

Research Article

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# ***Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira* (Cuculiformes: Cuculidae) in Brazil: a first example of male polymorphism in the family Dermationidae (Acariformes: Analgoidea)**

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**Abstract:** *Carcinopodacarus polymorphus* gen. n. et sp. n. (Acariformes: Dermationidae: Dermationinae) is described from the guira cuckoo *Guira guira* (Gmelin) (Cuculiformes: Cuculidae) in Brazil. The new genus differs from the closest genus, *Psittophagoides* Fain, 1964, by the following features: in both sexes, the anterior spines of trochanters I and II are absent (vs present in *Psittophagoides*), setae *d2* are distinctly developed (vs only alveoli), and genual setae *mGI* are absent (vs present); in males, the hysteronotal shield is split transversally at the level of trochanters III (vs hysteronotal shield entire); in females, the platelets situated posterior to the propodonal shield are absent (vs present), the metapodosomal sclerites are present (vs absent), and the adanal shields are fused anteriorly to each other (vs separated from each other). In this species, andropolymerism is detected for the first time for the family. It involves various characters but the most impressive feature is the structure of legs III. In hetero- and mesomorphic males, these legs are strongly hypertrophied and have a distinct ventral spur on femora III; in homeomorphic males, legs III are not modified and subequal to legs IV.

**Keywords:** Acari, andropolymerism, cuculiform birds, parasites, Psoroptidia, systematics

Astigmatan mites of the family Dermationidae Fain, 1965 (Acariformes: Analgoidea) are permanent parasites of birds living on the skin of their hosts. This family currently includes twelve genera arranged into three subfamilies: Dermationinae Fain, 1965 with nearly 50 species belonging to ten genera (*Apodicoptes* Fain, 1965, *Dermation* Trouessart et Neumann, 1888, *Neodermation* Fain, 1965, *Paddacoptes* Fain, 1965, *Paradermation* Fain, 1965, *Passeroptes* Fain, 1964, *Pelicanoptes* Fain et Atyeo, 1975, *Psittophagoides* Fain, 1964, *Rivoltasia* Canestrini, 1894 and *Trochiloptes* Mironov, Bochkov et Fain, 2005), Apocnemidocoptinae Mironov, Bochkov et Fain, 2005 (one species), and Otocoptoidinae Fain et Bochkov, 2001 (one species) (Fain 1965, Mironov et al. 2005, Bochkov and Mironov 2011).

The subfamily Dermationinae is characterised by the following features: in both sexes, the adanal shields are present, idiosomal setae *vi*, *dI*, *eI*, *f2*, and *hI* are absent, supracoxal setae *scx* and leg setae *sI* and *II*, *mGII*, famulus  $\varepsilon$ , solenidia  $\sigma 2I$ , and  $\sigma 3I$  are absent, setae *cGI*, *II* are situated near the bases of respective genua; in males, coxal apodemes Ia (epimerites) are free, the opisthosomal lobes are

well developed and bear distinct membranes; in females, apodemes Ia are fused with epigynum, the hysteronotal glands (*gl*) are not discernible, the genital papillae are situated posterior to the ovipore (Mironov et al. 2005).

In the present paper we describe a new genus and species of the subfamily Dermationinae from the guira cuckoo, *Guira guira* (Gmelin) (Aves: Cuculiformes) in Brazil.

## **MATERIALS AND METHODS**

Mites were collected from guira cuckoos *Guira guira* found dead alongside roads in the campus of the Universidade Estadual de Campinas (UNICAMP), Campinas, São Paulo, Brazil. Totally, six host individuals were examined and mites were found on three (50%). The individual birds were washed with water containing dish washing detergent and then the liquid was filtered. Mites were collected from the filter paper under a stereomicroscope, cleared in 30% lactic acid for 2–4 h and mounted in Hoyer's medium. Drawings were made with a Leica DM3000 microscope equipped with differential interference contrast optics (DIC) and a camera lucida. Photomicrographs were made with a scanning electron microscope (Quanta 250). Mites were preserved in 96%

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ethanol, next put to hexamethyldisilazane for 10 min, and then dried and sputtered with platinum.

In the descriptions below, the idiosomal setation follows Griffiths et al. (1990) with modifications of Norton (1998) concerning coxal setae. The leg chaetotaxy follows Grandjean (1939). All measurements are in micrometres ( $\mu\text{m}$ ) and were taken as follow: body length = the total length from the palpal extremities to the posterior margin of the body; body width = the width at level of setae *cp*; idiosomal length = length from the anterior margin of the propodonotal shield to the posterior margin of the body; length of the propodonotal shield = length measured along the median line of the shield; width of the propodonotal shield = width at level of the posterior margin of this shield; length of the anterior part of the hysteronotal shield = length, measured along the median line of the shield; width of the anterior part of the hysteronotal shield = width at level of setae *cp*; length of the posterior part of the hysteronotal shield = length of the lateral border of this shield; width of the posterior part(s) of the hysteronotal shield = width at level of the anterior margin of this shield; width of the opisthosomal lobes = width of each lobe at the level of setae *ps2*; length of the terminal membrane = length from the base of seta *h3* to the posterior end of this membrane; length of the posterior legs = length from the most basal point of the trochanter to the apex of the tarsus, excluding pretarsus; length of tarsi III, IV = length from the most basal point of the tarsus to its apex, excluding pretarsus.

Host systematics follows Clements et al. (2012). Specimen depositories are cited using the following abbreviations: DZUnesp-RC – Department of Zoology of the Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil; UMMZ – Museum of Zoology, University of Michigan, Ann Arbor, USA; ZISP – Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia.

## RESULTS

Family **Dermationidae** Fain, 1965

Subfamily **Dermationinae** Fain, 1965

***Carcinopodacarus*** gen. n.

ZooBank number for genus:

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**Diagnosis. Both sexes.** Gnathosoma with dorsal lobes. Dorsal shields without ornamentation, but propodonotal shield with short anteromedian fold. Setae *se* and *si* situated on propodonotal shield. Platelets posterior to propodonotal shield absent. Scapular shields with large ventral hook-like process curved inward, with harpoon-like apex. Setae *d2* distinctly developed, setae *e2* absent. Coxal fields without spine-like processes. Tibiae I and II and genua I and II with short anteroventral projection. Solenidion  $\omega$ II, setae *s*III, *r*III, and *r*IV present, setae *m*GI absent. Trochanters I and II without anterior spine.

**Male.** Humeral shields without dorsal valves. Hysteronotal shield transversally split at level of trochanters III into anterior hysteronotal and lobar parts. Apodemes IVb absent. Bases of tarsal setae *d*IV and *e*IV widely separated

from each other. Opisthosomal lobes well-developed, terminal cleft well developed, variable among different forms of males. Cupules *ih* situated posterior to adanal suckers. Male polymorphism present.

**Heteromorphic male.** Setae *c2* whip-like, subequal in size to *cp*. Scapular shield without dorsal process. Anterior hysteronotal shield fused with humeral shields; lobar part of hysteronotal shield entire. Coxal fields III closed. Interlobar and lateral lobar membranes absent. Terminal lobar membrane weakly developed, with short medial projection. Legs III much wider and about 2 times longer than legs IV. Tarsus III ending with large spur slightly curved apically. Pretarsus III strongly reduced, ambulacral disc rudimentary. Tibia III without projections, at least 2 times longer than respective tarsus; tibia IV with spine-like anteroventral projection. Genu III with short anterodorsal spine. Femur III with large, sharp spine.

**Mesomorphic male.** Similar to heteromorph but lobar part of hysteronotal shield with deep posterior median incision, legs III much wider but slightly longer than legs IV, and ventral spur of femur III with 2 spines in middle part.

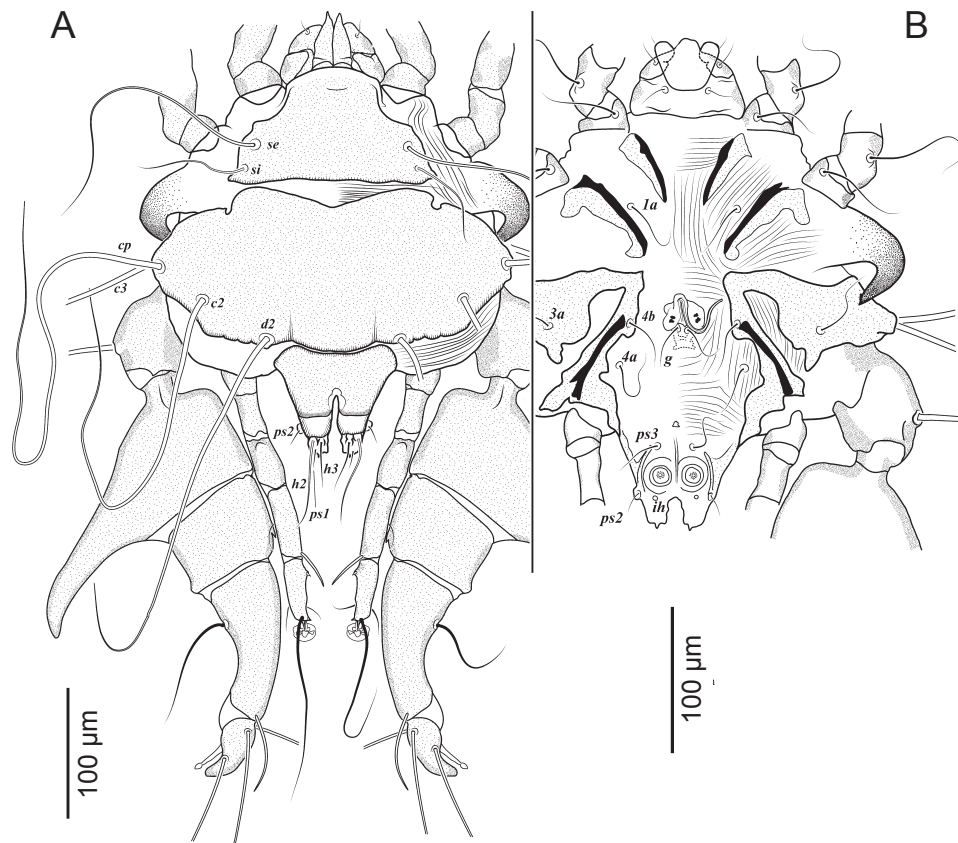
**Homeomorphic male.** Setae *c2* filiform, about 3–4 times shorter than *cp*. Scapular shield with short dorsal process directed inward. Humeral shields distinctly separated from anterior hysteronotal shield. Lobar part of hysteronotal shield split longitudinally. Coxal fields III opened. All 3 parts of lobar membrane (interlobar, terminal and lateral) well developed. Posterior part of interlobar membrane striae, terminal part with indentations. Legs III slightly longer and wider than legs IV. Tarsus III with rounded apex. Pretarsus IV well developed. Tibiae III, IV slightly shorter or subequal in length to respective tarsi, each with short spine-like anteroventral projection. Genu III without dorsal spine. Femur III without projection.

**Female.** Scapular shield with short triangular inwardly directed dorsal process. Metapodosomal sclerites present. Hysteronotal shield rectangular with slightly attenuated corners. Adanal shields fused to each other anteriorly. Tarsi III and IV with weakly developed basoventral spine each; projections on femora III and IV absent.

Type and only species: *Carcinopodacarus polymorphus* sp. n.

**Etymology:** The epithet is a combination of the Greek *καρκινός* (*karkinos*, *carcinos* = crab), *ποδός* (*podos* = feet), and *akari* (mite).

**Differential diagnosis.** The new genus is most similar to *Psittophagoides*. In both sexes of these genera, each scapular shield bears a large, ventral, hook-like process directed inward, setae *e2* are absent, solenidion  $\omega$ II, setae *s*III, *r*III and *r*IV are present. The new genus differs from *Psittophagoides* by the following features: in both sexes of species of the genus *Carcinopodacarus*, the anterior spines of trochanters I and II are absent, setae *d2* are distinctly well-developed and genual setae *m*GI are absent; in males, the hysteronotal shield is split transversally at the level of trochanters III; in females, paired platelets situated posterior to the propodonotal shield are absent, the metapodosomal sclerites are present, the adanal shields are fused to



**Fig. 1.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, heteromorphic male. **A** – dorsal view; **B** – ventral view.

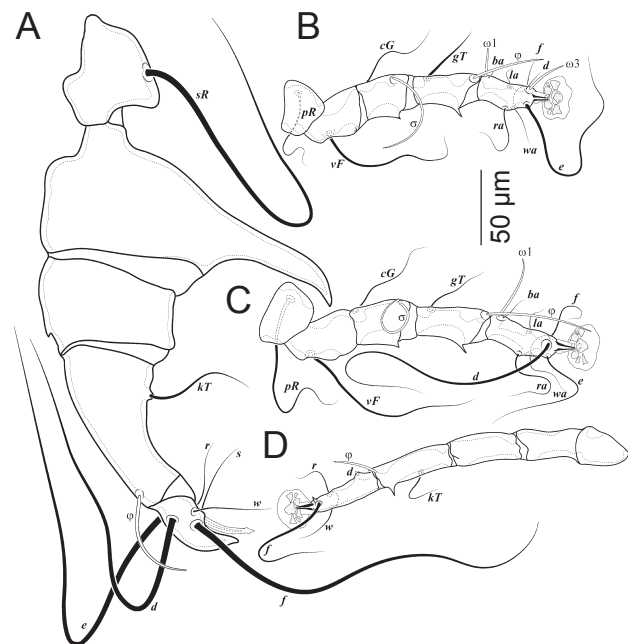
each other anteriorly. In both sexes of the genus *Psittophagoides*, an anterior spine is present on trochanters I and II, setae *d2* are represented by alveoli or absent and genual setae *mGI* are present; in males, the hysteronotal shield is not separated transversally; in females, a pair of platelets situated posterior to the propodonotal shield is present, the metapodosomal sclerites are absent and the adanal shields are well separated from each other.

***Carcinopodacarus polymorphus* sp. n.** Figs. 1–10

ZooBank number for species

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**Description. Heteromorphic male** (holotype, Figs. 1, 2, 6A, 8A, 9A). Body 305 long (290–355 in 5 paratypes) and 290 wide (255–290). Idiosoma 270 long (245–300). Distance between propodonotal and hysteronotal shields along midline 16 (10–21). Propodonotal shield trapezium-shaped, 86 (79–90) long and 150 (140–155) wide, lateral margins sinuous, posterior margin straight. Setae *se* broken in holotype (180–195) long, setae *si* 70 (67–105) long. Distance between levels of setae *se* and *si* 18 (17–25). Distances *se-se* 115 (105–125) and *si-si* 125 (120–135). Anterior part of hysteronotal shield 110 (100–125) long and 285 (255–290) wide, bearing setae *c2* 225 long (195–235), *cp* 260 long (255–310), *c3* 227 long (183–227), and *d2* 200 long (185–235). Lobar part of hysteronotal shield 62



**Fig. 2** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, posterior legs in dorsal view, heteromorphic male **A** – leg III; **B** – leg I; **C** – leg II; **D** – leg IV.

long (60–81), 93 wide (93–99). Supranal concavity weakly expressed. Terminal cleft 16 long (16–33). Aedeagus 72 long (58–73). Adanal suckers 16 (10–16) in diameter, distance between centres of their discs 19 (17–28), corolla smooth. Lengths of setae: *h2* 67 (54–71), *h3* 46 (46–51),



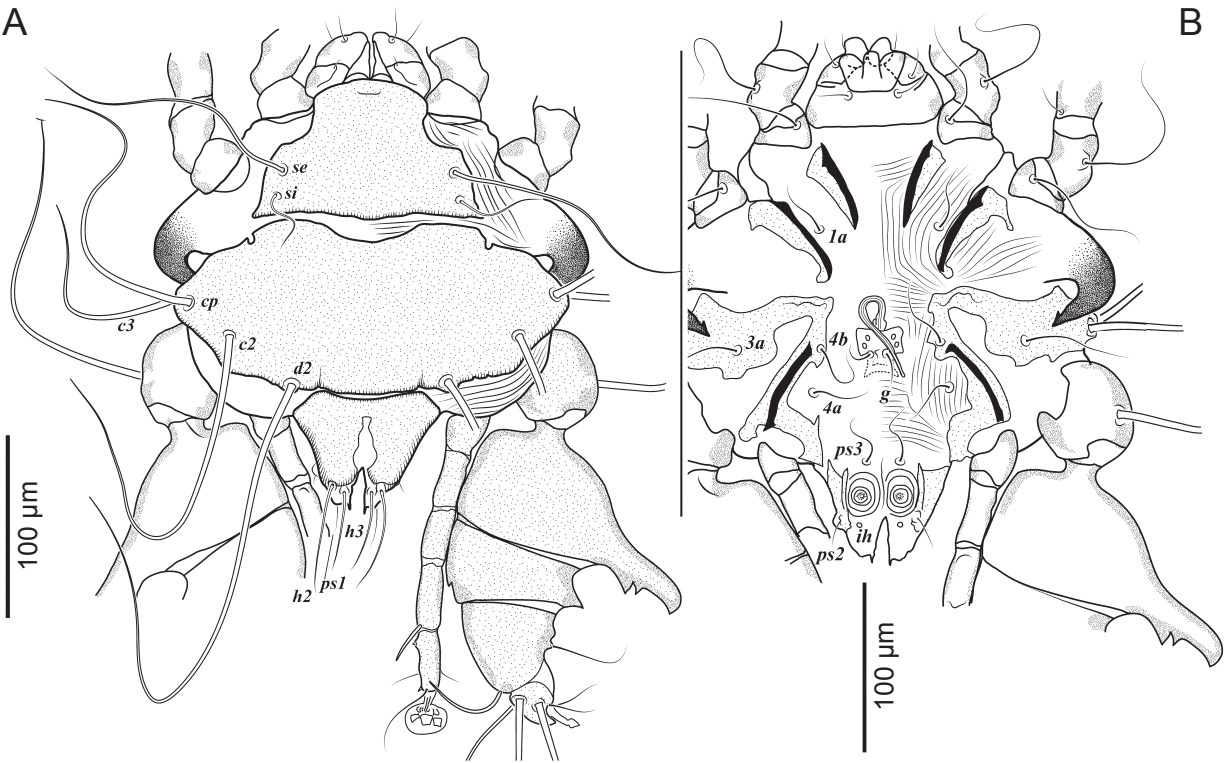


Fig. 3. *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, mesomorphic male. A – dorsal view; B – ventral view.

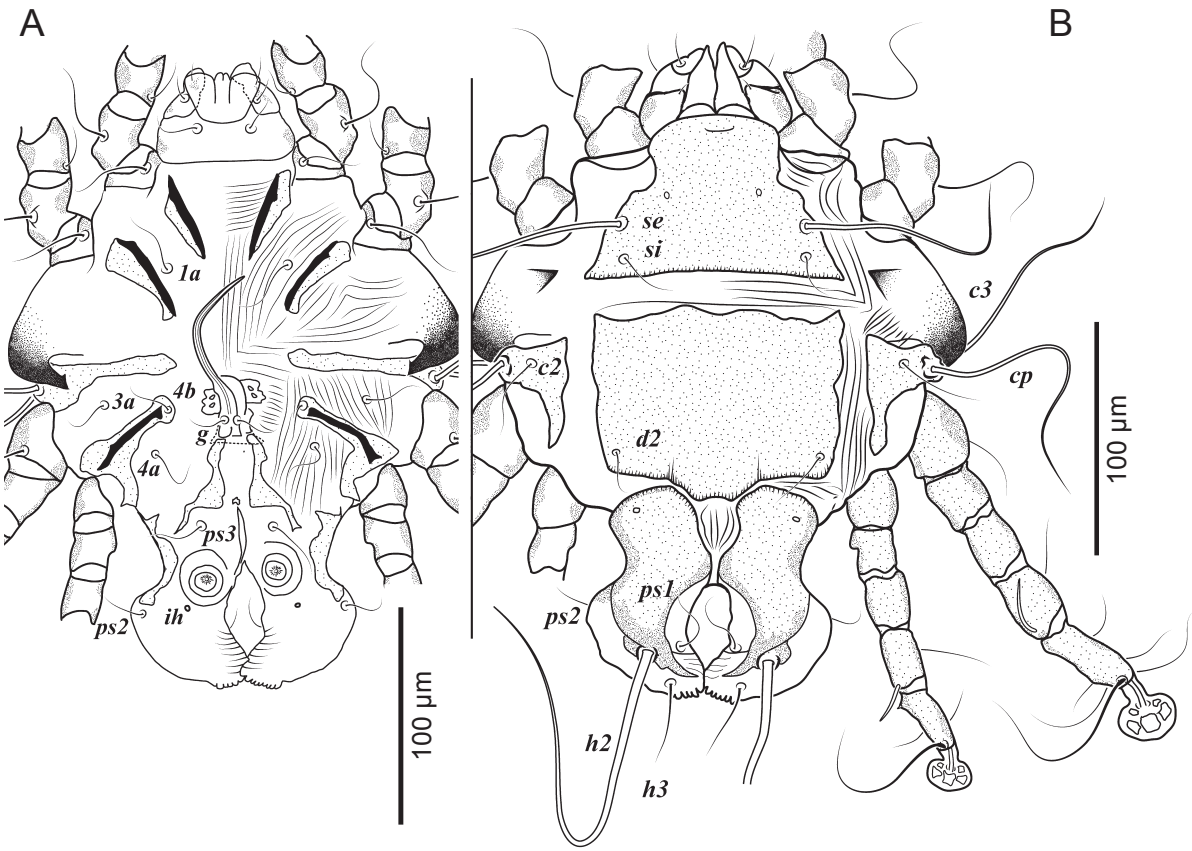
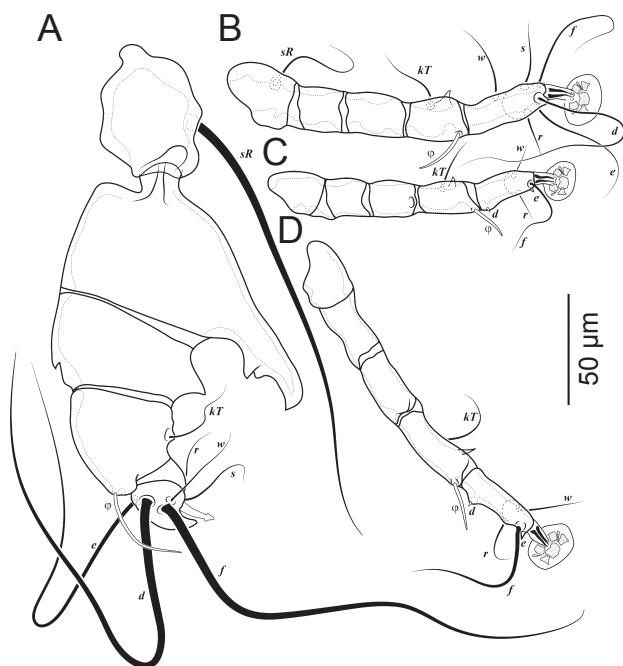
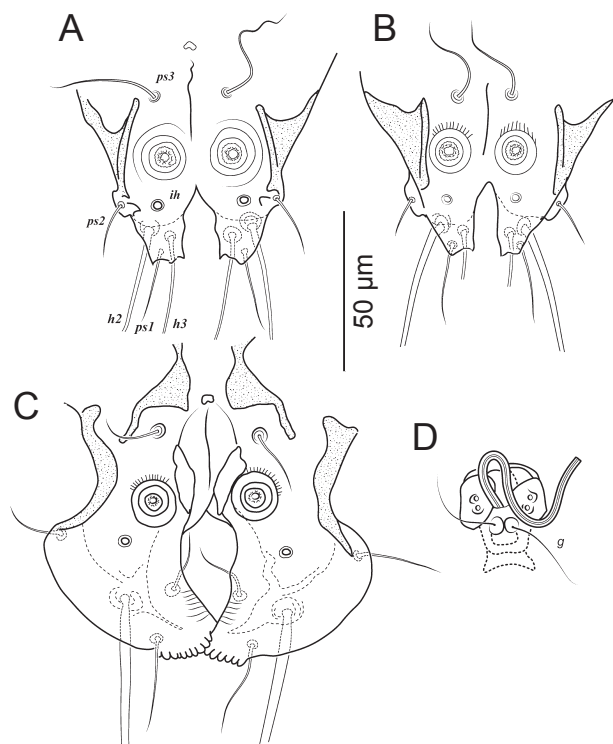


Fig. 4. *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, homeomorphic male. A – ventral view; B – dorsal view.



**Fig. 5.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, posterior legs in dorsal view, mesomorphic male (A, D). A – leg III; D – leg IV. Homeomorphic male (B, C). B – leg III; C – leg IV.



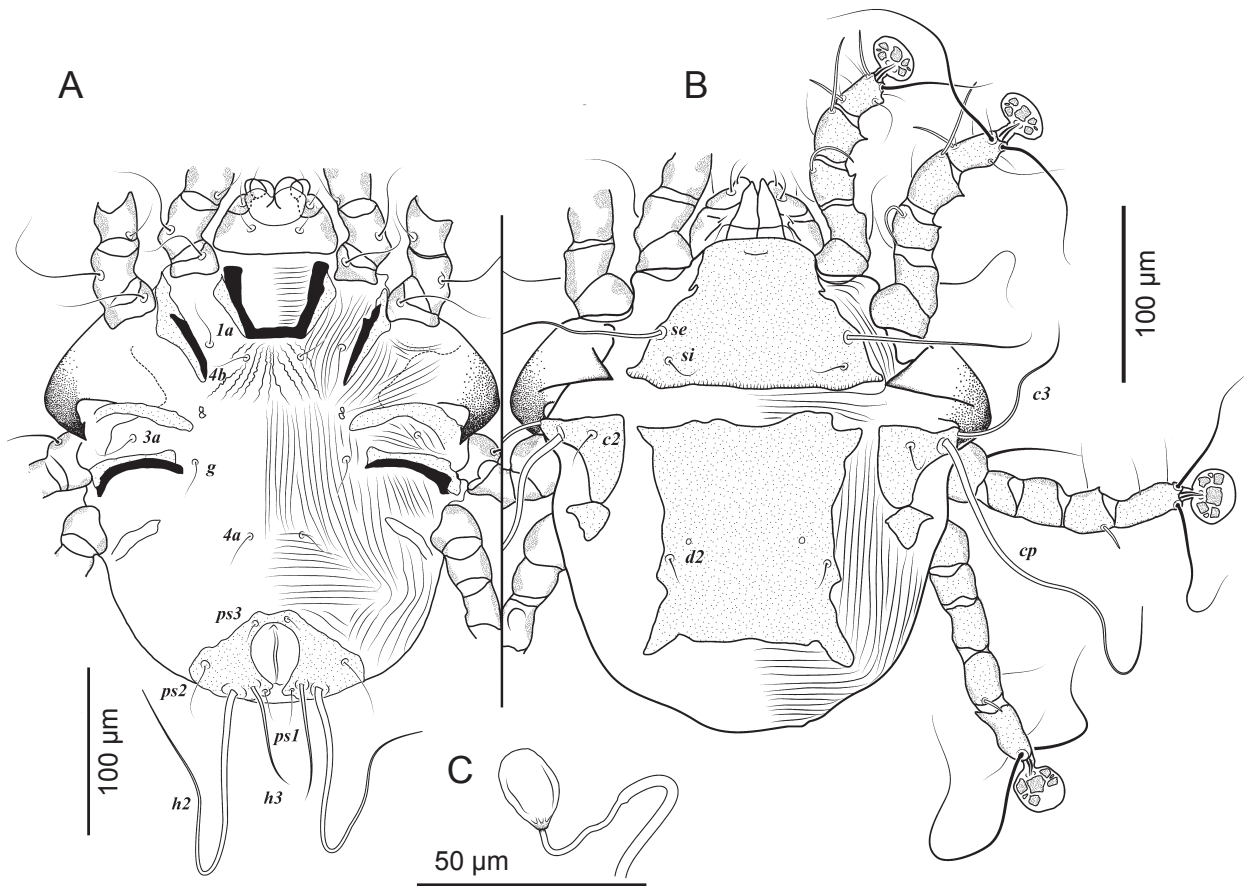
**Fig. 6.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, details of male. Opisthosoma in ventral view (A–C). A – heteromorphic male; B – mesomorphic male; C – homeomorphic male; D – aedeagus of heteromorphic male.

*ps1* 13 (13–23), *ps2* 16 (13–17), *ps3* 33 (29–43), *la* 51 (50–61), *3a* 78 (48–73), *4a* 33 (25–38), *4b* 37 (30–38) and *g* 15 (10–18). Width of opisthosomal lobe at base 15 (18–29). Maximal width of triangular terminal cleft 11 (9–22). Terminal membrane 5 (5–10) long. Legs III 360 (335–385) long. Setae *sRIII* 240 (240–265) long. Femur III 190 wide in midpart (185–210), its ventral projection 120 long (115–125). Tarsus III 54 long (52–67). Leg IV 205 long (190–230) and consistent in width along entire length, 18 (16–18). Tarsus IV 42 long (41–52). Lengths of solenidia: *σI* 60 (48–65), *σII* 53 (43–52), *φI* 47 (47–51), *φII* 62 (63–71), *φIII* 71 (65–71), *φIV* 32 (23–33), *ωI* 21 (19–23), *ωII* 40 (38–47), *ω3I* 24 (26–30).

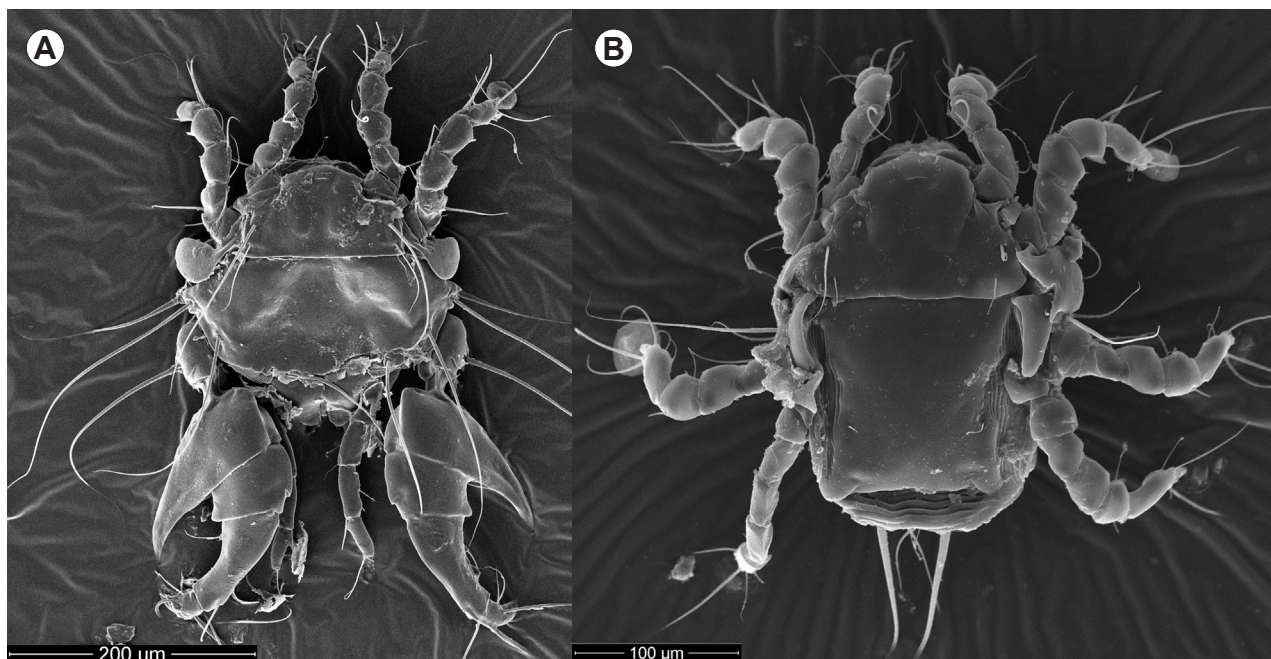
**Mesomorphic male** (6 paratypes, Figs. 3, 5A,D, 6B, 9B). Body 275–295 long and 230–250 wide. Idiosoma 235–265 long. Distance between propodonotal and hysteronotal shields along midline 14–21. Propodonotal shield trapezium-shaped, 75–84 long and 130–155 wide, lateral margins sinuously oblique, posterior margin straight. Setae *se* 150–185 long, setae *si* 45–72 long. Distance between levels of setae *se* and *si* 16–21. Distances *se-se* 99–116 and *si-si* 107–125. Anterior part of hysteronotal shield 94–105 long and 230–265 wide, bearing setae *c2* 150–210 long, *cp* 195–275 long, *c3* 145–190 long, and *d2* 145–185 long. Lobar part of hysteronotal shield 54–65 long, 74–91 wide, with posterior median insertion 28–41 long. Aedeagus 68–77 long. Adanal suckers 14–16 in diameter, distance between centres of their discs 17–26, corolla smooth. Lengths of setae: *h2* 48–74, *h3* 33–55, *ps1* 16–22, *ps2* 13–19, *ps3* 20–32, *la* 41–51, *3a* 43–53, *4a* 24–31, *4b* 27–39 and *g* 10–16. Width of opisthosomal lobe at base 19–24. Maximal width of terminal cleft 8–17. Terminal

membrane 4–7 long. Legs III 235–305 long. Setae *sRIII* 210–250 long. Femur III 136–177 wide in midpart, its ventral projection 78–105 long. Tarsus III 37–56 long. Leg IV 160–205 long and consistent width along all length, 13–19. Tarsus IV 34–52 long. Lengths of solenidia: *σI* 43–58, *σII* 39–48, *φI* 39–48, *φII* 40–62, *φIII* 56–73, *φIV* 21–27, *ωI* 15–22, *ωII* 37–42, *ω3I* 22–27.

**Homeomorphic male** (6 paratypes, Figs. 4, 5B,C, 6C, 9C). Body 240–280 long and 155–180 wide. Idiosoma 210–235 long. Distance between propodonotal and hysteronotal shields along midline 14–23. Propodonotal shield trapezium-shaped, 57–69 long and 90–115 wide, lateral margins sinuous, posterior margin straight. Setae *se* 63–94 long, setae *si* 14–21 long. Distance between levels of setae *se* and *si* 11–18. Distances *se-se* 68–84 and *si-si* 63–81. Anterior part of hysteronotal shield 62–79 long and 88–110 wide, bearing setae *d2* 20–30 long; *c2* 13–28 long, *cp* 115–155 long, *c3* 51–77. Lobar part of hysteronotal shield 68–85 long, 75–83 wide at level of trochanters IV. Greatest distance between anterior ends of lobar hysteronotal shields 36–42. Terminal cleft ovate, 68–85 long. Aedeagus 62–82 long. Adanal suckers 13–15 in diameter, distance between centres of their discs 24–35, corolla indentated. Lengths of setae: *h2* 175–215, *h3* 18–25, *ps1* 15–24, *ps2* 12–24, *ps3* 17–20, *la* 26–34, *3a* 20–39, *4a* 14–24, *4b* 18–26 and *g* 8–14. Width of opisthosomal lobe at base 75–83. Maximal distance between opisthosomal lobes 12–22. Terminal membrane 6–12 long, its margin with rounded indentations. Legs III and IV 118–142 and 99–119 long, respectively, and about 19–22 and 15–19

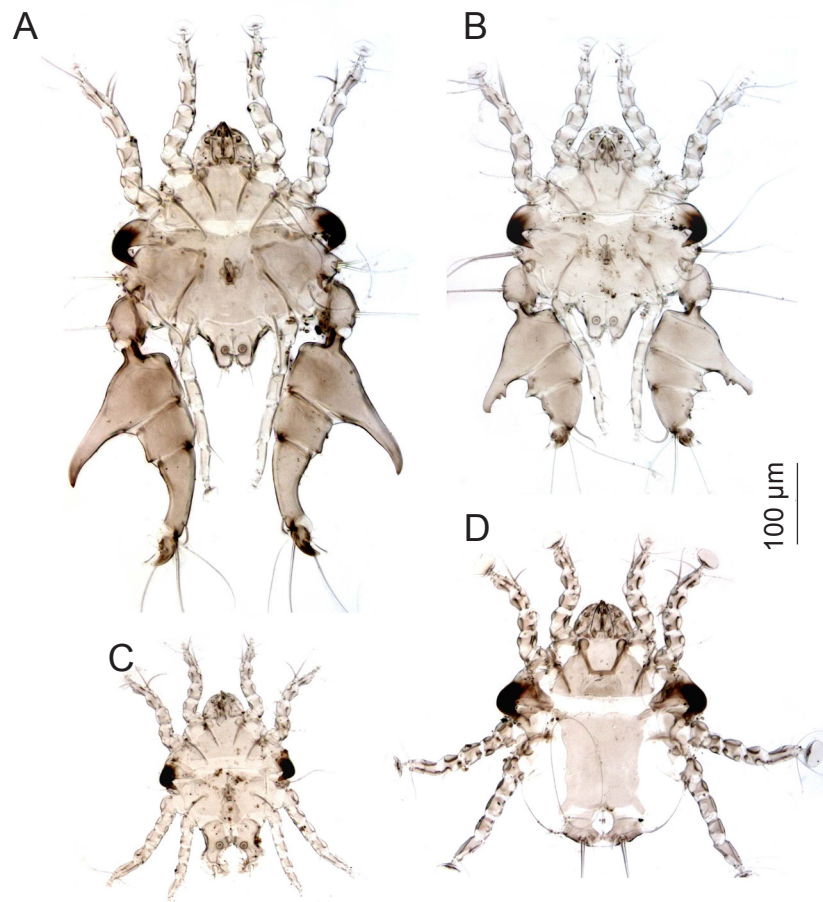


**Fig. 7.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, female. **A** – ventral view; **B** – dorsal view; **C** – spermatheca.



**Fig. 8.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, scanning electron micrographs, dorsal view. **A** – heteromorphic male; **B** – female.





**Fig. 9.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, photomicrographs. **A** – heteromorphic male; **B** – mesomorphic male; **C** – homeomorphic male; **D** – female.

wide, respectively. Setae *s*III 24–43 long. Tarsi III and IV 34–40 and 26–33 long, respectively. Lengths of solenidia:  $\sigma$ I 38–48,  $\sigma$ II 27–39,  $\phi$ I 31–41,  $\phi$ II 49–58,  $\phi$ III 15–25,  $\phi$ IV 15–21,  $\omega$ I 11–16,  $\omega$ II 31–39,  $\omega$ 3I 19–29.

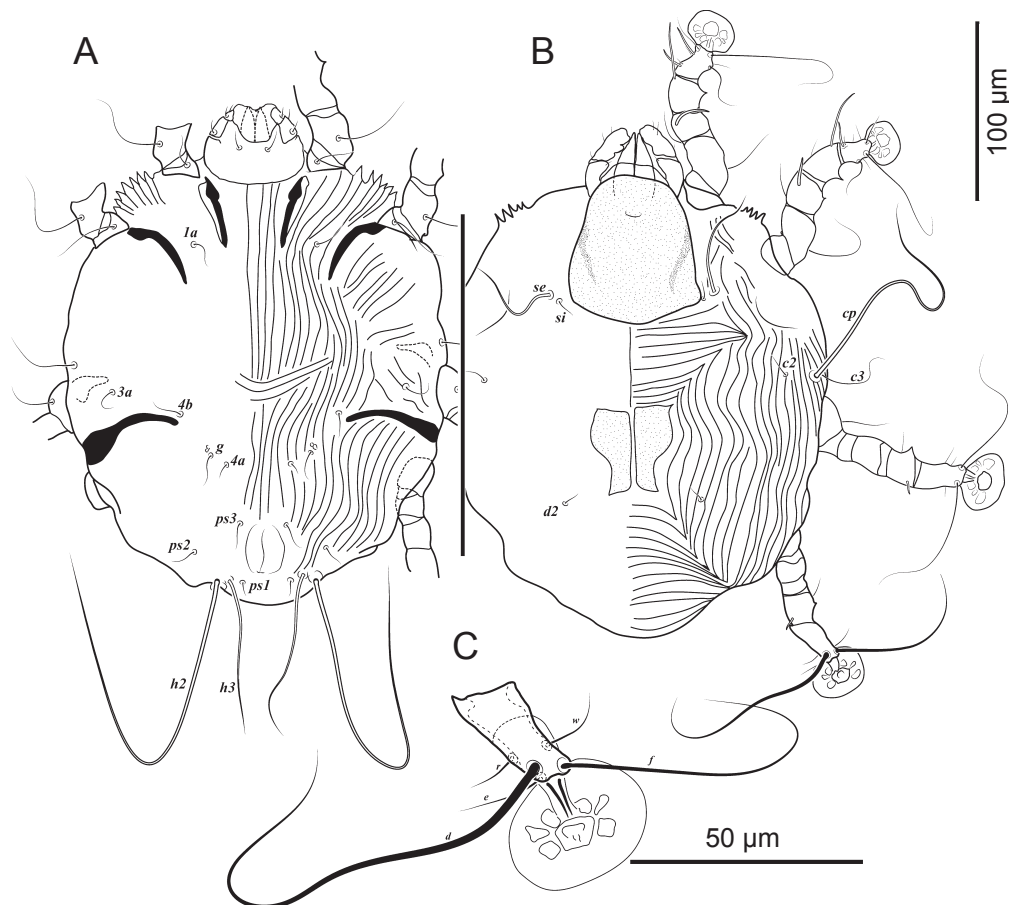
**Female** (8 paratypes, Figs. 7, 8B, 9D). Body 265–310 long and 195–230 wide. Idiosoma 236–272 long. Propodonal shield trapezium-shaped, 77–84 long and 125–140 wide, with sinuous lateral margins and straight posterior margin. Distance between propodonal and hysteronotal shields along midline 17–26. Setae *se* 59–78 long, setae *si* 11–20 long about 16–18 posterior to level of setae *se*. Distance *se*–*se* about 96–105, *si*–*si* 95–105. Humeral shields bearing setae *c*2 90–99 long, *cp* 115–150 long and *c*3 44–67 long. Small metapodosomal sclerites present immediately posterior to humeral shields. Hysteronotal shield 110–125 long and 115–125 wide at midlevel, bearing setae *d*2 6–13 long. Posterior margin of opisthosoma widely rounded. Coxal fields III open. Genital papillae situated near inner tips of apodemes IIIa. Lengths of setae: *h*2 190–240, *h*3 80–110, *ps*1 16–25, *ps*2 23–35, *ps*3 21–30, *la* 24–26, *3a* 20–35, *4a* 15–18, *4b* 8–14 and *g* 15–23. Legs III and IV 120–145 and 120–140 long, respectively. Tarsi III and IV 39–54 and 34–44 long, respectively. Length of solenidia:  $\sigma$ I 31–43,  $\sigma$ II 17–33,  $\phi$ I 37–40,  $\phi$ II 43–50,  $\phi$ III 8–12,  $\phi$ IV 8–10,  $\omega$ I 13–18,  $\omega$ II 23–28,  $\omega$ 3I 20–26.

**Tritonymph** (2 paratypes, Fig. 10). Body 275–280 long and 203–205 wide. Idiosoma 240–250 long. Propodonal shield 73–81 long and 69–70 wide, posterior margin convex. Distance between propodonal and hysteronotal shields in midline 46–51. Setae *se* 42–51 long, setae *si* 7–10 long about 8 posterior to level of setae *se*. Distances *se*–*se* about 89–89, *si*–*si* 78–79. Humeral shields absent. Hysteronotal shield small, narrowed posteriorly, dissected longitudinally, 44–45 long and 43–45 wide at midlevel. Posterior margin of opisthosoma widely rounded. Coxal fields III opened. Lengths of setae: *cp* 120–130, *c*3 35–48, *d*2 5–10, *h*2 190–200, *h*3 64–69, *ps*1 10–10, *ps*2 10–13, *ps*3 12–19, *la* 12–17, *3a* 14–16, *4a* 9–11, *4b* 9–12, and *g* 16–18. Legs III and IV 88–94 and 85–93 long, 16–17 and 14–15 wide, respectively. Tarsi III and IV 25–27 and 22–27 long, respectively. Length of solenidia:  $\sigma$ I 25–27,  $\sigma$ II 33–37,  $\phi$ I 24–27,  $\phi$ II 7–10,  $\phi$ III 10–11,  $\phi$ IV 5–6,  $\omega$ I 11–12,  $\omega$ II 12–18,  $\omega$ 3I 20–25.

**Type host:** Guira cuckoo *Guira guira* (Gmelin) (Cuculiformes: Cuculidae).

**Type locality:** Universidade Estadual de Campinas (UNICAMP; 22°54'S; 47°03'W), Campinas, São Paulo, Brazil.

**Type-material:** Heteromorphic male holotype (No. 1111), 5 heteromorphic male, 8 mesomorphic male, 6 homeomorphic male, 16 female and 2 tritonymph paratypes, 10 September 2010, Campinas, Brazil, coll. D. Vilas Boas-Filho, deposited



**Fig. 10.** *Carcinopodacarus polymorphus* gen. n. et sp. n. from *Guira guira*, tritonymph. **A** – ventral view; **B** – dorsal view; **C** – tarsus IV in dorsal view.

at DZUnesp-RC; 4 heteromorphic male, 5 mesomorphic male, 2 homeomorphic male and 14 female paratypes are at ZISP; 1 heteromorphic male, 2 mesomorphic male, 1 homeomorphic male and 2 female paratypes are at UMMZ.

**E t y m o l o g y :** The specific epithet reflects the presence of different morphs found in males; it is an adjective in the nominative singular.

**Remarks.** In the superfamily Analgoidea, mostly represented by feather mites, male polymorphism is very common and involves hypertrophy of the various parts of the male body, i.e. legs I, chelicerae, legs III, etc. (Proctor et al. 2009). In dermationids, however, the andropolymorphism had never been recorded before this investigation. The true polymorphism supposes the presence of genetic differences among recognised morphs (Mayr 1969). Notwithstanding, most cases of male ‘polymorphism’ in Acariformes so far investigated in this aspect have shown no genetic basis whatsoever (Regev 1974, Timms et al. 1981, Radwan 1995) and strictly speaking they cannot be named by this term. Nevertheless, this term is widely used by most acarologists for aims of utilitarian systematics.

Among acariform mites, most reported cases are represented by the continuous male polymorphism, because intermediate forms, even if rarely, can be found. In the Analgoidea, the discrete male polymorphism (dimorphism), when extreme morphs are strongly different from each other and intermediate forms do not exist, was recorded

only in a few genera, for example: *Zygochelifer* Atyeo, 1984 and *Bregetovia* Dubinin, 1951 (Avenzoariidae), and *Allopsoroptoides* Mironov, 2013 (Psoroptoididae) (S.V. Mironov, Zool. Inst., RAS, St. Petersburg – pers. comm.). No genetic studies were undertaken, however, to identify the nature of polymorphism in these mites.

In systematics of acariform mites, despite the lack of the genetic basis and the continuous nature of ‘polymorphism’, the separate description of male morphs (homeo-, meso-, and heteromorph) is the common and quite justified practice allowing to provide appropriate taxonomic descriptions because of rarity of intermediate forms. In our case, we did not examine mites genetically and have not enough material to statistically prove whether this polymorphism is continuous or discrete. However, the presence of ‘mesomorphic’ males in our material suggests that we are dealing with continuous polymorphism as in the most cases among analgoid mites.

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