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A new species of *Asecodes* Förster (Hymenoptera, Eulophidae) and first record of *A. reticulatum* (Kamijo) from China, with a key to Chinese species

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Abstract

A new species of *Asecodes* Förster, *A. medogense* **sp. nov.** is described from Tibet, China and *A. reticulatum* (Kamijo) is reported from China for the first time. A key to all known species of genus *Asecodes* in China is provided.

Keywords

Chalcidoidea, Entedoninae, natural enemy, parasitoid wasp, taxonomy

Introduction

The genus *Asecodes* (Hymenoptera, Eulophidae, Entedoninae) was established by Förster (1856), but he did not include any species in it. Förster (1861) described the first two species in *Asecodes*: *A. fuscipes* Förster and *A. nitens* Förster. Ashmead (1904) designated both species as type species of *Asecodes*, and Bouček (1988) subsequently selected *A. fuscipes* as its type species. Graham (1993) synonymized these two species under *A. congruens* (Nees, 1834). Bouček and Askew (1968) synonymized *Ganahlia* Dalla Torre with *Asecodes*, Hansson (1996) synonymized *Teleopterus* Silvestri, *Metasecodes*

Erdős and *Desmatocharis* Graham with *Asecodes*. Up to now, this genus contains 26 valid species worldwide: 22 species were recorded in the Universal Chalcidoidea Database (Noyes 2019), and four species were described recently by Jamali et al. (2021).

The genus *Asecodes* can be easily separated from other genera in Entedoninae by: subtorular grooves present (Figs 2, 10); having a strong and complete occipital median sulcus which reaches from the occipital margin to the foramen magnum (Fig. 21), instead of a weak fold (Fig. 22). More characters of *Asecodes* can be seen in Hansson (1994) and Hansson (1996).

Before this study, there are only three species of *Asecodes* known from China, *Asecodes sinense* (Ling) was first described from China by Ling (2000), *A. turcicum* (Nees) and *A. delucchii* (Bouček) were reported from China by Ling (2000) and Zhang et al. (2007) respectively. This paper includes five species of *Asecodes* distributed in China, *A. medogense* sp. nov. is described as new to science, and *A. reticulatum* (Kamijo) is first reported from China. A key to all known Chinese species based on females is provided.

Materials and methods

Specimens were collected by Malaise traps and sweeping nets and were mounted on a card, or dissected and mounted in Canada Balsam on slides following methods described by Noyes (1982). Photos were taken with an Aosvi AO-HK830-5870T digital microscope or a digital CCD camera attached to an Olympus BX51 compound microscope. The quality of these photos was improved by using Helicon Focus 7 and Adobe Photoshop 2020. Measurements were made using the built-in software of Aosvi AO-HK830-5870T.

Terminology follows the Hymenoptera Anatomy Consortium (2021), and the following abbreviations are used: F1–5–flagellomeres 1–5; HE–height of eye; MS–malar space; MV–marginal vein; OOL–minimum distance between a posterior ocellus and corresponding eye margin; PMV– postmarginal vein; POL–minimum distance between posterior ocelli; SMV–submarginal vein; STV–stigmal vein; WM–width of mouth opening.

Type material is deposited in the insect collections at Northeast Forestry University (**NEFU**), Harbin, China.

Taxonomy

Key to Chinese species of the genus *Asecodes* (females)

1 Fore wing hyaline, without infuscate transverse band, and with three stigmal hairlines (Fig. 20).....***A. delucchii* (Bouček, 1971)**

– Fore wing with an infuscate transverse band below MV, and with two stigmal hairlines (e.g., Figs 5, 13).....**2**

2 Pedicel much shorter than F1; anterior 2/3 of mesoscutellum reticulate and posterior 1/3 smooth **3**

– Pedicel as long as F1 (Figs 3, 11); mesoscutellum entirely reticulate (Figs 4, 12) **4**

3 Gaster ovate; metasoma subequal to mesosoma, shorter than head plus mesosoma (ratio length of: metasoma : head : mesosoma about 3.2:1:3)..... ..... ***A. turcicum*** **(Nees, 1834)**

– Gaster oblong ovate; metasoma distinctly longer than mesosoma, also slightly longer than head plus mesosoma (ratio length of: metasoma : head : mesosoma about 5.2:1:3.5) ..... ***A. sinense*** **(Ling, 2000)**

4 Scape with apex of ventral margin curved smoothly in a wide arc (Fig. 11); meshes of reticulation on mesoscutum and mesoscutellum relatively coarser and larger (Fig. 12); disc of fore wing with sparse setation (Fig. 13) .... ***A. reticulatum*** **(Kamijo, 1986)**

– Scape with apex of ventral margin curved nearly in a right-angle (Fig. 3); meshes of reticulation on mesoscutum and mesoscutellum relatively denser and smaller (Fig. 4); disc of fore wing with denser setation (Fig. 5) .... ***A. medogense*** **sp. nov.**

Asecodes medogense **Li & Li, sp. nov.**

http://zoobank.org/6C5E7366-1C1A-4B4E-9699-78C819C9D500

Figs 1–8

Type material. ***Holotype*****:** ♀ [NEFU; on card], CHINA, Tibet, Medog County (altitude: 1400 m), 11–18.V.2017, Zhaxi, by Malaise trap. ***Paratypes*****:** 1♀ [NEFU; on slide], CHINA, Tibet, Medog County (altitude: 1400 m), 15–22.VI.2017, Zhaxi, by Malaise trap; 3♀ [NEFU; 2 on cards, 1 on slide], CHINA, Tibet, Medog County (altitude: 1400 m), 6–13.VII.2017, Zhaxi, by Malaise trap.

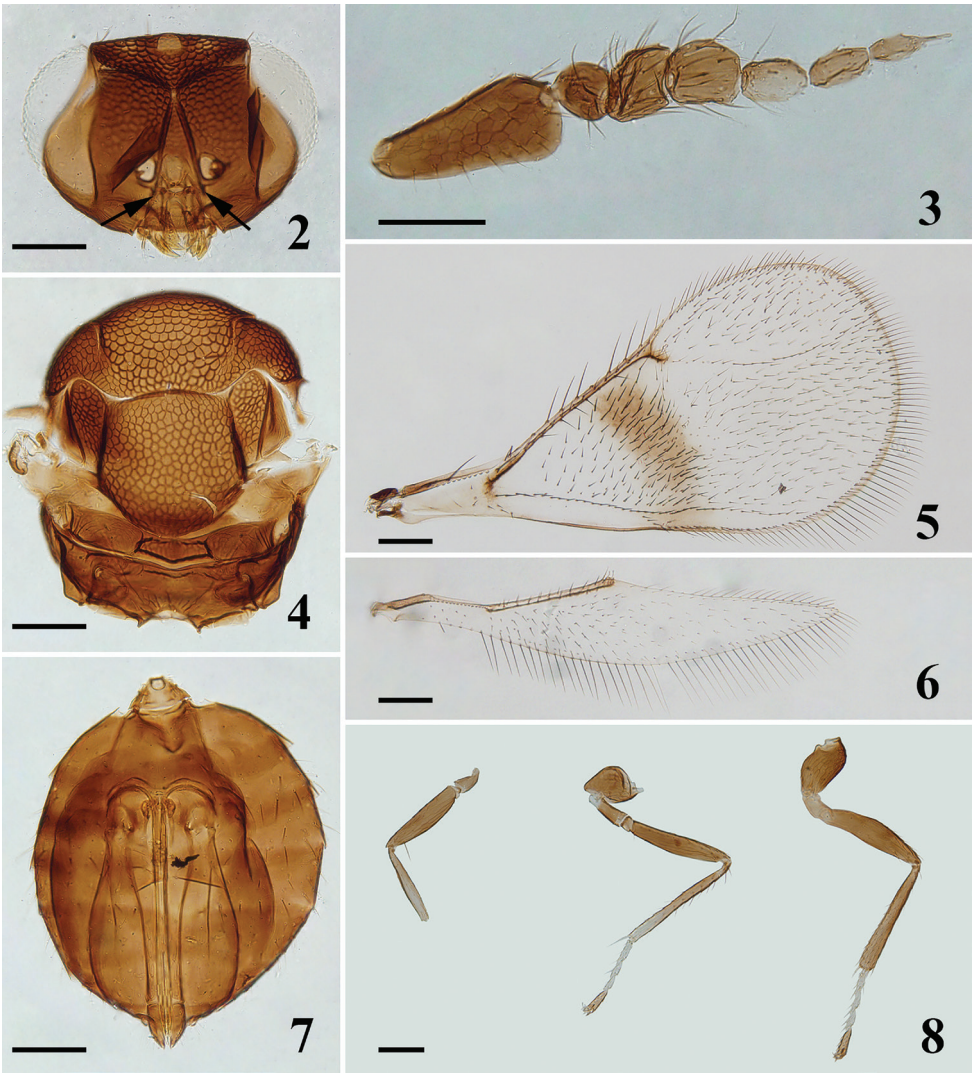
Diagnosis. Female. Scape strongly compressed from side to side and expanded from base to apex, with apex of ventral margin curved nearly in right-angle; pedicel as long as F1; F3 distinctly paler than other segments (Fig. 3); mesoscutellum densely and entirely reticulated with small meshes; propodeum with groove along median anterior margin, without carina or plica (Fig. 4); fore wing with a complete infuscate transverse band below MV (Fig. 5).

Description. Female. Body length 0.8–0.9 mm. Antenna mainly dark brown, except F3 distinctly paler than other segments (Fig. 3). Vertex and frons above frontofacial sulcus metallic bluish-green, frons below sulcus golden green. Mesosoma dark brown with weak metallic blue tinges. Gaster dark brown to brown with weak metallic bronze reflections. Fore wing with a complete infuscate transverse band below MV (Fig. 5). All coxae and femora dark brown. Protibia mainly pale brown with basal part slightly daker; mesotibia mainly dark brown with apical 1/4 pale brown; metatibia dark brown. All tarsi with tarsomeres 1–3 pale yellow, tarsomere 4 dark brown.

Figure 1. *Asecodes medogense* Li & Li, sp. nov., holotype, female **I** habitus in lateral view. Scale bar: 200 μm.

Head (Fig. 2), narrow in dorsal view. Upper face and vertex with strong reticulate sculpture, lower face with weak and irregular sculpture. Frontofacial sulcus weakly V-shaped, in an angle of about 130°. POL:OOL = 8:5. Occipital median sulcus present and complete. Inner orbits sinuate in lower part. HE:MS:WM about 3.3:1: 1.8. Malar sulcus present. Antenna (Fig. 3) inserted above level of lower margin of eyes. Subtorular grooves present. Scape reticulated, strongly compressed laterally and expanded from base to apex, about 2.1 times as long as its maximum width, with apex of ventral margin curved nearly in a right-angle. Pedicel as long as wide, and as long as F1. F1 quadrate, slightly shorter than F2 (about 0.8 times); F2 slightly longer than wide (about 1.2 times); pedicel and F1–F2 with strong and long setae. F3–F5 longer than wide and distinctly narrower than F2; F3 1.7 times as long as wide; F4 twice as long as wide; F5 narrowest, with a long terminal spine.

Mesosoma (Fig. 4), 1.2 times as long as wide. Pronotum reduced, invisible in dorsal view. Mesoscutum, mesoscutellum and axillae entirely with strong reticulate sculpture, meshes on midlobe of mesoscutum and mesoscutellum small and dense (compared with *A. reticulatum*), but wider than that on lateral lobe of the mesoscutum and axillae; propodeum almost smooth; metascutellum and lateral panels of metanotum with weak and irregular sculpture. Notauli incomplete, indicated only in anterior part. Midlobe of mesoscutum with two pairs of setae. Anterior part of axillae advanced forward in front of level of anterior margin of mesoscutellum. Mesoscutellum as long as wide, with one pair of setae. Propodeum long, about 0.34 times as long as mesoscutellum, with a groove along median anterior margin, without carina or plica. Fore wing



Figures 2–8. *Asecodes medogense* Li & Li, sp. nov., paratype, female, on slide **2** head, frontal view, arrows show subtorular grooves **3** antenna **4** mesosoma **5** fore wing **6** hind wing **7** metasoma **8** legs, from left to right: fore, mid and hind leg. Scale bars: 100 μm.

(Fig. 5) twice as long as wide. Ratio length of: SMV:MV:PMV:STV about 5.5:8.5:1:1. Speculum closed below, with two stigmal hairlines. Hind wing (Fig. 6), 5.2 times as long as wide. Legs (Fig. 8), with coxae distinctly reticulated; mesotibial spur as long as corresponding basitarsus; metatibial spur shorter than corresponding basitarsus.

Metasoma (Fig. 7), gaster ovate, as long as mesosoma; petiole short, conical; first gastral tergite occupying nearly 1/4 length of gaster; ovipositor originates from about the anterior margin of second gastral tergite and slightly exserted beyond apex of gaster.

Male. Unknown.

Host. Unknown.

Etymology. The specific name is derived from the name of the collection locality of the type specimens.

Distribution. China (Tibet).

Remarks. *Asecodes medogense* is similar to *A. reticulatum* in having the mesoscutellum entirely reticulate; pedicel nearly as long as F1; fore wing with an infuscate transverse band below MV. The new species differs from *A. reticulatum* in having scape with apex of ventral margin curved nearly in a right-angle (curved smoothly in a wide arc in *A. reticulatum*); meshes of reticulation on mesoscutum and mesoscutellum relatively denser and smaller (relatively coarser and larger in *A. reticulatum*); disc of fore wing with more dense setation than *A. reticulatum*.

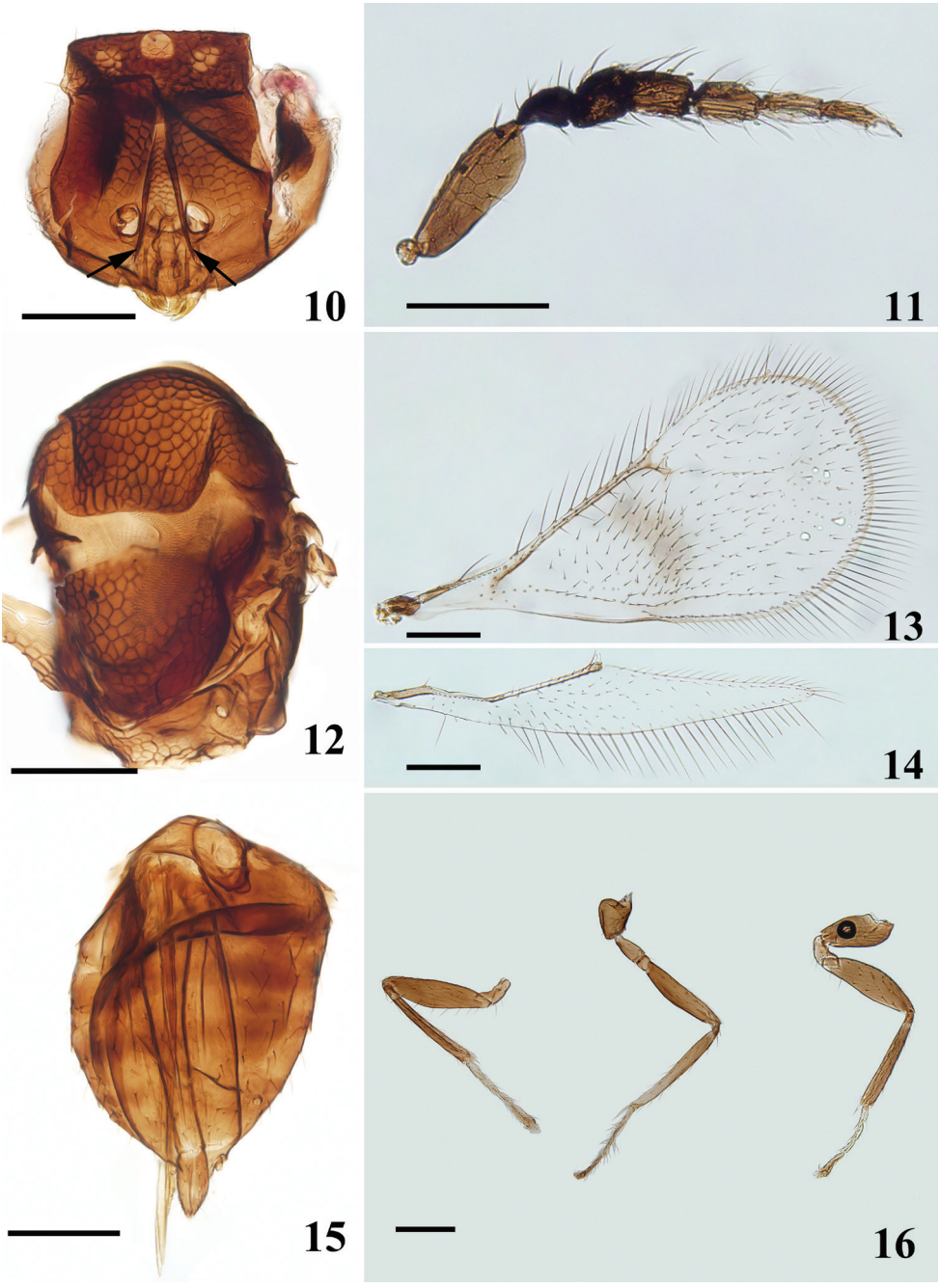
Asecodes reticulatum (Kamijo)

Figs 9–16

Closterocerus reticulatus (Kamijo): Gumovsky 2003: 33.
Desmatocharis reticulata Kamijo, 1986: 243.
Teleopterus reticulatum (Kamijo): Hansson 1996: 162.
Teleopterus reticulatus (Kamijo): Hansson 1994: 669.

Material examined. 1♀ [NEFU; on slide], China, Heilongjiang Province, Yichun City, Dailing District, Liangshui Forestry Station, 28.VII.2015, Si-Zhu Liu, Xin-Yu

Figure 9. *Asecodes reticulatum* (Kamijo), female **9** habitus in lateral view. Scale bar: 200 μm.



Figures 10–16. *Asecodes reticulatum* (Kamijo), female, on slide **10** head, frontal view, arrows show subtorular grooves **11** antenna **12** mesosoma **13** fore wing **14** hind wing **15** metasoma **16** legs, from left to right: fore, mid and hind leg. Scale bars: 100 μm.

Zhang and Xing-Yue Jin, sweeping; 2♀ [NEFU; 1 on card, 1 on slide], CHINA, Heilongjiang Province, Yichun City, Dailing District, Liangshui Forestry Station, 9.VII.2013, Guo-Hao Zu, Si-Zhu Liu and Hui Geng, sweeping.

Diagnosis. Female. Scape compressed, with apex of ventral margin curved smoothly in a wide arc, pedicel as long as F1 (Fig. 11); mesoscutellum sparsely and entirely reticulated with wide meshes, propodeum shorter than 1/3 length of mesoscutellum (Fig. 12); fore wing twice as long as wide, and with an infuscate transverse band below MV, disc of fore wing with sparse setation (Fig. 13).

Host. Primary parasitoid of *Rhamphus oxyacanthae* (Marsham) (Coleoptera, Curculionidae) (Hansson 1994).

Distribution. China (Heilongjiang Province) (new record), Japan (Kamijo 1986), Russia (Gumovsky 2003), Ukraine (Gumovsky 2003) and Sweden (Hansson 1994).

Comments. See Kamijo (1986) for a detailed description; our specimens agree well with this description.

***Asecodes sinense* (Ling)**
Fig. 17

Desmatocharis sinensis Ling, 2000: 260.

Material examined. 2♀ [NEFU; 1 on card, 1 on slide], China, Sichuan Province, Guangyuan City, Qingchuan County, 22.VIII.2015, Ye Chen and Chao Zhang,

Figure 17. *Asecodes sinense* (Ling), female **17** habitus in lateral view. Scale bar: 200 μm.

sweeping; 2♀ [NEFU; 1 on card, 1 on slide], CHINA, Yunnan Province, Lvchun County, Huanglianshan Natural Reserve, 18.I.2019, Jun-Jie Fan, Jun Wu and Ting-Ting Zhao, sweeping.

Diagnosis. Female. Scape compressed, pedicel slightly shorter than half the length of F1; mesoscutellum with anterior 2/3 reticulated, posterior 1/3 smooth and shiny; fore wing with an infuscate transverse band below MV; metasoma longer than head plus mesosoma (ratio length of: metasoma : head : mesosoma about 5.2:1:3.5); gaster oblong ovate, about 2.2 times as long as its maximum width.

Host. Unknown.

Distribution. China (Yunnan (new record) and Sichuan (Ling 2000) Provinces).

Comments. The original description of *Asecodes sinense* was given by Ling (2000). This species is similar to *A. turcicum* in having the fore wing with an infuscate transverse band below MV; mesoscutellum with anterior 2/3 reticulated, posterior 1/3 smooth and shiny. It can be separated from *A. turcicum* by its oblong ovate gaster, which distinctly longer than mesosoma (metasoma subequal to mesosoma in *A. turcicum*).

***Asecodes turcicum* (Nees)**
Fig. 18

Asecodes turcicus (Nees): Hansson 1996: 162.
Closterocerus turcicus (Nees): Gumovsky 2003: 32.
Desmatocharis turcica (Nees): Graham 1959: 199.
Desmatocharis turcicus (Nees): Schauff 1991: 47.
Entedon turcicus (Nees): Walker 1839: 23.
Eulophus turcicus Nees, 1834: 155.
Teleopterus turcicus (Nees): Hansson 1994: 669.

Material examined. 2♀ [NEFU; 1 on card, 1 on slide], China, Tibet, Medog County (altitude: 1400 m), 22–29.VI. 017, Zhaxi, by Malaise trap; 3♀ [NEFU; 2 on cards, 1 on slide], CHINA, Tibet, Medog County (altitude: 1400 m), 6–13.VII.2017, Zhaxi, by Malaise trap.

Diagnosis. Female. Scape compressed; mesoscutellum with anterior 2/3 reticulated, posterior 1/3 smooth and shiny; fore wing hyaline with an infuscate transverse band below MV; metasoma subequal to mesosoma, shorter than head plus mesosoma (ratio length of: metasoma : head : mesosoma about 3.2 : 1 : 3); gaster ovate.

Host. Unkonwn.

Distribution. China (Tibet (new record), Gansu (Zhang et al. 2007) and Sichuan (Ling 2000) Provinces), Japan (Kamijo 1986), Russia (Gumovsky 2003), India (Gumovsky 2003), Germany (Nees 1834), Czechoslovakia, France, Ireland (north and south), United Kingdom, Moldova (Bouček and Askew 1968), Netherlands (Gijswijt 2003), Sweden (Hansson 1991), Czech Republic (Kalina 1989).

Figure 18. *Asecodes turcicum* (Nees), female **18** habitus in lateral view. Scale bar: 200 μm.

Comments. See Nees (1834) for the original description, and Jamali et al. (2021) for the photographs of the neotype of *Asecodes turcicum*.

***Asecodes delucchii* (Bouček)**
Figs 19, 20

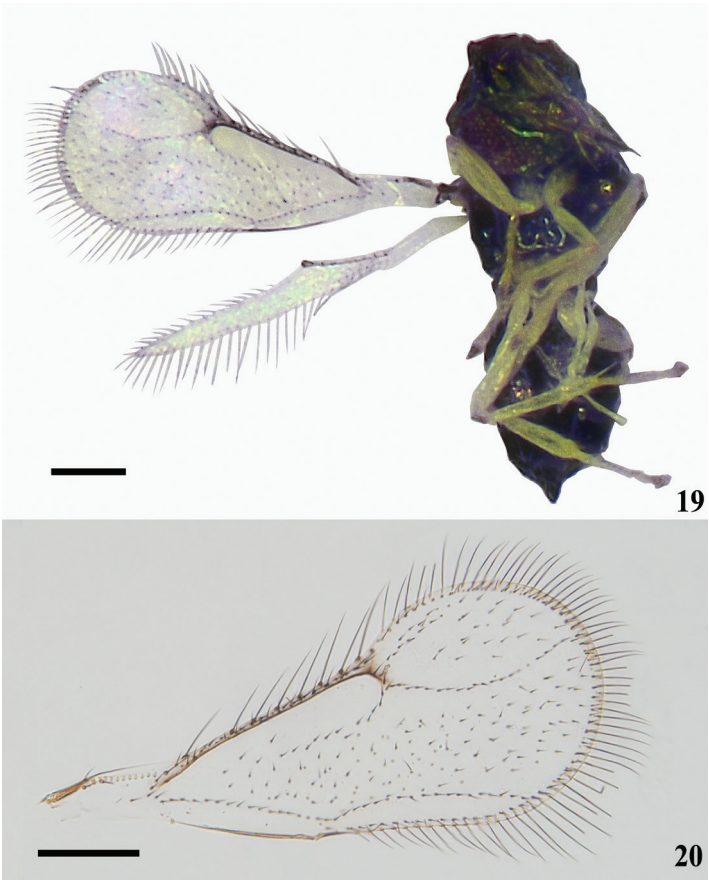
Asecodes delucchii (Bouček): Hansson 1996: 162.
Asecodes deluchii (Bouček): Supartha and Ridland 2004: 3668 (misspelling).
Chrysocharoidea sp.: Graham 1963: 269.
Omphale sp.: Delucchi 1958: 241.
Teleopterus delucchii Bouček, 1971: 537.

Material examined. 4♀ [NEFU; 2 on cards, 2 on slides], China, Guizhou Province, Zunyi City, Suiyang County, 6.VIII.2020, Jun Wu, sweeping.

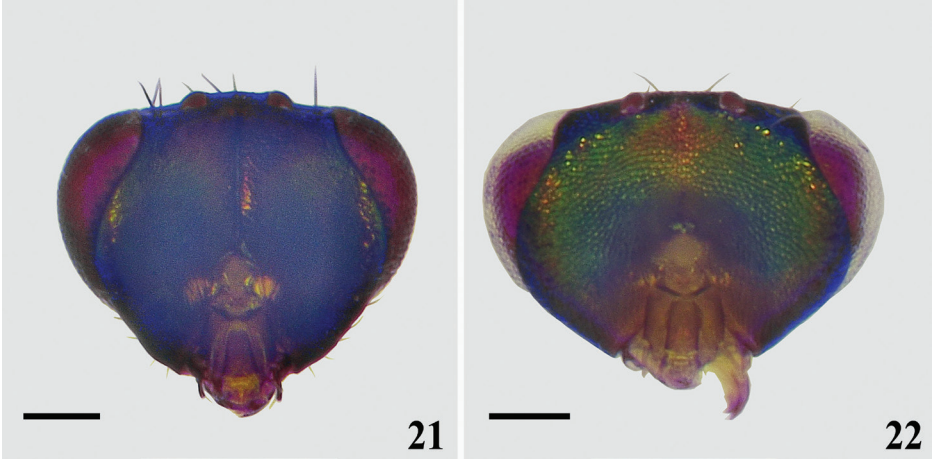
Diagnosis. Female. Scape normal, not compressed; fore wing hyaline, without infuscate transverse band, and with three stigmal hairlines: two stigmal hairlines toward the apex of wing and one towards parastigma (Fig. 20).

Host. Primary parasitoid of the peach leafminer, *Lyonetia clerckella* (Linnaeus) (Lepidoptera, Lyonetiidae) (Adachi 1998) and the citrus leafminer *Phyllocnistis citrella* Stainton (Lepidoptera, Phyllocnistidae) (Ujiye and Adachi 1995).

Distribution. China (Guizhou (new record) and Gansu (Zhang et al. 2007) Provinces), Japan (Adachi 1998), India (Jamali et al. 2021), Indonesia (Supartha and Rid-



Figures 19, 20. *Asecodes delucchii* (Bouček), females **19** habitus in ventral view **20** fore wing. Scale bars: 100 μm.



Figures 21, 22. Head, showing occiput, females **21** *Asecodes sinense* (Ling) **22** *Closterocerus* sp. Scale bars: 100 μm.

land 2004), Croatia (Bouček 1977), Czechoslovakia, Italy, Poland, United Kingdom, Yugoslavia (pre-1991), Moldova (Bouček 1971), Romania (Hansson 2016).

Comments. *Asecodes delucchii* can be easily separated from other species distributed in China by its characteristic fore wing. An Indian species, *A. zhui* Jamali having a similar fore wing was described by Jamali et al. (2021). *Asecodes delucchii* differs from *A. zhui* in having the fore wing about 2.4 times as long as wide (fore wing more than three times as long as wide in *A. zhui*); with the longest marginal cilia 1/3–1/2 the maximum wing width (4/5 the maximum wing width in *A. zhui*).

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Psychodidae (Diptera) of Azerbaijan and Georgia – faunistics with biodiversity notes

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Abstract

Records of 46 Psychodidae (Sycoracinae 1, Trichomyiinae 1, Psychodinae 44) species/subspecies are presented in this paper based on specimens collected by sweep-netting in Azerbaijan and Georgia in 2019. Nine species are recorded for the first time since their original description; 12 species are new for Transcaucasia; 22 species are new for Azerbaijan; and 17 species are new for Georgia. *Saraiella ressli montana* Ježek, 1990 is proposed as a synonym of *S. ressli* Wagner, 1983, **syn. nov.** Knowledge of some aspects of the ecology and biogeography of selected (especially rare) species has been expanded and a clear pattern was found in species richness, rare species, and new records in relation to land use, habitat diversity, and preservation of the environment surrounding the sampling site.

Keywords

Biodiversity, Caucasus, faunistics, moth flies, new records, new synonymy, taxonomy, zoogeography

Introduction

The purpose of faunistic studies is the registration of species. Intensive faunistic studies are necessary if we want to determine species richness on a local scale and track long-term changes in species diversity (Ejsmont-Karabin 2019). This applies in particular to areas that are of the utmost importance from the point of view of biodiversity but are still insufficiently researched for some groups of organisms. One such biodiversity

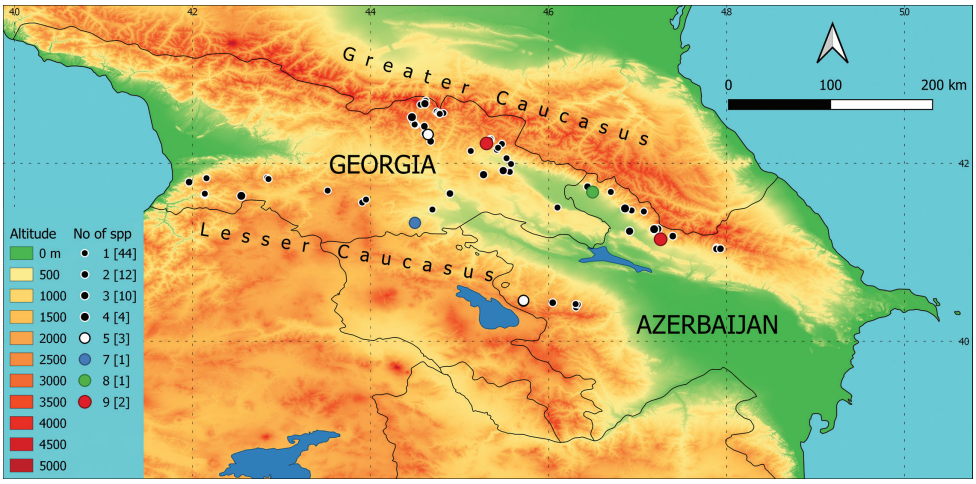

Figure 1. Recent collecting sites on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l., and circle diameters and colours indicate the number of species recorded at each sampling site. The number of sites where the specific number of species is present is given in brackets.

hotspot is the Caucasus, and one of its hitherto insufficiently known groups is the family Psychodidae. For the above reasons, this is another contribution to knowledge of the Diptera: Psychodidae, especially Sycoracinae, Trichomyiinae and Psychodinae from Azerbaijan and Georgia.

Psychodidae is a relatively species-rich family, with nearly 500 species known to occur in Europe and the adjacent island areas; for more details, see Wagner (2018). The following authors contributed considerably to knowledge on the Transcaucasian Psychodidae: Perfiľev (1966); Lewis (1982); Artemiev and Neronov (1984); Vaillant (1972–1983); Vaillant and Joost (1983); Wagner (1981, 1990, 2018); Wagner and Joost (1986, 1988); Gugushvili and Lomtadze (2002); Wagner et al. (2002); Ježek (1987, 2004, 2006a, 2007, 2009); Melaun et al. (2014); Ježek et al. (2014, 2018) and recently Oboňa et al. (2017, 2019a).

The Caucasus consists of several mountain ranges with different connectivity and serves heterogeneous environments, with different climatic conditions between lowlands and highlands as a result of orogenic activity in the Miocene-Pliocene (Hrivniak et al. 2020). The parts of Georgia and Azerbaijan sampled in this research cover parts of the Greater Caucasus and Lesser Caucasus (see Fig. 1), separated by the Rieni and Kura river valleys and partly connected in the Likhi (Surami) mountain range at a relatively high elevation, with the lowest point of 949 m a.s.l. (Surami Pass).

Following our results and findings in Transcaucasia (Ježek et al. 2018, 2021; Oboňa et al. 2017, 2019a), which indicate the relatively high diversity of this family in the Caucasus, we continued to collect material in 2019. We did so in an effort to better understand the diversity and occurrence of the family Psychodidae in the Caucasus and to make the data on the faunistics and biodiversity of this group more complete.

Materials and methods

Dipterans were collected by PM, JO, T. Kovács (Mátra Museum of Hungarian Natural History Museum, Gyöngyös, Hungary), D. Murányi (Eszterházy Károly University, Eger, Hungary), and G. Vinçon (Grenoble, France) in the three periods between iv–v, vii, and ix–x, all in 2019, by sweep-netting from vegetation growing along watercourses and lakes. The captured specimens were preserved in 75% ethanol in the field. In the laboratory, specimens of Psychodidae were cleared in chloralphenol, treated in xylol, and mounted on glass slides in Canada balsam, subsequently identified by JJ and deposited at the National Museum (Natural History Museum), Department of Entomology, Prague, Czech Republic. The slides are labelled with the inventory slide number of the family Psychodidae (Inv. No.) and are included in the Diptera collection of National Museum Prague collections (**NMPC**), see Tkoč et al. (2014). The nomenclature is modified from Vaillant (1972–1983) and Wagner (1990, 2018) using the classifications of Ježek (1990a, 2007); Ježek and van Harten (2005); Omelkova and Ježek (2012); Oboňa and Ježek (2014) and Kroča and Ježek (2015, 2019). We use the term "Transcaucasia" (Armenia, Azerbaijan, and Georgia) according to the Catalogue of Palaearctic Diptera; for more details, see Wagner (1990). Information on the distribution (simple distribution overview) is given for the species recorded from Azerbaijan and Georgia for the first time.

In the list of localities in Suppl. material 1: Table S1, data are presented in the following order: number (in brackets), territorial unit (district, region etc.), name of the locality, nearest settlement (where appropriate), specified location and habitat, coordinates, and elevation. The localities are listed alphabetically. Data for the material examined are arranged in the following order: number, date of collection, number of males and females, slide number and collector's or determinator's name (abbreviated).

Abbreviations used:

TK Tibor Kovács;
DM Dávid Murányi;
GV Gilles Vinçon.

The distribution of the sampling sites (Fig. 1) and species recorded in this study (Figs 2–7) are presented in maps prepared using data derived from USGS/NASA SRTM data providing seamless continuous topography surfaces (Jarvis et al. 2008). Areas with different elevations were painted in QGIS (version: 3.10.10-A Coruña) with the 'Band Rendering' (Singleband Pseudocolor, Oranges Colour Ramp, the colour for values from > 0 to ≤ 500 was changed to green). When species co-occurred at the locality, the offset was set to x = 1 mm, y = 1 mm for species marked with square symbol, x = -1 mm, y = -1 mm for species marked with triangles and x = 1 mm, y = -1 mm for diamonds, respectively.

Results

We analysed material obtained in 2019 from 80 sites located in Transcaucasia in the territories of Azerbaijan and Georgia. Based on 182 slides from this material, we identified 46 species/subspecies belonging to three subfamilies. Below we present a list of recorded species and their distribution, together with the information on the material examined and notes.

Family Psychodidae
Subfamily Sycoracinae

Sycorax caucasica Ježek, 1990

Material examined. Georgia: G 13, 8.7.2019 (Fig. 2), 1♂, slide Inv. No. 25630, leg. PM, GV.

Distribution. Caucasian species, not rare in Abkhazia (Ježek 1990a).

Note. Species known only from the original description from Abkhazia (Ježek 1990a). First record since the original description, first record from Georgia, from a territory other than Abkhazia. Although this is a typical mountain species (elevation of ca. 2000 m a.s.l.), it is also known from the small hills (Ježek 1990a) and foothills of the Greater Caucasus (see above).

Subfamily Trichomyiinae

Trichomyia urbica Haliday in Curtis, 1839

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25663, leg. JO (Fig. 2).

Distribution. Rare species, known from Austria, Belgium, Czech Republic, Denmark, France, Germany, Great Britain, Greece, Hungary, Ireland, the Netherlands, Norway, Poland, Romania, Slovakia, and Sweden; larvae are xylophagous and occur in shaded slope spring areas and some other habitats with decaying organic matter (Ježek 2003; Ježek and Omelková 2012).

Note. First record for Azerbaijan and Transcaucasia.

Subfamily Psychodinae

Clytocerus (*Boreoclytocerus*) *grusinicus* Wagner, 1981

Material examined. Azerbaijan: A 14, 7.5.2019, 1♂, slide Inv. No. 25708, leg. JO; A 22, 5.5.2019, 1♂, slide Inv. No. 25625, leg. JO. **Georgia**: G 09, 2.5.2019, 2♂♂, slide Inv. No. 25642 and 25727, leg. JO; G 14, 2.5.2019, 1♂, slide Inv. No. 25710, leg. JO; G 26, 15.7.2019, 1♂, slide Inv. No. 25583, leg. TK, DM, GV; G 40, 13.7.2019, 1♂, slide Inv. No. 25633, leg. TK, PM, DM, GV (Fig. 2).

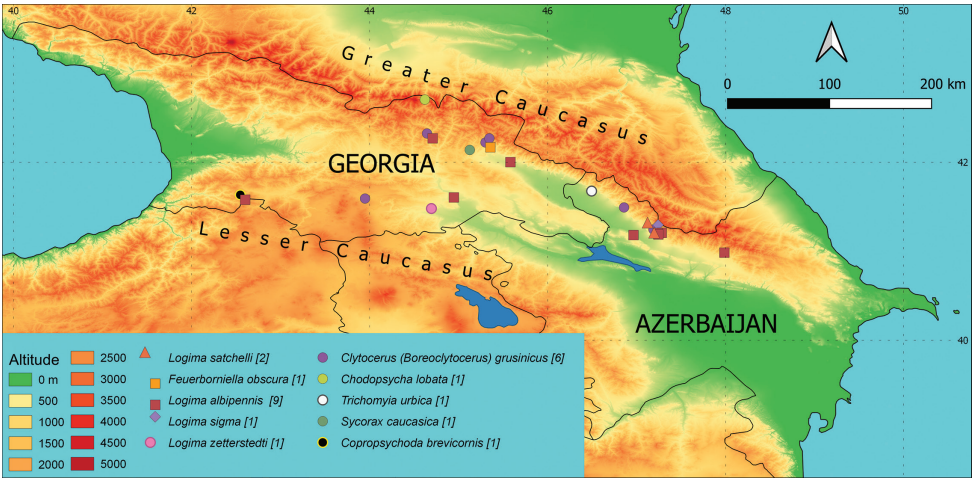

Figure 2. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols mark the sampling sites with occurrence of the species. When species co-occurred at the locality, an offset is shown in the legend and described in the Materials and methods. The number of sites where the species is present is given in brackets.

Distribution. Rare Caucasian species known only from a few localities (Wagner 1981; Oboňa et al. 2019).

Note. Described from Georgia by Wagner (1981) on the basis of the only holotype from a right tributary above the village Kwarchi. After the second record from Georgia (Oboňa et al. 2019), the species was recorded from another six sites in this study. Species found in low numbers in a range of elevations from 295 m (Oboňa et al. 2019) to 1520 m a.s.l. (see above). First records for Azerbaijan.

Copropsychoda brevicornis (Tonnoir, 1940)

Material examined. Georgia: G 03, 27.9.2019, 1♀, slide Inv. No. 25604, leg. PM (Fig. 2).

Distribution. Coprophagous species with a Western Palaearctic distribution. Known from Europe (Belgium, Great Britain, France, Germany, Ireland, the Netherlands, and Norway) (Ježek et al. 2018b; Wagner 2018).

Note. First record for Georgia and Transcaucasia.

Feuerborniella obscura (Tonnoir, 1919)

Material examined. Georgia: G 09, 2.5.2019, 1♀, slide Inv. No. 25731, leg JO (Fig. 2).

Distribution. A common European species, distributed in Central Europe, along the Atlantic coast, in the British Isles and reaching the Apennines and the Balkans in the south, known from habitats with sprayed moss cushions, spring areas,

and stream meanders across a wide range of elevations (Ježek and Omelková 2012; Oboňa et al. 2019b).

Note. First record for Georgia and Transcaucasia.

Chodopsycha lobata (Tonnoir, 1940)

Material examined. Georgia: G 28, 6.7.2019, 1♂, slide Inv. No. 25609, leg. PM (Fig. 2).

Distribution. Generally common species, occurring across Europe to Transcaucasia, associated with fungi (Kroča and Ježek 2019).

Note. First record for Georgia, from a territory other than Abkhazia.

Logima albipennis (Zetterstedt, 1850)

Material examined. Azerbaijan: A 9, 6.5.2019, 1♀, slide Inv. No. 25716, leg. JO; A 18, 10.5.2019, 1♀, slide Inv. No. 25644, leg. JO; A 20, 5.5.2019, 1♀, slide Inv. No. 25720, leg. JO; A 21, 8.5.2019, 1♀, slide Inv. No. 25752, leg. JO; A 22, 5.5.2019, 1♀, slide Inv. No. 25627, leg. JO; A 23, 6.5.2019, 2♀♀, slide Inv. No. 25688 and 25695, leg. JO. **Georgia**: G 03, 27.9.2019, 1♀, slide Inv. No. 25605, leg. PM; G 18, 1.5.2019, 1♀, slide Inv. No. 25715, leg. JO; G 49, 28.4.2019, 1♀, slide Inv. No. 25670, leg. JO; G 56, 26.4.2019, 1♀, slide Inv. No. 25696, leg. JO (Fig. 2).

Distribution. A cosmopolitan species known from Europe (Austria, Azores, Belgium, Bosnia and Herzegovina, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Luxemburg, Madeira, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Slovakia, Slovenia, and Sweden). In Asia from Armenia, Azerbaijan, Afghanistan, China, India, Japan, North Korea, Syria, and Turkey. In Africa, from Algeria, the Canary Islands, Gambia, South Africa, and Tunisia. Also from Australia, New Zealand, South America, USA, Campbell Island, Juan Fernandez Islands, Kerguelen Island, and Macquarie Island (Ježek and Yağci 2005; Kvifte 2012; Afzan and Belqat 2016; Ježek et al. 2018).

Note. First record for Georgia.

Logima satchelli (Quate, 1955)

Material examined. Azerbaijan: A 21, 8.5.2019, 1♀, slide Inv. No. 25751, leg. JO; A 23, 6.5.2019, 1♀, slide Inv. No. 25689, leg. JO (Fig. 2).

Distribution. Common Holarctic species, eurybiotic (Kroča and Ježek 2019).

***Logima sigma* (Kincaid, 1899)**

Material examined. Azerbaijan: A 22, 5.5.2019, 1♀, slide Inv. No. 25626, leg. JO (Fig. 2).

Distribution. Uncommon Holarctic species. Recorded from Austria, Belgium, Czech Republic, France, Great Britain, Norway, Poland, Slovakia, Spain (incl. Madeira); Antipodes Is., Auckland L. (lake or lakes), Australia, Campbell L., Chile, Enderby L., Ewing L., French L., Macquarie L., New Zealand, Ocean L., Rose L., Saint Helena, and USA (Andersen and Håland 1995; Ježek 2003; Kvifte et al. 2011; Kvifte and Andersen 2012; Elgueta and Ježek 2014; Haselboeck 2016; Ježek et al. 2018b; Oboňa and Kozánek 2018; Wagner 2018).

Note. First record for Azerbaijan and Transcaucasia.

***Logima zetterstedti* Ježek, 1983**

Material examined. Georgia: G 23, 29.4.2019, 1♀, slide Inv. No. 25714, leg. JO (Fig. 2).

Distribution. Common European and Western Siberian species recorded from Belgium, Czech Republic, Greit Britain, Slovakia, Slovenia, and the Netherlends (Omelková and Ježek 2012; Ježek et al. 2018b; Wagner 2018).

Note. First record for Georgia and Transcaucasia.

***Mormia ckvitariorum* Ježek, 1987**

Material examined. Azerbaijan: A 14, 7.5.2019, 3♂♂, slide Inv. No. 25738, 25739 and 25740, leg. JO (Fig. 3).

Note. Species known only from the original description from Abkhazia (Ježek 1987). First record since the original description, first record for Azerbaijan. Species known only from lowland and foothills of the Greater Caucasus.

***Promormia silesiensis* (Ježek, 1983)**

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25661, leg. JO (Fig. 3).

Distribution. Species known only from Czech Republic, Greece, Slovakia, and Slovenia; until now considered as a rare European species (Ježek 1983; Omelková and Ježek 2012; Oboňa and Ježek 2014).

Note. Based on the record from the southern slope of the Greater Caucasus foothills (see above), it is necessary to reconsider it as a European and Transcaucasian species. First record for Azerbaijan and Transcaucasia.

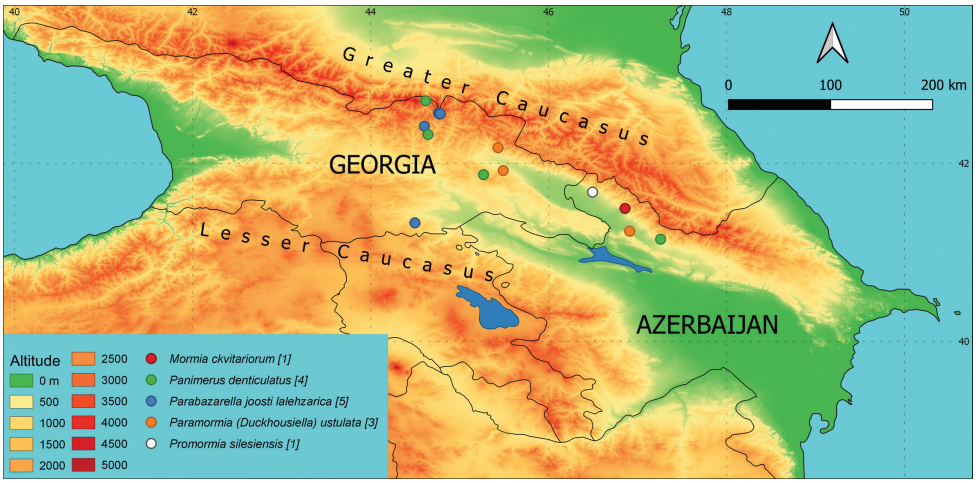

Figure 3. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols mark the sampling sites with occurrence of the species. The number of sites where the species is present is given in brackets.

Panimerus denticulatus Krek, 1971

Material examined. Azerbaijan: A 23, 6.5.2019, 1♂, slide Inv. No. 25693, leg. JO (Fig. 3). **Georgia**: G 12, 9.7.2019, 1♂, slide Inv. No. 25613, leg. PM, GV; G 32, 2.7.2019, 1♂, slide Inv. No. 25615, leg. TK, DM, GV; G 40, 13.7.2019, 1♂, slide Inv. No. 25634, leg. TK, PM, DM, GV.

Distribution. Locally common species, known from several European countries: Belgium, Austria, Great Britain, Ireland, Bosnia and Herzegovina, Czech Republic, Greece, and Macedonia (Omelková and Ježek 2012; Ježek et al. 2018b).

Note. Records scattered over a large area of Transcaucasia (Fig. 3) suggest that the species is also relatively common in Transcaucasia. It is necessary to reconsider it as a European and Transcaucasian species. First record for Azerbaijan, Georgia, and Transcaucasia.

Paramormia (*Duckhousiella*) *ustulata* (Walker, 1856)

Material examined. Azerbaijan: A 19, 7.5.2019, 1♂, 1♀, slide Inv. No. 25671 and 25723, leg. JO. **Georgia**: G 19, 30.4.2019, 1♂, slide Inv. No. 25649, leg. JO; G 21, 3.5.2019, 1♀, slide Inv. No. 25681, leg. JO (Fig. 3).

Distribution. Holarctic species, known from most of Europe, very common locally, mainly in extreme localities (salt works, thermal springs, calcareous water, mineral-rich springs). Also recorded in Algeria, Morocco, Israel, Armenia, Azerbaijan, Afghanistan, Iran, and USA (Ježek and Yağci 2005; Salmela et al. 2014; Kvifte et al. 2016; Ježek et al. 2018a; Oboňa et al. 2019a).

Note. First record for Georgia.

***Parabazarella joosti lalehzarica* Ježek, 1990**

Material examined. Georgia: G 24, 29.4.2019, 3♂♂, slide Inv. No. 25678, 25734 and 25745, leg. JO; G 35, 11.7.2019, 1♂, slide Inv. No. 25616, leg. TK, PM, DM; G 34, 11.7.2019, 1♂, slide Inv. No. 25581, leg. TK, PM, DM; G 35, 11.7.2019, 1♂, slide Inv. No. 25571, leg. TK, PM, DM, GV; G 43, 11.7.2019, 1♂, slide Inv. No. 25617, leg. TK, PM, DM, GV (Fig. 3).

Distribution. *Bazarella joosti* Vaillant, 1983, was described from Schelda nr. Kashadl (Central Caucasus: Georgia, probably Gora Shkhel'da, omitted (overlooked) from Georgia in Oboňa et al. 2019a); the subspecies *lalehzrica* is known only from the original description (Ježek 1990b) from S. E. Iran, Kerman province, Kuh-e Lalehzar (top m a.s.l. 4374, 3850–4374 m), holotype and 9 paratypes (males).

Note. *Parabazarella* Vaillant, 1983 was raised to genus level by Ježek (2001) after previously being considered a subgenus of *Bazarella* Vaillant, 1961. This is the first record since the original description.

***Pericoma* (*Pachypericoma*) *blandula* Eaton, 1893**

Material examined. Azerbaijan: A 01 9.5.2019, 1♂, slide Inv. No. 25624, leg. JO; A 02, 9.5.2019, 1♂, slide Inv. No. 25665, leg. JO; A 23, 6.5.2019, 1♂, slide Inv. No. 25687, leg. JO. **Georgia**: G 02, 24.9.2019, 1♂, slide Inv. No. 25584, leg. TK, PM; G 09, 2.5.2019, 1♂, slide Inv. No. 25732, leg. JO; G 25, 29.4.2019, 1♂, slide Inv. No. 25713, leg. JO; G 47, 9.7.2019, 1♂, slide Inv. No. 25638, leg. TK, PM, DM, GV.

Distribution. Common European and Transcaucasian species, penetrates into North Africa (Kroča and Ježek 2019).

***Pericoma* (*Pachypericoma*) *fallax* Eaton, 1893**

Material examined. Azerbaijan: A 01, 9.5.2019, 1♂, slide Inv. No. 25707, leg. JO; A 02, 9.5.2019, 1♂, slide Inv. No. 25664, leg. JO; A 13, 7.5.2019, 1♂, slide Inv. No. 25743, leg. JO; A 14, 7.5.2019, 1♂, slide Inv. No. 25709, leg. JO. **Georgia**: G 20, 3.5.2019, 1♂, slide Inv. No. 25717, leg. JO; G 24, 29.4.2019, 1♂, slide Inv. No. 25749, leg. JO.

Distribution. European, western Siberian, and Caucasian species (Kroča and Ježek 2019).

Note. First record for Georgia, from a territory other than Abkhazia.

***Pericoma* (*Pachypericoma*) *nielseni* Kvifte, 2010**

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25662, leg. JO; A 13, 7.5.2019, 1♂, slide Inv. No. 25742, leg. JO. **Georgia**: G 24, 29.4.2019, 1♂, slide Inv. No. 25747, leg. JO.

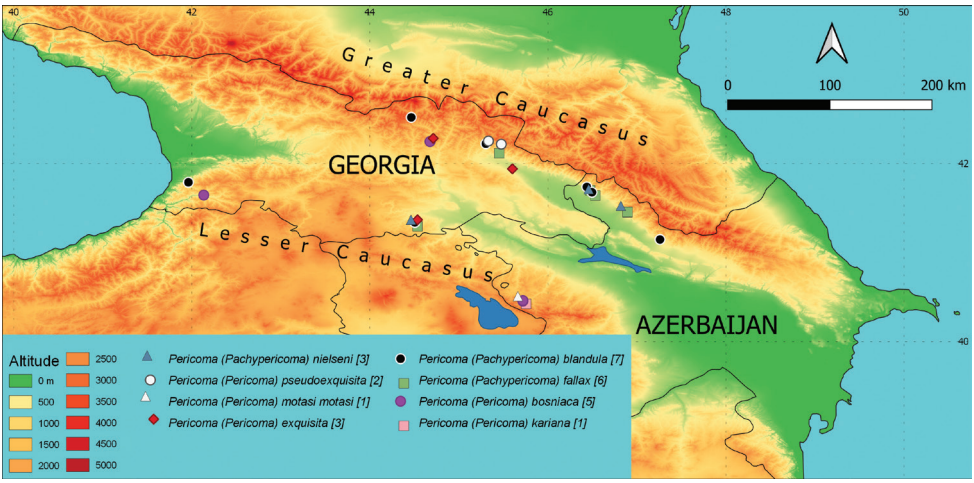

Figure 4. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols the sampling sites with occurrence of the species. When species co-occurred at a locality, an offset is shown in the legend and described in the Materials and methods. The number of sites where the species is present is given in brackets.

Distribution. Not a common European species, known from Czech Republic, Denmark, Finland, France, Norway, Slovakia, and Ukraine (Ježek 2009; Kvifte 2010; Kvifte et al. 2011; Ježek et al. 2017).

Note. It is necessary to reconsider this as a European and Transcaucasian species. First record for Azerbaijan, Georgia, and Transcaucasia.

Pericoma (*Pericoma*) *bosniaca* Krek, 1966

Material examined. Azerbaijan: A 04, 1.10.2019, 1♂, slide Inv. No. 25597, leg. PM; A 05, 1.10.2019, 1♂, slide Inv. No. 25578, leg. PM; A 06, 1.10.2019, 1♂, slide Inv. No. 25574, leg. PM. **Georgia**: G 01, 25.9.2019, 1♂, slide Inv. No. 25601, leg. PM; G 41, 27.4.2019, 2♂♂, slides Inv. No. 25653 and 25654, leg. JO.

Distribution. Species known from Bosnia and Herzegovina, Bulgaria, Montenegro, Serbia, Macedonia, Armenia, and Azerbaijan (Krek 1966, 1967a, 1967b, 1970, 1972, 1974, 1979a, 1999; Krek et al. 1976; Mučibabič et al. 1984; Vaillant 1978; Wagner and Joost 1988; Wagner 1990; Ježek et al. 2018; Oboňa et al. 2019a).

Note. First record for Georgia.

Pericoma (*Pericoma*) *exquisita* Eaton, 1893

Material examined. Georgia: G 17, 30.4.2019, 1♂, slide Inv. No. 25657, leg. JO; G 24, 29.4.2019, 2♂♂, slide Inv. No. 25736 and 25746, leg. JO; G 41, 27.4.2019, 1♂, slide Inv. No. 25652, leg. JO.

Distribution. Species widespread in Europe, North Africa, and Transcaucasia (Armenia, Azerbaijan). In Europe, known from Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Czech Republic, Crete, Croatia, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Macedonia, Montenegro, Poland, Serbia, Slovakia, Slovenia, Spain, and Ukraine (Ježek 2004, 2009; Kvifte et al. 2013; Wagner 2013; Oboňa and Ježek 2014; Ježek et al. 2017; Oboňa et al. 2019a).

Note. First record for Georgia.

Pericoma (*Pericoma*) *kariana* Vaillant, 1978

Material examined. Azerbaijan: A 05, 1.10.2019, 1♂, slide Inv. No. 25577, leg. PM.

Distribution. Species known only from the original description from Greece (Vaillant 1978).

Note. Extremely rare species. First record since the original description, and therefore a first record for Azerbaijan.

Pericoma (*Pericoma*) *motasi motasi* Vaillant, 1978

Material examined. Azerbaijan: A 04, 1.10.2019, 1♂, slide Inv. No. 25596, leg. PM.

Distribution. An extremely rare species known from Bulgaria, Georgia, Greece, Macedonia, Serbia, and Romania (Wagner and Joost 1988; Oboňa et al. 2019a; Ježek et al. 2020).

Note. First record for Azerbaijan.

Pericoma (*Pericoma*) *pseudoexquisita* Tonnoir, 1940

Material examined. Georgia: G 11, 3.5.2019, 1♂, slide Inv. No. 25674, leg. JO; G 16, 2.5.2019, 1♂, slide Inv. No. 25680, leg. JO.

Distribution. Species known from the whole of Europe: Austria, Belgium, Bulgaria, Czech Republic, France, Germany, Greece, Great Britain, Hungary, Ireland, Italy, Slovakia, Slovenia, Spain, and Switzerland (Ježek et al. 2018b; Wagner 2018).

Note. First record for Georgia and Transcaucasia.

Pneumia canescens (Meigen, 1804)

Material examined. Azerbaijan: A 03, 1.10.2019, 1♂, slide Inv. No. 25588, leg. PM. **Georgia**: G 12, 9.7.2019, 1♂, slide Inv. No. 25612, leg. PM, GV.

Distribution. This is a common European and western Siberian species. In Europe it is known from Austria, Belgium, Great Britain, Czech Republic, Denmark, European Turkey, France, Germany, Greece, Hungary, Slovakia, Sweden, and the Netherlands. In

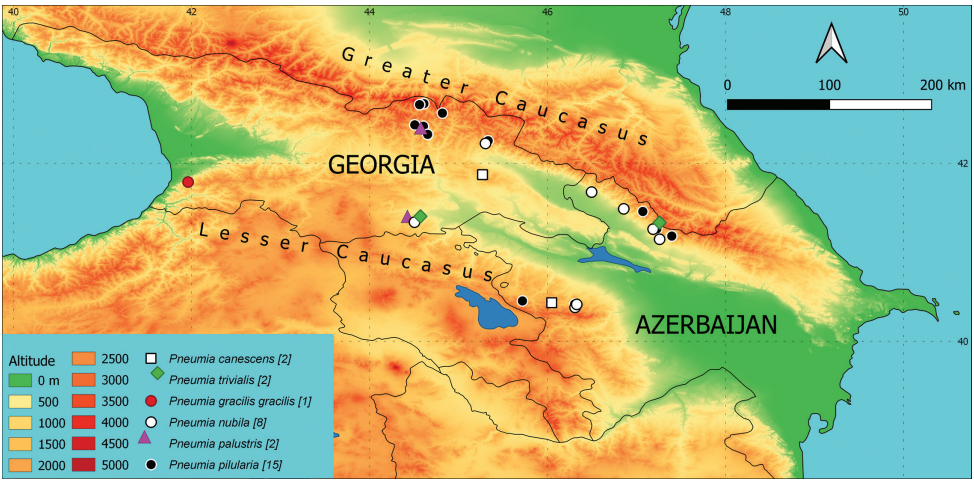

Figure 5. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols the sampling sites with occurrence of the species. When the species co-occurred at the locality, an offset is shown in the legend and described in the Materials and methods. The number of sites where the species is present is given in brackets.

Asia, it is known from Armenia, Turkey, Kyrgyzstan, Afghanistan, and China; it occurs from lowlands to mountains, usually associated with mosses in running water habitats; its larvae are rheobiotic (Ježek 2006; Omelková and Ježek 2012; Ježek et al. 2013, 2018b).

Note. First record for Azerbaijan and Georgia.

Pneumia gracilis gracilis (Eaton, 1893)

Material examined. Georgia: G 02, 24.9.2019, 1♂, slide Inv. No. 25585, leg. TK, PM.

Distribution. The nominal subspecies was recorded from several European countries and is also known from Abkhazia in the Transcaucasia; it lives in forest slope spring areas, brooks, and marshes (Ježek 2002, 2004; Ježek et al. 2012, 2017; Ježek and Omelková 2012; Omelková and Ježek 2012).

Note. First records for Georgia outside of Abkhazia.

Pneumia nubila (Meigen, 1818)

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25659, leg. JO; A 07, 30.9.2019, 1♂, slide Inv. No. 25590, leg. PM; A 08, 30.9.2019, 1♂, slide Inv. No. 25602, leg. PM; A 13, 7.5.2019, 1♂, slide Inv. No. 25741, leg. JO; A 21, 8.5.2019, 1♂, slide Inv. No. 25750, leg. JO; A 23, 6.5.2019, 1♂, slide Inv. No. 25684, leg. JO. **Georgia**: G 09, 2.5.2019, 1♂, slide Inv. No. 25641, leg. JO; G 25, 29.4.2019, 1♂, slide Inv. No. 25712, leg. JO.

Distribution. This is a very common species which is recorded from throughout Europe, Armenia, and the Canary Islands. In Europe, it is known from Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Georgia, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Luxembourg, Macedonia, Montenegro, Poland, Romania, Sardinia, Serbia, Slovakia, Slovenia, Spain, Switzerland, the Netherlands, and Ukraine; abundant especially in shaded habitats with decaying organic matter, e.g., ponds, brooks, spring areas, water reservoirs, and swamps (Wagner 1981; Ježek and Goutner 1995; Krek 1999; Ježek 2002; Omelková and Ježek 2012; Kvifte et al. 2013; Ježek et al. 2017, 2018a).

Note. First record for Azerbaijan.

Pneumia palustris (Meigen, 1804)

Material examined. Georgia: G 24, 29.4.2019, 1♂, slide Inv. No. 25677, leg. JO; G 48, 28.4.2019, 1♂, slide Inv. No. 25646, leg. JO.

Distribution. European species, also registered from Turkey, Georgia, and the Canary Islands (Kroča and Ježek 2019; Oboňa et al. 2019).

Pneumia pilularia (Tonnoir, 1940)

Material examined. Azerbaijan: A 03, 2.10.2019, 1♂, slide Inv. No. 25587, leg. PM; A 04, 1.10.2019, 1♂, slide Inv. No. 25593, leg. PM; A 09, 30.9.2019, 1♂, slide Inv. No. 25582, leg. PM; A 10, 6.5.2019, 2♂♂, slide Inv. No. 25647 and 25675, leg. JO; A 12, 8.5.2019, 1♂, slide Inv. No. 25698, leg. JO; A 20, 5.5.2019, 1♂, slide Inv. No. 25721, leg. JO. **Georgia**: G 16, 2.5.2019, 1♂, slide Inv. No. 25679, leg. JO; G 29, 30.9.2019, 1♂, slide Inv. No. 25600, leg. GV; G 36, 27.4.2019, 1♂, slide Inv. No. 25667, leg. JO; G 39, 9.7.2019, 1♂, slide Inv. No. 25705, leg. PM; G 42, 4.7.2019, 1♂, slide Inv. No. 25620, leg. PM; G 44, 10.7.2019, 1♂, slide Inv. No. 25628, leg. TK, PM, DM; G 45, 10.7.2019, 1♂, slide Inv. No. 25607, leg. TK, PM, DM. JO; G 46, 1.10.2019, 1♂, slide Inv. No. 25608, leg. GV; G 49, 28.4.2019, 1♂, slide Inv. No. 25669, leg. JO; G 50, 28.4.2019, 1♂, slide Inv. No. 25656, leg. JO.

Distribution. European species. Known also from Tajikistan, Azerbaijan, and Georgia (Kroča and Ježek 2019; Oboňa et al. 2019a).

Pneumia trivialis (Eaton, 1893)

Material examined. Azerbaijan: A 21, 8.5.2019, 1♂, slide Inv. No. 25725, leg. JO. **Georgia**: G 24, 29.4.2019, 1♂, slide Inv. No. 25744, leg. JO.

Distribution. A very common European species. Known from Austria, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Finland, France, Ger-

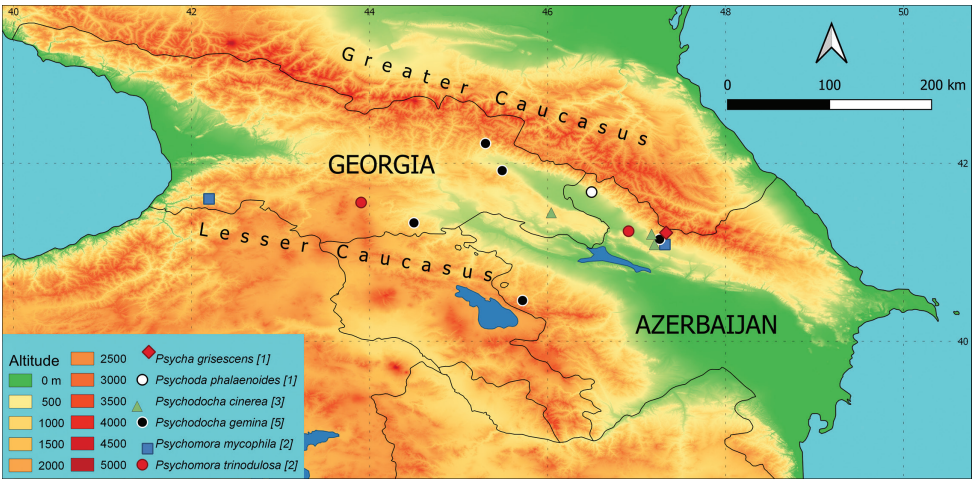

Figure 6. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols the sampling sites with occurrence of species. When species co-occurred at the locality, an offset is shown in the legend and described in the Materials and methods. The number of sites where the species is present is given in brackets.

many, Great Britain, Hungary, Ireland, the Netherlands, Norway, Poland, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, and Ukraine, in both shaded and unshaded habitats with decaying organic matter (ponds, brooks, spring areas, swamps, and water reservoirs) where larvae develop (Krek 1999; Ježek 2002; Kvifte et al. 2011, 2013; Omelková and Ježek 2012; Ježek et al. 2017).

Note. First record for Azerbaijan, Georgia, and Transcaucasia.

Psycha grisescens (Tonnoir, 1922)

Material examined. Azerbaijan: A 23, 6.5.2019, 1♂, slide Inv. No. 25691, leg. JO.

Distribution. Species known throughout Europe, including northern areas (British Isles, Scandinavian bioregion) and Central European countries, penetrating eastwards as far as Turkey (Anatolia) and Azerbaijan; southern frontier of distribution is limited by North Africa (Kroča and Ježek 2019; Oboňa et al. 2019a).

Psychoda phalaenoides (Linné, 1758)

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25666, leg. JO.

Distribution. Widespread Holarctic polyvoltine species occurring from lowlands to mountains; known also from Georgia (e.g., Ježek 1990b; Oboňa and Ježek 2014; Oboňa et al. 2019a).

Note. First record for Azerbaijan.

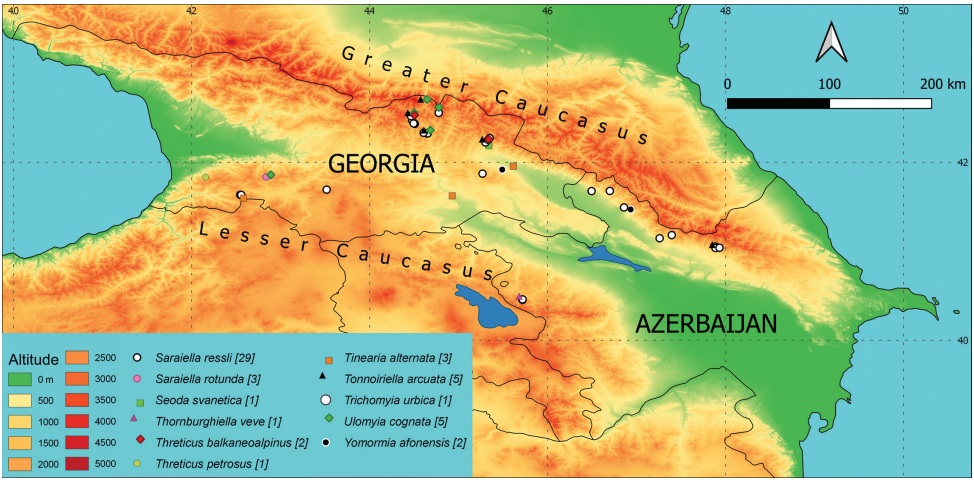

Figure 7. Occurrence of individual species on a map of the area of interest. Different colours (altitude) indicate the elevation in m a.s.l. and different symbols the sampling sites with occurrence of the species. The number of sites where the species is present is given in brackets after the species name. When species co-occurred at the locality, an offset is also shown in the legend and described in the Materials and methods.

Psychodocha cinerea (Banks, 1894)

Material examined. Azerbaijan: A 20, 5.5.2019, 1♂, slide Inv. No. 25722, leg. JO; A 23, 6.5.2019, 2♀♀, slide Inv. No. 25686 and 25694, leg. JO. **Georgia**: G 10, 4.5.2019, 1♀, slide Inv. No. 25711, leg. JO.

Distribution. A very common cosmopolitan species ranging from lowlands to mountains. The larvae are saprobiotic, occasionally associated with fungi; the adults are often found in unclean bathrooms. Known from Austria, Azores, Belgium, Bosnia and Herzegovina, Bulgaria, the Canary Islands, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy (incl. Sardinia), Madeira, the Netherlands, Norway, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, Turkey, Abkhazia, Afghanistan, Africa mer., Algeria, Argentina, Australia, Azores, Brazil, Canada, Chile, Iran, Israel, Juan Fernandéz Islands, New Zealand, Puerto Rico Islands, Tunisia, USA (Krek 1985; Wagner 1990, 2018; Ježek and Goutner 1995; Ježek and Yağci 2005; Kvifte et al. 2011; Salmela et al. 2014; Ježek et al. 2017).

Note. First record for Azerbaijan. First record for Georgia, from a territory other than Abkhazia.

Psychodocha gemina (Eaton, 1904)

Material examined. Azerbaijan: A 05, 1.10.2019, 1♀, slide Inv. No. 25579, leg. PM; A 23, 6.5.2019, 1♀, slide Inv. No. 25685, leg. JO. **Georgia**: G 09, 2.5.2019, 1♀, slide

Inv. No. 25733, leg. JO; G 19, 30.4.2019, 1♀, slide Inv. No. 25651, leg. JO; G 24, 29.4.2019, 1♂, 1♀, slide Inv. No. 25735 and 25748, leg. JO.

Distribution. A common European species, it occurs commonly from lowlands to mountains. The larvae are saprobiotic and often develop in nests of water birds. Recorded from Austria, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Great Britain, Denmark, France, Finland, Germany, Greece, Hungary, Ireland, Norway, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland, the Netherlands, Ukraine, and Georgia: Abkhazia (Ježek and Goutner 1995; Krek 1999; Ježek 2002; Kvifte et al. 2011, 2013; Ježek and Omelková 2012; Salmela et al. 2014; Ježek et al. 2017; Oboňa et al. 2019a).

Note. First record for Azerbaijan.

Psychomora mycophila (Vaillant, 1988)

Material examined. Azerbaijan: A 23, 6.5.2019, 1♂, slide Inv. No. 25690, leg. JO; **Georgia**: G 05, 25.9.2019, 1♂, slide Inv. No. 25589, leg. PM.

Distribution. A rare species associated with fungi, occurs from lowlands to mountains, so far known only from the Czech Republic, France, Slovakia, Slovenia, Switzerland, and Ukraine (Ježek and Omelková 2012; Ježek et al. 2017).

Note. First record for Azerbaijan, Georgia, and Transcaucasia.

Psychomora trinodulosa (Tonnoir, 1922)

Material examined. Azerbaijan: A 19, 7.5.2019, 1♂, slide Inv. No. 25724, leg. JO. **Georgia**: G 22, 15.7.2019, 1♂, slide Inv. No. 25599, leg. TK, DM, GV.

Distribution. A very common Holarctic species. Known from Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Great Britain, the Greek mainland, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Romania, Russia, Sardinia, Slovakia, Slovenia, the Spanish mainland, Sweden, Ukraine, Georgia, Algeria, and USA (Ježek 1990c; Wagner 2013; Salmela et al. 2014; Ježek et al. 2017; Oboňa et al. 2019a).

Note. First record for Azerbaijan. It is a vector of larval stages of *Rhabditis* nematodes and Gamasidae mites (Ježek and Omelková 2012).

Saraiella ressli Wagner, 1981

S. ressli montana Ježek, 1990, syn. nov.

Material examined. Azerbaijan: A 02, 9.5.2019, 1♂, slide Inv. No. 25660, leg. JO; A 04, 1.10.2019, 1♂, slide Inv. No. 25595, leg. PM; A 05, 1.10.2019, 1♂, slide Inv.

No. 25576, leg. PM; A 06, 1.10.2019, slide Inv. No. 25573, 1♂, leg. JJ, PM; A 10, 6.5.2019, 2♂♂, slide Inv. No. 25676 and 25648, leg. JO; A 14, 7.5.2019, 1♂, slide Inv. No. 25737, leg. JO; A 16, 10.5.2019, 1♂, slide Inv. No. 25643, leg. JO; A 17, 10.5.2019, 1♂, slide Inv. No. 25700, leg. JO; A 18, 10.5.2019, 1♂, slide Inv. No. 25645, leg. JO; A 23, 6.5.2019, 1♂, slide Inv. No. 25692, leg. JO; A 24, 9.5.2019, 1♂, slide Inv. No. 25703, leg. JO. **Georgia**: G 03, 27.9.2019, 1♂, slide Inv. No. 25606, leg. PM; G 04, 27.9.2019, 1♂, slide Inv. No. 25592, leg. PM; G 09, 2.5.2019, 2♂♂, slides Inv. No. 25640, 25726, leg. JO; G 12, 9.7.2019, 1♂, slide Inv. No. 25614, leg. PM, GV; G 14, 2.5.2019, 1♂, slide Inv. No. 25658, leg. JO; G 15, 2.5.2019, 2♂♂, slides Inv. No. 25673, 25702 leg. JO; G 16, 28.9.2019, 1♂, slide Inv. No. 25586, leg. GV; G 31, 27.4.2019, 1♂, slide Inv. No. 25697, leg. JO; G 37, 2.10.2019, 1♂, slide Inv. No. 25701, leg. PM; G 38, 27.4.2019, 1♂, slide Inv. No. 25704, leg. JO; G 40, 13.7.2019, 1♂, slide Inv. No. 25632, leg.TK, PM, DM, GV; G 47; 9.7.2019, 1♂, slide Inv. No. 25636, leg. TK, PM, DM, GV; G 49, 28.4.2019, 1♂, slide Inv. No. 25668, leg. JO; G 50, 28.4.2019, 1♂, slide Inv. No. 25655, leg. JO; G 51, 28.4.2019, 1♂, slide Inv. No. 25699, leg. JO; G 52, 11.7.2019, 1♂, slide Inv. No. 25618, leg. TK, PM, DM, GV; G 53, 9.7.2019, 1♂, slide Inv. No. 25623, leg. TK, PM, DM, GV; G 54, 27.4.2019, 1♂, slide Inv. No. 25672, leg. JO; G 55, 29.9.2019, 1♂, slide Inv. No. 25580, leg. PM.

Distribution. Species known from Iran, Armenia, Azerbaijan, and Russia (Wagner and Joost 1983; Ježek et al. 2018). First record for Georgia.

Note. *Saraiella ressli* Wagner, 1981, was described only on the basis of a holotype from the environment of the Caspian Sea (northern Iran, Veyshar nr. Nowshahr env. Chalus – Mazandaran, 1400 m a.s.l.). *Saraiella ressli montana* Ježek, 1990, was described from S. E. Iran, Kerman province, Kuh-e-Lalehzar, 3850–4374 m a.s.l. with top 4374 m (holotype and two paratypes), and additionally two paratypes from E. Iran, Kerman province, Deh Bakri, Kuh-e Jebal Barez (Jebal Barez Mts). The numerous materials from Caucasus (males) cited above proved a large variability of specimens (last three flagellomeres almost globular or long-oval, terminal flagellomere with small apiculus or without a protuberance, coxopodites basally with or without several bristles, gonostylus with a small subapical tooth terminally or not; all characters are mixed on the same localities). The subspecific rank is therefore groundless and *S. ressli montana* Ježek, 1990 is thus sunk as a synonym herein.

Saraiella rotunda (Krek, 1970)

Material examined. Azerbaijan: A 04, 1.10.2019, 1♂, slide Inv. No. 25594, leg. PM, A 06, 1.10.2019, 1♂, slide Inv. No. 25572, leg. PM. **Georgia**: G 07, 17.7.2019, 1♂, slide Inv. No. 25591, leg. GV.

Distribution. European species, known from Bosnia and Herzegovina, Czech Republic, Italy, Poland, Serbia, and Slovakia (Ježek 2006; Oboňa et al. 2019b). Occurs in spring areas and swamps, forest edge in Slovakia (High Tatras Mts.) (Ježek 2006).

Note. First record for Azerbaijan, Georgia, and Transcaucasia.

Seoda svanetica (Ježek, 1988)

Material examined. Georgia: G 09, 2.5.2019, 1♂, slide Inv. No. 25729, leg. JO.

Distribution. Species known only from the original paper from Abkhazia, where only one specimen was collected on the bank of a stream in 2000 m a.s.l. (Ježek 1988 as *Telmatoscopus*).

Note. First record since the original description. First record for Georgia, a territory other than Abkhazia. An extremely rare species known from only two sites in Greater Caucasus.

Thornburghiella veve Oboňa & Ježek, 2017

Material examined. Azerbaijan: A 05, 1.10.2019, 1♂, slide Inv. No. 25575, leg. PM.

Distribution. Species known only from the original paper from Armenia (Oboňa et al. 2017).

Note. First record since the original description, first record for Azerbaijan. An extremely rare species known from only two sites in the Lesser Caucasus at elevations higher than 1000 m.

Threticus balkaneoalpinus Krek, 1972

Material examined. Georgia: G 09, 2.5.2019, 1♂, slide Inv. No. 25728, leg. JO; G 30, 13.7.2019, 1♂, slide Inv. No. 25611, leg. TK, PM, DM, GV.

Distribution. Species known from Austria, Bosnia, Czech Republic, France, Germany, Kosovo, Poland, Slovakia, Switzerland, and the United Kingdom as well as Abkhazia (Krek 1990; Ježek 1995; Withers 1997; Ježek and Omelková 2007; Oboňa and Ježek 2014; Oboňa et al. 2019b).

Note. First record for Georgia, territory other than Abkhazia.

Threticus petrosus Ježek, 1997

Material examined. Georgia: G 06, 24.9.2019, 1♂, slide Inv. No. 25598, leg. GV.

Distribution. Known only from the original paper from Abkhazia (Ježek 1997; Bzybskij khrebet, pastoral community Kot-Kot nr. peak Khimsa (3033 m a.s.l.) – holotype + 9 paratypes (males)).

Note. First record since the original description. First record for Georgia, from a territory other than Abkhazia. An extremely rare species known from only two sites at a distance ca. 20–30 km from the Black Sea coast at elevations of ca. 2000 and 2600 m.

***Tinearia alternata* (Say, 1824)**

Material examined. Georgia: G 03, 27.9.2019, 1♀, slide Inv. No. 25603, leg. PM; G 08, 1.5.2019, 1♀, slide Inv. No. 25683, leg. JO; g 56, 26.4.2019, 1♀, slide Inv. No. 25682, leg. JO.

Distribution. Cosmopolitan and euryvalent species (Kroča and Ježek 2019).

***Tonnoiriella arcuata* Ježek, 1997**

Material examined. Azerbaijan: A 17, 10.5.2019, 2♂♂, slide Inv. No. 25718 and 25719, leg. JO. **Georgia**: G 09, 2.5.2019, 1♂, slide Inv. No. 25730, leg. JO; G 40, 13.7.2019, 1♂, slide Inv. No. 25635, leg. TK, PM, DM, GV; G 42, 4.7.2019, 1♂, slide Inv. No. 25622, leg. PM; G 47, 9.7.2019, 1♂, slide Inv. No. 25637, leg. TK, PM, DM, GV.

Distribution. Species known only from the original paper from Abkhazia (Ježek 1997; Pskhu), holotype + 6 paratypes (males).

Note. First record since the original description, first record for Azerbaijan. Occurs at a wide range of elevations (810–3050 m a.s.l.) at small forest or bushy streams, springs, and side brooks of the Greater Caucasus.

***Ulomyia cognata* (Eaton, 1893)**

Material examined. Georgia: G 27, 17.7.2019, 1♂, slide Inv. No. 25570, leg. GV; G 33, 5.7.2019, 1♂, slide Inv. No. 25629, leg. PM, GV; G 40, 13.7.2019, 1♂, slide Inv. No. 25631, leg. TK, PM, DM, GV; G 42, 4.7.2019, 2♂♂, slide Inv. No. 25619 and 25621, leg. PM; G 47, 9.7.2019, 1♂, slide Inv. No. 25639, leg. TK, PM, DM, GV.

Distribution. This is a common European species known from Austria, Czech Republic, Finland, France, Germany, Great Britain, Italy, Lithuania, Poland, Slovakia, Slovenia, Ukraine, and Armenia (Ježek and Omelková 2012; Salmela et al. 2014; Ježek et al. 2017, 2018a).

Note. First record for Georgia. In Europe, a very common species from lowlands to mountains, but in Georgia it has been found only in mountain localities at an elevation of 2050 to 3050 m a.s.l.

***Yomormia afonensis* Ježek, 1987**

Material examined. Azerbaijan: A 15, 8.5.2019, 1♂, slide Inv. No. 25706, leg. JO. **Georgia**: G 19, 30.4.2019, 1♂, slide Inv. No. 25650, leg. JO.

Distribution. Species known only from the original paper from Abkhazia (Ježek 1987; only on the basis of a holotype (male) from Kolchidian lowland (Novyj Afon) at the Black Sea coast).

Note. First records since the original description, first record for Azerbaijan and Georgia, from a territory other than Abkhazia. An extremely rare species known from only three considerably remote localities in lowland and foothills of the Greater Caucasus (recent records at 655 and 845 m a.s.l.).

Discussion

Although faunistic research of the family Psychodidae has been the subject of a number of authors (see the Introduction for references) and a large number of sites were examined in our recent studies (Ježek et al. 2014, 2018; Oboňa et al. 2017, 2019a), each of our subsequent expeditions has highlighted species new for science and a number of new records for the Caucasus (or Transcaucasia) or for countries where we carried out the sampling. This study is no exception, and in addition to species new to science (Ježek et al. 2021), we provide faunistic data on 46 species of the family Psychodidae in this publication, up to 12 of which are first records for Transcaucasia, 22 for Azerbaijan, and 17 for Georgia. A total of 80 sampling sites was sampled during the 2019 campaign (24 in Azerbaijan and 56 in Georgia). Therefore, this is another significant shift in the knowledge of the faunistics of this family, but also in regard to the biogeographical and ecological aspects of several recorded species.

One of our most interesting results is that we confirmed several species that were described from the Abkhazia region, and no one has been able to confirm them anywhere else until this study was carried out, despite several sampling campaigns. These are species that are extremely rare or relatively common in Abkhazia. Extremely rare was *Seoda svanetica* (Ježek 1988), of which we recorded only other one male. Other extremely rare species known only from Abkhazia until now are *Threticus petrosus* Ježek, 1997, now known from only two sites, and *Yomormia afonensis* Ježek, 1987, which has been found at only three localities. The species *Tonnoiriella arcuata* Ježek, 1997, was also very rare in Abkhazia, but we found this species at five other sites located at a large range of elevations in the Greater Caucasus. Other species were not considered rare in Abkhazia, for example *Sycorax caucasica* Ježek, 1990, *Mormia ckvitariorum* Ježek, 1987, and *Seoda svanetica* (Ježek, 1988), but we found them at only one site and only one (*S. caucasica*, *S. svanetica*) to three (*M. ckvitariorum*) males. This could be caused by the great rarity of these species in other parts of Transcaucasia or in the change that the fauna has undergone under the influence of various factors during the 30 years that divide the records from Abkhazia and our recent ones. However, these assumptions are based on the results obtained using the collection methods described above. Therefore, in order to answer this question definitively, it is necessary to carry out research using more appropriate collection methods and corresponding statistical analyses.

Figure 8. The collecting site with the highest species richness in Azerbaijan (A 23), a karst brook in deciduous forest in the Şəki district, Şəki, Quirxbulaq, with seven species collected; general view (left) and different habitats (top right and bottom right which also include colleagues Libor Dvořák (left) and Ľuboš Hrivniak (right) collecting insects during a joint sampling campaign); photograph P. Manko.

Based on our new data, knowledge of some aspects of the ecology and biogeography of selected (especially rare) species has also expanded. Our records point out that several rare species show different patterns related to elevation: *Clytocerus* (*Boreoclytocerus*) *grusinicus* and *Tonnoiriella arcuata* occur at large range of elevations, *Mormia ckvitariorum* and *Yomormia afonensis* prefer low elevations in lowlands and low foothills, *Thornburghiella veve* elevations higher than 1000 m, and *Threticus petrosus* sites at elevations higher than 2000 m relatively close to the Black Sea coast. Several species considered as European (or rare European) occur at numerous localities in the Transcaucasia and should be reconsidered as European and Transcaucasian species (*Promormia silesiensis*, *Panimerus denticulatus*, *Pericoma* (*Pachypericoma*) *nielseni*).

Although we usually found only one to three species in most sites located in cultivated and managed areas, mosaic croplands and mostly open areas with dominant herbaceous cover, the species number was quite high at other sampling sites. The highest species richness was recorded at sites A 23 (Fig. 8) and G 09 (Fig. 9), which are located at relatively low elevations along watercourses flowing through preserved deciduous forests (G 09 in Nature Reserve) and characterized by a high diversity of habitats. Also, most of the other sampling sites with high diversity are located in forests (e.g., A 02, G 09, G 40) or rich lush shrub vegetation (e.g., A 05). It is also interesting that many of the first records and records of rare species were obtained from the above-mentioned (close to) natural sites with highest species richness (A 02 with seven spp, and A 23 and G 09 with nine spp each).

Figure 9. The collecting site with the highest species richness in Georgia (G 09), Batsara River and its side brook, Kakheti region, Batsara Nature Reserve, with nine species collected; photograph P. Manko.

Conclusions

Out of the total number of 46 species/subspecies (Sycoracinae 1 sp., Trichomyiinae 1 sp. Psychodinae 44 sp.) and 182 slides, 12 species are recorded for the first time for Transcaucasia (namely *Copropsychoda brevicornis*, *Feuerborniella obscura*, *Logima sigma*, *L. zetterstedti*, *Panimerus denticulatus*, *Pericoma* (*Pachypericoma*) *nielseni*, *P.* (*Pericoma*) *pseudoexquisita*, *Pneumia trivialis*, *Promormia silesiensis*, *Psychomora mycophila*, *Saraiella rotunda*, *Trichomyia urbica*), 22 species for Azerbaijan (namely *Clytocerus* (*Boreoclytocerus*) *grusinicus*, *Logima sigma*, *Mormia ckvitariorum*, *Panimerus denticulatus*, *Pericoma* (*Pachypericoma*) *nielseni*, *Pericoma* (*Pericoma*.) *kariana*, *P.* (*P.*) *motasi motasi*, *Pneumia canescens*, *P. nubila*, *P. trivialis*, *Promormia silesiensis*, *Psychoda phalaenoides*, *Psychodocha cinerea*, *P. gemina*, *Psychomora mycophila*, *P. trinodulosa*, *Saraiella ressli*, *S. rotunda*, *Thornburghiella veve*, *Tonnoiriella arcuata*, *Trichomyia urbica*, *Yomormia afonensis*), 17 species for Georgia (*Copropsychoda brevicornis*, *Feuerborniella obscura*, *Logima albipennis*, *L. zetterstedti*, *Panimerus denticulatus*, *Parabazarella joosti lalehzarica*, *Paramormia* (*Duckhousiella*) *ustulata*, *Pericoma* (*Pachypericoma*) *nielseni*, *Pericoma* (*Pericoma*) *bosniaca*, *P.* (*P.*) *exquisita*, *P.* (*P.*) *pseudoexquisita*, *Pneumia canescens*, *P. trivialis*, *Psychomora mycophila*, *Saraiella ressli*, *S. rotunda*, *Ulomyia cognata*), and nine

species for the first time since their original descriptions (*Clytocerus* (*Boreoclytocerus*) *grusinicus*, *Mormia ckvitariorum*, *Parabazarella joosti lalehzarica*, *Pericoma* (*P.*) *kariana*, *Sycorax caucasica*, *Thornburghiella veve*, *Threticus petrosus*, *Tonnoiriella arcuata*, *Yomormia afonensis*). The knowledge of some aspects of ecology and biogeography of selected (especially rare) species has been expanded and a clear pattern was found in species richness, rare species, and new records in relation to land use, habitat diversity and preservation of the environment surrounding the sampling sites.

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Supplementary material 1

Table S1. List of localities with altitudes and coordinates

Authors: Jan Ježek, Peter Manko, Jozef Oboňa

Data type: occurrence

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Clarification on the name-bearing type designation of several cyclophorid species (Mollusca, Gastropoda) by H. H. Godwin-Austen (1915)

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Abstract

The type series boundary and the name-bearing type designation of each cyclophorid taxon originally described by Godwin-Austen are clarified based on an interpretation that complies with the ICZN. Previous statuses of type specimens designated by previous authors are reconsidered. Lectotypes of *Spiraculum oakesi* Godwin-Austen, 1915, *Spiraculum kempi* Godwin-Austen, 1915, *Pterocyclos aborensis* Godwin-Austen, 1915, *Pterocyclos miriensis* Godwin-Austen, 1915, *Pterocyclos brahmakundensis* Godwin-Austen, 1915, *Spiraculum luyorensis* Godwin-Austen, 1915, *Spiraculum putaoensis* Godwin-Austen, 1915, and *Theobaldius oakesi* Godwin-Austen, 1915 are here designated to stabilize the existing nomenclature. In addition, the type specimens of *Pterocyclos miriensis* and *Theobaldius oakesi* are photographed and figured for the first time.

Keywords

Cyclophoridae, hypodigm, ICZN, NHM, nomenclature, NZSI, onomatophore

Introduction

The phylogenetic analyses of the operculated land snail genus *Cyclophorus* (Caenogastropoda: Cyclophoridae) from Thailand uncovered a high degree of intra- and interspecific morphological variation and a wide distribution of the genus (Nantarat et al. 2014b, c; 2019). Southeast Asia, including Thailand, also hosts a high diversity of related cyclophorid genera, such as *Pterocyclos* Benson, 1832, *Spiraculum* Pearson, 1833 (= *Pearsonia* Kobelt, 1902), and *Rhiostoma* Benson, 1860, in which the members of each genus are conchologically very similar (BEDO 2017; Sutcharit et al. 2018), and for which precise species identification is not possible without direct comparison with the type specimens.

The Natural History Museum in London (hereafter the NHM) holds the type specimens of 42 nominal *Cyclophorus* species (Nantarat et al. 2014a), which is approximately a quarter of all currently recognized species (Kobelt 1902, 1908). The type specimens of 95 nominal species in six other cyclophorid genera, namely *Crossopoma* Martens, 1891, *Cyclotus* Swainson, 1840, *Myxostoma* Troschel, 1847, *Pterocyclos*, *Scabrina* Blanford, 1863, *Spiraculum*, and *Rhiostoma* are also housed in the NHM (Sutcharit et al. 2019), and constitute about half of all currently known nominal species of these genera (Kobelt 1902). These type specimens have already been catalogued and illustrated, and in certain cases lectotypes were designated in accordance with the International Code of Zoological Nomenclature (ICZN 1999) to stabilize the usage of each nominal name (Nantarat et al. 2014a; Sutcharit et al. 2019).

Of the type specimens housed in the NHM, the cyclophorid taxa originally described in the "Zoological Results of the Abor Expedition" by Godwin-Austen (1915) require special consideration as the original descriptions contain the explicit designation of "Type" and specimen lot numbers (which correspond to the NHMUK registration numbers; note: NHM is the institutional acronym, whilst NHMUK is the registration number prefix of samples kept at the NHM). This way of type designation was not applied in the other works of Godwin-Austen in the same series (Godwin-Austen 1914b, 1916, 1917, 1918a, b). In contrast, the type lot numbers were explicitly designated in the original descriptions of some taxa in other monographs by Godwin-Austen (1910, 1914a, 1920). Consequently, the interpretation of Godwin-Austen's type series boundaries and the designation of the name-bearing type(s) is often contentious (Nantarat et al. 2014a; Sajan et al. 2019).

In this article, we review the type status of all cyclophorid taxa originally described by Godwin-Austen (1915). Some lectotype designations by Nantarat et al. (2014a) and Sutcharit et al. (2019) and the type status of *Cyclophorus koboensis* as recognized by Sajan et al. (2019) are reconsidered as we clarify the boundaries of the type series and the name-bearing type designation of each taxon.

The problem with the name-bearing type designations in Godwin-Austen (1915)

When Godwin-Austen (1915) introduced new taxa, he explicitly placed the word "Type" in the beginning of the first paragraph below the shell description and dimen-

sions (hereafter regarded as the "Type" paragraph), and this was followed by the specimen lot number belonging to either "Ind. Mus.", currently The National Zoological Collection of the Zoological Survey of India (hereafter the NZSI), or "B.M." referring to the 'British Museum (Natural History)' as it was then known (currently the NHM). However, the original descriptions of some taxa contained more than one specimen lot number, either separated by a semicolon in the same paragraph or appearing in subsequent paragraphs. In addition, for some taxa Godwin-Austen (1915) provided figures of more than one specimen from different specimen lots, but associated the word "Type" in the plate caption to the figures of one specimen only. Therefore, to clarify the name-bearing type designation by Godwin-Austen (1915), it is necessary to answer the following two questions, with verbatim applicable definitions and articles from the fourth edition of the ICZN online version (ICZN 1999) provided in italics:

1) Which specimens constitute the type series as recognized by Godwin-Austen (1915)?

Article 72.4.1. The type series of a nominal species-group taxon consists of all the specimens included by the author in the new nominal taxon (whether directly or by bibliographic reference), except any that the author expressly excludes from the type series [Art. 72.4.6], or refers to as distinct variants (e.g. by name, letter or number), or doubtfully attributes to the taxon.

Article 72.4.1.1. For a nominal species or subspecies established before 2000, any evidence, published or unpublished, may be taken into account to determine what specimens constitute the type series.

Article 72.4.6. If an author when establishing a nominal species-group taxon nominates either "syntypes" (by that term, or by use of one of the terms "cotypes" or "types" alone), or "holotype and paratypes" used together (or by use of the term "type" together with "allotype" or "cotypes"), and also lists other specimens, the separate mention of the latter expressly excludes them from the type series.

Article 72.4.7. The mere citation of "Type" or equivalent expression, in a published work other than that in which the nominal species-group taxon is established, or in an unpublished catalogue of a museum, or on a label, is not necessarily evidence that a specimen is or is fixed as any of the kinds of types referred to in this Chapter.

Article 73.2. Syntypes are specimens of a type series that collectively constitute the name-bearing type. They may have been expressly designated as syntypes (see Article 73.2.1 for acceptable terms); for a nominal species-group taxon established before 2000 [Art. 72.3] all the specimens of the type series are automatically syntypes if neither a holotype [Art. 72.1] nor a lectotype [Art. 74] has been fixed. When a nominal species-group taxon has syntypes, all have equal status in nomenclature as components of the name-bearing type.

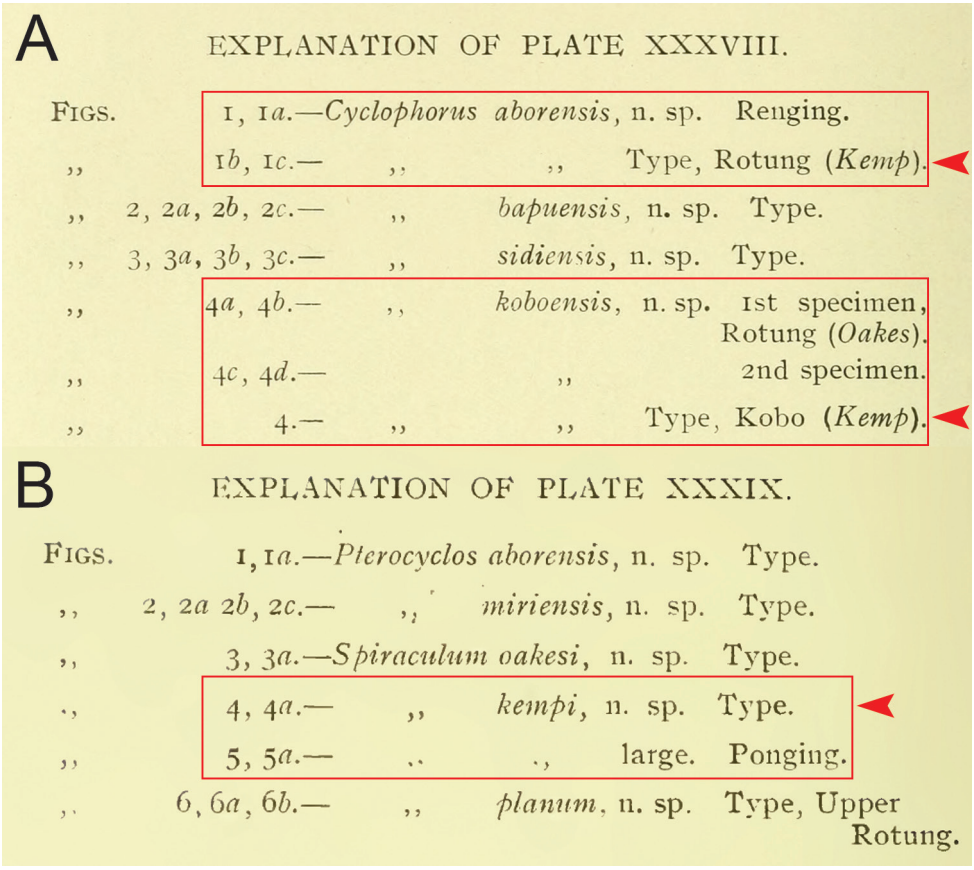
Godwin-Austen (1915) did not explicitly indicate which specimens were included or excluded from the type series, as he did not use terms such as "syntypes", "cotypes", "types", "type and cotypes" or "holotype and paratypes", while he did refer to other specimens, so that the actual type series cannot be unequivocally delimited using Art.

72.4.6. Therefore, based on Art. 72.4.1., the type series of each taxon recognized by Godwin-Austen (1915) should consist of all specimen lots mentioned in the original description, except any that the author referred to as distinct variants.

According to Art. 72.4.1.1, additional evidence found within or outside the original descriptions, either published or unpublished, may be considered when determining which specimens constitute a type series. Yet, if we do so for the type material of Godwin-Austen (1915), then we are confronted with the following situation. On the one hand, for taxa of which more than one specimen from multiple specimen lots were illustrated, each specimen which was marked as "Type" in the plate captions (Fig. 1) always belongs to the first lot in the "Type" paragraph (Figs 2, 3) and this first specimen lot was always labelled as "Type" in Godwin-Austen's handwriting (Figs 4A, 5A and Sajan et al. 2019: fig. 1h). On the other hand, specimens from other specimen lots, either in the text delimited from the first lot by a semi-colon or mentioned in subsequent paragraphs, are never marked as "Type" in the plate captions (Fig. 1) or elsewhere in the text. Likewise, these other specimen lots were never labelled as "Type" (Fig. 5B, C), although they may be marked as "Co-Type", "Typic", or "Typical" in Godwin-Austen's handwriting (Figs 4B, 6). According to Art. 72.4.7., the mere citation of "Type" or its equivalent expression on a label does not by itself indicate that those specimens are fixed as any of the kinds of types. In addition, the labels "Typic" and "Typical" did not always relate to type material in the current sense of the word (see Raheem et al. 2014). Therefore, one can argue to restrict the type series of Godwin-Austen's (1915) taxa to the first and only specimen lot in the "Type" paragraph.

These two possible interpretations of the type series are rooted in the ambiguous usage of the "type" terminology in the 19th century. The term "type" had been given three operational functions by Simpson (1940) as: "(a) a sample from which the characters of a group of individuals or a population are estimated, (b) a standard of comparison between samples, or (c) name-bearers" (Melville 1970). The first two are taxonomic functions of type, while the third one is the nomenclatural function (Dubois 2005). As such, Simpson (1940) introduced the term "hypodigm" for the first two taxonomic functions, meaning "all the specimens used by the author of a species as his basis for inference, and this should mean all the specimens that he referred to the species, constitute his hypodigm of that species". For the third function of "types", i.e., as name-bearers, several terms were proposed, two of which, "onomatophore" (Simpson 1940) and "nomenifer" (Schopf 1960), have been more frequently adopted (e.g., Dubois 2005; Sluys 2021). Here we will use the term "onomatophore" to refer to the name-bearer simply because this term was introduced first.

The ICZN regulates the nomenclatural rules but is not involved in "restricting the freedom of taxonomic thought or actions" (ICZN 1999). Hence, the ICZN is supposed to only deal with rules regulating onomatophores, not with rules that regulate the function of "types" as "hypodigm". However, in Art. 72.4.1. the definition of the type series is identical to that of Simpson's (1940) hypodigm. Consequently, according to Art. 73.2., for all taxa originally described before 2000 and for which neither a holotype, nor a lectotype has been fixed, the Code automatically equates the original hypodigm (= all specimens in the type series) with onomatophores (= syntypes). So,



A

EXPLANATION OF PLATE XXXVIII.

FIGS. 1, 1a.—*Cyclophorus aborensis*, n. sp. Renging.
,, 1b, 1c.— ,, ,, Type, Rotung (*Kemp*).
,, 2, 2a, 2b, 2c.— ,, *bapuensis*, n. sp. Type.
,, 3, 3a, 3b, 3c.— ,, *sidiensis*, n. sp. Type.
,, 4a, 4b.— ,, *koboensis*, n. sp. 1st specimen, Rotung (*Oakes*).
,, 4c, 4d.— ,, 2nd specimen.
,, 4.— ,, ,, Type, Kobo (*Kemp*).

B

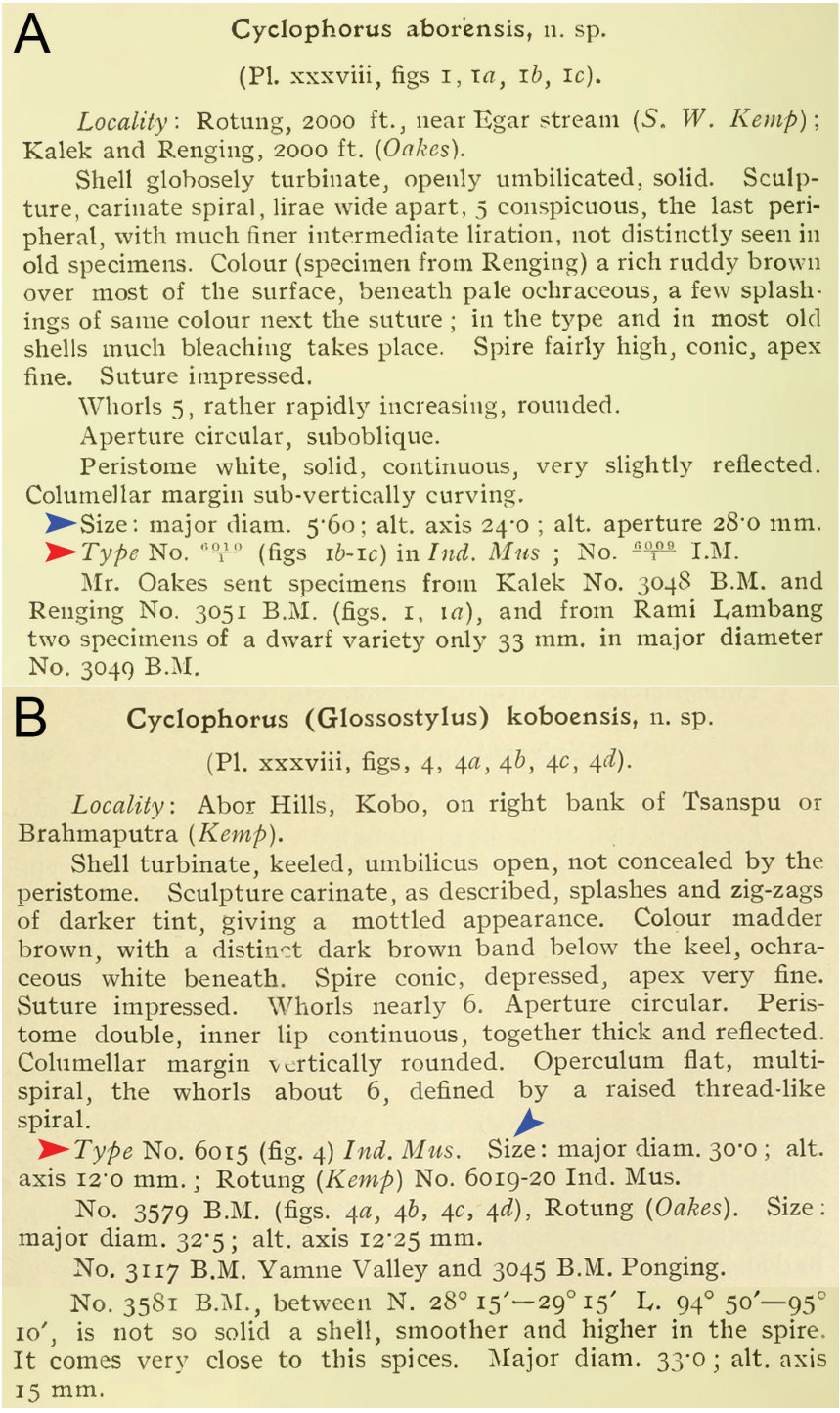
EXPLANATION OF PLATE XXXIX.

FIGS. 1, 1a.—*Pterocyclos aborensis*, n. sp. Type.
,, 2, 2a 2b, 2c.— ,, *miriensis*, n. sp. Type.
,, 3, 3a.—*Spiraculum oakesi*, n. sp. Type.
,, 4, 4a.— ,, *kempi*, n. sp. Type.
,, 5, 5a.— ,, ,, large. Ponging.
,, 6, 6a, 6b.— ,, *planum*, n. sp. Type, Upper Rotung.

Figure 1. Figure caption with no page number of some cyclophorid taxa originally described by Godwin-Austen (1915) in **A** plate 38 and **B** plate 39. Red boxes indicate the figure caption of the same taxa. Red arrows indicate the annotation of "Type". Credit: The Biodiversity Heritage Library.

the application of this article is problematic because the word "type" in the term "type series" does not have the same function as in the term "name-bearing type", as was recognized earlier (Melville 1970). This misunderstanding that the name-bearing type possesses taxonomic functions, in being "a typical example, a prototype, or an archetype of the species to which it belongs and to which it affixes a name" still prevails to this day (Sluys 2021). See Witteveen (2016) for more details on the development of the type concept in both taxonomic and nomenclatural functions.

The problem of defining Godwin-Austen's (1915) type series arises because we posit that Godwin-Austen (1915) assigned specimens to the original hypodigm and onomatophores differently. The type series, as defined by Art. 72.4.1., corresponds well to the hypodigm concept. Accordingly, Godwin-Austen (1915) in establishing the original hypodigm applied the terms "Typic" or "Typical" on the label of some specimen lots mentioned in the original description. However, the term "Type" in the sense of onomatophore, as recognized by Godwin-Austen (1915), cannot apply to all specimens in the type series because accepting all specimens in the type series as types



A

Cyclophorus aborensis, n. sp.

(Pl. xxxviii, figs 1, 1*a*, 1*b*, 1*c*).

Locality: Rotung, 2000 ft., near Egar stream (*S. W. Kemp*); Kalek and Renging, 2000 ft. (*Oakes*).

Shell globosely turbinate, openly umbilicated, solid. Sculpture, carinate spiral, lirae wide apart, 5 conspicuous, the last peripheral, with much finer intermediate liration, not distinctly seen in old specimens. Colour (specimen from Renging) a rich ruddy brown over most of the surface, beneath pale ochraceous, a few splashings of same colour next the suture; in the type and in most old shells much bleaching takes place. Spire fairly high, conic, apex fine. Suture impressed.

Whorls 5, rather rapidly increasing, rounded.

Aperture circular, suboblique.

Peristome white, solid, continuous, very slightly reflected. Columellar margin sub-vertically curving.

Size: major diam. 5·60; alt. axis 24·0; alt. aperture 28·0 mm.

Type No. $\frac{6010}{1}$ (figs 1*b*-1*c*) in *Ind. Mus*; No. $\frac{6009}{1}$ I.M.

Mr. Oakes sent specimens from Kalek No. 3048 B.M. and Renging No. 3051 B.M. (figs. 1, 1*a*), and from Rami Lambang two specimens of a dwarf variety only 33 mm. in major diameter No. 3049 B.M.

B

Cyclophorus (Glossostylus) koboensis, n. sp.

(Pl. xxxviii, figs, 4, 4*a*, 4*b*, 4*c*, 4*d*).

Locality: Abor Hills, Kobo, on right bank of Tsanspu or Brahmaputra (*Kemp*).

Shell turbinate, keeled, umbilicus open, not concealed by the peristome. Sculpture carinate, as described, splashes and zig-zags of darker tint, giving a mottled appearance. Colour madder brown, with a distinct dark brown band below the keel, ochraceous white beneath. Spire conic, depressed, apex very fine. Suture impressed. Whorls nearly 6. Aperture circular. Peristome double, inner lip continuous, together thick and reflected. Columellar margin vertically rounded. Operculum flat, multispiral, the whorls about 6, defined by a raised thread-like spiral.

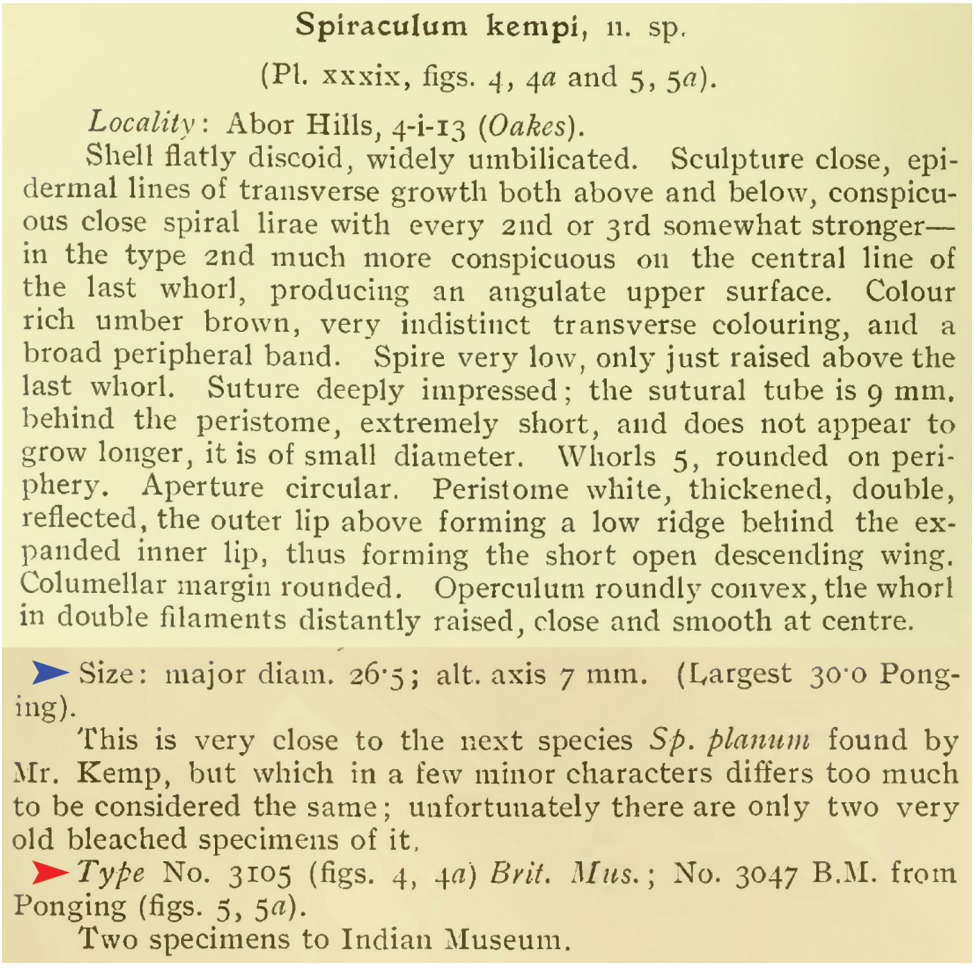
Type No. 6015 (fig. 4) *Ind. Mus.* Size: major diam. 30·0; alt. axis 12·0 mm.; Rotung (*Kemp*) No. 6019-20 Ind. Mus.

No. 3579 B.M. (figs. 4*a*, 4*b*, 4*c*, 4*d*), Rotung (*Oakes*). Size: major diam. 32·5; alt. axis 12·25 mm.

No. 3117 B.M. Yamne Valley and 3045 B.M. Ponging.

No. 3581 B.M., between N. 28° 15′—29° 15′ L. 94° 50′—95° 10′, is not so solid a shell, smoother and higher in the spire. It comes very close to this spices. Major diam. 33·0; alt. axis 15 mm.

Figure 2. Original descriptions of **A** *Cyclophorus aborensis* and **B** *Cyclophorus* (*Glossostylus*) *koboensis* from Godwin-Austen (1915). Red arrows indicate the annotation of "Type". Blue arrows indicate the set of measurements. Credit: The Biodiversity Heritage Library.



Spiraculum kempi, n. sp.

(Pl. xxxix, figs. 4, 4*a* and 5, 5*a*).

Locality: Abor Hills, 4-i-13 (*Oakes*).

Shell flatly discoid, widely umbilicated. Sculpture close, epidermal lines of transverse growth both above and below, conspicuous close spiral lirae with every 2nd or 3rd somewhat stronger—in the type 2nd much more conspicuous on the central line of the last whorl, producing an angulate upper surface. Colour rich umber brown, very indistinct transverse colouring, and a broad peripheral band. Spire very low, only just raised above the last whorl. Suture deeply impressed; the sutural tube is 9 mm. behind the peristome, extremely short, and does not appear to grow longer, it is of small diameter. Whorls 5, rounded on periphery. Aperture circular. Peristome white, thickened, double, reflected, the outer lip above forming a low ridge behind the expanded inner lip, thus forming the short open descending wing. Columellar margin rounded. Operculum roundly convex, the whorl in double filaments distantly raised, close and smooth at centre.

Size: major diam. 26·5; alt. axis 7 mm. (Largest 30·0 Ponging).

This is very close to the next species *Sp. planum* found by Mr. Kemp, but which in a few minor characters differs too much to be considered the same; unfortunately there are only two very old bleached specimens of it.

Type No. 3105 (figs. 4, 4*a*) *Brit. Mus.*; No. 3047 B.M. from Ponging (figs. 5, 5*a*).

Two specimens to Indian Museum.

Figure 3. Original description of *Spiraculum kempi* from Godwin-Austen (1915). Red arrow indicates the annotation of "Type". Blue arrow indicates the set of measurements. Credit: The Biodiversity Heritage Library.

would contradict the writing structure of Godwin-Austen's (1915) original descriptions, plate captions, and the labels of the specimens. As such, the onomatophores as recognized by Godwin-Austen (1915) are limited to the first and only specimen lot in the "Type" paragraphs and corresponding to the labels in Godwin-Austen's handwriting of the respective specimen lots.

Godwin-Austen's (1915) interpretative "type" problem is illustrated by *Spiraculum kempi*. Two specimen lots, "No. 3105 B.M." from Abor Hills and "No. 3047 B.M." from Ponging, were mentioned in the original description so these two lots constitute the original hypodigm and become the type series. However, only the specimen from lot "No. 3105 Brit. Mus." was marked as "Type" in the plate caption (Fig. 1B) and this lot was labelled as "Type" in Godwin-Austen's handwriting (Fig. 4A). In contrast, specimen lot "No. 3047 B.M." was not marked as "Type" in the plate caption and was labelled as "Typic." in Godwin-Austen's handwriting (Fig. 4B). Thus, this could mean

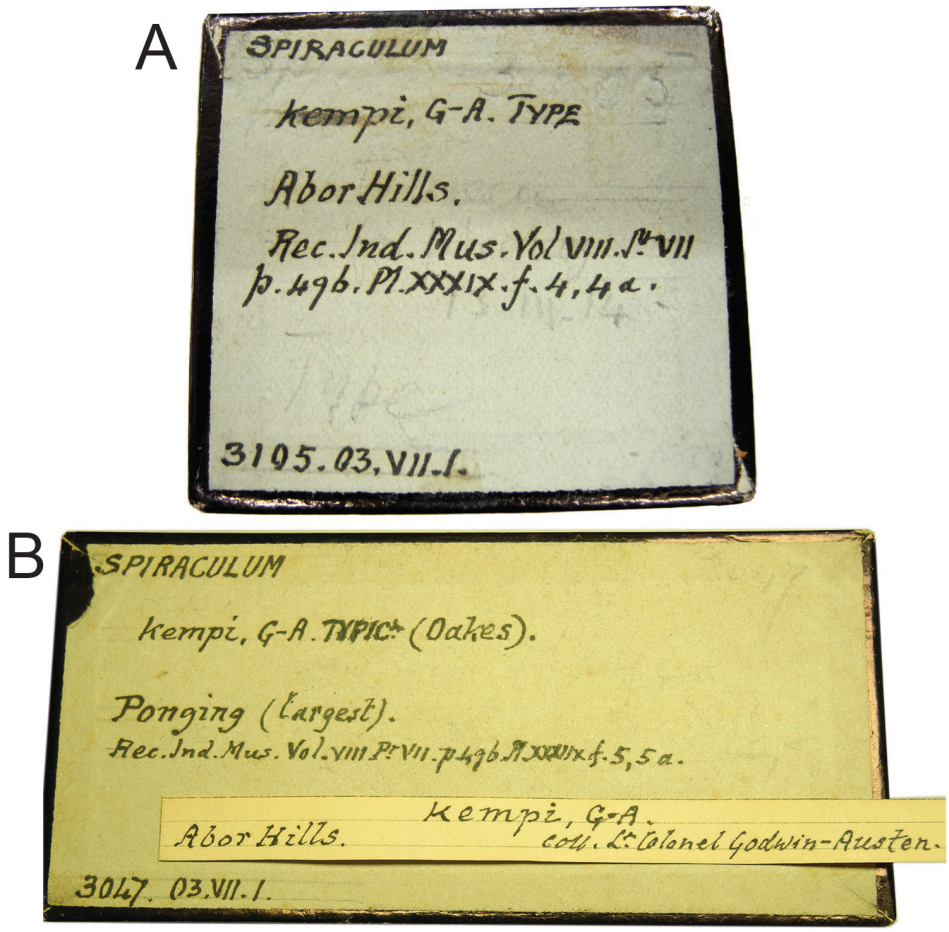


Figure 4. Original labels bearing Godwin-Austen's handwriting of *Spiraculum kempi* **A** NHMUK 1903.7.1.3105 with the word "Type" and **B** NHMUK 1903.7.1.3047 with the word "Typic.".

that Godwin-Austen (1915) designated only lot "No. 3105 B.M." as onomatophores, but not lot "No. 3047 B.M.". However, without an explicit holotype designation or any equivalent expression (see below), the Code dictates that all specimens in both lots constitute the type series and so automatically become syntypes.

Consequently, following Art. 72.4.1. the type series cannot be restricted to only the first lot in the type paragraph, and this action corresponds well to the hypodigm as recognized by Godwin-Austen (1915). However, as the Code automatically equates the original hypodigm to onomatophores if there is no holotype designation, it is possible that a subsequent author selects a lectotype from a syntype that is not part of the originally intended onomatophores, but that is part of the original hypodigm. This has happened with *Spiraculum minimum* when Sutcharit et al. (2019) designated a specimen that was not part of the originally intended onomatophores as lectotype (see below), an action that is deemed valid under the Code.

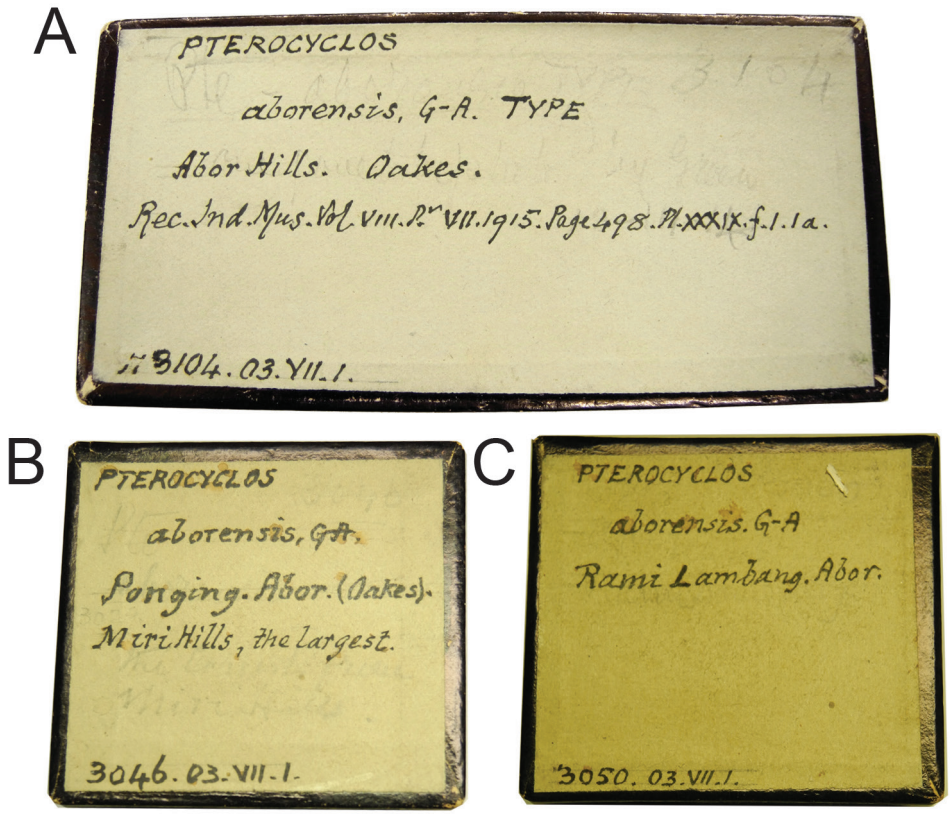


Figure 5. Original labels bearing Godwin-Austen's handwriting of *Pterocyclos aborensis* **A** NHMUK 1903.7.1.3104 with the word "Type" **B** NHMUK 1903.7.1.3046, and **C** NHMUK 1903.7.1.3050.

2) Are there indications in the holotype designation that comply with an "equivalent expression"?

Article 73.1.1. If an author when establishing a new nominal species-group taxon states in the original publication that one specimen, and only one, is the holotype, or "the type", or uses some equivalent expression, that specimen is the holotype fixed by original designation.

Article 73.1.2. If the nominal species-group taxon is based on a single specimen, either so stated or implied in the original publication, that specimen is the holotype fixed by monotypy (see Recommendation 73F). If the taxon was established before 2000 evidence derived from outside the work itself may be taken into account [Art. 72.4.1.1] to help identify the specimen.

Recommendation 73F. Avoidance of assumption of holotype. Where no holotype or syntype was fixed for a nominal species-group taxon established before 2000, and when it is possible that the nominal species-group taxon was based on more than one specimen, an author should proceed as though syntypes may exist and, where appropriate, should designate a lectotype rather than assume a holotype (see also Article 74.6).

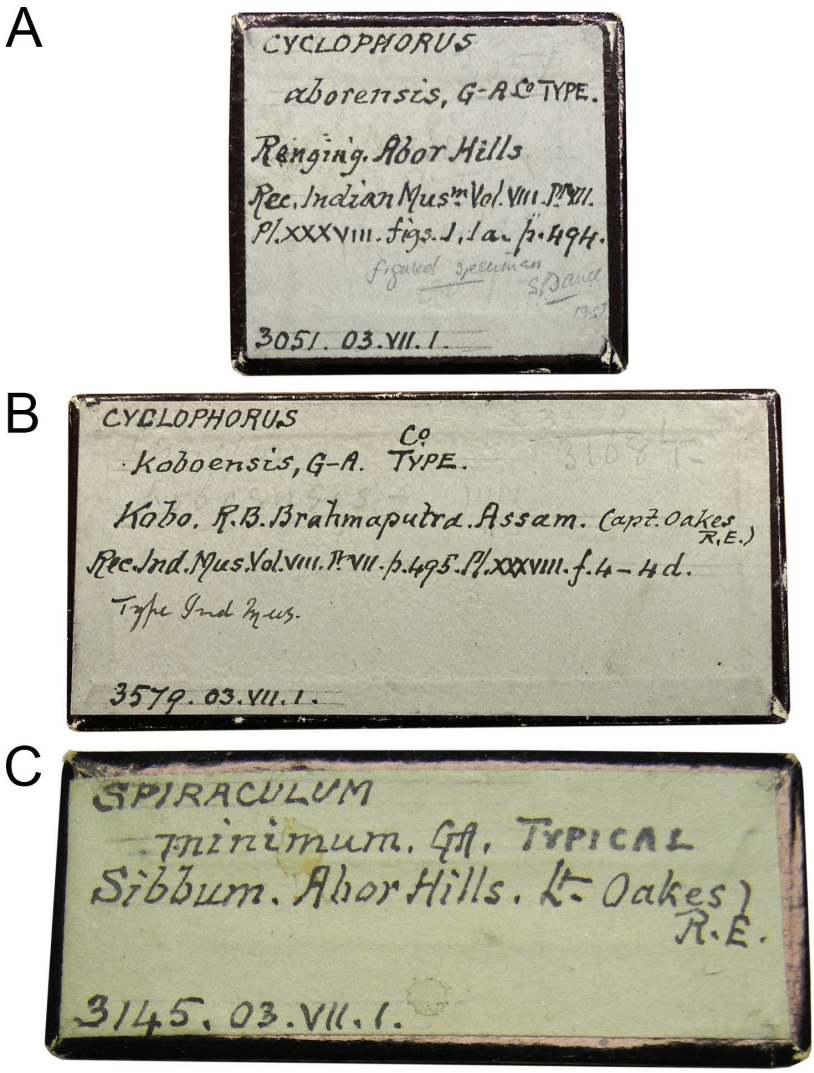


Figure 6. Original labels bearing Godwin-Austen's handwriting of **A** *Cyclophorus aborensis* NHMUK 1903.7.1.3051 with the word "Co-Type" **B** *Cyclophorus* (*Glossostylus*) *koboensis* NHMUK 1903.7.1.3579 with the word "Co-Type", and **C** *Spiraculum minimum* NHMUK 1903.7.1.3145 with the word "Typical" in different handwriting.

The indication whether the holotype designation of each taxon comply with an "equivalent expression" is a crucial point because if the original author explicitly designated only one onomatophore (= holotype), that holotype designation would comply with the Code and there would be no contradiction in accepting a type (series) as the original hypodigm. Unfortunately, Godwin-Austen (1915) used the term "Type" instead of "Holotype", and although the term "holotype" had already been coined in the late 19th century (Schuchert 1897), it was not commonly used until the 1950s.

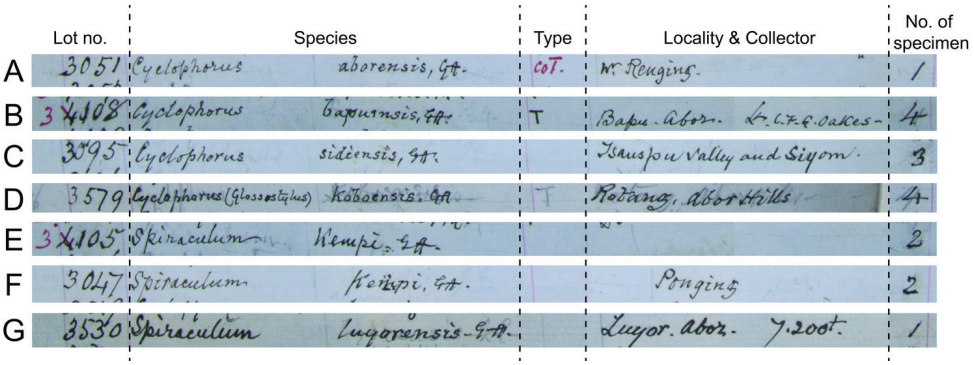


Figure 7. Record in the NHM Register of Godwin-Austen Collection in Godwin-Austen's handwriting of **A** No. 3051 *Cyclophorus aborensis* **B** No. 3108 *Cyclophorus* (*Glossostylus*) *bapuensis* **C** No. 3095 *Cyclophorus* (*Glossostylus*) *sidiensis* **D** No. 3579 *Cyclophorus* (*Glossostylus*) *koboensis* **E** No. 3105 *Spiraculum kempi* **F** No. 3047 *Spiraculum kempi*, and **G** No. 3530 *Spiraculum luyorensis*.

For example, Simpson (1940) and Newell (1949) still used the term "Type", although they mentioned "Holotype" in their works, whereas Shenefelt (1959), Schopf (1960), and Simpson (1960) did apply the term "Holotype". However, in some taxa Godwin-Austen (1915) additionally referred to "the type" in the body of texts. It is, therefore, necessary to demonstrate whether Godwin-Austen (1915) applied "the type" in the sense of a holotype or as an equivalent expression of a holotype designation.

We identified four ways of type annotation by Godwin-Austen (1915). The first way is the most prevalent among his original descriptions, i.e., those for which multiple specimen lots are mentioned in the description, whereas only one specimen is figured and marked as "Type" in the plate caption. This way of type annotation is not an equivalent expression of a holotype designation, as it can refer to any "Type" rather than specifically to "Holotype", while it does not unequivocally imply a single specimen. This interpretation is similar to that of some taxa listed by Cowie et al. (2017) (e.g., *fraternus* Pilsbry & Bequaert, 1927). In addition, parallel to a lectotype designation before 2000 (ICZN 1999: Arts. 74.5., 74.6.), the expression "Type" does not a priori demonstrate that an author regarded a given specimen as a unique, name-bearing type, and simply figuring a specimen with a "Type" caption is not enough to change this (Welter-Schultes 2013; Calhoun 2017). Therefore, in such cases all specimens in the type series are syntypes and all have an equal nomenclatural status as name-bearing types.

The second way of type annotation by Godwin-Austen (1915) occurs in the original description of *Spiraculum kempi*, which mentions two specimen lots (Fig. 3). Two specimens, each from a different lot, were figured but only one specimen was marked as "Type" in the plate caption (Fig. 1B). Although this way of type annotation is more specific in pinpointing a single specimen of a particular lot, the expression "Type" still does not necessarily indicate a unique, name-bearing type selected by the original author. Moreover, the specimen lot to which the specimen marked as "Type" in the plate caption belongs, contains more than one specimen. Thus, following Recommendation

73F to avoid the assumption of a holotype, we regard all the specimens in the type series as syntypes.

The third way of Godwin-Austen's (1915) type annotation occurs in *Cyclphorus koboensis* and is an extension of the second way, in that a set of shell measurements was added to each specimen lot number in the "Type" paragraph (and subsequent paragraphs) (Fig. 2B). In all the other taxa, these measurements were provided in their own lines above the "Type" paragraph (e.g., Figs 2A, 3). The "Type" annotation in *C. koboensis* is an equivalent expression of a holotype designation similar to some cases in Cowie et al. (2017) (e.g., *langi* Pilsbry & Bequaert, 1927 and *planogyra* Pilsbry, 1933).

Finally, the fourth way of type annotation occurs in the original description of *Cyclophorus aborensis*. Two specimens were figured in the plate but only one specimen was marked as "Type" in the plate caption (Fig. 1A), and this specimen belongs to the specimen lot number with the number one under the horizontal fraction bar (Fig. 2A). This is an equivalent expression of a holotype designation as the number under the horizontal fraction bar is commonly used to represent the number of the specimen in that lot, and this means that only one specimen was designated as the type by Godwin-Austen (1915).

Although Godwin-Austen (1915) referred to "the type" in the body of the text of the original descriptions of *C. aborensis* and *S. kempi*, this should not be taken as implying only one single individual. It is more likely that "the type" in Godwin-Austen's sense indicated an association to one specimen lot, which sometimes contains more than one specimen (e.g., *S. kempi*).

Status of Godwin-Austen's (1915) cyclophorid taxon name-bearing type(s)

The order of taxa below follows that of Godwin-Austen (1915) and the recent species combination follows MolluscaBase (2021). A summary is given in Table 1.

1. *Cyclophorus aborensis* Godwin-Austen, 1915

Cyclophorus aborensis Godwin-Austen, 1915: 494, pl. 38, fig. 1, 1a–c. Nantarat et al. 2014a: 3, 4, fig. 2a, b.

Type material. ***Holotype*** NZSI M.6010/1. ***Paratypes*** NZSI M.6009/1 (1 shell) from Rotung, 2000 ft., near Egar stream; NHMUK 1903.7.1.3048 (2 shells; Nantarat et al. 2014a; fig. 2b) from Kalek; NHMUK 1903.7.1.3051 (1 shell; Nantarat et al. 2014a; fig. 2a) from Renging.

Other non-type materials. NHMUK 1903.7.1.3049 (2 shells) from Rami Dambang, Abor.

Specimen "No. 6010/1 in Ind. Mus." (NZSI M.6010/1) is deemed the holotype fixed by original designation as explained above. All specimens in the remaining lots

Table 1. Current status of type series, other non-type materials, type locality, and original onomatophores of cyclophorid taxa in Godwin-Austen (1915). The number of shells in some specimen lots are unknown and not specified.

Taxon	Type series	Type locality	Original onomatophores recognized by Godwin-Austen (1915)	Remarks
1. *Cyclophorus aborensis*	Holotype NZSI M.6010/1. Paratypes NZSI M.6009/1, NHMUK 1903.7.1.3048, NHMUK 1903.7.1.3051	Rotung, 2000 ft., near Egar stream	NZSI "No. 6010/1" (1 shell)	Invalid lectotype and paralectotype designation by Nantarat et al. (2014a).
2. *Cyclophorus* (*Glossostylus*) *bapuensis*	Lectotype NHMUK 1903.7.1.3108/1. Paralectotypes NHMUK 1903.7.1.3108/2–3	Abor Hills, vicinity of Bapu	NHMUK 1903.7.1.3108 (4 shells)	Valid lectotype and paralectotype designation by Nantarat et al. (2014a).
3. *Cyclophorus* (*Glossostylus*) *sidiensis*	Syntypes NZSI M.6002, NZSI M.6001, NHMUK 1903.7.1.3095	On Sidi River, Abor Hills; Rotung; Tsanpu Valley	NZSI "No. 6002"	–
4. *Cyclophorus* (*Glossostylus*) *koboensis*	Holotype NZSI M.6015/1. Paratypes NZSI M.6019–20, NHMUK 1903.7.1.3045, NHMUK 1903.7.1.3117, NHMUK 1903.7.1.3579	Abor Hills, Kobo, on right bank of Tsanspu or Brahmaputra River	NZSI "No. 6015" (1 shell)	Invalid lectotype and paralectotype designation by Nantarat et al. (2014a).
5. *Spiraculum oakesi*	Lectotype (design. nov.) NHMUK 1903.7.1.3081/1. Paralectotypes NHMUK 1903.7.1.3081/2–5, NZSI	Abor Hills	NHMUK 1903.7.1.3081 (5 shells)	–
6. *Spiraculum kempi*	Lectotype (design. nov.) NHMUK 1903.7.1.3105/1. Paralectotypes NHMUK 1903.7.1.3105/2, NHMUK 1903.7.1.3047, NZSI	Abor Hills	NHMUK 1903.7.1.3105 (2 shells)	–
7. *Spiraculum planum*	Syntypes NZSI M.5992, NZSI M.5992a	Upper Rotung, Abor Hills; Yembung	NZSI "No. 5992"	–
8. *Pterocyclos aborensis*	Lectotype (design. nov.) NHMUK 1903.7.1.3104/1. Paralectotypes NHMUK 1903.7.1.3104/2–3, NHMUK 1903.7.1.3046, NHMUK 1903.7.1.3050	Abor Hills	NHMUK 1903.7.1.3104 (3 shells)	–
9. *Pterocyclos miriensis*	Lectotype (design. nov.) NHMUK 1903.7.1.3580/1 (Fig. 8A). Paralectotypes NHMUK 1903.7.1.3580/2–4	Miri Hills	NHMUK 1903.7.1.3580 (4 shells)	–
10. *Pterocyclos spiramentum*	Holotype NHMUK 1903.7.1.3082	Abor Hills	NHMUK 1903.7.1.3082 (1 shell)	–
11. *Pterocyclos brahmakundensis*	Lectotype (design. nov.) NHMUK 1903.7.1.713/1. Paralectotypes NHMUK 1903.7.1.713/2–3	Brahmakund, Eastern Assam	NHMUK 1903.7.1.713 (3 shells)	–
12. *Spiraculum luyorensis*	Lectotype (design. nov.) NHMUK 1903.7.1.3530/1	Luyor, Abor Hills	NHMUK 1903.7.1.3530 (1 shell)	–
13. *Spiraculum putaoensis*	Lectotype (design. nov.) NHMUK 1903.7.1.3598/1. Paralectotypes NHMUK 1903.7.1.3598/2–3	Putao, Upper Burma	NHMUK 1903.7.1.3598 (3 shells)	–
14. *Spiraculum minimum*	Lectotype NHMUK 1903.7.1.3145/1. Paralectotypes NHMUK 1903.7.1.3145/2–3, NHMUK 1903.7.1.3147, NZSI M.6142, NZSI M.6143	Sibbum, Abor Hills	NZSI "No. 6142–43" (2 shells)	Valid lectotype and paralectotype designation by Sutcharit et al. (2019), while contradicting the original intension of onomatophore designation by Godwin-Austen (1915).
15. *Theobaldius oakesi*	Lectotype (design. nov.) NHMUK 1903.7.1.3083/1 (Fig. 8B). Paralectotype NHMUK 1903.7.1.3083/2 (Fig. 8C).	Tsanspu Valley, Abor Hills	NHMUK 1903.7.1.3083 (2 shells)	–

are paratypes, except for lot "No. 3049 B.M.", which Godwin-Austen (1915) regarded as a dwarf variety. In addition, the designation of a lectotype from lot NHMUK 1903.7.1.3051, labelled with "Co-Type" in Godwin-Austen's handwriting (Fig. 6A) and recorded as "CoT" in the Register of Godwin-Austen (Fig. 7A), by Nantarat et al. (2014a) is invalid. The type locality of this taxon is restricted to "Rotung, 2000 ft., near Egar stream" only.

2. *Cyclophorus* (*Glossostylus*) *bapuensis* Godwin-Austen, 1915

Cyclophorus (*Glossostylus*) *bapuensis* Godwin-Austen, 1915: 494, 495, pl. 38, fig. 2, 2a–c. Nantarat et al. 2014a: 6, fig. 4a, b.

Type material. ***Lectotype*** NHMUK 1903.7.1.3108/1 (Nantarat et al. 2014a: fig. 4a). ***Paralectotypes*** NHMUK 1903.7.1.3108/2–3 (2 shells; Nantarat et al. 2014a: fig. 4b) from Abor Hills, vicinity of Bapu.

Only one specimen lot, "No. 3108 Brit. Mus.", was mentioned in the "Type" paragraph of the original description and was labelled as "Type" in Godwin-Austen's handwriting (Nantarat et al. 2014a: fig. 1a). One figured specimen from this lot was marked as "Type" in the plate caption. As there are three specimens in type lot NHMUK 1903.7.1.3108, Nantarat et al. (2014a) designated a lectotype (NHMUK 1903.7.1.3108/1; Nantarat et al. 2014a: fig. 4a) based on the specimen figured in the original description, corresponding to the given shell measurements. This lectotype designation is here confirmed as valid. The record in the Register of the Godwin-Austen Collection reveals that there were originally four specimens in this lot (Fig. 7B).

3. *Cyclophorus* (*Glossostylus*) *sidiensis* Godwin-Austen, 1915

Cyclophorus (*Glossostylus*) *sidiensis* Godwin-Austen, 1915: 495, pl. 38, fig. 3, 3a–c.

Type material. ***Syntypes*** NZSI M.6002 from Sidi River, Abor Hills; NZSI M.6001 from Rotung; NHMUK 1903.7.1.3095 (3 shells) from Tsanpu Valley.

The type series of this species comprises three specimen lots. Without any explicit holotype designation or equivalent expression, all specimens in these three lots are syntypes. However, only specimen lot "No. 6002 Ind. Mus." was mentioned in the "Type" paragraph, and one specimen from this lot was figured with the annotation "Type" in the plate caption. This specimen lot is, therefore, the onomatophore as originally intended by Godwin-Austen (1915). Subsequent authors should select that particular figured specimen from lot NZSI M.6002 as the lectotype. There is one additional specimen lot (NHMUK 1903.7.1.3095; Fig. 7C) that contains syntypes, but currently this lot could not be located in the NHM.

4. *Cyclophorus* (*Glossostylus*) *koboensis* Godwin-Austen, 1915

Cyclophorus (*Glossostylus*) *koboensis* Godwin-Austen, 1915: 495, 496, pl. 38, fig. 4, 4a–d. Nantarat et al. 2014a: 14, fig. 12a, b. Sajan et al. 2019: 25–28, fig. 1.

Type material. ***Holotype*** NZSI M.6015/1 (Sajan et al. 2019: fig. 1). ***Paratypes*** NZSI M.6019–20 (2 shells) from Rotung; NHMUK 1903.7.1.3045 (3 shells) from Ponging; NHMUK 1903.7.1.3117 (2 shells) from Yamme Valley; NHMUK 1903.7.1.3579 (4 shells; Nantarat et al. 2014a: fig. 12a, b) from Rotung.

Other non-type materials. NHMUK 1903.7.1.3581 (1 shell) from between N. 28°15'–29°15'L. 94°50'–95°10'.

Specimen "No. 6015 Ind. Mus." (NZSI M.6015/1) is deemed the holotype fixed by original designation as explained above. All specimens in the remaining lots are paratypes, except for lot "No. 3581 B.M." of which Godwin-Austen (1915) stated that it "comes very close to this spices [sic; species]". We regard this as a doubtful attribution (ICZN 1999: Art. 72.4.1). The status of the type series and of the holotype has been correctly clarified by Sajan et al. (2019), whereas the designation of a lectotype and paralectotypes from lot NHMUK 1903.7.1.3579, labelled with "Co-Type" in Godwin-Austen's handwriting (Fig. 6B) and recorded as "CoT" in the Register of Godwin-Austen (Fig. 7D), by Nantarat et al. (2014a) is invalid. The type locality of this taxon is retained and restricted to "Abor Hills, Kobo, on right bank of Tsanspu or Brahmaputra River" only.

5. *Spiraculum oakesi* Godwin-Austen, 1915

Spiraculum oakesi Godwin-Austen, 1915: 496, pl. 39, fig. 3, 3a.
Pearsonia oakesi – Sutcharit et al. 2019: 43, fig. 10d, e.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3081/1 (Sutcharit et al. 2019: fig. 10d). ***Paralectotypes*** NHMUK 1903.7.1.3081/2–5 (4 shells; Sutcharit et al. 2019: fig. 10e) from Abor Hills; NZSI (2 shells).

The type series of this species comprises lot "No. 3081 Brit. Mus." and two uncatalogued specimens in the Indian Museum. Without any explicit holotype designation or equivalent expression, all specimens are syntypes. However, only specimen lot "No. 3081 Brit. Mus." was mentioned in the "Type" paragraph, and one specimen from this lot was figured with the annotation "Type" in the plate caption. The author explicitly indicated that five specimens were examined, and type lot NHMUK 1903.7.1.3081 accordingly contains five specimens with a label in Godwin-Austen's handwriting stating "Type". We hereby designate the specimen from lot NHMUK 1903.7.1.3081 which is figured in the original description and in Sutcharit et al. (2019: fig. 10d) as the lectotype (NHMUK 1903.7.1.3081/1) to stabilize the name. This lectotype designation is based on the idea that Godwin-Austen (1915) selected this specimen lot as onomatophores.

6. *Spiraculum kempi* Godwin-Austen, 1915

Spiraculum kempi Godwin-Austen, 1915: 496, 497, pl. 39, figs 4, 4a, 5, 5a.
Pearsonia kempi – Sutcharit et al. 2019: 31, fig. 7d, e.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3105/1 (Sutcharit et al. 2019: fig. 7d). ***Paralectotypes*** NHMUK 1903.7.1.3105/2 (1 shell) from Abor Hills; NHMUK 1903.7.1.3047 (2 shells; Sutcharit et al. 2019: fig. 7e) from Ponging; NZSI (2 shells).

The type series of this species comprises two specimen lots, "No. 3105 Brit. Mus." and "No. 3047 B.M.", and two uncatalogued specimens in the Indian Museum. Without any explicit holotype designation or equivalent expression, and given that the Register of Godwin-Austen Collection explicitly states that each lot contains two specimens (Fig. 7E, F), all specimens in these lots are syntypes. However, only the figured specimen from lot "No. 3105 Brit. Mus." from Abor Hills was marked as "Type" in the plate caption (Fig. 1B) and this lot is labelled as "Type" in Godwin-Austen's handwriting (Fig. 4A). In contrast, the figured specimen from lot "No. 3047 B.M." from Ponging was not marked as "Type" in the plate caption and this lot is labelled as "Typic" in Godwin-Austen's handwriting (Fig. 4B). Although, according to Art. 73.2., all the specimens of the type series are automatically syntypes and have equal status in being name-bearing types, we hereby designate the specimen from lot NHMUK 1903.7.1.3105 that is figured in Godwin-Austen (1915: pl. 39, fig. 4, 4a) and Sutcharit et al. (2019: fig. 7d) as the lectotype (NHMUK 1903.7.1.3105/1) to stabilize the name. This lectotype designation is based on the idea that Godwin-Austen (1915) selected this specimen lot as onomatophores and thus prevents any future attempt to designate a specimen from the other lots as the lectotype. The type locality of this taxon is restricted to "Abor Hills".

7. *Spiraculum planum* Godwin-Austen, 1915

Spiraculum planum Godwin-Austen, 1915: 497, pl. 39, fig. 6, 6a, b.

Type material. ***Syntypes*** NZSI M.5992 from Upper Rotung, Abor Hills; NZSI M.5992a from Yembung.

Other non-type materials. NHMUK 1903.7.1.3596 (1 shell) from the Miri Hills.

The type series of this species comprises two specimen lots, except for lot "No. 3596 B.M." that Godwin-Austen (1915) regarded as a small variety. Without any explicit holotype designation or equivalent expression, all specimens in these lots are syntypes. However, only specimen lot "No. 5992 Ind. Mus." was mentioned in the "Type" paragraph, and one specimen from this lot was figured with the annotation "Type" in the plate caption. This specimen lot is, therefore, deemed onomatophore as originally

intended by Godwin-Austen (1915). Therefore, subsequent authors should select that particular figured specimen from the lot NZSI M.5992 as the lectotype.

8. *Pterocyclos aborensis* Godwin-Austen, 1915

Pterocyclos aborensis Godwin-Austen, 1915: 498, pl. 39, fig. 1, 1a. Sutcharit et al. 2019: 5, fig. 1b, c.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3104/1 (Sutcharit et al. 2019: fig. 1b). ***Paralectotypes*** NHMUK 1903.7.1.3104/2–3 (2 shells; Sutcharit et al. 2019: fig. 1c) from Abor Hills; NHMUK 1903.7.1.3046 (2 shells) from Ponging; NHMUK 1903.7.1.3050 (3 shells) from Rami Lambang.

The type series of this species comprises three specimen lots. Without any explicit holotype designation or equivalent expression, all specimens in these lots are syntypes. However, only specimen lot "No. 3104 Brit. Mus." from Abor Hills was mentioned in the "Type" paragraph, one figured specimen from this lot was marked as "Type" in the plate caption, and this lot was labelled as "Type" in Godwin-Austen's handwriting (Fig. 5A). In contrast, two remaining lots, "No. 3046 B.M." from Ponging and "No. 3050 B.M." from Rami Lampang, were not labelled as type (Fig. 5B, C). Although, according to Art. 73.2., all the specimens of the type series are automatically syntypes and have equal status in being name-bearing type, we hereby designate the specimen from lot NHMUK 1903.7.1.3104 that is figured in the original description and in Sutcharit et al. (2019: fig. 1b) as the lectotype (NHMUK 1903.7.1.3104/1) to stabilize the name. This lectotype designation is based on the idea that Godwin-Austen (1915) selected this specimen lot as onomatophores and thus prevents any future attempt to designate a specimen from the other lots as the lectotype. The type locality of this taxon is restricted to "Abor Hills".

9. *Pterocyclos miriensis* Godwin-Austen, 1915

Fig. 8A

Pterocyclos miriensis Godwin-Austen, 1915: 498, pl. 39, fig. 2, 2a–c.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3580/1 (Fig. 8A). ***Paralectotypes*** NHMUK 1903.7.1.3580/2–4 (3 shells) from Miri Hills.

Godwin-Austen (1915) explicitly stated that four specimens of this taxon were obtained, the type specimen lot number was given as "No. 3580 Brit. Mus." and three specimens were transferred to the Indian Museum. However, currently there are four specimens in lot NHMUK 1903.7.1.3580, so it is presumed that none were sent to the NZSI. Without any explicit holotype designation or equivalent expression, these

four specimens are syntypes. The specimen figured in the original description that corresponds to the shell measurements given is hereby designated as the lectotype (NHMUK 1903.7.1.3580/1; Fig. 8A) to stabilize the name.

10. *Pterocyclos spiramentum* Godwin-Austen, 1915

Pterocyclos spiramentum Godwin-Austen, 1915: 498, 499, pl. 40, fig. 4, 4a, b. Sutcharit et al. 2019: 49, fig. 11j.

Type material. ***Holotype*** NHMUK 1903.7.1.3082 (Sutcharit et al. 2019: fig. 11j).

Godwin-Austen (1915) explicitly stated that only one specimen was obtained and belonged to specimen lot "No. 3082 Brit. Mus." According to Art. 73.1.2., Sutcharit et al. (2019) validly deemed this specimen (NHMUK 1903.7.1.3082) as the holotype fixed by monotypy.

11. *Pterocyclos brahmakundensis* Godwin-Austen, 1915

Pterocyclos brahmakundensis Godwin-Austen, 1915: 499, 500, with text figure 1. Sutcharit et al. 2019: 14, fig. 3d, e.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.713/1 (Sutcharit et al. 2019: fig. 3d). ***Paralectotypes*** NHMUK 1903.7.1.713/2–3 (2 shells; Sutcharit et al. 2019: fig. 3e) from Brahmakund, Eastern Assam.

Godwin-Austen (1915) explicitly stated that three specimens of this taxon were obtained, and the type specimen lot number was "No. 713 B.M." Without any explicit holotype designation or equivalent expression, these three specimens are syntypes. The specimen figured in Sutcharit et al. (2019: fig. 3d) that corresponds to the text figure and the shell measurements given in the original description is hereby designated as the lectotype (NHMUK 1903.7.1.713/1) to stabilize the name.

12. *Spiraculum luyorensis* Godwin-Austen, 1915

? *Spiraculum luyorensis* Godwin-Austen, 1915: 500, pl. 40, fig. 5, 5a, b.
Pearsonia luyorensis – Sutcharit et al. 2019: 36, fig. 8d.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3530/1 (Sutcharit et al. 2019: fig. 8d).

Only one specimen lot, "No. 3530 Brit. Mus.", was mentioned in the original description and associated with the "Type" paragraph. Although this type lot contains only one specimen and the Register of Godwin-Austen Collection reveals that

Figure 8. A lectotype of *Pterocyclos miriensis*, NHMUK 1903.7.1.3580/1 **B, C** *Theobaldius oakesi*: **B** lectotype NHMUK 1903.7.1.3083/1 and **C** paralectotype NHMUK 1903.7.1.3083/2.

there is only one specimen in this lot (Fig. 7G), it is nevertheless not evident in the original description that this taxon is based on a single specimen (ICZN 1999: Art. 73.1.2). Therefore, without any explicit holotype designation or equivalent expression, Sutcharit et al. (2019) validly deemed this specimen (NHMUK 1903.7.1.3530) as a syntype, following Recommendation 73F. We hereby designate this specimen, which is figured in the original description and also figured in Sutcharit et al. (2019: fig. 8d), as the lectotype (NHMUK 1903.7.1.3530/1) to stabilize the name.

13. *Spiraculum putaoensis* Godwin-Austen, 1915

Spiraculum putaoensis Godwin-Austen, 1915: 500, 501, pl. 40, fig. 3, 3a, b.
Pearsonia putaoensis – Sutcharit et al. 2019: 46, 48, fig. 10j, k.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3598/1 (Sutcharit et al. 2019: fig. 10j). ***Paralectotypes*** NHMUK 1903.7.1.3598/2–3 (2 shells; Sutcharit et al. 2019: fig. 10k) from Putao, Upper Burma.

Godwin-Austen (1915) explicitly stated that three specimens of this taxon were obtained but did not specify the specimen lot number to which these specimens belong. Without any explicit holotype designation or equivalent expression, these three specimens in lot NHMUK 1903.7.1.3598 labelled as "Type" in Godwin-Austen's handwriting are syntypes. The specimen figured in Sutcharit et al. (2019: fig. 10j) that is closest to the given shell measurements and figured in the original description is hereby designated as the lectotype (NHMUK 1903.7.1.3598/1) to stabilize the name.

14. *Spiraculum minimum* Godwin-Austen, 1915

Spiraculum minimum Godwin-Austen, 1915: 501, 502, pl. 40, fig. 2, 2a–c.
Pearsonia minima – Sutcharit et al. 2019: 40, fig. 9b, c.

Type material. ***Lectotype*** NHMUK 1903.7.1.3145/1 (Sutcharit et al. 2019: fig. 9b). ***Paralectotypes*** NHMUK 1903.7.1.3145/2–3 (2 shells; Sutcharit et al. 2019: fig. 9c) and NHMUK 1903.7.1.3147 (2 shells) from Sibbum, Abor Hills; NZSI M.6142 (1 shell) and NZSI M.6143 (1 shell) from Jeku, Abor Hills.

The type series of this species comprises four specimen lots. Only two specimen lots, "No. 6142–43 Ind. Mus.", which were explicitly stated to contain two specimens from "Jeku, Abor Hills", were mentioned in the "Type" paragraph, and one of these two specimens was figured and marked as "Type" in the plate caption. In contrast, the remaining lots were mentioned in the body of the text of subsequent paragraphs. This could mean that Godwin-Austen (1915) selected specimen lots "No. 6142–43 Ind. Mus." as onomatophores. However, without any explicit holotype designation or equivalent expression, all specimens of the type series are automatically syntypes with equal status in being name-bearing types. Thus, the designation of the lectotype from lot NHMUK 1903.7.1.3145, labelled as "Typical" in Godwin-Austen's handwriting (Fig. 6C), by Sutcharit et al. (2019) is valid under the Code, although this action contradicted the intention of the onomatophore designation by Godwin-Austen (1915). The type locality of this taxon is restricted to "Sibbum, Abor Hills".

15. *Theobaldius oakesi* (Godwin-Austen, 1915)
Fig. 8B, C

Cyclophorus oakesi Godwin-Austen, 1915: 502, pl. 40, fig. 1, 1a.
Theobaldius oakesi – Gude 1921: 39. Ramakrishna and Dey 2010: 44.

Type material. ***Lectotype*** (design. nov.) NHMUK 1903.7.1.3083/1 (Fig. 8B). ***Paralectotype*** NHMUK 1903.7.1.3083/2 (1 shell; Fig. 8C) from Tsanspu Valley, Abor Hills.

Godwin-Austen (1915) explicitly stated that two specimens of this taxon were obtained, with a type specimen lot number of "No. 3083 Brit. Mus.". Without any explicit holotype designation or equivalent expression, both specimens are syntypes. The specimen figured in the original description that corresponds to the shell measurements given is hereby designated as the lectotype (NHMUK 1903.7.1.3083/1; Fig. 8B) to stabilize the name.

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RESEARCH ARTICLE

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Morphological and molecular data on tadpoles of the westernmost Himalayan spiny frog *Allopaa hazarensis* (Dubois & Khan, 1979)

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Abstract

Little is known about the life history, ecology, and distribution of the genus *Allopaa* (Dicroglossidae) and far less recent data are available about the larvae of this taxon. Here, we provide data on the larval stage of *Allopaa hazarensis* (Dubois & Khan, 1979) from northern Pakistan based on the examination of three tadpoles. Specimens were obtained from two sites in Buner, Khyber Pakhtunkhwa province, Pakistan. Morphological and genetic analysis (mtDNA and nDNA) confirmed the identity of the tadpoles as *A. hazarensis*. Tadpole characterizations were illustrated by detailed imagery. Basic measurements and details on oral apparatus provide relevant taxonomic characteristics to distinguish the tadpoles of this species from other spiny frogs. The illustration and description of the tadpole of *A. hazarensis* should facilitate the identification of this species in the field.

Keywords

Chaparana, Dicroglossidae, DNA barcoding, larva, *Paa*, Pakistan, species identification

Introduction

The Hazara (Torrent) Frog, *Allopaa hazarensis* (Dubois & Khan, 1979), belongs to the tribe Paini (Dicroglossidae), which are found across the Himalayan mountain arc from northern Afghanistan, Pakistan, and northern India, through Nepal, Sikkim, and Bhutan, and in the valleys of southern and eastern Tibet, eastwards to eastern China, and southwards to the mountains of Indochina (Myanmar, Thailand, Laos, northern Vietnam; Frost 2021). They live mostly in boulder-rich streams (Dubois 1975) or clear pools with flowing water (Khan et al. 2008; Ahmed et al. 2020; own observation). Males are characterized by black, keratinous spines, scattered on the fingers, arms, breast, or belly (Ohler and Dubois 2006). The Paini tribe is currently composed of the genus *Quasipaa* Dubois, 1992 (11 species), *Nanorana* Günther, 1896 (around 30 species), *Allopaa* Ohler & Dubois, 2006 (possibly two species), and the monotypic genus *Chrysopaa* Ohler & Dubois, 2006, with *C. sternosignata* (Murray, 1885). The latter two genera represent the most western dicroglossid frogs that occur in the Himalayan-Tibetan orogenic belt (HTO). Recently, the phylogenetic placement of *Allopaa* from Kashmir Himalaya and *Chrysopaa* from the Hindu Kush has been addressed for the first time (Hofmann et al. 2021). This study indicates no close taxonomic relations between the two genera and their geographical neighbouring spiny frogs and suggests a trans-Tibet dispersal during the late Oligocene (*Chrysopaa*) and early Miocene (*Allopaa*) from the eastern margin of the HTO.

Allopaa hazarensis was described from near Datta (~34.30°N, 73.26°E), northern Pakistan (Manshera District, Hazera Division, about 1,200 m a.s.l.) and is known to occur in Khyber Pakhtunkhwa Province, Pakistan, and in adjacent Kashmir, India (see Frost 2021). It has been also reported from Taluka Kotri and Thano Bula Khan of District Jamshoro (~25.35°N, 68.27°E; ~25.36°N, 67.84°E), southern Pakistan, but no photographs and morphological or molecular data were provided (Shaikh et al. 2015). Little is known about the life history, ecology, and distribution of *Allopaa*, and far less recent data are available about the larvae of this taxon. *Allopaa hazarensis* can be found in pools of clear water in small creeks or torrents running in deep gorges. Breeding starts probably in June with the first summer rain. No acoustic data of the mating call exist, and it is still unknown whether tadpoles may develop from eggs deposited the preceding year or if larvae can over-winter in water (Dubois and Khan 1979). Tadpoles of *A. hazarensis* were morphologically described in the original species description (Dubois and Khan 1979). Further details on the oropharyngeal morphology of the larva in relation to feeding mechanisms in supposedly torrenticole habitats were provided by Khan and Malik (1987).

In the present study, we provide detailed photographs and a brief description of *A. hazarensis* tadpoles from northern Pakistan. We used mitochondrial and nuclear DNA sequence data to validate the identity of our specimens by assigning them to existing *Allopaa* sequences. These recent data may support future research on this taxon in the Kashmir Himalaya and adjacent regions.

Methods

Sampling, illustrations, and character assessment

Two larvae (ZFMK 103353, ZFMK 103354) were collected in September 2020 during night time in Buner, Khyber Pakhtunkhwa province, Pakistan (34.66°N, 72.50°E, 1,520 m a.s.l.; Fig. 1, Suppl. material 1: Table S1). An additional tadpole (ZFMK 103351) was collected at lower elevation near Qadir Nagar River, Buner, Khyber Pakhtunkhwa province, Pakistan (34.64°N, 72.47°E, 935 m a.s.l.). The larvae were observed in clear water pools of a boulder-rich torrents (Fig. 2).

Sampling was conducted according to the regulations for the protection of terrestrial wild animals under the permits of the Pakistan Museum of Natural History, Islamabad, Pakistan [no. PMNH/EST-1(89)/05]. A small piece of the tail was taken

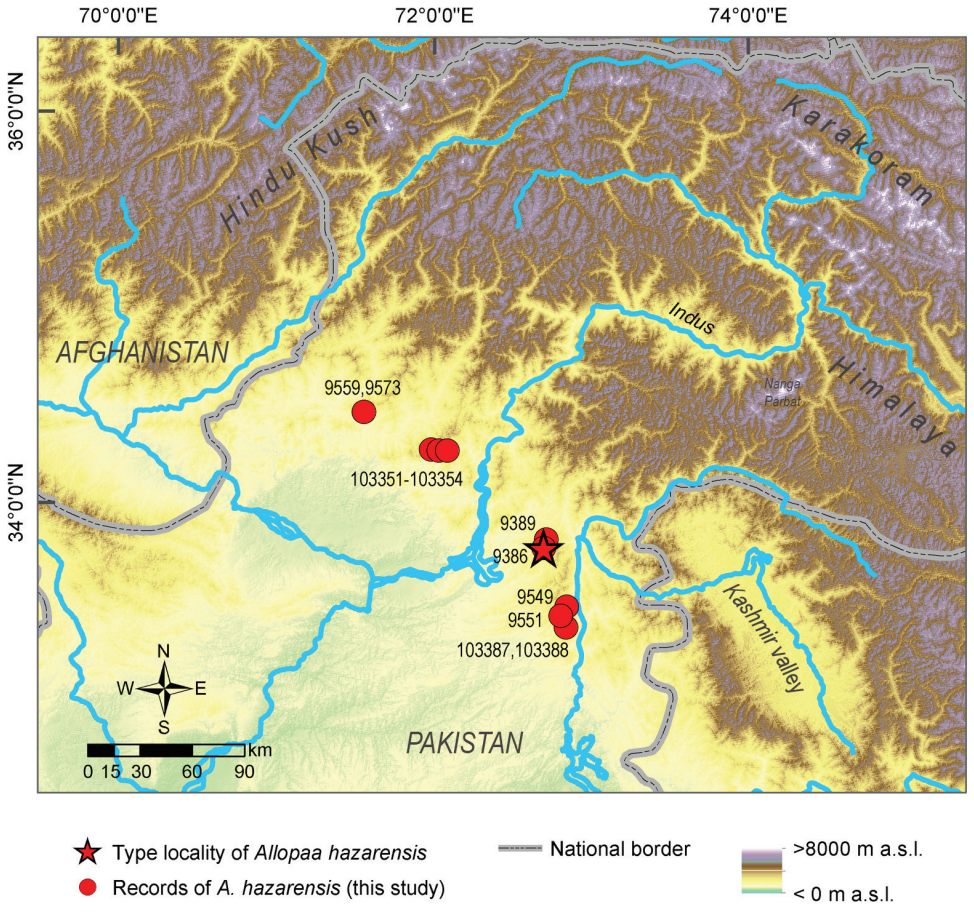

Figure 1. Map showing the locations of the *Allopaa hazarensis* specimens reported herein and further known records (for details, see Suppl. material 1: Table S1). The type locality of *A. hazarensis* is indicated by a star.

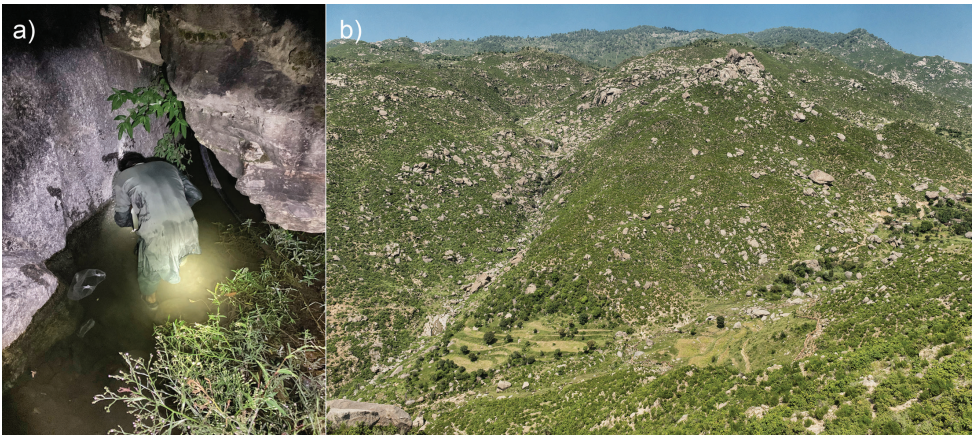

Figure 2. Typical habitat of *Allopaa hazarensis* from Buner, Khyber Pakhtunkhwa province, Pakistan (34.64°N, 72.47°E, 935 m a.s.l.) **a** collection site of one of the tadpoles (ZFMK 103351) **b** overview of the collection site. Photo credit: Daniel Jablonski.

from two of the tadpoles (ZFMK 103354, ZFMK 103351), transferred into absolute ethanol, and stored at –20 °C. All investigated specimens are deposited in the Zoological Research Museum Alexander Koenig, Bonn, Germany.

Tadpoles were staged according to Gosner (1960), preserved in 70% ethanol, and morphologically described under a stereomicroscope. Photos of entire tadpoles were taken at the lab with a Nikon D750 digital camera, a 105 mm macro lens, and a 2.0× teleconverter for detail shots. Morphometric measurements were taken with digital calipers (accuracy ± 0.1 mm). Tadpole terminology follows Altig and McDiarmid (1999); the following measurements were taken: TL (total length), BL (body length), TAL (tail length), TMH (tail muscle height at tail base), TMW (tail muscle width at tail base), IOD (interorbital distance), IND (inter-narial distance), EN (eye-nostril distance), ODW (oral disc width). All measurements are provided in Suppl. material 1: Table S2. Characteristics of the oral disc were described according to the system suggested by Altig (1970). The formula of keratodonts (= labial tooth rows) is abbreviated LTRF and is presented according to Altig and McDiarmid (1999), with the anterior (A-) and posterior (P-) rows indicating gaps in brackets and a backslash separating the upper and lower jaw sheaths (Schulze et al. 2015).

DNA extraction, sequence alignment and phylogenetic reconstruction

Genomic DNA was extracted from tissues using the DNeasy Blood & Tissue Kit (Qiagen, Venlo, The Netherlands) following the manufacturer's protocol. Approximately 546 bp of the 16S ribosomal RNA (rRNA), 499 bp of the Cytochrome c oxidase I (COI), and a fragment of 1,207 bp of the Recombination activating gene 1 (Rag1) gene were amplified via the polymerase chain reaction (PCR) using primers and PCR conditions as previously described (Hofmann et al. 2019). PCR products were purified

using the mi-PCR Purification Kit (Metabion, Planegg, Germany) and sequenced in both directions by Macrogen (Amsterdam, Netherlands; http://www.macrogen.com).

We aligned the new sequences (accession numbers 16S: MW723172–MW723173, COI: MW723177–MW723178, Rag1: MW728951–MW728952) to data available from our previous studies (Hofmann et al. 2019, 2021) by eye; for accession numbers and detailed information of these previous data see supplementary table in Hofmann et al. (2021). The 16S sequences were aligned based on secondary structures. Alignment based on amino acids produced similar results, since no ambiguities, such as deletions, insertions, or stop codons, were found. The final concatenated rRNA + mtDNA + nuDNA sequence dataset consisted of 183 taxa and contained 2,317 alignment positions of which 494 were phylogenetically informative. We inferred a maximum-likelihood (ML) tree using RAxML v. 8.2.12 (Stamatakis 2014). The dataset was partitioned a priori by gene and codon fragments, and PartitionFinder v. 1.1.1 (Lanfear et al. 2012) was applied to optimize partitions using linked branch lengths, the corrected Aikaike Information Criterion (AICc), the greedy search algorithm, and the substitution models implemented in RAxML. We ran RAxML with the GTR-GAMMA model and 1,000 bootstrap replicates on CIPRES (Cyberinfrastructure for Phylogenetic Research) (Miller et al. 2010).

Results

Phylogenetic assignment

We confirmed the identity of the two tadpoles as *Allopaa hazarensis*. Our tadpole sequences nested in the clade of *A. hazarensis* that includes sequences from the type locality; the placement within this clade was highly supported (Suppl. material 1: Fig. S1).

Tadpole characterization

Tadpoles identified as *A. hazarensis* have been described by Khan and Dubois (1979) and Khan and Malik (1987). These morphological descriptions agree with the specimens studied herein in terms of body shape, coloration, caudal muscle, and oral disc, but differ in some basic measurements, details on oral apparatus, and Gosner stage. Thus, the following brief description is based on three specimens (ZFMK 103351, ZFMK 103353, ZFMK 103354) at Gosner stages 26 from Buner, Pakistan: total length 61.6, 76.5, and 73.2 mm, body length 19.8, 25.3, and 22.8 mm, respectively (for details see Suppl. material 1: Table S2). Large body, oblong-ovoid in dorsal and ventral views, compressed in lateral view; snout semicircular rounded in dorsal and ventral views, and slightly sloped in lateral view (Fig. 3a–c; Suppl. material 1: Fig. S2). Eyes and nostrils small, located and directed dorsolaterally. Oral disc large, located and directed ventrally to anteroventrally (Fig. 3d). Marginal papillae uniseriate with a wide median gap on upper labium, biseriate anterolaterally to laterally and on lower

Figure 3. Tadpoles (Gosner stage 26) of *Allopaa hazarensis* from Buner, Khyber Pakhtunkhwa province, Pakistan, 1520 m **a–c** dorsal, ventral, lateral views **d** mouthpart **e** spiracle of preserved specimens (**A** ZFMK 103353 **B** ZFMK 103354).

labium. Submarginal papillae present and cumulated laterally, in the wrinkle between labia (Figs 3d, e, 4). Jaw sheaths robust and finely serrated, the upper sheath slightly arc-shaped, the lower V-shaped; LKRF 8(2–8)/3(1), or 7(2–7)/3(1) (see Suppl. material 1: Table S1). Spiracle sinistral, opening posterodorsally (Fig. 4).

Discussion

Here we report on larvae of the dicroglossid frog *Allopaa hazarensis*. Our work is based on morphological and DNA data of *A. hazarensis* tadpoles and previously compiled molecular data sets (Hofmann et al. 2019, 2021). The study provides the first photographs of *A. hazarensis* larvae, supporting morphological data, and additional distribution records of the species.

Our new data mainly agree with previous descriptions (Dubois and Khan 1979; Khan and Malik 1987) in characterizing *A. hazarensis* tadpoles as typical ranoid type.

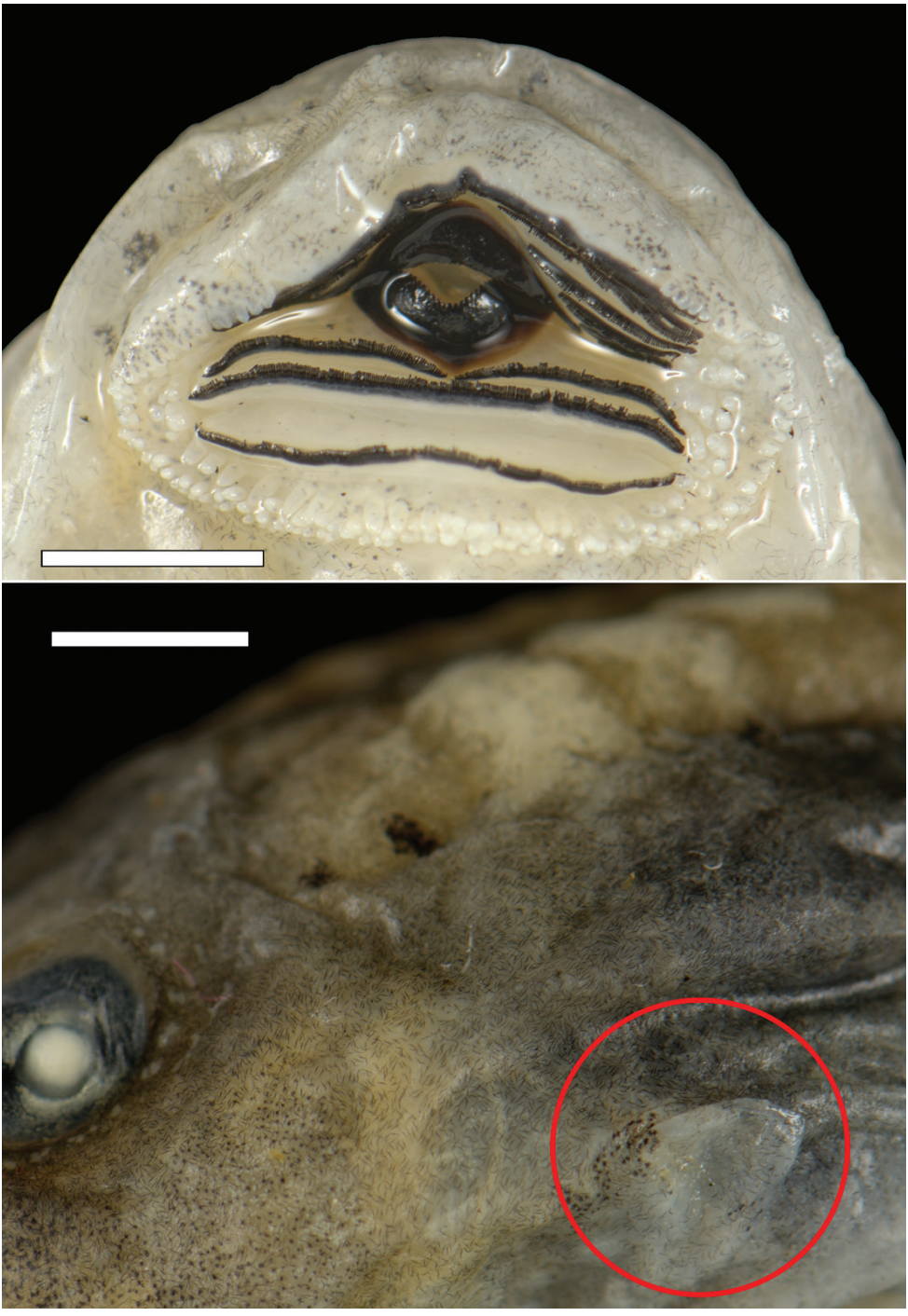

Figure 4. Close up of the oral disc and spiracle of a preserved tadpole of *Allopaa hazarensis* larva (ZFMK 103351; Gosner stage 26). Scale bars: 2 mm.

These larvae have a large body (19.8–25.3 mm) with a strong muscular tail. In the original description, body lengths of five tadpoles ranged between 13.7 and 25.3 mm (stages 25–42); Khan and Dubois (1987) reported 25 mm for 11 tadpoles at stage 40. The mouth is located almost ventrally but close to tip of snout. The oral disc is prominent, bordered by marginal papillae with a larger gap on the upper lip, with multiple submarginal papillae at the libs' commissure, and the serrated jaws are robust. The number of keratodonts varies between seven and eight in the anterior part of the mouth with A_2–A_n being discontinous rows, while three labial tooth rows are present in the posterior part (P_1 discontinous), which is consistent with the description of Khan and Malik (1987). However, in the original description, a tadpole at stage 25 with only six tooth rows on the upper labia has been also reported (Dubois and Khan 1979).

Based on the original description, *A. hazarensis* has been assumed to be most closely related to *Nanorana minica* (Dubois, 1995), which has been reported to occur in Indian Uttar Pradesh and Himachal Pradesh, and in western Nepal (Frost 2021). The tadpoles of the two species have been denoted to be "quite similar" (Dubois and Khan 1979). However, phylogenetically, *Allopaa* does not cluster together with geographically neighboring species of the subgenus *Paa* from India and Nepal, but with the subgenus *Chaparana* from montane regions of the southeastern margin of the Tibetan Plateau and mountains of NE China (Suppl. material 1: Fig. S2). This corroborates the strong morphological differences between adult *A. hazarensis* and *N. minica* and the lack of the typical characteristics of the subgenus *Paa* in *A. hazarensis*, namely, the very prominent secondary sex characters in males, and the large size and the low number of the eggs, which have been considered to represent adaptive features related to breeding in swiftly running torrents (Dubois and Khan 1979). All specimens mentioned in the present study were observed in pools (1–4 m in diameter) of small to medium-sized streams under warm-temperate conditions in the foothill to lower montane zone (comparable to those of its sister group *Chaparana*; Ohler et al. 2000; Che et al. 2010). Thus, given the habitats in which we found *A. hazarensis*, we agree with the assumption that, in contrast to *Paa*, this taxon is not truly a torrent species but occupies clear water pools of boulder-rich creeks (Dubois and Khan 1979). We also suspect that larvae of *A. hazarensis* can overwinter in shallow standing or flowing permanent waters, as we found tadpoles at early Gosner stages repeatedly in September, making it unlikely that they will metamorphose before the winter.

Our tadpoles differ significantly from those of *Nanorana vicina* (Stoliczka, 1872), which is endemic to uplands in northern Pakistan and India. Compared to *A. hazarensis*, the number of tooth rows on the upper labia of the *N. vicina* tadpoles is fewer (5 *vs.* 7 or 8; no difference on lower labia), and the submarginal papillae are not cumulated laterally (Gill et al. 2020). Furthermore, except for *N. taihangnica*, the keratodont row formula for the upper labia differs between *A. hazarensis* and *Chaparana* (*N. aenea*, *N. quadranus*, *N. unculuanus*, *N. yunnanensis*), several *Paa* species (*N. chayuensis*, *N. conaensis*, *N. maculosa*, *N. medogensis*, and all *Nanorana* species (*N. parkeri*, *N. pleskei*, *N. ventripunctata*; Fei et al. 2012; Chuaynkern et al. 2018). In contrast, tadpoles of the geographically neighboring *Chrysopaa sternosignata* share the same number of keratodonts on the upper and lower labia as *A. hazarensis* (Ohler and Dubois 2006).

Conclusions

The illustration and description of the tadpole of *A. hazarensis* should facilitate the identification of this species, for example, during tadpole surveys in Pakistan. As the tadpoles of this species need several weeks to even months to complete development, they can be often more easily detected than their adult conspecifics, both at night and during the day. The sparse knowledge about the genus *Allopaa*, and particularly of their larval stages, requires more research to utilize the valuable tadpole data, especially for monitoring and conservation efforts.

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Supplementary material 1

Tables S1, S2, Figures S1, S2

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Data type: occurences, morphological, and phylogenetic

Explanation note: List of *Allopaa hazarensis* specimens used in the present study; Measurements (in mm) and counts of voucher specimens (V-ID) of tadpole series of *Allopaa hazarensis*; Maximum-likelihood tree based on concatenated mtDNA and nuDNA sequence data; Tadpole (103351; Gosner stage 26) of *Allopaa hazarensis* from Buner, Pakistan.

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Census of the longhorn beetles (Coleoptera, Cerambycidae and Vesperidae) of the Macau SAR, China

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Abstract

An intensive census, extended over a period of approximately three and a half years, October 2017– May 2021, was conducted in the remaining green areas of the Macau SAR in order to provide an updated status of the biodiversity of longhorn beetles in this region. This insect group includes more than 36,000 species worldwide, subdivided into four families of mainly xylophagous or saproxylic insects, the Vesperidae, Oxypeltidae, Disteniidae, and Cerambycidae. They are of key importance in agricultural and forestry science, and are often used as an indicator of forest habitat health. A total of 52 species was recorded during this census, 2.6 times more than previously reported in the literature for this area. However, recorded abundances and frequency of occurrence for the various species were remarkably low, and of the 20 species previously reported for the region, some prominent ones remained unaccounted for. Among others, these include *Batocera horsfieldii* (Hope, 1839), *Apriona rugicollis* Chevrolat, 1852 [previously incorrectly reported as *Apriona germarii* (Hope, 1831)], *Aristobia reticulator* (Fabricius, 1781) [previously reported as *Aristobia testudo* (Voet, 1778)] and *Imantocera penicillata* (Hope, 1831). It is hypothesised that this may be related to the ongoing manipulation of the natural vegetation of the Macau SAR, which is rapidly being converted to plantations, city parks, and gardens. In particular, dead or dying trees and lower tree branches are systematically removed in order to improve the aesthetic appearance of these green areas. However, this process is also depriving xylophagous and saproxylic species of their essential habitats.

Keywords

Biodiversity, Cerambycidae, China, new records, Palaearctic Region, Vesperidae

Introduction

Longhorn beetles represent one of the largest groupings of extant insects with more than 36,000 species currently described worldwide (Leschen and Beutel 2014; Monné et al. 2017). The four families currently recognized within this grouping (Vesperidae, Oxypeltidae, Disteniidae, Cerambycidae) are part of the superfamily Chrysomeloidea. They have been often regarded as sufficiently distinct to possibly form a separate superfamily of Cerambycoidea, but this is not supported by results of mitochondrial genomic analysis (Nie et al. 2021). The predominantly xylophagous and saproxylic habits of their larval stages make them one of the most important groups of insects in the forestry and agricultural sciences. While crepuscular and nocturnal adult longhorn beetles are generally dull and sombre-coloured in their body aspect, diurnal species are mostly ornamented to brightly coloured species that use either Batesian mimicry or aposematism to protect themselves against potential predators (Švácha and Lawrence 2014). Also, with the exception of some Lamiinae, nocturnal species generally do not feed at the adult stage, while diurnal ones often seek high energy nutrition from either flowers, leaves, bark, fermenting fruits, or sap flows. Longhorn beetles are, therefore, important as pollinators but above all as recyclers of dead wood, and their diversity and abundance are used as indicators of forest habitat health (Švácha and Lawrence 2014).

Records of longhorn beetles from the Macau Special Administrative Region (SAR) of China are historically very scarce and, consequently, this territory normally does not feature in either the regional or global revisions of this insect group (e.g., Löbl and Smetana 2010; Danilevsky 2020). This sharply contrasts with the nearby Hong Kong SAR, where several comprehensive and dedicated publications have been produced to date on this insect group (e.g., Yiu 2009; Yiu and Yip 2011). To our knowledge, so far only two species have been described using Macau types and six published accounts have reported information on the species diversity of longhorn beetles in Macau. These include the earliest Gressitt's (1951) monograph, the early 1990's series by Easton (1991, 1992, 1993), the later general manual by Pun and Batalha (1997) and the recent catalogue by Lin and Yang (2019). Collectively, two species with type locality from Macau were included in Gressitt (1951), i.e., "*Chlorophorus macaumensis* (Chevrolat) and *Pterolophia annulata* (Chevrolat)", 10 species were then reported in the three works of Easton (1991–1993), namely: "*Anoplophora chinensis* (Forster), *Batocera rubus* (L.), *Imantocera penicillata* (Hope), *Olenecamptus bilobus*, *Aeolesthes induta* (Newman), *Aristobia approximator* (Thomson), *Pyrestes haematica* Pascoe, *Chelidonium sinense* (Hope), *Chlorophorus annularis* (Fabricius) and *Xystrocera globosa* (Olivier)". Pun and Batalha (1997), on the other hand, listed a total of 13 species, adding six new species on top of those already reported by Gressitt (1951) and Easton (1991–1993), namely: "*Apriona germari* (Hope), *Batocera horsfieldi* (Hope), *Glenea cantor* (Fabricius), *Megopis marginalis* (Fairmaire), *Oberea ferruginea* Thunberg and *Pothyne rugifrons* Gressitt". Two more species were finally added in the catalogue by Lin and Yang (2019), i.e., "*Pterolophia* (*Pterolophia*) *crassipes* (Wiedemann) and *Purpuricenus temminckii sinensis* White". Thus, the current total diversity formally reported in the literature for this group from Macau is 20 species.

The Macau SAR has a special local government structure within the "One Country – Two Systems" dispensation of 1999. It is a very prosperous region with per-capita incomes among the highest in the world. It is, however, also one of the most densely populated places on the planet and, consequently, under enormous residential and developmental pressure (Leong et al. 2017). Despite the massive urban development that the SAR has experienced over the last few decades, some pockets of natural vegetation still occur throughout its territory, albeit in a very fragmented manner and often encroached upon by alien species. These are mainly focused around 18 areas, where remnants of subtropical forest are currently administered as city parks and gardens, or in the largest cases as country parks. The ecological conditions of these areas are currently being assessed and biodiversity records are an essential component of this process, particularly in the field of terrestrial invertebrates for which there are still insufficient data available (cf. Direcção dos Serviços de Protecção Ambiental 2020). The main objective of this study is, therefore, to provide an updated account of the longhorn beetles of the Macau SAR, based on extended and frequent field surveys, comprehensive observation gathering methods and updated identification approaches using local and global expertise. Only three other similar studies have recently been completed for this region, on the ants (Hymenoptera, Formicidae) (Leong et al. 2017), the butterflies (Lepidoptera, Rhopalocera) (Department of Green Areas and Gardens, Municipal Affairs Bureau of Macao Special Administrative Region, Guangdong Institute of Applied Biological Resources 2019) and the fruit and flower chafers (Scarabaeidae, Cetoniinae) (Perissinotto and Clennell 2021), respectively. These will hopefully stimulate further research initiatives in the region and provide the local authorities with supporting information towards their ongoing environmental management and biodiversity conservation programmes. A recent survey undertaken by the authorities has shown that the overwhelming majority of the Macau population (i.e., 79% of questionnaire returns) regards as a priority the maintenance of the ecological integrity and biodiversity of its green areas (Direcção dos Serviços de Protecção Ambiental 2020).

Materials and methods

The Macau SAR of China is biogeographically part of the Palaearctic Region, but is characterised by a subtropical climate and is close to the interface with the Oriental Region. Thus, many species that occur within its boundaries are actually also found further south and are shared with the latter region. Although the area has undergone extreme urban transformation during the last few decades, some pockets of its natural terrestrial vegetation still remain. Their plant assemblages include five vegetation types, namely coniferous forest, coniferous and broad-leaved mixed forest, evergreen broad-leaved forest, evergreen and deciduous broad-leaved mixed forest, and shrub (Peng et al. 2014; Direcção dos Serviços de Protecção Ambiental 2020).

Physically, the Macau SAR occupies a total area of ca. 30 km^2 (Leong et al. 2017), which includes the Macau Peninsula, linked directly to the mainland province of

Figure 1. Map of the Macau SAR showing its various components including the Peninsula, the islands of Taipa and Coloane, as well as the reclaimed lands of Cotai, the International Airport, and the Hong Kong – Zhuhai – Macau Bridge Port (adapted from https://www.britannica.com; used with permission).

Guangdong, and one larger island resulting from the merger of the two previously separated islands of Taipa (Cantonese: Tam Chai) and Coloane (Cantonese: Lou Wan) through the land reclaimed area of Cotai (Cantonese: Lou Tam) (Fig. 1). Land reclamation is an ongoing activity in the SAR, and since 1995 both the International Airport and the Hong Kong-Zhuhai-Macau Bridge Port have been added through this process to the Taipa-Coloane island complex and the Peninsula, respectively (Fig. 1). The remaining pockets of semi-natural landscape are often encroached upon by alien vegetation (Leong et al. 2017). They consist mainly of densely forested hilly outcrops intersected by networks of hiking trails, service roads and recreational facilities. The largest among the 18 areas identified are located in the Coloane area (e.g., Alto de

Coloane, Barragem de Ká-Hó, and Monte de Ká-Hó) and Taipa (Taipa Grande and Taipa Pequena), but there are lesser pockets in the Peninsula as well (e.g., Colina da Guia, Colina da Barra, Parque Municipal de Mong Há, and Ilha Verde) (Figs 1, 2; cf. Direcção dos Serviços de Protecção Ambiental 2020). All these sites were visited on a regular basis during the census period, in order to provide an areal cover as comprehensive as possible of the potential habitats for longhorn beetles within the SAR.

Considering the exclusive either diurnal or nocturnal activity of most adult longhorn beetles, observations were undertaken during both daylight hours and at night. Flowers, dead trees and freshly cut branches were inspected during the hottest part of the day, in order to maximise potential encounters with beetles during their peak period of diurnal activity. At night, searches were limited to particularly brightly illuminated areas at the periphery of town, including street lights, public ablution blocks and monument spot-lights. Observations were made on an opportunistic basis from October 2017 and virtually on a daily basis during the period October 2018–May 2021. This generally involved non-manipulative methods, with photographs taken in situ as much as possible. No light traps were used, but the UV-based electric mosquito traps mounted by the authorities in each public ablution block were regularly inspected during the census. Where possible, electrocuted beetles were removed from the traps and preserved as voucher specimens for reference and identification verification purposes, along with other specimens retrieved already dead or moribund in the field. All specimens were analysed in detail and identified at the Key Laboratory of Zoological Systematics and Evolution of the Chinese Academy of Sciences in Beijing. Most of these specimens are now deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences (**IZCAS**, Beijing), while smaller collections are also housed in the Macau Anglican College (**MACT**, Taipa). Specimens from older collections housed in the Library of the University of Macau (Easton Collection, **UMEC**), at the Macau Municipal Affairs Bureau ("Collection de Instituto para os Assuntos Municipais" **CIAM**, Coloane) and at the Sun Yat-Sen University (**SYSU**, Guangzhou) were also included in the analysis.

Observations and data records were also obtained from the citizen science platform iNaturalist (https://www.inaturalist.org) and the following literature references: Easton (1991, 1992, 1993) and Pun and Batalha (1997).

As far as possible, photos of specimen dorsal and lateral habitus were taken in situ using a Nikon CoolPix S9700 digital camera with macro setting. However, when this was not practical in the field, specimens were photographed and measured under controlled conditions. Also, on rare occasions visual disturbances were removed from the photos using Microsoft Word 2010 (Picture Tools), in order to increase clarity and resolution of the images. All the species recorded during the census in the Macau SAR are illustrated with photos of live specimens in their natural or reconstructed setting, highlighting their key dorsal and, where possible, lateral characters. Specimen body length and maximum width were measured using a Vernier caliper, from the anterior margin of the mandibles to the apex of the pygidium and at the widest point of the elytra or pronotum, respectively. All measurements were approximated to the closest 0.5 mm. Within the text, only the original name, the essential synonyms and the currently recognised names are

Figure 2. Examples of remaining pockets of subtropical evergreen forest in Macau **A** Guia Hill (Macau Peninsula) **B** Barra Hill (Macau Peninsula) **C** Great Taipa (Taipa) **D** Little Taipa (Taipa) **E** Coloane Heights (Coloane) **F** Ká-Hó Mountain (Coloane). Photographs: **A** Wikiwand.com **C** JTM.co.mo **B** culturalheritage.mo **C–E** LC **F** Hio Lou Chang.

listed under each taxon, while for a comprehensive list of synonyms the reader is referred to the Catalogue of Chinese Coleoptera Volume IX, by Lin and Yang (2019), and the latest revision of the Catalogue of the Palaearctic Coleoptera, Volume 6/1, by Danilevsky (2020). The taxonomic structure used in these two catalogues is also followed in this work whenever an unresolved or controversial tribal or generic position exists, either in the literature or in the experts' discussion forums. Type Locality (**TL**) and Type Depository (**TD**) are reported for each species along with their known distribution range, information on host plants, and other biological notes when available.

Public collections depositories of historical type material are abbreviated as follows:

AMNH American Museum of Natural History, New York, USA;
NHMUK Natural History Museum, London, United Kingdom;
BPBM Bernice Pauahi Bishop Museum, Honolulu, USA;

CASF	California Academy of Sciences, San Francisco, USA;
EMHU	Entomological Museum of Hokkaido University, Sapporo, Japan;
LSLU	Linnean Society of London, London, United Kingdom;
MNHN	Muséum national d'Histoire naturelle, Paris, France;
MNLI	Museum für Naturkunde am Leibniz Institut für Evolutions und Biodiversitätsforschung, Berlin, Germany;
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden;
NSMT	National Science Museum, Tokyo, Japan;
OXUM	Hope Entomological Collections, University Museum, Oxford, United Kingdom;
SFNF	Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany;
UZIU	Universitets Zoologiska Institutionen, Uppsala, Sweden;
ZMUC	Zoologisk Museum Københavns Universitet, Copenhagen, Denmark.

Results

Historical and updated checklists

Gressitt (1951): 2 species

1) *Chlorophorus macaumensis* (Chevrolat)
2) *Pterolophia* (*Hylobrotus*) *annulata* (Chevrolat)

Easton (1991–1993): 10 species

1) *Anoplophora chinensis* (Forster)
2) *Batocera rubus* (Linnaeus)
3) *Imantocera penicillata* (Hope)
4) *Olenecamptus bilobus* (Fabricius)
5) *Aeolesthes induta* (Newman)
6) *Aristobia approximator* (Thomson)
7) *Pyrestes haematica* Pascoe
8) *Chelidonium sinense* (Hope)
9) *Chlorophorus annularis* (Fabricius)
10) *Xystrocera globosa* (Olivier)

Pun and Batalha (1997): 13 species

1) *Anoplophora chinensis* (Forster)
2) *Apriona germari* (Hope)
3) *Batocera horsfieldi* (Hope)

4) *Batocera rubus* (Linnaeus)
5) *Chlorophorus annularis* (Fabricius)
6) *Glenea cantor* (Fabricius)
7) *Imantocera penicillata* (Hope)
8) *Megopis marginalis* (Fairmaire)
9) *Oberea ferruginea* Thunberg
10) *Olenecamptus bilobus tonkinus* Dillon & Dillon
11) *Pothyne rugifrons* Gressitt
12) *Pterolophia annulata* (Chevrolat)
13) *Xystrocera globosa* (Olivier)

Lin and Yang (2019): 5 species

1) *Chlorophorus macaumensis* (Chevrolat)
2) *Glenea* (*Stiroglenea*) *cantor* (Fabricius)
3) *Pterolophia crassipes* (Wiedemann)
4) *Pterolophia* (*Hylobrotus*) *annulata* (Chevrolat)
5) *Purpuricenus temminckii sinensis* White

This Study, 2017–2021: 52 species

1) *Philus antennatus* (Gyllenhal, 1817)
2) *Philus pallescens pallescens* Bates, 1866
3) *Aegolipton marginale* (Fabricius, 1775)
4) *Cephalallus unicolor unicolor* (Gahan, 1906)
5) *Chelidonium argentatum* (Dalman, 1817)
6) *Embrikstrandia unifasciata* (Ritsema, 1896)
7) *Polyzonus sinensis* Hope, 1842
8) *Ceresium elongatum elongatum* Matsushita, 1933
9) *Ceresium longicorne* Pic, 1926
10) *Ceresium sinicum ornaticolle* Pic, 1907
11) *Ceresium zeylanicum* Yokoi, 2015
12) *Trirachys indutus* (Newman, 1842)
13) *Rhytidodera integra* Kolbe, 1886
14) *Chlorophorus annularis* (Fabricius, 1787)
15) *Chlorophorus macaumensis macaumensis* (Chevrolat, 1845)
16) *Demonax bimaculicollis* (Schwarzer, 1925)
17) *Perissus indistinctus* Gressitt, 1940
18) *Stromatium longicorne* (Newman, 1842)
19) *Kuegleria annulicornis* (Pic, 1935)
20) *Nysina rufescens asiatica* (Schwarzer, 1925)
21) *Pyrestes haematicus* Pascoe, 1857

22) *Purpuricenus temminckii sinensis* White, 1853
23) *Xystrocera globosa* (Olivier, 1795)
24) *Rondibilis undulata* (Pic, 1922)
25) *Apomecyna longicollis longicollis* Pic, 1926
26) *Apomecyna saltator* (Fabricius, 1787)
27) *Ropica dorsalis* Schwarzer, 1925
28) *Sybra marmorea* Breuning, 1939
29) *Sybra posticalis* (Pascoe, 1858)
30) *Batocera rubus rubus* (Linnaeus, 1758)
31) *Pseudoterinaea bicoloripes* (Pic, 1926)
32) *Sophronica apicalis* (Pic, 1922)
33) *Zotalemimon ciliatum* (Gressitt, 1942)
34) *Olenecamptus taiwanus* L.S. Dillon & D.S Dillon, 1948
35) *Exocentrus alboguttatus subconjunctus* Gressitt, 1940
36) *Exocentrus formosofasciolatus* Kusama & Tahira, 1978
37) *Bumetopia oscitans* Pascoe, 1858
38) *Coptops licheneus* (Pascoe, 1865)
39) *Anoplophora chinensis chinensis* (Forster, 1771)
40) *Blepephaeus subcruciatus* (White, 1858)
41) *Blepephaeus succinctor* (Chevrolat, 1852)
42) *Eutaenia tanoni* Breuning, 1962
43) *Monochamus alternatus alternatus* Hope, 1842
44) *Desisa subfasciata* (Pascoe, 1862)
45) *Mispila tholana* (Gressitt, 1940)
46) *Prosoplus bankii* (Fabricius, 1775)
47) *Pterolophia kaleea inflexa* Gressitt, 1940
48) *Pterolophia consularis* (Pascoe, 1866)
49) *Pterolophia* (*Hylobrotus*) *annulata* (Chevrolat, 1845)
50) *Glenea* (*Stiroglenea*) *cantor cantor* (Fabricius, 1787)
51) *Oberea ferruginea* (Thunberg, 1787)
52) *Oberea walkeri* Gahan, 1894

Taxonomic account

Family VESPERIDAE Mulsant, 1839
Subfamily Philinae J. Thomson, 1861
Tribe Philini J. Thomson, 1861

Genus *Philus* Saunders, 1853: 110.

Type species. *Philus inconspicuus* Saunders, 1853 (= *Stenochorus antennatus* Gyllenhal, 1817).

***Philus antennatus* (Gyllenhal, 1817)**
Fig. 3

Stenochorus antennatus Gyllenhal, 1817: 180. TL: India ("orientali"); TD: NHRS

Distribution. Palaearctic Region: China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangxi, Shaanxi, Shandong, Taiwan, Zhejiang) (Yiu 2009; Danilevsky 2020). Oriental Region: India (eastern) (Gressitt 1951; Švácha et al. 1997).

Macau records. São Francisco Xavier, Ilhas [Coloane], 1 May 2021 8:37, Kisu Wong (https://www.inaturalist.org/observations/76970773); Coloane, Barragem de Ká-Hó, 1 May 2021 8:30, Wai Chan (https://www.inaturalist.org/observations/76102979).

Remarks. Only two observations of male specimens from Macau could be found in the citizen science platform iNaturalist, but unfortunately the accompanying data did not contain any information about their size or habits. A third observation of a female specimen could not be confirmed due to the poor resolution of the photograph (https://www.inaturalist.org/observations/78005663). On Plate IV of Hua et al. (2009), the male represented in Fig. 40 is actually that of *Philus pallescens*, while the females in Fig. 40 and Fig. 41 represent the same specimen of *P. antennatus*. Unfortunately, their figure legends on p. 4 reflect this mistake. In Hong Kong, specimens attain a total length within the range of 24–31 mm (Yiu 2009). The mature larva of this species has been comprehensively described by Švácha et al. (1997) and feeds on the roots of a range of plants, including cultivated species such as *Citrus* spp., *Morus alba*, *Pinus elliottii*, and *P. taeda*, to which it can

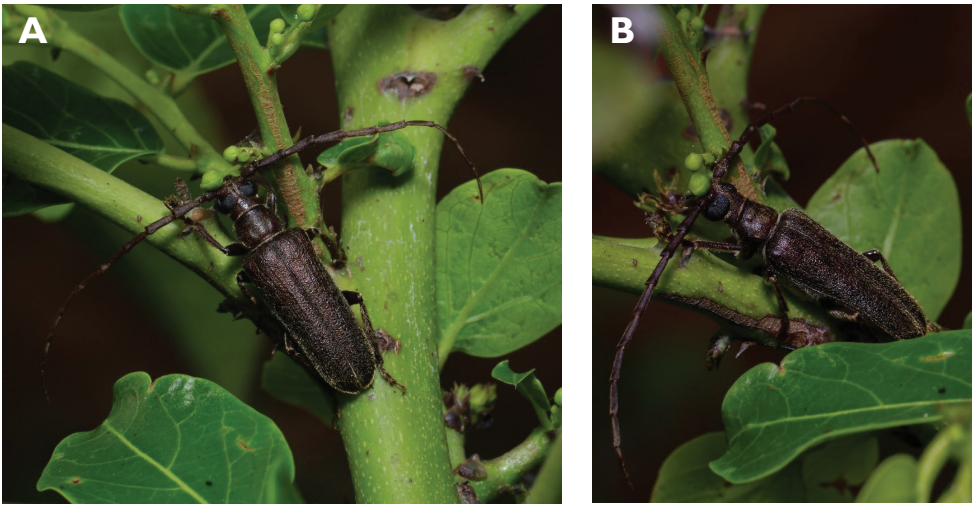

Figure 3. *Philus antennatus* (Gyllenhal, 1817): dorsal (**A**) and lateral (**B**) views of specimen observed in the Ká-Hó area of Coloane, on 1 May 2021 (photographs: Kisu Wong).

cause serious damage and death in young trees (Gressitt 1951; Chen et al. 1959; Švácha et al. 1997).

Philus pallescens pallescens Bates, 1866

Fig. 4

Philus pallescens Bates, 1866: 350. TL: China (Taiwan); TD: MNHN
Philus cantonensis Pic, 1930: 14. TL: China ("Canton"); TD: MNHN

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Henan, Hong Kong, Hubei, Hunan, Inner Mongolia, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Zhejiang) (Lin and Yang 2019; Danilevsky 2020).

Macau records. Coloane, Hác-Sá, crushed under street light, 5 May 2018, R Perissinotto & L Clennell; ibidem 10 May 2019, electrocuted inside UV mosquito trap of ablution block, R Perissinotto (IZCAS); ibidem 1 Jun 2020 outside ablution block, R Perissinotto.

Remarks. The size of this species in Macau ranges 18–23 mm in total length and 5–7 mm in maximum width. In the Macau SAR, this species is very scarce and has only been recorded in late spring and always in the Hác-Sá area of Coloane. Like in all Vesperidae, the larvae are presumably subterranean, feeding on root sapwood and pupating within the soil (Švácha and Lawrence 2014). According to Hua (2002), host plants for the species include *Citrus* and *Saccharum sinensis*.

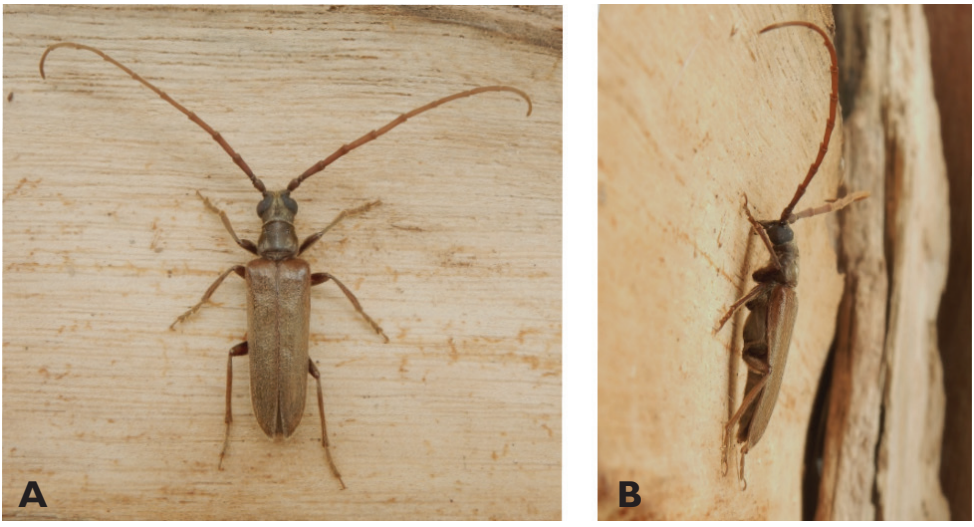

Figure 4. *Philus pallescens pallescens* Bates, 1866: dorsal (**A**) and lateral (**B**) views of specimen observed at Hác-Sá, Coloane, on 1 Jun 2020 (photographs: LC).

Family CERAMBYCIDAE Latreille, 1802
Subfamily Prioninae Latreille, 1802
Tribe Aegosomatini J. Thomson, 1861

Genus *Aegolipton* Gressitt, 1940: 22.

Type species. *Cerambyx marginalis* Fabricius, 1775.

***Aegolipton marginale* (Fabricius, 1775)**
Fig. 5

Cerambyx marginalis Fabricius, 1775: 169. TL: "Cap Bonae Spei"; TD: NHMUK

Distribution. Palaearctic Region: China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, Yunnan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Indonesia (Java, Sumatra, Borneo-Kalimantan, Sulawesi, Ambon); Laos; Myanmar; Thailand; Vietnam (Kumawat et al. 2015).

Macau records. 1♂, Taipa, 1 Jun 1988, WW Pun, *Megopis marginalis* (CIAM); 1♀, Coloane, 26 Jul 1989, WW Pun, *Megopis marginalis* (CIAM); No data, "*Megopis marginalis* (Fairmaire), 毛角薄翅天牛28 mm" (Pun and Batalha 1997: 65, fig. 101); Taipa Grande, 2 May 2018, under street light, R Perissinotto & L Clennell; Macau, Guia Hill, 12 May 2019, under light in ablution block, R Perissinotto & L Clennell (IZCAS); Coloane Village, 14 May 2020, under light outside ablution block,

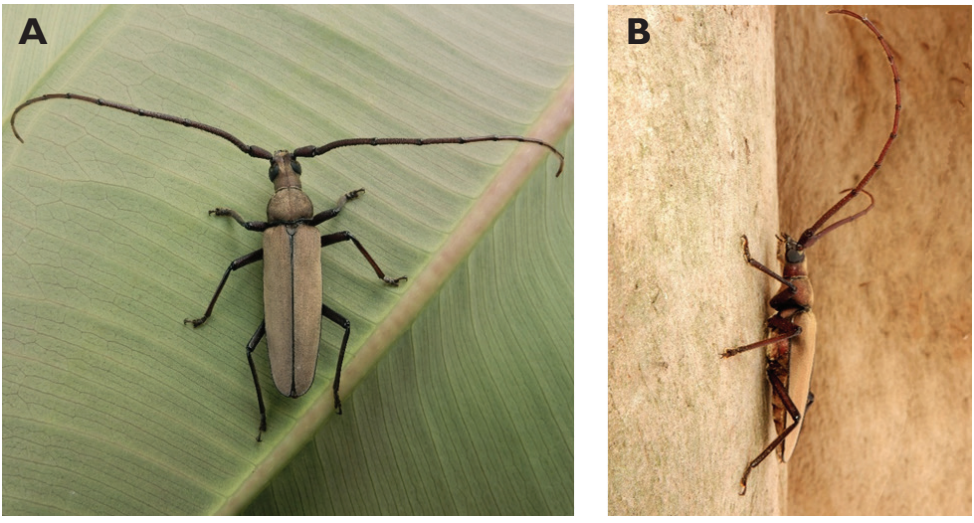

Figure 5. *Aegolipton marginale* (Fabricius, 1775): dorsal (**A**) and lateral (**B**) views of specimens observed on Guia Hill (12 May 2019) and Coloane Village (14 May 2020), respectively (photographs: LC).

R Perissinotto & L Clennell (MACT); Coloane, Caminho do Quartel de Hác-Sá, 5 May 2019 16:16, Jay Airosa (https://www.inaturalist.org/observations/28923060); Coloane, A-Má Goddess Statue, 16 May 2020 21:06, keanu83225 (https://www.inaturalist.org/observations/47820472); St. Francis Xavier's Parish, [Coloane], 16 May 2020 21:20, Kisu Wong (https://www.inaturalist.org/observations/53851807); Our Lady of Carmel's Parish [Great Taipa], 12 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/78523372).

Remarks. The size of this species in Macau ranges 28–38 mm in total length and 8–11 mm in maximum width. Like most prionines, this is an exclusively crepuscular and nocturnal species with activity in Macau restricted to the spring months. It is promptly attracted to artificial light, under which it often remains hidden throughout the daytime. Hua (2002) reported as host plants for this species *Casuarina equisetifolia*, *Cryptomeria fortunei*, *Eucalyptus exserta*, *Morus alba*, *Paulownia* sp., *Pinus* sp. and *Vernicia fordii*.

Subfamily Spondylidinae Audinet-Serville, 1832
Tribe Asemini J. Thomson, 1861

***Genus Cephalallus* Sharp, 1905: 148.**

Type species. *Cephalallus oberthueri* Sharp, 1905.

***Cephalallus unicolor unicolor* (Gahan, 1906)**
Fig. 6

Criocephalus unicolor Gahan, 1906: 97. TL: India (North Khasi Hills); TD: NHMUK.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guizhou, Hainan, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Sichuan, Taiwan, Yunnan, Zhejiang); Japan; Mongolia; North and South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India (Assam); Laos; Myanmar (Kariyanna et al. 2017).

Macau records. Macau, University of East Asia, Block I, 17 Aug 1989, ER Easton leg (UMEC); ibidem Block F, 25 Apr 1991, ER Easton leg (UMEC); ibidem [no data], ER Easton leg (UMEC); Great Taipa, 11 Apr 2019, R Perissinotto; Coloane Heights, A-Má Statue, 1 Apr 2020, R Perissinotto; ibidem 9 Nov 2020, under spotlight, R Perissinotto (IZCAS); ibidem, A-Má Cultural Village, 17 May 2020, R Perissinotto & L Clennell (MACT); Coloane Village, 14 May 2020, under light in ablution block, R Perissinotto & L Clennell (MACT); [Taipa] Our Lady of Carmel's Parish, 4 Apr 2020 22:59, Kit Chang (https://www.inaturalist.org/observations/41601849); ibidem 4 Apr 2020 21:15, Kisu Wong (https://www.inaturalist.org/observations/49550023); ibidem 23 Jul 2020 1:24, Kit Chang (https://www.inaturalist.org/observations/53971681); ibidem 3 Apr 2021 16:27, Lynette Clennell (https://www.inaturalist.org/observa-

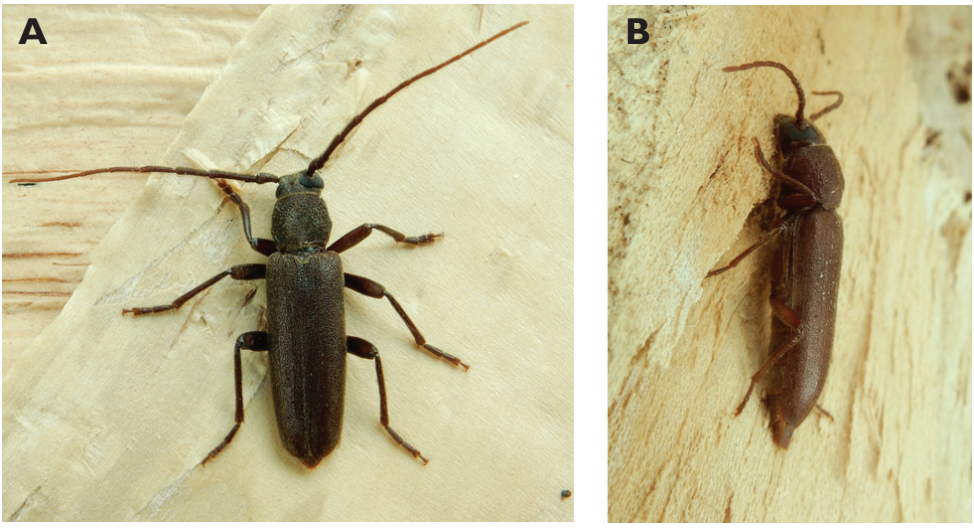

Figure 6. *Cephalallus unicolor unicolor* (Gahan, 1906): dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa (11 Apr 2019) and Coloane Village (1 Apr 2020), respectively (photographs: LC).

tions/72763759); [Coloane] St. Francis Xavier's Parish, 26 Apr 2020 23:52, Kisu Wong (https://www.inaturalist.org/observations/43868265); ibidem Apr 27 2020 12:45, Kit Chang (https://www.inaturalist.org/observations/43868614); ibidem 30 May 2020 1:22, Kit Chang (https://www.inaturalist.org/observations/47765485).

Remarks. This species varies remarkably in size, from 12–21 mm in total length, to 3–5 mm in maximum width. In Macau, adults are active throughout the warmer parts of the year, from April till November. Larvae are reported to develop in pine trees, *Pinus* spp. (Yiu 2009; Lim et al. 2014) but have not been reported as causing damage to plantations or becoming invasive.

Subfamily Cerambycinae Latreille, 1802
Tribe Callichromatini Swainson & Shuckard, 1840

Genus *Chelidonium* J. Thomson, 1864: 175.

Type species. *Cerambyx argentatus* Dalman, 1817.

***Chelidonium argentatum* (Dalman, 1817)**
Fig. 7

Cerambyx argentatus Dalman, 1817: 151. TL: Unknown; TD: NHRS

Distribution. Palaearctic Region: China (Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Hainan, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi,

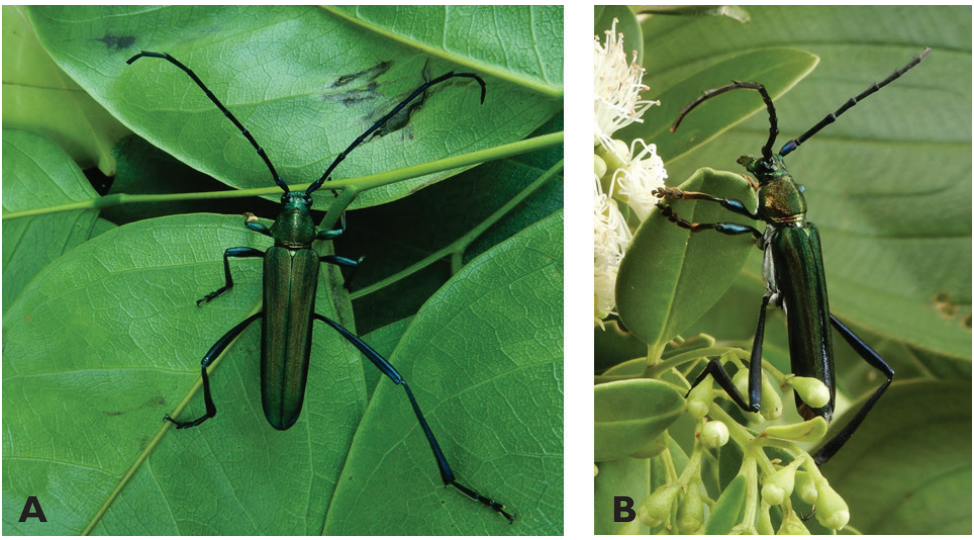

Figure 7. *Chelidonium argentatum* (Dalman, 1817): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights (22 May 2019) and Coloane Village (22 May 2020), respectively (photographs: LC).

Ningxia, Sichuan, Shaanxi, Taiwan, Yunnan, Zhejiang); India (Sikkim) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Laos; Myanmar; Sri Lanka; Vietnam (Kariyanna et al. 2017).

Macau records. Taipa, University of East Asia Campus, 28 May 1992, on wall of Tai Fung building and 30 May 1992 outside classroom CLG 401, "*Chelidonium sinense* (Hope)" (Easton 1992: 35; Easton 1993: 47); Coloane, 30 May 2000, ML Lei (CIAM); Coloane, Cheoc-Van, 15 May 2019, on coastal vegetation, R Perissinotto; Coloane Heights, 22 May 2019, dead on path, R Perissinotto (IZCAS); ibidem 17 Jun 2020, on flowers of *Acronychia pedunculata*, R Perissinotto; ibidem 29 Jun 2020, R Perissinotto & L Clennell; Coloane Village, 22 May 2020, on flowers of *Psychotria serpens*, R Perissinotto (IZCAS); Coloane, Ká-Hó coast, 26 May 2020, on flowers of *Syzigium buxifolium*, R Perissinotto (MACT); ibidem 3 Jun 2020, R Perissinotto; Estrada do Alto de Coloane, 2 May 2021 9:45, jbsandsmacau (https://www.inaturalist.org/observations/77236125); St. Francis Xavier's Parish [Coloane], 5 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/77700701).

Remarks. The size of this species in Macau ranges 24–31 mm in total length and 5–7 mm in maximum width. Adults are active during the hottest part of the day during May–June and have been observed while feeding on flowers of *Acronychia pedunculata*, *Psychotria serpens*, *Dalbergia benthamii*, and *Syzigium buxifolium* (RP pers. obs.). In nearby Hong Kong, larvae of this species have been recorded boring into the wood of citrus plants (Yiu 2009). More specifically, host plants include *Citrus aurantifolia*, *C. aurantium*, *C. limonia*, *C. microcarpa*, *C. reticulata* and *Fortunella margarita* (Duffy 1968; Makihara et al. 2008).

Genus *Embrikstrandia* Plavilstshikov, 1931: 278.

Type species. *Callichroma bimaculatum* White, 1853.

***Embrikstrandia unifasciata* (Ritsema, 1896)**
Fig. 8

Zonopterus unifasciatus Ritsema, 1896: 376. TL: Vietnam (Annam); TD: MNHN.

Distribution. Palaearctic Region: China (Anhui, Fujian, Gansu, Guangdong, Guangxi, Hainan, Henan, Hong Kong, Hubei, Hunan, Jiangxi, Sichuan, Shanxi, Taiwan, Zhejiang); India (Sikkim) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India (Assam); Laos; Vietnam (Huang et al. 2006).

Macau records. Coloane, Ká-Hó near lighthouse, 1 Jun 2020, on flowers of *Syzigium buxifolium*, R Perissinotto; Coloane, A-Mà Cultural Village, 17 Jun 2020, on flowers of *Acronychia pedunculata*, R Perissinotto (IZCAS); St. Francis Xavier's Parish [Coloane], 20 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/79506657).

Remarks. In Macau, this species has a total length of 21–27 mm and a maximum width of 6–8.5 mm. Three out of a total of four specimens observed during the study exhibit an expanded pale-yellow band across the elytra reaching all the way to the basal margin (Fig. 8), in a similar fashion to that shown by *Embrikstrandia vivesi* Bentanachs, 2005. However, the antennal segments 1–4 and all the legs are entirely black as is typical of *E. unifasciata*. Adult specimens appear to be active only in May–June and feed on flowers of *Syzigium buxifolium*, *Dalbergia benthamii* and *Acronychia pedunculata*

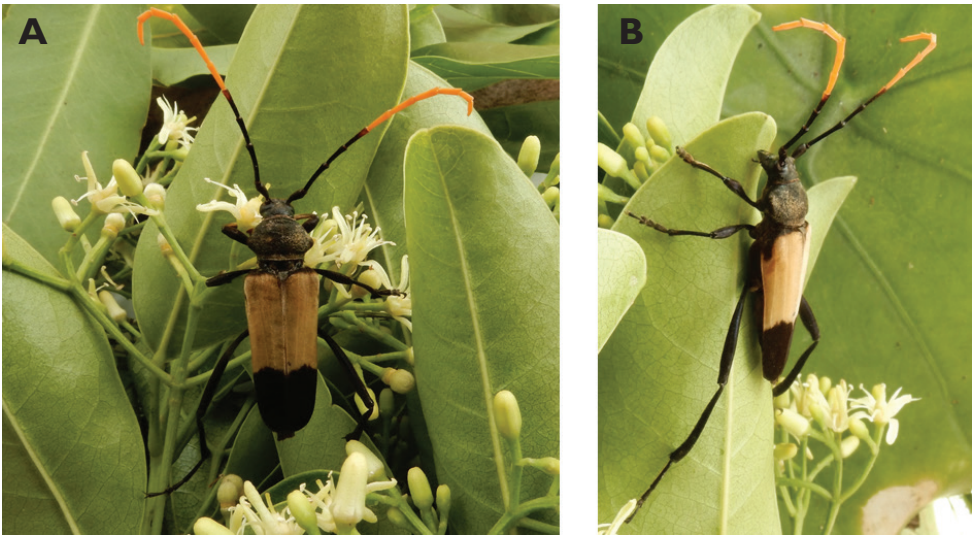

Figure 8. *Embrikstrandia unifasciata* (Ritsema, 1896): dorsal (**A**) and lateral (**B**) views of specimen observed on Coloane Heights on17 Jun 2020 (photographs: LC).

during the hottest part of the day. In nearby Hong Kong, where this species has been erroneously reported as the related species *E. bimaculata* (White, 1853) (cf. Huang et al. 2006; Yiu 2009; Yiu and Yip 2011), larvae have been reported to bore into wood of *Zanthoxylum* sp. and *Tetradium glabrifolium* (Yiu 2009).

Genus *Polyzonus* Dejean, 1835: 324.

Type species. *Saperda fasciata* Fabricius, 1781

***Polyzonus sinensis* (Hope, 1842)**
Fig. 9

Promeces sinensis Hope, 1842: 63. TL: China (Guangdong); TD: MNHN.

Distribution. Palaearctic Region: China (Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Hunan, Jiangxi, Jilin, Liaoning, Sichuan, Taiwan, Yunnan); India (Sikkim) (Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Myanmar; Thailand; Vietnam (Lin and Yang 2019).

Macau records. Coloane, 20 May 1994, MW Ng (CIAM); Parque Natural de Taipa Grande, 24 May 2020 5:36, Wai Chan (https://www.inaturalist.org/observations/70479773); ibidem 8 May 2021 17:07, Kit Chang (https://www.inaturalist.org/observations/77868888); Great Taipa, 8 May 2021, perched on leaves on road margin, R Perissinotto & Lynette Clennell (IZCAS).

Remarks. Easton (1993) reported this species as "*Chelidonium sinense* (Hope)" but it seems most likely that the main species involved in his observations was actually

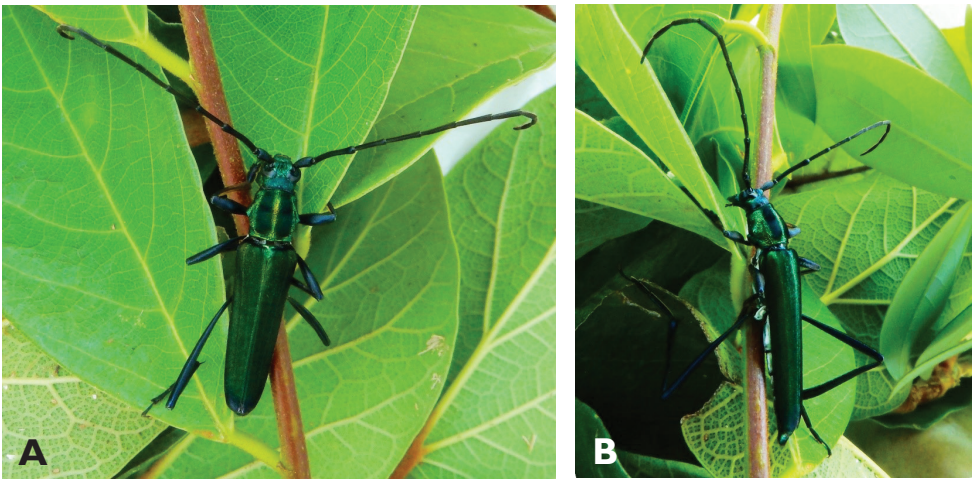

Figure 9. *Polyzonus sinensis* (Hope, 1842): dorsal (**A**) and lateral (**B**) views of specimen observed on Great Taipa Hill on 8 May 2021 (photographs: LC).

C. argentatum and not *Polyzonus sinensis*, given the laterally expanded metatibia and short tarsal segments exhibited by the typical specimen illustrated in his work (Easton 1993: 47). During the current census, *P. sinensis* was only observed on three occasions and always on Great Taipa Hill. The total length of these specimens varies between 23 and 26 mm, while their maximum width lies in the range of 5–6 mm. Adult specimens appear to have their peak of activity in May and have so far only been observed feeding on flowers of *Schima superba* during the hottest part of the day. Yiu (2009) reported that in Hong Kong the larvae of this species bore into *Citrus* plants and Hua (2002) also listed *Acacia* spp. as host plants in its broader distribution range.

Tribe Callidiopini Lacordaire, 1868

Genus *Ceresium* Newman, 1842a: 322.

Type species. *Ceresium raripilum* Newman, 1842.

***Ceresium elongatum elongatum* Matsushita, 1933**
Fig. 10

Ceresium elongatum Matsushita, 1933: 301. TL: Japan (Okinawa); TD: EMHU

Distribution. Palaearctic Region: China (Hong Kong, Taiwan); Japan (Ryukyus) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

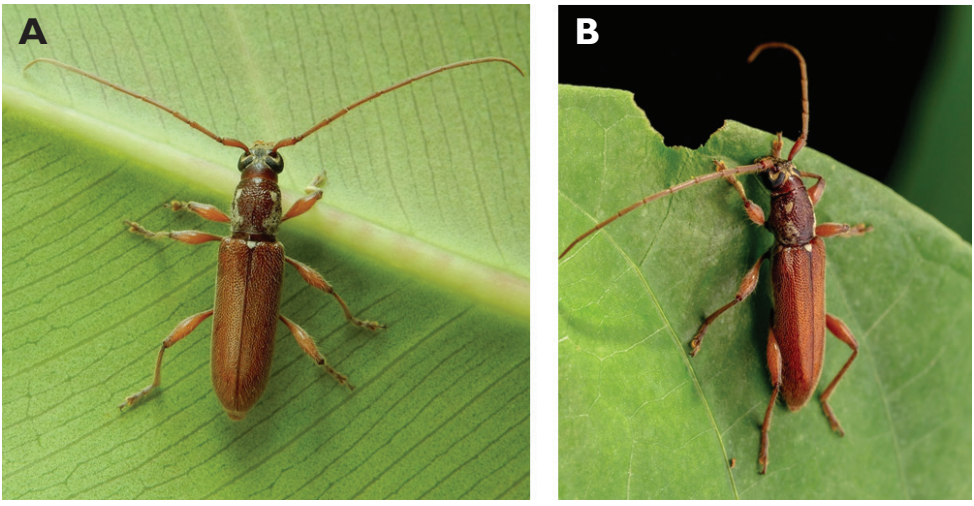

Figure 10. *Ceresium elongatum elongatum* Matsushita, 1933: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa Hill (13 May 2019) and on Guia Hill (2 Jun 2020), respectively (photographs: **A** LC **B** Benny Kuok).

Macau records. Great Taipa, 13 May 2019, under light in ablution block, R Perissinotto & L Clennell; Coloane Village, 19 May 2019, among flowers of *Psychotria serpens*, R Perissinotto & L Clennell (IZCAS); [Guia Hill] St. Lazarus' Parish, 1 Jun 2020 22:36, Kit Chang (https://www.inaturalist.org/observations/48249964); ibidem 2 Jun 2020, Benny Kuok (https://www.inaturalist.org/observations/48308902); [Coloane] St. Francis Xavier's Parish, 16 May 2020 21:25, Kit Chang (https://www.inaturalist.org/observations/46100618); ibidem 24 May 2020 23:14, Kit Chang (https://www.inaturalist.org/observations/47149856).

Remarks. This species varies in the range of 10–14 mm in total length and 2–3 mm in maximum width. In Macau, adults appear to be active mainly during late spring, in May–June, and like those of the other species in this genus they are promptly attracted to artificial light during night-time, but are also occasionally seen during the day, hidden, and possibly feeding inside thick inflorescences. In Hong Kong, the larval stages of this species are known to develop within the wood of *Citrus* spp. and *Morus alba* (Yiu 2009).

Ceresium longicorne Pic, 1926

Fig. 11

Ceresium longicorne Pic, 1926: 24. TL: China (Taiwan); TD: MNHN

Distribution. Palaearctic Region: China (Hong Kong, Hubei, Jiangxi, Taiwan); Japan; South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Figure 11. *Ceresium longicorne* Pic, 1926: dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights on 24 May 2019 and 2 May 2020, respectively (photographs: **A** LC **B** Kit Chang).

Macau records. 1♀, Coloane, 11 Aug 1993, *Melia azedarach*, WW Pun (CIAM); Great Taipa, 1 Apr 2019, under light in ablution block, R Perissinotto & L Clennell (IZCAS); 1♀, Coloane Village, 19 May 2019, at light in ablution block, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 24 May 2019, R Perissinotto; Coloane Village, 13 Jun 2020, under light in ablution block, R Perissinotto & L Clennell; [Coloane] St. Francis Xavier's Parish, 2 May 2020 1:06, Kit Chang (https://www.inaturalist.org/observations/44572787); ibidem 24 May 2020 21:05, Kisu Wong (https://www.inaturalist.org/observations/54388846); ibidem 30 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/81141600).

Remarks. In Macau, adults of this species are active throughout the spring and are generally found in proximity to artificial lights at night. Their range in total length is 9–11 mm, and 1.5–3 in maximum width. In nearby Hong Kong, larvae of this species bore into *Citrus* spp. plants (Yiu 2009). Other larval host plants include *Diospyros kaki*, *Mallotus japonicas*, *Quercus acuta* (Lim et al. 2014), and in Japan even cultivated *Prunus salicina* (Kusigemati 1985).

Ceresium sinicum ornaticolle Pic, 1907

Fig. 12

Ceresium ornaticolle Pic, 1907: 20. TL: China (Yunnan); TD: MNHN.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shanxi, Sichuan, Xizang, Yunnan, Zhejiang) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Vietnam (Gressitt and Rondon 1970).

Macau records. Great Taipa, 3 Mar 2019, at light in ablution block, R Perissinotto & L Clennell; ibidem16 Mar 2019, R Perissinotto; ibidem 13 Jun 2019, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 28 Apr 2019, at light in ablution block, R Perissinotto & L Clennell (IZCAS); Coloane Hác-Sá, 8 Apr 2020, on flowers of *Ligustrum sinense*, R Perissinotto & L Clennell); Coloane Ká-Hó, 22 May 2020, dead on tree trunk, R Perissinotto & L Clennell (IZCAS, MACT); Mong-Há Hill Municipal Park, 30 Apr 2019 22 :47, Eric Kwan (https://www.inaturalist.org/observations/24195774); [Coloane] Hác-Sá Dam, 21 Apr 2019 15:29, Kit Chang (https://www.inaturalist.org/observations/23059827); [Coloane] St. Francis Xavier's Parish, 12 Apr 2020 21:33, Kit Chang (https://www.inaturalist.org/observations/48646082); ibidem 13 Apr 2020 21:50, Kisu Wong (https://www.inaturalist.org/observations/49577131); Taipa Grande, 12 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/78523364).

Remarks. In Macau, this species ranges 11–13 mm in total length and 2.5–3 mm in maximum width. During the current census it has been observed mainly at night under artificial lights, however on one occasion it was found during daytime feeding on flowers of *Ligustrum sinense*. In nearby Hong Kong, larvae have been documented

Figure 12. *Ceresium sinicum ornaticolle* Pic, 1907: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa (3 Mar 2019) and at the Hác-Sá Dam in Coloane (12 Apr 2020), respectively (photographs: **A** LC **B** Kit Chang).

to bore into wood of *Cinnamomum camphora*, *Citrus* spp., and *Melia azedarach* (Yiu 2009). Liu (1992) reported them as serious pests of *Punica granatum* in Sichuan, but also more generally of *Malus domestica*, *Pyrus* sp. and *Ricinus communis*.

Ceresium zeylanicum Yokoi, 2015

Fig. 13

Ceresium zeylanicum Yokoi, 2015: 198. TL: Sri Lanka; TD: NHMUK.

Distribution. Palaearctic Region: China (Hong Kong) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Myanmar; Philippines; Sri Lanka; Thailand; Laos; Vietnam (Kariyanna et al. 2017; Lin and Yang 2019).

Macau records. Great Taipa, 6 May 2019, under light in ablution block, R Perissinotto (IZCAS); ibidem 16 May 2019, on flowers of *Lonicera japonica*, R Perissinotto; Coloane Village, 19 May 2019, at light in ablution block, R Perissinotto (IZCAS); ibidem 12 May 2020, R Perissinotto (MACT); ibidem 22 May 2020, R Perissinotto & L Clennell (IZCAS); [Coloane] St. Francis Xavier's Parish, 10 May 2019 20:57, Hannah Leung (https://www.inaturalist.org/observations/27731651); ibidem 24 May 2020 23:22, Kit Chang (https://www.inaturalist.org/observations/47149883); ibidem 24 May 2020 22:20, Kisu Wong (https://www.inaturalist.org/observations/54388793); ibidem 23 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/75004745); Coloane,

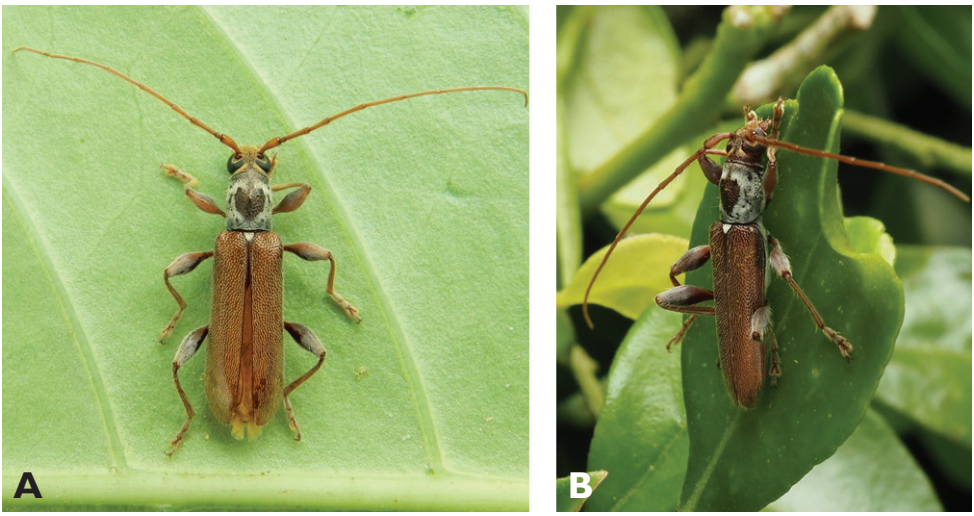

Figure 13. *Ceresium zeylanicum* Yokoi, 2015: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa (6 May 2019) and on Coloane Heights (24 May 2020), respectively (photographs: **A** LC **B** Kit Chang).

Hác-Sá Reservoir, 1 May 2020 22:32, Eric Kwan (https://www.inaturalist.org/observations/44495900).

Remarks. In Macau, adults are active only in the spring and range in total length 9.5–15 mm and 2–4 mm in maximum width. Although they have been found mainly around artificial lights at night, they have also been observed feeding on flowers of *Lonicera japonica* and *Gardenia jasminoides* during daytime (RP & LC pers. obs.). Larval host plants include *Artidesma tetrandrum*, *Bauhinia malabarica*, *Careya arborea*, *Heritiera minor*, *Lagerstroemia parviflora* and *Shorea robusta* (Duffy 1968; Makihara et al. 2008).

Tribe Cerambycini Latreille, 1802

Genus *Trirachys* Hope, 1843: 63.

Type species. *Trirachys orientalis* Hope, 1843

***Trirachys indutus* (Newman, 1842)**
Fig. 14

Hammaticherus indutus Newman, 1842b: 245. TL: Philippines (Luzon); TD: NHMUK

Distribution. Palaearctic Region: China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Jiangxi, Taiwan, Zhejiang) (Yiu 2009; Lin and Yang

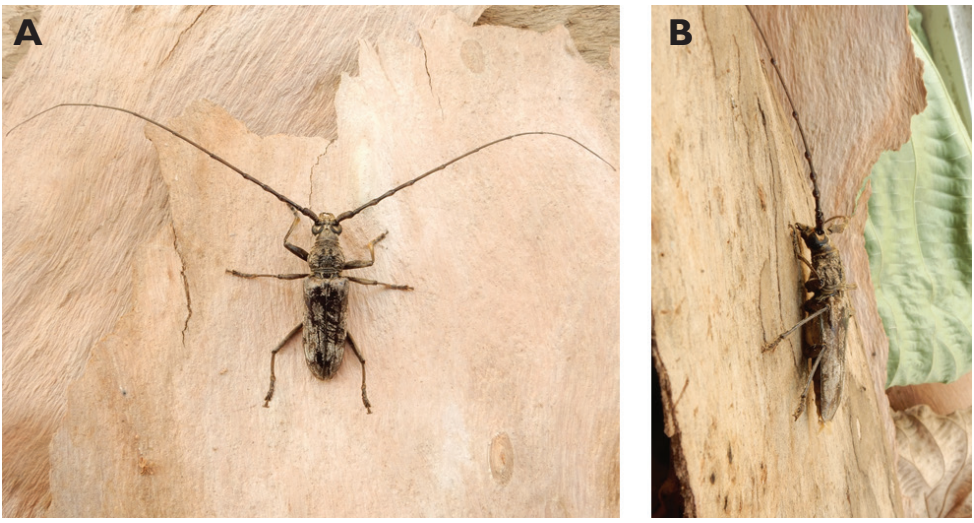

Figure 14. *Trirachys indutus* (Newman, 1842): dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 27 Apr 2020 (photographs: LC).

2019; Danilevsky 2020). Oriental Region: India; Indonesia (Sumatra, Java, Kalimantan); Laos; Malaysia; Myanmar; Philippines; Thailand; Sri Lanka; Vietnam (Makihara et al. 2008; Nga et al. 2014).

Macau records. Taipa, University of East Asia Campus, 5 Apr 1992, on outside wall of Block I building (Easton 1992: 34); Macau, University of East Asia [no data], ER Easton leg (UMEC); ibidem [no data], ER Easton leg (UMEC); 1♀, Coloane, 16 Apr 1994, WW Tong (CIAM); 1♂, Coloane Village, 27 Apr 2020, under street light at night, R Perissinotto (IZCAS); 1♀, ibidem 19 Mar 2021, Lynette Clennell (https://www.inaturalist.org/observations/71677935).

Remarks. This species was recorded only twice during the census and the specimens exhibited a total length of 30–37 mm and a maximum width of 8–10.5 mm. It has been reported previously from the region and from Hong Kong as *Aeolesthes induta* (Newman, 1842) (Easton 1992; Yiu 2009; Yiu and Yip 2011). Larval host plants include *Camellia thea*, *Chloroxylon swietenia*, *Delonix regia*, *Dracontomelon dao*, *Eugenia operculata*, *Hymenodictyon excelsum*, *Melia azedarach*, *M. japonica*, *Parashorea malayanonan*, *Pinus* sp., *Sapium sebiferum* and *Theobroma* sp. (Duffy 1968; Makihara et al. 2008; Yiu 2009).

Genus *Rhytidodera* White, 1853: 132.

Type species. *Rhytidodera bowringii* White, 1853

***Rhytidodera integra* Kolbe, 1886**
Fig. 15

Rhytidodera integra Kolbe, 1886: 237. TL: Korea; TD: MNLI

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hong Kong, Hubei, Hunan, Sichuan, Taiwan, Yunnan); South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Myanmar; Thailand; Vietnam (Nga et al. 2014).

Macau records. 1♀, Coloane, 3 Jul 2000, ML Lei (CIAM); [Coloane] St. Francis Xavier's Parish, 18 Jun 2020 21:53, Kit Chang (https://www.inaturalist.org/observations/50057385); Taipa, "Our Lady of Hope" Bay Wetland, 18 Jun 2020 23:36, Eric Kwan (https://www.inaturalist.org/observations/50069409); Macao Peninsula, Escola Luso-Chinesa Técnico-Profissional, 25 May 5:47, Wai Chan (https://www.inaturalist.org/observations/80195805).

Remarks. The only specimen available in Macau collections exhibits a total length of 26 mm and a maximum width of 6 mm. Three other observations of this species from Macau were obtained from the citizen science platform iNaturalist, but unfortunately the accompanying data did not contain any information about their size or habits. In nearby Hong Kong, adults may attain a total length of 22–34 mm (Yiu 2009; Yiu and Yip 2011). Larvae are known to bore into wood of *Mangifera indica*, *Ficus microcarpa* and *F. retusa* (Yiu 2009; Lim et al. 2014).

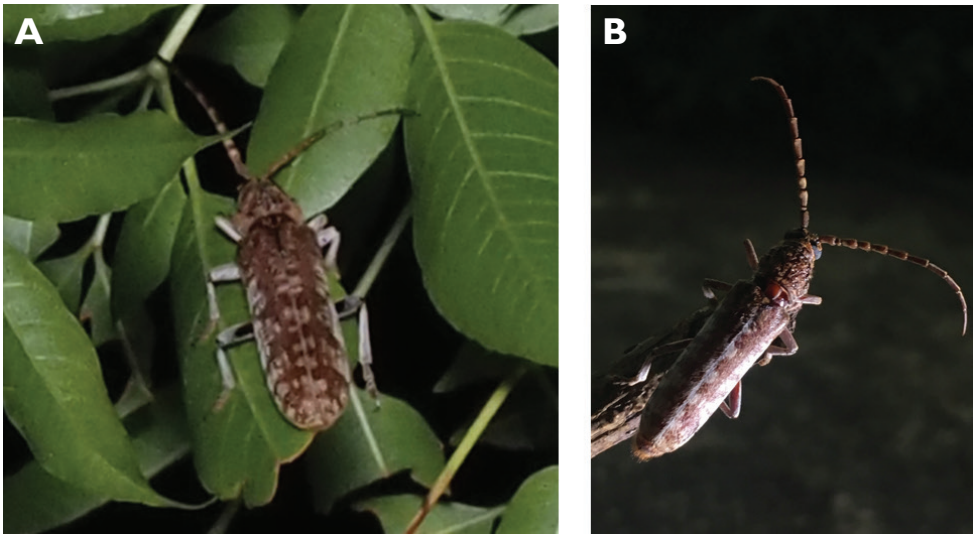

Figure 15. *Rhytidodera integra* Kolbe, 1886: Dorsal aspect of the two specimens observed at Coloane Heights and on the Taipa Bay Wetland on 18 Jun 2020 (photographs: **A** Kit Chang **B** Eric Kwan).

Tribe Clytini Mulsant, 1839

Genus *Chlorophorus* Chevrolat, 1863: 290.

Type species. *Callidium annulare* Fabricius, 1787

***Chlorophorus annularis* (Fabricius, 1787)**
Fig. 16

Callidium annularis Fabricius, 1787: 156. TL: Thailand ("Siam"); TD: NHMUK.

Distribution. Palaearctic Region: China (Anhui, Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Shaanxi, Shanghai, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang); Japan; Nepal; South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Cambodia; India; Indonesia; Laos; Malaysia; Myanmar; Philippines; Sri Lanka; Thailand; Vietnam. Australian Region: Papua New Guinea; Australia. Pacific Region: Micronesia; USA (Hawaii). Also, widely introduced into Nearctic, Neotropical and Afrotropical regions (Makihara et al. 2008; Kariyanna et al. 2017; Danilevsky 2020).

Macau records. Taipa, University of East Asia Campus, 28 May 1992 on outside wall of Tai Fung Building and 18 Jun 1992 near Library (Easton 1992: 35); no data,

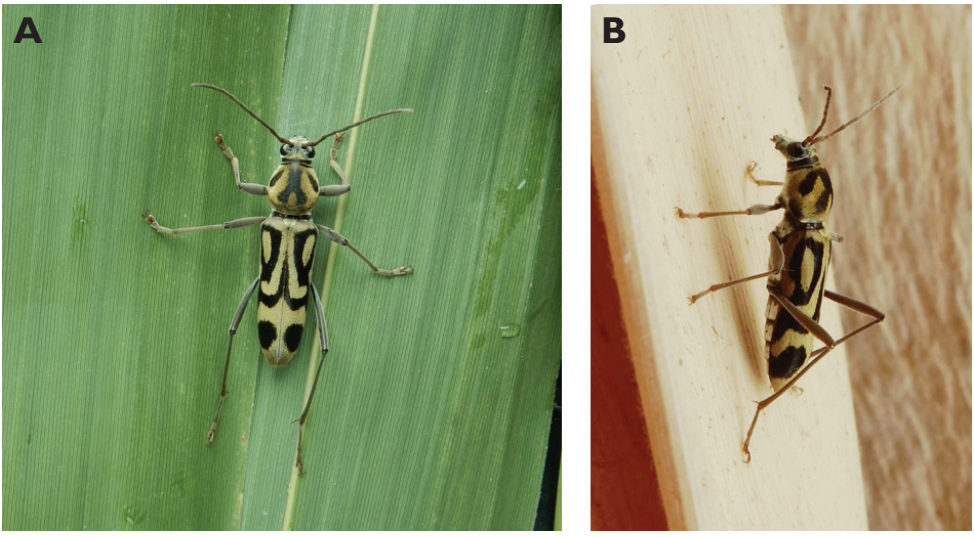

Figure 16. *Chlorophorus annularis* (Fabricius, 1787): dorsal (**A**) and lateral (**B**) views of specimens observed at Macau, Barra (1 May 2019) and Coloane Village (30 May 2020), respectively (photographs: LC).

"*Chlorophorus annularis* (Fabricius), 竹綠虎天牛10 mm" (Pun and Batalha 1997: 64, fig. 98); 1 ♂, Cotai Ecological Zone, 2nd zone, 6–7 Apr 2013, leg. Feng-Long Jia & Wei-Cai Xie (SYSU); Macau, Barra, 1 May 2019, on building wall, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 30 May 2020, on flowers of *Acronychia pedunculata*, R Perissinotto & L Clennell; Coloane Village, 5 Jul 2020, on house window, R Perissinotto & L Clennell (MACT); Macau Cultural Centre, 12 Jun 2020 14:49, Eric Kwan (https://www.inaturalist.org/observations/49306503); University of Macau Campus, 28 Apr 2021 19:38, SS23 (https://www.inaturalist.org/observations/75876080); Coloane, 1 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/76374764).

Remarks. According to Easton (1992), *C. annularis*, or bamboo longhorn, was very common in Macau in the early 1990s, particularly during 1990 when it was suggested that it may have emerged from the numerous bamboo poles used in the scaffolding of new buildings that were being constructed next to the university campus. However, during this census the species was a rare occurrence in Macau, where adults were active in spring and summer and ranged 10–14 mm in total length and 2–3.5 mm in maximum width. *Chlorophorus annularis* is primarily a borer of dry bamboo species belonging to several genera, but it also attacks cultivated crops and wild plant species (Friedman et al. 2008). Both larvae and adults have been introduced into several European, Middle East, African, American and Oceanian countries through bamboo canes and their derived products imported from south-east Asian countries, especially China (Suma and Bella 2018).

The main larval host plants for the species include *Bambusa* spp., *Chimonobambusa tumidissinoda*, *Dendrocalamus strictus*, *Dipterocarpus tuberculatus*, *Cassia fistula*, *Gossypium* sp., *Indosasa crassiflora*, *Phyllostachys reticulata*, *Saccharum officinarum*, *Sinocalamus* spp., *Vitis* spp., and *Zea mays* (Friedman et al. 2008; Suma and Bella 2018). Other plants utilised to a lesser extent are *Albizia* spp., *Betula* spp., *Citrus* spp., *Derris microphylla*, *Liquidambar formosana*, *Malus sylvestris*, *Pyrus malus*, *Shorea robusta*, *Sinobambusa gibbosa*, *Spondias* sp. and *Tectona grandis* (Duffy 1968; Makihara et al. 2008; Yiu 2009; Lim et al. 2014; Suma and Bella 2018).

Chlorophorus macaumensis macaumensis (Chevrolat, 1845)

Fig. 17

Clytus macaumensis Chevrolat, 1845: 98. TL: China (Macau); TD: NHMUK.

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Hong Kong, Hubei, Hunan, Shaanxi, Sichuan, Yunnan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Macau records. 1♀, Coloane, 21 Jul 1988, Bambú, *Chlorophorus annularis*, WW Pun (CIAM); 1♀, ibidem 3 Jun 1994, *Chlorophorus annularis*, WW Pun (CIAM); 1♂, ibidem 21 May 1999, ML Lei (CIAM); 1♀, ibidem 14 Jun 2001, ML Lei (CIAM); Coloane Village, Jun 2018, L Clennell (MACT); Little Taipa, 28 Sep 2018, on road-

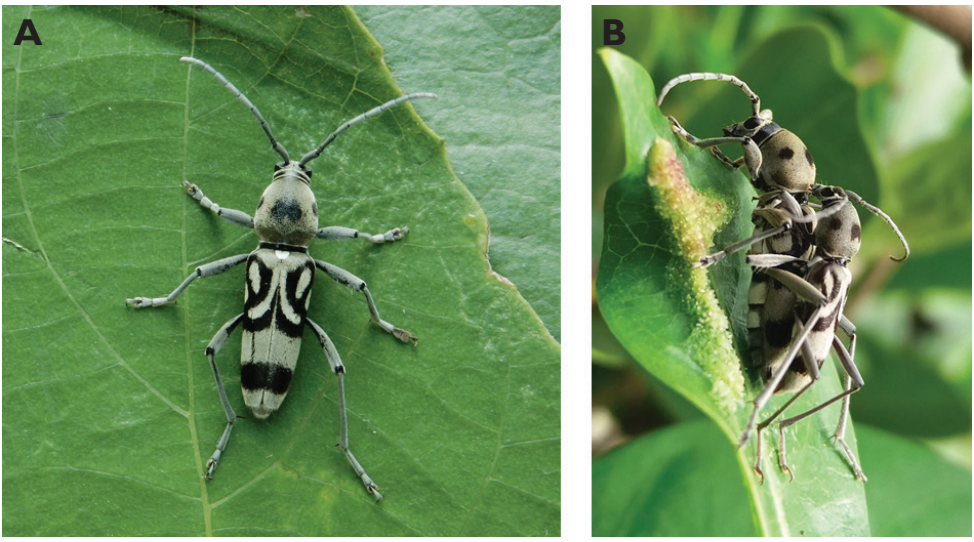

Figure 17. *Chlorophorus macaumensis macaumensis* (Chevrolat, 1845): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights on 28 Apr 2019 and 21 May 2020, respectively (photographs: LC).

side vegetation, R Perissinotto & L Clennell (MACT); Coloane Village, 28 Apr 2019, R Perissinotto & Clennell (IZCAS × 2); ibidem 20 Jun 2018, L Clennell; ibidem 1 Jul 2018, L Clennell (MACT × 2); ibidem 22 Jun 2019, L Clennell; Coloane Heights, 7 May 2020, R Perissinotto; ibidem 21 May 2020, R Perissinotto & L Clennell; ibidem 12 Jun 2020, numerous on flowers of *Acronychia pedunculata*, R Perissinotto & L Clennell (IZCAS); Macau, 27 May 2019, Kit Chang; ibidem 5 Jun 2019, Hannah Leung; St. Francis Xavier's Parish [Coloane], 4 May 2019 10:51, Kit Chang (https://www.inaturalist.org/observations/24501575); ibidem 11 May 2019 15:28, Kit Chang (https://www.inaturalist.org/observations/24924416); ibidem 16 Jun 2019 15:59, Hannah Leung (https://www.inaturalist.org/observations/27731211); ibidem 24 May 2020 10:00, Kit Chang (https://www.inaturalist.org/observations/47084089); ibidem 20 Jun 2020 10:44, Kit Chang (https://www.inaturalist.org/observations/50238923); ibidem 9 May 2020 8:40, Kisu Wong (https://www.inaturalist.org/observations/52141600); ibidem 24 May 2020 11:54, Kisu Wong (https://www.inaturalist.org/observations/54257986); ibidem 21 Jun 2020 11:40, Kisu Wong (https://www.inaturalist.org/observations/56481171); ibidem 28 Jun 2020 9:30, Kisu Wong (https://www.inaturalist.org/observations/56944974); ibidem 19 Jul 2020 8:45, Kisu Wong (https://www.inaturalist.org/observations/58154540); ibidem 24 Apr 2021 11:52, Kit Chang (https://www.inaturalist.org/observations/75019281); ibidem 1 May 2021 13:12, Lynette Clennell (https://www.inaturalist.org/observations/76100053); Coloane Village, 9 May 2020 7:39, Lynette Clennell (https://www.inaturalist.org/observations/55370837); Coloane, Hác-Sá Dam, 31 May 2020 8:46, Annie Lao (https://www.inaturalist.org/observations/47961012); Taipa Pequena, 18 May 2021 11:47, Annie Lao (https://www.inaturalist.org/observations/79262176).

Remarks. This is the only species that was found in reasonable abundance during the census, as shown by the extensive list of records above. Yet, remarkably it was not reported in the previous surveys by either Easton (1991, 1992, 1993) or Pun and Batalha (1997), despite Macau representing the type locality of the original description of the species by Chevrolat (1845). In Macau, adults are active during the hottest part of the day from spring till early autumn and range in total length 11–16 mm and 2.5–4 mm in maximum width. They feed on a wide variety of flowers, including *Acronychia pedunculata*, *Elaeocarpus sylvestris*, *Litsea glutinosa*, *Mallotus paniculatus*, *Paliurus spina-christi*, *Psychotria serpens*, *Dalbergia benthamii* and *Syzigium buxifolium* (RP & LC pers. obs.). Hua (2002) reported as host plants for this species *Acacia mearnsii*, *Bambusa textilis*, *Bauhinia variegata*, *Coffea* sp., *Cunninghamia lanceolata*, *Pinus* sp. (branches), *Populus* sp. and *Salix* sp.

Genus *Demonax* J. Thomson, 1861: 226.

Type species. *Demonax nigrofasciatus* J. Thomson, 1861

***Demonax bimaculicollis* (Schwarzer, 1925)**
Fig. 18

Chlorophorus bimaculicollis Schwarzer, 1925a: 28. TL: China (Taiwan); TD: SFNF.

Distribution. Palaearctic Region: China (Hainan, Taiwan) (Lin and Yang 2019; Danilevsky 2020).

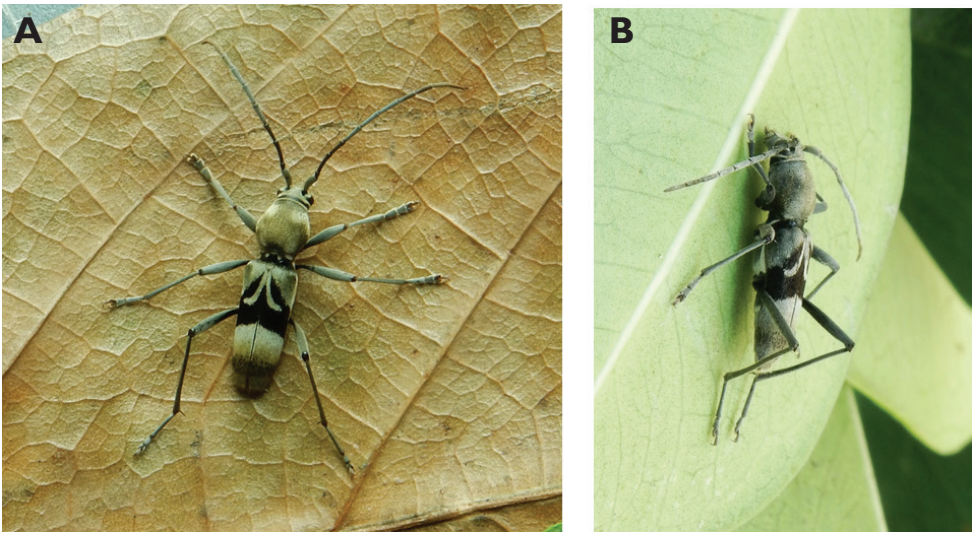

Figure 18. *Demonax bimaculicollis* (Schwarzer, 1925): dorsal (**A**) and lateral (**B**) views of specimens observed on Little Taipa Hill on 4 and 13 Mar 2019, respectively (photographs: LC).

Macau records. Little Taipa, 4 Mar 2019, on flowers of *Ligustrum sinense*, R Perissinotto; ibidem 13 Mar 2019, on dead tree trunk by roadside, R Perissinotto (MACT); ibidem 25 Apr 2019, on flowers of *Mangifera* sp. by roadside, R Perissinotto & L Clennell (IZCAS).

Remarks. In Macau, this species has so far only been recorded from Little Taipa Hill during March–April 1999 and ranges 8–11 mm in total length and 2–3 mm in maximum width. Adults appear to be active in daytime only during the early spring and have been observed mainly feeding on flowers of *Mangifera* sp. and occasionally also of *Ligustrum sinense*. Chou (2004, 2008) reported that adults visit flowers and leaves of *Acer cinnamomifolium*. Mating pairs and individuals near exit holes have also been found repeatedly on dead trunks of *Zanthoxylum avicennae*, indicating that this is possibly one of the host plants for larval development (RP pers. obs.).

Genus *Perissus* Chevrolat, 1863: 262.

Type species. *Perissus x-littera* Chevrolat, 1863

Perissus indistinctus Gressitt, 1940

Fig. 19

Perissus indistinctus Gressitt, 1940a: 72. TL: China (Hainan); TD: SYSU.

Distribution. Palaearctic Region: China (Hainan, Hong Kong) (Lin and Yang 2019; Danilevsky 2020).

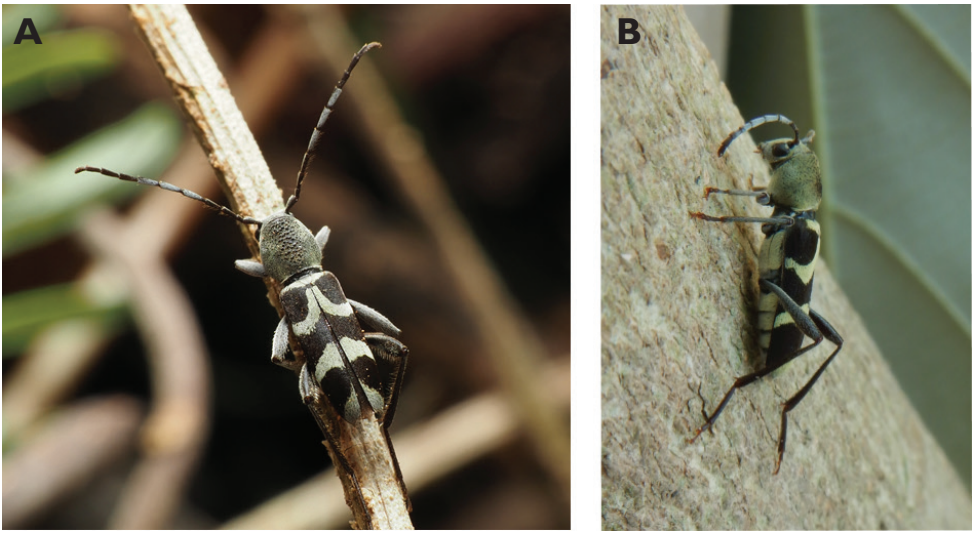

Figure 19. *Perissus indistinctus* Gressitt, 1940: dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights on 15 Nov 2020 and 12 Jul 2020, respectively (photographs: **A** Kit Chang **B** LC).

Macau records. Coloane Heights, A-Mà Cultural Village, 12 Jul 2020, on dead tree trunk, R Perissinotto & L Clennell (IZCAS); ibidem 19 Nov 2020, Lynette Clennell (https://www.inaturalist.org/observations/65209287) (MACT); St. Francis Xavier's Parish [Coloane], 15 Nov, 2020 15:48, Kit Chang (https://www.inaturalist.org/observations/64929674); ibidem 1 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/72595959); ibidem 21 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/79722351).

Remarks. In Macau, adult activity has been recorded from early spring till late autumn. Specimens range 7–10.5 mm in total length and 1.5–3 mm in maximum width. Adults are active during the hottest part of the day and are generally observed on dead tree branches or roots, where they crawl back and forth with extreme rapidity searching for mates and areas suitable for egg deposition. No information seems to be available in the literature on the larval food plants.

Tribe Hesperophanini Mulsant, 1839

Genus *Stromatium* Audinet-Serville, 1834: 80.

Type species. *Callidium barbatum* Fabricius, 1775

***Stromatium longicorne* (Newman, 1842)**
Fig. 20

Arhopalus longicornis Newman, 1842a: 246. TL: Philippines (Manila); TD: NHMUK
Stromatium asperulum White, 1855: 300. TL: China (Hong Kong); TD: NHMUK

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guidzou, Hainan, Hong Kong, Inner Mongolia, Jiangxi, Jilin, Liaoning, Shandong, Taiwan, Yunnan, Zhejiang); India (north); Japan; Nepal; (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India (Assam); Indonesia (Kalimantan, Sunda Islands); Laos; Malaysia; Myanmar; Thailand; Vietnam (Hua 2002; Nga et al. 2014). Nearctic Region: USA (intercepted) (Monné and Giesbert 1994).

Macau records. Great Taipa, 6 Jun 2019, on floor in ablution block, R Perissinotto & L Clennell (IZCAS); Coloane Village, 29 May 2020, on mosquito trap of ablution block, R Perissinotto & L Clennell (IZCAS); ibidem 1 Jun 2020, R Perissinotto & L Clennell (MACT); Taipa, Minho Str., 23 May 2020 19:58, Eric Kwan (https://www.inaturalist.org/observations/46988050); Taipa, Pac On Road, 28 May 2020 22:20, Eric Kwan (https://www.inaturalist.org/observations/47699525); Coloane Village, 20 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/79509103).

Remarks. In Macau, adults appear to be active only in late spring and range in total length 23–28 mm and 6.5–8 mm in maximum width. The species is exclusively

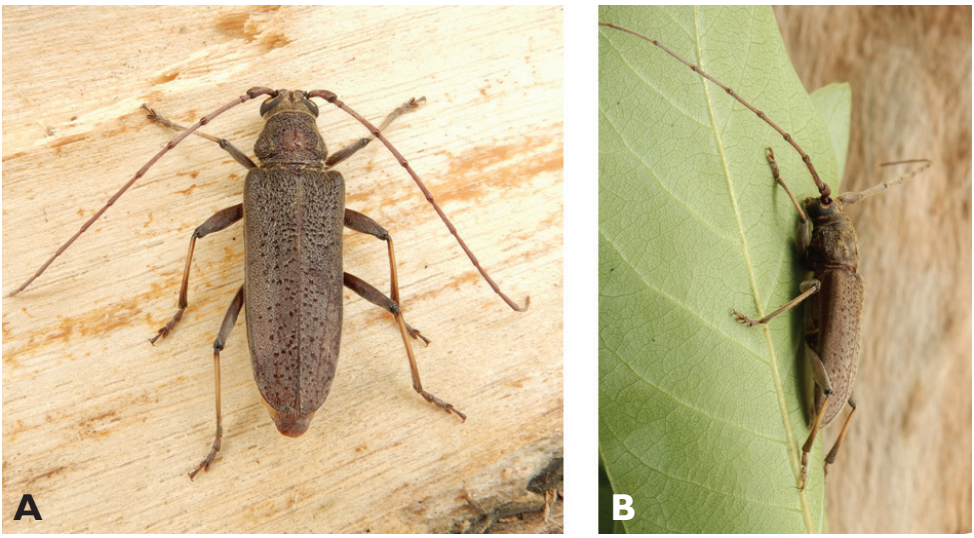

Figure 20. *Stromatium longicorne* (Newman, 1842): female dorsal (**A**) and male lateral (**B**) views of specimens observed at Coloane Village on 29 May 2020 (photographs: LC).

nocturnal and readily attracted to artificial lights. The larvae apparently bore into lumber and a variety of trees, such as *Machilus* spp., *Morus alba* and oaks (Yiu 2009). The species was introduced into Australia already in the 1960s (Duffy 1963) and adult specimens emerging from wood furniture and other processed timber have recently been intercepted in several European countries (Cocquempot et al. 2014).

Tribe Obriini Mulsant, 1839

Genus *Kuegleria* Holzschuh, 2017: 13.

Type species. *Obrium atricolor* Pic, 1953.

***Kuegleria annulicornis* (Pic, 1935)**
Fig. 21

Falsobrium annulicorne Pic, 1935: 13. TL: Vietnam (Tonkin); TD: MNHN

Distribution. Palaearctic Region: China [Hong Kong, new record: 1♂, Shing Mun, 24 May 2010, Atwood Chiu (on loan to IZCAS by V Yiu, Accession No. CO160601)]. Oriental Region: Laos; Vietnam (Holzschuh 2017).

Macau records. Great Taipa, 9 May 2019, on pile of dead wood in barbeque area, R Perissinotto & L Clennell (IZCAS); ibidem 7 May 2021, [in ablution block], Lynette Clennell (https://www.inaturalist.org/observations/77993530).

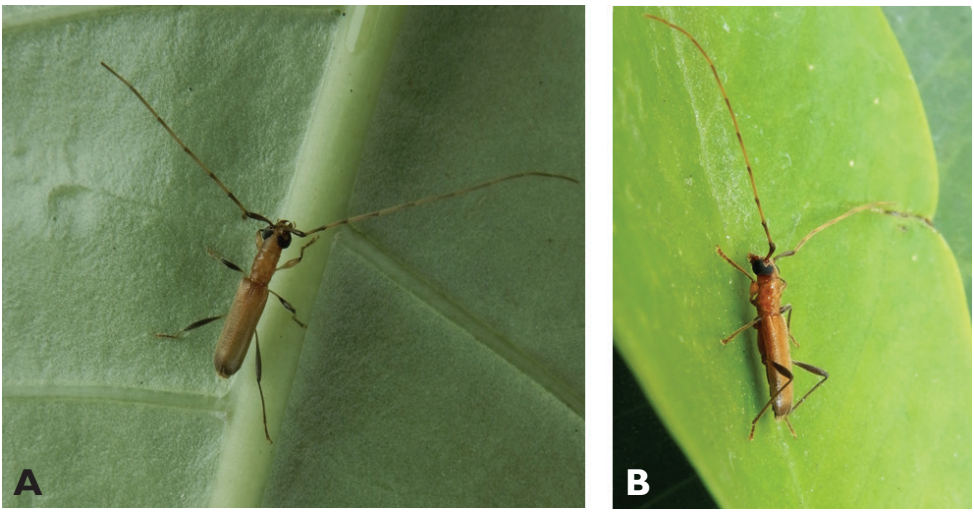

Figure 21. *Kuegleria annulicornis* (Pic, 1935): dorsal (**A**) and lateral (**B**) views of specimen observed on Great Taipa Hill on 9 May 2019 (photographs: LC).

Remarks. This species represents a new record for China and the broader Palaearctic Region. The two specimens recorded during this survey exhibit a total length of 6–7 mm and a maximum width of 1–1.5 mm. One specimen was active during daytime, flying above a pile of dead wood, while the second specimen was recovered from an ablution block, where it had likely been attracted by artificial lights during the night.

Tribe Phoracanthini Newman, 1840

Genus *Nysina* Gahan, 1906: 153.

Type species. *Sphaerion orientale* White, 1853.

***Nysina rufescens asiatica* (Schwarzer, 1925)**
Fig. 22

Neosphaerion asiaticum Schwarzer, 1925a: 22. TL: China (Taiwan); TD: SFNF

Distribution. Palaearctic Region: China (Fujian, Guangxi, Hainan, Hong Kong, Taiwan, Zhejiang) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Vietnam (Lin and Yang 2019).

Macau records. Coloane Heights, 5 Jul 2019, feeding on unidentified flower in garden, R Perissinotto & L Clennell (IZCAS); ibidem 10 May 2020, R Perissinotto & L Clennell (IZCAS); Coloane Village, 28 Jun 2020, on mosquito trap in ablution block, R Perissinotto & L Clennell (IZCAS); Great Taipa, 21 Mar 2019, inside mosquito trap, R Perissinotto (MACT); ibidem 1 Mar 2020, Kit Chang; Guia Hill,

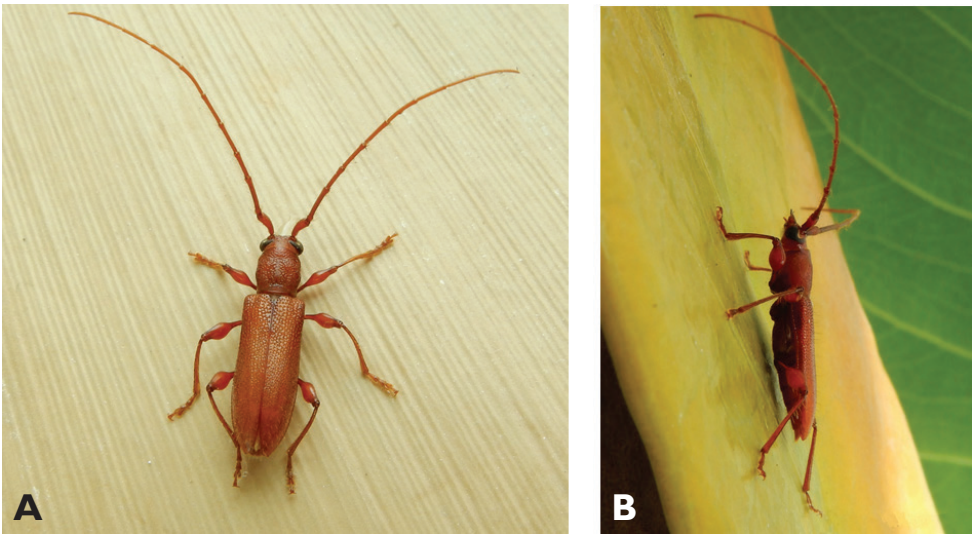

Figure 22. *Nysina rufescens asiatica* (Schwarzer, 1925): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights (5 Jul 2019) and at Coloane Village (28 Jun 2020), respectively (photographs: LC).

7 Mar 2020, Kit Chang; St. Francis Xavier's Parish [Coloane], 27 Apr 2020 12:24, Kit Chang (https://www.inaturalist.org/observations/43868608); ibidem 19 Apr 2020 23:45, Kisu Wong (https://www.inaturalist.org/observations/51105296); ibidem 22 Mar 2021, Lynette Clennell (https://www.inaturalist.org/observations/71851567); Our Lady of Carmel's Parish [Little Taipa], 1 Mar 2020 23:30, Kit Chang (https://www.inaturalist.org/observations/48545850; ibidem 29 Mar 2021, Lynette Clennell (https://www.inaturalist.org/observations/72418305).

Remarks. In Macau, adults are active throughout the spring and summer, both during the day feeding on flowers and at night when they are attracted to artificial lights. They range in total length 10.5–13 mm and 2.5–3 mm in maximum width. There appears to be no information available in the literature on the larval food plant(s) of this species.

Tribe Pyrestini Lacordaire, 1868

Genus *Pyrestes* Pascoe, 1857: 96.

Type species. *Pyrestes haematicus* Pascoe, 1857.

***Pyrestes haematicus* Pascoe, 1857**
Fig. 23

Pyrestes haematicus Pascoe, 1857: 97. TL: China (North); TD: NHMUK
Pyrestes cardinalis Pascoe, 1863: 50. TL: China (Hong Kong); TD: NHMUK. Synonymised by Gressitt 1939: 31.

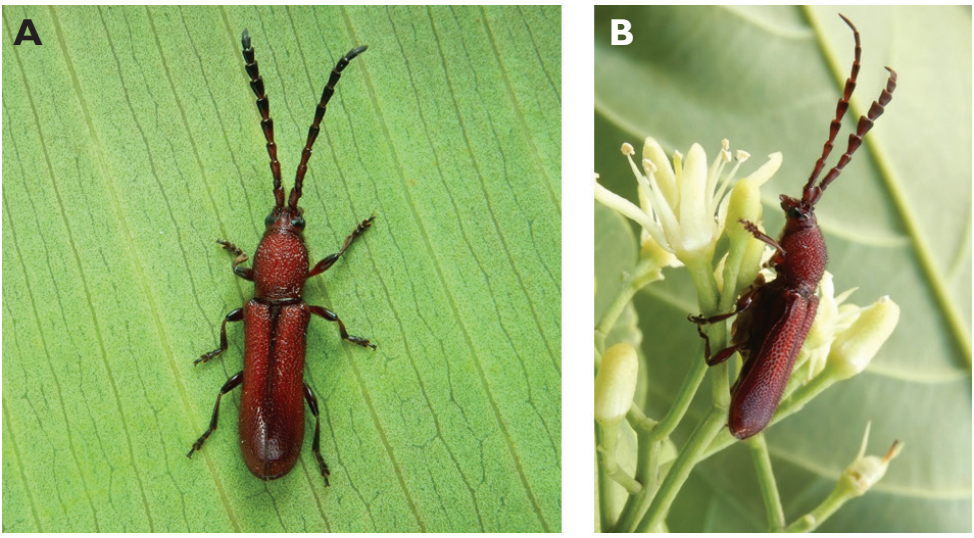

Figure 23. *Pyrestes haematicus* Pascoe, 1857: dorsal (**A**) and lateral (**B**) views of specimens observed at Coloane, Cheoc-Van (16 May 2019) and on Coloane Heights (18 Jun 2020), respectively (photographs: LC).

Distribution. Palaearctic Region: China (Anhui, Fujian, Guangdong, Guizhou, Hainan, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jangxi, Shaanxi, Taiwan, Yunnan, Zhejiang); North & South Korea (Yiu and Yip 2011; Lin and Yang 2019; Danilevsky 2020).

Macau records. Taipa, University of East Asia Campus, 28 March & 24 April on wall of Block I building, "*Pyrestes haematica* Pascoe" (Easton 1992: 34); Coloane, Cheoc Van, 16 May 2019, perched on coastal vegetation, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 18 Jun 2020, on flowers of *Acronychia pedunculata* in garden, R Perissinotto & L Clennell (MACT, IZCAS); ibidem 3 Jul 2020, on flowers of *Elaeocarpus sylvestris*, R Perissinotto; Coloane, 20 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/79506655).

Remarks. In Macau, adults are active only during late spring to early summer and specimens range in total length 10–16 mm and 2–4 mm in maximum width. They feed on a variety of flowers during the hottest part of the day, including *Acronychia pedunculata*, *Dalbergia benthamii* and *Elaeocarpus sylvestris*. Known larval food plants include *Cinnamomum camphora*, *Machilus* spp. and *Pueraria lobata* (Lim et al. 2014).

Tribe Trachyderini Dupont, 1836

Genus *Purpuricenus* Dejean, 1821: 105.

Type species. *Cerambyx kaehleri* Linnaeus, 1758

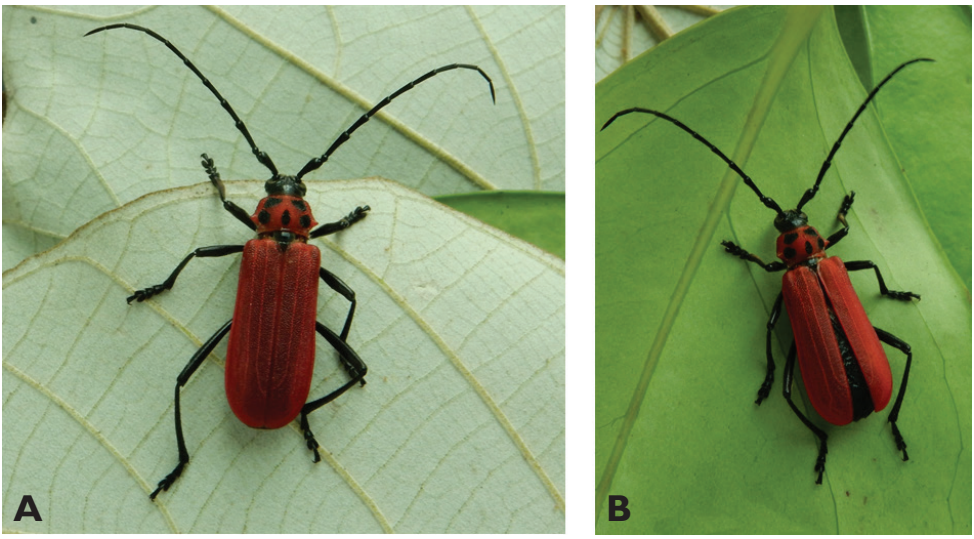

Figure 24. *Purpuricenus temminckii sinensis* White, 1853: Dorsal views of specimen observed at Taipa on 19 Mar 2019 (photographs: LC).

***Purpuricenus temminckii sinensis* White, 1853**
Fig. 24

Purpuricenus sinensis White, 1853: 139. TL: China (Shanghai); TD: NHMUK.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang); India (Arunachal Pradesh); South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Vietnam (Ambrus and Tichý 2017).

Macau records. Taipa Central, 19 Mar 2019, flying near bus stop, R Perissinotto.

Remarks. The only specimen observed in Macau had a total length of 16.5 mm and a maximum width of 5.5 mm. Yiu (2009) reported that the larval stages develop in bamboo canes and jujube trees. This is supported by Hua (2002), who listed *Bambusa* and *Ziziphus sativa* as host plants of this species.

Tribe Xystrocerini Blanchard, 1845

Genus *Xystrocera* Audinet-Serville, 1834: 69.

Type species. *Cerambyx globosus* Olivier, 1795; designated by Thomson 1864: 247.

***Xystrocera globosa* (Olivier, 1795)**
Fig. 25

Cerambyx globosus Olivier, 1795: 27, pl. XII, fig. 81. TL: Indonesia ("Batavia"); TD: Unknown.

Distribution. Palaearctic Region: Bhutan; China (Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Taiwan, Shaanxi, Shandong, Sichuan, Yunnan, Zhejiang); Egypt; India (Arunachal Pradesh, Sikkim, Uttarakhand); Israel (introduced); Japan; Nepal; North & South Korea; Pakistan (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Bangladesh; Cambodia; India; Indonesia; Laos; Malaysia; Myanmar; Philippines; Sri Lanka; Thailand; Vietnam (Hua 2002; Kariyanna et al. 2019). Also widely distributed in Afrotropical Region (Africa), Nearctic Region (North America) as well as Australian and Pacific regions (Oceania) (Danilevsky 2020).

Macau records. Taipa, University of East Asia Campus, 9 Apr & 5 May 1992, on outside wall of Block I building, (Easton 1992: 35); Macau, University of East Asia, Taipa [no date], ER Easton leg (UMEC); ibidem Block F, 9 Apr 1990, ER Easton leg (UMEC); no data, "*Xystrocera globosa* (Olivier), 合歡雙條天牛27 mm" (Pun and Batalha 1997: 65, fig. 106); 1♀, Coloane, 2 Apr 1993, *Albizia chinensis*, WM Ng, *Xystrocera globosa* (CIAM); 1♂, ibidem 16 Oct 1993, *Xystrocera globosa*, WW Pun (CIAM); Taipa Central, 18 Mar 2019, on building wall, R Perissinotto; Little Taipa, 28 Apr 2019, under monument spotlight, R Perissinotto & L Clennell (IZCAS); ibidem 1 Sep 2019, R Perissinotto & L Clennell (MACT); Coloane Village, 6 Oct 2019, L Clennell; Coloane Heights 7 Mar 2020, on trunk of *Albizia lebbeck*, R Perissinotto; ibidem 26 Mar 2020, R Perissinotto; ibidem 11 Apr 2020, R Perissinotto & L Clennell; ibidem 21 Apr 2020, on trunk of *Albizia lebbeck*, R Perissinotto; ibidem 28 Aug 2020, under spotlight, R Perissinotto & L Clennell (IZCAS); ibidem 4 Sep 2019, R Perissinotto & L Clennell (MACT); Great Taipa, 4 Apr 2020 20:57, Eric Kwan (https://www.inaturalist.org/observations/41422999); ibidem 4 Apr 2020 20:55, Kisu Wong (https://www.inaturalist.org/observations/49550012); ibidem 4 Apr 2020 21:02, Kit Chang (https://www.inaturalist.org/observations/48643480); ibidem 12 Mar 2021, Lynette Clennell (https://www.inaturalist.org/observations/71056521); Coloane, Tin Hau Temple, 26 Apr 2020 23:55, Eric Kwan (https://www.inaturalist.org/observations/43840228); St. Francis Xavier's Parish [Coloane], 5 Oct 2019 16:24, Lynette Clennell (https://www.inaturalist.org/observations/56122495); ibidem 26 Apr 2020 23:32, Kisu Wong (https://www.inaturalist.org/observations/43868252); ibidem 4 Apr 2021 13:49, Lynette Clennell (https://www.inaturalist.org/observations/72875264); [Macau Peninsula] Jardim de Lou Lim Loc, 5 Apr 2021 10:46, Eric Kwan (https://www.inaturalist.org/observations/72982387).

Remarks. In Macau, adults are active from early spring till mid-autumn and range in total length 24–30.5 mm and 5–8 mm in maximum width. In the Coloane area, adults have repeatedly been observed while emerging from exit holes on dead or moribund trunks of *Albizia lebbeck*. In nearby Hong Kong, host plants for this species include *Acacia confusa*, *Albizia lebbeck*, *Bauhinia* spp. and *Bombax ceiba* (Yiu 2009). Elsewhere,

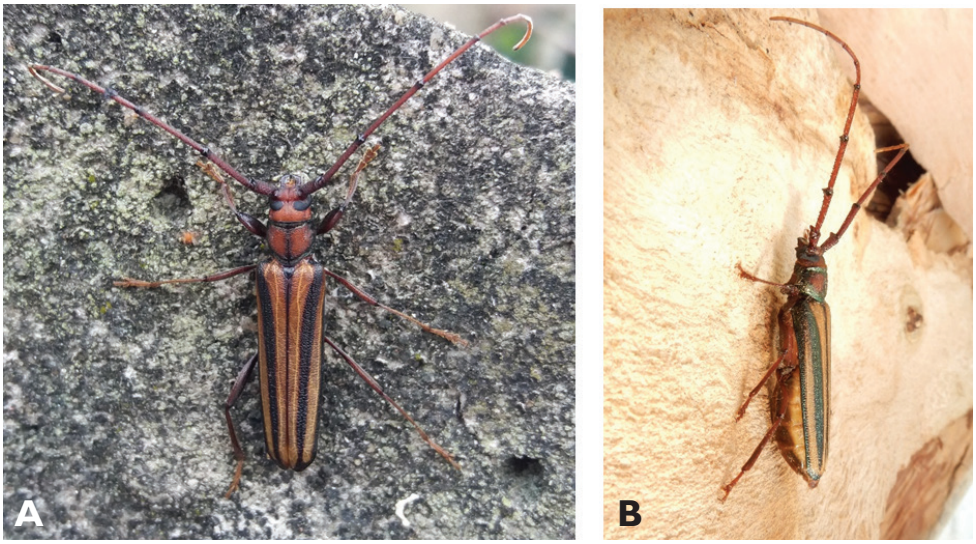

Figure 25. *Xystrocera globosa* (Olivier, 1795): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights on 27 Mar 2020 and 11 Apr 2020, respectively (photographs: LC).

the following additional species have also been recorded: *Acacia arabica*, *A. catechu*, *A. chinensis*, *A. cordifolia*, *A. modesta*, *A. auriculoformis*, *A. mangium*, *Acrocarpus fraxinifolius*, *Adenanthera pavonina*, *Albizia julibrissin*, *A. lucida*, *A. odoratissima*, *A. procera*, *A. stipulata*, *Bauhinia acuminata*, *Cassia glauca*, *Chamaecrista* spp., *Duabanga sonneratioides*, *Grewia parviflora*, *G. tiliaefolia*, *Haematoxylon campechianum*, *Paraserianthes falcataria*, *Parkia speciosa*, *Prunus persica*, *Salmalia malabarica*, *Samanea samon*, *Theobroma* spp., *Xylia dolabriformis* and *X. xylocarpa* (Duffy 1968; Matsumoto et al. 2000; Makihara et al. 2008; Lim et al. 2014).

Subfamily Lamiinae Latreille, 1825
Tribe Acanthocinini Blanchard, 1845

Genus *Rondibilis* Thomson, 1857b: 306.

Type species. *Rondibilis bispinosa* Thomson, 1857.

***Rondibilis undulata* (Pic, 1922)**
Fig. 26

Erysamena [sic] *undulata* Pic, 1922: 14. TL: Vietnam (Tonkin); TD: MNHN.
Rondibilis multinotatus Gressitt, 1939: 83. TL: China (Guangdong); TD: SYSU.

Distribution. Palaearctic Region: China (Guangdong, Hainan); South Korea (Lin and Yang 2019; Danilevsky 2020). Oriental Region: Vietnam (Lin and Yang 2019).

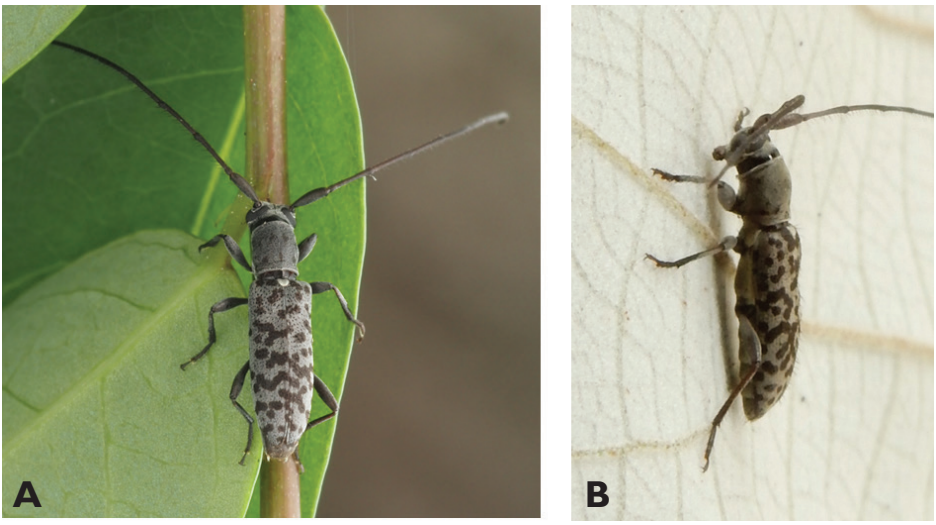

Figure 26. *Rondibilis undulata* (Pic, 1922): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights (25 May 2020) and Coloane Village (26 May 2020), respectively (photographs: **A** Kit Chang **B** LC).

Macau records. Great Taipa, 26 Apr 2019, in mosquito trap, R Perissinotto & L Clennell (IZCAS × 2); ibidem 9 May 2019, on dead tree branch, R Perissinotto (IZCAS); Coloane Village, 26 May 2020, under light in ablution block, R Perissinotto & L Clennell; ibidem 1 Jun 2020, R Perissinotto (MACT); St. Francis Xavier's Parish [Coloane], 25 May 2020 12:10, Kit Chang (https://www.inaturalist.org/observations/47149980); ibidem 24 May 2020 19:33, Kisu Wong (https://www.inaturalist.org/observations/54388818); Taipa Grande, 30 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/76032776).

Remarks. In Macau, adults are active only in late spring and range in total length 6.5–8 mm and 1.5–2 mm in maximum width. They are strictly nocturnal and readily attracted to artificial lights. No information is available in the literature on their larval host plant(s).

Tribe Apomecynini J. Thomson, 1860

Genus *Apomecyna* Dejean, 1821: 108.

Type species. *Saperda alboguttata* Megerle, 1802 (= *Lamia histrio* Fabricius, 1793).

***Apomecyna longicollis longicollis* Pic, 1926**
Fig. 27

Apomecyna longicollis Pic, 1926: 28. TL: Vietnam (Tonkin); TD: MNHN

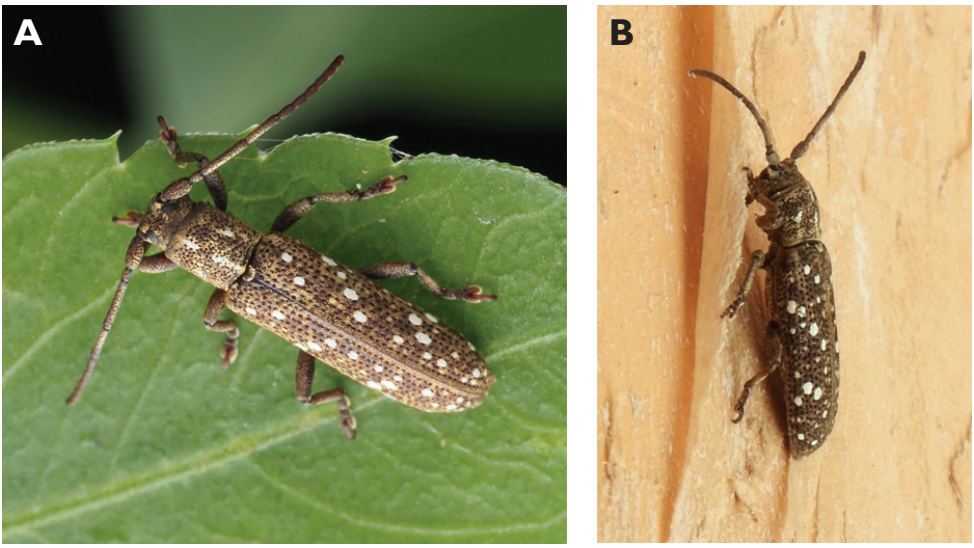

Figure 27. *Apomecyna longicollis longicollis* Pic, 1926: dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights (12 Jun 2020) and Coloane Village (25 Apr 2020), respectively (photographs: **A** Kit Chang **B** LC).

Distribution. Palaearctic Region: China (Guizhou, Hong Kong, Jiangxi, Yunnan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Thailand; Vietnam (Hua 2002).

Macau records. Great Taipa, 26 Apr 2019, in ablution block, R Perissinotto & L Clennell (IZCAS); Little Taipa, 28 Apr 2019, crushed in ablution block, R Perissinotto (IZCAS); ibidem 26 Apr 2019, under monument spotlight (IZCAS × 2); Coloane Village, 25 Apr 2020 under light in ablution block, R Perissinotto & L Clennell (MACT); ibidem 31 Aug 2020, R Perissinotto & L Clennell; Taipa, Minho Str., 23 May 2020 8:04, Eric Kwan (https://www.inaturalist.org/observations/46988120); St. Francis Xavier's Parish [Coloane], 24 May 2020 1:50, Kit Chang (https://www.inaturalist.org/observations/47082158); ibidem 12 Jun 2020 2:13, Kit Chang (https://www.inaturalist.org/observations/49251842); ibidem 24 May 2020 22:19, Kisu Wong (https://www.inaturalist.org/observations/54388789); ibidem 6 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/77832643); Our Lady of Carmel's Parish [Great Taipa], 31 Aug 2020 16:10, Lynette Clennell (https://www.inaturalist.org/observations/58131197).

Remarks. In Macau, adults are active throughout spring and summer, ranging in total length 7–10 mm and 1.5–3 mm in maximum width. Like the other species of this genus, *A. l. longicollis* is nocturnal and readily attracted to artificial lights. There is no published information on its larval host plant(s).

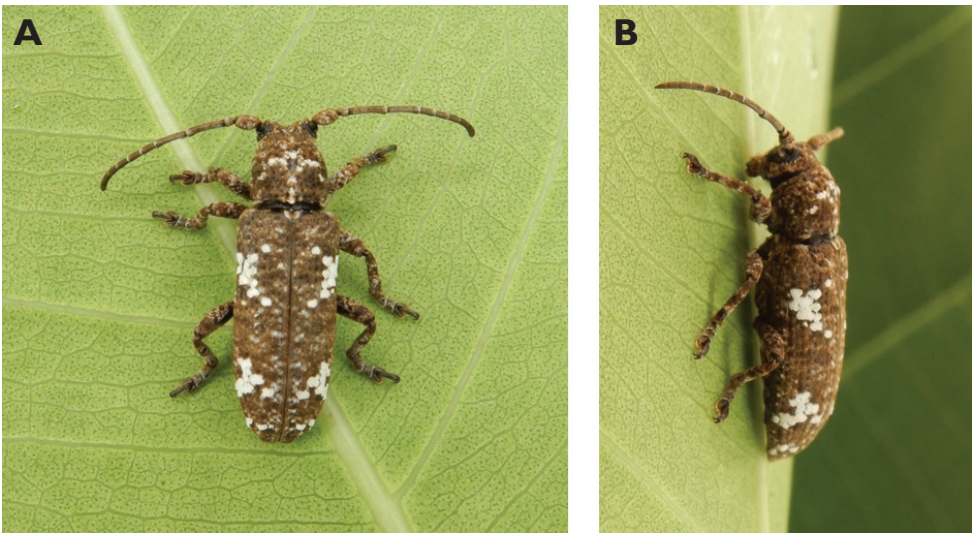

Figure 28. *Apomecyna saltator* (Fabricius, 1787): dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 31 May 2020 (photographs: LC).

***Apomecyna saltator* (Fabricius, 1787)**
Fig. 28

Lamia saltator Fabricius, 1787: 141. TL: Unknown; TD: ZMUC.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Hubei, Hunan, Jangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang); India (Arunachal Pradesh, Himachal Pradesh); Pakistan; Nepal (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Laos; Vietnam (Hua 2002; Kumawat et al. 2015).

Macau records. Great Taipa, 29 Apr 2019, on mosquito trap, R Perissinotto & L Clennell (IZCAS); Coloane Village, 31 May 2020, under light in ablution block, R Perissinotto & Lynette Clennell; St. Francis Xavier's Parish [Coloane], 9 Jun 2020 2:38, Kit Chang (https://www.inaturalist.org/observations/49012866); ibidem 12 Jun 2020 23:50, Kisu Wong (https://www.inaturalist.org/observations/55504513).

Remarks. In Macau, adults have so far been recorded only in late spring and range in total length 10–12 mm and 3–4.5 mm in maximum width. In nearby Hong Kong, however, they have been observed throughout the summer and there larval food plants include *Cucurbita moschata*, *Benincasa hispida*, *Luffa acutangula* and *Lagenaria siceraria* (Yiu 2009). Elsewhere, larvae have also been found boring into stems of *Coccinia indica*, *Luffa aegyptiaca* and *Trichosanthes cucumerina* (Beeson 1941; Nair 1975; David and Ramamurthy 2012; Kumawat et al. 2015).

Genus *Ropica* Pascoe, 1858: 247.

Type species. *Ropica piperata* Pascoe, 1858.

***Ropica dorsalis* Schwarzer, 1925**
Fig. 29

Ropica formosana var. *dorsalis* Schwarzer, 1925b: 145. TL: China (Taiwan); TD: SFNF

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Hong Kong, Hunan, Jiangsu, Shanghai, Taiwan, Zhejiang); Japan, Nepal (Hayashi 1972, 1982; Lazarev and Murzin 2019; Lin and Yang 2019). Oriental Region: India; Laos; Vietnam (Lazarev 2019; Lin and Yang 2019).

Macau records. 1♀, Cotai Ecological Zone, 1st zone, 14 Oct 2015, leg. Feng-Long Jia (SYSU); 1♂, ibidem 7 Apr 2018, leg. Wei-Cai Xie (SYSU); Great Taipa, 7 May 2019, on wall in ablution block, R Perissinotto & L Clennell (IZCAS); ibidem 12 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/78523371); St. Francis Xavier's Parish [Coloane], 30 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/76108157).

Remarks. Macau specimens exhibit a total length of 6.0–6.5 mm and a maximum width of 2.0–2.5 mm. The species is nocturnal and attracted to artificial lights. In the past, it has been misidentified and confused with *R. honesta* (Hua 2002; Chou 2004, 2008; Yiu

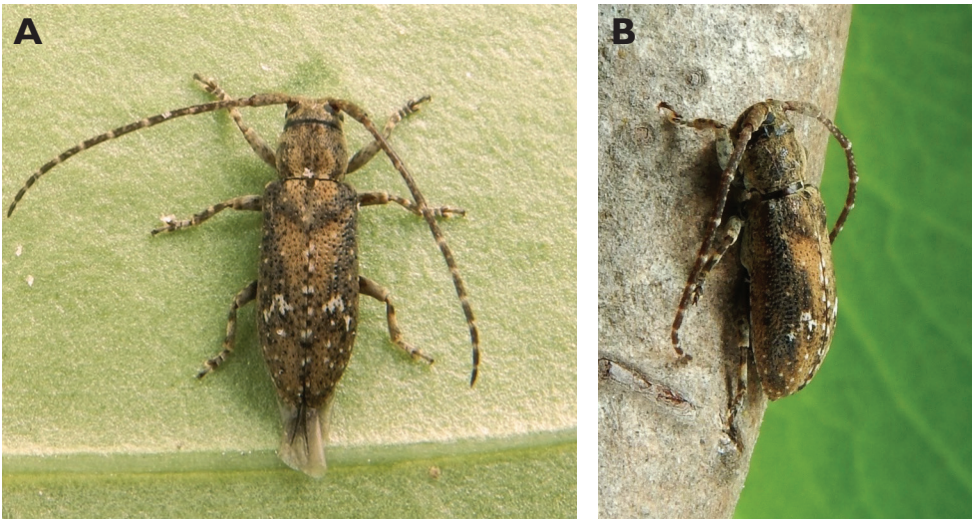

Figure 29. *Ropica dorsalis* Schwarzer, 1925: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa Hill on 7 May 2019 and at Coloane Village on 30 Apr 2021, respectively (photographs: LC).

2009), with consequent mix up of their respective distribution records (Hua 2002; Lin and Yang 2019). According to Gressitt (1951), *Cucumis sativus* is among its host plants and in Hong Kong larvae have been found boring into stems of *Cucumis melo* (Yiu 2009).

Genus *Sybra* Pascoe, 1865: 141.

Type species. *Ropica stigmatica* Pascoe, 1859.

***Sybra marmorea* Breuning, 1939**
Fig. 30

Sybra marmorea Breuning, 1939: 264. TL: China; TD: NHMUK.

Distribution. Palaearctic Region: China (Lin and Yang 2019; Danilevsky 2020). Oriental Region: Vietnam (Lin and Yang 2019).

Macau records. Coloane Village, 20 May 2021, on building wall under street light, R Perissinotto & L Clennell (IZCAS; https://www.inaturalist.org/observations/79725419).

Remarks. This is a highly significant record, as the type locality of this species was only vaguely reported as "China" in the original description of Breuning (1939), without reference to specific region or place. The only specimen observed in Macau so far exhibits a total length of 9 mm and a maximum width of 2.5 mm. The species

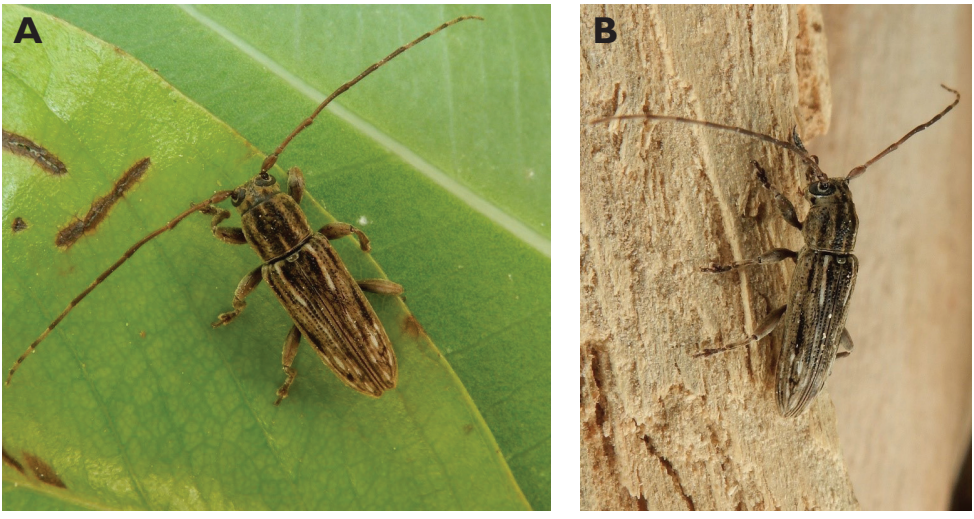

Figure 30. *Sybra marmorea* Breuning, 1939: dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 20 May 2021 (photographs: LC).

is obviously nocturnal and attracted to artificial lights. Nothing appears to be known about the larval host plant(s) and general biology of this species.

***Sybra posticalis* (Pascoe, 1858)**
Fig. 31

Ropica posticalis Pascoe, 1858: 248. TL: China (Hong Kong); TD: NHMUK.

Distribution. Palaearctic Region: China (Hainan, Hong Kong, Taiwan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Macau records. 1♂, Coloane, 16 Apr 1994, PF Cheong (CIAM); 2♂, 2♀, Cotai Ecological Zone, 1st zone, 4–5 Apr 2013, leg. Feng-Long Jia & Wei-Cai Xie (SYSU); Great Taipa, 22 Apr 2019, in mosquito trap, R Perissinotto & L Clennell (IZCAS × 2); ibidem 13 May 2019, on wall in ablution block, R Perissinotto & L Clennell (MACT): ibidem 13 Jun 2019, on floor in ablution block, R Perissinotto & L Clennell (IZCAS); Coloane Village, 22 Jun 2019, on wall in ablution block, R Perissinotto & L Clennell (IZCAS); St. Francis Xavier's Parish [Coloane], 24 May 2020 2:14, Kit Chang (https://www.inaturalist.org/observations/47082176); Nossa Senhora do Carmo, Ilhas [Little Taipa], 9 May 2021 13:27, Kit Chang (https://www.inaturalist.org/observations/78034724).

Remarks. In Macau, adults seem to be active only in late spring and range in total length 5.5–8 mm and 1.5–3 mm in maximum width. Activity is mainly nocturnal

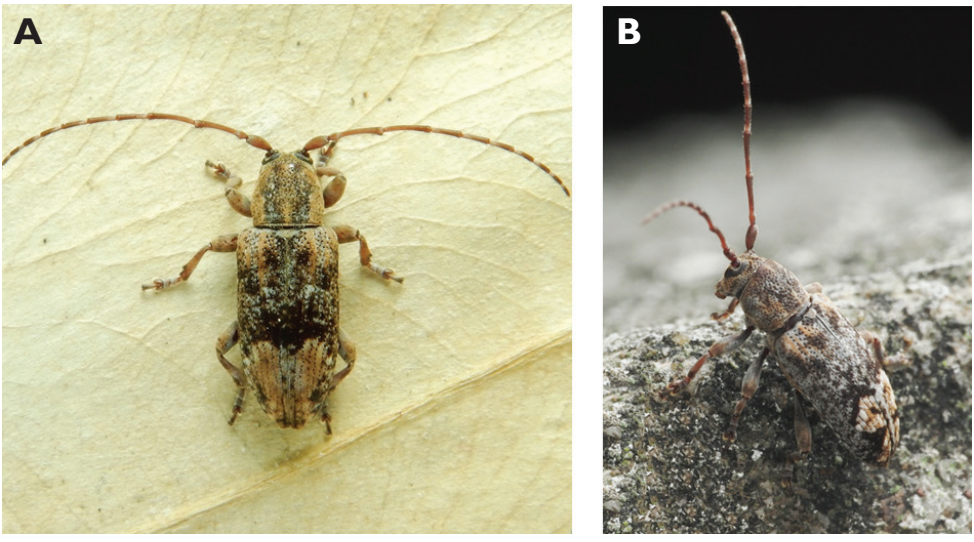

Figure 31. *Sybra posticalis* (Pascoe, 1858): dorsal (**A**) and lateral (**B**) views of specimens observed at Coloane Village (22 Jun 2019) and on Coloane Heights (24 May 2020), respectively (photographs: **A** LC **B** Kit Chang).

and individuals are readily attracted to artificial lights. In Hong Kong, a larva was reared successfully in captivity to adulthood when fed a mixture of soft dead woods (Yiu 2009).

Tribe Batocerini J. Thomson, 1864

Genus *Batocera* Dejean, 1835: 341.

Type species. *Cerambyx rubus* Linnaeus, 1758.

***Batocera rubus rubus* (Linnaeus, 1758)**
Fig. 32

Cerambyx rubus Linnaeus, 1758: 390. TL: India; TD: Unknown

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Shaanxi, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang); India (Arunachal Pradesh, Uttarakhand); Japan (Ryukyus); Nepal; Pakistan; Saudi Arabia; Turkey (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Indonesia (Lesser Sunda Islands, Borneo-Kalimantan, Sumatra); Laos; Malaysia (Malayan Peninsula, Sarawak, Sabah); Myanmar; Thailand, Vietnam (Kumawat et al. 2015).

Macau records. Taipa, University of East Asia Campus, 6 July 1991, on Block I (Easton 1991: 110; 1993: 46); Macau, University of East Asia, no data, ER Easton leg (UMEC); no data, "*Batocera rubus* (Linnaeus), 榕八星天牛32 mm " (Pun and Batalha 1997: 64, fig. 97); 1♂, Coloane, 3 Sep 1993, F Macedo, *Batocera rubus* (CIAM); 1♂, ibidem 31 May 2000, CN Chan (CIAM); 1♀, ibidem 11 Oct 2002, KW Ho (CIAM); 1♀, Macau, 7 Sep 1997, SV Lam (CIAM); 1♂, No data, *Batocera rubus* (CIAM); Little Taipa, 23 Apr 2019, at monument spotlight, R Perissinotto & L Clennell (IZCAS); ibidem 26 Apr 2019, R Perissinotto; ibidem 13 May 2019, R Perissinotto & L Clennell (IZCAS); Great Taipa, 8 May 2019, under spotlight, R Perissinotto; Macau, 11 May 2019 (Daisy Li); Coloane Village, 24 Apr 2020, under spotlight outside prison building, R Perissinotto; ibidem 18 May 2020, on trunk of *Ficus rumphii*, R Perissinotto; ibidem 12 Jun 2020, R Perissinotto; ibidem 7 Jul 2020, R Perissinotto; Coloane, Cheoc Van, 6 Jul 2019, dead on ground, Lynette Clennell (MACT); Great Taipa, 28 Aug 2019, R Perissinotto & L Clennell (MACT); Guia Hill Municipal Park, 31 Jul 2017 22:41, Eric Kwan (https://www.inaturalist.org/observations/23090665); Macau, St Lazarus Parish, 5 Nov 2016 21:09, Kisu Wong (https://www.inaturalist.org/observations/23851435); Little Taipa Hill, 3 May 2019 10:11, Eric Kwan (https://www.inaturalist.org/observations/24446612); Taipa, Northeast Road, 23 May 2020 22:53, Eric Kwan (https://www.inaturalist.org/observations/47008047); Taipa, Qitan Highway, 28 May 2020 21:52, Eric Kwan (https://www.inaturalist.org/observations/47699538); St. Francis Xavier's Parish [Coloane], 30 May 2020 1:21, Kit Chang (https://www.inaturalist.org/observations/47765481); ibidem 7 Jun 2020 20:58, Kisu Wong (https://www.inaturalist.org/observations/55385398); Coloane, Tin Hau Temple,

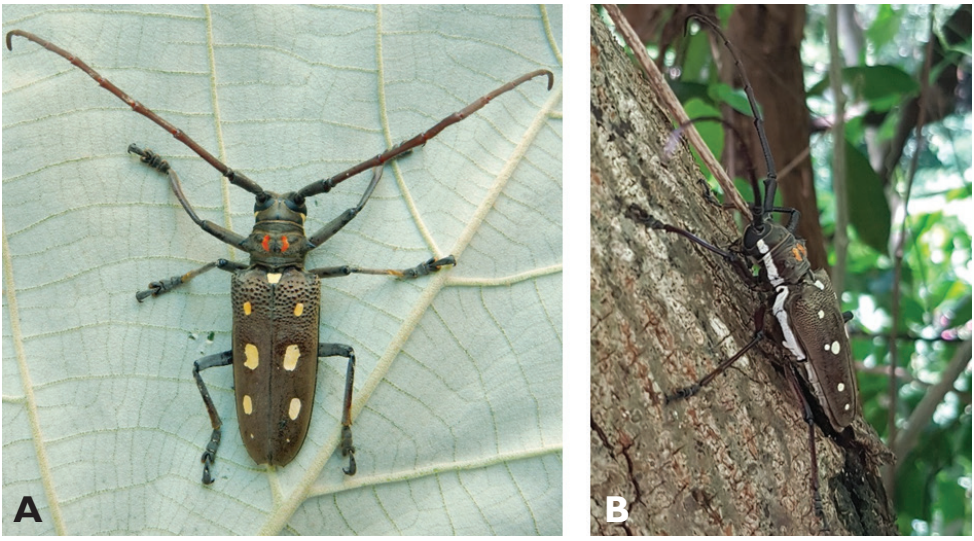

Figure 32. *Batocera rubus rubus* (Linnaeus, 1758): dorsal (**A**) and lateral (**B**) views of specimens observed on Little Taipa Hill (23 Apr 2019) and Coloane Village (2 Jul 2020), respectively (photographs: LC).

13 Jun 2020 00:35, Benny Kuok (https://www.inaturalist.org/observations/49416193); Coloane Heights Road, 18 Jun 2020 21:53, Kelvin Joshua Che (https://www.inaturalist.org/observations/50051088).

Remarks. This is the largest longhorn beetle encountered in the Macau SAR during the current census, attaining a total length of 24–36 mm and a maximum width of 8–11 mm. Adults are active from late spring till mid-autumn, both during the day and night. The larvae burrow in a wide variety of forest trees, including *Artocarpus heterophyllus*, *Careya arborea*, *Ficus* spp. and *Mangifera* spp., from India through southeast Asia and south China, including Hong Kong (Easton 1991; Kumawat et al. 2015).

Tribe Desmiphorini Thomson, 1860

Genus *Pseudoterinaea* Breuning, 1940: 178.

Type species. *Pseudanaesthetis bicoloripes* Pic, 1926.

***Pseudoterinaea bicoloripes* (Pic, 1926)**
Fig. 33

Pseudanaesthetis bicoloripes Pic, 1926: 26. TL: Vietnam (Tonkin); TD: MNHN

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Hainan, Hong Kong, Yunnan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Vietnam (Hua 2002).

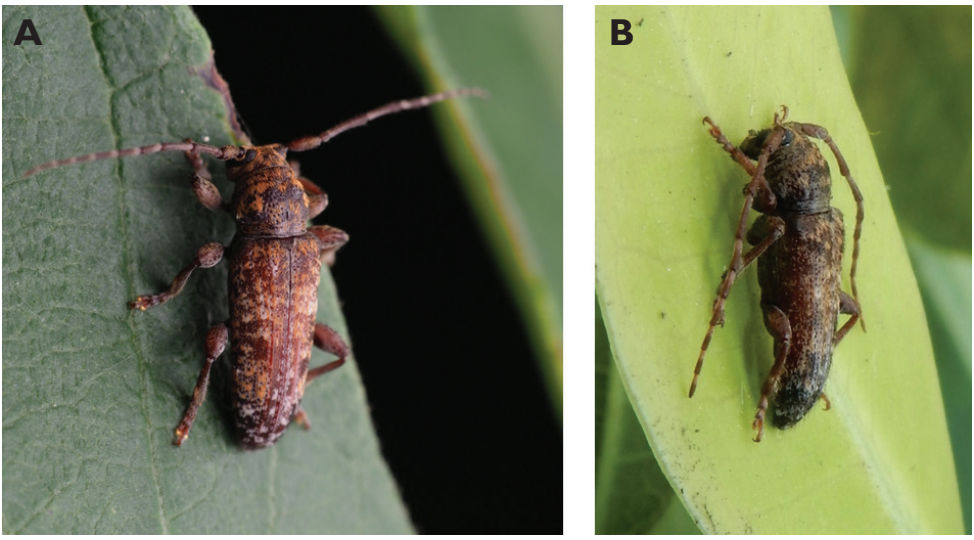

Figure 33. *Pseudoterinaea bicoloripes* (Pic, 1926): dorsal (**A**) and lateral (**B**) views of specimens observed on Little Taipa (3 May 2019) and Great Taipa (15 May 2019), respectively (photographs: **A** Kit Chang **B** LC).

Macau records. 1♀, Coloane, 9 May 1994, WW Pun (CIAM); Great Taipa, 9 Apr 2019, under light in ablution block, R Perissinotto & L Clennell; ibidem 28 Apr 2019, R Perissinotto & L Clennell (IZCAS); ibidem 15 May 2019, R Perissinotto & L Clennell (IZCAS); Macau, 27 May 2019, Kit Chang; Our Lady of Carmel's Parish [Little Taipa], 3 May 2019 21:45, Eric Kwan (https://www.inaturalist.org/observations/24446701); ibidem 3 May 2019 21:46, Kit Chang (https://www.inaturalist.org/observations/24501567); ibidem 4 Apr 2020 12:30, Kit Chang (https://www.inaturalist.org/observations/43052257); ibidem 24 Apr 2020 12:37, Kisu Wong (https://www.inaturalist.org/observations/43313431); St. Francis Xavier's Parish [Coloane], 24 May 2020 23:45, Kit Chang (https://www.inaturalist.org/observations/47149914); ibidem 24 May 2020 19:18, Kisu Wong (https://www.inaturalist.org/observations/54388784); Taipa, "Our Lady of Hope" Wetland, 18 Jun 2020 22:36, Eric Kwan (https://www.inaturalist.org/observations/50069191); St. Lazarus' Parish [Guia Hill], 24 Jul 2020 22:55, Kit Chang (https://www.inaturalist.org/observations/54172350); Taipa Grande, 15 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/78919645).

Remarks. In Macau, adults are active throughout the spring and summer and range in total length 7–8.5 mm and 2–3 mm in maximum width. Activity appears to be mainly during night time, when specimens are readily attracted to artificial lights. No information is available in the literature on the larval food plant(s) of this species.

Genus *Sophronica* Blanchard, 1845: 160.

Type species. *Sophronica calceata* Chevrolat, 1855

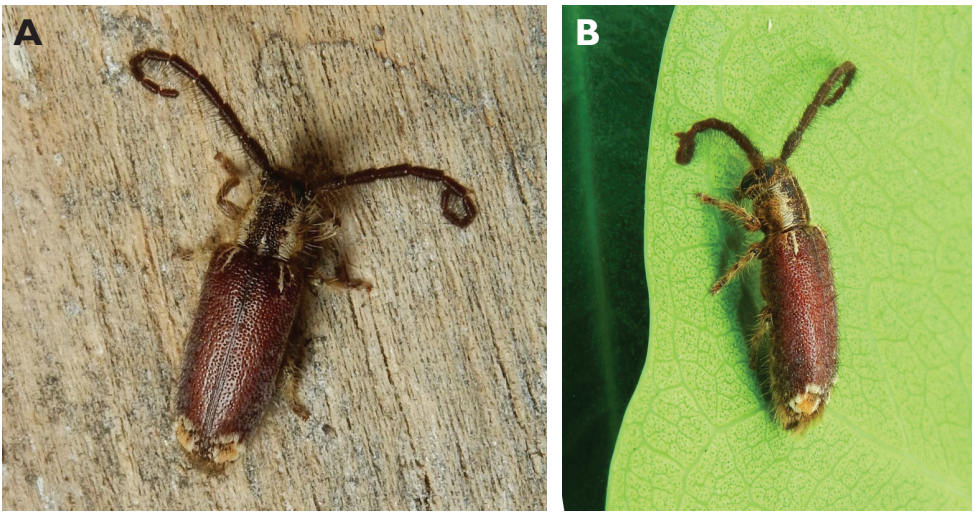

Figure 34. *Sophronica apicalis* (Pic, 1922): dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 1 May 2021 (photographs: LC).

***Sophronica apicalis* (Pic, 1922)**
Fig. 34

Phunginus apicalis Pic, 1922: 15. TL: Vietnam (Tonkin); TD: MNHN

Distribution. Palaearctic Region: India (Uttarakhand); Nepal (Danilevsky 2020). Oriental Region: Thailand (https://www.thailandnatureproject.com/sophronica-apicalis.html).

Macau records. Coloane Village, 1 May 2021, on wall under light in ablution block, R Perissinotto & L Clennell (IZCAS).

Remarks. This is a new record for China. The specimen observed at Coloane exhibits a total length of 9 mm and a maximum width of 2.5 mm. Adult activity is presumably nocturnal and the specimen in question was obviously attracted to artificial light. No information is available in the literature on the larval food plant(s) or general biology of this species.

Genus *Zotalemimon* Pic, 1925: 29.

Type species. *Zotalemimon apicale* Pic, 1925 (= *Sybra posticata* Gahan, 1895).

***Zotalemimon ciliatum* (Gressitt, 1942)**
Fig. 35

Donysia ciliata Gressitt, 1942: 212. TL: China (Guangdong, Honan Island); TD: SYSU.

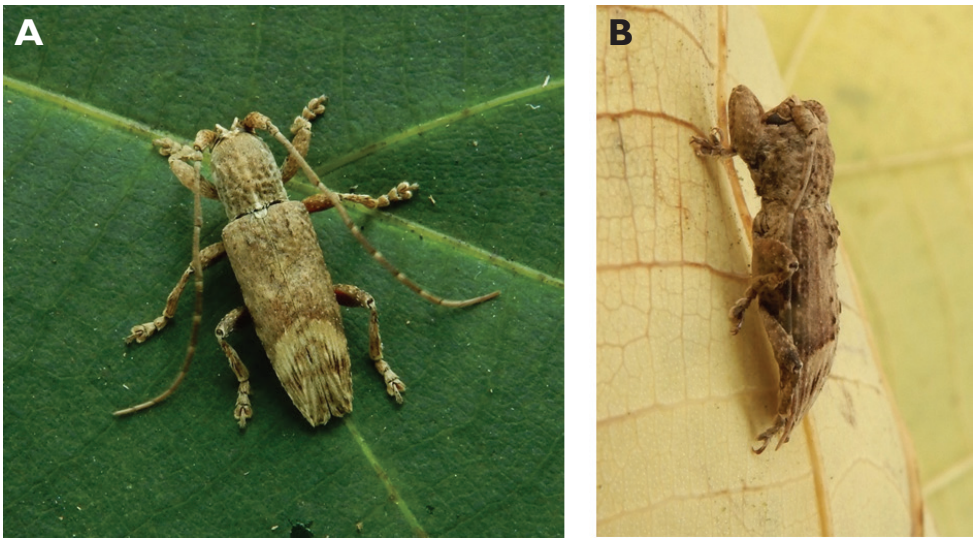

Figure 35. *Zotalemimon ciliatum* (Gressitt, 1942): dorsal (**A**) and lateral (**B**) views of specimens observed on Little Taipa (3 May 2019) and Great Taipa (15 May 2019), respectively (photographs: LC).

Distribution. Palaearctic Region: China (Fujian, Guangdong, Hainan, Hong Kong, Yunnan) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Macau records. Great Taipa, 16 Mar 2019, under light in ablution block, R Perissinotto; Coloane Village, 3 Apr 2020, on the wall in ablution block, R Perissinotto.

Remarks. In Macau, adults appear to be active only in the spring and range in total length 10.5–12 mm and 3–4 mm in maximum width. Adults are nocturnal and attracted to artificial lights. Known larval host plants include *Dendrocalamus latiflorus* and *Xylosma* sp. (Hua 2002; Yiu 2009).

Tribe Dorcaschematini J. Thomson, 1860

Genus *Olenecamptus* Chevrolat, 1835: 134.

Type species. *Olenecamptus serratus* Chevrolat, 1835 (= *Saperda biloba* Fabricius, 1801).

Olenecamptus taiwanus L. S. Dillon & E. S. Dillon, 1948

Fig. 36

Olenecamptus bilobus taiwanus L. S. Dillon & E. S. Dillon, 1948: 229, pl. X, fig. 9. TL: China (Taiwan); TD: AMNH

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Hong Kong, Taiwan, Yunnan); Japan (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

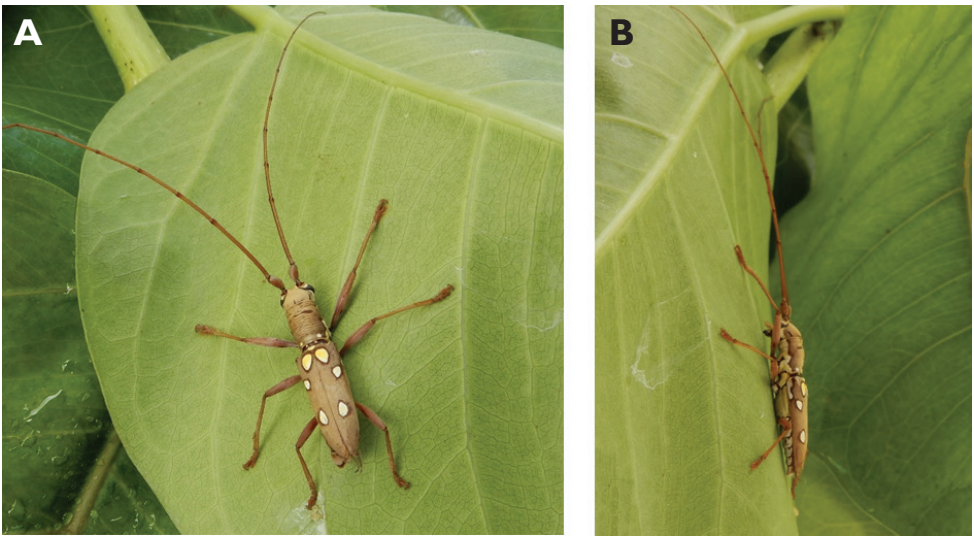

Figure 36. *Olenecamptus taiwanus* L. S. Dillon & E. S. Dillon, 1948: dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 26 May 2020 (photographs: LC).

Macau records. Taipa, University of East Asia Campus, 10 Sep 1991, on Block I, "*Olenecamptus bilobus*" (Easton 1991: 110); Macau, University of East Asia, 23 Apr 1990, ER Easton leg (UMEC); no data "*Olenecamptus bilobus tonkinus* Dillon et Dillon, 南方粉天牛15 mm" (Pun and Batalha 1997: 65, fig. 103); 1♂, Coloane, 28 Jun 1988, WW Pun, *Olenecamptus bilobus tonkinus* (CIAM); 1♀, ibidem 2 May 1994, PF Cheong, *Olenecamptus bilobus tonkinus* WW Pun det. (CIAM); Little Taipa, 23 Apr 2019, at monument spotlight, R Perissinotto & L Clennell (IZCAS); ibidem 19 Sep 2019, dead on trunk of *Ficus microcarpa*, R Perissinotto (MACT); Coloane Village, 26 May 2020, in mosquito electric trap, R Perissinotto & L Clennell (MACT); ibidem 26 May 2020, on branch of *Ficus rumphii*, R Perissinotto; ibidem 2 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/76790090).

Remarks. In Macau, adults are active from late spring to late summer and range in total length 11.5–20 mm and 2.5–5 mm in maximum width. According to Yiu (2009), in Hong Kong the larvae of this species complete their development inside dead branches of *Ficus* spp. trees. In Macau, adults were repeatedly found on the trunk of large *F. rumphii* and *F. microcarpa* trees on Little Taipa Hill (RP pers. obs.). Known host plants for the species include *Artocarpus* sp., *Bauhinia* sp., *Ficus infectoria*, *Hevea brasiliensis*, *Mangifera indica*, *Mangifera* sp., *Morus alba* and *Morus* sp. (Lin and Yang 2019).

Tribe Exocentrini Pascoe, 1864

Genus *Exocentrus* Dejean, 1835: 339.

Type species. *Cerambyx balteatus* Fabricius sensu Dejean 1835 (= *Cerambyx lusitanus* Linnaeus, 1767).

***Exocentrus alboguttatus subconjunctus* Gressitt, 1940**
Fig. 37

Exocentrus alboguttatus subconjunctus Gressitt, 1940a: 184. TL: China (Hainan); TD: SYSU

Distribution. Palaearctic Region: China (Guangxi, Hainan, Hong Kong) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Macau records. Great Taipa, 29 Apr 2019, at light in ablution block, R Perissinotto & L Clennell (IZCAS); ibidem 9 May 2019, R Perissinotto & L Clennell (IZCAS); ibidem 15 May 2019 on dead tree branch, R Perissinotto & L Clennell (IZCAS); ibidem 13 Jun 2019, on mosquito trap, R Perissinotto & L Clennell (IZCAS); Little Taipa, 26 Apr 2019, at monument spotlight, R Perissinotto & L Clennell (IZCAS); Coloane Village, 2 Jun 2019, on floor in ablution block (MACT); ibidem 13 May 2020, R Perissinotto & L Clennell (MACT, × 2); ibidem 8 Jun 2020, R Perissinotto & L Clennell (IZCAS); St. Francis Xavier's Parish [Coloane], 24 May 2020 2:08, Kit Chang (https://www.inaturalist.org/observations/47082171); ibidem 24 May 2020 19:32, Kisu Wong, (https://www.inaturalist.org/observations/54388816); ibidem 30 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/76032774); Taipa, Evora Str., 6 Jun 2020 1:38, Eric Kwan (https://www.inaturalist.org/observations/48558660); Our Lady of Carmel's Parish [Great Taipa], 28 May 2020 00:37, Kit Chang (https://www.inaturalist.org/observations/47611059).

Remarks. In Macau, adults are active from late spring till early summer and range in total length 4.5–7.5 mm and 1.5–3 mm in maximum width. They are readily

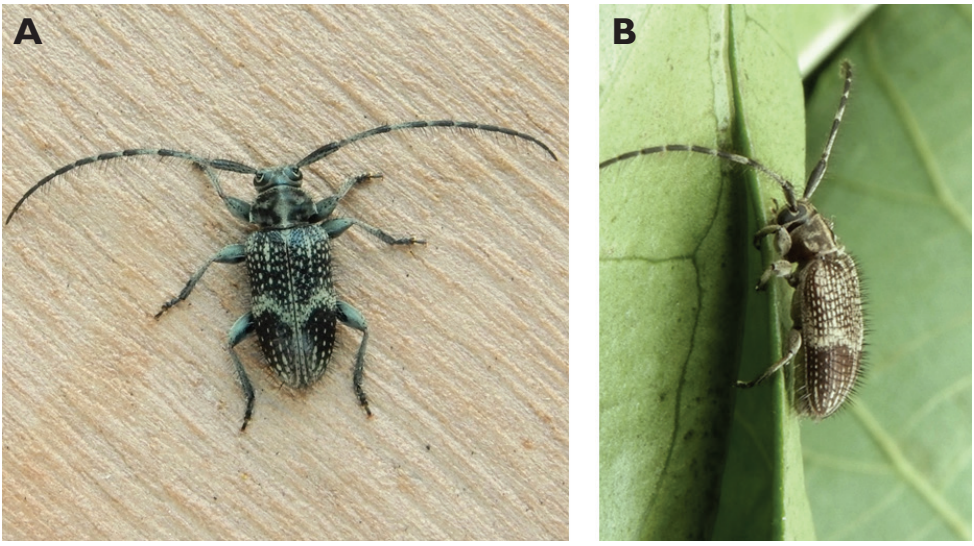

Figure 37. *Exocentrus alboguttatus subconjunctus* Gressitt, 1940: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa Hill (3 Jun 2018) and Coloane Village (25 May 2020), respectively (photographs: LC).

attracted to artificial lights at night, but are also active during daytime when they can be observed crawling and mating on dead tree twigs and branches. In nearby Hong Kong, where in the past this species has been erroneously reported as *E. guttulatus subconjunctus*, the larval host plants include *Acacia farnesiana*, *Mallotus* spp. and *Morus alba* (Yiu 2009; Yiu and Yip 2011).

Exocentrus formosofasciolatus Kusama & Tahira, 1978

Fig. 38

Exocentrus (*Camptomyne*) *formosofasciolatus* Kusama & Tahira, 1978: 17, figs 7, 7 p. TL: China (Taiwan); TD: NSMT.

Distribution. Palaearctic Region: China (Taiwan) (Lin and Yang 2019; Danilevsky 2020).

Macau records. Great Taipa, 13 May 2019, in mosquito trap, R Perissinotto & L Clennell (MACT × 2); ibidem 13 Jun 2019, R Perissinotto & L Clennell (IZCAS); Taipa Village, 15 May 2019 on dead tree branch, R Perissinotto & L Clennell (IZCAS); Little Taipa, 13 May 2019, at monument spotlight, R Perissinotto & L Clennell (IZCAS).

Remarks. In Macau, adults seem to be active only in late spring and range in total length 4–5 mm and 1.5–2 mm in maximum width. Like in its congeneric species above, individuals are active both during the daytime and at night, when they are readily attracted to artificial lights. No information is available on its larval food plant(s).

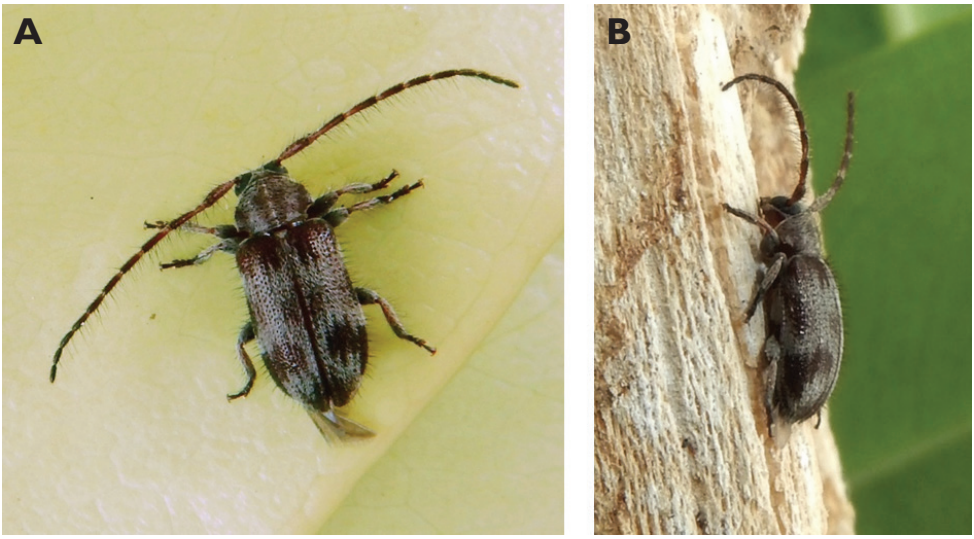

Figure 38. *Exocentrus formosofasciolatus* Kusama & Tahira, 1978: dorsal (**A**) and lateral (**B**) views of specimen observed on Great Taipa Hill on 13 May 2019 (photographs: LC).

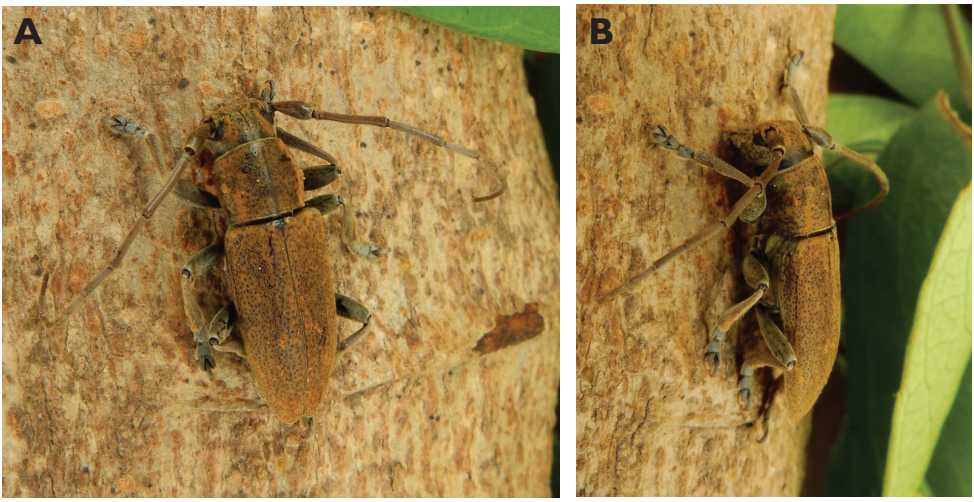

Figure 39. *Bumetopia oscitans* Pascoe, 1858: dorsal (**A**) and lateral (**B**) views of specimen observed on Little Taipa Hill on 25 Mar 2021 (photographs: LC).

Tribe Homonoeini J. Thomson, 1864

Genus *Bumetopia* Pascoe, 1858: 252.

Type species. *Bumetopia oscitans* Pascoe, 1858.

***Bumetopia oscitans* Pascoe, 1858**
Fig. 39

Bumetopia oscitans Pascoe, 1858: 252. TL: China (Hong Kong); TD: NHMUK

Distribution. Palaearctic Region: China (Hong Kong, Shaanxi, Taiwan); South Korea (Lin and Yang 2019; Danilevsky 2020).

Macau records. 1♂, Little Taipa, 25 Mar 2021, on branch of *Cinnamomum burmannii*, R Perissinotto (IZCAS).

Remarks. The only specimen observed in Macau during this study exhibits a total length of 13 mm and a maximum width of 4 mm. In Hong Kong, adults have been reported feeding on *Miscanthus* sp. (Yiu 2009).

Tribe Lamiini Latreille, 1825

***Genus Anoplophora* Hope, 1839: 43.**

Type species. *Anoplophora stanleyana* Hope, 1839.

***Anoplophora chinensis chinensis* (Forster, 1771)**
Fig. 40

Cerambyx chinensis Forster, 1771: 39. TL: China; TD: LSLU

Distribution. Palaearctic Region: Austria (introduced); China (Anhui, Beijing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jangsu, Jiangxi, Jilin, Liaoning, Shaanxi, Shandong, Shanghai, Sichuan, Taiwan, Yunnan, Zhejiang); Croatia (introduced); France (introduced); Germany (introduced); Italy (introduced); Netherlands (introduced); Turkey (introduced); South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Indonesia; Malaysia; Myanmar; Philippines; Vietnam (Lingafelter and Hoebeke 2002).

Macau records. Taipa, University of East Asia Campus, 22 May 1991, near tennis courts under street lamp (Easton 1991: 110; 1993: 49); Macau, University of East Asia, no data, ER Easton leg (UMEC x3); no data, "*Anoplophora chinensis* (Forster), 星天牛34 mm " (Pun and Batalha 1997: 64, fig. 94); 1♂, Coloane, 16 Jun 1992, Tai Ip, *Anoplophora chinensis* (CIAM); 1♀, ibidem 25 May 1995, Tai Ip, *Anoplophora chinensis* (CIAM); 1♂, ibidem 19 May 1994, *Melia azedarach*, Tai Ip, *Anoplophora chinensis* WW Pun det. (CIAM); 1♀, Taipa, 14 Apr 1993, *Casuarina equisetifolia*, WM Ng, *Anoplophora chinensis* (CIAM); Taipa Village, 23 Apr 2018, on trunk of *Leucaena leucocephala*, R Perissinotto & L Clennell; Taipa Central, 2 May 2019, dead on floor, R Perissinotto & L Clennell; Coloane Village, 20 Apr 2020, fresh elytron on road, R Perissinotto & L Clennell (MACT); ibidem 26 Apr 2020,

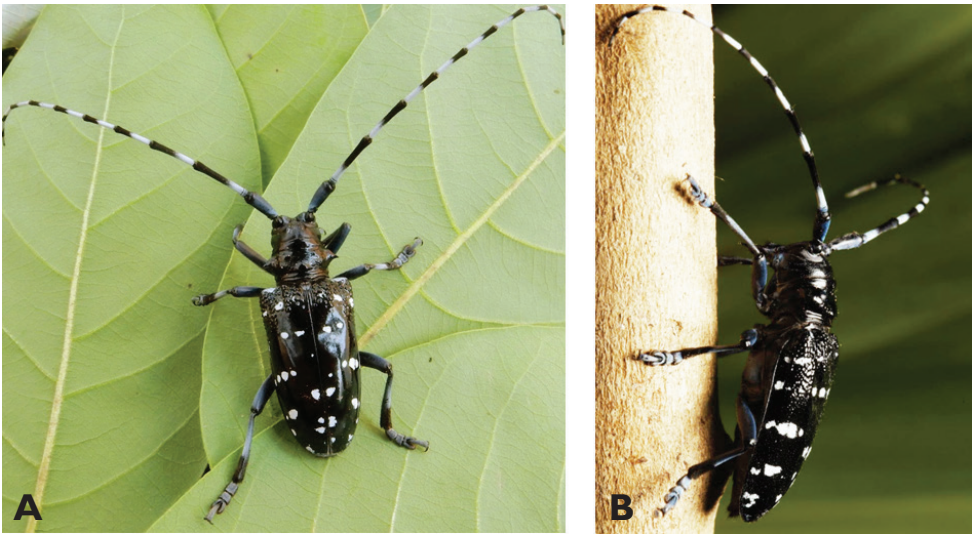

Figure 40. *Anoplophora chinensis chinensis* (Forster, 1771): dorsal (**A**) and lateral (**B**) views of specimens observed at Coloane Village on 26 Apr 2020 and Taipa Village on 10 May 2020, respectively (photographs: **A** LC **B** Kisu Wong).

female on tree trunk, R Perissinotto & L Clennell (MACT); ibidem 15 Jun 2019, on trunk of *Mallotus paniculatus*, R Perissinotto & L Clennell (MACT); Taipa, Museum Houses, 10 May 2020 14:05, Kisu Wong (https://www.inaturalist.org/observations/52588617); Coloane Village, 30 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/76032800); ibidem 1 May 2021 13:02, Lynette Clennell (https://www.inaturalist.org/observations/76100043); Macau University of Science & Technology, 1 May 2021 10:43, Amanda Wan (https://www.inaturalist.org/observations/76454987).

Remarks. Easton (1993) reported that this species was common in Macau during the period 1991–1993. Despite having a very wide distribution range and being regarded as a pest and invasive species in some countries, it is now a rather scarce occurrence in Macau, where adults are active only from late spring to early summer. It ranges in total length 24–35 mm and 10.5–13 mm in maximum width. This species is often referred to as "the citrus longhorn beetle" (Easton 1991, 1993) and its larvae are considered a serious pest of citrus in Hong Kong and adjacent mainland China (Hill et al. 1982). In Macau, where citrus trees are very scarce, it has been suggested that larvae may complete their growth in wood of *Melia azedarach* (Easton 1993). The larvae of this species are actually extreme opportunists in their diet and consume a large variety of woody plants, including horticultural species, and adults are therefore often encountered in city gardens and farms (Yiu 2009). Among the best known host plants are *Acer saccharinum*, *Alnus firma*, *A. hirsuta* f. *glabra*, *Atalantia buxifolia*, *Betula platyphylla* var. *japonica*, *Broussonetia papyrifera*, *Castanea* sp., *C. crenata*, *Citrus* sp., *C. junos*, *C. unshiu*, *Cryptomeria japonica*, *Ficus carica*, *Hibiscus* sp., *H. syriacus*, *Juglans* sp., *J. mandshurica*, *Lagerstroemia indica*, *Mallotus japonicus*, *Malus pumila*, *Melia azedarach*, *Momordica charantia*, *Morus* sp., *M. alba*, *Platanus occidentalis*, *P. orientalis*, *Poncirus trifoliata*, *Populus* spp., *Prunus* spp., *Psidium guajava*, *Punica granatum*, *Pyrus pyrifolia* var. *culta*, *P. ussuriensis*, *Rosa* sp., *R. multiflora*, *R. rugosa*, *Salix* sp., *S. babylonica*, *S. koreensis*, *Styrax japonicas* and *Ulmus davidiana* var. *japonica* (Lim et al. 2014; Lin and Yang 2019).

Genus *Blepephaeus* Pascoe, 1866: 249.

Type species. *Monohammus succintor* Chevrolat, 1852.

***Blepephaeus subcruciatus* (White, 1858)**
Fig. 41

Monohammus subcruciatus White, 1858: 410. TL: China (Hong Kong); TD: NHMUK

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Hong Kong) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020).

Macau records. Guia Hill, 12 May 2019, near light in ablution block, R Perissinotto & L Clennell (IZCAS).

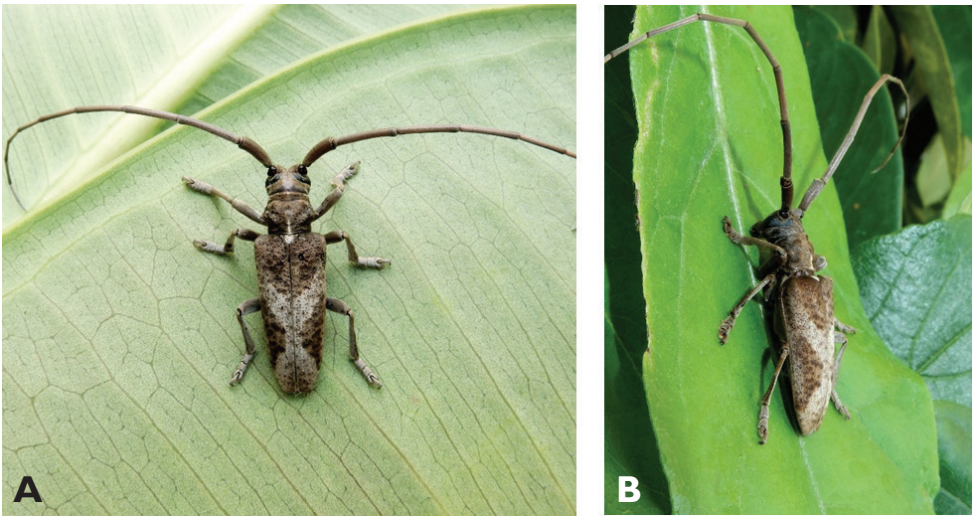

Figure 41. *Blepephaeus subcruciatus* (White, 1858): dorsal (**A**) and lateral (**B**) views of specimen observed on Guia Hill on 12 May 2019 (photographs: LC).

Remarks. Only one specimen was observed in Macau during the entire study period, exhibiting a total length of 20 mm and a maximum width of 6 mm. Adults seem to be active in late spring and mainly at night, being attracted to artificial lights. There is no published information on its biology.

Blepephaeus succinctor (Chevrolat, 1852)

Fig. 42

Monohammus succinctor Chevrolat, 1852: 417. TL: China (Shanghai); TD: NHMUK

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Hunan, Hong Kong, Jiangsu, Jiangxi, Shaanxi, Shanghai, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang); India (Arunachal Pradesh, Sikkim); Nepal (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Bangladesh; India; Laos, Malaysia; Thailand, Vietnam (Mitra et al. 2017).

Macau records. Guia Hill, 4 May 2019, crushed on pavement, R Perissinotto & L Clennell (IZCAS); Coloane Heights, under statue spotlight, 11 May 2019, R. Perissinotto & L Clennell (IZCAS); ibidem 31 May 2020, R Perissinotto & L Clennell; Great Taipa, 4 Jun 2019, at light in ablution block, R Perissinotto & L Clennell; St. Francis Xavier's Parish [Coloane], 24 May 2020 2:22, Kit Chang (https://www.inaturalist.org/observations/47082181); ibidem 7 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/77838218).

Remarks. In Macau, adults are active only in late spring and range in total length 22–27 mm and 6–9 mm in maximum width. They are mainly nocturnal and readily attracted to artificial lights. In nearby Hong Kong, larvae utilise a wide variety of

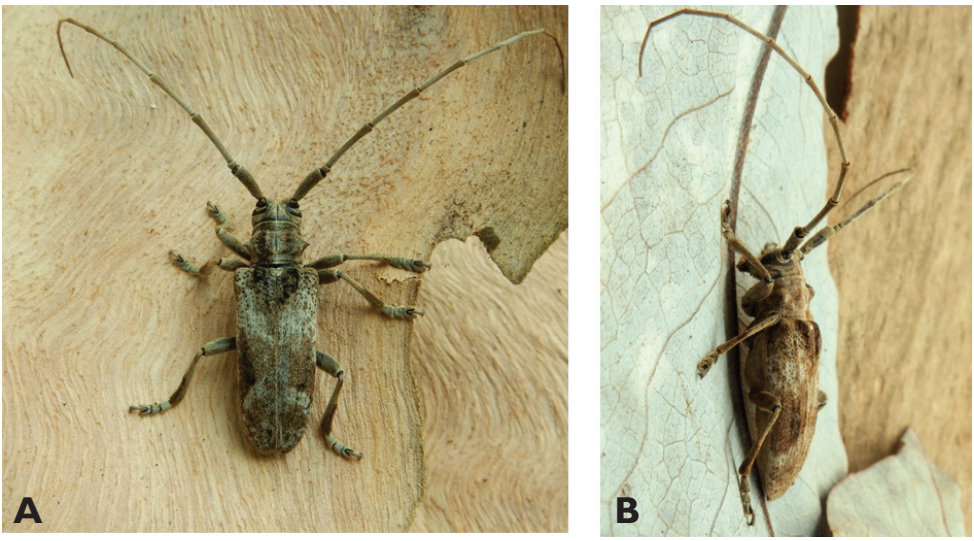

Figure 42. *Blepephaeus succinctor* (Chevrolat, 1852): dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa Hill (4 Jun 2019) and Coloane Heights (31 May 2020), respectively (photographs: LC).

food plants, including *Adenanthera miscrosperma*, *Citrus reticulata*, *Melia azedarach*, *Morus alba*, and *Vernicia fordii* (Yiu 2009). Other host plants include *Acacia confusa*, *Adenanthera pavonina*, *Albizia* sp., *Bambusa* sp., *Casuarina equisetifolia*, *Cinnamomum camphora*, *Citrus* sp., *Cunninghamia lanceolata*, *Firmiana simplex*, *Juglans regia*, *Olea europaea*, *Paulownia* sp., *Quercus* sp. and *Styphnolobium japonicum* (Lin and Yang 2019).

Genus *Eutaenia* J. Thomson, 1857a: 184.

Type species. *Ceroplesis javeti* J. Thomson, 1857 (= *Lamia trifasciella* White, 1850).

Eutaenia tanoni Breuning, 1962

Fig. 43

Eutaenia tanoni Breuning 1962a:18. TL: Laos; TD: BPBM

Distribution. Palaearctic Region: China (Guangxi) (Huang et al. 2002). Oriental Region: Laos (Breuning 1962a; Rondon and Breuning 1970).

Macau records. Coloane, Cheoc Van, on coastal vegetation, 18 May 2019, R Perissinotto & L Clennell (IZCAS); ibidem 19 May 2020, R Perissinotto & L Clennell; ibidem 22 May 2020, R Perissinotto & L Clennell (MACT); Coloane, Aldeia Road, 16 May 2020 17:55, Annie Lao (https://www.inaturalist.org/observations/46079399).

Remarks. Since this species was originally described on the basis of a single specimen, Rondon and Breuning (1970) suggested that it may have represented a natural

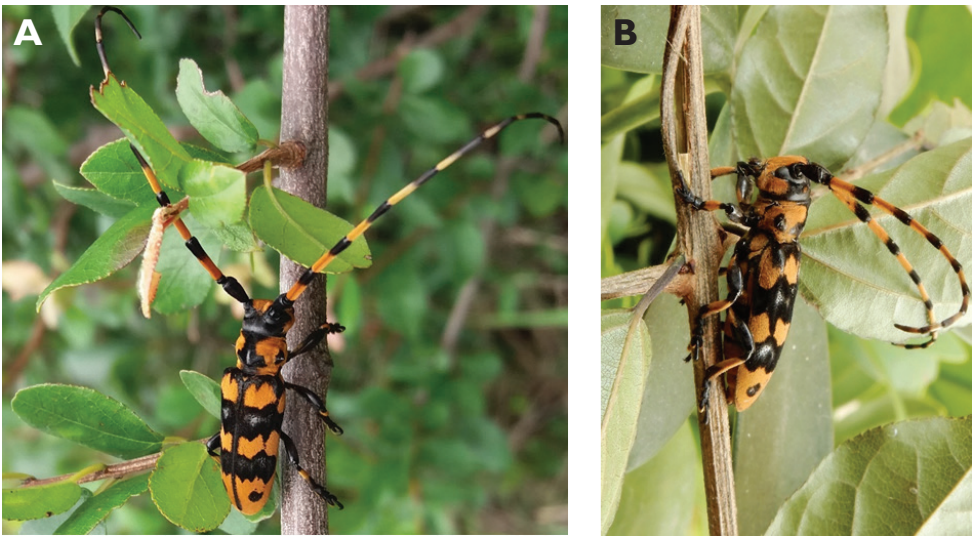

Figure 43. *Eutaenia tanoni* Breuning 1962: dorsal (**A**) and lateral (**B**) views of specimens observed along the Coloane coast on 19 May 2020 (photographs: LC).

hybrid between the more common and widely distributed *Eutaenia trifasciella* (White, 1850) and *E. corbetti* Gahan, 1893. It differs from the closely related *E. trifasciella* from Hong Kong mainly by having the apical four antennomeres with basal parts lightly testaceous rather than completely black and the black marking on pronotum extending to both anterior and posterior margins, instead of forming only a middle transverse black stripe. In Macau, adults are active only in late spring and range in total length 20.5–23 mm and 6–7 mm in maximum width. They are strictly diurnal and feed on the bark of coastal shrubs (RP & LC pers. obs.).

Genus *Monochamus* Dejean, 1821: 106.

Type species. *Cerambyx sutor* Linnaeus, 1758.

***Monochamus alternatus alternatus* Hope, 1842**
Fig. 44

Monohammus alternatus Hope, 1842: 61. TL: China (Zhejiang); TD: OXUM
Monohammus tesserula White, 1858: 408. TL: China (Hong Kong): TD: NHMUK

Distribution. Palaearctic Region: China (Anhui, Beijing, Fujian, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang); South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Vietnam (Akbulut et al. 2017).

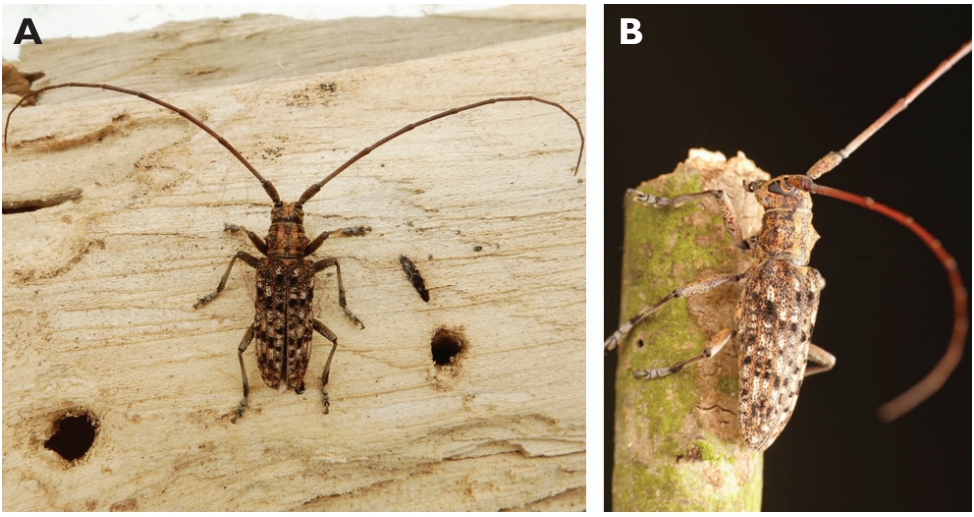

Figure 44. *Monochamus alternatus alternatus* Hope, 1842: dorsal (**A**) and lateral (**B**) views of specimens observed on the Coloane Heights on 22 May 2020 and on 24 May 2020, respectively (photographs: **A** LC **B** Kisu Wong).

Macau records. 1♀, Coloane, 19 Apr 2001, CM Chan, *Monochamus alternatus* Hope ♀ (CIAM); 1♂, ibidem 25 Apr 2001, CM Chan, *Monochamus alternatus* Hope ♂ (CIAM); 1♂, ibidem 26 Apr 2001, CM Chan, *Monochamus alternatus* Hope ♂ (CIAM); Coloane Heights, A-Mà statue, 22 May 2020, R Perissinotto; ibidem 30 May 2020, dead under spot-light, R Perissinotto & L Clennell (IZCAS); St. Francis Xavier's Parish [Coloane], 24 May 2020 22:52, Kit Chang (https://www.inaturalist.org/observations/47149824); ibidem 24 May 2020 9:13, Kisu Wong (https://www.inaturalist.org/observations/542858480).

Remarks. In Macau, adults are active mainly at night and only in late spring; they range in total length 18–21 mm and 6–7.5 mm in maximum width. In Hong Kong, larvae reportedly bore into *Pinus massoniana* and carry the pine-wood nematode *Bursaphelenchus xilophilus*, which is a pest of pine plantations (Yiu 2009). Other larval food plants include *Abies firma*, *A. holophylla*, *Cedrus deodara*, *C. libani*, *Cryptomeria japonica*, *Juniperus* sp., *J. chinensis*, *Larix* sp., *Larix gmelinii*, *Malus asiatica*, *M. pumila*, *Morinda umbellata*, *Picea* sp., *P. excelsa*, *P. morinda*, *Pinus armandii*, *P. banksiana*, *P. densiflora*, *P. elliottii*, *P. khasya*, *P. koraiensis*, *P. luchuensis*, *P. massoniana*, *P. rigida*, *P. strobus*, *P. taeda*, *P. thunbergii*, *P. yunnanensis* and *Quercus* sp. (Lim et al. 2014; Lin and Yang 2019).

Tribe Mesosini Mulsant, 1839

Genus *Coptops* Audinet-Serville, 1835: 64.

Type species. *Coptops parallela* Audinet-Serville, 1835 (= *Lamia aedificator* Fabricius, 1793).

***Coptops licheneus* Pascoe, 1865**
Fig. 45

Coptops lichenea Pascoe, 1865: 118. TL: Malaysia (Malacca); TD: NHMUK

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Hainan, Hong Kong, Yunnan); Nepal (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Malaysia (Malacca); Myanmar (Lin and Yang 2019).

Macau records. Coloane, Hác-Sá, 28 Apr 2019, on dead tree branch, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 3 May 2019, on dead tree trunk, R Perissinotto; ibidem 15 May 2020, R Perissinotto; ibidem 11 Jul 2020, R Perissinotto; Coloane Village, 2 Jun 2020, under light in ablution block, R Perissinotto & L Clennell (MACT); ibidem 5 Jun 2020, on dead tree, R Perissinotto & L Clennell (MACT); St. Francis Xavier's Parish [Coloane], 25 Apr 2020 11:21, Kisu Wong (https://www.inaturalist.org/observations/43868250); ibidem 27 Apr 2020 00:16, Kit Chang (https://www.inaturalist.org/observations/43868602); ibidem 28 May 2020 2:33, Kit Chang (https://www.inaturalist.org/observations/47612775); ibidem 12 Jun 2020 2:36, Kit Chang (https://www.inaturalist.org/observations/49251853); ibidem 12 Jun 2020 2:44, Kit Chang (https://www.inaturalist.org/observations/49251860); ibidem 4 Apr 2021 15:08, Lynette Clennell (https://www.inaturalist.org/observations/72875242); ibidem 5 Apr 2021 11:21, Wai (https://www.inaturalist.org/observations/72974838).

Remarks. In Macau, adults are active from late spring to mid-summer and range in total length 15–18 mm and 6–7.5 mm in maximum width. Individuals are readily attracted to artificial lights at night, but are also active during the day while crawling

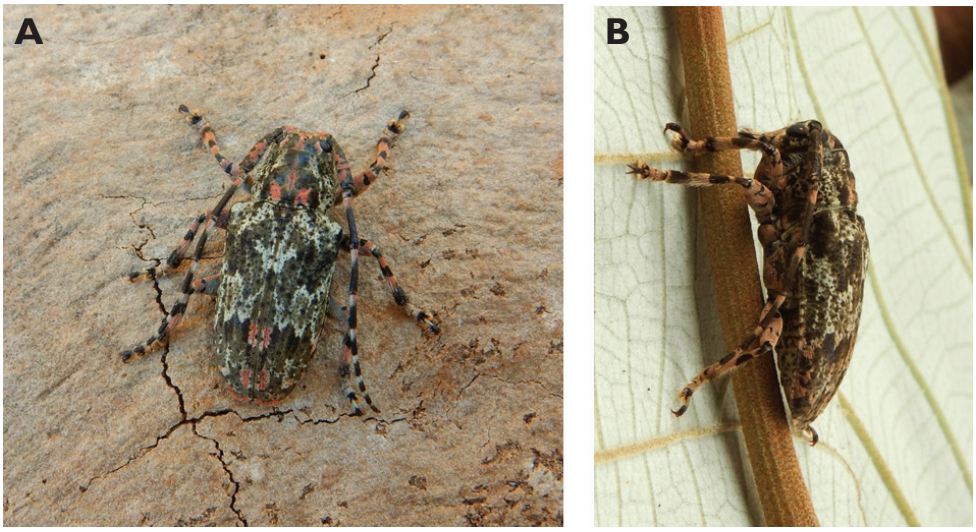

Figure 45. *Coptops licheneus* Pascoe, 1865: dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights, on 11 Jul 2020 and 26 May 2020, respectively (photographs: LC).

and mating on dead tree surfaces. In Hong Kong, *Mangifera indica* and *Derris* spp. have been reported as food plants for the larvae of this species (Yiu 2009). Other host plants include *Derris trifoliata*, *Hevea brasiliensis*, *Mangifera indica*, *Quercus* sp., *Shorea* sp. and *Terminalia* sp. (Lin and Yang 2019).

Tribe Pteropliini J. Thomson, 1860

Genus *Desisa* Pascoe, 1865: 163.

Type species. *Praonetha subfasciata* Pascoe, 1862.

***Desisa subfasciata* (Pascoe, 1862)**
Fig. 46

Praonetha subfasciata Pascoe, 1862: 348. TL: Cambodia; TD: NHMUK

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Hainan, Henan, Hong Kong, Hubei, Jiangsu, Jiangxi, Yunnan, Zhejiang); India (Uttarakhand); Nepal (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Cambodia; Laos; Vietnam (Hua 2002).

Macau records. Coloane, A-Má Cultural Village, 28 Apr 2019, R Perissinotto & L Clennell (IZCAS); ibidem 6 May 2020, R Perissinotto; Coloane Village, 14 May

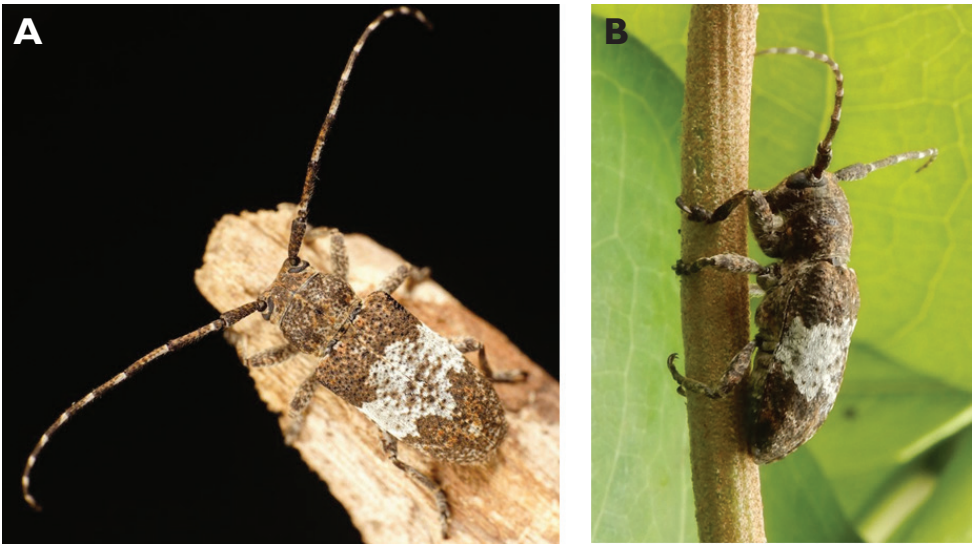

Figure 46. *Desisa subfasciata* (Pascoe, 1862): dorsal (**A**) and lateral (**B**) views of specimens observed on the Coloane Heights on 16 May 2020 and on 24 May 2020, respectively (photographs: **A** Kisu Wong **B** LC).

2020, at light in ablution block, R Perissinotto & L Clennell (MACT); ibidem 24 May 2020, on dead tree trunk, R Perissinotto & L Clennell; ibidem 26 May 2020, in mosquito trap, R Perissinotto & L Clennell (MACT); ibidem 31 May 2020, on mosquito trap, R Perissinotto & L Clennell (IZCAS); Great Taipa, 30 Apr 2019, on floor in ablution block, R Perissinotto & L Clennell (IZCAS); St. Francis Xavier's Parish [Coloane], 16 May 2020 21:42, Kit Chang (https://www.inaturalist.org/observations/46100622); ibidem 3 May 2020 00:54, Kit Chang (https://www.inaturalist.org/observations/47765453); ibidem 16 May 2020 20:50, Kisu Wong (https://www.inaturalist.org/observations/53851800); ibidem 19 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/79472969); ibidem 22 May 2021 8:33, Kit Chang (https://www.inaturalist.org/observations/79764029); Coloane Heights, Walking Trail, 16 May 2020 20:31, Eric Kwan (https://www.inaturalist.org/observations/46146716); Macau, 18 Jun 2020 22:13, Kelvin Joshua Che (https://www.inaturalist.org/observations/50638425).

Remarks. In Macau, adults are active only in mid to late spring and range in total length 10–15 mm and 4–6 mm in maximum width. They are both nocturnal, being readily attracted to artificial lights, and diurnal, crawling and mating on dead tree branches and trunks. In Hong Kong, larvae have been found boring into various trees, including *Mallotus philippensis*, *Morus alba* and *Prunus persica* (Yiu 2009). Other reported host plants include *Bauhinia vahlii* and *Prunus armeniaca* (Lin and Yang 2019).

Genus *Mispila* Pascoe, 1864: 58.

Type species. *Mispila venosa* Pascoe, 1864.

***Mispila tholana* (Gressitt, 1940)**
Fig. 47

Enispia tholana Gressitt, 1940a: 157, pl. 4, fig. 11. TL: China (Hainan); TD: CASF.

Distribution. Palaearctic Region: China (Hainan, Yunnan) (Lin and Yang 2019; Danilevsky 2020).

Macau records. Coloane Heights, A-Má Cultural Village, 28 Apr 2019, on wall near artificial light, R Perissinotto & L Clennell (IZCAS); St. Francis Xavier's Parish [Coloane], 18 Jun 2020 22:53, Kit Chang (https://www.inaturalist.org/observations/50057362); ibidem 27 Jun 2020 2:03, Kit Chang (https://www.inaturalist.org/observations/51012816).

Remarks. In Macau, adults are active only in the spring and during night time, when they are attracted to artificial lights. The only specimen that could be measured

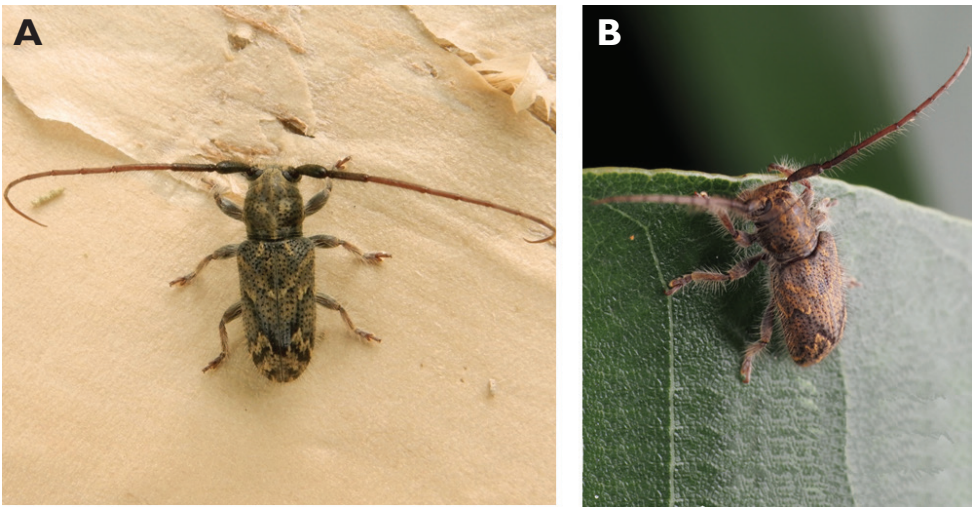

Figure 47. *Mispila tholana* (Gressitt, 1940): dorsal (**A**) and lateral (**B**) views of specimens observed on the Coloane Heights on 28 Apr 2019 and on 18 Jun 2020, respectively (photographs: **A** LC **B** Kit Chang).

exhibited a total length of 9 mm and a maximum width of 3 mm. There is no information in the literature on the biology of this species.

Genus *Prosoplus* Blanchard, 1853: 290.

Type species. *Leiopus sinuatofasciatus* Blanchard, 1853

***Prosoplus bankii* (Fabricius, 1775)**
Fig. 48

Lamia bankii Fabricius, 1775: 176. TL: South Africa ("Cap Bonae Spei"); TD: NHMUK.

Distribution. Palaearctic Region: China (Guangdong, Hainan, Taiwan); Japan (Lin and Yang 2019; Danilevsky 2020). Oriental Region: Indonesia; Philippines; Thailand; Vietnam (Lin and Yang 2019). Also widely distributed in the Afrotropical, Australian and Pacific regions (Lin and Yang 2019).

Macau records. Coloane, Tin Hau Temple, 14 Jun 2019, R Perissinotto & Lynette Clennell (IZCAS); Coloane Village, 27 May 2020, on mosquito trap, R Perissinotto & L Clennell (IZCAS); ibidem Coloane, 22 May 2020, at light in ablution block, R Perissinotto & L Clennell; Coloane Village, 2 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/76790089).

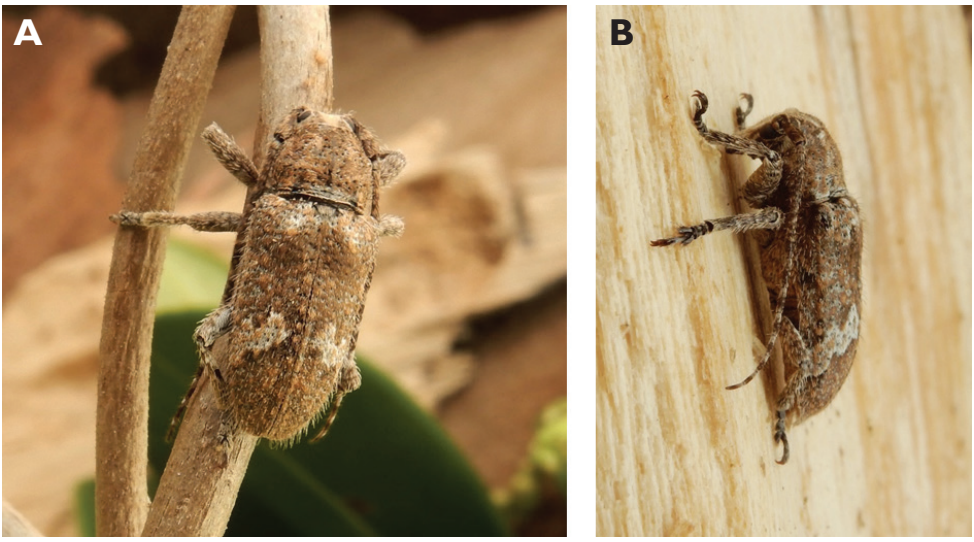

Figure 48. *Prosoplus bankii* (Fabricius, 1775): dorsal (**A**) and lateral (**B**) views of specimens observed at Coloane Village on 27 May 2020 and 22 May 2020, respectively (photographs: LC).

Remarks. In Macau, adults seem to be active only in late spring and range in total length 8–13 mm and 3–5 mm in maximum width. Individuals have so far only been found around artificial lights, indicating a predominant nocturnal activity. Hua (2002) reported as host plant for this species *Anacardium* sp., *Ananas comosus* and *Mangifera indica*.

Genus *Pterolophia* Newman, 1842c: 370 [NP].

Type species. *Mesosa bigibbera* Newman, 1842.

***Pterolophia kaleea inflexa* Gressitt, 1940**
Fig. 49

Pterolophia kaleea inflexa Gressitt, 1940b: 11, pl. 1, fig. 3. TL: China (Guangdong); TD: SYSU.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Sichuan, Taiwan) (Lin and Yang 2019; Danilevsky 2020).

Macau records. Great Taipa, 21 May 2019, at light in ablution block, R Perissinotto & L Clennell (IZCAS).

Remarks. Only one female specimen was found during the census period and this exhibited a total length of 6.5 mm and a maximum width of 2 mm. The species

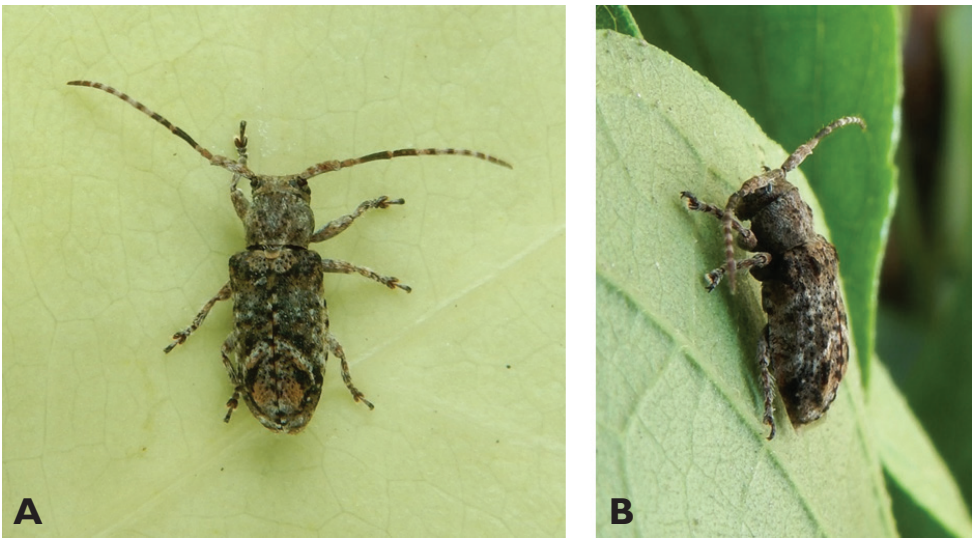

Figure 49. *Pterolophia kaleea inflexa* Gressitt, 1940: dorsal (**A**) and lateral (**B**) views of specimen observed on Great Taipa Hill on 21 May 2019 (photographs: LC).

appears to be mainly nocturnal and attracted to artificial lights. Hua (2002) reported as host plants for this species *Sophora* sp.

Pterolophia consularis **(Pascoe, 1866)**
Fig. 50

Praonetha consularis Pascoe, 1866: 240. TL: Malaysia (Malacca); TD: NHMUK
Pterolophia cervina Gressitt, 1939: 74. TL: China (Guangdong); TD: SYSU

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Yunnan); Bhutan; India (Sikkim) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Malaysia (Malacca); Myanmar; Indonesia (Sumatra); Vietnam (Kariyanna et al. 2017). Afrotropical Region: Madagascar (Kariyanna et al. 2017).

Macau records. Coloane Village, 1 Jun 2020, on mosquito trap in ablution block, R Perissinotto & L Clennell (IZCAS); ibidem 2 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/76790081).

Remarks. The only two specimens observed in Macau exhibited a total length of 9–9.5 mm and a maximum width of 4 mm. Its general morphology matches rather well that of *Pterolophia cervina* Gressit, 1939 from Guangdong, which was recently considered as a synonym of *Praonetha consularis* Pascoe, 1866 (Weigel et al. 2013). It also resembles closely *P.* (*Mimoron*) *brevegibbosa* Pic, 1926 from Lantau Island, Hong Kong (Hayashi 1982, pl. 2, fig. 6). So, it is possible that all of them actually represent

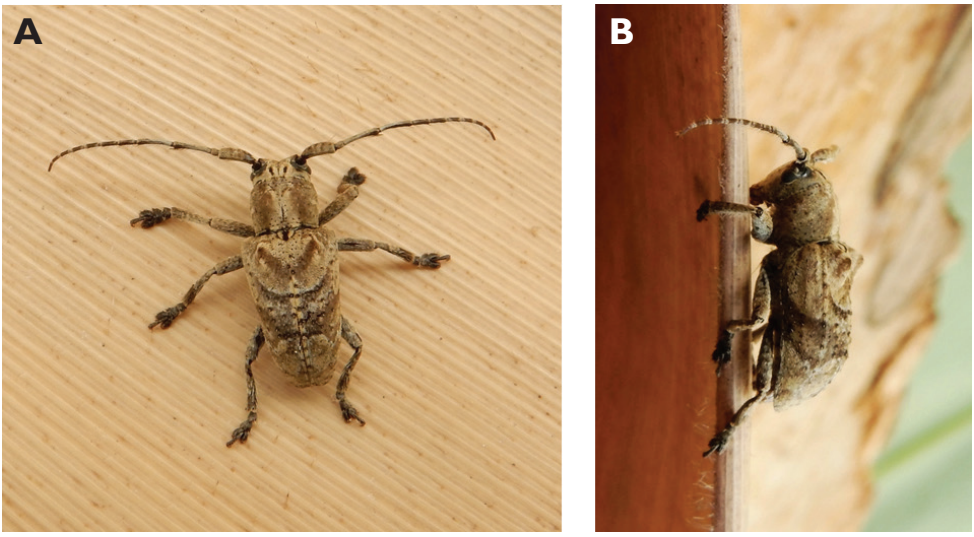

Figure 50. *Pterolophia consularis* (Pascoe, 1866): dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 1 Jun 2020 (photographs: LC).

the same species, with the name *P.* (*P.*) *consularis* being the most senior. However, if the type species from Malaysia is different, then *P.* (*M.*) *brevegibbosa* will be the senior name for the species from Macau, Guangdong, Hong Kong and Hainan Island. Yiu (2009) reported that larvae of this species in Hong Kong bore into plants of *Zea mays* and Hua (2002) listed as host plant also *Casuarina equisetifolia*.

Subgenus *Hylobrotus* Lacordaire, 1872: 538.

Type species. *Hylobrotus ploemi* Lacordaire, 1872.

***Pterolophia* (*Hylobrotus*) *annulata* (Chevrolat, 1845)**
Fig. 51

Coptops annulata Chevrolat, 1845: 99. TL: China (Macau); TD: NHMUK.
Praonetha bowringii Pascoe, 1865: 170. TL: China (Hong Kong); TD: NHMUK. Synonymised by Gressitt, 1939: 73.

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hong Kong, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shanghai, Sichuan, Taiwan, Yunnan, Zhejiang); India (Sikkim); Japan; Nepal; North & South Korea (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Myanmar; Thailand; Vietnam (Duffy 1968; Hua 2002).

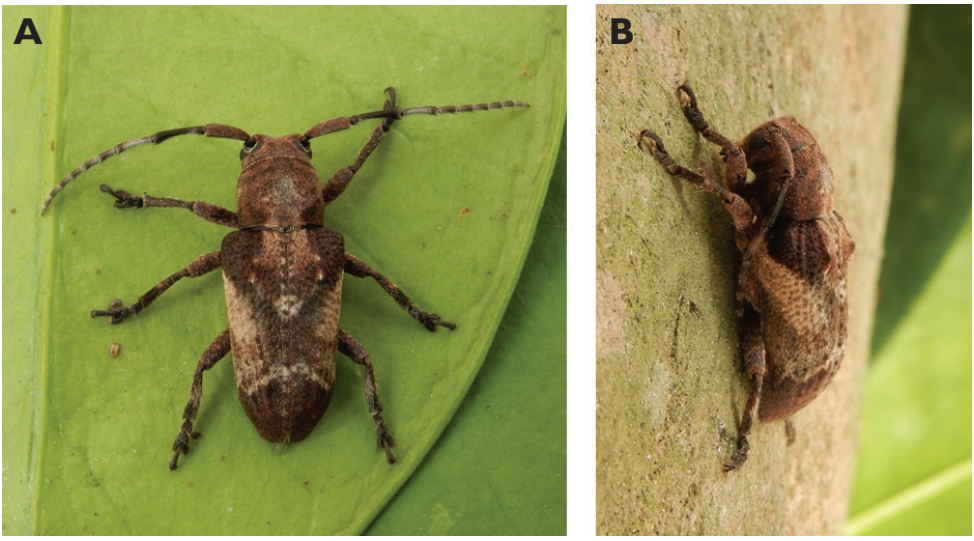

Figure 51. *Pterolophia* (*Hylobrotus*) *annulata* (Chevrolat, 1845): dorsal (**A**) and lateral (**B**) views of specimen observed at Coloane Village on 30 Apr 2020 (photographs: LC).

Macau records. Coloane, 28 Jan 1992, *Morus alba*, A Fai, *Pterolophia annulata* (CIAM); No data, "*Pterolophia annulata* (Chevrolat), 桑坡天牛12 mm " (Pun and Batalha 1997: 65, fig. 105); 1♀, Cotai Ecological Zone, 1st zone, 9 Oct 2013, leg. Feng-Long Jia (SYSU); Coloane Village, 15 May 2019, in mosquito trap, R Perissinotto & L Clennell (IZCAS × 2); ibidem 31 Mar 2019, at light in ablution block, R Perissinotto; ibidem 30 Apr 2020, on dead tree branch, R Perissinotto & L Clennell (IZCAS); ibidem 13 May 2020, on mosquito trap, R Perissinotto & L Clennell (MACT); Coloane Heights, Tin Hau temple, 25 Mar 2021, crushed on pavement, R Perissinotto & L Clennell (MACT); Coloane, A-Má Statue, 20 Oct 2020 15:01, under spot-light, Lynette Clennell (https://www.inaturalist.org/observations/63084216); St. Francis Xavier's Parish [Coloane], 24 May 2020 1:45, Kit Chang (https://www.inaturalist.org/observations/47082155); ibidem 24 May 2020 2:09, Kit Chang (https://www.inaturalist.org/observations/47082175); ibidem 28 May 2020 2:54, Kit Chang (https://www.inaturalist.org/observations/47612790); ibidem 12 Jun 2020 23:00, Kelvin Joshua Che (https://www.inaturalist.org/observations/49412284); ibidem 12 Mar 2021, Lynette Clennell (https://www.inaturalist.org/observations/71103753); ibidem 1 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/76374763); Macau, Luis de Camoes Garden, 10 Jun 2020 10:30, Eric Kwan (https://www.inaturalist.org/observations/49141547).

Remarks. In Macau, adults are active from early spring till mid-autumn and range in total length 11–15 mm and 4–6 mm in maximum width. The species is mainly nocturnal and promptly attracted to artificial lights. In Hong Kong, larvae of this species bore into wood of *Morus alba* (Yiu 2009). Elsewhere, larval host plants include also *Albizia julibrissin*, *Celtis sinensis*, *Ficus pumila*, *Machilus thunbergii*, *Pinus massoniana* and *Prunus persica* (Hua 2002; Lim et al. 2014).

Tribe Saperdini Mulsant, 1839

Genus *Glenea* Newman, 1842d: 301.

Type species. *Saperda novemguttata* Guérin-Méneville, 1831, designated by Thomson 1879: 1.

Subgenus *Stiroglenea* Aurivillius, 1920

Glenea Sg. *Stiroglenea* Aurivillius, 1920: 30.

Type species. *Lamia cantor* Fabricius, 1787.

***Glenea* (*Stiroglenea*) *cantor cantor* (Fabricius, 1787)**
Fig. 52

Lamia cantor Fabricius, 1787: 142. TL: China; TD: ZMUC

Distribution. Palaearctic Region: China (Guangdong, Guangxi, Guizhou, Hainan, Hong Kong, Jiangxi, Yunnan, Zhejiang) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: India; Laos; Philippines; Thailand; Vietnam (Kariyanna et al. 2017).

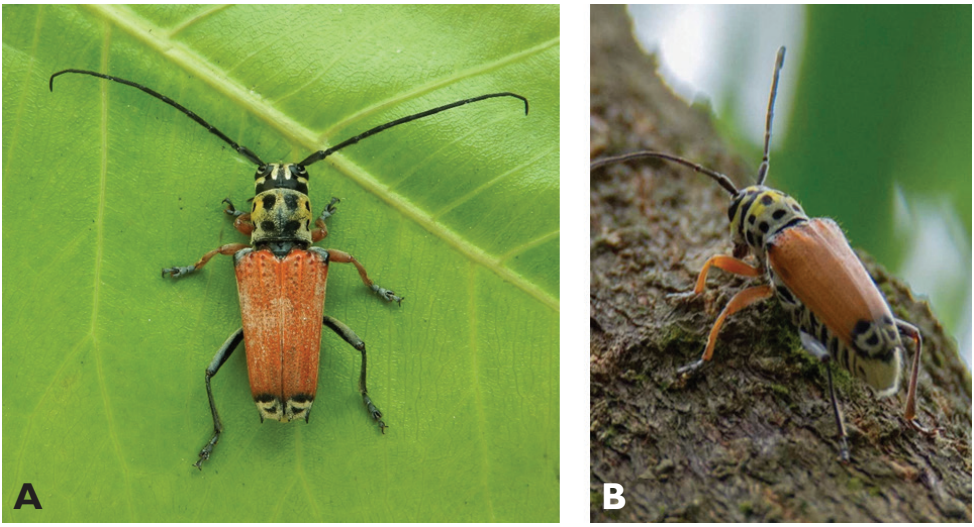

Figure 52. *Glenea* (*Stiroglenea*) *cantor cantor* (Fabricius, 1787): dorsal (**A**) and lateral (**B**) views of specimens observed on Coloane Heights on 23 Sep 2020 and 15 Sep 2019, respectively (photographs: **A** LC **B** Eric Kwan).

Macau records. 1♀, Coloane, 20 Jul 1994, Tai Ip, *Glenea cantor* (CIAM); No data, "*Glenea cantor* (Fabricius), 眉斑并脊天牛15 mm" (Pun and Batalha 1997: 64, fig. 99); Coloane, 15 Sep 2019, Eric Kwan; Coloane, Seac Pai Van Road, 23 Sep 2020 11:23, Lynette Clennell (https://www.inaturalist.org/observations/60909845) (IZCAS); ibidem, inside Seac Pai Van Park, 28 May 2021 8:10, Macau Friend (https://www.inaturalist.org/observations/80630954).

Remarks. This species has been recorded only three times in Macau during the current census, in late spring and late summer. Adult activity is mainly during the hottest part of the day, when individuals promptly take off in flight when disturbed in the forest undergrowth, or display thanatosis if captured (Yiu 2009; pers. obs.). The only specimen that could be measured had a total length of 13 mm and a maximum width of 4 mm. The host plants known so far in its wide distribution range include *Aesculus chinensis*, *Bombax ceiba*, *B. malabaricum*, *Castanea mollissima*, *Ceiba pentandra*, *Excentrodendron hsiemmu*, *Melastoma candidum*, *Melia azedarach*, *Paulownia* sp. and *Quercus* sp. (Hua 2002; Yiu 2009; Lin and Yang 2019).

Genus *Oberea* Dejean, 1835: 351.

Type species. *Cerambyx linearis* Linnaeus, 1760.

Oberea ferruginea (Thunberg, 1787)

Fig. 53

Saperda ferruginea Thunberg, 1787: 57. TL: Unknown; TD: UZIU.
Oberea semiargentata Pic, 1923: 15. TL: China (Guangdong); TD: MNHN.
Oberea notativentris Pic, 1924: 30. TL: China (Guangdong); TD: MNHN. [RN] Synonymised by Breuning 1962b: 159.

Distribution. Palaearctic Region: China (Fujian, Gansu, Guangdong, Guangxi, Hubei, Hunan, Shaanxi, Yunnan); India (Sikkim); Nepal (Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Malaysia; Myanmar; Vietnam (Hua 2002).

Macau records. 1♂, Taipa, 14 Jul 1992, Dr Easton, *Oberea ferruginea* (CIAM); Trilho da Taipa Grande, 19 Sep 1995, hovering over false tea, ER Easton, J Bizarro & T Novo leg (UMEC); No data, "*Oberea ferruginea* Thunberg, 短足筒天牛16 mm" (Pun and Batalha 1997: 65, fig. 102); 1♀, Coloane, 18 Jul 1996, KW Ho, *Oberea ferruginea* (CIAM); 1♂, ibidem 20 Jul 1994, WM Ng, *Oberea ferruginea* (CIAM); 1♀, ibidem 25 Apr 2000, ML Lei (CIAM); 1♂, ibidem 8 Aug 2002, KL Tang (CIAM); Little Taipa Hill, 26 Sep 2018, R Perissinotto & L Clennell; ibidem 11 Oct 2018, R Perissinotto & L Clennell; Taipa, Lou Lim Ieok Road, 4 Apr 2019 R Perissinotto & L Clennell (IZCAS); ibidem 23 Apr 2019, on shrub leaves, R Perissinotto & L Clennell (IZCAS); ibidem 26 Oct 2018, R Perissinotto & L Clennell

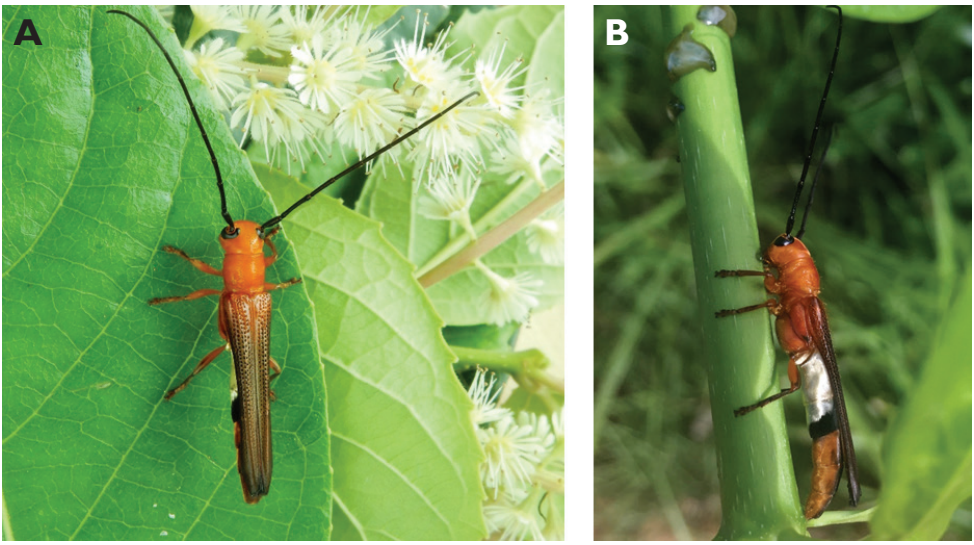

Figure 53. *Oberea ferruginea* (Thunberg, 1787): dorsal (**A**) and lateral (**B**) views of specimens observed on Little Taipa Hill (11 Oct 2018) and around Hác-Sá Dam (4 Jul 2020), respectively (photographs: **A** LC **B** Annie Lao).

(MACT); Great Taipa, 20 Apr 2020, R Perissinotto; Great Taipa, 13 Oct 2020, dead on shrub leaf, R Perissinotto & L Clennell (IZCAS); Coloane Heights, 15 May 2020, dead on trail path, R Perissinotto (MACT); St. Francis Xavier's Parish [Coloane], 24 Oct 2019 12:15, Stanley Chan (https://www.inaturalist.org/observations/34898344); ibidem 23 Mar 2021 10:21, Kit Chang (https://www.inaturalist.org/observations/71862552); Coloane, Hác-Sá Dam, 4 Jul 2020 15:43, Annie Lao (https://www.inaturalist.org/observations/51888124); Macau, Lou Lim Loc Garden, 25 Aug 2020 14:19, Eric Kwan (https://www.inaturalist.org/observations/57519347); Coloane, 13 May 2021, Lynette Clennell (https://www.inaturalist.org/observations/78657008).

Remarks. In Macau, adults are active during daytime from early spring till mid-autumn and range in total length 16–23 mm and 2.5–4 mm in maximum width. The larvae of this species are known stem-borers of a variety of plants, including *Bambusa* spp., *Schima superba* and *Vernicia fordii* (Hua 2002).

***Oberea walkeri* Gahan, 1894**

Fig. 54

Oberea walkeri Gahan, 1894: 487. TL: China (Hong Kong); TD: NHMUK

Distribution. Palaearctic Region: China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hong Kong, Hunan, Jiangxi, Shaanxi, Sichuan, Xizang, Yunnan,

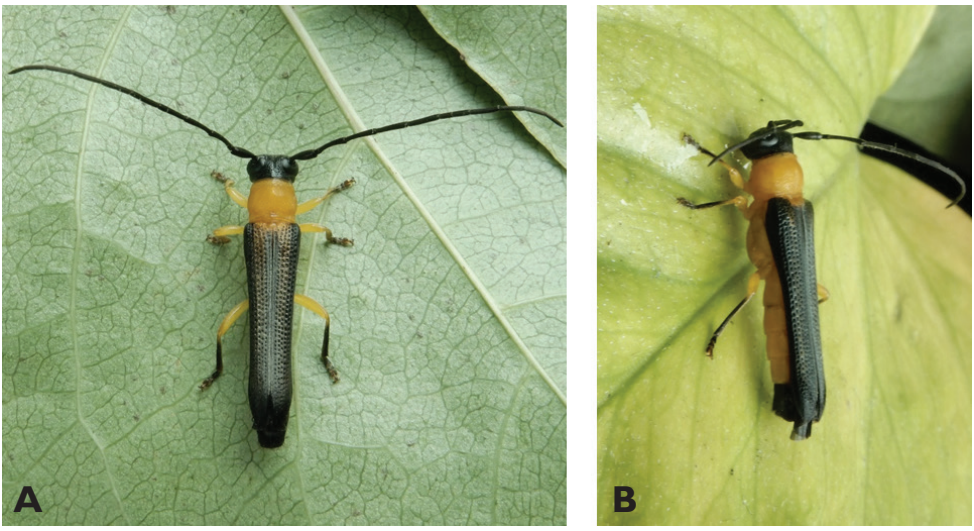

Figure 54. *Oberea walkeri* Gahan, 1894: dorsal (**A**) and lateral (**B**) views of specimens observed on Great Taipa Hill (9 May 2019) and on Coloane Heights (28 Apr 2019), respectively (photographs: LC).

Zhejiang); India (Sikkim) (Yiu 2009; Lin and Yang 2019; Danilevsky 2020). Oriental Region: Laos; Myanmar; Vietnam (Kurihara 2009).

Macau records. Coloane Heights, A-Má Cultural Village, 28 Apr 2019, R Perissinotto & L Clennell (IZCAS); Great Taipa, Barbeque Park, 9 May 2019, R Perissinotto & L Clennell (IZCAS); Coloane, 20 Apr 2021, Lynette Clennell (https://www.inaturalist.org/observations/74708252) .

Remarks. This species is rather scarce in Macau, having been observed only three times and only in mid spring. Adults are active during daytime and range in total length 14–18 mm and 2.5–4 mm in maximum width. The only larval host plant reported so far for this species is *Sassafras tzumu* (Hua 2002).

Discussion

A total of 52 longhorn beetle species was recorded during this census, 2.6 times more than previously reported in the literature for this area (Easton 1991, 1992, 1993; Pun and Batalha 1997; Lin and Yang 2019). Among these, two are new records for China and one also for the entire Palaearctic Region. These findings are undoubtedly due mainly to the exceptional observation efforts undertaken in this study during the past 3.5 years, with diurnal and nocturnal visits to key areas conducted on a daily basis. By comparison, in nearby Hong Kong a total of 137 species has been recorded thus far (Yiu 2009; Yiu and Yip 2011; Lin and Aston 2014). This is expected, as the total surface area of the Hong Kong SAR is ca. 36 × larger than that of Macau and exhibits a much larger diversity of vegetation types and habitats (Dudgeon and Corlett 1994). It is noteworthy that despite their close geographic proximity, these two regions of the Pearl River Delta actually ex-

hibit a distinct difference in their longhorn beetle composition, as already pointed out for instance in the historical reports by Easton (1991, 1992, 1993). It is also likely that some species do not have viable resident populations in Macau and that their occasional presence there may be due to stray specimens landing randomly during their dispersal flights from either the Hong Kong islands or the Chinese mainland (i.e., Guangdong Province).

There are, however, still species that while previously recorded from Macau were not encountered during the current census. These include *Imantocera penicillata* (Hope, 1831), *Aristobia approximator* (Thomson, 1865), *Apriona germarii* (Hope, 1831), *Batocera horsfieldi* (Hope, 1839), *Pothyne rugifrons* Gressitt, 1940 (Easton 1991, 1992, 1993; Pun and Batalha 1997) and *Pterolophia* (*Pterolophia*) *crassipes* (Wiedemann) (Hua 2002; Lin and Yang 2019). *Imantocera penicillata* was reported in the accounts by both Easton (1991, 1993) and Pun and Batalha (1997), with the former author observing this species attracted by artificial lights to the Taipa university buildings and to breadfruit or jackfruit trees (*Artocarpus* spp.) on the island of Coloane (Easton 1993). Indeed, several old specimens of this species are still housed in the UMEC and CIAM collections, as testimony of its historical presence in the region. *Pothyne rugifrons* and *B. horsfieldi* were only reported in Pun and Batalha (1997), and a few specimens of both species collected in the 1980s–1990s at Coloane are currently housed in the CIAM collection. The first species is known to occur also in nearby Hong Kong, while *B. horsfieldi* has not been recorded there yet (Yiu 2009; Yiu and Yip 2011) but is known to occur throughout mainland China (Lin and Yang 2019). On the other hand, *A. germarii* and *A. approximator*, reported in Pun and Batalha (1997) and Easton (1992), respectively, both appear to represent erroneous identifications. They do not occur in south-eastern China and therefore the correct species involved are actually *A. rugicollis* Chevrolat, 1852 and *A. reticulator* (Fabricius 1781), respectively, which are well known from nearby Hong Kong albeit reported in the past literature as either *A. germarii* the first, or with its invalid synonym of "*A. testudo* (Voet, 1778)" the second (Yiu 2009; Yiu and Yip 2011). Similarly, *Pterolophia* (*P.*) *crassipes* (Wiedemann, 1823) was first mentioned from Macau by Gemminger and Harold (1873), and subsequently also included in the catalogues of Hua (2002) and Lin and Yang (2019). However, it was not found in any of the more recent studies, including this survey, and therefore it is presumed that its initial Macau identification may have been erroneous.

On the more concerning side, this census has also revealed that while longhorn species diversity in Macau is remarkably higher than previously reported, the relative abundance and frequency of occurrence of most species is actually extremely low. This is an unfortunate development that is currently being reported from across the whole world, as the so-called "insect apocalypse" (Jarvis 2018; Cardoso et al. 2020). This drastic global reduction in insect abundance and biomass has been attributed to several compounding causes, chiefly habitat loss and fragmentation, intensive use of pesticides, light, air, and noise pollution as well as climate change (Samways et al. 2020).

In Macau, all these factors are exacerbated by high human population density and sophisticated infrastructure. Most of the beetle species observed during this study are predominantly nocturnal in their adult activity, and, therefore readily attracted to artificial lights. Thus, like in all nocturnal insects their orientation and navigation are

disrupted when light pollution interferes with the natural light from the moon or stars they generally use for these purposes (Cardoso et al. 2020). Changes in natural light/dark cycles also de-synchronise vital activities, such as feeding and egg-laying, and cause temporal mismatches in mutualistic interactions (Owens and Lewis 2018). To add to this, UV-light mosquito traps, like those deployed in all public ablution blocks in Macau, attract and electrocute a wide variety of non-target insects, including all the nocturnal longhorn beetles that can pass through the protective grid of these traps (RP & LC pers. obs.). An inordinate proportion of specimens observed during this census were also found crushed by vehicles or pedestrians on roads and paths under artificial illumination, killed by thermal shock on the surface of incandescent spot-lights or otherwise dismembered by insectivore birds at illuminated sites in the early morning hours.

As virtually all the longhorn beetles found in this region are xylophagous or saproxylic, with larval development depending entirely on availability of dead or dying trees that are preferably still standing (Nieto and Alexander 2010), adequate management of the remaining forest patches is of critical importance in Macau. Unfortunately, these habitats which are already extremely reduced and fragmented are under increasing pressure from recreational infrastructure development and aesthetic sanitation. Dead, damaged, and diseased trees are systematically removed and shredded for compost, or alternatively cut to small pieces and left on the ground. While the latter option may offer some habitat space for a limited number of xylophagous and saproxylic species, the vast majority of them will be prevented from colonising this wood, as ground-based predators such as ants, spiders and centipedes will rapidly take over. These trees, which are often veteran, are normally replaced with young trees, but these are planted in a plantation-type manner, with ample space between each other and all understorey continuously removed in between. Trees are also regularly pruned of their lower branches, in order to accelerate their growth in height. To quote from one of the latest "Scientists' Warning to Humanity" publications: "forest recovery entails more than just the trees, but also the epiphytes, a natural understorey, dead wood, and leaf litter... restoration should aim at a natural age structure, including veteran trees... as forests have high structural diversity, possess many microhabitats, and create sheltered microclimates allowing many species to co-exist under optimal conditions" (Samways et al. 2020).

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Notes on the genus *Theopropus* Saussure (Mantodea, Hymenopodidae) from China, with description of a new species from the Himalayas

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Abstract

The genus *Theopropus* Saussure, 1898 is distributed with five species in SE Asia, three of which were recorded in South China: *T. elegans* (Westwood), *T. cattulus* (Westwood) and *T. sinecus* Yang. After examining numerous specimens of *Theopropus*, we attempt to resolve some taxonomic confusion about *Theopropus* occurring in China. Those Chinese specimens that were inaccurately identified as *T. cattulus* represent a new subspecies of *T. sinecus* Yang: *T. s. qiongae* Wu & Liu, **ssp. nov.**. A new species, *T. xishiae* Wu & Liu, **sp. nov.**, is described from the rainforests of the southern slopes of the Himalayas. The records of *T. elegans* in China are also clarified. Biological characteristics of the species and subspecies, necessary illustrations, and ecological images are provided. The distribution of the known Chinese *Theopropus* species is discussed and mapped.

Keywords

Distribution, mantis, new subspecies, Oriental region, taxonomy

Introduction

The genus *Theopropus* Saussure, 1898 was erected for *Blepharis elegans* Westwood, 1832, the type of which was collected in Tanesserim, Myanmar. Previously it included five species (Yang 1999; Otte and Spearman. 2005): *T. borneensis* Beier, 1942 record-

ed from Borneo, *T. cattulus* (Westwood, 1889) described from Java, *T. sinecus* Yang, 1999 described from South China, *T. elegans* (Westwood, 1832) widely distributed in Southeast Asia, and *T. rubrobrunneus* Beier, 1931 described from Malaysia. Additionally, two taxa were also listed as synonyms of *T. elegans* (Otte & Spearman, 2005): *T. elegans* var. *flavicans* Giglio-Tos, 1927 and *T. praecontatrix* Saussure, 1898, although *T. elegans* var. *rubrobrunneus* Beier, 1931 was also considered as synonym of *T. elegans* in the research of Beier (1934) and of Ehrmann (2002).

Theopropus is widely distributed in southern China, the Indochinese Peninsula, and the Malay Archipelago. In China, *T. elegans* was first mentioned to be distributed in Yunnan by Tinkham (1937), but without specimen records. The report of *T. elegans* from Yunnan in Tinkham (1937) was questioned by Wang (1993) and Yang and Wang (1999) because no specimens were examined. Afterwards, a male specimen of *T. elegans* was reported from Wuyishan Mountain in Fujian Province by Wang (1993). Subsequently, the new species *T. sinecus* was described by Yang (1999) based on a female (holotype) and a male (paratype) specimen, which were collected from Jinxiu in Guangxi Province. Additionally, *T. cattulus* Westwood was reported to be distributed in Hainan Island by Zhu et al. (2012), who also noted that *T. sinecus* was a synonym of *T. elegans*, but without standard taxonomic treatment. As a consequence, there is considerable taxonomic confusion concerning the common and attractive mantis genus *Theopropus* in China.

In this research, we examined numerous specimens, which were collected in China and neighboring countries, aiming to illustrate the taxonomic situation of the genus *Theopropus* in China. We clarified the validity of *Theopropus sinecus* Yang, the distributions of *T. elegans* and *T. cattulus*, redescribed the known Chinese species and describe a new taxon.

Materials and methods

Classification system follows Schwarz and Roy (2019). Descriptive terminology of adult morphology and the male genitalia follows Brannoch et al. (2017) and Schwarz and Roy (2019). Specimens were collected during the daytime through careful observation or by light trap (male). Genitalia were dissected in 10% KOH solution, cleared with pure water, and finally stored in 70% ethanol in Eppendorf tubes for further research. Pictures were taken with a Nikon digital camera.

The specimens were deposited in the following institutions or private collections.

CAU China Agricultural University, Beijing, China;
CJZ Collection of Jia-Zhi Zhang, Shanghai, China;
CWC Collection of Chao Wu, Beijing, China;
IZCAS Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Taxonomic treatment

Order Mantodea Wood-Mason, 1889
Family Hymenopodidae Giglio-Tos, 1915
Subfamily Hymenopodinae Giglio-Tos, 1915
Tribe Hymenopodini Giglio-Tos, 1915

Genus *Theopropus* Saussure, 1898
Figs 1–14

Theopropus Saussure, 1898: 204; Kirby 1904: 293; Giglio-Tos 1915: 106; Giglio-Tos 1927: 561; Beier 1934: 27; Beier 1942: 152; Beier 1964: 939; Beier 1968: 6; Ehrmann 2002: 353; Otte and Spearman 2005: 99; Zhu et al. 2012: 52; Schwarz and Konopik 2014: 145; Schwarz and Roy 2019: 118, 152.

Type species. *Blepharis elegans* Westwood, 1832

Diagnosis. Medium to large-sized Hymenopodidae, with mottled body coloration. Male and female distinctly differing by body size, male body smaller, often shorter than half body length of females.

Head (Fig. 5): Triangular. Compound eyes oval, convex, uprising beyond vertex. Vertex with a robust vertical process, coniform. Lower frons wider than high. Antennae filiform, shorter than body length; antennae thick and long in males, thin and short in females.

Pronotum (Figs 6, 7): Short, wide, with obvious lateral pronotal expansion at transverse groove, prozone slightly shorter than metazone. Lateral margins of pronotum with small spines.

Prothoracic legs (Fig. 8): Long, robust; coxa distinctly longer than pronotum, with small dorsal spines. Femora with 4 posteroventral, 3 discoidal and about 15–20 anteroventral spines; tibia with about 15–20 anteroventral and posteroventral spines, posteroventral spines decumbent.

***Meso- and metathoracic legs*:** Long, robust; subapical part of the femur with a posteroventral lobe (Fig. 9D–F). Base half of tibia swollen.

***Wings*:** Forewings opaque, narrow, long in males, wide, fusiform in females; a white spot lying subbasally in the discoidal area; a white band with black borders on both lateral margins lying in middle of the discoidal area; anal area long, narrow. Hindwings broad, shorter than forewings; transparent or with opaque areas in males, subopaque in females.

***Abdomen*:** Narrow, long in male, wide in female. Cerci short, hairy. Male subgenital plate short, wide, with small styli.

External genitalia (Fig. 10A–F): Male genitalia simple, similar among congeners. Secondary distal process reduced.

Ootheca (Fig. 4C): Very elongated, flat, narrowing at both ends.

Discussion. The characteristics for the head, pronotum, and the range of the ratio of the pronotum length to supracoxal dilatation width are relatively stable in the species; these characteristics can be used to identify species. The male genitalia of *Theopropus* lack sclerotized projections and show little differences between species.

Distribution. The genus *Theopropus* is distributed in the tropical areas of southern Asia. In China, *Theopropus* species are widely distributed in South and Southwest China (Fig. 12).

Theopropus sinecus Yang, 1999

Theopropus sinecus Yang, 1999: 28; *T. elegans* Zhu et al. 2012: 52–55.

Comments. *Theopropus sinecus* Yang is widely distributed in South China. Its types were collected from Guangxi Province. Specimens from the mainland and Hainan Island have similar body features and were mated to produce fertile offspring in our own breeding facilities, but they clearly differ by body color and spots' characteristics in the forewings. Therefore, we consider specimens from Hainan Island as a new subspecies for *T. sinecus* Yang.

Theopropus sinecus sinecus Yang, 1999 sensu str.

Figs 1; 2A; 3A; 5A, D; 6A; 7A; 8A, D; 9B, E; 10A, E; 11; 12; 13A, B; 14C

Type locality. China: Guangxi, Jinxiu.

Material examined. 17♂, 15♀. ***Holotype*.** **China** • 1♀, Guangxi, Jinxiu; 18-XI-1981, No type label, CUA; • 1♂ ***Paratype*.** Guangxi, Jinxiu; 21-IX-1981, No type label, CUA; • 1♂; Guangxi, Longsheng, Huaping; 980 m; IX-2009; Ye Liu leg.; IZCAS; • 3♂; Guangxi, Longsheng, Huaping; 25°37'28"N, 109°54'07"E; 900–1000 m; 15-20-IX-2012; Chao Wu leg.; CWC; • 5♀; same as before; • 2♂; Guangxi, Guilin; 25°19'04"N, 110°23'24"E; 700 m; 13-X-2014; Chao Wu leg.; CWC; • 1♀; Guangxi, Jinxiu, Lianhuashan Mt.; 950 m; 30-IX-2014; Chao Wu leg.; IZCAS; • 2♂; same as before; • 1♂; Guangdong, Shaoguan, Nanling Mt.; 24°56'30"N, 113°01'07"E; 1000 m; 10-X-2011; IZCAS; • 1♀; Fujian, Nanping, Wuyishan Mt.; 27°42'25"N, 117°39'04"E; 1200 m; 15-VII-2020; Zhao-Nan Xia leg.; CJZ; • 2♀, 5♂; Fujian, Nanping, Wuyishan Mt.; 27°43'N, 117°40'E; 800–1000 m; 13-VIII-2019; Zhao-Nan Xia leg.; CWC; • 1♀, 1♂; Fujian, Nanping, Wuyishan Mt.; 27°43'N, 117°40'E; 800–1000 m; 9-IX-2020; Chao Wu leg.; CWC; • 1♀; Hubei, En'shi, Lichuan, Liangwu; 1300 m; 8-VIII-2018; Chuan Qin leg.; CJZ; • 1♂; Yunnan, Honghe, Hekou; 22°39'12"N, 103°58'52"E; 800 m; 15-XI-2017; Chao Wu leg. CWC; • 2♀ same as before. **Vietnam** • 1♀; N-Vietnam; VIII-2001; other information unknown; CWC.

Redescription. Male. Large-sized compared with congeners, body length reaching half that of females.

Figure 1. Female *Theopropus sinecus sinecus* in natural habitat, from Guangxi.

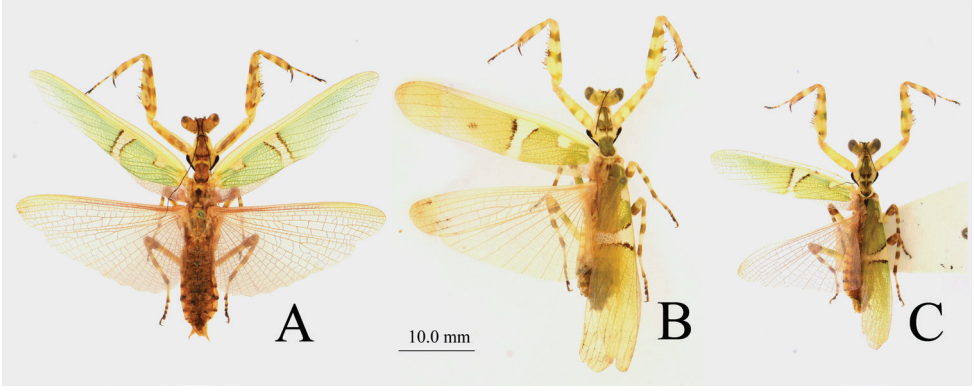

Figure 2. Male *Theopropus* spp. body in dorsal view **A** *T. sinecus sinecus* from Guangxi **B** *T. xishiae* sp. nov. paratype **C** *T.* sp. from Yunnan.

***Head*:** Compound eyes oval, anteriorly protruding, with a very weak conical elongation at tip (Fig. 5A). Vertical process distinct, coniform, lower than the apex of compound eyes (Fig. 5A). Lower frons with arched superior margins and raised lateral margins. Antennae filiform, shorter than body length.

***Pronotum*:** Short, lateral pronotal expansion wide. Ratio of pronotum length to supracoxal dilatation width about 1.49–1.53. Lateral margins of the pronotum indistinctly granulated. Lateral margin of metazone with continuous black edge (Fig. 6A).

Figure 3. Female *Theopropus* spp. body in dorsal view **A** *T. sinecus sinecus* from Guangxi **B** *T. xishiae* sp. nov. paratype **C** *T.* sp. from Yunnan.

***Prothoracic legs*:** Coxa bearing 6–9 small dorsal spines, femora bearing 15–16 anteroventral spines, tibia bearing 15–16 anteroventral and 18–19 posteroventral spines.

Meso- and metathoracic legs (Figs 2A, 3A): posteroventral genicular lobe on femur long, narrow (Fig. 9E). Base half of tibia swollen.

Wings (Figs 2A, 3A): Forewings narrow, long. A wide white band lying in middle of discoidal area; two black parallel arc-shaped borders at lateral margins of the wide white band directing proximad, "))"-shaped; anal area narrow, long, transparent. Hindwings broad, hyaline.

***Abdomen*:** Long, narrow, without lobe. Subgenital plate short, wide, more or less asymmetrical, with styli.

***External genitalia*:** Simplified. Left phallomere wide, secondary distal process (spd) indistinct; phalloid apophysis (afa) short; posterior process of left phallomere (paa) digitiform (Fig. 10A).

Female. Similar to male, but body more robust, size larger than that of male. Vertical process distinct, conical, extending beyond apex of eyes (Fig. 5D). Pronotum wide, lateral pronotal expansion very wide, ratio of pronotum length to supracoxal dilatation width about 1.37–1.40; black band on each lateral margin of metazone traversed by a white band (Fig. 7A). Forewings wide, fusiform, extending beyond abdominal apex. Hindwings broad, opaque. Abodomen broad, nearly rounded, 4^{th}-6^{th} abdominal tergite inconspicuously slightly expanded laterad.

Coloration. Overall green, with white spots and bands. Antennae black. Lateral margin of metazone band black. The two horizontal ventral bands on prothoracic femora and tibia black in male (Fig. 8A), absent on femora for females (Fig. 8D). A black ventral spots near prothoracic tibial spur (Figs 6A, 7A). Forewings green, costal area white, discoidal area green; the large subbasal spot of discoidal area white, with black hind edge; wide band in middle of discoidal area white, with black lateral margins;

anal area orange in males and white in females. Hindwings orange with red-brownish veins in males, whitish to slightly yellowish with hyaline margin in females. Abdomen yellowish white, plaques on lateral margins of 2th-6th abdominal tergite green (Fig. 9B).

Measurements (length in mm). Body (head to wings): male 28.2–29.3, female 46.3–47.3; body (vertex to abdomen end): male 25.6–27.3, female 44.1–47.1; pronotum: male 5.9–6.0, female 11.9–12.1; fore coxae: male 5.9–6.1 , female 13.0–13.7; fore femora: male 7.2–7.3, female 15.0–15.5; fore tibiae: male 5.4–5.41, female 11.1–11.4; middle femora: male 6.0–6.1 , female 10.8–11.0; hind femora: male 7.1–7.2, female 13.0–13.5; forewing: male 21.1–21.8, female 29.9–31.8; hindwing: male 18.9–19.2, female 25.0–26.0.

Note. When examining numerous specimens from Wuyishan, Fujian Province (listed above), we found that they are the same as the types of *Theopropus sinecus*. Their body is larger than in *T. elegans* from Malaysia; the compound eyes possess a conical elongation at the tip in males; the black band on each lateral margin of the pronotum is continuous in males, but disconnected in females. In *T. elegans*, the compound eyes do not have a conical elongation in males, and the black band on the lateral margin of the pronotum is contiguous in both sexes. Also, female hindwings are orange with smoky margins in *T. elegans*. The specimens of *Theopropus* from Wuyishan should therefore be identified as *T. sinecus sinecus*. We think that the record of *T. elegans* (in Wuyishan, Fujian Province) might have been mistaken by Wang (1993) and Wang and Yang (1999).

Yang (1999) wrote the specimen information in the Chinese description as "Guangxi-Dayaoshan Mt., 1981-VIII, Qijing You leg.", however, the specimens of *Theopropus* with the same collection information could not be found among Yang's research specimens. Only one female labeled "Guangxi, Jinxiu; 18-XI-1981" and one male labeled "Guangxi, Jinxiu; 21-IX-1981" could be found. We re-measured these specimens and obtained the following measurements: length of body (head to wings) about 29.3 in male and 45.2 in female, length of forewings about 21.6 in male and 29.2 in female (impaired), in original description, length of body (head to wings) 31 in male and 44 in female, length of forewings about 22 in male and 29 in female. In addition, as the illustration (hand-painted) of the original description is similar to the posture of the female specimen, we confirm that these two specimens are the types of *T. sinecus* Yang.

Distribution. China: Guangxi, Guangdong, Yunnan, Fujian, Hubei; Vietnam.

***Theopropus sinecus qiongae* Wu & Liu, ssp. nov.**
Figs 4; 10F; 12; 13C; 14A, E

Theopropus cattulus, Zhu et al. 2012: 56–58 (erroneously identified).

Material examined. 10♂, 6♀. ***Holotype.*** China • 1♂; Hainan, Ledong, Jianfengling Mt., Mingfenggu; 18°44'75"N, 108°50'28"E; 950 m; 30-VI-2020; Chao Wu leg.; IZCAS. ***Paratypes.*** China • 2♀; Hainan, Ledong, Jianfengling Mt., Tianchi;

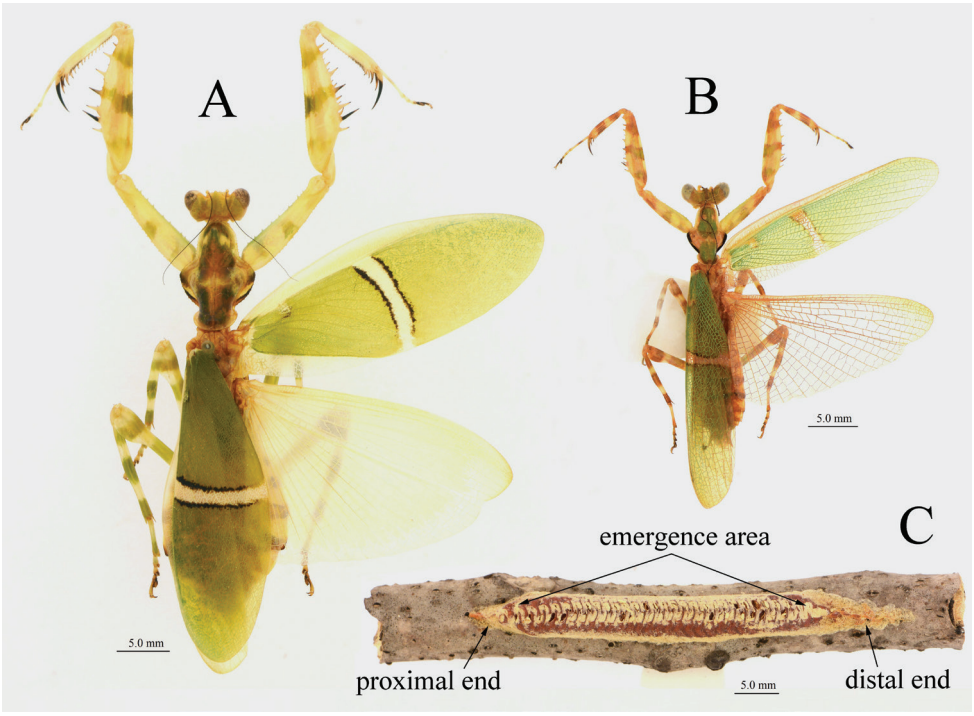

Figure 4. *Theopropus sinecus qiongae* ssp. nov. body in dorsal view and ootheca **A** female, paratype **B** male, paratype **C** ootheca.

18°44'25"N, 108°51'37"E; 900 m; 15-XI-2016; Chao Wu leg. IZCAS. • 1♀; Hainan, Ledong, Jianfengling Mt., Tianchi; 10-IV-2010; Xin-Lei Huang leg. IZCAS. • 1♀; Hainan, Baisha, Shuiman, Wuzhishan Mt.; 18°53'17"N, 109°40'01"E; 750 m; 20-VII-2020; Chao Wu & Cai-Wen Nie leg.; CWC. • 1♀; Hainan, Baisha, Hongkan, Ying'geling Mt.; 600 m; 23-X-2014; Chao Wu leg.; CWC. • 3♂; same as before; IZCAS. • 4♂; Hainan, Qiongzhong, Limushan Mt.; 700 m; 20-X-2014; Chao Wu leg.; CWC. • 1♂ Hainan, Ledong, Jianfengling Mt., Mingfenggu; 950 m; 28-X-2014; Chao Wu leg.; CWC. • 1♀; Hainan, Ledong, Jianfengling Mt., Mingfenggu; 20-XII-2017; Jia-Zhi Zhang leg.; CJZ. • 1♂; same as before.

Description. Male. Similar to *T. s. sinecus* (Figs 4A, B, 10F), except the following characteristics: smaller; on surface of forewing, the white subbasal spot of discoidal area small, even disappearing in some specimens; white band at the middle of discoidal area narrow, the two black parallel arc-shaped lateral borders of the white band converging at their distal ends in rare instances; hindwing base reddish brown, with red-brownish veins.

Female. Similar to *T. s. sinecus* but smaller. The forewing is similar to male, white spot in base of discoidal area small or indistinct, white band in middle of discoidal area narrow; hindwings opaque, maize-yellow, with hyaline margin.

Discussion. Zhu et al. (2012) identified the specimens from Hainan Island as *Theopropus cattulus* (Westwood, 1889). After checking the pictures of the types of

T. cattulus Westwood, 1889 in "The Mantodea Image Database" https://specimens.mantodearesearch.com/default/zoom/835, we found that there is only a small black spot on each lateral margin of the metazone in *T. cattulus*, whereas, in those specimens from Hainan Island, a black band extends backwards on each lateral margin of metazone. Also, *Theopropus cattulus* is endemic on Java, Indonesia. Thus, we think the identification of these specimens from Hainan Island in Zhu et al. (2012) is wrong. We establish a new subspecies of *T. sinecus* for these specimens from Hainan Island.

Measurements (length in mm, holotype in parentheses). Body (head to wings): male 27.9–28.6 (28.5), female 44.9–46.2; body (vertex to abdomen end): male 22.0–26.5 (25.8), female 40.3–42.1; pronotum: male 5.8–6.0(5.9), female 11.6–11.9; fore coxae: male 5.8–6.0 (5.9), female 12.88–13.02; fore femora: male 6.9–7.1 (7.0), female 14.0–14.9; fore tibiae: male 5.2–5.3 (5.2), female 10.4–10.9; middle femora: male 5.9–6.0 (5.9), female 10.3–10.6; hind femora: male 7.0–7.2 (7.1), female 12.0–13.1; forewing: male 20.0–20.1 (20.1), female 28.5–30.0; hindwing: male 18.2–18.9 (18.6), female 24.9–25.9.

Distribution. China: Hainan Island.

Etymology. The new subspecies was named after the other name for Hainan Island, Qiong.

***Theopropus xishiae* Wu & Liu, sp. nov.**

http://zoobank.org/15E6FA92-601D-402F-A605-0B822A1CE170

Figs 2B; 3B; 5B, E; 6B; 7B; 8B, E; 9A, D; 10B, D; 12; 13D; 14B, D

Material examined. 6♂, 1♀, 1♀ juv.. ***Holotype.*** China • 1♂; Tibet, Medog, Beibeng; 29°14'58.14"N, 95°10'31.55"E; 960 m; 12-VII-2013; Chao Wu leg.; IZCAS. ***Paratypes.*** China • 1♀; Tibet, Medog, Beibeng; 29°14'58.14"N, 95°10'31.55"E; 960 m; 12-VII-2013; Chao Wu leg.; IZCAS. • 2♂; Tibet, Medog, Dexing cun; 29°19'36.48"N, 95°16'59.82"E; 770 m; 15-VII-2013; Chao Wu leg.; IZCAS. • 2♂; Tibet, Medog, Jiangxin cun; 29°13'02.90"N, 95°08'05.61"E; 1200 m; 20-VII-2014; Chao Wu leg.; CWC. • 1♂; Tibet, Medog, Beibeng; 29°14'21.52"N, 95°12'00.21"E; 1320 m; 24-VII-2019; Chao Wu leg.; CJZ. • 1♀ juv.; Tibet, Medog, Beibeng; 1000 m; VII-2010; Wen-Xuan Bi leg.; IZCAS.

Description. Male. Large-sized species for *Theopropus*. Body size much larger than in other congeners.

***Head*:** Compound eyes oval, anteriorly protruding, with rounded top. Vertical process conical, extending about as high as the imaginary line between the apexes of the eyes; lower frons narrow, with arched dorsal margin and raised lateral margins (Fig. 5B). Antennae filiform, shorter than body length.

Pronotum (Fig. 6B): Wide. Lateral pronotal expansion very wide; lateral margins bearing small, sparsely arranged spines. Black band on each lateral margin of metazone disconnected in middle. Ratio of pronotum length to supracoxal dilatation width about 1.39–14.2.

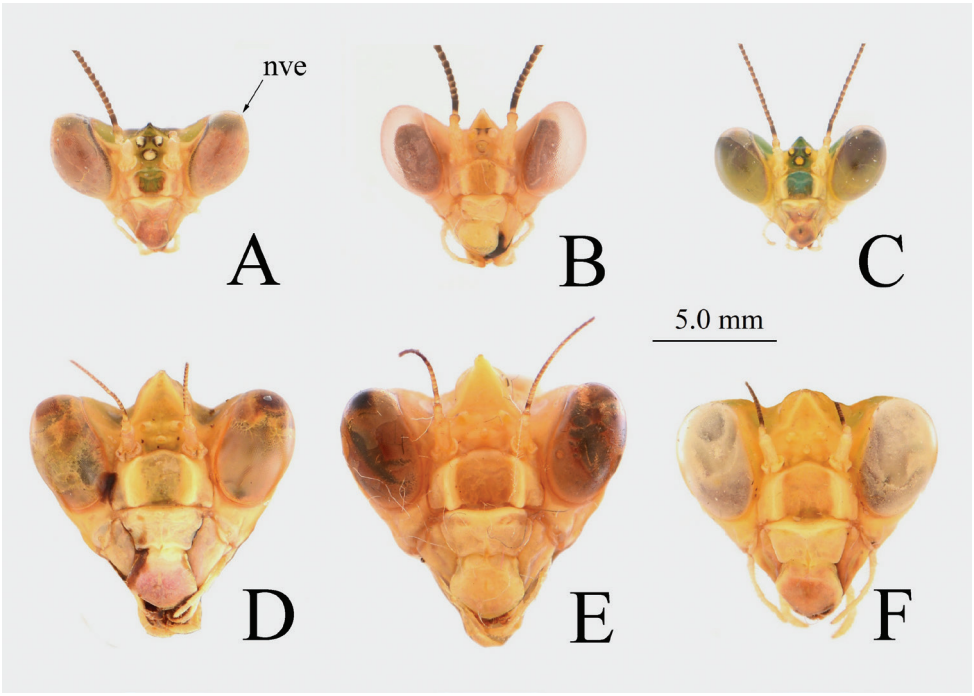

Figure 5. Head of *Theopropus* spp., anterior view **A, D** *T. sinecus sinecus* **B, E** *T. xishiae* sp. nov. **C, F** *T.* sp. **A–C** male **D–F** female. Abbreviations: **nve** = non-visual elongation.

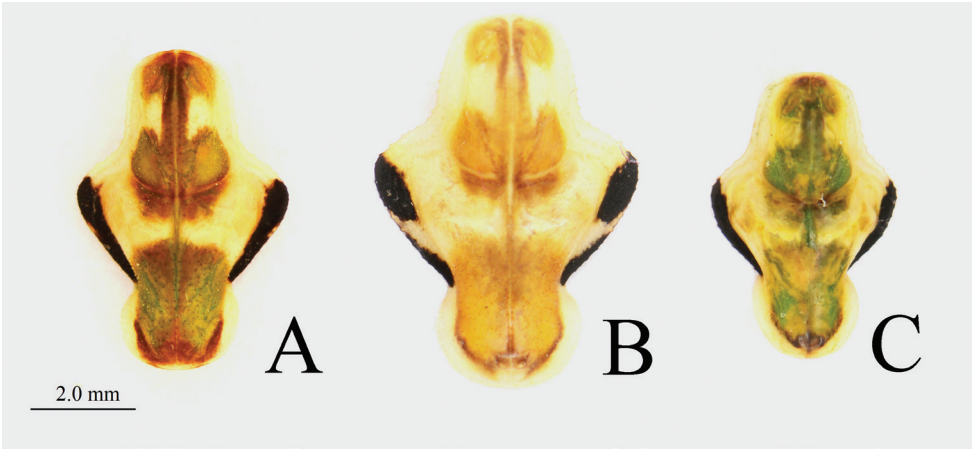

Figure 6. Pronotum of male *Theopropus* spp. in dorsal view **A** *T. sinecus sinecus* from Guangxi **B** *T. xishiae* sp. nov. holotype **C** *T.* sp. from Yunnan.

Prothoracic legs (Fig. 8B): Coxa bearing 6–7 small dorsal spines, femora with 15 anteroventral spines, tibia with 15 anteroventral and 18 posteroventral spines.

***Meso- and metathoracic legs*:** Long, robust; a subapical posteroventral lobe on mid and hind femora, narrow, long. Base half of tibia swollen.

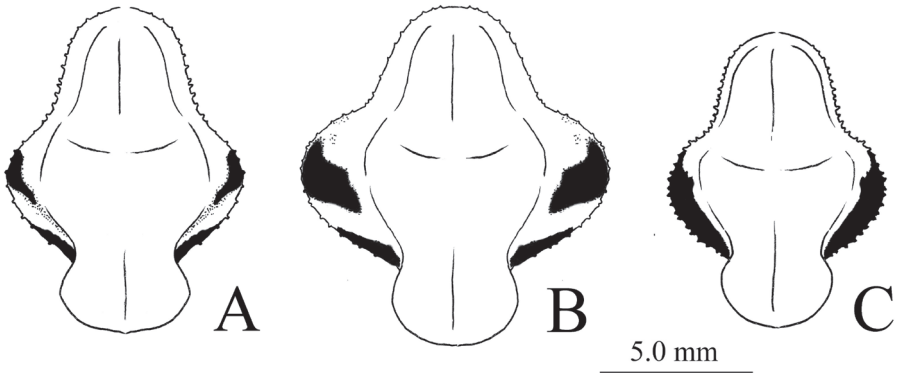

Figure 7. Pronotum of female *Theopropus* spp. in dorsal view **A** *T. sinecus sinecus* from Guangxi **B** *T. xishiae* sp. nov. paratype **C** *T.* sp. from Yunnan.

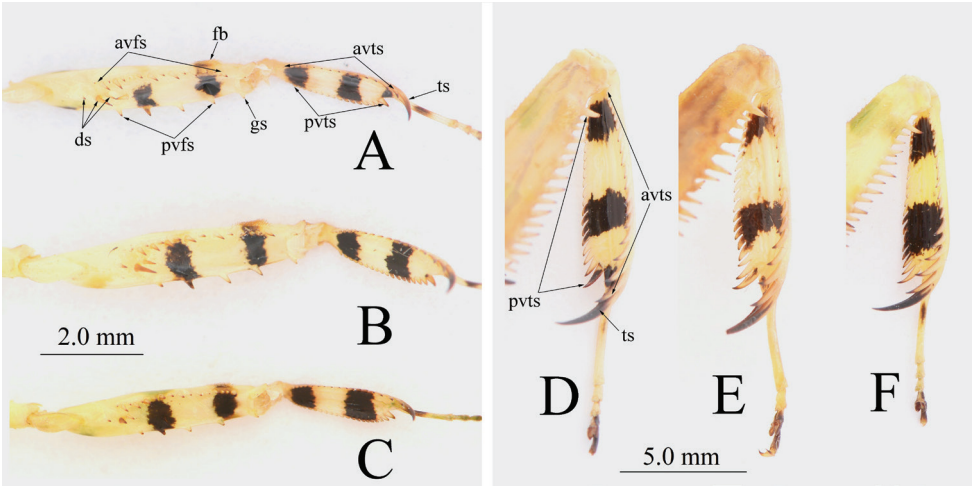

Figure 8. Prothoracic legs of *Theopropus* spp. **A, D** *T. sinecus sinecus* **B, E** *T. xishiae* sp. nov. **C, F** *T.* sp. **A–C** male **D–F** female. Abbreviations: **avfs** = anteroventral femoral spines; **avts** = anteroventral tibial spines; **ds** = discoidal spines; **fb** = femoral brush; **gs** = genicular spur; **pvfs** = posteroventral femoral spines; **pvts** = posteroventral tibial spines; **ts** = tibial spur.

***Forewings*:** Long, narrow, opaque. Discoidal area possessing a large subbasal white spot with blurry black edges; the two black lateral borders of the wide white band in middle of the discoidal area arched, the anterior margin of the frontal one directing proximad, of the caudal one directing distad (Fig. 13D). Anal area long, narrow, hyaline.

Hindwings (Fig. 2B): Hyaline.

***Abdomen*:** Long, narrow, with very small lobes. Subgenital plate short, wide, more or less asymmetrical, with styli.

External genitalia (Fig. 10B, D): Simplified. Similar to those of congeners. Left phallomere wide with inconspicuous secondary distal process (spd); phalloid apophysis (afa) short; posterior process of left phallomere (paa) digitiform.

Female. Large-sized, robust. Body size largest among known *Theopropus* species.

Head (Fig. 5E)*:* Similar to male, but vertex extending beyond apex of eyes.

Pronotum (Fig. 7B): Wide. Lateral pronotal expansion very wide. Lateral margins bearing small, sparsely arranged spines. Black band on each lateral margin of metazone disconnected in middle. Ratio of pronotum length to supracoxal dilatation width about 1.08.

Prothoracic legs (Fig. 8E): Coxa bearing 7–8 small dorsal spines; femora with 16 anteroventral spines; tibia with 16 anteroventral and 19 posteroventral spines. Two black horizontal bands present on ventral side of tibia, but absent in femora. No black spots observed near tibial spur.

***Meso- and metathoracic legs*:** Long, robust. The subbasal posteroventral lobe on femur wide, disc-shaped (Fig. 9D); base half of tibia swollen.

Forewings (Fig. 3B): Wide, fusiform, opaque. The large white subbasal spot of the discoidal area with black edges; frontal one of the two black lateral margins of the wide white band in the middle of discoidal area arc-shaped, pointing proximad, and hind one approximately straight. Anal area long, narrow, hyaline.

Hindwings (Fig. 3B): Wide, opaque, except for margin.

Abdomen (Fig. 9A): Broad, nearly round. Lateral margins of 4th-7th abdominal tergite with significantly expanded lobes.

Coloration. Yellowish green, with white spots and bands. Antennae black. Band on each lateral margin of metazone black. Two horizontal ventral bands on prothoracic femora and tibia black in males (Fig. 8B), which is absent on femora in females (Fig. 8E). Forewings yellowish green, costal area white; the large spot in base of discoidal area white, with black hind edge; the wide band in middle of discoidal area white, with black lateral margins; anal area orange in males and white in females. Hindwings hyaline, with red-brownish veins in males, ivory in females. Abdomen yellowish white; lateral margins of 3th-5th abdomen tergite with green plaques, and 6th-7th mostly white in females.

Measurements (length in mm, holotype in parentheses). Body (head to wings): male 33.0–33.7 (33.7), female 52.45; body (vertex to abdomen end): male 27.2–28.1, female 49.1; pronotum: male 6.3–6.4 (6.4), female 13.4; fore coxae: male 6.6–6.7 (6.7), female 13.6; fore femora: male 7.4–7.5 (7.5), female15.5; fore tibiae: male 5.3–5.4 (5.4), female 11.4; middle femora: male 6.8–6.9 (6.9), female 11.1; hind femora: male 8.0–8.1 (8.1), female 13.6; forewing: male 25.0–25.2 (25.2), female 35.1; hindwing: male 22.0–22.2 (22.2), female 29.8.

Differential diagnosis. The new species most resembles *Theopropus sinecus*. It is distinguished by the larger body size, wider pronotum, and fewer femoral and tibial spines than those of its congener. Concerning the males, the two black lateral borders of the wide white band in the middle of discoidal area are pointing in opposite directions in *T. xishiae* sp. nov. (Fig. 13D), however, are parallel in *T. sinecus* (Fig. 13B). The structure of the female's abdomen is also different from that of its congeners (Fig. 9A): lateral margins of 4th-7th abdominal tergites each bear a distinctly expanded lobe; abdomen yellowish white, lateral margins of 3th-5th abdomen tergite with green plaques; 6th-7th completely white.

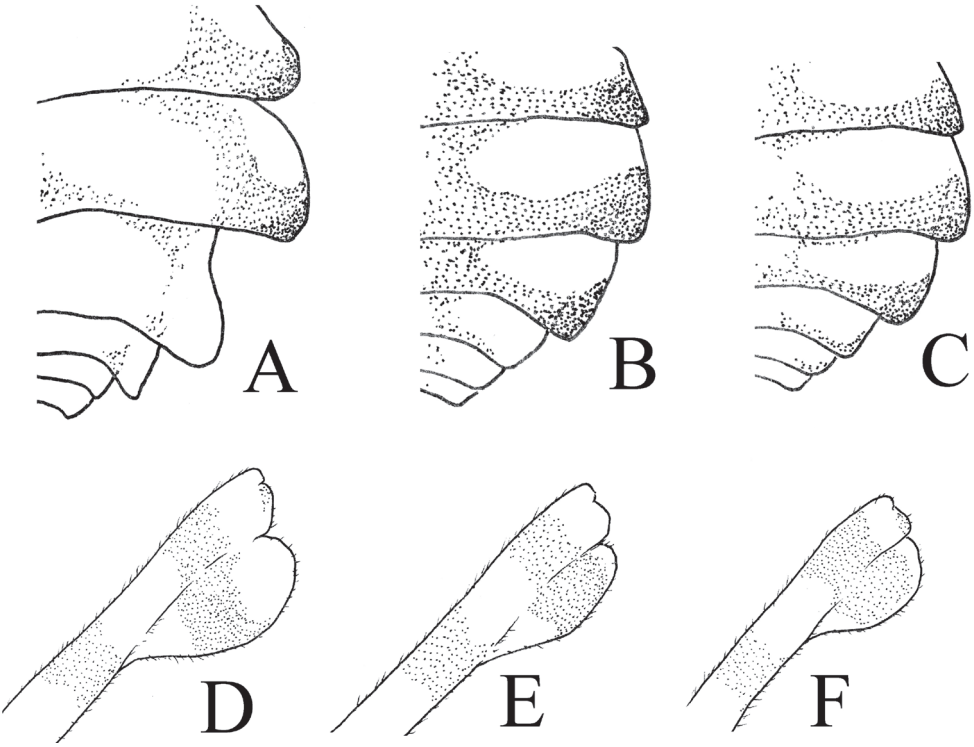

Figure 9. Abdomen and posteroventral metafemoral lobe of female *Theopropus* spp. **A, D** *T. xishiae* sp. nov. **B, E** *T. sinecus sinecus* **C, F** *T.* sp. **A–C** abdomen **D–F** posteroventral metafemoral lobe.

This beautiful species is distributed in the southern Himalayas, which is the northernmost and westernmost record for *Theopropus*.

Distribution. China: Tibet, Medog. Expected to also occur in N India.

Etymology. The new species was named after Xi Shi who was born in The Spring-Autumn Period, the top of the four beautiful women in ancient China, the beauty representative in Chinese culture.

***Theopropus* sp.**

Figs 2C; 3C; 5C, F; 6C; 7C; 8C, F; 9C, E; 10C; 12; 13E, F; 14F

Material examined. 35♂, 6♀. **China** • 5♂; Yunnan, Jinghong, Xiaopuxi; 22°01'52"N, 100°58'19"E; 1100 m; 10-V-2019; Chao Wu leg.; CWC; • 7♂; Yunnan, Jinghong, Menglun; 21°57'37"N, 101°12'17"E; 850 m; 6-V-2019; Chao Wu leg.; IZCAS; • 8♂; Yunnan, Mengla, Bubeng; 21°37'02"N, 101°34'44"E; 900 m; 11-X-2014; Chao Wu leg.; CWC; • 15♂; Yunnan, Mengla, Mohan; 21°11'04"N, 101°43'31"E; 1000 m; 30-IX-2017; Chao Wu leg.; CWC; • 1♀; Yunnan, Jinghong, Menglun; 21°57'37"N, 101°12'17"E; 850 m; 5-X-2014; Chao Wu leg.; IZCAS; • 1♀; Yunnan, Mengla, Mohan; 21°11'04"N, 101°43'31"E; 1000 m; 22-IX-2017; Chao Wu leg.; CWC; • 1♀;

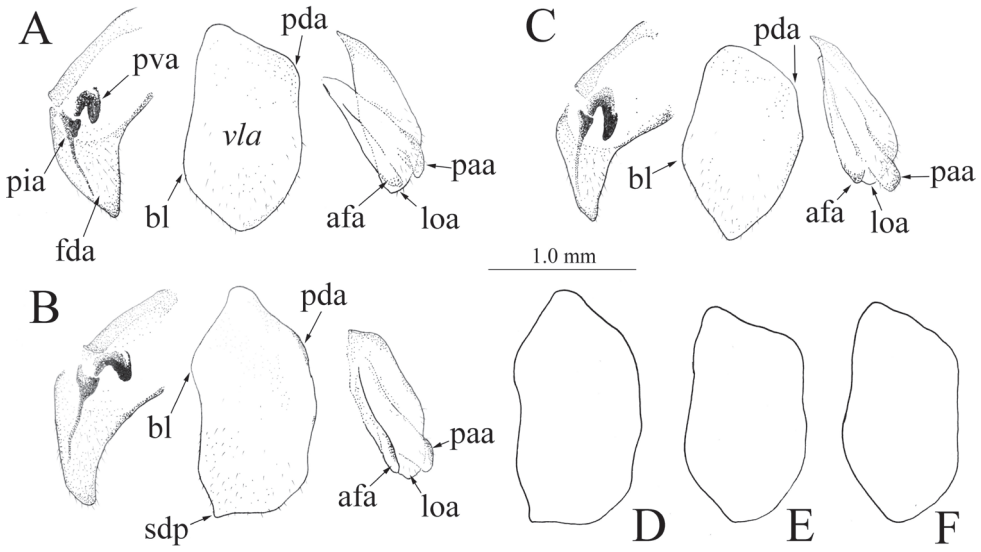

Figure 10. Male genitalia of *Theopropus* spp., Disarticulated genital complex, ventral view **A** *T. sinecus sinecus* from Guangxi, Jinxiu **B** *T. xishiae* sp. nov. holotype **C** *T.* sp. from Yunnan, Mengla **D** *T. xishiae* **sp. nov.** paratype **E** *T. sinecus sinecus* from Yunnan, Honghe **F** *T. sinecus qiongae* ssp.nov. holotype. Abbreviations: **afa** = phalloid apophysis; **bl** = basal lobe of ventral phallomere; **fda** = main posterior lobe of right phallomere; **loa** = membra- nous lobe; **paa** = posterior process of left phallomere; **pda** = primary distal process; **pia** = process posterolateral to pva of right phallomere; **pva** = process anteromesal to pia of right phallomere; **sdp** = secondary distal process.

Yunnan, Jinghong, Menglun; 21°57'37"N, 101°12'17"E; 850 m; 22-IX-2013; Chao Wu leg.; CWC; • 1♀; Yunnan, Jinghong, Damenglong; 21°30'43"N, 100°40'22"E; 600 m; 10-X-2013; Chao Wu leg.; CWC.

Thailand • 2♀; Thailand; Chiang Mai; VII-2017; Nan Jiang leg.; CWC.

Comments. Male. Compound eyes oval, anteriorly protruding. Prolongation bifid vertex conical, not reaching imaginary line extending between the apexes of the eyes (Fig. 5C). Lateral pronotal expansion wide, ratio of pronotum length to supracoxal dilatation width about 1.51–1.53. Lateral margins of pronotum bearing inconspicuous teeth. Black band on each lateral margin of metazone continuous (Fig. 6C). Anterior coxa bearing 8–10 dorsal spines, femora with 17 anteroventral spines, tibia with 17–18 anteroventral and 21 posteroventral spines; tibia with two black horizontal bands on ventral side (Fig. 8C, F). Forewings green; the black lateral borders of the white band in middle of discoidal area wide, blurry. Hindwings orangish red, transparent.

***External genitalia*:** Simple. Left phallomere wide, rhomboidal; secondary distal process (spd) indistinct; phalloid apophysis (afa) short; posterior process of left phallomere (paa) digitiform (Fig. 10C).

Female. Large-sized, robust. Ratio of pronotum length to supracoxal dilatation width about 1.37–1.40; black band on lateral margin of metazone continuous (Fig. 7C). Lateral margins of pronotum bearing prominently serrated teeth. Hindwings yellow, transparent at edges.

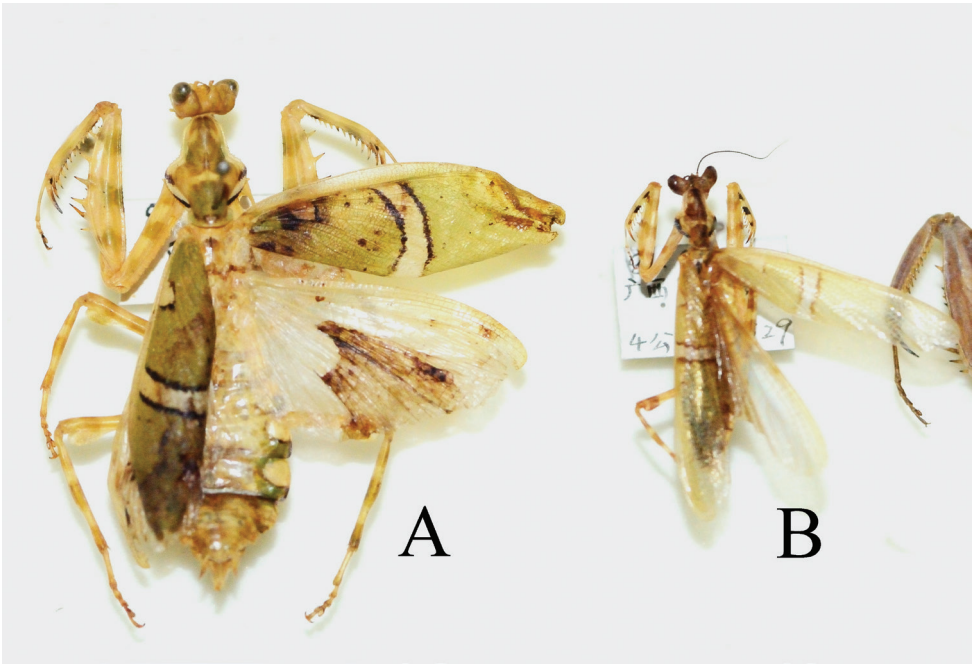

Figure 11. Holotype and paratype of *Theopropus sinecus* Yang, 1999 **A** holotype, female **B** paratype, male.

Differential diagnosis. Compared with the other two species of *Theopropus* in China, this species is smaller in body size, the prolongation on the vertex is small in the female, and the difference in body size between the sexes is more pronounced. The dorsal spines on anterior coxae are larger and longer than those of the other two species. The anterior tibia does not have a black spot near the spur. The male characteristics are also close to that of *T. cattulus* (Westwood, 1889) (type locality in Java, Indonesia) but the markings of the pronotum and forewings are different. In addition, in this species, the male hindwings do not have the opaque area which is present in the male specimens of *T. elegans* from the Malay Peninsula. These specimens may represent another new species, and further research on this species is needed.

Measurements (length in mm). Body (head to wings): male 24.8–25.3, female 41.2–42.0; body (vertex to abdomen end): male 20.4–21.8, female 38.5.1–49.8; pronotum: male 5.1–5.2, female 10.8–10.9; fore coxae: male 5.0–5.1, female 12.6–13.0; fore femora: male 5.7–5.8, female 14.1–14.3; fore tibiae: male 4.8–4.9, female 11.0–11.2; middle femora: male 4.9–5.0, female 10.7–10.9; hind femora: male 5.8–5.9, female 11.6–11.8; forewing: male 17.1–17.4, female 27.2–27.6; hindwing: male 15.6–16.1, female 23.6–23.8.

Distribution. China: Yunnan; Thailand.

Biological characteristics. *Theopropus* species often live among flowers. In Huaping of Guangxi Province (southwestern of China), *T. sinecus sinecus* often appears among the inflorescences of Valerianaceae plants, the mottling pattern of the mantis allows them to blend in such an environment (Fig. 13A, B). The males have phototaxis during night time.

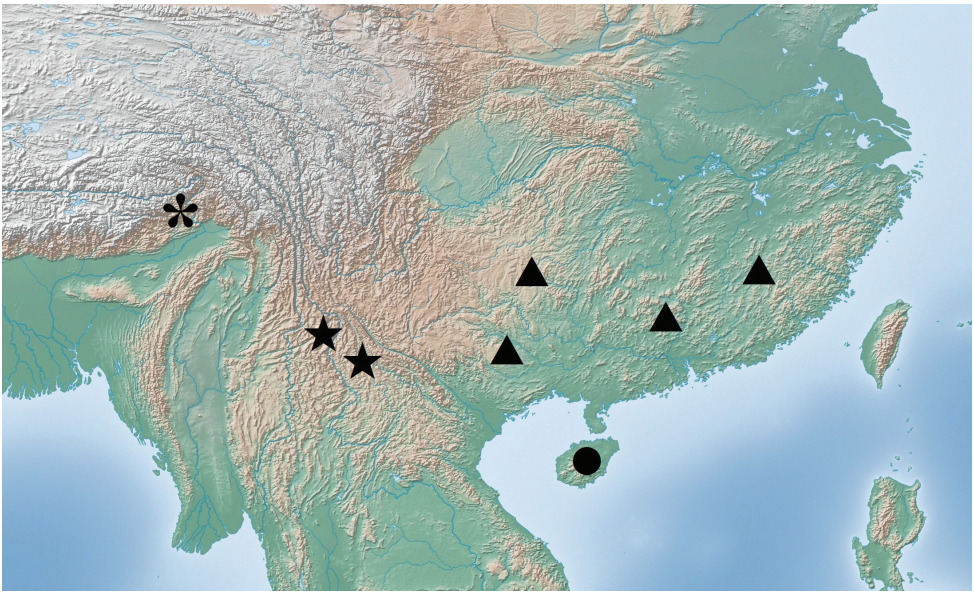

Figure 12. Distribution map of the distribution *Theopropus* spp. in South China. ▲: *T. sinecus sinecus*; ●: *T. sinecus qiongae* ssp. nov.; * *T. xishiae* sp. nov.; ★: *T.* sp..

Figure 13. *Theopropus* spp. adult in its natural habitat **A, B** *T. sinecus sinecus* **C** *T. sinecus qiongae* ssp. nov. **D** *T. xishiae* sp. nov. **E, F** *T.* sp. **A, C, E** female **B** pair **D, E** male.

Figure 14. *Theopropus* spp. nymph in its natural habitat and environment **A** *T. sinecus qiongae* ssp. nov. female nymph in Hainan Is **B** *T. xishiae* sp. nov. male nymph in Medog **C** *T. sinecus sinecus* of Guangxi, Longsheng, Huaping **D** *T. xishiae* sp. nov. of Tibet, Medog, Beibeng **E** *T. sinecus qiongae* ssp. nov. of Hainan Is. Jianfengling Mt. **F** *T.* sp. of Yunnan, Mengla, Mohan.

In China, the genus *Theopropus* ranges northwestwards to Medog, Tibet, and eastwards to the central Fujian Province. *Theopropus* species often inhabit medium-elevation forests. In Guangxi Province, *T. sinecus sinecus* is distributed at an altitude of about 800–1400 m. *Theopropus sinecus qiongae* ssp. nov. was collected from 800–1000 m in Hainan Island. *Theopropus* species in Yunnan Province were collected from 600–1100 m. *Theopropus xishiae* sp. nov. from Tibet were collected from 900–1400 m. *Theopropus sinecus sinecus* overwinters as eggs or nymphs in Guangxi, Fujian, and Guangdong Provinces. In the mountains of these areas, it snows in winter, and the lowest temperature about -5~-10 °C. Nymphs of *T. sinecus sinecus* hide in the deciduous layers during winter, and begin to grow about April of the following year; adults can be seen from July to November. In Hainan Island, no clear seasonality patterns can be observed in *T. sinecus qiongae* ssp. nov., for which adults and nymphs can be found in each season. The same situation is found in southern Yunnan. The situation for *T. xishiae* sp. nov. in Medog of Tibet is unclear, but adults of *T. xishiae* can be seen from July to October.

In rare instances, females of *Theopropus sinecus* collected from Guangdong and Hainan have been discovered to be parasitized by horsehair worms.

Discussion

Hainan Island is an isolated island in southeastern China. The Qiongzhou Strait between Hainan Island and the mainland is a geographical barrier for the separation and differentiation among closely-related species which separately live on either side of the barrier, as is the case postulated for *T. s. sinecus* and *T. s. qiongae* ssp. nov.. The ancestor of *T. xishiae* sp. nov. in the Himalayas is speculated to come from the Assam Region, and numerous mountains have become obstacles which prevented them from spreading northwards. However, in southern Yunnan, the distribution boundaries of *T. s. sinecus* and *T.* sp. are not yet clear, the two species seem to be separated in the Honghe area; *T. s. sinecus* lives in the eastern part, and *T.* sp. lives in the western part.

The structure of the male genitalia of *Theopropus* is rather simple compared to other species within the order Mantodea. Nonetheless, the shape of the ventral phallomere can be used to distinguish the three species in China: the ventral phallomere is wide and secondary distal process (spd) indistinct in *T. sinecus*; it is wide and with inconspicuous secondary distal process in *T. xishiae* sp. nov.; and it is rhomboidal in *T.* sp.

Conclusion

After examining numerous specimens, which were collected in China and neighboring countries, we reached the following conclusion. *Theopropus sinecus* Yang is valid. Those specimens that were collected from Hainan Island and identified as *T. cattulus* Westwood by Zhu et al. (2012) belong to a new subspecies for *T. sinecus*, i.e., *T. sinecus qiongae* ssp. nov.. The male specimen, which was identified as *T. elegans* in Wuyishan, Fujian Province by Wang (1993) should also be identified as *T. sinecus*. A unique new species, *T. xishiae* sp. nov. was discovered in the Himalayas (Tibet in China). In addition, numerous specimens of *Theopropus* from southern Yunnan are temporarily assigned to an unidentified species not identical with the previous two, and also not identical with *T. elegans*. The species *T. elegans* is not distributed in China.

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