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Revision of the genus *Spilopteron* Townes, 1965 (Hymenoptera: Ichneumonidae: Acaenitinae) from Japan

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Abstract. Ten Japanese species of the genus *Spilopteron* Townes, 1965 are recognized. Five new species, *S. albiventre* sp. nov., *S. brachyurum* sp. nov., *S. nigrum* sp. nov., *S. oblongulum* sp. nov. and *S. pseudonigrum* sp. nov., are described from Japan. Morphological discrimination between most Japanese species is confirmed by sequence analysis of the mitochondrial COI gene, which indicates the following relationships: *S. oblongulum* sp. nov. + *S. apicale* (Matsumura, 1912), *S. brachyurum* sp. nov. + *S. nigrum* sp. nov. + *S. pseudonigrum* sp. nov., and *S. tosaense* (Uchida, 1934) + *S. luteum* (Uchida, 1930). A key to the Japanese species of *Spilopteron* is provided. This genus seems to have its center of diversity in the mid-latitude area of East Asia.

Keywords. New species, parasitoid, mtCOI, taxonomy, geographical color variation, melanism, East Asia.

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Introduction

Spilopteron Townes, 1965 is a medium-sized genus of the ichneumonid subfamily Acaenitinae, containing 30 species, of which eleven are known from the Palearctic region, four from the Nearctic region, and 15 from the Oriental region (Yu *et al.* 2012). Host insects reported for *Spilopteron* species are as follows: *Pygoleptura nigrella* (Say, 1826) and *Strangalepta vittata* (Olivier, 1792) (Cerambycidae) for *S. vicinum* (Cresson, 1869) (Cushman & Rohwer 1920; Townes *et al.* 1960), *Strangalia bicolor* (Swederus, 1787) (Cerambycidae) for *S. occiputale* (Cresson, 1869) (Cushman & Rohwer 1920; Townes *et al.* 1960), *Bellamira scalaris* (Say, 1826) (Cerambycidae) for *S. formosum* (Cresson, 1868) (Champlain 1922; Townes 1944), *Pyrrhona laeticolor* (Bates, 1884) (Cerambycidae) for *S. pyrrhonae* Kusigemati, 1981, and *Eriotremex formosanus* (Matsumura, 1912) (Siricidae) for *S. fuscomaculatum* Wang, 1988 (Sheng & Sun 2010); the non-coleopteran host record (*E. formosanus*) should be considered doubtful. Shaw & Wahl (1989) reported that a related species *Acaenitus dubitator* (Panzer, 1800) is a

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koinobiont endoparasitoid of curculionid larvae, and thus species of *Spilopteron* may also have the same strategy of parasitism.

In Japan, five species of *Spilopteron* have hitherto been recorded: *S. apicale* (Matsumura, 1912), *S. tosaense* (Uchida, 1934), *S. pyrrhonae*, *S. mucronatus* Lee, 2008, and *S. luteum* (Uchida, 1930), (Kusigemati 1981; Ito *et al.* 2012).

The purpose of this study is to revise the five established Japanese species of *Spilopteron* and to propose five new species, based on morphological and molecular evidence. We also provide a key to the Japanese species of *Spilopteron*.

Material and methods

Morphological examination

Specimens from the following collections were used: the Department of Systematic Entomology, Hokkaido University, Sapporo (SEHU) (M. Ohara); the National Institute of Agro-Environmental Science, Tsukuba (NIAES) (S. Yoshimatsu); the National Museum of Nature and Science, Tsukuba (NSMT) (A. Shinohara); the Kanagawa Prefectural Museum of Natural History, Odawara (KPMNH) (K. Watanabe); the Entomological Laboratory of Meijo University, Nagoya (MU) (K. Yamagishi); the Osaka Museum of Natural History, Osaka (OMNH) (R. Matsumoto); the Entomological Laboratory of Kagoshima University, Kagoshima (KU) (Y. Sakamaki).

Specimens were observed using a stereoscopic microscope (Nikon SMZ660) and an optical microscope (Nikon ECLIPSE 50i). Images were taken using a digital microscope (Keyence Digital Microscope VHX-600) (Figs 1–2, 4–5) or a scanning electron microscope (JEOL JSM-6010LV) (Figs 3, 6). General morphological terminology follows Gauld (1991, 2002), and terminology for surface sculpture follows Eady (1968). The following abbreviations are used in descriptions: metasomal tergite (T), and metasomal sternite (S). The anterior, raised section of the pronotum is indicated as the "collar".

Mitochondrial DNA analysis

Partial DNA sequences of the mtCOI gene, so-called DNA barcodes, are widely used for the taxonomy of Hymenoptera (e.g., Sakurai *et al.* 2009; Stigenberg *et al.* 2011). Those of all Japanese species, except for *S. albiventre* sp. nov., were analyzed with *Yamatarotes chishimensis* (Uchida, 1929) (GenBank accession number AB932961 (Ito & Maeto 2014)) as an outgroup. The accession numbers of specimens are indicated in square brackets ([ ]) under "Material examined".

Adult specimens were preserved in 99.5% ethanol and stored at -30°C until dissection. A middle tarsus was removed and preserved in 99.5% ethanol. After drying, the tarsus was ground in 20 µl of 50 mM NaOH and digested for 15 min at 95°C. Thereafter, the sample was neutralized with 20 µl of 200 mM Tris-HCl.

The mtCOI primers designed by Folmer *et al.* (1994) (LCO1490: 5′-GGT CAA CAA ATC ATA AAG ATA TTG G-3′; HCO2198: 5′-TAA ACT TCA GGG TGA CCA AAA AAT CA-3′) (648 bp) were used for the polymerase chain reaction (PCR), which was conducted with KOD FX NEO (Toyobo). Cycling conditions were 94°C for 2 min, followed by 35 cycles at 98°C for 10 s, 48°C for 30 s, and 68°C for 15 s. The PCR products were purified using the illustra GFX kit (GE Healthcare Life Sciences). Gene regions were sequenced using the same primers as used in the PCRs with the BigDyeTM Terminator ver. 3.1 Cycle Sequencing kit (Applied Biosystems). Cycling conditions were 25 cycles at 96°C for 10 s, 50°C for 5 s, and 60°C for 4 min. The products were purified using 3 M sodium acetate, 95% ethanol, and 70%

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ethanol, and redissolved by the Hi-Di Formamide (Applied Biosystems). Cycle sequencing reactions were run on the ABI Prism 3100 Genetic Analyzer (Applied Biosystems).

Sequence data were assembled using the DNA Dynamo Sequence Analysis Software (Blue Tractor Software) and were aligned using ClustalW (http://www.genome.jp/tools/clustalw/) to obtain 590 alignable base pairs for analysis. Genetic distances were calculated according to the Kimura's two-parameter model (Kimura 1980), implemented in MEGA6 (Tamura *et al*. 2013). Maximum likelihood (ML) trees were constructed using MEGA6 with 1000 bootstrap replications (Tamura *et al*. 2013). The model selection for ML was performed according to the Akaike information criterion (AIC) in MEGA6. The best-fit substitution model was Kimura's two-parameter distance, with rate heterogeneity among sites modeled using a proportion of a gamma distribution (+G). All the DNA sequences obtained are deposited in the DDBJ (http://www.ddbj.nig.ac.jp/index-j.html)/EMBL GenBank database (https://www.ncbi.nlm.nih.gov/genbank/).

Results

Analysis of mitochondrial DNA

Our ML analysis of mtCOI sequences demonstrated nine compact clusters of Japanese *Spilopteron* (except for *S. albiventre* sp. nov., the sequence of which was not examined because the specimens were too old), within each of which the genetic distances among specimens were less than 3% in Kimura's two-parameter model (Fig. 9). They all corresponded exactly to the five already known and four new species described below. The analysis indicated the following relationships: *S. oblongulum* sp. nov. + *S. apicale* (bootstrap value: 95, mean genetic distance: 7.5 %), *S. brachyurum* sp. nov. + *S. nigrum* sp. nov. + *S. pseudonigrum* sp. nov. (bootstrap value: 81, mean genetic distance: 9.7 %), and *S. tosaense* + *S. luteum* (bootstrap value: 68, mean genetic distance: 10.9 %).

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Ichneumonidae Latreille, 1802
Subfamily Acaenitinae Förster, 1869

Genus ***Spilopteron*** Townes, 1960

Spilopteron Townes, 1960 in Townes & Townes 1960: 568. Original designation. Type-species: *Spilopteron franclemonti* Townes, 1960.

Diagnosis

Head 0.6–0.7 times as long as wide in dorsal view. Face strongly punctate and weakly convex (Fig. 2). Clypeus with a transverse median ridge (Figs 2–3). Frons punctate, with a median longitudinal carina (Fig. 2). Subocular groove present (Fig. 2). Mandible striate except apex (Figs 2–3). Lower tooth of mandible longer than upper tooth. Vertex and gena weakly and sparsely punctate. Occiput smooth. Occipital carina complete. Scutellum roundly convex in lateral view. Propodeum roundly convex in lateral view (Fig. 5). Propodeal spiracle elongate (Fig. 5). Fore wing with areolet open (Fig. 4). Hind wing with vein *Cu&cu-a* intercepted near middle (Fig. 4). Hind tarsus claws without an accessory tooth. Basal convexity of S1 covered with some erect setae. Ovipositor tip without transverse ridges.

Distribution

Palearctic, Oriental and Nearctic regions.

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Systematic position

The genus used to belong to the tribe Acaenitini *sensu* Townes (1971), but Wahl & Gauld (1998) proposed the discontinuance of the use of tribes within the subfamily Acaenitinae; we follow their opinion here. This genus closely resembles *Siphimedia* Cameron, 1902, known from the Oriental region, and *Metachorischizus* Uchida, 1928 from the Palearctic and Oriental regions, but it can be distinguished from them by the maxillary palpus with short hairs (vs long hairs in *Siphimedia*), the propodeal spiracle not enclosed by an elliptical carina (vs enclosed in *Siphimedia*), the propodeum with distinct regular carinae (vs irregular carinae in *Metachorischizus*), and the bullae in *2m-cu* a little distant from each other (vs very close in *Metachorischizus*).

Spilopteron albiventre sp. nov.
urn:lsid:zoobank.org:act:5EAE1212-248A-4020-8684-0FCE656C56A9
Figs 1a–b, 2a, 3a, 4a, 5a, 6a, 7a–b, 8a

Etymology

This specific epithet of this new species is derived from the yellowish white metasomal apex.

Type material

Holotype

JAPAN: ♀, "Hyakumatsu-zawa, Sapporo-shi, Hokkaido, Japan, 20. July 2001, T. Yoshida leg." (SEHU).

Paratypes

JAPAN: 2 ♀♀, same locality as holotype, Malaise trap, 12–18 Jul. 2001, T. Yoshida (SEHU); 1 ♀, same locality as holotype, Malaise trap, 4–18 Aug. 2001, T. Yoshida (SEHU); 1 ♀, Kannon-zawa, Sapporp-shi, Hokkaido, Malaise trap, 24 Aug.–7 Sep. 1993, N. Kuhara (NIAES); 1 ♀, same locality, Malaise trap, 1–8 Aug. 2000, K. Uesugi (KPMNH); 1 ♀, Mt Soranuma-dake, Sapporo-shi, Hokkaido, Malaise trap, 27 Jul.–21 Aug. 2007, A. Ueda (OMNH); 1 ♂, Onneto, Ashoro-cho, Hokkaido, Malaise trap, 23 Jul.–30 Aug. 2002, K. Uesugi (KPMNH); 1 ♂, Nippu, Bifuka-cho, Hokkaido, Malaise trap, 19 Jun.–17 Jul. 2010, N. Kuhara and M. Sueyoshi (OMNH); 1 ♂, Mt Hachimori-yama, Asahi-mura, Nagano Pref., 25 Jul. 1998, T. Tachi (OMNH); 1 ♂, Maruno-cho, Nirasaki-shi, Yamanashi Pref., 26 Jun.–20 Jul. 2007, K. Hosoda (OMNH); 8 ♂♂, Mt Odamiyama, Ehime Pref., 27 Jun. 1997, E. Yamamoto (NIAES); 1 ♀, same locality, 10 Jun. 1997, E. Yamamoto (NIAES); 1 ♀, same locality, 1 Jul. 1995, E. Yamamoto (NIAES); Onogahara, Ehime Pref., 6–7 Jul. 1979, Y. Seiyama (EUM).

Differential diagnosis

The new species most resembles *S. brachyurum* sp. nov. and *S. pyrrhonae*, but it is distinguished from them by the long malar space, 1.3–1.4 times as long as the basal mandibular width (0.9–1.2 times in *S. brachyurum* and *S. pyrrhonae*), and the yellowish white marking on the apex of the metasoma (entirely black in *S. brachyurum* and *S. pyrrhonae*).

Description

Female (n = 11)

Body length. 7.5–10.0 mm.

Head. Vertex 0.4–0.5 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2a). Clypeus 0.5–0.7 times as long as wide, with three weak projections of equal size (Figs 2a, 3a). Face 0.7–0.8 times as long as wide. Length of malar space 1.3–1.4 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter

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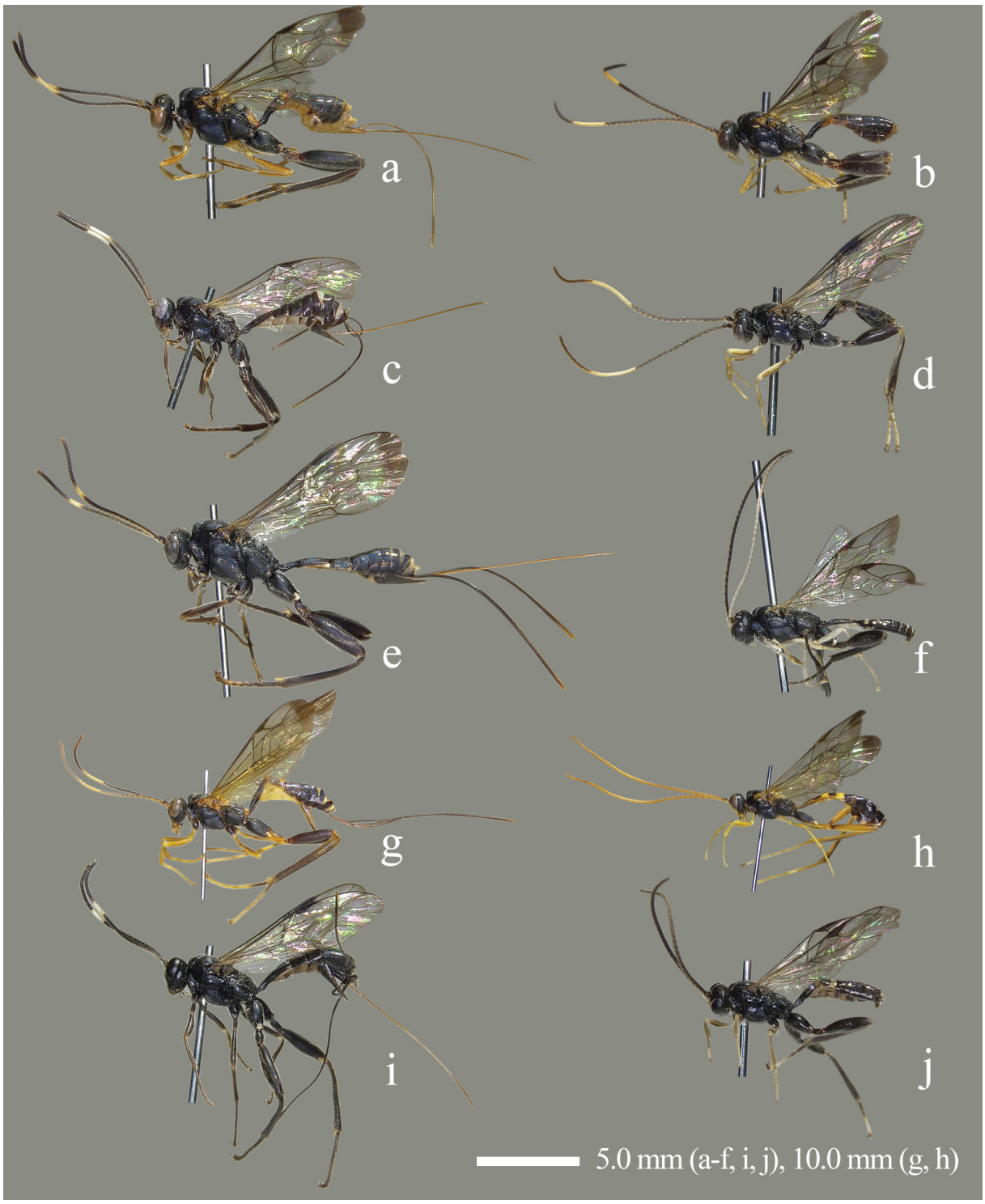

Fig. 1. Habitus in lateral view. **a–b**. *Spilopteron albiventre* sp. nov. **a**. Holotype, ♀, Ehime Pref. **b**. Paratype, ♂, Ehime Pref. – **c–d**. *Spilopteron brachyurum* sp. nov. **c**. Holotype, ♀, Hokkaido. **d**. Paratype, ♂, Hokkaido. – **e–f**. *Spilopteron nigrum* sp. nov. **e**. Holotype, ♀, Wakayama Pref. **f**. Paratype, ♂, Hyogo Pref. **g–h**. *Spilopteron oblongulum* sp. nov. **g**. Holotype, ♀, Kanagawa Pref. **h**. Paratype, ♂, Hyogo Pref. **i–j**. *Spilopteron pseudonigrum* sp. nov. **i**. Holotype, ♀, Hyogo Pref. **j**. Paratype, ♂, Hyogo Pref..

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= 1.1–1.3. Postocellar line/lateral ocellar diameter = 0.7–1.0. Antenna with 30–31 flagellomeres; first flagellomere 1.3–1.5 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5a). Lateral area of pronotum weakly punctate and transversely striate medially. Collar sparsely punctate. Mesoscutum densely punctate (Fig. 5a). Subalar prominence densely punctate (Fig. 5a). Scutellum weakly punctate in dorsal view. Postscutellum flattened in lateral view (Fig. 5a). Metapleuron strongly punctate (Fig. 5a). Propodeum indistinctly carinate (Fig. 6a). Area superomedia confluent with area petiolaris. Fore wing length 6.5–9.0 mm. Vein *cu-a* basal to vein *Rs&M* (Fig. 4a). Vein *rs-m* opposite or basal to vein *2m-cu* (Fig. 4a). Hind femur 3.2–3.5 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 10.0–11.7 times as long as maximum depth in lateral view. First hind tarsomere 2.1–2.6 times as long as second and 1.9–2.2 times as long as longer hind tibial spur.

Metasoma. T1 1.9–2.2 times as long as maximum width, 1.9–2.2 times as long as T2. T2 0.7 times as long as maximum width. T1 sparsely punctate. T2–T8 densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 2.1–2.5 times as long as hind tibia.

Color. Body black (Fig. 1a). Antennal flagellum with a white band (Fig. 1a). Inner margin of eye yellowish white, pale color sometimes extended to most of face (Fig. 2a). Clypeus, basal area of mandible, scutellum, postscutellum, propodeum, apices of metasomal tergites, apex of metasoma, and subgenital plate yellowish white (propodeum and T1 sometimes entirely black). Fore and mid legs yellowish brown (Fig. 1a). Fore wing with a rounded apical dark mark (Fig. 4a).

Male (n = 12; genitalia, n = 2)
Similar to female (Fig. 1b). Body length 6.0–10.0 mm. Head 0.6–0.7 times as long as wide in dorsal view. Vertex 0.4–0.5 times as long as maximum length of eye in dorsal view. Ocello-ocular line/ lateral ocellar diameter = 1.0–1.4. Postocellar line/lateral ocellar diameter = 0.8–1.2. Antenna with 31–35 flagellomeres. Hind femur 3.4–3.6 times as long as maximum depth in lateral view. Hind tibia 10.0–11.7 times as long as maximum depth in lateral view. First hind tarsomere 1.9–2.2 times as long as longer hind tibial spur. T1 2.0–2.5 times as long as maximum width, 1.8–2.1 times as long as T2. T2 0.7–0.8 times as long as maximum width. Face entirely yellow.

Subgenital plate pentagonal with a basal angle obtuse (Fig. 8a). Paramere short, basal part strongly projected toward the base of subgenital plate (Fig. 7a). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7b).

Distribution

Japan (Hokkaido, Honshu, and Shikoku).

Bionomics

Host unknown. Adults fly mainly in July and August.

Spilopteron apicale (Matsumura, 1912)
Figs 2b, 3b, 4b, 5b, 6b, 7c–d, 8b

Chorischizus apicalis Matsumura, 1912: 149. Type locality: Japan, Hokkaido, Sapporo City.

Phaenolobus apicalis – Uchida 1928: 34.
Arotes apicalis – Uchida 1932: 160.
Siphimedia apicalis – Uchida 1934: 52.

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Spilopteron apicalis – Townes *et al.* 1965: 391. — Kusigemati 1981: 121 (in part).
Spilopteron apicale – Yu *et al.* 2005, 2012. — Ito *et al.* 2015: 546.

Material examined

JAPAN: 1 ♀ (lectotype of *Chorischizus apicalis*), Jozan, Sapporo-shi, Hokkaido, late Aug. 1907, S. Matsumura (SEHU); 1 ♀ (paralectotype of *Chorischizus apicalis*), Sapporo-shi, Hokkaido, Aug. 1907, S. Matsumura (SEHU); 1 ♀, same locality as lectotype, early Sep. 1914, S. Matsumura (SEHU); 1 ♀, same locality as lectotype, 18 Aug. 1915, S. Matsumura (SEHU); 2 ♀♀, same locality as paralectotype, 17 Sep. 1932, C. Watanabe (SEHU); 1 ♀, Maruyama, Sappori-shi, Hokkaido, 21 Sep. 1931, M. Takizawa (SEHU); 1 ♀, Hitsujigaoka, Sappori-shi, Hokkaido, 1–8 Aug. 2011, K. Konishi (LC041250 OMNH); 8 ♀♀, Soranumadake, Sapporo-shi, Hokkaido, 27 Jul.–21 Aug. 2007, A. Ueda (OMNH, EUM); 1 ♀, same locality, 4–27 Jul. 2007, A. Ueda (OMNH); 2 ♀♀, Kuriyama-cho, Yubari-

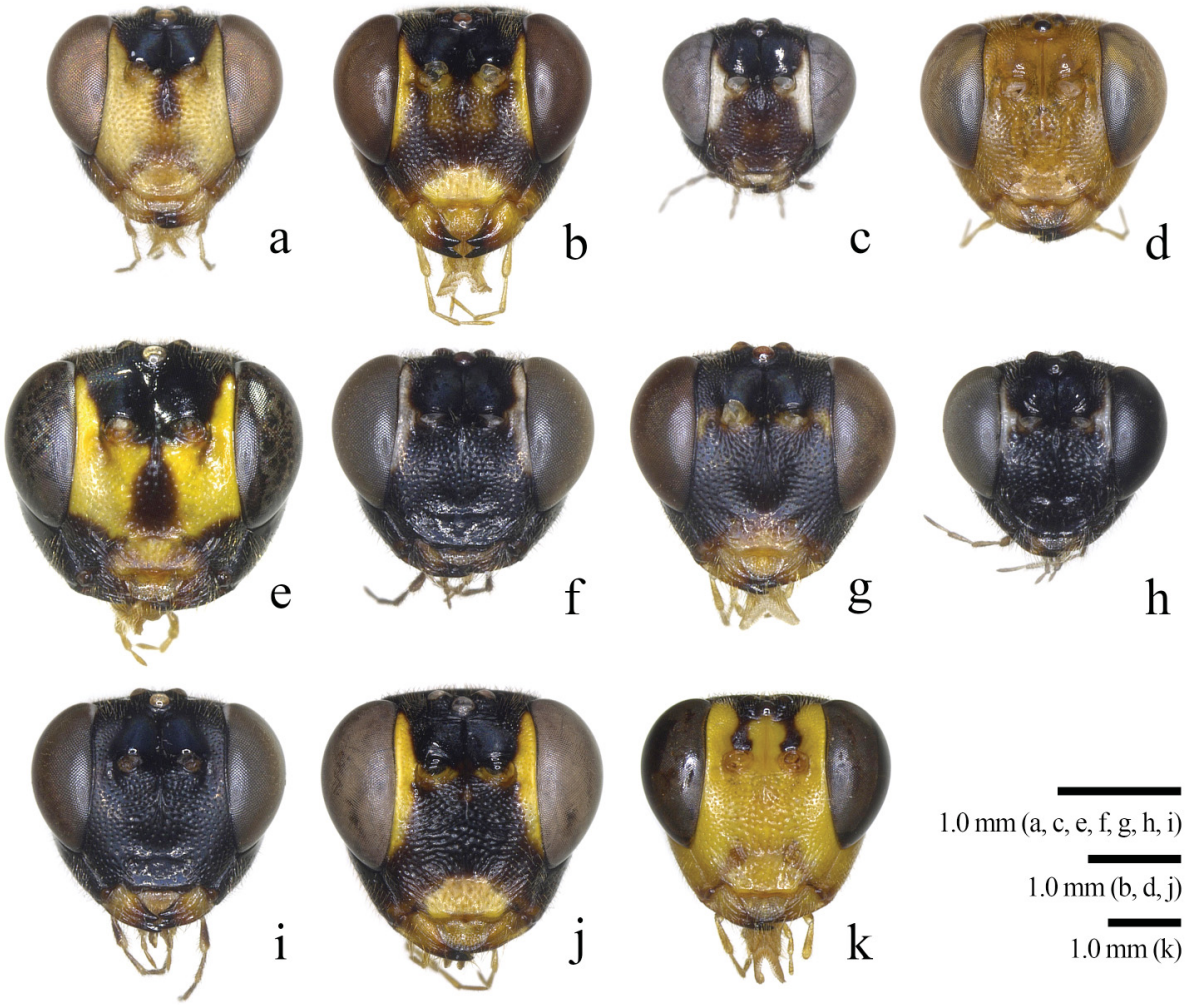

Fig. 2. Head of females in frontal view. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Fukuoka Pref. **f**. *Spilopteron nigrum* sp. nov., paratype, Hyogo Pref. **g**. *Spilopteron oblongulum* sp. nov., paratype, Kanagawa Pref. **h**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **i**. *Spilopteron pyrrhonae* Kusigemati, 1981, Kanagawa Pref. **j**. *Spilopteron tosaense* (Uchida, 1934), Hokkaido. **k**. *Spilopteron tosaense* (Uchida, 1934), Yakushima Is.

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shi, Hokkaido, 24 Jul.– 24 Aug. 2006, A. Ueda (OMNH); 1 ♀, Yubari-shi, Hokkaido, 3–17 Aug. 2007, A. Ueda (OMNH); 2 ♀♀, same locality, 24 Jul.–24 Aug. 2006, A. Ueda (OMNH); 1 ♀, Takinoshita, Kuriyama-cho, Hokkaido, 16 Jul.–5 Aug. 2009, A. Ueda (OMNH); 2 ♀♀, Chikkabetsu, Tokachi, Hokkaido, 29–31 Jul. 1946, Takahashi, Kosugi and Sakagami (SEHU); 6 ♀♀, Tomuraushi, Hokkaido, 24–27 Aug. 1954, C. Watanabe *et al.* (SEHU); 3 ♀♀, Kushiro, Hokkaido, 20 Aug. 1942, T. Uchida (SEHU); 1 ♀, Kawayu, Kushiro, Hokkaido, 1 Sep. 1941, T. Uchida (SEHU); 1 ♀, same locality, 8 Aug. 1947, S. Sakagami (SEHU); 1 ♀, Niibushi, Kushiro, Hokkaido, 9 Aug. 1947, S. Sakagami (SEHU); 1 ♂, Kamioboro, Kushiro, Hokkaido, 6 Aug. 1947, S. Sakagami (SEHU); 1 ♀, Utoro-Iwaobetsu, Shiretoko, Hokkaido, 15–17 Aug. 1953, T. Kumata (SEHU); 1 ♀, Teshio, Hokkaido, 6 Sep. 1956, K. Kamijo (SEHU); 1 ♀, Kawaratai, Nishimeya-mura, Aomori Pref., 6–14 Aug. 2013, T. Nakamura (EUM); 1 ♀, Tsukuba Univ., Sugadaira-kogen, Ueda-shi, Nagano Pref., 8 Aug.–3 Sep. 2014, S. Shimizu (KPMNH); 1 ♀, same locality, 3–26 Sep. 2014, S. Shimizu (KPMNH); 3 ♀♀, Utsukushimatsu, Daimon, Nagawa-cho, Nagano Pref., 25 Aug. 2011, S. Fujie (LC041254, LC041255 OMNH); 2 ♀♀, same locality, 22 Aug. 2012, S. Fujie (LC041256 OMNH); 1 ♀, same locality, 23 Aug. 2012, S. Fujie (LC041257 OMNH); 1 ♀, same locality, 26 Aug. 2011, S. Fujie (OMNH); 1 ♀, same locality, 27 Aug. 2011, S. Fujie (OMNH); 7 ♀♀, Ontake-kogen, Outaki-mura, Nagano Pref., 31 Jul. 2013, M. Ito (KPMNH); 2 ♀♀, same locality, 28 Jul. 2013, M. Ito (SEHU); 5 ♀♀, 2 ♂♂, Hakkaisan, Outaki-mura, Nagano Pref., 28 Jul. 2013, M. Ito (SEHU, KPMNH); 1 ♂, same locality, 6 Aug. 2007, H. Kawai (KPMNH); 1 ♂, same locality, 7 Aug. 2010, K. Watanabe (KPMNH); 2 ♀♀, 1 ♂, Karei-kogen, Ina-shi, Nagano Pref., 30 Jul. 2013, K. Watanabe (KPMNH); 1 ♀, same locality, 30 Jul. 2013, N. Kikuchi (KPMNH); 1 ♀, Karasugawa-keikoku, Hotakamaki, Azumino-shi, Nagano Pref., 24 Aug. 2012, S. Fujie (OMNH); 1 ♂, Mt Asamayama, Nagano Pref., 1 Aug. 1978, K. Mizuno (OMNH); 1 ♀, Biwakubosawa, Masutomi, Hokuto-shi, Yamanashi Pref., 7 Aug. 2007, K. Watanabe (OMNH); 1 ♀, same locality, 8 Aug. 2008, K. Watanabe (OMNH); 3 ♀♀, same locality, 28 Jul.–7 Aug. 2007, K. Watanabe (OMNH); 1 ♀, same locality, 8 Aug. 2008, K. Watanabe, (OMNH); 1 ♀, Hikawa, Enzan-shi, Yamanashi Pref., 5 Aug. 2008, H. Katahira (KPMNH); 1 ♂, Tano, Yamato-cho, Koshu-shi, Yamanashi Pref., 5 Aug. 2008, K. Watanabe (KPMNH); 1 ♂, Shorakuji, Akeno-mura, Yamanashi Pref., 7 Aug. 2007, K. Watanabe (KPMNH); 5 ♀♀, Nabedaira-kogen, Takayama-shi, Gifu Pref., 13 Aug. 2013, M. Ito (NSMT); 1 ♀, same locality, 3 Aug. 2013, S. Fujie (NIAES); 1 ♀, 1 ♂, Kute, Nyukawa-cho, Takayama-shi, Gifu Pref., 4 Aug. 2013, S. Fujie (NIAES); 1 ♀, Odaigahara, Kamikitayama-mura, Nara Pref., 15–22 Aug. 2005, A. Kawazoe (OMNH); 1 ♀, Sobosan, Oita Pref., 28 Jul. 1978, R. Noda (NIAES).

Differential diagnosis

Until the revision by Ito *et al.* (2015), this species had been confused with *S. tosaense* due to color variation. However, it can be distinguished from *S. tosaense* by the following character states: fore wing with the apical dark mark rounded and not extending downward (extending downward in *S. tosaense*), and without a dark mark below the pterostigma (Fig. 4b); frons with a depression between eye and antennal socket (absent in *S. tosaense*); and clypeus with a very weak median projection and two strong lateral projections (Fig. 3b) (with three equal-sized projections in *S. tosaense*).

Description

Female (n = 84)

Body length. 13.5–16.0 mm.

Head. Vertex 0.6–0.7 times as long as maximum length of eye in dorsal view. Frons with a depression between eye and antennal socket in frontal view (Fig. 2b). Clypeus 0.6–0.7 times as long as wide, with two strong lateral projections and a weak median projection (Figs 2b, 3b). Face 0.6 times as long as wide. Length of malar space 0.9–1.2 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.6–2.1. Postocellar line/lateral ocellar diameter = 1.0–1.4. Antenna with 34–35 flagellomeres; first flagellomere 1.2 times as long as second flagellomere.

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Mesosoma. Propleuron densely punctate (Fig. 5b). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5b). Collar sparsely punctate. Mesoscutum densely punctate. Subalar prominence extensively punctate (Fig. 5b). Scutellum sparsely punctate in dorsal view. Postscutellum roundly convex in lateral view (Fig. 5b). Metapleuron strongly and densely punctate (Fig. 5b). Propodeum strongly carinate (Fig. 6b). Area externa weakly punctate (Fig. 6b). Area basalis weakly carinate (Fig. 6b). Area dentipara, area posteroexterna and area petiolaris confluent with area superomedia, and weakly carinate (Fig. 6b). Fore wing length 10.5–14.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4b). Vein *rs-m* opposite or distad of vein *2m-cu* (Fig. 4b). Hind femur 4.1–4.2 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 11.4–12.7 times as long as maximum depth in lateral view. First hind tarsomere 2.5–2.6 times as long as second one and 3.3–3.6 times as long as longer hind tibial spur.

Metasoma. T1 2.2–2.6 times as long as maximum width, 2.2–2.6 times as long as T2. T2 0.7 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 1.8 times as long as hind tibia.

Color. Body black (Fig. 5b). Antennal flagellum with a white band. Inner margin of eye, clypeus, basal area of mandible, subalar prominence, scutellum, postscutellum, apex of propodeum, fore and mid legs, hind trochanter, hind trochantellus, apex of hind tarsus, and apices of T1 and T2 yellowish brown. Fore

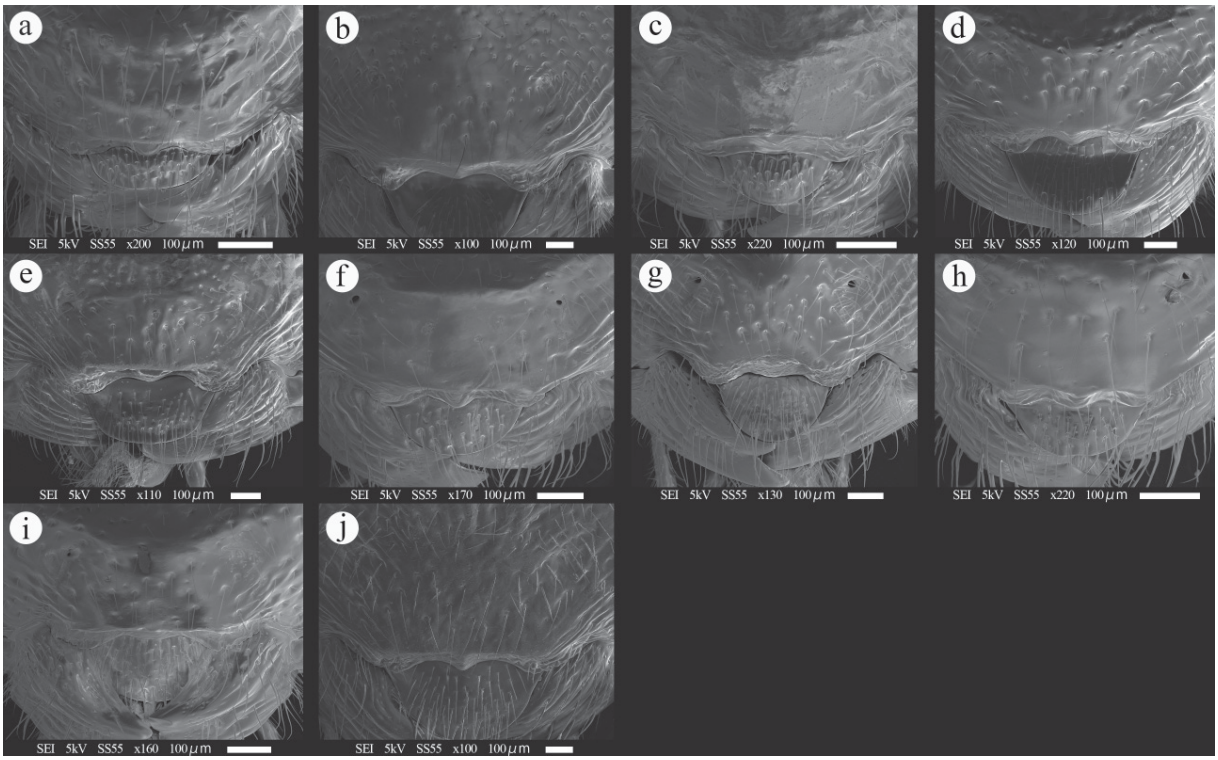

Fig. 3. Clypeus of female in frontal view. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Fukuoka Pref. **f**. *Spilopteron nigrum* sp. nov., paratype, Hyogo Pref. **g**. *Spilopteron oblongulum* sp. nov., paratype, Kanagawa Pref. **h**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **i**. *Spilopteron pyrrhonae* Kusigemati, 1981, Kanagawa Pref. **j**. *Spilopteron tosaense* (Uchida, 1934), Hokkaido.

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wing with an apical dark mark rounded and not extending downward, without a dark mark below the pterostigma (Fig. 4b).

Male (n = 10; genitalia, n = 3)
Similar to female. Body length 12.5–15.0 mm. Head 0.6 times as long as wide. Face 0.7 times as long as wide. Length of malar space 0.8–1.1 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.3–1.5. Postocellar line/lateral ocellar diameter = 1.2–1.4. Antenna with 38–39 flagellomeres; first flagellomere 1.1–1.4 times as long as second flagellomere. Hind tibia 11.7–13.2 times as long as maximum depth in lateral view. First hind tarsomere 2.1–2.3 times as long as second and 3.6–4.8 times as long as longer hind tibial spur. T1 2.4–3.3 times as long as maximum width, 2.0–2.4 times as long as T2. T2 0.8–0.9 times as long as maximum width. Face entirely yellow. Antennal flagellum without a white band.

Subgenital plate hexagonal with an obtuse basal angle (Fig. 8b). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7c). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7d).

Distribution

Japan (Hokkaido, Honshu, Shikoku, and Kyushu), China, and Far East Russia (Sakhalin Oblast).

Bionomics

Host unknown. In Honshu MI often observed females ovipositing into trunks of Japanese larch (*Larix kaempferi* (Lamb.) Carr.) (Pinaceae), into which a Cerambycidae (*Etorofus* (*Nakanea*) *vicaria* (Bates, 1844)) was also ovipositing. Adults fly in July and August, visiting flowers of *Angelica pubescens* Maxim. (Apiaceae) and *Aralia cordata* Thunb. (Araliaceae).

Spilopteron brachyurum sp. nov.

urn:lsid:zoobank.org:act:FDA2ACF6-526E-479C-BF27-0B0B8DB1B0C9

Figs 1c–d, 2c, 3c, 4c, 5c, 6c, 7e–f, 8c

Etymology

The specific epithet of this new species is derived from the short ovipositor sheath.

Type material

Holotype
JAPAN: ♀, "Mt. tarumae-san, Hokkaido, Japan, 12–18 July 1998, K. Konishi leg. (MsT)" (NIAES).

Paratypes
JAPAN: 2 ♂♂, same data as holotype (NSMT); 2 ♂♂, same locality, Malaise trap, 18–21 Jul. 1998, K. Konishi (NIAES); 1 ♀, 2 ♂♂, same locality, Malaise trap, 21–26 Jul. 1998, K. Konishi (NIAES); 1 ♂, Mt Teinekanayama, Sapporo-shi, Hokkaido, 19 Jul. 2012, M. Ito (LC154925 OMNH); 1 ♂, Nanamagari, Aomori-shi, Aomori Pref., 25 Jul.–1 Aug. 1992, T. Ichita (NIAES).

Differential diagnosis

This new species most resembles *S. albiventre* sp. nov. and *S. pyrrhonae*, but it is easily distinguished from both by the rounded area superomedia on the propodeum (the area is square in *S. albiventre* and *S. pyrrhonae*).

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Description

Female (n = 2)

Body length. 6.5–8.0 mm

Head. Vertex 0.4–0.6 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2c). Clypeus 0.4–0.5 times as long as wide, with a median projection (Figs 2c, 3c). Face 0.6 times as long as wide. Length of malar space 0.9–1.0 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.2–1.5. Postocellar line/lateral ocellar diameter = 1.0. Antenna with 29 flagellomeres; first flagellomere 1.2–1.3 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5c). Lateral area of pronotum densely punctate and transversely striate medially. Collar weakly punctate. Mesoscutum densely punctate (Fig. 5c). Subalar prominence sparsely punctate (Fig. 5c). Scutellum densely punctate in dorsal view. Postscutellum

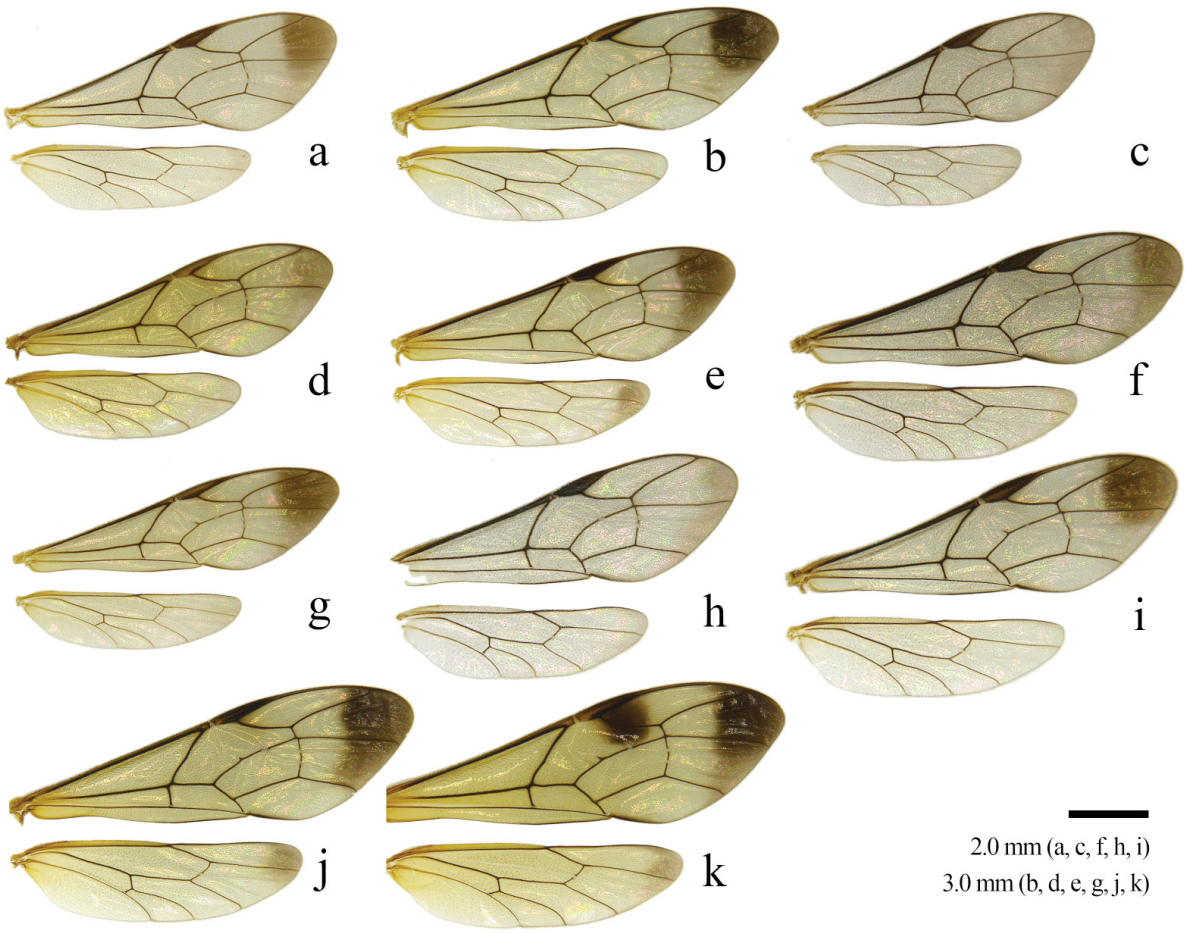

Fig. 4. Wings of females. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Fukuoka Pref. **f**. *Spilopteron nigrum* sp. nov., paratype, Hyogo Pref. **g**. *Spilopteron oblongulum* sp. nov., paratype, Kanagawa Pref. **h**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **i**. *Spilopteron pyrrhonae* Kusigemati, 1981, Kanagawa Pref. **j**. *Spilopteron tosaense* (Uchida, 1934), Hokkaido. **k**. *Spilopteron tosaense* (Uchida, 1934), Yakushima Is.

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flattened in lateral view (Fig. 5c). Metapleuron sparsely punctate (Fig. 5c). Propodeum strongly carinate (Fig. 6c). Area superomedia rounded. Area externa weakly punctate (Fig. 6c). Area basalis, area superomedia and area dentipara polished (Fig. 6c). Area posteroexterna confluent with area petiolaris and polished (Fig. 6c). Fore wing length 6.5–8.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4c). Vein *rs-m* opposite or basad of vein *2m-cu* (Fig. 4c). Hind femur 3.1–3.6 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 9.0 times as long as maximum depth in lateral view. First hind tarsomere 2.6–2.8 times as long as second and 2.8–3.0 times as long as longer hind tibial spur.

Metasoma. T1 1.9–2.2 times as long as maximum width, 2.3–2.4 times as long as T2. T2 0.5–0.6 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 1.9 times as long as hind tibia.

Color. Body black (Fig. 1c). Antennal flagellum with a white band (Fig. 1c). Inner margin of eye yellowish white (Fig. 2c). Basal area of mandible, face, clypeus, and fore and mid legs brown. Fore wing with a weakly infuscate apical area, extending downwards (Fig. 4c).

Male (n = 8; genitalia, n = 2)
Similar to female (Fig. 1d). Body length 7.5–9.0 mm. Face 0.6–0.7 times as long as wide. Length of malar space 0.8–0.9 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.2–1.6. Postocellar line/lateral ocellar diameter = 0.8–1.2. Antenna with 35–38 flagellomeres; first flagellomere 1.0–1.3 times as long as second flagellomere. Fore wing: length 7.5–9.0 mm. Hind tibia 9.6–10.7 times as long as maximum depth in lateral view. First hind tarsomere 2.0–2.5 times as long as second and 2.5–2.6 times as long as longer hind tibial spur. T1 2.1–2.5 times as long as maximum width, 2.0–2.1 times as long as T2. T2 0.6–0.8 times as long as maximum width. Face, clypeus, basal area of mandible, hind tarsus and apices of T1 and T2 yellowish white. Fore and mid legs yellowish white with brown markings. Apex of hind tarsus yellowish white (Fig. 1d).

Subgenital plate pentagonal with obtuse basal angle (Fig. 8c), its length ca 0.7 times as long as aedeagus. Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7e). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7f).

Distribution

Japan (Hokkaido and Honshu).

Bionomics

Host unknown. Adults mainly fly in July.

Spilopteron luteum (Uchida, 1930)
Figs 2d, 3d, 4d, 5d, 6d, 7g–h, 8d

Acoenitus luteus Uchida, 1930: 126. Type locality: Taiwan, Urai.

Arotes luteus – Uchida 1932: 141.
Siphimedia lutea – Cushman 1933: 12. — Uchida 1934: 52. — Sonan 1936: 249.
Spilopteron luteum – Townes *et al.* 1961: 325. — Chiu 1971: 22.— Yu *et al.* 2005, 2012. — Ito *et al.* 2012: 443.

Material examined

TAIWAN: 1 ♀ (type of *Acoenitus luteus*), Urai, 20. Jul. 1929, C. Watanabe (SEHU).

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JAPAN: Amami-oshima Is., Kagoshima Pref., 1 ♀, Kamiya, 1. Aug. 1992, R. Noda (NIAES); 9 ♀♀, Mt Yui-dake, 2 Jul. 2004; 2 ♀♀, same locality, 15 Jul. 2004, 1 ♀, same locality, Malaise trap, 10 Aug. 2004, H. Makihara (NIAES); 1 ♂, same locality, 6 Jul. 2013, M. Ito (KPMNH); 1 ♂, Wase-toge, 25 Jun. 2010; 9 ♂♂ Mt Yuwan-dake, 26–27 Jun. 2010; 1 ♂, same locality, 26–28 Jun. 2010, A. Shimizu (TMU); 1 ♂, Mt Akatsuchi-yama, 27 Jun. 2011, H. Sawada (LC041303 OMNH); 1 ♀, same locality, 28 Jun. 2011, K. Watanabe (LC041304 OMNH); 2 ♀♀, same locality, Malaise trap, 28 Jun.–4 Jul. 2011, K. Kikuchi, T. Yoshida, K. Watanabe and S. Fujie (KPMNH); 1 ♂, Oodana, Yamato-son, 3 Jul. 2011, H. Sawada (TUA); 1 ♂, same locality, 4 Jul. 2011, K. Watanabe (NSMT); 1 ♀, same locality, 4 Jul. 2011, S. Fujie (NSMT).

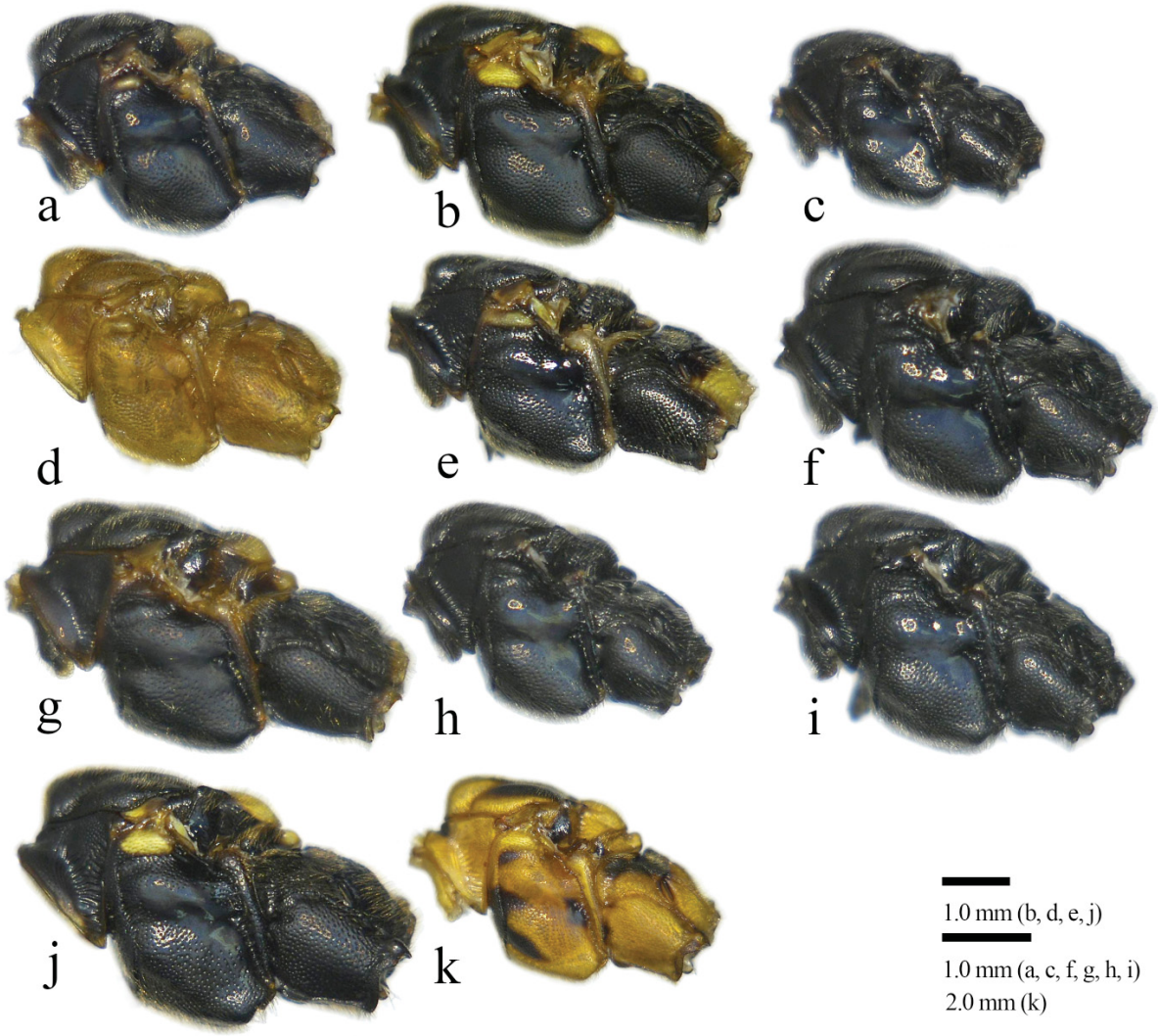

Fig. 5. Mesosoma of females, lateral view. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Fukuoka Pref. **f**. *Spilopteron nigrum* sp. nov., paratype, Hyogo Pref. **g**. *Spilopteron oblongulum* sp. nov., Kanagawa Pref. **h**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **i**. *Spilopteron pyrrhonae* Kusigemati, 1981, Kanagawa Pref. **j**. *Spilopteron tosaense* (Uchida, 1934), Hokkaido. **k**. *Spilopteron tosaense* (Uchida, 1934), Yakushima Is.

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Differential diagnosis

This species can easily be distinguished from other Japanese species of *Spilopteron* by the entirely yellowish brown body (largely black or at least with black areas in other Japanese species) (Ito *et al.* 2012). ML analysis indicates that this species is most closely related to *S. tosaense* (Fig. 9), and this is also supported by the morphological similarity (except for the body coloration).

Description

Female (n = 18)

Body length. 10.5–14.0 mm.

Head. Vertex 0.5–0.6 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2d). Clypeus 0.6 times as long as wide, with two strong lateral projections and a weak median projection (Figs 2d, 3d). Face 0.7 times as long as wide. Length of malar space 0.8–1.0 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 2.0–2.1. Postocellar line/lateral ocellar diameter = 1.0–1.1. Antenna with 33–38 flagellomeres; first flagellomere 1.2–1.3 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5d). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5d). Collar weakly punctate. Mesoscutum densely punctate. Subalar prominence extensively punctate (Fig. 5d). Scutellum weakly punctate in dorsal view. Postscutellum roundly convex in lateral view (Fig. 5d). Metapleuron densely punctate (Fig. 5d). Propodeum strongly carinate (Fig. 6d). Area externa weakly punctate (Fig. 6d). Area basalis polished (Fig. 6d). Area dentipara, area posteroexterna and area petiolaris confluent with area superomedia (Fig. 6d). Fore wing length 10.5–14.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4d). Vein *rs-m* opposite or distad of vein *2m-cu* (Fig. 4d). Hind femur 3.4–3.6 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 10.4–12.6 times as long as maximum depth in lateral view. First hind tarsomere 2.3–2.8 times as long as second and 2.4–2.8 times as long as longer hind tibial spur.

Metasoma. T1 2.5–2.9 times as long as maximum width, 2.4–2.6 times as long as T2. T2 0.6–0.8 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 1.7–1.8 times as long as hind tibia.

Color. Body reddish yellow (Fig. 5d). Antennal flagellum brown, usually with a distinct white band, but sometimes band not clear. Apex of mandible black (Fig. 3d). Apical area of hind trochantellus and basal area of hind femur brown. Fore wing with an apical dark mark extending downwards (Fig. 4d).

Male (n = 15; genitalia, n = 2)

Similar to female. Clypeus 0.6–0.7 times as long as wide. Antenna with 39–42 flagellomeres; first flagellomere 1.1–1.2 times as long as second flagellomere. Hind femur 4.4 times as long as maximum depth in lateral view. Hind tibia 13.4–14.2 times as long as maximum depth in lateral view. First hind tarsomere 2.1 times as long as second and 2.9–3.1 times as long as longer hind tibial spur. T1 3.1–3.2 times as long as maximum width, 2.3–2.4 times as long as T2. T2 0.9 times as long as maximum width. Antennal flagellum black, without a white band.

Subgenital plate hexagonal with basal angle obtuse (Fig. 8d). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7g). Aedeagus gently curved, its penis valve ca 1.6 times as long as basal apodeme (Fig. 7h).

Distribution

Japan (Amami-oshima Is.), and Taiwan.

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Bionomics

Host unknown. Adults mainly fly in June and July.

Spilopteron mucronatus Lee, 2008
Figs 2e, 3e, 4e, 5e, 6e, 7i–j, 8e

Spilopteron mucronatus Lee, 2008 in Lee *et al.* 2008: 276. Type locality: Korea, Gyeonggi-do Province, Yangpyeong-gun Yongnum-myeon Mt Yongmun.

Spilopteron mucronatus – Yu *et al.* 2012. — Ito *et al.* 2012: 445.

Material examined

JAPAN: 1 ♂, Soun-kyo, Kamikawa-cho, Hokkaido Pref., 13 Jul. 2012, M. Ito (LC041302, NIAES); 1 ♀, Mt Teinekanayama, Sapporo city, Hokkaido Pref., 19 Jul. 2012, Y. Nakatani (NSMT); 1 ♀, Rishiri Is., Hokkaido, 15 Jul. 1975, E. Nishida (OMNH); 1 ♀, Mt Hayachinesan, Iwate Pref., 25 Jul.–2 Aug. 1989, M. Sharkey and H. Makihara (NIAES); 1 ♀, Hanase-toge, Sakyo-ku, Kyoto Pref., 23 Jun. 2012, M. Ito (LC041301 NIAES); 1 ♀, Ideno, Mitsuse-mura, Saga Pref., 17 May 1998, R. Matsumoto (OMNH); 3 ♀♀, Mt Hiko-san, Soed-cho, Fukuoka Pref., 15 Jun. 1996, R. Matsumoto (OMNH); 1 ♀, Mt Tatera-san, Tsushima Is., Nagasaki Pref., 28 May 1997, N. Takahashi (OMNH); 1 ♂, Kamisaka, Tsushima Is., Nagasaki Pref., 3 Jun. 1996, R. Matsumoto (OMNH).

Differential diagnosis

This species can easily be distinguished from other species of *Spilopteron* by the ventral convexity of the hind femur, and the distinct sharp projection on S1 (see Ito *et al.* 2012).

Description

Female (n = 8)

Body length. 11.5–15.0 mm.

Head. Vertex 0.7–0.9 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2e). Clypeus 0.5–0.6 times as long as wide, with two strong lateral projections and a weak median projection (Figs 2e, 3e). Face 0.6 times as long as wide. Length of malar space 0.9–1.0 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 2.0–2.1. Postocellar line/lateral ocellar diameter = 1.4–1.6. Antenna with 33–35 flagellomeres; first flagellomere 1.2–1.4 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5e). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5e). Collar densely punctate. Mesoscutum densely punctate. Subalar prominence densely punctate (Fig. 5e). Scutellum strongly and sparsely punctate in dorsal view. Postscutellum flattened in lateral view (Fig. 5e). Metapleuron strongly punctate (Fig. 5e). Propodeum weakly carinate (Fig. 6e). Area externa densely punctate (Fig. 6e). Area basalis polished (Fig. 6e). Area dentipara confluent with area superomedia and transversely carinate (Fig. 6e). Area posteroexterna confluent with area petiolaris and transversely carinate (Fig. 6e). Fore wing length 9.0–12.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4e). Vein *rs-m* opposite or basad of vein *2m-cu* (Fig. 4e). Hind femur 3.1–3.5 times as long as maximum depth in lateral view, with a distinct convexity ventrally. Hind tibia 10.6–12.0 times as long as maximum depth in lateral view. First hind tarsomere 2.5–3.2 times as long as second and 3.0–3.6 times as long as longer hind tibial spur.

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Metasoma. T1 2.7–2.9 times as long as maximum width, 2.3–2.4 times as long as T2. T2 0.7–0.8 times as long as maximum width. T1 and T2 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 with a distinct sharp projection basally. Ovipositor sheath 2.7–3.0 times as long as hind tibia.

Color. Body black (Fig. 5e). Antennal flagellum without a white band, brown apically. Face and postscutellum yellow with black marking medially, but sometimes entirely black except for inner margin of eye. Clypeus, subalar prominence, propodeum, fore and mid legs, hind trochanter, hind trochantellus, apex of hind femur, and apex of T1 yellow. Fore wing with an apical dark mark extending downwards (Fig. 4e).

Male (n = 2; genitalia, n = 2)
Similar to female. Body length 10.0–13.0 mm. Face 0.6–0.7 times as long as wide. Length of malar space 0.8–0.9 times as long as basal mandibular width. Postocellar line/lateral ocellar diameter = 1.4–1.7. Antenna with 37–42 flagellomeres. Hind femur 3.0–3.1 times as long as maximum depth in lateral

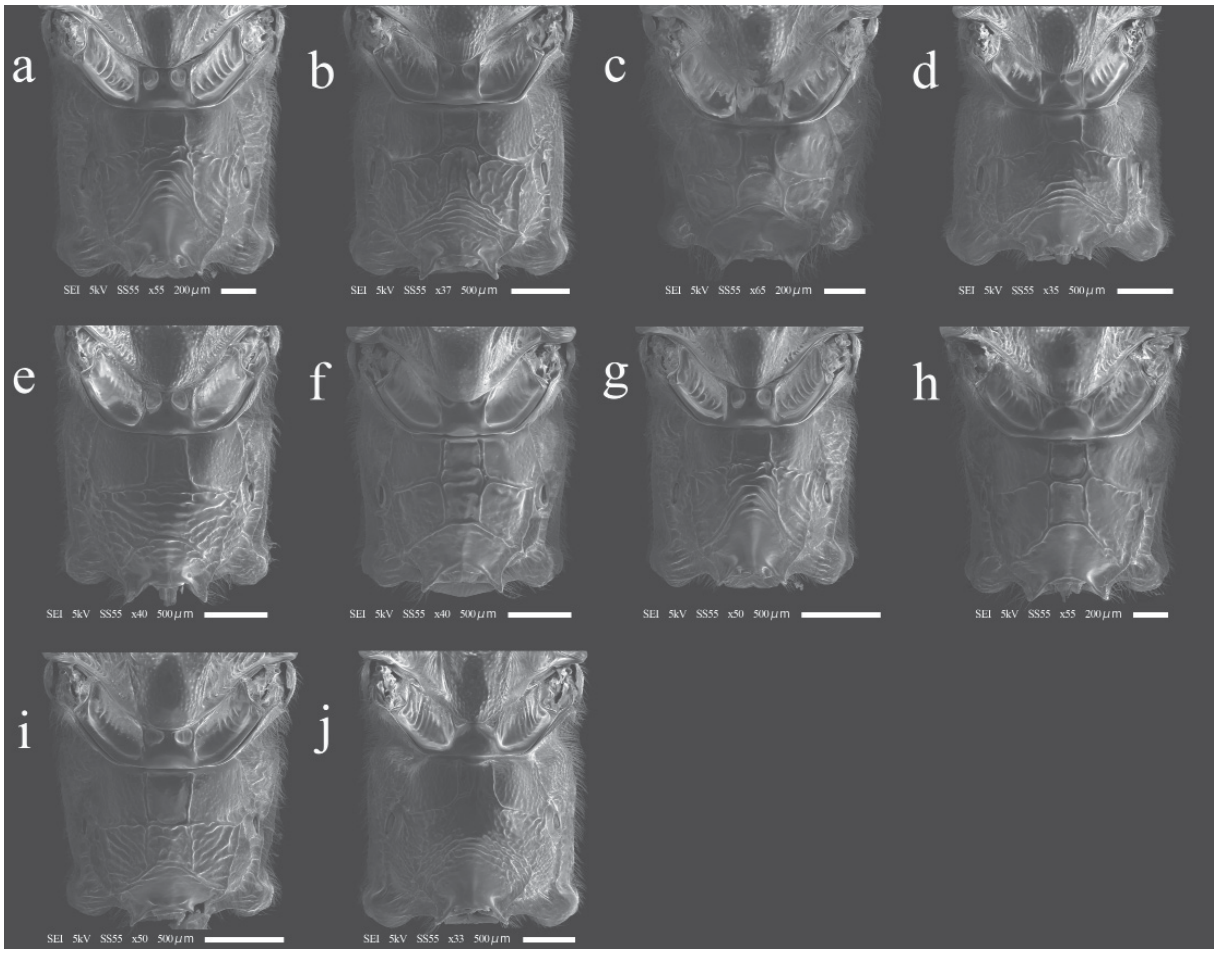

Fig. 6. Propodeum of females, dorsal view. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Fukuoka Pref. **f**. *Spilopteron nigrum* sp. nov., paratype, Hyogo Pref. **g**. *Spilopteron oblongulum* sp. nov., paratype, Kanagawa Pref. **h**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **i**. *Spilopteron pyrrhonae* Kusigemati, 1981, Kanagawa Pref. **j**. *Spilopteron tosaense* (Uchida, 1934), Hokkaido.

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view. First hind tarsomere 3.0–3.3 times as long as second. T1 3.1–3.2 times as long as maximum width, 2.0–2.2 times as long as T2. T2 0.8–1.0 times as long as maximum width. Antennal flagellum brown in apical half. Face entirely yellow. Basal area of hind tibia and apex of hind tarsus yellow.

Subgenital plate pentagonal with basal angle obtuse (Fig. 8e). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7i). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7j).

Distribution

Japan (Hokkaido, Rishiri Is.*, Honshu, Kyushu, and Tsushima Is.) and Korea. * New record.

Bionomics

Host unknown. Adults mainly fly from May to July.

Spilopteron nigrum sp. nov.
urn:lsid:zoobank.org:act:B1048E8D-173E-47D0-B0C1-9D38E8802E83
Figs 1e–f, 2f, 3f, 4f, 5f, 6f

Etymology

The specific epithet of this new species is derived from the entirely black body.

Type material

Holotype

JAPAN: ♀, "Mt. Mikuniyama, Katsuragi-cho, Wakayama Pref., Japan, 4 July 2003, R. Matsumoto leg." (OMNH).

Paratypes

JAPAN: 3 ♀♀, Mt Soranumadake, Sapporo-shi, Hokkaido, Malaise trap, 4–27 Jul. 2007, A. Ueda (OMNH); 2 ♀♀, same locality, Malaise trap, 27 Jul.–21. Aug. 2007, A. Ueda (KPMNH); 1 ♀, Ashoro-cho, Hokkaido, Malaise trap, 15 Jul.–7 Aug. 2008, A. Ueda (OMNH); 1 ♀, Nippu, Bifuka-cho, Hokkaido, Malaise trap, 19 Jun.–17 Jul. 2010, N. Kuhara and M. Sueyoshi (OMNH); 1 ♀, Shiretoko, Hokkaido, 13 Aug. 1996, T. Tachi (OMNH); 1 ♀, Nishirappu, Furano, Hokkaido, 26 Jun.–17 Jul. 2009, A. Ueda (OMNH); 2 ♀♀, Okawa, Nishimeya-mura, Aomori Pref., Malaise trap, 21–30 Jun. 2013, T. Nakamura (LC154920, LC154921 EUM); 2 ♀♀, Biwakubo-sawa, Masutomi, Hokuto-shi, Yamanashi Pref., 28 Jul. 2007, K. Watanabe (KPMNH); 2 ♀♀, same locality, Malaise trap, 28 Jul.–7 Aug. 2007, K. Watanabe (KPMNH); 1 ♀, Otaki-fudou, Katsunuma-cho, Koushu-shi, Yamanashi Pref., 9 Jul. 2007, K. Watanabe (KPMNH); 2 ♀♀, Gozaishi-onsen, Nirasaki-shi, Yamanashi Pref., Malaise trap, 8–17 Jul. 2005, K. Hosoda (OMNH); 5 ♀♀, Mt Kariyasu-yama, Kaga-shi, Ishikawa Pref., 28 Jun.–18 Jul. 2002, K. Esaki (OMNH); 1 ♀, same locality, 28 Jun.–19 Jul. 2002, K. Esaki (SEHU); 3 ♀♀, same locality, 19–31 Jul. 2002, K. Esaki (SEHU); 1 ♀, Hikagedaira, Gifu Pref., 24 Sep. 1980, E. Nishida (OMNH); 1 ♀, Utsukushimatsu, Nagawa-cho, Nagano Pref., 23 Aug. 2012, S. Fujie (KPMNH); 2 ♀♀, Nakajima, Ono-shi, Fukui Pref., Malaise trap, 22 Jun.–13 Jul. 2014, S. Fujie and T. Hirooka (LC154917, LC154919 KPMNH); 1 ♀, Akasai-keikoku, Haga-cho, Hyogo Pref., 16 Jun. 2009, R. Matsumoto (OMNH); 2 ♀♀, Mt Hyonosen, Yabu-shi, Hyogo Pref., Malaise trap, 16 Jun.–14 Jul. 2013, M. Ito and S. Fujie (NIAES); 3 ♀♀, Niiya, Kami-cho, Hyogo Pref., Malaise trap, 16 Jun.–14 Jul. 2013, M. Ito and S. Fujie (NIAES); 1 ♀, 1 ♂, same locality, Malaise trap, 26 Jun.–18 Jul. 2011, S. Fujie (NIAES); 2 ♀♀, Mt Odaigahara, Nara Pref., Malaise trap, 25 Jul.–1 Aug. 2005, A. Kawazoe (EUM).

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Differential diagnosis

This new species most resembles *S. pseudonigrum* sp. nov., but is easily distinguished from it by the distinct apical marking on the fore wing (the apical portion is only infuscate in *S. pseudonigrum* sp. nov.).

Description

Female (n = 41)

Body length. 10.0–12.0 mm.

Head. Vertex 0.4–0.5 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2f). Clypeus 0.5–0.6 times as long as wide, with three weak projections of equal size (Fig. 2f). Face 0.6–0.7 times as long as wide. Length of malar space 1.1–1.2 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.1–1.7. Postocellar line/lateral ocellar diameter = 1.0–1.3. Antenna with 28–30 flagellomeres; first flagellomere 1.3–1.4 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5f). Lateral area of pronotum densely punctate and transversely striate medially. Collar weakly punctate. Mesoscutum densely punctate (Fig. 5f). Subalar prominence extensively punctate (Fig. 5f). Scutellum densely punctate in dorsal view. Postscutellum flattened in lateral view (Fig. 5f). Metapleuron strongly punctate (Fig. 5f). Propodeum strongly carinate (Fig. 6f). Area externa and area dentipara sparsely punctate (Fig. 6f). Area basalis and area superomedia polished (Fig. 6f). Area posteroexterna confluent with area petiolaris and polished (Fig. 6f). Fore wing length 6.0–8.5 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4f). Vein *rs-m* opposite or distad of vein *2m-cu* (Fig. 4f). Hind femur 3.4–3.6 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 9.4–11.3 times as long as maximum depth in lateral view. First hind tarsomere 2.4–2.8 times as long as second and 2.2–2.5 times as long as longer hind tibial spur.

Metasoma. T1 2.0–2.3 times as long as maximum width, 2.4–2.6 times as long as T2. T2 0.6 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 2.1–2.3 times as long as hind tibia.

Color. Body black (Fig. 1e). Antennal flagellum with a white band (Fig. 1e). Inner margin of eye and middle area of mandible yellowish white (Fig. 2f). Fore and mid legs grayish brown (Fig. 1e). Apex of hind tarsus sometimes yellowish white (Fig. 1e). Fore wing with an apical dark mark, extending downwards (Fig. 4f).

Male (n = 1).

Similar to female (Fig. 1f). Body length: 9.0 mm. Head 0.7 times as long as wide in dorsal view. Face 0.8 times as long as wide. Antenna with 36 flagellomeres; first flagellomere 1.1 times as long as second flagellomere. Fore wing length 8.0 mm. Hind femur 3.2 times as long as maximum depth in lateral view. First hind tarsomere 3.7 times as long as longer hind tibial spur. T1 2.5 times as long as maximum width, 2.3 times as long as T2. T2 1.0 times as long as maximum width. Antennal flagellum without a white band (Fig. 1f). Face, clypeus, basal area of mandible, apices of T1–3, and fore and middle legs yellowish white.

Male genitalia of this species were not examined due to the limited number of specimens.

Distribution

Japan (Hokkaido and Honshu).

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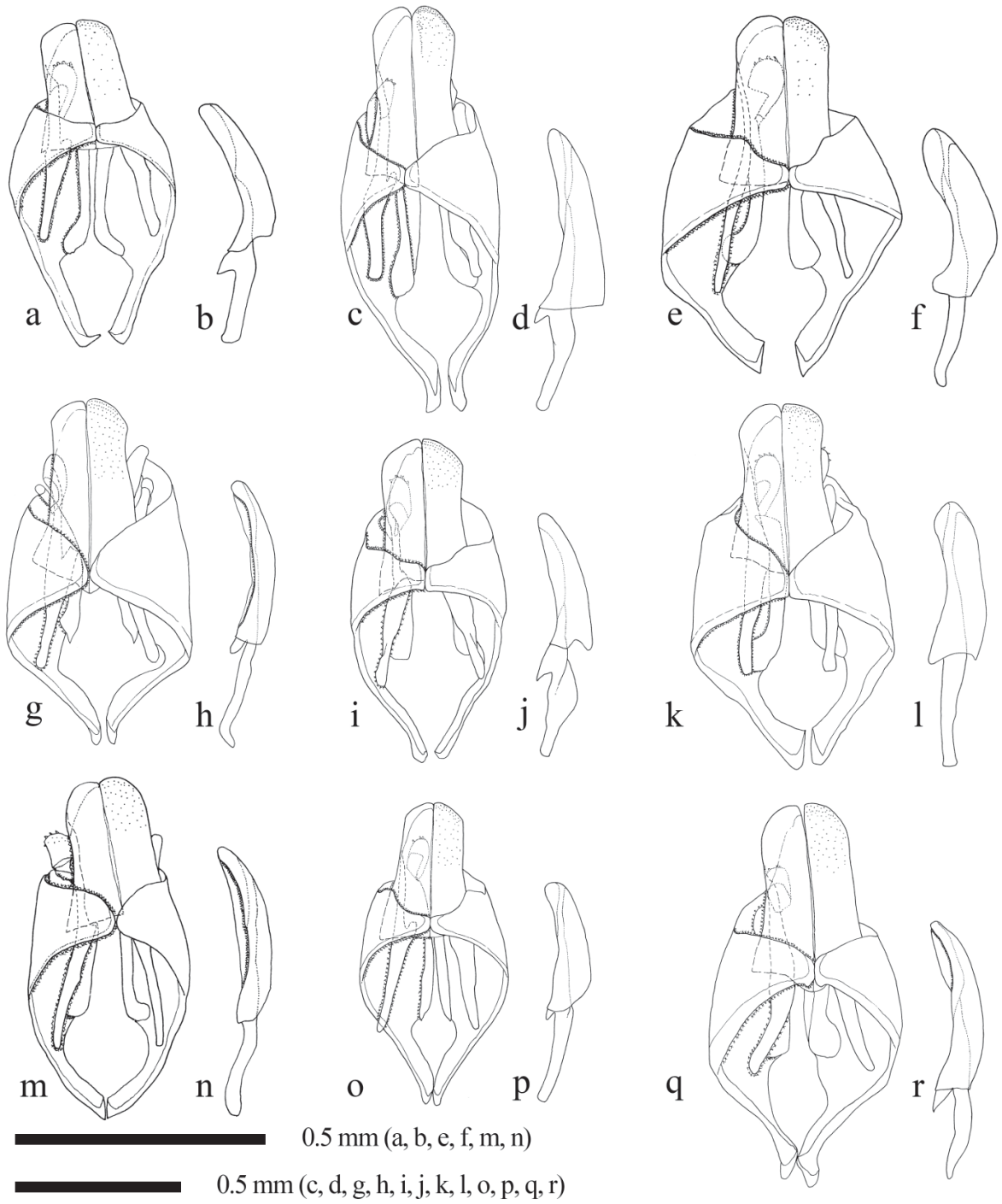

Fig. 7. Male genitalia. **a–b**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **c–d**. *Spilopteron apicale* (Matsumura, 1912), Nagano Pref. **e–f**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **g–h**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **i–j**. *Spilopteron mucronatus* Lee, 2008, Hokkaido. **k–l**. *Spilopteron oblongulum* sp. nov., paratype, Gunma Pref. **m–n**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **o–p**. *Spilopteron pyrrhonae* Kusigemati, 1981, Shizuoka Pref. **q–r**. *Spilopteron tosaense* (Uchida, 1934), Hyogo Pref. a, c, e, g, i, k, m, o, q = genital capsule, ventral view; b, d, f, h, j, l, n, p, r = aedeagus, lateral view.

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Bionomics

Host unknown. Adults mainly fly in July and August.

Spilopteron oblongulum sp. nov.
urn:lsid:zoobank.org:act:E842665F-8874-4BCA-92B0-919E768DADCE
Figs 1g–h, 2g, 3g, 4g, 5g, 6g, 7k–l, 8f

Etymology

The specific epithet of this new species is derived from the long ovipositor sheath.

Type material

Holotype

JAPAN: 1 ♀, "Oku-nikko, Nikko-shi, Tochigi Pref., Japan, 9. August 1980, K. Konishi leg." (NIAES).

Paratypes

JAPAN: 1 ♀, Doudaira, Tanzawa, Kanagawa Pref., 29 Aug. 1993 T. Kinoshita (NIAES); 1 ♀, 1 ♂, Mt Mikuniyama, Yamakita-cho, Kanagawa Pref., 11 Aug. 2015, T. Taniwaki (LC154926, LC154927 KPMNH); 1 ♂, same locality, 1–2 Aug. 2005, M. Takakuwa (NIAES); 1 ♂, Mt Hotaka-san, Katashina-mura, Gumma Pref., 2 Aug. 2007, K. Watanabe (KPMNH); 1 ♂, Mt Ontake-san, Outaki-mura, Nagano Pref., 7 Aug. 2010, K. Watanabe (KPMNH).

Differential diagnosis

This new species most resembles *S. flavescutatum* Wang, 2004 and *S. longitubus* Wang, 2004 from China, but is easily distinguished from the former by the long T1, which is 3.5–4.3 times as long as wide (2.7 times in *S. flavescutatum*), and from the latter by the polished area petiolaris (rugose in *S. longitubus*); the female antenna has 35 flagellomeres (43 flagellomeres in *S. longitubus*), and the male S1 ends in front of the spiracles of T1 (a little behind in *S. longitubus*). ML analysis indicates that this species is most closely related to *S. apicale*. Morphologically, this species shares some unique character states with *S. apicale*, such as the shape of clypeus and the depression between the eye and antennal socket, but it has an obviously longer ovipositor.

Description

Female (n = 3)

Body length. 13.0–17.0 mm.

Head. Vertex 0.5 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2g). Clypeus 0.6 times as long as wide, with two lateral projections (Figs 2g, 3g). Face 0.7–0.8 times as long as wide. Length of malar space 1.0–1.1 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.4–1.6. Postocellar line/lateral ocellar diameter = 1.1. Antenna with 35 flagellomeres; first flagellomere 1.2–1.3 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5g). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5g). Collar weakly punctate. Mesoscutum densely punctate. Subalar prominence extensively punctate (Fig. 5g). Scutellum densely punctate in dorsal view. Postscutellum roundly convex in lateral view (Fig. 5g). Metapleuron extensively punctate (Fig. 5g). Propodeum strongly carinate (Fig. 6g). Area externa densely punctate (Fig. 6g). Area basalis, area dentipara and area superomedia weakly carinate (Fig. 6g). Area posteroexterna confluent with area petiolaris (Fig. 6g). Fore wing length 11.5–14.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4g). Vein *rs-m* opposite or basad

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of vein *2m-cu* (Fig. 4g). Hind femur 4.7–5.1 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 13.3–13.5 times as long as maximum depth in lateral view. First hind tarsomere 2.3–2.6 times as long as second and 3.5–3.8 times as long as longer hind tibial spur.

Metasoma. T1 2.9–3.7 times as long as maximum width, 2.1–2.2 times as long as T2. T2 0.9–1.0 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 2.3–2.6 times as long as hind tibia.

Color. Body black (Fig. 5g). Antennal flagellum with a white band (Fig. 1g). Inner margin of eye, clypeus, basal area of mandible, scutellum, postscutellum, area petiolaris and apices of T1 and T2 yellow. Fore and mid legs, trochanter, trochantellus and hind tarsus tinged yellowish brown. Fore wing with an apical dark mark extending downwards (Fig. 4g).

Male (n = 4; genitalia, n = 2)
Similar to female (Fig. 1h). Vertex 0.6–0.7 times as long as maximum length of eye in dorsal view. Face 0.7–0.8 times as long as wide. Ocello-ocular line/lateral ocellar diameter = 1.3–1.5. Postocellar line/lateral ocellar diameter = 0.9–1.3. Antenna with 39–41 flagellomeres; first flagellomere 1.0–1.2 times as long as second flagellomere. Fore wing length 12.0–14.5 mm. Hind femur 5.5–5.7 times as long as maximum depth in lateral view. Hind tibia 12.6–14.0 times as long as maximum depth in lateral view. First hind tarsomere 2.2–2.4 times as long as second and 4.3–4.8 times as long as longer hind tibial spur. T1 3.5–4.3 times as long as maximum width. S1 in front of spiracles of T1. T2 1.0–1.1 times as long as maximum width. Antennal flagellum yellowish brown, without a white band (Fig. 1h). Face, basal area of T1 yellowish brown. Hind femur and tibia yellow to brown.

Subgenital plate hexagonal with basal angle obtuse (Fig. 8f). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7k). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7l).

Distribution

Japan (Honshu).

Bionomics

Host unknown. Adults fly in August.

Spilopteron pseudonigrum sp. nov.
urn:lsid:zoobank.org:act:649F2A74-91F4-44EB-A17B-0F9687FE819D
Figs 1i–j, 2h, 3h, 4h, 5h, 6h, 7m–n, 8g

Etymology

The specific epithet of this new species is derived from the similarity to *S. nigrum* sp. nov.

Type material

Holotype
JAPAN: ♀, "Mt. Hyonosen, Yabu-shi, Hyogo Pref., Japan, 16 June–14 July 2013, M. Ito & S. Fujie leg." Malaise trap, (OMNH).

Paratypes
JAPAN: 7 ♂♂, Kawaratai, Nishimeya-mura, Aomori Pref., Malaise trap, 12–21 Jun. 2013, T. Nakamura (LC154923, LC154924 EUM); 6 ♂♂, same locality, Malaise trap, 21–30 Jun. 2013, T. Nakamura

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(EUM); 2 ♀♀, 5 ♂♂, same locality, Malaise trap, 30 Jun.–15 Jul. 2013, T. Nakamura (LC154922 EUM); 1 ♀, Asahi-kosen, Yamagata Pref., 23 Jul. 1971, A. Nagatomi (SEHU), 1 ♂, Mt Yudono-san, Asahi-mura, Yamagata Pref., 12 Aug. 1996, N. Takahashi (OMNH); 1 ♀, Hinoemata-mura, Fukushima Pref., 24–25 Aug. 1989, K. Konishi (NIAES); 1 ♀, Suginosawa, Myoko-shi, Niigata Pref., 3 Aug. 2012, M. Ito (KPMNH); 1 ♀, same locality, 16 Jul. 2013, S. Shimizu (KPMNH); 1 ♀, same locality, 17 Aug. 2013, S. Shimizu (KPMNH); 2 ♀♀, Mt Hotaka-san, Katashina-mura, Gunma Pref., 1 Aug. 2007, T. Ishizaki (KPMNH); 1 ♀, same locality, 2 Aug. 2007, M. Irie (KPMNH); 1 ♀, Hirogawara, Ashiyasu-mura, Yamanashi Pref., 14 Jul. 1996, T. Tachi (OMNH); 1 ♀, Mt Hakkaisan, Outaki-mura, Nagano Pref., 28 Jul. 2013, S. Shimizu (KPMNH); 1 ♀, Hirugano-kogen, Gujo-shi, Gifu Pref., 8 Jul. 2006, H. Yoshida (OMNH); 1 ♀, Nakajima, Ono-shi, Fukui Pref., Malaise trap, 22 Jun.–13 Jul. 2014, S. Fujie and T. Hirooka (OMNH); 1 ♀, Mt Haku-san, Ishikawa Pref., 3 Aug. 1988, I. Togashi (NIAES); 9 ♀♀, 1 ♂, same data as holotype (OMNH); 1 ♀, Mt Koya-yama, Odamiyama, Ehime Pref., 11 Jul. 1994, E. Yamamoto (NIAES).

Differential diagnosis

This new species most resembles *S. nigrum* sp. nov., although it can be distinguished by the merely infuscate apical area of the fore wing (with a distinct apical mark in *S. nigrum* sp. nov.). Although *S. pseudonigrum* sp. nov. and *S. nigrum* sp. nov. are difficult to distinguish from each other, they are distinct by molecular analysis (Fig. 9); the genetic distance between them was about 9.8 %. This species also resembles *S. brachyurum* sp. nov., but it has a square area superomedia of the propodeum (the area is rounded in *S. brachyurum* sp. nov.).

Description

Female (n = 27).

Body length. 6.5–9.5 mm.

Head. Vertex 0.4 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2h). Clypeus 0.3–0.6 times as long as wide, with three weak projections of equal size (Figs 2h, 3h). Face 0.7 times as long as wide. Length of malar space 1.1–1.3 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.3–1.7. Postocellar line/lateral ocellar diameter = 1.2. Antenna with 27–28 flagellomeres; first flagellomere 1.2–1.4 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5h). Lateral area of pronotum densely punctate and transversely striate medially. Collar weakly and sparsely punctate. Mesoscutum densely punctate (Fig. 5h). Subalar prominence extensively punctate (Fig. 5h). Scutellum sparsely punctate in dorsal view. Postscutellum flattened in lateral view (Fig. 5h). Metapleuron sparsely punctate (Fig. 5h). Propodeum strongly carinate (Fig. 6h). Area superomedia square. Area externa and area dentipara sparsely punctate (Fig. 6h). Area basalis and area superomedia polished (Fig. 6h). Area posteroexterna confluent with area petiolaris and polished (Fig. 6h). Fore wing length 6.0–8.5 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4h). Vein *rs-m* opposite or distad of vein *2m-cu* (Fig. 4h). Hind femur 3.5–3.7 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 8.7–9.5 times as long as maximum depth in lateral view. First hind tarsomere 2.4–2.8 times as long as second one and 2.1–2.4 times as long as longer hind tibial spur.

Metasoma. T1 1.9–2.4 times as long as maximum width, 2.2–2.7 times as long as T2. T2 0.5–0.7 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 2.0–2.3 times as long as hind tibia.

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Color. Body black (Fig. 1i). Antennal flagellum with a white band (Fig. 1i). Inner margin of eye and middle area of mandible yellowish white (Fig. 2h). Fore and mid legs grayish brown (Fig. 1i). Apex of hind tarsus sometimes yellowish white (Fig. 1i–j). Fore wing lacking dark marks, with only an infuscate apical area (Fig. 4h).

Male (n = 19; genitalia, n = 2)
Similar to female (Fig. 1j). Vertex 0.4–0.5 times as long as maximum length of eye in dorsal view. Face 0.7–0.8 times as long as wide. Length of malar space 0.9–1.2 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.2–1.4. Postocellar line/lateral ocellar diameter = 1.0–1.4. Antenna with 33–36 flagellomeres; first flagellomere 1.1–1.4 times as long as second flagellomere. Hind tibia 8.3–9.6 times as long as maximum depth in lateral view. First hind tarsomere 2.4–2.9 times as long as second and 2.2–2.6 times as long as longer hind tibial spur. T1 2.3–3.2 times as long as maximum width. T2 0.7–0.9 times as long as maximum width. Antennal flagellum without a white band. Face, clypeus, basal area of mandible, apices of T1 and T2, and fore and mid legs yellowish white.

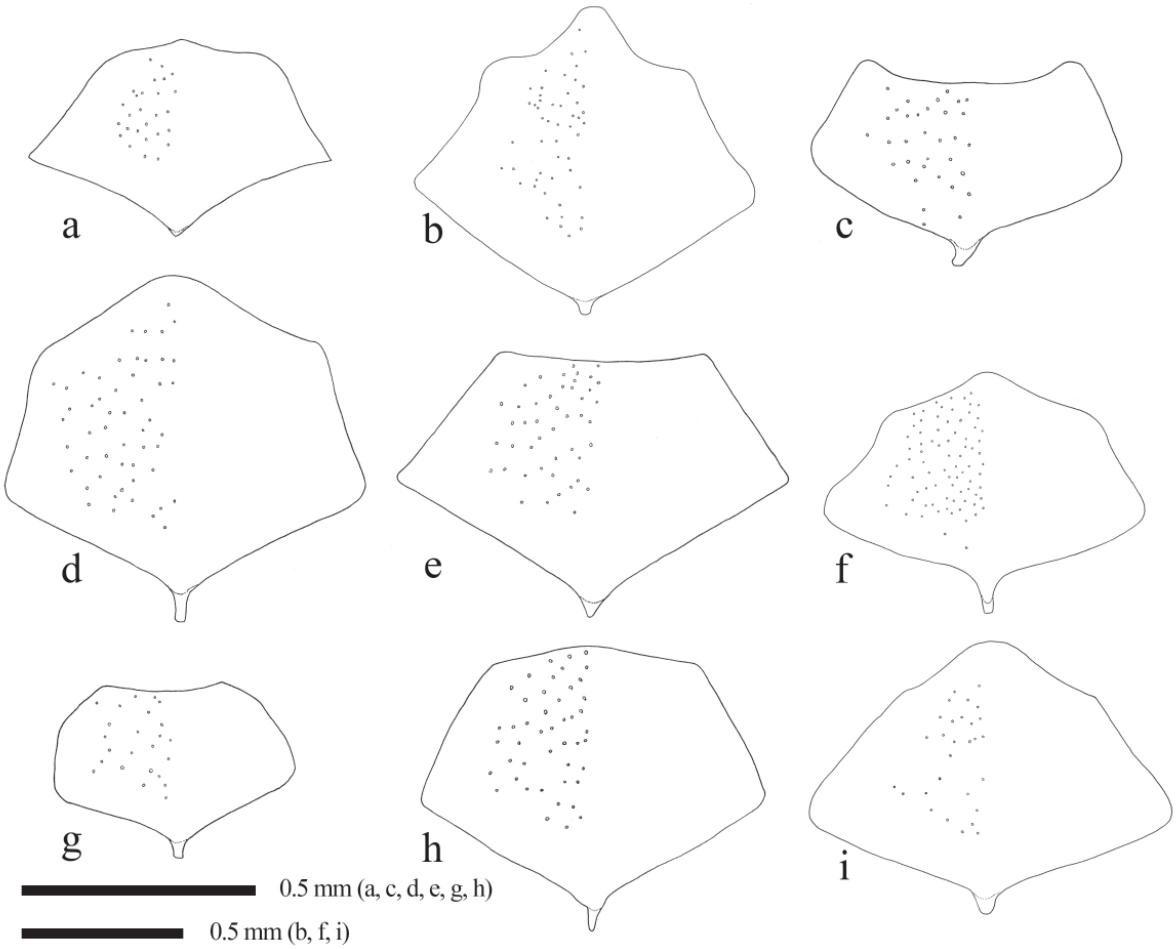

Fig. 8. Male subgenital plate, ventral view. **a**. *Spilopteron albiventre* sp. nov., paratype, Ehime Pref. **b**. *Spilopteron apicale* (Matsumura, 1912), Yamanashi Pref. **c**. *Spilopteron brachyurum* sp. nov., paratype, Hokkaido. **d**. *Spilopteron luteum* (Uchida, 1930), Amami-oshima Is. **e**. *Spilopteron mucronatus* Lee, 2008, Hokkaido. **f**. *Spilopteron oblongulum* sp. nov., paratype, Gunma Pref. **g**. *Spilopteron pseudonigrum* sp. nov., paratype, Hyogo Pref. **h**. *Spilopteron pyrrhonae* Kusigemati, 1981, Shizuoka Pref. **i**. *Spilopteron tosaense* (Uchida, 1934), Hyogo Pref.

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Subgenital plate pentagonal with basal angle obtuse (Fig. 8g). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7m). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7n).

Distribution

Japan (Honshu and Shikoku).

Bionomics

Host unknown. Adults mainly fly in July and August.

Spilopteron pyrrhonae Kusigemati, 1981
Figs 2i, 3i, 4i, 5i, 6i, 7o–p, 8h

Spilopteron pyrrhonae Kusigemati, 1981: 123. Type locality: Japan, Kagoshima Pref.

Spilopteron pyrrhonae – Yu *et al.* 2005, 2012.

Material examined

Holotype
JAPAN: 1 ♀, Takachiho-gawara, Kagoshima Pref., 24 Apr. 1975, Y. Minami (SEHU).

Other material examined
JAPAN: 3 ♀♀, 2 ♂♂, Kamiyu, Hakone-machi, Kanagawa Pref., 20 Dec. 2003 (emerged), K. Watanabe (KPMNH); 1 ♀, 1 ♂, Amagi-kogen, Izu-shi, Shizuoka Pref., Apr. 2008 (emerged), H. Kawai (KPMNH); 1 ♀, 1 ♂, Amagi-toge, Kawazu-shi, Shizuoka Pref., 27 Apr. 2013 (emerged), A. Kosaki (LC041988, LC041989 OMNH); 1 ♀, same locality, 27 Apr. 2013 (emerged), Y. Shiozawa (LC041990 NIAES); 1 ♀, Kurodake, Oita Pref., 8–9 Jun. 1985, T. Hirowatari (NIAES); 1 ♂, Katamukiyama, Ogata-machi, Oita Pref., 6 Jun. 1992, R. Noda (NIAES); 1 ♂, Hikosan, Fukuoka Pref., 19 Apr. 1980 (emerged), R. Noda (NIAES); 1 ♀, 1 ♂, same locality, Jun. 1982 (emerged), R. Noda (NIAES); 1 ♀, same locality, 30 Mar. 1982 (emerged), R. Noda (NIAES).

Differential diagnosis

This species resembles *S. brachyurum* sp. nov. and *S. nigrum* sp. nov.; however, it can be distinguished from them by the rounded apical dark mark on the fore wing (extending downwards in *S. brachyurum* sp. nov. and *S. nigrum* sp. nov.), and turned up clypeus in lateral view (not turned up in *S. brachyurum* sp. nov. and *S. nigrum* sp. nov.). It is also easily distinguished from other Japanese *Spilopteron* by the above character states.

Description

Female (n = 11)
Body length. 10.5–13.0 mm.

Head. Vertex 0.6–0.7 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2i). Clypeus 0.6 times as long as wide, with two strong lateral projections, and anterior margin turned up (Figs 2i, 3i). Face 0.6–0.7 times as long as wide. Length of malar space 0.9–1.2 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.4–1.8. Postocellar line/lateral ocellar diameter = 0.9–1.4. Antenna with 32–33 flagellomeres; first flagellomere 1.3 times as long as second flagellomere.

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Mesosoma. Propleuron densely punctate (Fig. 5i). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5i). Collar weakly punctate. Mesoscutum densely punctate. Subalar prominence extensively punctate (Fig. 5i). Scutellum weakly punctate in dorsal view. Postscutellum flattened in lateral view (Fig. 5i). Metapleuron weakly punctate (Fig. 5i). Propodeum strongly carinate (Fig. 6i). Area externa and area dentipara punctate (Fig. 6i). Area basalis polished (Fig. 6i). Area superomedia weakly carinate (Fig. 6i). Area petiolaris polished (Fig. 6i). Fore wing length 9.5–10.0 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4i). Vein *rs-m* opposite vein *2m-cu* (Fig. 4i). Hind femur 3.5–3.9 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 10.8–11.8 times as long as maximum depth in lateral view. First hind tarsomere 2.4–2.6 times as long as second and 2.2–2.5 times as long as longer hind tibial spur.

Metasoma. T1 2.2–2.5 times as long as maximum width, 2.0–2.3 times as long as T2. T2 0.6–0.7 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 2.0–2.1 times as long as hind tibia.

Color. Body black (Fig. 5i). Antennal flagellum with a white band. Inner margin of eye and hind tarsomeres 3–5 white to yellowish white. Fore and mid legs brown. Fore wing with a rounded apical dark mark (Fig. 4i).

Male (n = 7; genitalia, n = 2)
Similar to female. Clypeus 0.6–0.8 times as long as wide. Length of malar space 1.0–1.3 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.4–2.0. Postocellar line/lateral ocellar diameter = 1.1–1.5. Antenna with 37–39 flagellomeres; first flagellomere 1.2–1.3 times as long as second flagellomere. Hind femur 3.4–4.1 times as long as maximum depth in lateral view. First hind tarsomere 2.1–2.7 times as long as second and 2.7–3.3 times as long as longer hind tibial spur. Metasoma. T1 2.6–3.0 times as long as maximum width, 1.9–2.3 times as long as T2. T2 0.8–1.0 times as long as maximum width. Face, basal area of mandible, hind tarsus and apices of T1 and T2 yellowish white. Fore and mid legs, trochanters and trochantelli yellowish brown.

Subgenital plate pentagonal with basal angle obtuse (Fig. 8h), its length ca 0.7 times as long as aedeagus. Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7o). Aedeagus gently curved, its penis valve ca 1.3 times as long as basal apodeme (Fig. 8h).

Distribution

Japan (Honshu, Shikoku and Kyushu).

Bionomics

Kusigemati (1981) reported that this species is a parasitoid of *Pyrrhona laeticolor* (Cerambycidae). Adults fly in May and June.

Spilopteron tosaense (Uchida, 1934)
Figs 2j–k, 3j, 4j–k, 5j–k, 6j, 7q–r, 8i

Siphimedia apicalis f. *tosaensis* Uchida, 1934: 53. Type locality: Japan, Kochi Pref.
Siphimedia apicalis var. *yakushimemsis* Uchida, 1934: 53. Synonymized by Townes *et al.* (1965).

Spilopteron tosensis – Townes *et al.* 1965: 39. — Kusigemati 1981: 121.
Spilopteron apicalis – Kusigemati 1981: 118 (in part).
Spilopteron tosaense – Yu *et al.* 2005, 2012. — Ito *et al.* 2015: p. 547.

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Material examined

JAPAN: 1 ♀ (holotype of *Siphimedia apicalis* f. *tosaensis*), Mt Koeda, Kochi Pref., 12 Jul. 1933, Y. Sugihara (SEHU); 1 ♀ (holotype of *Siphimedia apicalis* f. *yakushimensis*), Hananoegawa, Kuriu, Yakushima Is., Kagoshima Pref., 31 Jul. 1929, H. Hori (SEHU); 1 ♀, Hitsujigaoka, Sapporo-shi, Hokkaido, 26 Jul.–2 Aug. 2008, K. Konishi (EUM); 2 ♀♀, same locality, 4–11 Aug., 2008, K. Konishi (EUM); 2 ♀♀, same locality, 20–27 Jul. 2010, K. Konishi (EUM); 3 ♀♀, same locality, 25 Jul.–1 Aug. 2011, K. Konishi (EUM); 2 ♀♀, same locality, 1–8 Aug. 2011, K. Konishi (EUM); 5 ♀♀, same locality, 25 Jul.–1 Aug. 2012, K. Konishi (LC041271 EUM); 3 ♀♀, same locality, 1–8 Aug. 2012, K. Konishi (EUM); 3 ♀♀, Oyubari, Yubari-shi, Hokkaido, 24 Jul.–24 Aug. 2006, A. Ueda (OMNH); 1 ♀, same locality, 3–17 Aug. 2007, A. Ueda (OMNH); 1 ♀, Ashoro-cho, Hokkaido, 17 Jul.–7 Aug. 2008, A. Ueda (OMNH); 1 ♀, Takinoshita, Kuriyama-cho, Hokkaido, 16 Jul.–5 Aug. 2009, A. Ueda (OMNH); 1 ♀, Mt Hakkodasan, Aomori Pref., 15 Aug. 1927, T. Uchida (SEHU); 1 ♀, Kodomari Peninsula, Nakadomari-cho, Aomori Pref., 28 Jul. 2013, D. Kato (KPMNH); 1 ♀, Okawa, Nishimeya-mura, Aomori Pref., 25 Jul.–6 Aug. 2013, T. Nakamura (EUM); 2 ♀♀, Kawaratai, Nishimeya-mura, Aomori Pref., 4–19 Aug. 2011, T. Nakamura (EUM); 1 ♀, Mt Hakaseyama, Showa-mura, Fukushima Pref., 29 Jun.–26 Jul. 1998, T. Muroi and S. Morishita (MU); 1 ♀, Mt Nokogiriyama, Suyoshi-cho, Nagaoka-shi, Niigata Pref., 21 Jul.–21 Aug. 2014, So Shimizu and R. Shimizu (KPMNH); 1 ♀, Mt Houhyousan, Oda, Tsukuba-shi, Ibaraki Pref., 28 Jun.–2 Aug. 2013, S. Shimizu (NSMT); 1 ♂, Mt Togarisengen, Tojoji, Tsuchiura-shi, Ibaraki Pref., 1 Jul.–5 Aug. 2014, S. Shimizu (NSMT); 1 ♀, Kurabuchi-mura, Takasaki-shi, Gunma Pref., 2 Aug. 2002, H. Suzuki (KPMNH); 1 ♂, Ayuta, Mogi-machi, Tochigi Pref., 23 Jul. 2011, M. Inaizumi (KPMNH); 1 ♂, Otaki-mura, Chichibu-shi, Saitama Pref., 13–14 Jul. 2002, T. Nambu (KPMNH); 1 ♂, Irikawa forest road, Otaki-mura, Chichibu-shi, Saitama Pref., 20–21 Jul. 2013, N. Kikuchi (NSMT); 2 ♂♂, Shiraishi-toge, Higashichichibu-mura, Saitama Pref., 20 Jul. 2013, N. Kikuchi (NSMT); 1 ♂, Manazuru, Manazuru-cho, Kanagawa Pref., 30 Jun. 2013, K. Watanabe (KPMNH); 1 ♀, Tanzawa, Kanagawa Pref., 21 Aug. 1993, K. Kudo (NIAES); 1 ♀, 1 ♂, Otone-toge, Hankone, Kanagawa Pref., 27 Jul. 1999, H. Nagase (KPMNH); 1 ♀, Mt Koboyama, Hadano-shi, Kanagawa Pref., 28 Jun. 2008, K. Watanabe (KPMNH); 1 ♂, Fudago, Kimitsu-shi, Chiba Pref., 18 Jul. 2010, S. Tsuyuki (KPMNH); 1 ♀, Takekura, Mishima-shi, Shizuoka Pref., 23 Jun.–8 Jul. 2012, A. Ishikawa (KPMNH); 1 ♀, Inatori, Higashiizu-shi, Shizuoka Pref., 7 Jul. 2009, T. Muraki (KPMNH); 1 ♂, Biwakubo-zawa, Masutomi, Hokuto-shi, Yamanashi Pref., 8 Aug. 2008, K. Watanabe (KPMNH); 1 ♀, Tano, Yamato-cho, Koshu-shi, Yamanashi Pref., 5 Aug. 2008, K. Watanabe (KPMNH); 2 ♀♀, Maruno-cho, Nirasaki-shi, Yamanashi Pref., 26 Jun.–20 Jul. 2007, K. Hosoda (OMNH); 2 ♀♀, same locality, 30 Jul.–30 Aug. 2008, K. Hosoda (OMNH); 3 ♀♀, 2 ♂♂, 1 Aug.–10 Oct. 2007, K. Hosoda (OMNH); 8 ♀♀, 1 ♂, Mt Kariyasuyama, Kaga-cho, Ishikawa Pref., 28 Jun.–19 Jul. 2002, K. Esaki (NIAES); 4 ♀♀, same locality, 19–31 Jul. 2002, K. Esaki (NIAES); 3 ♀♀, same locality, 18–30 Jul. 2002, K. Esaki (NIAES); 1 ♀, Kute, Nyukawa-cho, Takayama-shi, Gifu Pref., 4 Aug. 2013, S. Fujie (NSMT); 2 ♀♀, Nabedaira-kogen, Takayama-shi, Gifu Pref., 13 Aug. 2013, M. Ito (LC041284 NSMT); 1 ♀, Sugadaira-kogen, Ueda-shi, nagano Pref., 10 Aug. 2012, D. Kato (LC041277 KPMNH); 1 ♂, same locality, 18 Aug. 2012, D. Kato (KPMNH); 1 ♀, same locality, 8 Aug.–3 Sep. 2014, S. Shimizu (KPMNH); 1 ♀, Utsukushimatsu, Daimon, Nagawa-cho, Nagano Pref., 26 Aug. 2011, S. Fujie (OMNH); 1 ♀, same locality, 22 Aug. 2012, S. Fujie (LC041280 OMNH); 1 ♀, 1 ♂, Ontake-kogen, Outaki-mura, Nagano Pref., 31 Jul. 2013, M. Ito (NIAES); 4 ♀♀, Yawata, Asahi-cho, Aichi Pref., 18–28 Jul. 1998, M. Ozawa (MU); 3 ♀♀, Sanage, Toyota-shi, Aichi Pref., 8–14 Jul. 2002, M. Kiyota (MU); 2 ♀♀, Tanoshiri, Asuke, Aichi Pref., 28 Jun.–5 Jul. 2005, M. Kato (MU); 2 ♀♀, Ouda, Iitaka, Matsusaka-shi, Mie Pref., 2 Sep. 2012, E. Nishida (OMNH); 2 ♀♀, same locality, 7 Aug. 2011, E. Nishida (OMNH); 3 ♀♀, same locality, 13 Aug. 2011, E. Nishida (OMNH); 3 ♀♀, 1 ♂, Oohora, Misugi-mura, Tsu-shi, Mie Pref., 24 Jul. 2011, E. Nishida (OMNH); 5 ♀♀, Mt Tadosan, Kuwana-shi, Mie Pref., 11 Jun. 2009, A. Kawazoe (EUM); 11 ♀♀, same locality, 12 Jul. 2009, A. Kawazoe (EUM); 1 ♀, Mt Syakagatake, Totsukawa-mura, Nara Pref., 10 Aug. 2013, M. Ito (SEHU); 4 ♀♀, same locality, 20 Jul.–11 Aug. 2013,

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Differential diagnosis

As shown in Ito *et al.* (2015), this species has a distinct geographical gradient in body color across the Japanese Archipelago. For that reason, this species had long been confused with *S. apicale* (see remarks on *S. apicale*).

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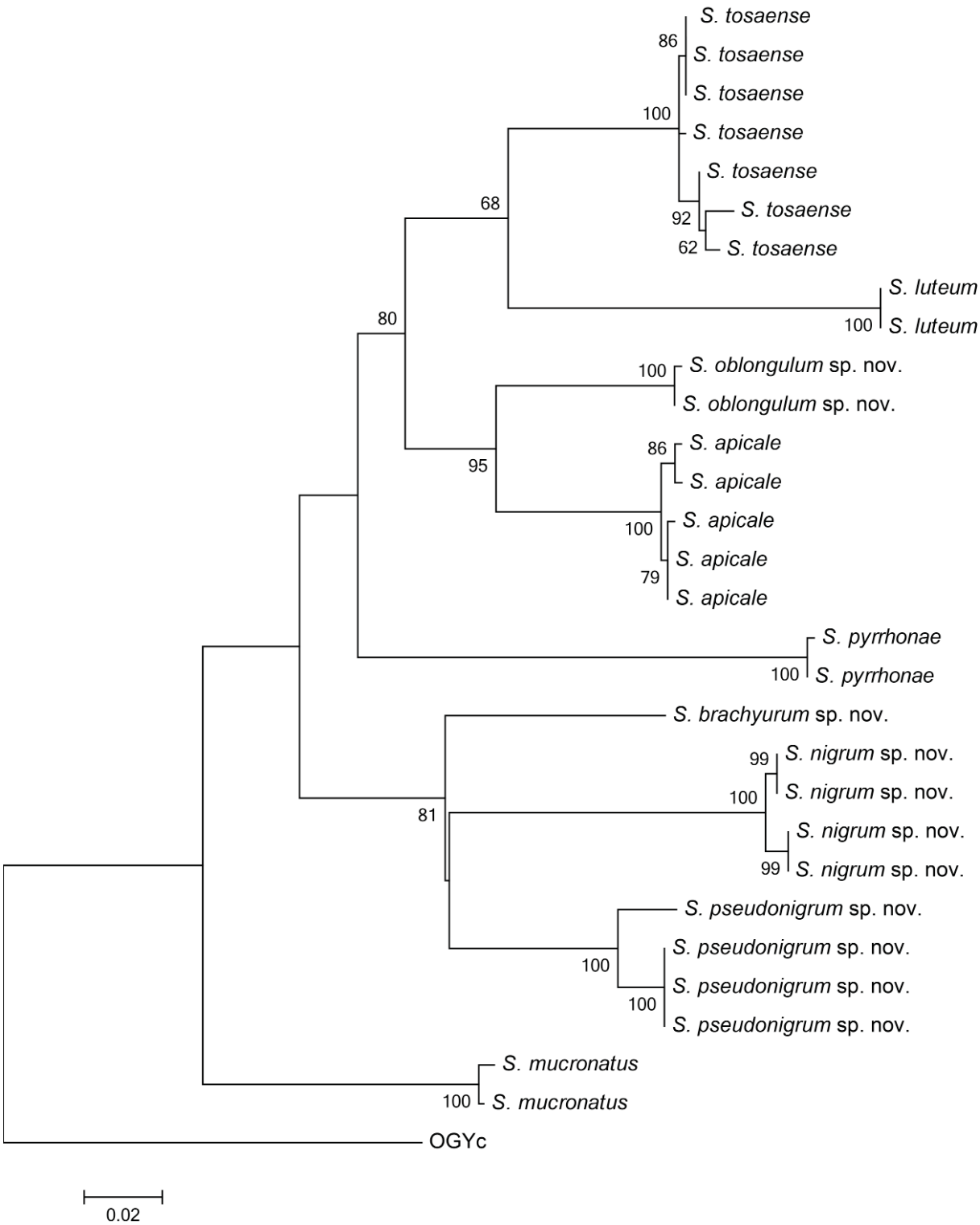

Fig. 9. Maximum-likelihood tree based on mtCOI sequences of Japanese species of *Spilopteron* and *Yamatarotes chishimensis* (Uchida, 1929) (OGYc) as an out-group. Bootstrap values (>50%) are indicated at the nodes.

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Description

Female (n = 181)

Body length. 13.0–17.0 mm.

Vertex. 0.4–0.6 times as long as maximum length of eye in dorsal view. Frons without a depression between eye and antennal socket in frontal view (Fig. 2j–k). Clypeus 0.6–0.7 times as long as wide, with three weak projections (Figs 2j–k, 3j). Face 0.6–0.7 times as long as wide. Length of malar space 0.9–1.2 times as long as basal mandibular width. Ocello-ocular line/lateral ocellar diameter = 1.5–1.8. Postocellar line/lateral ocellar diameter = 1.1–1.3. Antenna with 33–35 flagellomeres; first flagellomere 1.3–1.4 times as long as second flagellomere.

Mesosoma. Propleuron densely punctate (Fig. 5j–k). Lateral area of pronotum densely punctate and transversely striate medially (Fig. 5j–k). Collar weakly and sparsely punctate. Mesoscutum densely punctate. Subalar prominence extensively punctate (Fig. 5j–k). Scutellum densely punctate in dorsal view. Postscutellum roundly convex in lateral view (Fig. 5j–k). Metapleuron densely punctate (Fig. 8i). Propodeum indistinctly carinate (Fig. 6j). Area externa densely punctate (Fig. 6j). Area basalis polished (Fig. 6j). Area dentipara, area posteroexterna and area petiolaris confluent with area superomedia (Fig. 6j). Fore wing length 11.5–15.5 mm. Vein *cu-a* basad of vein *Rs&M* (Fig. 4j–k). Vein *rs-m* opposite or basad of vein *2m-cu* (Fig. 4j–k). Hind femur 4.0–4.3 times as long as maximum depth in lateral view, without distinct convexity ventrally. Hind tibia 10.6–12.2 times as long as maximum depth in lateral view. First hind tarsomere 2.4–2.5 times as long as second and 2.7–3.2 times as long as longer hind tibial spur.

Metasoma. T1 2.4–2.8 times as long as maximum width, 2.1–2.6 times as long as T2. T2 0.7 times as long as maximum width. T1 weakly and sparsely punctate. T2–T8 weakly and densely punctate. S1 without distinct sharp projection basally. Ovipositor sheath 1.5–1.8 times as long as hind tibia.

Color. Body black to yellowish brown (Fig. 5j–k). Antennal flagellum with a white band. Inner margin of eye, clypeus, basal part of mandible, fore and mid legs, hind legs, and basal part of T1 yellowish brown to black. Fore wing with an apical dark mark extended downwards, and in some individuals with a dark mark below the pterostigma (Fig. 4j–k).

Male (n = 66; genitalia, n = 4)

Similar to female. Body length 12.0–17.0 mm. Head 0.6 times as long as wide in dorsal view. Clypeus 0.7–0.8 times as long as wide. Face 0.5–0.8 times as long as wide. Ocello-ocular line/lateral ocellar diameter = 1.2–1.5. Antenna with 37–43 flagellomeres; first flagellomere 1.2–1.3 times as long as second flagellomere. Hind femur 4.3–4.8 times as long as maximum depth in lateral view. Hind tibia 11.0–13.2 times as long as maximum depth in lateral view. First hind tarsomere 1.9–2.3 times as long as second and 3.3–4.3 times as long as longer hind tibial spur. T1 2.5–2.9 times as long as maximum width, 1.9–2.2 times as long as T2. T2 0.9–1.0 times as long as maximum width. Body invariably yellow with dark stripes.

Subgenital plate hexagonal with basal angle obtuse (Fig. 8i). Paramere short, basal part strongly projecting towards base of subgenital plate (Fig. 7q). Aedeagus gently curved, its penis valve ca 2.0 times as long as basal apodeme (Fig. 7r).

Distribution

Japan (Hokkaido*, Honshu, Shikoku, Kyushu, Tsushima Is.* and Yakushima Is.) and China. *New records.

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Bionomics

Host unknown, although in Honshu the first author (M.I.) often observed females ovipositing into coniferous trunks, into which a Cerambycidae (*Leptura ochraceofasciata* (Motschulsky, 1861)) was also ovipositing. Adults fly from June to August, visiting flowers of *Angelica pubescens* and *Aralia cordata*.

Key to the Japanese species of Spilopteron

1. Hind femur with a distinct convexity ventrally; S1 with a distinct sharp projection basally (see Ito *et al.* 2012). Ovipositor sheath long (2.7–3.0 times as long as hind tibia) ..... ***S. mucronatus*** Lee, 2008
– Hind femur without a convexity ventrally; S1 without a sharp projection basally. Ovipositor sheath short to long (less than 2.6 times as long as hind tibia) 2

2. Postscutellum roundly convex in lateral view (Fig. 5b, d, g, j–k). Body with yellow markings or entirely reddish yellow (Fig. 5b, d); males never with a white band on antennal flagellum (Fig. 1h); body relatively large (10–17 mm) 3
– Postscutellum flat in lateral view (Fig. 5a, c, e, f, h–i). Body entirely black or with yellow markings (Fig. 5a, c); males sometimes with a white band on antennal flagellum (Fig. 1b); body relatively small (6–13 mm) 6

3. Body entirely reddish yellow (Fig. 5d); fore wing with only an infuscate marking apically (Fig. 4d) ..... ***S. luteum*** (Uchida, 1934)
– Body at least with black parts (Fig. 5b, k); fore wing with one or two distinct dark markings (Fig. 4b, k) 4

4. Depression between eye and antennal socket absent (Fig. 2j–k); clypeus with three weak projections (Fig. 2j–k). Body black with yellow markings or yellow with black markings (Fig. 5j–k); fore wing sometimes with a black spot below the pterostigma (Fig. 4k) ..... ***S. tosaense*** (Uchida, 1934)
– Depression between eye and antennal socket present (Fig. 2b, g); clypeus with two strong lateral projections (Fig. 2b, g). Body black with yellow markings (Fig. 5b, g); fore wing never with a black spot below the pterostigma (Fig. 4b, g) 5

5. Apical black marking of fore wing extending downwards (Fig. 4g); T1 slender (3.5–4.3 times as long as wide); ovipositor sheath long (2.3–2.6 times as long as hind tibia) ..... ***S. oblongulum*** sp. nov.
– Apical black marking of fore wing rounded, not extending downwards (Fig. 4b); T1 broad (2.2–3.3 times as long as wide); ovipositor sheath short (1.8 times as long as hind tibia) ..... ***S. apicale*** (Matsumura, 1912)

6. Fore wing with only an infuscate apical portion (Fig. 4c, h) 7
– Fore wing with a distinct black marking apically (Fig. 4a, f, i) 8

7. Area superomedia of propodeum rounded (Fig. 6c); ovipositor sheath short (1.9 times as long as hind tibia) (Fig. 1c). Antennal flagellum with a white band in female and male (Fig. 1d) ..... ***S. brachyurum*** sp. nov.
– Area superomedia of propodeum squared (Fig. 6h); ovipositor sheath long (2.0–2.3 times as long as hind tibia). Antennal flagellum with a white band in female but without it in male (Fig. 1f, j) ..... ***S. pseudonigrum*** sp. nov.

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8. Malar space long (length of malar space 1.3–1.4 times as long as basal mandibular width); apex of metasoma yellowish white (Fig. 1a–b) ..... ***S. albiventre*** sp. nov.
– Malar space short (length of malar space 0.9–1.2 times as long as basal mandibular width); apex of metasoma black (Fig. 1e–f) 8

9. Apical black marking of fore wing rounded, not extending downwards (Fig. 1i); apical margin of clypeus turned up in lateral view. Antennal flagellum with a white band in female and male .....***S. pyrrhonae*** Kusigemati, 1981
– Apical black marking of fore wing extending downwards (Fig. 1f); apical margin of clypeus flattened. Antennal flagellum with a white band in female but without it in male (Fig. 1f) ....***S. nigrum*** sp. nov.

Discussion

We recognize ten species of *Spilopteron* from Japan, of which six occur in Hokkaido, nine in Honshu, five in Shikoku, four in Kyushu and two in the Nansei Islands (Yakushima Is., Amami-oshima Is.). In other countries, this genus is known from the U.S.A. (four species), Canada (three species), Far East Russia (one species), mainland China (22 species), Korea (one species), and Taiwan (two species) (Yu *et al.* 2012; Ito *et al.* 2012). Therefore, this genus seems to have its center of diversity in the mid-latitude area of East Asia.

In terms of body color, female *S. tosaense* are known to show an increasing melanism from south to north in the Japanese Archipelago (Ito *et al.* 2015). Also, *S. luteum*, distributed in Taiwan and southern Japan, has an entirely yellowish body color, although most Japanese species are dark. Similarly, many Chinese species of *Spilopteron* in southern areas have a yellowish body color (Wang 2004). In another case from ichneumonids, species of *Apechthis* Förster, 1869 show two conspicuous body color patterns: black or yellow (Watanabe & Takasuka 2013). The black species are mainly distributed in the Holarctic and Himalayan regions, but the yellow species are mainly in the Oriental and Neotropical regions. Therefore, such geographical color variation within or among species, along a latitudinal gradient or related to ecology (open or closed environment), seems not to be uncommon in ichneumonid wasps.

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