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The status of the genus Bostryx Troschel, 1847, with description of a new subfamily (Mollusca, Gastropoda, Bulimulidae)

Abraham S.H. Breure[1,†]

1 *Netherlands Centre for Biodiversity Naturalis, P.O. Box 9517, 2300 RA Leiden, the Netherlands*

† *urn:lsid:zoobank.org:author:A4D47A33-9B0B-4FC5-9260-055562CF12EF*

Corresponding author: *Abraham S.H. Breure* (ashbreure@gmail.com)

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Abstract
The status of the genus *Bostryx* is discussed and, based on morphological and molecular data, restricted to a group of species related to *B. solutus*, for which the new subfamily name Bostrycinae is introduced.

Keywords
Orthalicoidea, taxonomy, Bostrycinae subfam. n.

Introduction

Troschel (1847: 49) described a new, peculiar land snail, as *Bulimus* (*Bostryx*) *solutus*. He wrote: "Diese durch Herrn Dr. von Tschudi in Peru in vielen Exemplaren gesammelte Art ist so eigenthümlich, dass ich überzeugt bin, sie werde bei einer naturgemässen Theilung der Gattung *Bulimus*, wovon die Notwendigkeit nach meinem anatomischen Untersuchungen keinen Zweifel unterliegt, eine eigene Gattung bilden, für die ich den Namen *Bostryx* vorschlage". However, Troschel's conviction that *Bostryx* constituted a separate genus was not readily accepted. Most authors (e.g. Pilsbry 1896 [1895–1896], Thiele 1931) regarded it as a subgenus of *Bulimulus* Leach, 1814. It was not until 1944 when Pilsbry used it as a separate genus (Pilsbry 1944). Subsequent authors have classified many other taxa as subgenera — based purely on shell shape — within *Bostryx* (e.g. Zilch 1960 [1959–1960], Schileyko 1999). Breure (1979) in his revision of the Bulimulidae, using the external shell morphology and internal anatomical characters, listed 22 taxa as synonyms of *Bostryx* (*s.l.*) and 274 available names at the species-level. He wrote: "It has been mentioned before that a number of species groups may be recognized with *Bostryx* (sensu lato) that correspond more or less with some of the 'subgenera' listed in the above-mentioned synonymy. There are, however, a rather large number of taxa that can not be allocated to one of these species groups and it is preferred, therefore, to treat the genus here sensu lato". During recent molecular work 10 *Bostryx* species were sequenced, showing that *Bostryx* (*s.l.*) is a polyphyletic taxon (Breure and Romero 2012). For the monophyletic species group with *B. solutus* the subfamily name Bostrycinae subfam. n. was introduced; however, without proper diagnosis fulfilling the requirement of Art. 13.1 ICZN this is a nomen nudum. To correct this (surprising) mistake, the necessary data for a valid description are presented in this paper.

Systematics

Superfamily Orthalicoidea Martens in Albers, 1860
Family Bulimulidae Tryon, 1867

Subfamily Bostrycinae subfam. n.
urn:lsid:zoobank.org:act:66E52BE3-12DE-41B4-8455-1FAC18112985

Diagnosis. Shells with a smooth protoconch; genital organs with a relatively long penis sheath (ca. 1/4–1/6 total phallus length) (Breure 1978: fig. 176).

Type genus. *Bostryx* Troschel, 1847; type species by monotypy *Bulimus (Bostryx) solutus* Troschel, 1847.

Remarks. It should be stressed that this genus needs a thorough revision, based both on a re-evaluation of morphological characters and molecular data. In molecular analyses, species of this subfamily are forming a monophyletic group with *Bostryx solutus* (Troschel, 1847) included. Given current understanding (Breure and Romero 2012, Breure unpublished data) the following, additional taxa at least belong to *Bostryx s.str.*: *Bostryx (Peronaeus) agueroi* Weyrauch, 1960, *Bostryx (Bostryx) aguilari* Weyrauch, 1967, *Bostryx (Bostryx) agueroi beltrani* Weyrauch, 1964, *Bulinus conspersus* Sowerby I, 1833, *Bostryx edmundi* Breure & Neubert, 2008, *Bostryx granulatus* Breure & Neubert, 2008, *Bostryx (Pseudoperonaeus) longispira* Weyrauch, 1960, *Bulinus modestus* Broderip, 1832, *Bostryx multiconspectus* Breure, 2008, *Drymaeus torallyi peruvianus* Pilsbry, 1944, *Bostryx primigenius* Breure, 2008, *Bulinus scalariformis* Broderip, 1832, *Helix sordidus* Lesson, 1826, *Bostryx (Multifasciatus) superbus* Weyrauch, 1967, *Helix torallyi* d'Orbigny, 1835.

As may be seen from this — necessarily incomplete — list, shell shape alone may be a misleading character for classification (e.g., with representatives of three 'subgenera'). Further research needs to clarify which of the 22 synonyms of *Bostryx (s.l.)* may be given (sub)generic status within this subfamily.

Finally, Breure and Romero (2012) showed that *Helix apodemeta* d'Orbigny, 1835, *Bulimulus (Scansicochlea) strobeli* Parodiz, 1956, and *Bulinus bilineatus* Sowerby I, 1833 may need to be re-classified with *Naesiotus* Albers, 1850; this genus (also treated *s.l.* in Breure 1979) is in need of an in-depth revision and its relationship to *Bulimulus* to be clarified.

Further research, especially using molecular data, will undoubtedly give new insights, thus leading to either more support for the current classification or perhaps other surprises.

Acknowledgements

I am most grateful to Philippe Bouchet for enlightening me with the invalid introduction of the new subfamily name according to the ICZN Code.

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RESEARCH ARTICLE

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Description of a new species of the genus *Glenea* from Tibet, China (Coleoptera, Cerambycidae, Lamiinae, Saperdini)

Meiying Lin[1,†], Li Dai[2,‡]

1 *Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beichen West Road, Chaoyang Dist., Beijing, 100101, China* **2** *Shanghai Entomological Museum, Chinese Academy of Science, Shanghai 200032, China*

† *urn:lsid:zoobank.org:author:4725CAC1-80E0-442D-BAFD-D5723AE41B6B*
‡ *urn:lsid:zoobank.org:author:77949401-6A16-443E-BDEC-06D3428E1955*

Corresponding author: *Meiying Lin* (linmeiying@ioz.ac.cn)

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Abstract

A new species, *Glenea jini* **sp. n.** is described from Tibet, China. It can be separated from other species of the genus *Glenea* Newman by the complicated black and ochre markings as well as characters of the genitalia.

Keywords

New species, taxonomy, Oriental region

Introduction

In the progress of our research project on the "Study on the Systematics of Saperdini from China and the adjacent areas (Coleoptera: Cerambycidae: Lamiinae)", many Chinese saperdine specimens have been recently collected as well as loaned from institutions, museums or private collections. In these collections two years ago, we found a noticeable new species from Tibet belonging to the genus *Glenea*. Since only male specimens were known, we were waiting for female specimens before officially publishing. Fortunately, during the first author's visit to Shanghai Entomology Museum, some female specimens were found in their collection, and one fresh female was collected in August 2011 by a friend. In the current work, we describe this new species with detailed features of both the male and female genitalia.

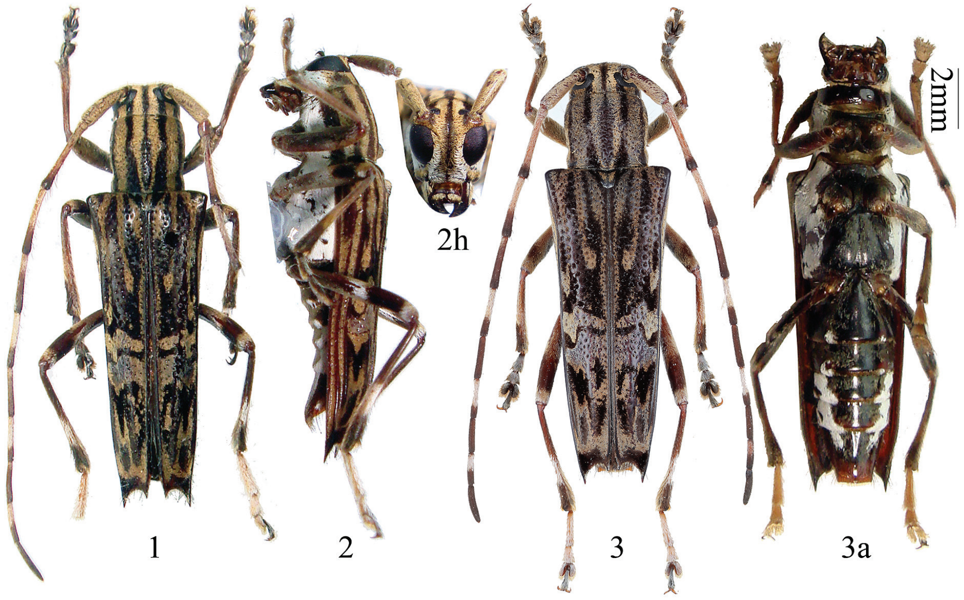
Type depositories are abbreviated as follows:

CCCC Collection of Chang-chin Chen, Tianjin, China
IZAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China
SHEM Shanghai Entomology Museum, Chinese Academy of Sciences, Shanghai, China

Results

***Glenea jini* sp. n.**
urn:lsid:zoobank.org:act:81EB4C33-7179-4CF6-8993-A02AABCA3EF9
http://species-id.net/wiki/Glenea_jini
Figs 1–8

Description. Male (Figs 1–2): length: 11.5–14.0 mm, humeral width: 2.5–3.9 mm. Female (Figs 3, 3a): length:12.0–15.0 mm, humeral width: 3.0–4.5 mm. Body dark brown to black, all with thick pubescence except ventral medial part. The pubescence in dorsal view is black and ochre, forming quite complicated markings on head, pronotum and elytra. The pubescence in ventral view is white. Head (dark brown to black Fig. 2h); frons with ochre pubescence, with white pubescence along eyes (only lower half) and from genae to clypeus; pubescence of genae and temple white with ochre; vertex with two parallel ochre stripes and one black stripe between upper eye lobes; behind eyes striped with vittae of black, ochre, black, ochre and finally white (the white pubescence surrounding lower half of inferior eye lobes); those vittae matching with the vittae of prothorax except one additional black vitta before white ventral pubescence on sides of prothorax. Antennae reddish brown mixing with black, scattered with black bristles on undersides of 1st to 8th segments; tips of 3rd, 4th, 6th, 8th, 10th and more than half apicalend of 5th, 7th, 9th segments, and the whole of 11th segment black, other parts covered with ochre and white pubescence. Prothorax with a medial black narrow stripe, then 6 stripes with alternating color of ochre and black on each side; prosternum with white pubescence, which extends to procoxal cavity. Scutellum black with ochre pubescence. Elytra black with complicated pubescent ochre stripes or vittae (Figs 1, 3): each elytron provided with three longitudinal stripes starting from the base, of which the middle one is the shortest, only reaching 3/10^{ths} of elytron length; two transverse wavy vittae just behind midpoint; apical 2/5^{ths} somewhat half black half ochre, with black apex. Sides of elytron covered with ochre pubescence except for the ridges and a black vitta after humerus (Fig. 2). Ventral surface mostly dark brown to



Figures 1–3. Habitus, *G. jini* sp. n. **1–2** male, from Tibet, China **1** holotype, IOZ(E)1859443 **2** paratype, IOZ(E)1859444. 2h. head, frontal view **3** paratype, female, from Tibet, China, photo by Wenxuan Bi. 3a. ventral view. Scale 2 mm.

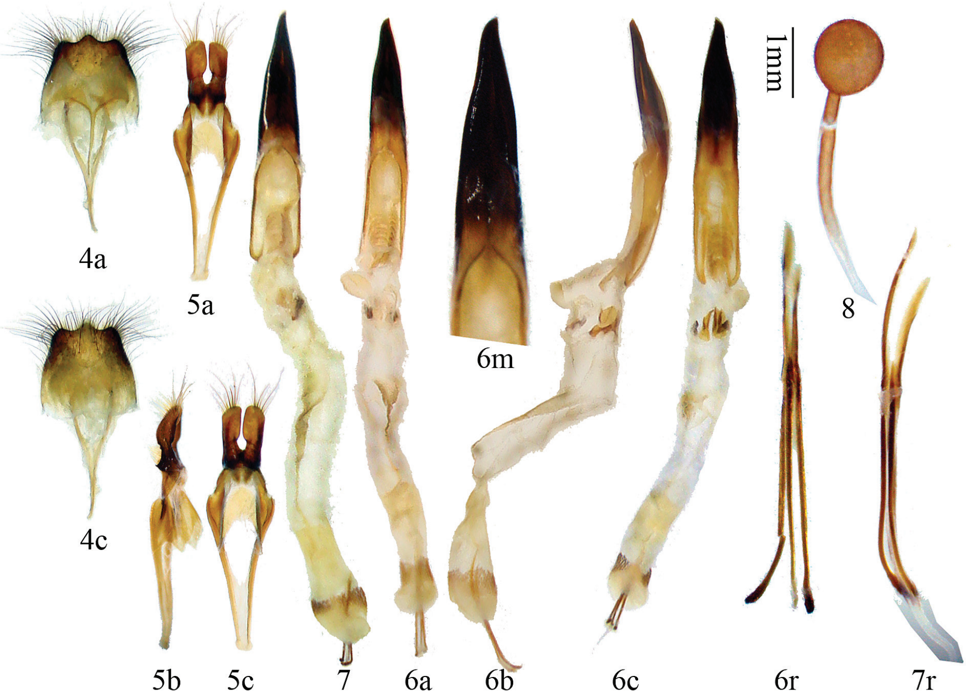
black, with sides covered with dense white pubescence (Fig 3a). Legs reddish brown to black with white (sometimes mixed with some ochre) pubescence, especially middle and tip of hind femora, part of hind tibia, and first three tarsal segments covering with dense white pubescence.

Head slightly narrower than prothorax, closely punctured, feebly concave at vertex. Eyes deeply emarginate, inferior eye lobes slightly higher (female) or twice as high (male, Fig. 2h) as genae below it, width less than (female) or more than (male, Fig. 2h) half of frons. Antennae exceeding elytral apex in both sexes, but male is slightly longer than female; scape feebly thickened apicad, without any ridge, apex without cicatrix; ratio of the length of segments (male): 17 : 2 : 23 : 22 : 19 : 17 : 15 : 14 : 13 : 12 : 15; (female): 16 : 2 : 21 : 20 : 18 : 17 : 15 : 13 : 12 : 11 : 13.

Prothorax almost as broad as long (female) or slightly longer than broad (male), swollen laterally before middle; disc feebly convex and closely punctured.

Elytra angled at humeri, slightly narrowed apically, each with two longitudinal humeral ridges, first one beginning at humeri and not reaching to apex, second one beginning after humeri and reaching apical outer spine; apex emarginated apically, with shorter but sharp teeth at the suture, long sharp spine at the outer angle, disc with coarse and irregular punctures.

Legs stout; middle tibiae obliquely grooved ecto-apically; hind femur reaching 5th abdominal segment; 1st hind tarsal segment longer than following two segments combined in both sexes; male claws appendiculate; female claws simple.



Figures 4–8. Terminalia of *G. jini* sp. n. **4** tergite VIII and sternite VIII & IX **5** tegmen **6** median lobe & internal sac of the male IOZ(E)1859444 **7** median lobe & internal sac of the male IOZ(E)1859443 **a** ventral view **b** lateral view **c** dorsal view **r** rods of endophallus (not to scale) **m** magnified, showing apex of ventral plate of median lobe curved to right in ventral view (not to scale) **8** female genitalia, only showing spermathecal capsule (not to scale). Scale 1 mm.

Male genitalia (Figs 4–7): Tegmen approximately 3.4 mm in length; lateral lobes can be divided into two parts (Figs 5a–5c), basal 1/3rd thinner, with fine soft hairs in ventral groove (Fig. 5b), apical 2/3rds expanded in three directions (dorsal, ventral and inner), with apex obliquely rounded (in both ventral and outer directions) and with fine setae which are shorter than lateral lobes; ringed part elbowed in the widest portion, converging; basal piece bifurcated distally; median lobe plus median struts slightly curved (Fig. 6b), longer than tegmen in length; the median struts less than half of the whole length of median lobe; dorsal plate shorter than ventral plate; apex of ventral plate (Figs 6a, 6m, 7) pointed, apex a little sharp and curved to right side (in ventral view); median foramen (Fig. 6m) slightly elongated; internal sac approximately three times as long as median lobe, with 3–4 pieces of basal armature, two bands of supporting armature and three unequally long rods; the longest rod approx. 1.8 mm, roughly half the length of tegmen, the middle rod shortest. Ejaculatory duct single (Fig. 7r). Tergite VIII (Fig. 4c) broader than long, apical margin tri-lobed, of which the middle one is slightly longer than lateral ones; setae around sides slightly longer than the middle ones.

Female genitalia (Fig. 8): Spermathecal capsule with a slender basal stalk and a rounded apical orb, stalk more than twice the length of apical orb.

Diagnosis. Differs from other species of the genus *Glenea* by the complicated black and ochre markings and some characters of the genitalia, especially the three unequally long rods of the endophallus and the shape of the lateral lobes of the tegmen in the male. It resembles *G. diversimembris* Pic in the color of the pubescent markings, and the apex and humeral longitudinal ridges of the elytra, but differs in having annulate antennae; elytron with two transverse wavy vittae just behind middle; apical margin of tergite VIII (male) tri-lobed; apex of ventral plate of median lobe curved to right side (male); spermathecal capsule with a slender basal stalk and a rounded apical orb (spermathecal capsule of *G. diversimembris* without such rounded apical orb).

It resembles *G. pallidipes* Pic in the apex and longitudinal humeral ridges of the elytra, apical margin of tergite VIII (male) with a median protruding lobe, apex of ventral plate of median lobe curved to right side (male), spermathecal capsule with a slender basal stalk and a rounded apical orb; but differs in having annulate antennae; elytra with two transverse wavy vittae just behind middle; apical margin of tergite VIII (male) tri-lobed (without such lateral lobes in *G. pallidipes*); the slender basal stalk of spermathecal capsule not as curved as that of *G. pallidipes*.

From the color pattern, this species somewhat resembles *Dystomorphus* species (*notatus* Pic, *esakii* Hayashi, *piceae* Holzschuh), but differs in lacking lateral tubercles on the prothorax, the elytra bearing two longitudinal humeral ridges instead of one, and the elytral apex having a long and sharp spine at the outer angle, and so on.

Etymology. The specific epithet is dedicated to Mr. Gentao Jin, a good collector, who has collected many specimens for IZAS and SHEM.

Distribution. China: Tibet.

Type material. Holotype: China: Tibet: male (14.0 mm long), Mêdog, Hanmi, alt. 1100–2100 m (IZAS, IOZ(E)1859443). Paratypes: China: Tibet: 1 male, Mêdog, Xirang, alt. 600–700 m, 1981.IX.25, leg. Yinheng Han (IZAS, IOZ(E)1859444); 1 male, Mêdog, Baibung, alt. 940 m, 1979.VI.4, leg. Gentao Jin & Jianyi Wu (SHEM 24207072); 1 female, Mêdog, Baibung, alt. 1000 m, 2011.VIII.10, leg. Wenxuan Bi (CCCC); 1 female, Mêdog, Dexing, alt. 980 m, 1980.V.31, leg. Gentao Jin & Jianyi Wu (SHEM 24203410); 1 female, Mêdog, Dexing, alt. 900 m, 1980.VI.2, leg. Gentao Jin & Jianyi Wu (SHEM 24204637); 1 female, Mêdog, Kabu, alt. 1030–1670 m, 1980.V.11, leg. Gentao Jin (SHEM 24204617).

Discussion

Most of the saperdine species were historically described based only on external characters, without any genitalia characteristics being provided (Breuning 1952, 1954, 1956a, 1956b, 1958a, 1958b; Gahan 1889, 1897). An identification key for the genus *Glenea* including this species is not included in the present paper because the genus needs further taxonomical revision including genital features of the other species.

However, the description of this new species provides sufficient information to allow identification and differenctiation from similar species. The morphological details of male genitalia and high quality figures presented here support the identification of the species. Preliminary studies by the first author (unpublished data) separate this species from all known saperdine species from Oriental region.

We were surprised to observe the three unequally long rods of the endophallus in this species. According to the first author's study on saperdine beetles from Oriental regions, even when there are three rods of the endophallus, usually two equally long rods form one pair (Lin et al. 2006, 2008, 2009a, b, c; Lin and Yang 2011b), or three rods are subequal in length (Chou et al. 2010; Lin and Lin 2011; Lin and Yang 2011a). Additionally, in the tribe Phytoecini, when there are four rods of the endophallus, they usually form two pairs (Lin and Yang 2012). Ehara (1954) did not mention any species with three unequally long rods in his comparative anatomy of male genitalia in 101 cerambycid species from Japan.

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A study on the apterous genus *Clytomelegena* Pic, 1928 (Coleoptera, Disteniidae)

Meiying Lin[1], Sergey V. Murzin[2]

1 *Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101* **2** *8-1-23, Proletarsky prosp., Moscow, Russia*

Corresponding author: *Meiying Lin* (linmeiying@ioz.ac.cn)

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Abstract

The genus *Noeconia* Murzin, 1988 is synonymized with *Clytomelegena* Pic, 1928. *Clytomelegena kabakovi* (Murzin, 1988), **comb. n.** is newly recorded from China (Guangxi Prov.). And Laos (Attapeu Prov.) is a new locality of this genus. Both sexes are apterous. Photographs and genitalic descriptions of *C. kabakovi* are presented for the first time.

Keywords

Clytomelegena Pic, *Noeconia* Murzin, new synonym, new combination, new locality, Oriental region, Disteniidae

Introduction

The first author, Meiying Lin found an old strange Distenidae specimen in the collection of the Chinese Agriculture University in Beijing in the past. Surprisingly in 2011, additional specimens collected at the same locality in China were brought to her by Messrs. Xinlei Huang and Huihua Zeng. It was first determined as *Noeconia kabakovi* Murzin, 1988 with the help of her European friends. Later, the second author, Sergey V. Murzin visited her Institute and informed her that *Noeconia kabakovi* could be a synonym of *Clytomelegena postaurata* Pic, 1928.

The genus *Clytomelegena* was first described by Pic (1928) on the basis of a unique specimen, *C. postaurata* Pic, 1928 from South Vietnam. Later in 1988, Murzin described the genus *Noeconia* on the basis of *N. kabakovi* Murzin, 1988 from North Vietnam.

According to our study of the type specimens of these two genera, it is concluded that the genus *Noeconia* should be a synonym of *Clytomelegena* by the resemblance of the structures of antennae, prothorax, elytra, abdomen and lack of hind wings. However, these two species are thought to be different species in spite of the problem that the type specimen of *C. postaurata* seems to be a teneral individual.

As luck would have it, one specimen collected in Laos was brought to us as an addition to the abnormal unique type of *C. postaurata*, which suggests that *C. postaurata* and *N. kabakovi* are surely different species, and the elytral shape could be a useful character to separate species. As a result, it is indicated that *C. postaurata* is distributed in South Vietnam and Laos, and *N. kabakovi* is distributed in North Vietnam and South China. The Chinese fauna of the Disteniidae is thus updated to 3 tribes, 8 genera and 28 species (Lin et al. 2010).

Types and other material studied are deposited in the following institutions or private collections:

CAU China Agricultural University, Beijing, China
CWD Private collection of Dong Wen, Qingdao, Shandong, China
EVC Eduard Vives collection, Terrass a, Spain
IEER A. N. Severtzov Institute of Ecology and Evolution (=IEMEA, A. N. Severtzov Institute of Evolutionary Morphology and Ecology of Animals), Moscow, Russia
IZAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China
MNHN Muséum National d'Histoire Naturelle, Paris, France
NMPC National museum, Prague, Czech Republic
USNM National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
ZIN Zoological Institute, Saint-Petersburg, Russia

Results

Genus *Clytomelegena* Pic, 1928
http://species-id.net/wiki/Clytomelegena

Clytomelegena Pic, 1928: 11. Type-species: *Clytomelegena postaurata* Pic, 1928. Monotypy. —Villiers 1958: 267.

Noeconia Murzin, 1988: 161. syn. n. Type-species: *Noeconia kabakovi* Murzin, 1988. Original designation and monotypy.

Redescription. Body small, slender; elytra not wider than prothorax at humeri and widened behind middle. Eyes finely faceted, oval; with very small emargination. Prothorax subequal to or more than 1.5 times as long as basal width, with round lateral tubercles behind middle; with a slight apical constriction, apical part subequal to or a little narrower than base. Scutellum pentagonal. Elytra depressed behind scutellum, swollen behind middle, evenly rounded apically. Hind wings reduced (Fig. 11; not mentioned in either of the original descriptions). Antennae thin, about 1.5 to 1.8 times as long as body, 3rd to 10th antennal joints internally with recumbent undulating long hairs, reaching the apex of corresponding joint. Procoxal cavity open behind (Fig. 14). Femora spindle-shaped, petiolate (Fig. 7); male hind femora reach elytral apex. Middle tibiae with an oblique groove bearing a brush of hairs. 1st joint of posterior tarsi shorter than or subequal to following two joints together.

Remarks. The genus belongs to the tribe Disteniini, close to *Nericonia* Pascoe and *Noemia* Pascoe, but differs by having the elytra swollen (Murzin 1988) and hind wings lacking. Our study of *Noeconia kabakovi* Murzin, 1988 revealed no huge high-level differences from *Clytomelegena postaurata* Pic, 1928, and therefore *Noeconia* Murzin, 1988 is herein synonymized with *Clytomelegena* Pic, 1928. It hosts two species up to now: *C. postaurata* Pic, 1928 and *C. kabakovi* (Murzin, 1988), comb. n.

Two flightless Oriental genera are known up to now: *Clytomelegena* Pic, 1928 and *Olemehlia* Holzschuh, 2011.

Distribution: China (new country record): Guangxi Prov.; Laos (new country record): Attapeu Prov.; Vietnam: Vinh Phuc Prov., Batkhay Prov., Ninh Binh Prov. (Cuc Phuong National Park, new province record), Cao Bang Prov. (new province record), Lamdong Prov.

Clytomelegena postaurata Pic

http://species-id.net/wiki/Clytomelegena_postaurata
Figs 1–2

Clytomelegena postaurata Pic, 1928: 11.
Clytomelegena postaurata; Villiers 1958: 267; Jiang and Wu 1986: 5.

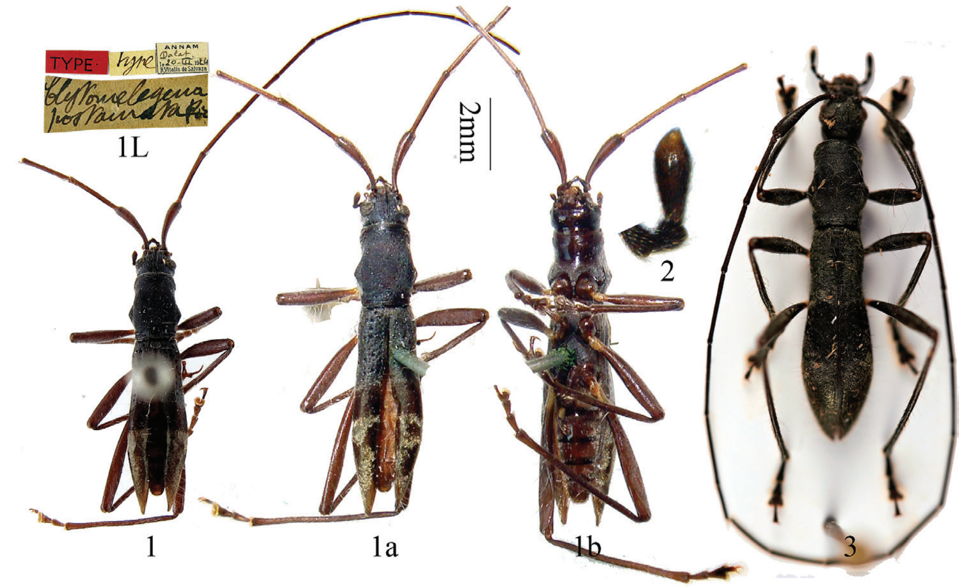
Remarks. The unique type specimen deposited in MNHN is a newly emergent individual, which is difficult to compare with other specimens. The testaceous antennae and legs could be its color, or they would become as dark as the specimen from Laos or same to Murzin's *kabakovi*. The elytra are not fully sclerotized, making specific character coding such as maculae unclear but revealing the absence of hind wings without opening the elytra. The last segment of maxillary palp (Fig. 2) and the last visible sternite (Fig. 1b) indicate that it is a female.

Measurement on the holotype: Elytra length: humeral width = ca. 3.5; pronotum length: pronotum maximum width = ca. 1.2; elytra length: prothorax length = ca. 2.7.

The relative length of antennal joints: 17:0.5:18:17:18:18:17:16:15:14:11.

Specimens examined. Holotype (Fig. 1) of *Clytomelegena postaurata* Pic, female, Vietnam, Annam, Dalat (South Vietnam, LamDong Prov.) (MNHN, ex collection M. Pic).

Distribution: Vietnam (LamDong Prov.).



Figures 1–3. *Clytomelegena postaurata* Pic, 1928. **1** Holotype of *Clytomelegena postaurata* Pic, female, from Annam of Vietnam. **a** dorsal view **b** ventral view. L. labels **2** showing the shape of last segment of maxillary palp, in dorsal view **3** *Clytomelegena* sp., a female from Attapeu Prov. of Laos, similar to *C. postaurata*. **1a** & **1b** scale 2 mm, others not to scale.

***Clytomelegena* sp.**
Fig. 3

Remarks. The female from Laos is more similar to Pic's *postaurata* than Murzin's *kabakovi* based on the measurement and the shape of elytral apex.

Measurement of the *Clytomelegena* sp. from Laos: Elytra length: humeral width = ca. 4.0; pronotum length: pronotum maximum width = ca. 1.3; elytra length: prothorax length = ca. 2.6.

Specimens examined. 1 female, Laos, Attapeu Prov., Annam Highlands Mts., Dong Amphan NBCA, ca 1,160 m, Nong Fa (Crater Lake env.), 15°05.9'N, 107°25.6'E, 2010.IV.30–V.6, Jiři Hájek leg (NMPC).

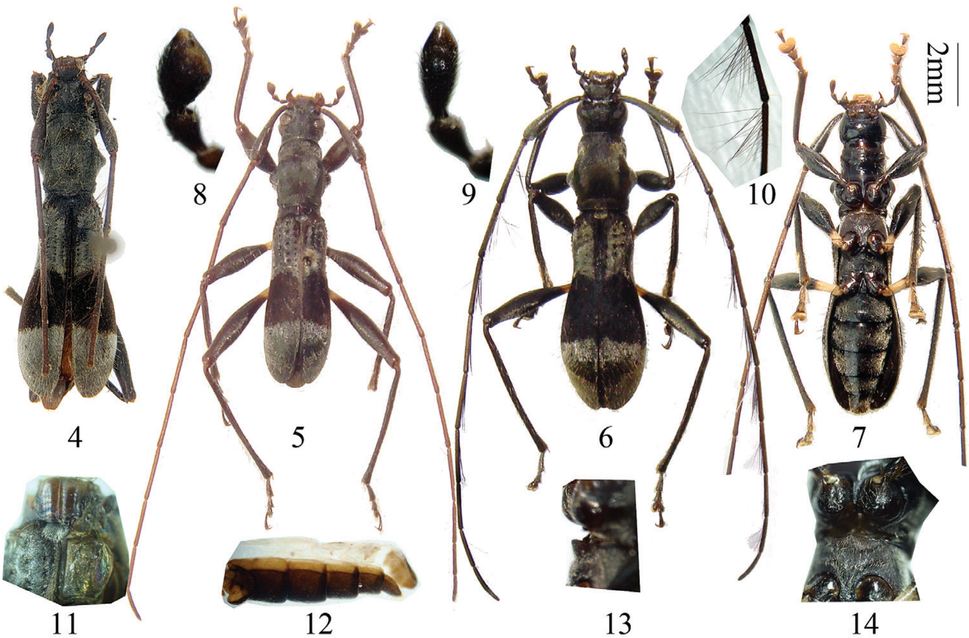
***Clytomelegena kabakovi* (Murzin), comb. n.**
http://species-id.net/wiki/Clytomelegena_kabakovi
Figs 4–27

Noeconia kabakovi Murzin, 1988: 162, fig. 1. — Jeniš 2001: 17, Pl. III, fig. 22.

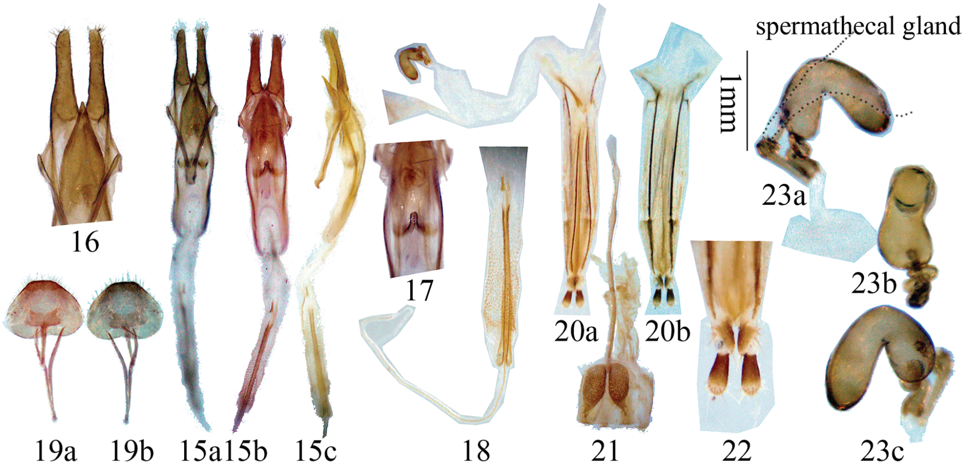
Redescription of species. Body length 8.8–14.5 mm, width at humeri 1.7–2.2 mm. Black; trochanters and bases of femora yellow; mouth parts, most parts of legs and antennae brownish. Body with long scattered erect setae and recumbent silvery pubescence, which is sparser on head and abdominal sternites and absent on ventral sides of head and prothorax. Elytra with a transverse band behind middle created by recumbent dark-brown setae and pubescence, of which width is about 1/4 of elytral length.

Head finely irregularly rugose between eyes, with longitudinal rugose sculpture under eyes and behind antennal bases. The last segment of maxillary palp stout (male, Fig. 8) or slender (female, Fig. 9). Pronotum longer than broad, with very fine and dense punctation. Elytra with 4 longitudinal rows of punctures, which are deep and hollow-shaped anteriorly and missing at middle, with very fine indistinct sculpturing between punctures, independently rounded apically, with a row of 7–10 pointed tubercles behind humeri. Antennae long and thin, 1.5 (female) to 1.8 (male) times longer than body; Scape dilated toward apex, reaching midlength of pronotum. Pedicel very small, spherical, hidden inside apical hollow of scape. The relative length of antennal joints (male and female almost same): 20:1:19:17:18:18:17:16:15:13:14.

Measurement on male: Elytra length: humeral width = ca. 3.1; pronotum length: pronotum maximum width = ca. 1.1; elytra length: prothorax length = ca. 2.5.



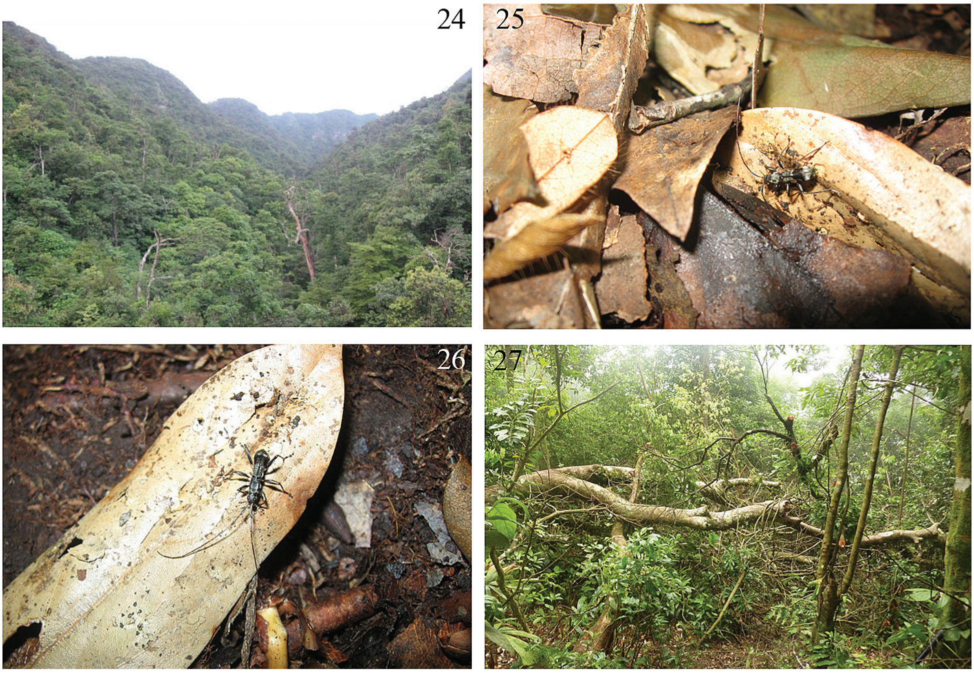
Figures 4–14. *Clytomelegena kabakovi* (Murzin, 1988). **4–7** Habitus. **4** female, from Tonkin of Vietnam **5** male, from Guangxi of China **6** female in dorsal view, from Guangxi of China **7** female in ventral view, from Guangxi of China. **8–9** showing last segment of maxillary palp. **8** male **9** female. **10** showing the fringed long hairs of antennomeres **11** showing mesonotum with a median groove and hind wings reduced (right elytron removed) **12** lateral view of male abdomen, showing membranous tergites (except tergite VII) **13** mesosernum in lateral view, showing median basal part protruding **14** procoxal cavity, open posteriorly. 4–7 Scale 2 mm. **8–14** not to scale.



Figures 15–23. Genitalia of *Clytomelegena kabakovi* (Murzin, 1988). **15–19** male. **15** male genitalia **16** showing lateral lobes and apex of ventral plate **17** showing basal armature in intersal sac **18** showing rods of endophallus and ejaculatory duct **19** tergite VIII and sternites VIII & IX in ventral view. **a** ventral view **b** dorsal view **c** lateral view. **20–23** female. **20** female genitalia. **a** dorsal view **b** ventral view **21** tignum, ventral view **22** showing stylus **23** spermathecal capsule in different views. **15, 19, 20, 21** scale 1 mm, others not to scale.

Measurement on the female: Elytra length: humeral width = ca. 3.2; pronotum length: pronotum maximum width = ca. 1.1; elytra length: prothorax length = ca. 2.6.

Male terminalia (Figs 15–19): Tegmen approximately 1.6 mm in length; lateral lobes slender, approximately 0.5 mm long and 0.1 mm wide, apex with short setae; median lobe plus median struts slightly curved, subequal to tegmen in length; the median struts less than 1/3 of the whole median lobe in length; dorsal plate shorter than ventral plate; apex of ventral plate sharply pointed; internal sac moderately long, about twice the median lobe in length, bearing a basal armature (Fig. 17) and two apical rods of endophallus (Fig. 18), ejaculatory duct single (Fig. 18). Apex of tergite VIII truncated with rounded sides (Fig. 19). Female terminalia (Figs 20–23): Paraproct moderate in size, its baculi thick and long, straight and not bifurcate at base; valvifer baculum very thick at base and narrowed towards apex (Fig. 20b); coxite lobes sclerotized at each inner part, with tactile hairs; stylus articulated to the tip of each coxite lobe, sclerotized except for apex and bearing tactile hairs (Fig. 22); dorsal baculi straight and longer than paraproct baculi (Fig. 20a); proctiger baculi long and almost straight (Fig. 20a). Spermathecal capsule (Fig. 23) is complex and coiled, composed of two parts, with two openings to bursa copulatrix (or spermathecal duct); bigger one with basal 1/4 twisted, strongly curved near middle; the other small part also strongly sclerotized, curved and twisted at middle, connected with bigger part with a thin duct; spermathecal gland (Fig. 23a) attached to middle of smaller part of capsule, membranous. Tignum (Fig. 21) slightly longer than half of abdomen. In one measured specimen, tignum was 2.3 mm for an adult with 4.2 mm abdomen length in ventral view.



Figures 24–27. Biotope of *Clytomelegena kabakovi* (Murzin, 1988). **24** tropical rainforest of collecting site in Guangxi, China (by Huihua Zeng) **25–26** crawling on the leaf litter near light trap site (by Huihua Zeng) **27** collecting site in Tam Dao National Park of North Vietnam (by E. Vives).

Biology and ecology: Prior to this study, no biological or ecological information was published on this species. The second author S. Murzin collected some specimens of this species in Cuc Phuong National Park (N. Vietnam) on 3–5 May 1991 on leaves of different plants. On 5 June 2011, Huihua Zeng collected one specimen on the ground near a light trap, but it was not certain whether this was an accidental occurrence or whether the specimen was attracted by light. Later (9 July 2011), the same collector observed another specimen on a stump near the light trap, later crawling in the leaf litter on the ground (Figs 24–26). The light trap was located in Damingshan of Guangxi, a tropical rainforest, at the altitude of 1,200 m. The other collector, Xinlei Huang, also collected one specimen at the same locality, by sweep net, which likewise did not elucidate any information on its biology.

Eduard Vives collected one female on 14 June 2011 in Tam Dao National Park of North Vietnam. It was crawling in a very antlike manner on the trunk of a large, recently fallen tree (Fig. 27) that was also attracting many *Agrilus* (Buprestidae) and small Lamiinae (genus *Sybra*, *Pterolophia*, *Exocentrus*). The day was very sunny and Eduard watched this trunk for 80 minutes more and did not see any additional specimens of *Clytomelegena* (personal communication, Aug. 2011).

In 2012, 3 additional specimens were collected in North Vietnam from Cao Bang Province and Ninh Binh Province in April and May by an expedition of Steven Lingafelter, Eduard Jendek, and Pham Hong Thai.

Remarks. We consider Murzin's *kabakovi* a different species from Pic's *postaurata* based on the following reasons:

1) Elytron with a row of 7–10 pointed tubercles behind humeri, while tubercles missing in *C. postaurata* (based on the unique type specimen);
2) Elytral apex broader (bluntly rounded instead of sharply rounded) and elytra shorter (the ratio of elytral length to basal width smaller);
3) Antennomere XI slight longer than antennomere X (much shorter in *C. postaurata*)
4) Hairs on elytra much shorter;
5) Pronotum with bigger lateral tubercles and swellings on the sides of the disc not as flattened as that on *C. postaurata*;
6) Width of the dark-brown transverse band behind middle of elytra is about 1/4 of elytral length, while in *C. postaurata* is only 1/6.

This species is recorded from China for the first time. It is the 28^{th} recorded species for the Chinese Disteniidae fauna.

Distribution: China (new country record): Guangxi Prov.; Vietnam: Vinh Phuc Prov., Batkhay Prov., Ninh Binh Prov. (Cuc Phuong National Park, new province record), Cao Bang Prov. (new province record).

Specimens examined. Type series of *Noeconia kabakovi* Murzin, 1988. Holotype, male, Batkhay Prov.: mountains in 50 km N-E Tkhaynguen, 1963.V.14, coll. O.N. Kabakov; paratype, 1 female, (Bakthai Prov.), distr. Fulyong, village Kuangtchu, 1986.IV.23, coll. A.V. Sharkov; paratype, 1 female, Prov. Vin'fu; Tamdao, alt. 800m, 1962.V.14, coll. O.N.Kabakov. All the types were preserved in the collections of IEER and ZIN.

Specimens from China, Guangxi: 1 male, Nanning, Wuming county, Mt. Damingshan, 1963.V.21, coll. Jikun Yang (CAU); 1 female, Nanning, Wuming county, Mt. Damingshan, Tianping station, alt. 900–1,260 m, 23.51770°N, 108.39295°E, 2011.V.23, by sweeping net, coll. Xinlei Huang (IZAS); 1 female, Nanning, Wuming county, Mt. Damingshan, alt. 1200 m, 2011.VI.5, coll. Huihua Zeng (CWD); 1 female, same data but 2011.VII.9 (CWD).

Specimen from North Vietnam: 1 female, Vietnam North, Prov. Vinh Phuc, Tam Dao National Park, 1,100 m, 2011.VI.14, coll. Eduard Vives (EVC); 2 females, Cao Bang Prov., Phja-Den Environs, 22°32.433'N, 105°52.012'E, alt. 948 m, 2012.V.2, day collecting, coll. Steven Lingafelter, Eduard Jendek, Pham Hong Thai (USNM); 1 female, Ninh Binh Prov., Cuc Phuong National Park, 20°21.012'N, 105°35.592'E, alt. 439 m, 2012.IV.25, day collecting, coll. Steven Lingafelter, Eduard Jendek, Pham Hong Thai (USNM).

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RESEARCH ARTICLE

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A review of the species of Rhynchopsilopa Hendel from China (Diptera, Ephydridae)

Junhua Zhang[1,†], Ding Yang[2,‡], Wayne N. Mathis[3,§]

1 *Institute of Plant Quarantine, Chinese Academy of Inspection and Quarantine, Beijing 100029, China (zjhcome@yahoo.com.cn)* **2** *Department of Entomology, China Agricultural University, Beijing 100193, China* **3** *Department of Entomology, Smithsonian Institution, NHP 169, PO Box 37012, Washington, D. C. 20013-7012, USA*

† *urn:lsid:zoobank.org:author:F961706F-038E-4F32-AFA8-9448ABB5CFDA*
‡ *urn:lsid:zoobank.org:author:FD9077E0-D8D5-4A3A-80FD-2862726AA066*
§ *urn:lsid:zoobank.org:author:343B52CC-CFFB-4DC1-AE3A-EC76D0C4B94A*

Corresponding author: *Junhua Zhang* (zjhcome@yahoo.com.cn)

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Abstract

Species of the shore-fly genus *Rhynchopsilopa* Hendel from China are reviewed. Four new species (*Rhynchopsilopa guangdongensis* **sp. n.**, *R. huangkengensis* **sp. n.**, *R. jinxiuensis* **sp. n.**, *R. shixingensis* **sp. n.**) and two previously known species, *R. longicornis* (Okada) and *R. magnicornis* Hendel, are described or redescribed. A key to the species hitherto known from China is presented.

Keywords

Diptera, Ephydridae, *Rhynchopsilopa*, new species, China

Introduction

Among shore flies, *Rhynchopsilopa* is apparently unique in having an association with ants (Farquharson 1921, Wirth 1968, Freidberg and Mathis 1985). Freidberg and Mathis (1985) demonstrated through choice experiments that this association, which may be obligate, is specific to workers of the genus *Crematogaster* Lund, with no apparent association with other ant genera. *Crematogaster* is an abundant, ecologically diverse genus of ants that is found worldwide and is easily recognized by its unusual, heart-shaped gaster. The adult flies are proctophiles on workers of *Crematogaster* and feed by injecting digestive liquids through the anus and into the abdomen of the ant prey. The fly then ingests the resultant slurry of partially digested liquids from the ant's abdomen. We know nothing about the immature stages of *Rhynchopsilopa*, nor has a biological association with *Crematogaster* been documented for most of the species.

The unique and somewhat bizarre biology of *Rhynchopsilopa* is not the only feature that makes *Rhynchopsilopa* appealing to research. Adults of *Rhynchopsilopa* are relatively attractive in having a shiny habitus that is metallic dark blue to black in luster and color. Despite their striking appearance and exhibiting a unique biology, the basic systematics of the genus remains fragmentary and incomplete, with many undescribed species, especially from the Afrotropical Region (Freidberg personal communication).

The genus *Rhynchopsilopa* Hendel 1913 is one of 11 genera in the tribe Psilopini (subfamily Discomyzinae) and currently includes 20 species (Mathis and Zatwarnicki 1995). The genus is distinctive and is easily recognized by the long, pendant antennae; the short frons; the depressed face with a sharp epistoma; the long proboscis, and the convex thorax and abdomen (Wirth 1968). *Rhynchopsilopa* is only known from the Old World, and the Afrotropical Region has greatest species diversity, with 14 described species. One species, *R. nitidissima* Hendel, is known from the Palearctic Region, and five have been recorded from the Oriental Region. Of the five Oriental species, only two have been recorded from China (Cogan and Wirth 1977, Mathis and Zatwarnicki 1995): *Rhynchopsilopa longicornis* (Okada) and *R. magnicornis* Hendel. The purpose of this paper is to redescribe the species of *Rhynchopsilopa* that are known from China, and to describe four additional species as new to science. A key to the Chinese species is also provided.

Material and methods

The descriptive terminology, with the exceptions noted in Mathis (1986) and Mathis and Zatwarnicki (1990a), follows that published in the Manual of Nearctic Diptera (McAlpine 1981). Because specimens are small, less than 2.50 mm in length, study and illustration of the male terminalia require use of a compound microscope. For most of the structures of the male terminalia, we follow the terminology that other workers in Ephydridae have used (see references in Mathis 1986 and Mathis and Zatwarnicki 1990a, 1990b). The species descriptions are composite and not based solely on holotypes.

Two venational indices used in the descriptions are defined below

Costal vein index is the straight line distance between the apices of R_1 and R_{2+3} (costal section II) divided by the distance between the apices of R_{2+3} and R_{4+5} (costal section III).

M vein ratio is the straight line distance apicad of crossvein dm-cu divided by the distance along M between crossvein dm-cu and r-m.

The holotypes and most paratypes are deposited in the Entomological Museum of the China Agricultural University (CAU), Beijing, some paratypes are also deposited in the National Museum of Natural History (USNM), Washington, D.C. We also studied specimens from the following museums: **BMNH** - The Natural Museum, London, England; **DEI** - Deutsches Entomologisches Institut, Müncheberg, Germany; and **ZMAN** - Instituut voor Taxonomische Zoologie, Zoologisch Museum, Universiteit van Amsterdam, Amsterdam, Netherlands. The following abbreviations are used for setae: acr = acrostichal, av = anteroventral, dc = dorsocentral, ia = intra-alar, npl = notopleural, oc = ocellar, orb = orbital, pd = posterodorsal, posts = postsutural, pres = presutural, psa = postalar, pv = posteroventral, sa = supra-alar, sc = scutellar, vt = vertical.

Taxonomy

Rhynchopsilopa Hendel, 1913

http://species-id.net/wiki/Rhynchopsilopa

Rhynchopsilopa Hendel 1913: 96. Type species: *Rhynchopsilopa magnicornis* Hendel 1913, original designation. –Wirth 1968: 37–46 [review]. –Cogan and Wirth 1977: 330 [Oriental catalog]. –Freidberg and Mathis 1985: 13–20 [feeding habits].

Lissodrosophila Okada 1966: 45. Type species: *Lissodrosophila longicornis* Okada 1966, original designation. –Cogan and Wirth 1977: 330 [synonymy].

Diagnosis. Small to moderately small shore flies, body length 1.7–2.8 mm; microtomentum generally sparse or lacking, cuticle appearing subshiny to shiny; mostly dark blue to black species.

Head in lateral view with antenna inserted at anterodorsal corner of head; frons conspicuously wider than long, often lenticular; a single, well-developed, proclinate fronto-orbital seta (sometimes an additional, distinctly shorter proclinate setula is present posteriad); reclinate seta and pseudopostocellar setae lacking or, in the latter case, very weakly developed; both medial and lateral vertical setae well developed; ocellar seta well developed, subequal in length to lateral vertical seta, proclinate, almost parallel; vertex convex; posterior ocelli situated immediately before convex vertex, ocelli forming an isosceles triangle. Antenna very elongate, pendant; scape exerted, oriented dorsally to anterodorsally; pedicel oriented anteroventrally, moderately elongate, lacking a prominent, well-developed dorsoapical seta; basal flagellomere pendant, very elongate, sometimes longer than face height; arista with 7–10 dorsal rays. Face depressed, mostly plain, lacking pits, transverse microrugosity or striae, bearing a sharp epistoma; a well-developed facial seta lacking; palpus whitish yellow to brown; proboscis elongate, longer than eye height, forming a well-sclerotized tube.

Thorax generally convex, dark blue to black, with microtomentum sparse to lacking; supra-alar seta absent; prescutellar acrostichal seta well developed; only posteriormost dorsocentral seta well developed; scutellum conspicuously wider than long, posterior margin broadly rounded, disc sparsely setulose; basal scutellar seta at most about 1/2 length or less than apical seta; anepisternum with 2 large setae. Wing mostly hyaline; crossveins not darkened; vein R_{2+3} usually extended to costal margin, lacking stump vein; R stem vein bare of setulae dorsally. Knob of haltere yellow to tan. Legs yellow to dark brown; forebasitarsus yellow to tan, only apical 1–2 tarsomeres dark brown.

Abdomen generally convex, bare of microtomentum, shiny, blackish; tergites 3–4 long, 5th tergite very short and lacking prominent, dorsally erect setae along posterior margin. Male terminalia: epandrium in posterior view as an inverted, rounded U (open ventrally), in lateral view generally elongate, usually thin to very thin, often slightly wider subventrally; cercus in posterior view thinly lunate to hemispherical; presurstylus, if present, short, no more than ½ length of postsurstylus, tapered to point ventroapically, apex bearing setulae, often greatly reduced or lacking; postsurstylus longer than wide, tapered to a ventral point, often with sinuous or curved margins; subepandrial plate usually bar-like, attenuate medially; pregonite bearing short setulae; aedeagus longer than wide, with sclerotized portion deeply bifurcate, appearing as 2 ventral extensions; phallapodeme long and narrow, in lateral view with a rod-like keel; hypandrium in lateral view moderately deep, pocket-like, or very shallow, nearly flat.

Key to species of *Rhynchopsilopa* from China

1 Forefemur dark brown or brownish yellow **2**

– Forefemur yellow **4**

2 Face metallic black with blue or brownish reflections; palpus brownish yellow or yellowish; forefemur with moderate pd and pv, at most as long as width of forefemur; mesonotum and abdomen with short and sparse setulae **3**

– Face white; palpus whitish yellow; forefemur with strong pd and pv, each long, about twice width of forefemur; mesonotum and abdomen with long and numerous setulae .... ***R. jinxiuensis* sp. n.**

3 Palpus brownish yellow; forecoxa brown at extreme base; costal vein index 0.43, M vein index 2.0; costal section I of male not thickened .... ***R. huangkengensis* sp. n.**

– Palpus and forecoxa yellowish; costal vein index 0.33, M vein index 2.2; costal section I of male greatly thickened .... ***R. magnicornis* Hendel**

4 Mid and hind tarsomeres 4–5 dark; hypandrium large, postsurstylus broad at apex, but pointed at extreme apex, gonite slender at base .... ***R. shixingensis* sp. n.**

– Mid and hind tarsomeres 5 dark; hypandrium small, postsurstylus tapering at apex, gonite short and thick **5**

5 Body brownish yellow; face reddish orange; palpus brown; mid and hind femora yellow ....***R. guangdongensis* sp. n.**
– Body black with blue reflections; face metallic black with blue reflections; palpus yellow; mid and hind femora dark brown .....***R. longicornis* (Okada)**

***Rhynchopsilopa guangdongensis* sp. n.**
urn:lsid:zoobank.org:act:7523AD49-FB44-4FFD-AA17-A0A42894E659
http://species-id.net/wiki/Rhynchopsilopa_guangdongensis
Figs 1–8

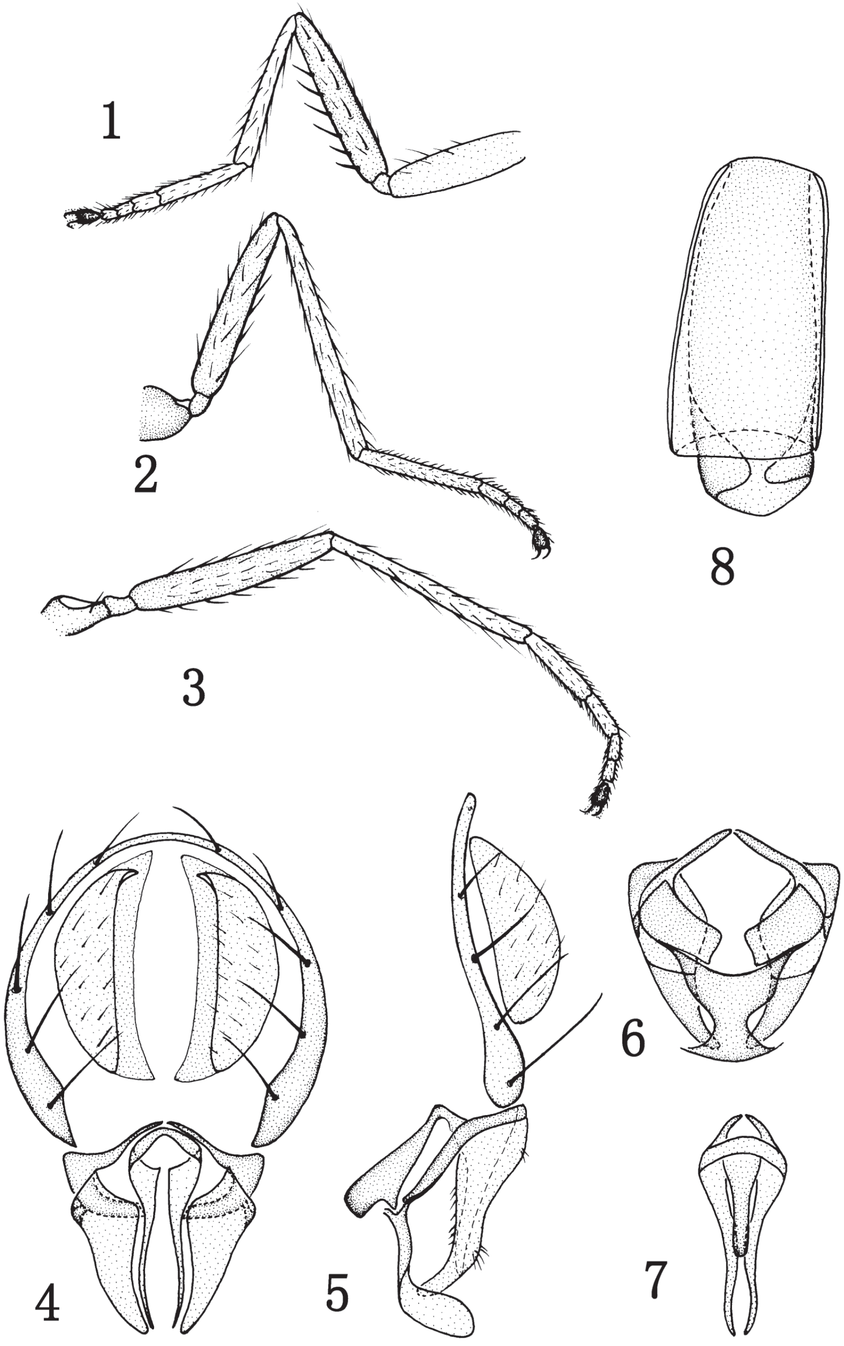
Diagnosis. Body brownish yellow. Face subshiny, reddish orange; epistoma yellow; palpus brown, not stout at apex; arista with 8 dorsal rays. 1 pair of posts dc, sutural dc absent. Forecoxa yellowish, mid and hind coxae brownish yellow; femora yellow; tibia and tarsomeres 1–4 yellowish, tarsomere 5 dark. Forefemur with a row of pd and pv shorter than width of forefemur. Mesonotum and abdomen with short and sparse setulae. Costal vein index 0.45, M vein index 2.1. Male genitalia: epandrium narrow; hypandrium in ventral view hourglass-like, in lateral view shallow to nearly flat; postsurstylus tapered toward apex in lateral view; gonite/subepandrial plate shallowly sinuous, rod-like; phallapodeme vertically elongate, with short extended keel oriented more toward hypandrial attachment of phallapodeme.

Description. Male. Body length 2.0–2.2 mm; wing length 2.3–2.4 mm.

Head subshiny, brownish red. Setulae and setae of head black; lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of strong proclinate orb. Face subshiny, reddish orange; epistoma yellow; palpus brown. Gena with 1 strong seta. Arista with 8 dorsal rays.

Thorax subshiny, brown, with violet reflections; mesonotum dark brown, with short and sparse setulae; anepisternum and katepisternum brownish yellow. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of acr weak and short; posterior npl as long as anterior npl; anepisternum with 2 setae, length of ventral seta 2× that of dorsal seta; katepisternal seta weaker than ventral anepisternal seta; 1 weak sa, 1 strong ia; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa yellowish, mid and hind coxae brownish yellow; femora yellow; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark (Figs 1–3). Forefemur with rows of pd and pv shorter than width of forefemur. Costal vein index 0.45, M vein index 2.1. Wing and veins yellowish. Haltere white.

Abdomen subshiny, brownish yellow, bearing short and sparse setulae. Male genitalia (Figs 4–7): epandrium in lateral view (Fig. 5) very thin, bearing long setae on entire length along posterior margin; cercus in posterior view (Fig. 4) hemispherical; presurstylus greatly reduced; postsurstylus in posterior view (Fig. 4) broader basally, thereafter shallowly sinuous, tapered to point, in lateral view (Fig. 5) broad basally, evenly tapered at ventral margin, symmetrically sinuous at dorsal margin; aedeagus in posterior view (Figs 4, 7) narrowly elongate, more so than postsurstylus, slightly arched



Figures 1–8. *Rhynchopsilopa guangdongensis* sp. n. (male) **1** foreleg **2** midleg **3** hindleg **4** terminalia (epandrium, cercus, postsurstyli, aedeagus), posterior view **5** terminalia (epandrium, cercus, postsurstyli, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **6** terminalia (surstyli, gonite/subepandrial plate and hypandrium), ventral view **7** aedeagus and phallapodeme, ventral view. (female) **8** Ventral receptacle.

ventrally; phallapodeme in lateral view (Fig. 5) vertically elongate with short extended keel oriented more toward hypandrial attachment of phallapodeme; subepandrial plate in posterior view (Fig. 4) rod-like, shallowly curved, not attenuate medially; hypandrium in ventral view (Fig. 6) hourglass-like, in lateral view (Fig. 5) shallow to nearly flat.

Female. Body length 1.7–2.0 mm; wing length 2.3–2.5 mm. Similar to male. Female ventral receptacle as in Fig 8.

Specimens examined. Holotype ♂, Guangdong: Dapu, Fengxi National Nature Reserve, 28 Jul 2003, Xingyue Liu (CAU). Paratypes 1♀, same data as holotype (CAU); 1♂, 1♀, Guangdong: Dapu, Fengxi National Nature Reserve, 29 Jul 2003, Shuwen An (CAU & USNM); 1♂, Guangdong: Dapu, Fengxi National Nature Reserve, 30 Jul 2003, Xingyue Liu (CAU); 1♀, Guangxi: Luocheng, Jiuwanshan National Nature Reserve, Yuxi, 28 Jul 2003, Lili Zhang (USNM).

Distribution. China (Guangdong, Guangxi).

Etymology. The species epithet is derived from the type locality, Guangdong.

Remarks. This new species is similar to *R. pallipes* Wirth but may be distinguished from the latter by the reddish orange face, the costal vein index (0.45), the M vein index (2.1), and by the darkened 5th tarsomere. In *R. pallipes*, the face is yellow, the costal vein index is 0.59, the M vein index is 2.1, and all tarsi are yellow (Wirth 1968).

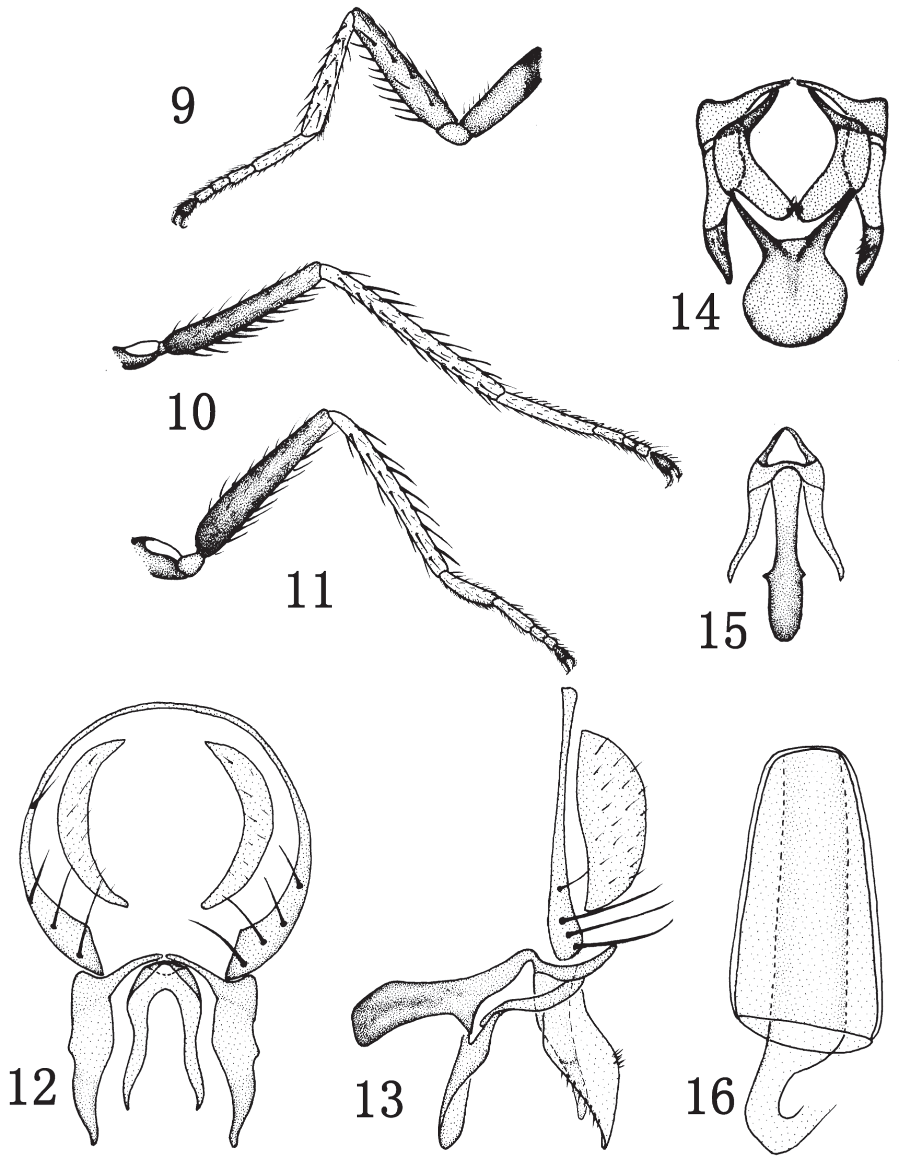
Rhynchopsilopa huangkengensis sp. n.

urn:lsid:zoobank.org:act:504B5DEB-A780-4B96-BD4F-B0C356765374
http://species-id.net/wiki/Rhynchopsilopa_huangkengensis
Figs 9–16

Diagnosis. Body shiny black, with some bluish reflections. Face black, with blue reflections; palpus brownish yellow, moderate at apex; arista with 7–8 dorsal rays. 1 pair of posts dc, sutural dc absent. Forecoxa brown at extreme base, yellow at apex, mid and hind coxae brown; femora dark brown; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 brown. Forefemur with rows of pd and pv, each about as long as width of forefemur; mid femur with a row of av, which are shorter than width of mid femur. Mesonotum and abdomen with short and sparse setulae. Costal vein index 0.43, M vein index 2.0; first costal section of male not thickened. Male genitalia: epandrium very thin, only slightly expanded ventrally; hypandrium in ventral view hourglass-like, with rounded anterior margin, in lateral view shallow to nearly flat; postsurstylus wide at base and slender at apex in lateral view; gonite/subepandrial plate slender, sinuous; phallapodeme with long, extended keel.

Description. Male body length: 1.9–2.1 mm; wing length: 2.4–2.6 mm.

Head shiny black, with blue reflections. Setulae and setae of head black. Lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of proclinate orb. Face black, with blue reflections; epistoma brownish yellow; palpus brownish yellow, moderate at apex. Gena with 1 strong seta. Arista with 7–8 dorsal rays.



Figures 9–16. *Rhynchopsilopa huangkengensis* sp. n. (male) **9** foreleg **10** midleg **11** hindleg **12** terminalia (epandrium, cercus, postsurstyli, aedeagus), posterior view **13** terminalia (epandrium, cercus, postsurstyli, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **14** terminalia (presurstyli, postsurstyli, gonite/subepandrial plate, hypandrium), ventral view **15** aedeagus and phallapodeme, ventral view. (female) **16** Ventral receptacle.

Thorax shiny black, with blue reflections; mesonotum with short and sparse setulae. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of weak, short acr, posterior npl as long as anterior npl; katepisternal seta weaker than anepisternal seta; 1 weak sa, 1 strong ia; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa brown at extreme base, yellow at apex, mid and hind coxae brown; femora dark brown; tibiae and tarsomeres 1–4 yellow, tarsomere 5 brown (Figs 9–11). Forefemur with rows of pd and pv, each nearly as long as width of forefemur; mid femur with a row of av, which are shorter than width of mid femur. Costal vein index 0.43, M vein index 2.0; first costal section of male not thickened. Wing brownish yellow, veins brown. Haltere white.

Abdomen shiny black, with blue reflections, bearing short and sparse setulae. Male genitalia (Figs 12–15): epandrium in posterior view (Fig. 12) very thin, bearing long setae on ventral half along posterior margin; cercus in posterior view (Fig. 12) narrowly lunate; presurstylus greatly reduced; postsurstylus in posterior view (Fig. 12) broader basally, thereafter shallowly sinuous with a shallow, lateral bump, tapered to ventral point, in lateral view (Fig. 13) more or less evenly broad on basal half, ventral half tapered to ventral point, more symmetrically angulate; aedeagus in posterior view (Figs 12, 15) narrowly elongate, more so than postsurstylus, slightly arched on ventral ¼; phallapodeme in lateral view (Fig. 13) transversely elongate, with long extended, more or less evenly thick keel; subepandrial plate in posterior view (Fig. 12) rod-like, shallowly curved; hypandrium in ventral view (Fig. 14) hourglass-like, with anterior margin rounded, in lateral view (Fig. 13) shallow to nearly flat.

Female. Body length: 2.4–2.8 mm; wing length: 2.7–2.8 mm. Similar to male. Female ventral receptacle as in Fig. 16.

Specimens examined. Holotype ♂, Fujian: Huangkeng, Aotou, 2 May 2004, Xingxue Liu (CAU). Paratypes 1♀, same data as holotype (CAU); 1♂, 2♀♀, Fujian: Huangkeng, Aotou, 1 May 2004, Dakang Zhou (CAU); 1♂, Fujian: Huangkeng, Aotou, 2 May 2004, Lili Zhang (CAU); 1♂, 3♀♀, Guangdong: Dapu, Fengxi National Nature Reserve, 29 Jul 2003, Shuwen An (CAU); 2♂♂, Guangdong: Dapu, Fengxi National Nature Reserve, 28 Jul 2003, Xingyue Liu (CAU); 1♂, Guangdong: Nanling National Nature Reserve, Qinshuigu, 25 Aug 2005, Junhua Zhang (CAU); 2♂♂, Guangdong: Nanling National Nature Reserve, Shumuyuan, 8 May 2004, Mengqing Wang (CAU); 5♂♂, 9♀♀, Guangdong: Nanling National Nature Reserve, Shumuyuan, 8 May 2004, Yang Ding (CAU); 3♂♂, Guangdong: Shaoguan, Chebaling National Nature Reserve, 12 Jul 2003, Shuwen An (CAU); 9♂♂, 7♀♀, Guangxi: Jinxiu, Dayaoshan National Nature Reserve, Fenzhancun, 23 Jul 2005, Yajun Zhu (CAU & USNM); 3♂♂, 2♀♀, Guangxi: Jinxiu, Dayaoshan National Nature Reserve, Hekou, 31 Jul 2005, Yajun Zhu (CAU); 5♂♂, 3♀♀, Guangxi: Jinxiu, Dayaoshan National Nature Reserve, Luoxiangcun, 28 Jul 2005, Yajun Zhu (CAU & USNM); 2♂♂, Guizhou: Libo, Yaolancun, 12 Jun 2005, Junhua Zhang (CAU); 1♀, Fujian: Huangkeng, Aotou, 2 May 2004, Junhua Zhang (CAU); 2♀♀, Guangdong: Zengcheng, Nankunshan, 15 Jul 2003, Xingyue Liu (CAU).

Distribution. China (Fujian, Guangdong, Guangxi, Guizhou).

Etymology. The species epithet is derived from the type locality, Huangkeng.

Remarks. This new species is similar to *R. magnicornis* Hendel, but may be distinguished from the latter by the following characters: palpus brownish, forecoxa with a brown base, costal vein index 0.43, M vein index 2.0, and costal section I of the male not thickened. In *R. fuscipennis* Wirth, the palpus is yellowish, the forecoxa is yellowish, the costal vein index is 0.50, the M vein index is 2.2; and the costal section I of the male is thickened (Wirth 1968).

***Rhynchopsilopa jinxiuensis* sp. n.**
urn:lsid:zoobank.org:act:B2503CA3-0586-4EA1-8B9D-BE5883B33E2C
http://species-id.net/wiki/Rhynchopsilopa_jinxiuensis
Figs 17–24

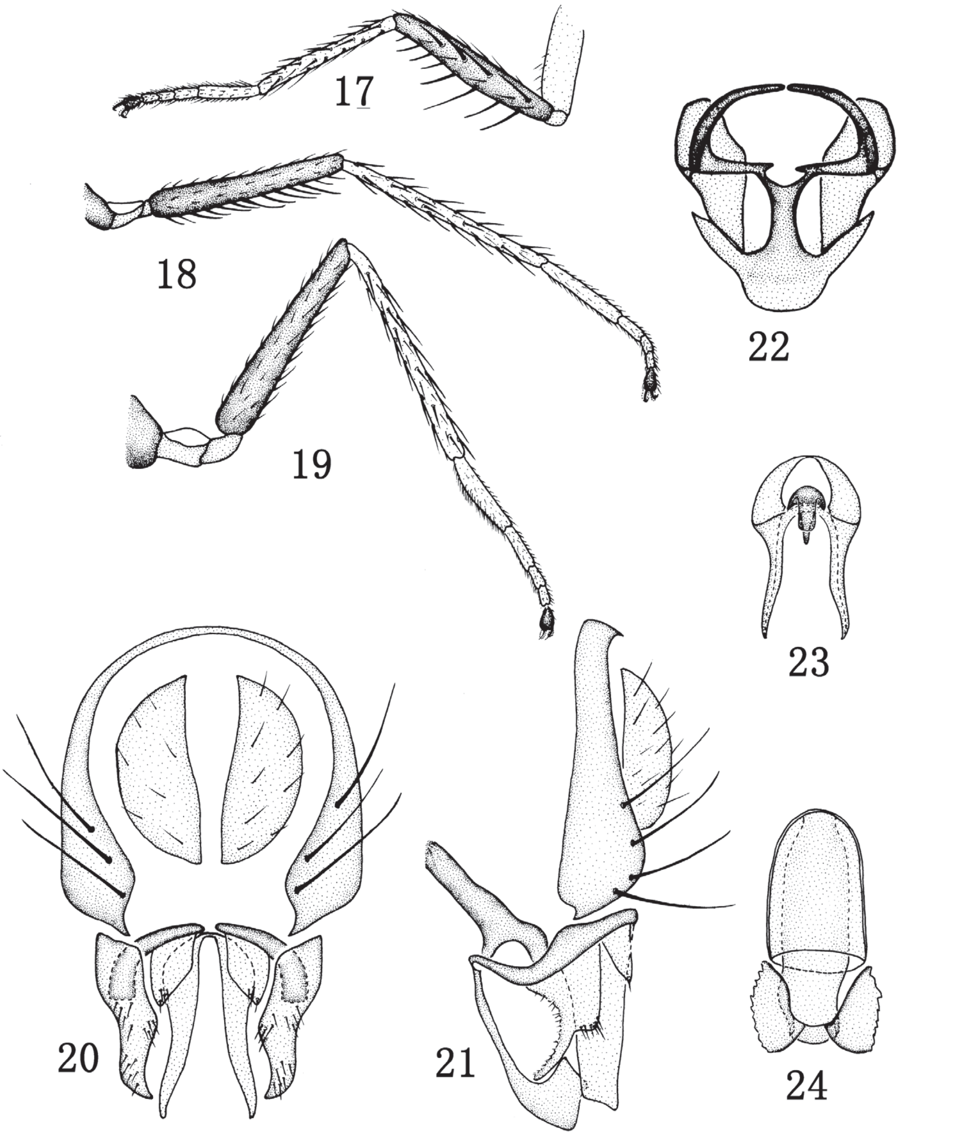
Diagnosis. Body shiny black, with blue reflections. Face white; palpus white, stout at apex; arista with ten dorsal rays. 1 pair of posts dc, sutural dc absent. Forecoxa yellowish, mid and hind coxae brownish yellow; femora dark brown; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark. Forefemur with strong pd and pv, each long, about twice width of forefemur; mid femur with a row of strong av. Mesonotum and abdomen with long and numerous setulae. Costal vein index 0.30, M vein index 2.0. Male genitalia: epandrium moderately wide, especially subventrally; hypandrium in ventral view anchor-like, in lateral view with narrow base and expanded anterior extension; postsurstylus with ventral half bearing a long, narrow process extended from anteroventral angle of basal portion, forming a long, curved anterior margin; gonite thick at base and slender at apex in ventral view; phallapodeme with arched base, extended keel narrow, elongate, width of keel somewhat uniform.

Description. Male body length: 2.1–2.4 mm; wing length: 2.8–3.0 mm.

Head shiny black, with blue reflections. Setulae and setae of head black. Lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of lateroclinate orb. Face, epistoma, and palpus white, the latter stout at apex. Gena with 1 strong seta. Arista with 10 dorsal rays.

Thorax shiny black, with blue reflections; mesonotum with long and numerous setulae. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of long and numerous acr; posterior npl as long as anterior npl; katepisternal seta weaker than anepisternal seta; 1 weak sa, 1 strong ia; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa yellowish, mid and hind coxae brownish yellow; femora dark brown; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark (Figs 17–19). Forefemur with strong pd and pv, each long, about 2× width of forefemur; mid femur with a row of strong av. Costal vein index 0.30, M vein index 2.0. Wing brownish yellow, veins brown. Haltere white.

Abdomen shiny black, with blue reflections. Abdomen with long and numerous setulae. Male genitalia (Figs 20–23): epandrium in lateral view (Fig. 21) moderately thin, bearing long setae on ventral portion, along posterior margin; cercus in posterior view (Fig. 20) hemispherical; presurstylus small, in posterior view parallelogram-like (Fig. 20), with acute angle ventrad, less than ½ length of postsurstylus; postsurstylus in posterior view (Fig. 20) broader basally, thereafter tapered to ventral point, concave curve at outer margin and convex curve at inner margin, bearing setulae, in lateral view (Fig. 21) with basal half roughly triangular, slightly tapered ventrally, ventral half bear-



Figures 17–24. *Rhynchopsilopa jinxiuensis* sp. n. (male) **17** foreleg **18** midleg **19** hindleg **20** terminalia (epandrium, cercus, presurstyli, postsurstyli, aedeagus), posterior view **21** terminalia (epandrium, cercus, presurstylus, postsurstylis, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **22** terminalia (surstyli, gonite/subepandrial plate, hypandrium), ventral view **23** aedeagus and phallapodeme, ventral view. (female) **24** Ventral receptacle.

ing a long, narrow process extended from anteroventral angle of basal portion, forming a long, curved anterior margin; aedeagus in posterior view (Figs 20, 23) narrowly elongate, more so than postsurstylus, slightly splayed latero-ventrally; phallapodeme in lateral view (Fig. 21) with arched base, extended keel narrow, elongate, width of keel somewhat uniform; subepandrial plate in posterior view (Fig. 20) rod-like, curved, attenuate medially; hypandrium in ventral view (Fig. 22) anchor-like, in lateral view (Fig. 21) with narrow base and expanded anterior extension.

Female. Body length: 2.3–2.4 mm; wing length: 2.8–3.0 mm. Similar to male. Female ventral receptacle as in Fig. 24.

Specimens examined. Holotype ♂, Guangxi: Jinxiu, Dayaoshan National Nature Reserve, Luoxiangcun, 28 Jul 2005, Yajun Zhu (CAU). Paratypes 25 ♂♂, 1♀, same data as holotype (CAU & USNM); 1♂, 1♀, Guangdong: Dapu, Fengxi National Nature Reserve, 29 Jul 2003, Shuwen An (CAU); 2 ♂♂, Guangxi: Jinxiu, Dayaoshan National Nature Reserve, Hekou, 31 Jul 2005, Yajun Zhu (CAU).

Distribution. China (Guangdong, Guangxi).

Etymology. The species epithet is derived from the type locality, Jinxiu.

Remarks. This new species is similar to *R. fuscipennis* Wirth, from which it may be distinguished by having 10 dorsal aristal rays, costal vein index of 0.30, and M vein index of 2.0. In *R. fuscipennis* Wirth, the arista has 7 dorsal rays, the costal vein index is 0.50, and the M vein index is 1.8 (Wirth 1968).

***Rhynchopsilopa longicornis* (Okada)**

http://species-id.net/wiki/Rhynchopsilopa_longicornis
Figs 25–32

Lissodrosophila longicornis Okada 1966: 45 [Nepal. Taplejung District, below Sangu; HT ♂, BMNH].

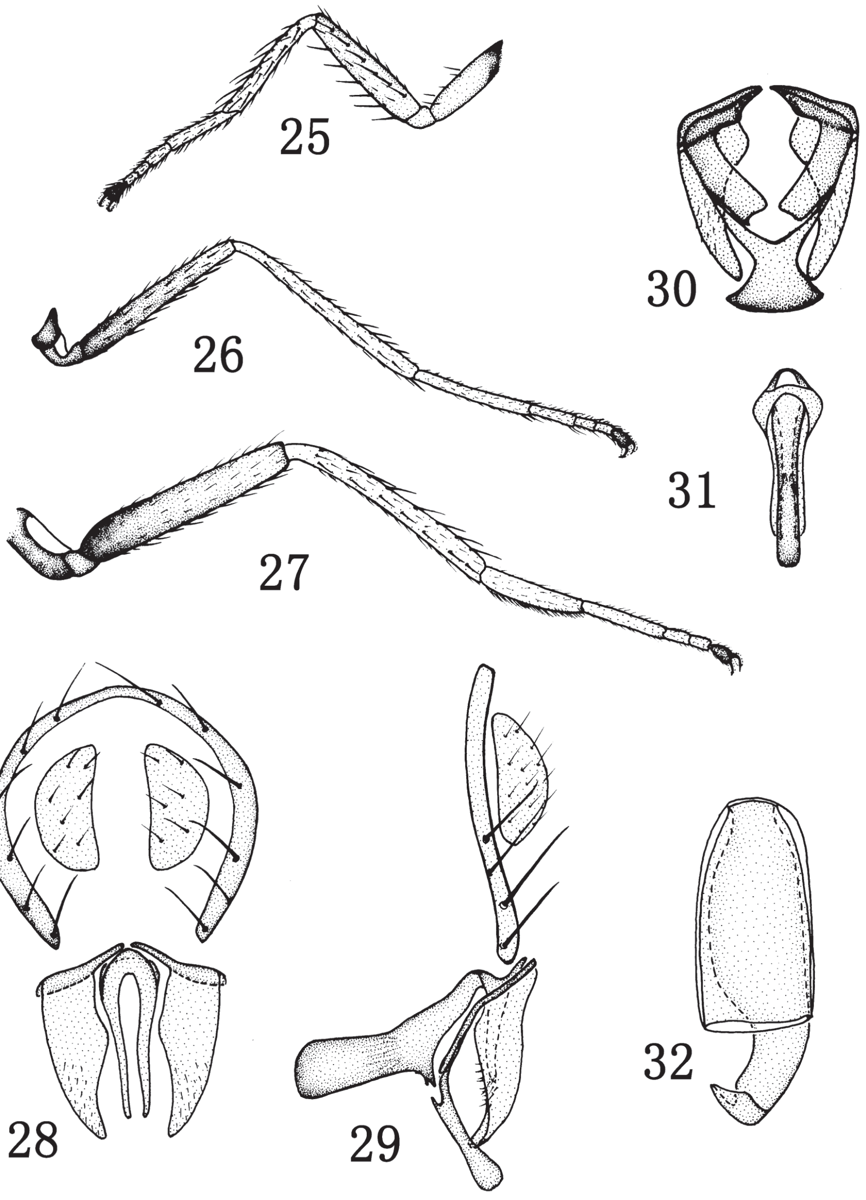
Rhynchopsilopa longicornis. –Cogan and Wirth 1977: 330 [Oriental catalog; generic combination]. –Mathis and Zatwarnicki 1995: 48 [world catalog].

Rhynchopsilopa coei Wirth 1968: 41 [Nepal. Taplejung: North of Sangu (5000 ft); HT ♀, BMNH]. –Cogan and Wirth 1977: 330 [synonymy].

Diagnosis. Face shiny black, with blue reflections; palpus yellow; epistoma brownish yellow; arista with 9 dorsal rays. 1 pair of posts dc, sutural dc absent. Forecoxa brown at extreme base, mid and hind coxae brown; forefemur yellow, mid and hind femora dark brown at base; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark. Forefemur with pd and pv, about as long as width of forefemur; mid femur with a row of av. Mesonotum and abdomen with short and sparse setulae. Costal vein index 0.50, M vein index 2.2. Male genitalia: epandrium narrow; hypandrium in ventral view hourglass-like, with anterior margin shallowly rounded, in lateral view shallow to nearly flat; postsurstylus tapered toward apex in lateral view; gonite/subepandrial plate slightly thick; phallapodeme with process at middle in lateral view.

Description. Male body length: 1.8–2.0 mm; wing length: 2.1–2.4 mm.

Head shiny black, with blue reflections. Setulae and setae of head black. Lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of proclinate orb. Face shiny black, with



Figures 25–32. *Rhynchopsilopa longicornis* (Okada) (male) **25** foreleg **26** midleg **27** hindleg **28** terminalia (epandrium, cercus, postsurstyli, aedeagus), posterior view **29** terminalia (epandrium, cercus, postsurstylus, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **30** terminalia (presurstyli, postsurstyli, gonite/subepandrial plate, hypandrium), ventral view **31** aedeagus and phallapodeme, ventral view. (female) **32** Ventral receptacle.

blue reflections; palpus yellow, stout at apex; epistoma brownish yellow. Gena with 1 strong seta. Arista with 9 dorsal rays.

Thorax shiny black, with blue reflections; mesonotum with short and sparse setulae. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of weak and short acr; posterior npl as long as anterior npl; anepisternum with 2 strong setae; 1 strong katepisternal seta, weaker than anepisternal seta; 1 weak sa, 1 strong ia seta; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa yellow, with brown extreme base, mid and hind coxae brown; forefemur yellow, mid and hind femora dark brown, with yellow apex; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark (Figs 25–27). Forefemur with rows of pd and pv, about as long as width of forefemur; mid femur with a row of av. Costal vein index 0.50, M vein index 2.2. Wing brownish yellow, veins brown. Haltere white.

Abdomen shiny black, with blue reflections. Abdomen with long and numerous setulae. Male genitalia (Figs 28–31): epandrium in lateral view (Fig. 29) very thin, bearing long setae on entire length along posterior margin; cercus in posterior view (Fig. 28) hemispherical; presurstylus greatly reduced; postsurstylus in posterior view (Fig. 28) evenly broad on basal half, thereafter tapered to ventral point, medial surface of ventral half shallowly concave, in lateral view (Fig. 29) more or less evenly tapered and smoothly sinuous from broad base to pointed apex; aedeagus in posterior view (Figs 28, 31) narrowly elongate, more so than postsurstylus, ventral extensions nearly straight; phallapodeme in lateral view (Fig. 29) transversely elongate with long extended, more or less evenly thick keel; subepandrial plate in ventral view (Fig. 30) slightly thick; hypandrium in ventral view (Fig. 30) hourglass-like, with anterior margin shallowly rounded, in lateral view (Fig. 29) shallow to nearly flat.

Female. Body length: 1.9–2.0 mm; wing length: 2.3–2.4 mm. Similar to male. Female ventral receptacle as in Fig. 32.

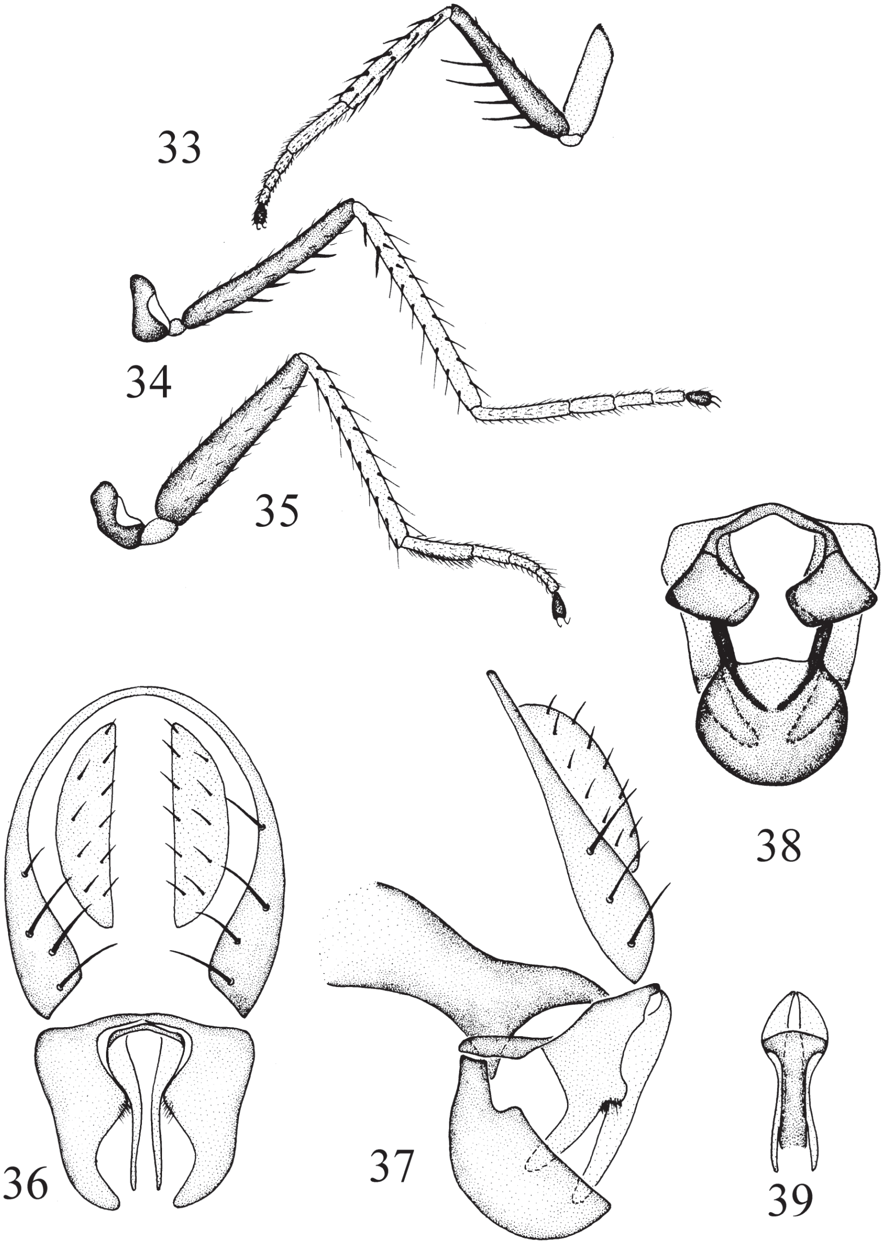
Specimens examined. 1♂, Guangdong: Dapu, Fengxi National Nature Reserve, 29 Jul 2003, Shuwen An (CAU); 4♂♂, 2♀♀, Guangdong: Dapu, Fengxi National Nature Reserve, 28 Jul 2003, Xingyue Liu (CAU); 1♂, Guangdong: Shixing, Chebaling National Nature Reserve, 10 Jul 2003, Xingyue Liu (CAU); 4♂♂, Guangdong: Wuhua, Qimuzhang, 31 Jul 2003, Shuwen An (CAU); 1♂, Guangxi: Luocheng, Jiuwanshanyuxi, 28 Jul 2003, Lili Zhang (CAU); 1♀, Fujian: Huangkeng, Aotou, 2 May 2004, Xingyue Liu (CAU); 2♀♀, Guangdong: Dapuxian, Fengxi National Nature Reserve, 30 Jul 2003, Xingyue Liu (CAU).

Distribution. China (Fujian, Guangdong, Guangxi); Nepal.

Rhynchopsilopa magnicornis **Hendel**

http://species-id.net/wiki/Rhynchopsilopa_magnicornis
Figs 33–39

Rhynchopsilopa magnicornis Hendel 1913: 96 [Taiwan. Kankau, Paroe, N Paiwan District; ST ♂ & ♀, DEI]. –Cogan and Wirth 1977: 330 [Oriental catalog]. –Mathis and Zatwarnicki 1995: 48 [world catalog].



Figures 33–39. *Rhynchopsilopa magnicornis* Hendel(male) **33** foreleg **34** midleg **35** hindleg **36** terminalia (epandrium, cercus, postsurstyli, aedeagus), posterior view **37** terminalia (epandrium, cercus, postsurstylus, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **38** terminalia (presurstyli, postsurstyli, gonite/subepandrial plate, hypandrium), ventral view **39** aedeagus and phallapodeme, ventral view.

Rhynchopsilopa rugosiscutata de Meijere 1916: 267 [Indonesia. Java: "G. Ungaran"; HT ♂, ZMA]. –Wirth 1968: 43 [synonymy].

Diagnosis. Face brownish, epistome yellowish; palpus yellowish, short, distally stout; mesonotum metallic bluish violet, with sparse squamose pubescence; sutural dc absent; legs dark brown, forecoxa, tibiae, extreme apices of femora, and tarsomeres 1–4 yellowish; wing slightly brownish; costal vein index 0.33, M vein index 2.2; haltere whitish (Wirth 1968).

Description. Male body length: 1.7–1.8 mm; wing length: 2.8–3.0 mm.

Head shiny black, with blue reflections. Setulae and setae of head black. Lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of proclinate orb. Face and palpus yellow, the latter stout at apex; epistoma yellow. Gena with 1 strong seta. Arista with 8–9 dorsal rays.

Thorax shiny black, with blue reflections; mesonotum with long and numerous setulae. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of acr long and numerous; posterior npl as long as anterior npl; katepisternal seta weaker than anepisternal seta; 1 weak sa, 1 strong ia; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa yellowish, mid and hind coxae brownish yellow; femora dark brown; tibiae and tarsomeres 1–4 yellowish, tarsomere 5 dark (Figs 33–35). Forefemur with strong pv, about two times longer than width of forefemur; mid femur with a row of strong av. Costal vein index 0.33, M vein index 2.2. Wing brownish yellow, veins brown. Haltere yellow.

Abdomen shiny black, with blue reflections. Abdomen with long and numerous setulae. Male genitalia (Figs 36–39): epandrium in lateral view (Fig. 37) slightly wide, bearing long setae on ventral 2/3 along posterior margin; cercus in posterior view (Fig. 36) narrowly hemispherical; presurstylus greatly reduced; postsurstylus in posterior view (Fig. 36) robust, broader basally, thereafter unevenly tapered to pointed apex, medial margin deeply sinuous, in lateral view (Fig. 37) with basal half roughly triangular, slightly tapered ventrally, ventral half bearing a long, narrow process extended from anteroventral angle of basal portion, forming a long, slightly curved process from ventroanterior margin of basal portion, with a posterior knob at juncture of basal and ventral portions along porterior margin; aedeagus in posterior view (Figs 36, 39) narrowly elongate, more so than postsurstylus, ventrally extended process nearly straight; phallapodeme in lateral view (Fig. 37) transversely elongate with long extended, more or less evenly thick keel; subepandrial plate in ventral view (Fig. 38) subquadrangular; hypandrium in ventral view (Fig. 38) hourglass-like, with anterior margin broadly rounded, in lateral view (Fig. 37) deeply pocket-like, bowl shaped.

Specimens examined. 3♂♂, India: Meghalaga Nongph-Forest, 25–28 Apr 1980, A. Freidberg (CAU).

Distribution. China (Taiwan), India, Indonesia (Java, Sumatra), Malaysia, Philippines (Mindanao, Tawi Tawi), Thailand.

Rhynchopsilopa shixingensis **sp. n.**
urn:lsid:zoobank.org:act:0B787DBA-9ECC-4E25-9252-732941F150D7
http://species-id.net/wiki/Rhynchopsilopa_shixingensis
Figs 40–47

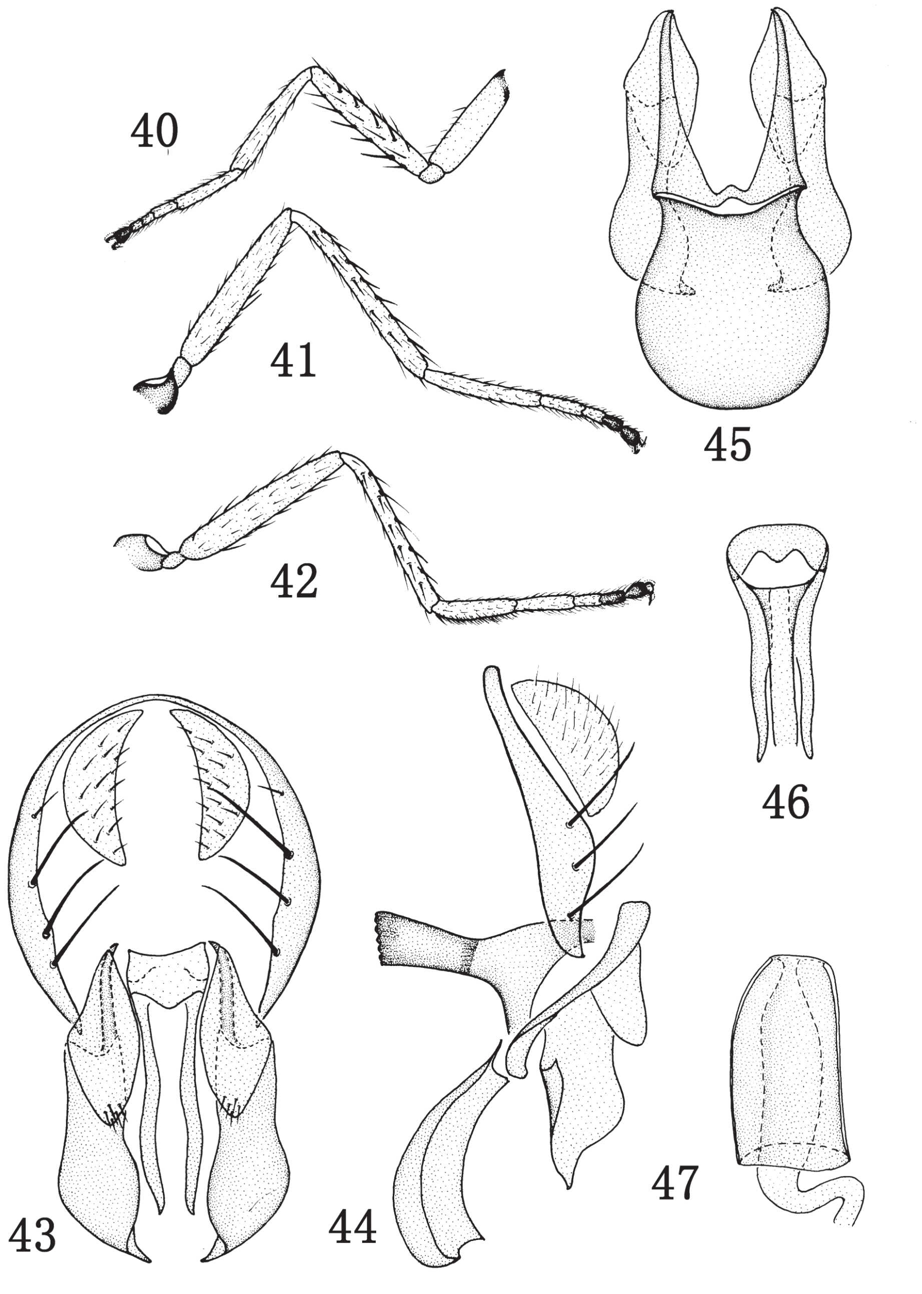
Diagnosis. Body shiny black, with blue reflections. Face reddish brown; palpus yellow, not stout at apex; arista with 8–9 dorsal rays. 1 pair of posts dc, sutural dc absent. Forecoxa yellow, with brown extreme base, mid and hind coxae brownish yellow; femora and tibiae yellow; foretarsomere 5 brown, mid and hind tarsomeres 4 and 5 brown, other yellow. Forefemur with rows of strong pd and pv, longer than width of forefemur. Mesonotum and abdomen with short and sparse setulae. Costal vein index 0.45, M vein index 2.3. Male genitalia: epandrium narrow; hypandrium large, round in ventral view; postsurstylus broadened at apex, but pointed at extreme apex, gonite/subepandrial plate slender at base; phallapodeme with process at base in lateral view.

Description. Male body length: 1.9–2.1 mm; wing length: 2.4–2.6 mm.

Head shiny black, with blue reflections. Setulae and setae of head black. Lateral vt as long as medial vt; 1 pair of strong oc; 1 pair of proclinate orb. Face reddish brown; epistoma and palpus yellow, the latter stout at apex. Gena with 1 strong seta. Arista with 8–9 dorsal rays.

Thorax shiny black, with blue reflections; mesonotum with short and sparse setulae. Thoracic setulae and setae black. 1 pair of posts dc, sutural dc absent; 2 rows of weak and short acr, posterior npl as long as anterior npl; katepisternal seta weaker than anepisternal seta; 1 weak sa, 1 strong ia; scutellum with 2 pairs of sc, apical sc stronger than lateral sc. Forecoxa yellow, with brown extreme base, mid and hind coxae brownish yellow; femora and tibiae yellow; foretarsomere 5 brown, mid and hind tarsomeres 4 and 5 brown, other yellow (Figs 40–42). Forefemur with rows of strong pd and pv, each longer than width of forefemur. Costal vein index 0.45, M vein index 2.3. Wing yellowish, veins yellow. Haltere white.

Abdomen shiny black, with blue reflections. Abdomen with short and sparse setulae. Male genitalia (Figs 43–46): epandrium in posterior view (Fig. 43) moderately thin, bearing long setae on ventral 2/3, along posterior margin; cercus in posterior view (Fig. 43) relatively short, lunate; presurstylus small, in posterior view parallelogram-like (Fig. 43), with acute angle ventrad, less than ½ length of postsurstylus; postsurstylus in posterior view (Fig. 43) becoming broader ventrally, sinuous to pointed, ventral apex, in lateral view (Fig. 44) with basal 2/3 roughly rectangular, abruptly tapered ventrally; aedeagus in posterior view (Figs 43, 46) narrowly elongate, more so than postsurstylus, ventrally extended processes shallowly sinuous; phallapodeme in lateral view (Fig. 44) with broad base, extended keel narrow, elongate, width of keel somewhat uniform; gonite/subepandrial plate in lateral view (Fig. 44) rod-like, sinuous; hypandrium in ventral view (Fig. 45) bulbous, anterior margin deeply rounded, in lateral view (Fig. 44) with narrow base and expanded anterior extension shallowly curved, moderately shallow.



Figures 40–47. *Rhynchopsilopa shixingensis* sp. n. (male) **40** foreleg **41** midleg **42** hindleg **43** terminalia (epandrium, cercus, presurstyli, postsurstyli, aedeagus), posterior view **44** terminalia (epandrium, cercus, presurstylus, postsurstylus, aedeagus, phallapodeme, gonite/subepandrial plate, hypandrium), lateral view **45** terminalia (presurstyli, postsurstyli, gonite/subepandrial plate, hypandrium), ventral view **46** aedeagus and phallapodeme, ventral view. (female) **47** ventral receptacle.

Female. Body length: 2.4–2.80 mm; wing length: 2.70–2.80 mm. Similar to male. Female ventral receptacle as in Fig. 47.

Specimens examined. Holotype ♂, Guangdong: Shixingxian, Chebaling National Nature Reserve, 10 Jul 2003, Xingxue Liu (CAU). Paratypes 1♂, 1♀, same data as holotype (CAU); 1♂, Fujian: Huangkengxian, Aotou, 1 May 2004, Dakang Zhou (USNM); 1♀, Fujian: Huangkengxian, Aotou, 1 May 2004, Xingyue Liu (USNM); 1♀, Fujian: Huangkengxian, Aotou, 2 May 2004, Yajun Zhu (CAU).

Distribution. China (Fujian, Guangdong).

Etymology. The species epithet is derived from the type locality, Shixing.

Remarks. This new species is similar to *R. magnicornis* Hendel, but may be distinguished from the latter by having a yellow palpus, the extreme base of the forecoxa brown, the costal vein index of 0.45, and the M vein index of 2.0. In *R. fuscipennis* Wirth, the palpus and forecoxa are yellowish, the costal vein index is 0.5, and the M vein index is 2.2 (Wirth 1968).

Acknowledgments

We are very grateful to Dr. Lili Zhang, Dr. Mengqing Wang, Ms. Shuwen An, Dr. Yajun Zhu, and Dr. Xingyue Liu (Beijing) for their kind help in many ways. This research was supported by the National Natural Science Foundation of China (No. 30970397, No. 31093430). For reviewing a draft of this paper we thank Ms. Hollis B. Williams and Dr. Irina Brake.

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RESEARCH ARTICLE

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A comparison of two common flight interception traps to survey tropical arthropods

Greg P.A. Lamarre[1,3], Quentin Molto[1,2], Paul V.A. Fine[4], Christopher Baraloto[3,5]

1 *Université Antilles-Guyane, UMR Ecologie des Forêts de Guyane, Campus agronomique de Kourou. Avenue de France. 97310, Kourou, French Guiana* **2** *CIRAD, UMR Ecologie des Forêts de Guyane. Campus agronomique de Kourou. Avenue de France. 97310, Kourou, French Guiana* **3** *INRA, UMR Ecologie des Forêts de Guyane, Campus agronomique de Kourou. Avenue de France. 97310, Kourou, French Guiana* **4** *Department of Integrative Biology, 1005 Valley Life Sciences Bldg. #3140, University of California, Berkeley CA 94720* **5** *Department of Biology, University of Florida, Gainesville, FL 32611*

Corresponding author: *Greg P.A. Lamarre* (Greg.Lamarre@ecofog.gf)

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Abstract

Tropical forests are predicted to harbor most of the insect diversity on earth, but few studies have been conducted to characterize insect communities in tropical forests. One major limitation is the lack of consensus on methods for insect collection. Deciding which insect trap to use is an important consideration for ecologists and entomologists, yet to date few study has presented a quantitative comparison of the results generated by standardized methods in tropical insect communities. Here, we investigate the relative performance of two flight interception traps, the windowpane trap, and the more widely used malaise trap, across a broad gradient of lowland forest types in French Guiana. The windowpane trap consistently collected significantly more Coleoptera and Blattaria than the malaise trap, which proved most effective for Diptera, Hymenoptera, and Hemiptera. Orthoptera and Lepidoptera were not well represented using either trap, suggesting the need for additional methods such as bait traps and light traps. Our results of contrasting trap performance among insect orders underscore the need for complementary trapping strategies using multiple methods for community surveys in tropical forests.

Keywords

flight interception trap, malaise trap, performance, sampling strategies, tropical forest, windowpane trap, French Guiana

Introduction

Recent estimates suggest there are between 3 to 6 million arthropods species on Earth (Thomas 1990, Ødegaard 2000, Novotny et al. 2002, Hamilton et al. 2010), but these estimates remain a subject of debate because no more than 30% of tropical insects are currently described (Godfray et al. 1999). Tropical forests likely support most of the insect diversity on earth, but only a few studies have attempted to broadly sample insect communities in tropical forests. One reason that there remains little consensus regarding the total number of insect species is because there has been so little sampling in the Neotropics (Basset et al. 2005). Large scale and multi-protocol projects including IBISCA (Basset et al. 2007) and the ALAS project (Longino and Colwell 1997) have produced different sampling methodologies in different regions, including Central America (Basset et al. 2007), Australia (Stork et al. 1997; Kitching et al. 2001), and Africa (Missa et al. 2009). However, it is difficult to integrate data from the few existing studies because of a lack of standardized methods for insect sampling across locations and/or regions.

A massive sampling strategy of arthropods via an insecticidal fogging method is the technique most widely used in the tropics to study host specialization or the vertical stratification of arthropods on focal tree species (Erwin 1982, Basset 2001, Wilkie et al. 2010). However, this method is generally used for canopy surveys and very few studies have investigated understory insect communities, especially in the Amazon basin. Key among the understory trap methods are interception traps, including the Malaise trap (MT), which is considered one of the most popular sampling strategies by entomologists (Malaise 1937, Townes 1972, Southwood and Henderson 2000, Leather 2005, Fraser et al. 2008).

In this study, we introduce a modified version of the windowpane trap, which recently has become popular in French Guiana, and we investigate the relative performance of this alternative trap in comparison with the more conventional malaise trap. We present results of a standardized arthropod survey across different habitats representative of lowland forests in French Guiana in both wet and dry seasons to evaluate the relative performance of interception traps for different insect orders. We then discuss the implications for arthropod surveys in tropical rain forests.

Methods

Study sites

The study was conducted in two different regions of French Guiana: Laussat Conservation Area of French Guiana (05°28'N, 053°35'W, ~ 2600 mm annual precipitation) located in the west, and Petite Montagne Tortue (04°19'N, 052°14'W, ~ 3900 mm annual precipitation) located in the east. Climate in the region is driven by a seasonal alternation between a wet season (December to August) and a dry season (September to November). For each site, we conducted a long-term insect sampling campaign within permanent vegetation plots representing the three dominant tropical forest habitats in each region. We will compare trap performance among insect orders in French Guiana region that include common habitat types throughout the Amazon basin (Wittman et al. 2006, Baraloto et al. 2011): terra firme forests, flooded forests and white-sand forests.

Each plot is designed using modified Gentry methods of ten aggregate transects of 50 m subplot across a 2 ha area, with measures of soil and botanical descriptors (for plot details see Baraloto et al. 2011).

Insect Sampling

Malaise traps (MT) are designed to intercept insects flying through the understory, and they function by passively collecting the many insects that exhibit geotaxis and/or heliotaxis. Insects flying through the forest understory enter the central sheet of the MT, and fly upward until they fall into the collecting jar (Fig. 1). We used black malaise traps equipped with a transparent 500mL container filled with 96% alcohol. Our traps are a standard design constructed of lightweight black nylon mesh (EFE and GB Nets®, Bodmin, UK). More recently, the malaise trap has been modified to act as a flight interception trap using a mosquito net (as collecting surface) has become popular in tropical insect surveys (Barberena-Arias and Aide 2002, Chatzimanolis et al. 2004, Stork and Grimbacher 2006).

We introduce here a modified version of the windowpane trap (WT), which was originally based on suspended window frames (Southwood 1978, Chapman and Kinghorn 1995, Southwood and Henderson 2000). A large number of windowpane trap types have been developed based on this model (Springate and Basset 1996, Hill and Cermak 1997, Carrel 2002, Fielding 2003, Fayt et al. 2006, Bouget et al. 2008, Missa et al. 2009, Grimbacher and Stork 2009), but to date no standardized method has been widely accepted.

Here, we designed our WT to have a large transparent Plexiglas® pane that function as the interception surface (200 cm length; 130 cm width, 1 mm thick), in addition to a plastic rain gutter placed below the pane which functions as a collecting container (Fig. 2). In each lateral side of the gutter, two holes are drilled and filled with wire screening to evacuate rainwater. We inserted a collecting device beneath the gutter to empty insect collections from the trap. A mixture of 5L of water, 150 mL of detergent and 500 g of salt are used as killing and conservative agents, respectively. Fixed with two vertical ropes, a piece of wood is screwed into the Plexiglas pane to support the weight of the device. Using a metal screw (10 cm length), three holes are drilled in the bottom of the pane and attached to the gutter. The windowpane must be in the center of the gutter allowing for bi-directional capture of insects. We used a 5-liter water bottle top as a stopper. For each census, we opened the water bottle tap to empty the entire liquid/insect collection. A hole into the gutter has to be drilled with the exact same di-

Figure 1. Picture of a malaise trap installed in a flooded forest of French Guiana (Lamarre G).

ameter of the stopper. We recommend the use of a powerful and hermetic glue to affix the stopper inside the gutter hole. Because it is made from lightweight plexiglass, our WT model is also easy to transport and to install. This type of insect trap can be built with low-cost materials. For example, in French Guiana (the most expensive country in the region), we estimate the cost per trap as 90 euros, whereas in Peru the materials to make the trap cost only 40 euros (prices verified in 2011 by the first author).

To compare the traps, we set up two pairs of each trap in each of six permanent plots of tropical forest, representing a total of 24 interception traps. Within each plot, pairs of MT-WT were installed in the same location in staggered rows at equal distance from each other (each traps are separated by at least 25 meters) on two representative sites with similar topography and canopy structure. Both WTs and MTs were attached and fixed to trees using cords and installed approximately two meters above the ground. A collection of each trap was made weekly for two census periods, each lasting three months; April to June and September to November 2010, respectively, corresponding to one dry and one wet season in French Guiana. We estimated trap performance as the sum of collected insect abundance across all orders using a standardized sampling protocol. We focused our study on seven well-studied arthropod orders: Blattaria, Coleoptera, Lepidoptera, Hemiptera, Hymenoptera, Orthoptera, and Diptera. Each collection was sorted to order and then to family level by the first author. Identification at species level is still pending in collaboration with taxonomic specialists.

Figure 2. Picture of the modified windowpane trap described in this study (Lamarre G).

Statistical analyses

For each insect order, we modeled the number of captured insects with a quasi-Poisson Generalized Linear Model, which is appropriate for abundance and count data (Bolker et al. 2009). The explanatory variables included trap type (two levels), season (two levels), and plot (six levels). The first-order interactions were also included. An analysis of variance (ANOVA) was performed on each model. When the trap type variable had a significant effect (with a 5% critical probability), the trap type resulting in higher abundance was determined to be significantly more efficient than the other to capture the insects of the considered order. The statistical analysis was performed with R software 2.13.1 (R Core Team 2011).

Results

Overall, 71,822 individuals representing the seven focal insect orders were collected during the 6 month survey using the two types of entomological traps. We found consistent patterns in overall insect abundance between the two interception traps. Overall, MT caught more individual insects (41,292) than the new windowpane trap (30,530) (Fig. 3). We found that Diptera and Hymenoptera are caught more often by

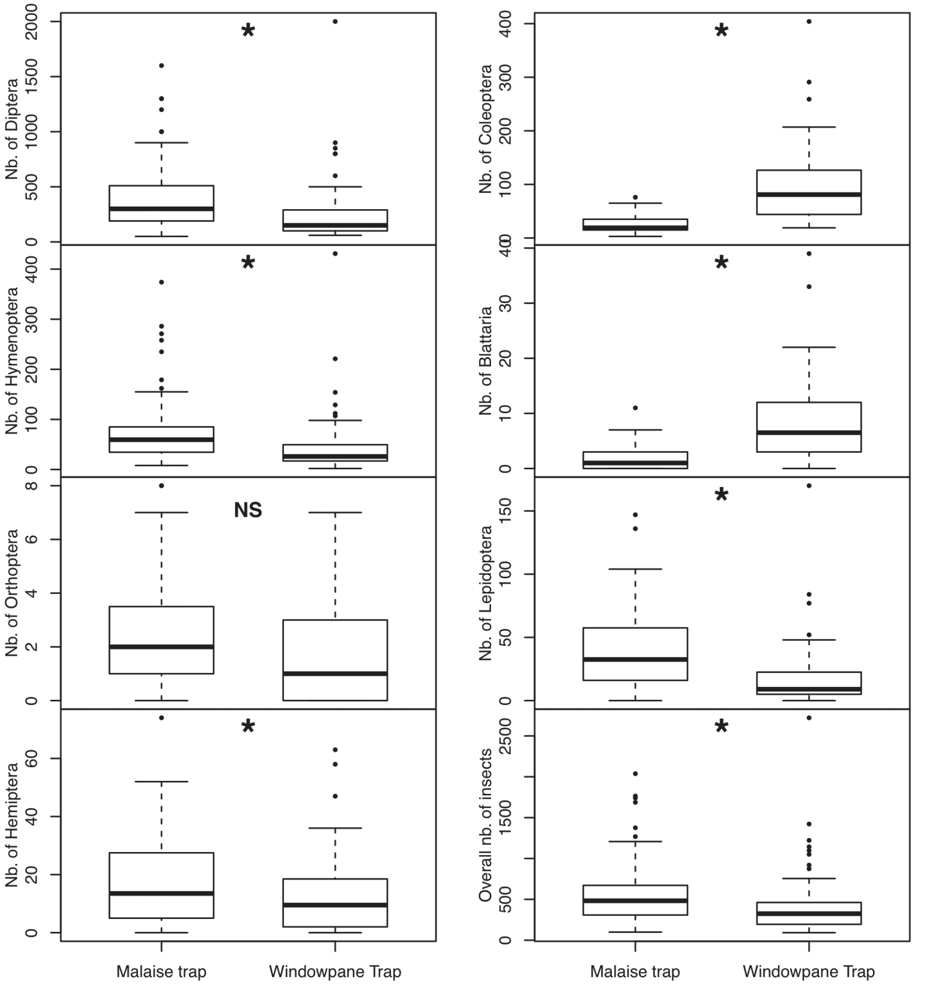

Figure 3. Box plot representing the relative abundance of the seven focal insect orders collected in each of the two traps. An asterisk above the bars represents significant differences between traps based on analysis of variance.

MT with nearly twice as many specimens as WT ($F_{(1,125)}$= 24.9, P<0.001 for Diptera and, $F_{(1,125)}$=2.95, P<0.001 for Hymenoptera). Our results show that the more efficient interception trap to sample Hemiptera is the malaise trap ($F_{(1,125)}$=11.13, P=0.001). Beetles were more efficiently captured by WT than MT with nearly four times more beetle specimens captured using WT ($F_{(1,125)}$=189,02, P<0.001). Blattaria yielded more specimens in our windowpane traps ($F_{(1,125)}$=103,24, P<0.001) than our MTs. Lepidopterans were more effectively trapped by the MT ($F_{(1,125)}$=62,60, P<0.001) than WT. We found no significant differences of Orthoptera abundance between the two interception traps ($F_{(1,125)}$=3,1, P=0.08).

In summary, our results show that the most efficient trap to collect Diptera, Hymenoptera, Lepidoptera, Hemiptera and Orthoptera is the MT with significantly greater abundance than the WT. On the other hand, significantly more Coleoptera and Blattaria individuals were collected using the WT.

Discussion

Contrasting responses among insect orders

We report strong divergence in performance between interception traps among insect orders. Compared to WT, we found that MT captured significantly more small and lightweight insects which exhibit strong heliotropism and/or high mobility within the understory vegetation (i.e. Hemiptera, Diptera and Hymenoptera). In addition, we found that some insect orders, including Blattaria and Coleoptera, are likely to be collected most efficiently using WT because of differences in flight strength among orders. Our findings strongly suggest that beetles are best captured using WT, probably because WT can collect strong fliers like beetles more effectively than the MT.

Diptera and Hymenoptera

Some authors argue that small-sized insects are likely to be blown by air currents into devices near the ground, which would explain the high density of flies when using the MT near ground level as we did (Kitching et al. 2004). This suggests that these groups of insect are more sensitive to the MT collecting surface representing an effective obstacle. Previous studies have found that malaise traps are highly effective for capturing Diptera and Hymenoptera (Ozanne 2005, Sääksjärvi et al. 2006, and Fraser et al. 2008) especially in the forest understorey (Ozanne 2005). We speculate that the low effectiveness of WT in capturing both Diptera and Hymenoptera is likely to be related to the poor point-to-point flight capabilities of these groups. High mobility in flight is probably related to the search of prey (or host plants), increasing the chance to be intercepted along a flight path by MT for Dipterans and Hymenopterans within the understory vegetation.

Hemiptera

Most hemipterans are included within the sap sucker feeding guild (Moran and Southwood 1982); and hemipterans movement patterns in the forest understory are thought to be associated with the search for host plant (i.e. the availability of new leaves). Although hemipterans were more abundant in our MT than WT samples (Fig. 3), we note that overall both interception traps sampled a relatively low abundance of hemipterans. We therefore suggest that effective sampling of this order may require an additional complementary method such as light trapping (see Broadbent 1947; Hodkinson and Casson 1991).

Coleoptera

Although similar types of WT have been employed before by entomologists, we adapted the design and made it larger than others have used in the past, expanding the width (i.e. interception surface) to at least twice the size of previous models (Hill and Cermak 1997, Bouget et al. 2008). We believe this may have made it even more effective at intercepting the flight path of Coleopterans. Furthermore, one difference between our WT model and other interception traps in general is that with our WT, beetles could be stunned by the window itself (in comparison to the soft cloth or plastic as interception material, see Springate and Basset 1996, Stork and Grimbacher 2006, Basset et al. 2007), leading to greater captures by WT compared to MT. Heavy beetles (i.e. Scarabaeidae, Cerambycidae, Passalidae etc.) are probably more likely to be stunned by the Plexiglas pane than lighter beetles. While others have noted that the use of heavy and bulky glass could damage some insect wings (Peck and Davis 1980), our model uses flexible and very thin Plexiglas that is less likely to damage insects. Our results strongly suggest that this alternative model of FIT could be an efficient alternative to capture beetles in tropical rainforest.

Blattaria

Because they are not completely sclerotized, Blattaria are unlikely to be fatally stunned by the windowpane. We speculate that flying cockroaches are attracted to the device by the olfactory stimulus of other dead insects and/or the killing agent. Because they inhabit the litter at ground level, dead plant materials are thought to be the most important component of Blattarian diet (i.e. detritivory, see Bell et al. 2007). This order includes several other guilds as well, including wood feeders, scavengers, pollen and nectar feeders, although most of them generally feed on dead plant and animal material (Bell et al. 2007). Cockroaches are mostly associated with microhabitats within the understory. For this reason, if the goal is to sample Blattaria, we recommend the use of the windowpane trap installed close to the ground where the chance of capture is higher. However, specific insect traps installed within the litter could also be effective to capture cockroaches; we therefore also recommend the use of other types of traps, for example the pitfall trap (Sabu and Shiju 2008).

Lepidoptera

Surprisingly, we caught a large number of adult moths and butterflies with both interception traps, which suggests that these insects fly through the forest understory with enough frequency to be effectively sampled by both MT and WT. Lepidopterans were more effectively trapped by the MT, which may be explained because they are more likely to be trapped within the malaise "tent", flying upward towards either the sun (for butterflies) or the moon (for moths). However, we emphasize that the use of MT will only capture a small proportion of the Lepidopteran community, as many Lepidoptera species are not associated with understory vegetation. In our collection, the most abundant and diverse families were the Noctuidae for the moths and the Satyrinae for the butterflies. The latter are well known to fly close to the ground within the understorey (Braby and New 1988). We therefore recommend the use of bait trap and light trapping techniques as a complement to interception traps for butterfly and moth communities, respectively.

Orthoptera

Very few data are available on tropical forest orthopterans, although there are a few studies on the grasshopper super-family Acridoidea in the canopy. In this group, population densities have been studied along a vertical gradient in French Guiana (Amédégnato 1997, 2003), with canopy grasshopper communities appearing to be richer than those in the understory. This trend could be explained by the very low abundance of orthopterans collected in both interception traps installed near the ground. As with Lepidoptera, we recommend the use of other type of traps for Orthoptera surveys such as light trapping techniques that exhibit very high efficiency in tropical forest surveys in Peru and French Guiana (G. Lamarre, unpubl. data).

Perspectives for arthropod surveys in tropical forests

Our finding that so many coleopterans were captured by WT highlights the high level of flight activity of beetles, the most ecologically diverse group in the tropics, and strongly suggests that our model of WT should be used as an alternative method for future empirical studies contributing towards global as well as in areas that include gradients of anthropogenic disturbance. Furthermore, we recommend the use of our WT model to study ground beetles in forest microhabitats such as gaps, dead wood as well as anthropogenic gradient of perturbation. In French Guiana, some preliminary insect collections are showing very promising results with the placement of the WT up to 25 m above the ground within the forest canopy (S. Brûlé, pers. comm.). We therefore recommend the use of this interception trap for tropical arthropod surveys where coleopterans are the main targets, and we propose that it can nicely complement fogging methods for more comprehensive collections in the forest canopy.

To develop effective policies and management strategies in the context of escalating threats due to land use changes (Asner et al. 2010) and climate change in the Amazon basin (Malhi et al. 2008), we are in critical need of more complete descriptions of arthropod communities (May 2010). Indeed, arthropods represent an important indicator group to study future environmental changes in the tropics (Stork et al. 2003).

This study represents a first step towards a better understanding of how we should orient these sampling strategies. Our study clearly shows significant performance differences between two interception trap methods for the most common studied arthropods in tropical forests (Fig. 3). Among the seven groups on which we focused our study, at most three would be effectively sampled using a single trap method (MT for Dipterans, Hymenopterans and to a lesser extent Hemipterans), and only five would be well sampled using both methods (above in addition to WT for Coleopterans and to a lesser extent Blattaria), with two groups (Lepidoptera sensus largo and Orthoptera) requiring methods complementary to interception traps, such as light trapping and fruit traps. We therefore recommend that tropical entomological surveys should include a multiple-trapping-method approach rather than relying on a single trap type (Russo et al. 2011). We also advise the use of appropriate sampling techniques targeting focal insect groups (Basset et al. 2007). Our results clearly illustrate that there is no silver bullet for tropical arthropod sampling strategies.

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RESEARCH ARTICLE

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A new species of the genus *Helcogramma* (Blenniiformes, Tripterygiidae) from Taiwan

Min-Chia Chiang[1,†], I-Shiung Chen[1,2,‡]

1 *Institute of Marine Biology, National Taiwan Ocean University, Keelung 202, Taiwan, ROC* **2** *Center for Marine Bioenvironment and Biotechnology (CMBB), National Taiwan Ocean University, Keelung 202, Taiwan, ROC*

† *urn:lsid:zoobank.org:author:D82C98B9-D9AA-46E1-83F7-D8BB74776122*
‡ *urn:lsid:zoobank.org:author:6094BBA6-5EE6-420F-BAA5-F52D44F11F14*

Corresponding author: *I-Shiung Chen* (isc@ntou.edu.tw)

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Abstract

A new species of triplefin fish (Blenniiformes: Tripterygiidae), *Helcogramma williamsi*, is described from six specimens collected from southern Taiwan. This species is well distinguished from its congeners by possessing 13 second dorsal-fin spines; third dorsal-fin rays modally 11; anal-fin rays modally 19; pored scales in lateral line 22-24; dentary pore pattern modally 5+1+5; lobate supraorbital cirrus; broad, serrated or palmate nasal cirrus; first dorsal fin lower in height than second; males with yellow mark extending from anterior tip of upper lip to anterior margin of eye and a whitish blue line extending from corner of mouth onto preopercle. Comparisons and a diagnostic key are provided for the species of *Helcogramma* now known from Taiwan: *H. fuscipectoris*, *H. inclinata*, *H. striata*, *H. trigloides*, and the newly recorded, *H. rhinoceros*.

Keywords

Fish fauna, fish taxonomy, marine fish, new triplefin, Taiwan

Introduction

The genus *Helcogramma* McCulloch & Waite (1918) contains small to medium sized tripterygiid fishes with rather fusiform bodies. It can be distinguished from other genera of Tripterygiidae by the following combination of features: a single continuous lateral line; first dorsal fin with three spines; anal fin with a single spine; pelvic fin with one hidden spine and two simple rays (Rosenblatt 1960; Fricke 1997). Species of the genus *Helcogramma* share the following characters: lateral line with 12-37 pored scales, curving ventrally from the posttemporal to mid-body and extending to below the second or third dorsal fin or onto caudal peduncle; spine of anal fin usually less than half the length of first ray; the two segmented rays of pelvic fin sometimes joined by membrane for part of their length; dentary canals with 1-7 pores at the symphysis and 2-10 on either side; supraorbital cirrus simple to palmate or absent; nasal cirrus simple to palmate. Body with ctenoid scales; nape usually naked, rarely with a few scales; head, abdomen and pectoral-fin base always naked (Hansen 1986; Shen and Wu 1994; Fricke 1997; Holleman 2007).

Fishes of *Helcogramma* are widely distributed through the Indo-West Pacific and southeastern Atlantic. This genus comprises 37 valid species (not including *Helcogramma* sp. listed in Fricke 2009), of which 13 species were described in the past ten years (Williams and Howe 2003; Holleman 2006, 2007). There are at least seven nominal species of *Helcogramma* that have been recorded from Taiwan (Holleman 1982; Hansen 1986; Williams and McCormick 1990; Shen and Wu 1994; Fricke 1997) inclulding: *H. fuscipectoris* (Fowler, 1946), *H. fuscopinna* (Holleman, 1982), *H. habena* (Williams & McCormick, 1990), *H. inclinata* (Fowler, 1946), *H. obtusirostre* (Klunzinger, 1871), *H. striata* Hansen (1986), and *H. trigloides* (Bleeker, 1858). *Helcogramma fuscipectoris* specimens collected from the Ryukyu Islands of Japan and Taiwan were considered by Hansen (1986) to be a junior synonym of *H. obtusirostre*. However, the Japanese *H. fuscipectoris* was classified by Fricke (1997) as a different species from *H. obtusirostre*, which occurs only in the Red Sea and Oman (Holleman 2007). Some Taiwanese specimens identified by Holleman (1982) and Hansen (1986) as *H. fuscopinna* were determined to represent a distinct species and were described by Williams and McCormick (1990) as *H. habena*. Subsequently, *H. habena* was considered by Fricke (1997), and confirmed by Williams and Howe (2003), to be a junior synonym of *H. inclinata*, which previously had been synonymized with *H. hudsoni*. Thus, only four valid species of the genus *Helcogramma* were known from Taiwan prior to this study.

A new species from southern Taiwan is described in the present paper increasing the total number of recognized valid species of *Helcogramma* to 38. We also report a new locality record for *H. rhinoceros* Hansen (1986) and redescribe Taiwanese specimens of the species known from Taiwan.

Materials and methods

All Taiwanese specimens examined in this study were collected from 2006-2010 from coastal waters of Taiwan using either hand-nets in tide pools or while SCUBA diving. Specimens used for morphological studies were preserved in 10% formalin before being transferred into 70% ethanol for long-term preservation. The type specimens of the new species and specimens of congeners examined that were collected from Taiwan have been deposited at the Institute of Marine Biology, National Taiwan Ocean University (NTOU-P), Keelung. Other comparative materials, including types, examined in this study are deposited in the National Museum of Natural History, Smithsonian Institution (USNM), Washington DC.

Counts and measurements follow those given by Holleman and Bogorodsky (2012) and Chiang and Chen (2008). Measurements were made with needle-point calipers under a dissecting microscope and recorded to the nearest 0.1 mm. Proportional measurements given in the text are in relation to standard length (SL), head length (HL) and eye diameter. Meristic abbreviations include A = anal-fin rays and D = dorsal-fin rays. Elements of the three dorsal fins are presented as a formula: number of spines in first dorsal fin, number of spines in second fin, number of segmented rays in third fin. Dentary pore counts are listed as a formula: right dentary + symphyseal + left dentary. Osteological observations were made on cleared and stained specimens and from radiographs. Number of vertebrae represented as precaudal + caudal vertebrae following Holleman (1982).

Systematics

Helcogramma williamsi **sp. n.**
urn:lsid:zoobank.org:act:33C9C3E3-E385-4FC4-8383-80DF75FF20A4
http://species-id.net/wiki/Helcogramma_williamsi
Fig. 1

Holotype. NTOU-P 2012-02-002, male, 27.5 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 1-3 m depth, M. C. Chiang and J. H. Huang, 3 June 2008.

Paratypes. 5 paratypes were collected with holotype: NTOU-P 2012-02-001, male, 29.0 mm SL; NTOU-P 2012-02-003, male, 25.4 mm SL; NTOU-P 2012-02-004, female, 28.5 mm SL; NTOU-P 2012-02-005, 2 females, 21.1 and 21.3 mm SL.

Diagnosis. The new species can be distinguished from congeners by the following combination of features. Second dorsal-fin spines XIII; third dorsal-fin rays modally 11; anal-fin rays modally 19; lateral line with 22-24 pored scales; pattern of dentary pores modally 5+1+5; nape naked; supraorbital cirrus lobate; nasal cirrus broad, serrated or palmate; first dorsal fin lower in height than second; males with yellow mark from anterior tip of upper lip to anterior margin of eye and a whitish blue line extending from corner of mouth onto preopercle.

Description. D III, XIII-XIV (holotype: XIII), 10-11 (holotype: 11). A I, 19-20 (holotype: 19). Pectoral fin rays 1+8+7, uppermost ray simple, eight middle rays branched, seven lowermost rays simple. Pelvic fin I, 2, rays united by membrane for half the length of shorter ray. Caudal fin rays 2+9+2, two uppermost and lowermost rays simple, nine middle rays branched. Scale rows 36-37. Lateral line with 22-24

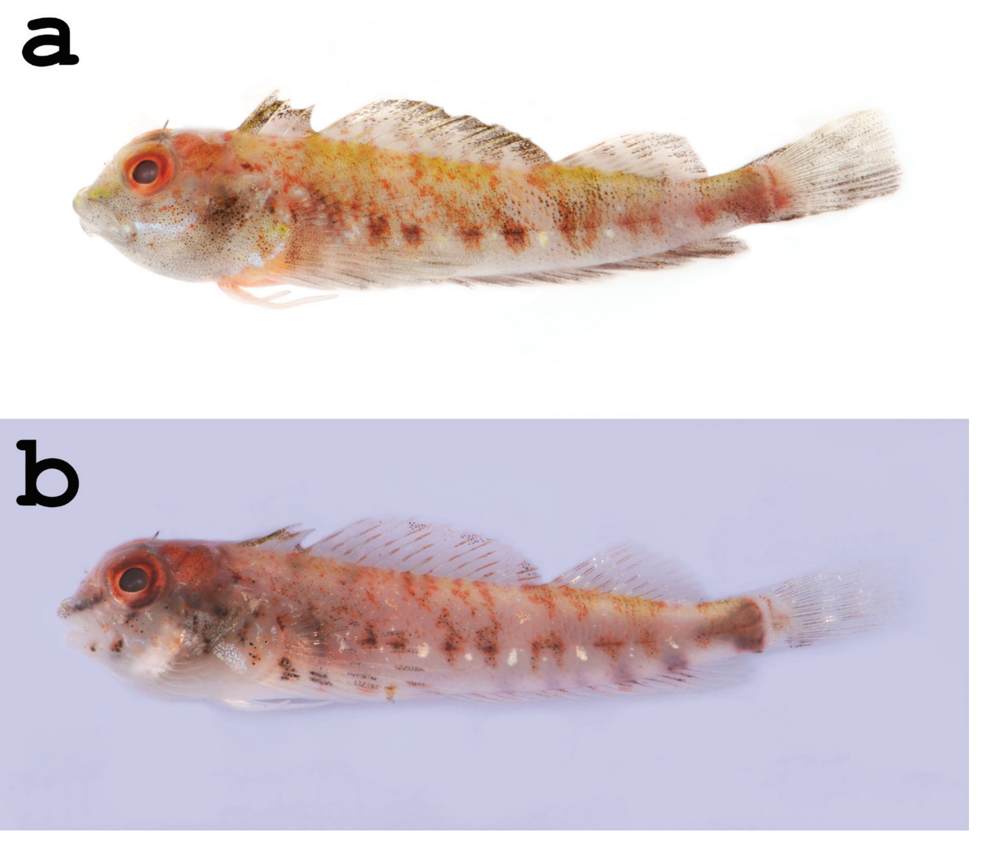

Figure 1. *Helcogramma williamsi* sp. n., Feng-chui-sha, Pingtung, Taiwan **a** Holotype, NTOU-P 2012-02-002, male, 27.5 mm SL **b** Paratype, NTOU-P 2012-02-005, female, 21.3 mm SL.

(holotype: 24) pored scales, ending below 2nd-4th ray of third dorsal fin. Patterns of cephalic sensory canal pores are illustrated in Fig. 2. Dentary with a single symphyseal pore, dentary pore pattern 5-6+1+5-6 (holotype: 5+1+5). Vertebrae 10+26. No free pterygiophore between second and third dorsal fins.

Body moderately elongate and compressed. Head moderately large, dorsal profile triangular. Body covered with ctenoid scales. Head, nape, base of pectoral fin, and abdomen naked; body scales not extending to bases of first and anterior portion of second dorsal fins. Mouth terminal, posteriormost margin of maxilla just reaching vertical through anterior margin of pupil. Eye moderately large and slightly angled dorsally. Supraorbital cirrus lobate, usually with micromelanophores. Anterior nostril a short tube with broad, serrated or palmate nasal cirrus. First dorsal fin lower in height than second in both sexes. Anal fin beginning below vertical through base of 7th or 8th spine of second dorsal fin; pectoral fin large and pointed, posterior tip of longest ray below last spine of second dorsal fin; caudal fin truncate to slightly rounded. Morphometric data are listed in Table 1.

Table 1. Measurements of type specimens of *Helcogramma williamsi*, sp. n., from Taiwan.

Type status	Holotype	All type specimens (n = 6)	
Standard length (mm)	27.5	21.1 –29.0	
In % of standard length			
Head length	29.1	28.4 –29.5	(28.9)
Body depth of anal fin origin	18.2	16.6 –18.2	(17.4)
Body width of anal fin origin	14.5	12.3 –14.5	(13.3)
Head width in maximum	24.7	23.0 –24.9	(24.1)
Predorsal(1) length	26.2	25.2 –27.2	(26.1)
Predorsal(2) length	37.1	34.0 –38.5	(36.0)
Predorsal(3) length	70.2	68.4 –71.8	(70.2)
Prepectoral-fin length	32.0	32.0 –33.8	(33.0)
Prepelvic-fin length	23.6	22.1 –26.8	(23.7)
Preanal-fin length	48.7	48.7 –52.6	(50.4)
Caudal-peduncle length	10.2	8.5 –10.2	(9.4)
Caudal-peduncle depth	8.7	8.0 –9.1	(8.5)
Pectoral-fin length	33.8	29.0 –35.7	(32.8)
Pelvic-fin length	21.1	20.4 –21.1	(20.8)
Caudal-fin length	20.7	20.3 –23.0	(21.2)
D1 fin base	11.3	9.8 –11.7	(10.7)
D2 fin base	34.9	34.3 –36.2	(35.0)
D3 fin base	19.6	19.3 –20.4	(19.9)
A fin base	43.6	41.1 –45.3	(43.1)
D1 1st spine length	9.8	8.4 –9.8	(9.3)
D2 1st spine length	12.0	11.6 –13.1	(12.3)
Head length (mm)	8.0	6.0–8.5	
In % of head length			
Head width in maximum	85.0	78.8 –89.3	(84.4)
Eye diameter	30.0	28.0 –33.3	(30.5)
Interorbital width	8.8	8.2 –9.9	(9.0)
Upper-jaw length	43.8	41.0 –43.8	(42.4)
Snout length	35.0	34.4 –36.5	(35.0)
Eye diameter (mm)	2.4	2.0–2.5	
In % of eye diameter			
Nasal tentacle length	12.5	12.0 –16.7	14.2
Orbital tentacle length	16.7	15.0 –20.0	17.9

Colouration when fresh. Males with top of head orange red; lower half of head below eyes, inclusive of lips and branchiostegal membranes, covered with scattered melanophores on pale gray background; opercle heavily spotted and mostly dusky. A whitish blue line extending from posterior flange of maxilla across cheek onto preopercle; faint orange spots below eye and along sides of mouth. Iris orange to red. Snout with iridescent yellow mark, bordered ventroposteriorly by dusky line from anterior margin of eye to anterior tip of upper lip. Body mottled yellow and orange on dorsum;

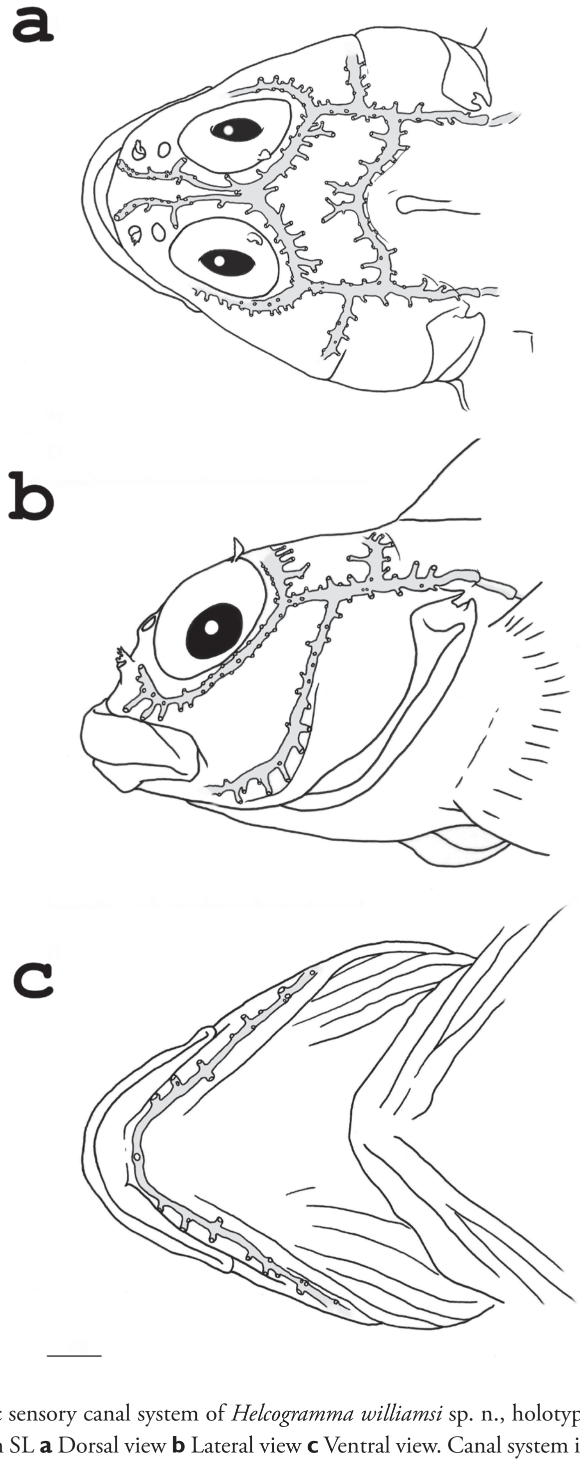

Figure 2. Cephalic sensory canal system of *Helcogramma williamsi* sp. n., holotype, NTOU-P 201202-002, male, 27.5 mm SL **a** Dorsal view **b** Lateral view **c** Ventral view. Canal system indicated in gray. Scale bar = 1 mm.

pairs of orange or red, indistinct, slightly angled semi-bars from behind pectoral-fin base to caudal fin, last half-pair forming triangular mark on caudal peduncle. Mid-lateral series of reddish brown blotches, elongating into slender dorsal bars, with intervening white spots. Pectoral-fin base with yellowish white splotch centrally, red and white marks ventrally; pectoral fins dusky with irregular dark and pale bars. Pelvic fins mostly white, pink or pale orange basally. Dorsal fin dusky to black along distal margins of all membranes; first dorsal fin speckled with yellow and black on membrane between first two spines; second and third dorsal fins diagonally striped with faint reddish or dusky markings, markings roughly in line with semi-bars, those on side of body. Anal fin dusky red. Caudal fin dusky.

Females with head reddish above, dark brown behind centre of eye and onto upper portion of opercle; ventral half of head pale cream below eye, with some black and orange spots. Iris red to reddish brown. Snout with brownish black line from anterior margin of eye onto upper lip. Body pale pink, sides of body with orange and red marks forming pairs of discontinuous semi-bars and blotches, from dorsum to below lateral midline, last half-pair forming triangular mark on caudal peduncle; a row of white spots along mid-body between each dark blotch. Pectoral-fin base with a white splotch at lower edge, which seems to extend form white marking on lower portion of opercle, and red and white marks above; fin rays with alternating white and black bars. Pelvic fin white. First dorsal fin as in males; second dorsal fin diagonally striped with red markings; third dorsal fin banded with dusky red and white oblique bands. Anal fin with dusky red blotches along base. Caudal fin dusky, melanophores concentrated along outlines of ray shafts, interspaced with two white, vertical bars.

Colouration in preservative. Males with head and body dusky, except belly and area behind eye clear. Body dusky with irregular double bars. Pectoral fins dusky with clear blotches on upper and lower margins of base. Distal halves of first and second dorsal fins dusky, membrane between first two spines of first dorsal with dense melanophores; third dorsal fin irregularly banded. Anal and caudal fins dusky.

Females generally pale to dusky. Top of head, opercle and pectoral-fin base with scattered melanophores; small clusters of melanophores below eye and along sides of mouth; a dusky bar of melanophores extending from eye onto upper lip. Body with faint, barely discernible, irregular markings. First dorsal fin as in males; second dorsal fin with clusters of melanophores near distal margin. Pectoral, third dorsal and caudal fins banded, melanophores concentrated along margins of fin elements. Anal fin with blotches of melanophores basally.

Etymology. The specific name, *williamsi*, is in honor of Jeffrey T. Williams, Smithsonian Institution, National Museum of Natural History, in recognition of his excellent research work on marine blenniiform fishes.

Distribution. The samples were collected from rocky shore areas with sand channels at depths of 1-3 m, along the southern coast of Taiwan.

Remarks. *Helcogramma williamsi* shares the pattern of dentary pores and the numbers of fin rays and lateral-line scales with three congeners: *H. capidata* Rosenblatt

(1960), *H. alkamr* Holleman (2007), and *H. rharhabe* Holleman (2007). These four species, as well as others in the *H. obtusirostris* species group, also share a putative synapomorphy- a blue line running from the corner of the mouth onto the preopercle in mature males.

However, *Helcogramma williamsi* is distinguished from *H. capidata* by its lobate supraorbital cirrus vs. without supraorbital cirrus; upper jaw extending to a point below anterior half of eye vs. extending to a point below posterior half of eye; and moderately complex cephalic sensory canal pores vs. rather simple pore pattern. *Helcogramma williamsi* can be distinguished from *H. rharhabe* by the following features: vertebrae 10+26 vs. 10+24-25; males with yellow mark from anterior tip of upper lip to anterior margin of eye vs. crimson marks on upper lip on either side of center, black in the centre; body with 5-6 pairs of indistinct semi-bars vs. body of males almost entirely black with 3-4 pale narrow streaks from dorsum to midline. *Helcogramma williamsi* seems to be more similar to *H. alkamr* than to any other congeneric species in overall pattern of colouration. However, it can be distinguished from *H. alkamr* by the following features: height of first dorsal fin more than half height of second dorsal fin vs. height of first dorsal fin less than half height of second dorsal fin; lateral-line scales extending to a point below insertion between 2nd-4th rays of third dorsal fin vs. lateral-line scales extending to a point just below the junction of second and third dorsal fins; ventral side of caudal peduncle with cycloid scales vs. ventral side naked; iris orange-red with reddish brown ring vs. red and pale gold.

Helcogramma fuscipectoris **(Fowler, 1946)**

http://species-id.net/wiki/Helcogramma_fuscipectoris
Fig. 3a

Enneapterygius fuscipectoris Fowler 1946: 186 (Type locality: Aguni shima, Riu kiu Island).
Enneapterygius personatus: Fowler 1946: 185.
Enneapterygius quadrimaculatus: Fowler 1946: 189.
Helcogramma obtusirostris (non Klunzinger 1871): Hansen 1986: 341 (part: Japan; Taiwan).
Helcogramma obtusirostris (non Klunzinger 1871): Shen and Wu 1994: 21.
Helcogramma fuscipectoris: Fricke 1997: 429.

Material Examined for Description. NTOU-P 2009-06-058, male, 22.1 mm SL, Chenggong Township, Taitung County, Taiwan, intertidal rock pools, J. H. Huang, 6 June 2006; NTOU-P 2009-06-059, male, 22.3 mm SL, Chenggong Township, Taitung County, Taiwan, intertidal rock pools, M. C. Chiang and J. H. Huang, 19 Aug 2006; NTOU-P 2009-06-060, male, 22.0 mm SL, San-diao-jiao, Gongliao Township, Taipei County, Taiwan, J. T. Chen, 18 Aug 2006; NTOU-P 2009-06-61, male, 21.2 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 6-12 m depth, M. C. Chiang and J. H. Huang., 20 July 2007; NTOU-P 2009-06-062, male, 21.8 mm SL, Ba-dou-zi, Keelung City, Taiwan, intertidal pools, M. C. Chiang and W. H. Li, 27 Aug 2008; NTOU-P 2009-06-063, male, 20.8 mm SL, Chenggong Township, Taitung County, Taiwan, intertidal pools, M. C. Chiang and J. H. Huang, 31 May 2008; NTOU-P 2009-06-064, male, 25.1 mm SL, Chenggong Township, Taitung County, Taiwan, intertidal pools, M. C. Chiang, 25 April 2009; NTOU-P 2009-06-065, 3 specimens, 20.0-23.3 mm SL, Da-bai-sha, Lyutao Township, Taitung County, Taiwan, 12 m depth, M. C. Chiang, 27 April 2009; NTOU-P 2009-06-066, female, 24.5 mm SL, Chenggong Township, Taitung County, Taiwan, intertidal pools, M. C. Chiang et al., 7 April 2007.

Description. D III, XIII-XIV (modally XIV), 9-11 (modally 10). A I, 19-20. Lateral line with 21-22 pored scales (usually 22). Dentary pore pattern 3-4+1+3-4 (modally 4+1+4). Supraorbital cirrus simple and minute, sometimes too small to find. Nasal cirrus leaf-like and slender. First dorsal fin lower in height than second in both sexes. Vertebrae 10+26-27. Males with black mask on lower half of head below eye, black area extending onto base of pectoral-fin rays; fresh males with narrow, horizontal bright blue stripe extending from corner of mouth onto the preopercle, and a whitish blue dashed line on lower pectoral-fin base may be present. Fresh male specimens orange to red generally, series of pale marks and black or dark brown tiny dots along midline and back; females white or pale yellow with orange to red or brown markings extending from dorsum to midline or below, in which red to brown chromatophores are concentrated along lateral line. Dorsal-fin elements red. Anal fin with four, sometimes five or six, basal dusky red to black blotches. (Note. The orange/red body colouration described above is apparent after fresh specimens have been immersed in ice; when first captured, the head and body are pale olive to green or brownish green.)

Distribution. The specimens described herein were collected at depths of 0-3 m from eastern and northeastern Taiwan. This species previously has been recorded from the eastern and southern coasts of Taiwan, Ryukyu Islands, Izu Islands (Japan), China, Philippines, Vietnam, Thailand, Malaysia, Indonesia, and Vanuatu (Fricke 1997).

Remarks. *H. fuscipectoris*, *Enneapterygius personatus* Fowler (1946) and *Enneapterygius quadrimaculatus* Fowler (1946), which were described in the same paper, were subsequently placed in the synonymy of *H. obtusirostre* (Klunzinger 1871) by Hansen (1986). However, *H. fuscipectoris* was recognized by Fricke (1997) as a valid species, and he determined that *E. personatus* and *E. quadrimaculatus* were junior synonyms. *Helcogramma obtusirostre* is distinguished from *H. fuscipectoris* by geographical distribution, body colouration, anal fin colour pattern, and other characters (Fricke 1997).

Helcogramma inclinata **(Fowler, 1946)**
http://species-id.net/wiki/Helcogramma_inclinata
Fig. 3b

Enneapterygius inclinatus Fowler 1946: 190 (Type locality: Aguni shima, Riu Kiu Island).
Helcogramma habena Williams and McCormick 1990: 1026 (Type locality: Philippines)
Helcogramma habena: Shen and Wu 1994: 19.
Helcogramma inclinatum: Fricke 1997: 446.
Helcogramma inclinata: Williams and Howe 2003: 164.

Material Examined for Description. NTOU-P 2009-06-050, 1 specimen, 29.0 mm SL, Chenggong Township, Taitung County, Taiwan, 6 m depth, J. H. Huang, 12 June 2006; NTOU-P 2009-06-051, 2 specimens, 30.6 and 32.2 mm SL, Chenggong Township, Taitung County, Taiwan, 6-9 m depth, M. C. Chiang and I-S. Chen, 19 Aug 2006; NTOU-P 2009-06-052, 1 specimen, 37.5 mm SL, Ma-gang, Taipei County, Taiwan, 5-8 m depth, M. C. Chiang et al., 1 Sep 2006; NTOU-P 2009-06-053, 2 specimens, 33.4 and 36.3 mm SL, NW shore of Liouciou Township, Pingtung County, Taiwan, 5-12 m depth, M. C. Chiang et al., 8 July 2007; NTOU-P 2009-06-054, 2 specimens , 33.4 and 35.3 mm SL, Nan-ren-road Ferry, Pingtung County, Taiwan, 5-10 m depth, M. C. Chiang et al., 19 July 2007; NTOU-P 2009-06-055, 1 specimen, 34.2 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 1-3 m depth, M. C. Chiang et al., 3 June 2008; NTOU-P 2009-06-056, 2 specimens, 30.2 and 34.3 mm SL, Xian-jiao-wan, Pingtung County, Taiwan, 9 m depth, M. C. Chiang and W. H. Li, 8 Sep 2008; NTOU-P 2009-06-057, 2 specimens, 29.0 and 30.9 mm SL, Wan-Li-Tong, Pingtung County, Taiwan, 6 m depth, M. C. Chiang and W. H. Li, 10 Sep 2008.

Description. D III, XIV-XV (modally XV), 10-11. A I, 20-22 (usually 21-22). Lateral line with 25-32 pored scales. Dentary pore pattern 7-10+5-7+7-11 (modally 8+6+8). Supraorbital cirrus small and pointed. Nasal cirrus simple and slender. First dorsal-fin height almost equal to second dorsal-fin height. Nape scales present. Vertebrae 10+28-29. Head mottled red to reddish brown, a white or blue line extending from tip of the upper jaw to dorsal angle of the preopercle; males with dark brown or black mask on lower half of head and the the blusish white line beneath eye conspicuous. Body with 7-8 reddish brown to brown oblique single bars or Y-shaped markings; males with more densely scattered melanophores over body. Dorsal fin with alternating white and reddish brown bands on spines and rays, many tiny melanophores speckled on membrane especially near the basal and marginal parts of fins. Anal fin gray or yellowish brown to black. Caudal fin translucent with dusky area basally and distally on center of fin.

Distribution. This species has been recorded from the northeastern, eastern and southern shores of Taiwan, Ryukyu Islands, and the northern Philippines (Fricke 1997; Williams and Howe 2003).

Remarks. *H. inclinata* was regarded as a junior synonym of *H. hudsoni* (Jordan and Seale 1906) by Hansen (1986). However, it had been recognised as a valid species and a senior synonym of *H. habena* (Williams & McCormick, 1990) by Fricke (1997) and Williams and Howe (2003).

Helcogramma rhinoceros **Hansen, 1986**
http://species-id.net/wiki/Helcogramma_rhinoceros
Fig. 3c

Helcogramma rhinoceros Hansen 1986: 344 (Type locality: Putic Island, Philippines).
Helcogramma rhinoceros: Fricke 1997: 467.

Material Examined for Description. USNM 222370, holotype, 27.5 mm SL, N.W. Putic Island, Palawan province, Philippines, V. G. Springer, 22 May 1978; NTOU-P 2009-06-043, 1 male, 29.6 m SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 9 m depth, M. C. Chiang et al., 20 July 2007.

Description. D III, XIV-XV, 10-11. A I, 20. Lateral line with 19-22 pored scales. Dentary pore pattern 4+1+4. Supraorbital cirrus small and pointed. Nasal cirrus simple and slender. First dorsal-fin height equal to second dorsal-fin height. Vertebrae 11+26. Males with a proboscis-like dermal prolongation on tip of upper lip. Head of males orange above; head below level of eye, including upper lip and its extension, black; black pigment extending onto basal portion of pectoral fin. A yellowish or bluish white line extending along edge of black mask from upper rim of upper jaw to opercle and onto pectoral-fin base. Body pale yellow with indistinct H-shaped yellowish orange to orange markings. In males, H-shaped markings diffuse, narrow pale saddle marks extending discontinuously from dorsum to midline and below. A row of reddish blotches present along lateral midline, yellowish orange spots present at dorsal-fin base, and a dark blotch comprising densely packed melanophores present at posterior base of first dorsal fin and at anterior base of second dorsal fin. Dorsal-fin spines and rays orange near distal margin of fin; membranes yellowish orange on basal half and spotted with small melanophores on distal half. Uppermost pectoral-fin rays translucent, lowermost grayish or blackish. Anal fin orange. Caudal fin pale red and semi-translucent. Colour pattern of females based on Hansen (1986): head and body overall lighter than males; body with same pigment pattern as males; head without dark mask but with irregular scattered melanophores on face and diffuse band from eye onto upper lip.

Distribution. One specimen was collected in this study at a depth of 9 m from southern Taiwan. This species previously has been recorded from the Philippines, Thailand, Indonesia, Solomon Islands, and Vanuatu (Hansen 1986; Fricke 1997).

Remarks. This species is recorded herein for the first time in Taiwanese waters.

***Helcogramma striata* Hansen, 1986**
http://species-id.net/wiki/Helcogramma_striata
Fig. 3d

Helcogramma striata Hansen 1986: 349 (Type locality: Toga Point rocks, Miyakejima, Izu Islands, Japan).
Helcogramma striata: Shen and Wu 1994: 22.
Helcogramma striatum: Fricke 1997: 480.
Helcogramma striata: Holleman 2007: 77.

Material Examined for Description. USNM 221667, holotype, 41.0 mm SL, Toga Point Rocks, Miyakejima, Izu Island, Japan, 34°07'N, 139°30'E, 1-3 m depth, P. E. Hadley and L. Cuyvers, 10 July 1977; NTOU-P 2009-06-044, 1 specimen, 20.5 mm SL, Wan-li-tong, Pingtung County, Taiwan, 6-9 m depth, M. C. Chiang et al., 14 Sep 2006; NTOU-P 2009-06-045, 1 specimen, 22.1 mm SL, Ho-bi-hu, Pingtung County, Taiwan, 12 m depth, M. C. Chiang and J. H. Huang, 2 June 2008; NTOU-P 2009-06-046, 1 specimen, 26.2 mm SL, Shan-hai, Pingtung County, Taiwan, 6-10 m depth, M. C. Chiang and J. H. Huang, 16 July 2008; NTOU-P 2009-06-047, 3 specimens, 25.5-26.4 mm SL, Xian-jiao-wan, Pingtung County, Taiwan, 9 m depth, M. C. Chiang and W. H. Li, 8 Sep 2008; NTOU-P 2009-06-048, 1 specimen, 27.4 mm SL, Chuan-fan-shi, Pingtung County, Taiwan, 9 m depth, M. C. Chiang and W. H. Li, 8 Sep 2008; NTOU-P 2009-06-049, 1 specimen, 21.6 mm SL, Hong-chai-keng, Pingtung County, Taiwan, 6-8 m depth, M. C. Chiang et al., 9 Sep 2008; NTOUP 201202-007, 1 male, 28.2 mm SL, Hong-chai-keng, Pingtung County, Taiwan, 9 m depth, M. C. Chiang et al., 5 Sep 2009; NTOUP 201202-008, 1 specimen, 28.5 mm SL, Nan-wan, Pingtung County, Taiwan, 10-12 m depth, M. C. Chiang et al., 27 May 2010.

Description. D III, XIV-XV (modally XIV), 10-11 (modally 11). A I, 20-21 (modally 21). Lateral line with 18-20 (modally 18) pored scales. Dentary pore pattern 3+2+3. Supraorbital cirrus absent. Nasal cirrus simple and slender. First dorsal fin about half height of second dorsal fin. Vertebrae 10+27-28. Males and females with similar colour pattern. A characteristic colour pattern of three bluish white stripes along side of body: dorsalmost stripe originating over top of eye, extending backward along bases of dorsal fins; middle stripe originating on snout, extending through eye and terminating at caudal-fin base; ventralmost stripe originating on lips, extending across cheek and pectoral-fin base, and ending on ventral part of caudal peduncle. Dorsal part of head and body above ventralmost stripe red; body below ventral stripe gray or pink to white. Body with row of bluish or grayish white spots between middle and ventral stripes. Dorsal-fin elements and basal membranes reddish. Anal fin red. Caudal fin with red extending from body onto middle portion of fin.

Distribution. The specimens described herein were collected at depths of 6-12 m from southern Taiwan. This species has been recorded in shallow waters of 1-20 m depth from the southern tip of Taiwan, Ryukyu Islands, Japan, Philippines, Sri Lanka, Australia, Thailand, Indonesia, Timor Sea, Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Kiribati, and Line Islands (Fricke 1997).

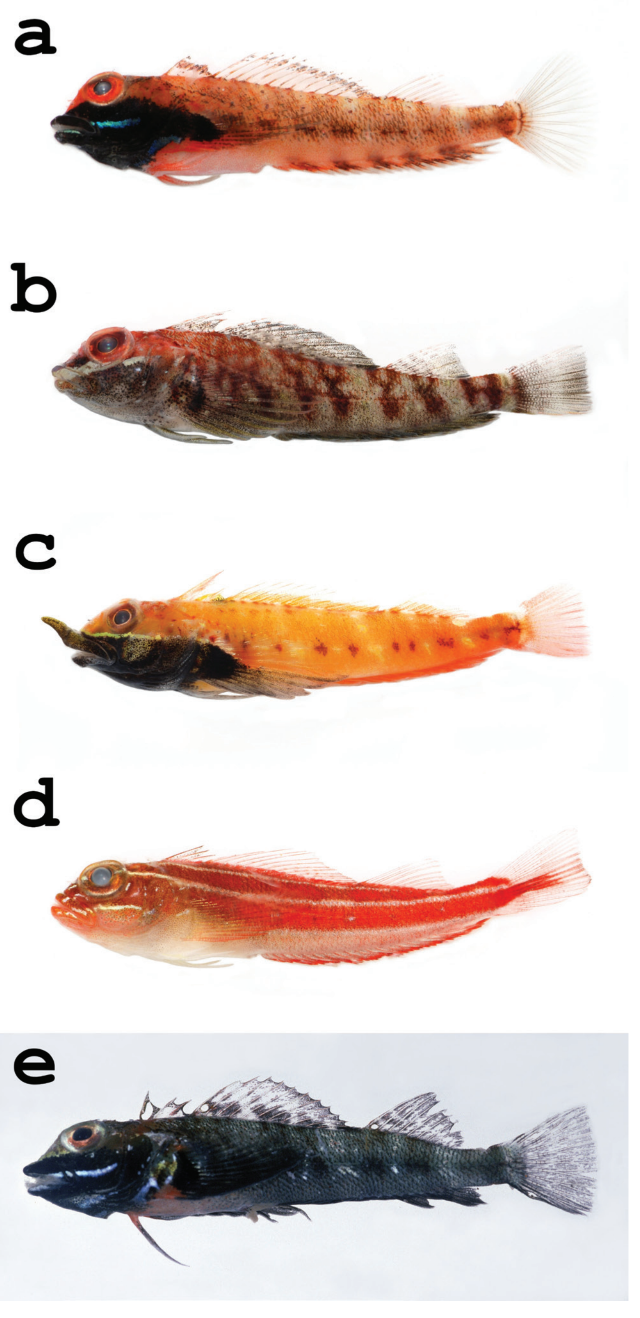

Figure 3. Specimen photographs of **a** *Helcogramma fuscipectoris*, NTOU-P 2009-06-063, male, 20.8 mm SL, Chenggong, Taitung, Taiwan **b** *Helcogramma inclinata*, NTOU-P 2009-06-054, male, 35.3 mm SL, Nan-ren-road, Pingtung, Taiwan **c** *Helcogramma rhinoceros*, NTOU-P 2009-06-043, 29.6 m SL, Feng-chui-sha, Pingtung, Taiwan **d** *Helcogramma striata*, NTOU-P 2009-06-048, 27.4 mm SL, Chuan-fan-shi, Pingtung, Taiwan **e** *Helcogramma trigloides*, male, 31.2 mm SL, Efate Island, Vanuatu, photograph by JT Williams.

Helcogramma trigloides **(Bleeker, 1858)**
http://species-id.net/wiki/Helcogramma_trigloides
Fig. 3e

Tripterygion trigloides Bleeker 1858: 234 (Type locality: Biliton Occidentalis, Indonesia).
Helcogramma trigloides: Fricke 1997: 489 (Neotype locality: Port Narevin, Erromango Island, Vanuatu).
Helcogramma trigloides: Hansen 1986: 351.

Material Examined for Description. USNM 343890, Neotype, 33.3 mm SL, Port Narevin, Erromange Island, Vanuatu, 0-6 m depth, J. T. Williams et al., 28 May 1996.

Description. D III, XIII, 9. A I, 18. Lateral line with 24 pored scales. Dentary pore pattern 3+3+3. Supraorbital cirrus small and semi-rounded. Nasal cirrus slender. First dorsal fin lower in height than second. Based on colour photo from Efate Island, Vanuatu by Jeffrey T. Williams. Body blackish green with indistinct black bars. Males with black mask on lower half of head below eye and a bluish white line extending from corner of mouth onto preopercle. Pectoral-fin base with yellow splotch and bluish white marks; a red blotch on lower base of pectoral fin and bases of ventralmost few rays. All fins dusky to black.

Distribution. Although there are no specimens of this species in Taiwanese museums or other institutions, it has been recorded from the eastern shore of Taiwan (Fricke, 1997) and from Malaysia, Thailand, Indonesia, Palau New Guinea, Solomon Islands, and Vanuatu (Hansen 1986; Fricke 1997).

Discussion

Within the genus *Helcogramma*, *H. williamsi* n. sp. and the *H. steinitzi* species group share the presence of dense micromelanophores on the membrane between the first two dorsal-fin spines in both males and females. However, *H. williamsi* is different from the *H. steinitzi* species group in having the distance between the first two dorsal-fin spines more than 1/2 of the distance between the second and third spines (vs. the distance between the first two dorsal-fin spines less than 1/2 of the distance between the second and third spines), the origin of the first dorsal behind a vertical through the posterior margin of the preopercle (vs. the origin of the first dorsal over the posterior margin of the preopercle), and the supraoccipital sensory canal forms a flattened curve (Fig. 2) anterior to the first dorsal-fin spines (vs. an open 'V'-shaped anterior to the first dorsal-fin spines).

The common diagnostic feature of the *H. obtusirostre* species group is the blue line extending from the corner of the mouth onto the preopercle. *Helcogramma capidata*, *H. ellioti, H. fuscipectoris*, *H. obtusirostre*, *H. rharhabe*, *H. trigloides*, and *H. alkamr* share this character (Holleman, 2007) and thus may belong to this species complex. The presence of a pale blue line extending from the corner of the mouth onto the preopercle in mature males of *Helcogramma williamsi* suggests that it is a member of the *H. obtusirostre* species group. However, further investigation is required to confirm this. More characters need to be proposed to distinguish the *H. obtusirostre* species group from other groups.

Key to the species of *Helcogramma* from Taiwan:

1	Trunk with several longitudinal stripes	***H. striata***
–	Trunk without longitudinal stripes	**2**
2	Symphyseal dentary pores 3 or more	**3**
–	Symphyseal dentary pores 1	**4**
3	Lateral line with more than 25 scales; anal fin with more than 20 rays; male with bluish white stripe from middle of upper lip to the dorsal angle of the preopercle	***H. inclinata***
–	Lateral line with fewer than 25 scales; anal fin with fewer than 19 rays; male with bluish white stripe from corner of jaw onto preopercle	***H. trigloides***
4	Upper lip with proboscis-like extension on males, head with horizontal yellowish or bluish white line from the upper rim of upper jaw to opercle	***H. rhinoceros***
–	Upper lip without proboscis-like extension; males with whitish blue line form corner of mouth to preopercle	**5**
5	Pattern of dentary pores 5+1+5	***H. williamsi* sp. n.**
–	Pattern of dentary pores 4+1+4	***H. fusipectoris***

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