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The world fauna of Synchroidae Lacordaire, 1859 (Coleoptera, Tenebrionoidea, Synchroidae)

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Abstract. Synchroidae Lacordaire, 1859 is a taxonomically and biologically poorly known group. In the present paper, diagnostic characters used to separate genera are analysed and the phylogenetic relationships within this family are preliminarily investigated. Results suggest that the characteristic *Synchroa pangu* Hsiao, Li, Liu & Pang, 2016 can be removed to establish a new genus, *Thescelosynchroa* gen. nov. The new combination, *T. pangu* (Hsiao, Li, Liu & Pang) gen. et comb. nov., is proposed. The definitions of *Synchroa* Newman, 1838 and *Synchroina* Fairmaire, 1898 are revised. Moreover, morphological analysis and character comparison also suggest that the familial placement of *Mallodrya subaenea* Horn, 1888 is questionable. Six species are re-examined and re-diagnosed: *Synchroa chinensis* Nikitsky, 1999, *S. elongatula* Nikitsky, 1999, *S. formosana* Hsiao, 2015, *S. melanotoides* Lewis, 1895, *S. punctata* Newman, 1838 and *Synchroina tenuipennis* Fairmaire, 1898. The male of *S. chinensis* and the female of *S. formosana* are described for the first time. *Synchroa elongatula* and *Synchroina tenuipennis* are newly recorded from Laos and Indonesia, respectively. We also hypothesize that the Eastern Asian-North American disjunction of *Synchroa* could be connected to a Mid-Late Tertiary migration of plants via the Bering Land Bridge.

Keywords. Synchroa bark beetles, taxonomy, phylogeny, new genus, EA-ENA disjunction.

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Introduction

Synchroidae Lacordaire, 1859 is a small family, including only nine extant species subdivided amongst three genera (Nikitsky 1999; Hsiao 2015; Hsiao *et al.* 2016); the fossil record includes only one species

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from the Eocene Florissant Formation of Colorado (Wickham 1911). Comparative morphological studies of larval characters suggest that synchroids may be more closely related to Zopheridae and Stenotrachelidae than Melandryidae, although adult synchroids and melandryids are extremely similar in overall appearance (Böving & Craighead 1931; Crowson 1966). Synchroidae was recovered as sister to a clade including Pterogeniidae, Tetratomidae, Mycetophagidae, Archeocrypticidae, Chalcodryidae, Promecheilidae and Ulodidae (McKenna *et al.* 2015) although the results are not exhaustive due to the low number of species included in the analyses.

Synchroids are generally poorly known and notoriously difficult to collect, except *Synchroa punctata* Newman, 1838 and *S. melanotoides* Lewis, 1895. Furthermore, the majority of the species were described based on a single or few specimens, including females, and diagnostic characters and intraspecific variation have been scarcely considered. During our study more specimens of previously described species were examined. This paper aims to provide precise information on the morphology of Synchroidae, with major emphasis on the diagnostic characters. *Synchroa chinensis* Nikitsky, 1999, *S. melanotoides* Lewis, 1895, *S. punctata* Newman, 1838 and *Synchroina tenuipennis* Fairmaire, 1898 are redescribed, and the male of *S. chinensis* and female of *S. formosana* Hsiao, 2015 are described for the first time. *Synchroa elongatula* Nikitsky, 1999 and *Synchroina tenuipennis* are newly reported from Laos and Indonesia, respectively. The previously established key for the identification of Synchroidae (Nikitsky 1999; Hsiao 2015; Hsiao *et al.* 2016) is modified. In addition, a morphology-based phylogenetic analysis including all described taxa of Synchroidae is performed. The results reveal that *Synchroa pangu* Hsiao, Li, Liu & Pang, 2016 cannot be assigned to any previously described genus. Together with the morphological comparison, we herein separate this species to establish a new genus, *Thescelosynchroa* gen. nov., with a new combination proposed: *T. pangu* (Hsiao, Li, Liu & Pang, 2016) gen. et comb. nov. Furthermore, a preliminary and brief discussion of familial placement of *Mallodrya subaenea* Horn, 1888 and the biogeography of the family are provided.

Material and methods

All specimens examined in this paper are deposited in the following institutions and private collections:

HUM = Hokkaido University Museum, Sapporo, Japan
MAIC = Michael A. Ivie collection, Montana State University, Bozeman, USA
NMNS = National Museum of Natural Science, Taichung, Taiwan
OKZC = O. Konvička's private collection, Zlín, Czech Republic
SYSBM = Museum of Biology, Sun Yat-Sen University, Guangzhou, China (mainland)
TARI = Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan
TFRI = Taiwan Forestry Research Institute, Taipei, Taiwan
YHC = Y. Hsiao's private collection, Taichung, Taiwan

Terminology for morphology used in the paper follows Ślipiński & Lawrence (2010) and Hsiao (2015). Abdomens detached from the body were kept in 20% KOH for 1–2 hours before observation. Elytra were detached and placed in 75% alcohol to make the elytral striae clearer to examine. Photographs and measurements were produced following Hsiao (2015) and Hsiao *et al.* (2016). The distribution map was prepared using the SimpleMappr program (Shorthouse 2010).

Abbreviations

cx = coxite
ex. = specimen(s)
ml = median lobe
pm = paramere
pp = paraproct
te = tegmen

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Characters

Twenty eight adult morphological characters and one geographical character were used for the phylogenetic analysis, listed as follows:

01 Body size: (0) small (6.5–9.0 mm); (1) large (> 10.0 mm).

02 Body form judged on the ratio of the length to the width at the widest part of the conjoint elytra: (0) distinctly widened posteriorly (ca 2.85); (1) strongly narrowed posteriorly, flattened (ca 3.40–3.60); (2) lateral sides of elytra parallel in anterior half, similar to (1), but more slender (ca 3.80–4.00); (3) considerably slender (> 5.0).

03 Shape of head: (0) stout (Fig. 1A); (1) elongate, abruptly constricted posteriorly to form broad neck (Fig. 1B).

04 Frontoclypeus: (0) broad (Fig. 1A); (1) narrow (Fig. 1B).

05 Mandible: (0) stout, obtuse (Fig. 1C); (1) slender, acute (Fig. 1D).

06 Shape of eyes in dorsal view: (0) oval, shallowly emarginate (Fig. 1A); (1) deeply emarginate (Fig. 1B).

07 Eyes size judged on the ratio of eye diameter to interocular space in males: (0) large, eye diameter longer than interocular space; (1) middle, ca 1.5–1.7; (2) smaller than (1), ca 1.8–2.2; (3) very small, ca 3.0.

08 Interfacetal setae: (0) very short or absent; (1) usually with long interfacetal setae.

09 Shape of apical maxillary palpomere: (0) stout, subtriangular (Fig. 1E); (1) stout, more elongate than (0), obliquely truncate (Fig. 1F); (2) securiform (Fig. 1G); (3) elongate and more expanded (Fig. 1H).

10 Form of antennae: (0) filiform (Fig. 1I); (1) filiform, with last three segments expanded (Fig. 1J); (2) submonoliform, antennomeres IV–X gradually shortened; antennomere XI oval (Fig. 1K).

11 Shape of pronotum: (0) transverse, lateral sides strongly narrowed anteriorly, with complete lateral carinae (Fig. 2A); (1) transverse, lateral sides feebly arcuate, with complete lateral carinae (Fig. 2B); (2) transverse, lateral sides somewhat rounded, moderately narrowed anteriorly, with complete lateral carinae (Fig. 2C); (3) bell-shaped, with incomplete lateral carinae (Fig. 2D).

12 Posterior edge of pronotum: (0) unmargined; (1) margined.

13 Lateral pronotal carinae: (0) lateral sides unmargined; (1) lateral sides entirely or partially margined.

14 Greatest width of pronotum: (0) distinctly narrower than elytra (≤ 0.8 times elytral width at humeri); (1) as wide as elytra at humeri.

15 Prosternum in front of coxae: (0) shorter than shortest diameter of procoxal cavity; (1) as long as or longer than shortest diameter of procoxal cavity.

16 Prosternal process: (0) complete, broad, extending well beyond procoxae, the apex narrowed apically (Fig. 2E); (1) complete, broad, extending well beyond procoxae, the apex long oval (Fig. 2F); (2) complete, laminate, ending just before posterior edges of procoxae; (3) incomplete.

17 Surface of mesoventral cavity: (0) absent; (1) present, the surface distinctly punctate (Fig. 2G); (2) present, the surface smooth (Fig. 2H).

18 Median field of metathoracic wings: (0) with entire subcubital fleck; (1) without subcubital fleck.

19 Procoxae: (0) not projecting below prosternum; (1) slightly projecting below prosternum; (2) projecting well below prosternum.

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20 Meso-metaventral junction: (0) absent; (1) with a complex fitting.

21 Epipleuron: (0) incomplete; (1) complete.

22 Apical edge of sternite IX in male: (0) without spiculum gastrale; (1) with short spiculum gastrale.

23 Tergite IX and X: (0) completely fused; (1) tergite IX in males emarginate, tergite X well developed and free.

24 Pretarsal claws: (0) simple; (1) serrate.

25 Pretarsal lobe: (0) with ventral lobe beneath each claw; (1) without ventral lobe.

26 Parameres: (0) separated; (1) fused together forming apicale (Fig. 2J).

27 Median lobe of aedeagus (Fig. 2J): (0) short, stout, tube-like; (1) elongate, slender, tapered; (2) elongate, slender, clavate.

28 Ovipositor (Fig. 2K): (0) with styli; (1) without styli.

29 Zoogeographical regions: (0) Palearctic region; (1) Oriental region; (2) Nearctic region.

The ingroup taxa include all described species of Synchroidae. The outgroup taxon is *Cephaloon pallens* (Motschulsky, 1860), Stenotrachelidae Thomson, 1859, which was considered to be related to synchroids based on immature morphology (Böving & Craighead 1931; Crowson 1966; Hayashi 1975). The data matrix (Table 1) was coded and edited with WinClada ver. 10.00.08 (Nixon 2002). Inapplicable data were coded as '-' and missing data were coded with '?'. Characters were coded based on our own anatomical observations and descriptions provided by Horn (1888), Nikitsky (1999) and Ślipiński & Lawrence (2010). The data matrix was analysed using NONA v. 2.0 (Goloboff 1999) from WinClada. All characters were run equally weighted and not additive. The commands of heuristic analysis, 'hold 10000', 'mult*50', 'hold/20' and 'mult*max*' were used to search for the most parsimonious tree(s). In the resultant trees, the unsupported nodes were hard collapsed and only the best trees were kept in WinClada. The characters and character states on the tree were optimized using unambiguous character changes in WinClada.

Character analysis

Diagnostic characters of Synchroidae and intergeneric/intraspecific variation are listed and discussed as follows:

01 Body size. *Synchroa* species are mostly 10.0–13.0 mm although a few exceptional specimens are ca 8.0–9.0 mm. The length varies from 7.0–9.0 mm in *Synchroina* and from 6.0–8.5 mm in *Mallodrya* according to the original description (Horn 1888).

02 Body form. *Mallodrya* is characterized by its elongate, oblong and somewhat convex body, which is widened posteriorly. It is similar to melandryid genera such as *Melandrya* (*Melandrya*) Fabricius, 1801 and *M.* (*Emmesa*) Newman, 1838 (Horn 1888). *Synchroa* (excl. *S. elongatula* Nikitsky, 1999 and *S. pangu* Hsiao, Li, Liu & Pang, 2016) and *Synchroina* are similar in overall appearance, with the length ca 3.4–3.6 times as long as maximum width and flat body. *S. elongatula* and *S. pangu* are more slender, with the length ca 3.8–4.0 times as long as maximum width.

03 Antennae. *Synchroa* and *Synchroina* possess filiform antennae (Fig. 1I). Sexual dimorphism is notable. Male antennae are longer than in females. *Mallodrya* can be distinguished from remaining synchroids by its short antennae; gradually shortened antennomeres IV–X; oval antennomere XI (Horn 1888) (Fig. 1K).

04 Shape of apical maxillary palpomere. The apical maxillary palpomere of *Synchroa* is slightly more elongate and more sharply truncate apically (Fig. 1G) than in *Synchroina* (Fairmaire 1898; Nikitsky

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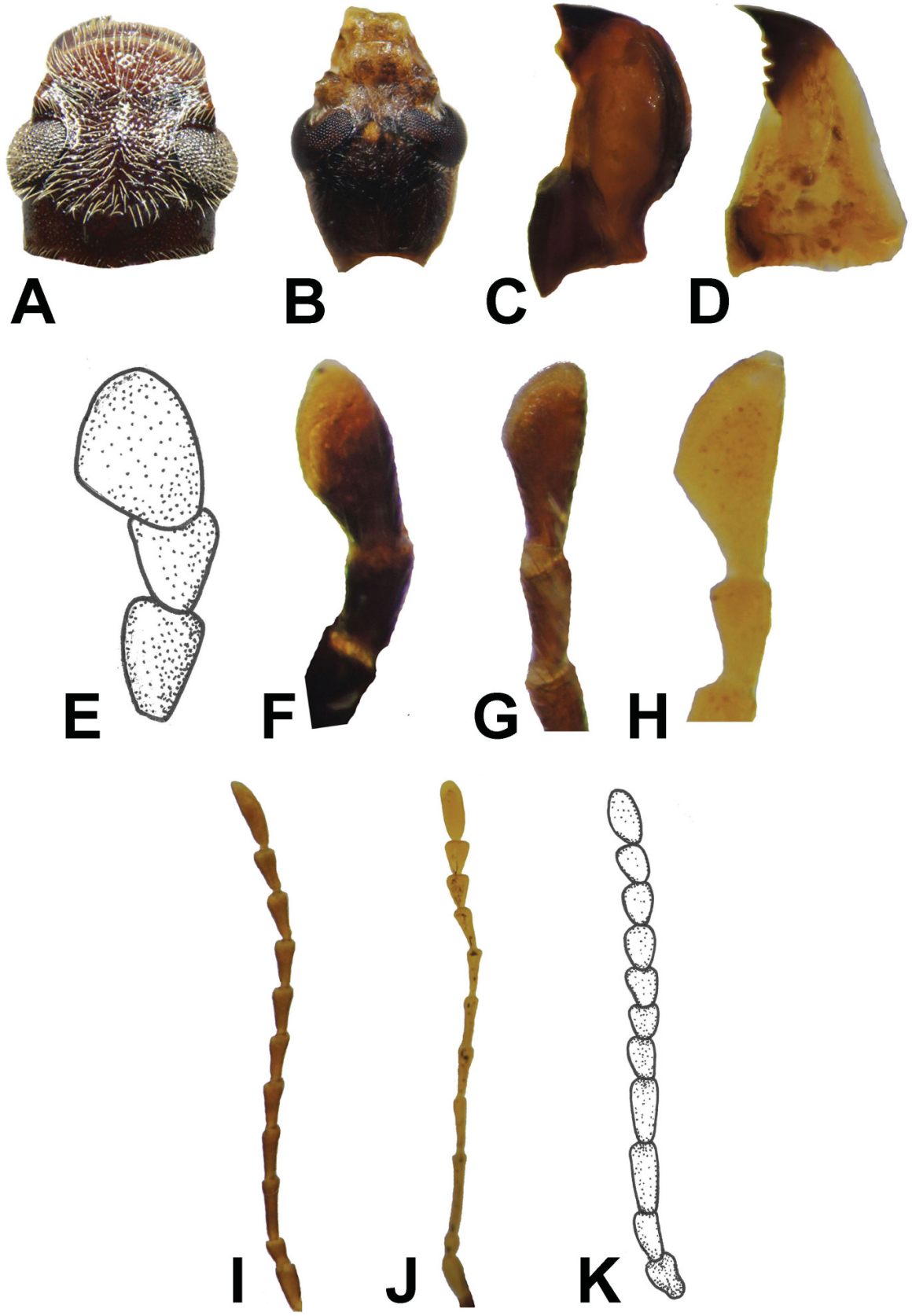

Fig. 1. Morphological characters used for the analysis. **A–B**. Head. **C–D**. Mandible. **E–H**. Apical maxillary palpomere. **I–K**. Antenna.

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1999) (Fig. 1F). In *Mallodrya*, the apical maxillary palpomere is stout, subtriangular and arcuate distally (Fig. 1E).

05 Eyes. Eyes are lateral, oval, and emarginate in front of antennal insertions in synchroids, with long interfacetal setae (excl. *Mallodrya*). The eyes are large in *Synchroa* (excl. *S. pangu*), with ratio of eye diameter to interocular space ca 1.2–1.7 and small in *Synchroa pangu* and species of *Synchroina*, with ratio of eye diameter to interocular space ca 1.8–2.2. The eyes of *Mallodrya subaenea* are similar to other synchroids, but very small, lacking long interfacetal setae, with a ratio of eye diameter to interocular space ca 3.0.

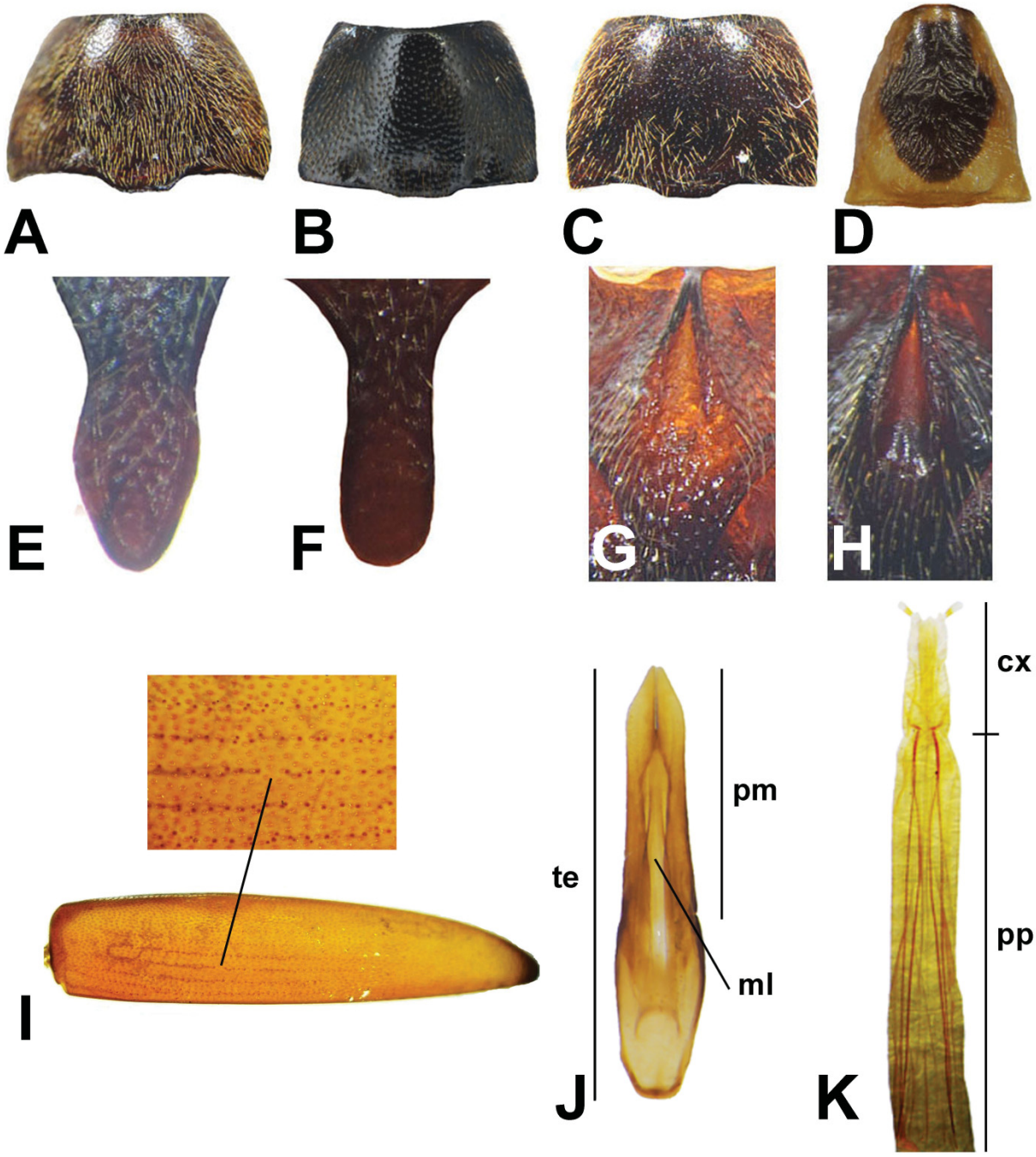

Fig. 2. Morphological characters used for the analysis and key. **A–D**. Pronotum. **E–F**. Prosternal process. **G–H**. Mesoventral cavity. **I**. Elytral striae. **J**. Aedeagus. **K**. Ovipositor.

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Table 1. Data matrix.

Taxa	*Cephaloon pallens*	*Mallodrya subaenea*	*Synchroa punctata*	*Synchroa melanotoides*	*Synchroa formosana*	*Synchroa chinensis*	*Synchroa elongatula*	*Synchroa pangu*	*Synchroina tenuipennis*	*Synchroina cuneata*
01	1	0	1	1	1	1	1	1	0	0
02	3	0	1	1	1	1	2	2	1	1
03	1	0	0	0	0	0	0	0	0	0
04	1	0	0	0	0	0	0	0	0	0
05	1	0	0	0	0	0	0	0	0	0
06	1	0	0	0	0	0	0	0	0	0
07	0	3	1	1	1	1	1	2	2	2
08	0	0	1	1	1	1	1	1	1	1
09	3	0	2	2	2	2	2	2	1	1
10	1	2	0	0	0	0	0	0	0	0
11	3	2	0	0	0	0	0	1	2	2
12	1	1	0	0	0	0	0	0	0	0
13	-	1	1	1	0	0	1	0	1	1
14	0	1	1	1	1	1	1	0	1	1
15	0	1	1	1	1	1	1	1	1	1
16	3	2	1	1	0	0	0	1	0	0
17	0	0	1	1	1	1	1	1	2	2
18	1	0	0	0	0	0	0	?	0	0
19	2	1	0	0	0	0	0	0	0	0
20	0	0	1	1	1	1	1	1	1	1
21	1	0	0	0	0	0	0	0	0	0
22	1	0	0	0	0	0	0	?	0	0
23	1	0	0	0	0	0	0	?	0	0
24	1	0	0	0	0	0	0	0	1	1
25	0	1	1	1	1	1	1	1	1	1
26	0	?	1	1	1	1	1	1	1	1
27	0	?	1	1	1	1	1	2	2	2
28	1	?	0	0	0	0	0	?	0	?
29	0	2	2	0	1	0	1	0	1	1

06 Shape of pronotum. In *Synchroa* (excl. *S. pangu*), the lateral sides of the pronotum are strongly narrowed anteriorly; anterior edge is ca 0.50–0.60 times as long as posterior edge; the posterior edge is unmargined; pronotum is as wide as elytra at humeri (Fig. 2A). *Synchroa pangu* can be distinguished from its congeners on the basis of the following character combination: feebly arcuate lateral sides; anterior edge ca 0.65 times as long as posterior edge; unmargined posterior edge; pronotum narrower than elytra at humeri (Fig. 2B). The lateral sides of the pronotum of *Synchroina* are somewhat rounded; anterior edge is ca 0.60–0.70 times as long as posterior edge; posterior edge is unmargined; pronotum is as wide as elytra at humeri (Fig. 2C). Although the shape of pronotum

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in *Mallodrya* is similar to that in *Synchroina*, it can be easily separated from other synchroids by distinctly margined posterior edge of pronotum.

07 Elytral striae (Fig. 2I). Nikitsky (1999) used elytral striae as a diagnostic character, followed by Hsiao (2015) and Hsiao *et al.* (2016). However, elytral striae of synchroids are dark brown and faint, difficult to observe in dried specimens and possibly leading to erroneous observations. To solve this problem, a new examination method has been developed (see Material and methods for details). Furthermore, we confirm that the intraspecific variation of elytral striae is notable after examining more specimens, which varies from obviously present to extremely indistinct (see the detail in description). It suggests that the variations of this character among specimens should not be overestimated for species delimitation in future works.

08 Prosternal process and procoxae. The prosternal process is laminate in *Mallodrya*, ending just before the posterior edges of procoxae, which is slightly projecting below prosternum and nearly contiguous. In *Synchroa* and *Synchroina*, the prosternal process is broad, markedly extending beyond procoxae, which is not projecting below prosternum and separated. The prosternal process is narrowed apically, with rounded apex in *Synchroa* (excl. *S. melanotoides*, *S. pangu* and *S. punctata*) and *Synchroina* (Fig. 2E). *S. melanotoides*, *S. pangu* and *S. punctata* have prosternal process with long oval apex (Fig. 2F).

09 Mesoventral cavity and mesometaventral junction. A mesoventral cavity and mesometaventral junction are absent in *Mallodrya*, but the former is moderately large, shallow and the latter usually a complex fitting in *Synchroa* and *Synchroina*. In *Synchroa*, the mesoventral cavity is distinctly punctate (Fig. 2G) while *Synchroina* species have smoother mesoventral cavity (Fig. 2H).

10 Pretarsal claws. The pretarsal claws of *Synchroa* and *Mallodrya* are simple and serrate in *Synchroina*.

11 Aedeagus (Fig. 2J). The shape of fused parameres and median lobe are diagnostic for species identification, although *Synchroa punctata* appears to be similar to *S. melanotoides* in aedeagus, and intraspecific variation is present in some species (see details in descriptions and figures). The median lobe of *Synchroa* (excl. *S. pangu*) is tapered apically, not exceeding from the apex of parameres in natural condition; on the other side *S. pangu* has a slender, elongate and clavate median lobe with an apex, extending over the apex of parameres. In *Synchroina*, the median lobe is elongate, clavate and slightly narrowed apically, not exceeding the apex of parameres.

Results

Phylogenetic relationships within Synchroidae

The heuristic analysis resulted in eight most parsimonious trees (L 53; CI 83; RI 65) and their majority consensus tree (L 54; CI 81; RI 61) is used in the Discussion (Fig. 10). The results suggest four major lineages within Synchroidae including: (1) *Mallodrya subaenea*; (2) *Synchroa* spp. (excl. *S. pangu*); (3) *Synchroina* spp.; (4) *Synchroa pangu*. The clade *Mallodrya subaenea* is the most basal group of this family based on the morphological cladistic analysis, which distinctly differs from other synchroids in appearance (see character analysis). The monophyly of the remaining synchroids is well supported by the following synapomorphies: eyes with long interfacetal setae; unmargined posterior pronotal edge; moderately large and shallow mesoventral cavity; mesometaventral junction with a complex fitting, and their relationship remains unresolved. The clade *Synchroa* spp. (excl. *S. pangu*) is supported synapomorphically by eye diameter to interocular space in males ca 1.5–1.7; pronotum with anterior edge slightly concave and lateral sides strongly narrowed anteriorly; elongate, slender and tapered aedeagal median lobe. The relationships among members of this group are not well-resolved. *Synchroina* spp. synapomorphically share small body size (ca 6.0–8.5); obliquely truncate apical maxillary palpomere; surface of mesoventral cavity smooth; serrate claws. Moreover, this group is endemic to the Oriental Region. *Synchroa pangu* is treated as a separated monophyletic group on the

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basis of the following characters: body slender and elongate; pronotum narrower than elytra; anterior edge of the pronotum slightly concave in dorsal view; lateral margins of the pronotum feebly arcuate and unmargined; apex of prosternal process long oval. The character combination suggests that the species should not be placed into any previously established genus and assigned to a new one.

Taxonomy

Key to the world fauna of Synchroidae Lacordaire, 1859

(after Nikitsky 1999; Hsiao 2015; Hsiao *et al.* 2016)

1. Procoxae almost contiguous. North America ……***Mallodrya subaenea*** Horn, 1888
– Procoxae distinctly separated ……2

2. Pretarsal claws serrate ……3
– Pretarsal claws simple ……4

3. Elytra finely and sparsely punctate in apical two-thirds; sutural stria on elytra strongly marked in apical part. Indonesia (Borneo: South Kalimantan) …***Synchroina cuneata*** (Champion, 1916)
– Elytra densely and coarsely punctate; sutural stria on elytra shallower. Malaysia (Kelantan, Perak, Pahang); Indonesia (West Sumatra, Borneo: South Kalimantan) …… ……***Synchroina tenuipennis*** Fairmaire, 1898

4. Pronotum slightly narrowed anteriorly (Fig. 2B), distinctly narrower than elytra at humeri (≤ 0.8 times elytral width at humeri); median lobe of the aedeagus clavate, slender, long, exceeding from the tegmen in natural condition. Mainland China (Sichuan) …… ……***Thescelosynchroa pangu*** (Hsiao, Li, Liu & Pang, 2016)
– Pronotum strongly narrowed anteriorly (Fig. 2A), nearly as long as elytra at humeri; median lobe of the aedeagus tapered, not extending over the tegmen in natural condition ……5

5. Sides of pronotum almost entirely margined; median part of posterior half of pronotum smooth and impunctate. North America ……***Synchroa punctata*** Newman, 1838
– Sides of pronotum unmargined or only partially margined; median part of posterior half of pronotum not smooth. Asia ……6

6. Lateral margins of pronotum not margined ……7
– Lateral margins of pronotum distinctly margined in posterior one-third or one-fourth ……8

7. Body and legs blackish-brown; parameres slender, basal part of median lobe gradually narrowed apically. Mainland China (Sichuan, Shaanxi, Gansu) ……***Synchroa chinensis*** Nikitsky, 1999
– Body and legs reddish to dark brown; parameres stout, basal one-fourth of median lobe subparallel. Taiwan ……***Synchroa formosana*** Hsiao, 2015

8. Antennae, maxillary palpi blackish-brown; body elongate, slender; prosternal process narrowed apically; aedeagus: parameres stout, wide, with lateral sides subparallel or sinuate. Vietnam; Laos …… ……***Synchroa elongatula*** Nikitsky, 1999
– Antennae, legs and maxillary palpi reddish-brown; body stout; prosternal process with long oval apex; aedeagus: parameres slender, with lateral sides gradually narrowed apically …… ……***Synchroa melanotoides*** Lewis, 1895

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Class Hexapoda Blainville, 1816
Order Coleoptera Linnaeus, 1758
Suborder Polyphaga Emery, 1886
Superfamily Tenebrionoidea Latreille, 1802
Family Synchroidae Lacordaire, 1859

Genus ***Synchroa*** Newman, 1838

Synchroa Newman, 1838: 378. Type species: *Synchroa punctata* Newman, 1838, by monotypy.
Phaiona Haldeman, 1848: 99. Type species: *Phaiona murina* Haldeman, 1848.

Diagnosis

This genus is similar to *Synchroina* and *Thescelosynchroa* gen. nov.; the differential diagnosis is given in Table 2.

Synchroa punctata Newman, 1838
Figs 3A–B, 4A, G, 5A–B, M, 6A–E

Synchroa punctata Newman, 1838: 378.

Diagnosis

This species can be easily distinguished from other species of *Synchroa* by the following combination of characters: body densely covered by pale simple setae; pronotum smooth and impunctate in medio-longitudinal part of posterior half, lateral sides almost entirely margined; prosternal process with long oval apex; aedeagus: parameres moderately narrowed apically, abruptly strongly narrowed at apex.

Material examined

UNITED STATES OF AMERICA: 3 larvae, Hemlock Draw, Sauk Co., Wisconsin, 43°21′50″ N, 89°56′49″ W, 30 Mar. 2001, D.S. Biggs leg. (YHC); 1 ♀, Hemlock Draw, Sauk Co., Wisconsin, 43°21′46″ N, 89°56′34″ W, 11–20 Jun. 2001, Lindgren Funnel Trap, D. Young leg. (YHC); 1 ♂, 1 ♀, same locality data as previous, 6–11 Jul. 2001, Lindgren Funnel Trap, D. Young leg. (YHC); 1 ♂, 2 ♀♀, same locality data as previous, 19–25 Jul. 2001, Lindgren Funnel Trap, D. Young leg. (YHC); 1 larva, Merrill, Marathon Co., Wisconsin, 22 Feb. 2003, E. Nowak leg. (YHC); 1 larva, Hemlock Draw, Sauk Co., Wisconsin, 43°21′46″ N, 89°56′57″ W, 21 Apr. 2003, A. Bendlin leg. (YHC); 5 larvae, Otter Creek, Rock Co., Wisconsin, 27 Apr. 2003, A. Bendlin leg. (YHC); 1 ex., West Jefferson, 20 km W of Columbus, Ohio, 6 Jun. 2008, Košťál leg. (OKCZ).

CANADA: 1 ex., Warwick Conservation Area, Ontario, 42.995 N, 81.948 W, Jul. 2014, collector unknown (OKCZ); 1 ex., Ottawa, Stittsville, Ontario, 45.275 N, 75.972 W, 3 Jul. 2014, collector unknown (OKCZ); 1 ex., Cornwall, Ontario, 45.04384 N, 74.71467 W, 14 Jul. 2014, collector unknown (OKCZ); 2 ex., Cornwall, Ontario, 45.04384 N, 74.71467 W, 14 Jul. 2014, collector unknown (OKCZ); 2 ex., Merritt island, Ontario, 43.00255 N, 79.241 W, 16 Jul. 2014, collector unknown (OKZC); 1 ♂, Boucherville, Québec, 45.55 N, 73.42 W, 21 Aug. 2014, collector unknown (YHC); 1 ♂, Québec, 46.79416 N, 71.32895 W, 14 Jul. 2015, collector unknown (YHC); 2 ex., Brantford, Ontario, 43.15806 N, 80.35835 W, 27 Jul. 2015, collector unknown (OKCZ).

Redescription

Colour. Body and legs completely blackish-brown. Antennae brown in some specimens.

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Table 2. Diagnostic characters among *Synchroa* Newman, 1838, *Synchroina* Fairmaire, 1898 and *Thescelosynchroa* gen. nov.

	Synchroa	***Synchroina***	***Thescelosynchroa* gen. nov.**
Size	Large (mostly 10.0–13.0 mm)	Small (7.0–9.0 mm)	Large (ca 10.0 mm)
Eyes	Large; ratio of eye diameter to interocular space in males ca 1.5–1.7	Small; ratio of eye diameter to interocular space in males ca 1.8–2.2	
Apical maxillary palpomere	Securiform	Obliquely truncate	Securiform
Shape of pronotum	Lateral sides strongly narrowed anteriorly	Lateral sides somewhat rounded, moderately narrowed anteriorly	Lateral sides feebly arcuate
Greatest width of pronotum	As wide as elytra at humeri		Distinctly narrower than elytra
Surface of mesoventral cavity	Distinctly punctate	Smooth	Distinctly punctate
Claws	Simple	Serrate	Simple
Aedeagal median lobe	Slender and tapered, not extending the apex of the tegmen	Elongate and clavate, not extending the apex of the tegmen	Elongate and clavate, extending from the apex of the tegmen

Male (Fig. 3A)

Measurements. Length: 9.50–11.50 mm; width: 2.25–2.75 mm.

Body. Elongate, slightly flattened, elytra rather strongly narrowed posteriorly, covered with pale, elongate and decumbent setae.

Head. Eyes lateral, large, emarginate in front of antennal insertions, ratio of eye diameter to interocular space 1.0 : 1.5–1.7. Antennae filiform, when directed backwards exceeding the humeri of elytra. Scape cylindrical, wider than other antennomeres, pedicel short, antennomere III–XI somewhat clavate, XI longest, length ca 4.5–4.6 times maximum width. Length ratio of antennomeres as follows: 1.90 : 1.00 : 2.60 : 2.45 : 2.30 : 1.95 : 1.85 : 2.10 : 2.10 : 1.90 : 3.20. Apical maxillary palpomere securiform, apical margin moderately rounded, terminal angle somewhat obtuse. Surface lustrous, densely and coarsely punctate; interspaces slightly narrower than puncture diameter.

Pronotum. Truncate anteriorly, anterior edge slightly concave, bisinuate posteriorly, with obtuse median lobe, width ca 1.4–1.5 times as long as length, ca 1.6–1.7 times as wide as head. Lateral sides rounded and strongly narrowed in anterior two-thirds toward head, subparallel in posterior one-third, completely or almost completely margined. Anterior angle rounded; posterior angle rectangular and obtuse. Disc slightly flattened medially, surface lustrous, densely and coarsely punctate; spaces between punctures smaller than puncture diameter. Scutellum width ca 1.50–1.70 times length.

Elytra. Elongate, narrowed posteriorly, apex rounded, as wide as pronotal width at humeri, length ca 2.6–2.7 times width, surface lustrous. Disc covered with oval punctures, denser in lateral and basal part;

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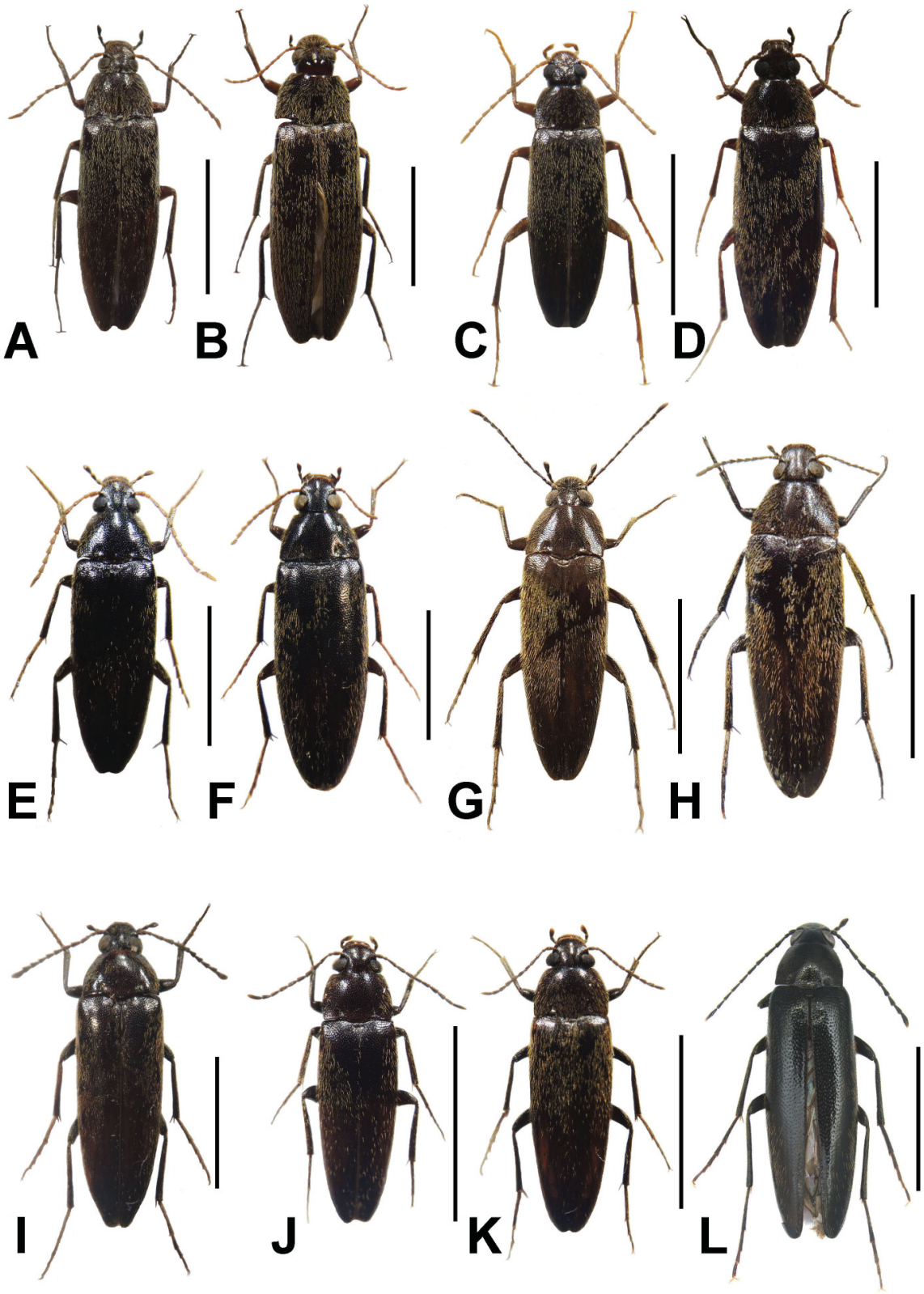

Fig. 3. Habitus, dorsal view. **A–B**. *Synchroa punctata* Newman, 1838. **C–D**. *S. melanotoides* Lewis, 1895. **E–F**. *S. chinensis* Nikitsky, 1999. **G–H**. *S. formosana* Hsiao, 2015. **I**. *S. elongatula* Nikitsky, 1999. **J–K**. *Synchroina tenuipennis* Fairmaire, 1898. **L**. *Thescelosynchroa pangu* (Hsiao, Li, Liu & Pang, 2016) gen. et comb. nov. A, C, E, G, I, J, L = ♂. B, D, F, H, K = ♀. Scale bars: 5.0 mm.

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interspaces wider than puncture diameter. Nine faint traces of striae in each elytron in dorsal view, stria I fused with II (numbered from suture to lateral side) (Fig. 4A), gradually shortened outwards; elytral striae indistinct in some specimens. Prosternum before procoxae about as long as shortest diameter of procoxae. Prosternal process long, margined laterally, long oval, extending well beyond procoxae; length behind procoxae longer than width between procoxae. Width between procoxae ca 0.2 times transverse coxa diameter. Mesoventrite with shallow, oval mesoventral cavity, moderately punctate. Abdominal ventrite V truncate, with lateral sides nearly straight (Fig. 4G); sternite VIII concave in middle of apical edge, forming two rounded lobes on both sides, moderately pubescent apically (Fig. 5B); sternite IX without spiculum gastrale on apical edge (Fig. 5M); tergite VIII without median strut on apical edge, rounded apically, moderately pubescent apically (Fig. 5A); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5M).

Legs. Slender. Tarsomeres simple, tarsal formula 5-5-4. The longest spur of hind tibiae ca 0.3 times as long as first tarsal segment; length ratio of tarsomeres as follows: 2.30 : 1.00 : 0.55 : 0.85 (measured without claws). Claws simple.

Aedeagus (Fig. 6A–E). Lanceloate, basal piece curved dorsally, lateral sides roundly arcuate, narrowed basically. Parameres narrowly separated apically with a groove in dorsal median part; lateral sides of the aedeagus almost straight, slightly constricted medially (Fig. 6A–B) or distinctly widened in middle (Fig. 6C), moderately narrowed apically, abruptly strongly narrowed at apex, length ca 3.3–3.5 times maximum width. Median lobe elongate, tapered, strongly narrowed in the apical half.

Female (Fig. 3B)

Measurements. Length: 10.00–13.50 mm; width: 2.50–3.00 mm.

Body. Similar to male.

Head. Eyes smaller than in male, ratio of eye diameter to interocular space 1.0 : 1.9–2.0. Antennae shorter in male, when directed backwards extending the posterior edge of pronotum, antennomere XI ca 3.6–3.7 times as long as maximum width. Length ratio of antennomeres as follows: 1.50 : 1.00 : 2.85 : 2.00 : 1.70 : 1.90 : 1.70 : 1.75 : 1.70 : 1.75 : 2.85.

Pronotum. Ca 1.5 times wider than length, ca 1.7 times as wide as head.

Elytra. Slightly wider than in male, as wide as pronotal width at humeri, length ca 2.5–2.6 times width.

Ovipositor. Paraproct elongate, ca 3.1–3.2 times length of coxite, sides straight and subparallel; proctiger subtruncate.

Notes

This species is fairly common in eastern North America, found on tree bark or attracted to light. It can also be collected using Malaise or Lindgren funnel traps. Larvae develop in the moist environment beneath the bark of decaying woods (Payne 1931; Young 1991, 2002; Majka & Pollock 2006; Ślipiński & Lawrence 2010).

Distribution

Eastern North America: USA, Canada.

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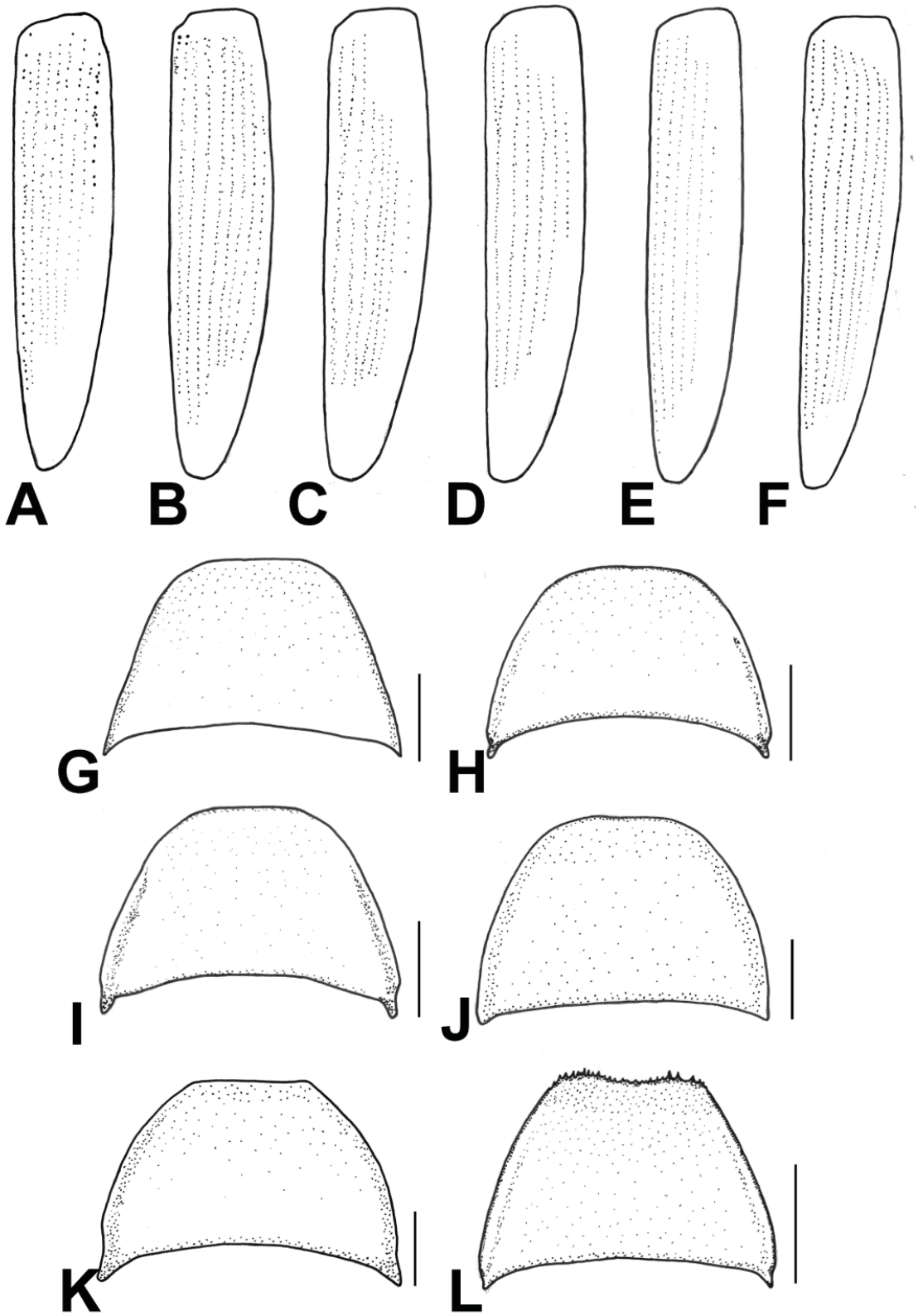

Fig. 4. Elytron and abdominal ventrite V. **A–F**. Elytron. **G–L**. Abdominal ventrite V of ♂♂. — **A**, **G**. *Synchroa punctata* Newman, 1838. **B**, **H**. *S. melanotoides* Lewis, 1895. **C**, **I**. *S. chinensis* Nikitsky, 1999. **D, J**. *S. formosana* Hsiao, 2015. **E**, **K**. *S. elongatula* Nikitsky, 1999. **F**, **L**. *Synchroina tenuipennis* Fairmaire, 1898. Scale bars: 0.5 mm.

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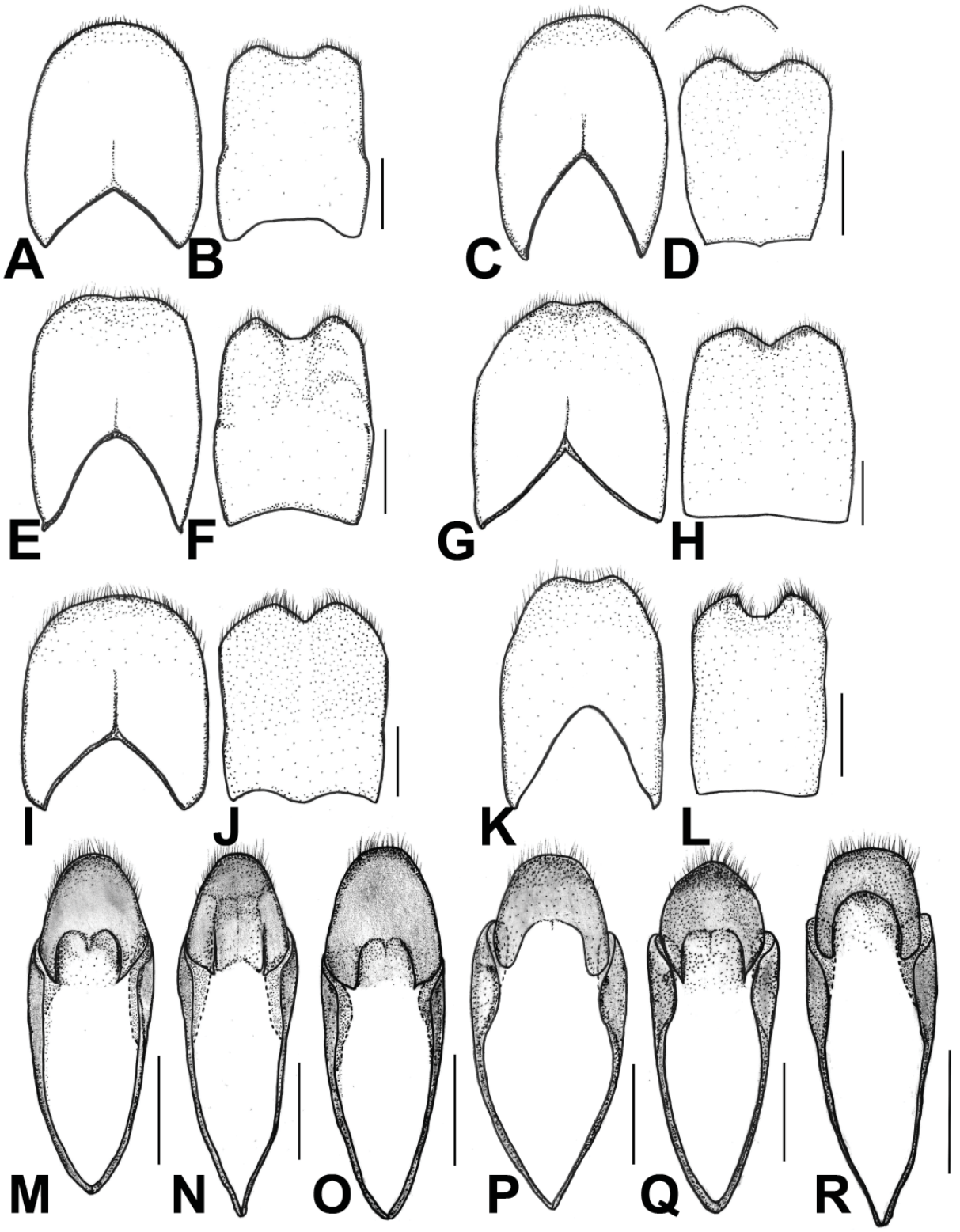

Fig. 5. Abdominal sternite VIII–IX and tergite VIII–X of ♂♂. **A**, **C**, **E**, **G**, **I**, **K**. Abdominal tergite VIII. **B**, **D**, **F**, **H**, **J**, **L**. Abdominal sternite VIII. **M–R**. Abdominal sternite IX, and fused tergite IX and X. — **A–B**, **M**. *Synchroa punctata* Newman, 1838. **C–D**, **N**. *S. melanotoides* Lewis, 1895. **E–F**, **O**. *S. chinensis* Nikitsky, 1999. **G–H**, **P**. *S. formosana* Hsiao, 2015. **I–J**, **Q**. *S. elongatula* Nikitsky, 1999. **K–L**, **R**. *Synchroina tenuipennis* Fairmaire, 1898. Scale bars: 0.5 mm.

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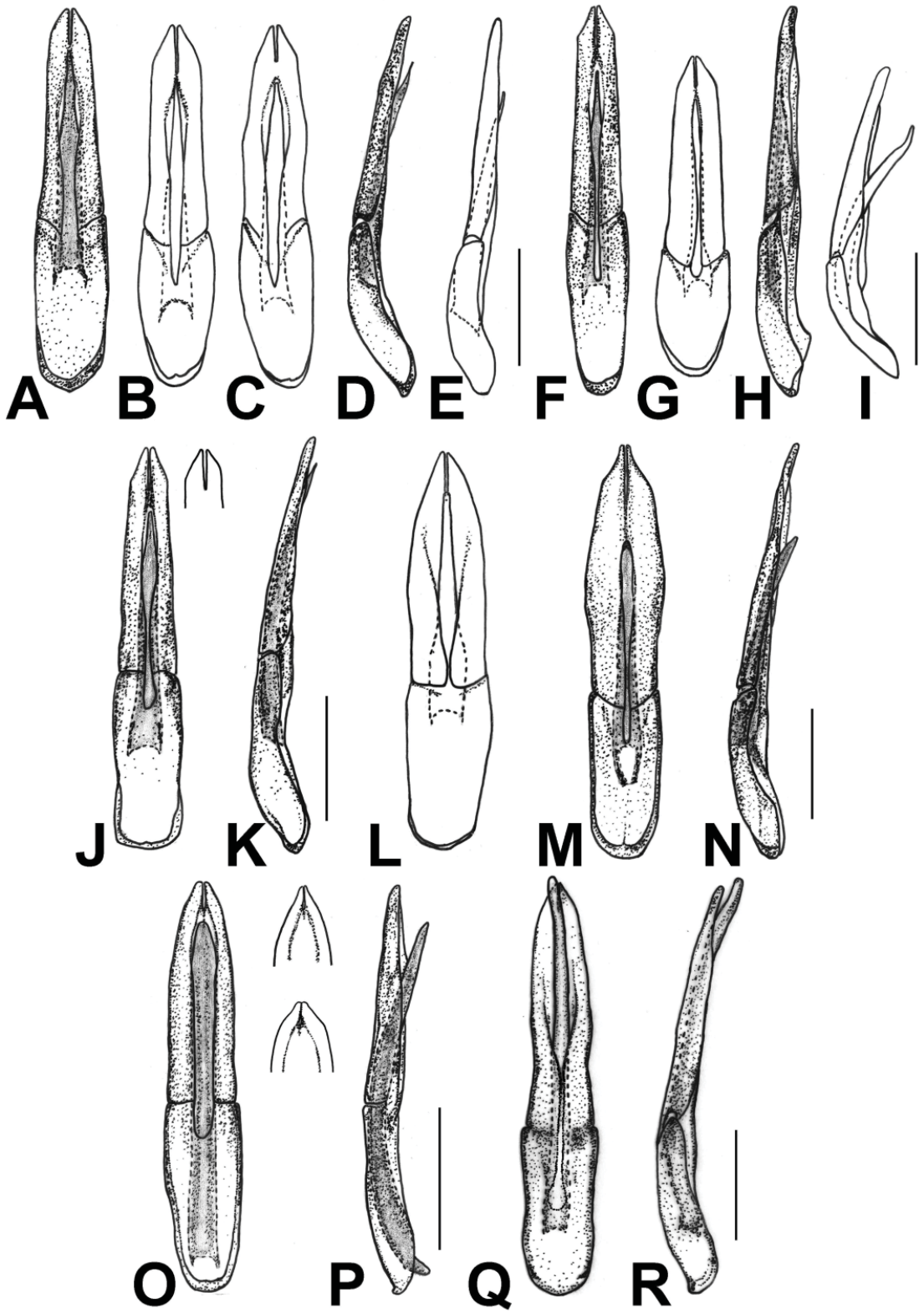

Fig. 6. Aedeagus. **A–E**. *Synchroa punctata* Newman, 1838. **F–I**. *S. melanotoides* Lewis, 1895. **J–K**. *S. chinensis* Nikitsky, 1999. **L**. *S. formosana* Hsiao, 2015. **M–N**. *S. elongatula* Nikitsky, 1999. **O–P**. *Synchroina tenuipennis* Fairmaire, 1898. **Q–R**. *Thescelosynchroa pangu* (Hsiao, Li, Liu & Pang, 2016) gen. et comb. nov. — **A–C**, **F–G**, **J**, **L–M**, **O**, **Q**. Dorsal view. **D–E**, **H–I**, **K**, **N**, **P**, **R**. Lateral view. Scale bars: 0.5 mm.

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Synchroa melanotoides Lewis, 1895
Figs 3C–D, 4B, H, 5C–D, N, 6F–I

Synchroa melanotoides Lewis, 1895: 263.

Diagnosis

This species resembles *Synchroa elongatula* Nikitsky, 1999 in pronotal configuration with lateral sides of the pronotum margined in posterior one-third to one-fourth, but it can be also separated by its reddish-brown antennae and legs; stout elytra; prosternal process with long oval apex; aedeagus: paramere more slender, with lateral sides gradually narrowed apically. It resembles *S. punctata* in the shape of the aedeagus, but can be separated in the body being closely covered with yellowish simple setae; eyes larger; pronotum margined in posterior one-third to one-fourth of lateral sides; prosternal process thinner; dorsal groove of aedeagus narrower basally.

Material examined

JAPAN: 1 ex., Matsum, date and collector unknown (HUM); 1 ♂, Kuzukawa, Hiraka-cho, Aomori Pref., 10 Aug. 1957, K. Shimoyama leg. (NMNS); 2 ♀♀, 1 ex., Kuzukawa, Hiraka-cho, Aomori Pref., 18 Aug. 1957, K. Shimoyama leg. (NMNS); 1 ♀, Kuzukawa, Hiraka-cho, Aomori Pref., 20 Aug. 1957, K. Shimoyama leg. (NMNS); 1 ♂, Kuzukawa, Hiraka-cho, Aomori Pref., 21 Aug. 1957, K. Shimoyama leg. (NMNS); 1 ♀, Mennoki-toge, Tsugu, Aichi Pref., 27–28 Jul. 1974, H. Yamada leg. (NMNS); 1 ♂, Kamitakara-mura, Gifu Pref., 11 Aug. 1979, M. Satô leg. (NMNS); 1 ♀, Ohboshi-yama, Tsushima, 30 Jun. 1980, N. Ohbayashi leg. (NMNS); 1 ex., Taniyama, Ohno-shi, Fukui Pref., 5–6 Aug. 1984, M. Saitô leg. (OKCZ); 1 ex., Kobiyaku Imaichi, Tochigi Pref., 20 Jul. 1986, K. Emoto leg. (OKCZ); 1 ex., Mt. Gomadan-zan, Ryûjin-mura, Hidaka-gun, Wakayama Pref., 10 Jul. 1988, H. Miyazaki leg. (OKCZ); 2 ex., Uchinokaya, Ina-shi, Nagano Pref., collected on host (*Juglans mandshurica* var. *sachalinensis*) 1 May 1990, emerged 11–13 Jun. 1990, R. Toyoshima leg. (OKCZ); 2 ex., Mt. Asuwa, Fukui-shi, Fukui Pref., 18 Jun. 1994, M. Saitô leg. (OKCZ); 1 ex., Jyôzan-kei, Minami-ku, Sapporo-shi, Hokkaido, 7 Aug. 2008, R. Toyoshima leg. (OKCZ); 1 ♀, Fushimiinari, Fushimi, Kyoto Pref., 10 Jul. 2013, S. Makita leg. (YHC); 2 ♂♂, 1 ♀, Kanayama [timber-yard], 43.510 N, 143.149 E, Mianmifurano-chô, Sorachi-gun, Hokkaido, 4 Aug. 2016, N. Kikuchi leg. (YHC).

Redescription

Colour. Body completely blackish-brown. Antennae and legs somewhat reddish-brown.

Male (Fig. 3C)

Measurements. Length: 8.25–10.50 mm; width: 2.00–2.5 mm.

Body. Elongate, slightly flattened, elytra rather strongly narrowed posteriorly, covered with yellowish, elongate and decumbent setae.

Head. Eyes lateral, large, emarginate in front of antennal insertions, ratio of eye diameter to interocular space 1.0 : 1.2–1.3. Antennae filiform, when directed backwards exceeding the humeri of elytra. Scape cylindrical, wider than other antennomeres, pedicel short, antennomere III–XI somewhat clavate, XI longest, length ca 3.1–4.1 times maximum width. Length ratio of antennomeres as follows: 1.60 : 1.00 : 2.60 : 2.50 : 2.10 : 2.10 : 2.05 : 2.05 : 1.85 : 1.75 : 2.85. Apical maxillary palpomere securiform, apical margin moderately rounded, terminal angle somewhat obtuse. Surface lustrous, densely and coarsely punctate; interspaces slightly narrower than puncture diameter.

Pronotum. Truncate anteriorly, anterior edge slightly concave, bisinuate posteriorly, with obtuse median lobe, width ca 1.4–1.5 times length, ca 1.5–1.6 times as wide as head. Lateral sides rounded and strongly

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narrowed in anterior two-thirds toward head, subparallel in posterior one-third, margined in posterior one-third to one-fourth. Anterior angle rounded; posterior angle rectangular and obtuse. Disc slightly flattened medially, surface lustrous, densely and coarsely punctate; spaces between punctures smaller than puncture diameter. Scutellum width ca 1.4–1.6 times length.

Elytra. Elongate, narrowed posteriorly, apex rounded, as wide as pronotal width at humeri, length ca 2.4–2.6 times width, surface lustrous. Disc covered with oval punctures, denser in lateral and basal part; interspaces wider than puncture diameter. Nine faint traces of striae in each elytron from dorsal view, stria I fused with II (Fig. 4B), gradually shortened outwards, elytral striae indistinct in some specimens. Prosternum before procoxae about as long as shortest diameter of procoxae. Prosternal process long, margined laterally, long oval; length behind procoxae shorter than or as long as width between procoxae. Width between procoxae ca 0.2 times transverse coxa diameter. Mesoventrite with shallow, oval mesoventral cavity, moderately punctate. Abdominal ventrite V subtruncate, with lateral sides nearly straight to slightly rounded (Fig. 4H); sternite VIII concave in middle of apical edge, forming two roundly angular lobes on both sides, moderately pubescent apically (Fig. 5D); sternite IX without spiculum gastrale on apical edge (Fig. 5N); tergite VIII without median strut on apical edge, rounded apically or emarginate in middle, moderately pubescent apically (Fig. 5C); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5N).

Legs. Slender. Tarsomeres simple, tarsal formula 5-5-4. The longest spur of hind tibiae ca 0.2 times as long as first tarsal segment; length ratio of tarsomeres as follows: 2.10 : 1.00 : 0.50 : 0.70 (measured without claws). Claws simple.

Aedeagus (Fig. 6F–I). Lanceloate, basal piece curved dorsally, lateral sides roundly arcuate, narrowed basically. Parameres narrowly separated apically and with a groove in dorsal median part, lateral sides straight, slightly narrowed apically, abruptly strongly narrowed at apex, length ca 3.0–3.9 times maximum width. Median lobe elongate, tapered, strongly narrowed apically in apical half.

Female (Fig. 3D)

Measurements. Length: 10.25–12.00 mm; width: 2.5–3.25 mm.

Body. Similar to males.

Head. Eyes smaller than in male, ratio of eye diameter to interocular space 1.0 : 1.4–1.5. Antennae shorter in male, when directed backwards extending the posterior edge of pronotum, antennomere XI ca 2.8 times as long as maximum width. Length ratio of antennomeres as follows: 1.90 : 1.00 : 2.10 : 2.30 : 2.25 : 2.10 : 2.10 : 2.05 : 2.00 : 1.90 : 2.60.

Pronotum. Ca 1.5 times wider than length, ca 1.5–1.6 times as wide as head.

Elytra. Slightly wider than in male, as wide as pronotal width at humeri, length ca 2.5 times width.

Ovipositor. Paraproct elongate, ca 3.0 times length of coxite, sides straight and subparallel; proctiger subtruncate.

Notes

This is a common species in Japan, which can be captured at light (S. Makita, personal communication). Larvae can be collected under the bark of decaying oak wood (Hayashi 1975) and walnut trees, *Juglans mandshurica* var. *sachalinensis*. Nikitsky (1999) mentioned that antennomere XI of this species is ca 2.5–2.8 times as long as the width, whose data were followed by Hsiao (2015) and Hsiao *et al.* (2016). However, our examination shows that this species has a wider variation in the length of antennomere XI than previously documented.

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Distribution

Russia (Far East); Japan; Korea; China (Jilin) (Löbl 2008).

Notes

Nikitsky (1999) and Löbl (2008) indicated this species as present in Korea; these data were neglected by Hsiao (2015) and Hsiao *et al.* (2016). Thus, we herein list Korea in the distribution. Additionally, Löbl (2008) referred to China (Jilin prov.); however, we cannot find any further literature or specimen to confirm this assumption.

Synchroa chinensis Nikitsky, 1999
Figs 3E–F, 4C, I, 5E–F, O, 6J–K, 7

Synchroa chinensis Nikitsky, 1999: 478.

Diagnosis

This species resembles *Synchroa formosana* Hsiao, 2015 by the unmargined lateral sides of pronotum, but can be distinguished by the following combination of characters: blackish-brown body and reddish-brown to dark brown antennae, apical maxillary palpomere and tarsi; aedeagus: more slender paramere and narrower basal part of median lobe.

Material examined

CHINA (mainland): 2 ♂♂, Tajbashan Range, Houzhenzi vill. env., Shaanxi [prov.], 33°55′ N, 107°49′ E, 1900 m, 15 Aug.–15 Oct. 1999, collector unknown (OKZC); 1 ex., 15 km south of Shouman, Daba Shan Mts, Shaanxi Prov., 32°08′ N, 108°37′ E, 1800–2100 m, 25 May–14 Jul. 2000, A. Plutenko leg. (OKCZ); 1 ♀, Lueyang, Shaanxi prov., 23–30 May 2009, E. Kučera leg. (MAIC); 1 ♀, Qingchenghou Shan Mts, 70 km NW of Chengdu, Sichuan prov., 1500 m, 6–13 Aug. 2010, S. Murzin leg. (OKZC); 4 ♂♂, 1 ♀, Nanping (Jiunaigou) [=Jiuzhaigou] env., Sichuan prov., 1700 m, 33.2435 N, 104.2383 E, 4–20 Jul. 2012, M. Murzin leg. (OKZC); 4 ♂♂, Lueyang env., Shaanxi [prov.], 21 Jun.–6 Jul. 2014, E. Kučera leg. (OKZC); 1 ♀, 100 km S of Jayuguan, Tulai env., NW of Gansu [prov.], 4200 m, 10 Jul. 2014, V. Patrikeev leg. (OKZC).

Redescription

Colour. Body and legs blackish-brown. Antennae, apical maxillary palpomere and tarsi reddish brown to dark brown.

Male (Fig. 3E)

Measurements. Length: 9.25–13.25 mm; width: 2.25–3.50 mm.

Body. Elongate, slightly flattened, elytra rather strongly narrowed posteriorly, covered with yellowish, elongate and decumbent setae.

Head. Eyes lateral, large, emarginate in front of antennal insertions, ratio of eye diameter to interocular space 1.0 : 1.3–1.5. Antennae filiform, when directed backwards exceeding the humeri of elytra. Scape cylindrical, wider than other antennomeres, pedicel short, antennomere III–XI somewhat clavate, XI longest, length ca 4.3–5.6 times maximum width. Length ratio of antennomeres as follows: 1.50 : 1.00 : 2.25 : 2.10 : 1.85 : 1.95 : 1.95 : 1.90 : 1.85 : 1.60 : 2.75. Apical maxillary palpomere securiform, apical margin moderately rounded, terminal angle somewhat obtuse. Surface lustrous, densely and coarsely punctate; interspaces slightly narrower than puncture diameter.

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Pronotum. Truncate anteriorly, bisinuate posteriorly, with obtuse median lobe, width ca 1.5 times length, ca 1.6–1.7 times as wide as head. Lateral sides slightly rounded and strongly narrowed in anterior two-thirds toward head, subparallel in posterior one-third, unmargined. Anterior angle rounded; posterior angle rectangular and obtuse. Disc slightly flattened medially, surface lustrous, densely and coarsely punctate; spaces between punctures smaller than puncture diameter. Scutellum with width ca 1.6–1.7 times length.

Elytra. Elongate, narrowed posteriorly, apex rounded, as wide as pronotal width at humeri, length ca 2.4–2.7 times width, surface lustrous. Disc covered with oval punctures, denser in lateral and basal part; interspaces wider than puncture diameter. Eight faint traces of striae in each elytron from dorsal view, stria I fused with II (Fig. 4C), gradually shortened outwards, only four traces of elytral striae present or extremely indistinct in some specimens. Prosternum before procoxae about as long as shortest diameter of procoxae. Prosternal process long, margined laterally, rounded and narrowed apically; length behind procoxae longer than width between procoxae. Width between procoxae ca 0.3 times transverse coxa diameter. Mesoventrite with shallow, oval mesoventral cavity, moderately punctate. Abdominal ventrite V subtruncate, with lateral sides somewhat rounded (Fig. 4I); sternite VIII concave in middle of apical edge, forming two roundly angular lobes on both sides, densely pubescent apically (Fig. 5F); sternite IX without spiculum gastrale on apical edge (Fig. 5O); tergite VIII without median strut on apical edge, rounded apically or slightly emarginate in middle, moderately pubescent apically (Fig. 5E); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5O).

Legs. Slender. Tarsomeres simple, tarsal formula 5-5-4. The longest spur of hind tibiae ca 0.3 times as long as first tarsal segment; length ratio of tarsomeres as follows: 2.35 : 1.00 : 0.55 : 0.85 (measured without claws). Claws simple.

Aedeagus (Fig. 6J–K). Lanceloate, basal piece curved dorsally, lateral sides narrowed basically. Parameres narrowly separated apically and with a groove in dorsal median part, lateral sides slightly sinuate, moderately narrowed apically, abruptly strongly narrowed at apex, length ca 3.5–3.9 times maximum width. Median lobe elongate, tapered, strongly narrowed apically in apical half.

Female (Fig. 3F)

Measurements. Length: 9.50–13.00 mm (11.50 in holotype); width: 2.25–3.25 mm.

Body. Similar to males.

Head. Eyes smaller than in male, ratio of eye diameter to interocular space 1.0 : 1.2–1.5 (1.49 in holotype). Antennae shorter in male, when directed backwards extending the posterior edge of pronotum, antennomere XI ca 2.9 times as long as maximum width. Length ratio of antennomeres as follows: 2.20 : 1.00 : 2.10 : 1.90 : 1.85 : 1.90 : 2.00 : 1.90 : 1.80 : 1.80 : 2.40.

Pronotum. Ca 1.5–1.6 times wider than length (1.5 in holotype), ca 1.5–1.6 times as wide as head.

Elytra. Slightly wider than in male, as wide as pronotal width at humeri, length ca 2.4–2.5 times width (2.6–2.7 in holotype).

Ovipositor. Paraproct elongate, ca 2.6–3.0 times length of coxite, sides straight and subparallel; proctiger subtruncate.

Remarks

In the original description, Nikitsky (1999) provided as diagnostic character the presence of faint striae only in apical part and illustrated it. This character together with the posteriorly narrowed elytra has been used in Hsiao (2015) and Hsiao *et al.* (2016) as comparative information to distinguish *S. formosana*.

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However, in the course of this study we discovered that the elytral striae are variable, noticeable on the entire elytron or even indistinct in some specimens. Elytral striae of synchroids are vague and difficult to observe accurately if the specimen is dry and not dissected, consequently it is possible that the elytral striae of the holotype have not been not observed correctly. After examining a large number of specimens, the shape of the elytra appears proved to be variable as well (length ca 2.4–2.7 times width). Therefore, we eliminate both inappropriate characters from the diagnosis and re-diagnose the differences between the species (see the detail in diagnosis and key).

Distribution

China (Sichuan, Shaanxi, Gansu) (Fig. 7).

Notes

This species was described based on a single female from Qingchengshan in Sichuan Province. On the basis of new available specimens *S. chinensis* is confirmed as a valid species, distributed in Shaanxi and Gansu province.

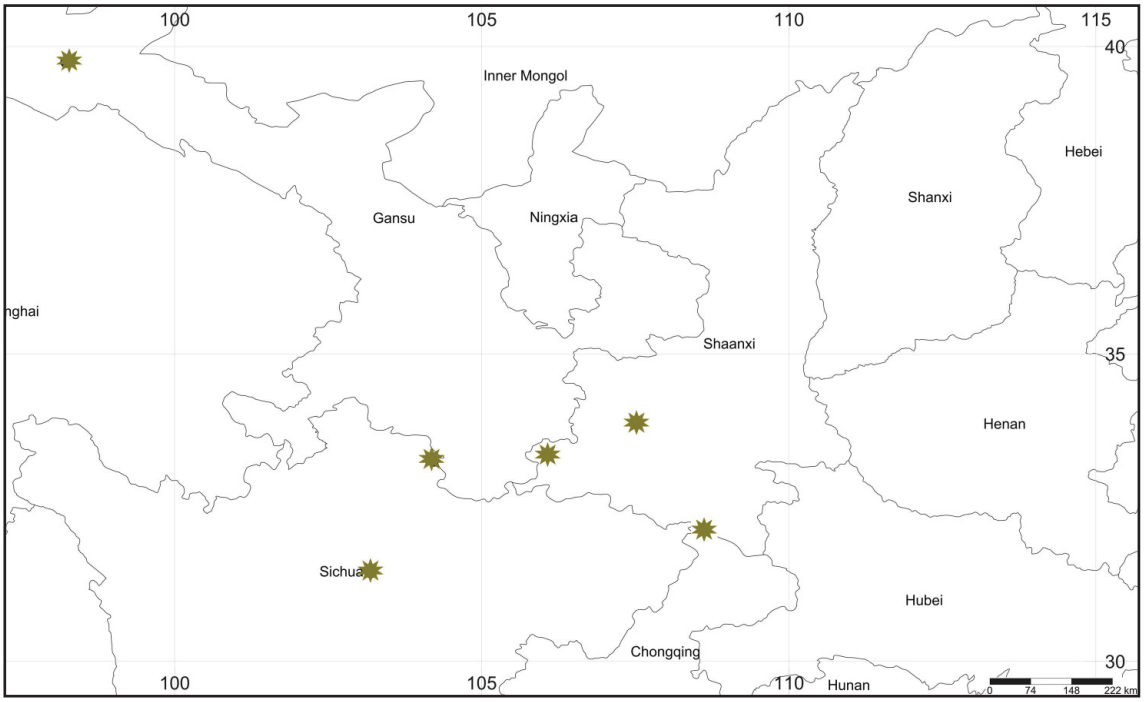

Fig. 7. Distribution map of *Synchroa chinensis* Nikitsky, 1999 from China.

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Synchroa formosana Hsiao, 2015
Figs 3G–H, 4D, J, 5G–H, P, 6L, 8

Synchroa formosana Hsiao, 2015: 244.

Diagnosis

This species is similar to *Synchroa chinensis* Nikitsky, 1999 in possessing unmargined lateral sides of pronotum, but can be distinguished by the following combination of characters: reddish-brown to brown body and legs; aedeagus: wider and more rounded paramere and wider basal part of median lobe.

Material examined

Holotype (Fig. 3G)
TAIWAN: ♂, Malunshan, 1167 m, 24°11′30″ N, 121°1′10″ E, 4 Apr. 2013, ex larva, Y. Hsiao leg. (NMNS).

Paratype
TAIWAN: 1 ex., same data as for holotype (NMNS).

Other material
TAIWAN: 1 ♀, Fushan, Ilan Co., 29 May 1995, light trap, site C, 2000, A. Warneke leg. (TFRI); 1 ♂, Tengchih, Kaoshiang, 18 Aug. 2008, C.-T. Yao leg. (TARI); 1 ♀, Ssumahsien Trail, Miaoli, 9 Jul. 2011, Y.-L. Lin leg. (TARI); 1 ♀, Fenchihu, Chiayi, 4 Sep. 2012, C.-F. Lee leg. (TARI); 1 ♂, Dalulintao [= Dalu Forest Trail], Wufeng, Hsinchu, 1 Jul. 2017, Y.-L. Lin leg. (YHC).

Supplementary description of male

Abdomen. Abdominal ventrite V subtruncate, with lateral sides somewhat rounded, terminal margin slightly emarginate in middle (Fig. 4J); sternite VIII concave in middle of apical edge, forming two roundly angular lobes on both sides, densely pubescent apically (Fig. 5H); sternite IX without spiculum gastrale on apical edge (Fig. 5P); tergite VIII without median strut on apical edge, emarginate in middle, moderately pubescent apically (Fig. 5G); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5P).

Supplementary description of female (Fig. 3H)

Maesurements. Length: 10.90–13.00 mm; width: 2.95–3.35 mm.

Body. Similar to males.

Head. Eyes smaller than in male, ratio of eye diameter to interocular space 1.0 : 1.6–2.0. Antennae shorter in male, when directed backwards extending the posterior edge of pronotum, antennomere XI ca 3.3–4.0 times as long as maximum width. Length ratio of antennomeres as follows: 2.00 : 1.00 : 2.30 : 2.00 : 2.10 : 2.00 : 1.90 : 2.00 : 2.10 : 2.00 : 2.85.

Pronotum. Ca 1.5 times as wide as length, ca 1.7–1.8 times as wide as head.

Elytra. Slightly wider than in male, as wide as pronotal width at humeri, length ca 2.6–2.7 times width.

Ovipositor. Paraproct elongate, ca 2.7–3.0 times length of coxite, sides straight and subparallel; proctiger subtruncate.

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Notes

Although this species was described as having elytral striae in the basal half of the elytron, we discovered that the elytral striae are noticeable on the entire elytron (Fig. 4D) or indistinct in some specimens. Besides, elytral striae on each elytron vary from 4–7 traces in this species. On the other hand, we examined one specimen having narrower apical half of paramere than the holotype (Fig. 6L). After examination of the external morphological characters and the median lobe of the aedeagus, and in consideration of the intraspecific variation of other synchroids, we herein conclude that it is conspecific with *S. formosana*.

Distribution

Taiwan (Fig. 8).

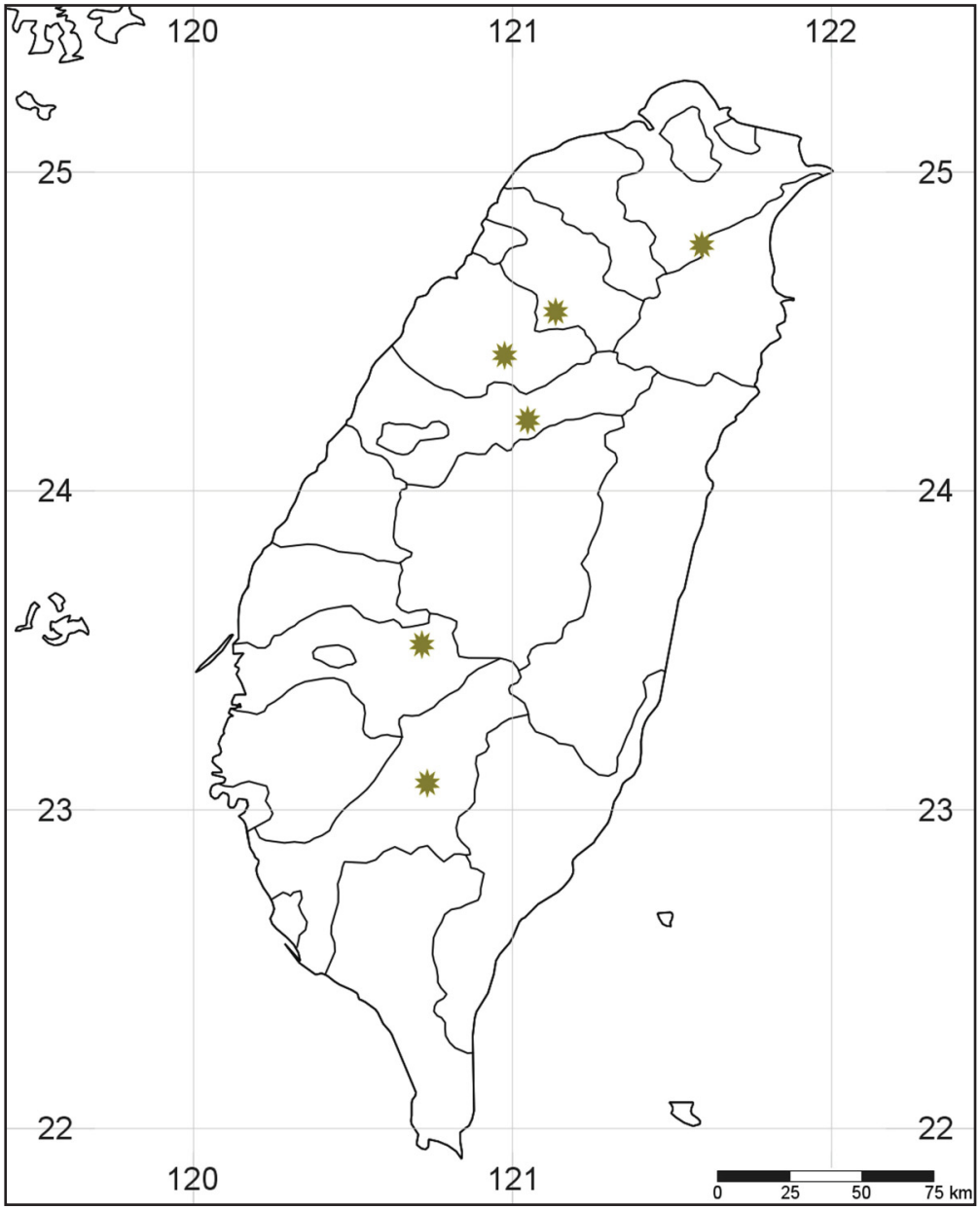

Fig. 8. Distribution map of *Synchroa formosana* Hsiao, 2015 from Taiwan.

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Synchroa elongatula Nikitsky, 1999
Figs 3I, 4E, K, 5I–J, Q, 6M–N

Synchroa elongatula Nikitsky, 1999: 476.

Diagnosis

This species resembles *Synchroa melanotoides* in pronotal structure, with lateral sides margined in posterior one-third to one-fourth, but it can be distinguished by its blackish brown antennae and legs; elongate and slender elytra; prosternal process narrowed apically; aedeagus: paramere wider, with lateral sides subparallel or sinuate. It is also similar to *S. formosana*, but differs in partially margined pronotum; aedeagus: basal part of median lobe narrower.

Material examined

LAOS: 1 ♂, Ban Satuei village env., 20°12′ N, 103°50′ E, Mt. Phu Pane, 1200–1900 m, Huaphanne prov. [= Houaphanh prov. in NE Laos], 1–20 May 2014, St. Jakl and Lao leg. (OKZC).

Supplementary description of male from Laos (Fig. 3I)

Measurements. Length: 11.50 mm (10.00–11.00 in type series); width: 3.00 mm.

Head. Ratio of eye diameter to interocular space 1.0 : 1.6 (1.41–1.49 in type series). Antennomere XI ca 3.0 times as long as maximum width. Length ratio of antennomeres as follows: 1.65 : 1.00 : 2.10 : 1.95 : 1.50 : 1.50 : 1.40 : 1.50 : 1.55 : 1.50 : 2.20.

Pronotum. Ca 1.5 times wider than length, ca 1.7 times as wide as head.

Elytra. Ca 3.0 times as long as maximum width. Seven faint traces of striae in each elytron from dorsal view, stria I fused with II (Fig. 4E), gradually shortened outwards. Prosternal process long, margined laterally, rounded and narrowed apically; length behind procoxae longer than width between procoxae. Mesoventrite with shallow, oval mesoventral cavity, moderately punctate. Abdominal ventrite V truncate, with lateral sides rounded (Fig. 4K); sternite VIII concave in middle of apical edge, forming two roundly angular lobes on both sides, densely pubescent apically (Fig. 5J); sternite IX without spiculum gastrale on apical edge (Fig. 5Q); tergite VIII without median strut on apical edge, rounded apically, densely pubescent apically (Fig. 5I); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5Q).

Aedeagus (Fig. 6M–N). Lanceloate, basal piece curved dorsally, lateral sides narrowed basically. Parameres narrowly separated apically and with a groove in dorsal median part, lateral sides distinctly widened in middle, length ca 3.2 times maximum width. Median lobe elongate, tapered, strongly narrowed apically in apical half.

Notes

In the original description, this species was mentioned as having striae only in the apical part of the elytral suture. However, we discovered extremely indistinct elytral striae on this specimen. Together with our analysis of this character, it is possible that the elytral striae of the type series are too faint to observe or this character varies from absent to indistinct within this species. On the other hand, although most of the characters are in accordance with the original description, the parameres of this specimen are different from the illustration given in Nikitsky (1999) by its distinctly widened lateral sides and narrower dorsal groove, which implies that it could belong to another taxon new to science. Considering the insufficient material, intraspecific variation within other species and geographic distribution, we herein regard this specimen as representing a variation of *S. elongatula* instead of giving it a new taxonomic status.

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Distribution

Vietnam; Laos, new record.

Genus ***Synchroina*** Fairmaire, 1898

Synchroina Fairmaire, 1898: 399. Type species: *Synchroa tenuipennis* Fairmaire, 1898, by monotypy.

Diagnosis

This genus is similar to *Synchroa* and *Thescelosynchroa* gen. nov.; the differential diagnosis is given in Table 2.

Synchroina tenuipennis Fairmaire, 1898
Figs 3J–K, 4F, L, 5K–L, R, 6O–P, 9

Synchroina tenuipennis Fairmaire, 1898: 399.
Synchroa malaccana Pic, 1917: 14.

Diagnosis

This species resembles *Synchroina cuneata* (Champion, 1916), but can be distinguished by the following combination of characters: elytra densely and coarsely punctate, spaces between punctures mostly less than 0.5 times puncture diameter; sutural stria on elytra shallower; aedeagus: basal piece ca 0.7–0.9 times parameres (Champion 1916; Nikitsky 1999).

Material examined

MALAYSIA: 1 ♂, Korbu mt., Banjaran Titi Wangsa mts, 25 km NE of IPOH, Perak, 1200 m, 27 Jan.–2 Feb. 1999, P. Čechovský leg. (OKZC); 1 ♂, Korbu mt., Banjaran Titi Wangsa mts, 25 km NE of IPOH, Perak, 1200 m, 1–15 Apr. 2000, P. Čechovský leg. (OKZC); 1 ♀, Tanah Rata env., gun. Jasar, Cameron Highlands, Pahang distr., 04°28.25′ N, 101°22.43′ E, 1450–1650 m, 14 Mar.–7 Apr. 2011, R. Hergovits leg. (OKZC); 2 ♂♂, 1 ♀, Mt. Noring Timur, 150 km S of Jeli, Kg. Tunku, Kelantan, 1200 m, 21 Feb.–14 Mar. 2013, P. Čechovský leg. (OKZC); 1 ♂, Kampong Perias, Mt. Chamah, 70 km NW of Gua Musang, Kelantan, 1900 m, 17 Apr.–9 May. 2014, P. Čechovský leg. (OKZC).

INDONESIA: 1 ♂, Solok, W. Sumatra, Sep. 1995, unknown collector (OKZC); 1 ♀, Haratai env., Loksado, 2°46′58″ S, 115°33′19″ E, S Kalimantan, 13–17 Oct. 2014, R. Gabriš leg. (OKZC).

Redescription

Colour. Body and legs reddish-brown to blackish-brown.

Male (Fig. 3J)
Measurements. Length: 6.50–9.25 mm; width: 1.50–2.25 mm.

Body. Elongate, slightly flattened, elytra rather strongly narrowed posteriorly, covered with yellowish, elongate and decumbent setae.

Head. Eyes lateral, large, emarginate in front of antennal insertions, ratio of eye diameter to interocular space 1.0 : 1.8–2.0. Antennae filiform, when directed backwards exceeding the humeri of elytra. Scape cylindrical, wider than other antennomeres, pedicel short, antennomere III–XI somewhat clavate, XI longest, length ca 3.5–4.4 times maximum width. Length ratio of antennomeres as follows: 1.65 : 1.00 : 2.25 : 2.10 : 1.90 : 2.00 : 2.05 : 2.05 : 2.10 : 1.90 : 2.50. Apical maxillary palpomere securiform,

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apical margin rounded, terminal angle somewhat obliquely truncate. Surface lustrous, densely and coarsely punctate; interspaces slightly narrower than puncture diameter.

Pronotum. Truncate anteriorly, bisinuate posteriorly, with obtuse median lobe, width ca 1.5 times length, ca 1.4–1.5 times as wide as head. Lateral sides slightly rounded and moderately narrowed in anterior two-thirds toward head, subparallel in posterior one-third, shortly margined basally. Anterior angle rounded; posterior angle rectangular and obtuse. Disc slightly flattened medially, surface lustrous, densely and coarsely punctate; spaces between punctures smaller than puncture diameter. Scutellum width ca 1.5–1.9 times length.

Elytra. Elongate, narrowed posteriorly, apex rounded, as wide as pronotal width at humeri, length ca 2.6 times width, surface lustrous. Disc covered with oval punctures, denser in lateral and basal part; interspaces narrower as long as or slightly wider than puncture diameter. 4–8 faint traces of striae in each elytron from dorsal view, stria I fused with II (Fig. 4F), gradually shortened outwards, elytral striae indistinct in some specimens. Prosternum before procoxae about as long as shortest diameter of procoxae. Prosternal process long, margined laterally, rounded and narrowed apically; length behind procoxae longer than width between procoxae. Width between procoxae ca 0.4 times transverse coxa diameter. Mesoventrite with shallow, oval mesoventral cavity, smooth. Abdominal ventrite V truncated apically, with terminal margin serrate and slightly concave, serrations at both sides larger than in middle, lateral sides nearly straight (Fig. 4L); sternite VIII concave in middle of apical edge, forming two horn-shaped lobes curved inwards on both sides, densely pubescent apically (Fig. 5L); sternite IX without spiculum gastrale on apical edge (Fig. 5R); tergite VIII without median strut on apical edge, subtruncated apically, emarginate in middle, densely pubescent apically (Fig. 5K); tergite IX and X completely fused, rounded apically, densely pubescent on apical edge (Fig. 5R).

Legs. Slender. Tarsomeres simple, tarsal formula 5-5-4. The longest spur of hind tibiae ca 0.2 times as long as first tarsal segment; length ratio of tarsomeres as follows: 2.50 : 1.00 : 0.50 : 0.75 (measured without claws). Claws serrate.

Aedeagus (Fig. 6O–P). Lanceloate, basal piece curved dorsally, lateral sides narrowed basically. Parameres narrowly separated apically, with inner margin narrowly concave, dorsal median part with a groove, lateral sides subparallel, slightly sinuate, strongly narrowed at apex, length ca 3.1–3.5 times maximum width. Median lobe elongate, clavate, slightly narrowed apically.

Female (Fig. 3K)

Measurements. Length: 8.00–9.25 mm; width: 2.00–2.25 mm.

Body. Similar to males.

Head. Eyes smaller than in male, ratio of eye diameter to interocular space 1.0 : 1.6–1.9. Antennae shorter in male, when directed backwards extending the posterior edge of pronotum, antennomere XI ca 3.2 times as long as maximum width. Length ratio of antennomeres as follows: 2.00 : 1.00 : 2.30 : 2.20 : 2.05 : 2.10 : 2.05 : 2.05 : 2.10 : 2.10 : 2.90.

Pronotum. Ca 1.5 times wider than length, ca 1.5 times as wide as head.

Elytra. Slightly wider than in male, as wide as pronotal width at humeri, length ca 2.5–2.6 times width.

Ovipositor. Paraproct elongate, ca 2.6–2.8 times length of coxite, sides straight and subparallel; proctiger subtruncate.

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Distribution

Malaysia; Indonesia (West Sumatra, South Kalimantan), new record (see below) (Fig. 9).

Notes

This species was described based on specimens from "Perak, Sumatra" (Fairmaire 1898); however, Nikitsky (1999) mentioned that only "Perak" was written on the label, and there is no locality in Sumatra called Perak; it is in Malaysia. During our study *S. tenuipennis* is newly recorded for Indonesia, based on two specimens from West Sumatra and South Kalimantan, respectively.

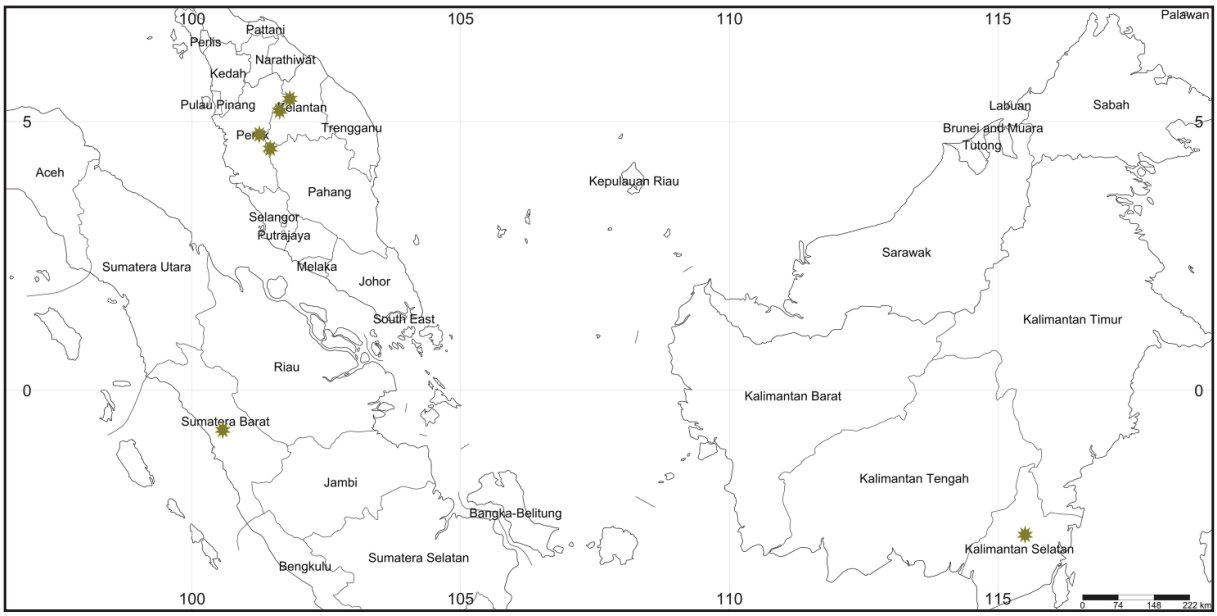

Fig. 9. Distribution map of *Synchroina tenuipennis* Fairmaire, 1898 from Malaysia and Indonesia.

Genus ***Thescelosynchroa*** gen. nov.
urn:lsid:zoobank.org:act:88962476-A4E1-4040-95E5-E2E4E314CDB0

Type species

Synchroa pangu Hsiao, Li, Liu & Pang, 2016, here designated.

Diagnosis

This genus is similar to *Synchroa* and *Synchroina*; the differential diagnosis is given in Table 2.

Etymology

The genus name is composed of the Greek prefix '*Thescelos*', meaning 'marvellous, wonderful' and the root -*synchroa* derived from the type genus of Synchroidae. It is feminine in gender.

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Description

Male

Body. Elongate, slender, slightly flattened, elytra rather strongly narrowed posteriorly.

Head. Eyes lateral, large, emarginate in front of antennal insertions. Antennae filiform, when directed backwards exceeding the humeri of elytra. Scape cylindrical, wider than other antennomeres, pedicel short, antennomere III–XI somewhat clavate, XI longest. Apical maxillary palpomere securiform, apical margin moderately rounded, terminal angle somewhat obtuse.

Pronotum. Truncate anteriorly, bisinuate posteriorly, with obtuse median lobe. Lateral sides rounded and narrowed in anterior two-thirds toward head, subparallel in posterior one-third. Anterior angle rounded; posterior angle rectangular and obtuse.

Elytra. Elongate, narrowed posteriorly, wider than pronotum at humeri (e.g., 1.2 times in holotype of type species). Prosternal process complete, broad, extending well beyond procoxae. Mesoventrite with shallow, oval mesoventral cavity, punctate.

Legs. Slender. Tarsomeres simple, tarsal formula 5-5-4. Claws simple.

Aedeagus. Lanceloate. Parameres fused together forming apicale, narrowly separated apically and with a groove in dorsal median part. Median lobe long, slender and clavate, extending from the tegmen in natural condition.

Female

Unknown.

Thescelosynchroa pangu (Hsiao, Li, Liu & Pang, 2016) gen. et comb. nov.
Figs 3L, 6Q–R

Synchroa pangu Hsiao, Li, Liu & Pang, 2016: 596.

Material examined

Holotype (Fig. 3L)

CHINA (mainland): ♂, Sichuan prov., Ya'an, Tianquan, Labahe, 1500–2500 m, 8–9 Jul. 2012, Living [= Yun Li, Sun Yat-Sen University, Guangzhou, China] and M.-C. Chen leg. (SYSBM).

Description

See details in Hsiao *et al.* (2016).

Notes

Two errata were present in the original description and are corrected as follows: (1) the ventral view of aedeagus was misplaced as dorsal view in figures 6–8; (2) transverse coxal diameter is 4.38 times width between fore coxae, rather than the width between fore coxae 4.38 times transverse coxa diameter.

Distribution

China (Sichuan).

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Discussion

The division of Synchroidae into four major clades was mostly consistent with the current generic classification except *Synchroa pangu* (Fig. 10), which can be easily distinguished from other synchroids as summarized by Hsiao *et al.* (2016). Although this morphologically distinctive species was attributed to *Synchroa*, based on a previously established generic classification, the shape of the median lobe of the aedeagus of *S. pangu* suggests its relation with *Synchroina*. Apart from its unique characteristics, which make a possible placement in *Synchroa* or *Synchroina* difficult, the monophyly of this species as a distinct lineage is supported in our cladistic analysis. Therefore, we herein separate this species to propose a new genus.

Monophyly of Synchroidae has not been rigorously tested in this analysis, but based on previous research (Lawrence & Newton 1995; Nikitsky 1999; Lawrence *et al.* 1999; Young 2002; Ślipiński & Lawrence 2010), this group is mostly treated as a distinct family. Our phylogenetic analysis supports the monophyletic Synchroidae excluding *Mallodrya subaenea*. *Mallodrya subaenea* was originally placed in Melandryidae (Horn 1888) and shares several characters with some stenotrachelid and melandryid species, such as very short or absent interfacetal setae; a margined posterior pronotal edge; the prosternal process extending before posterior edges of coxae; the slightly projecting procoxae; the mesoventral cavity absent; the mesocoxae partly confluent; the mesometaventral junction absent. It implies that this species may be more related to these two families. The systematic placement of *M. subaenea* is possibly inappropriate and should be re-evaluated. Nevertheless, we herein chose not to exclude it from Synchroidae without a further examination of the adult genital organs, and larval characters and a comprehensive phylogenetic study of Tenebrionoidea.

The historical biogeography and speciation of synchroa bark beetles remain unclear. On the one hand, the Eastern Asian-North American disjunction (EA-NA disjunction) is present in the distribution pattern of the nominal genus. Given the greater species diversity, it implies that the area from Eastern Asia to northern Indochina could be the centre of origin of this group, especially Northwest China (Shaanxi, Gansu) to Southwest China (Sichuan) as well as northern Vietnam and Laos. This suggests the species

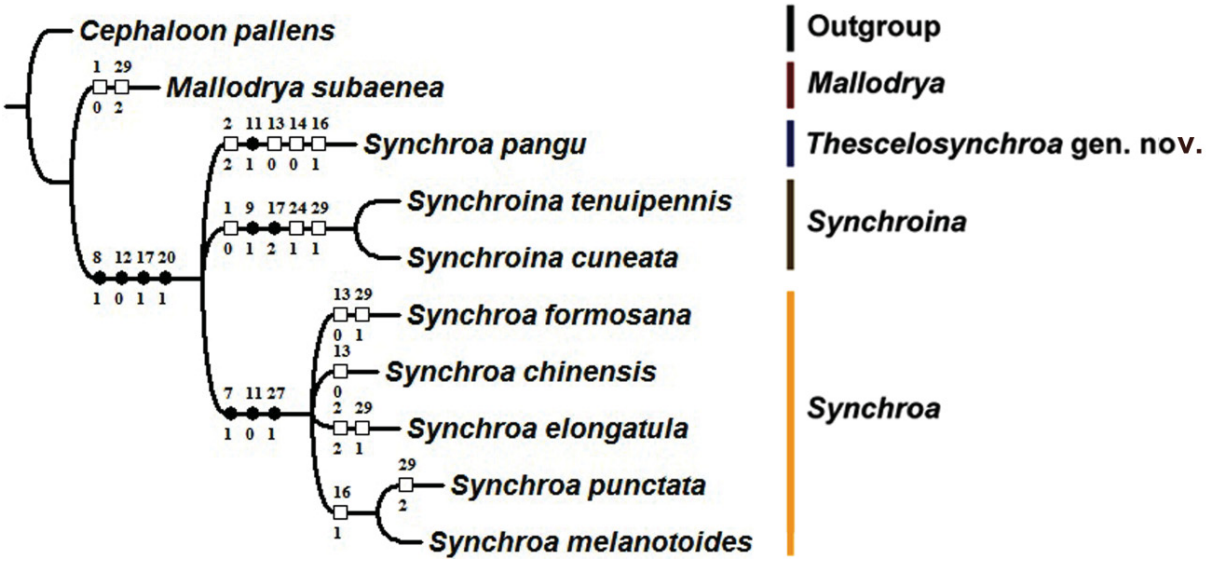

Fig. 10. Phylogenetic reconstruction of Synchroidae. Majority consensus tree with characters mapped on branches using unambiguous character changes in WinClada. Tree length = 54; Consistency Index = 81; Retention Index = 61.

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diversification in Asia and dispersal of a branch to America is comparable in some cases of butterflies (Mullen 2006; Vila *et al.* 2011). The previous studies on the EA-NA disjunction primarily utilized plants as model organisms and the timing of most disjunctions could be dated to less than 30 Ma (Mid-Late Tertiary), which suggests vicariance over the Bering Land Bridge (Wen 1999; Sanmartin *et al.* 2001; Donoghue & Smith 2004; Ren *et al.* 2013). The studies of insects distributed in EA and NA, such as swallowtail butterflies of the *Papilio elwesi* species-group, support a dispersal route of the ancestor to Eurasia via the Bering Land Bridge (BLB) (Wu *et al.* 2015), and the cases of aphids and leaf beetles reveal a consistent biogeographic pattern with their host plants, highlighting the significance of host distribution for diversification (von Dohlen *et al.* 2002; Sota *et al.* 2008; Ren *et al.* 2013). Apart from its diversification in Eastern Asia, no species have been recorded in the western Palaearctic region. Given the wood-feeding on cambium of decaying deciduous trees during the immature stage (Payne 1931; Young 1991; Majka & Pollock 2006) and the fossil record from the Late Eocene Florissant Formation of Colorado (34.07 ± 0.10 Ma, Evanoff *et al.* 2001), which corresponds to closure of the BLB, it is likely that the EA-NA disjunction of *Synchroa* could also be related to plant migration through BLB during Tertiairy climate change, although synchroids are not specialized phytophagous insects such as aphids and the classification of the Eocene *S. quiescens* Wickham, 1911 may require reevaluation.

On the other hand, the endemic genus *Synchroina* of West Malesia (i.e., the area west of Wallace's line), possibly originated from the route through the Indo-Chinese peninsula, as is the case for most plants and animals distributed in this area (Turner *et al.* 2001).

However, due to a lack of recognized synapomorphies in the phylogenetic analysis, the relationships among the members of this family are not well resolved, which results in difficulties proposing a biogeographic scenario to explain their distribution pattern and evolution. A molecular approach could solve the problem of insufficient characters to give a higher resolution to the relationships and date the timing of *Synchroa* disjunction. Further studies of phylogeny and historical biogeography are badly needed and will give insight into the evolutionary history of Synchroidae.

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