

## A Peculiar New Species of the Genus *Ishikawatrechus* (Coleoptera, Trechinae) from Northwestern Shikoku, Japan

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**Abstract** A new anophthalmic trechine beetle, *Ishikawatrechus annulus* sp. nov., is described from Mt. Saragamine in the northwestern part of Shikoku, southwestern Japan. This new species is distinguished clearly from any other congeners by the elongate pronotum without postangular setae, elytra with very narrow bases, very long prehumeral margins, and several unique features in elytral chaetotaxy, labium and aedeagal internal sac. These peculiarities are considered as a result from the high specialisation, and may support the placement of this new species as an isolated taxonomic group, at least at the species-group level within the genus.

**Key words:** Palaearctic, Trechini, taxonomy, subterranean fauna.

### Introduction

The genus *Ishikawatrechus* HABU, 1950 (Carabidae, Trechinae) comprises 30 species and one subspecies, and is endemic to Shikoku in southwestern Japan (SUGAYA & YAMASAKO, 2014). The genus is easily distinguished from the other trechine genera in Japan by having the following characteristics: 1) mentum free, not fused with submentum; 2) pronotum with both lateral and postangular setae; 3) stria 3 with two setiferous dorsal pores before the middle of elytra, stria 5 with one setiferous dorsal pore behind the middle of elytra; 4) humeral group of umbilicate pores not aggregated, first three pores arranged nearly equidistantly and adjoining marginal gutter, but 4th pore more distant from the others; 5) protibiae grooved externally and glabrous, even at apex; 6) aedeagus with a sharp hook at the apical-end of the ventral groove (UÉNO, 1957).

The genus is mainly distributed in the central region of Shikoku, particularly in the Ishizuchi Range and its adjacent mountains that extend along an east-west axis, parallel to the northern coast of the island (UÉNO, 2008). Of these mountains, Mt. Saragamine (1,270 m in height), in the northwestern part of the Ishizuchi Range, was not known to be inhabited by anophthalmic trechids. However, a very extraordinary trechid was discovered recently on Mt. Saragamine. A close examination revealed that this trechid belonged to *Ishikawatrechus*, but the presence of several specialised features warrants description of this taxon as a new species. In this study, the peculiarity and taxonomic importance of this new species are discussed.

### Material and Methods

This study was based on dried specimens from the private collections of ourselves. All the specimens were collected from upper hypogean zone, approximately 50–150 cm in depth below the surface, by digging out or setting bait traps. The holotype of this new species will be deposited in the Ehime University Museum, Matsuyama, Japan (EUMJ), and the paratypes will be in EUMJ and the

National Museum of Nature and Science, Tsukuba (NMNS).

The verbatim label data for the holotype was provided in double quotation marks (" ") with a slash (/) indicating the line breaks.

The observations were conducted under a stereoscopic microscope (Leica S8 APO) and optical microscope (Olympus BX43). The method of SUGAYA and YAMASAKO (2014) and YAMASAKO (2015) were used for observation of the internal sac of male genitalia and the membranous structures of female genitalia, respectively. The photograph of genital organs were taken by a digital camera (Olympus OM-D E-M1 Mark II) mounted with a macro lens (Olympus M.ZUIKO DIGITAL ED 60mm F2.8 Macro) through an optical microscope (Olympus BX43).

The terminology follows mainly UÉNO (1957) but LIEBHERR (2011, 2018) for female reproductive tract except for "bcv", the abbreviation for bursa copulatrix ventral lobe, is uniquely used in this study for convenience. The abbreviations of genital organs refer in the caption of Figs. 12–25.

The abbreviations used for measurements are as follows: ABL — approximate body length (apical margin of clypeus to elytral apex); ATL — approximate total length (apex of mandible to anal end); EBW — width of elytral base along the posterior margin of basal transverse furrow; EHL — length from posterior margin of the basal transverse furrow to the tips of shoulder; EHW — width between the tips of shoulders; EL — elytral length (from posterior margin of basal transverse furrow to elytral apex); EW — maximum width of elytra; EWL — length from posterior margin of basal transverse furrow to widest part of elytra; HL — head length (apical margin of clypeus to neck constriction); HW — maximum width of head; HWL — length from apical margin of clypeus to widest part of head; PAW — width of pronotal apical margin (between the tips of pronotal front angles); PBW — width of pronotal basal margin (between the tips of pronotal hind angles); PL — pronotal length; PW — maximum width of pronotum; PWL — length from apical margin to the widest part of pronotum; SBL — standardised body length (HL+PL+EL). All longitudinal measurements were measured along the mid-line of the body in dorsal view. The mean of measurements and ratios of each body part is indicated in parentheses after the range.

## Taxonomy

### *Ishikawatrechus annulus* sp. nov.

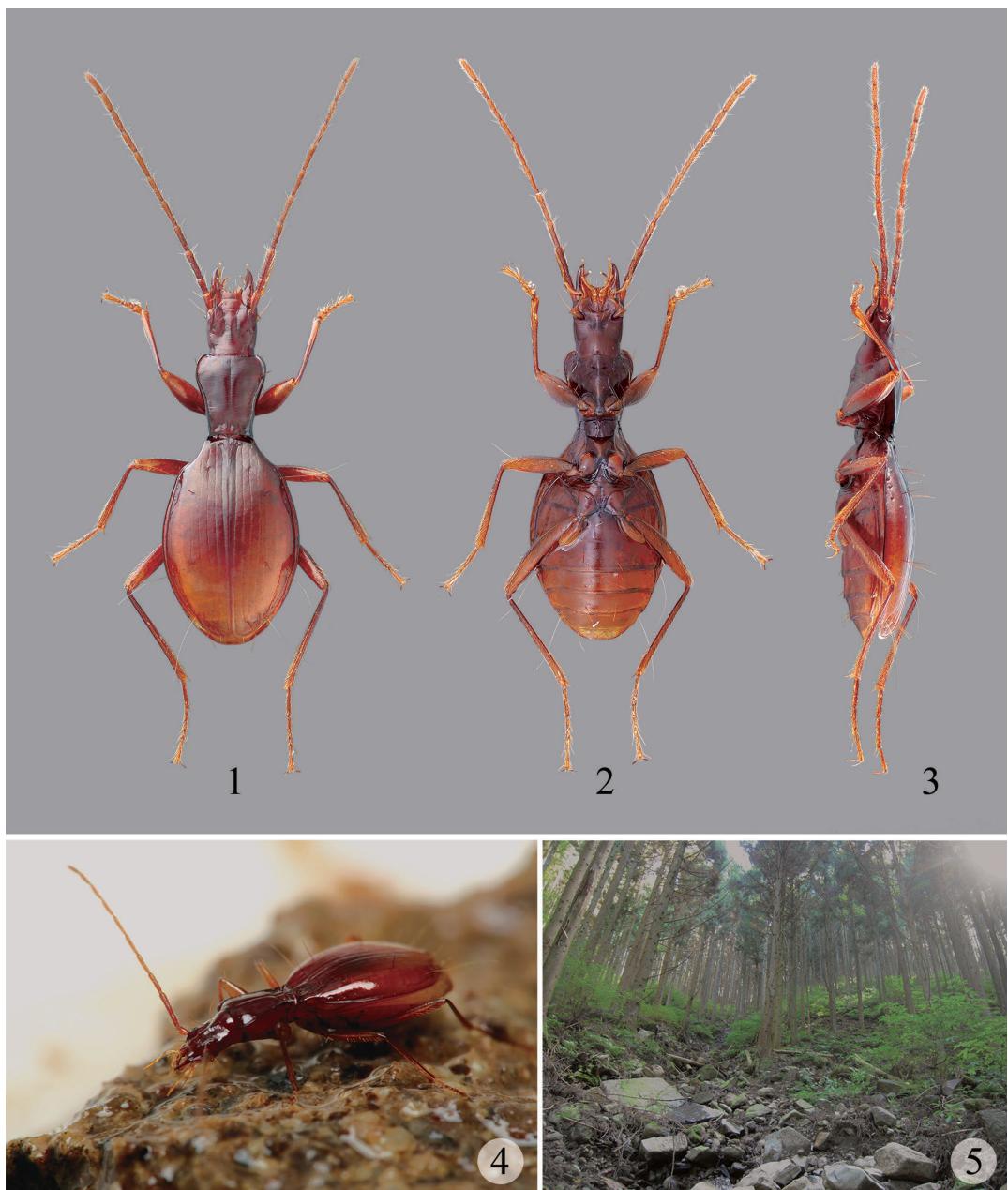
[Japanese name: Saragamine-tsuya-mekura-chibigomimushi]

(Figs. 1–4, 6, 8, 10 & 12–25)

*Type series.* Holotype: ♂ (EUMJ), "[Ehime: JAPAN] / Mizunomoto, Kanbayashi / Tôon-shi, alt. 840 m / 30. VIII. 2013 / Y. HARA leg." (printed on white label), "愛媛県東温市上林水元 / (地中トラップ)" (printed on white label), "HOLOTYPE / *Ishikawatrechus annulus* sp. nov. / Sugaya & Hara des. 2020." (printed on red label). Paratypes: 1 ♀ (NMNS), same data as holotype except alt. 865 m, 8.VI.2012, Y. HARA & K. SUGAYA leg.; 1 ♀ (NMNS), ditto except alt. 860 m, 12.X.2012, K. SUGAYA leg.; 2 ♀♀ (NMNS), ditto except alt. 840 m, 24.V.2013, K. SUGAYA leg.; 1 ♀ (EUMJ), ditto except alt. 840 m, 7.VI.2013, K. SUGAYA leg.; 1 ♂ (NMNS), ditto except alt. 845 m, 25.X.2016, Y. HARA leg.

*Type locality.* North-northwestern slope of Mt. Saragamine, 840–860 m in altitude, at Mizunomoto of Kanbayashi in Tôon-shi, Ehime Prefecture, northwestern Shikoku in southwestern Japan (Fig. 5).

*Description* (n = 7). Male and female. Coloration (Figs. 1–3) reddish brown, darker in



Figs. 1–5. Habitus and type locality of *Ishikawatrechus annulus* sp. nov. —— 1–3, Holotype, dorsal view (1), ventral view (2) and left lateral view (3); 4, living specimen; 5, type locality.

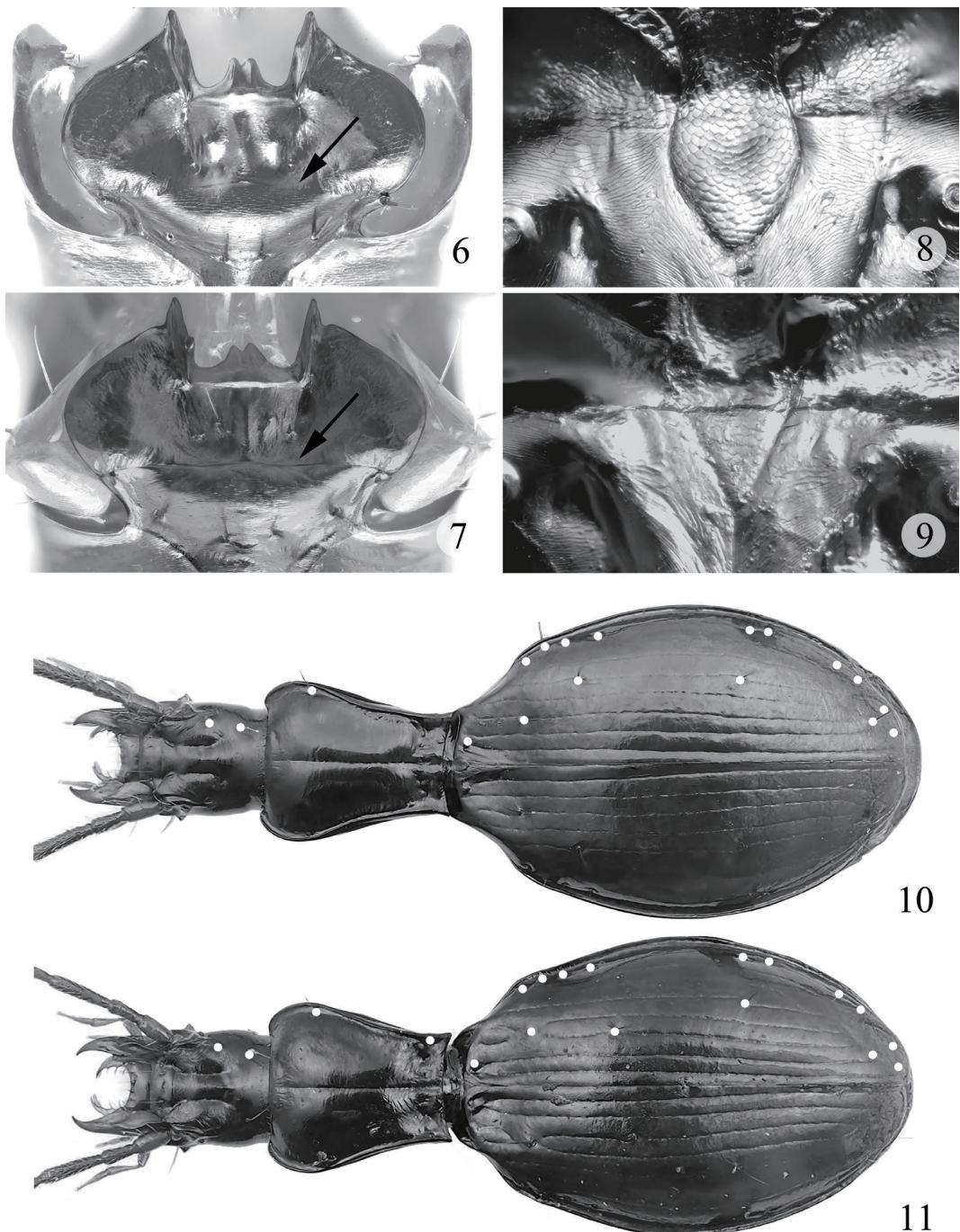
head and pronotum, lighter and become paler towards apices in elytra; antennae and legs light reddish brown near base but become lighter and yellowish brown towards apices; body surface strongly shiny and vaguely iridescent on pronotum and elytra.

Head (Figs. 1–4, 6 & 10) completely glabrous, subquadrate, widest at about 2/3 from apical

margin of clypeus; HL/HW 0.95–1.02 (0.99), HWL/HL 0.62–0.73 (0.68); dorsum slightly convex in frons and occiput, depressed in supraorbital area; frontal furrows almost parallel at middle, moderately divergent in front, more strongly so at behind, finely denticulate throughout, and strongly impressed although becoming shallower from level before posterior supraorbital pore towards neck constriction; supraorbital pores composed of two pairs on each sides; microsculptures deeply engraved by almost isodiametric meshes; eyes almost vanished; genae very slightly dilated at posterior parts laterally; neck constriction distinct. Mentum imperfectly fused with submentum; suture between them very shallow and slightly visible near middle but almost effaced at sides; mental tooth either bifid or emarginate at apex. Antennae extend beyond middle of elytra; approximate ratio of antennomeres of holotype as follows: 1.00 : 1.00 : 1.82 : 1.81 : 1.64 : 1.67 : 1.50 : 1.45 : 1.44 : 1.31 : 1.54.

Prothorax (Figs. 1–4 & 10) completely glabrous. Pronotum elongate subcordate, evidently wider and longer than head, much longer than wide, widest at about 1/5 from apex; PW/HW 0.13–1.44 (1.21), PL/HL 1.48–1.61 (1.54), PL /PW 1.08–12.2 (2.68), PWL/PL 0.14– 0.18 (0.16), PW/PAW 0.13–1.42 (1.21), PW/PBW 0.14–1.67 (1.38); sides moderately arcuate and dilated latero-anteriorly before middle, moderately and widely emarginate near middle, almost straight behind middle, and thence very slightly divergent towards hind angle; apical margin almost straight, wider than base; PAW /PBW 1.06–1.23 (1.14); front angles short, but distinctly produced anteriorly; basal margin moderately emarginate between hind angles which are distinct but very short and produced latero-posteriorly; dorsum moderately convex; apical transverse impression obsolete, with longitudinal wrinkles; longitudinal small areas on each sides of median line shallowly depressed behind widest point; median line distinct; basal transverse impression distinct; postangular carinae absent; radial waving wrinkles on disc extending from median line to each side distinctly; microsculptures moderately engraved by transverse lines; lateral setae situated at about 1/4 from apex; postangular setae absent. Proepipleuron swollen laterally and obviously visible from above.

Elytra (Figs. 1–4 & 10) completely glabrous, oval, obviously wider and longer than pronotum, much longer than wide, widest at about middle; EW/PW 1.9–21.28 (4.71), EL/PL 2.50–2.57 (2.54), EL/EW 1.41–1.47 (1.43); EWL/EL 0.48–0.52 (0.51); basal transverse furrow clearly defined on disc between each striae 4, about same width to pronotal base, faintly arcuate backwardly in whole width, hardly stretching backwardly both external ends; EBW/PBW 1.02–1.13 (1.07); EBW/EHW 0.48–0.52 (0.50); prehumeral margin extending on basal 2/13 of disc, strongly oblique, distinctly emarginate, and visible from above entirely; EHL/EL 0.12–0.16 (0.14); shoulders distinct, widely rounded; sides straight or very slightly emarginate behind shoulders, semicircularly arcuate at middle, and thence connected to rounded conjoint apices through preapical emarginations; dorsum moderately convex; basal depression distinct but shallowly depressed on basal 2/7 of disc, limited on each sides by indistinct basal carina composed of intervals 5 and 6; surface smooth, with fine transverse wrinkles sparsely on each striae intervals; microsculptures moderately engraved by fine transverse lines; striae 1–5 distinct but shallowly impressed entirely, and finely and irregularly sinuated respectively; striae 6 very shallowly impressed and becoming indistinct towards base; striae 7 more shallowly so than striae 6; stria 8 almost effaced, though deeply impressed from front of 5th pore of marginal umbilicate pores towards apex of disc; apical striae deeply impressed, moderately curved, not connected with any stria but directed to the termination of stria 5; scutellar striae distinct; each striae intervals flattened throughout; stria 3 with a single setiferous dorsal pore on 1/7 from base of disc; stria 5 with two setiferous dorsal pores on 1/4 and 3/5 from base of disc, respectively; humeral group of marginal umbilicate pores not aggregated, with 2nd pore adjoining marginal gutter and somewhat closer to 3rd pore than 1st pore, while with 4th pore slightly distant from the others and marginal gutter. Epipleuron



Figs. 6-11. Comparison of body parts in *Ishikawatrechus* spp. — 6, 8 & 10, *I. annulus* sp. nov., paratype, female (6) and holotype, male (8 & 10); 7, 9 & 11, *I. bidilatatus* Sugaya, paratype, female. — 6 & 7, Labium in ventral view (black arrow indicates labial suture); 8 & 9, scutellum in dorsal view; 10 & 11, chaetotaxy of head, pronotum and elytra (white points).

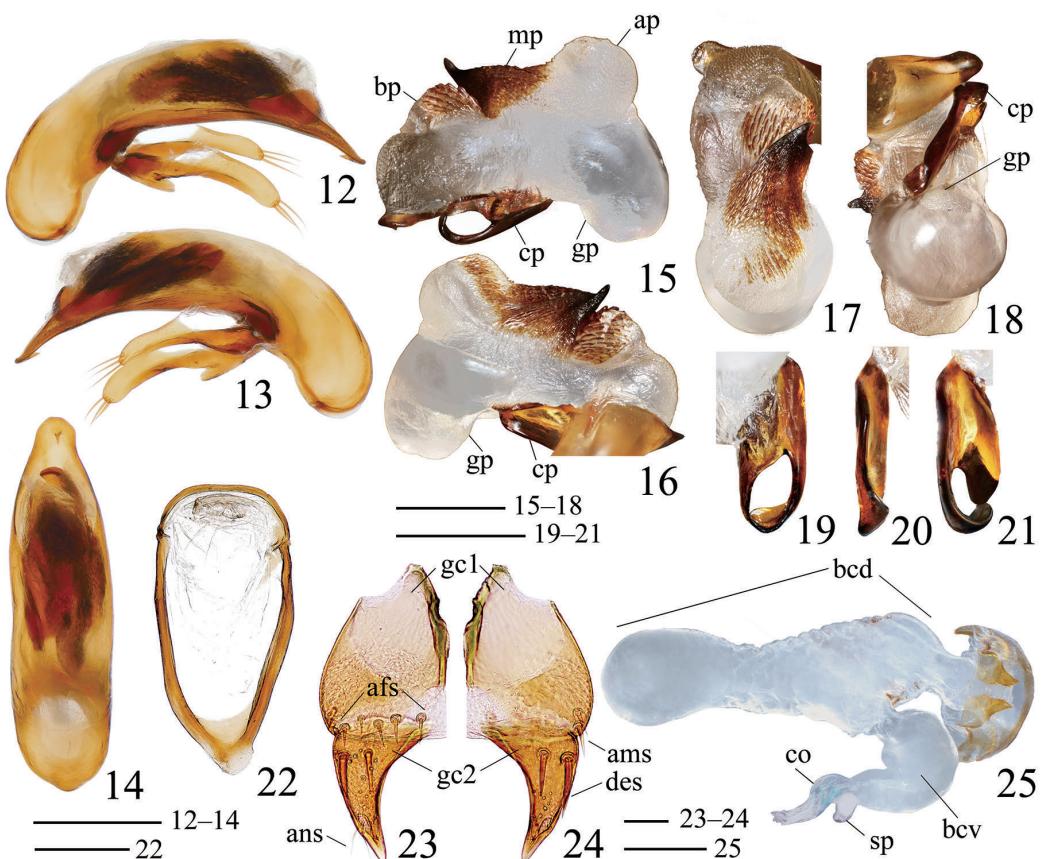
moderately depressed dorso-laterally and slightly visible from above on prehumeral margins, reflexed upwards and forming carina from just before shoulder to before preapical emargination; suture between elytron and epipleuron along prehumeral margin very weak and superficial, slightly visible from above, diminishing anteriorly and disappeared just before external end of basal transverse furrow; marginal gutter extending from just before shoulder to before preapical emargination.

Hind wings absent. Scutellum (Fig. 8) subrhomboid shaped with rounded apex. Ventral surface (Fig. 2) completely glabrous and smooth; sternites 3–5 with a pair of ordinary setae respectively; anal sternite simply arcuate at apical margin, with a pair of setae in ♂, two pairs of setae in ♀.

Legs (Fig. 1–2) typical as those of the genus; protibiae grooved externally and glabrous even at apex; in ♂, two proximal segments of each protarsus widely dilated and produced inwardly at apices, and furnished beneath with sexual adhesive appendages.

Male genitalia ( $n = 2$ ; Figs. 12–22) heavily sclerotised. Aedeagus about 1/4 as long as elytra, moderately curved ventrally, highest at about 1/3 from apex, and thence rapidly tapered towards apex; dorsal margin in lateral view semicircularly rounded from base to highest area, and thence connected to apical orifice; ventral margin in lateral view moderately bent ventrally behind joint with styles, very slightly swollen ventrally at about middle, very slightly emarginate from level of highest area of aedeagus, and thence connected to apical lobe; basal part about 1/3 as long as aedeagus, very slightly curved ventrally, with basal margin widely rounded; basal orifice about 1/5 as long as aedeagus, with left side in lateral view moderately emarginate at apical half, while right side very slightly emarginate; sagittal aileron very narrow and hyaline; apical orifice immediately opened behind highest area of aedeagus, about 2/7 as long as aedeagus, with sides in lateral view moderately and widely sinuated; apical lobe about 1/9 as long as aedeagus; apical lobe in dorsal view gently inclined leftward, gradually narrowed towards subrhomboidally dilated apex and somewhat truncate at extremity; apical lobe in lateral view elongate, gradually tapered, slightly curved ventrally, and briefly reflexed at extremity which are rounded; ventral hook large and elongate triangular. Internal sac in fully inflated condition with eversion stubby-tube shaped, a little shorter than aedeagus, strongly twisted rightward near base, and thence moderately arcuate ventrally in basal 2/3, roundly projected ventrally in apical 1/3; dorsal surface with three remarkable projections; basal projection (bp) swollen in bulbous towards base, produced at apex, with large scaly sclerotised spicules dorsally; middle projection (mp) same size as bp, swollen in corniform towards base dorsally, moderately curved rightward, densely covered with large and strongly sclerotised spicules which are fused with each other towards apex of mp and forming a large uncinate structure; apical projection (ap) larger than bp and mp, swollen in bulbous towards apex, dominantly covered with fine hyaline spicules, but with large and well scaly sclerotised spicules on longitudinal area of right side dorsally; membranous surface, except in three projections and around gonopore (go), covered with fine hyaline spicules, although apical 1/3 bared; go opened on ventral surface preapically; copulatory piece (cp) attached on middle area of internal sac left latero-ventrally, about 1/3 as long as internal sac, 2/5 as long as aedeagus, strongly sclerotised, with each sides extended towards apex and forming a pseudo-ring shape, though not fused with each other at tips. Styles in lateral view elongate, moderately curved ventrally, provided with three setae at each apex which is rounded, with left much longer and broader than right. Genital segment oblong ring shaped, widest at apex, and narrowed to base.

Female reproductive tract ( $n = 3$ ; Figs. 23–25) basically agree with those of other carabids. Bursa copulatrix (bc) bilobate; dorsal lobe of bc (bcd) elongate columnar with a constriction before apex which is largely expanded and bulbous; ventral lobe of bc (bcv) strongly bended towards apex, clearly shorter than bcd, connected to bcd near base right laterally; bursal surface wrinkled from base to near constriction of bcd, not wrinkled at apex of bcd and whole surface of bcv. Common oviduct (co) con-



Figs. 12–25. Genital organs of *Ishikawatrechus annulus* sp. nov. — 12–22, Male genitalia (holotype); 23–25, female reproductive tract (paratype). — 12–14, Median lobe; 15–18, internal sac; 19–21, copulatory piece; 22, genital segment, 23 & 24, left gonocoxite; 25, reproductive tract. — 12, 15 & 20, Left lateral view; 13 & 16, right lateral view; 14, 17, 19 & 24 dorsal view; 18, 23 & 25, ventral view; 21, left latero-ventral view; 22, reverse side view. Abbreviations: afs, apical fringe setae; ams, apicomедial seta; ans, apical nematiform setae; ap, apical projection; bcd, bursa copulatrix dorsal lobe; bcv, bursa copulatrix ventral lobe; bp, basal projection; co, common oviduct; cp, copulatory piece; des, dorsal ensiform seta; gc1, gonocoxite 1; gc2, gonocoxite; gp, gonopore; mp, middle projection; sp, spermatheca. Scale bars: 0.5 mm for 12–22 & 25; 0.1 mm for 23 & 24.

nected with termination of bcv. Spermatheca (sp) unsclerotised bulbous, placed on bcv near co/bcv juncture. Ramus absent. Gonocoxite 1 (gc1) elongate pick shaped, arcuately dilated apically on inside, with four to five short apical fringe setae (afs) ventrally, and two short apicomедial seta (ams) dorsally. Gonocoxite 2 (gc2) corniform, curved outwardly, and salient at apex, with two long dorsal ensiform seta (des) basally, two apical nematiform setae (ans) pre-apico-ventrally.

*Measurements.* (n = 7; in mm). ATL 6.08–6.79 (6.44); ABL 5.57–6.16 (5.87); SBL 5.43–5.95 (5.69); HW 0.84–0.91 (0.89); HL 0.84–0.93 (0.88); HWL 0.52–0.68 (0.60); PW 0.11–1.29 (1.08); PL 1.31–1.43 (1.36); PWL 0.19–0.25 (0.22); PAW 0.86–0.93 (0.89); PBW 0.74–0.84 (0.78); EBW 0.81–0.86 (0.84); EHW 1.57–1.80 (1.67); EHL 0.42–0.57 (0.47); EW 2.29–2.52 (2.41); EL 3.28–3.62 (3.45); EWL 1.69–1.87 (1.75).

*Distribution.* Japan: Shikoku (known only from the type locality).

*Etymology.* The name of this new species is derived from the remarkably specialised copulatory piece forming a pseudo-ring shape.

*Differential diagnosis.* This new species can be distinguished easily from any other congeners in the genus *Ishikawatrechus* by the following characteristics: 1) mentum (Fig. 6) fused with submentum, with suture between them very shallow and becoming effaced at sides (clearly divided from submentum by a deep suture in other congeners; Fig. 7); 2) pronotum (Figs. 1–4 & 10) very narrow, without postangular setae (rather wide, provided with postangular setae in other congeners; Fig. 11); 3) elytra (Figs. 1–4 & 10) provided with very narrow bases, and very long prehumeral margins (provided with slightly more broadened bases, and moderate prehumeral margins in other congeners; Fig. 11); 4) stria 3 (Fig. 10) provided with a single setiferous dorsal pore near the base of elytra (provided with two setiferous dorsal pores near the base and before the middle of elytra, respectively in other congeners; Fig. 11); 5) stria 5 (Fig. 10) provided with two setiferous dorsal pores before and behind the middle of elytra, respectively (provided with a single setiferous dorsal pore behind the middle of elytra in other congeners; Fig. 11); 6) scutellum (Fig. 8) subrhomboid shaped, rounded at apex (usually triangular shaped, pointed at apex in other congeners; Fig. 9); 7) internal sac (Figs. 15–21) provided with three dorsal projections, of which middle projection is covered with strongly sclerotized spicules which are fused with each other and forming a large uncinate structure, and with a large sclerotised copulatory piece which is pseudo-ring shaped and is situated on left latero-ventrally (without obvious dorsal projections and copulatory piece in other congeners except some species such as *Ishikawatrechus bidilatatus*, *I. hayashii*, *I. pubithorachis*, *I. satoi*, and *I. yoshiianus* (SUGAYA, unpublished data).

*Comparative specimens examined.* *Ishikawatrechus bidilatatus* SUGAYA, 2014 (Figs. 7, 9 & 11): 1 ♂ (holotype, EUMJ), Ôyashiki, Kawano-uchi, Tôon-shi, Ehime Pref.; 1 ♂, 3 ♀♀ (paratypes, EUMJ), same locality as holotype.

## Discussion

Based on the presence of an aedeagal ventral hook, which has been considered to be an autapomorphy of the genus to date, it is clear that this new species is derived from a common ancestor of the other congeneric members of the genus *Ishikawatrechus*. In addition, this hypothesis is supported by the fact that all the species of the genus including *I. annulus* share some of the following taxonomically important characteristics: 1) elytra with distinct transverse furrow on the basal peduncle for the reception of pronotal base; 2) marginal umbilicate pores on elytra not aggregated; 3) protibiae grooved externally and glabrous, even at apices.

In contrast, this new species has several unique features in elytral chaetotaxy, labial structure and the configuration of aedeagal internal sac, of which the morphological states are regarded as very important for trechine taxonomy to date (UÉNO, 1978 a). These peculiarities are considered as the result from high specialisation, and may support the placement of this new species as an isolated taxonomic group, at least at the species-group level within the genus, judging from previous taxonomic studies on trechines (cf. UÉNO, 1955, 1959, 1965, 1970, 1978 a, b, 1982 a, b, 2009). However, given the ambiguous definitions used for existing species groups as well as several taxonomic problems, including the definition of the genus, revealed by our recent studies, it is considered preferable to refrain from describing a new species group at this time and to leave this problem for future studies.

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### 要 約

菅谷和希・原 有助：四国北西部で発見されたツヤメクラチビゴミムシ属（鞘翅目オサムシ科チビゴミムシ亜科）の特異な1新種。——石鎚連峰西方に位置する皿ヶ峰の北北西麓から得られたメクラチビゴミムシを、サラガミネツヤメクラチビゴミムシ（和名新称）*Ishikawatrechus annulus* sp. nov. として命名記載した。本新種は、下唇縫合線が不完全であること、前胸背板後角の剛毛を欠くこと、上翅剛毛式が1+2であること、雄交尾器内袋に鱗片群由来と考えられる特大の鉤状突起と、大きく発達したリング状の交尾片が認められることなどから、既知の同属他種から容易に識別することが可能である。以上のように、ツヤメクラチビゴミムシ属*Ishikawatrechus* HABU としては極めて特異な形質状態を示し、既知の同属他種のいずれとも直接の関連性が認められないことから、本新種は単独で独立した分類群を形成すると考えられる。

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