

A TAXONOMIC TREATMENT OF THE SPECIES OF *ORTHOGONIUS* MACLEAY (COLEOPTERA: CARABIDAE: ORTHOGONIINI) OF SINGAPORE

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ABSTRACT. – Two new species of *Orthogonius* Macleay are described and illustrated: *O. emarginatus* and *O. cyclothorax*, the type locality for both being Nee Soon, Singapore. In addition, *O. hopei* Gray, 1832, *O. thaicus* Tian & Deuve, 2003, and *O. andrewesianus* Tian & Deuve, 2006, are reported from Singapore for the first time. A key is provided for the ten known species of *Orthogonius*.

KEYWORDS. – Coleoptera, Carabidae, Orthogoniini, *Orthogonius*, new species, new records, Singapore.

INTRODUCTION

Singapore is located at the southern tip of the Malay Peninsula, with a total area of 622.6 km², and holds some remnants of tropical rain and swamp forests. The purpose of this paper is to make known the species of *Orthogonius* Macleay, 1825 (Coleoptera: Carabidae: Orthogoniini) found in Singapore. Five species have been recorded previously from Singapore. More than 71 species are resident in Southeast Asia, with centres of concentration in the Malay Peninsula, Borneo, Sumatra and Java (Chaudoir, 1871; Andrewes, 1930; Csiki, 1932; Jedlička, 1963; Tian & Deuve, 2001, 2003a, b, 2004, 2006a, b). The first species of *Orthogonius* recorded in Singapore was *O. saundersi* Andrewes (1926). In 2003, *O. solidicornis* Tian & Deuve, was added to the genus as the second Singapore species (Tian & Deuve, 2003a). Then, three further species, viz. *O. dongnanya* Tian & Deuve, *O. singaporenensis* Tian & Deuve, and *O. fairmairei* Tian & Deuve, were described (Tian & Deuve, 2006b).

Recently, thanks to Dr. P. Grootaert and Mr. A. Drumont (the Royal Belgian Institute of Natural Sciences, Brussels), we were able to study some interesting specimens of *Orthogonius* collected from Singapore. Among them, two new species were discovered and, are described and illustrated herein. Three additional species, viz. *O. hopei* Gray, 1832, *O. thaicus* Tian & Deuve, 2003 and *O. andrewesianus* Tian & Deuve, 2006, were recorded in Singapore for the first time. To make identification easily, a key to the presently-known species

is provided. Although ten species of *Orthogonius* in total have been recorded, it is assumed that more species are still waiting to be discovered in Singapore.

MATERIAL AND METHODS

All specimens of *Orthogonius* from Singapore for this study were collected by Dr. P. Grootaert and deposited in the Royal Belgian Institute of Natural Sciences, Brussels (IRSNB) except for two specimens in Muséum National d'Histoire Naturelle, Paris (MNHN). Additional specimens of related species in other museums were also studied.

Dissection of specimens was made following the technique described by Lindroth (1974). Genitalia and other small structures were glued on small paper cards and pinned beneath the specimen from which they were removed.

Measurements of body parts and abbreviations used in the descriptions are as follows:

HL = length of head, measured from mandibular apex to hind margin of head;

HW = width of head (maximum distance of head, including eyes);

PL = length of pronotum, measured along median line;

PW = width of pronotum, at greatest transverse distance;

EL = length of elytra, from base to apex of right elytron, measured along suture;
 EW = width of elytra, greatest transverse distance across both elytra.
 Length of body was measured directly from mandibular apex to elytral apex.

***Orthogonius emarginatus*, new species**
 (Figs. 1–6)

Type material. – Holotype: male, labeled “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Mal trap 1, Swamp forest, Station 25046. 5 Apr. 2005. P. Grootaert coll.”, collected at Nee Soon, Singapore (type locality) and deposited in IRSNB.

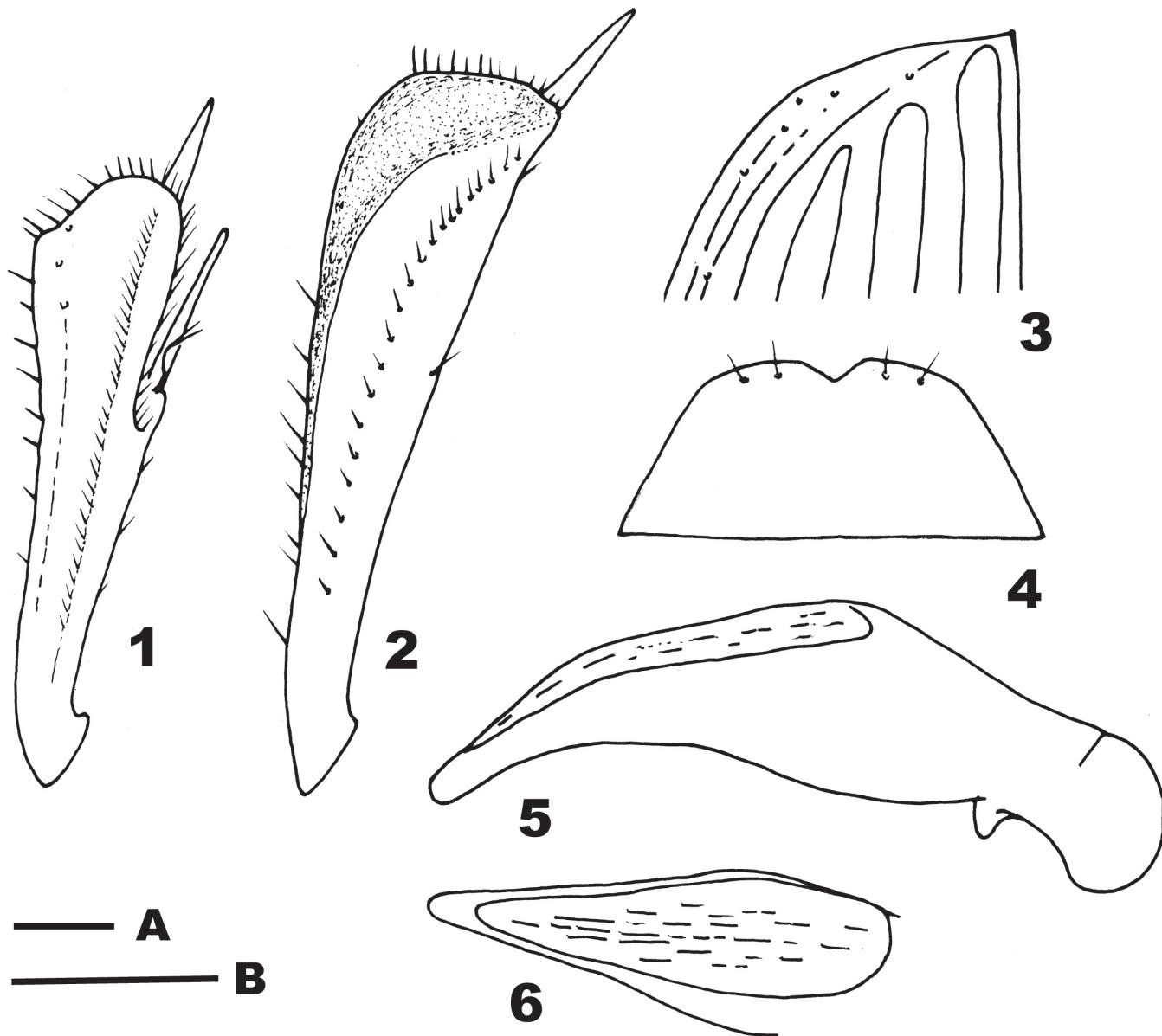
Description. – Body: Length 15.0 mm; width 6.0 mm. Form stout; surface markedly shiny.

Color: Body black; antennae, palpi, legs and ventral surface reddish dark brown.

Macrosculpture. Head: dorsal surface without striation, but densely and moderately punctate; base of neck and median portion of vertex impunctate. Pronotum smooth, glabrous, shallowly striate. Elytra with intervals very shallowly and sparsely punctate. Ventral surface smooth and glabrous.

Microsculpture: Mesh pattern isodiametric on dorsal surface of head, but densely and moderately transverse on pronotum and elytra.

Head: Slightly wider than long (HW/HL = 1.15), convex. Frontal impressions large and deep, fovea-like, not extended to level of anterior pair of supraorbital setae; clypeus bisetose, surface uneven, slightly raised at base. Eyes very large and



Figs. 1–6. Line drawings of structural features of *Orthogonius emarginatus*, new species: 1, left fore tibia, dorsal view; 2, left mid femur, ventral view; 3, apex of right elytron; 4, abdominal ventrite VII of male, ventral view; 5, aedeagus, right lateral view; 6, apical portion of aedeagus, dorsal view. Scale bars: 1 mm. A for Figs. 3–4; B for Figs. 1–2 and 5–6.

markedly prominent, longitudinal diameter of eye about two-thirds distance between eyes. Antennae rather long, slightly extended over base of elytra; antennomere 4 longer than antennomere 3, almost twice as long as antennomere 2.

Mouthparts: Labrum six setose, straight at front margin.

Maxillae: palpal articles subcylindrical, glabrous.

Labium: submentum with a pair of setae; mentum without median tooth, with a pair of setae; glossal sclerite short, quite stout, bisetose at apex; palpal articles subcylindrical, glabrous; palpiger asetose; palpomere 2 bisetose on inner margin.

Prothorax: Pronotum — form transverse ($PW/PL=1.66$), widest at about middle; both fore and basal margins finely beaded; sides anteriorly and posteriorly evenly contracted; the lateral expanded margins comparatively narrow, quite even throughout, smooth and evidently reflexed; both fore and hind angles round; disc markedly convex; anterior and posterior transverse impressions distinct, deep and wide; posterolateral foveae small. Prosternum — intercoxal process unbordered at apex.

Elytra: Form elongate ($EL/EW=1.5$), parallel at sides in middle portion; surface rather flat; basal border indistinct basad intervals 1–5; humeri square; apex roundly truncate, sutural angle nearly rectangular (Fig. 3); striae fine and deep, intervals slightly convex, except interval 7 carinate in basal half; intervals subequal in width in middle portion; interval 3 with only basal setiferous puncture.

Legs: Middle coxae glabrous. Femora — hind femur comparatively slender, with only one seta on posterior margin of ventral surface, at one-fourth from base. Tibiae — fore tibia slightly dilated at apex, latter rounded and sinuate near outer apical angle (Fig. 1); middle tibia robust, markedly dilated at apical portion, outer apical surface slightly but evidently emarginate in outer apical portion (Fig. 2); apical spurs of hind tibia long and sharp. Tarsi — hind tarsomere 3 much longer than tarsomere 4; tarsomere symmetrically bilobed at apex; all tarsal claws pectinate, pectens very short.

Abdomen: Abdominal ventrite VII of male deeply emarginate at apical margin (Fig. 4).

Male genitalia: Median lobe of aedeagus robust (Figs. 5–6), ventral margin markedly sinuate, evenly constricted toward apex, obtuse and somewhat tube-like; dorsal orifice long; apical lamella slightly narrowed toward apex, slightly longer than wide.

Female: Unknown.

Etymology. — The specific epithet, “*emarginatus*”, is a Latin adjective, nominative case, referring to the emargination of middle tibia in outer apical portion, which characterises this species.

Comparisons. — This new species is closely resembles to *O. andrewesianus* Tian & Deuve (2006d), but it is easily distinguishable from the latter by its larger size, labrum that is straight at the front margin (slightly convex in *O. andrewesianus*), base of elytra indistinctly bordered (unbordered against intervals 1–3 in *O. andrewesianus*) and the stouter aedeagus.

Distribution. — This species is known only from Singapore.

Orthogonius cyclothorax, new species (Figs. 7–11)

Type material. — Holotype: male, labeled “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Mal trap 2, Swamp forest, Station 25068. 19 Apr. 2005. P. Grootaert coll.”, collected at Nee Soon, Singapore (type locality) and deposited in IRSNB.

Description. Body: Length 10.5 mm; width 4.5 mm. Form stout, moderately shiny.

Color: Head dark brown, pronotum and elytra reddish brown; legs (except femora), ventral surface, palpi of mouthparts, antennae and labrum brown; femora yellow.

Macrosculpture: Head and pronotum shallowly striate, impunctate, intervals 3, 5, 6 and 8 of elytra with sparse, small punctures.

Microsculpture: Mesh pattern isodiametric on head, pronotum and elytra; microlines dense.

Head: Slightly narrower than long ($HW/HL = 0.92$), stout, evidently convex. Frontal impressions pit-like, small; clypeus bisetose, surface quite even. Eyes very large, prominent. Antennae rather long, extending to about one-fifths of elytra from base; pubescent from apical two-thirds of antennomere 4; antennomere 4 as long as antennomere 3, but less than two times of antennomere 2.

Mouthparts: Labrum six setose, anterior margin distinctly emarginate. Maxillae: palpi subcylindrical, palpomeres 3 and 4 subequal; palpomere 3 with several short setae at apex. Labium: submentum with one seta on either side; mentum without median tooth, asetose; glossal sclerite of ligula small, bisetose at apex; palpomeres with articles subcylindrical, palpomere 2 slightly longer than palpomere 3; palpomere 2 bisetose on inner margin with a few short setae at apex.

Prothorax: Pronotum — form transverse ($PW/PL = 1.82$), widest at slightly posteriad middle; both anterior and posterior margins beaded; fore and hind angles round; sides evenly broadened; lateral expanded margins clearly defined, smooth and hardly reflexed; disc convex; anterior and posterior transverse impressions shallow, posterolateral foveae small. Prosternum — intercoxal process distinctly bordered at apex.

Elytra: Form broadly ovate ($EL/EW = 1.44$), parallel at sides at middle portion, surface moderately convex; basal border complete; humeri square, apex broadly truncate, sutural angle nearly rectangular (Fig. 8); striae rather deep, intervals quite flat, subequal in width at middle portion; interval 7 flat, not carinate; interval 3 with middle and hind setiferous punctures, basal puncture absent.

Legs: Middle coxae glabrous. Femora — hind femur moderate, with two setae on posterior margin of ventral surface. Tibiae — fore tibia stout, gradually enlarged at apex, apical margin sinuate, outer angle rectangular (Fig. 7); middle tibia slender; hind tibia hardly dilated at apex, apical spurs long and sharp. Tarsi — hind tarsomere 4 shorter than tarsomere 3, shallowly emarginate at apex; all tarsal claws pectinate, pectens long.

Abdomen: Abdominal ventrite VII of male complete, without emargination at apical margin (Fig. 9).

Male genitalia: Median lobe of aedeagus slightly expanded in middle portion, apex abruptly terminated and pointed; apical lamella small, longer than wide, obtuse at apex (Figs. 10–11).

Female: Unknown.

Etymology. — The specific epithet is a combination of the Greek adjectival prefix “cyclo-”, meaning round, and feminine noun “thorax”, referring to the form of the pronotum which has rounded fore and hind angles.

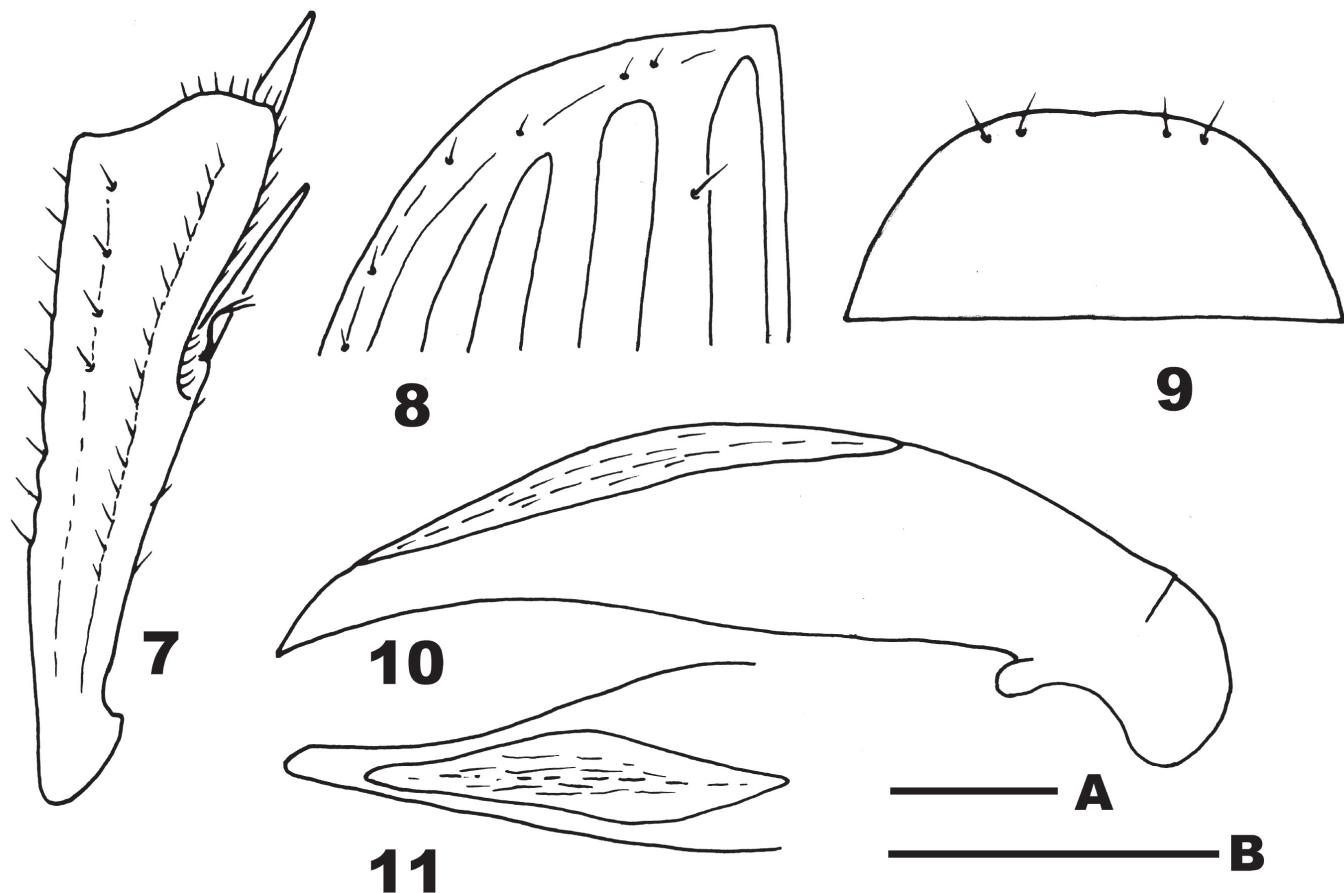
Comparisons. — This new species is similar to *O. medanensis* Tian & Deuve, 2006 of Sumatra, but is markedly distinct in the following morphological features: its mentum is without seta (2 setae in *O. medanensis*), interval 3 of elytra is without basal setiferous punctures (evident in *O. medanensis*) and apical lamella of aedeagus is narrower (broader in *O. medanensis*).

Distribution. — This species is known only from the type locality, Singapore.

Orthogonius hopei Gray

Orthogonius hopei Gray, in Griffith, 1832: 273; Chaudoir, 1871: 103; Csiki, 1932: 1859.

Specimens examined. — 1 female, “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Swamp Forest, Mal. trap 1, Station 25028. P. Grootaert coll.”; 1 male and 1 female, “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Swamp forest, Mal trap 2, Station 25068. 19 Apr. 2005. P. Grootaert coll.”; 1 female, “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Mal. trap 1, Swamp Forest, Station 25046. 5 Apr. 2005. P.



Figs. 7–11. Line drawings of structural features of *Orthogonius cyclothorax*, new species: 7, left fore tibia, dorsal view; 8, apex of right elytron; 9, abdominal ventrite VII of male; 10, aedeagal median lobe, right lateral view; 11, apical portion of aedeagal median lobe, dorsal view. Scale bars: 1 mm. A for Figs. 8–9; B for Figs. 7, 10–11.

Grootaert coll.”, all are deposited in IRSNB except for one female in MNHN. 1 female, “Hopei Gray, Indes Orient, C. G. Gray” (MNHN); 1 female, “Malacca, H. Deyralle” (MNHN); 1 female, “Malacca”, “Coll. E. Steinheil” (MNHN); 1 female, “Inde”, “Ex-Musaeo Mniszech” (MNHN); 1 male, “Malais”, “Ex-Musaeo Mniszech” (MNHN); 1 female, “Ex-Musaeo L. Fairmaire” (MNHN); 1 female, “Malacca”, “Collection Cal. Pradier” (MNHN); 1 female, “Ex-Musaeo Mniszech” (MNHN); 1 female, “Malacca”, “Malacca, Oberthur, 1896” (MNHN).

Distribution. – This species has so far been cited from India and Malay Peninsula. Here, it is recorded from Singapore for the first time.

Orthogonius thaicus Tian & Deuve

Orthogonius thaicus Tian & Deuve, 2003a: 46.

Material examined. – 2 males, “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Mal. trap 2, swamp forest, Station 25068. 19 Apr. 2005. P. Grootaert coll.”; 2 males, “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Mal. trap 2, Swamp forest, Station 25028. 19 Apr. 2005. P. Grootaert coll.” deposited in IRSNB except for one in MNHN. All the type materials were also studied (for detail see Tian & Deuve, 2003a: 47).

Distribution. – This species was described from southern Thailand (Tian & Deuve, 2003a), and is recorded from Singapore for the first time.

Orthogonius andrewesianus Tian & Deuve

Orthogonius andrewesianus Tian & Deuve, 2006b: 109.

Specimens examined. – 1 male, labeled “Coll. I. R. Sc. N. B. / Singapore, Nee Soon, Swamp forest, Station 25068. 26 Aug. 2005. P. Grootaert coll.”, deposited in IRSNB. All the type materials were also studied (for detail see Tian & Deuve, 2006b: 109).

Distribution. – This species was described from Malaysia (Penang) and Indonesia (Sumatra), and is recorded from Singapore for the first time.

Key to species of *Orthogonius* of Singapore

1. Clypeus quadrisetose 2
- Clypeus bisetose 4
2. Body rather flat and broad, reddish-brown, large (Length 20.0–21.0 mm) *O. hopei* Gray
- Body more convex and slender, dark brown, medium sized 3
3. Elytral striae shallow, intervals flat. Length 14.0 mm *O. saundersi* Andrewes
- Elytral striae deep, intervals convex. Length 14.5 mm *O. thaicus* Tian & Deuve
4. Ligula with glossal sclerite quadrisetose at apex, mentum with a median tooth, hind angle of pronotum angular 5
- Glossal sclerite bisetose at apex, mentum without median tooth, hind angle of pronotum rounded 6

5. Head impunctate, labrum straight at front, interval 6 of elytra impunctate near base, smaller. Length 13.5–14 mm *O. singaporenensis* Tian & Deuve
- Head sparsely punctate on vertex, labrum slightly emarginate at front, interval 6 of elytra with a few punctures near base, larger. Length 16.0–17.5 mm *O. fairmairei* Tian & Deuve
6. Head punctate, interval 7 of elytra more or less carinate 7
- Head impunctate, interval 7 of elytra not carinate 9
7. Head densely punctate, pronotum impunctate 8
- Head and pronotum sparsely punctate. Length 12.0 mm *O. solidicornis* Tian & Deuve
8. Labrum straight at front, the elytral base obscurely bordered, aedeagus stout. Length 15.0 mm *O. emarginatus*, new species
- Labrum slightly convex at front, the elytral base unbordered against intervals 1–3, and aedeagus slender in), and aedeagus stouter. Length 13.0 mm *O. andrewesianus* Tian & Deuve
9. Elytral striae shallow, intervals slightly convex, impunctate. Length 13.5–14.0 mm *O. dongnanya* Tian & Deuve
- Elytral striae deep, intervals moderately convex; intervals 3, 5, 6 and 8 sparsely punctate, punctures small. Length 10.5 mm *O. cyclothorax*, new species

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