



A review of the genus *Satonius* Endrödy-Younga from China with description of seven new species (Coleoptera: Myxophaga: Torridincolidae)

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Abstract

Species of the genus *Satonius* Endrödy-Younga from China are briefly reviewed. Seven new species are described: *Satonius cheni* sp. nov. from Guangdong, *Satonius nigriventralis* sp. nov. from Shaanxi, *Satonius panghongae* sp. nov. from Jiangxi, Hunan, Guangxi and Zhejiang, *Satonius quzhouensis* sp. nov. from Zhejiang and Anhui, *Satonius xinhuiensis* sp. nov. from Guangdong, *Satonius zhangii* sp. nov. from Hunan, and *Satonius zhenhuai* sp. nov. from Hubei. Species diagnoses of the new species are provided, along with images of the habitus and illustrations of the aedeagus and metatrochanters for all available Chinese species. Additionally, further faunistic data of known Chinese species is supplemented. A key to all known species of the genus is also included.

Key words: taxonomy, Torridincolidae, *Satonius*, new species, China, Sino-Japanese realm

Introduction

Torridincolidae is a family of aquatic beetles in the suborder Myxophaga. With 54 described species in seven genera (Shepard *et al.* 2013; Benetti & Hamada 2016; Sampaio & Ferreira 2014, 2018; Sampaio & Short 2018; Perkins & Bergsten 2019; Bergsten 2022; Bilton & Mlambo 2023), it is the largest of four extant Myxophaga families. Torridincolids are known from Central and Southern Africa, Madagascar, Central and Northern South America, Japan and China. They mostly live in seasonal mountain streams, hygropetric habitats or spray zones of waterfalls (Beutel & Vanin 2016).

The genus *Satonius* Endrödy-Younga was established by Endrödy-Younga (1997) based on a single Japanese species described as *Delevea kurosawai* Satô, 1982. *Satonius* is similar to South African *Delevea* Reichardt, 1976, but can be distinguished by the sharply crested mesocoxal edge of metaventrite, a large discal emargination on the apical tergite of females (Endrödy-Younga 1997). Currently, *Satonius* is known to occur in Japan and China, and it is the sole genus of Torridincolidae found in China. Jäch (1998) first reported the occurrence of this genus in China, followed by a revision conducted by Hájek & Fikáček (2008), who described three new species. Subsequently, two more species were reported from China (Hájek *et al.* 2011).

Recently, a significant amount of *Satonius* material collected from China was examined by the authors at Sun Yat-sen University and the Institute of Zoology, Chinese Academy of Sciences, among which seven undescribed species were discovered – they are formally introduced/named in the present paper.

Material and Methods

Representative specimens of each species were dissected, and male genitalia were mounted in a drop of glycerol on transparent plastic slides for examination and photography. Photographs of habitus were taken by using a Nikon SM225 Microscope. Drawings of male genitalia and metatrochanters were prepared using software Adobe Illustrator 2023 based on light microscope and SEM images. Photographs of male genitalia were taken with a Zeiss Scope A1 Microscope and SEM photographs of hind trochanters were taken with a Phenom Prox scanning electronic microscope respectively. The distributional map was created on <https://www.simplemappr.net>. The plates were created and processed using Adobe Photoshop 2023.

Morphological terminology largely follows Hájek & Fikáček (2008), with only diagnostic characters mentioned. Body colour and shape of metatrochanter were added as new diagnostic characters, as they were found useful in identifying some of the new species. Most labels were written in Chinese and translated into English, with location information in Chinese included within square brackets “[]”. The abbreviation of collections listed below are as follows:

SYSU	Entomological collection of Sun Yat-sen University, Guangzhou, China
IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing China
NMPC	National Museum, Prague, Czech Republic
BMNH	The Natural History Museum [former British Museum], London, UK
CNCO	Canadian National Collections, Ottawa, Canada
EUMJ	Ehime University Museum, Matsuyama, Japan
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
NHMW	Naturhistorisches Museum Wien, Austria
ZSMC	Zoologische Staatssammlung, München, Germany
CASS	Chinese Academy of Sciences, Institute of Applied Ecology, Shenyang, China

Taxonomy

Satonius cheni sp. nov.

Chinese common name: 陈氏佐藤淘甲
(Figs 1E, 3E, 4C, 6A, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Guangdong, Danxiashan, Jinshiyan [广东丹霞山锦石岩], 2012.VI.8, leg. Jia Fenglong. **PARATYPES:** CHINA: **Guangdong:** 52 exs. (SYSU) same data as holotype; 42 exs. (SYSU) Guangdong, Danxiashan, Xianglong Lake [广东丹霞山翔龙湖], on wet cliff, 2012.VI.8, leg. Jia Fenglong; 1 ex. (SYSU) Guangdong, Danxiashan, Elder Peak [广东丹霞山长老峰], 2012.VI.8, leg. Jia Fenglong; 48 exs. (NMPC) CHINA, GUANGDONG Prov., Danxia Shan NP, 23.+26.iv.2013, Xianglong lake (wet rock) [广东丹霞山翔龙湖], 25°01.244'N, 113°44.342'E, 98 m, J.Hájek & J.Růžička leg.; 190 exs. (NMPC, SYSU) Guangdong, Danxiashan, Xianglong Lake [广东丹霞山翔龙湖], on wet cliff, 2011.VII.22, leg. Jia Fenglong; 217 exs. (NMPC, SYSU) Guangdong, Danxiashan, Jinshiyan [广东丹霞山锦石岩], on wet cliff, 2011.VII.22, leg. Jia Fenglong; 62 exs. (SYSU) Guangdong, Danxiashan, Jinshiyan [广东丹霞山锦石岩], 2012.IV.22, leg. Jia Fenglong, Liao Junlei; 17 exs. (SYSU) Guangdong, Shaoguan, Danxiashan [广东韶关丹霞山], 2013.IV.23–26, leg. Jia Fenglong; 32 exs. (SYSU) Shaoguan, Danxiashan, Jinshiyan [广东丹霞山锦石岩], 2012.VIII.28, leg. Jia Fenglong.

Diagnosis. Very small, broad and convex species, body 1.2–1.4 mm in length, 0.8–0.9 mm in width. Dorsal side brown to dark brown, ventral side reddish brown in colour (Figs 1E, 3E). Side of pronotum slightly rounded, narrowly bordered. Lateral margin of elytra visible only in humeral part from above (Fig. 1E). The majority of individuals are micropterous, and only a minority of individuals are macropterous. Apical angle of metatrochanter evidently extended (Fig. 6A).

Male genitalia (Fig. 4C). Median lobe fairly broad, with apical portion bent dorsad; parameres narrow, rather long, ca. half as long as median lobe, with four long apical setae and two long subapical setae, lateral side of parameres with a wide field of pores basally.

Differential diagnosis. This species is closely related to *Satonius jaechi* Hájek, Yoshitomi, Fikáček, Hayashi & Jia, 2011. There are only a few minor differences in the apical angle of metatrochanter and male genitalia between

the two species. Apical angle of metatrochanter in this species is evidently extended (Fig. 6A), while not extended or only slightly extended in *S. jaechi* (Fig. 6B). Median lobe of male genitalia in this species is a little broader than that in *S. jaechi*, with apical part that bends dorsad slightly shorter (Fig. 4C). Besides, parameres are longer in this species.

Biology. Collected in hygropetric habitats on wet cliffs. At Xianglong Lake, it was found together with larvae of hygropetric diving beetle *Hydrotrupes chinensis* Nilsson, 2003 (Alarie *et al.* 2019). Dissection showed that some females bear two eggs within their abdomen, indicating they may lay two eggs at a time.

Distribution. Only known from several close spots in type locality (Danxiashan Mt., Guangdong) (Fig. 10).

Etymology. This species is dedicated to Mr. Zaixiong Chen (陈再雄) (Administrative Office of Danxiashan National Natural Reserve, Shaoguan, China), for his generous help in material collecting.

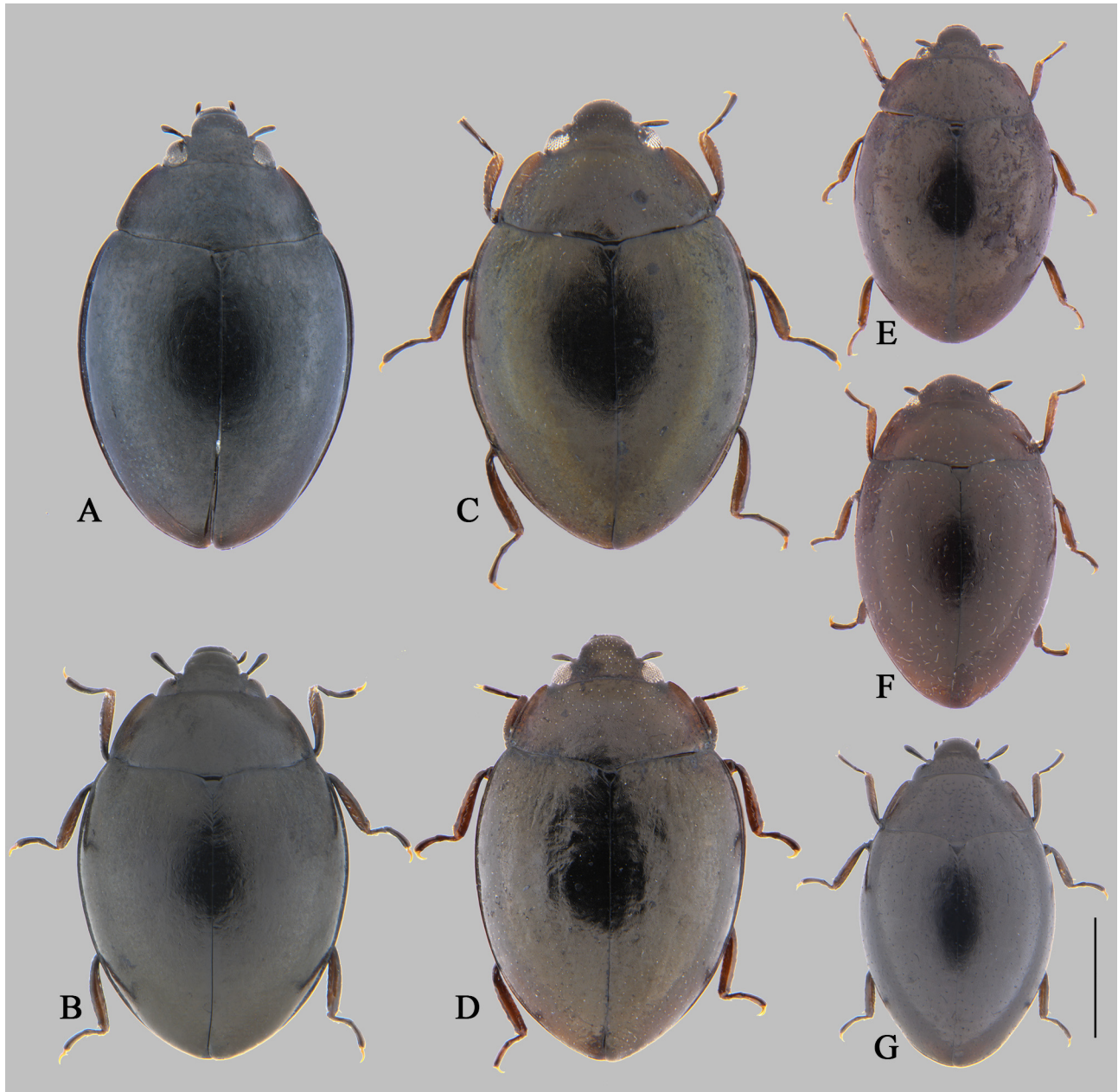


FIGURE 1. Dorsal habitus of new species. **A.** *Satonius nigriventralis* sp. nov. **B.** *Satonius quzhouensis* sp. nov. **C.** *Satonius zhangji* sp. nov. **D.** *Satonius zhenhuai* sp. nov. **E.** *Satonius cheni* sp. nov. **F.** *Satonius panghongae* sp. nov. **G.** *Satonius xinhuiensis* sp. nov. Scale bar = 0.5 mm.

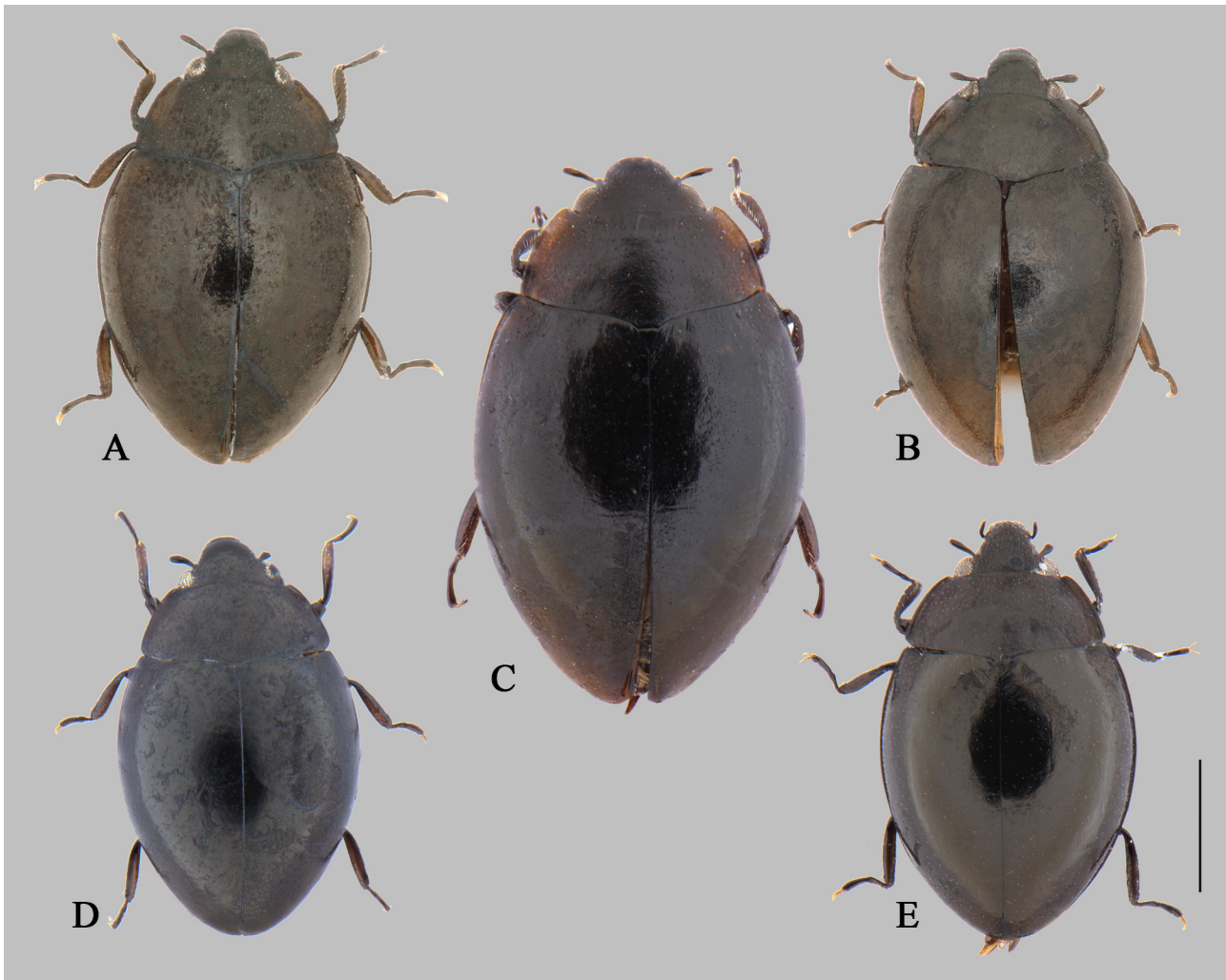


FIGURE 2. Dorsal habitus of species described before. **A.** *Satonius fui* (paratype). **B.** *Satonius schoenmanni* (holotype). **C.** *Satonius stysi*. **D.** *Satonius jaechi* (paratype). **E.** *Satonius wangi*. Figures A and B were taken by Mr. Zuqi Mai in NMPC. Scale bar = 0.5 mm.

***Satonius nigriventralis* sp. nov.**

Chinese common name: 黑腹佐藤淘甲
(Figs 1A, 3A, 4E, 6C, 7A–B, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Shaanxi, Qinling Mountains, Shibazhang Waterfall [陕西秦岭十八丈瀑布], spray zone of the waterfall, 33°25'12"N, 108°21'39"E, 1600m, 2013.VIII.14–15, leg. Ruan Yongying. **PARATYPES: CHINA: Shaanxi:** 6♀♀ (SYSU) same data as holotype; 45 exs. (IZCAS, NMPC) Shaanxi, Hanzhong Prefecture, Yang County, Huayang Town [陕西汉中市洋县华阳镇], 33°35'22"N, 107°32'29"E, 1094m, 2021.VII.21, leg. Jin Chen & Yuan Feng.

Diagnosis. Small, fairly elongate and convex species, body 1.4–1.8 mm in length, 0.7–0.9 mm in width. Dorsal and ventral sides pitch-black with dull violet sheen (Figs 1A, 3A). Side of pronotum rounded, broadly bordered. Lateral margin of elytra broad, widest in humeral part, narrowed posteriorly, visible throughout the elytra except for apex from above (Fig. 1A). Macropterous species. Apical angle of hind trochanter evidently extended and prolonged into a round appendix (Fig. 6C).

Male genitalia (Fig. 4E). Similar to that of *Satonius schoenmanni* Hájek & Fikáček, 2008. Median lobe of aedeagus with dorsal side slightly rounded in basal two thirds, straight in apical third; ventral side slightly concave in a smooth line, apically with a minute hook. Parameres rather wide, with four to five long setae apically, base with a long field of pores along ventral surface.

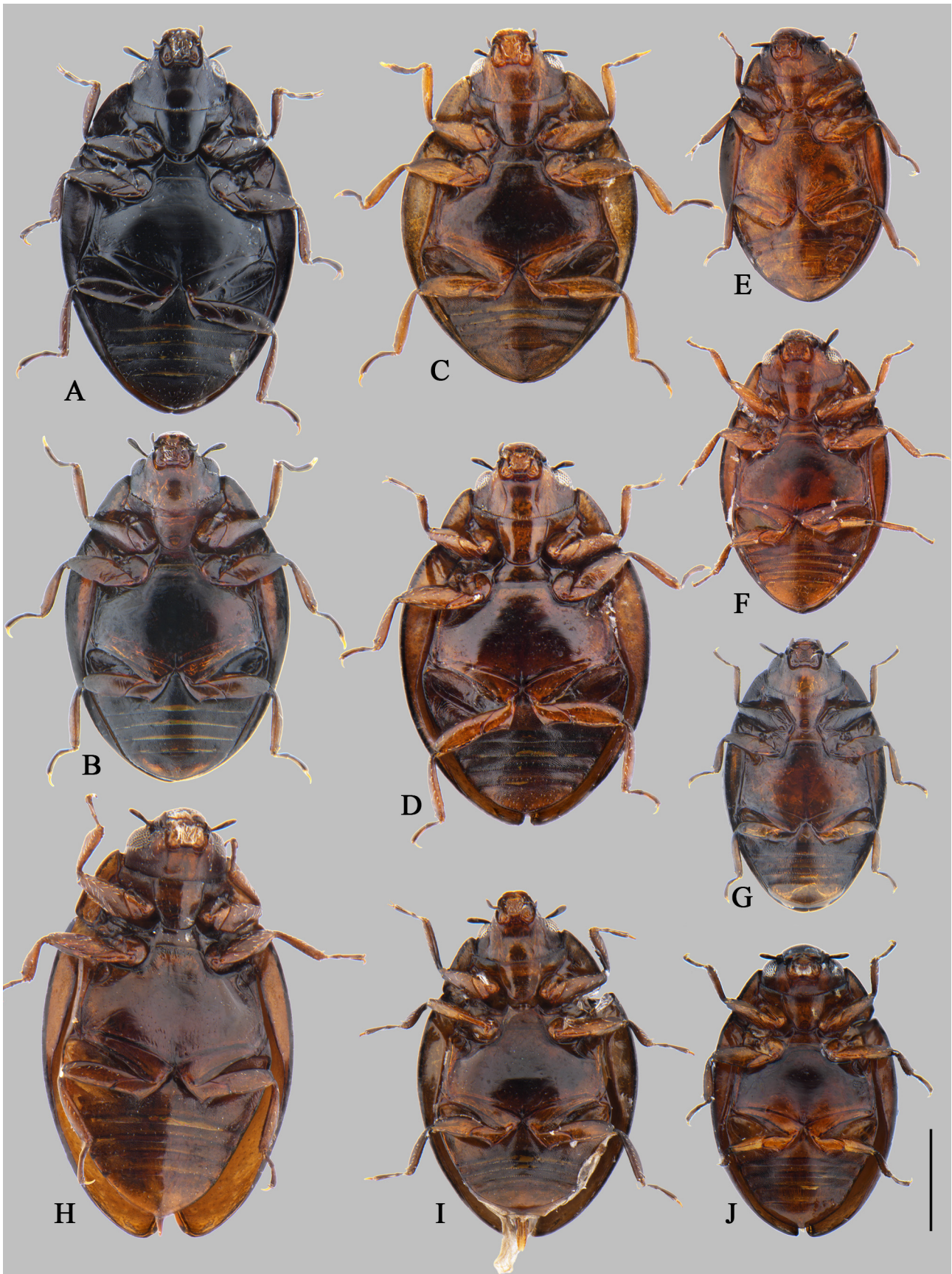


FIGURE 3. Ventral habitus of species. **A.** *Satonius nigriventralis* sp. nov. **B.** *Satonius quzhouensis* sp. nov. **C.** *Satonius zhang* sp. nov. **D.** *Satonius zhenhuai* sp. nov. **E.** *Satonius cheni* sp. nov. **F.** *Satonius panghongae* sp. nov. **G.** *Satonius xinhuiensis* sp. nov. **H.** *Satonius stysi*. **I.** *Satonius wangi*. **J.** *Satonius jaechi* (paratype). Scale bar = 0.5 mm.

Differential diagnosis. This species can be easily distinguished from other species by its ventral colour and lateral margin on elytra. The ventral side is completely pitch black in this species, while reddish to brown in other known species. Lateral margin of elytra in this species is broad and visible throughout the elytra from dorsal view, which also distinctly differs from other species. The male genitalia of this species are very similar to *S. schoenmanni*, but it can be easily distinguished from the latter by habitus morphology mentioned above.

Biology. Collected from spray zones of a waterfall as well as hygropetric habitats on wet cliffs (Fig. 7A). Some individuals coexisted with caddisfly larvae *Stactobia* sp. [滴水小石蛾属] (Trichoptera: Hydroptilidae) and sometimes hide under the cases of the larvae (Fig. 7B). Dissection showed that some females bear two or three eggs within their abdomen.

Distribution. Only known two spots in type locality (Qinling Mts., Shaanxi) (Fig. 10).

Etymology. The specific name is derived from the Latin adjectives “*niger, -a, um*” (= black) and “*ventralis*” (=ventral), referring to the pitch-black ventral colour of this species.

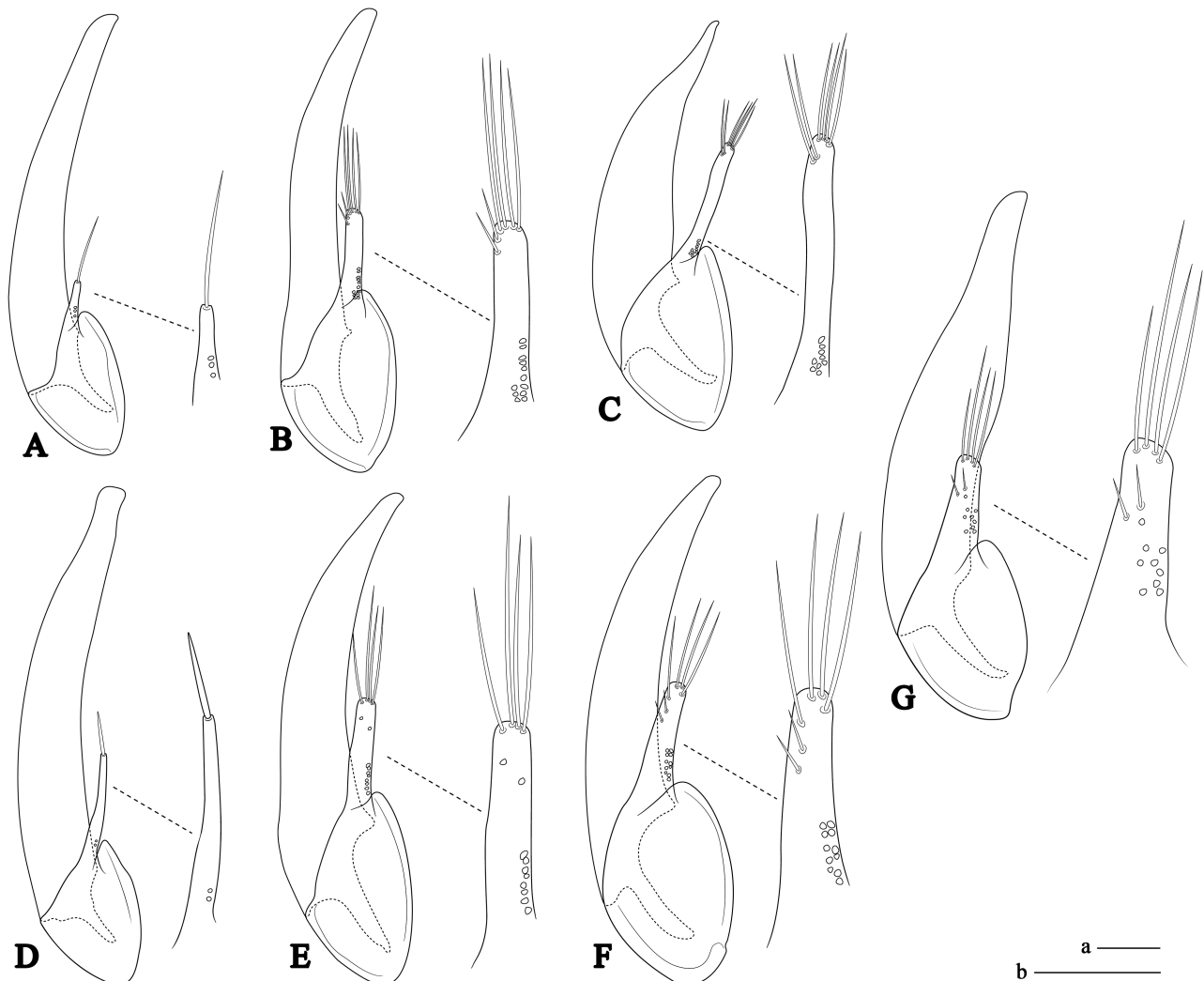


FIGURE 4. Aedeagus and details of parameres of new species in lateral view. **A.** *Satonius panghongae* sp. nov. **B.** *Satonius quzhouensis* sp. nov. **C.** *Satonius cheni* sp. nov. **D.** *Satonius xinhuiensis* sp. nov. **E.** *Satonius nigriventralis* sp. nov. **F.** *Satonius zhangji* sp. nov. **G.** *Satonius zhenhuai* sp. nov. Scale bars = 50 μ m, a – aedeagus; b - detail of paramere.

***Satonius panghongae* sp. nov.**

Chinese common name: 庞虹佐藤淘甲
(Figs 1F, 3F, 4A, 6D, 8A–B, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Jiangxi, Jianggangshan Mt., main peak [江西井冈山主峰], 605m, 2011.IV.29, leg. Jia Fenglong. **PARATYPES: CHINA: Jiangxi:** 44 exs. (SYSU) same data as holotype;

17 exs. (SYSU) Jiangxi, Jianggangshan Mt., main peak [江西井冈山主峰], 605m, 2011.IV.29, leg. Zhao Shuang; **Hunan**: 16 exs. (NMPC, SYSU) Hunan, Yanling County, Taoyuandong, Shennong Valley [湖南炎陵县桃源洞神农谷], wet cliff, 2012.VII.1, leg. Jia Fenglong; 28 exs. (IZCAS) Hunan, Yizhang, Mangshan National Natural Reserve, Xiangyue Diyifeng [湖南宜章县莽山自然保护区湘粤第一峰], 24°55'40"N, 112°59'20"E, 1750m, 2020.VIII.30, leg. Liang Zulong; 2 exs. (IZCAS) Hunan, Yizhang, Mangshan National Natural Reserve, Jiangjunzhai [湖南宜章县莽山自然保护区将军寨], wet cliffs, 24°57'17"N, 112°55'23"E, 1185m, 2020.VIII.31, leg. Liang Zulong; **Guangdong**: 8 exs. (NMPC) CHINA, GUANGDONG Prov., exposed wet rock, ca. 0.5 km NE of Taipingdong Ziran Baohuqu [dam], 24°58.478'N, 110°38.633'E, 660 m, J.Hájek & J.Růžička leg., 18.iv.2013; 69 exs. (NMPC) CHINA, GUANGDONG Prov., Nanling National Nature Reserve, Dadongshan, 19-21.iv.2013, (exposed wet rocks near river), 24°55.768'N, 112°42.960'E, 680 m, J.Hájek & J.Růžička leg.; **Guangxi**: 59 exs. (SYSU) Guangxi, Longsheng County, Huaping Reserve [广西龙胜县花坪自然保护区], 25.6336°N, 109.9075°E, 566.6m, 2020.VIII.21, leg. Jiang Zhuoyin; **Zhejiang**: 1♂ (SYSU) Zhejiang Prov., Qujiang Dist., Housuntang [浙江省衢江区猴狮塘], 28.8133°N, 118.9776°E, 539.4m, 2020.V.3, leg. Jiang Zhuoyin.

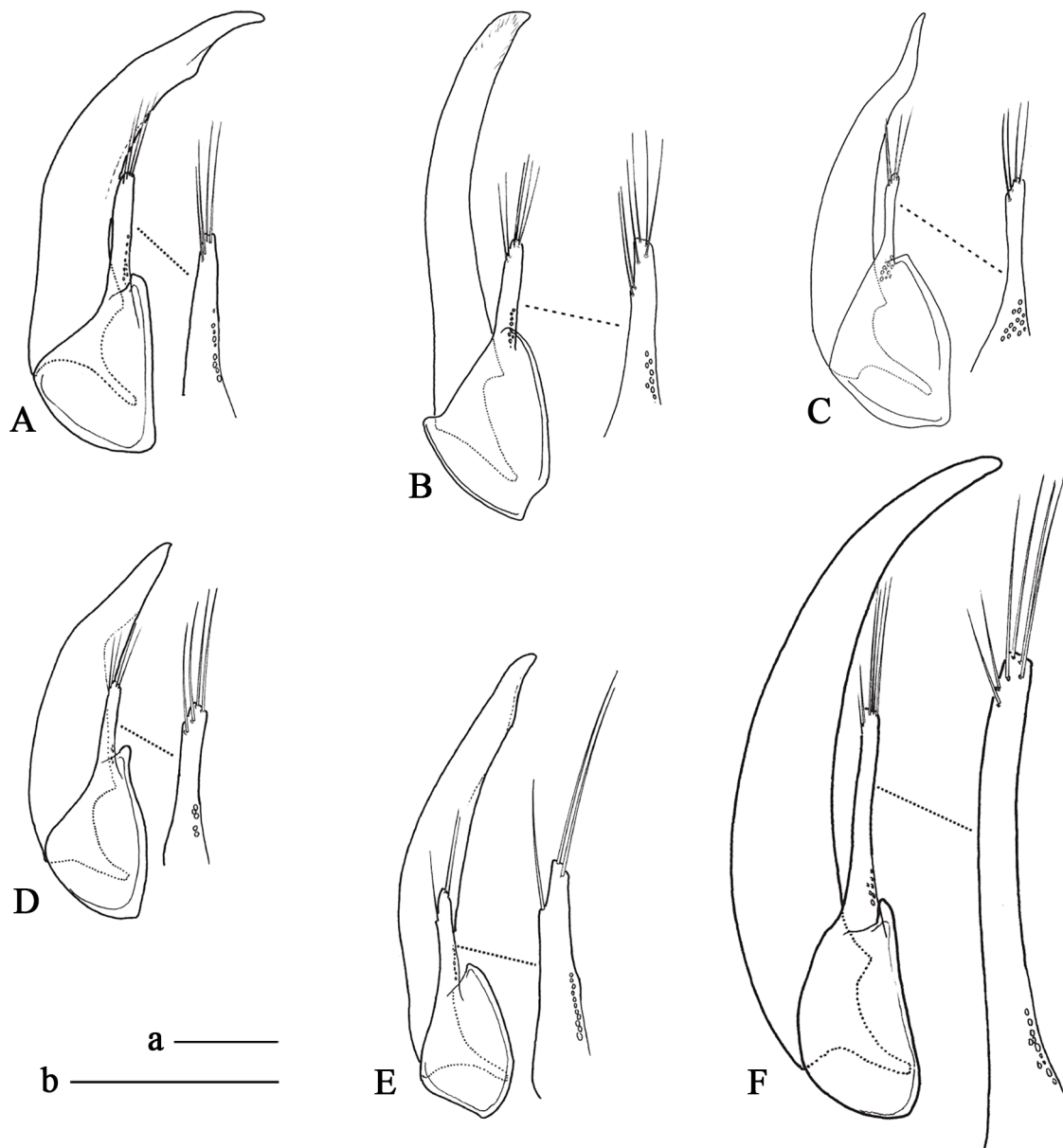


FIGURE 5. Aedeagus and details of parameres of species described before in lateral view. **A.** *Satonius kurosawai*. **B.** *Satonius fui*. **C.** *Satonius jaechi*. **D.** *Satonius schoenmanni*. **E.** *Satonius wangi*. **F.** *Satonius stysi*. Figures A, D, E are copied from Hájek & Fikáček (2008), figures B–C are copied from Hájek *et al.* (2011). Scale bars = 50 μ m, a – aedeagus; b – detail of paramere.

Diagnosis. Very small, fairly elongate and convex species, body 1.2–1.4 mm in length, 0.6–0.8 mm in width. Dorsal side brown, ventral side reddish brown in colour (Figs 1F, 3F). Side of pronotum slightly rounded, narrowly bordered. Lateral margin of elytra visible only in humeral part from above (Fig. 1F). Brachypterous or macropterous species. Apical angle of hind trochanter not extended, forming an obtuse angle (Fig. 6D).

Male genitalia (Fig. 4A). Median lobe narrow and slender, evenly curved towards apex; parameres strongly reduced, ca. 1/7× as long as median lobe, with only one apical seta, lateral side of parameres with a short field of pores basally.

Differential diagnosis. This species is very similar to *Satonius jaechi*. It can be easily distinguished from the latter by its strongly reduced parameres in male genitalia. Besides, this species is relatively elongate in body shape.

Biology. Collected in hygropetric habitats on wet cliffs, with a thin film of flowing water covered by algal mats (Figs 8A–B). Dissection showed that some females bear two eggs within their abdomen.

Distribution. Known from multiple localities in Jiangxi, Hunan, Guangdong, Guangxi and Zhejiang (Fig. 10).

Etymology. This species is named after Prof. Hong Pang (庞虹) (Life Science School, Sun Yet-sen University, Guangzhou, China), a specialist on Coccinellidae.

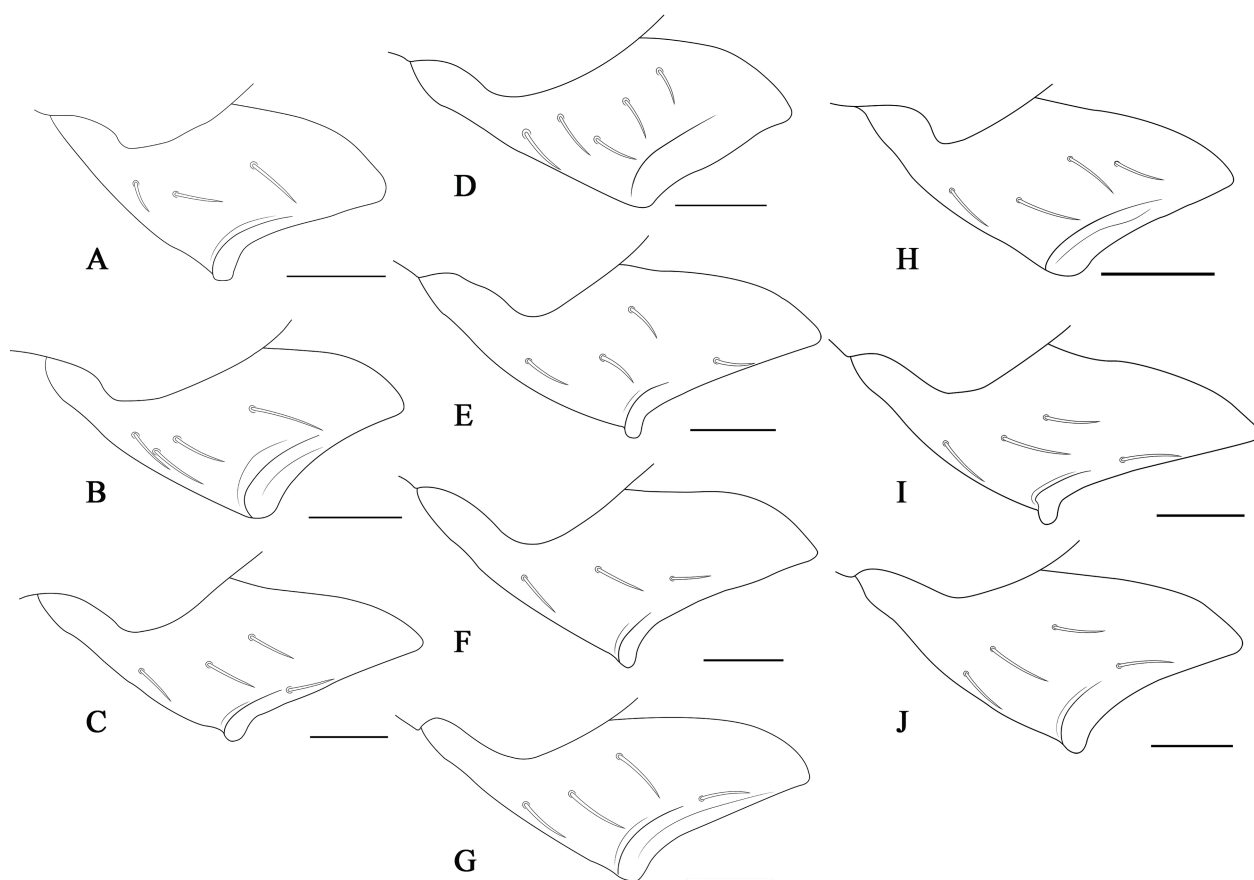


FIGURE 6. Metatrochanter of *Satonius*. A. *Satonius cheni* sp. nov. B. *Satonius jaechi*. C. *Satonius nigriventralis* sp. nov. D. *Satonius panghongae* sp. nov. E. *Satonius quzhouensis* sp. nov. F. *Satonius stysi*. G. *Satonius wangi*. H. *Satonius xinhuiensis* sp. nov. I. *Satonius zhangi* sp. nov. J. *Satonius zhenhuai* sp. nov. Scale bars = 50 μ m.

***Satonius quzhouensis* sp. nov.**

Chinese common name: 衢州佐藤淘甲
(Figs 1B, 3B, 4B, 6E, 9A–B, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Zhejiang Prov., Qujiang Dist., Huangmeng Village [浙江省衢江区黄蒙村], 29.1321°N, 118.8498°E, 364.5m, 2020.IV.26, leg. Jiang Zhuoyin. PARATYPES: CHINA:

Zhejiang: 16 exs. (SYSU, NMPC) same data as holotype; 20 exs. (SYSU) Zhejiang Prov., Qujiang Dist., Housuntang [浙江省衢江区猴孙塘], 28.8133°N, 118.9776°E, 539.4m, 2020.V.3, leg. Jiang Zhuoyin; **Anhui:** 10 exs. (SYSU) Anhui Prov., Huangshan Prefecture, Huang Shan, Jiulongtan Scenic area [安徽省黄山市黄山九龙潭风景区], 30.1118°N, 118.2000°E, 853m, 2020.VII.1, leg. Shi Hongliang.

Diagnosis. Small, fairly elongate and convex species, body 1.4–1.7 mm in length, 0.7–0.9 mm in width. Dorsal side pitch-black with obscure green sheen, ventral side largely black, with part of legs, epipleura and last abdominal segment yellowish brown (Figs 1B, 3B). Sides of pronotum rounded, narrowly bordered. Lateral margin of elytra narrow, widest in humeral part, narrowed posteriorly but visible throughout the elytra except for apex from above (Fig. 1B). Macropterous species. Apical angle of hind trochanter strongly extended, prolonging into a short digitus (Fig. 6E).

Male genitalia (Fig. 4B). Median lobe narrow and slender, evenly curved towards apex, apex narrowly rounded, without a hook; parameres short and stout, with four long setae on apex and two short setae located subapically, lateral side of parameres with a long field of pores basally.

Differential diagnosis. This species is most similar to *Satonius zhangi* sp. nov. It can be distinguished from the latter by the dark ventral side and narrower median lobe of male genitalia.

Biology. Collected from the spray zone of waterfalls (Figs 9A–B).

Distribution. Known from Zhejiang (Quzhou) and Anhui (Huang Shan) (Fig. 10).

Etymology. This species is named after the type locality, Quzhou Prefecture, Zhejiang Province, the hometown of the second author.

Note: Hájek *et al.* (2011) recorded the occurrence of *Satonius fui* Hájek, Yoshitomi, Fikáček, Hayashi & Jia, 2011 in Huangshan, Anhui, based on a single female. This location overlaps with the distribution of *Satonius quzhouensis* sp. nov. Given the similar external morphology of the two species, it is probable that the record by Hájek *et al.* (2011) may refer to *S. quzhouensis*.

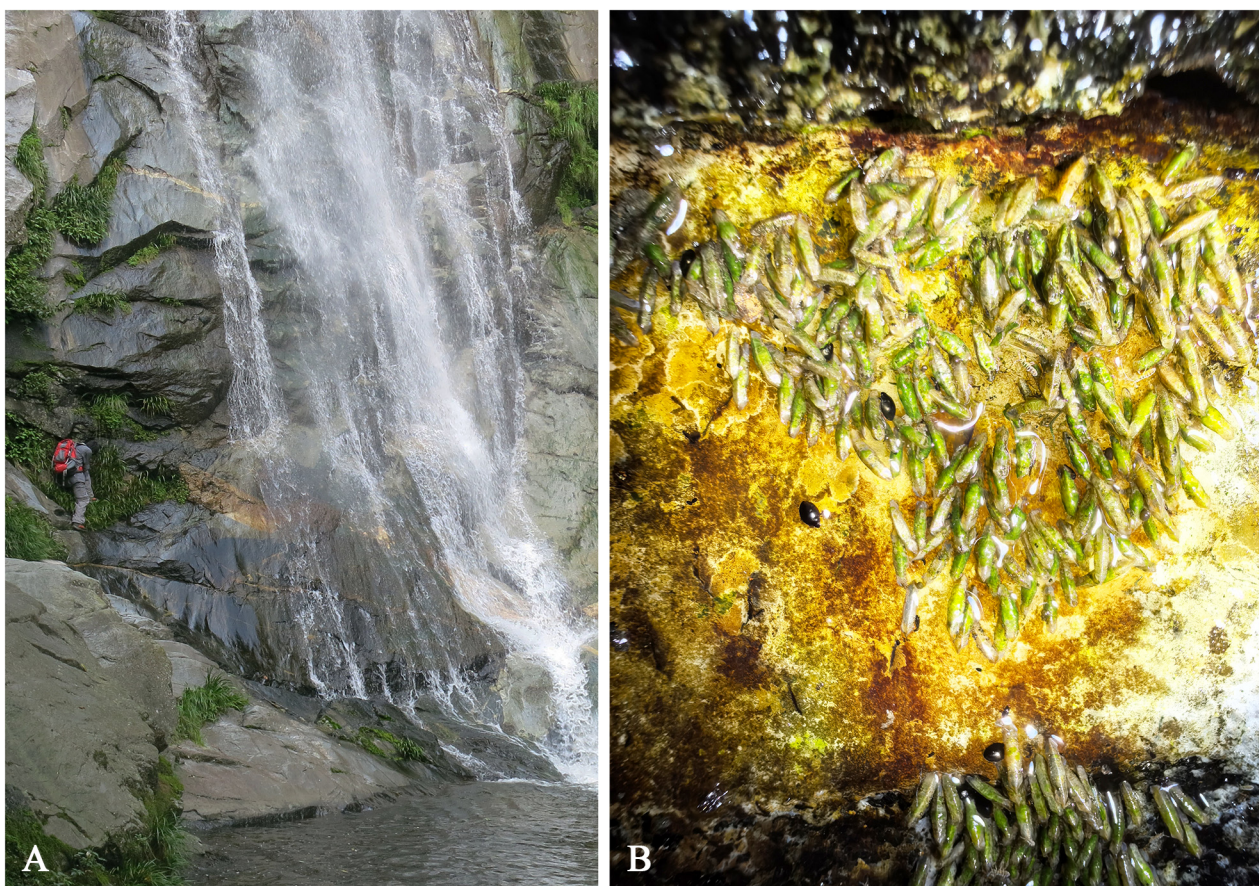


FIGURE 7. Habitats of *Satonius nigriventralis* sp. nov. **A.** Dr. Yongying Ruan collected samples at the type locality (Shibazhang Waterfall). Photo provided by Dr. Yongying Ruan. **B.** detail of habitat at the type locality, showing the individuals of *Satoniu nigriventralis* coexisting with the larvae of caddisfly *Stactobia* sp.



FIGURE 8. Habitat of *Satonius panghongae* sp. nov. **A.** type locality (Hunan, Mangshan Mt.), red arrow indicates the location where the specimens were collected. **B.** details of habitat, red circle indicates the beetle.

***Satonius xinhuiensis* sp. nov.**

Chinese common name: 新会佐藤淘甲
(Figs 1G, 3G, 4D, 6H, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Guangdong Prov., Jiangmen Prefecture, Xinhui Dist., Guifengshan National Forest Park [广东江门市新会区圭峰山国家森林公园], 22.9389°N, 113.0444°E, 2022. VI.22, leg. Jia Fenglong. **PARATYPES:** CHINA: 13 exs. (SYSU, NMPC) same data as holotype.



FIGURE 9. Habitat of *Satonius quzhouensis* sp. nov. **A.** Zhuoyin Jiang collected the beetles at the waterfall of type locality (Huangmeng Village). **B.** details of habitat, red circle indicates the beetle.

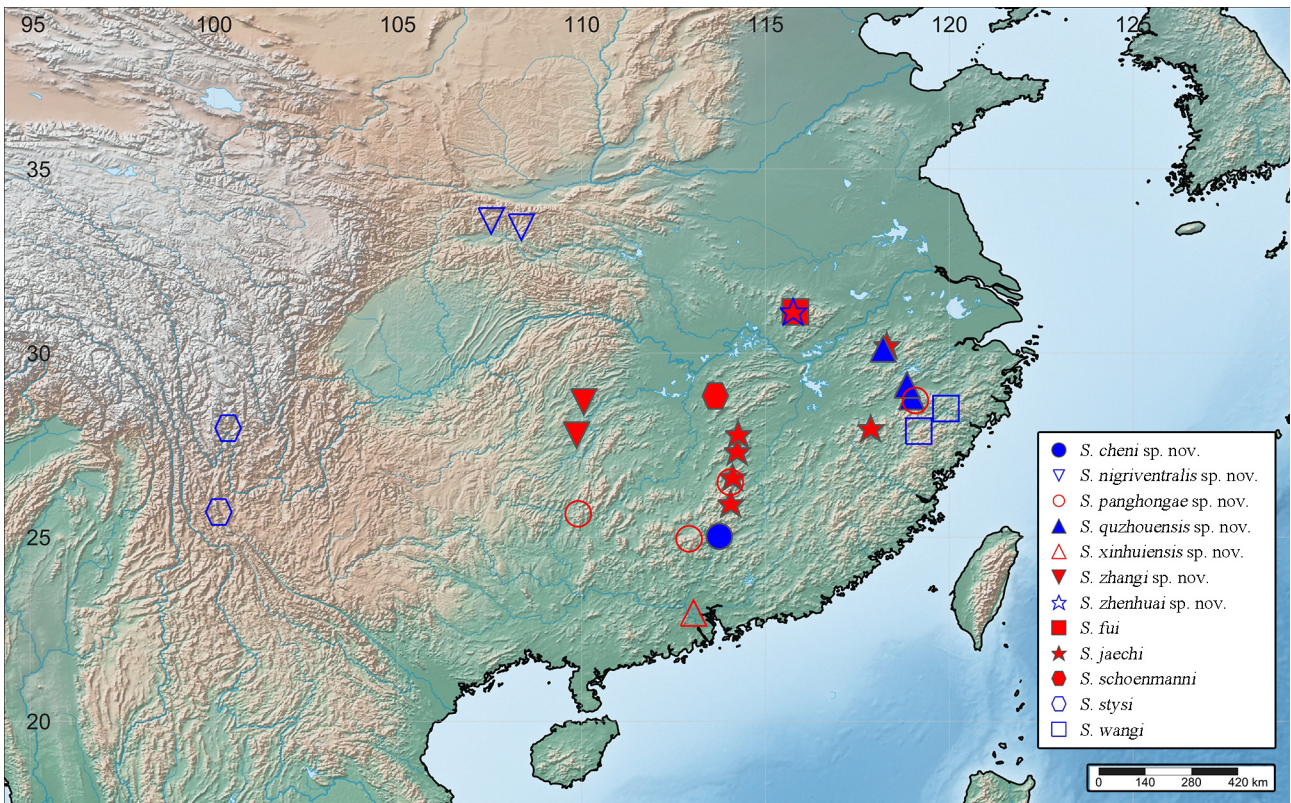


FIGURE 10. Distribution of Chinese *Satonius* species. For distribution of *Satonius kurosawai* in Japan see distribution map in Hájek *et al.* (2011).

Diagnosis. Very small, fairly elongate and convex species, body 1.2–1.4 mm in length, 0.6–0.8 mm in width. Dorsal side black, ventral side black laterally, with central part reddish brown (Figs 1G, 3G). Side of pronotum slightly rounded, narrowly bordered. Lateral margin of elytra visible only in humeral part from above (Fig. 1G). Macropterous species. Apical angle of hind trochanter not extended, forming an obtuse angle (Fig. 6H).

Male genitalia (Fig. 4D). Median lobe rather narrow and slender, evenly curved towards apex, apex slightly expanded; parameres very slender, ca. 2/7× as long as median lobe, with only one apical seta, apical seta shorter than parameres, lateral side of parameres with a short field of pores basally.

Differential diagnosis. This species resembles *Satonius panghongae* sp. nov. It can be easily distinguished from the latter by the darker body. Besides, the median lobe of male genitalia is broader in this species, and the parameres are much longer.

Biology. Collected in hygropetric habitats, with thin film of water flowing on rock covered by algal mat.

Distribution. Only known from the type locality (Xinhui, Guangdong) (Fig. 10).

Etymology. This species is named after the type locality, Xinhui District in Jiangmen Prefecture, Guangdong Province.

Satonius zhangii sp. nov.

Chinese common name: 张氏佐藤淘甲
(Figs 1C, 3C, 4F, 6I, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) Hunan, Huaihua Prefecture, Mayang County, Lancun Town [湖南麻阳县兰村镇], rice-grass crop rotation scientific-research base of Sun Yet-sen University, 27°46'18"N, 109°51'51"E, 2017.VIII.14, leg. Xie Weicai & Wang Shishuai. **PARATYPES:** CHINA: Hunan: 22 exs. (SYSU, NMPC) same data as holotype; 55 exs. (SYSU) Hunan, Guzhang County, Gaowangjie National Natural Reserve [湖南古丈县高望界国家自然保护区], 28°40.359'N, 110°3.605'E 822m 2017.VI.21, leg. Jia Fenglong.

Diagnosis. Small, broad and convex species, body 1.5–1.8 mm in length, 0.9–1.3 mm in width. Dorsal side dark brown with greenish sheen, ventral side reddish brown with epipleura and legs yellow (Figs 1C, 3C). Side of pronotum rounded, fairly broadly bordered. Lateral margin of elytra quite broad, visible throughout the elytra except for apex from above (Fig. 1C). Macropterous species. Apical angle of hind trochanter strongly extended, prolonged into short digitus (Fig. 6I).

Male genitalia (Fig. 4F). Median lobe quite broad, evenly curved towards apex; parameres short and stout, with four long apical setae and two short subapical setae, lateral side of parameres with long field of pores basally.

Differential diagnosis. This species closely resembles *Satonius wangi* Hájek & Fikáček. However, this species is relatively wider in shape, and apical angle of hind trochanter prolongs into a digitus-shaped extension (Fig. 6I) in this species instead of a simple round protrusion (Fig. 6G). Furthermore, the male genitalia of these two species are clearly different in that this species lacks the small spurs on the median lobe and has more setae on the parameres (four on the apical and two on the subapical) than *S. wangi* (two and one respectively).

Distribution. Known from two localities in Hunan Province (Fig. 10).

Etymology. This species is dedicated to Mr. Youxiang Zhang (张佑祥) (Jishou University, Jishou, China), for his kind help in material collecting.

Satonius zhenhuai sp. nov.

Chinese common name: 振华佐藤淘甲
(Figs 1D, 3D, 4G, 6J, 10)

Type material. HOLOTYPE: CHINA: ♂ (SYSU) China, Hubei, Dabieshan, Wujiashai [湖北大别山吴家寨], 31°7.6'N, 115°45.1'E, 2014.VI.28–30, leg. Liu Zhenhua. **PARATYPES:** CHINA: 2♀ (SYSU) same data as holotype.

Diagnosis. Small, broad and convex species, body 1.8–1.9 mm in length, 1.1–1.2 mm in width. Dorsal side dark brown with weak greenish sheen, ventral side reddish brown with epipleura and legs yellowish (Figs 1D, 3D). Side of pronotum slightly rounded, fairly broadly bordered. Lateral margin of elytra narrow, visible throughout the elytra

except for apex from above (Fig. 1D). Macropterous species. Apical angle of hind trochanter evidently extended, prolonged into a round appendix (Fig. 6J).

Male genitalia (Fig. 4G). Median lobe quite broad, dorsal side slightly rounded in basal two thirds, apical third slightly bent dorsad, ventral side distinctly convex in the middle; parameres short and stout, with four long apical setae and two short subapical setae, lateral side of parameres with wide field of pores basally.

Differential diagnosis. This species closely resembles *Satonius zhangii* **sp. nov.** in external morphology. It can be easily distinguished from the latter by the narrower lateral margin of the elytra. Besides, the median lobe is slightly bent at the apical third on the dorsal side and convex in the middle of the ventral side in this species (Fig. 4G), while it is evenly curved towards apex in *S. zhangii* **sp. nov.** (Fig. 4F).

Distribution. Only known from the type locality (Dabieshan Mt., Hubei) (Fig. 10).

Etymology. This species is dedicated to the collector of the type material, Dr. Zhenhua Liu (刘振华) (Institute of Zoology, Guangdong Academy of Sciences, Guangzhou).

Satonius fui Hájek, Yoshitomi, Fikáček, Hayashi & Jia, 2011

Chinese common name: 付氏佐藤淘甲

(Figs 2A, 5B, 10)

Satonius fui Hájek *et al.*, 2011: 52. TL: China (Hubei). TD: SYSU, BMNH, CNCO, EUMJ, USNM, NHMW, NMPC, ZSMC. *Satonius* sp. 2: Hájek & Fikáček 2008: 666 (note).

Type material examined: HOLOTYPE: CHINA: ♂ (SYSU) CHINA: Hubei province, DABIE SHAN (Mts.) [湖北省大别山], 640m, 31°07'06"N, 115°48'57"E, V. Grebennikov leg., 11-21.IV. 2008. **PARATYPES: CHINA:** 1♂ 1♀ (no. 11) (SYSU, NMPC) same data as holotype;

Distribution. Only known from the type locality (Dabieshan Mt., Hubei) (Fig. 10). Hájek *et al.* (2011) recorded the occurrence of this species in Huangshan, Anhui, based on a single female. Yet our study indicates that this record probably refers to the new species *Satonius quzhouensis* **sp. nov.** (see note of the new species).

Satonius jaechi Hájek, Yoshitomi, Fikáček, Hayashi & Jia, 2011

Chinese common name: 耶氏佐藤淘甲

(Figs 2D, 3J, 5C, 6B, 10)

Satonius jaechi Hájek *et al.*, 2011: 53. TL: China (Fujian). TD: SYSU, NMPC, USNM, NHMW. *Satonius* sp.: Jäch 1998: 51 (note). *Satonius* sp. 1: Hájek & Fikáček 2008: 665 (note).

Type material examined: HOLOTYPE: CHINA: ♂ (SYSU) CHINA: Fujian, Wuyishan, Da'an, Upper Chongyang River, wet cliff, [福建武夷山大安崇阳溪上游路边石壁], Elev. 444.5m, 27°57'32"N, 117°51'58"E, 15.7.2010, Leg. F.L. Jia. **PARATYPES: CHINA:** 49exs. (SYSU) same data as holotype.

Additional material examined. Anhui: 10 exs. (SYSU) Anhui Prov., Huangshan Prefecture, Huang Shan, Jiulongtan Scenic area [安徽省黄山市黄山九龙潭风景区], 30.1118°N, 118.2000°E, 853m, 2020.VII.1, leg. Shi Hongliang; **Fujian:** 1ex. (SYSU) Fujian, Wuyishan, Xiamei Village, puddle [福建武夷山下梅村水坑], 2020.VII.17, leg. Jia Fenglong; **Jiangxi:** 15 exs. (NMPC, SYSU) Jiangxi, Jinggangshan Mt., Dabali [江西井冈山大坝里], 500m, 2011.IV.28, leg. Jia Fenglong; 25 exs. (SYSU) Wugongshan Mt., Jiangxi [江西武功山], 27.33°N, 114.23°E, 400m 2014.VII.24, leg. Lin Renchao; 3 exs. (SYSU) Jiangxi, Jinggangshan Mt., Huyangta [江西井冈山湖羊塔], 2011.IV.28, leg. Jia Fenglong; 98 exs. (SYSU) Jiangxi Prov., Shangyou County, Guanggushan Nature Reserve [江西省上犹县光姑山自然保护区] 25°54'55"N, 114°03'09"E, 183m, 2016.IX.19–21, leg. Ruijuan Zhang & Yandang Tang; 98 exs. (SYSU) Jiangxi Prov., Pingxiang Prefecture, Wugongshan Mt. [江西省萍乡市武功山], 27°47'53"N, 114°14'83"E, 520m, 2016.IX.22–24, leg. Ruijuan Zhang & Yandang Tang.

Distribution. Endemic to China (Jiangxi, Anhui, Fujian) (Fig. 10). **New for Jiangxi and Anhui.**

***Satonius schoenmanni* Hájek & Fikáček, 2008**

Chinese common name: 申氏佐藤淘甲
(Figs 2B, 5D, 10)

Satonius schoenmanni Hájek & Fikáček, 2008: 663. TL: China (Hunan). TD: CASS, NHMW, NMPC.

Type material examined: PARATYPE: HOLOTYPE: CHINA: ♂(MNPC) CHINA: Hunan, ca. 25 km N Pingjiang City, 28°50'10"N, 113°38'05"E, ca. 200m, leg. Schoenman, Komarek & Wang (CWBS 499).

Distribution. Known from two close localities in Hunan (Fig. 10).

***Satonius stysi* Hájek & Fikáček, 2008**

Chinese common name: 史氏佐藤淘甲
(Figs 2C, 3H, 5F, 6F, 10)

Satonius stysi Hájek & Fikáček, 2008: 663. TL: China (Yunnan). TD: MNPC, BMNH, CASS, CZUG, KSEM, NHMW, TMSA.

Satonius stysi: Hájek *et al.*, 2011: 53: 61 (faunistic record).

Material examined. Yunnan: 2♀♀ (SYSU) P. R. CHINA, Yunnan, Cangshan [云南苍山], N25°41', E100°08', 2000.VI.23, 2600m, hygropetric, habitat, V. Grebennikov leg.

Distribution. Known from two localities, Jizushan Mt. [鸡足山] and Cangshan Mt. [苍山] in Dali, Yunnan (Fig. 10).

***Satonius wangi* Hájek & Fikáček, 2008**

Chinese common name: 王氏佐藤淘甲
(Figs 2E, 3I, 5E, 6G, 10)

Satonius wangi Hájek & Fikáček, 2008: 665. TL: China (Zhejiang). TD: CASS, NHMW, NMPC.

New material examined. Zhejiang: 10 exs. (SYSU) China, Zhejiang, Longquan Prefecture, Fengyangshan N.R., Erzhepu [浙江龙泉凤阳山附近, 二折瀑], 1494m, 2017.X.18, 27°52'49.46"N, 119°10'10.76"E, tiny stream near waterfall, leg. Jiang Ri-xin.

Distribution. Known from two localities, Baiyunshan Forest Park, Lishui Prefecture and Fengyangshan N. R., Longquan Prefecture in Zhejiang (Fig. 10).

Key to Chinese species of *Satonius*

The following key contains all known species of *Satonius* with a total of 13 species included, and was established based on the examination of material deposited in SYSU and IZCAS, as well as description in Hájek & Fikáček (2008) and Hájek *et al.* (2011).

- 1 Ventral side pitch-black (Fig. 3A) *S. nigriventralis* sp. nov.
- At least with part of ventral side reddish brown to brown, not entirely black 2
- 2 Lateral margin of elytra only visible in basal part from above, never reaching middle of elytra (Fig. 1E) 3
- Lateral margin of elytra visible throughout elytra except for apex from above, evidently reaching beyond middle of elytra (Fig. 1C) 9
- 3 Median lobe of male genitalia with a small spur subapically (Fig. 5A); occurring in Japan *S. kurosawai* (Satô)
- Median lobe of male genitalia without subapical spur; occurring in China 4
- 4 Size larger, 2.0–2.4 mm in body length (Fig. 2C) *S. stysi* Hájek & Fikáček
- Size smaller, 1.2–1.6 mm in body length 5
- 5 Parameres of male genitalia reduced, with only one apical seta 6
- Parameres of male genitalia normal, with four apical setae 7

6	Dorsal side brown (Fig. 1F); parameres of male genitalia strongly reduced, ca. 1/7 × as long as median lobe, apical seta longer than paramere (Fig. 4A)	<i>S. panghongae</i> sp. nov.
-	Dorsal side black (Fig. 1G); parameres of male genitalia narrow and long, ca. 2/7 × as long as median lobe, apical seta shorter than paramere (Fig. 4D)	<i>S. xinhuiensis</i> sp. nov.
7	Parameres of male genitalia with two long setae located subapically (Fig. 4C)	<i>S. cheni</i> sp. nov.
-	Parameres of male genitalia without any seta subapically	8
8	Size smaller, 1.2–1.4 mm in body length (Fig. 2D); median lobe of male genitalia with apical portion bent dorsad, apical part very narrow (Fig. 5C)	<i>S. jaechi</i> Hájek, Yoshitomi, Fikáček, Hayashi & Jia
-	Size larger, 1.6 mm in body length (Fig. 2B); median lobe of male genitalia not bent dorsad, apical part wider (Fig. 5D)	<i>S. schoenmanni</i> Hájek & Fikáček
9	Parameres of male genitalia with two apical setae and one subapical seta (Fig. 5E)	<i>S. wangi</i> Hájek & Fikáček
-	Parameres of male genitalia with four apical setae and two subapical setae	10
10	Parameres of male genitalia with subapical setae as long as apical setae (Fig. 5B)	<i>S. fui</i> Hájek, Yoshitomi, Fikáček, Hayashi & Jia
-	Parameres of male genitalia with subapical setae shorter than apical setae	11
11	Ventral side largely black, with some parts reddish brown (Fig. 3B); median lobe of male genitalia slender (Fig. 4B)	<i>S. quzhouensis</i> sp. nov.
-	Ventral side yellowish brown to reddish brown, not black (Fig. 3C); median lobe of male genitalia broader (Fig. 4F–G)	12
12	Median lobe of male genitalia slender, evenly curved towards apex (Fig. 4F)	<i>S. zhangji</i> sp. nov.
-	Median lobe of male genitalia broader, slightly bent at apical third on the dorsal side and convex in the middle of ventral side (Fig. 4G)	<i>S. zhenhuai</i> sp. nov.

Discussion

With the herein described species there are now 61 named species of Torridincolidae although additional ones are known especially from the Neotropics (Sampaio & Short 2018). *Satonius* is a small genus endemic to Eastern Asia. While only a single species of this genus, *S. kurosawai*, is found in Japan, it exhibits a wide-ranging distribution within the country. In China, *Satonius* species are predominantly found south of the Yangtze River, with their northernmost distribution extending to the Qinling Mountains. These mountains serve as geographical demarcations between southern and northern China and are often regarded as part of the boundary between the Palearctic and Oriental realms (Chen *et al.* 2008). However, in the updated terrestrial zoogeographic regions proposed by Holt *et al.* (2013), the transitional area of Palearctic and Oriental was defined as a new realm, the Sino-Japanese realm. Although this study was based on vertebrates, the distribution of *Satonius* aligns very well with the Sino-Japanese realm, suggesting that the updated divisions of zoogeographic regions might also apply to other groups of terrestrial invertebrates.

Prior studies showed that each Chinese species is typically restricted to one or two neighbouring locations (Hájek & Fikáček 2008; Hájek *et al.* 2011). Our study reveals that some Chinese species actually have a broader distributional range. For instance, the distribution of *S. jaechi* extends from Wuyishan Mt., Fujian eastward to Huangshan Mt. in Anhui (30.11°N, 118.20°E), and westward to Luoxiao Mountains in Jiangxi (25.92°N, 114.05°E). The new species, *S. panghongae* **sp. nov.** exhibits an even wider distributional range, from Quzhou, Zhejiang (28.8133°N, 118.9776 °E) in the east to Longsheng, Guangxi (25.63°N, 109.91°E) in the west. Despite these findings, the known distribution areas of most Chinese species remain limited to only one or two closely adjacent locations. This limitation can be attributed partly to insufficient and biased surveys. While some provinces, such as Jiangxi, Hunan, and Zhejiang, have accumulated relatively comprehensive faunistic data from several field expeditions in the past decade, surveys in other provinces remain inadequate. Furthermore, habitat fragmentation exacerbates this situation. The majority of *Satonius* specimens are collected in mountainous areas within natural reserves or forest parks, where vegetation is rather well-preserved and the water source is far away from pollution and human disturbance. However, the high habitat requirements and limited dispersal ability of *Satonius* make it difficult for them to disperse to adjacent suitable ecological patches. Thus, protecting the habitats and preservation of water sources are crucial for the conservation of species within this taxon.

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中国佐藤淘甲属 *Satonius* 回顾及七新种描述 (鞘翅目: 藻食亚目: 淘甲科)

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摘要: 对中国佐藤淘甲属 *Satonius* 进行了简要回顾, 并描述7新种, 即陈氏佐藤淘甲 *S. cheni* sp. nov. (广东)、黑腹佐藤淘甲 *S. nigriventralis* sp. nov. (陕西)、庞虹佐藤淘甲 *S. panghongae* sp. nov. (江西、湖南、广西、浙江)、衢州佐藤淘甲 *S. quzhouensis* sp. nov. (浙江、安徽)、新会佐藤淘甲 *S. xinhuensis* sp. nov. (广东)、张氏佐藤淘甲 *S. zhangii* sp. nov. (湖南) 和振华佐藤淘甲 *S. zhenhuai* sp. nov. (湖北)。提供了新种的鉴别特征, 给出了中国物种的整体图和阳茎及后足腿节绘图。此外, 补充了中国佐藤淘甲属已知种的分布信息, 并附上该属所有已知种检索表。

关键词: 分类; 淘甲科; 佐藤淘甲属; 新种; 中国; 中日界