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RESEARCH PAPER

# Review of the genus *Coelostoma* of Taiwan with description of a new species (Coleoptera: Hydrophilidae)

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**Abstract.** The water scavenger beetle genus *Coelostoma* Brullé, 1835 of Taiwan is reviewed based on freshly collected material and museum specimens. Seven species are recognized, of which one new species, *Coelostoma* (*Lachnocoelostoma*) *taiwanense* sp. nov., is described. Distributional data of *C. fallaciosum* Orchymont, 1936 and *C. stultum* (Walker, 1858) are summarized. *Coelostoma phallicum* Orchymont, 1940, *C. wui* Orchymont, 1940, *C. vitalisi* Orchymont, 1923 and *C. bhutanicum* Jayaswal, 1972 are reported for the first time from Taiwan. *Coelostoma vagum* Orchymont, 1940 is excluded from Taiwanese fauna pending the rediscovery of vouchers or newly collected specimens. A distribution map and key to Taiwanese species of the genus are provided.

**Key words.** Coleoptera, Hydrophilidae, Coelostomatini, *Coelostoma*, taxonomy, new species, new records, Taiwan, Sino-Himalayan Subregion, Oriental Region

**Zoobank:** http://zoobank.org/urn:lsid:zoobank.org:pub:16B1C03F-93E7-4BFF-B895-F846EA4CD029


## Introduction

*Coelostoma* Brullé, 1835 is a genus widely distributed in the eastern hemisphere; it currently contains 111 species (Hansen 1999; Short & Hebauer 2006; Short & Fikáček 2011; Jia et al. 2014, 2017, 2019). Adults of *Coelostoma* are usually collected from sides of different kinds of water bodies (e.g., rivers, bogs and ponds) with decomposing organic material or algae. They are more active at night and sometimes attracted to light.

Up to present, only three species of the genus have been reported from Taiwan: *Coelostoma fallaciosum* Orchymont, 1936, *C. stultum* (Walker, 1858) and *C. vagum* Orchymont, 1940 (Orchymont 1928; Jia 2005a,b). Our study is based on the field survey performed across Taiwan in 2018–2019 and on the examination of museum collections. In conclusion, *Coelostoma phallicum* Orchymont, 1940, *C. wui* Orchymont, 1940, *C. vitalisi* Orchymont, 1923 and *C. bhutanicum* Jayaswal, 1972 are recorded as new to Taiwan. A new species, *C. taiwanense* sp nov., is described.

## Material and methods

**Specimen preparation and photographs.** Male genitalia were dissected from water-relaxed specimens and examined in temporary glycerine slides without using the cover glass. In case the aedeagus was already dissected by previous authors and dry-mounted, it was relaxed in a drop of water, then transferred to 95% alcohol which was left on the hot plate heated to 65°C until the air bubbles disappeared or were reduced in number and volume as much as possible. Once ready, the genitalia were transferred directly to glycerine for examination. After the examination, the aedeagus was transferred through a short bath in 95% alcohol to the drop of Euparal resin on a small slide below the respective specimen. In some duplicate specimens, the aedeagus was mounted on the same card as the specimen using a water-soluble glue. Specimens were examined using a Leica DM750 compound microscope. Photographs were taken by a Leica DFC 495 microscope camera attached to a Leica S6 E compound microscope. Subgenera were identified using the key by Jia

et al. (2014). Morphological terminology follows Hansen (1991) and Komarek (2004). The distribution map was drawn in Photoshop CS6.

**Specimen depositories.** Specimens examined for this study are deposited in the following collections:

| | |
|---|---|
| CNUT | Chia Nan University of Pharmacy & Science, Rende district, Tainan City, Taiwan (Kai-Ying Zheng); |
| HCLC | H.-C. Liu collection, Hsinchu County, Taiwan; |
| KMNH | Kitakyushu Museum of Natural History and Human History, Japan (Yûsuke N. Minoshima); |
| NCHU | National Chung Hsing University, Taiwan (Man-Miao Yang, Bao-Cheng Lai, Sheng-Feng Lin); |
| NMNS | National Museum of Natural Science, Taiwan (Jing-Fu Tsai); |
| NMPC | National Museum, Prague, Czech Republic (Jiří Hájek, Martin Fikáček); |
| TARI | Taiwan Agricultural Research Institute, Taiwan (Chi-Feng Lee). |

**DNA barcode.** To facilitate future studies of *Coelostoma*, we extracted the genomic DNA of the holotype of *C. taiwanense* sp. nov. before its mounting, using the Tissue Genomic DNA Mini Kit (Geneaid Biotech Ltd., Taiwan) following the manufacturer's instructions, but with adapted incubation times (3.5 hours with proteinase K + GT buffer, 1 hour with proteinase K + GT buffer + LGT buffer). The DNA extract is deposited in NMPC. We amplified the 3′ fragment of the cytochrome oxidase I (*cox1*) mitochondrial gene using the sJerry (CAACATYTATTYTGATTYTTTGG) + sPat (GCACTAWTCTGCCATATTAGA) primers (Timmermans et al. 2010) with the following PCR protocol: 95°C for 5 mins, 40× (95°C for 0:30 min, 50°C for 0:40 min, 72°C for 2:00 min), 72°C for 8 mins.

## Taxonomy

### *Coelostoma* Brullé, 1835

**Diagnosis.** The genus can be distinguished from other hydrophilid genera occurring in Taiwan by the following combination of characters: body rather convex, brown to black (Fig. 1); eyes of moderate size, deeply excised internally; antenna with 9 antennomeres, antennal club loosely segmented; mesoventrite with arrow-head shaped median elevation; metaventrite longer than mesoventral elevation, with strongly raised median portion broadly projecting anteriorly and abutted to mesoventral process; elytra lacking serial punctures; sutural stria reaching basal half of elytra.

**Bionomics.** All species inhabit moist environments, typically being found on gravely, sandy or muddy shores of rivers and pools. Some species live directly in shallow vegetated standing water (Fikáček et al. 2019) and others are found on seepages and wet rocks with algae (Jia et al. 2014).

### Description of a new species

### *Coelostoma* (*Lachnocoelostoma*) *taiwanense* sp. nov.

(Figs 1A–E, 2G, 3C)

**Type material.** Holotype: ♂ (TARI): TAIWAN: Chiayi: 1.8 km SW of Meishan Township [梅山鄉], small stream crossing Ruishui Rd. 23.528787°N 120.6772476°E, 900m 29.iv.2019; Damaška, Fikáček, Liu & Tkoč lgt. 2019-TW10 (DNA extract MF2429 deposited in NMPC). Paratypes: **TAIWAN: Kaohsiung:** 34 spec. (TARI, KMNH, NMPC): Fuhsin hot spring [復興溫泉], 19.ii.2007, Wei-Chia Wang leg. **Nantou:** 4 spec. (NMNS): Dongpu [東埔], 19.vi.2000, C.-S. Lin leg. **Taichung:** 3 spec. (NCHU, HCLC): Wufeng District [霧峰區], Tonglin Vill. [桐林里], 24.0768°N 120.7252°E, 110 m, 29.x.2018, Hsing-Che Liu leg, at the edge of a stream, beneath a stone. **Taitung:** 1 ♂, 2 spec. (TARI): Chihpentrail (知本林道), 13.x.2018, B.-H. Kuo leg. **Chiayi:** 2 spec. (NMPC): same data as the holotype.

**DNA barcode of the holotype.** GenBank accession number MN883391.

**Description.** ***Form and color.*** Body length 4.8–5.2 mm (holotype: 5.0 mm), maximum body width 3.0–3.2 mm (holotype: 3.1 mm). Body oval, strongly convex, dorsal surface black to dark brown (Fig. 1A), but pronotum with reddish margins. Whole labrum yellowish. Maxillary and labial palpi yellowish, antennae yellowish to reddish brown with dark club. Ventral surface reddish brown with reddish pubescence (Fig. 1B). Femora and tibiae dark reddish brown, tarsi pale yellow.

***Head.*** Surface densely punctated. Clypeus truncate anteriorly. Eyes moderately sized, separated by ca. 2.5× width of one eye. Labrum coarsely punctate and pubescent, anterior margin not emarginate. Mentum ca. 1.6× wider than long. Antennae with 9 antennomeres, antennal club loosely segmented and finely pubescent.

***Thorax.*** Pronotum ca. 2.0× wider than long, very densely punctate. Mesoventrite with raised, arrowhead-shaped process ca. 1.25× longer than wide, surface pubescent. Metaventrite ca. 3.3× longer than mesoventral elevation, with strongly raised median portion broadly projecting anteriorly between mesocoxae and abutted to mesoventral process; lateral portions of metaventrite densely microsculptured and pubescent, middle portion bare, with very sparse pubescence. Metepisterna ca. 4.5× as long as wide, parallel-sided. Scutellar shield in form of equilateral triangle with punctation as on pronotum. Elytral surface very densely punctate, punctation finer than on pronotum, without traces of punctural series, sutural stria reaching basal half of elytra.

***Legs.*** Profemora almost entirely pubescent except in extreme distal portion, with straight hairline; mesofemora densely pubescent except distal portion, with intermixed stout setae (Fig. 1D). Metafemur without pubescence, only densely punctate on ventral surface. Tibiae flattened. Metatibia slender and densely punctate. Metatarsus slightly shorter than tibia. Claws of moderate size, moderately curved, without basal additional tooth; empodium with a pair of long curved setae.

***Abdomen.*** Abdominal ventrites pubescent. Ventrite I without median carina. Ventrite V not emarginated, but with a row of stout setae apically (Fig. 1E).

***Male genitalia*** (Fig. 1C). Aedeagus 1.5 mm long, of simply trilobed type; median lobe slightly widening from base to apex, shorter than parameres, apex widely angulate; gonopore subtriangular in shape, well defined, situated subapically; parameres weakly narrowing in apical third, slightly bent inward.

**Differential diagnosis.** *Coelostoma taiwanense* sp. nov. belongs to the *C. phallicum* group, i.e. a group of Asian species characterized by a large and very elongate aedeagus with an extremely reduced phallobase and large subapical gonopore. The group consists of five species: *C. bipunctatum* Jayaswal, 1972 from the Himalaya,

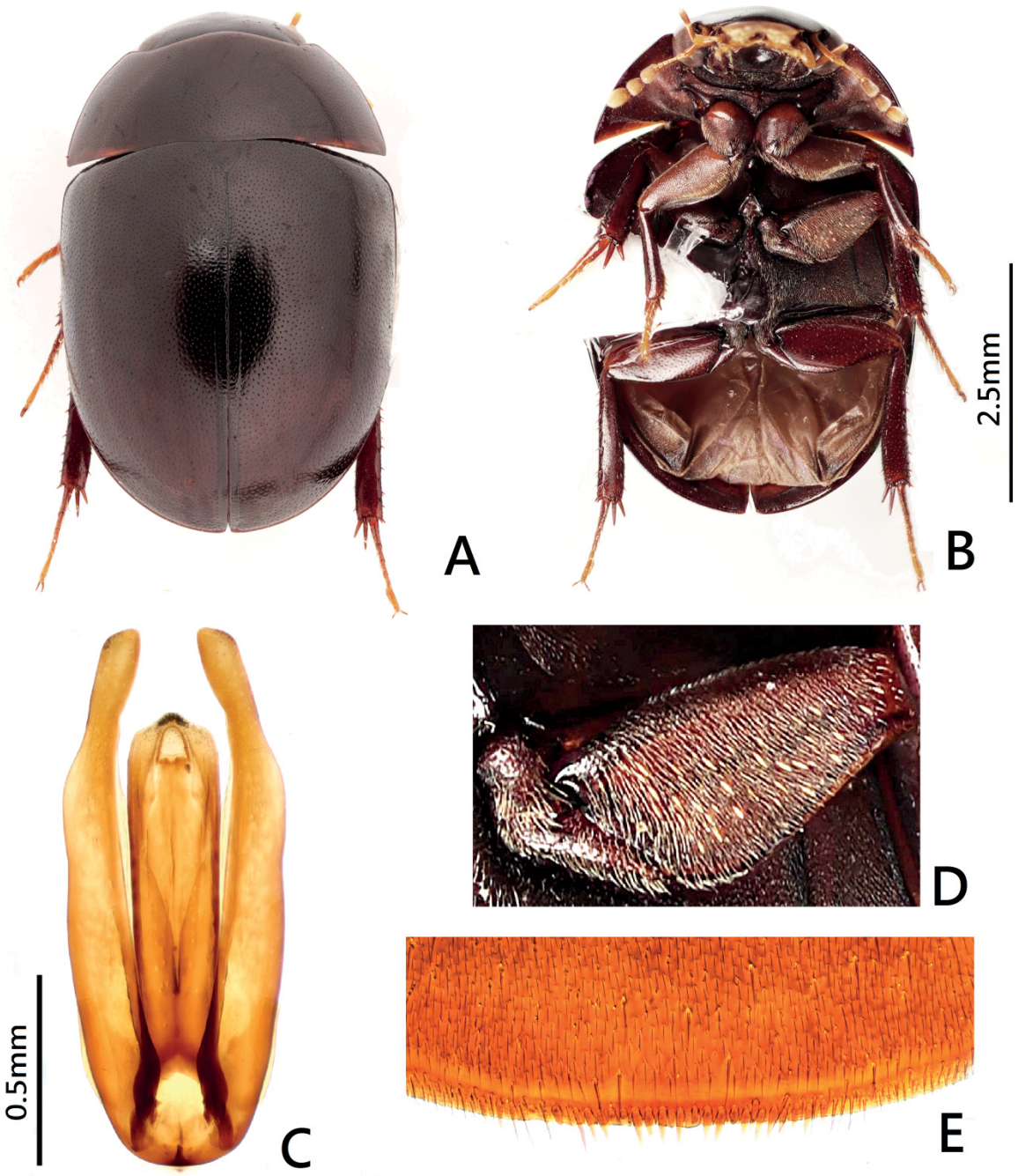


Fig. 1. *Coelostoma* (*Lachnocoelostoma*) *taiwanense* sp. nov.., male. A–B – habitus of the paratype (A – dorsal, B – ventral); C – aedeagus of the holotype, dorsal view; D – mesofemur in ventral view, paratype; E – posterior margin of abdominal ventrite, holotype.

*C. parkeri* Mouchamps, 1958 from Myanmar, *C. phallicum* Orchymont, 1940 from SE Asia, *C. vagum* Orchymont, 1940 from SE Asia and *C. wui* Orchymont, 1940 from China and Korea. The aedeagus of the new species is most similar to *C. wui* in the shape of the median lobe but can be distinguished from it by the more angulate apex and having parameres that are not widened apically (compare Figs 1C and 2D). The remaining species have the apex of the median lobe either triangular without the lateral flanks (*C. bipunctatum*, *C. parkeri* and *C. vagum*) or trilobate (*C. phallicum*). The species was found to co-occur with *C. bhutanicum* from which it can be distinguished by subgeneric characters (see the key below).

**Etymology.** The species name is an adjective, derived from Taiwan where all examined specimens were collected.

**Bionomics.** Most of specimens were collected from the edge of a stream, beneath stones and between fallen leaves and rocks (e.g., Fig. 3C). Specimens from Taitung were collected from a moist rock surface near a waterfall (B.-H. Kuo, pers. comm.). Specimens from Chiayi and Nantou are from an altitude of 800–1000 m which is the highest record of *Coelostoma* in Taiwan (Fig. 5). In Wufeng, the species co-occurred syntopically with *C. bhutanicum*. Specimens from Taitung and Chiayi were observed active at night.

**Distribution.** This species is only known from Taiwan (Fig. 4).

## Occurrence records of other *Coelostoma* species in Taiwan

### *Coelostoma* (*Holocoelostoma*) *bhutanicum* Jayaswal, 1972

(Figs 2E, 3C)

*Coelostoma* (*Holocoelostoma*) *bhutanicum* Jayaswal, 1972: 409.

**Material examined. TAIWAN: Taipei:** 1 ♂ (TARI): Taihokn, Ankeng [安坑], 2.xi.1941, S.Miyamoto leg.; 1 ♂ (TARI): Taihokn, 2.iv.1940, S. Miyamoto leg. **Penghu:** 1 ♂, 1 ♀♀ (NMNS): Makung [馬公], 19.vi.2000, C.-S. Lin & W.-T. Yang leg. **Taichung:** 1 ♂ (HCLC): Wufeng District [霧峰區], Tonglin Vill. [桐林里], 24.0768°N 120.7252°E, 110 m, 19.x.2018, Hsing-Che Liu leg, at the edge of a stream, beneath a stone; 3 ♂♂ (HCLC): Wufeng District [霧峰區], Tonglin Vill. [桐林里], 24.0768°N 120.7252°E, 110 m, 29.x.2018, Hsing-Che Liu leg, at the edge of a stream, beneath a stone; 1 ♂ (HCLC): Wufeng District [霧峰區], Tonglin Vill. [桐林里], 24.0768°N 120.7252°E, 110 m, 5.xi.2018, Hsing-Che Liu leg, at the edge of a stream, beneath a stone. **Taitung:** 1 ♂ 1 ♀ (NMNS): Lanyu Yurean [蘭嶼漁人], III/6/2012, Y. T. Wang (王宇堂). **Changhua:** 3 spec. (HCLC): Fuxing Township [福興鄉], Fubao Village [福寶], 24.046974°N 120.398450°E, 3 m, 24.xi.2019, Hsing-Che Liu leg. **Kaohsiung:** 19 spec. (NCHU): Dongsha Island (東沙島), 20.708°N, 116.71654°E, 21–25.iv.2005, pitfall trap, leg. J.-F. Tsai, Z.-Y. Liu & B.-F. Chen (DE03) [specimens NCHU 0007-1823 to NCHU 0007-1831]; 2 spec. (NCHU): Dongsha Island (東沙島), 20.708°N, 116.71654°E, 21–25.iv.2005, pitfall trap, leg. J.-F. Tsai, Z.-Y. Liu & B.-F. Chen (DE02) [specimens NCHU 0007-1832 and NCHU 0007-1833]; 5 spec. (NCHU): Dongsha Island (東沙島), 20.708°N, 116.716540°E, 26.iv.2005, DE sample plot, leg. J.-F. Tsai, Z.-Y. Liu & B.-F. Chen, [specimens NCHU 0007-1834 to NCHU 0007-1838]; 7 spec. (NCHU): Dongsha Island (東沙島), 20.708°N, 116.716540°E, 26.iv.2005, DE sample plot, marsh, leg. J.-F. Tsai, Z.-Y. Liu & B.-F. Chen [specimens NCHU 0007-1839 to NCHU 0007-1845].

**Diagnosis.** Body size 4.1–4.5 mm, body width 2.7–2.9 mm. Body oval. Labrum black with yellow edges, its front margin emarginate. Elytral surface densely punctate, without traces of series, sutural stria reaching basal half of elytra. Mesofemora with strong setae, but without dense pubescence. Abdominal ventrite V with row of stout setae situated in apical emargination.

***Male genitalia*** (Fig. 2E): aedeagus 1.0–1.1 mm long. median lobe shorter than parameres, almost of the same width from base to apex, only slightly widened at the very base, apex subangulate; gonopore small, situated apically; parameres bent inwards in apical third, truncate apically.

**Differential diagnosis.** This species is very similar to *C. stultum*, it can be distinguished from it by median lobe almost parallel-sided and slightly spoon-like, not distinctly widened basally.

**Comments.** It seems that this species was confused with *C. stultum* by previous authors. The concept of *C. bhutanicum* and *C. stultum* adopted here is based on the study of material from the Indian subcontinent (including the types of *C. stultum* from Sri Lanka) prepared as part of a study of the Indian *Coelostoma* by S. Sheth, H. Ghate and M. Fikáček and will be explained and justified in detail there.

**Bionomics.** Specimens from Changhua and Taichung were collected among plant roots around a pond and in the mud on the river shore. All specimens from Donsha Island (Fig. 3A) were collected by a pitfall trap which was set near a seasonal marsh.

**Distribution.** This species is so far only known from the Himalayas (India, Nepal and Bhutan) (Fikáček et al. 2015). First record for Taiwan (Fig. 4).

### *Coelostoma* (*Coelostoma*) *fallaciosum* Orchymont, 1936

(Figs 2A, 2H, 3D)

*Coelostoma fallaciosum* Orchymont, 1936: 19.

*Coelostoma fallacosum* [sic!]: Jia (2005b): 148 (recorded from Taiwan without specified locality).

**Material examined. TAIWAN: Taitung:** 1 ♂ (TARI): Lanyu (蘭嶼), 5.iv.2011, Y.-T. Wang leg. **Hsinchu:** 7 spec. (HCLC): Beipu Township [北埔鄉], 24.707676°N 121.060744°E, 140 m, 1.vi.2018, Hsing-Che Liu leg.; 2 ♂♂ (HCLC): same locality, 9.ix.2019, Hsing-Che Liu leg. **Changhua:** 4 ♂♂ (NMNS, HCLC): Huatan Township (花壇鄉), 24.030731°N 120.545094°E, 60 m, 3.xii.2018, Hsing-Che Liu leg. **Tainan:** 3 ♂♂ (HCLC): Guantian District [官田區], 23.182170°N 120.307721°E, 19.i.2019, Hsing-Che Liu leg. **Pingtung:** 3 ♂♂ (CNUT): Nanjenshan (南仁山), 1.xii.2018, Kai-Ying Zheng leg.

**Diagnosis.** Body length 4.8–5.2 mm, maximum body width 3.0–3.2 mm. Body oval, strongly convex, dorsal surface black to dark brown. Elytra surface densely punctate, without traces of series, sutural stria reaching basal half of elytra. Labrum black with yellow edges, its front margin deeply emarginate (Fig. 2H). Mesofemora without dense pubescence.

***Male genitalia*** (Fig. 2A): Median lobe bottle-shaped, narrowly rounded apically, strongly widened close to the base, gonopore situated subapically; parameres bent inwards in apical third, but not truncate apically.

**Differential diagnosis.** *Coelostoma fallaciosum* is similar to *C. vividum* Orchymont, 1936 and *C. vitalisi* in genitalia morphology; it can be differentiated easily by the median lobe which is bottle-shaped and has the gonopore situated subapically.

**Distribution.** This species is known from China (Fujian, Guangdong, Hong Kong), Indonesia, Malaysia, Nepal, Taiwan (Fig. 4) and Vietnam (Orchymont 1936; Hansen 1999; Jia 2005a; Jia et al. 2014, 2017; this paper).

**Bionomics.** All examined specimens were collected from the surface of soil around a pond, perched on rotting aquatic plants (Fig. 3D).

### *Coelostoma* (*Lachnocoelostoma*) *phallicum* Orchymont, 1940

(Figs 2C, 3E)

*Coelostoma phallicum* Orchymont, 1940: 158.

**Material examined. TAIWAN: Taitung:** 1 ♂ (TARI): Hsiaotianchi (小天池), 2.iv.2016, B.-X. Guo leg. **Yilan:** 2 ♂♂ (KMNH): 'Yijie (溢界)' [incorrect spelling, correct name of the locality is Aijie (隘界)], Yunshan Township [員山鄉], 12–14.ix.2000, Takashi Shimada leg.; 2 ♂♂, 6 ♀♀ (NMNS): Jiaoxi Township [礁溪鄉], Tangwei Brook Park [湯圍溝溫泉公園], 24°49'41.9"N 121°46'12.4"E, 22.iv.2018, F. S. Hu leg., hand collecting; 5 ♂♂ (HCLC): Jiaoxi Township [礁溪鄉], 24.824385°N 121.769800°E, 2.vii.2019, Hsing-Che Liu leg; 26 spec. (HCLC): Luodong sports park (羅東運動公園), Luodong To. [羅東鎮], 24.6841°N, 121.7517°E, 19.i.2020, leg. F. S. Hu (near pond). **Hsinchu:** 1 ♂ (HCLC): Emei Township [峨眉鄉], 11.ix.2018, Hsing-Che Liu leg; **Taipei:** 1 ♂, 1 ♀♀ (NMNS): NTU Farm [臺灣大學農場], 22.ix.2011, Y. T. Wang (王宇堂).

**Diagnosis.** Body length 5.2–5.5 mm, maximum body width 3.2–3.3 mm. Body black. Labrum yellowish. Maxillary and labial palpi yellowish. Elytra densely punctate, without traces of series, sutural stria reaching basal half of elytra. Ventral face of pro- and mesofemora densely pubescent.

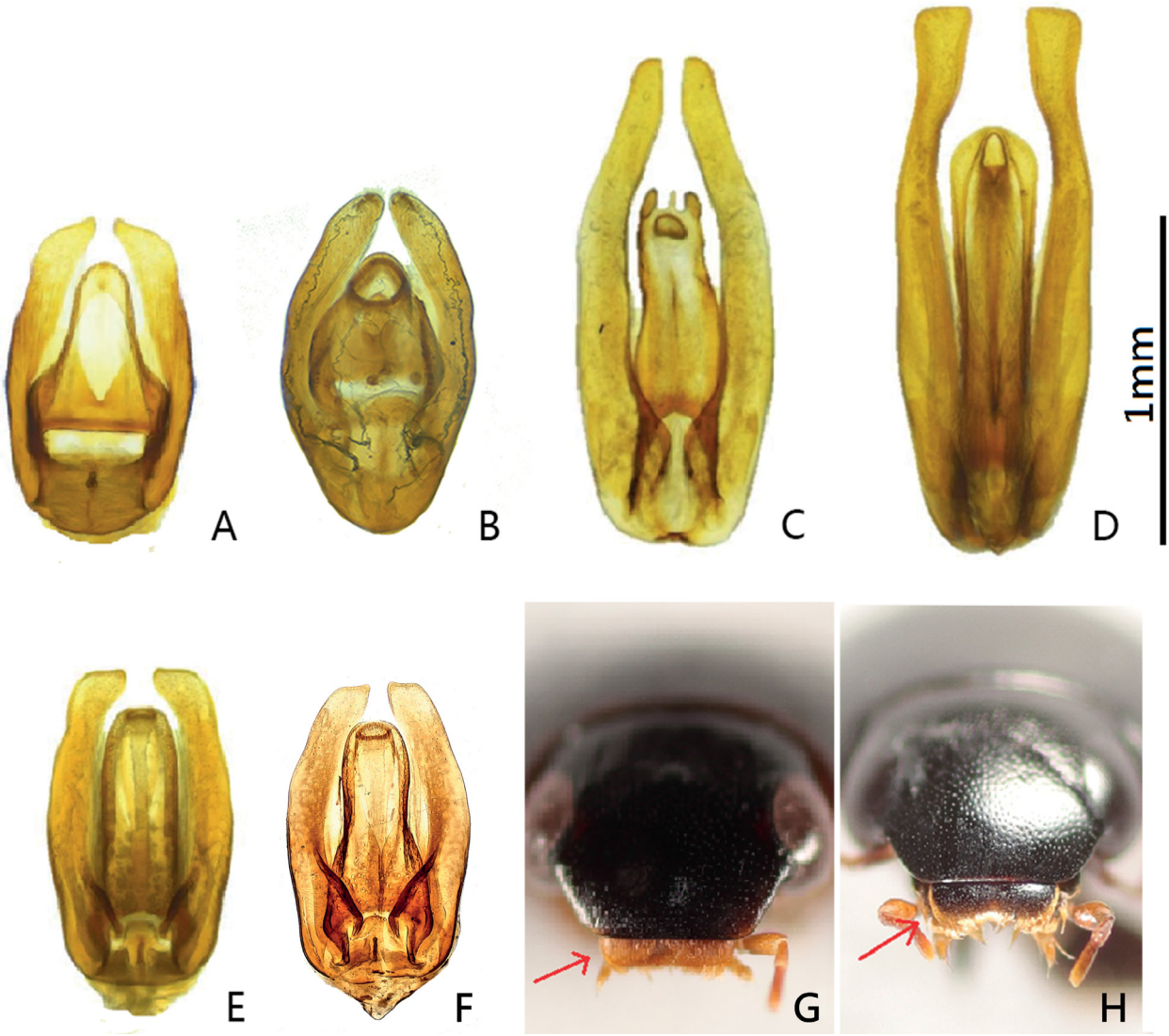


Fig. 2. male genitalia and front view of the head of Taiwanese *Coelostoma* species. A–F – ♂ genitals in dorsal view: A – *C. fallaciosum* Orchymont, 1936; B – *C. vitalisi* Orchymont, 1923; C – *C. phallicum* Orchymont, 1940; D – *C. wui* Orchymont, 1940; E – *C. bhutanicum* Jayaswal, 1972; F – *C. stultum* (Walker, 1858), specimen from Japan: Iriomote Island; G–H – front view of head with labrum: G – *C. taiwanense* sp. nov., paratype; H – *C. fallaciosum*.

***Male genitalia*** (Fig. 2C). Aedeagus 1.5 mm long, apical part of the median lobe trilobed apically, much shorter than parameres; gonopore semicircular; apical third of the paramere bends inwards.

**Differential diagnosis.** *Coelostoma phallicum* is unique among Taiwanese *Coelostoma* in having the median lobe trilobed apically.

**Bionomics** (Fig. 3E). The specimens of *C. phallicum* from Yilan were found in mud with abundant *Brassica* plants and from accumulations of rotten leaves in a small, artificial brook draining the water from a hot spring hotel. They were found either submerged in water or on the border of the shore zone of the stream. The specimen from Hsinchu was collected from the surface of a wet stone near the stream. The beetles were observed active at night.

**Distribution.** This species is known from China (Guangdong, Hainan, Guangxi), Cambodia, Indonesia, Malaysia, Laos and Vietnam (Orchymont 1940, Hansen 1999, Jia et al. 2014). New record for Taiwan (Fig. 4).

### *Coelostoma* (*Holocoelostoma*) *stultum* (Walker, 1858)

(Figs 2F, 3A)

*Hydrobius stultus* Walker, 1858: 209.

*Coelostoma stultum*: Orchymont (1928: 56) (recorded from 'Formosa' without specified locality).

*Coelostoma* (*Holocoelostoma*) *stultum*: Mouchamps (1958: 3).

For complete synonymy see Hansen (1999).

**Material examined. TAIWAN: Hsinchu:** 1 ♂ 1 ♀ (HCLC): Zhudong [竹東鎮], 28.viii.2018, 24.784950°N 121.036672°E, 83 m, Hsing-Che Liu leg. **JAPAN: Yaeyama Isl.:** 1 ♂, 1 spec. (NMPC): Iriomote Is., 28.vi.1981, S. Morita lgt. [this specimen was used to illustrate the genitalia of *C. stultum* in Fig. 2F].

**Diagnosis.** Body size 5.4–5.7 mm, body width 3.0–3.2 mm. Body oval. Labrum black with yellow edges, its front margin emarginate. Elytral surface densely punctate, without traces of series, sutural stria reaching basal half of elytra. Mesofemora with strong setae, but without dense pubescence. Abdominal ventrite V with row of stout setae situated in apical emargination.

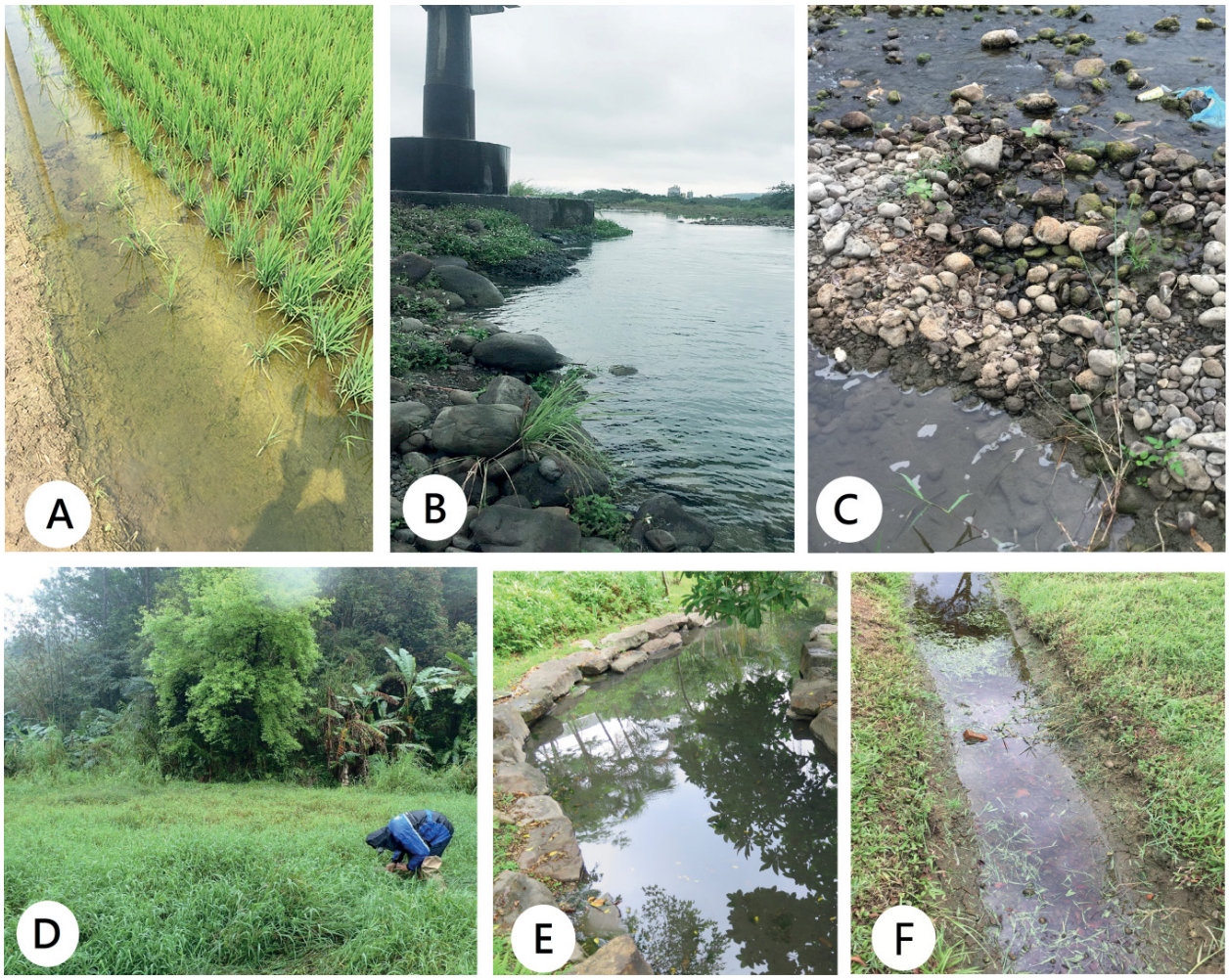


Fig. 3. Habitat of *Coelostoma* species. A – Hsinchu County, Zhudong: habitat of *C. stultum* (Walker, 1858); B – Hsinchu County, Hengshan Township: habitat of *C. wui* Orchymont, 1940; C – Taichung City, Wufeng District: habitat of *C. taiwanense* sp. nov. and *C. bhutanicum* Jayaswal, 1972; D – Hsinchu County, Beipu Township: habitat of *C. fallaciosum* Orchymont, 1936; E – Yilan County, Jiaoxi Township: habitat of *C. phallicum* Orchymont, 1940; F – Taipei city, Neihu District: habitat of *C. vitalisi* Orchymont, 1923. Photos by H.-C. Liu (A–C, F), R. Matsushima (D) and F.-S. Hu (E).

***Male genitalia*** (Fig. 2F): aedeagus 0.8–0.9 mm long. Median lobe shorter than parameres, wide basally, narrowing towards midlength, apical half narrowly parallel-sided, rounded apically; gonopore wide, situated apically; parameres bent inwards in apical third, truncate apically.

**Differential diagnosis.** This species differs from other Taiwanese species except *C. bhutanicum* in the following combination of characters: mesofemora without dense pubescence and the apical portion of abdominal ventrite 5 with a shallow emargination possessing stout setae (i.e. diagnostic characters of *Holocoelostoma*). It can be distinguished from *C. bhutanicum* by having the median lobe wide in the basal half and not spoon-like in shape. In contrast to *C. bhutanicum*, specimens of *C. stultum* are slightly larger but with a relatively smaller and less sclerotized aedeagus.

**Bionomics.** Both examined specimens from Taiwan were found in rotten rice stems near a rice field (Fig. 3A).

**Distribution.** China (Chongqing, Fujian, Guangxi, Guangdong, Hainan, Jiangxi, Sichuan, Yunnan, Xizang), Andaman Is., India, Indonesia, Japan, Malaysia, Mascarene Is., Myanmar, Nicobar Is., Oman, Philippines, Saudi Arabia (south), South Korea, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam (Jia et al. 2014, 2017; this paper). Some of these records may actually refer to *C. bhutanicum* (see above under that species).

### *Coelostoma* (*Coelostoma*) *vitalisi* Orchymont, 1923

(Figs 2B, 3F)

*Coelostoma vitalisi* Orchymont, 1923: 418.

**Material examined. TAIWAN: Taipei:** 4 ♂♂ (NCHU, HCLC): Neihu District [內湖區], 25.0546204°N 121.5843285°E, 29.vi.2018, Bin-Hong Ho leg.

**Diagnosis.** Body length 4.1–4.7 mm, maximum body width 2.5–2.8 mm. Body oval, strongly convex, dorsal surface black. Labrum black with yellow edges, Elytra surface densely punctate, without traces of series, sutural stria reaching basal half of elytra. Mesofemora with sparse strong setae. Abdominal ventrite V without stout setae.

***Male genitalia*** (Fig. 2B): Aedeagus 0.8 mm long; median lobe short and wide, shorter than parameres, apex widely angulate; gonopore large and wide, situated subapically; parameres bent inward, with tuft of setae at apex.

**Differential diagnosis.** *Coelostoma vitalisi* is similar to *C. fallaciosum* and *C. vividum*; it can be differentiated

by the parameres being bent inwards, with a tuft of setae at the apex.

**Bionomics.** (Fig. 3F). All examined specimens were attracted to light; the locality is situated near Keelung River in Taipei City.

**Distribution.** This species is known from China (Guangdong, Guangxi, Hainan, Shandong, Yunnan), India, Indonesia, Japan, Malaysia, Nepal, Singapore, Sri Lanka, Vietnam (Jia et al. 2014, Hayashi 2015, Minoshima 2017). First record for Taiwan (Fig. 4).

### *Coelostoma* (*Lachnocoelostoma*) *wui* Orchymont, 1940

(Figs 2D, 3B)

*Coelostoma wui* Orchymont, 1940: 160.

**Material examined. TAIWAN: Pingtung**: 2 ♂♂ (TARI): v.1933, Y. Miwa leg.; 2 ♂♂ (TARI): Neipu Township (內埔鄉), 7.v.2014, Y.-T. Chung leg.; 6 spec. (TARI): Wanluan (萬巒), 5.xii.2017, Y.-T. Chung leg. **Hsinchu:** 4 ♂♂ (NMNS, HCLC): Hengshan Township [橫山鄉], 24.713662°N 121.141443°E, 120 m, 8.iii.2019, Hsing-Che Liu & Ryosuke Matsushima leg.

**Diagnosis.** Body length 5.2–5.8 mm, maximum body width 3.2–3.5 mm. Head black. Labrum yellowish. Maxillary palpi, labial palpi yellowish. Pronotum blackish brown, with broad yellowish lateral margins. Elytra black, densely punctate, without traces of series, sutural stria reaching basal half of elytra. Ventral face of pro- and mesofemora pubescent, except at extreme apex.

***Male genitalia*** (Fig. 2D). Aedeagus 1.8 mm long. Median lobe much shorter than parameres, slightly widening from base to apex, apex widely rounded; gonopore subtriangular, situated subapically; parameres widened and parallel-sided in apical third.

**Differential diagnosis.** The aedeagus of this species is very long and hence similar to *C. vagum* and *C. taiwanense* sp. nov. *Coelostoma wui* can be distinguished from both the latter species by having the parameres widened and nearly parallel-sided in their apical third, and by the apex of the median lobe being rounded.

**Bionomics.** The specimens were found under the stones on the border of streams (Fig. 3B).

**Distribution.** This species is known from China (Hubei, Hunan, Jiangxi, Shaanxi, Shandong) and Korea (Hansen 1999, Jia et al. 2014). New record for Taiwan (Fig. 4).

## Species excluded from Taiwanese fauna

### *Coelostoma* (*Lachnocoelostoma*) *vagum* Orchymont, 1940

**Comments.** *Coelostoma vagum* was reported from Taiwan (without specified locality) by Jia (2005b), but the respective specimen from the Hokkaido University Museum is lost (A. L. Suzumura, pers. comm. 2019). The aedeagus of the species resembles that of *C. taiwanense* sp. nov. and it is hence possible that this record in fact refers to that species. We remove this species from the Taiwanese fauna at the moment, until the vouchers or fresh specimens from Taiwan are available.

## Key to Taiwanese species of *Coelostoma*

1 Mesofemora densely pubescent except on apex (Fig. 2E). Labrum yellowish (Fig. 2G). (subgenus *Lachnocoelostoma*). ..... 2
– Mesofemora not densely pubescent, at most with sparse short setae. Labrum black with yellow margins (Fig. 2H). ..... 4
2 Apical part of median lobe trilobate (Fig. 2C). ..... ***C. phallicum*** Orchymont, 1940
– Apical part of median lobe simple. ..... 3
3 Parameres widened apically, apex of median lobe rounded (Fig. 2D). ..... ***C. wui*** Orchymont, 1940
– Parameres not distinctly widened apically, apex of median lobe subtriangular (Fig. 1C). ..... ***C. taiwanense* sp. nov.**
4 Abdominal ventrite V feebly emarginate posteromesally, bearing stout setae mesally. Gonopore apical (subgenus *Holocoelostoma*). ..... 5
– Posterior margin of abdominal ventrite V entire, not emarginate in the middle, without stout setae. Gonopore subapical (subgenus *Coelostoma*). ..... 6
5 Median lobe of aedeagus almost parallel-sided with broadly rounded apex (Fig. 2E). ..... ***C. bhutanicum*** Jayaswal, 1972
– Median lobe of aedeagus wide in basal half, narrow in apical half (Fig. 2F). ..... ***C. stultum*** (Walker, 1858)
6 Parameres rounded apically, with tuft of setae at apex. Median lobe gradually narrowing towards apex (Fig. 2B). ..... ***C. vitalisi*** Orchymont, 1923
– Parameres pointed apically, without tuft of setae at apex. Median lobe wide basally and abruptly narrowed at midlength (Fig. 2A). ..... ***C. fallaciosum*** Orchymont, 1936

## Discussion

Our study of a relatively small material of *Coelostoma* revealed the presence of seven species of the genus in Taiwan (including Penghu, Lanyu and Dongsha islands), compared to three species recorded from Taiwan by previous authors (Orchymont 1928, Jia 2005b). It indicates that the fauna of aquatic beetles in Taiwan is still insufficiently known and new species may still be discovered, including endemic ones (see Liu & Watanabe (2018) and Fikáček & Liu (2019) for recent discoveries of new and endemic species of other aquatic groups in Taiwan).

The Taiwanese fauna of *Coelostoma* consists mostly of lowland species that are widespread in the Oriental Region (*C. bhutanicum*, *C. fallaciosum*, *C. stultum*, *C. vitalisi* and *C. phallicum*) or in eastern China and Korea (*C. wui*). The only endemic species, *C. taiwanense* sp. nov., is closely related to *C. wui* (M. Fikáček, unpubl. data) with which it co-occurs in Taiwan. It shares the same microhabitat, i.e. the stony shores of small rivers, but differs from *C. wui* in not being confined to lowlands, inhabiting higher altitudes up to 1000 m a.s.l. (Fig. 5) as well. Further studies clarifying the age of *C. wui* and *C. taiwanense* and the timing of their colonization of Taiwan are needed to evaluate the evolutionary origin of the different altitudi-

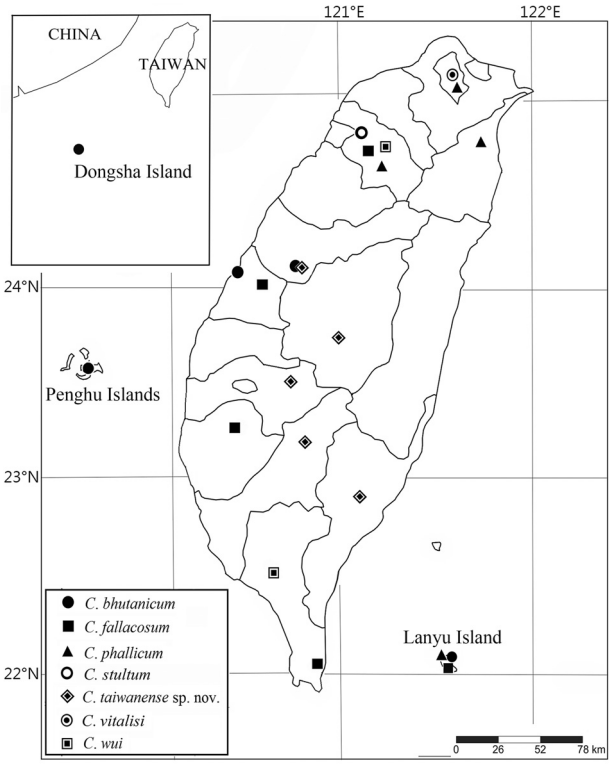


Fig. 4. Map of Taiwan showing distribution of species of the *Coelostoma* species.

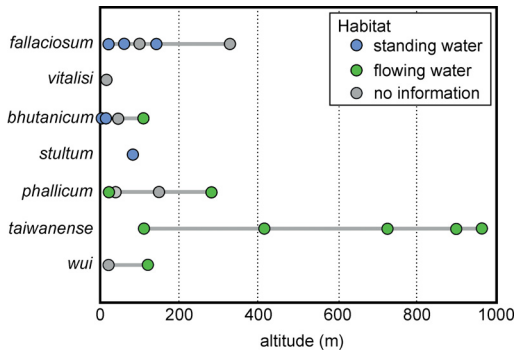


Fig. 5. Summary of altitudinal distribution and habitat preferences of Taiwanese *Coelostoma* species based on material examined for this study.

nal preferences. For example, altitude may have played a role in a divergence of both species, or the occurrence of *C. taiwanense* at higher altitudes may be a secondary consequence of delayed arrival of *C. wui* to Taiwan and a subsequent competitive exclusion of *C. taiwanense* from lower altitudes.

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