

# Contribution to the Knowledge of the *Rakantrechus* Complex (Coleoptera, Carabidae, Trechini), with Description of a New Subgenus and a New Species of the Genus *Nipponaphaenops* S. Uéno, 1971 from Northwestern Shikoku, Western Japan

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(Received 30 March 2022; accepted 22 June 2022)

<http://zoobank.org/urn:lsid:zoobank.org:pub:8856369E-7DDF-4274-92C3-6AE5960BB64F>

**Abstract** A group of eyeless trechini ground beetles' genera distributed in western Japan, the *Rakantrechus* Complex, is reviewed, and a key to this Complex and a key to its component genera are provided. A new species of the genus *Nipponaphaenops* S. Uéno, 1971, *N. kojii* sp. nov. is described under the new subgenus *Tanakaphaenops* subgen. nov. Additionally, new taxonomic treatment *Rakantrechus* (*Iyotrechus*) *hisamatsui* (S. Uéno et Naitô, 2009) comb. nov. is proposed. Keys to the subgenera of *Rakantrechus* and *Nipponaphaenops* are provided. Revised definition of the genus *Nipponaphaenops* is proposed.

**Key words:** Morphology, new taxonomic treatment, trechine beetle, *Nipponaphaenops*, *Iyotrechus*, Shikoku district.

## Introduction

From the Pacific side of southwestern Japan, mostly south of the Median Tectonic Line, around 150 species (including subspecies) of eyeless trechine beetles represented by eleven genera (*Ishikawatrechus* Habu, 1950, *Ryugadous* Habu, 1950, *Rakantrechus* S. Uéno, 1951, *Kusumia* S. Uéno, 1952, *Awatrechus* S. Uéno, 1955, *Yamautidius* S. Uéno, 1957, *Himiseus* S. Uéno, 1969, *Allotrechiamia* S. Uéno, 1970, *Nipponaphaenops* S. Uéno, 1971, *Chaetotrechiamia* S. Uéno, 1982, *Iyotrechus* S. Uéno et Naitô, 2009; hereafter collectively referred to as the *Rakantrechus* Complex) have been discovered up to present (Belousov, 2017). They are generally believed to be more or less related to the East Asian trechine genus *Trechiamia* Jeannel, 1927, so that, in this

connection, they are assigned to the Phyletic Series of *Trechiamia* (Casale and Laneyrie, 1982; Casale *et al.*, 1998; Uéno, 1982c, 1988) in the current taxonomic treatment.

Among the components of the *Rakantrechus* Complex, this study focuses on two genera, *Nipponaphaenops* S. Uéno, 1971 and *Iyotrechus* S. Uéno et Naitô, 2009, both of which seem to require fundamental taxonomic revision. The hitherto monobasic genus *Nipponaphaenops* S. Uéno is well-known as a unique so-called “aphaenopsian” representative in the *Trechiamia* Phyletic Series in the current sense. A new species to be described under this genus, *N. kojii* sp. nov. has some remarkable traits, which do not conform with some of the previously known generic diagnostic characters including the absence of complete frontal furrows, which is usually regarded as one of the requisites of the true “aphaenopsian” trechine (cf. Uéno, 1978, p.

9). Nevertheless, the new species seems to be regarded as a representative of *Nipponaphaenops* belonging to a different subgenus. To include this new subgenus, *Tanakaphaenops* subgen. nov., a revised definition of the genus *Nipponaphaenops* is proposed. *Iyotrechus* was described as an independent genus of the *Rakantrechus* Complex (Uéno and Naitô, 2009). In my present opinion, however, characterization of *Iyotrechus* at genus level was only insufficiently made in the original description. After a comparative study, I decided to regard *Iyotrechus* as a subgenus of the genus *Rakantrechus* and to propose a new taxonomic treatment, *Rakantrechus (Iyotrechus) hisamatsui* (S. Uéno et Naitô 2009), comb. nov. for the type species of *Iyotrechus*, in this paper.

In closing the introductory part, it seems important to note that the photographs of the holotype specimen of *Nipponaphaenops kojii* sp. nov. to be described in this paper have already been presented in Uéno and Naitô (2009). However, the specimen was treated only as one of the comparative materials presumably related to *Iyotrechus hisamatsui* Uéno et Naitô, 2009 (= *Rakantrechus hisamatsui* comb. nov.) therein. Even though it was supposed that the specimen is more likely to belong to an independent new species, it has been left unnamed to date.

### Material and Methods

This study is based on the examination of specimens deposited in the collection of the National Museum of Nature and Science, Tsukuba, Japan (NSMT). Holotype designated in this paper is deposited in NSMT.

Label data for the holotype specimen are cited word for word between quotation marks “-”, with data for multiple labels separated by slash “/”. Any editorial comments are included between square brackets “[-]”.

For assessing character states, this study employed the criteria stated in Uéno (1988, especially p. 36–37).

The photographs were processed using Adobe Photoshop CC and Adobe Photoshop Elements

2018, if needed. Stacked images were generated by using the Software CombineZP (Hadley, 2010) or/and Adobe Photoshop Elements 2018.

Abbreviations used in this study are as follows: BL—body length, measured from the anterior margin of clypeus to apices of elytra; AL—length of antenna; HW—width of head; HL—length of head, measured between the anterior margin of clypeus and neck constriction along mid-line; PW—width of pronotum; PL—length of pronotum, measured from the apex to base along mid-line; PA—length of the pronotal apex; PB—length of the pronotal base, measured between the tips of hind angles; PSa—ratio (in percent) of the distance between the pronotal apex and the anterior latero-marginal seta of pronotum to the length of pronotum; PwL—ratio (in percent) of the distance between the apex of pronotum and the widest point of pronotum to the length of pronotum; EW—maximum width of elytra; EL—length of elytra; (m, n)—formula of elytral discal setae (m, the number of discal setae on or near the stria 3; n, the number of discal setae on or near the stria 5; in both, preapical seta is not counted); U1–U8—ratio (in percent) of the distance between the anterior end of elytral disc and the corresponding umbilicate pore of the left elytron to the length of the longer elytron; D1—ratio (in percent) of the distance between the anterior end of elytral disc and the first setiferous pore on (or near) stria 3 of the left elytron to the length of the longer elytron; D2—the same for the second setiferous pore on (or near) stria 3 of the left elytron; D3—the same for the setiferous pore on (or near) stria 5 of the left elytron; DP—the same for the preapical pore of the left elytron; M—arithmetic mean. In obtaining the value PSa, the distance was measured between the two levels, i.e., between the level of pronotal apex and that of anterior lateral seta, on a line parallel to mid-line. Method of measuring is similar in PwL, D1–D3, DP, and U1–U8.

## Taxonomy

### Phyletic Series of *Trechiana*

*Historical context.* Concept of the Phyletic Series of *Trechiana* (or *Trechiana* Phyletic Series) and that of the *Rakantrechus* Complex in this study are adopted from Casale and Laneyrie (1982), Casale *et al.* (1998) and Uéno (1982c, 1988). In early studies of the Japanese subterranean trechines, Uéno (1951, 1957 etc.) had already pointed out, in comparison with *Trechiana* species, the morphological peculiarities of the genus *Rakantrechus* S. Uéno, 1951 and its supposed allies, which include the non-aggregate condition of the humeral set of marginal umbilicate pores of elytra and the peculiar structure of the elytral basal parts. In the monographic study on the trechines of the Far East, Jeannel (1962) classified the Trechini genera from this geographic region into four phyletic series, i.e., that of *Epaphius*, that of *Trechiana*, that of *Trechoblemus*, and that of *Rakantrechus*; here Jeannel's phyletic series (série phylétique) means "a group of all genera, in any degree of evolution, having common ancestry" (Jeannel, 1922, p. 166), and this term has been used as the highest category under the subtribe Trechina. Diagnostic character of the "*Rakantrechus* Phyletic Series" in Jeannel's sense, which comprised the six genera then known, *Ishikawatrechus*, *Rakantrechus*, *Awatrechus*, *Ryugadous*, *Kusumia*, *Yamautidius*, was the non-aggregate condition of the humeral set of umbilical pores of elytra (Jeannel, 1962). Uéno (1971, p. 453) opposed Jeannel's taxonomic treatment with regard to the statuses of the two phyletic series, those of *Trechiana* and *Rakantrechus*, on the ground of his idea that the genus group of *Trechiana* and that of *Rakantrechus*

should be regarded as two subgroups nested within a single larger group, which is to be called the *Trechiana* Phyletic Series. Uéno's concept was accepted by the successive authors such as those noted above.

*Range of taxa.* In the sense of Casale *et al.* (1998) and Uéno (1982c, 1988), this series comprises: *Trechiana*-like three genera, *Accoella* S. Uéno, 1990, *Trechiana* Jeannel, 1927, and *Trechiotetes* Jeannel, 1954, and ten genera of the *Rakantrechus* Complex, which are referred to as "the Phyletic Line of *Rakantrechus*" in Casale *et al.* (1998, p. 1051, 1060).

*Diagnostic characters.* Having plural series of discal setae on elytra (apart from preapical seta), though in the derivative species, only a single series of discal setae is retained; the number of elytral discal setae arranged in a single series not more than 6; preapical setae of elytra usually settled on the apical anastomosis of striae 2 and 3, usually in apical 15% of elytra (rarely more anteriorly positioned up to apical 17%), though lost in the derivative species; submentum usually with six setae; protibia usually glabrous on anterior face (with some exceptions in the *Rakantrechus* Complex).

*Remarks.* Considering the remarkable increase in the number of trechini taxa described from Mainland China in recent years, the range of taxa delineated above may not be exhaustive. Especially, as was noted in Uéno (1995, p. 303; 2006, p. 22, 26) *Trechiana*-like two genera *Trechiamiotetes* Deuve, 1997 from Thailand (Deuve, 1988) and *Protrechiana* Belousov et Kabak, 2003 from Sichuan, China are likely to be included in this series.

*Geographic range.* East and Southeast Asia.

### Key to the Genera and the Genus Complex of the *Trechiana* Phyletic Series

1. Elytron each with three longitudinal series of discal setae (apart from preapical seta), which are in stria 2, 3, and 5; preapical setae of elytra in apical curve of stria 2; apical portions of elytral striae showing weak anastomosing tendency ..... *Trechiotetes* Jeannel
- Elytron each with at most two longitudinal series of discal setae (apart from preapical seta), which are in the area between interval 3 and stria 5, excepting individual aberrancy; elytral striae usually

- forming apical anastomosis.....2
2. The first four pores (humeral set) and pore 5 of the marginal umbilicate series of elytra close to or adjoining marginal gutter, distance between the pore 1 and the pore 4 usually divided into three sub-equal parts by the insertions of the pore 2 and 3.....3
- Pores 1, 3, 4 and 5 of the marginal umbilicate series of elytra more or less removed from marginal gutter dorsad, and pores 1–4 are usually unevenly arranged also in longitudinal direction; preapical setae of elytra always present..... *Rakantrechus* Complex
3. Pronotum barrel-shaped, with sides hardly sinuate before hind angles, with both front and hind angles hardly produced; striae of elytra deep and coarsely punctate; elytral discal chaetotaxy (3–4, 2–3); preapical setae of elytra in apical anastomosis of striae 2 and 3 ..... *Accoella* S. Uéno
- Pronotum usually cordate to subcordate, rarely subquadrate to subcampanulate, with sides usually sinuate before hind angles, with both front and hind angles produced in most cases; striae of elytra variable in depth, and usually less coarsely punctate than in the above entry; number of elytral discal setae variable from 0 to 5 in both inner and exterior series according to species; preapical setae of elytra either present (usually in apical anastomosis of striae 2 and 3) or absent
- ..... *Trechiana* Jeannel

### ***Rakantrechus* Complex**

*Range of taxa.* Comprising ten genera: *Ishikawatrechus* Habu, 1950, *Ryugadous* Habu, 1950, *Rakantrechus* S. Uéno, 1951 (including *Iyotrechus* S. Uéno et Naitô, 2009; see below), *Kusumia* S. Uéno, 1952, *Awatrechus* S. Uéno, 1955, *Yamautidius* S. Uéno, 1957, *Himiseus* S. Uéno, 1969, *Allotrechiana* S. Uéno, 1970, *Nipponaphaenops* S. Uéno, 1971, *Chaetotrechiana* S. Uéno, 1982. It seems worthy of attention that sometimes the term, “*Rakantrechus* Complex”, is ambiguously used to indicate a part of the taxa listed above. For example, in Uéno (2010, p. 131), and Uéno and Naitô (2009, p. 245), the term “*Rakantrechus* Complex” refers, at least explicitly, only to the subgenera of the genus *Rakantrechus*. However, in any case of the temporal variant usage, the term is used to indicate a part of the *Rakantrechus* Complex defined above, usually centering the genus *Rakantrechus*.

*General morphology.* First pore of the marginal umbilicate series of elytra is usually slightly to weakly removed dorsad from latero-marginal border; more obviously removed (regarded as a re-appearance of plesiomorphy; Jeannel, 1928) in the nominate subgenus of *Rakantrechus*, in *Yamautidius*, and in subgenus *Tanakaphaenops* sub-

gen. nov. of *Nipponaphaenops* than in the others (Figs. 3d, g–h). Elytra usually with two longitudinal series of discal setae, but with only external series (derivative) in some species of *Kusumia*, *Awatrechus*, and in all species of *Himiseus* (Fig. 4). The number of discal setae is comparatively large in *Chaetotrechiana*, in some species of *Rakantrechus* subgenus *Paratrechiana*, which is supposed to be related to the former, and in some species of *Kusumia*; and the chaetotaxies represented by them are likely to be comparable with the plesiomorphic types of the *Rakantrechus* Complex, even though the first case is possibly an example of atavism (cf. Figs. 4 and 7) (Uéno, 1982a, p. 52). Genae usually pubescent, glabrous (derivative) only in some species of *Rakantrechus* and *Ishikawatrechus*, and in all species of *Nipponaphaenops*. Posterior latero-marginal setae of pronotum usually present, absent (derivative) only in some species of *Rakantrechus*, *Ishikawatrechus*, and *Nipponaphaenops*. Inclined face of elytral basal peduncle deeply furrowed in all species of four genera, *Kusumia*, *Ryugadous*, *Awatrechus*, *Ishikawatrechus* (Fig. 3a); of these in the former two genera, body surface is almost entirely densely pubescent (plesiomorphic) both on dorsum and venter (Fig. 2n); also in *Awatrechus* species body surface is usually nearly

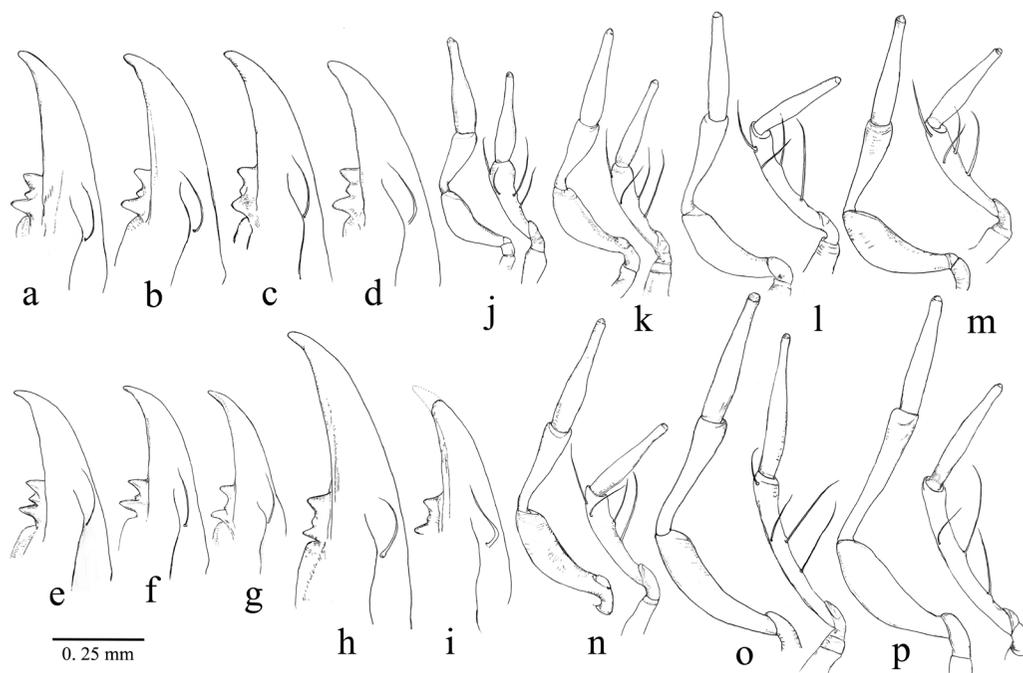


Fig. 1. Right mandible in dorsal view (a–i) and labial (right) and maxillary (left) palpi in ventral view (j–p).—a, *Chaetotrechiamia procerus* S. Uéno; b, *Rakantrechus* (*Paratrechiamia*) sp. (*nomurai* group from Shikoku); c & l, *R. (Iyotrechus) hisamatsui* (S. Uéno et Naitô) comb. nov.; d & m, *R. (Uozumitrechus)* sp.; e, *R. (Pilosotrechiamia) mirabilis* S. Uéno; f & k, *R. (Izushites)* sp.; g & j, *R. (Rakantrechus) kawasawai* S. Uéno; h & o, *Nipponaphaenops* (*N.*) *erraticus* S. Uéno; i & n, *N. (Tanakaphaenops) kojii* subgen. et sp. nov.; p, *Trechiamia pluto* S. Uéno (this species is unique in having trisetose penultimate labial palpomere in the *Trechiamia* Series).

entirely pubescent except on dorsum of head and protibia, but rarely glabrous also on elytra; in *Ishikawatrechus* species surface varies from nearly entirely pubescent (except on dorsum of head and protibia) to entirely glabrous. Within the genera without basal transverse furrow of elytra, body surface is nearly entirely pubescent only in *Himiseus* and subgenus *Miyamaidius* S. Uéno of *Yamautidius*. Last visible ventrite usually with a pair of apical setae in male, with two pairs of them in female (Figs. 2g–m); but in *Kusumia*, in *Himiseus*, and in the nominate subgenus of *Ryugadous* with two pairs (plesiomorphic) in male; and in *Kusumia*, in *Himiseus*, and in the subgenus *Nothaphaenops* S. Uéno of *Allotrechiamia* with three pairs (plesiomorphic) in female (Fig. 2n).

*Identification.* Usually discriminated from the other genera of the *Trechiamia* Phyletic Series

by the non-aggregate condition of the humeral set of marginal umbilicate pores of elytra. However, the following exceptional cases rarely occur in *Trechiamia* species: pore 1 of the umbilicate series is dorsally translocated (Fig. 3b); pore 4 of the series is relatively widely removed from the pore 3 (or pore 1 from pore 2) (cf. Uéno, 1972, 1983). Nevertheless, even in these cases, usually distance between the pores 1 and 4 (as a value U4–U1) is smaller, and the pores 4 and 5 are closer to marginal border in *Trechiamia* species than in the constituents of the *Rakantrechus* Complex. Besides, widely pubescent areas of body surface, which are present in the great majority of the species belonging to the *Rakantrechus* Complex, are not found in *Trechiamia* species neither on dorsum nor on venter, even though small number of hairs are very rarely present on some parts of body surface (genae, pronotum, anterior face of

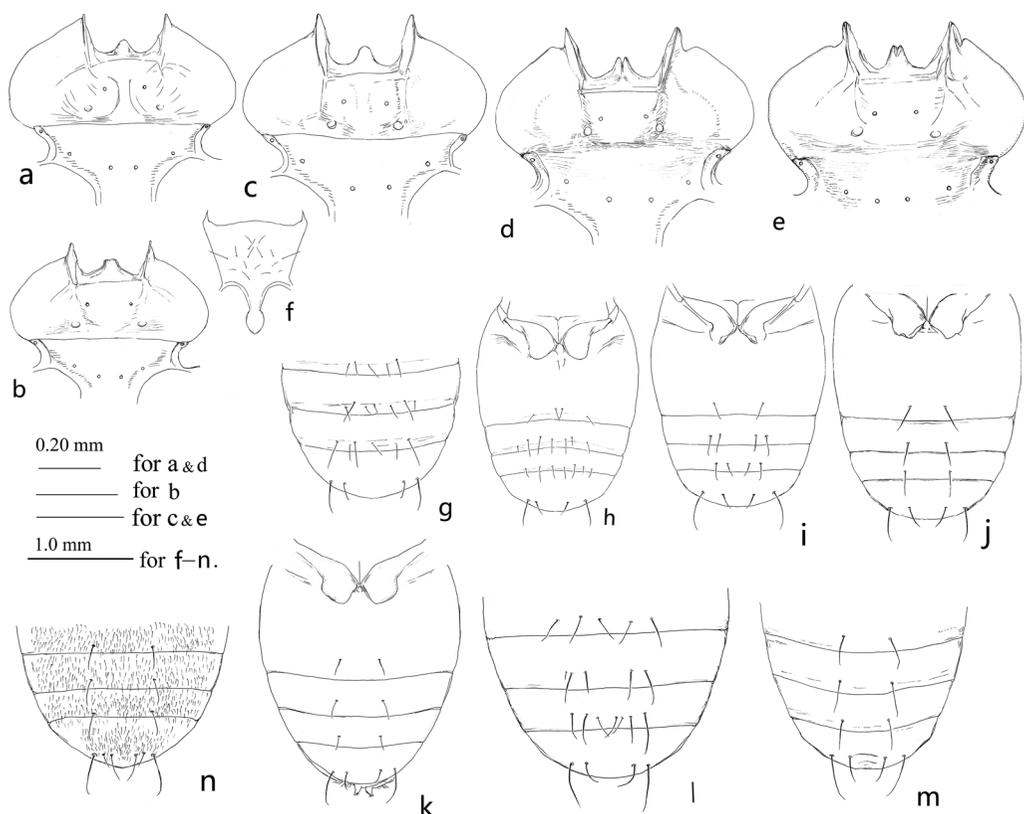


Fig. 2. Labium (a–e), prosternum (f), and female abdominal sterna (setae on metasternum and metacoxae are omitted).—a & j, *Rakantrechus* (*Uozumitrechus*) sp.; b & h, *R. (Rakantrechus) kawasawai* S. Uéno; c & m, *R. (Iyotrechus) hisamatsui* (S. Uéno et Naitô) comb. nov.; d, *R. (Paratrechiamia)* sp. (*nomurai* group from Shikoku); e & k, *Nipponaphaenops (Tanakaphaenops) kojii* subgen. et sp. nov.; f–g, *R. (Pilosotrechiamia) peninsularis* S. Uéno et Naitô; i, *R. (Izushites)* sp.; l, *N. (N.) erraticus* S. Uéno; n, *Kusumia takahasii* S. Uéno.

protibia) also in *Trechiamia* species (Fig. 3b) (e.g., Uéno, 1959, 1972).

**Geographic range.** Southwestern Japan, mostly south of the Median Tectonic Line; more precisely, with two exceptions, distributed in southern part of the Kii Peninsula, southern part of Shikoku, and central part of Kyushu, but the subgenus *Uozumitrechus* S. Uéno, 1958 of *Rakantrechus* occurs in westernmost part of Honshu and the islands of the Seto Inland Sea, and the subgenus *Miyamaidius* S. Uéno, 1978 of *Yamautidius* occurs in north-western corner of Shikoku.

**Remarks on distribution.** Constituents of the *Rakantrechus* Complex are mostly distributed on the southwestern side of the range of the genus *Trechiamia* in the Japanese Archipelago, with

some sympatric (with *Trechiamia* species) areas in the westernmost Honshu and in eastern Shikoku (Fig. 7). Taiwanese *Trechiamia* species are distributed to the southwest of the *Rakantrechus* Complex (Uéno, 1988).

**Explanation of Figure 4.** Diagrams in Figure 4 illustrate supposed derivation mode of elytral discal chaetotaxy in each genus of the *Rakantrechus* Complex; the left side of arrow is ancestral state and the right side is derivative one. These follow from two criteria: having plural series of discal setae is plesiomorphic; having larger number of discal setae is plesiomorphic (Uéno, 1988), plus two conditions: increase in the number of setae is not permitted; the transposition of setae between internal and external series is not taken

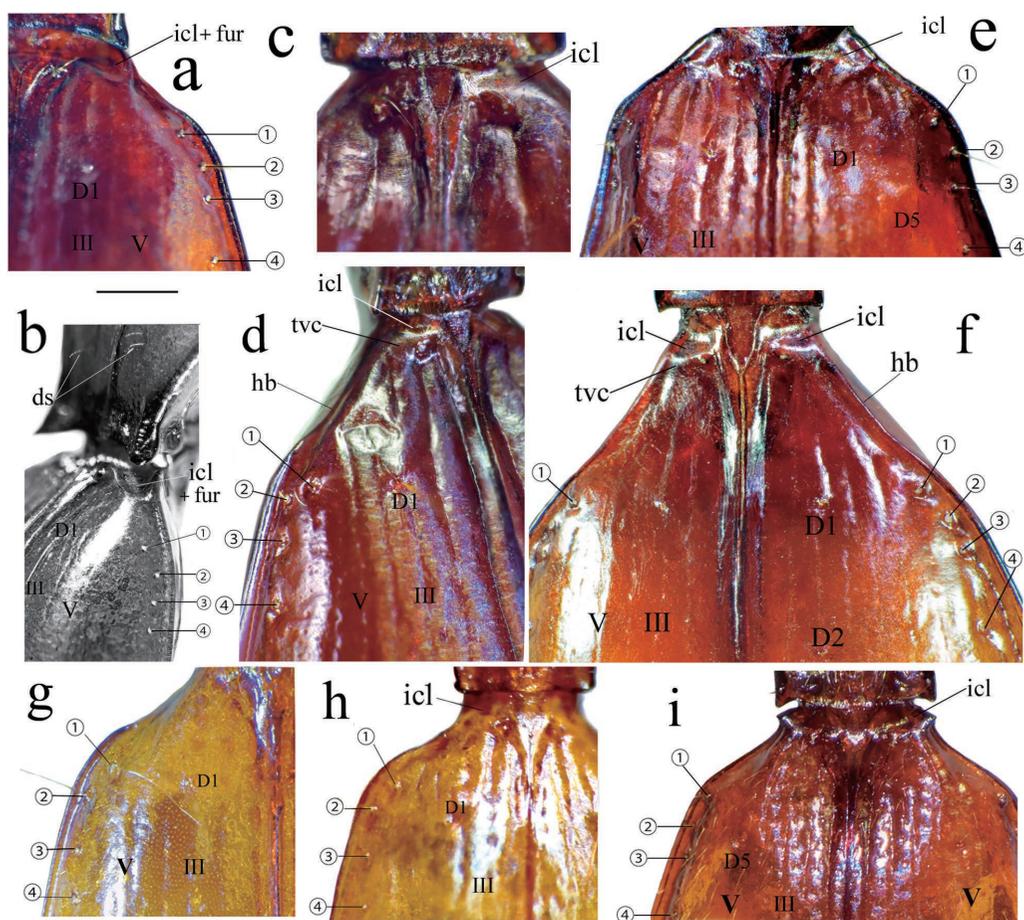


Fig. 3. Basal parts of pronotum and elytra in the *Trechiana* Series.—a–d, f & h–i, basal parts of pronotum and elytra; e & g, basal parts of elytra (a, c & e–i, dorsal view; b & d, oblique dorsal view).—a, *Ishikawatrechus septemtrionalis* S. Uéno; b, *Trechiana ohruii* S. Uéno; c–d, *Nipponaphaenops* (*Tanakaphaenops*) *kojii* subgen et sp. nov. (holotype female); e, *Rakantrechus* (*Paratrechiana*) sp. (*nomurai* group from Shikoku); f, *Nipponaphaenops* (s. str.) *erraticus* S. Uéno; g, *Yamauidius* (*Miyamauidius*) *anaulax* S. Uéno; h, *Rakantrechus* (s. str.) *kawasawai* S. Uéno; i, *Himiseus* sp.—D1, first elytral discal seta on or near stria 3; D2, second elytral discal seta on or near stria 3; D5, first elytral discal seta on or near stria 5; ds, discal setae on pronotum; fur, basal transverse furrow; hb, prehumeral border of elytra; icl, inclined face of elytral basal peduncle; tvc, transverse carina bordering elytral disc and inclined face; ①–④, pores 1–4 of marginal umbilicate series of elytra, respectively; III, elytral stria 3; V, elytral stria 5. Scale: 0.25 mm for a, d & h; 0.5 mm for b; 0.21 mm for c & g; 0.32 mm for e, f & i.

into consideration. Even though Uéno (1988) simply asserted these criteria, they may not be universally valid for entire Trechini; however, as far as the members of the *Rakantrechus* Complex are concerned, use of these criteria seems to be safely justified. Except asterisked one, all the chaetotaxy illustrated in diagrams occur in the extant species of the *Rakantrechus* Complex, i.e., variety is restricted to a minimum; therefore, it is

possible that the number of discal setae is larger (or smaller) in unknown ancestral (or derivative) states than illustrated ones. Sole asterisked chaetotaxy in *Ishikawatrechus* is only hypothetical one; under the above supposition, it is required that the common ancestor of *Ishikawatrechus* should have had at least two discal setae in both internal and external series. *Ishikawatrechus* species having this chaetotaxy is either as-yet-

unfound or non-existent. Note that, within the previously known species having deep basal transverse furrow on elytra, plural discal setae are not present in both internal and external series. Finally, it cannot fail to be noticed that the aug-

mentation and the transposition (between striae 3 and 5) of discal setae are, unlike otherwise premised sequences above, not unrealistic as case-studied in some Trechini groups (e.g., Jeannel, 1954, p. 159, 176).

**Key to the Genera of the *Rakantrechus* Complex**

1. Elytra with at most three discal setae in a single longitudinal series (apart from preapical seta), if the one series with three discal setae, the other with 0–2 discal setae (Fig. 4).....2  
 — Elytra with 3–6 discal setae in both stria 3 and 5 (apart from preapical seta) (Fig. 4)  
 .....*Chaetotrechiamia* S. Uéno
2. Inclined face of elytral basal peduncle not deeply transversely furrowed (Figs. 3c–i & 5a–f), if the inclined face is moderately concave (Fig. 3e), plural setae are present in both two series of elytral discal setae (apart from preapical seta) (Fig. 4) .....3  
 — Inclined face of elytral basal peduncle deeply transversely furrowed (Fig. 3a); not plural setae present in both two series of elytral discal setae (apart from preapical seta) (Fig. 4) .....7
3. Vertex glabrous; elytra with two longitudinal series of discal setae (apart from preapical seta).....4  
 — Vertex with numerous stout hairs; elytra with discal setae only in stria 5 (apart from preapical seta); basalmost portion of each elytron forming a denticle at the level of the inclined face (Fig. 3i)  
 .....*Himiseus* S. Uéno
4. Ventrite 4–6 each pubescent at least in postero-median part; pronotum always widely pubescent at least in the posterior half; elytral intervals usually glabrous, pubescent only in species with only a

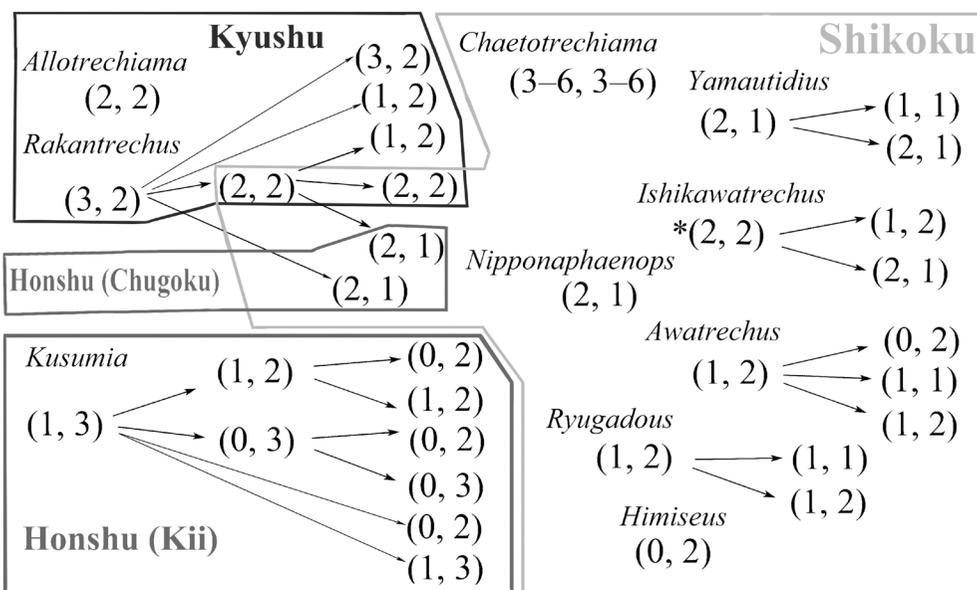


Fig. 4. Reconstructed derivation pattern of elytral discal chaetotaxy in the *Rakantrechus* Complex.—Except asterisked one, all the chaetotaxy presented in diagrams are exhibited by the extant species of the *Rakantrechus* Complex (including undescribed *Kusumia* species), but the asterisked one of *Ishikawatrechus* is only theoretically required.—Left side of arrow is ancestral state and right side is derivative one; the transposition of setae between internal and external series is not taken into consideration.

- single discal seta in stria 3 (apart from preapical seta) ..... *Yamautidius* S. Uéno
- Ventriles 4–6 glabrous except for fixed apico-marginal setae; pronotum usually glabrous or only with paramedian setae, widely pubescent only in species having pubescent elytral intervals; elytral intervals usually glabrous, pubescent only in species having pubescent pronotum and two discal setae in stria 3 (apart from preapical seta) ..... 5
5. Elytral discal setae of the internal series smaller in size than those of the external series, if the size difference of setae is not distinct, mandibles are extraordinarily elongate, as long as head; protibia entirely pubescent ..... *Allotrechiana* S. Uéno
- Elytral discal setae of the internal series subequal in size to those of the external series; mandibles shorter than head; protibia with anterior face glabrous ..... 6
6. Pronotum very elongate (PW/PL not more than 0.86), and distinctly narrower than a single elytron (EW/PW not less than 2.19 on average); mentum always fused with submentum (Fig. 2e); elytral stria 5 with a single discal seta; pore 1 of the marginal umbilicate series of elytra widely distant from elytral base (U1 more than 15.8) ..... *Nipponaphaenops* S. Uéno
- Pronotum transverse to slightly elongate (PW/PL not less than 0.91), usually wider than a single elytron (EW/PW not more than 1.88 on average); mentum usually not fused with submentum (Figs. 2a–c), if labial suture is almost completely vanished (Fig. 2d), elytral stria 5 with two discal setae; pore 1 of the marginal umbilicate series of elytra moderately distant from elytral base (U1 less than 12.6) ..... *Rakantrechus* S. Uéno
7. Vertex and anterior face of protibia entirely glabrous or nearly so, at most with some minute hairs ..... 8
- Vertex with numerous stout hairs; anterior face of protibia entirely or mostly pubescent ..... 9
8. Apical portion of male aedeagus dilated into sub-vertical disc apicad; pronotum always widely pubescent; elytral stria 3 with 0–1 discal seta (apart from preapical seta) ..... *Awatrechus*, S. Uéno
- Apical portion of male aedeagus usually with a ventral hook apically; pronotum either glabrous or pubescent (widely or partially), if pubescent, elytral stria 3 with two discal setae (apart from preapical seta) ..... *Ishikawatrechus* Habu
9. Ventricle 7 with two pairs of apical setae in female; elytral stria 3 always with a single discal seta (apart from preapical seta); prehumeral border with or without marginal cilia ..... *Ryugadous* Habu
- Ventricle 7 with three pairs of apical setae in female (Fig. 2n); elytral stria 3 with or without a discal seta (apart from preapical seta); prehumeral border always with (at least a single) marginal cilia ..... *Kusumia* S. Uéno

#### Genus *Rakantrechus* S. Uéno, 1951

*Rakantrechus* S. Uéno, 1951: 88 (type species: *Rakantrechus kawasawai* S. Uéno, 1951: 89, pl. 4, fig. B); 1957: 184 (redescription).

#### Subgenus *Iyotrechus* S. Uéno et Naitô, 2009

*Iyotrechus* S. Uéno et Naitô, 2009: 246 (type-species: *Iyotrechus hisamatsui* S. Uéno et Naitô, 2009: 248, figs. 1–4, 6–8; genus *Iyotrechus*)

*Remarks.* As noted in the introduction,

*Iyotrechus* S. Uéno et Naitô, 2009 was originally described as an independent genus in comparison with the genus *Ishikawatrechus* Habu, 1950 from which the former is distinctly different in the absence of deep transverse furrow on the inclined face of elytral basal peduncle and in the position of the fourth pore of marginal umbilicate series of elytra. However, despite the supposition in the original description that *Iyotrechus* is probably more closely related to members of the *Rakantrechus* Complex than to *Ishikawatrechus*, no key characters that allow the discrimination of

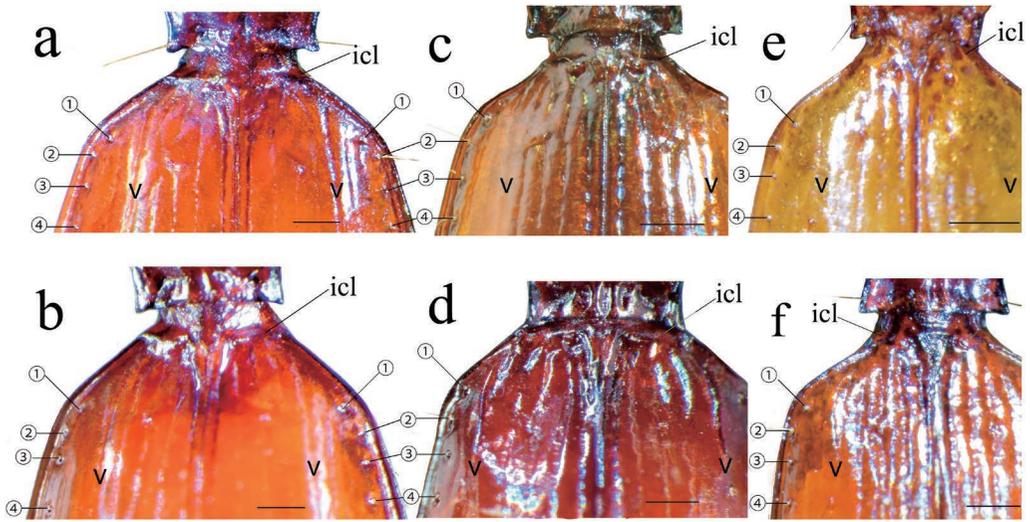


Fig. 5. Basal parts of pronotum and elytra in *Rakantrechus* species.—a, *Rakantrechus* (*Uozumitrechus*) *mukaibarai* S. Uéno (holotype male); b, *R. (Iyotrechus) hisamatsui* (S. Uéno et Naitô) comb. nov. (non-type diminutive individual, female); c, *R. (Izushites)* sp. (female); d, *R. (Paratrechiana) elegans* S. Uéno (paratype male); e, *R. (P.) pallescens* S. Uéno (non-type female); f, *R. (P.) gracillimus* S. Uéno (paratype male)—icl, inclined face of basal peduncle of elytra; ①–④, pores 1–4 of marginal umbilicate series of elytra, respectively; V, fifth elytral stria. Scales: 0.25 mm.

*Iyotrechus* from the other constituents of the *Rakantrechus* Complex were proposed by us (Uéno & Naitô, 2009, p. 245–246). Even the range of taxa indicated by the term “*Rakantrechus* Complex” was not clearly defined in that paper; in any case, *Ishikawatrechus* was not included in it. Actually *Iyotrechus* is very similar to subgenera of *Rakantrechus* (Figs. 1a–g, j–m, 2a–d, f–j, m, 5) but barely discriminated from them as shown in the *Identification* section below. Based on these, it seems reasonable to regard *Iyotrechus* as a subgenus of the genus *Rakantrechus*.

*Identification.* Within the subgenera of *Rakantrechus*, *Iyotrechus* is comparatively similar to *Uozumitrechus* S. Uéno, and *Izushites* S. Uéno in the structure of elytral basal parts and in the shape of mentum tooth (Uéno, 1982b) (Figs. 2a, c, 5a–c), but different from them in larger body size (BL: 5.55–6.10 mm), in having glabrous genae and in the absence of pronotal postangular setae. On the other side, in having glabrous genae and in the absence of pronotal postangular setae, *Iyotrechus* is similar to the species of the subgenus *Paratrechiana* S. Uéno

belonging to the species-group of *R. nomurai*, which is the only one species-group represented in Shikoku within the subgenus (the latter character state is known only in *R. (P.) elegans* S. Uéno, 1959 of the group; Fig. 5d). However, a single representative of *Iyotrechus* differs from the latter in larger body size (BL: 4.4–5.60 mm, in the *nomurai*-group), in having simple mentum tooth (bifid in the *nomurai*-group; Fig. 2d), in having only a single discal seta on elytral stria 5, and in having elytral intervals 5–6 which are not distinctly carinate basally (carinate and embracing a round depression between carinae in the *nomurai*-group; Figs. 3e, 5d).

*Taxonomic notes.* This subgenus is presently monotypic. In this subgenus (as far as known from the type species), the distance between the pore 1 and 4 of the marginal umbilicate series of elytra (as a value U4–U1) is on average smallest within the genus *Rakantrechus* (cf. Figs. 5a–f); besides, the pore 4 and 5 of the series are relatively close to marginal gutter in this subgenus: the condition closest to that exhibited by the *Trechiana* species. In a diminutive individual of

*R. (I.) hisamatsui* recorded as one of the problematical specimens in the original description (Uéno & Naitô, 2009, p. 247, 251), pore 4 of the humeral set is more widely removed from pore 3 than in the type specimens of the same species, though this condition is observed solely at the left side (Fig. 5b).

*Geographic range.* Northwestern area of Shikoku, southwestern Japan; traversing the ranges

of the subgenera *Rakantrechus* S. Uéno and *Izushites* S. Uéno (Fig. 7).

*Erratum.* Morphometric value of PW/PL given in the original description of *Iyotrechus hisamatsui* S. Uéno et Naitô, 2009 (= *Rakantrechus hisamatsui* comb. nov.) is an error. It is to be corrected as follows: (Page 250, line 3–4) For: PW/PL 0.82–1.00 (M 0.93) Read: PW/PL 0.92–1.00 (M 0.93).

### Key to the Subgenera of *Rakantrechus*

1. Elytral stria 5 with a single discal setae, and stria 3 (or interval 4) with two discal setae (apart from preapical setae); labial suture entirely visible (Figs. 2a–c).....2
- Elytral stria 5 with two discal setae, and stria 3 with 1–3 discal setae (apart from preapical setae); labial suture in varied condition, sometimes nearly vanished (Fig. 2d); genae either pubescent or glabrous (the latter case occurs only in species of the *nomurai*-group); posterior latero-marginal setae of pronotum either present or absent (the latter case occurs in one species of the *nomurai*-group; Fig. 5d); pronotum, prosternum, and elytral intervals always completely glabrous (apart from fixed setae); inclined face of elytral basal peduncle variable from distinctly defined to not separately defined (Figs. 5d–f), but always distinctly defined in species of the *nomurai*-group (Figs. 3e, 5d); male endophallus with or without copulatory piece.....Subgen. *Paratrechiana* S. Uéno, 1959
2. Genae pubescent; posterior latero-marginal setae of pronotum present (Figs. 5a, c).....3
- Genae glabrous; posterior latero-marginal setae of pronotum absent; inclined face of elytral basal peduncle distinct, flat (Fig. 5b); basal part of elytral disc moderately depressed; male endophallus without copulatory piece..... Subgen. *Iyotrechus* S. Uéno et Naitô, 2009
3. Intervals of elytra glabrous; pronotum and prosternum glabrous or only with paramedian setae.....4
- Intervals of elytra pubescent; pronotum and prosternum widely pubescent at least in posterior half (Fig. 2f); ventrites 4–6 with a row of 4–7 apical setae among which one or two pairs of paramedian setae are mingled (Fig. 2g); male endophallus with a large copulatory piece  
..... Subgen. *Pilosotrechiana* S. Uéno, 1958
4. Pore 1 (and 3, 4) of marginal umbilicate series of elytra obviously translocated dorsad (Fig. 3h); ventrite 3 with a few central setae, ventrites 4–6 each with a row of 4–7 hairs (Fig. 2h); in right mandible, median cusp of the tricuspid retinacular tooth (which is supposedly formed by the union of premolar and primarily bicuspid retinaculum) strongly reduced (Fig. 1g); mentum tooth slightly emarginate, or very slightly cleft at apex (Fig. 2b); hind angles of pronotum subrectangular, not posteriorly produced; inclined face of elytral basal peduncle not separately defined, continuous to the slope of elytral disc (Fig. 3h); male endophallus with a copulatory piece; highly depigmented; size smaller, not more than 3.50 mm .....Subgen. *Rakantrechus* S. Uéno, 1951
- Pore 1 (and 3, 4) of marginal umbilicate series of elytra more or less removed from marginal gutter, but more weakly so than the above entry (Figs. 5a, c); ventrite 3 without central setae (Figs. 2i–j); in right mandible, median cusp of the tricuspid retinacular tooth (which is supposedly formed by the union of premolar and primarily bicuspid retinaculum) small but distinct in intact specimens (Figs. 1d, f); mentum tooth with apex simply rounded or pointed (Fig. 2a); hind angles of pronotum latero-posteriorly produced; inclined face of elytral basal peduncle usually distinct, more steeply declivous than the sloping angle of elytral disc (Figs. 5a, c); less depigmented than above entry; size

- larger, not less than 3.55 mm .....5
5. Basal portion of elytral intervals 2–6 less distinctly depressed than the below entry (Fig. 5c); ventrites 4–6 each with one or two pairs of paramedian setae (Fig. 2i); aedeagal apical lobe deflexed, shorter (than the below entry), truncate at apex; male endophallus with a large copulatory piece; size smaller, not more than 4.00 mm .....Subgen. *Izushites* S. Uéno, 1982
- Basal portion of elytral intervals 2–6 more distinctly depressed than the above entry, (Fig. 5a); ventrites 4–6 each only with a pair of paramedian setae (Fig. 2j); aedeagal apical lobe reflexed, longer and slenderer (than the above entry,), pointed at apex; male endophallus with or without copulatory piece which is smaller than the above entry, if present; size larger, not less than 4.20 mm .....Subgen. *Uozumitrechus* S. Uéno, 1958

Genus *Nipponaphaenops* S. Uéno, 1971

*Nipponaphaenops* S. Uéno, 1971: 453 (type-species: *Nipponaphaenops erraticus* S. Uéno, 1971: 458).

*Diagnostic characters.* Diagnosed by the combination of the following character states, all of which are present in both of the two known congeners; (1) body surface including genae glabrous apart from fixed setae; (2) head elongate (HW/HL 0.76–0.98), subparallel-sided, and proportionally (as compared with pronotum) large (PW/HW 1.14–1.30, PL/HL 1.08–1.50); (3) mentum fused with submentum; (4) mentum tooth clearly bifid at apex; (5) pronotum very elongate (PW/PL 0.79–0.86); (6) hind angles of pronotum not distinctly laterally produced; (7) baso-lateral portion of pronotum along lateral margin with a rather deep unusually elongate depression before the basal transverse impression, which is close to and subparallel with basal margin; (8) scutellum not strongly deflexed at the level of the inclined face of elytra, and elongate triangular with very acute apex; (9) inclined face of elytral basal peduncle nearly flat; (10) elytra very broad (EW/PW 2.09–2.31) and very strongly constricted basad; (11) basal portions of elytral interval 1 including scutellar area elongate triangularly raised; (12) basal portions of elytral intervals 2–5 depressed; (13) elytral striae nearly entire, except lateral ones; (14) scutellar striole absent or vestigial; (15) apical recurrent stria relatively short and moderately arcuate, close to apical border of elytra; (16) both first and fourth pore of the marginal umbilicate series of elytra widely distant from elytral base (U1 15.8–18.8, U4 29.2–36.1);

(17) internal series of elytral discal setae with two setae (located 1/7–2/11 and 3/10–4/11 from base, respectively), and the external series with a single seta (located 6/11–11/17 from base); (18) preapical setae of elytra positioned before the level of the anterior end of recurrent stria (in apical 10–15% of elytra); (19) antennae and legs very long; (20) protibia with anterior face glabrous, with external face longitudinally grooved; (21) last visible ventrite with two pairs of apical setae in female.

*Identification.* *Ishikawatrechus* species usually share characters (4), (12), (13), (17), (20), (21) and sometimes (1), (14), (19) with *Nipponaphaenops* species; further, they are rarely close in morphometric values of (2), (5), (10), (16) to those of the latter, resulting in a body form relatively similar to the latter, and also have (3), (11), (15) too. But *Ishikawatrechus* species are discriminated from *Nipponaphaenops* species by the characters (6), (7), (8), (9), (18). *Rakantrechus* species usually share characters (20), (21) and sometimes (1), (3), (4), (6), (8), (9), (11), (12), (13), (14), (15), (17), (18), (19) with *Nipponaphaenops* species; rarely close in morphometric values of (2), (10) to those of the latter species, resulting in a body form somewhat reminiscent of the latter. However, *Rakantrechus* species are discriminated from *Nipponaphaenops* species by the characters (5), (7), (16). *Kusumia* species usually share characters (12), (13), and sometimes (4), (6), (7), (11), (14), (15), (18), (19) with *Nipponaphaenops* species; and sometimes overlapping in morphometric values of (2), (5), (10),

(16) with those of the latter species, resulting in a body form fairly similar to the latter (especially to subgen. *Tanakaphaenops* species). But *Kusumia* species differ in characters (1), (3), (8), (9), (17), (20), (21) from *Nipponaphaenops* species.

*Geographic range.* West-central to north-western area of Shikoku, southwestern Japan; between the ranges of *Rakantrechus* and *Ishikawatrechus* (Fig. 7).

*Remarks on distribution.* Similar geographical pattern of differentiation at subgenus level is observed between *Nipponaphaenops* and *Rakantrechus*; the ranges of two subgenera of the former basically parallel with those of the two subgenera, *Rakantrechus* and *Izushites*, of the latter (Fig. 7).

#### Subgenus *Nipponaphaenops* S. Uéno, 1971

*Diagnostic characters.* As far as known from the type species, this subgenus is different from another subgenus in the following character states; larger (BL: 5.8–7.3 mm); head more macrocephalic (PW/HW 1.14–1.27, PL/HL 1.08–1.20), more elongate (HW/HL 0.76–0.84); frontal furrows abbreviated posteriorly; tempora to genae only with a genal seta; penultimate labial palpomere about 1.15 times longer than ultimate one, with two subapical setae on the external face of the former reduced in size (Fig. 1o); antennae longer, slenderer, more than a half longer than elytra; pronotum with hind angles with acute denticle produced posteriad; posterior latero-marginal setae of pronotum absent; elytra more elongate (EL/EW 1.48–1.57), with longer prehumeral borders more arcuately sinuate; pore 1 of the marginal umbilicate series of elytra closer to marginal gutter and more distant from elytral base (U1 17.2–18.8), pore 4 of the series more distant from elytral base (U4 33.6–36.1); elytral discal seta of the external series more inwardly (in interval 4), more anteriorly (basal 6/11–10/17) positioned; legs longer and slenderer; ventrites 4–6 each with two or three pairs of paramedian setae (Fig. 2l).

*Taxonomic notes.* This subgenus is presently monotypic. One of the diagnostic characters of this subgenus, posteriorly abbreviated frontal furrows, makes the type species, in combination with the so-called aphaenopsian body form, a unique truly aphaenopsian representative within the members of the *Trechiamia* Phyletic Series, as far as the currently included members of the series are considered (Uéno, 1978, p. 9).

*Geographic range.* Ohnogahara Karst, west-central area of Shikoku, southwestern Japan (Fig. 7).

#### Subgenus *Tanakaphaenops* subgen. nov.

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Type-species: *Nipponaphaenops kojii* sp. nov.

*Diagnostic characters.* Discriminated from the nominate subgenus by the following character states; body size smaller (BL: 5.39 mm); head smaller, shorter (PW/HW 1.30, PL/HL 1.50, HW/HL 0.98); frontal furrows complete; tempora to genae with a temporal seta in addition to a genal seta; penultimate labial palpomere about 1.05 times longer than ultimate one, with two subapical setae on the external face of the former usual in size (Fig. 1n); antennae shorter, stouter, less than a half longer than elytra; pronotum with hind angles obtuse at the tip; posterior latero-marginal setae of pronotum present; elytra shorter (EL/EW 1.39), with prehumeral borders shorter and more straight; pore 1 of the marginal umbilicate series of elytra more distant from marginal gutter and closer to elytral base (U1 15.8), pore 4 of the series closer to elytral base (U4 29.2); elytral discal seta of the external series more externally (in stria 5), more posteriorly (basal 11/17) positioned; legs shorter and stouter; ventrites 4–6 each with a pair of paramedian setae (Fig. 2k)

*Description.* Body size small for the genus.

Chaetotaxy of head as in the nominate subgenus except that genae with a temporal seta; both two pairs of latero-marginal setae of pronotum

present; elytral discal and preapical setae as in the nominate subgenus; pore 1 of the humeral set of marginal umbilicate series of elytra postero-dorsally translocated, positioned on stria 7 and close to the level of the pore 2 of the series, and pore 4 of the series widely distant from pore 3 (Fig. 3d). Ventrite 7 of female with two pairs of apical setae (Fig. 2k).

Head elongate subquadrate; frontal furrows complete, deep in most part, though becoming superficial behind the level of posterior supraorbital pores; labial suture nearly completely vanished; mentum tooth relatively long and slender, sharply bifid at apex (Fig. 2e); right mandible (Fig. 1i) with a tricuspid retinacular tooth (which is supposedly formed by the union of premolar and primarily bicuspid retinaculum) whose median cusp is rather reduced (cf. Deuve *et al.*, 2016, p. 380).

Pronotum elongate subcordate, wider than head, obviously longer than wide, with front angles rounded but advanced, with hind angles as a whole subrectangular though obtuse at the tip.

Elytra large, oval, with basal parts strongly rectilinearly constricted basad, with prehumeral marginations becoming evanescent anteriad a short way before shoulders; baso-lateral areas of elytral disc just before shoulders nearly vertically deflexed ventrad, forming oblique longitudinal carinae consisted of basal parts of intervals 6–7,

with the outlines of prehumeral portion of elytra barely visible from above beneath these carinae (Fig. 3d); basal portions of intervals 2–5 more or less depressed, while basal parts of interval 1 including scutellar area left undepressed as in the nominate subgenus; inclined face of basal peduncle rather narrowly flat, embraced in gentle slope, which is bordered posteriorly by the obtuse transverse carinae formed by the basalmost portion of elytral disc (Figs. 3c–d).

Legs long, but relatively stout.

Male characters. Unknown.

*Taxonomic notes.* This subgenus is presently monotypic. In this subgenus (as far as known from the type species), the position of the first pore of the marginal umbilicate series of elytra is most strongly postero-dorsally translocated within the *Trechiana* Phyletic Series in a current sense (cf. Figs. 3d, g–h). However, in Japanese trechines as a whole, the pore is most strongly postero-dorsally translocated in *Suzuka* S. Uéno, 1956 species, which belongs to the *Trechoblemus* Phyletic Series.

*Geographic range.* Northwestern area of Shikoku, southwestern Japan; northwest of the range of the nominate subgenus (Fig. 7).

*Etymology.* This new subgenus is named in honour of Mr. Kôji Tanaka, who discovered the type species of this subgenus. Gender: masculine.

### Key to the Subgenera of *Nipponaphaenops*

1. Frontal furrows incomplete, vanished behind the level of the posterior supraorbital pores; posterior latero-marginal setae of pronotum absent; prehumeral border of elytra complete and reflexed; pore 1 of the marginal umbilicate series of elytra only slightly removed dorsad from marginal gutter (Fig. 3f); ventrites 4–6 each with two or three pairs of paramedian setae (Fig. 2l)  
 .....Subgen. *Nipponaphaenops* Uéno
- Frontal furrows complete, extending along the sides of neck constriction posteriad; posterior latero-marginal setae of pronotum present; prehumeral border of elytra incomplete; pore 1 of the marginal umbilicate series of elytra translocated postero-dorsally, close to the level of the pore 2 of the series (Fig. 3d); ventrites 4–6 each with a pair of paramedian setae (Fig. 2k)  
 .....Subgen. *Tanakaphaenops* nov.

*Nipponaphaenops (Tanakaphaenops) kojii*  
sp. nov.

(Figs. 1h, n, 2e, k, 3c–d, 6)

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Semiaphaenopsoid ♀ [sic]: Uéno & Naitô, 2009: 247.  
Semiaphaenopsoid specimen: Uéno & Naitô, 2009: 252.

*Type material.* Holotype: ♀ (NSMT), “Kuroyama, 480m alt., Furuhashi, Ishidatami, Uchiko-chô [typed on white label] / Ehime Pref. northwestern Shikoku, western Japan, 9.V.2009, K. Tanaka leg. [typed on white label] / found in a baited trap set by K. Tanaka on 10.IV.2009 [typed on white label] / Holotype [typed on red label]”.

*Diagnostic characters.* See the diagnostic characters of the subgenus.

*Description.* Female. Body size small, BL: 5.39mm. Colour of dorsum, venter, most of the appendages entirely dark reddish brown, maxilla and labial palpi pale yellowish brown. Surface polished, faintly iridescent. Microsculpture composed of fine transverse lines and strongly transverse meshes on head; very fine anastomosing transverse lines on pronotum and elytra.

Head elongate subquadrate, longer than wide, only feebly dilated anteriorly, with the widest point located at the level of antennal insertion; apical margin of labrum moderately emarginate; labial suture only partially visible as a superficial transverse lineation; frontovertex areas sharply convex, subcarinate along mid-line; genae flat, glabrous; neck constriction shallow; eye vestiges represented by small indistinct parallel-sided patches, with transverse wrinkles behind them; frontal furrows complete, rapidly divergent anteriorly in anterior 2/11 of their length, widely gradually divergent posteriorly in posterior 4/9 of their length, subparallel in between; anterior and posterior supraorbital pores widely distant from each other, on lines convergent posteriorly; HW/HL 0.98, AL/EL 1.32, relative length of each antennal segment from I to XI: 1 : 0.94 : 1.55 : 1.76 : 1.76 : 1.77 : 1.55 : 1.44 : 1.37 : 1.20 : 1.55.

Pronotum elongate subcordate, widest at about apical 3/14; apex wider than base, slightly arcuate at middle; base nearly straight; sides somewhat irregularly curved, arcuately convergent apically from the widest point, partially rectilinearly convergent posteriorly from that point to basal 1/10, then slightly divergent to base; lateral borders entire, narrow in basal 7/9, wider in api-

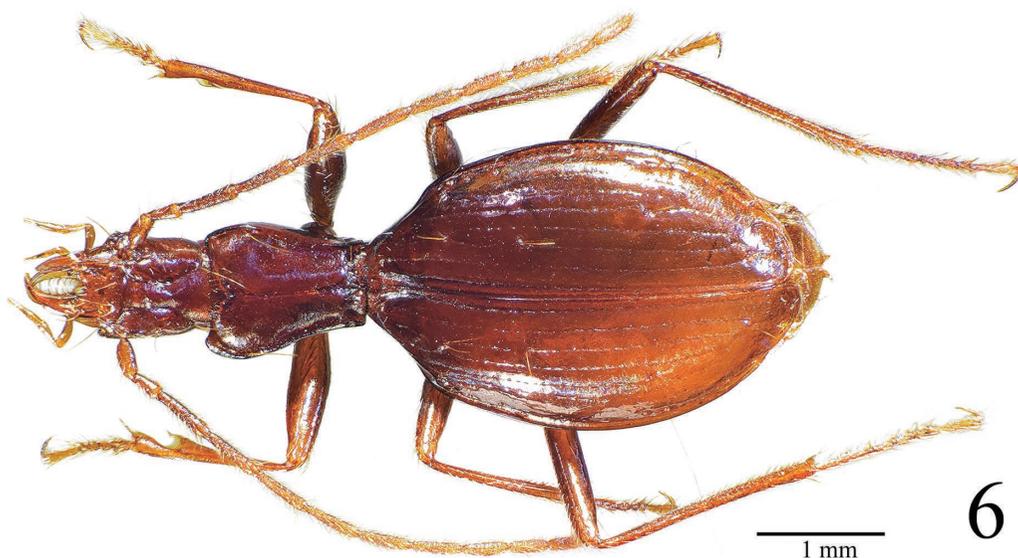


Fig. 6. Habitus.—*Nipponaphaenops (Tanakaphaenops) kojii* subgen et sp. nov. (holotype female). Scale: 1.0mm.

cal 2/9; anterior lateral seta inserted slightly behind the widest point, posterior one distinctly anteriorly shifted, located at 1/10 from base; dorsum convex in apical and median parts, baso-lateral areas before basal transverse impression narrowly longitudinally depressed along lateral borders, the bottom of the depressed areas transversely wrinkled; disc with a foveole on each side behind the widest parts; median-line distinct, deepening before vague apical transverse impression and also in and before basal transverse impression, but becoming shallower towards both ends; apical area rather strongly depressed at middle, rather deeply longitudinally strigose along apical margin; basal transverse impression deep and continuous, parallel to basal margin; basal area with a longitudinal paramedian impression and some deep longitudinal impressions; basal foveae rather small and deep; postangular carinae absent; PW/HW 1.30, PL/HL 1.50, PW/PL 0.86, PW/PA 1.33, PW/PB 1.56, PB/PA 0.85, PSa 22.7, PwL 21.5.

Elytra oval, large, more than twice as wide as pronotum, widest slightly behind middle; prehumeral basal parts strongly constricted basad in nearly straight lines; sides narrowly bordered and arcuate from behind shoulders to apices through slight preapical emargination; apices separately rounded; striae narrowly crenulate and weakly punctulate, 1–5 entirely moderately impressed, 6–7 superficial, partially represented by row of punctures, 8 partially impressed around marginal umbilicate pores; scutellar striole vanished; apical recurrent striole short, well incurved and directed to apical anastomosis of striae 3–5; intervals somewhat convex near suture and in basal parts, but flat in other parts; two discal setiferous pores on interval 4 next to stria 3 before middle; single discal setiferous pore on stria 5 behind middle; parascutellar pores on the base of stria 2; preapical pore on apical anastomosis of striae 2 and 3 before the level of anterior end of recurrent striole; apical triangle elongate, with inner edge away from mid-line anteriorly; EW/PW 2.19, EL/PL 2.69, EL/EW 1.43. The positions of the elytral setae are as follows: D1 16.4, D2 34.8,

D3 64.6, DP 87.8, U1 15.8, U2 17.5, U3 21.7, U4 29.2, U5 63.2, U6 68.7, U7 81.7, U8 89.1.

Legs fairly long and stout; protibia gradually dilated apicad, nearly straight, only slightly bowed near apex; mesotibia about 4/9 as long as elytra; metatibia feebly outcurved, about 5/9 as long as elytra; mesotarsus about 9/14 as long as mesotibia; mesotarsomere 1 longer than the mesotarsomeres 2–4 combined; metatarsus about 4/5 as long as metatibia; metatarsomere 1 much longer than metatarsomeres 2–4 combined.

Apical segment of the female gonopods unguiform, with a sensory fovea bearing a pair of sensory setae present on ventral face near apex; laterotergite with about ten or more apical fringing setae (Fig. 2k).

Reproductive tract. Not examined.

Male. Unknown.

*Remarks.* As mentioned in the introduction of this paper, the holotype specimen of this new species has already been introduced in Uéno and Naitô (2009), but it was treated as one of the problematical specimens supposedly related to (or a variant of) *Iyotrechus hisamatsui* S. Uéno et Naitô, 2009 (= *Rakantrechus hisamatsui* comb. nov.). A brief description of it (merely as a supposed variant of *Iyotrechus hisamatsui*) given therein was, however, not to the point, because important characteristics that differ between this new species and *Rakantrechus (Iyotrechus) hisamatsui* comb. nov., such as the shape of mentum tooth, presence/absence of pronotal postangular setae, and condition of labial suture were not mentioned. Further, we were completely erroneous in stating that the humeral set of marginal umbilicate pores of elytra is “almost aggregated” (Uéno & Naitô, 2009, p. 252). In fact, humeral set of *Nipponaphaenops (T.) kojii* sp. nov. is far from being aggregated as described above (Fig. 3 d). Having compared the holotype of *N. kojii* sp. nov. with the type series of *Rakantrechus hisamatsui* comb. nov. in that paper may seem to be widely misled or irrelevant to the subject. However, the late Dr. Uéno had intended to give a taxonomic consideration over a broader scope; he wrote (pers. comm.) in a letter to me dated 31

March, 2009 “I have an expectation that a certain affinity, like that between *Nipponaphaenops* and *Ishikawatrechus*, will be shown also between the former and *Iyotrechus*” (in Japanese).

*Notes on synonymy.* Two spellings cited in the synonymy of this new species are not available. These spellings were used to refer to the holotype specimen (designated in this paper) of this new species in Uéno and Naitô (2009), but were not proposed as scientific names for a new

species, as the taxonomic position of the specimen was not determined at the time.

*Habitat and bionomics.* The type locality of this remarkable new species is on the right (eastern) side of the Hiji-kawa River, about 0.7 km north of the type locality of *Rakantrechus hisamatsui* comb. nov. From nearby places, the members of *Rakantrechus* of the subgenera *Iyotrechus* and *Izushites* S. Uéno are also discovered (Fig. 7). The holotype specimen was obtained by a

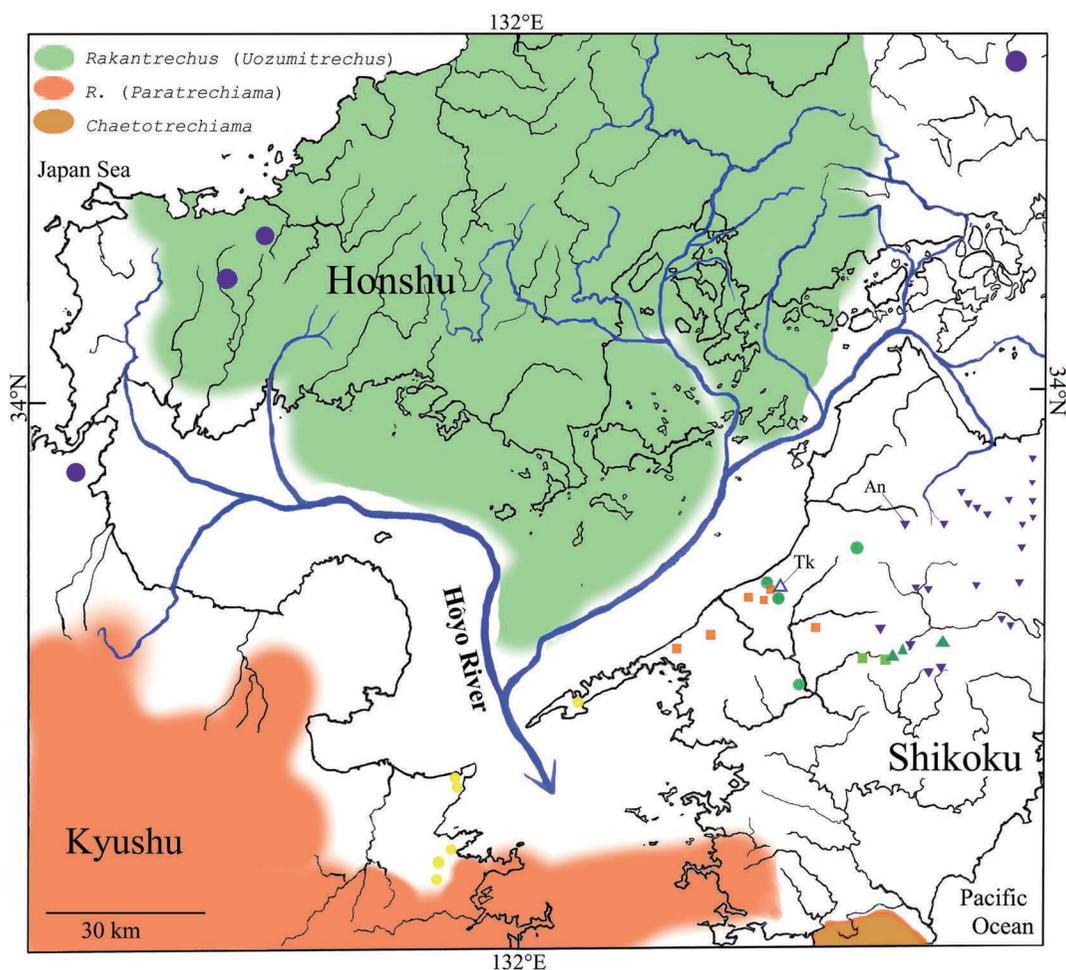


Fig. 7. Map showing the distribution of the *Rakantrechus* Complex (in part) and anophthalmic species of the genus *Trechiana* in western Japan.—Light green square, *Rakantrechus* (s. str.); orange square, *R. (Izushites)*; green circle, *R. (Iyotrechus)*; yellow circle, *R. (Pilosotrechiana)*; green triangle, *Nipponaphaenops* (s. str.); blue open triangle, *N. (Tanakaphaenops)* subgen. nov.; purple obtriangle, *Ishikawatrechus*; large purple circle, anophthalmic *Trechiana* species.—An, the type locality of *Ishikawatrechus annulus* Sugaya et Hara; Tk, the type locality of *Nipponaphaenops (Tanakaphaenops) kojii* sugen. et sp. nov. The course of the Hôyo River in the Last Glacial Maximum was drawn according to Kuwashiro (1959).

baited pit-fall trap set in upper-hypogean environment (cf. Juberthie and Bouillon, 1983; Yoshida, 2012).

*Etymology.* This new species is named after its discoverer, Mr. Kôji Tanaka.

### Discussion

*Taxonomic status of the genus Nipponaphaenops involving new taxon.* It is one of the well-known examples of convergent (or parallel) evolution that many species of trechines (and also other groups of Coleoptera) highly adapted to the subterranean environments (especially cave), irrespective of whose taxonomic position, independently exhibit a similar type of body form, i.e., so-called aphaenopsian morphotype, which involves enlargement of head, abbreviation of frontal furrows (in trechines), strong constriction of thoracic parts, elongation of appendages, and pseudophysogastry (e.g., Casale *et al.*, 1998; Jeannel, 1928; Miyama, 2011; Quéinnec, 2008; Uéno, 1971, 1988). This aphaenopsian syndrome likely to be responsible for the diagnostic character states (2), (5), (10), (19) of the genus *Nipponaphaenops*; even some of the other diagnostic character states of the genus, such as (16), may be coincidental with this particular modification of body form, suggesting that the similarities in these characters between two known congeners of *Nipponaphaenops* are homoplastic. In fact, as noted above, three different genera of the *Rakantrechus* Complex other than *Nipponaphaenops* show similar morphological tendency (see *Identification* section of the genus *Nipponaphaenops*). Even if these are the case, the share of all the generic diagnostic characters described above seems to justify the assignment of the new species, *N. kojii* sp. nov., to the genus *Nipponaphaenops*, despite the marked differences noted in the subgeneric diagnoses. Data on the geographic distribution pattern of the *Rakantrechus* Complex may serve as a circumstantial evidence for this taxonomic treatment (see, *Remarks on distribution* of the genus *Nipponaphaenops*).

*Derivation of Nipponaphaenops.* The genus *Nipponaphaenops* is generally believed to have evolved from a certain species of the genus *Ishikawatrechus* Habu (Miyama, 2011, p. 37; Uéno, 1971, 1988, 1992). In this case, we must bear in mind that if we suppose *Nipponaphaenops* species have derived from the ancestral trechine morphologically similar to the extant species of *Ishikawatrechus*, we must also suppose, as the original author did so (Uéno, 1971, p. 453), that the basal transverse furrow of elytra, which is present in all the extant *Ishikawatrechus* species, has secondarily degenerated in *Nipponaphaenops* species. If having basal transverse furrow is a derived state (for this issue, see below), this degeneration means a reversal, which is not parsimonious. Even if so, the furrow may have degenerated simply due to very strong constriction (as in *Nipponaphaenops*) in the basalmost portion of elytra. For example, in *Ishikawatrechus annulus* Sugaya et Hara, 2020, which is closest in the shape of elytra to *Nipponaphaenops* species among congeners, basal transverse furrow is narrower than in the other congeners, though the furrow is still distinct even in this species (cf. Sugaya and Hara, 2020). Alternatively, it seems equally possible that both of these two genera have descended from the ancestor in which basal transverse furrow of elytra has not yet developed. This course of evolution is not merely theoretically favoured, i.e., parsimonious, but also allows to be embodied in some scenarios, one of which is found to be feasible with the supposed ancestral chaetotaxic state of *Ishikawatrechus* (see *Explanation of Fig. 4* above) incorporated, as some species sufficing the required conditions (basal transverse furrow undeveloped; at least two discal setae in both series), such as *Paratrechiama* and *Chaetotrechiama* species, are actually distributed in the westernmost part of Shikoku (Fig. 7). In relation to this, to take the following into consideration seems important: as was pointed out above (see *Explanation of Fig. 4*), no extant species with basal transverse furrow is known to have plural discal setae in both external and internal series; however, given the

decreasing evolutionary trend in the number of discal seta, and if having deep basal transverse furrow is *not* a recently derived state, this present situation does not necessarily exclude the possibility that a certain lineage which possesses both of these two character states, and from which the extant *Ishikawatrechus*, and, possibly, other genera with basal transverse furrow and *Nipponaphaenops* may have been descended, once existed.

*Taxonomic implications of the basal transverse furrow of elytra.* Deep transverse furrow on the inclined face of elytral basal peduncle, which is employed for the characterization of some genera of the *Rakantrechus* Complex (e.g., Uéno, 1957), is probably a functionally adaptive structure, which enables mortise joint between the basal parts of pronotum and elytra (Fig. 3a). Very interestingly, in trechine beetles, this structure is exclusively found in species distributed in Japan and in a single species distributed in South Korea (*Gulaphaenops leptodiroides* S. Uéno, 1987), on the one hand. Within the Japanese trechines, on the other hand, this structure is found in species belonging to different genera and even to different phyletic series; i.e., among Japanese trechini representatives, this structure is found not only in the *Trechiamma* Series (in a few species of *Trechiamma* and four genera of the *Rakantrechus* Complex; Figs. 3a–b) but also in the *Trechoblemus* Series (in *Suzuka* S. Uéno, 1956 and *Dai-conotrechus* (*Tsuiblemus*) S. Uéno, 2007 species). As noted above, this structure is found in all the species of four genera, *Kusumia*, *Ryugadous*, *Awatrechus*, *Ishikawatrechus*, of the *Rakantrechus* Complex. However, taking the adaptive nature of this structure and possible convergent evolution into consideration, following two points about this character remain uncertain, as far as based on external morphological data: (i) which is the case as for this character, plesiomorphic or derivative, for each genus; (ii) whether or not share of this character is indicative of common ancestry. Since these points have influences on the understanding of the systematics of Japanese trechines, further studies addressing these

problems are necessary.

### Acknowledgements

This study owes much to the field researches carried out by Drs. Kazuo Ishikawa and Masahiro Sakai, Messrs. Yoshiyuki Itô, Kôji Tanaka, Masataka Yoshida and Ms. Fumi Miyoshi, to all of whom I wish to express my deep gratitude. I am very grateful to Dr. Shûhei Nomura (NSMT) for his kind support for the re-examination of the type specimens and for reading manuscript and making suggestions which greatly contributed to improve the manuscript. My special thanks are also due to an anonymous reviewer who enlightened me by helpful suggestions and detected several errors in the manuscript.

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