

## The Rhipiceridae of Taiwan and Japan (Insecta: Coleoptera: Dascilloidea)

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(Accepted August 20, 2005)

**Chi-Feng Lee, Masataka Satô, and Masahiro Sakai (2005)** The Rhipiceridae of Taiwan and Japan (Insecta: Coleoptera: Dascilloidea). *Zoological Studies* 44(4): 437-444. Species of the family Rhipiceridae in Taiwan and Japan are reviewed. Three known species are regarded as valid: *Sandalus kani* Sakai and Sakai (1981), *S. segnis* Lewis (1887), and *S. sauteri* Emden (1924). *Sandalus takizawai* Nakane (1985) is a junior synonym of *S. sauteri* Emden. *Sandalus taiwanicus* Lee et al., sp. nov. and *S. sauteri lanyuensis* Lee et al., ssp. nov. are described and *S. segnis* Lewis (1887) is recorded in Taiwan for the first time.  
<http://zoolstud.sinica.edu.tw/Journals/44.4/437.pdf>

**Key words:** Taxonomy, *Sandalus*, New species, Cicada parasite beetles

The common name, "cicada parasite beetles", of the Rhipiceridae reflects the biology of *Sandalus* larvae. According to observations in North America (Elzinga 1977), the female of *Sandalus niger* Knoch deposits enormous numbers of eggs (16,864 eggs; counted by Rings 1942) in holes or under bark of elms where cicadas possibly oviposit. Eggs are usually washed off by the first rain and hatch into triungulin larvae. A late-instar ectoparasitic larva was discovered within the nymphal exuviae of a dead cicada which had failed to emerge from its burrow (Craighead 1921). Young (1956) observed an abrupt abundance of *S. niger* adults in southern Indiana, and he suggested that the emergence of this rhipicerid might have been connected with the emergence of periodical cicadas (*Magicicada* spp.) in the preceding year.

Regarding the Far Eastern species, Fukuda (1969) reported the ovipositing behavior of *S. segnis* Lewis in Aomori Prefecture, Japan; he also stated that the host cicada of this species is presumably *Terpnosia nigricosta* (Motschulsky) or

*Tibicen bihamatus* (Motschulsky).

Rhipiceridae is a relatively small family, including 7 genera and about 100 species (Lawrence 2005). Only the genus *Sandalus* Knoch occurs in East Asia. Four species of *Sandalus* have been reported from Taiwan and Japan: *S. segnis* Lewis (1887) recorded from the main islands of Japan (Ohno 1995), *S. kani* Sakai and Sakai (1981) from Amami-Ōshima I., *S. takizawai* Nakane (1985) from Ishigaki I., and *S. sauteri* Emden (1924) from Taiwan. Although Sakai and Sakai (1981) and Nakane (1985) mentioned some diagnostic characters for distinguishing species, some of them are neither reliable nor useful. This paper provides a comprehensive study of the taxonomy of *Sandalus* from Taiwan and Japan. Some diagnostic characters are proposed through a comparison of all species.

### MATERIALS AND METHODS

Specimens were examined with a Leica

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MZ95 stereoscopic microscope under diffuse lighting. Genitalia and antennae were examined with a Nikon Optiphot transmitted light microscope and illustrated with the aid of a drawing tube. Illustrations of punctures on the pronotum were made with Photoshop software.

Specimens examined are deposited in the following museums or institutions (letter codes largely follow Arnett et al. 1993): BMNH, The Natural History Museum, London, UK; BPBM, Bernice P. Bishop Museum, Honolulu, HI, USA; DEI, Deutsches Entomologisches Institut im ZALF, Müncheberg, Germany; EIHU, Hokkaido Univ., Sapporo, Hokkaido, Japan; EUMJ, Ehime University, Matsuyama, Japan; HY, Collection of H. Yoshitomi, Hokkaido, Japan; MNHN, Muséum National d'Histoire Naturelle, Paris, France; NCHU, National Chung Hsing Univ., Taichung, Taiwan; NMNS, National Museum of Natural Science, Taichung, Taiwan; TARI, Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan; TFRI, Taiwan Forestry Research Institute, Taipei, Taiwan.

## SYSTEMATIC ACCOUNTS

### Genus *Sandalus* Knoch, 1801

*Diagnosis:* Head elongate-quadrate, weakly deflexed, inserted slightly into pronotum, and with prominent antennal tubercles. Eyes relatively large and visible. Antennae 11-segmented, flabellate from segments 3 to 11 in male, serrate to pectinate from segments 3 to 9 in female, 2 apical segments fused in females of some species. Mentum triangular and plate-like; submentum reduced; ligula small, conical, and densely setose; palpus 3-segmented, 1st segment much smaller than others, 2nd and 3rd segments subequal in length, apex of apical segment pointed, all segments covered with fine hairs except for apex of apical segment. Lacinia reduced; galea well developed, cylindrical, setose or spinose; palpus 4-segmented, 1st segment small, other segments cylindrical and with dense hairs except on apex. Mandibles large, apices strongly and abruptly curved inward, unidentate. Labrum small, bilobed, fused to head.

Pronotum densely punctate and setose, transverse, basally widened; apical margin rounded; basal margin smooth or weakly crenulate, median lobe bidentate; base of pronotum distinctly narrower than bases of elytra. Prosternal process

small, connecting with mesosternum. Anterior margin of mesosternum with a forward process, posterior margin with a bilobed process. Scutellum small, rhomboid. Metasternum large, with transverse suture parallel to posterior margin. Elytra punctuate and pubescent, with longitudinal and transverse carinae. All legs similar in shape; 1st and 2nd coxae globular, hind coxae transverse; trochanters small, but distinct; femora with ventral grooves for receiving tibiae; tibiae roughened, dorsal side bearing various teeth, ventral surface smooth, apex with 2 long curved spurs; tarsi 5-segmented, 1st 4 segments lobed, with paired, ventral, densely setose lobes; claws simple; empodium club-shaped, bearing hairs near apex.

Abdomen with 5 ventrites, densely pubescent. Male genitalia trilobate, symmetrical; penis with dorsal and ventral lobes, ventral lobe more slender than dorsal lobe, apex recurved; apices of parameres rounded, with sparse hairs; basal piece short, transverse.

*Notes:* This genus has attracted the attention of many Japanese entomologists. Ohno (1995) counted 104 papers on *S. segnis* Lewis and the allied species. In Taiwanese and Japanese species, antennomeres 10 and 11 are separated, differing from the fused antennomeres in American species.

*Distribution:* Nearctic, Neotropical, eastern Palaearctic, Oriental and Afrotropical regions (25 species: Katovich 2002).

### *Sandalus kani* Sakai and Sakai (Figs. 1A, B, 2C, 4A, 5A)

*Sandalus kani* Sakai and Sakai 1981: 151; Nakane 1985: 33.

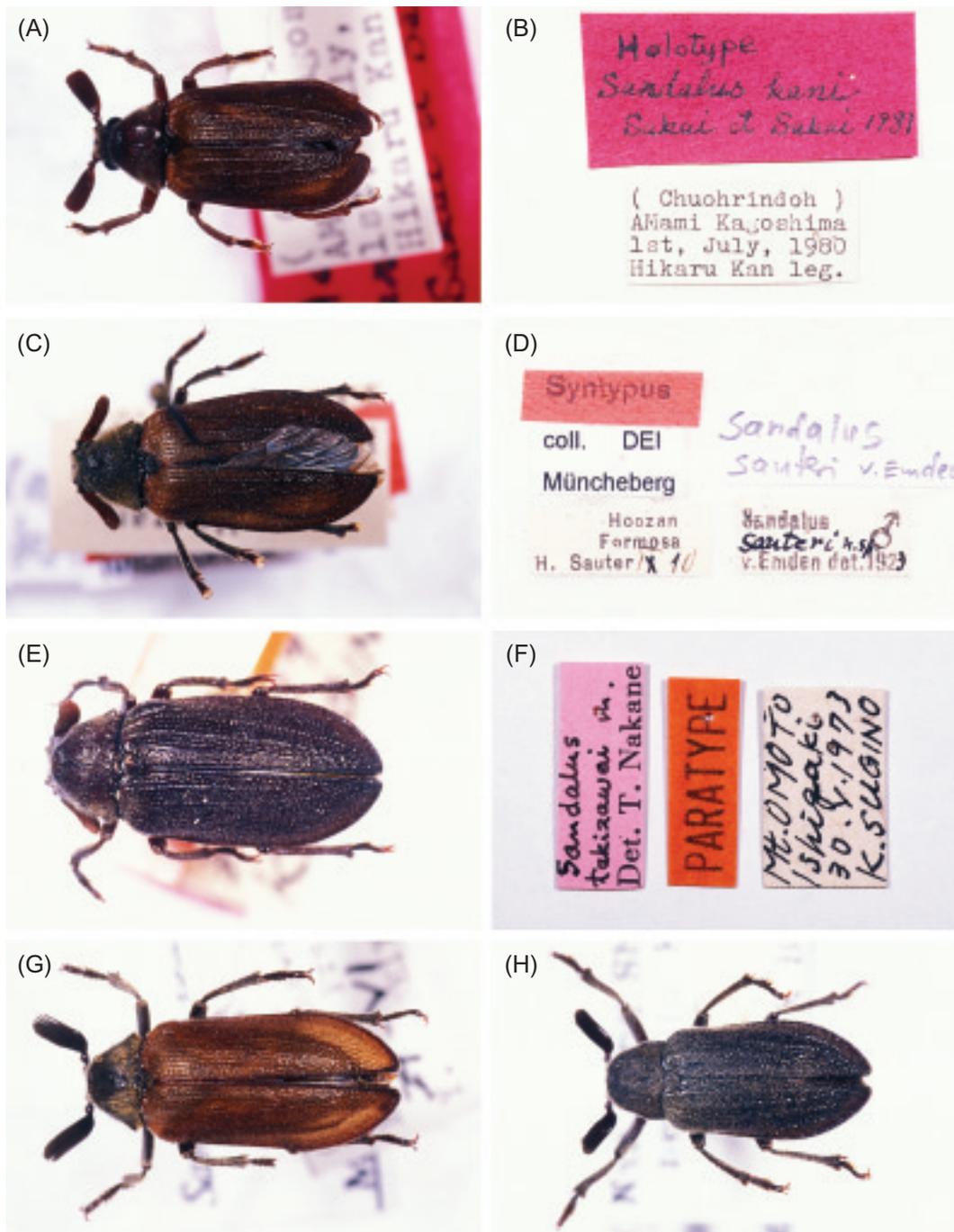
*Type series:* Holotype ♂ (Fig. 1A, B): "(Chuohrinodoh) Amami Kagoshima, 1st July, 1980 Hikaru Kan leg. / Holotype *Sandalus kani* Sakai et Sakai 1981 (red)" (EUMJ, examined).

*Description: Male:* Length 10.8 mm, width 4.8 mm. Body oblong, about 2.1 times longer than wide; coloration dark brown, but elytra brown; base of elytra and 1st to basal 1/2 of 3rd abdominal segments yellowish-brown; head, pronotum, venter, and base of elytra clothed with yellowish-brown pubescence, remainder of elytra and last abdominal sternite clothed with blackish-brown pubescence. Pronotum trapezoidal, slightly depressed on each side of middle at rear of anterior margin and anterior posterior margin, moderately angular near hind corner of lateral margin (Fig. 2C); punctures of 2 sizes: large punctures much fewer and

larger than small punctures (Fig. 4A). Elytra elongate, about 1.6 times as long as wide, each with 3 distinct longitudinal carinae; intervals finely punctured. *Genitalia*: parameres like those of *S. sauteri*; apex of ventral lobe recurved like that of *S. taiwanicus*, but recurved area and teeth smaller (Fig. 5A).

*Female*: Similar to male, but larger (16.5 mm); coloration blackish; elytral pubescence yellowish-brown; elytral punctures smaller; elytral carinae distinct, a number of cross-carinae present on elytra; antennae similar to those of *S. segnis*.

*Diagnosis*: This species is similar to *S. sauteri* but has a greater number of large-sized pronotal



**Fig. 1.** Habitus and labels of *Sandalus* species. (A) Habitus of the holotype of *S. kani*; (B) labels of the holotype of *S. kani*; (C) habitus of the syntype of *S. sauteri sauteri*; (D) labels of the syntype of *S. sauteri sauteri*; (E) habitus of the paratype of *S. takizawai*; (F) labels of the paratype of *S. takizawai*; (G) habitus of *S. segnis*; (H) habitus of *S. taiwanicus*.

punctures and differs by the fine elytral punctures.

*Distribution:* Japan (Amami-Ōshima I.).

***Sandalus sauteri sauteri* Emden**

(Figs. 1C, D, 2B, 3C, 4B, 5B, E)

*Sandalus sauteri* Emden 1924: 28; Miwa 1928: 374.

*Sandalus takizawai* Nakane 1985: 35. syn. nov.

*Type series:* Lectotype ♂, herewith designated (Fig. 1C, D): "Hoozan, Formosa, H. Sauter IX 10 / coll. DEI Müncheberg / *Sandalus sauteri* n. sp. v. Emden det. 1923 / Syntype (red)" (DEI, examined); number of syntypes uncertain.

*Synonym:* Holotype ♂ of *Sandalus takizawai*: "Omotodake, Ishigaki Is., Ryukyus, Japan, 6.VII.1974, H. Takizawa leg."; paratype ♂ (Fig. 1E, F): "Omotodake, Ishigaki Is., 30.V.1973, K Sugino leg. / *Sandalus takizawai* n. s. Det T. Nakane (pink) / PARATYPE (red)" (all in EIHU, paratype examined).

*Description: Male:* Length 12.1-14.4 mm, width 4.9-6.7 mm. Body oblong, about 2.1-2.4 times longer wide; coloration blackish-brown, but antennae brown, elytra brown or blackish-brown, elytral bases pale; head, pronotum, venter, and elytral bases clothed with yellowish-brown pubescence, remainder of elytra with blackish-brown pubescence. Antennae flabellate from segments 3 to 11 (Fig. 3A). Pronotum trapezoidal, slightly depressed on each side of middle at rear of anterior margin and anterior posterior margin, moderately angular near hind corner of lateral margin, hind corner lobed (Fig. 2B); punctures on surface of 2 sizes: large punctures fewer and much larger than small punctures (Fig. 4B). Elytra elongate, about 1.8 times as long as wide, each provided with 4 distinct longitudinal carinae, 5th carina indistinct in some individuals; intervals prominently punctured. *Genitalia* (Fig. 5E): parameres abruptly narrowed at apical 1/4, forming long, slender

apices; apex of ventral lobe open, ring-like, with lateral, upcurved teeth (Fig. 5B).

*Female:* Similar to male, but larger (20.0 mm); elytral pubescence yellowish-brown; elytral carinae more prominent, elytral punctures tiny; antennal segments 3-11 (Fig. 3C) pectinate, progressively longer toward segment 8, then progressively shortened toward apical segment; apical segment dilated

*Diagnosis:* See diagnosis of *S. kani*.

*Material examined:* 1 ♂: "C. Taiwan, Kukuian 730 m, Taichung Hsien 20-22.VI.1978. KSLin" (TARI); 1 ♂, 1 ♀: "Nakasuji, Ishigaki-jima, 26-IV-2001, T. Fukaishi" (NMNS); 9 ♂♂, 2 ♀♀: "Taiwan (Formosa), Puli (Hori), June-July, 1953-1954, Native Collector" (BPBM).

*Distribution:* Taiwan and Japan (Ishigaki I.).

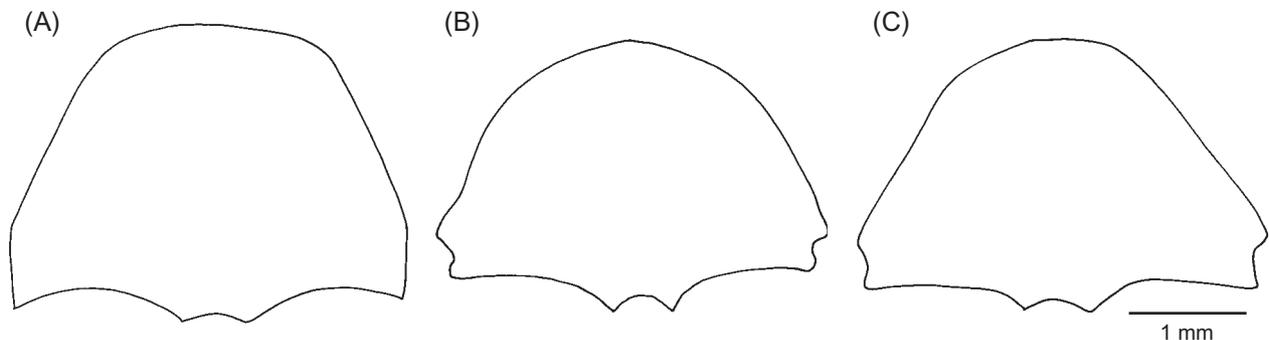
***Sandalus sauteri lanyuensis* Lee et al., ssp. nov.**

(Fig. 4C)

*Holotype* ♂: "TAIWAN Orchid I. (Botel Tobago) 4-8.III.1991 C.K. Starr and H.Y. Wang / NMNS ENT 1164-93 (NMNS).

Paratypes: 1 ♂, same collecting data for holotype / NMNS ENT 1164-97; 1 ♂: "Taiwan: Taitung, Lanyu I., Tien-shih, Apr. 2003, J.Y. Liou leg." (NCHU).

*Description: Male:* Length 9.6-11.0 mm, width 4.3-4.9 mm. Body oblong, about 2.1-2.2 times longer than wide; coloration blackish, but elytra brown and pale basally; head, pronotum, venter, and elytral bases clothed with yellowish-brown pubescence, remainder of elytra with blackish-brown pubescence. Pronotum trapezoidal, slightly depressed on each side of midline behind anterior margin, irregularly depressed, weakly angular near hind corner of lateral margin; punctures of 2 sizes: large punctures fewer than small punctures (Fig. 4C). Elytra elongate, about 1.7 times longer than wide, each with 4 distinct longitudinal carinae;



**Fig. 2.** Pronota. (A) *Sandalus taiwanicus*; (B) *S. sauteri sauteri*; (C) *S. kani*.

intervals prominently punctured. *Genitalia*: similar to nominate subspecies.

*Female*: Unknown.

*Diagnosis*: This new subspecies differs from the nominate subspecies by the smaller “large-sized punctures” on pronotum, and weak angular processes near the hind corners of the pronotum.

*Distribution*: Taiwan (Orchid I. [*Lanyu* in Chinese]).

***Sandalus segnis* Lewis**

(Figs. 1G, 3B, 4D, 5C, G)

*Sandalus segnis* Lewis 1887: 316; Miwa 1928: 374; Nakane 1985: 33. (see Ohno 1995 for additional references)

*Sandalus semitestaceus* Pic 1906: 1, synonymized by Jakobson (1913)

*Type series*: Lectotype ♂: “CO Type (yellow letters, circle label) / *Sandalus segnis* Lewis DET. Miwa / 17”; one paralectotype ♀, same data with holotype except 17 replaced with 16, TARI, herewith designated.

*Synonym*: Holotype ♂ of *Sandalus semitestaceus*: “Japon: Kyoto / type (hand writing) / Type (printed, black ink in red card) / *Sandalus semitestaceus* Pic (hand writing)” (MNHN, examined).

*Description*: *Male*: Length 12.9 mm, width 5.4 mm. Body oblong, about 2.4 times longer than wide; coloration blackish-brown, elytra blackish or yellowish; head, pronotum, venter, and elytral bases clothed with yellowish-brown pubescence, remainder of elytra with blackish-brown pubescence. Pronotum trapezoidal, lightly depressed on each side of middle at rear of anterior margin; moderately angular near hind corner of lateral margin; punctures subequal in size (Fig. 4D). Elytra elongate, about 2.0 times as long as wide, each with 4 indistinct longitudinal carinae; intervals prominently punctured. *Genitalia* (Fig. 5G): parameres parallel, slightly narrowed near apices; apex of ventral lobe depressed, with a pair of acute upcurved processes (Fig. 5C).

*Female*: Similar to male, but larger (length 18.1–19.2 mm); elytral pubescence yellowish-brown; elytral carinae indistinct; elytral punctures tiny; antennae similar to those of *S. sauteri sauteri*, but antennal rami shorter (Fig. 3B).

*Diagnosis*: It is characterized by the equal sized pronotal punctures and the indistinct elytral carinae.

*Material examined*: 1 ♂ (Fig. 1G): “(SHIKOKU) Mt. Takanawa Ehime Pref. 29-VI, 1980 Y. SEIYAMA leg.” (EUMJ); 2 ♀♀, same collector and locality, but with different dates: “26-VI,

1979”; and “27-VI, 1978” (EUMJ); 1 ♂: “Iyo (Ehime Pref.), Japan, 201116”; 1 ♂: Houheikyo, Sapporo-shi, Hokkaido, 29-VI-2000, H. Yoshitomi (HY); 1 ♀: Kanehachi-toge, Hokkaido, 20-VI-2001, H. Yoshitomi (HY); 1 ♂: “Fushan A2, Ilan Co., TAIWAN AN, III-(8-22)-2004, S. S. Lu / 00089428 (barcode)” (TFRI).

*Distribution*: Japan (Hokkaido, Honshu, Shikoku, and Kyushu) and Taiwan (new record).

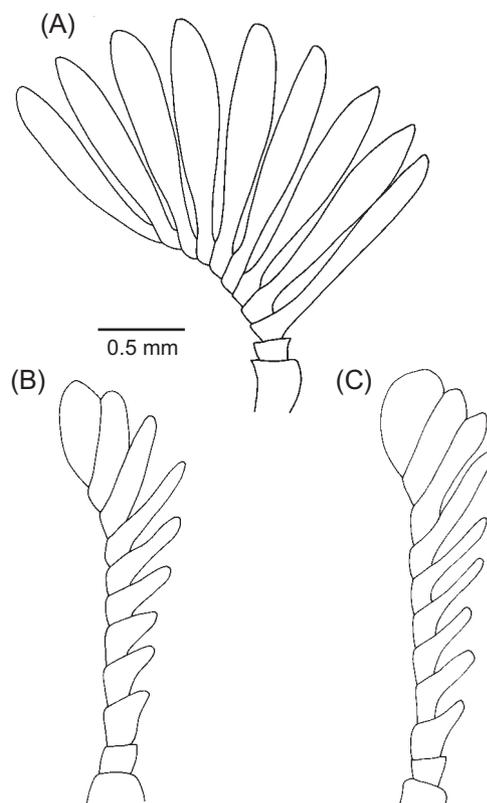
***Sandalus taiwanicus* Lee et al., sp. nov.**

(Figs. 1H, 2A, 4E, 5D, F)

*Holotype* ♂: Taiwan: “Pingtung, Dahanshan, 26-IV-2003, K.-S. Hsu” (NMNS).

*Paratypes*: 2 ♂♂ (Fig. 1H): “Nan Feng Shan, near Liu Kui, S. Taiwan, 18.IV.1986, Col. K. Baba” (EUMJ); 1 ♂, same locality as holotype, 25.III.2005, leg. S.-J. Lyu (DEI); 1 ♀: “S. TAIWAN: KaoShiung Co. Mid-elevation Exp. Station near Teng Zhih 27/IV-22/VI/2005 alt. ca 1600 m by FIT collr. C.-L. Li” (NMNS).

*Description*: *Male*: Length 13.4–17.7 mm, width 6.0–7.1 mm. Body oblong, about 2.2–2.5 times longer than wide; coloration blackish-brown;



**Fig. 3.** Antenna. (A) *Sandalus sauteri sauteri*, male; (B) *S. segnis*, female; (C) *S. sauteri sauteri*, female.

body clothed with yellowish-brown pubescence. Pronotum trapezoidal, slightly depressed on each side of middle at rear of anterior margin and deeply depressed anteriorly posterior margin; without angular process near hind corner of lateral margin (Fig. 2A); punctures of 2 sizes: large punctures much fewer and much larger than small punctures (Fig. 4E). Elytra elongate, about 1.8 times longer than wide, each provided with four distinct longitudinal carinae, intervals finely punctured. *Genitalia* (Fig. 5F): parameres parallel, internal margins abruptly depressed distally, forming short, slender apices; apex recurved, with 1 pair of teeth (Fig. 5D).

*Female*: Similar to male, but larger (length 19.2 mm); elytral carinae indistinct; elytral punctures tiny; antennae similar to those of *S. sauteri sauteri*.

*Diagnosis*: Similar to *S. kani* Sakai and Sakai with small elytral punctures, but characterized by lacking angular processes near the hind corners of the pronotum and having fewer large-sized pronotal punctures.

*Distribution*: Taiwan.

## DISCUSSION

A number of characters have previously been proposed as being diagnostic characters. Miwa (1928) indicated that *S. sauteri sauteri* was recognized by 4 longitudinal carinae on each elytron and a median longitudinal depression on the pronotum. Actually, most species have 3 or 4 distinct elytral carinae, and others are distal and too faint to observe. The latter character is shared among all species of Japan and Taiwan. Sakai and Sakai (1981) mentioned a number of characters for distinguishing *S. segnis* and *S. kani*. Most of them are too variable except for the punctures on the pronotum which are reliable. In addition to those

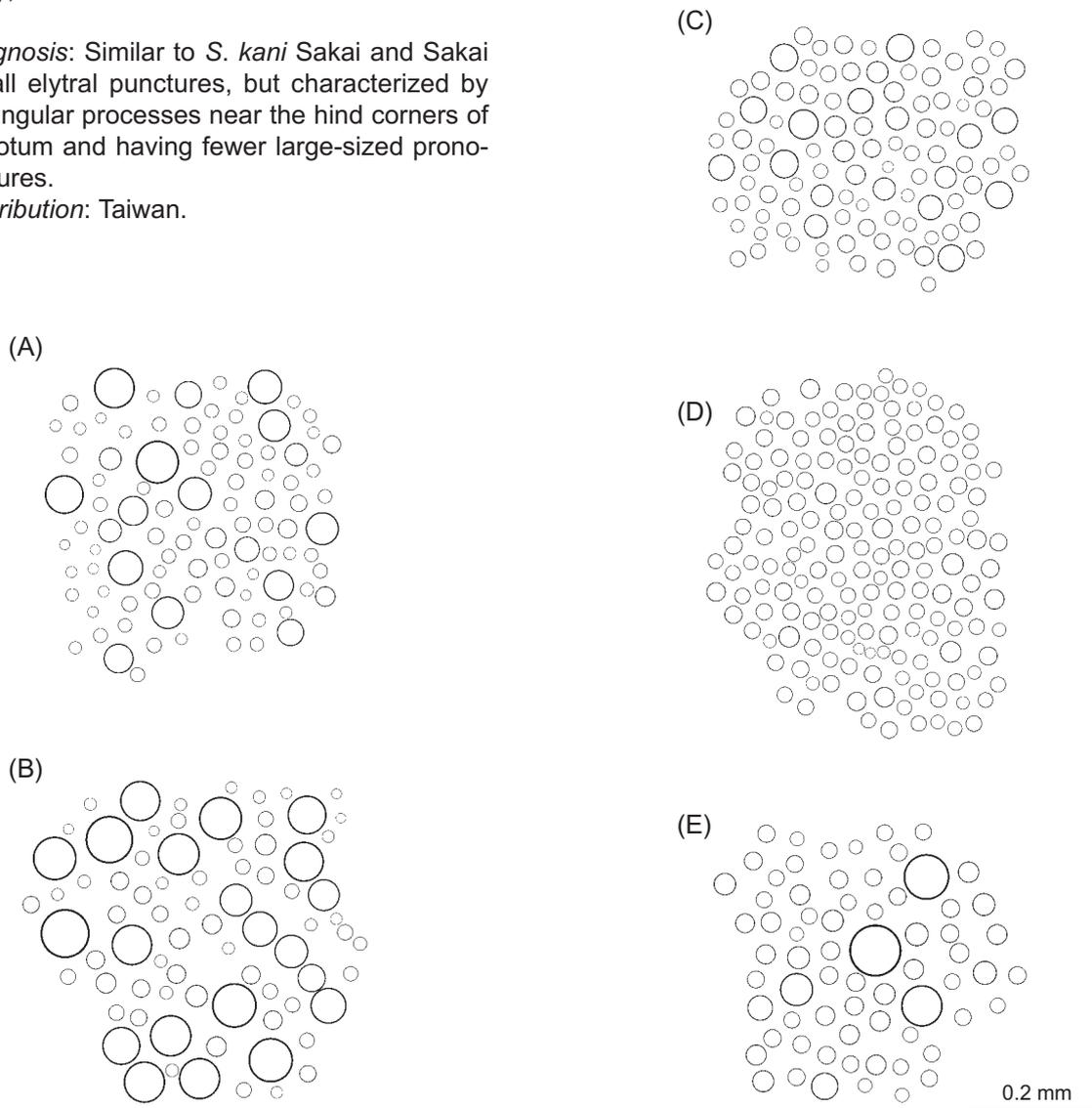


Fig. 4. Pronotal punctures. (A) *Sandalus kani*; (B) *S. sauteri sauteri*; (C) *S. sauteri lanyuensis*; (D) *S. segnis*; (E) *S. taiwanicus*.

characters, the elytral punctures, the pronotal shapes, and the male genitalic structures are also useful in differentiating the species. It should be noted that body sizes and coloration are so variable that it is impossible to use these characters to identify species. Variation in these characters are likely related to the sizes and species of hosts.

**Key to males of *Sandalus* species from Taiwan and Japan**

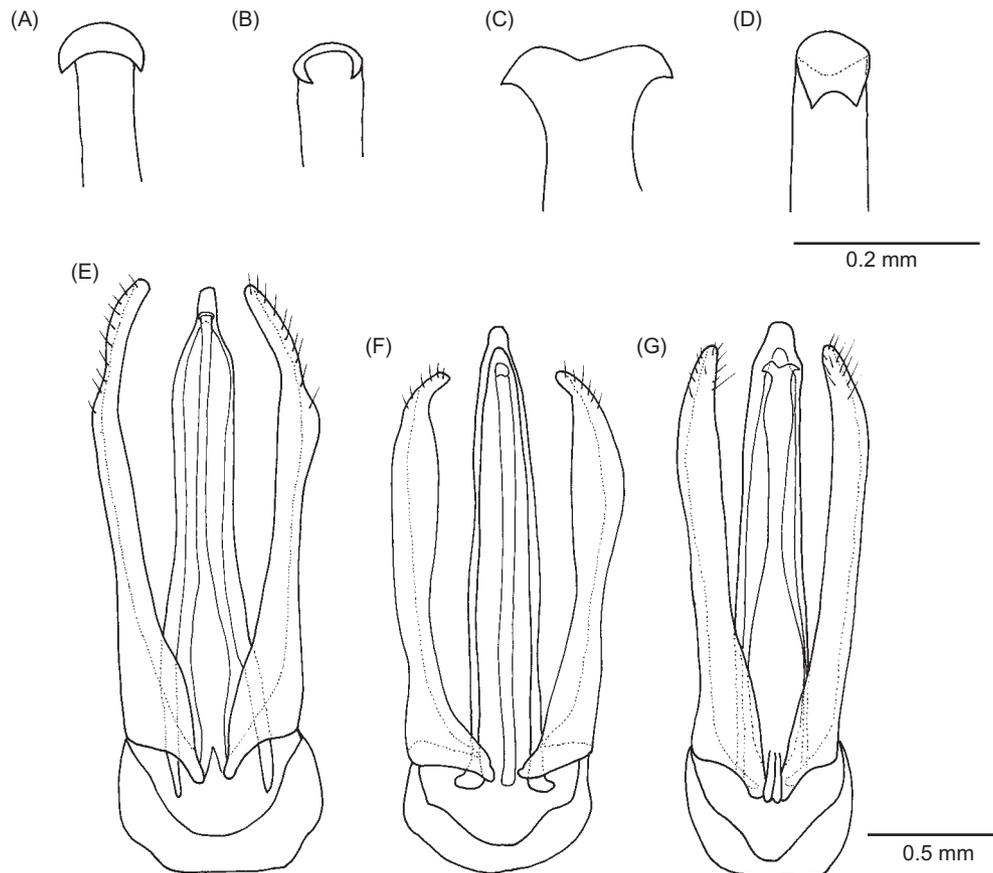
- 1. Elytra finely punctate ..... 2
- Elytra bearing prominent punctures ..... 3
- 2. Pronotum furnished with an angular process near corner, and bearing many large-sized punctures (Fig. 4A).....  
..... *S. kani* Sakai and Sakai
- Pronotum without an angular process near corner (Fig. 2A), and bearing fewer large-sized punctures .....  
..... *S. taiwanicus* Lee et al., sp. nov.
- 3. Pronotum with punctures of 1 size (Fig. 4D); elytral carinae indistinct ..... *S. segnis* Lewis
- Pronotum bearing different sizes of punctures (Fig. 4B, C); elytral carinae distinct ..... 4
- 4. Large-sized punctures on pronotum smaller, about 2

- times longer than small-sized punctures in diameter (Fig.4C) ..... *S. sauteri lanyuensis* Lee et al., ssp. nov.
- Large-sized punctures on pronotum larger, about 3 times longer than small-sized punctures in diameter (Fig. 4B) .....  
..... *S. sauteri sauteri* Emden

**Acknowledgments:** We are indebted to John F. Lawrence for providing valuable information. We also thank Yu-Long Lin and Chun-Lin Li (Taipei), Kuo-Sheng Hsu (Pingtung), Sheng-Jhih Lyu (Kaoshiung), Mei-Ling Chan (NMNS), Shen-Shan Lu (TFRI), Masahiro Ôhara (EIHU), Hsien-Tzung Shih (TARI), Man-Miao Yang (NCHU), Hiroyuki Yoshitomi (Sapporo) and Lothar Zerche (DEI) for loans of type specimens and unidentified materials. We also thank Ming-Luen Jeng who examined types at the Paris museum (MNHN).

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**Fig. 5.** Male genitalia and apices of penises, ventral view. (A) *Sandalus kani*, apex of penis; (B) *S. sauteri sauteri*, apex of penis; (C) *S. segnis*, apex of penis; (D) *S. taiwanicus*, apex of penis; (E) *S. sauteri sauteri*, genitalia; (F) *S. taiwanicus*, genitalia; (G) *S. segnis*, genitalia.

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