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RESEARCH ARTICLE

The genus *Ivalia* Jacoby 1887 (Coleoptera: Chrysomelidae: Galerucinae: Alticini) of the mount Kinabalu, Sabah, Malaysia

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Abstract: The following new species of *Ivalia* Jacoby 1887 are described from the mount Kinabalu (Sabah, Malaysia): *Ivalia besar* **sp. nov.**, *I. biasa* **sp. nov.**, *I. fulvomaculata* **sp. nov.**, *I. haruka* **sp. nov.**, *I. marginata* **sp. nov.**, *I. minutissima* **sp. nov.**, *I. nigrofasciata* **sp. nov.**, *I. pseudostriolata* **sp. nov.**, *I. rubrorbiculata* **sp. nov.**, *I. striolata* **sp. nov.**.

Key words: New species, flea beetles, moss feeding, local species diversity, Kinabalu, Malaysia.

Introduction

Mt. Kinabalu (4,095 m), one of the popular insect collecting spots in the Province of Sabah (Malaysia), is the type locality of a number of recently described leaf beetles species (e.g. *Coeligetes howardi* Bezděk 2016, *Kinabalua musaamani* Mohamedsaid 2010, *Orthaltica borneoensis* Konstantinov 1995, etc.). However, so far only a few leaf beetle species have been recorded from the area above 1,800 meters. From 2007 to 2010, the senior author had opportunities to collect leaf beetles rather intensely at the Kinabalu Park Headquarters at the altitude of 1,500 – 1,800 m and along the trails up to 3,600 m.

The Headquarters area is exceptionally rich in leaf beetles, for example, Mohamedsaid (1999) recorded ca. 80 species of the Galerucini in the strict sense. The senior author also collected some 280 leaf beetle species of both Galerucini and Alticini.

Considering these results, there must be nearly 300 species of the subfamily Galerucinae *sensu lato* occurring at the Headquarters of the Kinabalu Park. In contrast, the senior author found only 131 leaf beetle species above 1,800 m alt. on the mount Kinabalu.

Among collected leaf beetles, we found many specimens of an alticine genus *Ivalia* Jacoby 1887. They belong to 12 species of which 11 appeared undescribed. In this paper we describe 10 of these species, one species is represented by a single damaged female which is insufficient to describe. The twelfth species we identified as *Chabria kinabalensis* Bryant 1938 which undoubtedly belongs to *Ivalia* (Takizawa 2017).

So far out of total 65 species of *Ivalia*, distributed in the Oriental and Australian Regions only three have been reported from moss cushions [*I. korakundah* Prathapan et al. 2006 in south India, extracted from moss cushions of *Isopterygium* sp. (Hypnaceae) (Duckett *et. al.* 2006), *I. latus* (Samuelson 1966) and *I. muscus* (Samuelson 1966)]. In addition, eight species of *Ivalia* were collected in moss cushions in South India by the second author and remain undescribed. All the species treated in this paper, except *I. nigrofasciata* new species and *I. pseudostriolata* new species, were collected feeding on mosses as adults or larvae. Counting recently published *Baoshanaltica minuta* Konstantinov & Ruan (Ruan *et al.* 2017) found in moss in Yunnan, China, brings the number of moss feeding leaf beetle species to 40, while the number of genera remains 16.

Material and methods

Leaf beetles were collected using standard sweeping and observation technique, including those collected on moss cushions. Specimen observations were made with a Zeiss Stemi SV11 Apo microscope. The term "aedeagus" is used here instead of "median lobe of aedeagus". Digital photographs were taken with Axio Zoom V16 microscope and AxioCam HRC digital camera attached to it. All the holotypes and a series of paratypes will be deposited in the BORNEENSIS Collection of the Institute for Tropical Biology & Conservation (IBTP), Universiti Malaysia Sabah, Kota Kinabalu. Studied specimens are deposited in the following institutions: BMNH – The Natural History Museum, London; USNM – National Museum of Natural History, Washington DC., U.S.A.; SEHU – Systematic Entomology, Hokkaido University, Sapporo, Japan.

Results

***Ivalia besar* Takizawa & Konstantinov sp. nov.** (Figs 1–5)

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Male. Body strongly convex dorsally, 4.0–5.0 mm in length; black with antennae dark brown; elytron with a short yellowish patch near base, not reaching to sutural and lateral margins.

Head flat and shining, impunctate; frontal tubercles lacking; frons weakly delimited from vertex by shallow angulate sulcus; eyes small, widely separated; inter-ocular space 2 times as wide as longitudinal diameter of eye; labrum deeply incised in middle; antennae almost 0.6 times as long as body; 1st antennomere 1.6 times as long as 2nd, 1.2 times as long as 3rd; 11th antennomere longest, slightly longer than 1st. Pronotum subquadrate, 1.5 times as wide as long, rather straight on anterior margin, broadly arched on posterior margin,

subparallel-sided and weakly narrowed on anterior half on lateral margins; anterior angles rounded, produced anteriorly; disc evenly convex from side to side, shining, densely covered with obscure punctures; interspaces smooth. Scutellum roundly triangular. Elytron 2.3 times as long as wide, widest near middle, thence weakly narrowed to base, strongly so to somewhat produced apex; humeri not developed; disc dull, minutely shagreened; elytral epipleura covered with fine punctures near base, with several transverse undulations. Metasternum broadly elevated, without anterior median ridge. Surface of abdominal sternites granulate; first visible sternite distinctly punctate laterally, with robust median ridge; last visible sternite truncate, medially broadly but shortly produced. Aedeagus with 2 distinct transverse impressions on basal 1/3, gently narrowed to round apex on apical 1/3, weakly constricted sub-apically, gently curved in lateral view; on venter finely reticulate on lateral vertical areas; apex slightly curved dorsally; covered with fine longitudinal striae. Fore and middle legs with 1st tarsomeres distinctly widened.

Figures 1–5. *Ivalia besar* **sp. nov.**. **1,** habitus dorsal view; **2,** aedeagus, ventral view; **3,** aedeagus, lateral view; **4,** habitus lateral view; **5,** head, frontal view.

Female. Body 4.0–4.5 mm in length; labral incision not as deep as in male; last visible abdominal sternite evenly produced at apex; fore and middle legs with 1st tarsomere gently and weakly widened from base to apex.

Type material: Holotype. Male, Summit trail, 3,300–3,600m alt., Mt. Kinabalu, Ranau, Sabah, Malaysia, 22.V.2010, H. Takizawa leg. (IBTP). **Paratypes.** 2♀, the same data as holotype, except 3,300–3,500m alt., 3.II.2010, H. Takizawa leg.; 2♀, same as the holotype; 3♂, 2♀, the same data as holotype, except 3,600m alt., 8.VII.2010, H. Takizawa & T. S. Liew leg.; 5♂, 4♀, the same data as holotype, except Laban Rata, 3,300–3,450m alt., 10.X.2008, H. Takizawa & T. S. Liew leg. (4 exs.: USNM, BMNH).

Host plants: Unidentified mosses.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is characterized by its larger body, the opaque elytra each with a transverse yellow patch near the base, and by the aedeagus weakly constricted sub-apically.

Ivalia besar sp. nov. was found feeding on mosses on the ground and on rotten woods along the trails above 3,300m.

Etymology: The specific name is a noun in apposition based on a Malaysian adjective "besar" meaning "large" and referring to a relatively large beetle body.

***Ivalia biasa* Takizawa & Konstantinov sp. nov.** (Figs 6–10)

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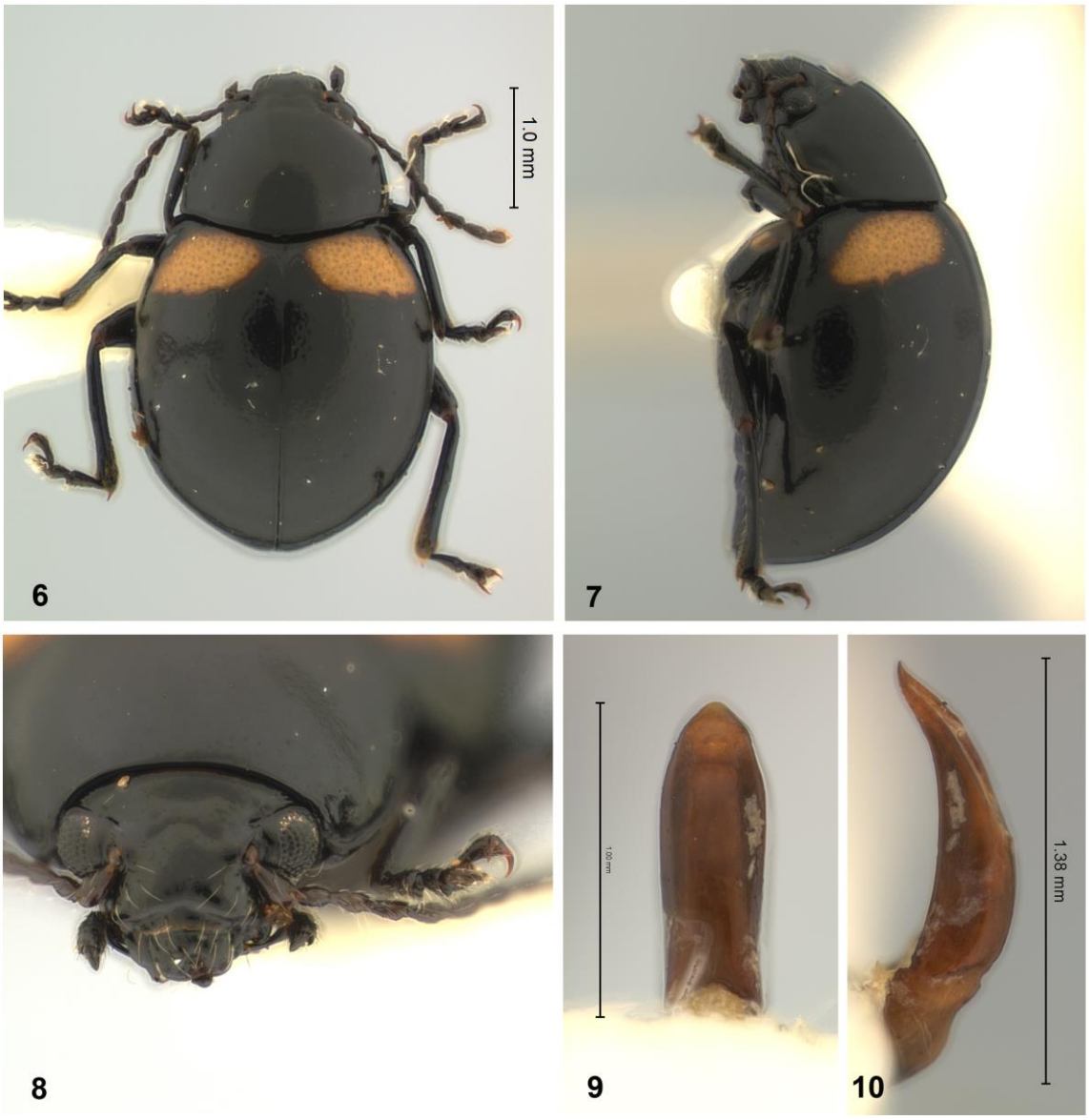
Male. Body round and strongly convex dorsally, 3.2–4.2 mm in length; shining black; elytron with transverse yellowish red patch sub-basally, not reaching sutural and lateral margins.

Head finely shagreened; frontal tubercles absent; inter-ocular space wide, almost 3 times as wide as longitudinal diameter of eye, with 2 weak transverse impressions; clypeus pentagonal and weakly raised, gently emarginated on anterior margin, with weak punctures on upper side; labrum deeply incised in middle; antennae 0.6 as long as body; 1st antennomere 1.5 times as long as 2nd, 1.2 times as long as 3rd; 11th antennomere longest, 1.3 times as long as 1st. Pronotum transverse, 1.6 times as wide as long, widest at base, thence gently narrowed to anterior rounded angles, which are indistinctly delimited from lateral margin, anterior margin gently emarginated, posterior margin broadly arched and produced; disc finely shagreened and sparsely punctate when viewed under high magnification. Scutellum broadly triangular. Elytra each 2.4 times as long as wide, widest near middle, thence roundly narrowed to both ends; apical portion weakly drawn posteriorly; humeri not developed; disc minutely aciculate when viewed under high magnification, densely covered with small punctures; elytral epipleura slightly convex basally, with weak transverse undulations on apical half. Mesosternum transverse and distinct, not covered by horseshoe-shaped metasternum; metasternum without median anterior ridge; 1st visible abdominal sternite with an acute median longitudinal ridge; last visible sternite finely granulate, weakly produced medially at apex. Fore and middle legs with 1st tarsomeres enlarged. Aedeagus slightly widened from sub-basal constriction to basal part of median orifice, thence gently narrowed to apex, without sub-apical constriction, gently curved in lateral view; apex produced into triangularly rounded lobe, venter finely wrinkled laterally on apical half.

Female. Body 3.1–4.0 mm in length; labral incision not as deep as in male; last visible abdominal sternite evenly convex at apex; fore and middle legs with 1st tarsomeres not enlarged.



Figures 6–10. *Ivalia biasa* **sp. nov.**. **6,** habitus dorsal view; **7,** habitus lateral view; **8,** head, frontal view; **9,** aedeagus, ventral view; **10,** aedeagus, lateral view.

Type material: Holotype. Male, Summit trail, 3,300–3,600m alt., Mt. Kinabalu, Ranau, Sabah, Malaysia, 22.V. 2010, H. Takizawa leg. (IBTP). **Paratypes.** 1♀, the same data as holotype, except Summit trail, 1,900 – 2,300m alt., 21,23.V.2010, H. Takizawa leg.; 1♂, 1♀, the same data as holotype, except 2,890m alt.,, 9.X.2008, H. Takizawa leg.; 1♂, Paka cave, Summit trail, 3,000m alt., Mt. Kinabalu, 11.X.2008, H. Takizawa & T. S. Liew leg.; 6♀, Summit trail, 2,700–3,300m alt., 22.V.2010, H. Takizawa leg.; 1♀, the same data as holotype, except 3,000–3,300m alt., 10.VII.2010, H. Takizawa leg.; 20♂, 10♀, Laban Rata, Summit trail, 3,300m alt., 9–11.X.2008, H. Takizawa & T. S. Liew leg. (14 exs.: USNA,

BMNH); 1♀, the same data as holotype, except 11–15.IX.2008, T. S. Liew leg.; 17♂, 12♀, Summit trail, 3,300–3,450m alt., 10.X.2008, H. Takizawa & T. S. Liew leg.; 1♂, 1♀, Summit trail, 3,300–3,500m alt., 3.II.2010, H. Takizawa leg.; 2♂, Summit trail, 3,300–3,600m alt., 27.III.2010, H. Takizawa leg.; 17♂, 11♀, the same data as holotype, except 22.V.2010, H. Takizawa leg.; 1♂, Summit trail, 3,450m alt., 10.X.2008, H. Takizawa & T. S. Liew leg.; 3♂, 4♀, Summit trail, 3,600m alt., 8.VII.2010, H. Takizawa leg.; 2♀, Mesilau Summit trail, Mt. Kianbalu, Ranau, 2,400–2,700m alt., 11.VII.2010, H. Takizawa leg.

Host plants: Unidentified mosses and lichens.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is characterized by the medium-sized body and shining black coloration with a yellowish red patch near base of the elytron. It is somewhat similar to *I. besar*, n. sp., but the latter species is distinguished by its larger body size, the dull elytra and by the aedeagus, which is rather preapically narrowed.

It is commonly found on mosses along trails between 3,000– 3,500 m alt. Larvae are also feeding on mosses.

Etymology: The specific name is a noun in apposition based on a Malaysian adjective “biasa” meaning “common” and referring to its common occurrence at the Mt. Kinabalu.

Ivalia fulvomaculata Takizawa & Konstantinov sp. nov. (Figs 11–16)

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Male. Body small, 2.8–3.0 mm in length, round and strongly convex dorsally, with apical portion gently drawn posteriorly; shining black with tarsi brown, antennae and tibiae dark brown; elytron with 3 large yellow patches: basal transverse patch covering largely from inside suture to humeral area, strongly and rectangularly incised medially, ovate patch near suture middle of elytron, and slightly larger ovate patch subapically.

Head shining and rather flat, obscurely depressed between eyes; vertex almost impunctate, with two distinct punctures in middle; supra-orbital furrows slender and short; frontal tubercles lacking; eyes widely separated, with inter-ocular space almost 2.6 times as wide as longitudinal diameter of eye; labrum deeply incised in middle; antennae 0.6 times as long as body; 1st antennomere 1.3 times as long as 2nd, 1.1 times as long as 3rd; 11th largest, 1.7 times as long as 1st. Pronotum transverse, 1.6 times as wide as long, anterior margin weakly emarginated, posterior margin broadly and strongly produced, lateral margins almost subparallel-sided in basal 3/4; anterior angles oblique, broadly thickened; disc evenly and strongly convex dorsally, sparsely covered with shallow punctures. Scutellum small and trianglular. Elytra each 2.1 times as long as wide, widest behind humeral area, thence gradually narrowed to weakly produced apex; disc sparsely covered with shallow punctures; humeri not developed; elytral epipleura irregularly undulated, with few distinct punctures. Mesothoracic sternum transverse and strongly depressed; metathoracic sternum broadly raised into flat horseshoe-shape, which has an oblique median branch anteriorly; 1st visible abdominal sternite with an acute median ridge; posterior margin of last visible abdominal sternite truncate with short and broad lobe medially. Forelegs with 1st tarsomere rather slender, slightly longer and wider than the 2nd. In ventral view, aedeagus subparallel-sided, gently narrowed in apical 1/3, apex round; gently curved with acutely pointed apex in lateral view.

Female. Similar to male, but body slightly larger; labral incision not as deep as in male; last visible abdominal sternite evenly produced at apex; forelegs with 1st and 2nd tarsomeres slender.

Figures 11–16. *Ivalia fulvomaculata* **sp. nov.**. **11,** habitus dorsal view; **12,** habitus lateral view; **13,** head, frontal view; **14,** aedeagus, ventral view; **15,** aedeagus, lateral view; **16,** median lobe of aedeagus, dorsal view.

Type material: Holotype. Male. Mt. Kinabalu, Summit trail, 2,300m, 10. IX. 2008, H. Takizawa & T. S. Liew leg. (IBTP). **Paratypes.** 1♀, the same data as holotype. Summit trail, 1,900 – 2,300m, 21,23.V.2010, H. Takizawa leg.; 1♀, the same data as holotype, except Summit trail, 2,300–2,700m, 9.VII.2010, H. Takizawa leg.; 1♀, the same data as holotype, except 1,900–2,300m, 8.X.2008, H. Takizawa leg.; 1♂, 3♀, the same data as holotype, except 2,600m, 9.X.2008, H. Takizawa leg. (USNM, BMNH); 1♂, the same data as holotype, except

Laban Rata, 3,450m, 10.X.2008, H. Takizawa leg.; 1♂, 2♀, Mesilau trail, 2,400–2,700m, 11.VII.2010, H. Takizawa leg.

Host plants: Unidentified mosses and lichens.

Distribution: Borneo (Sabah: Mt.Kinabalu).

Remarks: *Ivalia fulvomaculata* is characterized by the elytral pattern, composed by three large yellow patches, variable in size. Similarly colored beetles that occur on Mt. Kinabalu belong to a different (yet to be identified) genus having the metathoracic sternum flat in contrast to the metasternum broadly raised into a flat horseshoe-shape as in *Ivalia* species.

Ivalia fulvomaculata is found on mosses and lichen on the rotten woods or on the ground surface along summit trails.

Etymology: The specific name refers to the coloration of the elytra.

Ivalia haruka Takizawa & Konstantinov sp. nov. (Figs 17–22)

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Male. Body round and strongly convex dorsally, small, ca. 2.5 mm in length; black, with 3 basal antennomeres and tarsi dark brown; each elytron with reddish-orange, round spot below base, which is narrowly margined by yellow stripe except posteriorly.

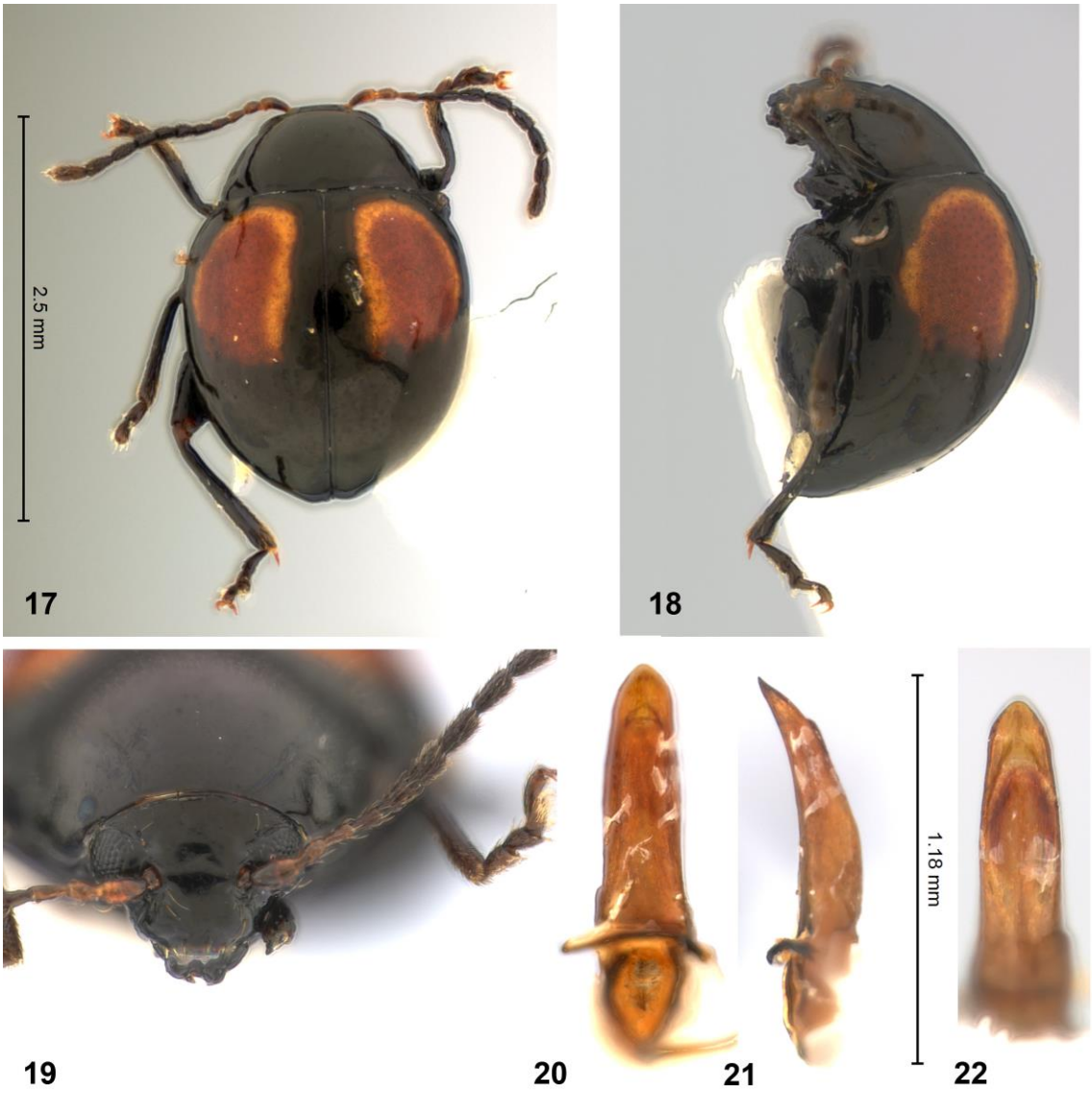
Head smooth and impunctate; frontal tubercles absent; eyes small and widely separated; inter-ocular space almost twice as wide as longitudinal diameter of eye; clypeus somewhat pentagonal, weakly delimited above by shallow impression; labrum deeply incised in middle; antennae 0.6 times as long as body; 1st antennomere 1.5 times as long as and subequal to 2nd and 3rd in length; 11th longest, 1.2 times as long as 1st. Pronotum transverse, 1.6 times as wide as long, widest at basal 1/4th, weakly and roundly narrowed anteriorly, anterior margin gently emarginated, posterior margin curved and broadly produced; anterior angles rounded, oblique, occupying anterior 1/4 of narrow lateral margins; disc shining, but finely punctulate under high magnification. Scutellum small, acutely triangular. Each elytron 2.4 times as wide as long, widest near basal 1/3rd, thence roundly narrowed to apex, apical portion drawn posteriorly; disc smooth and shining, but finely punctulate under high magnification; elytral epipleura shining, with obscure punctures especially on apical half. Mesosternum transverse and narrow; metasternum raised into horseshoe-shape; 1st visible abdominal sternite with an acute median ridge; 5th sternite almost truncate at apex. Fore and middle legs with first tarsal segments weakly enlarged. Aedeagus rather robust, in ventral view gently narrowed behind basal constriction to apex, apex obtusely rounded; in lateral view basal 2/3 almost straight, apical 1/3 gently curved down, acutely narrowed to apex.

Female. Body 2.4–2.5 mm in length; labral incision not as deep as in male; fore and middle legs with 1st tarsomeres slender; 5th visible abdominal sternite gently convex on apical margin.

Type material: Holotype. Male. Mt. Kinabalu, Laban Rata, 3,300–3,450 m alt., Ranau, Sabah, Malaysia, 10.X.2008, H. Takizawa leg. (IBTP). **Paratypes.** 3♀, Mt. Kinabalu, Summit trail, 2,500–2,700m alt., 21,23.V.2010, H. Takizawa leg. (USNM, BMNH, SEHU).

Host plants: Unidentified mosses.

Distribution: Borneo (Sabah: Mt. Kinabalu).



Figures 17–22. *Ivalia haruka* **sp. nov.**. **17,** habitus dorsal view; **18,** habitus lateral view; **19,** head, frontal view; **20,** aedeagus, ventral view; **21,** aedeagus, lateral view; **22,** median lobe of aedeagus, dorsal view.

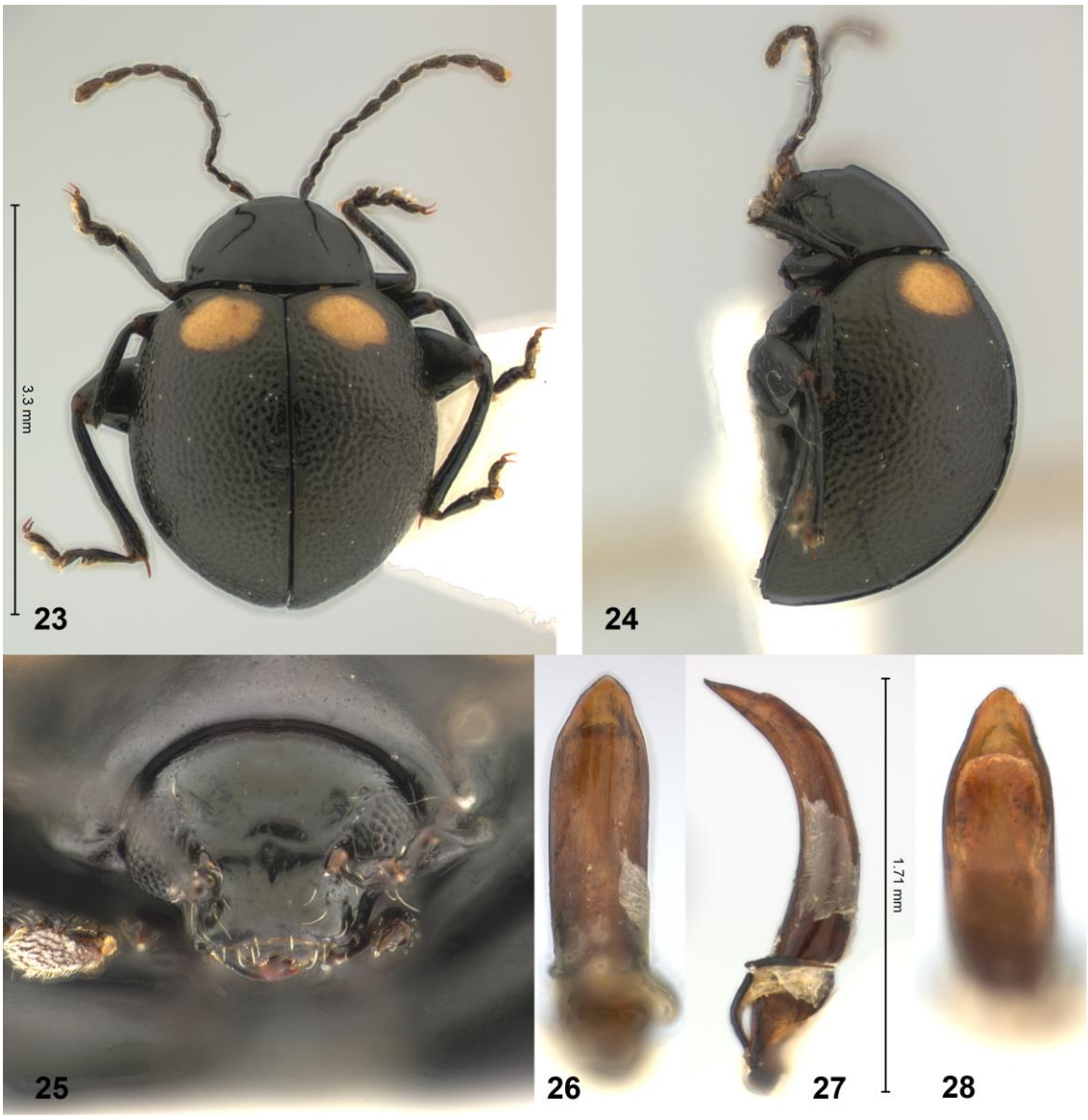
Remarks: This new species is similar to *I. rubrorbiculata* sp. nov., especially in having similar reddish orange spots on the elytra. But it is clearly distinguished from the latter by the larger spots, which are not completely margined with yellowish ring. Furthermore, the aedeagus is curved much more gently near the apex. *Ivalia haruka* sp. nov. is found on mosses along trails between 2,500–3,450 m alt., on Mt. Kinabalu. Another closely resembling species is found on mosses at 2,300–2,700m alt., which belongs to the same genus yet to be identified mentioned under *I. fulvoculata* sp. nov. But the latter species is easily distinguished from *I. haruka* sp. nov. by the flat metasternum.

Etymology: The specific name is a noun in apposition based on a Japanese adjective, meaning "far away"

***Ivalia kinabalensis* (Bryant 1938)** (Figs 23–28)

Chabria kinabalensis Bryant 1938: 251 (type locality: Mt. Kinabalu, Pakka, syntypes BMNH)

Male. Body round, strongly convex dorsally, 2.8–3.2 mm in length; black, elytra each with a transverse, oblong yellow patch below base.



Figures 23–28. *Ivalia kinabalensis* (Bryant). **23,** habitus dorsal view; **24,** habitus lateral view; **25,** head, frontal view; **26,** aedeagus, ventral view; **27,** aedeagus, lateral view; **28,** aedeagus, dorsal view.

Head smooth and flat, finely and sparsely punctulate; vertex hardly delimited anteriorly; frontal tubercles lacking; supra-orbital furrow weakly marked posteriorly to eyes; eyes roundly convex, widely separated, with inter-ocular space 1.3 times as wide as longitudinal diameter of eye; antennae rather slender, slightly longer than half the body length; labrum deeply incised in middle; 1st antennomere 1.6 times as long as 2nd, 1.4 times as long as 3rd; 11th largest, 1.3 times as long as 1st. Pronotum subquadrate, 1.3 times as wide as long, anterior margin almost straight, posterior margin broadly and strongly produced, lateral margins subparallel-sided; anterior angles broadly thickened and produced anteriorly;

disc evenly and strongly convex dorsally, shining, smooth, and finely punctate. Elytra round and strongly convex dorsally, each 2.3 times as long as wide, weakly drawn posteriorly at apex; disc densely covered with large punctures, their diameter is distinctly wider than interspaces; interspaces slightly raised and rugose, giving matted appearance; elytral epipleura concave, covered with weak punctures and irregular impressions. Mesothoracic sternum transversely depressed; metathoracic sternum wide and raised into horseshoe-shape; lst visible abdominal sternite with robust median ridge; last sternite gently truncate, with obscure short median lobe at apex. Fore and middle legs with 1st tarsomeres oblong and wide. Aedeagus subparallel-sided on basal half, thence gently widened to apical 1/3rd, thence narrowed to weakly produced apex, strongly curved in lateral view.

Female similar to male, but body slightly larger with narrow first tarsomeres; labral incision not as deep as in male; last visible abdominal sternite gently convex at apex.

Specimens examined: 6 exs., Laban Rata, Summit trail, 3,000–3,300 m alt., Mt. Kinabalu, Ranau, 10.VII.2010, H. Takizawa & T.S. Liew leg. (USNM, BMNH); 1 ex., the same data as holotype, except 3,300 m alt., Mt. Kinabalu, 9–11.X.2008, H. Takizawa & T.S. Liew leg.; 12 exs., Summit trail, 3,300 – 3,600 m alt., Mt. Kinabalu, 22.V.2010, H. Takizawa leg.; 8 exs., Summit trail, 3,600 m alt., Mt. Kinabalu, 8.VII. 2010, H. Takizawa leg.

Host plants: Unidentified mosses and lichens.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: Bryant described this species as a member of the genus *Chabria*, which is among other characters distinguished from *Ivalia* by the flat metasternum. Bryant's description 'the metasternum with a horseshoe-shaped plate' rather agrees well with *Ivalia*. Our specimens agree well with the original description and undoubtedly belong to the latter genus. There is one more similarly rugose and colored species at Mt Kinabalu which belongs to an undescribed genus mentioned under *I. fulvomaculata*, and is easily distinguished by the flat metasternum.

These specimens were collected along the summit trail at Pakka and forest above Raban Lata (3,000–3,600 m alt.), feeding on mosses and lichens on rotten woods.

***Ivalia marginata* Takizawa & Konstantinov sp. nov.** (Figs 29–32)

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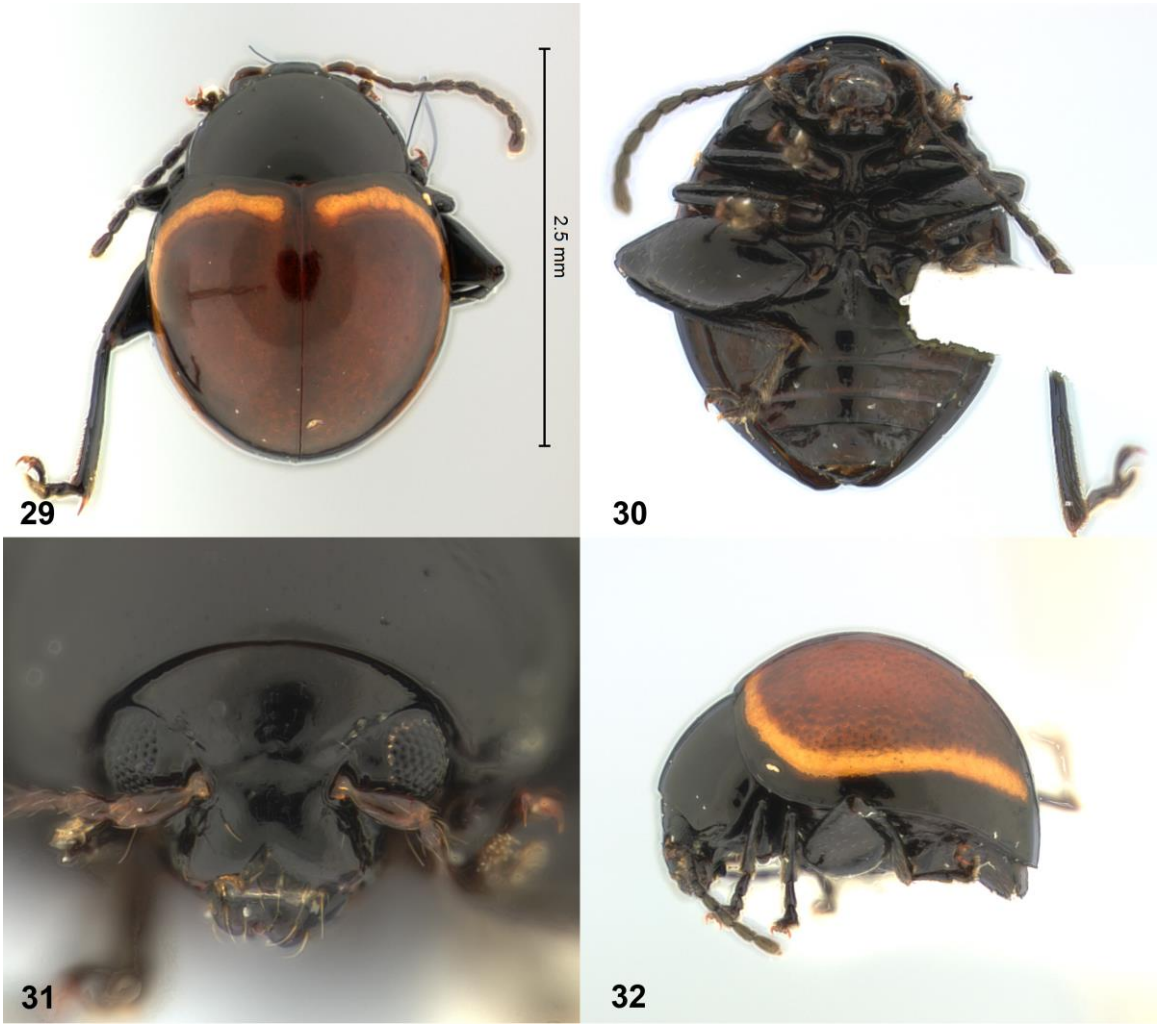
Female. Body round and strongly convex dorsally, small, 2.0–3.0 mm in length; black; antennae, tibiae and tarsi blackish brown; elytra largely deep dark red, except for narrow marginal areas; wine-red area margined with narrow yellowish stripe both basally and laterally.

Head rather flat and impunctate, transversely depressed between eyes; frontal tubercles absent; supra-orbital furrow narrow, obliquely running to antennal sockets; eyes small with inter-ocular space 1.8 times as wide as longitudinal diameter; clypeus hexagonal, smooth and gently raised; antennae long, nearly 0.6 times as long as body; labrum deeply incised in middle; 1st antennomere 1.6 times as long as 2nd, 1.2 times as long as 3rd; 11th longest, 1.2 times as long as 1st. Pronotum transverse, 1.6 times as wide as long, slightly emarginated at anterior margin, broadly produced at posterior margin, on lateral margins subparallel-sided on basal half, thence rather roundly narrowed anteriorly; anterior angles broad, roundly oblique; disc strongly convex, shining and smooth. Scutellum flat, broadly triangular. Elytra each 1.5 times as long as wide, widest near middle, thence roundly

narrowed to both ends, drawn posteriorly at apex; humeri not developed; disc shining and impunctate; elytral epipleura impunctate, with fine irregular transverse undulations. Mesosternum transverse; metasternum elevated into horseshoe-shape, without anterior branch; 1st visible abdominal sternite with acute median ridge; last sternite rather truncate at apex. Fore and middle legs with 1st tarsomeres slender.



Figures 29–32. *Ivalia marginata* **sp. nov.**. **29,** habitus dorsal view; **30,** habitus ventral view; **31,** head, frontal view; **32,** habitus lateral view.

Type material: Holotype. Female, Mt. Kinabalu, Summit trail, 2,450 m alt., Ranau, Sabah, Malaysia, 29.X.2007, T. S. Liew leg. (IBTP). **Paratypes.** 1♀, Mt. Kinabalu, Summit trail, 2,600 m alt., Ranau, Sabah, 9.X.2008, H. Takizawa leg. (SEHU); 1♀, Mt. Kinabalu, Mesilau Summit trail, Ranau, Sabah, 2,500–2,700 m alt., 21,23.V.2010, H. Takizawa leg. (USNM); 1♀, Mt. Kinabalu, Mesilau Summit trail, 1–1.5 km, 4.V.2010, H. Yoshitomi leg. (BMNH).

Host plants: Unidentified mosses.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is characterized by the elytral coloration: deep dark red patch margined with a narrow yellow stripe both anteriorly and posteriorly. One specimen collected

at a lower altitude along Mesilau summit trail is characteristic with the yellowish stripe extending along suture and united with the lateral stripe, thus enclosing dark red area. Sometimes the dark red areas of elytra are reduced and restricted to anterior half. This new species is also found on mosses on ground along the summit trail.

Etymology: The specific name refers to the coloration of the elytra, where the dark red area is sharply margined with a narrow yellow stripe.

***Ivalia minutissima* Takizawa & Konstantinov sp. nov.** (Figs 33–37)

urn:lsid:zoobank.org:act:8BD0D4A0-03E3-48BF-AB48-8258C9D93055

Male. Body round and strongly convex dorsally, small, 1.6–1.8 mm in length; yellowish orange, with head and tarsi slightly infuscate; antennae, elytra with basal and lateral margins linearly dark brown.

Head impunctate, weakly depressed with minute punctures on inter-ocular space; frontal tubercles lacking; clypeus weakly delimited from frons, smooth, pentagonal and weakly raised; eyes small, widely separated; inter-ocular space almost twice as wide as longitudinal diameter of eye; antennae slender, 0.6 times as long as body; labrum incised in middle; 1st antennomere twice as long as 2nd, 1.3 times as long as 3rd; 11th longest, 1.5 times as long as 1st. Pronotum transverse, twice as wide as long, widest at base, weakly and straightly narrowed on basal 2/3 on lateral margins, anterior margin gently emarginated, posterior margin broadly produced; anterior angles oblique, broadly rounded, occupying almost apical 1/3 of lateral margins; disc evenly convex, shining, but finely shagreened under high magnification. Scutellum small. Each elytron almost twice as long as wide, widest behind basal 1/3rd, thence gently narrowed to apex, apical portion weakly drawn posteriorly; humeri not developed; disc shining, but finely punctulate under high magnification, densely covered with obscure small round patterns; elytral epipleura slightly concave, with weak transverse undulations. First visible abdominal sternite with an acute median ridge; last sternite weakly truncate at apex. Fore legs with 1st tarsomeres weakly widened; hind femora strongly widened; hind tibia distinctly curved outward at middle. Aedeagus short and broad, subparallel-sided, on apical 1/3 gently narrowed to broadly rounded apex.

Female. Body 1.6–1.8 mm in length; labral incision not as deep as in male; last abdominal sternite evenly convex at apex; fore and middle legs with 1st tarsomeres slender.

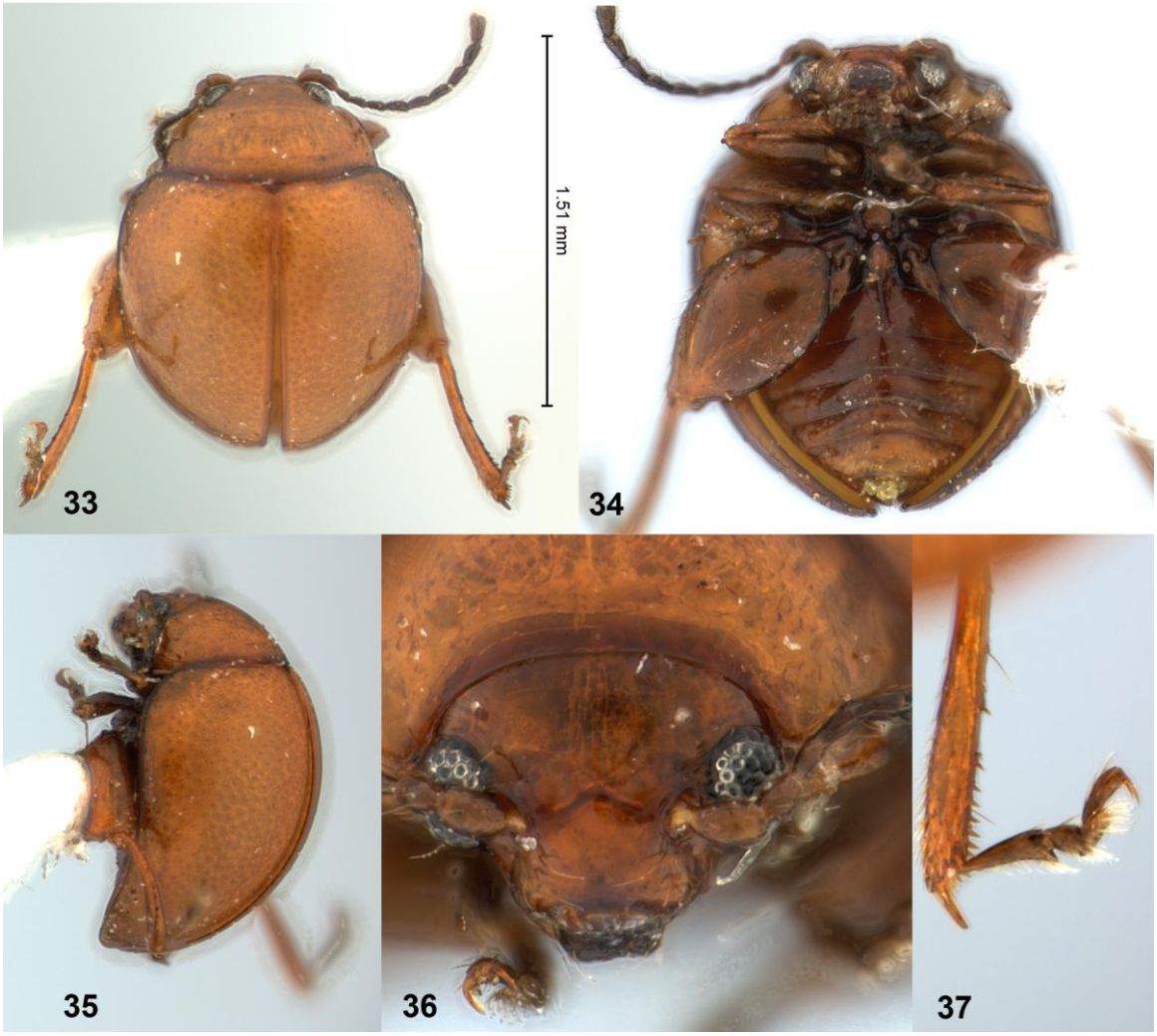
Type material: Holotype. Male, Mt. Kinabalu, Summit trail, 2,350–2,700 m alt., Ranau, Sabah, Malaysia, 18.X.2008, H. Takizawa leg. (IBTP). **Paratypes.** 1♂, Mt. Kinabalu, Summit trail, 2,300–2,400 m alt., 9–11.X.2008, T. S. Liew leg. ; 1♀, the same data as holotype, except 2,300–2,700 m alt., 9.VII.2010, H. Takizawa leg. (USNM); 3♀, the same data as holotype, except 2,600 m alt., 9.X.2008, H. Takizawa leg.; 1♀, same data as the holotype (1 ex.: BMNH).

Host plants: Unidentified mosses.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is well characterized by its small, almost entirely yellowish orange body. The coloration tends to change to yellowish brown in dried specimens. It was found on mosses along trails between 2,300–2,700m alt. at Mt. Kinabalu.

Etymology: The specific name refers to its very small body size.



Figures 33–37. *Ivalia minutissima* **sp. nov.**. **33,** habitus dorsal view; **34,** habitus ventral view; **35,** habitus lateral view; **36,** head, frontal view; **37,** hind leg.

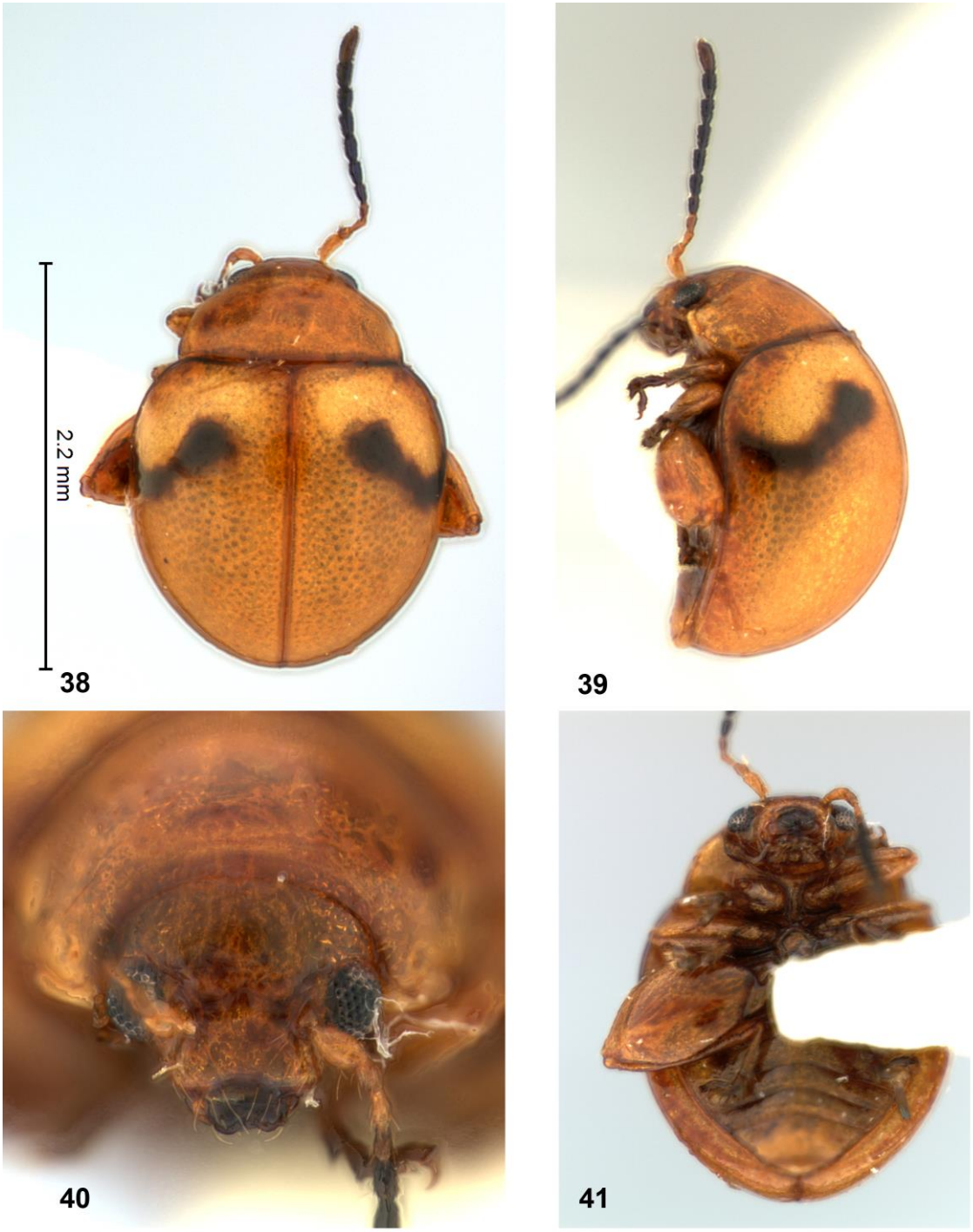
Ivalia nigrofasciata Takizawa & Konstantinov sp. nov. (Figs 38–41)

urn:lsid:zoobank.org:act:443FF3CF-4CA7-4ACB-BAA3-F44F6B41819F

Male. Body round, strongly convex dorsally, small, ca. 2.1 mm in length; light yellowish brown, with labrum, 7 apical antennomeres and tarsi blackish brown; elytra with a small black spot behind base, surrounded anteriorly by broad yellowish white band.

Head impunctate, shallowly depressed on inter-ocular space; frontal tubercles absent/indistinct; eyes small, with inter-ocular space twice as wide as longitudinal diameter of eye; clypeus rather trapezoid, distinctly emarginated at middle of apical margin; labrum deeply incised in middle; antennae 0.6 times as long as body; 1st antennomere 1.5 times as long as 2nd; 1st 1.2 times as long as 3rd; 11th longest, 1.3 times as long as 1st. Pronotum transverse, 1.7 times as wide as long, gently narrowed anteriorly on basal 3/4 on lateral margins, apical margin deeply emarginated; posterior margin broadly and archedly produced; anterior angles obliquely thickened, occupying apical 1/4 of lateral margins; disc evenly convex from side to side, rather densely punctulate under high magnification. Scutellum small and triangular. Each elytron 2.1 times as long as wide, widest near basal 1/3rd, thence

roundly narrowed to both ends, sub-acutely projected posteriorly at apex; disc sparsely covered with obscure punctures, except on sub-basal yellowish white band; humeri not developed; basal wide area of elytral epipleura smooth and slightly convex. First visible abdominal sternite with acute longitudinal ridge medially; 5th sternite weakly truncate and slightly produced medially on apical margin. Aedeagus subparallel-sided, gradually narrowed on apical 1/3 to sub-triangularly produced apex. Forelegs with 1st tarsomere weakly widened; hind tibiae weakly but distinctly curved outwardly at middle.



Figures 38–41. *Ivalia nigrofasciata* **sp. nov.**. **38,** habitus dorsal view; **39,** habitus lateral view; **40,** head, frontal view; **41,** habitus ventral view.

Female. Body 2.2–2.3 mm in length; labral incision not as deep as in male; elytra with sub-basal yellowish white band enlarged, almost touching to sutural and lateral margins, with black spot extending laterally along yellowish white band in shape of wavy narrow band; 5th visible abdominal sternite convexly produced on apical margin.

Type material: Holotype. Male, Mesilau Watergate, Kundasang, Ranau, Malaysia, 30.VIII.2013, H. Takizawa leg. (IBTP). **Paratypes.** 1♀, Mesilau Watergate, Kundasang, Ranau, Sabah, 12.XII.2014, H. Takizawa leg.; 1♀, Kinabalu Park, HQ, Ranau, Sabah, 18–20,21.I.2008, H. Takizawa leg. (USNM); 1♀, the same data as holotype, except 31.III.2016, H. Takizawa leg. (BMNH); 1♀, the same data as holotype, except 2.IV.2016, H. Takizawa leg.; 1♂, Peak, Jln. Kimanis 26 km to Keningau, Papar, Sabah, 24.III.2012, H. Takizawa leg.

Host plants: Unknown.

Distribution: Borneo (Sabah: Mt. Kinabalu, Crocker Range Park).

Remarks: This new species is uniquely characterized by its small body size and the elytra with black and yellowish white pattern. *I. ornata* Medvedev, 2010 from the Crocker Range Park has somewhat similar elytral pattern, having two oblique bands near the base. But the latter species is larger and elytra with a black stripe on the suture.

Unlike other species of the genus, it is not endemic to the Mt. Kinabalu and is recorded from the Kinabalu Park, Headquarters area, ca. 1,500–1,800 m alt., further down to the Watergate area, 1,300–1,500 m at Mesilau, and from the 26 km Peak, Jln. Kimanis in the Crocker Range Park, Papar at 1,300m alt. All these specimens were collected by sweeping along trails in well-preserved forests. The association with mosses is likely, but is still unconfirmed.

Etymology: The specific name refers to the black band on the elytra in the female.

Ivalia pseudostriolata Takizawa & Konstantinov sp. nov. (Figs 42–46)

urn:lsid:zoobank.org:act:18FDCBBA-648E-41FF-B568-748DB283C218

Male. Body round and strongly convex dorsally, ca. 2.0 mm in length; black with 3 narrow yellowish stripes on elytra: long arcuate stripe from posterior to suture, parallel to basal margin and curved posterior near humerus; 2nd longitudinal stripe near middle and along suture; and 3rd longitudinal stripe parallel to lateral margin, from basal 1/4th to behind middle of elytra. Antennae, and legs except for hind femora dark brown.

Head rather flat and shining, with 2 transverse impressions on inter-ocular space, with row of minute punctures above clypeus; inter-ocular space 1.7 times as wide as longitudinal diameter of eye; clypeus trapezoid, weakly raised; labrum deeply incised in middle; antennae 0.5 times as long as body; 1st antennomere 1.4 times as long as 2nd, 1.2 times as long as 3rd; 11th longest, 1.4 times as long as 1st. Pronotum transverse, almost twice as wide as long, widest at base, weakly and straightly narrowed to apex, nearly straight between anterior angles on apical margin, gently produced at basal margin; anterior angles oblique, rounded, produced anteriorly, occupying apical 1/4 of lateral margins; disk smooth and sparsely punctulate. Scutellum shining, broadly triangular. Each elytron 1.3 times as long as wide, widest near basal 1/3rd, thence narrowed, apex rounded; apical portion drawn posteriorly; disk shining, sparsely covered with obscure punctures under high maginification; elytral epipleura shinning and impunctate. Mesosternum transverse, not covered by metasternum; 1st visible abdominal sternite with a stout median ridge; 5th sternite truncate, with median

portion slightly produced posteriorly on apical margin. Fore and middle legs with 1st tarsomeres weakly widened. Aedeagus subparallel-sided, apical 1/4 gently narrowed into rounded triangular lobe, slightly curved in lateral view.

Female unknown.

Figures 42–46. *Ivalia pseudostriolata* **sp. nov.**. **42,** habitus dorsal view; **43,** habitus lateral view; **44,** head, frontal view; **45,** aedeagus, ventral view; **46,** aedeagus, lateral view.

Type material: Holotype. Male. Kinabalu Park, HQ., Ranau, Sabah, Malaysia, 16,17.XI.2007, H. Takizawa leg. (IBTP).

Host plants: Unknown.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species has the dorsal coloration similar to *I. striata*, but is easily distinguished from the latter by its smaller body size, and the smooth elytra not finely aciculate under high magnification. Only a single specimen was collected by sweeping along

trails in the Headquarters area, ca. 1,500–1,800 m alt. at Mt. Kinabalu. Its host plant is unknown.

Etymology: The specific name refers to the similarly between this species and *I. striata*, n. sp.

***Ivalia rubrorbiculata* Takizawa & Konstantinov sp. nov.** (Figs 47–51)

urn:lsid:zoobank.org:act:4B5C8670-5486-436B-B2C3-F74197871025

Male. Body small, strongly convex dorsally, 2.0–2.2 mm in length; black with antennae, tibiae and tarsi dark brown; elytra each with a reddish, round spot near base, surrounded with distinct golden-yellow ring.

Head flat and shining, vertex almost impunctate; inter-ocular space with fine transverse line; supra-antennal furrow obliquely reaching to eye margin; frontal tubercles lacking; labrum deeply incised in middle; antennae almost 0.6 times as long as body; 1st antennomere 1.5 times as long as 2nd, 1.3 times as long as 3rd; 11th largest, 1.2 times as long as 1st. Pronotum strongly convex dorsally, anterior margin weakly concave, posterior margin broadly arched, lateral margins evenly curved, narrowed from base to apex; anterior angles rounded, produced anteriorly; disc smooth and impunctate, but finely punctulate. Scutellum broadly triangular. Each elytron 2.1 times as long as wide, widest at middle, thence gradually narrowed to apex, slightly drawn posteriorly at apex; humeri not developed; disc shining, finely punctulate; elytral epipleura smooth and shining. Metathoracic sternum horseshoe-shaped, with a median longitudinal branch towards mesosternum. First visible abdominal sternite with an acute median ridge; 5th sternite truncate with median portion slightly produced posteriorly on apical margin. Aedeagus weakly widened behind subbasal constriction to median orifice, thence rounded, narrowed to apex, rather strongly curved in lateral view. Fore and middle legs with 1st tarsomeres slightly widened, wider than 2nd.

Female: Body slightly larger, 2.3mm in length; 5th visible abdominal sternite gently convex at apex; fore and middle legs with 1st tarsomeres slender.

Type material: Holotype. Male, Mesilau Summit trail, 2,500–2,700 m alt., Mt. Kinabalu, Ranau, Sabah, Malaysia, 21,23.V.2010, H. Takizawa leg. (IBTP). **Paratypes.** 1♂, Summit trail, 2,300–2,700 m alt., Mt. Kinabalu, Ranau, Sabah, Malaysia, 28.III.2010, H. Takizawa leg.; 1♀, the same data as holotype, except Laban Rata, 3,300–3,450 m alt., 10.X.2008, H. Takizawa & T. S. Liew leg.; 1♂, same data as the holotype (USNM); 1♂, the same data as holotype, except 2,400–2,700 m alt., 11.VII.2010, H. Takizawa leg (BMNH).

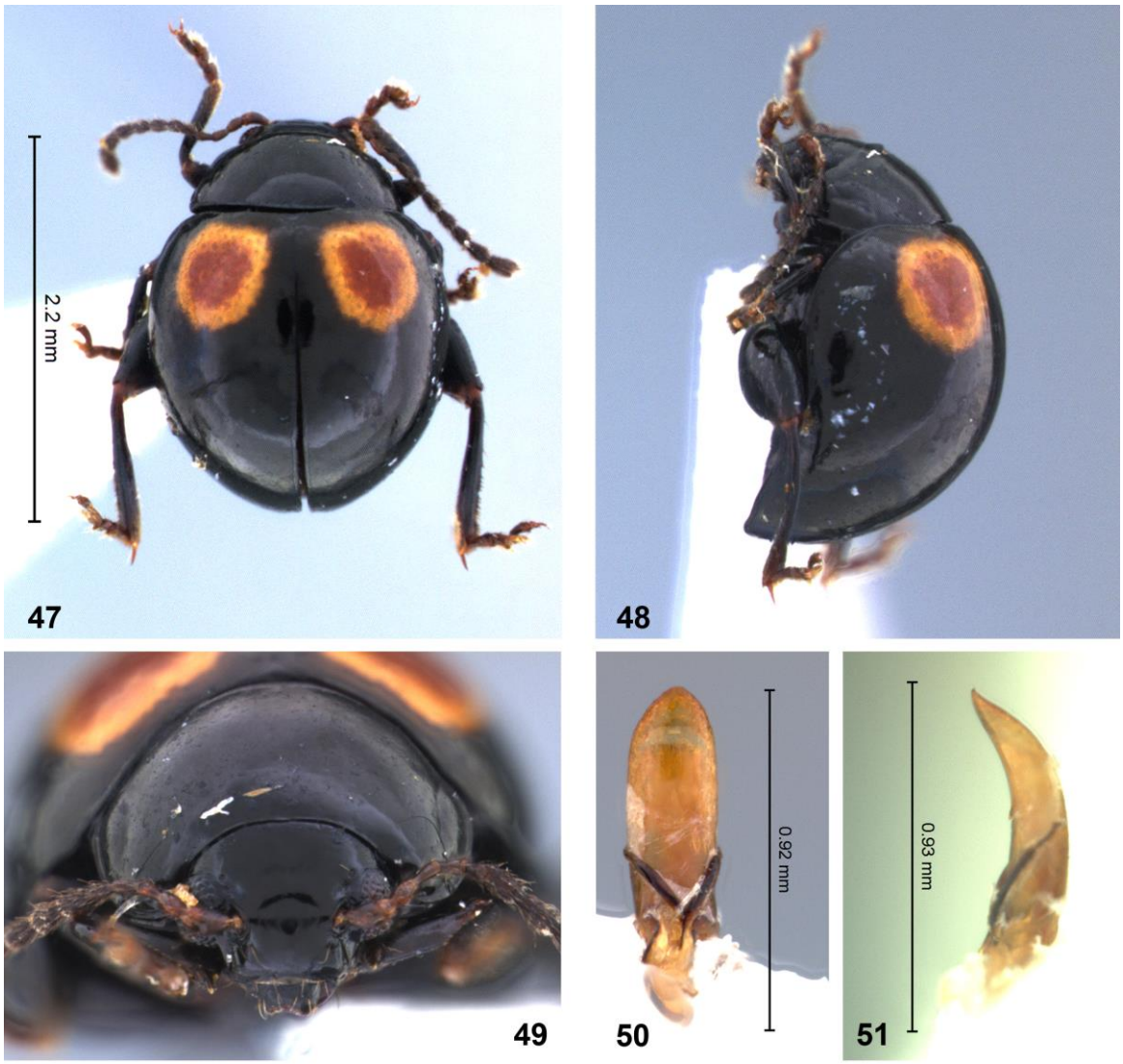
Host plants: Unidentified mosses.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is characterized by the elytral pattern, composed of a reddish spot surrounded by a golden yellow ring. This pattern is similar to the elytral pattern of *I. haruka* sp. nov. However *I. rubrorbiculata* can be easily differentiated from *I. haruka* sp. nov. based on the smaller body size, golden yellow ring completely surrounding a reddish spot, and the aedeagus being more robust and slightly more convex in lateral view than the one of *I. haruka* sp. nov.

This new species is found on mosses along the summit trail between 2,300–2,700 m alt. at Mt. Kinabalu.

Etymology: The specific name refers to reddish eye-spots on the elytra.



Figures 47–51. *Ivalia rubrorbiculata* **sp. nov.**. **47,** habitus dorsal view; **48,** habitus lateral view; **49,** head, frontal view; **50,** aedeagus, ventral view; **51,** aedeagus, lateral view.

Ivalia striolata Takizawa & Konstantinov sp. nov. (Figs 52–57)

urn:lsid:zoobank.org:act:6E39B663-02BB-4EA8-910D-1AAF8E4AB211

Male. Body round and strongly convex dorsally, 2.5–3.0 mm in length; black with antennae, tibiae and tarsi dark brown; elytron with two short yellow stripes; short transverse stripe parallel to base, and another longitudinal stripe, weakly obliquely situated at middle; slightly obscure red brown patch in between them; sometimes these two united to each other, with red brown patch superimposed.

Head flat and shining, almost impunctate, with flat transverse depression hardly recognized on inter-ocular space; eyes widely separated, inter-ocular space twice as wide as longitudinal diameter of eye; distance between eye and antennal sockets 1/8 time as wide as inter-ocular space; labrum deeply incised in middle; antennae long, almost 0.7 times as long as body; 1st antennomere 1.4 times as long as 2nd, 1.2 times as long as 3rd; 11th longest, 1.2 times as long as 1st. Pronotum transverse, 1.6 times as wide as long, anterior margin broadly and rather deeply emarginated, posterior margin broadly and rather deeply produced, lateral

margins subparallel-sided in basal half, thence gently narrowed anteriorly; anterior angles rounded; disk evenly and strongly convex dorsally, shining and finely punctulate. Scutellum small and broadly triangular. Elytron 2.2 times as long as wide, widest near middle, thence narrowed to apex, apex rounded; apical portion weakly drawn posteriorly; humeri not developed; disc densely covered with fine punctures or almost impunctate, with interspaces finely aciculate; elytral epipleura shining with irregular transverse fine undulations. Metathoracic sternum elevated into horseshoe-shape, with straight median branch anteriorly; abdominal sternites finely reticulate on lateral portions; 1st sternite with an acute median ridge; 5th sternite almost truncate, slightly produced posteriorly at apex. Aedeagus widest at middle, thence gently narrowed to both ends; before apex slightly constricted and thence narrowed again to subtriangular apex, gently curved in lateral view. Fore and middle legs with first tarsomeres distinctly widened.

Female: Body slightly larger, 2.8–3.2 mm in length; 5th sternite gently convex posteriorly at apex; fore and middle legs with first tarsomeres slender.

Figures 52–57. *Ivalia striolata* **sp. nov.**. **52,** habitus dorsal view; **53,** habitus lateral view; **54,** head, frontal view; **55,** aedeagus, ventral view; **56,** aedeagus, lateral view; **57,** median lobe of aedeagus, dorsal view.

Type material: Holotype. Male, Summit trail, 3,300–3,500 m alt., Mt. Kinabalu, Ranau, Sabah, Malaysia, 3.II.2010, H. Takizawa leg. (IBTP). **Paratypes.** 1♂, same as the holotype,

3,300–3,600 m alt., 22.V. 2010, H. Takizawa leg.; 1♂, Summit trail, 2,700–3,300 m alt., 22.V.2010, H. Takizawa leg.; 2♀, the same data as holotype, except 3,300–3,600 m alt., 10.VII.2010, H. Takizawa leg.; 3♂, 7♀, the same data as holotype, except Laban Rata, 3,300 m alt., 9–11.X.2008, H. Takizawa & T. S. Liew leg. (6 exs.: USNM, BMNH); 5♂, 7♀, the same data as holotype, except 3,300–3,450 m alt., 10.X.2008, H. Takizawa & T. S. Liew leg.

Host plants: Undetermined mosses and lichens.

Distribution: Borneo (Sabah: Mt. Kinabalu).

Remarks: This new species is characterized by its elytral pattern, which is composed of two distinct, rather broad yellow stripes, usually accompanied with an obscure reddish brown patch. *Ivalia pseudostriata*, n. sp. has the elytra similarly colored, but it is much smaller, and lacks obscure reddish brown patch on the elytra. Though this color pattern is characteristic, there are some color variations: in one case the elytra lacks the longitudinal stripe. Most specimens have the elytra almost impunctate, but some including the holotype have finely punctate elytra.

This new species was mostly found feeding mosses growing on rocks and fallen trees at 2,700–3,600 m alt. along the summit trail at Mt. Kinabalu.

Etymology: The specific name refers to the characteristic short yellow stripes on the elytra.

***Ivalia* sp.**

Specimens examined: 1♀, Mt. Kinabalu, Laban Rata, 3,300–3,450 m alt., Ranau, Sabah, 10.X.2008, H. Takizawa & T. S. Liew leg.

Remarks: This species somewhat resembles *I. striolata*, n. sp., having black body with a yellowish oblong ring pattern on the elytra. But it is distinguished from the former by the smaller body of 3.1 mm in length, its elytral pattern, which is oblong ring of yellow line, and by the pronotum finely punctate.

Only one specimen was collected on mosses, together with *I. striolata*, n. sp. Because the specimen is a damaged female, we refrain from describing it.

Key to *Ivalia* species of Mt. Kinabalu

1. Elytra neither shining nor smooth, dull, densely or rugosely punctate 2
– Elytra shining and smooth, almost impunctate or with fine punctures 4
2. Elytra distinctly punctate 3
– Elytra opaque, densely covered with minute punctures, with 2 transverse yellowish spots near base; body large, 4.0–5.0 mm in length ..... *I. besar* **sp. nov.**
3. Elytra rugosely punctate, except for yellow oval patch near base; pronotum punctate and smooth; aedeagus strongly curved in lateral view ..... *I. kinabalensis* (Bryant)
– Elytra densely punctate, except for yellowish red transverse patch near base; pronotum shagreened; aedeagus gently curved in lateral view ..... *I. biasa* **sp. nov.**
4. Body largely yellowish to orange brown; elytra with or without blackish patch..... 5
– Body largely black; elytra with yellow to reddish stripes or spots 6
5. Body small, less than 2.0 mm in length; yellowish brown, with femora slightly darker .... *I. minnutissima* **sp. nov.**
– Body 2.1–2.3 mm in length; elytra each with small black patch near base, surrounded by yellowish white band anteriorly ..... *I. nigrofasciata* **sp. nov.**

6. Elytra black with yellow to reddish patterns 7
– Elytra largely covered by wine-red patch, which is narrowly margined with yellow..... ..... *I. marginata* **sp. nov.**
7. Each elytron with a round spot on basal half only 8
– Each elytron with yellow stripes or patches 9
8. Body 2.0–2.2 mm; each elytron with small orange spot basally, entirely surrounded by narrow golden-yellow ring ..... *I. rubrorbiculata* **sp. nov.**
– Body 2.4–2.5 mm; each elytron with round spot larger, extending posteriorly, with yellow margin widely interrupted posteriorly ..... *I. haruka* **sp. nov.**
9. Elytra with yellow to reddish stripes or oblong ring-shaped spot 10
– Each elytron with 3 large yellow spots, black area strongly reduced to linear interspaces between spots; body 2.8–3.2 mm ..... *I. fulvomaculata* **sp. nov.**
10. Elytra with short yellow stripes 11
– Elytra with oblong ring-shaped spots; body ca. 3.1 mm ..... *Ivalia* sp.
11. Body larger, 2.5–3.2mm in length; elytra with 2 short yellow stripes, arcuate stripe near base and another longitudinal stripe at latero-posterior area; aedeagus strongly narrowed to apex on apical half ..... *I. striolata* **sp. nov.**
– Body smaller, ca. 2 mm in length; elytra with 3 narrow yellow stripes; long arcuate stripe running near base and subparallel to lateral margin, short longitudinal stripe running parallel to suture at middle, and another short longitudinal stripe on latero-posterior area; aedeagus subparallel-sided ..... *I. pseudostriolata* **sp. nov.**

Notes on larvae

Ducket et al. (2006) described larvae of *Ivalia korakundah* Prathapan, Konstantinov et Ducket in detail. I observed many, diurnally and openly feeding larvae of *I. biasa* sp. nov. on mosses growing on the rocks around Laban Rata, 3,300 m alt. at Mt. Kinabalu.

They are slender, cylindrical, with distinct bristles on blackish body. The dorsal and dorso-lateral tubercles are enlarged with interspaces densely covered with chitinous platelets. The tubercular patterns are summarized as follows (Takizawa 2005): prothorax with *D-DL-EPa*/*EPp* type; meso- and metathorax with *Da-Dp*/*DLi-DLe* type; abdominal segments with *Da-Dp*/*DL* type. The abdominal *Da* may be secondarily divided into *Dai* and *Dae* as in the case of *I. korakundah*.

The large, undivided dorso-lateral tubercle *DL*, with a spatulate seta and spiracle is characteristic of this genus. Furthermore, *Dp*, *DL* and *EP* each bears one spatulate primary seta.

These characters together with the habit of external leaf feeding show some similarity to the genus group *Altica* (sensu Takizawa 2005). But larva of *Altica* has different tubercular pattern on abdominal segments, viz. dorsal (*D*) and dorso-lateral (*DL*) tubercles are composed of 5 or 6 tubercles with a separated peritreme[1]. Whereas the corresponding tubercles in *Ivalia* are composed of only 3 tubercles.

A combination of the different tubercular pattern on the abdomen, presence of a large *DL* bearing spiracle on abdomen and spatulate setae on the dorsum is sufficient to establish twelth genus group for *Ivalia*.

[1] The senior author erroneously stated meso-and metathoracic tubercular pattern of *Altica* group as *Da*/*Dpi*/*Dpe* and *DLai*/*DLae*/*DLp* (p.189: Tab. 1). It should be corrected to *Da*/*Dp* and *DLi*/*DLe*.

Traditionally (Seeno & Wilcox 1982), *Ivalia* is grouped with genera of known leaf-mining larvae, such as *Argopistes* Motschulsky, *Halticorcus* Lea and *Chilocoristes* Weise, presumably based on the round body shape of adults. However, the larval tubercular pattern is at variance with such a grouping.

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