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# A Taxonomic Study on the Japanese Species of the Genus Sulcacis (Coleoptera, Ciidae)

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**Abstract** A new ciid species of the genus *Sulcacis* is described from Hokkaido, Northeast Japan, under the name of *S. nobuchii*. It seems to belong to the group of *S. lengi* from North America, and is mainly characterized by the 10-segmented antennae and unique conformation of the fronto-clypeal ridge in male. The type series of *S. japonicus* is examined and the lectotype is designated. Diagnostic characters of the genus and a key to the Japanese species are given.

The genus *Sulcacis* DURY, 1917, belonging to the tribe Ciini of the subfamily Ciinae, is a small group of ciid beetles comprising six known species (LAWRENCE, 1971). This genus is widely distributed in Eurasia and North America, and contains some widespread species. In the ciid fauna of Japan, two species, *S. affinis* (GYLLENHAL) and *S. japonicus* (NOBUCHI), were previously recorded from Hokkaido and the northern end of Honshu, Northeast Japan. In the course of my taxonomic study on this family, I have detected an undescribed species of the genus from Hokkaido. This new species seems to belong to the group of *S. lengi* of North America, and is mainly characterized by the 10-segmented antennae and unique conformation of the fronto-clypeal ridge in male. It is interesting from the zoogeographical viewpoint that the Japanese species of the Holarctic genus *Sulcacis* are restricted to Hokkaido and the northern part of Honshu.

In the course of comparative study of species, the syntypes of *S. japonicus* were examined, and its lectotype and paralectotypes are designated. The label data attached to each syntype were recorded exactly in the following way: (1), (2) and (3) indicate the sequence of labels on the pin from top to bottom, and slashes show the separation of printed or written lines on each label. A red label with lectotype designation, or yellow label with paralectotype designation, was attached to respective specimens.

The abbreviations used herein are the same as those explained in previous papers of mine.

Before going further, I wish to express my hearty thanks to the late Dr. A. NOBUCHI for his encouragement and advice. Deep gratitude is also due to Dr. S.-I. UÉNO, National Science Museum (Nat. Hist.), Tokyo, for critically reading the manuscript of this paper.

#### Genus Sulcacis DURY

#### [Japanese name: Togehime-tsutsukinokomushi Zoku]

Sulcacis DURY, 1917, J. Cincinnati Soc. nat. Hist., **22** (2), p. 20. Type species: Sulcacis lengi DURY, 1917, by subsequent designation of LAWRENCE, 1965, p. 278.

Cis: GYLLENHAL, 1827, Ins. Suec., 4, p. 624 [partim].

Cis (Entypus): KIESENWETTER, in ERICHSON, 1877, Naturg. Ins. Dtschl., 1 Coleopt., 5, p. 190.

Ennearthron: MELLIÉ, 1848, Annls. Soc. ent. Fr., (2), 6, p. 360 [partim].

Entypus REDTENBACHER, 1847, Fn. Austr., (ed. 1), 3, p. 350 (nec DAHLBON, 1843, Hymenoptera Europae praecipue borealis, 1, p. 35, a senior homonym). Type species: Apate fronticornis PANZER (misidentification of Cis affinis GYLLENHAL, 1827), by monotypy.

*Entypus (Entypocis)*: LOHSE, 1964, Ent. BL, **60**, p. 121. Type species: *Cis bidentulus* ROSENHAUER, 1847, by original designation. Synonymized by LAWRENCE, 1965, p. 278.

Rhopalodontus: JACQUELIN DU VAL, 1861, Gen. Coléopt. Eur., 3, p. 238 [partim].

Sulcacis (Entypocis): LOHSE, 1967, Käf. Mitteleur., Krefeld, 7, p. 284.

Other references are omitted (see LAWRENCE, 1965 & 1971).

Though the generic status of *Sulcacis* was discussed in detail by LOHSE (1964) and LAWRENCE (1965), a definition with some additional descriptions is given below.

Body oblong, cylindrical, strongly convex; vestiture short, dual, consisting of both erect and inclined bristles. Head moderately declined, partly concealed by pronotum as seen from above; fronto-clypeal ridge in male with two small tubercles; genal ridge rather strongly carinate; antennal fossa relatively deep. Antenna 9- or 10-segmented; apical three segments forming a loose club; each segment of the club provided with four sensillifers which are nearly equidistant from the apex. Pronotum strongly convex, more or less constricted anteriorly, narrowly margined laterally; lateral margins not visible from above for their entire length; anterior margin simple in both sexes; anterior angles broadly rounded. Elytra covered with dual, and irregular or seriate punctures; suture without apical inflexed margin. Prosternal disc in front of coxae slightly tumid medio-longitudinally but not carinate, slightly depressed just before each coxa; prosternal process relatively short and narrow, tapering behind, slightly shorter than prosternal process, upheaved to the basal level of pronotum. Protibia expanded at apex; outer apical angle forming a rounded process which is armed with several spines. Meso- and metatibiae slightly expanded and spinulose at the apices. Abdominal fovea present in male.

*Remarks.* Up to the present, a total of seven species, *S. affinis* (GYLLENHAL) [Eurasia and Japan], *S. bidentulus* (ROSENHAUER) [southern Europe and northern Africa], *S. curtulus* (CASEY) [northern North America], *S. fronticornis* (PANZER) [Eurasia], *S. japonicus* (NOBUCHI) [Japan], *S. lengi* DURY [eastern North America] and *S. nobuchii* sp. nov. [Japan], have been known, and three of them are distributed in Northeast Japan. It is interesting from the zoogeographical viewpoint that a species related to the North American one and the species common to Eurasia occur in Hokkaido and the northern end of Honshu.

In this genus, the two subgenera *Entypus* and *Entypocis* have been recognized based on the number of antennal segments. However, the number of antennal segments

seems to be a changeable character in the genus, and division of the species to subgenera on the basis of antennal segments may not always be reflected on the phylogeny.

# Sulcacis affinis (GYLLENHAL)

[Japanese name: Togehime-tsutsukinokomushi]

(Figs. 1-7, 11, 14, 18, 20 & 22)

Cis affinis GYLLENHAL 1827, Ins. Suec., 4, p. 628.

 Ennearthron affine: MELLIÉ, 1848, Annls. Soc. ent. Fr., (2), 6, p. 364, pl. 12, fig. 13. — ABEILLE DE PER-RIN, 1874, Ess. monogr. Cisid., p. 82. — REDTENBACHER, 1874, Fn. Austr., (ed. 3), 3, p. 72. — REIT-TER, 1878, Dtsch. ent. Z., 22, p. 24. — SEIDLITZ, 1891, Fn. Transsylv., p. 286. — SCHILSKY, 1901, Käf. Eur., 37, no. 48. — REITTER, 1902, Verh. naturf. Ver. Brünn, 40, p. 60. — NOBUCHI, 1960, Ent. Rev. Japan, 11, p. 41 [first record from Japan].

Entypus affinis: THOMSON, 1863, Skand. Coleopt., 5, p. 194. — LOHSE, 1964, Ent. Bl., 60, p. 118.

Sulcacis affinis: LAWRENCE, 1965, Bull. Mus. comp. Zool., 133, p. 277. — LOHSE, 1967, Käf. Mitteleur., Krefeld, 7, p. 284. — LAWRENCE, 1971, Bull. Mus. comp. Zool., 142, p. 503. — MIYATAKE, 1985, Coleopt. Japan Col., Osaka, 3, p. 284, pl. 46, fig. 29. — REIBNITZ, 1989, Käf. Mitteleur., Ökologie, Krefeld, 2, p. 255.

Apate fronticornis: REDTENBACHER, 1847, Fn. Austr., (ed. 1), **3**, p. 350. — BACH, 1854, Käferfn., **2**, p. 111. — KIESENWETTER, 1877, Naturg. Ins. Dtschl., **5**, p. 190.

Biology: MELLIÉ, 1848, Annls. Soc. ent. Fr., (2), 6, p. 365.

Male (Specimens from Hokkaido, Japan). Body oblong, strongly convex, weakly shiny on dorsum. Color reddish black; antennal clubs, mandibles and legs dark reddish brown; mouthparts, antennal funicles and tarsi yellowish brown.

Head slightly convex on vertex, transversely and somewhat strongly concave on frons, finely and conspicuously reticulated, rather closely and conspicuously punctate; each puncture bearing a yellow bristle; fronto-clypeal ridge weakly produced forward, with two small but conspicuous conical projections. Antennae 9-segmented; 3rd segment 2.8 times as long as 4th; 7th to 9th forming a loose club.

Pronotum wider than long; anterior margin not ridged, broadly rounded; anterior corners rounded in lateral view, somewhat constricted in dorsal view; lateral margins narrowly ridged, barely visible from above, nearly arcuate in dorsal view; basal margin narrowly ridged, and weakly arcuate; hind angles broadly rounded in lateral view; dorsum irregularly and closely punctate; punctures uniform in size and shape, deep, somewhat large and clear, each bearing a yellow, short and suberect bristle; interstices between punctures finely and conspicuously reticulate. Scutellum small, semicircular, slightly broader than length, with some punctures. Elytral sides subparallel from base to basal two-thirds, then gradually convergent apicad, invisible from above except for basal corners; disc somewhat shiny, closely punctate; punctures partially seriate, uniform in size and shape, but diminishing posteriorly in size, somewhat smaller than those on pronotum, separated by a distance about 0.5 to 2.5 times their diameters, each bearing a yellow, short and suberect bristle; suture weakly margined at posterior declivous portion.

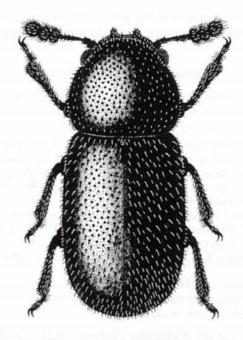


Fig. 1. Sulcacis affinis (GYLLENHAL), male, from Kawayu, Teshikaga-chô, Hokkaido.

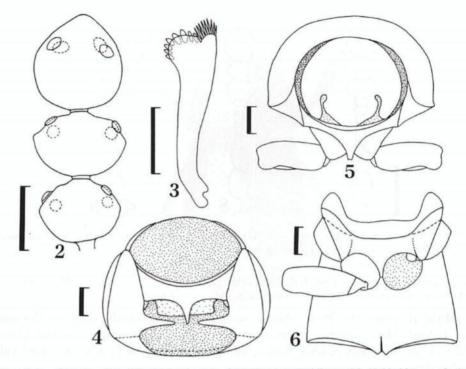
Prosternal disc in front of coxae slightly tumid medio-longitudinally, then transversely and weakly depressed just before each coxa; prosternal process relatively thick, tapering behind, somewhat upheaved to the level of the base of prosternum. First abdominal sternite with a large, circular and marginally pubescent fovea at the middle. Eighth abdominal sternite trapezoidal, with the apical margin inconspicuously emarginate at the middle, armed with relatively short hairs at the lateral corners. Tegmen subparallel-sided, angustate elliptical, about 0.5 times as long as the combined length of visible abdominal sternites.

Female. Frons weakly concave in the middle; fronto-clypeal ridge slightly produced but without conical projection at each side; first abdominal sternite devoid of pubescent fovea.

Variation in the specimens from Kawayu, Teshikaga-chô, Hokkaido.

Male $(n=15)$	Female $(n=15)$
TL (mm): 1.29–1.61 (1.48±0.08)	TL (mm): 1.4–1.56 (1.49±0.05)
EW (mm): 0.6-0.76 (0.67±0.03)	EW (mm): 0.67–0.71 (0.69±0.02)
TL/EW: 2.12-2.28 (2.19±0.04)	TL/EW: 2.1-2.2 (2.16±0.04)
PL/PW: 0.83-0.96 (0.89±0.03)	PL/PW: 0.86-0.93 (0.9±0.02)
EL/EW: 1.33-1.46 (1.39±0.04)	EL/EW: 1.33-1.41 (1.37±0.03)
EL/PL: 1.65-1.82 (1.74±0.05)	EL/PL: 1.7-1.79 (1.75±0.02)

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Figs. 2–6. Sulcacis affinis (GYLLENHAL), male, from Kawayu, Teshikaga-chô, Hokkaido. 2, Antennal club; 3, right protibia; 4, prothorax, ventral view; 5, prothorax, frontal view; 6, meso- and metasterna, ventral view. Scales for Fig. 2: 0.05 mm; for Figs. 3–6: 0.1 mm.

Specimens examined. [Hokkaido] 3 exs., Usubetsu, Jôzankei, 24–VII–1955, A. NOBUCHI leg.; 2 exs., Engaru, Monbetsu, 11–VIII–1955, K. MORIMOTO leg.; 85 exs., Kawayu, Teshikaga-chô, 10–VII–1990, M. KAWANABE leg. [Honshu] (Aomori Pref.) 10 exs., Yachi Spa, Towada, 23~28–VII–1952, T. KISHII & A. NOBUCHI leg.; 5 exs., Yunomata, Shimokita, 1–IV–1956, K. MORIMOTO leg.; 30 exs., Araya, Hiraka-chô, 3–V–1972, A. SATÔ leg.; 6 exs., Tsukushimori, Hirosaki-shi, 1–X–1992, M. KAWANABE leg.; 9 exs., Mt. Iwaki, Hirosaki-shi, 3–X–1992, M. KAWANABE leg.

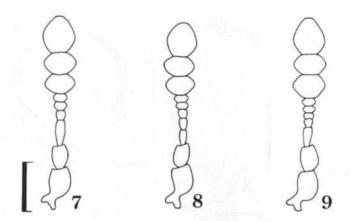
Distribution. Hokkaido, Honshu (Tôhoku District); Eurasia.

Host fungi. Coriolus versicolor (L.: FR.) QUÉL. (Kawaratake in Japanese), Coriolus hirsutus (WULF.: FR.) QUÉL. (Aragekawaratake in Japanese) and Daedaleopsis confragosa (BOLT.: FR.) SCHROET. (Chamidareamitake in Japanese).

### Sulcacis japonicus (NOBUCHI)

[Japanese name: Ezo-togehime-tsutsukinokomushi] (Figs. 8, 10, 12, 15 & 23)

Rhopalodontus japonicus NOBUCHI, 1960, Ent. Rev. Japan, 11, p. 39.



Figs. 7–9. Antennae of *Sulcacis* spp. — 7, *S. affinis* (GYLLENHAL), from Kawayu; 8, *S. japonicus* (NOBUCHI), paralectotype; 9, *S. nobuchii* sp. nov., paratype. Scale: 0.1 mm.

Sulcacis japonicus: LAWRENCE, 1965, Bull. Mus. comp. Zool., **133**, p. 277; 1971, ibid., **142**, p. 503. — МГУАТАКЕ, 1985, Coleopt. Japan Col., Osaka, **3**, p. 284.

Male (Lectotype). Body oblong, strongly convex, weakly shiny on dorsum. Color reddish black; anterior areas of pronotum somewhat paler; antennal clubs, mandibles and legs dark reddish brown; mouthparts, antennal funicles and tarsi yellowish brown.

Head slightly convex, transversely and inconspicuously concave in the middle, finely and conspicuously reticulated, rather sparsely and finely punctate; each puncture bearing a yellow bristle; fronto-clypeal ridge weakly produced forward, with two small and somewhat inconspicuous conical projections. Antennae 10-segmented; 3rd segment 1.2 times as long as 4th; 8th to10th forming a loose club.

Pronotum wider than long; anterior margin not ridged, broadly rounded; anterior corners rounded in lateral view, somewhat constricted in dorsal view; lateral margins narrowly ridged, invisible from above, nearly arcuate in dorsal view; basal margin narrowly ridged, and fairly sinuate; hind angles broadly rounded in lateral view; dorsum irregularly and closely punctate; punctures uniform in size and shape, a little finer at front and lateral portions, somewhat large and clear, each bearing a yellow, short and suberect bristle; interstices between punctures finely and conspicuously reticulated. Scutellum small, pentagonal, transverse, with some punctures. Elytra about five-sevenths as wide as long, nearly equal in width to base of pronotum; sides subparallel though weakly divergent from base to the middle, then gradually convergent apicad, invisible from above except for basal corners; disc somewhat shiny, closely and irregularly punctate; punctures uniform in size and shape, but diminishing posteriorly in size, somewhat smaller than those on pronotum, separated by a distance about 0.5 to 2.5 times their diameters, bearing yellow suberect bristles, which are a mixture of short and long ones; suture weakly margined at posterior declivous portion.

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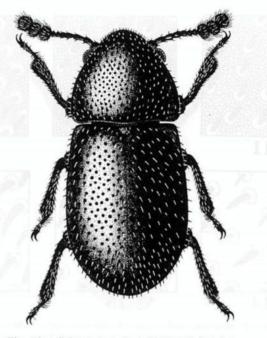


Fig. 10. Sulcacis japonicus (NOBUCHI), lectotype.

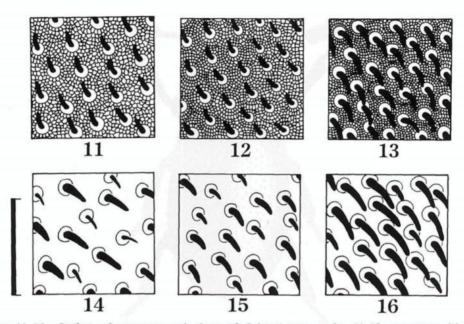
Prosternal disc in front of coxae slightly tumid medio-longitudinally, then transversely and weakly depressed just before each coxa; prosternal process relatively thick, tapering behind, somewhat upheaved to the level of the base of prosternum. First abdominal sternite with a large, circular and marginally pubescent fovea a little behind the middle.

Female. Fronto-clypeal ridge slightly produced but without conical projection at each side; first abdominal sternite devoid of pubescent fovea.

Variation in the type series.

Male $(n=1)$	Female $(n=7)$
TL (mm): 1.05	TL (mm): 1.0–1.31 (1.14±0.11)
EW (mm): 0.49	EW (mm): 0.46–0.61 (0.52±0.05)
TL/EW: 2.14	TL/EW: 2.14-2.23 (2.19±0.03)
PL/PW: 0.81	PL/PW: 0.88-0.92 (0.9±0.01)
EL/EW: 1.38	EL/EW: 1.33-1.43 (1.4±0.04)
EL/PL: 1.82	EL/PL: 1.66-1.82 (1.75±0.06)

Lectotype designation. Lectotype:  $\vec{o}$ , by present designation-(1) Japan, Hokkaido/Takinosawa/IV, 8, 1956/Akira Nobuchi, (2) COTYPE [red square label]. Paralectotypes:  $6 \ \varphi \ \varphi$ , same as lectotype;  $1 \ \varphi - (1)$  Japan, Hokkaido/Bifuka/VIII, 1, 1956/Akira Nobuchi, (2) COTYPE [red square label];  $1 \ \varphi - (1)$  Cotype, (2) Pyuka/



Figs. 11–16. Surface of pronotum and elytra of *Sulcacis* spp., male; 11–13, pronotum; 14–16, elytra. — 11, 14, *S. affinis* (GYLLENHAL), from Kawayu; 12, 15, *S. japonicus* (NOBUCHI), lectotype; 13, 16, *S. nobuchii* sp. nov., holotype. Scale: 0.1 mm.

VIII, 18, 1955/A. Nobuchi, (3) Rhopalodontus/japonicus/n. sp./Det. A. Nobuchi, '55 [Nobuchi's handwriting];  $1 \, \text{$\square}$ -(1) Cotype, (2) Pyuka/VIII, 18, '55, (3) Rhopalodontus/japonicus/n. sp./Det. A. Nobuchi, '55 [NOBUCHI's handwriting]. In the original description, the collecting date at Bifuka (=Pyuka) is different from the label data with the specimen.

All the type specimens are preserved in the collection of the National Institute of Agro-environmental Sciences, Tsukuba.

Distribution. Hokkaido. Host fungus. Unknown.

Sulcacis nobuchii M. KAWANABE, sp. nov.

[Japanese name: Moshiri-togehime-tsutsukinokomushi] (Figs. 9, 13, 16, 17, 19, 21 & 24)

Male (Holotype). Body length (excluding head): 1.54 mm; greatest breadth of elytra: 0.74 mm.

Body oblong, 2.09 times as long as elytral breadth, strongly convex, opaque on dorsum. Color reddish black; elytra, antennal clubs, mandibles and legs dark brown;

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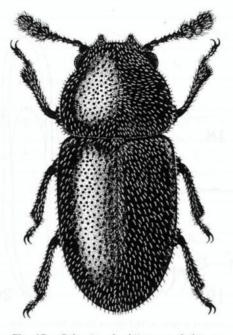
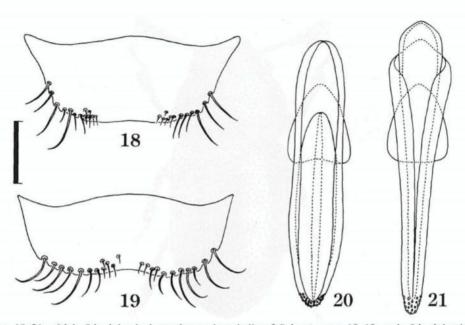


Fig. 17. Sulcacis nobuchii sp. nov., holotype.

mouthparts, antennal funicles and tarsi yellowish brown.

Head slightly convex, shallowly concave in the middle of vertex, finely and conspicuously reticulated, rather closely and conspicuously punctate; each puncture bearing a short yellow bristle; fronto-clypeal ridge weakly produced forward, with two small but conspicuous conical projections. Antennae 10-segmented; 3rd segment 1.7 times as long as 4th; 8th to 10th forming a loose club.

Pronotum somewhat transverse pear-shaped, 0.83 times as long as broad; anterior margin not ridged, broadly rounded; anterior corners rounded in lateral view, somewhat constricted in dorsal view; lateral margins narrowly ridged, invisible from above, nearly arcuate in dorsal view; basal margin narrowly ridged, and weakly arcuate; hind angles broadly rounded in lateral view; dorsum irregularly and very closely punctate; punctures uniform in size and shape, diminishing anteriorly in size, deep, somewhat small and clear, bearing yellow, short and suberect bristles aligned windingly; interstices between punctures finely and conspicuously reticulated. Scutellum transverse, nearly pentagonal, with some punctures. Elytra 1.34 times as long as broad, 0.79 times as long as pronotum; sides subparallel from base to basal two-thirds, then gradually convergent apicad, invisible from above except for basal corners; disc weakly shiny, irregularly and very closely punctate; punctures uniform in size, seemingly confluent at some places in basal areas, almost similar in size and shape to those on pronotum, separated by a distance about 0.5 to 1 times



Figs. 18–21. Male 8th abdominal sternites and genitalia of Sulcacis spp.; 18–19, male 8th abdominal sternites; 20–21, male genitalia, dorsal view. —— 18, 20, S. affinis (GYLLENHAL), from Kawayu; 19, 21, S. nobuchii sp. nov., paratype. Scale: 0.05 mm.

their diameters, bearing yellow suberect bristles consisting of short and long ones; suture weakly margined at posterior declivous portion.

Prosternal disc in front of coxae not or very slightly tumid medio-longitudinally, then transversely and weakly depressed just before each coxa; prosternal process relatively thick, nearly parallel-sided, somewhat upheaved to the level of the base of prosternum. First abdominal sternite with a large, circular and marginally pubescent fovea a little behind the middle.

Male genitalia in a paratype:— Eighth abdominal sternite trapezoidal, with the apical margin weakly emarginate at the middle, armed with relatively long and curled hairs at the lateral corners and short hairs at the bottom of the emargination. Tegmen slender, angustate obovate, gradually convergent apicad, 0.58 times as long as the combined length of visible abdominal sternites.

Female. Frons weakly concave in the middle; fronto-clypeal ridge slightly produced but without conical projection at each side; first abdominal sternite devoid of pubescent fovea.

Variation in the type series.

Male (n=5) TL (mm): 1.43-1.54 (1.48±0.04) Female (n=3) TL (mm): 1.45–1.54 (1.5±0.04)

EW (mm): 0.71–0.74 (0.71±0.02) TL/EW: 2.06–2.1 (2.08±0.02) PL/PW: 0.81–0.83 (0.82±0.01) EL/EW: 1.31–1.37 (1.33±0.02) EL/PL: 1.75–1.86 (1.8±0.04) EW (mm): 0.71–0.74 (0.73±0.01) TL/EW: 2.03–2.09 (2.06±0.02) PL/PW: 0.79–0.83 (0.82±0.02) EL/EW: 1.31–1.34 (1.32±0.01) EL/PL: 1.75–1.86 (1.8±0.05)

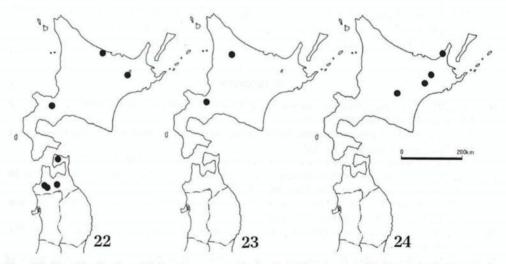
*Type series.* Holotype:  $\vec{\sigma}$ , Meakan Spa, Akan Natn. Park, Hokkaido, 6–VII– 1958, M. MIYATAKE leg. Paratypes: 1  $\hat{\varphi}$ , same data as holotype; 1  $\vec{\sigma}$ , 1  $\hat{\varphi}$ , Kawayu, Hokkaido, 22–VII–1970, M. SAKAI leg.; 2  $\vec{\sigma}\vec{\sigma}$ , Iwaobetsu, Shari-chô, Hokkaido, 8– VII–1990, M. KAWANABE leg.; 1  $\vec{\sigma}$ , 2  $\hat{\varphi}\vec{\varphi}$ , Nukabira Spa, Kamishihoro-chô, Hokkaido, 12~13–VII–1990, M. KAWANABE leg. All the type specimens are preserved in the collection of the Entomological Laboratory, College of Agriculture, Ehime University, Matsuyama.

Distribution. Hokkaido.

Host fungus. Coriolus versicolor (L.: FR.) QUÉL. (Kawaratake in Japanese).

*Remarks.* This new species is allied to *S. lengi* DURY, 1917, from North America in the features of the punctation and bristles on dorsum. In the latter, however, the antenna is 9-segmented and the fronto-clypeal ridge in the male is devoid of conical projections.

This new species is dedicated to the late Dr. Akira NOBUCHI, who unexpectedly passed away on June 22, 1996, at the age of 65, by traffic accident. Dr. NOBUCHI energetically studied ciid beetles in his youth, and was one of the pioneer specialists in the taxonomy of the Japanese Ciidae. He always encouraged my studies, and was a good instructor of mine.



Figs. 22–24. Distribution of Sulcacis spp. — 22, S. affinis (GYLLENHAL); 23, S. japonicus (NOBUCHI); 24, S. nobuchii sp. nov.

## Key to the Japanese Species of the Genus Sulcacis

約

要

川那部 真:日本産トゲヒメツツキノコムシ属の分類学的知見. — 日本に産するトゲヒ メツツキノコムシ属 Sulcacis を検討したところ,北海道産の標本中に1未記載種を見いだしたの で,モシリトゲヒメツツキノコムシS. nobuchii M. KAWANABEと命名して記載した.この種は, 北米産の Sulcacis lengi に類似するが,触角が10節からなることや雄頭部の二次性徴が顕著であ ることで,容易に区別できる.北米に産する種の近似種が北海道に産すること,またユーラシ ア北部から北米にかけて広く分布するトゲヒメツツキノコムシ属の種のうちの2種が,北海道 から本州北端付近に局在することは,生物地理学的にみて非常に興味深い.また,エゾトゲヒ メツツキノコムシS. japonicus については,原記載で正基準標本の指定がなされていなかったの で,総基準標本のうちから,北海道札幌市近郊の滝の沢産の標本を後基準標本に指定した.な お,今回記載した新種は,1996年6月に急逝された野淵 輝博士に捧げたものである.

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