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ORIBATID FAUNA (ACARI, ORIBATIDA) FROM THE KUMAYA CAVE OF IHEYA VILLAGE IN CENTRAL RYUKYU ARC, SOUTH JAPAN, WITH A DESCRIPTION OF SEVERAL NEW SPECIES

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ABSTRACT — Eleven oribatid species were collected from the Kumaya Cave of Iheya village in Central Ryukyu Arc, South Japan. The cave is a descending horizontal tunnel of a deep-sea abysmal quartziferous deposit formed in the Permian period of the Palaeozoic era and excavated by sea erosion. The floor of the cave was covered with sand, three to four meters deep. Fragments of psephite are found at the end of the cave. Each sample of about 200 cm³ was collected by hand from the following five marked points of the cave on 17 March 2010: A, Sand and a fragment of psephite; B, Sand and a fragment of psephite; C, Sand, a fragment of psephite, and litter of Ficus microcarpa; D, Litter and humus of F. microcarpa and Cassytha filiformis, and sand; E, Litter and humus of F. microcarpa and C. filiformis, and sand. All species belonged to Brachypylina: Oppiella (O.) nova from A; Mabulatrichus kumayaensis sp. nov., Protoribates kumayaensis sp. nov. and Zygogribatula iheyaensis sp. nov. from B; Tectocepheus kumayaensis sp. nov. from C; Tectocepheus iheyaensis sp. nov., Oribatula kumayaensis sp. nov., Protoribates hirokous sp. nov. and Haplozetes makii sp. nov. from D; Eupelops kumayaensis sp. nov. from E; Neoliodes iheyaensis sp. nov. from C, D and E.

KEYWORDS — Kumaya Cave; new species; Oribatid mite; Ryukyu Arc; South Japan

INTRODUCTION

In Central Ryukyu Arc of South Japan, faunistical research of soil animals began in the early 1970’s (Aoki, 1973; Aoki and Nakatamari, 1974). From Iheya Village, fifty seven oribatid species were already recorded by Aoki (2009). However, the present paper is the first contribution to the knowledge of the oribatid fauna in the Kumaya Cave of Iheya Village. Six species of soil animals in addition to oribatid mites were found. Eleven oribatid species, on which ten were new to Science were recorded. The objective of the present paper is to provide the description of these ten species. All examined oribatids belong to Brachypylina.

METHODS

Iheya village is located in the northern Central Ryukyu Arc, South Japan. The Kumaya Cave of Iheya village is located 27°05′N; 128°00′E, about 15-35 m a.s.l. in the North-East of Iheya village. The cave has a depth of 63 m, a height of 10 m and a breadth of 600 m² (Arakaki and Ooshiro, in Mo-
FIGURE 1: The plane figure, a cross section and a vertical section of Kumaya Cave (after Arakaki and Ooshiro, in Moromi, 1981), and sampling plots A-E (photos by Fukumori S.).
romi, 1981) (Fig. 1). The Kumaya Cave is a descending horizontal tunnel of a deep-sea abyssal quartziferous deposit formed in the Permian period of the Palaeozoic era and excavated by erosion of the sea. The floor of the cave was covered with sands washed ashore, three to four meters deep. Fragments of psephite are found at the end of the cave. Each sample of about 200 cm³ was collected by hand from the following five marked points of the cave on 17 March 2010 by Fukumori S. and Nakamura Y.-N. (Fig. 1): A, a single specimen of oribatid mite was collected from sample consisting of sand and a fragment of psephite; B, three specimens belonging to three oribatid species were collected in sand and fragment of psephite; C, two specimens of two oribatid species and three specimens of collembola were collected in sand, a fragment of psephite, and litter of Ficus microcarpa; D, eight specimens belonging to five oribatid species including one nymph were collected from litter and humus of F. microcarpa and Cassytha filiformis L., and sand; E, fifty specimens belonging to five oribatid species including one nymph were collected from litter and humus of F. microcarpa and Cassytha filiformis L., and sand.

Animals were extracted with a modified Tullgren apparatus. The type series (NSMT-Ac 13582-13602) are deposited in the National Museum of Nature and Science, Tokyo, and topotypes together with sampling materials in Iheya Village Office, Okinawa. The notations of descriptions and figures are mainly based on Balogh and Mahunka (1983), Grandjean (1952) and Hammen (1989) as follows: Aa, Ad, Al, Apo, A1-3: porose areas; a, m, h: anterior, medial and posterior subcapitular setae, respectively; acm: anteroculmal seta on pedipalpal tarsus; Bo: bothridium; bo: 1-4, sj: epimeral borders; c1-3, da, dm, dp, la, lm, lp, hdown1-3, p1-3: notogastral setae; cha, chib: posterior and anterior setae of chelicerae, respectively; ft': fastigial seta of legs; g1-7, ag, an1-3, ad1-3: genital, aggenital, anal and adanal setae, respectively; gla: opisthonal gland; hy: dorsiophragmatic apophyses; ia, iad, ian, ih, im, ip, ips: lyrifissures; ro, le, in, ex: rostral, lamellar, interlamellar and exobothridial setae, respectively; s: subunguinal seta of legs; ss: sensillus; Tg1-2: Trägårdh's organ; ε: famulus on tarsus of leg I; ω1-2, ϕ1-2, δ: solenidia on tarsi, tibiae and genua of legs, respectively; ω on tarsi of pedipalp; 1A-f, 2A-c, 3A-c, 4A-d: epimeral setae. Number of tarsal claws common to all legs. Setal formula of legs including famulus but excluding solenidia. Solenidiotaxy common to all examined species except for Eupelops kumayaensis sp. nov.: I (1-2-2), II (1-1-2), III (1-1-0), IV (0-1-0). Legs of some species could not be studied to not damage the holotypes (and to not break the legs when study). Measurements (µm) in the descriptions are according to holotype, except for Neoliodes iheyaensis sp. nov. The taxonomical grouping followed the systems proposed by Norton and Behan-Pelletier (2009), Subías (2004) and Weigmann (2006).

**Neoliodidae Sellnick, 1928**

*Neoliodes iheyaensis* sp. nov.

[Japanese name: Iheya-uzutakadani]  
(Figs. 2-4 and Plate 1)

**Diagnosis — Body length (15 exs.)** 771 (1098) 1214 µm; width 643 (742) 893 µm. Integument of prodorsum and legs reticulate: marginal region of prodorsum and notogaster, epimeral region and anal plates costate; central region of notogaster alveolate Sensilli consisting of conspicuously verrucose swollen head and smooth thin stem. Notogaster bearing porose area (Apo) at the center and a pair of conspicuous large hollow laterally considered as opisthonotal gland (gla). Five pairs of notogastral setae, lp, h1 and p1-3 at posterior margin. Mentotectum separated medially. Epimeral setal formula: [5,6,7]-3-3-4. Homotridactylous.

Material examined — Holotype (Female) (NSMT-Ac 13582) from point E; 47 paratypes (NSMT-Ac13583-13586): same data as holotype; 1 paratype (Nymph) (NSMT-Ac13587): from point C; 1 paratype (Nymph) (NSMT-Ac13588): from point D.

**Etymology** — After the name of sampling area, Iheya Village.

Measurements and body appearance — Body length 771 (1098) 1214 µm; width 643 (742) 893 µm
Figure 2: Neoliodes iheyaensis sp. nov. A, Prodorsum; B, Notogaster.
FIGURE 3: *Neoliodes iheyaensis* sp. nov. A, Part of femur IV; B, Camerostoma; C, Medial portion of mentotectum; D, Right ventral region; E, Genu and femur of leg I.
FIGURE 4: *Neoliodes iheyaensis* sp. nov. A, Claws of tarsus I; B, Bothridial region; C, Part of chelicera; D, Tarsus of pedipalp; E, Solenidial region on tarsus and tibia of leg I; F, Setae.
PLATE 1: Neoliodes iheyaensis sp. nov. by the scanning electron microscopy (photos by Nakamura Y.-N.). A-D: Adult female; E and F: Tritonymph; A, C and E: Without scalps; B, D and F: With scalps; C and D: Lateral side; F: Ventral side.
μm. Body colour purplish brown. Integument of prodorsum and legs reticulate; marginal region of prodorsum and notogaster, epimeral region and anal plates costate; central region of notogaster alveolate (Plate 1).

Prodorsum — Rostral tip widely rounded bearing roughened setae ro (110 μm) at the lateral margin. Lamellar region protuberant parting right and left (Fig. 2A). Lamellar setae absent. Setae in (52 μm) and ex (27 μm) short, smooth. Bothridia opened dorso-laterally. Sensilli (ss) (105 μm) consisting of conspicuously verrucose swollen head and smooth thin stem (Fig. 4B). Relative lengths and distances: ro > ss > in > cx; (Bo – Bo: 169 > ss > in > ex; (Bo – Bo: 169 > ss > in > ex; (Bo – Bo: 169 > ss > in > ex. All genua and femora bearing carina (Fig. 3A). Setae smooth spiniform; pedipalpl setal formula: 0-2-1-3-9[1] (Fig. 4D). Diarthric subcapitulum bearing 3 pairs of setae, a (35 μm), m (70 μm) and h (46 μm); setae smooth spiniform; m longest inserted near mid-ventral line (Fig. 3B). Setae cha and chb long spiniform bearing minute bars throughout length (Fig. 4C).

Legs — Homotridactylous; claws minutely barbed dorsally (Fig. 4A). Setal formula: I (1-5-3-7-23), II (1-5-3-6-20), III (2-4-3-5-20), IV (1-2-2-5-18). All genua and femora bearing carina (Fig. 3A). Seta d on femur IV smooth bacilliform (Fig. 3A). One solenidion of all tibiae and genua with coupled seta.

On tarsus I, famulus e spiniform situated posterior to solenidia ω2; ω2 lateral to ω1 (Fig. 4E). Solenidion ω1 and ω2 setiform. Solenidion ψ1 on tibia I originating from apophysis, coupled with seta d.

Immature (Plate 1 E-F) — Five tritonymphs: length 921 μm; width 571 μm. Body surface sulcate.

Remarks — Two species of genus Neoliodes, N. bataviensis Sellnick, 1925 and N. zimmermanni (Sellnick, 1959) have been recorded from Iheya Island (Aoki, 2009). However, descriptions of these latter specimens (Aoki, 2006; 2009) are different from the original descriptions of N. bataviensis and N. zimmermanni in regards to insertion of rostral setae, form of lamellar-interlamellar region and size of sensilli, and from the new species in insertions of setae in, form of lamellar-interlamellar region and notogaster, and absence of conspicuous hollows and porose area (Apo) at the notogastral center. The new species differs from all the species of the genus by having porose area (Apo) at the notogastral center, opisthobital gland as conspicuous hollows laterally on the notogaster, form of lamellar region, no- togaster and carina on genu and femur of all legs, and mentotectum separated medially.

OPPIIDAE GRANDJEAN, 1951

Oppiella (Oppiella) nova (Oudemans, 1902)

[Japanese name: Namitsubudani] (Fig. 5 and Plate 2)

Eremaeus novus Oudemans, 1902, Tijdschr. Ent., 46, pp. 6-7, pl. 2, fig. 22.

Oppia nova: van der Hammen, 1952, Zool. Verh., No.17, pp. 51-52, fig. 6a.
Oppiella nova: Hammer, 1968, Biol. Skr. Dan. Vid. Selsk., 16(2), p. 13; Fujikawa, 1981, Edaphologia, (24), p. 20, figs. 1 and 2; Fujikawa, 1999, Edaphologia, (62), pp. 23-28, figs. 12-19 and 21-28, tables 1 and 4.

Oppiella (Oppiella) nova: Subías, 2004, Graellsia, 60, p.128.

**Figure 5:** Oppiella (Oppiella) nova (Oudemans, 1902) Solenidial region of tarsus I.

Diagnosis — Body length 314 μm; width 150 μm. Parallel lamellar ridges connected with transversal ridge. Medial anterior part of notogaster not extending anterior crista. Setae c₂ glabrous. Epimeral grooves I, II and IV distinct. Setae ft' on tarsi I long.

Material examined — One female (NSMT-Ac 13589) from point A.

Measurements — Body length 314 μm; width 150 μm. Body colour light yellow brown.

Supplementary description — Morphological variation in form of lamellar region, anterior part of notogaster, setae c₂ and epimeral region, type A, A, A, and C, respectively (Pl. 2). The nomenclature used in the Figs. 15 and 16 is the one used by Fujikawa (1999).

Distribution — Cosmopolitan.

Remarks — The examined specimen has longer setae ft' on tarsi I than that of specimens collected in a nature farm in Hokkaido (Fujikawa, 1981) (Fig. 5). The present species is known as fungivorous, parthenogenetic and cosmopolitan species, with a fossil history of about 8,000 years ago (Karppinen and Koponen, 1973). Only the present species has been found in a deep horizontal drift of gold mine (Fujikawa, private information). Only the present species was collected from the point A where the wall and floor were covered with only sand or fragment of psephite without organic matter. It was observed that a total of 12,803 adults were issued from one female (for twelve years) and that this species was able to crawl in any crevice (Fujikawa, 1999).

**Tectocepheus velatus** (Michael, 1880) was not found from crevice the species rared with the same condition with *O. nova*.

Tectocepheidae GRANDJEAN, 1953[1954]

Tectocepheus kumayaensis sp. nov.

[Japanese name: Kumaya-kuwagatasani] (Figs. 6 and 7)

Diagnosis — Body length 264 μm; width 178 μm. Rostral anterior margin without incision, broadly truncate with two concavities. Setae in trigonal pyramidal, roughened. Sensilli with globular head. Bothridia with deep incision, without swelling or projection. Depression and dorsosejugal scissure absent. Humeral region with small triangular projection. Ten pairs of notogastral setae. Genito-anal setal formula: 6-1-2-3. Lyrifissures iad located along, near anterior margin of anal aperture. Epimeral setal formula: 3-1-3-3. Trochantera III and IV bearing carina with sharply pointed apex. Monodactyl.

Material examined — Holotype (Female) (NSMT-Ac 13590) from point C.

Etymology — After the name of sampling point, Kumaya Cave.
Plate 2: Oppiella (Oppiella) nova (Oudemans, 1902) (photos by Nakamura Y.)
FIGURE 6: Tectocephus kumayaensis sp. nov. A, Dorsal view; B, Camerostome; C, Genito-anal region.
Measurements and body appearance — Body length 264 µm; width 178 µm. Body colour light brown. Whole body surface covered cerotegument; cerotegument irregularly granulate.

FIGURE 7: Tectocephis kumayaensis sp. nov. A, Solenidial region on tarsus and tibia of leg I; B, Left epimeral region.

Prodorsum — Rostral anterior margin without incision, broadly truncate with two concavities (Fig. 6A). Setae ro (33 µm) and le (30 µm) spiniform, extending for a short distance anterior of rostral anterior margin; setae ro barbed unilaterally; setae le roughened throughout length; ro nearly as long as le. Lamellar cuspis without dent nor swelling, not extending to level of rostral anterior margin. Rostral and lamellar transverse ridges distinct. Setae in (5 µm) small trigonal pyramidal, roughened throughout length. Sensilli (45 µm) composed of thin, roughened stem and globular head which bears dark coloured spines. Setae ex (8 µm) smooth, short, longer than setae in. Bothridia opened anterolaterally, with deep incision, without swelling or projection.

Notogaster — Depression and dorsosejugal scissure absent. Humeral region with small triangular projection. Ten pairs of notogastral setae short setiform, roughened throughout length. Lyrifissures ia and id aligned perpendicular to notogastral outline, antero-laterally to setae c₂; im obliquely, laterally to lp; ip perpendicular to notogastral outline between p₁ and p₂. Setae h₃ inserted antero-lateral to gla.

Ventral region — Genital (36 µm) and anal (57 µm) apertures almost pentagonal in form; distance (22 µm) between them appreciably shorter than half length of anal aperture. Genito-anal setal formula: 6-1-2-3; all setae smooth setiform (Fig. 6C). Setae g₁ and g₂ inserted nearer anterior margin of plates. Setae ag inserted latero-posteriorly to genital aperture. Setae ad₁ and ad₂ aligned in postanal position, ad₃ in adanal. Lyrifissures iad located along, near anterior margin of anal aperture. Ectal ridge distinct at epimeres borders 2-4; bo. 1, 2, sj distinct. Epimeral setal formula: 3-1-3-3; setae smooth, minute setiform. Diarthric subcapitulum bearing 3 pairs of setae: a (13 µm), m (2 µm) and h (11 µm); setae thin smooth setiform; relative lengths: a ≈ 6x h; m ≈ 4x h (Fig. 6B).

Legs — Monodactyl; claws with few dens. Legs not studied. Trochanter III and IV bearing carina with sharply pointed apex (Fig. 7B). On tarsus I, famulus ε trigonal pyramidal situated between solenidia bacilliform ω₁ and setiform ω₂ (Fig. 7A). Solenidion ϕ₁ on tibia I originating from apophysis, about three times longer than the length of ω₁.

Remarks — Rostrum with two concavities of the new species is similar in appearance to those of Tectocephis alatus Berlese, 1913 and T. shirakamiensis Fujikawa, 2001. However, the new species differs from them in form of cuspis, dorsosejugal region, humeral region, and situation or direction of lyrifissures ia and iad. The new species has a small body size, verrucose globular sensilli and subparallel lyrifissures iad to anal aperture as is the case of T. minor Berlese, 1903 [1904] sensu Bernini (1973) and Japanese specimens collected by Fujikawa. At first she considered these Japanese specimens as T. cuspidentatus Knülle, 1954 (Fujikawa, 1988), because (1) she could not find out similar characters like rostrum with two deep incisions between Japanese specimens and Berlese Collection (204/6, 217/27-30 and 82/36-40) in addition slides in the Berlese Collection were hardly examinable for her, and (2) she could find that Japanese specimens beared a stricking resemblance in the rostrum shape, sensilli
Iheya Village.

Material examined — Holotype (Female) (NSMT-Ac 13591) from point D.

Measurements and body appearance — Body length 307 µm; width 179 µm. Body colour light yellowish brown. Whole body surface covered with cerotegument; cerotegument irregularly granulate.

Prodorsum — Rostral anterior margin broadly rounded without incision, bearing narrow projection at lateral sides, ending abruptly anteriorly, not extending anterior of rostral anterior margin (Fig. 8A). Lamellar cuspis with inner swelling, without dens, not extending to level of rostral anterior margin. Rostral and lamellar transverse ridges distinct. Setae ro and le spiniform, barbed unilaterally, extending for a short distance anterior of rostral anterior margin. Setae ro (41 µm) nearly as long as le. Setae in smooth, small bacilliform. Sensilli (38 µm) composed of thin, smooth stem and globular head which bears dark coloured spines. Setae ex (7 µm) smooth, short, shorter than setae in (11 µm). Bothridia opened dorsally.

Notogaster — Depression on notogaster absent. Dorsosejugal scissure reduced behind setae in (Fig. 9A). Ten pairs of notogastral setae short, smooth, setiform. Lyrifissures ia aligned obliquely to notogastral outline, antero-laterally to setae cz; im obliquely, laterally to almost mid-distance between lm and lp; ih and ip obliquely to, ip perpendicular to notogastral outline; lh postero-laterally to im; ips antero-laterally to h3; ip anterior to p2. Setae h3 inserted postero-laterally to gla. Posterior margin of notogaster with broadly truncate elevation bearing setae h3 at corners.

Ventral region — Genital (42 µm) and anal (76 µm) apertures almost pentagonal in form; distance (24 µm) between them appreciably one-third as long as length of anal aperture (Fig. 9B). Genito-anal setal formula 6-1-2-3; all setae smooth setiform. Setae g1 and g2 inserted nearer anterior margin of plates; setae g1 (14 µm) about more than twice as long as the rest setae (6 µm). Setae ag (6 µm) inserted latero-posteriorly to genital aperture. Setae ad1 and ad2 aligned in postanal position; ad3 in analan. Lyrifissures iad located transversely near anterior margin of anal aperture. Sternal ridge indistinct. Epimeral borders bo. 1, 2, sj distinct. Epimeral setal formula 3-1-3-3; setae smooth, setiform. Diarthric subcapitulum bearing 3 pairs of setae: a, m and h; setae a

and lamellar cusps, and situation of lyrifissures iad with a specimen of T. cuspiden- tatus in Zoological Museum Copenhagen. Latter the Japanese specimens were identified as T. minor (Fujikawa, 2001) according to Nübel-Reidelbach (1994). After that, Mahunk and Mahunka-Papp (1995) and Laumann and al (2007) pointed out that T. minor has medially weakly protruding rostral anterial margin, cusps bearing inner and outer dens, globular sensilli, notogaster without depressions, bothridium ventrally expanded, trochanter IV bearing a dorsal spur and lyrifissures iad situated subparallel to anal aperture. Fujikawa (1995; 1999) could not observe individual variation in presence or absence of rostral incisions, form of rostral anterior margin, presence or absence of dens of cusps, and situation of iad subparallel to anal aperture. Now we consider that the above-mentioned Japanese specimens should be reidentified as T. cuspiden- tatus. Tectocepheus minor by Fujita and Fujiyama (2001) should be also included in the species, T. cuspiden- tatus, Fujita and Fujiyama (2001) suggested that, unlike T. velatus, T. cuspiden- tatus could migrate in response to seasonal environ- mental changes. The new species differs from all the species of the genus in having rostral anterior margin with two concavities without incisions, cusps without dens and swelling, trignogonal pyramidal interlamellar setae, and form of carina on trochanter III and IV.

_Tectocepheus iheyaensis sp. nov._

[Japanese name: Iheya-kuwagatadani] (Figs. 8 and 9)

_Diagnosis_ — Body length 307 µm; width 179 µm. Rostral anterior margin without incision, bearing narrow projection at lateral sides, ending abruptly anteriorly, not extending anterior of rostral anterior margin. Lamellar cuspis with inner swelling, without dens, not extending to level of rostral anterior margin. Depression on notogaster absent. Genito- anal setal formula 6-1-2-3. Monodactyl.

Material examined — Holotype (Female) (NSMT-Ac 13591) from point D.

Etymology — After the name of sampling area, Iheya Village.

Meanings and body appearance — Body length 307 µm; width 179 µm. Body colour light yellowish brown. Whole body surface covered with cerotegument; cerotegument irregularly granulate.

Prodorsum — Rostral anterior margin broadly rounded without incision, bearing narrow projection at lateral sides, ending abruptly anteriorly, not extending anterior of rostral anterior margin (Fig. 8A). Lamellar cuspis with inner swelling, without dens, not extending to level of rostral anterior margin. Rostral and lamellar transverse ridges distinct. Setae ro and le spiniform, barbed unilaterally, extending for a short distance anterior of rostral anterior margin. Setae ro (41 µm) nearly as long as le. Setae in smooth, small bacilliform. Sensilli (38 µm) composed of thin, smooth stem and globular head which bears dark coloured spines. Setae ex (7 µm) smooth, short, shorter than setae in (11 µm). Bothridia opened dorsally.

Notogaster — Depression on notogaster absent. Dorsosejugal scissure reduced behind setae in (Fig. 9A). Ten pairs of notogastral setae short, smooth, setiform. Lyrifissures ia aligned obliquely to notogastral outline, antero-laterally to setae cz; im obliquely, laterally to almost mid-distance between lm and lp; ih and ip obliquely to, ip perpendicular to notogastral outline; lh postero-laterally to im; ips antero-laterally to h3; ip anterior to p2. Setae h3 inserted postero-laterally to gla. Posterior margin of notogaster with broadly truncate elevation bearing setae h3 at corners.

Ventral region — Genital (42 µm) and anal (76 µm) apertures almost pentagonal in form; distance (24 µm) between them appreciably one-third as long as length of anal aperture (Fig. 9B). Genito-anal setal formula 6-1-2-3; all setae smooth setiform. Setae g1 and g2 inserted nearer anterior margin of plates; setae g1 (14 µm) about more than twice as long as the rest setae (6 µm). Setae ag (6 µm) inserted latero-posteriorly to genital aperture. Setae ad1 and ad2 aligned in postanal position; ad3 in analan. Lyrifissures iad located transversely near anterior margin of anal aperture. Sternal ridge indistinct. Epimeral borders bo. 1, 2, sj distinct. Epimeral setal formula 3-1-3-3; setae smooth, setiform. Diarthric subcapitulum bearing 3 pairs of setae: a, m and h; setae a

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and \( h \) thin smooth; \( a \) spiniform; \( m \) and \( h \) setiform; \( m \) sparsely barbed; relative lengths: \( a \approx m \ (19 \mu m) \approx 2 \times h \ (10 \mu m) \) (Fig. 8B).

Legs — Monodactyl. Setal formula: I (1-5-3-5-17), II (1-4-2-4-14), III (2-3-1-3-12), IV (1-2-2-3-12). On tarsus I, famulus \( \varepsilon \) bacilliform situated beside solenidion \( \omega_1 \) originating from apophysis; solenidion \( \omega_1 \) bacilliform and \( \omega_2 \) setiform; \( \omega_2 \) situated anterior to \( \omega_1 \) (Fig. 8C). Solenidia \( \varphi_1 \) and \( \varphi_2 \) on tibia I originating from apophysis; \( \varphi_1 \) (79 \( \mu m \)) about four times longer than the length of \( \omega_1 \) (18 \( \mu m \)); \( \varphi_2 \) situated anterior to \( \varphi_1 \). Trochanter III bearing well developed carina, long and protruding. Carina of trochanter IV rounded. Tarsi II, tibiae I and II bearing thick setae different from other setae (Fig. 8D).

Remarks — The new species is similar in rostrum, cuspis, sensillus, setae on tarsi II, tibiae I and II, and carina of trochanter IV, and direction of lyrifissures \( \text{iad} \) to \text{Tectocepheus velatus} (Michael, 1880) and \text{T. velatus sarekensis} Trägårdh, 1910 (Fujikawa, 1988; Laumann \textit{et al.}, 2007; Weigmann, 2002). However, the new species differs from all the species of the genus in the characteristics of the rostrum with lateral projection, small smooth bacilliform interlamellar setae, notogaster with truncate elevation posteriorly without depression, genital setae \( g_1 \) longer than the remains and trochanter III bearing developed carina.

**Phenopelopidae Petrunkevitch, 1955**

**Eupelops kumayaensis** sp. nov.

[Japanese name: Kumaya-enmadani] (Figs. 10 and 11)

Diagnosis — Body length 607 \( \mu m \); width 486 \( \mu m \). Tutorium with sharply pointed apex, without dens. Anterior notogastral tectum broadly concave. Ten pairs of notogastral setae bacilliform, spinose. Four pairs of round porose areas. Genito-anal setal formula: 6-1-2-[2, 1]. Chelicerae bearing two
FIGURE 9: Tectocephus iheyaensis sp. nov. A, Notogaster; B, Genito-anal region.
FIGURE 10: *Eupelops kunayaensis* sp. nov. A, Dorsal view; B, Ventral view; C, Anterior tectum of notogaster of a depressed specimen; D, Areae porosae and setae; E, Tarsus of pedipalp.
FIGURE 11: *Eupelops kumayaensis* sp. nov. A, Left bothridial region and right sensillus; B, Tip of tutorium and rostral seta; C, Chelicera; D, Gnathosoma; E, Genu I; F, Solenidial region on tarsus and tibia of leg I; G, Tibia IV.
Trägårdh’s organs; Tg1 longer than Tg2. Heterotridactylyous.

Material examined — Holotype (Female) (NSMT-Ac 13592) from point E; 1 paratype (NSMT-Ac 13593): same data as holotype.

Etymology — After the name of sampling point, Kumaya Cave.

Measurements and body appearance — Body length 607 µm; width 486 µm. Body colour dark brown. Whole integument except for hypostoma bearing dark granules; hypostome laterally-costate.

Prodorsum — Rostrum protruding with rounded tip (Fig. 10A). Setae ro weakly expanded distally, spiculate throughout length, inserted on lateral margins at base of free tip of tutorium, extending for short distance anterior of rostral margin. Tutorium with sharply pointed apex, without tendings for short distance anterior of rostral margin. Setae g1 and g2 inserted at anterior margins of plates; g6 at posterior margins. Setae ag inserted latero-posteriorly to genital aperture. Setae an1 and an2 inserted near anterior and posterior margin of plates, respectively. Setae ad1 and ad2 aligned in postanal position; ad3 in analan. Lyrifissures iad located antero-laterally to anterior margin of anal aperture, along outline of aperture. Sternal ridge indistinct. Epimeral borders bo. 1-3, sj distinct. Epimeral setal formula: 3-1-3-3; setae short, smooth setiform. Relative lengths: Ia (18 µm) > g1 (17 µm) > ag (15 µm) > an1 (12 µm) > ad (10 µm). Pedipalpal setal formula: 0-2-1-3-9[1]; solenidion on tarsus short, not extending in front of tarsal anterior margin (Fig. 10E). Sectorial subcapitulum bearing 3 pairs of setae: a (32 µm), m (32 µm) and h (17 µm); all setae smooth; a, m spiniform; h setiform (Fig. 11D). Chelicerae bearing two Trägårdh’s organs; Tg1 longer than Tg2 (Fig. 11C).

Setae cha, chb smooth spiniform; cha long, chb short.

Legs — Heterotridactylyous; claws dentate dorsally. Setal formula: I (1-5-3-4-19), II (1-5-3-4-16), III (2-3-1-3-15), IV (1-2-2-4-12). All segment except for femur IV and all trochantera bearing thick, spiculate lateral setae (Fig. 11A). Carina on every segment indistinct. Solenidiotaxy: I (1-2-2), II (1-1-2), III (1-4-0), IV (0-0-0). Solenidion absent on tibiae IV (Fig. 11G). On tarsus I, famulus ε long setiform, situated posterior to solenidia w1; ω2 posteriolaterally to w1; ω1 bacilliform and ω2 setiform; seta ft’ contiguous and posterior to ω1 between ω1 and ω2 (Fig. 11F). Solenidion ϕ1 on tibia I originating from apophysis; ϕ2 lateral to ϕ1.

Remarks — As far as the authors know, the new species has concave anterior tectum of the notogaster as it is also observed in Eupelops bilobus (Sellnick, 1928) (Sellnick, 1929) and E. incompletes Mahunka, 1978. However, the new species is distinguished from these latter species by form and length of prodorsal setae, insertion of notogastral setae h3, and chelicerae with two Trägårdh’s organs.

Ventral region — Genital and anal apertures roughly circular in shape, almost equal (77 µm) in length; distance (130 µm) between them 1.7x as long as length of each aperture (Fig. 10B). Genito-anal setal formula: 6-1-2-[2, 1]; all setae short, smooth setiform (Fig. 10D); anal setae variable in number. Setae g1 and g2 inserted at anterior margins of plates; g6 at posterior margins. Setae ag inserted latero-posteriorly to genital aperture. Setae an1 and an2 inserted near anterior and posterior margin of plates, respectively. Setae ad1 and ad2 aligned in postanal position; ad3 in analan. Lyrifissures iad located antero-laterally to anterior margin of anal aperture, along outline of aperture. Sternal ridge indistinct. Epimeral borders bo. 1-3, sj distinct. Epimeral setal formula: 3-1-3-3; setae short, smooth setiform. Relative lengths: Ia (18 µm) > g1 (17 µm) > ag (15 µm) > an1 (12 µm) > ad (10 µm). Pedipalpal setal formula: 0-2-1-3-9[1]; solenidion on tarsus short, not extending in front of tarsal anterior margin (Fig. 10E). Sectorial subcapitulum bearing 3 pairs of setae: a (32 µm), m (32 µm) and h (17 µm); all setae smooth; a, m spiniform; h setiform (Fig. 11D). Chelicerae bearing two Trägårdh’s organs; Tg1 longer than Tg2 (Fig. 11C).
E. acronios (Hermann, 1804) (Grandjean, 1936) and E. kumaensis Fujikawa, 2009 have two Trägårdh’s organs, however they differ from the new species in form of notogastral anterior tectum and notogastral setae, and situation of Aa.

**ZETOMOTRICHIDAE GRANDJEAN, 1954[1955]**

*Mabulatrichus kumayaensis* sp. nov.

[Japanese name: Kumaya-nokomedani] (Figs. 12, 13 and 14)

**Diagnosis** — Body length 414 µm; width 229 µm. Numerous notogastral micropores. Rostrum dentate at anterior margin; seven dens small, rounded. Humeral saccule (hu) large. Piriform organ (py) conspicuous. Ten pairs of notogastral setae. Notogaster with marginal line between anterior of setae la. Epimeral setal formula 3-1-3-3. Trochanter IV bearing seta. Heterotridactylous.

**Material examined** — Holotype (Female) (NSMT-Ac 13594) from point B.

**Etymology** — After the name of sampling point, Kumaya Cave.

**Measurements and body appearance** — Body length 414 µm; width 229 µm. Body colour light brown. Whole integument smooth, with numerous notogastral micropores.

**Prodorsum** — Rostrum dentate at anterior margin; seven dens small, rounded (Fig. 12A). A pair of longitudinal ridges convergent, running from bothridia to anterior of setae le. Setae ro (48 µm), le (89 µm) and in (59 µm) spiniform, ciliate throughout length, originating from small apophyses. Bothridia opened antero-laterally. Sensilli (ss) (64 µm) setiform, ciliate throughout length; relative lengths ss ≈ 1.3x ro. Setae cx (15 µm) thin, short, smooth, setiform.

**Notogaster** — Medially interrupted dorsosejugal scissure directed forwards, ending at level of mid-distance between setae le and in. Humeral region developed, bearing barbed spiniform setae c2 (36 µm). Humeral saccule (hu) large. Piriform organ (py) conspicuous (Fig. 12B). Other nine pairs of notogastral setae except for c2, thin, smooth, short setiform (8 µm). Lyrifissures ia (16 µm) and im (18 µm) remarkable long, aligned almost perpendicular to notogastral outline; ih and ip transversely aligned; ips obliquely aligned to notogastral outline. Notogaster with marginal line between anterior of setae la (Fig. 12C). Notogaster separated medially and overlapping at posterior border (Fig. 14).

**Ventral region** — Genital aperture (41 µm) almost square in form; anal aperture (69 µm) rectangular; distance (99 µm) between them about 2.4x and 1.4x as long as lengths of genital and anal apertures, respectively. Genito-anal setal formula 4-1-1-2; all setae smooth, setiform; genital setae (15 µm) about 4x longer than anal (3 µm) and adanal (3 µm) setae, and about 2.5x longer than aggenital setae (6 µm). Setae an1 and ad2 absent. Genital setae (g1) inserted at anterior margins of plates; the others inserted at the mid-ventral line. Setae ag inserted almost at level of posterior margin of genital aperture. Setae ad1 aligned in postanal position, ad2 in adanal. Lyrifissures iad located postero-laterally to anterior margin of anal aperture. Sternal ridge and epimeral borders indistinct. Epimeral setal formula 3-1-3-3. Trochanter IV bearing seta. Heterotridactylous.

**Remarks** — The new species is distinguished from all the species of the genus Mabulatrichus, especially from *M. baloghi* (Mahunka, 1993) by the absence of two large incisions between medial and lateral teeth, from *M. dentatus* Coetzee, 1993 by the occurrence of a long epimeral setae la, from *M. litoralis* Aoki and Hirauchi, 2000 by the presence of rostral dens, conspicuous piriform organ, long dorsoseju-
FIGURE 12: Mabulatrichus kumayaensis sp. nov. A, Prodorsum; B, Anterior half of left notogaster; C, Posterior half of left notogaster.
FIGURE 13: Mabulatrichus kumayaensis sp. nov. A, Anterior half of ventral region; B, Solenidial region on tarsus and tibia of leg I.
FIGURE 14: *Mabulatrichus kunayaensis* sp. nov. Posterior half of ventral region.
gal scissure, and trochanter IV bearing seta \( v \), and from \( M. \ iranicus \) Akrami and Coetzee, 2007 by having round rostral dens and conspicuous piriform organ.

**Oribatulidae Thor, 1929**

*Oribatula kumayaensis* sp. nov.

[Japanese name: Kumaya-koitadani]

(Figs. 15 and 16)

**Diagnosis** — Body length 314 \( \mu \)m; width 193 \( \mu \)m. Rostral tip rounded, weakly protruding. Sensilli conspicuously verrucose club-shaped head. Four pairs of porose areas like deep cavity, surrounded by clearly sclerotized areas. Fourteen pairs of notogastral setae. Porose areas Aa situated posterior to \( c_1 \) and lateral to \( c_2 \); da posterior to \( c_2 \). Genito-anal setal formula 4-1-2-3. Epimeral setal formula: 3-1-3-3. Heterotridactylous.

**Material examined** — Holotype (Male) (NSMT-Ac 13595) from point D.

**Etymology** — After the name of sampling point, Kumaya Cave.

**Measurements and body appearance** — Body length 314 \( \mu \)m; width 193 \( \mu \)m. Body colour light yellowish brown. Whole integument smooth.

**Prodorsum** — Rostral tip rounded, weakly protruding, bearing setae \( ro \) (47 \( \mu \)m) thick, ciliate, setiform, at lateral margins, extending anterior of rostrum for distance equal to half of their length (Fig. 15A). Lamellae convergent, extending from bothridia to about half-way along length of prodorsum, setae \( le \) (51 \( \mu \)m) arising at base of short extention,
without cusp nor translamella. Setae \( le \) and \( in \) (54 \( \mu m \)) thick spiniform, ciliate throughout length, extending for short distance anterior of insertions of setae \( ro \) and \( le \), respectively. Relative distances, \( (in - in) \) (52 \( \mu m \)) > \( (ro - ro) \) (41 \( \mu m \)) > \( (le - le) \) (40 \( \mu m \)). Bothridia opened antero-laterally. Sensilli \( (ss) \) (34 \( \mu m \)) consisting of conspicuously verrucose club-shaped head and smooth thin long stem. Setae \( ex \) thin setiform, roughened throughout length.

Notogaster — Oval, bearing four pairs of porose areas like deep cavity (about 4 \( \mu m \) in depth, 9 \( \mu m \) in diameter), surrounded by clearly sclerotized areas (Fig. 16A). Fourteen pairs of notogastral setae present; \( c_1 \) (23 \( \mu m \)) barbed spiniform, thicker than the remainder; other setae thin, smooth setiform. Porose areas \( Aa \) situated posterior to \( c_1 \) and lateral to \( c_2 \); \( da \) posterior to \( c_2 \). Lyrifissures \( ia \) aligned obliquely lateral to \( c_1 \); \( im \) obliquely immediately anterior to \( A1 \); \( ih \) and \( ips \) obliquely to notogastral outline; \( ip \) obliquely behind \( h_1 \). A number of light spots arranged peripherally on notogaster.

Ventral region — Genital (42 \( \mu m \)) and anal (54 \( \mu m \)) apertures roughly circular; distance (78 \( \mu m \)) between them about 1.9x and 1.5x as long as length of genital and anal apertures, respectively (Fig. 16B). Genito-anal setal formula 4-1-2-3; all setae smooth setiform. Setae \( g_1 \) (12 \( \mu m \)) inserted at anterior margin of plates; setae \( g_3 \) near lateral margins. Setae \( ag \) (17 \( \mu m \)) inserted latero-posteriorly to genital aperture. Setae \( an_1 \) (12 \( \mu m \)) inserted almost midway along plates. Setae \( ad_1 \) (15 \( \mu m \)) aligned in postanal position; \( ad_2 \) in adanal; \( ad_3 \) in preanal. Lyrifissures \( iad \) located posterolaterally to \( ad_3 \), at anterior margin of anal aperture. Sternal ridge indistinct. Epimeral borders bo. 1, sj distinct. Epimeral setal formula: 3-1-3-3; setae thin, smooth setiform.
Diarthric subcapitulum bearing 3 pairs of setae: a (15 μm), m (19 μm) and h (19 μm); setae thin, smooth setiform (Fig. 15B).

Legs — Heterotridactylous. Setal formula: I (1-5-2-3-17), II (1-5-2-3-14), III (2-3-1-3-12), IV (1-2-2-3-12). On tarsus I, famulus e immediately posterior to solenidion ω2; ω2 posterior to ω1. Solenidion ω1 bacilliform and ω2 setiform. Solenidion ϕ1 on tibia I originating from apophysis; ϕ2 situated laterally at base of apophysis (Fig. 15C).

Remarks — The new species resembles in some respects of Oribatula (Oribatula) sakamorii Aoki, 1970 (Fujikawa, 1983; Bayartogtokh and Aoki, 2000). However, the new species differs from this latter species in having short lamellar setae, porose areas like deep cavity, sensilli with club-shaped head, long custodium, and mutual distances, (1a – 1a) ≈ (2a – 2a). As far as the authors know, form of porose areas such as found in the new species, was also, recorded in O. magniporosa Hammer, 1958, O. exsudans Travé, 1961, and Zygoribatula dubita Coetzer, 1967-1968. However, the new species has different insertion of lp, h2 and h3 than the ones of O. magniporosa, different form of humeral region, length of le, insertion of c2 and direction of im than those of O. exsudans, and different form of rostral anterior margin and lamellae than those of Z. dubita. Sensilli and lamellar tips of the new species are similar in appearance to those of O. parisi Travé, 1961 and O. interrupta (Willmann, 1939). However, the new species can be distinguished from them by relative distances between their mutual distances of ro, le and in, and from O. interrupta by situation of porose areas Aa.

Zygoribatula iheyaensis sp. nov.

[Japanese name: Iheya-koitadani] (Figs. 17 and 18)

Diagnosis — Body length 336 μm; width 214 μm. Sensilli with spiculate clavate head not terminating in fine point. Relative lengths le ≈ in > ss > ro > ex. Thirteen pairs notogastral setae. Four pairs of porose areas: Aa at a short distance from la; A1 posterior to lp; A3 near to h1. Genito-anal setal formula: 4-1-2-3. Epimeral setal formula: 3-1-3-3. Heterotridactylous.

Material examined — Holotype (Male) (NSMT-Ac 13596) from point B.

Etymology — After the name of sampling area, Iheya Village.

Measurements and body appearance — Body length 336 μm; width 214 μm. Body colour light yellowish brown. Whole integument smooth.

Prodorsum — Rostral tip rounded, weakly protruding, bearing setae ro (38 μm) at lateral margins, extending anterior of rostrum for distance equal to half of their length (Fig. 17A). Lamellae convergent, extending from bothridia to about halfway along length of prodorsum, connected by thick translamella, arising setae le (58 μm) at apices; le extending anterior of rostrum for distance equal to one-third of their length Setae in (58 μm) extending for short distance in front of translamella. Relative distances (ro – ro) (48 μm) ≈ (in – in) > (le – le) (21 μm). Bothridia opened antero-laterally. Sensilli (ss) (56 μm) with spiculate clavate head not terminating in fine point (17B). Setae ex (6 μm) short, thick. Relative lengths le ≈ in > ss > ro > ex.

Notogaster — Oval, medially weakly protruding at anterior margin, bearing thirteen pairs notogastral setae and four pairs of porose areas. All notogastral setae thin, smooth setiform; setae p2 absent. Porose areas Aa located lateral to setae la; A1 just behind lp; A2 postero-laterally to h3; A3 antero-laterally to h1. Lyrifissures ia aligned longitudinally postero-laterally to c1 (19 μm); im obliquely anterior to lp; ih obliquely lateral to lp; ips obliquely posterior to ih; ip obliquely behind h1. Opening gla situated postero-laterally to im.

Ventral region — Genital (48 μm) and anal (77 μm) apertures roughly circular; distance (77 μm) between them nearly as long as length of anal aperture (Fig. 18B). Genito-anal setal formula: 4-1-2-3; all setae smooth setiform. Setae g1 (10 μm) inserted at anterior margin of plates. Setae ag (10 μm) inserted latero-posteriorly to genital aperture. Setae ad1 (10 μm) aligned in postanal position; ad2 in analad; ad3 in preanal. Lyrifissures iad located lateral to ad3 in preanal position variable in direction. Epimeral borders bo. 1-3, sj interrupted medially. Sternal ridge
Figure 17: Zygoribatula iheyaensis sp. nov. A, Dorsal view; B, Bothridial region; C, Solenidial region on tarsus and tibia of leg I.

and bo 4 indistinct. Epimeral setal formula: 3-1-3-3; setae barbed setiform; setae 1a-c, 3b and 3c longer than other setae (Fig. 18A). Diarthric subcapitulum bearing 3 pairs of setae: a (4 μm), m (9 μm) and h (22 μm); a, m thin, smooth setiform; h barbed longer than a and m.

Legs — Heterotridactylous. Setal formula: I (1-5-3-4-18), II (1-5-2-4-15), III (2-4-1-3-13), IV (1-2-3-12). On tarsus I, famulus ε bacilliform situated posterior to solenidia ω2; ω2 setiform, sharply bending. Solenidion ω1 bacilliform inserted latero-anterior to ω2. Solenidion ϒ2 on tibia I lateral to ϒ2 (Fig. 17C).

Remarks — The new species resembles in some respects Zygoribatula truncata Aoki, 1961, however, it differs from this latter species by long interlamellar setae, rounded tip of head of sensilli, protruding anterior medial margin of notogaster, and different situation of porose areas Aa, A1 and A3: Aa at a short distance from la, A1 posterior to lp, A3 near to h1. Notogastral setae p2 of the new species is absent as it is in Z. connexa substriata Grobler et Kok, 1993. However, the new species is different from Z. connexa substriata in notogastral surface without faint yellow striations. Situation of notogaster setae...
FIGURE 18: *Zygorybatula iheyaensis* sp. nov. A, Anterior half of left ventral region; B, Genito-anal region.
and porose areas of the new species are very similar in appearance to those of Z. glabra (Michael, 1890) and Z. propinguus (Oudemans, 1902). However, the new species differs from them because of a rounded rostrum.

HAPLOZETIDAE GRANDJEAN, 1936

Protoribates kumayaensis sp. nov.

[Japanese name: Kumaya-kosodedani] (Figs. 19 and 20)

Diagnosis — Body length 314 µm; width 150 µm. Rostral with a pair of tooth-like tubercles (rt) in the interior. Setae le inserted far from lamellae, not reaching the insertions of rostral setae. Pteromorphs immovable. Pleurophrag-mata (hl) and dorsophragmatic apophyses (hy) conspicuously long and dark colourfull. Ten pairs of notogastral setae short, smooth setiform. Four pairs of porose areas present; Aa situated at the center of the isosceles triangle given by insertions of c2 (7 µm), l1 and l2 as three vertices; A1 immediately lateral to lp; A2 immediately antero-laterally to h3; A3 antero-laterally to p1. Lyrifissures ia aligned obliquely postero-laterally to c2; im transversely anterior to h3; ih transversely antero-laterally to h3; ip obliquely lateral to p1; ips obliquely postero-laterally to p3. Opening gla situated between im and h3.

Ventral region — Genital (40 µm) and anal (62 µm) apertures almost pentagonal and circle in form, respectively; length of anal aperture about 1.5x as long as that of genital aperture; distance (88 µm) between them twice as long as length of genital aperture; distance (88 µm) be-
tween them twice as long as length of genital aperture; distance (88 µm) be-
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FIGURE 19: Protoribates kumayaensis sp. nov. A, Prodorsum; B, Right half of notogaster; C, Right sensillus.
FIGURE 20: Protoribates kumyaensis sp. nov. A, Anterior half of ventral region; B, Posterior half of ventral region.
However, the new species is distinguished from \textit{Berlese, 1908} according to Hammer, 1961. \textit{P. capucinus} by the form of tubercles (rt), thickness of lamellar and interlamellar setae, and distances (le – in) > (le – le) and (ro – ro) > (ro – le). According to Hammer (1973), \textit{P. capucinus} has eleven pairs of notogastral setae, however the new species has ten pairs of notogastral setae. The new species has smaller body size than Italian specimen 420 µm in length and 250 µm in width (Berlese, 1908).

\textbf{Protoribates hirokous sp. nov.}

[Japanese name: Hiroko-kosodedani] (Figs. 21 and 22)

Diagnosis — Body length 429 (468) 507 µm; width 279 (300) 321 µm. Thin lamellar ridges situated marginally. Pteromorphae movable. Ten pairs of notogastral setae. Genito-anal setal formula: 5-1-2-3. Setae \(ad_1\) and \(ad_2\) longer than \(ad_3\). A short \(Trågårdh’s\) organ terminating in a fine apex. Monodactyl.

Material examined — Holotype (Female) (NSMT-Ac 13598) from point D; 2 paratypes (Female and male) (NSMT-Ac 13599 and 13600): same data as holotype.

Etymology — The new species is dedicated to Miss Hiroko Fukumori who gave the authors helpful suggestions for sampling.

Measurements and body appearance — Body length 429 (468) 507 µm; width 279 (300) 321 µm. Body colour light brown. Whole integument smooth. Muscle sigillae seen as a number of light spots arranged on epimeres and peripherally on notogaster.

Prodorsum — Prodorsum triangular (Fig. 21A). Rostral tip round bearing setae \(ro\) laterally. Setae \(ro\) (75 µm) long setiform, extending for two-third length of seta beyond rostral margin. Thin lamellar ridges situated at marginal position of prodorsum, extending forwards from bothridia to almost mid-distance along prodorsum setae \(le\) arising at base of short extension, without cuspis or translamellar; \(le\) short (35 µm) setiform, reaching insertions of setae \(ro\). Setae \(in\) long (75 µm) spiniform, extending for short distance anterior of insertions of setae \(le\). Setae \(ro\), \(le\) and \(in\) ciliate throughout length. Bothridia opened anterolaterally. Sensilli \(ss\) (75 µm) pectinate unilaterally, consisting of fusiform head and long stem, strongly elbowed near base (Fig. 21D). Setae \(ex\) (5 µm) short, smooth setiform. Relative lengths and distances of prodorsal setae: \(ro \approx in \approx ss\) ≈ 2x \(le > ex; (in – in) (123 \mu m) > (le – le) (83 \mu m) > (le – in) (63 \mu m) > (ro – ro) (56 \mu m) > (ro - le) (35 \mu m)

Notogaster — Pteromorphae movable, without acute angle, not extending anteriorly beyond level of arched dorsosejugal suture. Ten pairs of notogastral setae short smooth setiform. Four pairs of porose areas present: Aa largest, roughly triangle (Fig. 21C) situated anterior to mid-distance between \(la\) and \(lm\); \(A1, A2\) elliptical; \(A1\) immediately anterior to \(lp\); \(A2\) between \(l2\) and \(l3\); \(A3\) oval, lateral to \(p1\). Opening \(gla\) situated lateral to \(lp\). Lyrifissures \(ia\) aligned obliquely at the level of \(Aa\) on the pteromorphae; \(im\) transversely antero-laterally to \(gla\); \(ip\) obliquely between \(p1\) and \(p2\). Relative distances central notogastral setae: \(lp – h1\) (110 µm) > \((lm – lm) (104 \mu m) \approx (lm – lp) > (lp – lp) (87 \mu m) > (h1 – h1) (54 \mu m) > (p1 – p1) (48 \mu m).

Ventral region — Genital (48 µm) and anal (106 µm) apertures roughly circle in form; length of anal aperture about 2x as long as that of genital aperture; distance (123 µm) between them appreciably 2.5x as long as length of genital aperture (Fig. 21B). Genito-anal setal formula: 5-1-2-3; setae \(g, ag, an\) smooth setiform. Setae \(g1\) (11 µm) remote from anterior margin of the plate. Setae \(ag\) (11 µm) inserted latero-posteriorly to genital aperture. Setae \(an1\) and \(an2\) (33 µm) remote from each other and margins of plates. Adanal setae variable in form and length: \(ad1\) and \(ad2\) (45 µm) spiniform, barbed unilaterally, longer than \(ad3\) (21 µm); \(ad3\) short, smooth setiform. Setae \(ad1\) aligned in postanal position; \(ad2\) in adanal; \(ad3\) in preanal. Lyrifissures \(iad\) located at level of insertions of setae \(an2\). Sternal ridge distinct at bo 2. Epimeral borders bo. 1-3, sj distinct. Epimeral setal formula: 3-1-3-3; 1b, 3b, 3c barbed throughout length, longer (33 µm) than others; others simple. Diarthric subcapitulum bearing 3 pairs of setae; \(a\) (30 µm) smooth spiniform; \(n\) (11 µm) short seti-
FIGURE 21: Protoribates hirokous sp. nov. A, Dorsal view; B, Ventral view; C, Aa region; D, Setae.
FIGURE 22: Protoribates hirokous sp. nov. A, Gnathosomal region; B, Solenidial region on tarsus and tibia of leg I; C, Tibia II (narrow arrow: spur); D, Chelicera.
form, sparsely, minutely barbed; h (38 μm) closely barbed throughout length (Fig. 22A). Pedipalpal setal formula 0-2-1-3-9[1]; solenidion thick, strongly elbowed, originating from apophysis, coupled with acm. Chelicera bearing a short Trágardh’s organ terminating in a fine apex; cha unilaterally ciliate and chb smooth; cha longer than chb (Fig. 22D).

Legs — Monodactyl; claws without dens. Setal formula: I (1-5-3-4-2), II (1-5-3-4-15), III (2-3-1-3-15), IV (1-2-3-1-12). Tibiae II bearing small spur at proximal portion (Fig. 22C). On tarsus I, famulus bacilliform situated between solenidion ω1 and fastigial seta f (Fig. 22B). Solenidion ω1 bacilliform; ω2 setiform, inserted behind ω1; ω1 shorter than ω2; seta f’ as long as ω1. Solenidion ϕ1 originating from apophysis; ϕ2 contiguous to ϕ1.

Remarks — The new species has short lamellar setae such as in Protoribates paracapucinus (Mahunka, 1988) and P. brevisetosus (Fujita, 1989). However, it differs from them in distances among central notogastral setae, lm, lp and h1, and notogastral setae h2 inserted remote from porose areas A2. The prodorsal triangular form and arched dorsosejugal scissure extending beyond pteromorphs of the new species is very similar in appearance to those of P. dentatus (Berlese, 1883). However the new species has short lamellar, interlamellar and notogastral setae, and monodactyl, while P. dentatus has long prodorsal and notogastral setae, and tridactylous (Berlese, 1916 [1917]; Pérez-Iñigo, 1992).

Haplozetes makii sp. nov.

[Japanese name: Maki-koitadani] (Figs. 23 and 24)

Diagnosis — Body length 329 μm; width 193 μm. Four pairs of setae. Pteromorphs movable. Ten pairs of notogastral setae. Sensilli consisting of capitate spiculate head and long, smooth, thin stem. Thin lamellar ridges converge. Diarthric subcapitulum. Genito-anal setae: 4-1-2-3; all setae smooth, thin setiform. Heterotrideridactylous.

Material examined — Holotype (Female) (NSMT-Ac 13601) from point D; 1 paratype (Female) (NSMT-Ac 13602): same data as holotype.

Etymology — The new species is dedicated to Miss Maki Fukumori for her continual encouragement.

Measurements and body appearance — Body length 329 μm; width 193 μm. Body colour light brown. Whole integument smooth. A number of light spots arranged peripherally on notogaster.

Prodorsum — Rostrum protruding with blunt tip, bearing setae ro at lateral sides (Fig.23A). Setae ro long (40 μm) setiform bearing long and short barbs, antiaxially and paraaxially, respectively, extending for two-third length of seta anterior of rostral margin. Thin lamellar ridges convergent, situated not submarginal, extending anterior from bothridia to short distance in front of mid-distance along the prodorsum, setae le arising at ends, without cusp or translamellar; le long (58 μm) setiform, extending for short distance beyond rostral tip. Setae le and in barbed throughout length. Setae in (58 μm) extending for short distance anterior of insertions of setae le. Bothridia opened anterolaterally. Sensilli (ss) (43 μm) consisting of capitate spiculate head and long, smooth, thin stem (Fig. 23C). Setae ex (7 μm) short, smooth spiniform. Relative distances of prodorsal setae: (in – in) (48 μm) > (le – le) (44 μm) > (le – in) (37 μm) > (ro – ro) (35 μm) > (ro – le) (25 μm).

Notogaster — Pteromorphs movable, without acute angle, not extending anteriorly beyond level of arched dorsosejugal scissure. Ten pairs of notogastral setae short smooth setiform; variable in number, namely one specimen without pair of p2. Four pairs of saccules present: Sa and S1 situated anterior-laterally to lm and lp, respectively; S2 immediately postero-laterally to h2; S3 lateral to h1. Opening gla situated lateral to lp. Lyrifissures ia aligned nearly along joint of notogaster and pteromorph; im obliquely anterolaterally to S1; ip perpendicular to notogastral outline behind h2; ih and ips obliquely. Relative distances among central notogastral setae: (lm – lm) (96 μm) ≈ (h2 – h2) > (lp – lp) (87 μm) > (lm – lp) (73 μm) > (lp – h2) (58 μm).

Ventral region — Genital (48 μm) and anal (67 μm) apertures roughly circle in form; length of anal aperture about 1.4x as long as that of genital aperture; distance (100 μm) between them about twice as...
Figure 23: Haplozetes makii sp. nov. A, Dorsal view; B, Ventral view; C, Bothridial region; D, Setae; E, Trochanter IV; F, Pedipalp; G, Tarsus and tibia of leg I.
long as length of genital aperture (Fig. 23B). Genitoanal setae: 4-1-2-3; all setae smooth, thin setiform. Setae $g_1$, $g_2$ remote from $g_3$, $g_4$. Setae $ag$ inserted latero-posteriorly to genital aperture. Setae $an_1$ inserted near the mid-ventral line shorter than $an_2$. Setae $ad_1$ aligned in latero-posteriorly to aperture; $ad_2$ in adanal position; $ad_3$ in preanal. Lyrifissures $iad$ located at level of insertions of setae $an_2$, along outline of aperture. Sternal ridge and bo 4 indistinct. Epimeral borders bo. 1-3, sj interrupted medi ally. Epimeral setal formula: 3-1-3-3; all setae short, thin, simple (Fig. 24).

**Figure 24:** Haplozetes maki sp. nov. A part of left epimeral region.

Diarthric subcapitulum bearing 3 pairs of setae; all setae sparsely, minutely barbed (Fig. 23D). Pedipalpal setal formula: 0-2-1-3-9[1]; solenidion thick, originating from apophysis (Fig. 23F). Relative lengths of ventral and subcapitular setae $ad$ (23 $\mu$m) > $m$ (20 $\mu$m) > $a$ (19 $\mu$m) > $1a$ (17 $\mu$m) > $ag$ (15 $\mu$m) > $an$ (14 $\mu$m) > $g$ ≈ $h$ (13 $\mu$m).

Legs — Heterotridactylous; claws minutely denticate. Setal formula: I (1-5-3-4-18), II (1-5-3-4-16), III (2-3-1-3-14), IV (1-2-2-3-12). Trochanteral bearing carina terminating in fine point dorsally and ventrally (Fig. 23E). On tarsus I, famulus $\varepsilon$ bacilliform situated posterior to $\omega_2$ and lateral to seta $ft'$ (Fig. 22B). Solenidion $\omega_1$ bacilliform; $\omega_2$ setiform, inserted behind $\omega_1$; $\omega_1$ shorter than $\omega_2$; seta $ft'$ as long as, $\omega_1$. Solenidion $\varphi_1$ originating from apophysis; $\varphi_2$ contiguous to $\varphi_1$ (Fig. 23G).

Remarks — The new species is similar in form of rostrum and sensilli, length of notogastral setae and size of lamellae to *Haplozetes angustus* (Hammer, 1967) and *H. nudus* (Hammer, 1961). However, the new species differs from them in having sacculi S2 posterior to setae $h_2$ and their mutual distance of $lp$ smaller than those of $lm$ and $h_2$.

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REFERENCES

Akrami M. A., Coetzee L. 2007 — Mabulatrichus iranicus (Acari: Oribatida: Zetomotrichidae): a new species from Iran — System. Appl. Acar., 12: 245-252.

Aoki J.-I. 1961 — On six new oribatid mites from Japan — Sanitary Zoology, 12(4): 233-238.

Aoki J.-I. 1970 — A new species of oribatid mite found on melon fruits in greenhouses — Bull. Nat. Sci. Mus. Tokyo, 13(4): 581-584.

Aoki J.-I. 1973 — Oribatid mites from Iriomote-jima, the southernmost island of Japan (I) — Mem. Nat. Sci. Mus. Tokyo, 32(3): 105-124.

Aoki J.-I. 2000 — Two new species of the family Zetomotrichidae (Acari: Oribatida) from Japan — Species Diversity, 5: 351-359.

Aoki J.-I., Hirauchi Y. 2000 — Two new species of the family Zetomotrichidae (Acari: Oribatida) from Japan — Species Diversity, 5: 351-359.

Aoki J.-I., Nakatamari S. 1974 — Oribatid mites from Iriomote-jima, the southernmost island of Japan (II) — Mem. Natn. Sci. Mus., Tokyo, (7): 129-134.

Arai Y., Ooshiro I., in Moromi S. 1981 — In: Moromi, S. (Ed.). History of Iheya Village — Iheya Village Office. pp.538. (not seen)

Balogh J. 1972 — The oribatid genera of the world — Akadémiai Kiadó, Budapest. pp. 188, plates 71.

Balogh J., Mahunka S. 1983 — Primitive oribatids of the Palaeartic region — Elsevier Science Publishers B. V., Amsterdam, The Netherlands and Akadémiai Kiadó, The Publishing House of the Hungarian Academy of Sciences, Budapest, Hungary. pp. 372.

Bayartogtokh B., Aoki J.-I. 2000 — A new and some little known species of Eporibatula (Acari: Oribatida: Oribatulidae), with remarks on taxonomy of the genus — Zool. Sci., 17: 991-1012.

Berlese A. 1883 — Acari, Myriapoda et Scorpiones hucusque in Italia reperta — Padova. Ordo Cryptostigmat. fasc., 9(3).

Berlese A. 1903(1904) — — Spicilegia Zoologica. Acari Nuovi — Redia, 1: 235-252.

Berlese A. 1908 — Elenco di generi e specie nuove di Acari — Redia, 5: 1-15.

Berlese A. 1913 — — Acari nuovi. Maniologi VII-VIII — Redia, 9: 77-111, pls.1-8.

Berlese A. 1916[1917] — Centuria terza di Acari nuovi — Redia, 12: 289-338.

Bernini, F. 1973 — Notulale Oribatologicae VII. Gli Oribatei (Acarida) dell’isolotto di Basiluzzo (Isole Eolie) — Lav. Soc. It. Biogeogr. N. S., III: 355-480, Tav. I-XVII.

Coetzer A. 1967-1968 — New Oribatulidae Thor, 1929 (Oribatida, Oribatulidae) from South Africa, new combinations and a key to the genera of the family — Mems. Inst. Invest. cent. Moçamb., 9, Série A: 15-126.

Coetzee L. 1993 — New genera and species of the family Zetomotrichidae Grandjean, 1954 (Acari, Oribatida, Oripodoidea) from South Africa — Navors. nas. Mus., Bloemfontein, 9(5):133-178.

Fujikawa T. 1981 — Oribatid fauna from nature farm in Nayoro (3) — Edaphologia, (24): 19-24.

Fujikawa T. 1983 — Oribatid fauna from nature farm in Nayoro (7) — Edaphologia, (29): 1-5.

Fujikawa T. 1988 — Two species belonging to the genus Tectocepheus from nature farm at Nayoro in Northern Japan (Acari; Oribatiae) — Acarologia, 29(2):205-213.

Fujikawa T. 1999 — Individual variations of two reared oribatid species, Tectocepheus velatus (Michael,1880) and Oppiella nova (Oudemans, 1902) — Edaphologia, (62):11-46.

Fujikawa T. 1995 — Comparison among populations of Tectocepheus velatus (Michael,1880) from forests, grasslands and crop field — Edaphologia, (55): 1-82.

Fujikawa T. 2001 — A new and three known species of Tectocepheidae and Nodocepeheidae from northeastern part of Nippon including the Shirakami-sanchi World Heritage Area (Acari: Oribatida) — Edaphologia, (67): 23-30.

Fujikawa T. 2005 — A new species of Phenopelopidae (Acari, Oribatida) from south Japan — Edaphologia, (85):1-6.

Fujita M. 1989 — Taxonomic study on oribatid mites from crop lands of Japan (II) — Edaphologia, (41): 17-24.
Fujita, M., Fujiyama, S. 2001 — How can the minor species, *Tectocepheus minor* (Oribatida), dominate *T. velatus* in a no-tillage crop field? — Pedobiologia, 45: 36-45.

Grandjean F. 1936 — Les Oribates de Jean Frédéric Hermann et de son père (Arachn. Acar) — Ann. Soc. ent. France, 105: 27-110.

Grandjean F. 1952 — Au sujet de l’ectosquelette du podosoma chez les Oribates supérieurs et de sa terminologie — Bull. Soc. zool. France, 77: 13-36.

Grobler L., Kok D. J. 1993 — Species of the genus *Zygoreribatula* from South Africa II-new and existing species — Navor. nas. Mus., Bloemfontein, 9(6): 181-212.

Hammen L. van der 1989 — An introduction to comparative Arachnology — SPB Academic Publishing bv, pp.576.

Hammer M. 1958 — Investigations on the oribatid fauna of the Andes Mountains. The Argentine and Bolivia — Biol. Skr. Dan. Vid. Selsk., 10(1): 1-129, pls.I-XXXIV.

Hammer M. 1961 — Investigations on the oribatid fauna of the Andes Mountains II. Peru — Biol. Skr. Dan. Vid. Selsk., 13(1): 1-157, pls. I-XLIII.

Hammer M. 1967 — Investigations on the oribatid fauna of New Zealand Part II — Biol. Skr. Dan. Vid. Selsk., 15(4): 1-64, pls. I-XL.

Hammer M. 1973 — Oribatids from Tongatapu and Eua, the Tonga Islands, and from Upolu, Western Samoa — Dan. Vid. Selsk. Biol. Skr., 20(3): 1-70, pls. 1-29.

Hermann J.-F. 1804 — Mémoire Aptérologique — Strasbourg, de L’imprimerie de F. G. Levrault. an XII. pp. 1-144.

Karpipinen E., Koponen M. 1973 — The subfossil oribatid fauna of Sipolonsuo, a bog in southern Finland — Ann. Ent. Fenn., 39(1): 29-39.

Knülle W. 1954 — Die Arten der Gattung *Tectocepheus* Berlesee, 1916 (Acari, Oribatida, Oribatulidae) — Zool. Anz., 20(3): 1-70.

Laumann M., Norton R. A., Weigmann G., Scheu S., Maraun M., Heethoff M. 2007 — Speciation in the parthenogenetic oribatid mite genus *Tectocepheus* (Acari, Oribatida) as indicated by molecular phylogeny — Pedobiologia, 51: 111-122.

Mahunka S. 1978 — Neue und interessante Milben aus dem Genfer Museum XXXIV. A compendium of the oribatid (Acari) fauna of Mauritius, Reunion and the Seychelles Is. II. — Revue Suisse Zool., 85(2): 307-340.

Mahunka S. 1988 — New and interesting mites from the Geneva Museum LXXI. Oribatids from Sabah (East Malaysia) III (Acari: Oribatida) — Revue Suisse Zool., 95(3): 817-888.

Mahunka S. 1993 — *Hungaromotrichus baloghi* gen. et sp. n. (Acari: Oribatida), and some suggestions to the faunogenesis of the Carpathian Basin — Folia Entomol. Hung., 54: 75-83.

Mahunka S., Mahunka-Papp L. 1995 — The oribatid species described by Berlese (Acari) — Hungarian Natural History Museum, Budapest, pp. 1-325.

Michael A. D. 1880 — A further contribution to the knowledge of British Oribatidae. (Part II.) Journ. R. Micr. Soc., 3: 177-201, pls. 5 & 6.

Michael A. D. 1890 — On a collection of Acarina formed in Algeria — Proc. Zool. Soc. London, 37(6): 414-425.

Norton R. A., Behan-Pelletier V. M. 2009 — Suborder Oribatida. In: Krantz G. W., Walter D. E. (Eds.) (2009): A manual of Acarology.-3rd edition Texas Tech University Press: 430-564.

Nübel-Reidelbach E. 1994 — Taxonomie und Systematik der Gattung *Tectocepheus* Berlesee, 1895 (Acari, Oribatei) — andria, Staatliches Museum für Naturkunde Karlsruhe, 12: 3-94.

Oudemans A. C. 1902 — New list of dutch Acari — Tidschr. Ent., 45, Verslagen: 50-64.

Pérez-Iñigo C. 1992 — *Transoribates* gen. n. (Acari, Oribatei, Protoribatidae) — EOS, 68(1): 89-90.

Sellnick M. 1925 — Javanische Oribatiden (Acar.) — Treubia, 6(3-4): 459-475.

Sellnick M. 1928 — Formenkreis: Hormilben, Oribátei — Die Tierwelt Mitteleuropas, 3: 1-42.

Sellnick M. 1929 — Die Oribatiden (Hormilben) des Zehlaubruches — Phys.-Ökon. Ges. Königsberg, (66): 324-351.

Sellnick M. 1959 — Acarina from Southeastern Polynesia-II (Oribatidae) — Occ. Pap. Bernice P. Bishop Mus. Honolulu, Hawaii, 22(9): 109-152.

Subías L. S 2004 — Listado Sistemático, sinonímico y Biogeográfico de los Ácaros Oribatídios (Acariformes, Oribatida) del Mundo (1758-2002) — Graellsia, 60 (número extraordinario): 3-305.

Trägårdh I. 1910 — Acariden aus dem Sarekgbirge — Naturviss, Unters, Sarekgbirges Schwedisch-Lappland, 4 Zoologie: 488-550.

Travé J. 1961 — Contribution a l’étude des Oribatulidae (Oribates, Acariens) — Vie et Milieu, 12: 313-351.

Weigmann G. 2002 — Morphological variability between and within populations of *Tectocepheus* (Acari, Oribatida, Tectocepheidae) from the velatus-complex in central Europe — In: Bernini F., Nannelli R., Nuzzaci G., Lillo E. de (eds.): Acarid phylogeny and evolution. Adaptations in mites and ticks : 141-152 — Kluwer Academic Publishers, Printed in the Netherlands.
Weigmann G. 2006 — Acari, Actinochaetidae Hornmilben (Oribatida) — Die Tierwelt Deutschlands Begründet 1925 von Friedrich Dahl 76. Teil Goecke & Evers, Keltern, pp. 520.

Willmann, C. 1939 — Die Moorfauna des Glatzer Schneeberges 3. Die Milben der Schneebergmoore — Beitr. z. Biologied. Glatzer Schneeberges, 5: 427-458.

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