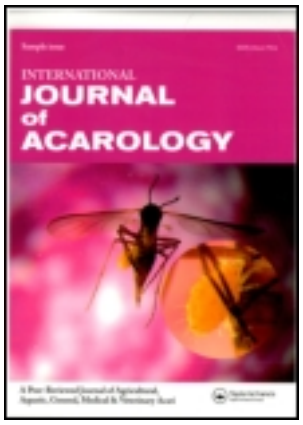

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The family Carabodidae (Acari: Oribatida) V. The genus Congocepheus (first part) with redescriptions of Congocepheus heterotrichus Balogh 1958, Congocepheus orientalis Mahunka 1987 and Congocepheus hauseri Mahunka 1989

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The family Carabodidae (Acari: Oribatida) V. The genus *Congocepheus* (first part) with redescriptions of *Congocepheus heterotrichus* Balogh 1958, *Congocepheus orientalis* Mahunka 1987 and *Congocepheus hauseri* Mahunka 1989

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Congocepheus heterotrichus Balogh 1958, *Congocepheus orientalis* Mahunka 1987 and *Congocepheus hauseri* Mahunka 1989 are redescribed and illustrated based on adult specimens, using optical microscopy. Detailed descriptions are given of the three species, but detailed leg studies are available only for specimens of *C.orientalis* and *C.hauseri.* Several errors in the original descriptions are addressed.

Keywords: Acari; Oribatida; Carabodidae; *Congocepheus heterotrichus*; *Congocepheus orientalis*; *Congocepheus hauseri*; Redescriptions

Introduction

We initially set out to revise the genus *Congocepheus* based on a redescription of the type species *Congocepheus heterotrichus* Balogh 1958, with the addition of descriptions of two new species. However, due to the complexity found within the group, we deemed it necessary to study several other species in order to understand the diagnostics of the genus. A decision was made to divide the work into three parts. In part one (this paper) we redescribe *C. heterotrichus* Balogh 1958*, Congocepheus orientalis* Mahunka 1987 and *Congocepheus hauseri* Mahunka 1989. In the second part, we will redescribe *Congocepheus involutus* Mahunka 1997 and describe two new species, and in the third part we will describe two new species and establish a new status for the genus *Congocepheus*.

The genus *Congocepheus* is presently represented by eight species: *C. heterotrichus* Balogh 1958 as type species; *C. hauseri* Mahunka 1989; *C. involutus* Mahunka 1997; *Congocepheus latilamellatus* Mahunka 1984; *C. orientalis* Mahunka 1987; *Congocepheus ornatus* Mahunka 1983; *Congocepheus taurus* Balogh 1961 and *Congocepheus velatus* Mahunka 1986 (Subías 2004, updated May 2013).

Material and methods

Specimens studied by means of light microscopy were macerated in lactic acid, and observed in the same medium using the open-mount technique (cavity slide and cover slip) as described by Grandjean (1949) and Krantz and Walter (2009). Drawings were made using an Olympus BHC (Rungis, France) compound microscope equipped with a drawing tube.

Measurements taken: total length (tip of rostrum to posterior edge of notogaster); width (widest part of notogaster) in micrometres (μm).

Leg chaetotaxy studies done by using standard, polarized and phase contrast microscopes, are provisory, as only a few adult specimens were available.

Setal formulae of the legs include the number of solenidia (in parentheses); tarsal setal formulae include the famulus (ε).

Morphological terminology

Morphological terms and abbreviations used are those developed by F. Grandjean (1928–1974) (cf. Travé and Vachon 1975); Norton and Pelletier (in Krantz and Walter 2009) and Fernandez et al. (2013).

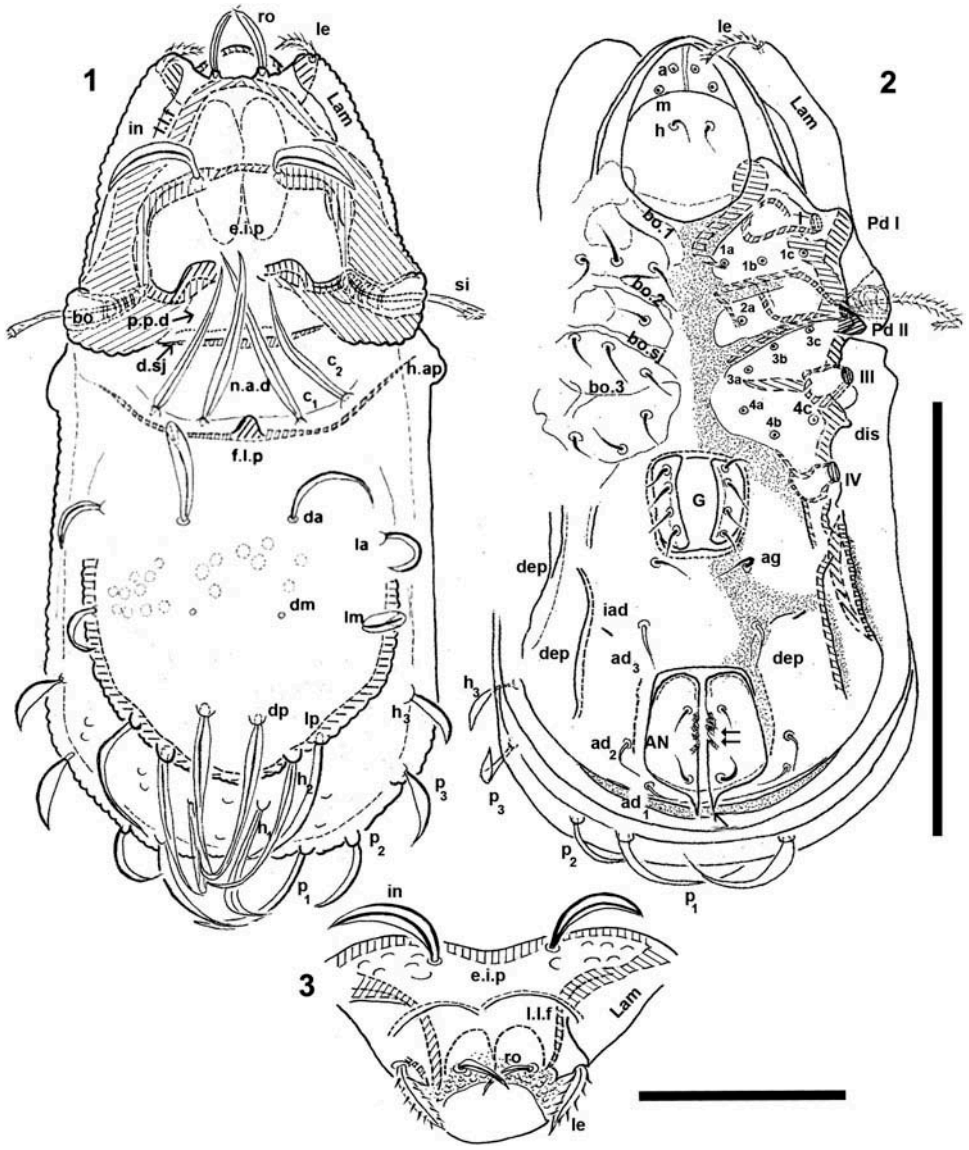
For setal types refer to Evans (1992, p. 73); ornamentation of cuticular surfaces Murley (1951*ex*: Evans 1992, p. 9) and for median eye Coineau (1970, 1974).

We add the following to terminology used in previous papers (see above): finger-like projection (*f.l.p*).

Redescriptions of taxa

Type species ***Congocepheus heterotrichus*** Balogh 1958 (Figures 1–8)

Original description, Balogh 1958; redescription, Mahunka 1986.



Figures 1–3. *Congocepheus heterotrichus* Balogh 1958, adult. 1. dorsal view. 2. ventral view. 3. frontal view.
Notes: Abbreviations: see section "Material and methods". Scale bar: 1–3 = 100 μm.

Material examined

Paratype: Congo, district du Kasai, Rivière Luebo, entre Tshikapa et Luluabourg, forêt equatoriale, 14.IX.1955, deposited Muséum d'Histoire Naturelle, Genève.

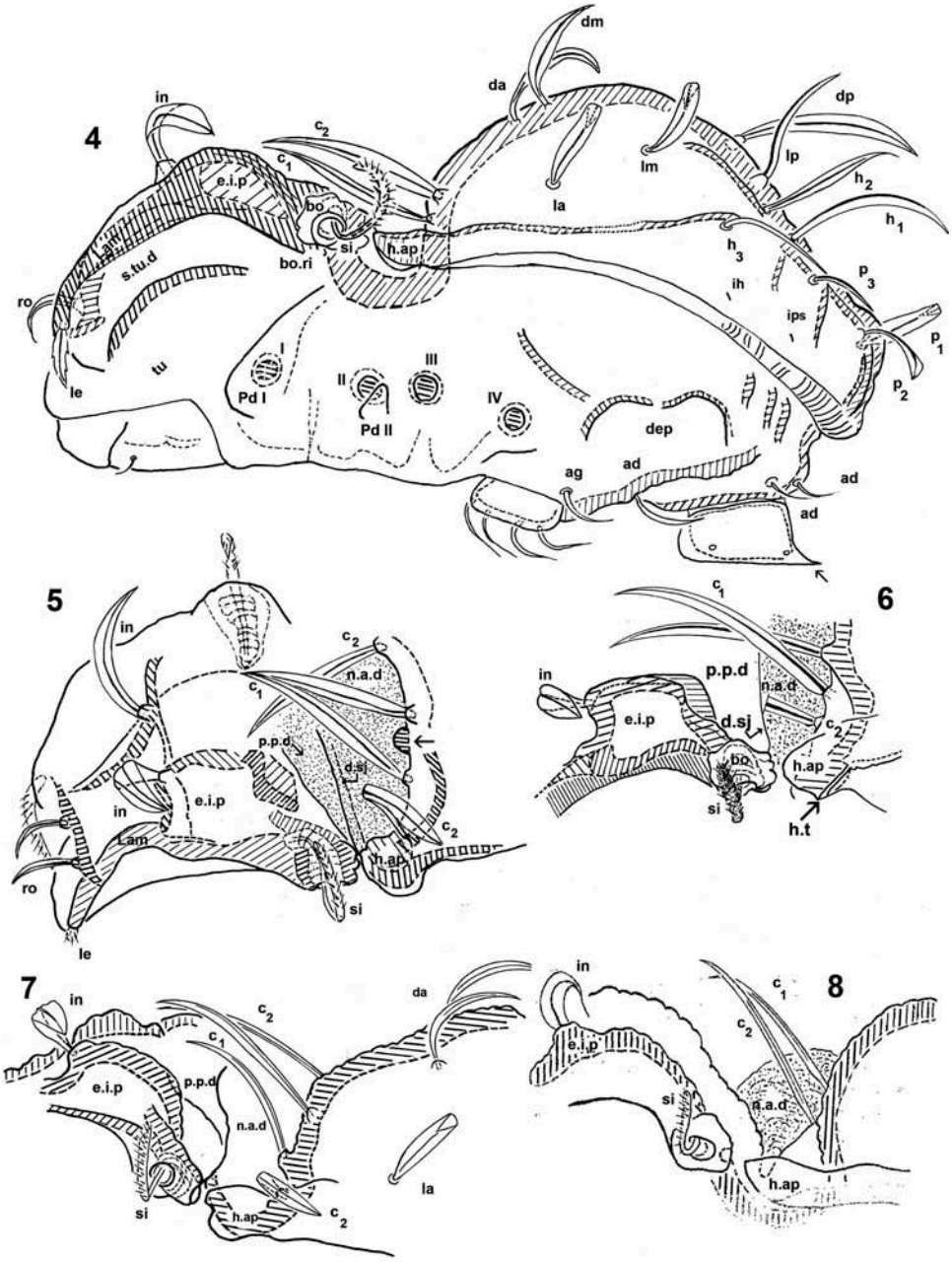
Redescription of adult

Diagnosis (adult female)

Setation: *lanceolate*: notogastral, adanal, *in*, *ro*; *barbate*: *le*; *simple*: epimeric, genital, aggenital, anal. Rostral setae directed forward. Interlamellar setae inserted on elevated interlamellar process directed laterally. Lamellar setae, lateral; *in* > *le* > *ro.* Notogastral setae, 14 pairs (c_1, c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2, h_3, p_1, p_2, p_3); c_1 and c_2 extending forward exceeding *d.sj* and *dp*; *lp*, h_1, h_2, h_3, p_1, p_2, p_3 always directed backwards.

Prodorsum, polyhedral (dorsal view); convex (lateral view); posterior zone depressed, induced by notogastral anterior depression (*n.a.d*); rostral margin, rounded; entire interlamellar process elevated; lamellae laterally; shallow lamellar furrow present; bothridial ring and bothridial tooth, present; sensillus uncate. Notogaster: anterior rectangular and posterior oval; in lateral view anterior part depressed; rest convex in shape; *d.sj* narrow, well delimited, curving slightly backward; anterior notogastral depression conspicuous, ovoid, extending forward exceeding *d.sj* up to posterior prodorsal zone; between c_1 seta, *f.l.p* present; circumgastric depression present, hardly discernible.

Tutorium, supra-tutorial depression, Pedotecta I, II and discidium, present; humeral apophysis (*h.ap*) triangular, basally slightly curved; anterior tip overlapping posterior bothridial zone. Lyrifissures, *ih* and *ips* clearly visible.



Figures 4–8. *Congocepheus heterotrichus* Balogh 1958, adult. 4. lateral view; 5. dorsal inclined to ventral; 6. same anterior view (5) positioned laterally, slightly inclined to ventral; 7. posterolateral view; 8. same anterior view, positioned laterally, posterior slightly inclined to ventral.

Notes: Abbreviations: see section "Material and methods". Scale bar: 4–8 = 100 μm.

Apodemes 1, 2, sejugal and 3 easily discernible. Epimeric chaetotaxy 3-1-3-3. Anterior genital furrow present. Four pairs of genital setae, three pairs of adanal setae. Anal setae two pairs. Anal plate ending in sharp tip. Lyrifissures *iad* present situated antriaxially to ad_3. Polyhedral depressions at level of genital and anal openings.

Description (adult female)

Measurements: Length 371 μm, width: 214 μm.

Shape: ovoid.

Colour: specimens without cerotegument, brown, slightly shiny when observed in reflected light.

Cerotegument: Remnants only, visible laterally behind legs, amorphous.

Integument: Prodorsal microsculpture: *irregularly tuberculate*: *bo*, lamellae, elevated interlamellar process (*e.i.p*); *slightly foveate-puncticulate*: central zone, near *dsj*; *smooth to alveolate*: zone near *in* setae, and between *e.i.p* and rostral setae insertion.

Notogastral microsculpture*: slightly foveate-puncticulate*: *n.a.d* zone; *foveate*: *h.ap*, notogaster (central dorsal zone).

Lateral microsculpture: *slightly foveate-puncticulate*: at level of Pd I, sejugal, and depressed zones (*dep*).

Ventral microsculpture: *slightly foveate*: epimeric zone (hardly discernible), genital and anal plate; *puncticulate*: epimeric furrows (Figure 5), and around genital and anal opening; *irregularly areolate*: epimeres and subcapitulum.

Setation: Lanceolate: in, *ro,* notogastral, adanal; *barbate*: *le*; *simple*: epimeric, genital, aggenital and anal.

Prodorsum: Polyhedral (dorsal view) (Figure 1); convex in lateral view (Figure 4); entire interlamellar process (*e.i.p*) elevated (Figures 1, 4, 5, 6 and 8). Posterior prodorsal zone depressed (*p.p.d*) due to *n.a.d* (Figures 1 and 5). Three pairs of setae; size *in* > *le* > *ro* (Figures 1 and 2). *Ro* setae, inserted slightly antiaxial to medial plane; directed forward and converging; each apical tip touching the other (Figures 1 and 2); *in* setae, inserted on *e.i.p,* antiaxially to medial plane and slightly external to *ro* insertion level; lateral externally directed, not exceeding prodorsal margin (Figures 1 and 5); *le*, setae laterally (Figures 3 and 4). Rostral margin rounded (Figure 1). Lamellae running laterally; anterior dorsal zone of prodorsum a shallow furrow (*l.l.f*) (Figure 3) demarcating inner paraxial margin; this furrow presents as a slightly darker zone in bleached animals. The *l.l.f* ending in the internal zone of inconspicuous lamellar apex (*la.ti*).

Notogaster: Shape: in dorsal view anterior part rectangular and posterior part oval (Figure 1); in lateral view, anterior part clearly depressed and rest convex (Figure 4); *d.sj* narrow, curving slightly backwards, well delimited (Figure 1); *n.a.d*, ovoid and prominent, extending forwards and exceeding *d.sj* up to basal central zone of prodorsum (*p.p.d*); posterior zone of *n.a.d*, between c_1 setae, *f.l.p*, clearly visible.

Circumgastric depression (*s.c*) present, hardly discernible (Figure 1) situated at level of notogastral lateral setal insertion (p_1, p_2, p_3, h_3).

Fourteen pairs of setae (c_1, c_2, *da*, *dm*, *dp*, la, lm, *lp*, h_1, h_2,h_3, p_1, p_2, p_3) similarly shaped; c_1 and c_2 extending forward exceeding *d.sj*; *dp*, *lp*, h_1, h_2, h_3, p_1, p_2, p_3 always directed backward.

Lateral region: Tutorium (*tu*) clearly visible as a strongly curving cuticular thickening (Figure 4). Between lamellae and tutorium a deep supratutorial depression (*s.tu.d*) running parallel to both structures (Figure 4).

Bothridia cup-shaped with smooth bothridial ring (*bo.ri*); *bo.ri* incomplete with bothridial tooth (*bo.to*), hardly discernible (Figure 4). Sensillus uncate arching to the top, tips usually pointed, more coarsely barbed on lateral edge (Figures 4–6).

Pedotectum I, prominent extended lamina covering the first acetabulum. Pedotectum II, a small polyhedral lamina, rounded edges. Sejugal depression slightly deeper than normal; clearly visible (Figure 4). Humeral apophysis more or less triangular; basally slightly curved; anterior tip overlapping posterior bothridial part (Figure 4); bearing rodlike cuticular ridge across *h.ap*, hardly visible (*h.t*). (Figure 6, indicated by arrow), delimited by a shallow furrow.

Observations were made from several different lateral positions (Figures 5–8) in order to clarify the relative position, shape and disposition of different prodorsal and notogastral structures and setae (*ro*, *le*, *in*, *bo*, *e.i.p*, *lam*, *h.ap*, *d.sj*, *p.p.d*, *n.a.d*, *f.l.p*, c_1, c_2).

Only lyrifissures *ih* and *ips* clearly visible (Figure 4). Discidium hardly discernible.

Several depressions (*dep*) are easily discernible at level of genital and anal openings (Figure 4).

Ventral region: (Figure 2): Epimera 1 and 2 distinctly defined by conspicuous shallow furrows; 3 and 4 not obviously separate; *apo.*1, *apo.*2, apo.sj and *apo.*3 clearly visible (Figure 2). Epimeral chaetotaxy 3-1-3-3; on examined material, the length of *1a*, *2a*, *3a* shorter than all others, but the setae are probably broken!

Genital plate small compared to anal plate; anal plate sharply tipped (Figure 2, simple arrow); paraxial border anal plates irregular with small teeth (Figure 2, indicated by double arrow).

In front of the genital plate a furrow (*a.g.f*) is clearly visible. Four pairs of genital setae in a line. Aggenital setae posterolaterally near posterior opening genital border (Figure 2).

Three pairs of adanal setae; ad_3 setae, inserted posterior and somewhat antiaxial to aggenital setal insertion level; lyrifissures *iad* clearly visible, situated antiaxially and not far from ad_3. Two pairs of anal setae. Many polyhedric depressions (*dep*) at level of anal and between anal and genital plates.

Remarks

Mahunka's redescription (1986, p. 120) contains several errors. Mahunka indicated "Balogh, 1985, p. 21", the correct citation should be "Balogh 1958, p. 21"; Mahunka also indicated that the material is deposited at MRAT. We have been unable to trace acronyms used by Mahunka (1986). The acronym probably refers to the Musée Royal de l'Afrique Centrale (MRAC), and MRAT presumably indicates the city were this Museum is situated (Tervuren, Belgium). We contacted the Musée Royal de l'Afrique Centrale (MRAC), and the reply was: "The material does not exist in the MRAC" (personal contact by e-mail 13/XI/2009 with MRAC mite curator, confirmed by an online search of the internet database of MRAC http://www.metafro.be/acari. The species *C. heterotrichus* is indicated: "No species found".

This situation causes a major problem, because the holotype and 30 paratypes are listed as deposited in MRAT and at present their location is unknown. The

other 30 paratypes deposited in the Hungarian Natural History Museum (HNHM) were not accessible and we were unable to obtain the material on loan. One hundred and three specimens, including the holotype, 62 paratypes and 40 other specimens (without indication of where these are deposited) were inaccessible and we could study only the two type specimens deposited in Muséum d'Histoire Naturelle, Genève. With only these two specimens, it was impossible to produce a detailed study of legs or to apply scanning electronic microscopy (SEM), while poor condition of specimens made it impossible to measure setae and to give setal and solenidial formulae. For these reasons our study of *Congocepheus* should be considered partial.

Taxon redescription

Congocepheus orientalis, Mahunka 1987
Figures 9–34

Material examined

Holotype, Sab82-27. Leg.B.Hauser; 1 Paratype, same date and locality, 10 other non-types Brunei 1988. Ungai Liang. Leg.B.Hauser. Deposited in the Muséum d'Histoire Naturelle, Genève.

Diagnosis

Setation: *barbate: le*; *lanceolate slightly dentate*, interlamellar, notogastral, subcapitular, epimeric, aggenital; *lanceolate smooth/slightly coarse*: rostral, adanal, genital; *simple*: anal. Rostral setae directed forward; interlamellar setae inserted on depressed central zone of elevated interlamellar process, directed exteriorly; lamellar setae lateral; 14 pairs of notogastral setae (c_1,c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2,h_3, p_1, p_2,p_3), extending forward; c_1 and c_2 inserted close to each other.

Prodorsum polyhedral (dorsal view), triangular in lateral view; complete elevated interlamellar process; posterior prodorsal zone depressed, large *in* setae extending externally; rostral margin rounded; lamellae laterally; lamellar tip (*la.ti*) extending to *le* setae insertion; shallow lamellar furrow clearly visible; bothridial ring and bothridial tooth present; sensillus barbate.

Notogaster dorsal view: anterior part rectangular, posterior oval; in lateral view anterior part depressed, rest convex; *dsj* clearly delimited, curving backwards; *n.a.d* ovoid, extending forward up to posterior zone of prodorsum and exceeding width of *d.sj*; *n.a.d* small in relation to posterior prodorsal depression; *f.l.p* present; circumgastric depression present.

Tutorium, supratutorial depression, Pedotecta I, II and discidium present; *h.ap* ovoid, anterior tip overlapping posterior of bothridia; lyrifissures not discernible; anterior genital furrow present; apodemes 1, 2, sejugal and 3 clearly visible; epimeric chaetotaxy 3-1-3-3; genital setae 4; adanal setae 3; anal setae 2. Anal plate terminating in long sharp tip.

Description

Type material: one male and one female; material measured three of each gender.

Measurements: Males, length 500 µm (486–580); width 260 µm (257–320). Female, length 520 µm (510–598), width 283 µm (260–341) (on Sabah type specimen and 3 Brunei non-type specimens).

Shape: ovoid.

Colour: specimens without cerotegument, brown; slightly shiny when observed in reflected light.

Cerotegument: Amorphous, only some residue visible.

Integument: Prodorsal microsculpture: *irregularly tuberculate: bo*, lamella, *e.i.p*; *faintly tuberculate–puncticulate*: near *in* setae insertions, between *e.i.p* and *ro* setae insertion (Figure 9); *puncticulate:* depressed zone posterior zone *e.i.p* (Figure 9).

Notogastral: prominent protuberances and ridges (Figures 9, 12 and 15).

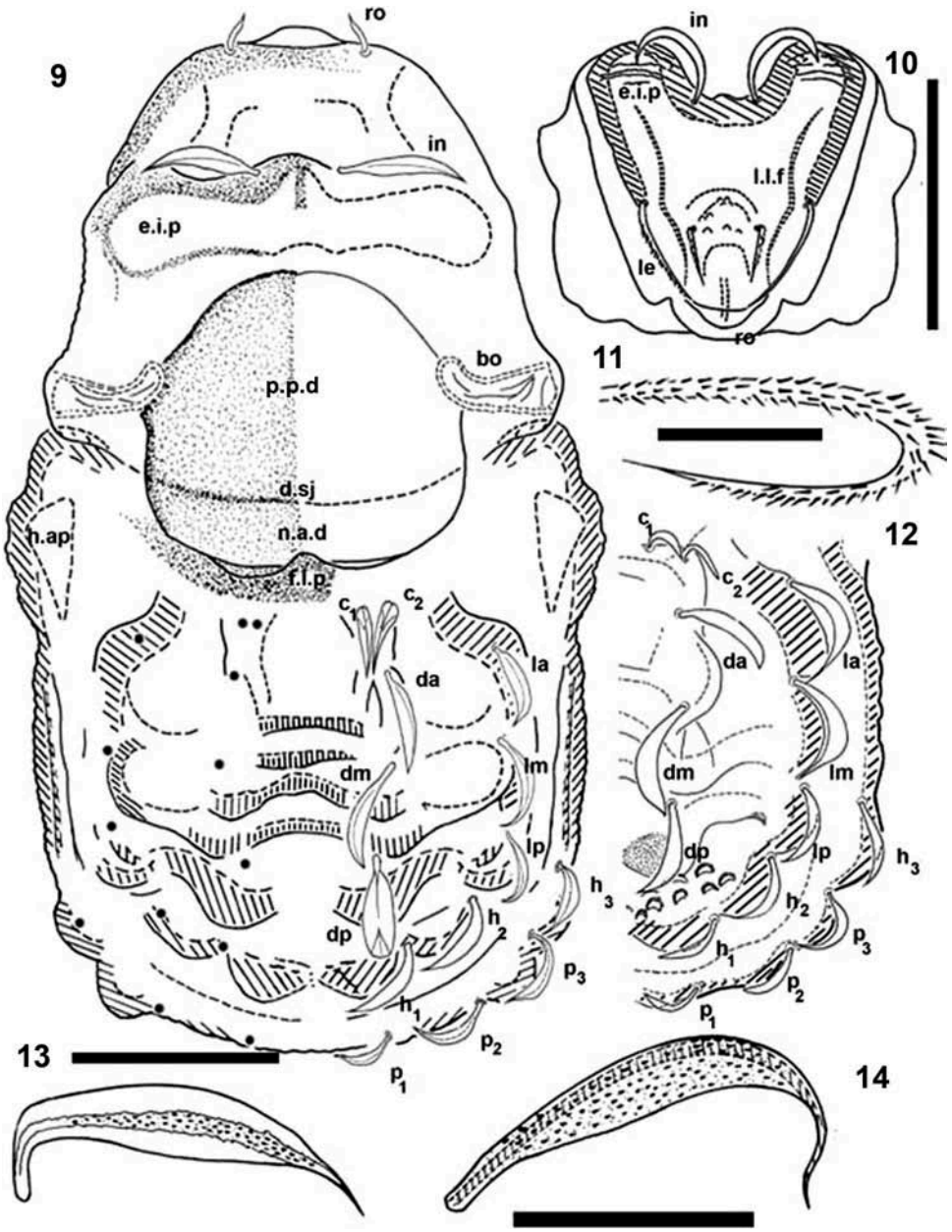
Large protuberances with three zones clearly visible (Figure 18), superior layer translucent; middle layer darker; inferior layer dark, dotted with small round to irregular points; both layers (middle and inferior) clearly differentiated. *Slightly puncticulate*: *n.a.d*, *f.l.p*, *h.ap* (Figure 9); *Slightly foveate:* posterior part notogaster (Figure12), more obvious on female.

Lateral microsculpture: Protuberances clearly visible on notogaster (Figure 15). Ridges, of different sizes: prodorsum, notogaster. *Puncticulate*: Pd I, Pd II, sejugal zone, *dep* (Figure 15).

Ventral microsculpture: *Small protuberances*: subcapitulum, epimeric zone, near genital and anal opening, sometimes hardly discernible (Figure 20); *puncticulate*: epimeric furrows, *dep* and around genital and anal opening (Figure 20).

Setation: Barbate: *le*, (Figure 16). *Lanceolate faintly dentate*: interlamellar, notogastral, subcapitular, epimeric, aggenital (Figures 13, 14 and 20–25); *lanceolate: smooth/slightly coarse:* rostral, adanal, genital (Figures 17, 26 and 27); *simple*: anal (Figure 28).

Prodorsum: Polyhedric to oval (in dorsal view) (Figure 9); triangular in lateral view (Figure 15); *e.i.p* complete (Figure 9); medial zone depressed (clearly visible in frontal view) (Figure 10); posterior zone of prodorsum depressed (*p.p.d*), this depression is the extension of the *n.a.d* due to the *n.a.d* crossing the *dsj*, and reaching the posterior prodorsal zone (Figure 9). The extension of *p.p.d* is more prominent than *n.a.d*. Three pairs of setae, size *in* > *le* > *ro*. *Ro* setae directed forward (Figure 10), situated far from each other; inserted slightly antiaxially to *in* setae insertion level and more or less at the level of *le* setae insertion (Figure 15); *in* setae inserted in depressed zone



Figures 9–14. *Congocepheus orientalis* Mahunka 1987, adult. 9. dorsal view male; 10. frontal view male; 11. sensillus, male; 12. notogaster, dorsal view, female; 13. interlamellar setae, male; 14. notogastral setae, male.

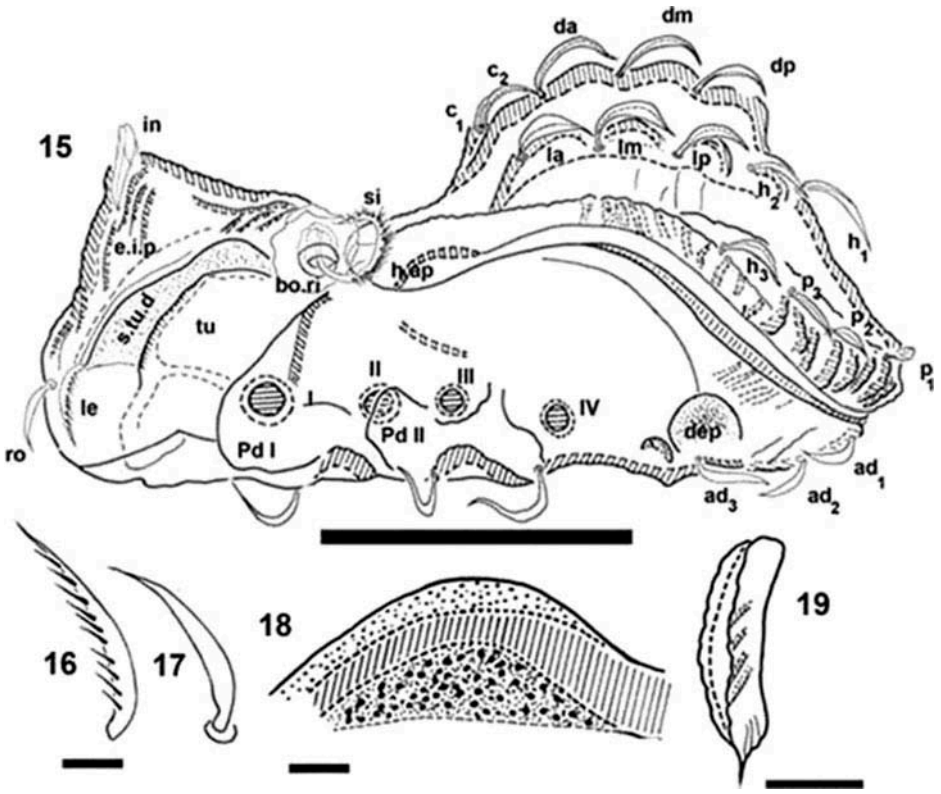
Notes: Abbreviations: see section "Material and methods". Scale bar: 9, 10, 12 = 100 μm; 11 = 20 μm; 13, 14 = 50 μm.

of *e.i.p,* directed externally (Figures 9 and 10). Rostral margin rounded (Figures 9 and 10). Lamellae, running laterally; *la.ti* far from *le* setae insertion level (Figure 10); lamellae well-defined dorsally by *l.l.f* ending internal zone of conspicuous *la.ti* (Figure 10). Bothridia cup-shaped with smooth, incomplete *bo.ri*; *bo.to* present, slightly visible. Sensillus, barbate, arching to the top, tips usually pointed (Figures 11 and 15).

Cornea superior of naso (*cso*) presumably situated between and slightly in front of *ro* setae (Figure 10).

Notogaster: Shape: in dorsal view, anterior rectangular and posterior oval (Figure 9); in lateral view, anteriorly clearly depressed and rest convex (Figure 15); *d.sj* narrow, curving to rear, well delimited (Figure 9); *n.a.d*, ovoid, extending forwards and exceeding width of *d.sj* up to posterior zone of prodorsum as *p.p.d* (Figure 9). Middle posterior zone *n.a.d* with *f.l.p* clearly visible; *s.c* present, easily discernible, situated antiaxially to *la*, *lm*, *lp*, h_2, h_1 setal insertion level (Figures 9 and 12).

Fourteen pairs of setae (c_1, c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2,h_3, p_1, p_2, p_3) similarly shaped (Figure 9); all setae extending backward; c_1 and c_2 setae smallest of all; situated close to each other (Figure 9); in male, insertion level almost parallel (Figure 9); in female, setae smallest and generally inserted



Figures 15–19. *Congocepheus orientalis* Mahunka 1987, adult male. 15. lateral view; 16. lamellar setae; 17. rostral setae; 18. notogastral protuberance, lateral view; 19. genital plate, lateral view.

Notes: Abbreviations: see "Material and methods". Scale bar: 15 = 100 μm; 16, 17 = 10 μm; 18 = 5 μm; 19 = 25 μm.

one behind the other (Figure 12); *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2, h_3, p_3 similar size; p_1, p_2 slightly smaller.

Lateral region: Prodorsum: *in* setae clearly visible on elevated *e.i.p*; *lam*, well discernible; *tu* strongly curving cuticular thickening (Figure 15); *s.tu.d* running between *lam* and *tu* (Figure 15). Pedotectum I, prominent extending lamina covering the first acetabulum; posterior zone with oblique ridge. Pedotectum II, a small rectangular lamina, rounded edges. Discidium hardly discernible. Bothridial opening directed downwards; smooth *bo.ri* and *bo.to* present (Figure 15).

Humeral apophysis ovoid; anterior tip overlapping posterior bothridial zone (Figure 15). Lyrifissures, hardly discernible due to oblique ridges (Figure 15). Discidium hardly discernible. Several depressions (*dep*) clearly discernible at level of genital and anal openings (Figure 15). Anal plate terminating in long sharp tip (Figure 19).

Ventral region: Epimeres 1 and 2 distinctly defined by furrows; 3 and 4 not clearly separate; *apo.*1, *apo.*2, *apo. sj* and *apo.*3 clearly visible (Figure 20). Epimeral chaetotaxy 3-1-3-3; setae 1*a*, 1*c,* 2*a*, 3*a* short. Discidium clearly visible (Figure 20).

Genital plate small in comparison to anal plate; anal plate terminating in sharp tip. Towards the front of genital plate, *a.g.f* present. Four pairs of aligned genital setae. Aggenital setae posterolateral, far from posterior border of genital opening (Figure 20).

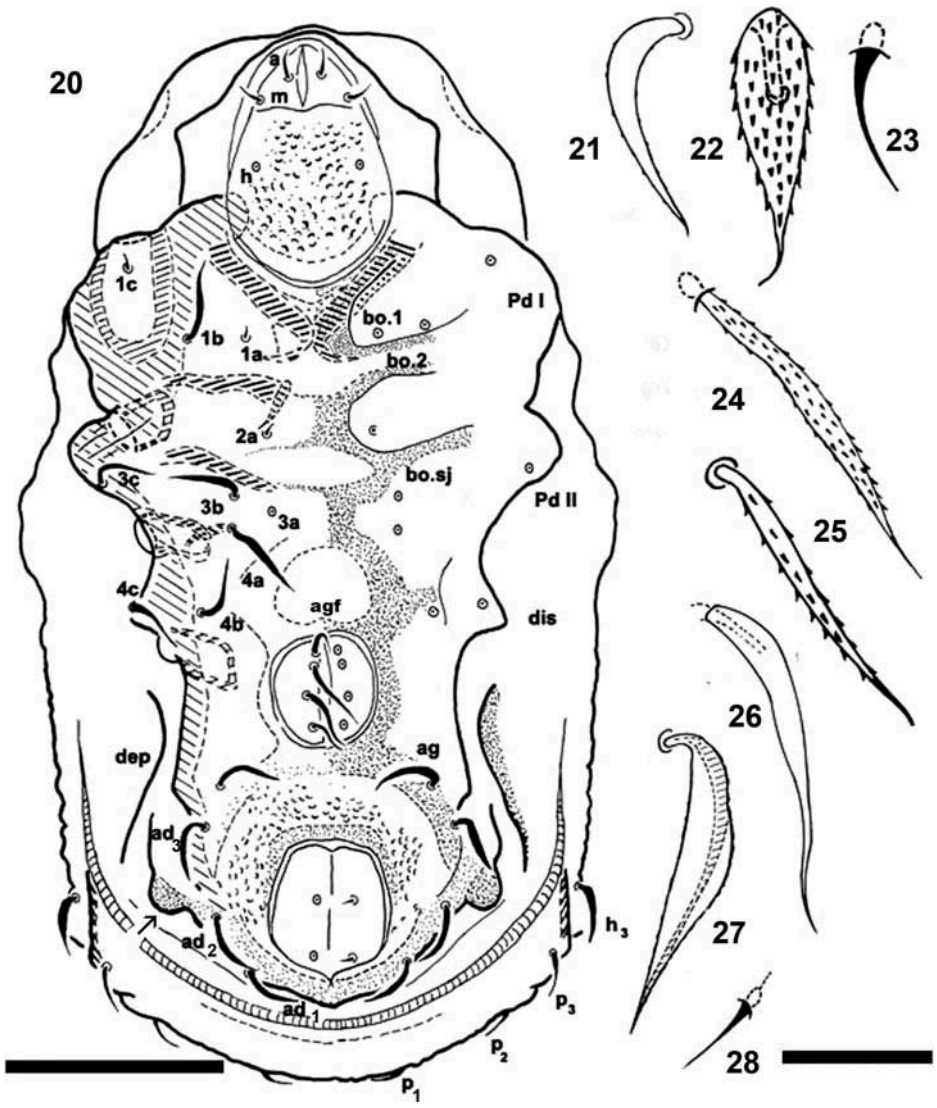
Three pairs of adanal setae; ad_3 setae posterior and inserted slightly antiaxially to aggenital seta insertion; prominent rounding behind ad_3 (Figure 20, indicated by arrow); lyrifissures *iad* not visible. Two pairs of anal setae. Many polyhedral depressions (*dep*), lateral to level of anal and genital plates. (Figure 20).

Legs (Figure 29–34): All legs monodactyle. Setal formulae I (1-4-3-4-17) (1-2-2); II (1-4-3-3-15) (1-1-2); III (2-3-1-2-14) (1-1-0); IV (1-2-2-2-12) (0-1-0). (See Table 1 and "Discussion".)

Setae l″ on femur and genua I and II, are particular (Figures 29 and 30), but with slight differences in shape (Figures 33 and 34)

Remarks

Mahunka's description (1987) was rather superficial, and the illustration in lateral view was unusable. We determined that several morphological characteristics were ignored, while detailed consideration was not given to varied shapes of setae (rostral, lamellar, subcapitular, epimeric, aggenital, genital, adanal and anal) and these were also not illustrated. Most important leg characteristics were also not described in detail.



Figures 20–28. *Congocepheus orientalis* Mahunka 1987, adult male; 20. ventral view; 21. subcapitular setae *a* lateral view. 22. subcapitular setae *a* dorsal view. 23. subcapitular setae m; 24. epimeric setae; 25. aggenital setae; 26. genital, setae; 27. adanal setae (ad_1–ad_3); 28. anal setae.

Notes: Abbreviations: see "Material and methods". Scale bar: 20 = 100 μm; 21–28 = 20 μm.

Taxon redescription

Congocepheus hauseri, Mahunka, 1989
(Figures 35–60)

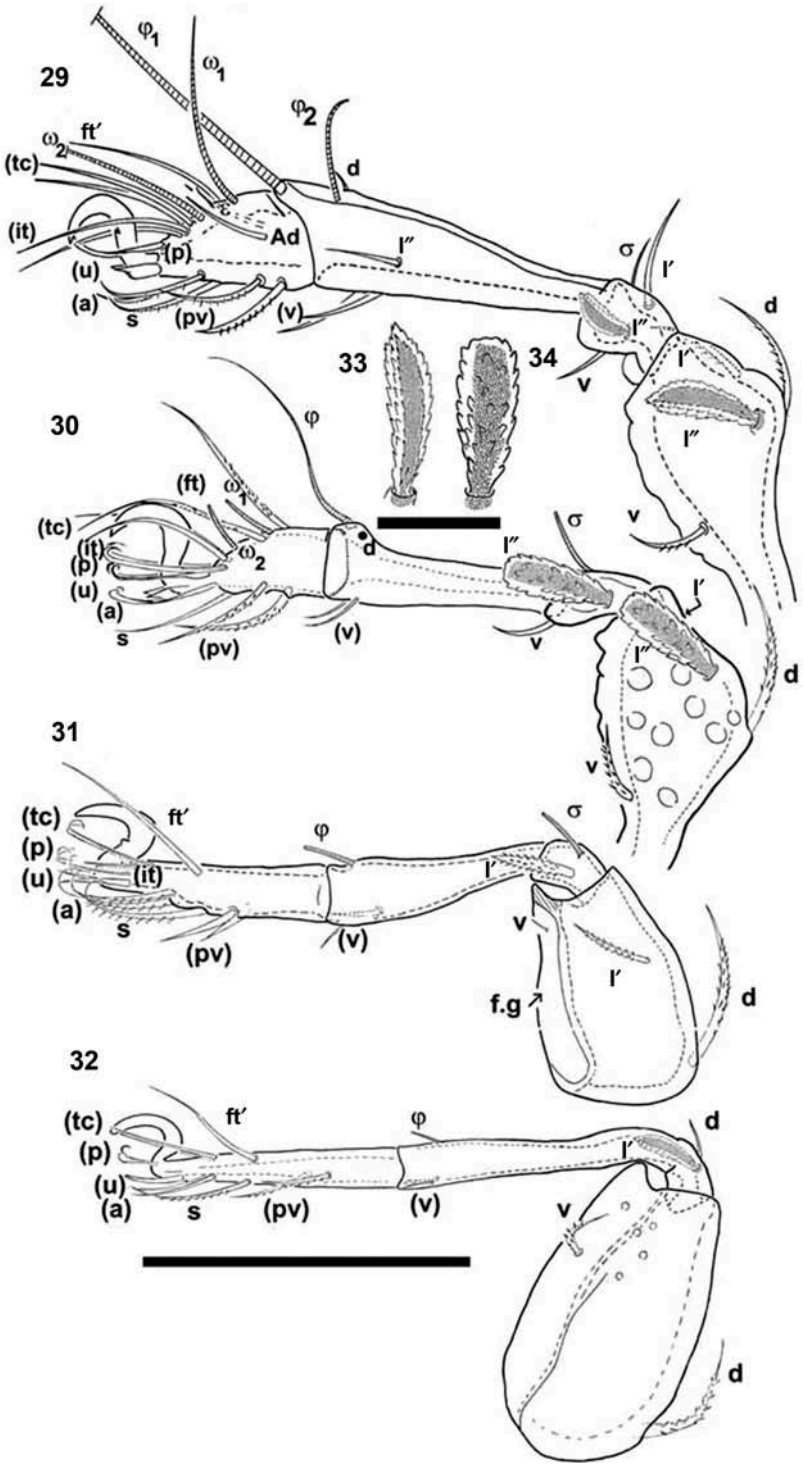
Material examined

Holotypus. Sum 85/49. Indonesia, Sumatra. Leg.B.Hauser; 6 non-types: Singapore, Bukit Limah; Leg.D.H.Murphy.4. VII.1969. D12-6; 6 non-types: Singapore, Bukit Limah. Leg.D.H.Murphy 9/VII-1969. D.13-1. Deposited in Muséum d'Histoire Naturelle, Genève.

Diagnosis

Setation: barbate, le; simple, subcapitular, *an*; *lanceolate*, *in*, notogastral, *ro*, genital, aggenital, epimeric and adanal.

Prodorsum, polyhedral (in dorsal view); ovoid, slightly curving in lateral view. Slightly elevated interlamellar process, medial posterior prodorsal zone depressed. Lamellar tip far from lamellar setal insertion level. Bothridia cup-shaped, opening laterally; bothridial ring and bothridial tooth present. Sensilllus uncate. Cornea of superior naso present. Anterior notogastral zone rectangular, posterior oval in dorsal view; convex lateral view. Notogastral anterior depression, ovoid, slightly deep, extending forward exceeding width of narrow rectilinear *d.sj*. Fourteen pairs of setae (c_1, c_2,*da, dm, dp, la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3) all extending backward; c_1 and c_2 situated close to each other. Circumgastric furrow well discernible. Lateral lamellae easily discernible; dorsal lamellar furrow clearly visible. Tutorium, supra tutorial depression, Pedotectum I, II, discidium, *h.ap*, present. Lyrifissures hardly discernible; only one visible due to



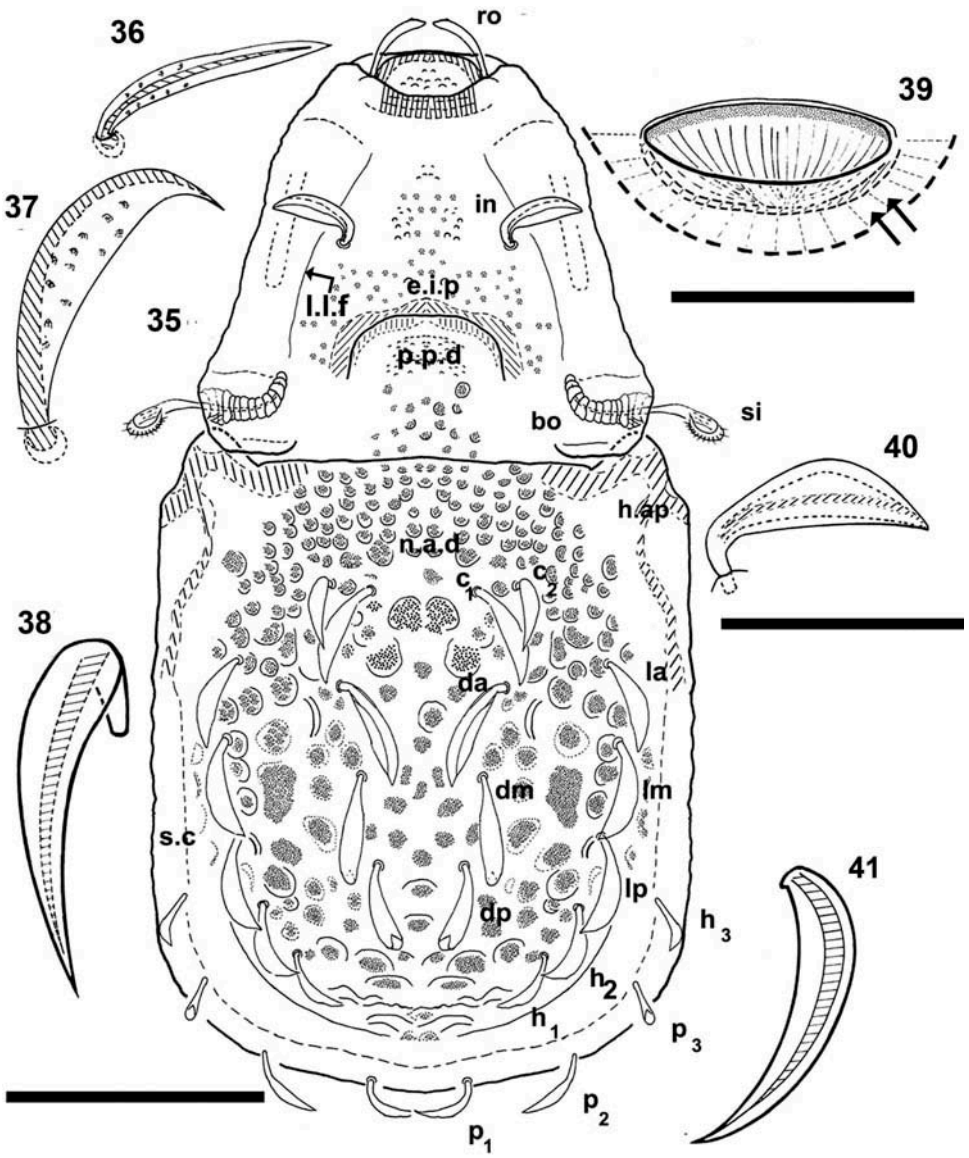
Figures 29–34. *Congocepheus orientalis* Mahunka 1987, adult female. 29. leg I, antiaxial. 30. leg II, antiaxial. 31. leg III, antiaxial. 32. leg IV; 33. seta l″ femur, genu I; 34. seta l″ femur, genu II.

Notes: Abbreviations: see "Material and methods". Scale bar: 29–32 = 50 μm; 33–34 = 10 μm.

transparency, epimera clearly defined by furrows; wide furrow separating 1 and 2; 3 and 4 by narrow furrow. Apodemes clearly discernible. Epimeric chaetotaxy 3-1-3-3. Anterior genital furrow, present. Aggenital setae postero-lateral. Four pairs of aligned genital setae. Between genital and anal openings, one paired ovoid-rounded depression. Three pairs of adanal setae. Two pairs of anal setae. Anal plate terminating in long sharp tip. Lyrifissures *iad* not discernible. Many polyhedral depressions, lateral to level of anal plates.

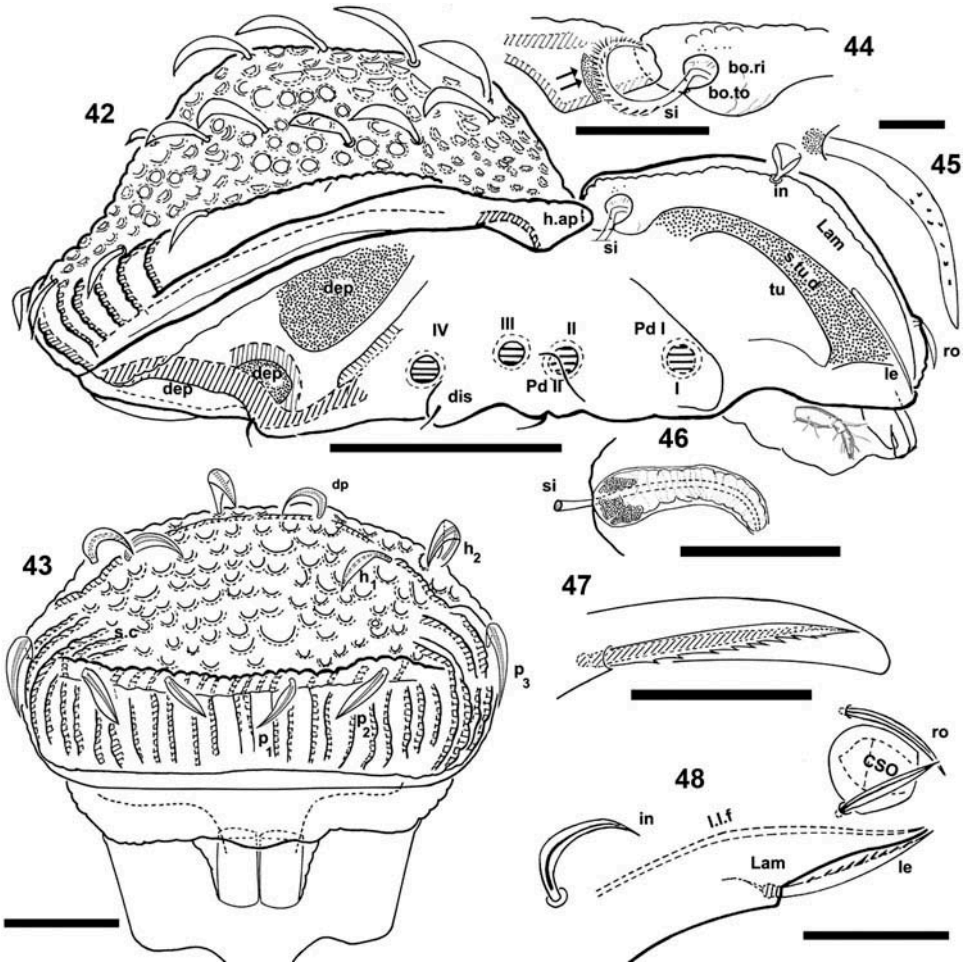
Table 1. Setae and solenidia *Congocepheus orientalis.*

	Femur	Genu	Tibia	Tasus	Claw
Leg I					
Setae	d, (l),v	(l),v	v, (l),d	ft′,ε,(tc),(it),(p),(Ad) (u),(a),s,(pv)	1
Solenidia		σ	φ_1 φ_2	ω_1 ω_2	
Leg II					
Setae	da, dm, l″, v	(l),v	(v),d	(pv), s,(a), (u), (p), (it), (tc),(ft)	1
Solenidia		σ	φ	ω_1 ω_2	
Leg III					
Setae	d, l′,v	l′	(v)	(pv),s,(a),(u),(p) (it),(tc),ft′	1
Solendia		σ	φ		
Leg IV					
Setae	d, v	l′	(v)	(pv), s,(a),(u), (p), (tc), ft′	1
Solenidia			φ		



Figures 35–41. *Congocepheus hauseri* Mahunka 1989, female. 35. dorsal view; 36. rostral setae dorsal view; 37. notogastral setae lateral view; 38. notogastral setae frontal view; 39. fovea structure, schematic; 40. interlamellar setae, lateral view; 41. p_3 notogastral setae.

Notes: Abbreviations: see "Material and methods". Scale bar 35 = 100 μm; 36–38, 40, 41 = 60 μm; 39 = 10 μm.



Figures 42–48. *Congocepheus hauseri* Mahunka 1989, male. 42. lateral view; 43. posterior view; 44. posterior zone of bothridia and anterior part of humeral apophysis; 45. rostral setae vista lateral; 46. bothridia; 47. lamella apical zone; 48. prodorsal zone, laterally inclined to ventral.

Notes: Abbreviations: see "Material and methods". Scale bar 42, 43 = 100 μm; 44 = 30 μm; 45, 46 = 5 μm; 47 = 10 μm; 48 = 10 μm.

Description

Measurements: Total length 597 μm (579–652) × 302 μm (317–359) (measurements from six female specimens).

Colour: Specimens without cerotegument, dark brown to clear brown; slightly shiny, observed in reflected light.

Shape: oval.

Cerotegument: Eliminated on specimens for study.

Integument: Prodorsal microsculpture: *irregularly foveate*: *e.i.p*, posterior depressed zone (Figure 35); *slightly foveate-faintly tuberculate*: zone between interlamellar setae; *faintly tuberculate*: posterior depressed zone *e.i.p*, in front of irregular foveate microsculpture and between rostral setae.

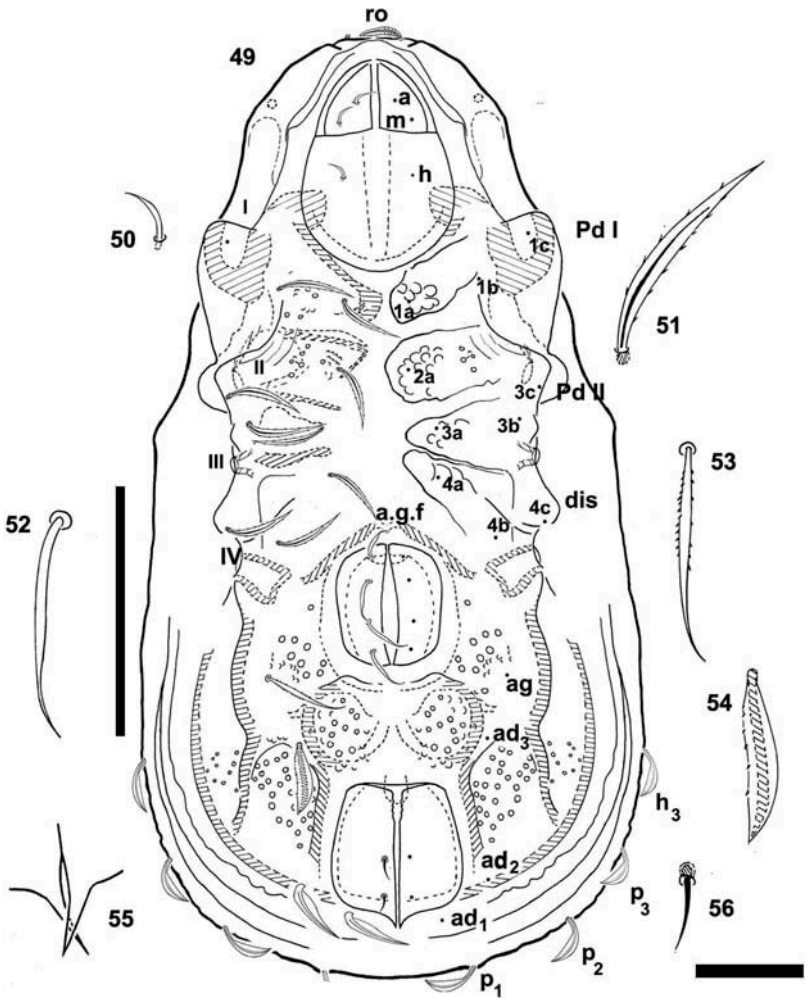
Notogastral microsculpture: *irregularly foveate*, but the size of fovea large in relation to similar prodorsal structures (Figure 35); in posterior and lateral zones of notogaster, several ridges and irregular tubercles.

Lateral microsculpture: *puncticulate*: *s.tu.d, dep*, several ridges and depression at level of genital and anal openings (Figure 42).

Ventral microsculpture: *foveate*: *dep* and zone around genital and anal openings*; small protuberances-slightly foveate*: epimeres (Figure 49).

The *fovea* is a densely puncticulate depression (schematized in Figure 39), with a small surrounding darker lucent gap (indicated with double arrow)

Setation: Three types of setae: *barbate*: *le*, (Figure 47); *simple*: sub-capitular (Figure 50), *an* (Figure 56); *lanceolate*: *in*, notogastral, *ro*, genital, aggenital, epimeric, adanal, but differing slightly: *in* (Figure 40), notogastral (Figures 37, 38, and 41) curving, rough or smooth; *ro*, (Figures 36 and 45), slightly lanceolate roughened; genital (Figure 52), slightly lanceolate smooth; *ag* (Figure 53),



Figures 49–56. *Congocepheus hauseri* Mahunka 1989, male. 49. ventral view; 50. sub-capitular setae; 51. epimeric setae; 52. genital setae; 53. aggenital setae; 54. adanal setae; 55. posterior zone anal plates; 56. anal setae.

Notes: Abbreviations: see section "Material and methods". Scale bar: 49 = 100; 50–55 = 60 μm; 56 = 20 μm.

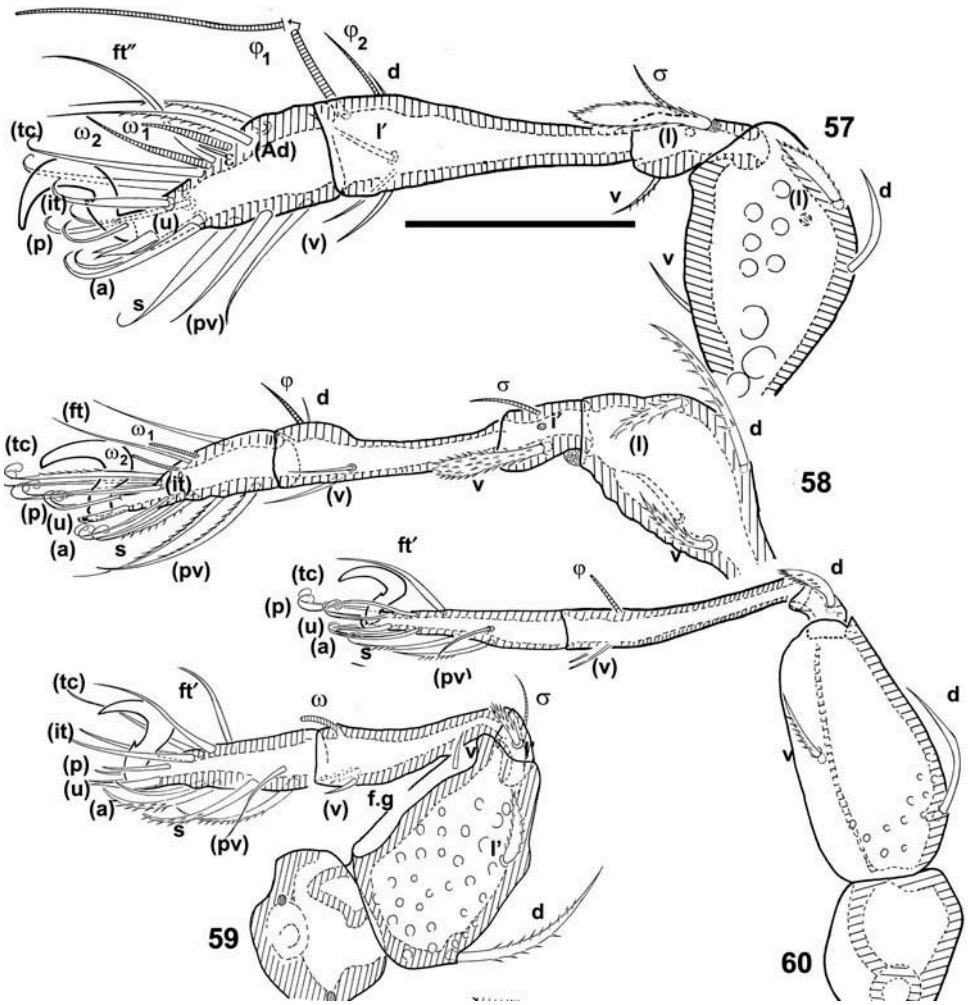
epimeric (Figure 51), *ad* (Figure 54) slightly lanceolate with serrate margin.

Prodorsum: Polyhedral (in dorsal view) (Figure 35); ovoid, slightly curving in lateral view (Figure 42); entire *e.i.p* slightly elevated (Figure 35); prodorsal media posterior zone (*p.p.d*) depressed, induced by *n.a.d* (Figure 35). Three pairs of setae: size *in* > *le* ≥ *ro*. *Ro* setae directing forward, each apical tip converging and close to each other; *in* setae, directed laterally (Figures 35 and 40). Rostral margin, rectilinear, slightly curving (Figure 35). Lamellae dorsolateral; laterally well-defined (Figure 42); dorsally *l.l.f* clearly visible (Figure 35), terminating in the internal zone of conspicuous *la.ti* (Figure 48); *la.ti* far from *le* setal insertion level (Figure 47). Bothridia cup-shaped (Figures 35 and 46) with smooth, incomplete *bo.ri*; *bo.to* present (Figures 42 and 44). Sensillus uncate arching to the top, tips usually pointed (Figure 44). Superior cornea of naso (*cso*) situated between *ro* setae (Figure 48).

Notogaster: Shape: dorsal view anterior rectangular and posterior oval (Figure 35); lateral view convex (Figure 42); *d.sj* narrow, rectilinear, well delimited (Figure 35). *n.a.d* ovoid, slightly deep, extending forward and exceeding width of *d.sj* up to posterior zone of prodorsum (*p.p.d*) (Figure 35).

Fourteen pairs of setae (c_1, c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2,h_3, p_1, p_2, p_3) similarly shaped (Figures 35, 38 and 41); all setae extending backward; c_1 and c_2 setae situated close to each other (Figure 35), insertion level almost parallel; c_2 small size relative to c_1. Setal size: c_1, *da, dm, dp, la, lm, lp,* $h_2 > c_2 > h_1$, h_3, p_3, p_2, p_1. Circumgastric furrow clearly discernible (Figure 35).

Lateral region: Prodorsum *e.i.p* slightly elevated. Setae *in* clearly visible directing laterally (Figure 42). *Lam*, well discernible; *tu* strongly curving cuticular thickening; *s.tu.d* running between *lam* and *tu*. Pedotectum I, prominently extending lamina covering the first acetabulum. Pd II, small s-shaped lamina, rounded edges; discidium easily discernible,



Figures 57–60. *Congocepheus hauseri* Mahunka 1989, male. 57. leg I, antiaxial; 58. leg II, antiaxial; 59. leg III, antiaxial; 60. leg IV, antiaxial.

Notes: Abbreviations: see "Material and methods". Scale bar: 57–60 = 50 μm.

ovoid shape, situated near IV acetabulum (Figure 42). Bothridial opening laterally; smooth *bo.ri* and *bo.to* present (Figure 44). Triangular shape *h.ap*; upper margin rounded; tip overlapping posterior bothridial zone; inferior margin continuous with *b.n.g*. Rod-shaped furrow across *h.ap* clearly visible (Figure 44, furrow indicated by double arrow).

Lamellar border, *s.tu.d*; inferior part of *bo* and inferior part of *h.ap* extending laterally forming a concave expansion which plays an important role in leg-folding (Figures 42 and 44). Lyrifissures hardly discernible; only one visible due to transparency, probably *im* (Figure 42). Several depressions (*dep*) are easily discernible.

Lamellae clearly discernible; *la.ti* extending to *le* setae insertion, rounded end (Figure 46); in laterodorsal view (Figure 47) *l.l.f.* well visible. Easily discernible *cso*, situated between *ro* setae insertions (Figure 48).

Posterior aspect: (Figure 43): Irregular foveate microsculpture with several chitinous ridges clearly visible. Circumgastric furrow, clearly discernible.

Ventral region: Epimeres clearly defined by furrows; 1 and 2 separated by wide furrow; 3 and 4 by narrow furrow (Figure 49); *apo.*1, *apo.*2, *apo.sj* and *apo.*3 well discernible. Epimeric chaetotaxy 3-1-3-3; *1a*, *2a*, *3a* in several cases only alveoli (see "Remarks"); all other epimeral setae of similar shape and length (Figures 49 and 51).

Discidium clearly visible as rounded expansion (Figure 49). Anteriorly on genital plate, *a.g.f* present. Aggenital setae positioned posterolaterally at a distance from posterior border of genital opening (Figure 49). Genital plate slightly smaller than anal plate; four pairs of aligning large genital setae (Figures 49 and 52). Aggenital setae situated far from and antiaxially to genital opening (Figures 49 and 53). Between genital and anal openings, one pair of well-defined ovoid-rounded depressions (Figure 49). Three pairs of adanal setae, very differently shaped than aggenital setae (Figures 49 and 54); ad_3 setae inserted posteriorly and slightly paraxial to insertion of aggenital setae. Two pairs of small anal setae (Figure 56); anal plate long, sharply tipped (Figures 49 and 55).

Table 2. Setae and solenidia: *Congocepheus hauseri*.

	Femur	Genu	Tibia	Tasus	Claw
Leg I					
Setae	d, (l),v	(l),v	v, (l),d	ft″,ε,(tc),(it),(p) (Ad) (u),(a),s,(pv)	1
Solenidia		σ	φ_1 φ_2	ω_1 ω_2	
Leg II					
Setae	da, dp, l″, v	(l),v	(v),d	(pv), s,(a), (u), (p), (it), (tc), (ft)	1
Solenidia		σ	φ	ω_1 ω_2	
Leg III					
Setae	d, l′,v	l′	(v)	(pv),s,(a),(u),(p) (it),(tc),ft′	1
Solendia		σ	φ		
Leg IV					
Setae	d, v	d	(v)	(pv), s,(a),(u), (p), (tc), ft′	1
Solenidia			φ		

Lyrifissures *iad* not discernible. Many polyhedral depressions (*dep*) lateral to anal plates (Figure 49).

Legs: (Figures 57–60) (Table 2): All legs monodactyle. Setal formulae I (1-4-3-4-17) (1-2-2); II (1-4-3-3-15) (1-1-2); III (2-3-1-2-14) (1-1-0); IV (1-2-1-2-12) (0-1-0).

Remarks

Medial epimeral setae very brittle, further SEM-studies are necessary in order to determine if they are small or broken. We found one specimen with 1*a* and 1*b* setae of normal size, for this reason we remain uncertain.

Leg chaetotaxy was very difficult to study and several reservations exist; evidently it is necessary to study the ontogeny (see "Discussion").

Discussion

In those species with specimens in good enough condition to permit study, we found all characters involved in leg folding ("protection mechanism") as in *Bovicarabodes* (Fernandez et al. 2013), except for the presence/absence of a depression in femur I, but studies on fresh material are necessary to confirm this. The *cso* (cornea of superior naso) was found on two of the species studied.

Legs were particularly difficult to study due to preservation condition of the type material. Legs showed several very interesting aspects in terms of the shape of each segment These are evidently adapted to the "leg folding process" (Fernandez et al. 2013). Finally, the chaetotaxy formulae and the notation of setae are very complex due to the particularity shown by the iteral and fastigial setae (Bellido 1978). We were unable to study the ontogenetic cycle and for this reason decided to follow the work of Bellido 1978 in this respect. Referring to the dorsal setae of femur I and II, named lateral setae by Bellido (op cit Figure 26, not named in Figure 27), we retain "dorsal setae" in order to study and compare several other species of *Congocepheus* with SEM, where they are situated near or associated with the solenidion.

Finally, we were uncertain about leg chaetotaxy of tarsus I, because Bellido (*op.cit*) indicated 15 pairs in text (adult stage). Evidently the famulus was included but in Figure 26, p. 430, we counted 16, with a pair of setae between solenidia ω_1 and ft′. The pair was illustrated but without nomination; the famulus (ε) in the same figure was not illustrated, and for this reason we consider the number to be 17 (16 pairs plus ε). This situation is in agreement with our findings.

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