933-254, 2才 3q (BMNH), same data but 28.viii.1932,
 Mulu Nat. Park, Site 7, Long Pala (Base), 324450, 50 m , Alluvial/secondary forest, Acl-understorey, J.D. Holloway, RGS Mulu exped., B.M. 1978-206, 4 § 4 ¢ (BMNH). Brunei: Temburong District, ridge NE of Kuala Belalong, approx. 300


Figures 5-6. Nelcyndana borneensis. 5 male abdomen in ventral view, paratype, Sarawak, Gunung Mulu, site $\mathbf{7 6}$ male pygofer in ventral view, paratype, Sabah, Danum Valley Field Centre.
m, x.1992, J.H. Martin, 125 W mv light, B.M. 1992-172, 3 § (BMNH), same data but: xi.1992, 1 § (BMNH).

Etymology. This species name refers to its distribution in Borneo.
Description. Ground colour yellowish to greenish brown, and reddish brown. Marking black or black variegated with reddish brown. Dorsal side of body silvery pilose, ventral side with longer silvery setae.

Male. Head (Fig. 3). Vertex black, with exception of a yellow area adjacent to supra-antennal plate and a yellow median triangle against posterior margin of head; in a few specimens the yellow colouration is more extended, leaving only the lateroproximal parts of the vertex black. Postclypeus protruding fairly strongly, black or black variegated with reddish brown, but anteriorly with greenish, glabrous nose, ventrally sometimes with reddish brown oblong marking from nose towards clypeal suture; anterior and ventral parts with 6 pairs of distinct, black transverse ridges, lateral margins of ventral part yellowish brown. Anteclypeus black, often with either basal triangle on medial keel or whole keel reddish brown. Rostrum brown with dark brown apical part reaching beyond anterior margin of hind coxae. Lorum and lateroproximal part of gena black. Antennae, supra-antennal plate and vertex lobe yellowish brown.

Thorax. Pronotum (Fig. 3). A pair of large, rounded rectangular, black markings, sometimes slightly variegated with reddish brown, is enclosed by a narrow, yellowish to greenish fascia along anterior pronotal margin, the pronotum collar of the same col-


Figure 7. Distribution of Nelcyndana borneensis.
our, and a broad median fascia of the same colour that strongly widens to the anterior margin of the pronotum and to the pronotum collar.

Mesonotum (Fig. 3) with a pair of paramedian, black, obconical spots at anterior margin, reaching to one fifth to one third of mesonotum disk; spots either juxtaposed or fused at base. Scutal depressions in front of cruciform elevation covered by often fairly large round, black spots. Lateral sigillae black, anteriorly 1.5 times as broad as anterior part of paramedian obconical spots, narrow a little abruptly at one fourth of its length from base and then gradually narrow to their distal ends. Cruciform elevation yellowish.

Legs. Yellow-brown, fore and middle tarsi and distal part of fore tibia often darker brown. Fore femora with four yellow-brown spines with dark brown apical parts: a long, erect spine at proximal end of lower ridge of femur, a second spine, two-thirds as long as proximal spine, at three-fifths of lower ridge, a third, slightly shorter, spine, at four-fifths of lower ridge and a very short, triangular spine near distal end of lower ridge.

Tegmina and wings. Hyaline. Venation of tegmina and wings yellowish to reddish brown.

Operculum (Fig. 5). Sickle-shaped with rounded apex reaching to either two-thirds or three-fourths of timbal cavity or to almost anterior margin of abdominal segment 2 , strongly narrowed from base to one fourth of its length, about equally wide in apical three fourths. Surface of operculum with short to fairly long, adjacent setae and apical one third with very long setae especially along margins of operculum.

Abdomen (Figs 3, 5). Timbal with 6 somewhat irregular evenly spaced long ribs and very faint intercalary ribs. Tergite 1 black or black-brown, tergite 2 black with a pair of paramedian yellow-brown spots at posterior margin, tergites $3-8$ with a laterally widening, black fascia along anterior margin medially reaching to one third or two thirds of segment length, a laterally narrowing reddish brown fascia at about halflength of tergite and a laterally narrowing yellowish green fascia along posterior margin. Sternite 2 brownish black, sternites 3 to 7 black to black-brown but sternites 3 to 6 yellowish along posterior margin, sternite 8 castaneous.

Genitalia (Fig. 6). Pygofer with more or less parallel lateral sides. Dorsal beak fairly long, slightly upcurved, yellowish brown, with black apex. Basal pygofer lobe very long, straight and narrow, apically outcurved and reaching about apex of anal segment. Upper pygofer lobes in ventral view hidden behind the basal lobes adjacent to basal pygofer lobe, narrowly rounded apically and about one fifth as long as apical part of basal lobe measured from base of upper pygofer lobe to its apex. Dorsal beak in dorsal view about an equilateral triangle with nipple-shaped apex. Clasper with basal two thirds about oval, and apical one third with a quadrangular median angle and an apically rounded lateral flap with a short spine at ventral margin. Theca chitinized, apically with a pair of long and slender, apically acute and curved, appendages. Aedeagal basal plates in ventral view triangular with strongly elongated anterior angles.

Female. Head as in male, but postclypeus reddish brown from nose to anterior margin of pronotum; vertex reddish brown with exception of the black lateroproximal parts that more or less enclose the paired ocelli; a black spot is attached to proximal side of median ocellus.

Thorax. Pronotum. Rectangular markings as described for males are not black but reddish brown with broad black marking in the oblique fissures and narrow black marking in lateral part of ambient fissure. Mesonotum as in males.

Legs, tegmina and wings as in males.
Operculum. Basal half broad, narrowed at half its length to two thirds of basal width; apical part curved mediad, medial margin weakly concave, and lateral margin convex to narrowly rounded apex, reaching to anterior margin or one third of sternite 2 .

Abdomen. Tergites 2-7 with a laterally widening, black fascia along anterior margin medially reaching to one third or two thirds of segment length, a laterally narrowing, reddish brown fascia at about half-length of tergite and a laterally narrowing yellowish, green fascia along posterior margin. Tergite 8 with narrow black fascia and broader reddish brown and yellowish fasciae. Sternite 2 medially black-brown, sternites 3 to 6 with brown-black transverse band, which is one third to half as wide as sternite and reaches from anterior sternite margin to two-thirds of sternite or at most almost to its posterior margin. Segment 9 with a pair of oblong, paramedian, brown to black-brown markings and a pair of round, lateral, brown spots and brownish colouration along basal two-thirds of lower margin.

Measurements (in mm; 6 ${ }^{\lambda}, 6$ ). Body length $\delta^{\lambda}: 8.1-9.2 q: 9.0-10.3$; tegmen length $\widehat{\sigma}^{7}: 8.7-10.2, ~ ㅇ: 10.0-11.8$; head width $\delta^{\lambda}: 2.8-3.2$, $q: 2.9-3.7$; pronotum width $\delta^{\top}: 2.5-2.9, \uparrow: 2.8-3.4$.

Distribution (Fig. 7). Nelcyndana borneensis is known from various places in Borneo (Sarawak, Sabah, Kalimantan and Brunei) and is probably a Borneo endemic.

## Nelcyndana vantoli Duffels, sp. n.

urn:lsid:zoobank.org:act:0C398A2C-6009-4673-B3BF-49F072AEBB64
Figs 4, 8-10
Type material. $2{ }^{\top}$. Holotype ${ }^{\top}$ : Malaysia: Sabah: "RMNH Leiden E SABAH / Lahad Datu, 60 km W of: / Danum Valley Field Centre / at junction Sg Segama and / Sg Palum Tambun, $150 \mathrm{~m} / 4^{\circ} 58^{\prime \prime} \mathrm{N} 117^{\circ} 48^{\prime} \mathrm{E}^{\prime}$, "At light. Bridge of Segama. / 26 Mar 1987, 18.30-21.30. / Clearing, edge of untouched / evergr. lowl. rainforest / leg. Van Tol \& Huisman" (RMNH). Paratype: Indonesia: Kalimantan Timur: Long Tua, edge of Bahau River, $3^{\circ} 10^{\prime} \mathrm{N} 115^{\circ} 47^{\prime} \mathrm{E}, 440 \mathrm{~m}, 5-9 . i v .1994$, UV light, B. Hubley \& D.C. Darling, IIS 940526, $1 \delta^{\hbar}$ (ROM).

Etymology. This species is dedicated to my colleague and friend Dr Jan Tol, odonatologist of the Leiden museum, for his significant contribution to our knowledge of the cicadas of Borneo.

Description of male holotype. Ground colour yellowish to reddish brown. Marking black or black variegated with reddish brown. Ventral side of body with short silvery setae.

Head (Fig. 4). Vertex reddish brown with a pair of paramedian, squarish, black markings, separated by a median reddish brown triangle at posterior margin of head and reaching from posterior margin of head to two thirds of vertex length beyond the paired ocelli. Frons black-brown. Postclypeus protruding fairly weakly, black variegated with reddish brown, medial part reddish brown from its glabrous nose ventrally to clypeal suture and dorsally to frontoclypeal suture; anterior and ventral parts of postclypeus black with 6 pairs of distinct, black transverse ridges, lateral margins of ventral part yellowish brown. Anteclypeus medially reddish brown, with dark brown mark at two thirds of keel, and turning to dark brown laterad. Rostrum brown with dark brown apical part reaching anterior margin of hind coxae. Lorum black with exception of brownish anterior angle. Gena black but brownish around antenna. Antennae, supra-antennal plate and vertex lobe yellowish to reddish brown.

Thorax. Pronotum (Fig. 4). A pair of large, rounded rectangular, black markings, sometimes slightly variegated with reddish brown, is enclosed by a narrow, yellowish to greenish fascia along anterior pronotal margin, the pronotum collar of the same colour, and a broad median fascia of the same colour that strongly widens to the anterior margin of the pronotum and to the pronotum collar.

Mesonotum (Fig. 4) with a pair of paramedian, juxtaposed, black, obconical spots at anterior margin, reaching to one fourth of mesonotum disk. Scutal depressions in front of cruciform elevation covered with small round, brown spots. Lateral sigillae mainly black, anteriorly 1.5 times as broad as anterior part of paramedian obconical spots, gradually narrow from base to distal end; basomedial part of sigillae variegated with the ground colour. Cruciform elevation yellowish.


Figure 8-9. Nelcyndana vantoli, holotype. 8 male abdomen in ventral view 9 male pygofer in ventral view.

Legs. Yellow-brown to greenish. Fore femora with four reddish brown spines: a long spine at proximal end of lower ridge, a second spine, two-thirds as long as proximal spine, at two thirds of lower ridge, a third spine, half as long as proximal spine at four fifths and a very short, triangular spine near distal end of lower ridge.

Tegmina and wings. Hyaline. Costa and basal half of radius + subcosta of tegmen reddish brown, radius anterior and distal half of subcosta reddish to dark brown. Remaining venation of tegmina and wings light to dark brown.

Operculum (Fig. 8). Sickle-shaped with rounded apex reaching to three-fourths of timbal cavity, strongly narrowed from base to one fourth of its length, about equally wide in apical three fourths. Surface of operculum with sparse, adjacent setae and apical one third with very long setae especially along margins of operculum.

Abdomen (Figs $4 \& 8$ ). Timbal with 6 somewhat irregular evenly spaced long ribs and faint intercalary ribs. Tergite 1 black-brown, tergite 2 dark brown to black with a pair of paramedian, transverse, reddish brown markings close to posterior margin, tergites 3-8 with a laterally widening, dark brown to black fascia along anterior margin medially reaching to half or two thirds of segment length, a laterally narrowing reddish brown fascia at about half-length of tergite and a narrow yellowish fascia along posterior margin. Sternite 2 brownish black, sternites 3-5 brownish black from anterior sternite margin to about three fourths of sternite length but with lateral reddish stripes, posterior margin yellowish; sternites 6-7 brownish black, sternite 8 light brown.


Figure 10. Distribution of Nelcyndana vantoli.

Genitalia (Fig. 9). Pygofer with convex lateral sides. Dorsal beak about equitriangular, reddish, with long and narrow, brown apex. Basal pygofer lobe long and convex, and reaching just beyond apex of anal segment. Upper pygofer lobe fused with basal pygofer lobe, narrowly rounded apically and about one fifth as long as apical part of basal lobe measured from base of upper pygofer lobe to its apex. Clasper basally round and flat with a medial, long and narrow, slightly flattened, incurved spine, a shorter slightly curved lateral spine and a round protrusion at its proximal margin; medial spines of both claspers juxtaposed and of unequal length. Theca chitinized, apically with a long and fairly slender, curved chitinized appendage, and a somewhat shorter and thinner appendage; the broadest appendage with very thin spine arising from its base. Aedeagal basal plates in ventral view divided in rounded, oval lobes.

Measurements (in mm; 2 ${ }^{\widehat{ }}$ ). Body length 10.4-10.7; tegmen length 10.8-12.0; head width 3.2-3.3; pronotum width 2.9-3.1.

Remark on paratype. The paratype from Kalimantan Timur is alike to the holotype in the male genitalia, but the marking on the body is more extended and black instead of black-brown. The head is black with exception of the medial triangle at posterior margin of head, the nose of the postclypeus and the supra-antennal plates, which are reddish brown. The pronotum has a pair of black squarish markings, the mesonotum is entirely black, and the abdomen has a similar marking as the holotype, but the marking is black instead of brownish black.

Distribution (Fig. 10). Nelcyndana vantoli seems to have a restricted range in northeastern Borneo. It is known from a specimen from Danum Valley N.P. in northeastern Sabah and a specimen from Long Tua in the northeastern part of Kalimantan Timur.

## Nelcyndana mulu Duffels, sp. n.

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Figs 11-14

Type material. Holotype ${ }^{\top}$ : Malaysia, Borneo: Sarawak: "SARAWAK / Gunong Mulu / Nat. Park", "Site 23, April / W. Melinau Gorge / 250 m. 430558", "J.D. Holloway / RGS Mulu exped. / B.M. 1978-206", "FEG 4. Limestone / forest. MV - / canopy/understorey" (BMNH). Paratypes: Malaysia, Borneo, Sarawak: same data as holotype, $4 \circlearrowleft^{\Uparrow} 3 ?$ (BMNH).

Etymology. This species name refers to its occurrence in Gunung Mulu National Park, Sarawak, Borneo.

Diagnosis. $N$. mulu is distinctly larger than $N$. borneensis and N. vantoli (head width ${ }^{1}$ : $N$. mulu: $3.8-4.0 \mathrm{~mm}$; $N$. borneensis: $2.8-3.2 \mathrm{~mm}$ and $N$. vantoli 3.2-3.3 $\mathrm{mm})$. The males of $N$. mulu can also be separated from the other two species by the colour of the male abdominal segment 2 . The anterior one third of male abdominal segment 2 is black in $N$. mulu, while the whole segment is black in $N$. borneensis and N. vantoli.

Description. Ground colour and pilosity as in $N$. borneensis.
Male. Head (Fig. 11). Vertex reddish brown with exception of a pair of paramedian, squarish, black markings between paired ocelli and posterior margin of head. Postclypeus fairly weakly protruding, medially yellowish to light reddish brown from its glabrous nose to frontoclypeal suture and ventrally (almost) to clypeal suture; lateral parts of postclypeus dark reddish brown to blackish with 6 pairs of distinct, black transverse ridges, grooves between ridges sometimes reddish brown, lateral margins of ventral part yellowish brown. Anteclypeus black with reddish brown basal triangle. Rostrum brown with dark brown apical part reaching beyond anterior margin of hind coxae. Posterior two thirds of lorum black, anterior part reddish brown. Gena reddish brown but black along inner margin of eye. Antennae, supra-antennal plate and vertex lobe yellowish to reddish brown.

Thorax. Pronotum (Fig. 11). A pair of large, rounded rectangular, reddish brown markings enclose a variable pattern of black marking; the reddish brown rectangles are enclosed by a narrow, greenish to yellow-brown, fascia along anterior pronotal margin, the pronotum collar of the same colour, and a broad median fascia of the same colour that strongly widens to anterior margin of pronotum and to pronotum collar.

Mesonotum (Fig. 11) with a pair of paramedian, black, obconical spots at anterior margin, reaching to one third to two fifths of mesonotum disk. Scutal depressions in front of cruciform elevation covered by round, black spots. Lateral sigillae black to


Figure II. Nelcyndana mulu, holotype, body in dorsal view.
black-brown or clouded with black to black-brown, anteriorly 1.5 times as broad as anterior part of paramedian fasciae, narrow a little abruptly at one fourth of its length from base and gradually narrow to their distal ends. Cruciform elevation yellowish.

Legs. Yellow-brown, fore tarsi and fore tibia darker brown; inner side of fore femur with dark brown marking. Fore femora with four, fairly stout, black-brown spines with light brown apices: a long and strong spine at proximal end of lower ridge of femur, a distinctly shorter spine at half-length of lower ridge, a somewhat shorter spine at four fifths of lower ridge and a very short, triangular spine near distal end of lower ridge.

Tegmina and wings. Hyaline. Venation of tegmina and wings greenish to reddish brown.

Operculum (Fig. 12). As in $N$. borneensis, reaching to three-fourths of timbal cavity or to almost anterior margin of abdominal segment 2 ,

Abdomen (Figs 11-12). Timbal with 6 evenly spaced long ribs and very narrow and faint intercalary ribs. Tergite 1 black or black-brown, tergites 2-8 with a laterally slightly widening, black fascia along anterior margin medially reaching to one third of segment or half-length, a laterally slightly narrowing reddish brown fascia at about half-length of tergite and a yellow-brown fascia along posterior margin. Sternites 2 to 7 for the greater part black-brown but yellow-brown along posterior margins; sternite 8 yellow-brown.


Figures 12-13. Nelcyndana mulu, holotype $\mathbf{1 2}$ male abdomen in ventral view $\mathbf{1 3}$ male pygofer in ventral view.

Genitalia (Fig. 13). Pygofer with convex lateral sides. Dorsal beak about equitriangular, slightly upcurved and yellowish brown with long and narrow, black-brown apex. Basal pygofer lobe long and convex, apically flattened and reaching about apex of anal segment. Upper pygofer lobe narrowly separated from basal pygofer lobe and two thirds as long as apical part of basal lobe measured from base of upper pygofer lobe to its apex. Claspers juxtaposed, narrow, incurved and narrowing to acute apex and with laterobasal equilateral triangular, protrusions; lateral clasper lobes protruding and rounded. Aedeagus apically slightly upcurved. Apex of theca with two fairly narrow dagger-shaped appendages, and a very thin, long spine and a very thin, short spine. Aedeagal basal plates triangular.

Female. Head. Vertex reddish brown with a black spot laterally of paired ocelli only or with black marking restricted to lateroproximal part of vertex. Postclypeus reddish brown to black, but medially yellowish from nose to frontoclypeal suture or from frontoclypeal suture to (almost) clypeal suture; lateral parts of postclypeus with 7 pairs of brown to black transverse ridges. Anteclypeus and rostrum as in male. Antenna, supra-antennal plate, vertex lobe and gena yellowish to reddish brown. Lorum reddish brown but posterior two thirds of lorum more or less black in two paratypes.

Thorax. Pronotum. As in male, but the rectangular, reddish brown markings do not enclose any black marking.


Figure 14. Distribution of Nelcyndana mulu.

Mesonotum with a pair of paramedian, juxtaposed, black to brown, obconical spots at anterior margin, reaching to two fifths of mesonotum disk. Scutal depressions in front of cruciform elevation with round, brown spots. Lateral sigillae black to very faint and reddish brown without black marking. Cruciform elevation yellowish.

Legs, tegmina and wings as in male
Operculum. Basal half broad, operculum narrowed at half its length to two thirds of basal width, medial margin concave, lateral margin of apical part basally parallel to medial margin, laterodistal angle obtusely rounded, apical margin straight, reaching to anterior margin or one third of sternite 2 and making an angle of 60 degrees with medial margin.

Abdomen. One paratype has the following marking: tergite 2 with black-brown fascia, about as broad as cruciform elevation, along anterior tergite margin, tergites 3-7 with transverse, black fasciae along anterior margins, that on tergite 3 reaches medially to two fifths of tergite length, that on tergite 4 to one third and those on tergites 5-8 to one fourth or one fifth of tergite length, the fasciae on tergites $3-8$ widen laterally to reach to two thirds of tergite length. Sternite 2 medially black-brown, sternites 3 to 6 with brown-black transverse band, which is two thirds as broad as sternite and reaches from anterior sternite margin to two-thirds of sternite, sternite 7 medially black-brown. Segment 9 dorsally with a pair of oblong, paramedian, dark brown markings, laterally with a pair of round, lateral, brown spots and ventrally with brownish colouration along basal two-thirds of lower margin. The other two paratypes differ in
the following features: dorsal marking with much narrower and partly missing fasciae; sternite 2 medially brownish, sternite 3 with black-brown transverse band, half as wide as sternite, sternites 4-6 with dark brownish median marking, one third to half as wide as sternite. Segment 9 similar but missing the lateral spots.

Measurements (in mm; 5 ${ }^{\lambda}, 2 q$ ). Body length $\delta^{\lambda}: 9.9-11.7, q: 12.0-12.4$; tegmen length $\widehat{\sigma}^{\top}: 12.7-12.9, q: 14.2-15.0$; head width $\delta^{\top}: 3.8-4.0, q: 4.0-4.3$; pronotum width ${ }^{\text {T}}: 3.6-3.8, ~ Q: 3.8-4.1$.

Distribution (Fig. 14). Nelcyndana mulu is only known from the Melinau Gorge in Gunung Mulu N.P. in Sarawak).

## Acknowledgements

I am very much indebted to the following curators of collections for the loan of material: Mr B. Hubley \& Dr D.C. Darling (ROM), Mr A.H. Kirk-Spriggs and Dr M.R. Wilson (NMWC), Dr. G. Lindberg (NHRS), Dr J. van Tol (RMNH) and Mr M. D. Webb (BMNH). I thank my late wife Greet Duffels van Egmond for her help in the field. Special thanks go to Dick Langerak (ZMAN) for preparing the figures, to Rob Portegies (ZMAN) for making the distribution maps, and to Gerard Verlaan (ZMAN) for technical assistance.

## References

Anonymous (1938) Atlas van tropisch Nederland. Koninklijk Nederlands Aardrijkskundig Genootschap \& Topografische Dienst in Nederlandsch-Indië, Amsterdam/Batavia, ix, 17 pp., 1-31b maps, 1-31b legends.
Anonymous (1999) The Times comprehensive atlas of the world. Times Books, London. 67, v, 220 pp., pls. 124.
Chou I, Lei L, Li L, Lu X, Yao, W (1997) The Cicadidae of China (Homoptera: Cicadoidea). Illustrataj Insect-faunoj 2: 1-380, pls. 1-16
Distant WL (1890) A monograph of Oriental Cicadidae 3. West, Newman \& Co., London, 49-72 + plates v-vi.
Distant WL (1892) A monograph of Oriental Cicadidae. Part 6. Indian Museum, Calcutta. 121-144, pls 13-14.
Distant WL (1905) Rhynchotal notes. XXXIII. Annals and Magazine of natural History (7) 16: 22-35.
Distant WL (1906) A synonymic catalogue of Homoptera. Part 1. Cicadidae. Trustees British Museum, London, 207 pp.
Duffels JP (1977) A revision of the genus Diceropyga Stål, 1870 (Homoptera, Cicadidae). Monografieën van de Nederlandse entomologische Vereniging 8: 1-227.

Duffels JP (1983) Taxonomy, phylogeny and biogeography of the genus Cosmopsaltria, with remarks on the historic biogeography of the subtribe Cosmopsaltriaria (Homoptera: Cicadidae). Pacific Insects Monograph 39: 1-127.
Duffels JP, Van der Laan PA (1985) Catalogue of the Cicadoidea (Homoptera, Auchenorhyncha) 1956-1980. Series Entomologica 34: i-xiv + 1-414.
Duffels JP, Turner H (2002) Cladistic analysis and biogeography of the cicadas of the IndoPacific subtribe Cosmopsaltriina. Systematic Entomology 27: 235-261.
GEOnet Names Server of the U.S. Defense Mapping Agency [http://www.nima.mil/gns/html/ index.html].
Lee, YJ (2010) Cicadas (Insecta: Hemiptera: Cicadidae) of Mindanao, Philippines, with the description of a new genus and a new species. Zootaxa 2351: 14-28.
Metcalf ZP (1963) Cicadoidea, General catalogue of the Homoptera 8 (2) Tibicinidae. North Carolina State College, Raleigh, North Carolina, iv +492 pp.
Moulds MS (2003) An appraisal of the cicadas of the genus Abricta Stål (Hemiptera: Auchenorrhyncha: Cicadidae) with special reference to the Australian fauna. Records of the Australian Museum 55: 245-304.
Moulds MS (2005) An appraisal of the higher classification of cicadas (Hemiptera: Cicadoidea) with special reference to the Australian fauna. Records of the Australian Museum 57: 375446.

Moulton JC (1923) Cicadas of Malaysia. Journal of the Federated Malay States Museum 11: 69-182, pls. 1-5.
Stål C (1870) Hemiptera insularum Philippinarum. Bidrag till Philippinska öarnes Hemipterfauna. Öfversigt af Svenska Vetenskaps-Akademiens Förhandlingar, Stockholm. 27: 607776; pls. 7-9.
Zaidi MI, Azman S, Nordin W (2004) Cicada (Homoptera: Cicadoidea) fauna of Tabin Wildlife Reserve, Lahad Datu, Sabah: A preliminary record. Serangga 9: 131-138.
Zaidi MI, Noramly BM, Ruslan MY (2000a) Cicadas (Homoptera: Cicadoidea) from Tibow, Sabah. Serangga 5: 319-333.
Zaidi MI, Ruslan MY, Azman S (2000b) Notes on Cicadas (Homoptera: Cicadoidea) in the reference collection of Sabah Forestry Research Institute, Sandakan. Serangga 5: 197-220.
Zaidi MI, Ruslan MY (1997) Notes on cicadas (Homoptera, Cicadoidea) in the Zoological Reference Collection, National University of Singapore. Serangga 2: 217-233.
Zaidi MI, Ruslan MY (1998) Notes on cicadas (Homoptera: Cicadoidea) in the reference collection of Sarawak Museum. Serangga 3: 343-371.

# The genus Trichocnemis LeConte, 185 I (Coleoptera, Cerambycidae, Prioninae) 

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Academiceditor:A. Konstantinov|Received 10November 2009|Accepted7September 2010|Published 13October 2010
Citation: Swift I, Santos-Silva A, Nearns EH (2010) The genus Trichocnemis LeConte, 1851 (Coleoptera, Cerambycidae, Prioninae). ZooKeys 61: 33-46. doi: 10.3897/zookeys.61.299


#### Abstract

The history of the genus Trichocnemis LeConte, 1851 (Coleoptera, Cerambycidae, Prioninae) is discussed. Its taxonomic status in relation to the genera Ergates Audinet-Serville, 1832 and Callergates Lameere, 1904 is clarified. The synonymy of Macrotoma californica White, 1853, Macrotoma spiculigera White, 1853, and Trichocnemis spiculatus LeConte, 1851 is confirmed. A key to all three genera and their species is provided.


## Keywords

Cerambycidae, Coleoptera, North American Fauna, Prioninae, taxonomy

## Introduction

The prionine genus Trichocnemis has not been formally recognized in North America since it was placed in synonymy with Ergates by Linsley (1962). While the two genera share several characters, and are likely related (Nishio 1956), many characters distinguish the species in these two genera. Earlier authors (Lameere 1901, Casey 1912) considered Trichocnemis a subgenus of Ergates, as was Callergates. More recent authors consider all three as separate genera (Villiers 1978, Jeniš 2001).

[^2]Members of all three genera are mainly Holartic in distribution: Ergates occurs in Europe and NW Africa (Jeniš 2008); Callergates occurs in Europe and Asia Minor (Jeniš 2001); and Trichocnemis occurs in western North America (Linsley 1962). Two species of Trichocnemis are recognized: T. spiculatus LeConte, 1851 and T. pauper Linsley, 1957. The species T. spiculatus also has a single subspecies, T. spiculatus neomexicanus Casey, 1890. Most species worldwide utilize coniferous hosts, generally in the genus Pinus (Pinaceae) (Linsley op.cit., Villiers 1978); however, T. pauper is known only from species in the genus Quercus (Fagaceae) (Tyson 1967). Typically, recently dead host material is preferred by adult females for oviposition, and larval development ranges from two to four years (Linsley op.cit.), depending upon host and environmental conditions.

Males and females are strongly sexually dimorphic, with males having an enlarged, generally smooth prothorax with less distinct lateral spines, while in females the prothorax is smaller and more distinctly spined at the lateral margins. Adults are frequently attracted to ultraviolet lights at night, and are generally active during July and August (Tyson 1967).

## Methods

We examined the external morphology of male and female specimens of Trichocnemis spiculatus spiculatus, T. s. neomexicanus, T. pauper, Ergates faber (Linnaeus, 1761), and Callergates gaillardoti (Chevrolat, 1854), in addition to male genitalia of one species of each genera as well as both species of Trichocnemis, to obtain the conclusions proposed in this study.

Specimens from the following collections were examined for this study:
BMNH The British Museum of Natural History, London, United Kingdom
CASC California Academy of Sciences, San Francisco, California, USA
CSCA California State Collection of Arthropods, Sacramento, California, USA
IRSN Institute Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium
INIA Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Spain
EMEC University of California Berkeley, Berkeley, CA USA
USNM United States National Museum, Washington DC, USA

## Taxonomic History

LeConte (1851) described the genus Trichocnemis for his new species T. spiculatus, stating it was similar to the genus Ergates Audinet-Serville, 1832, but differing in the pubescence of the protibiae. Although LeConte did not indicate the sex of the type specimen, his description suggests it was a female: "Tibiae vix compresse, filiformes";
"thorace scabro, dorso antice bicalloso, spiculis lateralibus valde acutis, apicali basalique majoribus, thorace latioribus"; "the elytra show some indications of costae"; and "the joints of the antennae are marked with a few scattered punctures." However, the type specimen deposited in the Museum of Comparative Zoology (MCZ) is a male (MCZWeb 2009). There is little doubt that LeConte (op. cit.) based his description on a single specimen, since he indicated only a single measurement, stating: "the specimen appears a little immature." In males, the tibiae are not clearly filiform, the prothorax is not scabrous and has well-marked depressions (a character omitted by LeConte), the pronotal callosities are less pronounced than in females, the lateral spines of the pronotum are much less prominent than in females, and the proximal antennomeres are strongly and abundantly punctate. In the type specimen (Fig. 1), the elytra show clear carinae, a character that does not agree with the original description.

Although the holotype label of Trichocnemis spiculuatus in the MCZ indicates "Ergates", and not Trichocnemis, it is believed that LeConte himself changed the label after having transferred the species to the genus Ergates. This is consistent with other LeConte specimens in which the labels indicate different names that the original taxon, for example: Mallodon gnatho LeConte, 1858, which have labels with LeConte's writing, [Mallodon (Nothopleurus) gnatho // Lec. dentiger Lec.]. Other specimen labels are clearly not written by LeConte (vide Mallodon mandibularis Gemm.).

The genus Ergates was established by Audinet-Serville (1832) to accommodate a single species: Prionus serrarius Panzer, 1793 (= Cerambyx faber Linnaeus, 1761). Among the many characters used to define the genus, Audinet-Serville (op.cit.) listed: legs without internal spines; antennae filiform, similar in both sexes, longer than the body in male, and reaching more or less the middle of elytra in female; antennomere III longer than IV-V together; prothorax finely crenulated laterally in male, more distinctly in female; mandibles and mentum glabrous; legs of medium length, the prolegs longer than the others.

White (1853) synonymyzed Trichocnemis under Macrotoma Audinet-Serville, 1832, but this nomenclatural act was not accepted or used by any later author. White (op.cit.) also did not explain why, in his opinion, that genus was synonymous of Macrotoma.

LeConte (1854) then synonymyzed Trichocnemis with Ergates, stating: "Trichocnemis Lec. (Journ. Acad. 2d, 2, 110) is not sufficiently distinct from Ergates; the Californian species must therefore be called E. spiculatus." Later, LeConte and Horn (1883) pointed out the same observation of Trichocnemis and placed Ergates in the tribe Ergatini. However, the characters used to define Ergatini (sensu LeConte and Horn) apply primarily to Ergates (= Trichocnemis) spiculatus, and largely excludes Ergatesfaber (Linnaeus, 1761) (Fig. 2) and Callergates gaillardoti (Chevrolat, 1854) (Fig. 3). LeConte and Horn (op.cit.) stated: "the tribe is easily recognized by the prothorax being much broader in the male than in the female, and finely punctured; in the latter sex the sculpturing is very coarse, and the small teeth of the lateral margin are longer and more acute. The head is small, the eyes reniform and coarsely granulated; antennae


Figures I-6. I Trichocnemis pauper, male $\mathbf{2}$ idem, female $\mathbf{3}$ T. spiculatus neomexicanus, male $\mathbf{4}$ idem, female 5 T. spiculatus spiculatus, holotype male (MCZWeb) 6 Macrotoma californica, syntype 1.

11-jointed, slender, two-thirds the length of the body in the $\widehat{\jmath}$, about half the length of the body in the $Q$, rough with elevated punctures, with the 3rd joint as long as the three following united; poriferous spaces on the 3rd joint small inconspicuous, on the under surface near the distal end, gradually becoming larger, until the outer joints become entirely poriferous, and irregularly reticulated with fine elevated lines forming elongate cells, which are much less distinct, and in fact hardly to be seen in the male." This tribal description excludes $E$. faber (Fig. 2) because the head is somewhat large, especially in males; the antennae surpass the elytral apex in males; antennomere III is (at most) as long as IV-V together; the pronotum lacks lateral spines in both sexes, and is
not clearly wider in males than in females. Callergates gaillardoti can be unsatisfactorily included, because the antennae is somewhat longer than two-thirds the length of the body in male, the antennomere III is shorter than IV-VI together in both sexes, and the teeth of the lateral margin are not "small" in the female.

Lacordaire (1869) did not revalidate Trichocnemis, although it is clear he did not agree with LeConte's (1854) synonymy stating: "Le genre Trichocnemis de M. J. L. Le Conte, établi primitivement sur la femelle d'une espèce (3) de Californie, a étè reconnu, plus tard, par se savant entomologiste, comme devant rentrer dans celui-ci. Cette femelle, que j'ai sous les yeux, diffère notablement, sous le rapport du facies, de celle de faber, et a celui d'une Macrotoma; son prothorax est multiépineux sur les côtés et les épines sont longues et irrégulières. D'après la description qu'en donne M. J. L. Le Comte, le mâle différerait également, d'une manière sensible, de celui de l'espèce européenne."

LeConte (1869) was the first author to attribute subgeneric status to Trichocnemis, when he listed "Ergates (Trichocnemis) spiculatus Lec.," but did not offer an explanation of this new status. Casey (1890) maintained Trichocnemis as a subgenus of Ergates based on the length of the antennae, anterior legs, and denticulation of the sides of the prothorax, stating: "It seems proper therefore that the name Trichocnemis Lec. should be preserved, if not with full generic value, at least as a subgenus."

Lameere (1901) considered Trichocnemis different from Ergates ("genre très distinct"), and included both in the tribe "Aegosomites" and subtribe "Callipogonines." Lameere (1904) assigned Ergates to "Callipogonines," and divided it into three subgenera: E. (Ergates); E. (Trichocnemis); and E. (Callergates) Lameere, 1904. Ergates (Callergates) is currently considered a different genus (Jeniš 2001, 2008).

Casey (1912) again considered Ergates and Trichocnemis as distinct taxa, stating: "This genus is distinct from Ergates and should be restored. The last joint of the maxillary palpi in Ergates is oval and more narrowly truncate at apex, while in Trichocnemis it is of a wholly different form, being broadly obtriangular, the sides straight and widely flaring from base to the truncate apex. In the former there is a prominent lateral spiniform tooth at basal third of the prothorax, wanting in the latter, and there are numerous other incongruities. The two genera are related tribally but are unquestionably distinct." While this diagnosis points out many of the differences between the two genera, several other characters previously mentioned (i.e. antennal length and ratios) were omitted. In addition, Casey (op. cit.) did not indicate a tribal assignment for either of these genera. Nevertheless, taken as a whole, the characters enumerated by Casey $(1890,1912)$ indicate substantial differences between Ergates and Trichocnemis.

Nishio (1956) pointed out that "the three species of Ergates strongly differ from each other in their morphology" and followed Lameere (1904) in maintaining each species in a different subgenus. Nishio (op. cit.) also compared the male genitalia of the three species, and stated (translated): "The male genitalia of gaillardoti and spiculatus are similar to each other and probably suggest that they are closely related...". In addition, Nishio (op. cit.) hypothesized the phylogenetic relationship among the
three taxa, stating that Callergates gailardoti is the most ancestral species of "Ergates," Trichocnemis spiculatus is sister to it, and Ergates faber is the most derived species. Moreover, Nishio (op. cit.) cites Plavilstshikov (1936) as stating that "spiculatus" differs from the remaining species (E. faber and C. gaillardoti) and should be classified in a different genus.

Linsley (1962) synonymyzed Trichocnemis under Ergates, and assigned it to the tribe Ergatini, stating: "I agree with LeConte and Horn that the characters do not warrant the generic recognition of Trichocnemis and that the phylogenetic unity of the group is better indicated by including all four species in Ergates". In placing Ergates in the tribe Ergatini, Linsley (op. cit.) apparently ignored the name "Callipogonitae" used by Thomson (1861), and gave "Ergatites," used by Fairmaire (1864), priority over the names that appear in Lameere (1904, 1912, 1919): "Callipogonines"; Callipogonini. There seems little doubt that Linsley was aware of the name "Callipogonides" in Lacordaire (1869), and probably incorrectly attributed this taxon to him. This would explain why Lisnley (op.cit.) did not use Thomson's name for Ergates and Callipogon in the same tribe: "This tribe is represented in America by two genera, Callipogon and Ergates". Therefore, to Linsley, Callipogonini was equal to Ergatini, and not a different group as considered formerly and by some contemporary authors.

In his work on the Cerambycidae of France, Villiers (1978) considered the three subgenera erected by Lameere (1904) as distinct genera, stating: "Trichocnemis J. LeConte et Callergates Lameere no sont pas des sous-genres d'Ergates, mais des genres bien individualisés". Villiers (op. cit.), used the tribal name Ergatini, although in a different sense from that employed by Linsley (op. cit.); to him, Callipogonini sensu Lameere included more than one tribe, while Linsley (op. cit.) used Ergatini only as a name with priority over Callipogonini.

The revalidation of Trichocnemis by Villiers (op.cit.) as a separate genus remained unnoticed by many contemporary authors possibly because it was published as a part of a regional faunal account. Nevertheless, subsequent checklists of Western Hemisphere Cerambycidae (Chemsak and Linsley 1982, Monné and Giesbert 1994) unintentionally maintained the synonymy of Trichocnemis with Ergates.

Although the tribal classification of Ergates and Callipogon Audinet-Serville, 1832, is beyond the scope of this paper, it is interesting to note Švácha (1987): "I would like to point out that it is undoubtedly incorrect to classify the genera Ergates and Callipogon in the same tribe, whatever its name may be." Unfortunately, Švácha did not enumerate the characters he used to base his opinion. Today, researchers of the Neotropical and Nearctic cerambycid fauna use Callipogonini sensu Lameere (1904), while those that work with the fauna of Palearctic, Ethiopian, Oriental, and Australian zoogeographic provinces (with some exceptions), do not agree and use more than one tribe to allocate the genera included by Lameere in Callipogonini.

A partial bibliography of Trichocnemis is listed below, including many citations of the generic name Ergates which actually refer to Trichocnemis (Monné 2006).

## Trichocnemis LeConte, 1851

Trichocnemis LeConte 1851: 110 (type species: Trichocnemis spiculatus LeConte, 1851, original designation); Melsheimer 1853: 100; White 1853: 35 (syn. under Macrotoma); LeConte 1854: 218 (synonymy under Ergates); Thomson 1861: 315 (involuntary revalidation); 1864: 298; Lacordaire 1869: 95 (involuntary synonymy); LeConte and Horn 1883: 271 (synonymy); Casey 1912 (revalidation; new status); Linsley 1962: 24 (synonymy); Villiers 1978: 55 (revalidation); Monné 1995: 15 (cat.; involuntary synonymy).
Ergates (Trichocnemis) LeConte 1869: 371 (reval.; new status); Casey 1890: 490 (revalidation); 1891: 20; Lameere 1904: 46; 1913: 46 (cat.; reversion of status); Lameere 1919: 81; Blackwelder 1946: 553 (cat.); Nishio 1956: 68.
Ergates Horn 1891: 41; Leng 1884: 8; Arnett 1962: 855; 874; Chemsak 1996: 84; Monné 2006: 37 (cat.; part); Monné and Hovore 2006: 10 (cat.; part).
Macrotoma White 1853: 35 (part).

Redescription. Body large, elongate, integument light brown to dark-brown; in general, elytra lighter than the head and the pronotum. Male (Figs 1,3, 5-7). Head proportionally small; coronal suture clearly surpasses the posterior edge of the eyes; dorsal surface coarsely punctate; pilosity short and scattered. Area behind the eyes confluent punctate; pilosity short and clearly more abundant than in dorsal surface of the head. Antennal tubercles moderately prominent; apex rounded. Eyes small, not as long as scape in lateral view, and lower lobe narrower than scape at its widest point; dorsal interocular space equal or just narrower than twice the width of one upper eye lobe. Hypostomal area depressed to slightly depressed, rugose-punctate. Mandibles shorter than half of the length of the head, strongly curved inwards at almost straight angle; outer surface slightly tumid at basal one-third; inner margin not tumid and not strongly separated by the punctate area. Antennae short, just attaining the apical one-third of the elytra. Scape attaining to just surpassing the posterior edge of the eye lobe. Antennomere III moderately thick, with prominent denticles on ventral and lateral surface; longer than IV-V together. Genal apex spiniform. Maxillary palps short; palpomere II longer than the others; apex of the IV securiform or barely wider than base. Prothorax strongly tumid, entirely micropunctate. Pronotum with two large, deep and subtriangular antero-medial depressions; three punctiform, small, shallow to moderate, lateral antero-medial depressions, arranged diagonally; five punctiform, small, shallow to moderate depressions, at basal area; lateral margins with spines clearly present, longer at anterior and posterior angles; lateral angles rounded; pilosity very short, very scattered (disc almost glabrous), longer and more dense laterally or close to the posterior and anterior angles. Prosternum with short and very scattered pilosity. Prosternal process wide; apex rounded; lateral margins and apical one-third with long dense pilosity. Meso-, metasternum, and metepisternum densely pilose. Elytra rugose-punctate, circum-scutellar area mostly punctate; each elytron with at least two clear carinae; sutural apex with short spine or inermis. Coxae abundantly pilose. Femora with short


Figures 7-I2. 7 Macrotoma californica, syntype 28 Macrotoma spiculigera, holotype female 9 Ergates faber, male $\mathbf{I} \mathbf{0}$ idem, female II Callergates gaillardoti, male $\mathbf{I} \mathbf{2}$ idem, female.
pilosity, becoming more dense ventrally, mainly at meso- and metafemora; profemora slightly rugose. Protibiae moderately short and thick. Protarsomere I short and wide. Urosternites pilose, mainly laterally. Parameres (lateral lobes) of the tegmen elongated, clearly narrowed, thickened, and carinate at apical half (subcylindrical).

Female (Figs 2, 4, 8). Differing from male in the following manner: antennae reaching or just surpassing middle of the elytra; scape shorter, just attaining the posterior edge of the eyes; antennomere III thinner, lacking denticles; curvature inwards at apex of the mandible at an obtuse angle; prothorax much less tumid; pronotum rugoso-punctate, strongly convex; with callosities in place of the depressions of the antero-medial and basal areas found in males, and without depressions at lateral of the
antero-medial areas; lateral margins with larger and more spines (usually, the spines are bifid or trifid at apex); lateral angles clearly acute; posterior angles rounded; proepisterna coarse punctate; proepimera nearly flat; profemora laterally flattened.

Diagnosis. Trichocnemis differs from Ergates (Figs 9, 10) in the following manner: head proportionally small ( 0.6 times greatest width of pronotum in males); mandibles not strongly tumid at basal one-third of the outer surface; inner margin of the mandible not tumid and weakly separated by a punctate furrow; antennae of males do not reach the elytral apex; scape of the males reaches or surpasses the posterior edge of the eyes; antennomere III in males clearly thicker, with denticles, longer than IV and V together; antennomere III in females longer than IV and V together, attaining or almost attaining the base of the prothorax; pronotum distinctly tumid, mainly laterally, with deep and well marked depressions at disc; proepisternum, proepimerum, and prosternum (mainly close to the head) strongly tumid; lateral margins of the pronotum with at least some spines in both sexes; anterior angles of pronotum spinose in both sexes; lateral angle of the pronotum of the males not marked; profemora of males slightly rugose; elytra rugoso-punctate, with clear carinae; protibiae of males moderately short and thick; protarsomere I short and wide in both sexes; parameres of the tegmen elongated, clearly narrowed, thickened, and carinate at apical half.

In Ergates, the head is proportionally large ( 0.6 times greatest width of pronotum in males); mandibles strongly tumid at basal one-third of the outer surface, mainly in males; inner margin of the mandible tumid and strongly separated by a punctate furrow; antennae of males attain or surpass the elytral apex; scape of males not attaining posterior edge of eyes; antennomere III of the males clearly thinner, without denticles, and as long as IV-V together; antennomere III of the females does not attain the base of the prothorax, as long as IV-V together; pronotum not tumid, with callosities in place of the punctate depressions found in Trichocnemis; proepisternum and proepimerum not tumid; prosternum not tumid near head; lateral margins of the pronotum crenulated in both sexes; anterior angles of the pronotum wide and rounded in both sexes; lateral angle of the pronotum with prominent spines in both sexes (lateral angles acute in males); profemora of males strongly rugose; elytra coarse and densely punctate, with feeble carinae; protibiae of the males long and narrow; protarsomere I long and narrow in both sexes; parameres of the tegmen short, not narrowed after middle, somewhat concave, thickened only at outer lateral and apical one-third.

Trichocnemis differs from Callergates (Figs 11, 12) as follows: eyes not large; prothorax with distinct lateral declivities; genitalia of male shorter, with apex of the parameres of the tegmen thickened at apical half, and the median lobe enlarged at base and distinctly convergent to the apex. In Callergates the eyes are large, the prothorax lacks lateral declivities, the genitalia of the male is longer, with the apex of the parameres of the tegmen not thickened at apical half, and the median lobe is distinct narrower at base and slightly convergent to the apex. Additionally, the protibia in males are similar to Ergates.

## Key to the genera and species of Callergates, Ergates, and Trichocnemis

1 Antennae surpassing middle of elytra; pronotum with distinct small, shining, impunctate areas contrasting with the remainder of the surface. Males ....... 2

- Antennae reaching, at most, middle of elytra; pronotum without distinct small shining, impunctate areas contrasting with the remainder of the surface. Females 5
2(1) Apex of antennal scape not surpassing posterior margin of lower eye lobe; antennomere III slender, lacking denticles; prolegs longer than meso- and metalegs. Europe, NW Africa ........Ergates faber (Linnaeus, 1761) (Fig. 9)
- Apex of antennal scape surpassing posterior margin of lower eye lobe; antennomere III distinctly thickened, with numerous denticles; prolegs not longer than meso- and metalegs 3
3(2) Scape distinctly surpassing the anterior margin of pronotum; antennomere III not distinctly longer than IV and V together; metasternum with a deep, somewhat small depression close to the mesocoxae. Europe, Asia Minor.

Callergates gaillardoti (Chevrolat, 1854) (Fig. 11)

- $\quad$ Scape reaching, at most, the anterior margin of pronotum; antennomere III distinctly longer than IV-V together; metasternum without deep depression close to the mesocoxae 4
4(3) Inner apical angles of elytra spined, elytra either uniformly dark brown (California) or with light brown maculae (western USA); lateral spines of pronotum of differing lengths. United States and Mexico (Baja California)

Trichocnemis spiculatus LeConte, 1851 (Figs 3, 5-7)

- Inner apical angles of elytra rounded, elytra uniformly light brown, contrasting with pronotum; lateral spines of pronotum generally of equal length. United States (Sierra Nevada and Coast Range mountains of California)

Trichocnemis pauper Linsley, 1957 (Fig. 1)
5(1) Distance between upper ocular lobes larger than twice the width of a single lobe; pronotum not spined laterally ..........Ergates faber (Linnaeus, 1767) (Fig. 10)

- Distance between upper ocular lobes smaller than twice the width of a lobe; pronotum spined laterally

$$
6
$$

6(5) Apex of antennal scape distinctly surpassing posterior margin of lower eye lobe; antennomere III as long as IV-V together or barely longer.

Callergates gaillardoti (Chevrolat, 1854) (Fig. 12)

- Apex of antennal scape not or just surpassing posterior margin of lower eye lobe; antennomere III distinctly longer than IV-V together. 7
7(6) Spines of lateral margins of pronotum as long as those at anterior and lateral angles; sutural angle of elytra unarmed.

Trichocnemis pauper Linsley, 1957 (Fig. 2)

- $\quad$ Spines of lateral margins of pronotum shorter than those at anterior and lateral angles; sutural angle of elytra with short spine

Trichocnemis spiculatus LeConte, 1851 (Figs 4, 8)

## Conclusions

Our analysis of these taxa, which corroborates that of Villiers (1978) and in part, those of Lameere (1904) and Nishio (1956), supports recognizing Trichocnemis and Ergates as distinct genera. Additionally, the fact that both species of North American Trichocnemis share several distinct characters not present in Ergates or Callergates further supports this hypothesis.

## Summary of taxonomic changes

Trichocnemis spiculatus spiculatus LeConte, 1851 (originally described as Trichocnemis spiculatus LeConte, 1851); Trichocnemis spiculatus neomexicanus (Casey, 1890) (originally described as Ergates (Trichocnemis) neomexicanus Casey, 1890), comb. n.; Trichocnemis pauper (Linsley, 1957) (originally described as Ergates pauper Linsley, 1957), comb. n.

## Synonyms of Trichocnemis spiculatus LeConte, I 85 I

White (1853) described two species from North America (California) that were later synonymyzed with T. spiculatus by Lameere (1904): Macrotoma californica and M. spiculigera. White's original description leaves some doubt as to the identity of the species involved. For example, in the description of M. spiculigera, he stated: "Elytra coriaceous, vermiculated, with three indistinct costae". Similarly, some details of the description of $M$. californica might encompass that of T. pauper. Since White probably did not examine the types of these species (frequently he indicated when he did), and his original descriptions do not provide enough detail to diagnose them among other Trichocnemis, primarily T. pauper, we examined photos of the types, provided by S. Shute (BMNH).

The syntype male of Macrotoma californica (Figs 6, 8) and the holotype female of M. spiculigera (Fig. 8), are in fact M. spiculatus, as suspected by even White (op.cit.) himself: "Trichocnemis spiculatus, Leconte, Journ. Acad. Nat. Sc. Phil. n. s. ii 110?", and "It is possible that this may be the female of the Macrotoma Californica". Photos of the holotype (Fig. 8) also clearly show three distinct carinae on each elytron, rather than three on the elytra. According to S. Shute (personal communication) the types have the following labels:

Macrotoma californica: Syntype 1 (Fig. 6): White H/W determination label (specimen also bears small circular white $\mathrm{H} / \mathrm{W} \mathrm{BM}(\mathrm{HN})$ registration label upper surface reads California, reverse [18] 48.135 (the register states that this specimen was purchased from Hartweg);
Syntype 2 (Fig. 7): no labels other than blue BM(NH) syntype label;

Macrotoma spiculigera (Fig. 8): White H/W label. The reverse of this label has Hermerius struck out in black ink and California written below. The generic name is in the large script of White and must have been the original label. This specimen also has a small white circular registration as for M. calfornica [18]48. 135 plus $\mathrm{BM}(\mathrm{NH})$ red type label.

## Acknowledgments

We wish to thank Norm Penny (CASC), Chuck Bellamy (CSCA), Cheryl Barr (EMEC), Steve Lingafelter (USNM), and Alain Drumont (IRSN) for the loan of specimens. To José Rafael Esteban Durán (INIA), for the photos of Ergates faber, and to Sharon Shute (BMNH), for the photos of White's types. Nobuo Ohbayashi (Ehime University Tarumi, Japan) assisted in locating Japanese literature and Kenji Nishida (Universidad de Costa Rica) generously provided translation of Japanese text. We also thank Kelly Miller (University of New Mexico) for critical suggestions to improve an earlier version of this manuscript.

## References

Arnett RH (1962) The beetles of the United States: A manual for identification. The Catholic University America, Washington, xi + 1112 pp.
Audinet-Serville JG (1832) Nouvelle classification de la famille des longicornes. Annales de la Société Entomologique de France, (1)1: 118-201.
Blackwelder RE (1946) Checklist of the coleopterous insects of Mexico, Central America, the West Indies and South America. Part 4. Bulletin of the United States National Museum 185: 551-763.
Casey TL (1890) Coleopterological Notices. II. Annals of the New York Academy of Sciences 5: 307-504.
Casey TL (1912) Studies in the Longicornia of North America. Memoirs on the Coleoptera 3: 215-376.
Chemsak JA (1996) Illustrated Revision of the Cerambycidae of North America. Volume I. Parandrinae, Spondylidinae, Aseminae, Prioninae. Wolfsgarden Books. Burbank, California, 1: i-x + 150 pp., est. I-X.
Chemsak JA, Linsley EG (1982) Checklist of Cerambycidae. The Longhorned beetles. Checklist of the Cerambycidae and Disteniidae of North America, Central America, and the West Indies. Plexus Publ. Inc., Medford, N.J., 138 pp.
Chevrolat LAA (1854) Coléoptères de Syrie (Suite.). Revue et Magasin de Zoologie (2)6: 479486.

Fairmaire L (1864) In: Jacquelin DuVal PN. Genera des Coleóptères d'Europe comprenant leur classification en famille naturelle. Author's edition, Paris, 4, 295 pp.

Horn GH (1891) New species and miscellaneous notes. Transactions of the American Entomological Society 18: 32-48.
Jeniš I (2001) Long-horned beetles. Distenidae, Oxypeltidae, Vesperidae, Anoplodermatidae \& Cerambycidae I. Vesperidae \& Cerambycidae Evropy / of Europe I. Atelier Regulus, 333 pp.
Jeniš I (2008) The Prionids of the World. Illustrated catalogue of the beetles. Kulturní Dědictví (publisher), Czech Republic, vol. 1, 128 pp.
Lacordaire JT (1869) Histoire Naturelle des Insectes. Genera des Coléoptères ou exposé méthodique et critique de tous les genres proposés jusqu'ici dans cet ordre d'insectes. Paris. Librairie Encyclopédique de Roret. 8: 1-552.
Lameere AA (1901) Étude sur la Phylogénie des Longicornes. Première communication préliminaire. Annales de la Société Entomologique de Belgique 45: 314-323.
Lameere AA (1904) Révision des Prionides. Neuvième mémoire. - Callipogonines. Annales de la Société Entomologique de Belgique 48: 7-78.
Lameere AA (1912) Révision des Prionides. Vingt-deuxième Mémoire. - Addenda et Corrigenda. Mémoires de la Société Entomologique de Belgique 21: 113-188.
Lameere AA (1913) Coleopterum Catalogus. Pars 52: Cerambycidae: Prioninae. W. Junk et S. Schenkling, Berlin, 108 pp.
Lameere AA (1919) Famille Cerambycidae: subfam. Prioninae. Coleoptera. In: Genera insectorum. P. Wytsman, Brussels, 172: 1-189, pls. 1-8.
LeConte JL (1851) An attempt to classify the Longicorn Coleoptera of the part of America North of Mexico. Journal of the Academy of Natural Sciences of Philadelphia (ser. 2) 2: 99-112.
LeConte JL (1854) Some corrections in the Nomenclature of Coleoptera found in the United States. Proceedings of the Academy of Natural Sciences of Philadelphia 7: 216-220.
LeConte JL (1858) Description of New Species of Coleoptera, chiefly collected by the United States and Mexican Boundary Commission, under Major W. H. Emory, U.S.A. Proceedings of the Academy of Natural Sciences of Philadelphia 10:59-89.
LeConte JL (1869) List of Coleoptera collected in Vancouver's Island by Henry and Joseph Matthews, with descriptions of some new species. The Annals and Magazine of Natural History 4: 368-385.
LeConte JL, Horn GH (1883) Classification of the Coleoptera of North America. Prepared for the Smithsonian Institution. Smithsonian Miscellaneous Collections 26(507): i-xxvii + 1-567.
Leng CW (1884) Synopses of Coleoptera (Cerambycidae). Bulletin of the Brooklyn Entomological Society 7: 7-11.
Linnaeus C (1761) Fauna Suecica sistens animalia Sueciae regni: Mammalia, Aves, Amphibia, Pisces, Insecta, Vermes. Distributa per classes \& ordines, genera \& species, cum differentiis specierum, synonymis auctorum, nominibus incolarum, locis natalium, descriptionibus insectorum (ed. 2). Salvius, Holmiae, 46 pp. + 1-578.
Linsley EG (1957) Descriptive and Synonymical Notes on Some North American Cerambycidae (Coleoptera). American Museum Novitates 1828: 1-21.

Linsley EG (1962) The Cerambycidae of North America. Part II. Taxonomy and Classification of the Parandrinae, Prioninae, Spondylinae \& Aseminae. University of California. Publications in Entomology 19: 1-102.
MCZWeb (2009) MCZ Type Database, Museum of Comparative Zoology, Harvard University, Cambridge, MA. insects.oeb.harvard.edu/MCZ/index.htm [Accessed on September 28, 2009].
Melsheimer FE (1853) Catalogue of the described Coleoptera of the United States. Washington, D.C., Smithsonian Institution, xvi + 174 pp .
Monné MA (1995) Catalogue of the Cerambycidae (Coleoptera) of the western hemisphere. Part XXII. Subfamily Prioninae. Sociedade Brasileira de Entomologia, Sáo Paulo, XXI: 1-115.
Monné MA (2006) Catalogue of the Cerambycidae (Coleoptera) of the Neotropical Region. Part III. Subfamilies Parandrinae, Prioninae, Anoplodermatinae, Aseminae, Spondylidinae, Lepturinae, Oxypeltinae, and addenda to the Cerambycinae and Lamiinae. Zootaxa 1212: 1-244.
Monné MA, Giesbert EF (1994) Checklist of the Cerambycidae and Disteniidae (Coleoptera) of the Western Hemisphere. Wolfsgarden Books. Burbank, California: i-xiv + 1-410.
Monné MA, Hovore FT (2006) Checklist of the Cerambycidae, or longhorned wood-boring beetles, of the Western Hemisphere. Rancho Dominguez, Bio Quip Publications, 394 pp.
Nishio Y (1956) Die Gattung Ergates Serville, 1832, inbesondere Phylogenie und Verbreitung der Arten. Seibutsu Kagaku 8: 68-73.
Plavilstshikov NN (1936) Cerambycidae (Part 1) In: Faune de l'URSS. Insects Coleopteres, volume 21. Moscow, Leningrad, 612 pp.
Švácha P (1987) In: Švácha P, Danilevsky ML. Cerambycoid Larvae of Europe and Soviet Union (Coleoptera, Cerambycoidea). Part I. Acta Universitatis Carolinae - Biologica 30: 1-176.
Thomson J (1861) Essai d'une classification de la famille des cérambycides et matériaux pour servir à une monographie de cette famille. Paris. 396 pp. +3 pls. [1860: pp. xvi +128 ; 1861: pp. 129-396].
Thomson J (1864) Systema cerambycidarum ou exposé de tous les genres compris dans la famille des cérambycides et familles limitrophes. Mémoires de la Société Royale des Sciences de Liège 19: 1-578 [1864: pp. 1-352; 1865: pp. 353-578].
Tyson WH (1967) California Ergates and Tragosoma, with Keys to the Adult and Immature Forms. Pan-Pacific Entomologist 43: 122-126.
Villiers A (1978) Faune des Coléoptères de France I. Cerambycidae. Paris, Paul Lechevalier I: i-xxviii +611 pp .
White A (1853) Catalogue of the coleopterous insects in the collection of the British Museum, pt. VII. Longicornia I, London, 7: 1-174.

# Two genera of Braconinae (Hymenoptera, Braconidae) in China, with descriptions of four new species 

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Academic editor:KeesvanAchterberg| Received 24March 2010|Accepted9 September 2010| Published 13 October 2010
urn:lsid:zoobank.org:pub:27A264E3-EECA-4610-A3CA-937EBB972C66
Citation: Wang YP, Chen XX, Wu H, He JH (2010) Two genera of Braconinae (Hymenoptera, Braconidae) in China, with descriptions of four new species. ZooKeys 61: 47-62. doi: 10.3897/zookeys.61.450


#### Abstract

Two genera, namely Dolabraulax Quicke and Scutibracon Quicke of Braconinae (Hymenoptera: Braconidae) from China are studied for the first time, and four new species, namely D. jigongshanus Wang \& Chen, sp. n., D. flavus Wang \& Chen, sp. n., D. brevivena Wang \& Chen, sp. n. and S. fujianensis Wang \& Chen, sp. n. are fully described and illustrated. The examined specimens are deposited in the Parasitic Hymenoptera Collection, Zhejiang University, Hangzhou, China (ZJUH).


## Keywords

Braconidae, Braconinae, Dolabraulax, Scutibracon, new species, China

## Introduction

The Braconinae is one of the largest and the most diverse cosmopolitan subfamilies of Braconidae with about 2900 described species of about 180 genera worldwide, and mainly occurring in tropical and subtropical regions but particularly rich in the Indo-

Australian and Afrotropical regions (Yu et al. 2005). The vast majority of species are ectoparasitoids principally of coleopterous and lepidopterous hosts although a few attack Diptera, Hymenoptera-Symphyta and possibly Homoptera, and one group, Aspidobraconina, are endoparasitic on pupa. Some species may be effective biocontrol agents to suppress agro-forestry insect pest populations (Quicke and Ingram 1993).

China is among the most diverse regions for braconids in the world because of large variation in climate, and its vast area, but unfortunately its fauna is poorly known. This is part of our on-going study of the subfamily Braconinae (Wang et al. 2003a, 2003b, 2003c, 2003d, 2004, 2006a, 2006b, 2006c, 2006d, 2007, 2008, 2009a, b). The present paper deals with two genera, namely Dolabraulax Quicke and Scutibracon Quicke of Braconinae from China for the first time, and four new species, i.e. D. jigongshanus Wang \& Chen, sp. n., D. flavus Wang \& Chen, sp. n., D. brevivena Wang \& Chen, sp. n. and S. fujianensis Wang \& Chen, sp. n. are recognized, which are fully described and illustrated. The examined specimens are deposited in the Parasitic Hymenoptera Collection, Zhejiang University, Hangzhou, China (ZJUH).

The morphological terminology used in this paper follows that of van Achterberg (1979), Harris (1979) and Quicke (1987). All descriptions and measurements were made under a Leica MZ 12.5 stereomicroscope (Wetzlar, Germany), and photos taken by a digital camera (Q-Imaging, Micropublisher 3.3 RTV) attached to a Leica MZ APO stereomicroscope (Wetzlar, Germany) using Synoptics Auto-Montage version 5.0 software.

## Descriptions

## Genus Dolabraulax Quicke, 1986

Dolabraulax Quicke 1986: Ent. Mon. Mag. 122 (1): 18; Type species: Dolabraulax implicatus Quicke 1986.

General. This genus may be separated from all other Braconinae by the combination of the following characters: scapus small, ventrally shorter than dorsally with dorsoand medio-basal expansions; propodeum posteriorly with a mid-longitudinal carina; and first metasomal tergite with the median area formed into a transverse ridge.

Dolabraulax is a small genus with only one species known from Java and the biology is unknown (Quicke, 1984). In this study, three new species of this genus are recognized, i.e. D. jigongshanus sp. n., D. brevivena sp. n. and D. flavus sp. n., which are fully described and illustrated.

## Key to the species of Dolabraulax Quicke

1. Propodeum with a completely mid-longitudinal carina or arising from the middle of the hind margin; vein $1-\mathrm{SR}+\mathrm{M}$ of fore wing slightly and evenly
curved; smooth carina or band of second metasomal tergite relatively narrow baso-medially; fourth metasomal tergite with a transverse groove basally .... 2

- Propodeum with an incompletely mid-longitudinal carina, arising from the $1 / 3$ of the hind margin; vein $1-S R+M$ of fore wing straight; smooth carina or band of second metasomal tergite wide baso-medially ; fourth metasomal tergite without a transverse groove basally. 3

2. Frons weakly impressed behind each antennal socket, hardly divided by a raised, mid- longitudinal ridge; notauli impressed along its entire length (Fig. 1c); body largely yellowish brown; length of body 3.8 mm (central China).
D. jigongshanus sp. $\mathbf{n}$.

- Frons deeply impressed behind each antennal socket, and distinctly divided by a raised, mid-longitudinal region; notauli only anteriorly impressed; body largely brown to black; length of body 4.9 mm (eastern Java)
D. implicatus Quicke

3. Face with long setae medially; propodeum with a longitudinal impressed area medially, densely setose laterally; vein $r$ of fore wing short, 0.3 times as long as 2-SR (Fig. 3f); length of body 2.3 mm (eastern China)
D. brevivena sp. n.

- Face without long setae medially; propodeum without a longitudinal impressed area, but with a longitudinal carina medially, sparsely setose laterally (Fig. 2e); vein r of fore wing relatively long, 0.5 times as long as vein 2-SR (Fig. 2f); length of body 3.0-4.5 mm (south-western China)
D. flavus sp. n.


## Dolabraulax jigongshanus sp. n. <br> urn:lsid:zoobank.org:act:0C84C65B-4AE3-4AA3-9249-60F483729D64 <br> Figs 1a-g

Type specimens examined: Holotype: + , Jigongshan, Henan, 12-VII-1997, Chen Xue-xin, No. 974960. Paratypes: $1 q 1 \delta^{\top}$, Jigongshan, Henan, 12-VII-1997, Chen Xue-xin, No. 974894, 974881.

Description. Length of body 3.8 mm , fore wing 3.4 mm , and ovipositor sheath 5.5 mm .

Head (Figs 1a-b, d): Antennae with 29 segments; first flagellomere parallel-sided, 3.1 times as long as its maximum width, 1.1 and 1.2 times as long as the second and third flagellomeres, respectively; second and third ones 2.8 and 2.9 times as long as their maximum width, respectively; median flagellomeres 2.6 times as long as their maximum width; terminal flagellomere tapering apically, approximately 2.9 times as long as its basal width; medio- transversal clypeal carina without a row sparse long setae; height of clypeus: inter-tentorial distance: tentorio-ocular distance $=1: 3$ : 5 ; malar space 0.35 times as long as height of eye; face with sparse long setae; height of face: width of face: width of head $=11: 13: 16$; frons smooth and shiny, weakly impressed and without longitudinal ridge medially; shortest distance between posterior ocelli:


Figures Ia-g. Dolabraulax jigongshanus sp. n.: a head, frontal view b head, dorsal view $\mathbf{c}$ mesoscutum, dorsal view $\mathbf{d}$ antenna $\mathbf{e}$ fore and hind wings $\mathbf{f}$ all of metasomal tergites, dorsal view $\mathbf{g}$ apical metasomal tergite, lateral view.
diameter of posterior ocellus: shortest distance between posterior ocellus and eye $=2$ : 1: 7; vertex smooth and shiny, with sparse long setae medially.

Mesosoma (Fig. 1c): Mesosoma 1.8 times as long as its maximum height, smooth and shiny with sparse long setae mid-posteriorly; notauli deeply impressed anteriorly and shallow posteriorly with sparse short setae along its whole length; middle lobe of mesoscutum rather raised anteriorly and protruding in front of the lateral lobes; scutellar sulcus relatively wide and deep, distinctly crenulate; metanotum with a strongly raised area medially; propodeum glabrous, with a mid-longitudinal carina and sparse setae, relatively densely setose laterally.

Wing (Fig. 1e): Length of fore wing veins SR1: 3-SR: $\mathrm{r}=38$ : 11: 7; vein 1-SR+M of fore wing weakly bent; length of fore wing veins 2-SR: $3-S R: r-m=10: 11$ : 7; length of veins of hind wing $S C+R 1: 2-S C+R: 1 r-m=12: 4$ : 5 ; vein $2-S R+R$ of hind wing distinctly longitudinal; vein $\mathrm{C}+\mathrm{SC}+\mathrm{R}$ of hind wing with short thickened humeral bristles apically.

Leg: Length of fore femur: tibia: tarsus $=23: 26: 34$; length of hind femur: tibia: basitarsus $=25: 43: 9$, and 3.9, 10.0 and 8.0 times their maximum width, respectively; tibia of hind leg with weakly longitudinal groove medially; spurs of hind leg 0.35 and 3.1 times as long as its basitarsus; tarsal claws simple but with basal lobe.

Metasoma (Figs 1f, g): Metasoma distinctly longer than head and mesosoma combined, more or less parallel-sided; first tergite 1.3 times as long as its maximum apical width, with strongly raised area medio-apically and crenulate laterally, occupying fourfifths of its entire length; second tergite with medio-basal glabrous band reaching the suture between second and third tergites, and lateral depressed longitudinal grooves crenulate laterally, the remainder with rugulose sculpture; suture between second and third tergites deep and crenulate, wide medially and narrowed laterally; third tergite with distinct raised areas antero-laterally, smooth and shiny, with sparse setae apically; fourth-seventh tergites uniformly smooth and shiny, with sparse short setae apically; hypopygium acute apically, distinctly extending beyond apex of metasoma; ovipositor sheath 1.6 times as long as fore wing, with dense setae; ovipositor with teeth apicoventrally and without dorsal notch pre-apically.

Colour: Head dark yellow; antenna yellowish brown; face dark yellow; frons and vertex brown; mesosoma black; fore leg pale yellow, middle and hind legs dark yellow; pterostima yellowish brown; wings membrane pale grey, and veins dark yellow; metasomal tergites yellowish brown dorsally and pale yellow ventrally; ovipositor sheath yellowish brown.

Male: Similar to the female, but relatively small, length of body 3.5 mm , metasoma black.

Biology: Unknown.
Distribution: China (Henan).
Etymology: The new species is named after the type locality, Jigongshan in Henan (Central China).

Diagnosis: This species is similar to Dolabraulax implicatus Quicke, but differs from the latter by the characters listed in the key above.

## Dolabraulax flavus sp. n.

urn:lsid:zoobank.org:act:2AE73720-FF4D-4E89-91D0-215C8CDF352B
Figs 2a-h

Type specimens examined: Holotype: $q$, Guan Xian, Sichuan, 4-VIII-1980, He Junhua, No. 802020. Paratypes: 1 q, Guan Xian, Sichuan, 4-VIII-1980, He Jun-hua, No. 802020; 1才, Emeishan, Sichuan, 7-VIII-1980, He Jun-hua, No. 802092; 1 q, Shaoguan, Guangdong, 12-V-1992, Chen Xue-Xin No. 921492; 1 , Meifeng, Fujian, 27-VI-1962, Zhao Xiu-fu, No. 20004179.

Description. Length of body 2.3 mm , fore wing 3.0 mm , and ovipositor sheath 4.1 mm .

Head (Figs 2a-b, d): Antennae with 29 segments; first flagellomere parallel-sided, 2.9 times as long as its maximum width, 1.1 and 1.2 times as long as the second and third flagellomeres, respectively; second and third ones 2.7 and 2.8 times as long as their maximum width, respectively; median flagellomeres 2.6 times as long as their maximum width; terminal flagellomere tapering apically, approximately 3.2 times as long as its basal width; medio-transversal clypeal carina with a row sparse short setae; height of clypeus: inter-tentorial distance: tentorio-ocular distance $=9: 14: 22$; malar space 0.34 times as long as height of eye; face with sparse long setae, relatively dense laterally; height of face: width of face: width of head $=12: 15: 17$; frons smooth and shiny, weakly impressed, and without longitudinal ridge medially; shortest distance between posterior ocelli: diameter of posterior ocellus: shortest distance between posterior ocellus and eye $=2: 1: 7$; vertex smooth and shiny, with sparse long setae medially.

Mesosoma (Figs 2c, e): Mesosoma 1.6 times as long as its maximum height, smooth and shiny with sparse long setae mid-posteriorly; notauli deeply impressed half of the anterior and flat posteriorly with sparse long setae along its whole length; middle lobe of mesoscutum rather raised anteriorly and protruding in front of the lateral lobes; scutellar sulcus relatively wide and deep, with distinctly crenulate; metanotum with a strongly raised area medially; propodeum glabrous, with a mid-longitudinal impressed area and carina, arising from the $1 / 3$ of the hind margin, with sparse setae, relatively densely setose laterally.

Wing (Fig. 2f): Length of fore wing veins SR1: 3-SR: $\mathrm{r}=40$ : 11: 6; vein $1-\mathrm{SR}+\mathrm{M}$ of fore wing weakly bent only medially; length of fore wing veins 2-SR: 3-SR: r-m = 10: 11: 7; length of veins of hind wing $S C+R 1: 2-S C+R: 1 r-m=12: 5: 4$; vein $2-S R+R$ of hind wing distinctly longitudinal; vein $\mathrm{C}+\mathrm{SC}+\mathrm{R}$ of hind wing with short thickened humeral bristles apically.

Leg: Length of fore femur: tibia: tarsus $=20: 24: 29$; length of hind femur: tibia: basitarsus $=25: 38: 15$, and $3.9,10.5$ and 7.0 times their maximum width, respectively; tibia of hind leg with weakly longitudinal groove medially; spurs of hind leg 0.34 and 3.0 times as long as its basitarsus; tarsal claws simple but with basal lobe.

Metasoma (Fig. 2g, h): Metasoma distinctly longer than head and mesosoma combined, more or less parallel-sided; first tergite 1.4 times as long as its maximum apical width, with strongly raised area medio-apically, crenulate laterally, occupying


Figures 2a-h. Dolabraulax flavus sp. n.: a head, frontal view $\mathbf{b}$ head, dorsal view $\mathbf{c}$ mesoscutum, dorsal view $\mathbf{d}$ antenna $\mathbf{e}$ propodeum, dorsal view $\mathbf{f}$ fore and hind wings $\mathbf{g}$ all of metasomal tergites, dorsal view $\mathbf{h}$ apical metasomal tergite, lateral view.
three-fifths of its entire length; second tergite with medio-basal glabrous band hardly reaching the suture between second and third tergites, and lateral depressed longitudinal grooves crenulate laterally, the remainder with rugulose sculpture; suture between second and third tergites deep and crenulate, wide medially and narrow laterally; third tergite with distinct raised areas antero-laterally, smooth and shiny, with sparse setae apically; fourth tergite with transversal impressed groove basally; fourth-seventh tergites uniformly smooth and shiny, with sparse short setae apically; hypopygium acute apically, distinctly extending beyond apex of metasoma; ovipositor sheath 1.8 times as long as fore wing, with dense setae; ovipositor with teeth apico-ventrally and without dorsal notch pre-apically.

Colour: Head dark yellow; antenna yellowish brown; face yellow; frons and vertex yellowish brown; mesosoma blackish brown; fore leg pale yellow, middle and hind legs dark yellow; pterostima yellowish brown; wings membrane pale grey, and veins dark yellow; metasomal tergites yellowish brown dorsally and pale yellow apically and ventrally; ovipositor sheath yellowish brown.

Male: Similar to the female, but relatively small, length of body 2.2 mm , metasoma dark yellow.

Biology: Unknown.
Distribution: China (Fujian, Guangdong and Sichuan).
Etymology: The new species is named after the colour of body, which is largely yellowish.

Diagnosis: This species is similar to Dolabraulax implicatus Quicke, but differs from the latter by characters listed in the key above.

## Dolabraulax brevivena sp. n.

urn:lsid:zoobank.org:act:7F7F9C17-B822-409E-8A71-2A973ECD58A0
Figs 3a-g
Type specimens examined: Holotype: , Tianmushan, Zhejiang, 10-12, IX-1983, He Jun-hua, No. 83215. Paratypes: 3q , Tianmushan, Zhejiang, 10-12, IX-1983, He Jun-hua, No. 832137, 832141, 832142; 1ठ, west Tianmushan, Zhejiang, 16-V1988, Lou Xiao-ming, No. 883232; 1 Q, West Tianmushan, Zhejiang, 25-VI-1984, Zhu Xi-liang, No. 842055; 1q, Longwangshan, Anji, Zhejiang, 31- VIII-1993, He Jun-hua, No. 9310586; 19, Si’an, Changxing, Zhejiang, 1-V-1984, Yuan Rong-lan, No. 940522.

Description. Length of body $3.0-4.5 \mathrm{~mm}$, fore wing $3.5-4.0 \mathrm{~mm}$, and ovipositor sheath $5.0-5.5 \mathrm{~mm}$.

Head (Figs 3a-b, d): Antennae with 27 segments; first flagellomere parallel-sided, 3.0 times as long as its maximum width, 1.1 and 1.2 times as long as the second and third flagellomeres, respectively; second and third ones 2.5 and 2.7 times as long as their maximum width, respectively; median flagellomeres 2.6 times as long as their maximum width; terminal flagellomere tapering apically, approximately 3.4 times as


Figures 3a-g. Dolabraulax brevivena sp. n.: a head, frontal view b head, dorsal view $\mathbf{c}$ mesoscutum, dorsal view $\mathbf{d}$ antenna $\mathbf{e}$ all of metasomal tergites, dorsal view $\mathbf{f}$ fore and hind wings $\mathbf{g}$ apical metasomal tergite, lateral view.
long as its basal width; medio-transversal clypeal carina without a row sparse short setae; height of clypeus: inter-tentorial distance: tentorio-ocular distance $=2.5$ : 6: 4; malar space 0.36 times as long as height of eye; face with sparse long setae, relatively dense laterally; height of face: width of face: width of head =10:11:23; frons smooth and shiny, weakly impressed, without longitudinal ridge medially; shortest distance between posterior ocelli: diameter of posterior ocellus: shortest distance between posterior ocellus and eye $=2.5: 1: 7$; vertex smooth and shiny, with sparse long setae laterally.

Mesosoma (Fig. 3c): Mesosoma 1.8 times as long as its maximum height, smooth and shiny with dense long setae medio-posteriorly; notauli shallowly impressed half of the anterior and flat posteriorly with sparse long setae along its whole length; middle lobe of mesoscutum relatively raised anteriorlly and protruding in front of the lateral lobes; scutellar sulcus rather wide and deep, with distinctly crenulate; metanotum with a strongly raised area medially; propodeum glabrous, with a mid-longitudinal carina, arising from the $1 / 4$ of the hind margin, with sparse setae medially, but relatively densely long setose laterally.

Wing (Fig. 3f): vein $r$ of fore wing relatively short, length of fore wing veins SR1: 3-SR: $\mathrm{r}=37$ : 11: 6; vein 1-SR+M of fore wing weakly bent apically; length of fore wing veins 2-SR: 3-SR: $\mathrm{r}-\mathrm{m}=12$ : 11: 6; length of veins of hind wing $\mathrm{SC}+\mathrm{R} 1: 2-\mathrm{SC}+\mathrm{R}: 1 \mathrm{r}-\mathrm{m}$ $=15: 3.5$ : 5 ; vein $2-\mathrm{SR}+\mathrm{R}$ of hind wing distinctly longitudinal; vein $\mathrm{C}+\mathrm{SC}+\mathrm{R}$ of hind wing with short thickened humeral bristles apically.

Leg: Length of fore femur: tibia: tarsus $=21: 23: 29$; length of hind femur: tibia: basitarsus $=12: 11: 6$, and $4.1,10.0$ and 7.5 times their maximum width, respectively; tibia of hind leg with weakly longitudinal groove medially; spurs of hind leg 0.36 and 3.3 times as long as its basitarsus; tarsal claws simple but with basal lobe.

Metasoma (Figs 3e, g): Metasoma distinctly longer than head and mesosoma combined, more or less parallel-sided; first tergite 1.3 times as long as its maximum apical width, with strongly raised area medio-apically, crenulate laterally, occupying four-fifths of its entire length; second tergite with medio-basal glabrous band hardly reaching the suture between second and third tergites, and lateral depressed longitudinal grooves crenulate laterally, the remainder with rugulose sculpture; suture between second and third tergites deep and crenulate, wide medially and relative narrow laterally; third tergite with distinct raised areas antero-laterally, smooth and shiny, with sparse setae apically; fourth tergite without transversal impressed groove basally; fourth-seventh tergites uniformly smooth and shiny, with sparse short setae apically; hypopygium acute apically, distinctly extending beyond apex of metasoma; ovipositor sheath 1.8 times as long as fore wing, with dense setae; ovipositor with teeth apicoventrally and without dorsal notch pre-apically.

Colour: Head reddish yellow; antenna dark yellow; face reddish yellow; frons and vertex yellowish brown; mesosoma dark brown; fore leg pale yellow, middle and hind legs dark yellow; pterostima yellowish brown; wings membrane pale grey, and veins dark yellow; metasomal tergites yellowish brown dorsally and pale yellow apically and ventrally; ovipositor sheath yellow brown.

Male: Similar to the female, but relatively small, length of body 3.2 mm , metasoma dark yellow.

Biology: Unknown.
Distribution: China (Zhejiang).
Etymology: The new species is named after the character of vein $r$ of fore wing, which is relatively shorter.

Diagnosis: This species is similar to Dolabraulax implicatus Quicke, but differs from the latter by characters listed in the key above.

## Genus Scutibracon Quicke, 1989

Scutibracon Quicke 1989: Ento. Mon. Mag. 125: 19. Type species: Microbracon hispae Viereck 1913.

General. This genus can be recognized by the following characters: small wasps with body length less than 3.0 mm ; all flagellomeres more than twice times longer than wide; scapus small, shorter ventrally than dorsally in lateral view; face largely densely short-setose, smooth and shiny; frons distinctly impressed behind each antennal socket, short setose; scutellum densely and evenly setose; propodeum rather flat, with a complete mid-longitudinal carina; marginal cell of fore wing long, second submarginal cell of fore wing short, parallel-sided and robust, vein cu-a of fore wing distinctly postfurcal; claws with pointed basal lobes; first metasomal tergite with distinctly dorso-lateral carinae, second and third metasomal tergites enlarged, broad and short, and the third metasomal tergite more than 3.0 times wider than long medially. Species of this genus have been reared from Hispa armigera Olivier (Coleoptera: Hispidae) and Acrocercops cramerella Snellen (Lepidoptera: Gracilariidae).

Scutibracon is a small genus with only one known species from Indo-Australian (Quicke, 1984). In this study, one new species of this genus is added, Scutibracon fujianensis sp. n., which is described and illustrated below.

## Scutibracon hispae (Viereck, 1915)

Microbracon hispae Viereck 1915: Proc. U. S. Natn. Mus. 44: 639-648.
Bracon hispae: Watanabe 1937: J. Fac. Agric. Hokkaido Univ. 42: 1-188.
Scutibracon hispae Quicke and Walker 1989: Ent. Mon. Mag. 125 (1): 19-20; He et al. 2002: Forest insects of Hainan, 883.

Biology: According to the literature, it has been reared from Hispa armigera Olivier (Coleoptera: Hispidae), mostly on rice (Quicke 1989; He et al. 2002).

Distribution: China (Hunan, Taiwan and Hainan), India and Java.

## Scutibracon fujianensis sp. n.

urn:lsid:zoobank.org:act:56D83B91-84B3-479D-92B7-4F41304924F2
Figs 4a-i

Type specimens examined: Holotype: $\uparrow$, small Wuyishan, Fujian, 26-29-VII-1983, He Jun-hua, Ex. Acrocercops cramerella Snellen, No. 832849. Paratype: 1q, Zhangzhou, Fujian, 9-X-1983, Wu Huang-quan, No. 881417.

Description. Length of body 2.6 mm , fore wing 2.7 mm , and ovipositor sheath 0.7 mm .

Head (Figs 4a-b, d): Antennae as long as the fore wing, with 30 segments; scapus slightly flared apico-ventrally, distinctly weakly emarginated apico-laterally; first flagellomere parallel-sided, 1.5 times as long as the second flagellomeres; the latter 1.8 times as long as its maximum width; median flagellomeres 1.5 times as long as its maximum width; terminal flagellomere tapering apically, approximately 2.1 times as long as its basal width; medio-transversal clypeal carina with a row sparse short setae; height of clypeus: inter-tentorial distance: tentorio-ocular distance $=3: 6: 5$; malar space 0.23 times as long as height of eyes; face with dense short setae, width of face: width of head: maximum length of eye in dorsal view $=15: 28: 14$; frons smooth and shiny, densely short setose, strongly impressed and with longitudinal groove medially; shortest distance between posterior ocelli: diameter of posterior ocellus: shortest distance between posterior ocellus and eye $=2.5: 2: 6$; vertex smooth and shiny, with dense setae.

Mesosoma (Fig. 4c): Mesosoma 1.2 times as long as its maximum height, smooth and shiny, densely evenly short setae; notauli deeply impressed along its whole length; middle lobe of mesoscutum strongly raised anteriorlly; scutellar sulcus relatively wide and deep, with distinctly crenulate; metanotum with strongly raised area medially; propodeum glabrous, with a completely mid-longitudinal carina, and sparse setae medially, but relatively densely setose laterally.

Wing (Figs 4e, h): Length of fore wing veins SR1:3-SR: $r=27: 11: 7$; vein $1-S R+M$ of fore wing weakly bent; length of fore wing veins 2-SR: 3-SR: $\mathrm{r}-\mathrm{m}=9: 11$ : 6; vein $\mathrm{cu}-\mathrm{a}$ of fore wing distinctly postfurcal. Length of veins of hind wing $\mathrm{SC}+\mathrm{R} 1: 2-\mathrm{SC}+\mathrm{R}$ : $1 \mathrm{r}-\mathrm{m}=11: 2$ : 4 ; vein $\mathrm{C}+\mathrm{SC}+\mathrm{R}$ of hind wing without thickened humeral bristles apically.

Leg: Length of fore femur: tibia: tarsus $=15: 19: 23$; length of hind femur: tibia: basitarsus = 22: 28: 12, and 3.2, 4.7 and 4.2 times their maximum width, respectively; tibia of hind leg without longitudinal groove medially; spur of hind leg 0.36 and 3.2 times as long as its basitarsus; tarsal claws simple and without basal lobe.

Metasoma (Figs 4f, g, i): Metasoma short and robust, evenly irregularly sculptured, slightly shorter than head and mesosoma combined; first metasomal tergite 1.3 times as wide as its maximum median long, with strongly raised area mid-apically occupying two-threes of its entire length, posterior part with coarse foveate rugose sculpture; second tergite without mid-basal triangular area, 2.0 times as long as its maximum width, with sub-lateral grooves medio-basally, extending to half of its entire length; third tergite broad and short, 2.7 times as wide as median long; suture between


Figures 4a-i. Scutibracon fujianensis sp. n.: a head, frontal view $\mathbf{b}$ head, dorsal view $\mathbf{c}$ mesoscutum and propodeum, dorsal view $\mathbf{d}$ head, lateral view $\mathbf{e}$ hind wing $\mathbf{f}$ first metasomal tergite, dorsal view $\mathbf{g}$ apical metasomal tergite, lateral view $\mathbf{h}$ fore wing $\mathbf{i}$ all of metasomal tergites, dorsal view.
second and third tergites deep and crenulate, moderately wide; four tergite 0.5 times as long as third tergite medially; sixth-seventh tergites invisible, hypopygium short, acute apically, hardly extending beyond apex of metasoma; ovipositor sheath 0.25 times as long as fore wing, with dense setae; ovipositor without teeth apico-ventrally and dorsal notch pre-apically.

Colour: Head yellow except for interocellar area black; mesosoma orange yellow but media and lateral lobes of mesoscutum with blackish spots; fore leg pale yellow, middle and hind legs dark yellow; wings membrane smokish grey, and veins yellowish brown; propodeum pale brown; metasomal tergites largely pale yellow but second metasomal tergite with blackish spots mid- apically, third metasomal tergite with black medially, four metasomal tergite with blackish spots sub-laterally; ovipositor sheath blackish brown.

Biology: Based on labels of type specimens, the host of this species is Acrocercops cramerella Snellen (Lepidoptera: Gracilariidae).

Distribution: China (Fujian).
Etymology: The new species is named after the name of Fujian province, where the type specimens are collected.

Diagnosis: This species is similar to Scutibracon hispae (Viereck), but distinctly differs from the latter by having the vein $r$ of fore wing longer, 0.6 times as long as vein 3-SR (Fig. 4h); the second tergite without a mid-basal triangular area, 2.0 times as long as its maximum width, with sublateral longitudinal grooves medio-basally, extending to half of its length (Fig. 4i); the interocellar area black (Fig. 4b); the middle and lateral lobes of mesoscutum with distinct blackish spots (Fig. 4c); the second- fourth tergites with blackish spots medio-apically, medially and sublaterally, respectively (Fig. 4i) and the length of body more than 3.0 mm .

## Acknowledgements

We thank Drs C. van Achterberg (Leiden, The Netherlands) and Donald L. J. Quicke (London, UK) for their providing lots of invaluable literature. We also thank anonymous reviewers for their important comments. Funding for this study was provided jointly by the National Science Fund for Distinguished Young Scholars (30625006), the 973 Program (2006CB102005), the National Science Foundation of China (No. 30970384, 30700063, 30499341), and the National Special Basic Research Funds (2006FY110500-3, 2006FY120100) and Postdoctoral Science Foundation of China (20090451482).

## References

Achterberg C van (1979) A revision of the subfamily Zelinae auct (Hymenoptera: Braconidae). Tijdschrift voor Entomologie, 122: 241-479.

Harris RA (1979) A glossary of surface sculpturing. Occasional Papers of the Bureau of Entomology of the California Department of Agriculture 28: 1-31.
He JH, Chen XX, Ma Y (2002) Braconidae. In: Huang FS (Ed) (2002) Forest insects of Hainan. Beijing: Science publishing house, 882-883.
Quicke DLJ (1986) Seven new genera and species of Braconinae (Hymenoptera, Braconidae) from Australia and Indonesia. Entomologist's Monthly Magazine 122: 9-29.
Quicke DLJ (1987) The Old World genera of braconine wasps (Hymenoptera: Braconidae). Journal of Natural History 21: 43-157.
Quicke DLJ (1989) A new Indo-Australian genus of Braconinae (Hym., Braconidae). Entomologist's Monthly Magazine 125: 19-24.
Quicke DLJ, Ingram SN (1993) Braconine wasps of Australia. Memoirs of the Queensland Museum 33 (1): 299-336.
Shenefelt RD (1978) Hymenopterorum catalogus (nov. editio). Pars 15. Braconidae 10. Braconinae, Gnathobraconinae, Mesostoinae, Pseudodicrogeniinae, Telengainae, Ypsistocerinae plus Braconidae in general, major groups, unplaced genera and species. Dr. W. Junk B.V., The Hague, Holland, 1425-1872.

Viereck HL (1915) Descriptions of six new genera and twelve new species of Ichneumon-flies. Proceedings of United State national Museum 44: 639-648.
Wang YP, Chen XX, He JH (2003a) Taxonomic studies on the subtribe Aphrastobraconina Ashmead (Hymenoptera: Braconidae, Braconinae) in China. Entomologica Fennica 14: 118-124.
Wang YP, Chen XX, He JH (2003b) First Chinese record of the genus Trispinaria Quicke (Hymenoptera: Braconidae, Braconinae) and a description of a new species. Acta Zootaxonomica Sinica 28: 333-335.
Wang YP, Chen XX, He JH (2003c) The genus Testudobracon Quicke in eastern China and the descriptions of three new species (Hymenoptera: Braconidae: Braconinae). European Journal of Entomology 100: 411-416
Wang YP, Chen XX, He JH (2003d) The discovery of the genus Shelfordia Cameron (Hymenoptera: Braconidae, Braconinae) in China, with description of one new species. Entomologia Sinica 10: 215-220.
Wang YP, Chen XX, He JH (2004) A review of Bracon (Rostrobracon) (Hymenoptera: Braconidae: Braconinae) from China, with description of new species. Oriental Insects 38: 341-346.
Wang YP, Chen XX, He JH (2006a) The discovery of genus Spinadesha Quicke of tribe Adeshini van Achterberg (Hymenoptera: Braconidae: Braconinae) in China, with description of one new species. Biologia 61: 145-147.
Wang YP, Chen XX, He JH (2006b) Three genera with eyes setose of Braconinae (Hymenoptera: Braconidae) in China, with the description of one new species. Entomotaxonomia, 28: 131-138.
Wang YP, Chen XX, He JH (2006c) The genus Pseudoshirakia van Achterberg (Hymenoptera: Braconidae) from China. The Pan-Pacific Entomologist 81: 46-49.
Wang YP, Chen XX, Wu H, He JH (2006d) The genus Coeloides Wesmael of subfamily Braconinae (Hymenoptera: Braconidae) in China. Zootaxa 1239: 1-17.

Wang YP, Chen XX, He JH (2007) The genera Aspidobracon van Achterberg and Philomacroploea Cameron (Hymenoptera: Braconidae: Braconinae) in China, with descriptions of two new species. Annals of the Entomological Society of America 100(3): 390-393.
Wang YP, Shi M, He JH, Chen XX (2008) Taxonomic study of the tribe Iphiaulacini (Hymenoptera: Braconidae: Braconinae) from China, with descriptions of two new species. Entomotaxonomia, 30(3): 181-195.
Wang YP, Shi M, He JH, Chen XX (2009a) The genus Atanycolus Foerster (Hymenoptera, Braconidae, Braconinae) in China with description of one new species. ZooKeys 27: 31-41.
Wang YP, Chen XX, Wu H, He JH (2009b) A new parasitoid (Hymenoptera: Braconidae) of Monochamus alternatus (Coleoptera: Cerambycidae) in China. Biologia 64(5): 1-5.
Watanabe C (1937) A Contribution to the knowledge of the Braconidae Fauna of the Empire of Japan (Hymenoptera). Journal of The Faculty Agriculture, Hokkaido (imp.) University Sappora 42(1): 1-187.

# The genus Arhaconotus Belokobylskij (Hymenoptera, Braconidae, Doryctinae) from China, with description of a new species 

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Academic editor: Kees van Achterberg| Received 27 May 2010 | Accepted 1 September 2010 | Published 13 October 2010
urn:lsid:zoobank.org:pub:9D9FB186-917E-4457-8120-85D0297C91A4
Citation: Tang P, He JH, Chen XX (2010) The genus Arhaconotus Belokobylskij (Hymenoptera, Braconidae, Doryctinae) from China, with description of a new species. ZooKeys 61: 63-68. doi: 10.3897/zookeys.61.488


#### Abstract

The genus Arhaconotus Belokobylskij (Hymenoptera: Braconidae, Doryctinae) is recorded for the first time from China. A new species of this genus, $A$. hainanensis Tang \& Chen, sp. n., is described and illustrated. A key to the species of this genus is updated to include the new species.


## Keywords

Hymenoptera, Braconidae, Doryctinae, Araconotus, new species, new record, Oriental region, China

## Introduction

The genus Arhaconotus Belokobylskij (Hymenoptera, Braconidae, Doryctinae) was described in 2000 by S.A. Belokobylskij (Belokobylskij 2000). To date three species of the genus have been described, of which one occurs in the Australasian region and two in the Oriental region (Belokobylskij 2000, 2001). During our study of Chinese

Braconidae, we discovered a new species of this genus. It represents the first record of this genus from China. In the present paper, the new species, $A$. hainanensis Tang \& Chen, sp. n., is described and illustrated and an updated key to the genus Arhaconotus is added.

## Material and methods

The terminology and measurements used follow van Achterberg (1979, 1988). Additional sources for the description of sculpture and setation are Belokobylskij (2001). All descriptions and measurements were made under a Leica MZ 12.5 microscope, and all figures were made by a digital camera (Q-Imaging, Micropublisher, 3.3 RTV) attached to a stereomicroscope (Leica MZ APO, Germany) and Auto-Montage Pro version 5.0 software. Type specimens and other materials are deposited in the Parasitic Hymenoptera Collection of the Zhejiang University, Hangzhou, China (ZJUH).

## Taxonomy

## Arhaconotus hainanensis Tang \& Chen, sp. n.

urn:lsid:zoobank.org:act:C2DEBB99-C921-4CE8-AE2E-E1DEE8ABCB50
Figs 1-8

Material examined. Holotype: $\uparrow$, China, Hainan Prov., Bawangling, 9-10.VI.2007, Liu Jingxian, No. 200703484 (ZJUH). Paratypes: China, Hainan Prov.: 1q, Jianfengling, 5-7.VI.2007, Weng Liqiong, No. 200806631; 1q, Jianfengling Tianchi, 22-23.X.2007, Liu Jingxian, No. 200710486 (ZJUH).

Description. Female. Body length 3.2 mm ; fore wing length 2.9 mm .
Head. Width 1.4 times its median length. Antennae slender, almost filiform, 32 -segmented. Scapus 1.6 times as long as maximum width. First flagellar segment 6 times as long as its apical width, almost equal to second segment. Penultimate segment 4.8 times as long as wide, 0.7 times as long as first segment, 0.9 times as long as apical segment. Eye 2.6 times as long as temple in dorsal view. Ocelli medium-sized, in triangle with base almost equal to its sides. POL: $\mathrm{OD}: \mathrm{OOL}=3: 3: 6$. Temple finely granulate ventrally. Vertex and frons densely granulate. Vertex with very sparse, short setosity. Eye glabrous, 1.2 times as high as broad. Face finely granulate-coriaceous, its width 1.2 times height of eye, 1.4 times height of face and clypeus combined. Malar space 0.3 times height of eye, 0.7 times as long as basal width of mandible. Malar suture absent. Occipital carina complete dorsally, not fused with hypostomal carina ventrally.

Mesosoma. Length 2.3 as long as its height. Pronotal carina fine, distinctly separated from posterior margin of pronotum; distances from carina to posterior and anterior margins of pronotum subequal. Mesoscutum entirely densely and evenly pubescent, densely granulate, highly and roundly raised above pronotum; its me-


Figures I-I0. Arhaconotus hainanensis sp. n. I habitus, lateral aspect $\mathbf{2}$ head, frontal aspect $\mathbf{3}$ head, dorsal aspect $\mathbf{4}$ first-fourth abdominal tergites, dorsal aspect $\mathbf{5}$ fifth-sixth abdominal tergites, dorsal aspect $\mathbf{6}$ posterior margin of the sixth tergite, dorsal aspect $\mathbf{7}$ fore and hind wings $\mathbf{8}$ mesosoma, lateral aspect $\mathbf{9}$ metasoma, lateral aspect $\mathbf{1 0}$ first and second tergites, lateral aspect. scale bar: 5 mm
dian lobe without median depression. Notauli deep, complete, crenulate. Scutellum densely granulate. Prescutellar depression deep, 0.5 times as long as scutellum. Mesopleuron densely coriaceous and its upper third longitudinally striate. Precoxal sulcus deep, coriaceous, weakly curved, running along anterior $2 / 3$ of mesopleuron, connected with prepectal carina. Prepectal carina distinct, wide ventrally, without widened lobes opposite to fore coxa. Propodeum with median carina in basal third, and without marginate areola; basolateral areas distinctly marginate, coriaceous; rest part of propodeum rugulose laterally and in posterior half.

Wings. Fore wing 3.3 times as long as maximum width. Vein r arising slightly before middle of pterostigma. 3-RS forming very obtuse angle with r. 3-RS: r: SR1= 24: 9: 40. Second submarginal cell large, 3 times as long as maximum width, 1.4 times as long as first subdiscal cell, almost equal to first discal cell. 1-SR+R weakly S-curved. $\mathrm{m}-\mathrm{cu}$ postfurcal. 1-CU1 almost equal to cu-a. Cula interstitial. Hind wing, $\mathrm{M}+\mathrm{CU}$ 0.6 times as long as $1-\mathrm{M}$. m-cu weakly curved, antefurcal and pigmented.

Legs. Hind coxa granulate. Hind femur coriaceous, 3.3 times as long as wide, with weak dorsal protuberance. Hind tibia with rather long, dense setae dorsally. Hind tarsus almost as long as hind tibia. Hind basitarsus 0.8 times as long as second-fifth segments combined; second tarsal segment 0.4 times as long as basitarsus, 1.3 times as long as fifth segment (excluding pretarsus).

Metasoma. Almost as long as mesosoma and head combined, with 6 visible tergites. First tergite entirely, distinctly longitudinally striate, its apical width 1.6 times its minimum width; its length 1.2 times as long as its maximum width. At most part of second tergite distinctly longitudinally striate, with a distinctly separated, smooth basal area and a rather wide smooth apical area, median length of second tergite 0.7 times as long as its basal width. Second suture deep and wide. Second-fifth tergites densely striate-punctulate in entire lateral parts. Third-fifth tergites in basal halves (their apical halves smooth) distinctly longitudinally striate. Sixth tergite rather large, densely punctulate on basal half, semicircularly striate on apical half, regularly rounded on apical margin with a shallow median emargination. Ovipositor sheath 1.2 times as long as metasoma and 0.6 times as long as fore wing.

Colour. Head reddish yellow. Mesonotum and apex of metasoma reddish brown; rest part of mesosoma and metasoma black. Basal quarter of antenna reddish brown, remainder dark reddish brown to black. Palpi pale yellow. Legs entirely yellow, sometimes hind coxa infuscate. Ovipositor sheath dark brown, paler basally. Wings faintly infuscate. Pterostigma brown, yellow in basal third and in apical 1/4.

Male. Unknown.
Variation. Body length $2.8-2.9 \mathrm{~mm}$; fore wing length $2.6-2.7 \mathrm{~mm}$. Fore wing 3.9 times as long as maximum width, 3-RS: r: SR1=21: 6: 39. Second submarginal cell 3 times as long as maximum width. Median length of second tergite 0.8 as long as its basal width.

Diagnosis. This new species is similar to $A$. vietnamicus Belokobylskij, but differs in antenna longer; sixth tergite densely punctulate on basal half and semicircu-
larly striate on apical half, its apical margin with a shallow median emargination; second to fifth tergites densely striate-punctulate in entire lateral parts, and metasoma black.

Distribution. China (Hainan).
Etymology. From the Hainan province, type locality of the species.

## Key to species of genus Arbaconotus Belokobylskij

1. Vertex and most part of mesosoma smooth; sixth tergite without medio-posterior emargination; propodeum with marginate areola $\qquad$ A. papuanus Belokobylskij

- Vertex granulate or coriaceous and most part of mesosoma granulate; sixth tergite with medio-posterior emargination; propodeum without marginate areola 2

2. Ovipositor sheath longer, 0.85 times as long as fore wing; lateral lobes of mesoscutum glabrous at large part; hind femur 3.8 times as long as wide
A. ishigakiensis Belokobylskij

- Ovipositor sheath shorter, $0.6-0.65$ times as long as fore wing; lateral lobes of mesoscutum entirely setose; hind femur 3-3.3 times as long as wide3

3. Sixth tergite densely punctulate on basal half and semicircularly striate on apical half, its apical margin with a shallow median emargination; secondfifth tergites densely striate-punctulate in entire lateral parts; metasoma black; antenna 32-segmented
A. hainanensis sp. n.

- $\quad$ Sixth tergite entirely semicircularly striate, its apical margin with a distinct median emargination; second-fifth tergites densely striate in entire lateral parts; metasoma reddish brown; antenna 27-segmented $\qquad$
A. vietnamicus Belokobylskij


## Acknowledgements

Funding for this study was provided jointly by the National Science Fund for Distinguished Young Scholars (30625006), the National Natural Science Foundation of China (30700063, 30970384), and the National Special Basic Research Funds (2006FY110500-3, 2006FY120100).

## References

Belokobylskij SA (2000) Two new Oriental-Australian genera of Dorycinae (Hymenoptera: Braconidae) with immovably fused first three metasomal tergites. Russian Entomological Journal 9: 345-351.

Belokobylskij SA (2001) New species of the genera Rhaconotus Ruthe, Ipodoryctes Granger and Arhaconotus Blkb. from the Oriental region (Hymenoptera: Braconidae, Doryctinae). Zoosystematica Rossica 10: 101-162.
van Achterberg C (1979) A revision of the subfamily Zelinae auct. (Hymenoptera, Braconidae). Tijdschrift voor Entomologie 122: 241-479.
van Achterberg C (1988) Revision of the subfamily Blacinae Foerster (Hymenoptera: Braconidae). Zoologische Vergandelingen (Leiden) 249: 1-324.

# The genus Ptilophora (Lepidoptera, Notodontidae) in China, with description of a new species 

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Academic editor: Erik van Nieukerken| Received 7 June 2010 | Accepted 23 August 2010 | Published 13 October 2010
urn:lsid:zoobank.org:pub:666562FA-65C6-4B4C-9AA1-281CAB863A28
Citation: Chen L et al. (2010) The genus Ptilophora (Lepidoptera, Notodontidae) in China, with description of a new species. ZooKeys 61: 69-75. doi: 10.3897/zookeys.61.494


#### Abstract

The genus Ptilophora Stephens in China is briefly reviewed, with the description of $P$. nanlingensis sp. n. The new species is most similar to $P$. horieaurea in wing pattern and to $P$. jezoensis in male genitalia, but they can be distinguished from each other by the following characters: forewing bright reddish brown in P. nanlingensis, chestnut brown in $P$. horieaurea; costa of male genitalia pointed, with a rounded subapical process ventrally in $P$ ? jezoensis, costa rounded, with apex inflated, and with pointed subapical process ventrally in P. nanlingensis. A key to the Ptilophora species from China and adjacent areas is presented and a distribution map is given. The holotype of the new species is deposited in the Department of Entomology, South China Agricultural University, P. R. China.


## Keywords

Lepidoptera, Notodontidae, Ptilophora, new species

## Introduction

The notodontid genus Ptilophora was established by Stephens in 1828 with Phalaena variegata Villers, 1789 as its type species. Currently, the genus consists of six species that are distributed in Europe (except northern Europe and the Iberian Peninsula), Caucasus, Asia minor, China, Far East Russia, Korea and Japan (Sugi 1982; Schintlmeister 1984; Kobayashi 1994; Wang 1996; Park et al. 1999; Wu and Fang 2003; Schintlmeister 2008). Hitherto, three species of the genus are restricted to China, P. rufula from Taiwan, and $P$. ala and P. horieaurea from mainland China. Adults of Ptilophora species emerge in late autumn. Schintlmeister and Fang (2001) described P. jezoensis ala as a new subspecies of P. jezoensis in Shaanxi Province; later, Kishida and Kobayashi (2002) revised the genus Ptilophora, divided the species into two species-groups: plumigera group and jezoensis group, and described two new species belonging to the jezoensis group from South West China: P. horieaurea Kishida
 raised $P$. ala to species, based on comparing the types of P. ala with those of P. fuscior, and reduced $P$. fuscior to a junior synonym of $P$. ala. In this paper, a new species of Ptilophora is described from China.

## Key to the species of Ptilophora Stephens from China and adjacent areas

1 Antenna black; forewing with a prominent discal spot; median fascia of hindwing blackish; male genitalia with rounded valve ........................................ 2

- Antenna brown to chestnut brown; forewings without prominent discal spot, median fascia of hindwing whitish or absent; male genitalia with irregular valves
2 Postmedian fascia of forewing is angled at $\mathrm{M}_{1}$; male genitalia with broad uncus, valve with a large harpe....................................................P. nohirae
- Postmedian fascia of is not angled at $\mathrm{M}_{1}$; uncus of male genitalia narrow, valve with a small triangular harpe ..................................................P. rufula
3 Color of forewing distal to postmedian fascia darker than basal and median areas of forewing; postmedian fascia distinct whitish, uniform from costal margin to inner margin P. ala
- Color of forewing distal to postmedian fascia similar to basal and median areas of forewing; postmedian fascia enlarged into white wedge-shaped spot at costal margin4

4 Forewing pale reddish brown, with two distinct rather straight whitish fasciae ........................................................................................... P. jezoensis

- Forewing reddish brown to chestnut brown, basal fascia indistinct ............. 5

5 Ground color of forewing uniformly bright reddish brown; a dusting of pale blue-gray scales in median and terminal areas of forewing; postmedian fascia white in costal area; frons near base of antennae with whitish hairs; thorax
with similar long hairs at base of forewing; uncus with a triangular ventralmiddle process, lateral processes serrated; valve with a triangular ventral process subapically $\qquad$ P. nanlingensis sp. n.

- Ground color of forewing chestnut brown; postmedian fascia yellowish brown in costal area; frons, thorax, and abdomen with yellowish-brown hairs; uncus with blunt ventral-middle process, lateral processes with smooth margins; valva with a rounded ventral process subapically $\qquad$ P. borieaurea


## Taxonomy

## Ptilophora ala Schintlmeister \& Fang, 2001

Ptilophora jezoensis ala Schintlmeister and Fang 2001: 88; Kishida and Kobayashi 2002: 87; Wu and Fang 2003: 650.
Ptilophora fuscior Kishida and Kobayashi 2002: 87 [synonymised by Schlintlmeister, 2008]. Ptilophora ala; Schintlmeister 2008: 323 [raised to species].

Notes. This species can be distinguished by the postmedian fascia of the forewing, which is distinctly whitish, and the darker shading beyond the postmedian fascia.

Distribution: China (Shaanxi and Sichuan Provinces).

## Ptilophora horieaurea Kishida \& Kobayashi, 2002

Ptilophora horieaurea Kishida and Kobayashi 2002: 89.

Notes. This species can be distinguished by external characters: frons, thorax, and abdomen covered with yellowish-brown hairs, the postmedian fascia is covered with yellowish brown in the posterior and costal areas.

Distribution: China (Sichuan Province).

## Ptilophora nanlingensis sp. n.

urn:lsid:zoobank.org:act:DA4A2641-4B7C-4102-BAE7-28578EB7E833
Figs 1-6

Diagnosis. The new species belongs to the $P$. jezoensis species group based on the wing pattern and male genital structure: forewing with distinct, whitish postmedian fascia, costa inflated and angulated apically. In the wing pattern, it seems to be closely related to $P$. horieaurea, whereas the male genital structures seem closer to those of $P$. jezoensis, but the two species can be distinguished from each other by the following characters:


Figures I-2. Adults of Ptilophora nanlingensis sp. n. I male adult $\mathbf{2}$ female adult.
forewing bright reddish brown in P. nanlingensis, chestnut brown in P. horieaurea; uncus three-dimentional, and the costa of the valve with a rounded subapical ventral process in $P$. jezoensis, uncus three-dimensional, bifurcated apically, with serrated edges, and costa of valve rounded with apex inflated and with pointed subapical ventral process in P. nanlingensis (see Figs 3-5).

Description. Male. Forewing length $15-18 \mathrm{~mm}$. Antenna plumose, about 0.5 x length of forewing, with yellowish-white hairs at base. Thorax and abdomen with dark reddish-brown hair. Forewing ground color from bright reddish brown to fuscous brown; chocolate toward costal and posterior margins, fuscous in terminal area; antimedian fascia visible, straighter than postmedian fascia; postmedian fascia distinct, whitish, slightly convex at vein $\mathrm{M}_{1}$, forming a triangular whitish spot at costa, brighter at veins; outer margin with ground color covered with pale blue-gray scales; cilia dark brown. Hindwing fuscous; postmedial fascia absent, a whitish spot near tornus, cilia from apex to middle of outer margin yellowish brown, fuscous brown toward tornus.

Female. Similar to male except forewing length $17 \mathrm{~mm}(\mathrm{n}=1)$; antenna filiform; vertex, thorax and forewing uniform fuscous brown, abdomen yellowish brown.

Male genitalia. Uncus three-dimensional, bifurcated apically, with serrated edges; a long triangular ventral process derive from middle of branches, smooth ventrally, slightly serrated dorsally. Socii heavily sclerotized with two horn-shaped processes. Tegumen short and broad. Valva broad with a large triangular subapical process ventrally; costa rounded with apex inflated, cucullus quadrangular; sacculus with a triangular central process, with dense setae from middle to apex. Aedeagus slender, slightly curved dorsally near caudal end, carina penis serrated dorsally.

Female genitalia. Papilla analis rather broad, covered with thin hairs; the apophysis anterior shorter than apophysis posterior; ostium wide, well sclerotized; ductus bursae very lightly sclerotized, inflated mesially; corpus bursae small, membranous.

Holotype. Male, Nanling, Shaoguan, Guangdong, China, 15.XII.2008, Hou-Shuai Wang leg.. Deposited in the Department of Entomology, South China Agricultural University, Guangzhou, P. R. China.

Paratypes. 1 female, Nanling, Shaoguan, Guangdong, China, 21.IX.2006, Min Wang leg.; 3 males, Nanling, Shaoguan, Guangdong, China, 2.XII.2007, Liu-Sheng


Figures 3-6. Genital structure of Ptilophora nanlingensis sp. n. $\mathbf{3}$ valva $\mathbf{4}$ aedeagus 5 uncus $\mathbf{6}$ female genitalia.

Chen leg.; 3 males, 3.XII.2008, Liu-Sheng Chen and Hou-Shuai Wang leg., Nanling, Shaoguan, Guangdong, China; 1 male, 10.XII.2009, Hou-Shuai Wang leg., Nanling, Shaoguan, Guangdong, China. Deposited in the Department of Entomology, South China Agricultural University, Guangzhou, P. R. China. 2 males, 1 female, Yuecheng Ling, Guangxi, China, $1800 \mathrm{~m}, 2^{\circ}{ }^{\circ} 6^{\prime} \mathrm{N}, 110^{\circ} 54^{\prime} \mathrm{E}, 5-8 . X I I .2007$, Viktor Siniaev leg. Deposited in coll. A. Schintlmeister, Dresden.

Etymology. The specific name is derived from the type locality: Nanling Nature Reserve, Shaoguan City, Guangdong Province.

Bionomics. Bionomics. The moths were collected at light near $10^{\circ} \mathrm{C}$ the late autumn.
Remarks. The adults of Ptilophora emerge late autumn, some species even flying at temperatures near $0^{\circ} \mathrm{C}$ (Kishida and Kobayashi 2002). However, adult of $P$. nanlingensis fly at slightly higher temperature, close to $10^{\circ} \mathrm{C}$ late autumn, which is unusual for the genus.

## Ptilophora rufula Kobayashi, 1994

Ptilophora rufula Kobayashi 1994: 17; Wang 1996: 201; Schintlmeister 2008: 322. Ptilophora jezoensis rufula: Shintlmeister and Fang 2001: 22 [sunk as subspecies].


Figure 7. Distribution of Chinese Ptilophora species

Notes. Kobayashi (1994) described P. rufula in Taiwan. Schinltmeister and Fang (2001) listed it as a subspecies of P. jezoensis without any explanation. Kishida and Kobayashi (2002) revalidated it as a species. It belongs to the plumigera group, based on the round valva in the male genitalia.

Distribution: This species is restricted to Taiwan.

## Acknowledgements

We are greatly indebted to Dr. Mamuru Owada (National Science Museum, Tokyo, Japan), Mr. Yasunori Kishida and Dr. Hideki Kobayashi (Tokyo, Japan) for their kind suggestions and help with the manuscript. Our thanks also go to Mr. Yue-Ning Gong (the director of the Nanling National Reserve, China), Mr. He-Shan Chen, Mr. GuoYi Wu, Mr. Hou-Shuai Wang and Mr. Yang Long (South China Agricultural University, China) for their welcome help in field work. The first author wishes to thank Dr. Alexander Schintlmeister (Germany) for his cordial support on his studies in many ways. research was partly by the ProvincNatural Science Foundation of Hunan, (no. 09JJ6028).

## References

Kishida Y, Kobayashi H (2002) Two new species of the genus Ptilophora (Lepidoptera, Notodontidae) from China. Tinea 17 (2): 86-91.
Kobayashi H (1994) A new species of genus Ptilophora (Notodontidae) from Taiwan. Japan Heterocerists' Journal 177: 17-19.
Park KT, Kim SS, Tshistjakov YA, Kwon YD (1999) Illustrated Catalogue of Moths in Korea (I). In: Park KT (Ed) Insects of Korea [Series 4]. Books LLC, Seoul, 290 pp.

Sugi S (1982) Notodontidae. In: Inoue H, Sugi S, Kuroko H, Moriuti S, Kawabe A (Eds) Moths of Japan, Kodansha, Tokyo, I: 329 pp., II: 625 pp.
Schintlmeister A (1984) Zum Status einiger fernöstlicher Taxa Notodontiden-Studien I. Zeitschrift der Arbeitsgemeinschaft Österr. Entomologen 35: 106-112.
Schintlmeister A, Fang CL (2001) New and less known Notodontidae from mainland China. Neue Entomologische Nachrichten 50: 88.
Schintlmeister A (2008) Palaearctic Macrolepidoptera: Notodontidae. Apollo Books, Stenstrup, 321-324.
Wang XY (1996) Guide book to insect in Taiwan (17). Chu Hai Publishing Co., Taibei, 201 pp.
Wu CS, Fang CL (2003) Lepidoptera: Notodontidae. Fauna Sinica, Insecta. Science Press, Beijing, 649-651.


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