

# MICROZETIDAE (ACARI: ORIBATIDA) FROM THE GALÁPAGOS ISLANDS

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ACARI  
ORIBATIDA  
MICROZETIDAE  
GALAPAGOS ISLANDS

**SUMMARY:** Five species of Microzetidae were found in the Galápagos Islands (Ecuador). Three new species of the genus *Acaroceras* (*A. galapagoensis* sp. n., *A. interiunctus* sp. n. and *A. taurus* sp. n.) are described and illustrated. A diagnosis and figure of *Kalyptrazetes* sp. is given. Notes on the distribution and ecological preferences of these species as well as of *Berlesezetes auxiliaris* (Grandjean, 1936) are included.

ACARI  
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**RESUMEN:** Cinco especies de la familia Microzetidae fueron encontradas en las Islas Galápagos (Ecuador). Se describen e ilustran tres nuevas especies del género *Acaroceras* (*A. galapagoensis* sp. n., *A. interiunctus* sp. n. y *A. taurus* sp. n.). Se da una diagnosis e ilustración de *Kalyptrazetes* sp. Se incluye información sobre distribución y preferencias ecológicas de estas especies y además de *Berlesezetes auxiliaris* (Grandjean, 1936).

ACARI  
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ILES GALAPAGOS

**RÉSUMÉ:** Cinq espèces de Microzetidae ont été trouvées aux Îles Galápagos (Équateur) dont trois nouvelles espèces du genre *Acaroceras* (*A. galapagoensis* sp. n., *A. interiunctus* sp. n. et *A. taurus* sp. n.) qui sont décrites et illustrées. Une diagnose et illustration du *Kalyptrazetes* sp. est aussi présentée. Des informations sur la répartition et les préférences écologiques de ces espèces sont fournies ainsi que sur *Berlesezetes auxiliaris* (Grandjean, 1936).

## INTRODUCTION

Microzetidae from the Neotropical region have been studied intensively by BALOGH (1962a, 1962b), GRANDJEAN (1936a, 1936b) and MAHUNKA & PALACIOS-VARGAS (1996). BALOGH & BALOGH (1988) have listed 69 species and 30 genera of Microzetidae which are recorded from Central and South America. MAHUNKA & PALACIOS-VARGAS (1996) give identification keys for the known species of the genera *Acaroceras*, *Kalyptrazetes* and *Protozetes*. Although spe-

cies of this family are found in most parts of the world, the majority of the genera seem to be restricted to the Neotropical region. No Microzetidae have been recorded from the Galápagos Islands yet. During four extended expeditions to the Galápagos Islands carried out by the senior author between 1982 and 1988 (SCHATZ, 1994, 1988; SCHATZ & SCHATZ, 1988, 1989) numerous samples of soil and organic litter were taken on all larger and most smaller islands of the archipelago, as well as in different vegetation zones.

The present material includes representatives of five species of the family Microzetidae, belonging to

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the genera *Acaroceras* (three species), *Berlesezetes*, and *Kalyptrazetes* (one species each). Only *Acaroceras galapagoensis* sp. n. and *Berlesezetes auxiliaris* (Grandjean, 1936) were found in considerable numbers on different islands of the Galápagos archipelago, the other species were recorded with a single specimen each. The adult instars are treated in this paper; juvenile instars were also collected, but will be discussed elsewhere.

The family Microzetidae was erected by GRANDJEAN (1936a). The combination of characters in this family (prodorsum mostly with large and complicated lamellae and membrane, pteromorpha present in adult instars, notogaster without areae porosae, upper process of chelicerae with a horny excrescence) makes a placement within the Oribatida difficult. GRANDJEAN (1953) joined the Microzetidae to the Circumdehiscentiae-Euphéredermes, BALOGH (1965) proposed a superfamily Microzetoidea within the Brachypylina. Due to the pattern of characters, this family might belong to a very basic evolutionary level of the pterogasterine organization *modus sensu* WOAS (1990).

A detailed description of the environmental setting of the Galápagos Islands was given recently by PORTER (1984) and SCHATZ (1998).

*Acaroceras galapagoensis* sp. n.

(Figs. 1–3)

**Diagnosis.** *A. galapagoensis* sp. n. differs from its congeners in the adult instar by the following combination of characters: simple interlamellar apophysis; moderately long and ciliate notogastral setae; each pteromorpha with one to three small denticulations distally; ciliate epimeral setae; two pores on the ventral side between genital and anal plates; known distribution restricted to the Galápagos Islands. The new species is similar to *A. feideri* Calugar and Vasiliu, 1977, but it differs from that species in larger ratio of body length to width; missing inner tooth on the anterior lamellar edge; generally shorter ventral setae; weaker denticulation of pteromorphae; and in the presence of two pores on the ventral side.

**ADULT. Dimensions and colour.** Size of adults ( $n=30$ ): 269 (235–320)  $\times$  172 (145–205)  $\mu\text{m}$ . Ratio body length to width: 1.56 (1.44–1.64). Colour light brown. Cerotegument finely granulated, body surface smooth dorsally, ventral plate with alveolate ornamentation.

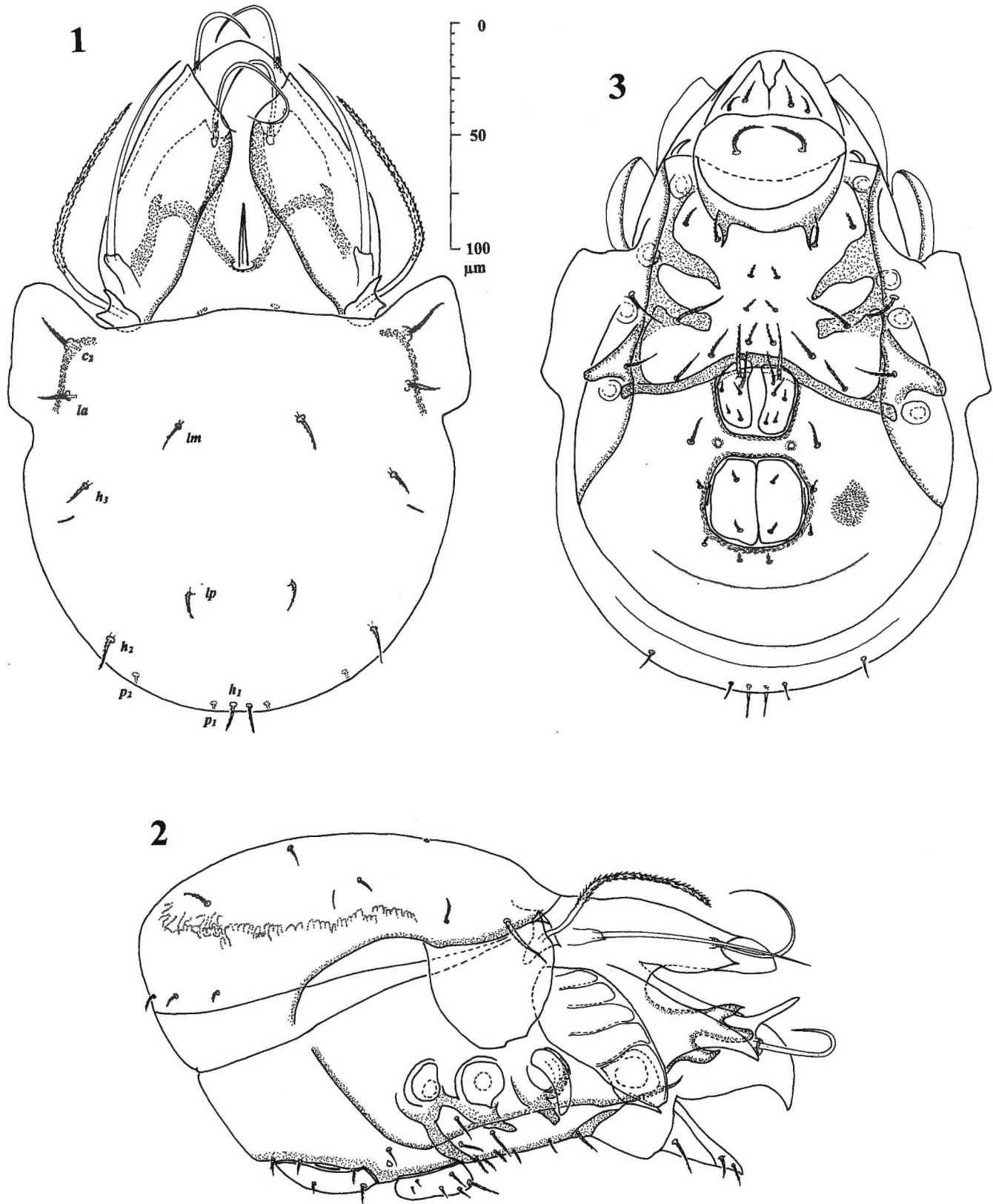
**Prodorsum** (Fig. 1). Length of prodorsum 140  $\mu\text{m}$ . Rostrum elongated, anteriorly rounded. Lamellae well developed and widened in their middle portion, with a small cuspidal tooth on the lateral corner. Interlamellar area lyriform with thickened edges. Interlamellar apophysis simple and pointed distally, length about  $\frac{1}{4}$  of lamella. Middle part of the prodorsum with a thickened transverse ridge forming a translamella; medially weaker developed and curved posteriad passing the base of the interlamellar apophysis. Rostral setae thin and smooth, curved. Lamellar setae originating on ventral surface of lamellae behind their border, long, smooth, curved distally with a flagelliform apex. Interlamellar setae arising on laterodorsal surface of lamellae, thick with slightly granulated surface, long, reaching the cuspis of each lamella, length 90  $\mu\text{m}$ . Sensillus proclinate and inclinate, setiform with small ciliae, length 115  $\mu\text{m}$ .

**Lateral region** (Fig. 2). Rostrum dorsally with an anteroad directed spine on each side. Tutorium long, pointed distally. A three-lobed structure present under tutorium; superior lobe acute, bent over dorsal ridge of rostrum. Pedotectum I large, forming a wide scale with horizontal ridges. Pedotectum II a small scale. Circumpedial lines distinct.

**Notogaster** (Fig. 1). Shape about as wide as long. Nine pairs of notogastral setae<sup>3</sup> present, all ciliate and most of them similar in length (12–25  $\mu\text{m}$ ), setae  $p_1$  and  $p_2$  shortest (5–10  $\mu\text{m}$ ), setae  $c_2$  and  $la$  longest (20–22  $\mu\text{m}$ ). Pteromorphae well developed, large; edges with one to three small denticulations on distal part (holotype with one, other specimens with more denticulations).

**Ventral region** (Fig. 3). Subcapitular setae  $a$ ,  $m$  and  $h$  ciliate, setae  $h$  longer than others; all ciliate. Apodemes II and sejugal apodemes medially incomplete. Apodeme III complete, well developed. Epimeral

3. Notogastral setal nomenclature based on BALOGH & BALOGH (1988).



FIGS. 1-3: *Acaroceras galapagoensis* sp. n., adult. 1. — Dorsal view. 2. — Lateral view. 3. — Ventral view.

setal formula: 3-1-3-3, all setae ciliate, epimeral setae *1a* and *2a* shorter than others. Six pairs of genital setae present, first pair (*g*<sub>6</sub>) longest (27 µm), slightly thickened and ciliate, inner anterior setae (*g*<sub>4</sub> and *g*<sub>5</sub>) also ciliate and somewhat longer (10–14 µm) than the remaining setae, which are short and smooth. One pair of aggenital setae present, long (16 µm) and ciliate. Distance between the anal and genital plate short. Two small porous fields present between genital and anal plates, mediad of aggenital setae. Anal region with 2 pairs of anal and 3 pairs of adanal setae, all of medium length (5–8 µm) and ciliate. Adanal lyrifissures *iad* in adanal position.

*Legs.* All legs monodactyl. Leg setal and solenidial formula as in type species (GRANDJEAN, 1936a). Setae unilaterally ciliate.

*Eggs.* Some females bearing 1–2 eggs each. Dimensions of eggs (*n*=5) 95–130 × 80–100 µm, surface of eggs pustulate.

IMMATURES: Unknown.

REMARKS. The presence of the small porous fields between genital and anal plates in *A. galapagoensis* sp. n. is unique in the genus *Acaroceras*. Within the Microzetidae this character is hitherto only known from *Protozetes digitifer* Mahunka, 1985. *Acaroceras porosus* Balogh and Mahunka, 1977 has large bean-shaped porous regions lateral of the anal plates<sup>4</sup>. Apart from this character, *Acaroceras galapagoensis* sp. n. is similar to *A. feideri* Calugar and Vasiliu, 1977. Common characters separating these two species from other *Acaroceras* species are the general shape of lamellae, length and direction of prodorsal setae and sensillus, the simple interlamellar apophysis, and the length ratio of the notogastral setae. *A. feideri* has two teeth on the anterior edge of each lamella, *A. galapagoensis* has only one small cuspidal tooth laterally. Also, the ratio of body length to width is larger in *A. galapagoensis* (1.56) than in *A. feideri* (1.16). *Acaroceras feideri* was found in several caves in Cuba, living in guano (CALUGAR & VASILIU, 1977).

The new species is widely distributed in Galápagos and lives in different habitats (see below). The body sizes of the studied populations of *Acaroceras gala-*

*pagoensis* from different islands in Galápagos are in the same range.

RECORDS FROM THE GALÁPAGOS ISLANDS (Fig. 4). Isla Fernandina, moist zone (62 specimens/6 samples): western part of the island, near “green crater”, 450 m a.s.l., in decayed leaf litter under *Zanthoxylum fagara* and *Psychotria rufipes*, in grass litter under *Cyperus andersonii*, in decayed fern litter under *Pteridium aquilinum*; open forest, 770 m, in decayed leaf litter under *Pityrogramma calomelos*.

Isla Floreana, littoral zone (1/1): peninsula south of Black Beach, in crevice; in leaf litter under *Cryptocarpus pyriformis*. Arid zone (14/2): above Black Beach, around Dr RITTER’s grave, 160–200 m, in decayed leaf litter with pieces of wood and humus under *Pisonia floribunda* and *Castela galapageia*. Agricultural area (37/4): highland north of Cerro Pajas, 320 m, in rotting wood and humus under dead *Psidium guajava*; trail to finca, 320 m, in decayed leaf litter and pieces of wood under *Kalanchoë pinnata* and *Croton scouleri*; near spring at Asilo de la Paz and near buccaneer caves, 340 m, in well-decayed leaf litter under *Datura stramonium* and *Lantana camara*. Moist highland (1/1): northeastern base of Cerro Pajas, 360 m, in well-decayed leaf litter under *Acacia* sp. and *Croton scouleri*.

Isla Gardner near Española, littoral zone (3/2): northern coast, 5 m, in partially-decayed leaf litter under *Sesuvium portulacastrum*.

Isla Isabela, V. Wolf, upper arid (*Psychotria*) zone (5/1): western side, *Psidium galapageium* forest with *Zanthoxylum fagara*, *Tournefortia* sp., *Cordia lutea*, *Macraea laricifolia*, 1000 m, in decayed leaf litter and humus (leg. L. BAERT, K. DESENDER, J. P. MAELFAIT). V. Alcedo, moist zone (53/15): northeastern slope, open woodland of *Scalesia microcephala*, *Trema micrantha* and *Pisonia floribunda*, 780–850 m, in grass and leaf litter under *Tournefortia rufo-sericea*; along eastern crater rim, 1030 m, in decayed fern litter under *Pteridium aquilinum* and *Ipomoea* sp.; along southern crater rim, under *Cyathea weatherbyana*, 1100 m, in moss from rocks and humus; inside small crater near fumarole, 900 m, in fern litter, in moss and roots; elfin forest inside the main crater, near sulphu

4. The drawings of *A. porosus* and *A. hamifer* are apparently exchanged in the original description. See remark under the description of *Acaroceras interiunctus* sp. n.

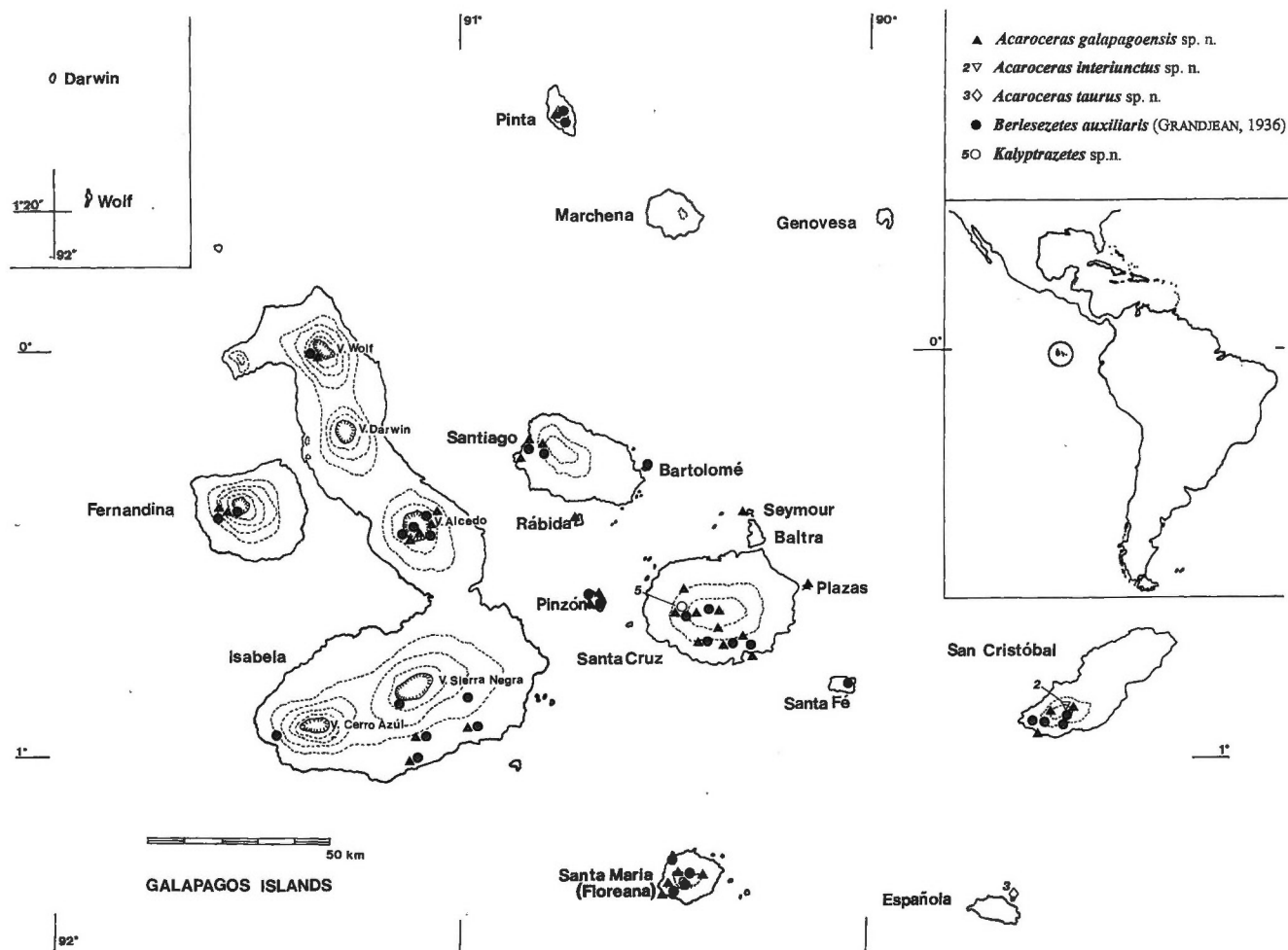


FIG. 4: Records of Microzetidae species from the Galápagos Islands.

rous fumaroles, dense *Croton* forest with *Tournefortia rufo-sericea*, *Zanthoxylum fagara*, *Scalesia microcephala*, 760 m, in decayed leaf litter (soil temperature 35° C); inside small crater near fumarole, dense forest of *Psychotria rufipes* and *Scalesia microcephala*, 900 m, in partially-decayed leaf litter and humus. V. Sierra Negra, arid zone (12/4): near Quinta Playa, open forest of *Scalesia cordata* and *Pisonia floribunda*, 20–30 m, in partially-decayed leaf litter and pieces of wood; north of Puerto Villamil, 10 m, in decaying wood under *Prosopis juliflora*. Transition zone (16/2): north of Quinta Playa, dense forest with *Scalesia cordata*, *Tournefortia pubescens*, *Sapindus saponaria*, 200–230 m, in litter and humus on a dead trunk with *Peperomia* sp.

Isla Pinta, moist zone (12/3): eastern slope of the main crater, dense forest of *Zanthoxylum fagara* and *Pisonia floribunda*, 530 m, in deeper soil layers, among roots; at summit near the main crater, 590–600 m, in decayed fern litter with roots and humus under uppermost layer, under *Pteridium aquilinum* (soil temperature >40° C due to volcanic activity).

Isla Pinzón, lower arid zone (24/3): eastern part, near isote, 30 m, in decaying wood and leaf litter under *Prosopis juliflora*; eastern part, 100–140 m, in leaf litter under *Croton scouleri*, and *Cordia lutea*; in litter under *Sesuvium portulacastrum*. Upper arid zone (226/12): Central valley, several sites, 270–290 m, in decayed cactus litter under *Opuntia echios*



var. *macrocarpa*; in grass litter; in decayed leaf litter and pieces of wood under *Acacia macracantha*, *Croton scouleri*, *Scalesia incisa*, *Alternanthera filifolia*, *A. echinocephala*, *Prosopis juliflora*, *Tournefortia pubescens*. Moist zone (59/11): southern crater rim of main caldera, 290–310 m, in decayed leaf litter with pieces of wood and humus under *Scalesia incisa*, *Croton scouleri*, *Lantana peduncularis*, *Zanthoxylum fagara*; above crater, 370 m, in decayed leaf litter under *Sesuvium portulacastrum*; summit, 460 m, in partially-decayed fern litter and humus; in moss on *Zanthoxylum fagara*; southern slope of the island near big rocks, 340 m, in decayed leaf litter and well-developed humus under *Cordia leucophlyctis*, *Croton scouleri*, *Alternanthera echinocephala*; fern litter under *Pteridium aquilinum* and *Peperomia petiolata*.

Isla Plaza Sur, arid zone (2/2): near landing area, 5 m, in decayed leaf litter with cactus litter and humus under dead *Opuntia echios* var. *echios* and *Maytenus octogona*.

Isla Rábida, arid zone (4/1): above lagoon in small valley, *Bursera graveolens* forest with *Cordia lutea* and *Croton scouleri*, 40 m, in partially-decayed grass litter.

Isla San Cristobal, arid zone (5/2): south of Wreck Bay, 20 m, in decayed leaf litter and humus under *Parkinsonia aculeata*. Moist zone (8/4): around lake El Junco, 640 m, in decayed leaf litter, moss, roots and humus under *Miconia robinsoniana*; San Joaquín, 700 m, in well-decayed leaf litter and roots under *Cyathea weatherbyana*.

Isla Santa Cruz, littoral zone (7/2): Puerto Ayora, near Charles Darwin Research Station, in leaf litter under *Maytenus octogona*; in mangrove leaves under *Conocarpus erecta* and *Avicennia germinans*. Arid zone (39/8): north of Research Station, at barranco, 30 m a.s.l., in leaf litter and humus under *Tournefortia pubescens*, *Acacia rorudiana*, *Scutia pauciflora*; between Puerto Ayora and Bellavista, 65–80 m, in decayed leaf litter and humus under *Tournefortia pubescens*, *Croton scouleri*, *Piscidia carthagenensis*, *Pisonia floribunda*, in well-decayed cactus litter under *Opuntia echios* var. *gigantea*; northern part of the island, 250 m, in deeper litter and humus under rocks under *Pisonia floribunda*. Transition zone (7/4): around Caseta, 180 m, in grass and leaf litter under *Psidium galapageium*; northern part of the island near Los Gemelos, 520 m, in decaying wood and

humus under *Pisonia floribunda* and *Alternanthera filifolia*. Agricultural area (12/3): near Cerro Chato, 200 m, in decayed grass litter of *Pennisetum purpureum*; in leaf litter under *Zanthoxylum fagara*; near Santa Rosa, 350 m, in grass litter in pasture. Moist zones: *Scalesia* zone (93/16): in *Scalesia pedunculata* forest around Los Gemelos, 590–610 m, in decayed leaf, fern, and grass litter; *Scalesia* forest near Cerro Crocker, 700 m, in leaf litter, partially with moss and roots. *Miconia* zone (14/5): near Media Luna, 570 m, in moist leaf and fern litter, partially with moss under *Miconia robinsoniana* and *Pteridium aquilinum*. Fern-sedge zone (85/9): small valley west of Cerro Crocker, 830 m, in moist patches of *Sphagnum*; Puntudo, 760 m, in decayed fern litter under *Pteridium aquilinum*; in leaf litter under *Cinchona succirubra* and *Furcraea cubensis*; around summit, 860 m, in decayed leaf and fern litter under *Cyathea weatherbyana* with *Peperomia galapagensis*.

Isla Santiago, littoral zone (29/2): around lagoon of Playa Espumilla, 5 m, in partially-decayed mangrove leaf litter under *Conocarpus erecta*. Lower arid zone (1/1): at spring below Pan de Azucar, 40 m, in decayed leaf litter under *Clerodendron molle* and *Heliotropium angiospermium*. Upper arid zone (3/1): western side, trail between Playa Espumilla and Los Aguacates, 300 m, in leaf litter under *Bursera graveolens* and *Acacia occidentalis* (leg. S. ABEDRABBO-RANDL).

Isla Seymour Norte, littoral zone (1/1): southeast corner of the island, near beach, in leaf litter under *Cryptocarpus pyriformis*.

*Acaroceras galapagoensis* sp. n. was represented by 835 specimens on 12 islands of the archipelago. It occurs in all vegetation zones, from the littoral zone (in mangrove leaf litter) up to the top of the volcanoes. Most specimens were collected in moister habitats, mainly in fern and leaf litter of shrubs and elfin forests. The species occurs also in the arid zone with numerous records in cactus litter and dry grass litter. It seems to prefer decaying wood and deeper humus layers. On the other hand, *Acaroceras galapagoensis* is rare in epiphytic samples on bushes, trees or in lichens.

The alcohol-preserved holotype (sample GAL 85-182: Ecuador, Galápagos Islands, 27.2.1985; Santa Cruz island, near Cerro Chato, Agricultural

area; 200 m a.s.l., in decayed grass litter of *Pennisetum purpureum*) and paratypes from the same habitat will be deposited in: Natural History Museum, Vienna, Austria. Paratypes in: senior author's collection, Innsbruck, Austria; Laboratório de Ecología y Sistemática de Microartrópodos, UNAM, México; Universidad Católica, Quito, Ecuador.

*Acaroceras interiunctus* sp. n.

(Figs. 5–7)

**Diagnosis.** *A. interiunctus* sp. n. differs from its congeners by the following combination of characters: medial edges of lamellae with interlocking teeth; bifurcate interlamellar apophysis with short distal appendages; pteromorphae with four serrations distally; notogastral setae differing extremely in length; known distribution restricted to the Galápagos Islands. The new species differs from the similar species *A. porosus* Balogh and Mahunka, 1977 in having a membranous scale covering the rostrum dorsally, the shape of the medial lamellar edges, length of distal appendages of the interlamellar apophysis, length of notogastral setae, shape of pteromorphae, and absence of the porous regions beside the anal plates.

**ADULT.** *Dimensions and colour.* Dimensions:  $282 \times 210 \mu\text{m}$ . Colour light brown. Surface finely punctated.

**Prodorsum** (Fig. 5). Length  $120 \mu\text{m}$ . Rostrum with a pointed apex medially, with a long appendage, curved mediad on each side, originating laterally of rostral setae (best seen in ventral view). Rostrum covered dorsally with a projecting membranous scale. Lamellae well developed and wide, on each lateral corner a sharp tooth, on the median corners interlocking small teeth. Interlamellar area U-shaped with converging sides. Interlamellar apophysis distally bifurcate, length about  $\frac{1}{3}$  of lamella, consisting of two parallel ridges, appendages short. A thickened chitinous ridge crosses the prodorsum transversally with an anteriad-directed tooth on each side, forming a slightly curved translamella passing the base of the interlamellar apophysis. Rostral setae thin and smooth, curved, with air-filled bases. Lamellar setae originating on

ventral surface of lamellae, long, smooth, curved distally, also with air-filled bases. Interlamellar setae arising on lateroventral surface of lamellae (origin of interlamellar setae covered by lamella in dorsal view), distally reaching beyond rostrum, length  $125 \mu\text{m}$ , smooth. Sensillus proclinate, thickened, setiform and densely ciliate on dorsal side, length  $100 \mu\text{m}$ .

**Lateral region** (Fig. 6). Rostrum dorsally with a longer, acute and slightly posteriad curved spine on each side. Tutorium well developed, long and acute distally. Pedotectum I large, forming a wide scale with horizontal ridges. Pedotectum II a small scale. Circumpedial lines distinct.

**Notogaster** (Fig. 5). Wider than long, semicircular, with porose fields in posterior part. Nine pairs of notogastral setae present, of different shape and length. Setae  $c_2$ ,  $la$  and  $h_2$  longest (length  $25\text{--}30 \mu\text{m}$ ) and thick, bases filled with air, other notogastral setae extremely short ( $3\text{--}7 \mu\text{m}$ ). Pteromorphae well developed, distally with 4 denticulations of different length.

**Ventral region** (Fig. 7). Subcapitular setae  $a$ ,  $m$  and  $h$  ciliate, setae  $h$  longer than others. Apodeme II and sejugal apodeme medially incomplete. Apodeme III complete, well developed and thickened in front of genital plates. Epimeral setal formula: 3-1-3-3, all setae ciliate, moderately long ( $12\text{--}16 \mu\text{m}$ ), setae  $3b$  and  $3c$  longer ( $20 \mu\text{m}$ ). Six pairs of genital setae present, first pair ( $g_6$ ) longest ( $20 \mu\text{m}$ ) and ciliate, others very short and smooth. One pair of short (length  $5 \mu\text{m}$ ) and smooth aggenital setae present. Distance between the anal and genital plate short. Anal region with 2 pairs of anal and 3 pairs of adanal setae, all short (length  $5\text{--}7 \mu\text{m}$ ) and smooth. Adanal lyrifissures *iad* in adanal position.

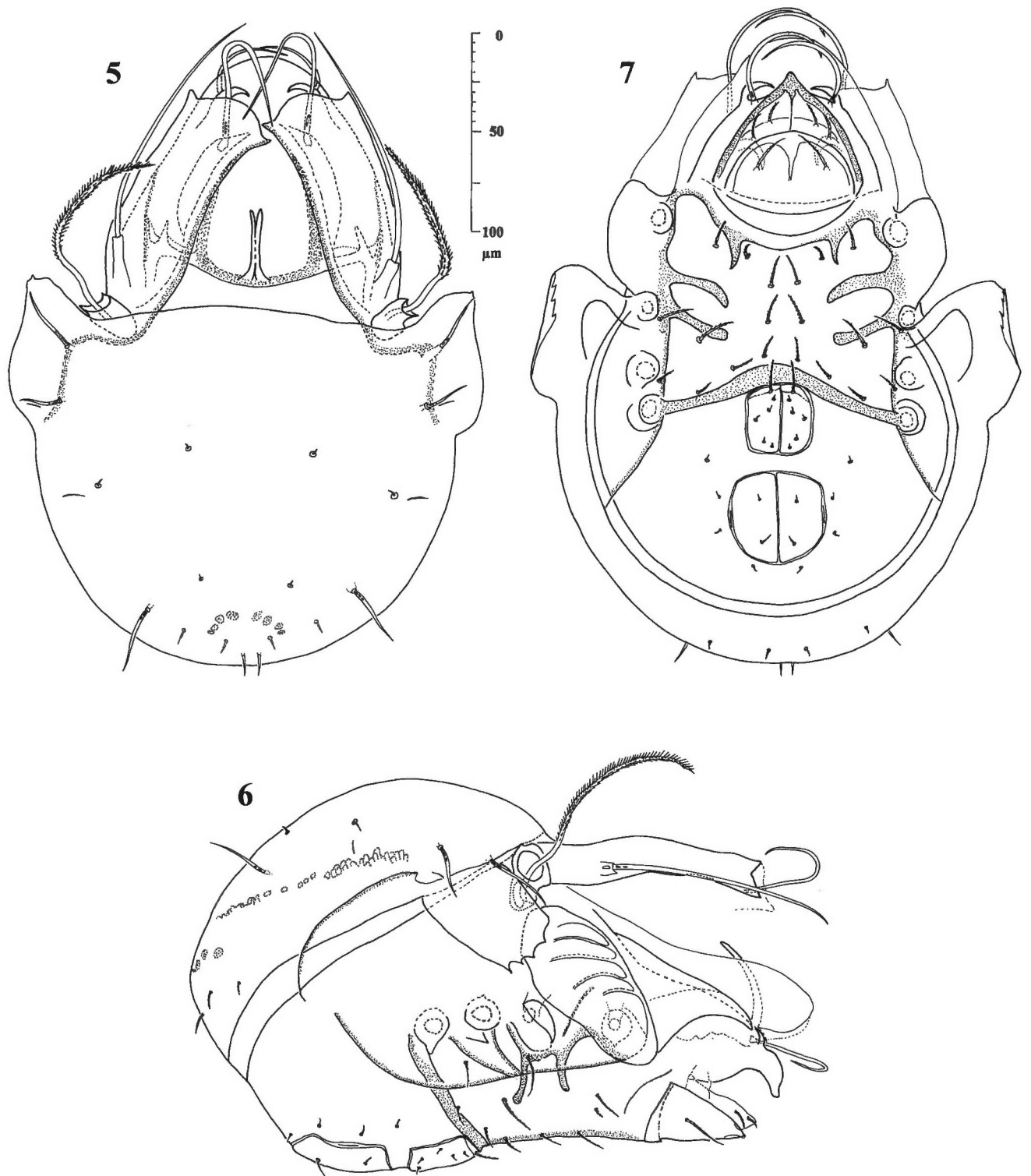
**Legs.** Tarsi partially broken off, remaining tarsi monodactyle. Setae on legs ciliate, position not studied in detail.

**Egg.** Specimen bearing one egg (dimensions  $135 \times 95 \mu\text{m}$ ).

**IMMATURES:** Unknown.

**ETYMOLOGY.** The species name "*interiunctus*" refers to the interlocking teeth of the lamellae.

**REMARKS.** Only one specimen was available for description. The new species is distinguished from all congeners by the interlocking lamellar teeth. In *A.*



FIGS. 5-7: *Acaroceras interiunctus* sp. n., adult. 5. — Dorsal view. 6. — Lateral view. 7. — Ventral view.



*dechambrieri* Mahunka, 1983 a comparable structure is formed by thin medial membranes of the lamellae. The new species resembles to *A. porosus* Balogh and Mahunka, 1977 in having a small rostral apex and lateral appendages, a bifurcate interlamellar apophysis, and long interlamellar setae. *A. porosus* is described from Bolivia. The extreme differences in length of notogastral setae as in the present species are only known in *Acaroceras taurus* sp. n., although different lengths of notogastral and ventral setae can be found in several species among the genus *Acaroceras*.

The drawings of *A. porosus* and *A. hamifer* are apparently exchanged by mistake in the original description (BALOGH & MAHUNKA, 1977) as well as in BALOGH & BALOGH (1988). The bifurcate interlamellar apophysis as well as the pores beside the anal plates refer clearly to the description of *A. porosus*, as do the calycoid apophysis and the rostral hooks to *A. hamifer*.

RECORD FROM THE GALÁPAGOS ISLANDS (Fig. 4). Only a single specimen has been recorded: Isla San Cristobal, north of lake El Junco, Fern-sedge zone, 630 m a.s.l., in lichens on rock. The alcohol-preserved holotype (sample GAL 87-451: Ecuador, Galápagos Islands, 1 Jan. 1987) will be deposited in: Natural History Museum, Vienna, Austria.

*Acaroceras taurus* sp. n.

(Figs. 8–10)

**Diagnosis.** *A. taurus* sp. n. differ from its congeners by the following combination of characters: trifurcate rostrum with two long horn-like apophyses laterally; short and triangular interlamellar apophysis with a pointed apex; relatively short and proclinate interlamellar setae; distally serrated pteromorphae; notogastral setae differing extremely in length; known distribution restricted to the Galápagos Islands. The new species is similar to *A. dechambrieri* Mahunka, 1983, but it differs from that species in the shape of rostrum, shape of medial edge of lamellae; shape of interlamellar apophysis; and in length of notogastral setae.

**ADULT. Dimensions and colour.** Size of holotype:  $292 \times 173 \mu\text{m}$ . Colour light brown. Cerotegument

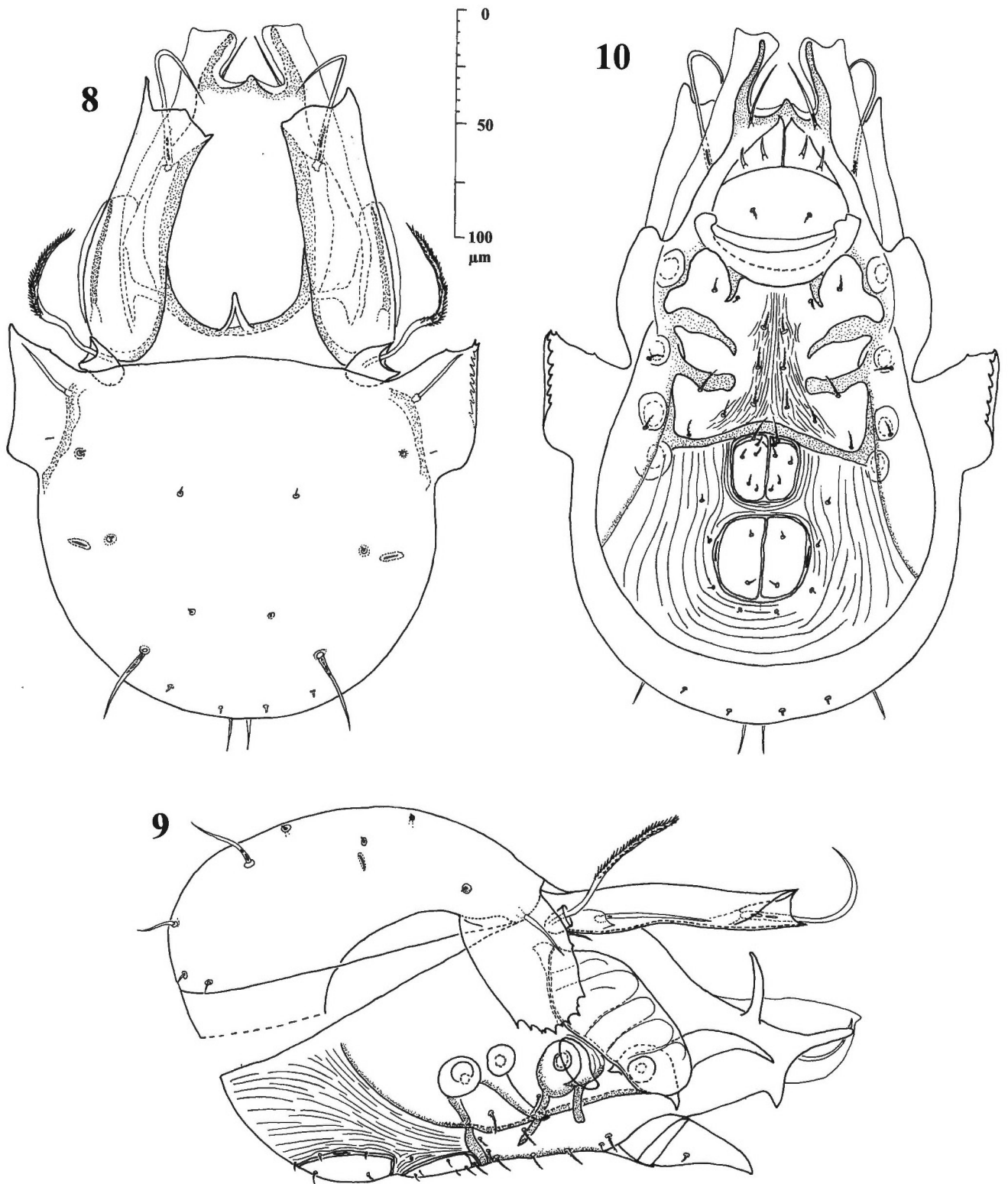
finely granulated. Notogaster smooth, coxisternal and genito-anal region finely and longitudinally lineated.

**Prodorsum** (Fig. 8). Length of prodorsum  $132 \mu\text{m}$ . Rostrum trifurcate, with a short apex medially and two long, horn-like apophyses laterally. These apophyses are covered dorsally with lamelliform membranous appendages with tooth-like lateral corners. Lamellae well developed and very long, outer and inner corners with a tooth each, lateral teeth larger and better developed than medial ones. Lamellae medially folded and bent ventrally. Interlamellar area with a lyriform structure, interlamellar apophysis short, triangular, with a pointed apex. Middle part of prodorsum with a transverse ridge with hook-like edges on each side, passing behind base of the interlamellar apophysis in a concave curve. Rostral setae relatively short (length  $25 \mu\text{m}$ ), thin and smooth, originating mediad of horn-like apophyses. Lamellar setae originating on the ventrally folded anterior lamellar border, long, smooth, curved distally. Interlamellar setae arising on the lateroventral surface of lamellae, length ( $65 \mu\text{m}$ ) about half of lamella. Rostral, lamellar and interlamellar setae with air-filled bases. Sensillus proclinate, distally inclinate, setiform and densely ciliate on dorsal side, length  $80 \mu\text{m}$ .

**Lateral region** (Fig. 9). In lateral view, three apophyses present on rostrum: anterior the horn-like rostral apophysis, dorsally a longer, acute spine curved posteriad, a shorter apophysis pointing ventrally. Tutorium long and distally acute, reaching towards rostrum. Pedotectum I large, forming a wide scale with horizontal ridges. Pedotectum II a small scale.

**Notogaster** (Fig. 8). Almost circular, length  $160 \mu\text{m}$ . Nine pairs of notogastral setae present, setae  $h_2$  longest (length  $35 \mu\text{m}$ ) and smooth, bases air-filled, setae  $c_2$  ( $30 \mu\text{m}$ ) and  $h_1$  ( $15 \mu\text{m}$ ) shorter, other notogastral setae extremely short ( $2\text{--}5 \mu\text{m}$ ). Pteromorphae well-developed, large; distally serrated with about 10 denticulations.

**Ventral region** (Fig. 10). Subcapitular setae *a* and *m* of medium length ( $10 \mu\text{m}$ ) and ciliate, setae *h* extremely short. Apodemes II and sejugal apodemes medially incomplete, apodeme III complete. Epimeral setal formula 3-1-3-3, most of medium length ( $6\text{--}10 \mu\text{m}$ ) and ciliate. Setae *1b* short, all epimeral setae pro- and inclinate. Circumpedial lines dis-



FIGS. 8-10: *Acaroceras taurus* sp. n., adult. 8. — Dorsal view. 9. — Lateral view. 10. — Ventral view.

tinct. Genital plates with 6 pairs of setae, first pair ( $g_6$ ) of medium length (8  $\mu$ m), ciliate, others shorter. One pair of very short aggenital setae present. Distance between anal and genital plate short. Anal region with 2 pairs of anal and 3 pairs of adanal setae, posterior pair of anal setae ( $an_1$ ) slightly longer and ciliate, others short. Adanal lyrifissures *iad* in adanal position.

*Legs.* All legs monodactyle. Setae on legs ciliate, leg setal formula as in type species (GRANDJEAN, 1936a).

*Eggs.* Specimen bearing two eggs. Dimensions of eggs 90  $\times$  70, 97  $\times$  60  $\mu$ m, surface pustulate.

**ETYMOLOGY.** The species name "*taurus*" refers to the shape of the rostral apophyses, resembling bull's horns.

**REMARKS.** Only one specimen was available for description. The new species is similar to *Acaroceras dechambrieri* Mahunka, 1983. Common characters separating these two species from its congeners are the trifurcate rostrum with a membranous dorsal appendage and the serration of pteromorphae. However, in *A. dechambrieri* the rostrum is more acute, and the lateral rostral apophyses are auriculate. The anterior edges of lamellae are more rounded, their inner parts are medially extended into a thin membrane. The interlamellar apophysis is trifurcate. *Acaroceras dechambrieri* was found in tropical moist forest in Tikal, Guatemala (MAHUNKA, 1983).

A trifurcate rostrum is found in several species of the genus *Acaroceras* with differently developed lateral apophyses: auriculate (*A. dechambrieri* Mahunka, 1983, *A. odontotus* Grandjean, 1936), small process (*A. becki* Balogh, 1962), or hooks bent inward (*A. hamifer* Balogh and Mahunka, 1977, *A. index* Balogh and Mahunka, 1977, *A. porosus* Balogh and Mahunka, 1977, *A. interiunctus* sp. n.). Among the congeners of the new species, only *A. feideri* Calugar and Vasiliu, 1977 has a triangular interlamellar apophysis. The extreme differences in length of notogastral setae are hitherto only known from *Acaroceras interiunctus* sp. n.

**RECORD FROM THE GALÁPAGOS ISLANDS (FIG. 4).** Only a single specimen has been recorded on the small island Gardner near Española in the southeast-

ern part of the archipelago, near the top of the island, 40 m a.s.l., arid zone, under *Bursera graveolens* and *Cordia leucophlyctis*, in moist, decayed leaf litter and humus. The alcohol-preserved holotype (sample GAL 87-771: Ecuador, Galápagos Islands, 14 March 1987) will be deposited in: Natural History Museum, Vienna, Austria.

A further distribution of this species is not yet known, but a dispersal by transportation with sea birds might be assumed, since several seabirds, such as blue footed boobies, masked boobies and frigatebirds are nesting on Isla Gardner and visit the island regularly.

#### *Berlesezetes auxiliaris* (Grandjean, 1936)

GRANDJEAN, 1936b: 138, Figs. 1–4 (*Microzetes auxiliaris*); MAHUNKA, 1980: 397; BALOGH & BALOGH, 1988: 117, pl. 84 H–J.

*Dimensions* ( $n = 20$ , from different islands): 201 (185–215)  $\times$  134 (120–142)  $\mu$ m. The adult specimens found in Galápagos correspond to the original description (GRANDJEAN, 1936b) in most respects and are considered conspecific. A minor difference consists in the number and length of the notogastral lines on notogaster. In the Galápagos population about 10–14 larger and shorter lines are present, some attenuating and reaching posteriad until setae *lp*. In the drawing given by GRANDJEAN (1936b: Fig. 1A) eight lines are present, but no number is mentioned in the description.

**RECORDS FROM THE GALÁPAGOS ISLANDS (Fig. 4).** Isla Bartolomé, littoral zone (1 specimen/1 sample): mangroves near Pinnacle rock, 0 m a.s.l., in leaf litter under *Maytenus octogona*.

Isla Fernandina, moist zone (203/15): western part of the island, 450–800 m, in decayed leaf litter under *Zanthoxylum fagara* and *Psychotria rufipes*; in grass litter under *Cyperus andersonii*; in decayed leaf litter under *Croton scouleri* and *Darwiniothamnus tenuifolius*; in decayed fern litter under *Pteridium aquilinum* and *Pityrogramma camomelos*; pampa with *Carex* sp. on crater rim, 1350 m, in grass and fern litter (leg. S. ABEDRABBO-RANDL); fumarole on western part of

the crater rim, 1290 m, dripping-wet pads of moss (temperature > 40° C due to volcanic activity).

Isla Floreana, littoral zone (1/1): Punta Cormorán, at lagoon, 5 m, in well-decayed leaf litter under *Avicennia germinans*. Arid zone (2/1): above Black beach, near Dr RITTER's grave, 160 m, in litter and humus under *Acacia* sp. Agricultural area (30/4): highland north of Cerro Pajas, 320–340 m, in decaying wood and humus under dead *Psidium guajava*; near trail to finca, 320 m, in decayed leaf litter and pieces of wood under *Kalanchoë pinnata* and *Croton scouleri*; near Asilo de la Paz, in crevice near buccaneer caves, 340 m, in well-decayed leaf litter with roots and humus under *Lantana camara*. Moist highland (3/3): at base of Cerro Pajas, 360 m, in well-decayed leaf litter under *Croton scouleri*; on crater rim of Cerro Pajas, 475–550 m, in decayed leaf litter under *Scalesia pedunculata* and *Zanthoxylum fagara*.

Isla Isabela, V. Wolf, upper arid (*Psychotria*) zone (8/1): western side, *Psidium galapageium* forest with *Zanthoxylum fagara*, *Tournefortia* sp., *Cordia lutea*, *Macraea laricifolia*, 1000 m, in decayed leaf litter and humus (leg. L. BAERT, K. DESENDER, J. P. MAELFAIT). V. Alcedo, moist zone (95/15): along southern and eastern crater rim, 1030 m, in decayed fern litter and humus under *Pteridium aquilinum* and *Ipomoea* sp.; inside crater near fumarole, 910 m.; in fern litter under *Polypodium* sp. and in moss on rocks (temperature in vegetation 35° C); elfin forest on northeastern slope, open woodland of *Scalesia microcephala*, *Trema micrantha*, *Pisonia floribunda*, *Tournefortia rufo-sericea*, 780–880 m, in leaf litter with pieces of wood and humus; *ibid.*, in dense grass; elfin forest inside of the main crater, near sulphurous fumaroles, dense *Croton scouleri* forest with *Tournefortia rufo-sericea*, *Zanthoxylum fagara*, *Scalesia microcephala*, 760 m, in decayed leaf litter of deeper layer (soil temperature 35° C); inside small crater near fumarole, dense forest of *Psychotria rufipes* and *Scalesia microcephala*, 890 m, in partially-decayed leaf litter and humus; western crater rim, dense forest, 1030 m, in decayed leaf litter and humus under dead trunk. V. Sierra Negra, arid zone (31/4): near Quinta Playa at Porvenir, open forest of *Pisonia floribunda* and *Acacia rorudiana*, 20–30 m, in partially-decayed leaf litter and pieces of wood, in decaying wood; north of Puerto Villamil, 10 m, in decaying wood under *Pro-*

*sopis juliflora*. Agricultural area (10/4): above S. Tomás, 340–370 m, in decayed leaf litter under *Inga edulis*, *Citrus limetta*, *Coffea arabica*, *Persea americana*, *Psidium guajava*; in decayed fern litter under *Pteridium aquilinum*. Transition zone (97/9): north of Quinta Playa, dense forest with *Scalesia cordata*, *Zanthoxylum fagara*, *Sapindus saponaria*, *Tournefortia pubescens*, 200–230 m, in decayed leaf litter with decaying pieces of wood and humus, in moss from trees and barks, on a dead trunk with *Peperomia* sp., in fern litter. Pasture/Pampa (2/1): southwestern crater rim, forest of *Psidium guajava*, 910 m, decaying wood and black humus under fallen log. V. Cerro Azul, southwestern part, (3/1): dry forest, 150 m, in thick litter layer under *Acacia* sp. (leg. L. BAERT, K. DESENDER, J. P. MAELFAIT).

Isla Pinzón, lower arid zone (2/2): eastern part, above islote, 30–100 m, in partially-decayed leaf litter under *Croton scouleri* and *Cordia lutea*; on decaying wood from bark from *Prosopis juliflora*. Upper arid zone (13/6): Central valley, 270–290 m, in decayed cactus litter under *Opuntia echios* var. *macrocarpa*; in grass litter; in litter and humus under *Lantana peduncularis*, *Acacia macracantha*, *Croton scouleri*. Moist zone (17/6): southern crater rim of main caldera, 320 m, in well-decayed leaf litter under *Cordia lutea*; summit, 460 m, in grass litter and in partially-decayed fern litter; southern slope of the island near big rocks, 340 m, in decayed leaf litter and black humus under *Cordia leucophlyctis*, *Croton scouleri*, *Alternanthera echinocephala*.

Isla Pinta, moist zone (17/4): eastern slope of the main crater, dense forest of *Zanthoxylum fagara* and *Pisonia floribunda*, 450–530 m, partially-decayed leaf litter and humus; in deeper soil layers, among roots; on summit near the main crater, 590–600 m, in decayed fern litter with roots and humus under uppermost layer, under *Pteridium aquilinum* (soil temperature >40° C due to volcanic activity).

Isla San Cristobal, arid zone (6/1): near electric power plant above Puerto Baquerizo Moreno, 100 m, in leaf and grass litter under *Parkinsonia aculeata* and *Pennisetum* sp. (leg. S. ABEDRABBO-RANDL). Agricultural area (3/2): near El Progreso, 350 m, in well-decayed leaf litter under *Psidium guajava*, *Persea americana*, *Eugenia jambos*. Moist zone (106/7): around lake El Junco, 640–650 m, in decayed leaf



litter, moss, and humus, in decaying wood and among roots under *Miconia robinsoniana* and *Psidium guayava*; in decayed fern litter under *Pteridium aquilinum*; pasture around lake, 660 m, in grass and herb litter in *Paspalum galapageium*, *Cyperus brevifolius*, *Commelina diffusa* (leg. S. ABEDRABBO-RANDL); small river southeast of lake, 500 m, in well-decayed leaf litter under *Miconia robinsoniana* and *Pteridium aquilinum*.

Isla Santa Cruz, arid zone (20/7): near Charles Darwin Research Station, 5 m, in well-decayed leaf litter under *Hippomane manzinella*; north of station, at barranco, 30 m, in leaf litter under *Tournefortia pubescens*, *Psidium galapageium*; between Puerto Ayora and Bellavista, dry forest of *Croton scouleri*, *Piscidia carthagenensis*, *Zanthoxylum fagara*, *Tournefortia* spp., 70–90 m, in decayed leaf litter and humus. Transition zone (1/1): near Cerro Chato, 200 m, in decayed leaf litter and humus under *Tournefortia pubescens* and *Zanthoxylum fagara*. Agricultural area (32/2): *ibid.*, 200 m, in decayed grass litter of *Pennisetum purpureum*; below Santa Rosa, 340 m, in decayed leaf litter with pieces of wood and humus under *Cedrela odorata*. Moist zones: *Scalesia* zone (290/16): in *Scalesia pedunculata* forest around Los Gemelos, 590 m, in decayed leaf and grass litter; in leaf litter under *Darwiniothamnus tenuifolius*; in roots and leaf litter of epiphytic *Peperomia galapagensis*; *Scalesia* forest near Cerro Crocker, 700 m, in leaf litter, partially with moss, pieces of wood, and roots. Fern-sedge zone (1/1): below Cerro Crocker near *Scalesia* forest, 710 m, in wet, decayed leaf and fern litter.

Isla Santa Fe, arid zone (2/1): northeastern part, behind sea-lion beach, 20 m, very dry leaf litter under *Croton scouleri*.

Isla Santiago, littoral zone (31/2): around lagoon of Playa Espumilla, 5 m, in partially-decayed mangrove leaf litter under *Conocarpus erecta*. Upper arid zone (2/1): western side, beside trail between Playa Espumilla and Los Aguacates, 300 m, in leaf litter under *Bursera graveolens* and *Acacia occidentalis* (leg. S. ABEDRABBO-RANDL).

*Berlesezetes auxiliaris* was represented by 1029 specimens on 10 islands of the Galápagos archipelago. Although it has been recorded in all vegetation zones including mangrove litter in the littoral zone, it shows a clear preference for moister habitats. It occurs in a

wide variety of microhabitats: in decayed grass, herb, cactus, leaf and fern litter, in decaying wood, in wet patches of moss, also in epiphytic litter and in deeper humus layers. A few specimens were found in or near agricultural areas, others in remote places on the islands Pinta, Isabela and Fernandina, where human introduction is unlikely. Several specimens were found in soils heated by volcanic activity.

GENERAL DISTRIBUTION. Gondwanan: known from South Asia (India), Southeast Asia (Hong Kong, Malaysia, Indonesia, Philippines), Pacific (Ryukyu islands: Yaeyama, Hawaii: Laysan, Fiji, Tonga: Tongatapu, Tahiti), Central and South America (Antilles: Cuba, Guadeloupe, S. Lucia; Panamá, Venezuela, Brazil), Galápagos Islands. Subspecies described from South Africa and USA: North Carolina.

*Kalyptrazetes* sp.

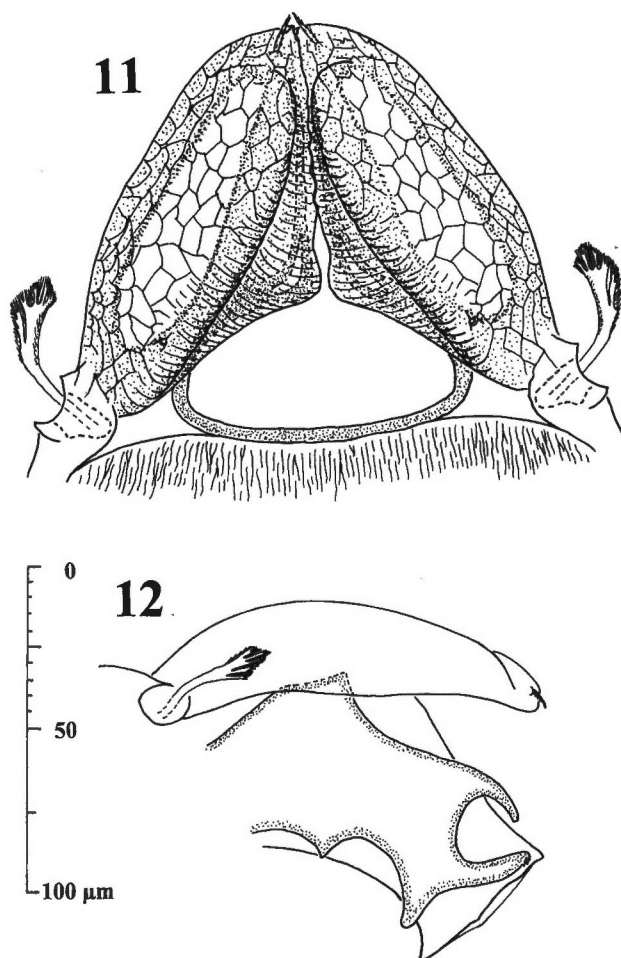
(Figs. 11–12)

The single specimen encountered is damaged with a broken notogaster. On this basis, only a short diagnosis is possible. A more detailed description can be given when more material is available. On the other hand, this specimen shows some interesting characters which separate it from other known species of the genus *Kalyptrazetes*, and shall be presented briefly.

Lamellae (Fig. 11–12) very wide and rounded anteriorly, covering rostrum and anterior part of prodorsum, posteriorly an elliptical interlamellar area left uncovered. Lateral part of lamellae bulbous, surface rugose with ridges forming an irregular network, below surface an oval opening on each side, only covered by a membrane with the network structure. Interlamellar area framed by a thick sclerotized ring posteriorly touching the dorsosejugal line, edges anteriorly and medially prolonged into two spines. Lamellar setae short and ciliate, interlamellar setae on dorsal surface of lamellae, short. Rostral setae not visible. Sensillus broadened distally, branched into thick rami and long ciliae.

Notogaster heavily sclerotized, rugose, notogastral setae short and simple. Tutorium with four apophyses on anterior part, superior lobe distally acute, bent over dorsal ridge of rostrum; anterior lobe reaching





FIGS. 11–12: *Kalyptrazetes* sp., adult. 11. — Dorsal view of prodorsum. 12. — Lateral view of rostral part with tutorium.

towards apex of rostrum. Ventral side as in other species of the genus: heavily sclerotized, sejugal apodemes and III fusing medially and forming a broad "X" anteriorly of genital plate. All ventral setae short and smooth.

Up to now, the genus *Kalyptrazetes* Balogh, 1972 (discussion of original author of the genus in MARSHALL *et al.*, 1987) consists of four described species: *K. harpezes* (Higgins, 1965), *K. desaussurei* Mahunka, 1983, *K. americanus* Mahunka, 1995 and *K. lupitae* Mahunka and Palacios-Vargas, 1996. The assignment of the specimen to this genus is indicated on the basis of the large lamellae and the position and length of the prodorsal setae, on the shape of the sensillus, as well as on the structure of the ventral region. Differences to the already known species are

mainly in the shape of the lamellae and in the large and rounded interlamellar area.

RECORD FROM THE GALÁPAGOS ISLANDS (Fig. 4): Only a single specimen has been recorded: Isla Santa Cruz, *Scalesia pedunculata* forest near Los Gemelos; 600 m a.s.l., in moss from bough of *Zanthoxylum fagara* (sample GAL 87-G073: Ecuador, Galápagos Islands, 8.3.1987). The alcohol-preserved specimen is deposited in the senior author's collection, Innsbruck, Austria.

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#### REFERENCES

- BALOGH (J.), 1962a. — New Microzetidae from Eastern Peru (Acari, Oribatei). — *Ann. Hist. Nat. Mus. Nat. Hung.*, **54**: 405–417.
- BALOGH (J.), 1962b. — An outline of the family Microzetidae Grandjean 1936 (Acari, Oribatei). — *Opusc. Zool.*, Budapest, **4**: 35–58.
- BALOGH (J.), 1965. — A synopsis of the world Oribatid (Acari) genera. — *Acta Zool. Acad. Sci. Hung.*, **11**: 5–99.
- BALOGH (J.) & BALOGH (P.), 1988. — Oribatid mites of the Neotropical region I. — *In* J. BALOGH (ed.), *The soil mites of the world vol. 2*, 335 pp. Elsevier, Amsterdam.
- BALOGH (J.) & MAHUNKA (S.), 1977. — New data to the knowledge of the oribatid fauna of Neogaea (Acari). I. — *Acta Zool. Acad. Sci. Hung.*, **23**: 1–28.

- CALUGAR (M.) & VASILIU (N.), 1977. — Contribution à la connaissance des oribates hypogés de Cuba. — Résultats des expéditions biospéologiques cubano-roumaines à Cuba, 2: 247-256.
- GRANDJEAN (F.), 1936a. — Les Microzetidae n. fam. (Oribates). — Bull. Soc. zool. France, 61: 60-93.
- GRANDJEAN (F.), 1936b. — *Microzetes auxiliaris* n. sp. (Oribates). — Bull. Mus. natl Hist. nat., (2), 8: 138-145.
- GRANDJEAN (F.), 1953. — Essai de classification des Oribates (Acariens). — Bull. Soc. zool. France, 78: 421-446.
- MAHUNKA (S.), 1980. — Data to the knowledge of mites preserved in the Berlese collection (Acari: Tarsonemina, Oribatida) I. — Acta Zool. Acad. Sci. Hung., 26: 377-399.
- MAHUNKA (S.), 1983. — Neue und interessante Milben aus dem Genfer Museum XLVII. Oribatida Americana 7: Guatemala II (Acari). — Rev. suisse Zool., 90: 709-724.
- MAHUNKA (S.) & PALACIOS-VARGAS (J. G.), 1996. — New Neotropical species of Microzetidae. — Acta Zool. Acad. Sci. Hung., 42: 251-260.
- MARSHALL (V. G.), REEVES (R. M.) & NORTON (R. A.), 1987. — Catalogue of the Oribatida (Acari) of continental United States and Canada. — Mem. ent. Soc. Can., 139: VI + 418 pp.
- PORTER (D. M.), 1984. — Endemism and evolution in terrestrial plants. — In R. PERRY (ed.) Key Environments—Galapagos, pp. 85-99. Pergamon Press, Oxford.
- SCHATZ (H.), 1994. — Lohmanniidae (Acari: Oribatida) from the Galapagos Islands, the Cocos Island, and Central America. — Acarologia, 35: 267-287.
- SCHATZ (H.), 1998. — Oribatid mites (Acari) of the Galapagos Islands — Faunistics, Ecology and Speciation. — Exp. appl. Acarol., 22: 373-409.
- SCHATZ (H.) & SCHATZ (I.), 1988. — An outline of arachnological research in the Galapagos Islands (Ecuador) with special reference to the Oribatida (Acari). — EURAAC News Letter, 1(2): 4-10.
- SCHATZ (H.) & SCHATZ (I.), 1988. — An outline of arachnological research in the Galapagos Islands (Ecuador) with special reference to the Oribatida (Acari), bibliography. — EURAAC News Letter, 2 (1): 3-6.
- WOAS (S.), 1990. — Die phylogenetischen Entwicklungslinien der Höheren Oribatiden (Acari) I. Zur Monophylie der Poronota Grandjean, 1953. — Andrias, Karlsruhe, 7: 91-168.