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Three new feather mites of the genus *Proterothrix* Gaud (Astigmata: Proctophyllodidae) from passerines (Aves: Passeriformes) in China

Shu-Xiang He^a, Li-Hua Sun^a, Huai Liu^a, Yu-Chuan Yuan^b, Zi-Ying Wang^a 

^a College of Plant Protection, Southwest University, No. 2, Tiansheng Road, Beibei district, Chongqing, China.

^b Nanjian administration and Protection Bureau of Yunnan Wuliangshan National Nature Reserve, No. 56, Boai Road, Nanjian district, Yunnan, China.

Original research

ABSTRACT

Three new species of the feather mite genus *Proterothrix* Gaud, 1968 (Proctophyllodidae: Pterodectinae) are described from passerines (Aves: Passeriformes) in China: *Proterothrix angusticorporis* **sp. n.** from the Chestnut-tailed Minla *Actinodura strigula* (Hodgson, 1837) (Leiothrichidae), *P. disulcatus* **sp. n.** from the Spectacled Fulvetta *Fulvetta ruficapilla* (Verreaux, J, 1871) (Paradoxornithidae), *P. ianthocinclae* **sp. n.** from the Spotted Laughingthrush *Ianthocincla ocellata* (Vigors, 1831) (Leiothrichidae). All three new species belong to the *paradoxornis* species group, which males are characterized by setae *e* of tarsi I thickened, usually spindle-shaped, and the whip-like aedeagus.

Keywords China; feather mites; new species; *Proterothrix*; taxonomy

Zoobank <http://zoobank.org/A882B50D-A456-45DE-A0F1-EB77DD46BECE>

Introduction


Feather mites of the genus *Proterothrix* Gaud, 1968 (Astigmata: Proctophyllodidae: Pterodectinae) have been found, to date, on birds of the orders Passeriformes, Coraciiformes, and Piciformes. According to the current taxonomic concept, the subfamily Pterodectinae is divided into the tribes Ramphocaulini and Pterodectini; in turn, the tribe Pterodectini is divided into the generic groups *Pterodectes* and *Proterothrix* (Mironov, 2009; Hernandez and Valim 2014). The genus *Proterothrix* belongs to the latter group and, is characterized by setae *ps3* situated anteromesal to the adanal suckers in males and seta *wa* situated anterior to setae *ra* and *la* on tarsi I and II in both sexes (Mironov 2009; Mironov and Proctor 2009; Mironov and OConnor 2017; Constantinescu *et al.* 2017b, 2019). To date, the genus *Proterothrix* has included 37 species; of these, 33 species were arranged in four species groups: *wolffi* (19 species), *paradoxornis* (6 species), *schizothyra* (5 species) and *megacaula* (3 species) (Table 1). Representatives of the *schizothyra* group are restricted to kingfishers (Coraciiformes: Alcedinidae). Species of the *wolffi* group are associated with various passerine families (Passeriformes), while those of the *megacaula* group are only known from the passerine family Muscicapidae. (Gaud 1952, 1962, 1968, 1979; Park and Atyeo 1971; Mironov 2009; Mironov and Proctor 2009, 2023; Mironov *et al.* 2008, 2010, 2012, Mironov and Tolstenkov 2013; Constantinescu *et al.* 2014, 2017a, 2017b, 2018, 2019, 2021, 2024; Han *et al.* 2019; Mironov and Galloway 2021). Mites of the *schizothyra* group have coxal fields III in males open, the terminal cleft in females with distinctly divergent margins (V-shaped); those of the *megacaula* group are

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Corresponding author

Zi-Ying Wang 

zhibaoy@swu.edu.cn

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characterized by the absence of dorsal setae *c1* in both sexes and an extremely long aedeagus in males (Constantinescu *et al.*, 2014, 2021). The *wolffi* group is characterized by the coxal fields III in males closed or with a very narrow gap in the anteromesal part and the terminal cleft in females usually parallel-sided (Mironov *et al.* 2008). In the *wolffi* group, Mironov and Proctor (2009) recognized the *paradoxornis* species complex, which is characterized by lanceolate seta *e* on tarsus I in males. As recently proposed by Mironov and Galloway (2021), it is reasonable to treat this complex as a fourth species group in *Proterothrix*.

Table 1 World checklist, host associations and distribution of described species of the genus *Proterothrix*.

Species group	Mite species	Type host	Family of the host	Locality
Group <i>wolffi</i>	<i>P. chachulae</i> Constantinescu, 2017	<i>Niltava grandis grandis</i>	Muscicapidae	India
	<i>P. coscinota</i> Gaud, 1968	<i>Rhipidura rennelliana</i>	Rhipiduridae	Rennell Island
	<i>P. cyornis</i> Mironov & Tolstenkov, 2013	<i>Cyornis tickelliae</i>	Muscicapidae	Vietnam
	<i>P. cyornissimilis</i> Constantinescu <i>et al.</i> , 2017	<i>Cyornis rubeculoides</i>	Muscicapidae	India
	<i>P. diminuta</i> (Trouessart, 1899)	<i>Manucodia ater</i>	Paradisaeidae	New Guinea
	<i>P. emarginata</i> (Trouessart, 1899)	<i>Manucodia chalybatus</i>	Paradisaeidae	New Guinea
	<i>P. hypothymis</i> Mironov & Tolstenkov, 2013	<i>Hypothymis azurea</i>	Monarchidae	Vietnam
	<i>P. maior</i> Constantinescu, 2024	<i>Manucodia chalybatus</i>	Paradisaeidae	New Guinea
	<i>P. modesta</i> (Trouessart, 1899)	<i>Manucodia ater</i>	Paradisaeidae	New Guinea
	<i>P. modestasimilis</i> Constantinescu, 2024	<i>Manucodia chalybatus</i>	Paradisaeidae	New Guinea
	<i>P. papuensis</i> Constantinescu, 2024	<i>Paradisaea minor</i>	Paradisaeidae	New Guinea
	<i>P. paradisiaca</i> (Trouessart, 1885)	<i>Paradisaea minor</i>	Paradisaeidae	New Guinea
	<i>P. phyllura</i> (Trouessart, 1899)	<i>Manucodia ater</i>	Paradisaeidae	New Guinea
	<i>P. ranci</i> (Gaud, 1952)	<i>Terpsiphone mutata singetra</i>	Monarchidae	Madagascar
	<i>P. sakatai</i> (Sugimoto, 1941)	<i>Dicrurus macrocercus harterti</i>	Dicruridae	China
	<i>P. stenochaeta</i> Gaud, 1968	<i>Clytorhynchus hamlini</i>	Monarchidae	Rennell Island
	<i>P. terpsiphone</i> Mironov <i>et al.</i> , 2010	<i>Terpsiphone viridis</i>	Monarchidae	Senegal
	<i>P. wolffi</i> (Gaud, 1962)	<i>Gerygone citrina</i>	Acanthizidae	Rennell Island
	<i>P. xiphiura</i> (Trouessart, 1885)	<i>Psarisomus dalhousiae</i>	Eurylaimidae	Malaysia
Group <i>paradoxornis</i>	<i>P. alcippeae</i> Mironov <i>et al.</i> , 2012	<i>Alcippe rufogularis</i>	Alcippeidae	Vietnam
	<i>P. angusticorporis</i> He & Wang sp. n.	<i>Actinodura strigula</i>	Leiothrichidae	China
	<i>P. disulcatus</i> He & Wang sp. n.	<i>Fulvetta ruficapilla</i>	Paradoxornithidae	China
	<i>P. dinghushani</i> Constantinescu <i>et al.</i> , 2021	<i>Alcippe hueti</i>	Alcippeidae	China
	<i>P. ianthocinclae</i> He & Wang sp. n.	<i>Ianthocinclae ocellata</i>	Leiothrichidae	China
	<i>P. indica</i> Constantinescu <i>et al.</i> , 2014	<i>Alcippe nipalensis</i>	Alcippeidae	India
	<i>P. longicaula</i> Mironov & Proctor, 2009	<i>Paradoxornis gularis</i>	Paradoxornithidae	China
<i>P. paradoxornis</i> Mironov & Proctor, 2009	<i>Paradoxornis webbianus</i>	Paradoxornithidae	China	
<i>P. sarahbushae</i> Mironov & Proctor, 2009	<i>Paradoxornis verreauxi</i>	Paradoxornithidae	China	
Group <i>megacaula</i>	<i>P. daberti</i> Constantinescu <i>et al.</i> , 2014	<i>Cinclidium leucurum</i>	Muscicapidae	India
	<i>P. khahnarensis</i> Constantinescu <i>et al.</i> , 2014	<i>Myophonus caeruleus</i>	Muscicapidae	India
	<i>P. megacaula</i> Mironov <i>et al.</i> , 2008	<i>Ficedula zanthopygia</i>	Muscicapidae	China
Group <i>schizothyra</i>	<i>P. allothyra</i> Gaud, 1979	<i>Megaceryle maxima</i>	Alcedinidae	Zaire
	<i>P. megaceryle</i> Mironov & Galloway, 2021	<i>Megaceryle alcyon</i>	Alcedinidae	Canada
	<i>P. melanura</i> Gaud, 1979	<i>Ceryle rudis</i>	Alcedinidae	Cameroon
	<i>P. schizothyra</i> (Gaud, 1952)	<i>Alcedo cristata</i> (= <i>Corythornis cristata</i>)	Alcedinidae	Madagascar
<i>P. stenothyra</i> Gaud, 1979	<i>Halcyon senegalensis</i>	Alcedinidae	Senegal	
Unassigned species	<i>P. aculeata</i> (Canestrini, 1899)*	<i>Eurylaemus ochromelas</i>	Eurylaimidae	Malaysia
	<i>P. caudacuta</i> (Trouessart, 1899)	<i>Lamprocolius glaucovirens</i>	Sturnidae	Gabon
	<i>P. murariui</i> Constantinescu, 2019	<i>Lobivanellus lobatus</i> (= <i>Vanellus miles</i>)	Charadriidae	Australia
	<i>P. picinus</i> Han <i>et al.</i> , 2019	<i>Meiglyptes tristis</i>	Picidae	Indonesia
		<i>Picus canus</i>	Picidae	Korea

* This species was originally recognized by Trouessart (1884: 81) as an unnamed form of *Pterodectes mainati* from two hosts, *E. ochromelas* and *L. glaucovirens*; Canestrini (in Canestrini and Kramer 1899: 126) provided this form with a valid name *Pterodectes mainati* var. *aculeatus* and mentioned the same hosts. A type host of this uncertain species has never been designated.

In this paper, we describe three new *Proterothrix* species belonging to the *paradoxornis* species group collected in China.

Materials and methods

The materials used in the present work were collected by Xiao-Ling Li in Yunnan Province, China, in April 2019 and by Shu-Xiang He and Li-Hua Sun in Sichuan Province, China, in September 2021. Avian hosts were captured by mist nets, identified and visually checked for the presence of mites. If mites were detected on feathers, they were brushed down by a small brush and put into a tube with 99% ethanol. Captured birds were released to the wild after the processing. In the laboratory, mite specimens were mounted on microscope slides in Hoyer's medium (Krantz and Walter 2009). Photos of mites were taken with a digital camera attached to the Olympus BX51 microscope. Drawings (line art) were made by importing photos into an APP called "Paintwork" on iPad, creating a new layer on the photos, and using an Apple Pencil to trace the shape of mites and their morphological structures. General morphological terms and the legs chaetotaxy follow Gaud and Atyeo (1996), the idiosomal chaetotaxy is that of Griffiths *et al.* (1990) with modifications to coxal setae by Norton (1998). Measuring techniques of particular structures follow the descriptive method presented in previous papers on the genus *Proterothrix* (Mironov and Proctor 2009; Mironov and Galloway 2021). All measurements are in micrometers (μm). The taxonomic system and scientific names of birds mentioned in the paper follow Clements *et al.* (2022). Type materials of new species are deposited in the Chinese Academy of Sciences, Beijing, China (IOZ) and the College of Plant Protection, Southwest University, Chongqing, China (IESWU).

Taxonomy

Family Proctophyllodidae Trouessart & Mégnin, 1884

Subfamily Pterodectinae Park & Atyeo, 1971

Genus *Proterothrix* Gaud, 1968

Proterothrix angusticorporis He & Wang sp. n.

Zoobank: [E1FAD665-A89A-41A6-BCCD-390A72BD1347](https://zoobank.org/E1FAD665-A89A-41A6-BCCD-390A72BD1347)

(Figs. 1–4)

Type Material

Holotype — Male, male and 5 female paratypes from Chestnut-tailed Minla *Actinodura strigula* (Hodgson, 1837) (Leiothrichidae), China, Yunnan Province, Wuliangshan Nature Reserve, 24°89'N, 100°32'E, April 2019, collector Xiao-Ling Li.

Depository — Holotype and one paratype — Chinese Academy of Sciences; other paratypes — College of Plant Protection, Southwest University.

Description

Male — (holotype, range for 4 paratypes in parentheses) (Figs. 1, 2). Length of idiosoma 518 (519–529), width 149 (148–155), length of hysterosoma 358 (355–368). Prodorsal shield: entire, anterolateral extensions acute, lateral margin slightly concave, posterior margin straight, length 152 (142–151), width 107 (110–123). Shield ornamentation: anterior half with large roughly ovate median lacuna and a pair of large strongly elongate lateral lacunae; posterior part with numerous circular and ovate lacunae. Distance between scapular setae *se* 63(63–68). Scapular shields narrow. Humeral shields narrow, fused with epimerites III. Setae *cp* situated on soft tegument near ventral margin of humeral shield. Setae *c2* situated on anterior margins

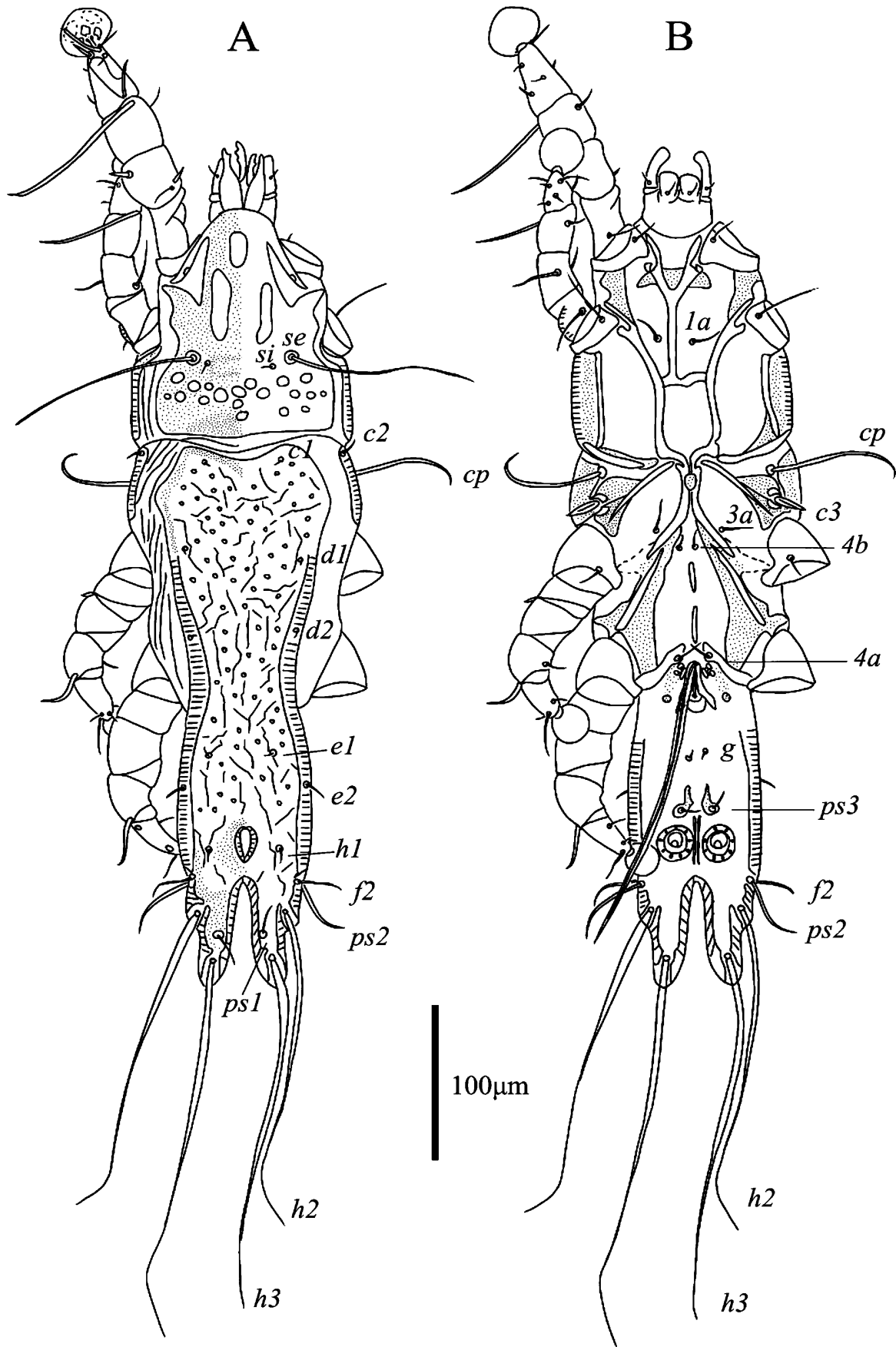


Figure 1 *Proterothrix angusticorporis* sp. n., male. A – dorsal view, B – ventral view.

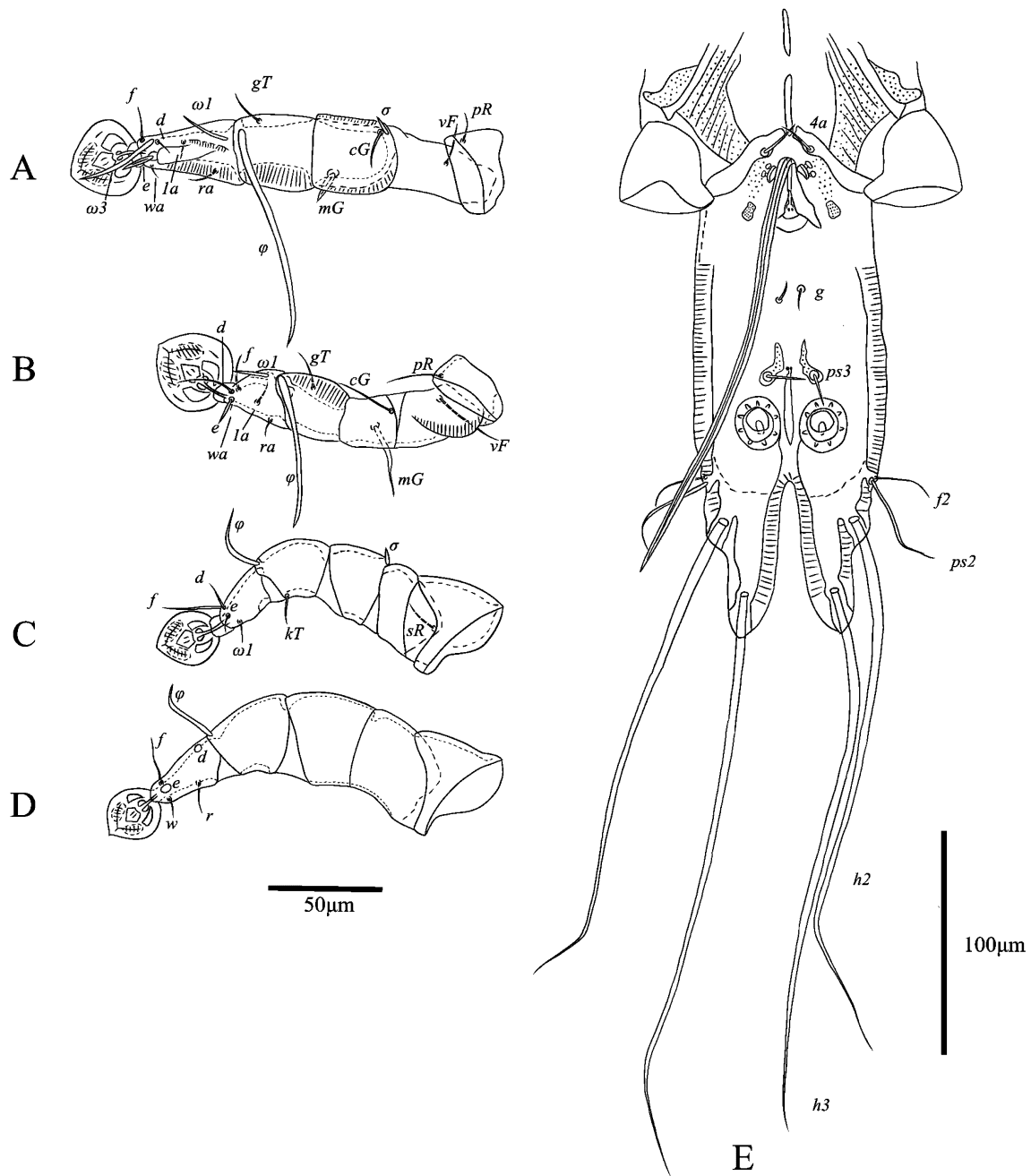


Figure 2 *Proterothrix angusticorporis* sp. n., details of male. A – leg I, B – leg II, C – leg III, D – leg IV, E – details of opisthosoma.

of humeral shields. Subhumeral setae $c3$ lanceolate, 22 (22–23) \times 8 (8–9). Hysteronotal shield: anterior margin slightly concave and sclerotized stronger than median part of the shield; surface with sparsely distributed small circular lacunae and numerous wavy striae of different length; greatest length from anterior margin to the base of setae $h3$ 351 (333–377), width in anterior part 111 (105–109). Distance between prodorsal shield and hysteronotal shield 15 (16–22). Lateral hysteronotal shield absent. Opisthosomal lobes elongate, without membranes, lobar apices semi-ovate, lateral margins of lobes with short rounded extensions bearing setae $h2$, setae $h3$ situated near lobar apices. Terminal cleft narrow U-shaped, length 69 (72–74), width at the

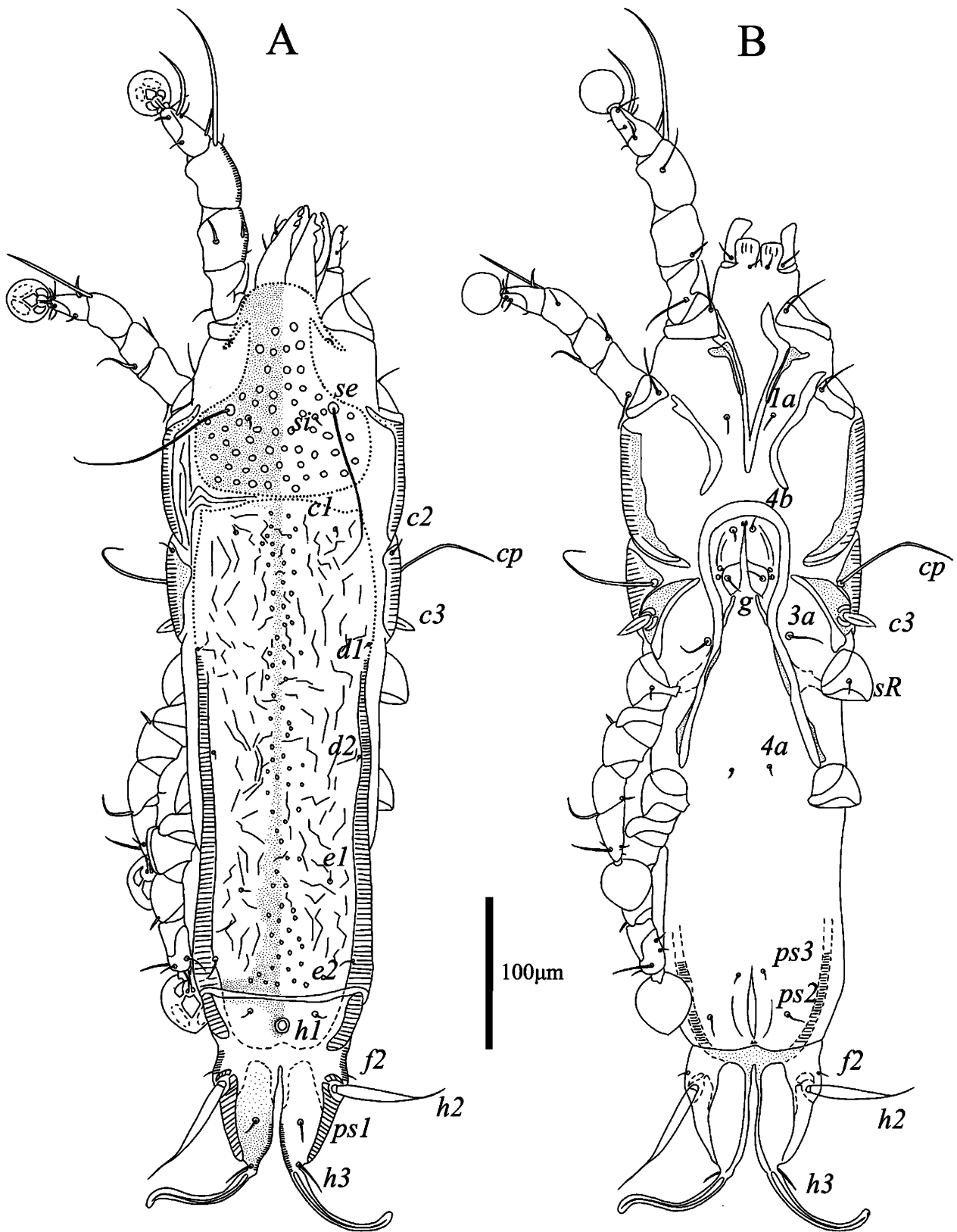


Figure 3 *Proterothrix angusticorporis* sp. n., female. A – dorsal view, B – ventral view.

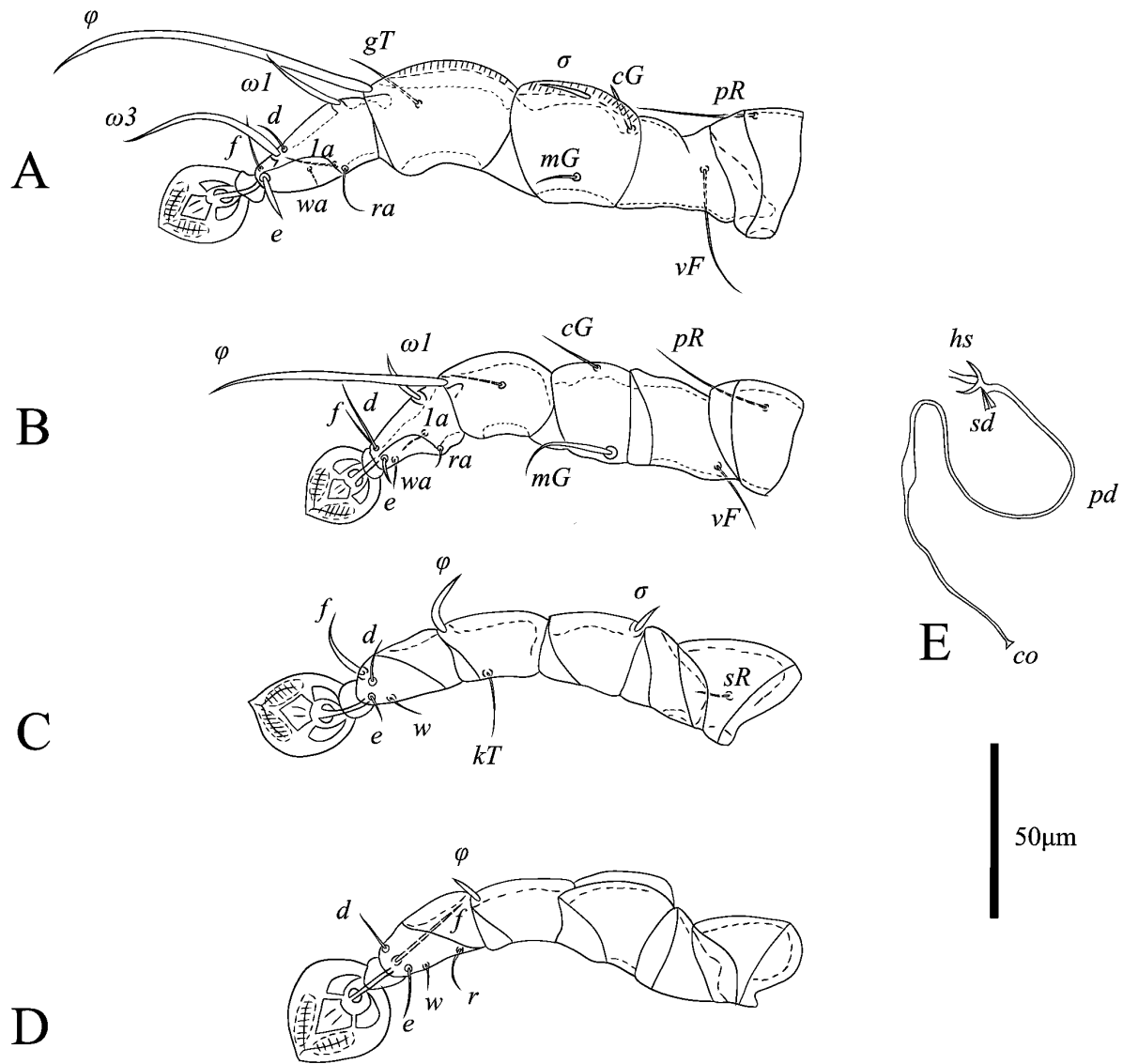


Figure 4 *Proterothrix angusticorporis* sp. n., details of female. A – leg I, B – leg II, C – leg III, D – leg IV, E – spermatheca and spermatheca. hs, head of spermatheca; pd, primary spermatheca; sd, secondary spermatheca; co, copulatory opening.

level of setae *h3* 11 (10–12). Supranal concavity clearly outlined, shaped as inverted teardrop, separated from terminal cleft. Setae *h1* situated at midlevel of supranal concavity, closer to level of setae *f2* than of setae *e2*. Setae *h3* represented by macrosetae, length 264 (201–263), greatest width 5 (4–6). Setae *h2* shorter than *h3*, length 246 (152–229), width 7 (5–8). Setae *ps1* filiform, 29 (23–33) long, situated at midlevel between setae *h2* and *h3*, slightly closer to inner margin of opisthosomal lobes than to outer margin. Setae *ps2* setiform, 44 (30–39) long, setae *f2* situated at level of setae *ps2* (Fig. 1A). Dorsal measurements: *c2–d2* 122 (199–124), *d2–e2* 107 (105–112), *e2–h3* 113 (111–117), *d1–d2* 56 (59–65), *e1–e2* 22 (25–32), *h1–ps2* 19 (18–23), *h2–h2* 59 (53–62), *h3–h3* 40 (31–44), *ps2–ps2* 72 (66–74).

Epimerites I fused into a Y, posterior end of sternum connected with middle parts of epimerites II by transverse sclerotized bands. Epimerites II long, their posterior ends almost touching each other and fused with corresponding anterior ends of epimerites IIIa forming a pentagonal structure in median area of propodosoma (Fig. 1B). Coxal fields I closed, coxal fields II, III almost closed, with narrow gap between tips of corresponding epimerites II, IIa and

epimerites III, IIIa. Anterior parts of epimerites IIIa fused with posterior ends of epimerites II encircle small drop-shaped sclerotized area. Epimerites IVa well developed, setae *4a* situated on their inner tips. Coxal fields IV with triangular sclerotized areas connecting epimerites IV and bases of epimerites IVa. Pregenital sclerite stick-shaped and usually divided into two parts, posterior part not connected with inner tips of epimerites IVa, distance between anterior and posterior ends of pregenital sclerite 55 (55–60). Genital arch of moderate size, length 25 (23–24), width 25 (24–28). Paragenital sclerites present; their poorly sclerotized anterior areas connected with epimerites IVa. Aedeagus long whip-shaped, directed anterior from genital arch, immediately bent backward and extends to midlength between setae *h2* and *h3*, length from bend to apex 206 (208–217). Genital papillae anterolateral to genital arch, their bases contiguous. Adanal suckers 20 (21–23) in diameter, corolla with 8–9 denticles. Setae *ps3* situated on comma-shaped adanal shields. (Fig. 1B). Ventral measurements: *3a–4b* 10 (7–9), *4b–4a* 73 (70–76), *4a–g* 66 (62–73), *g–ps3* 36 (36–41), *ps3–ps3* 20 (19–23), *ps3–h3* 98 (98–100).

Legs I longer and thicker than legs II. Femur II with ventral crest. Genu I with dorsal and lateral longitudinal crests. Tarsus and tibia I with lateral longitudinal crest. Tarsus II with lateral longitudinal crest. Tarsus I with thumb-like dorsal process. Solenidion σ of genu I stick-like, 8 (7–11) long, situated at base of this segment. Setae *cG* I, *cG* II setiform, setae *cG* II much longer than setae *cG* I. Setae *mG* I spiniform, 14 (12–15) long; setae *mG* II thickened, with filiform apex 34 (32–34) long. Setae *e* of tarsus I lanceolate, 15 (12–18) long. Setae *d*, *f* of tarsus II subequal in length (Fig. 2A, B). Setae *f* of tarsus III approximately 2.5 times longer than seta *d*. Leg III, IV similar in size. Tarsus IV 37 (36–38) long, without claw-like apical process (except one of paratypes with apical claw); setae *d*, *e* button-like, situated in basal and apical parts of this segment, respectively (Fig. 2C, D). Lengths of solenidia: ω I 21 (15–18), ω II 13 (15–25), ϕ I 101 (101–111), ϕ II 66 (58–68), ϕ III 29 (23–29), ϕ IV 29 (30–31).

Female — (range for 6 paratypes) (Figs. 3, 4). Idiosoma length 539–588, width 140–176, hysterosoma length 371–421. Prodorsal shield: entire, without clearly outlined border, without antrolateral extensions; most surface except anterior end with numerous circular and ovate lacunae; length 146–163, width 105–131. Scapular setae *se* separated by 66–79. Scapular shield narrow. Humeral shields narrow, connected by posterior ends to epimerites III. Setae *cp* situated on ventral margin of humeral shield, setae *c2* situated on anterior end of humeral shield. Setae *c3* lanceolate, 23–24 × 8–9. Distance between prodorsal and hysteronotal shields 1–4. Hysteronotal shield separated into anterior and lobar parts by narrow transverse band of soft tegument. Anterior hysteronotal shield: anterior margin and lateral margins up to level of trochanters III poorly outlined, narrow median area strongly sclerotized and with numerous small circular lacunae, remaining surface with irregular sparsely disposed striae, lateral areas are poorly sclerotized like soft tegument, length 305–103, width at anterior margin 146–163. Length of lobar region 104–117, width at level of setae *h2* 84–88. Terminal cleft shaped as a narrowly V, length 62–74, and greatest width at level of setae *h3* 12–20. Supranal concavity circular, clearly outlined. Setae *h1* situated on lobar shield anterior to supranal concavity. Setae *h2* spindle-shaped, with short terminal filaments, 92–114 × 8–10. Setae *ps1* close to inner margin of opisthosomal lobes, approximately equidistant from levels of setae *h2* and *h3*. Setae *h3* 19–26 long, about 1/3 the total length of terminal appendages (Fig. 3A). Dorsal measurements: *c2–d2* 129–149, *d2–e2* 111–133, *e2–h2* 78–83, *h2–h3* 45–55, *d1–d2* 53–78, *e1–e2* 46–53, *h1–h2* 43–50, *h2–ps1* 17–23, *h1–h1* 40–44, *h2–h2* 65–70.

Epimerites I fused as a short-stemmed Y. Coxal fields I, II without heavily sclerotized areas. Epimerites IVa absent. Translobar apodemes of opisthosomal lobes present, fused to each other anterior to terminal cleft. Epigynum horseshoe-shaped, greatest wide 58–66 (Fig. 3B). Primary spermatiduct with spindle-shaped enlargement in distal one third; secondary spermatiducts short (Fig. 4E). Distances between pseudanal setae: *ps2–ps2* 47–64, *ps3–ps3* 16–21, *ps2–ps3* 19–28.

Legs I thicker and longer than legs II. Genu, tibia I with lateral longitudinal crest. Setae *cGI* spiculiform, setae *mGII* filiform with thickened basal part; setae *cG* II and setae *mGI* filiform, former longer than latter. Setae *d* of tarsus II half the length of corresponding setae *f* (Fig. 4A,

B). Setae *f* of tarsi III, IV are 2 times longer than setae *d*. Genu IV slightly inflated dorsally, with narrow longitudinal crest (Fig. 4C, D). Solenidion ϕ of tibia IV much shorter than on tibia III. Lengths of solenidia: ω II 13–21, ω III 10–16, ϕ I 65–96, ϕ II 63–72, ϕ III 19–29, ϕ IV 6–8.

Etymology

The specific name is a contraction of *angustus* (L., narrow) and *corporis* (L., body) and refers to the narrow idiosoma in both sexes.

Differential diagnosis

The new species *Proterothrix angusticorporis* sp. n. belongs to the *paradoxornis* species group in having, in males, seta *e* of tarsus I lanceolate. Among six previously known species of this group, the new species is most similar to *P. sarabushae* Mironov & Proctor, 2009 described from the Golden Parrotbill *Suthora verreauxi* (Sharpe, 1883) (Paradoxornithidae) in having the following characteristics in males: the scapular shields have hook-like anteromesal extension, the aedeagus almost extends to the level of lobar apices; tarsus I has a thumb-like dorsal process. *Proterothrix angusticorporis* sp. n. differs from *P. sarabushae* by the following features: in males, the anterior half of prodorsal shield has one ovate median lacunae and a pair of long slit-like lacunae, the posterior ends of epimerites II are not fused with the anterior tips of epimerites IIIa, the posterior end of pregenital sclerite is not connected with the inner tips of epimerites IVa, and one pair of adanal shields is present; in females, the idiosoma length is 539–588; the anterior margin of the anterior hysteronotal shield is convex, the median area of this shield is heavily sclerotized and bears small circular lacunae, the lateral areas are poorly sclerotized like the soft tegument, and the posterior margin of the anterior hysteronotal shield is almost straight. In males of *P. sarabushae*, the prodorsal shield has numerous small circular lacunae, which are arranged in transverse rows in the anterior part of this shield; the posterior ends of epimerites II are fused with anterior tips of epimerites IIIa, the posterior end of pregenital sclerite is connected with the inner tips of epimerites IVa; and two pairs of adanal shields are present; in females, the idiosoma length is 422–482; the anterior margin of the anterior hysteronotal shield is straight, the entire surface of this shield is uniformly sclerotized and bears numerous small circular lacunae; the posterior margin has a pair of incisions extending beyond the level of setae *e*2 (Mironov and Proctor, 2009).

Proterothrix disulcatus He & Wang sp. n.

Zoobank: 41F7CE5A-1C5C-4D6E-A16F-9073341D732F

(Figs. 5–8)

Type Material

Holotype — Male, 4 male and 5 female paratypes from the Spectacled Fulvetta, *Fulvetta ruficapilla* (Verreaux, J, 1871) (Paradoxornithidae), China, Sichuan Province, Tangjiahe Nature Reserve, 32°60'N, 104°69'E, 25 September 2021, collector Shu-Xiang He and Li-Hua Sun.

Depository — Holotype and one paratypes — Chinese Academy of Sciences, other paratypes — College of Plant Protection, Southwest University.

Description

Male — (holotype, range for 3 paratypes in parentheses) (Figs. 5, 6). Length of idiosoma 472 (470–478), width 149 (150–156), length of hysterosoma 326 (322–336). Prodorsal shield: entire, anterolateral extensions acute, lateral margin shallowly concave, posterior margin slightly concave, length 137 (139–144), width 115 (117–121); anterior half with a pair of long and narrowly lateral lacunae and with a pair or one small longitudinal median lacuna, posterior half with numerous small circular lacunae. Distance between scapular setae *se* 55 (54–60). Scapular shield narrow, with hook-like anteromesal extensions. Humeral shield narrow, separated from epimerites III. Setae *c*2 situated on anterior ends of humeral shields.

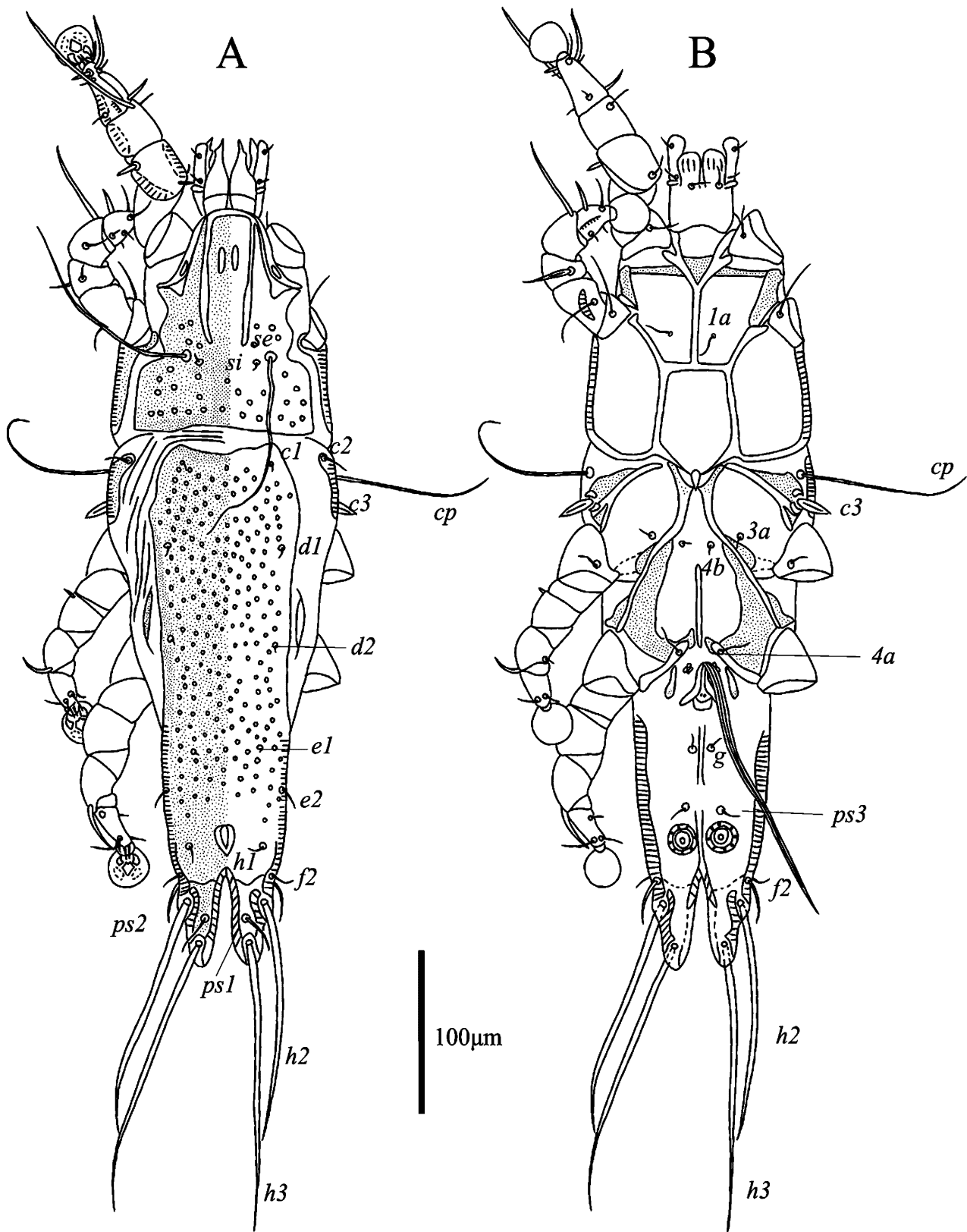


Figure 5 *Proterothrix disulcatus* sp. n., male. A – dorsal view, B – ventral view.

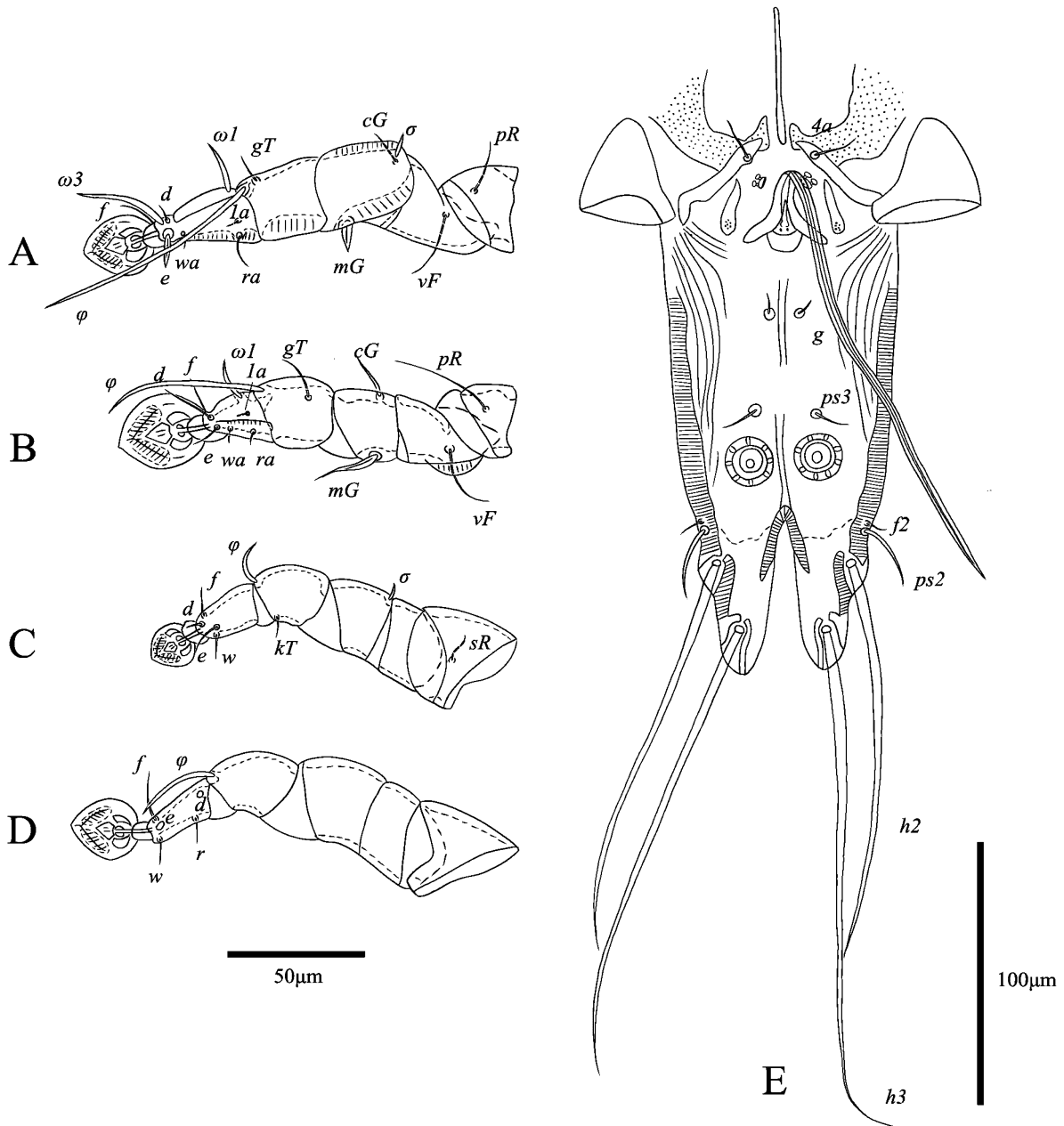


Figure 6 *Proterothrix disulcatus* sp. n., details of male. A – leg I, B – leg II, C – leg III, D – leg IV, E – details of opisthosoma.

Setae *cp* situated on soft tegument near ventral margins of humeral shields. Subhumeral setae *c3* lanceolate, 23 (21–22) × 7 (6–7). Hysteronotal shield with anterior margin slightly concave, surface with numerous small circular lacunae, greatest length 326 (322–336), greatest width 98 (98–99). Distance between prodorsal shield and hysteronotal shield 16 (10–17). Lateral hysteronotal sclerites present, situated slightly anterior to level of trochanter IV. Opisthosomal lobes elongated (approximately two times longer than wide), without membranes, lobar apices rounded and poorly sclerotized; lateral margins of lobes with convexities bearing setae *h2*, setae *h3* situated near lobar apices. Terminal cleft V-shaped, length 57 (59–62), width at level of setae *h3* 10 (9–11). Supranal concavity clearly outlined, shaped as inverted teardrop. Setae *h1* at level of supranal concavity, closer to level of setae *f2* than of setae *e2*. Setae *h3* represented

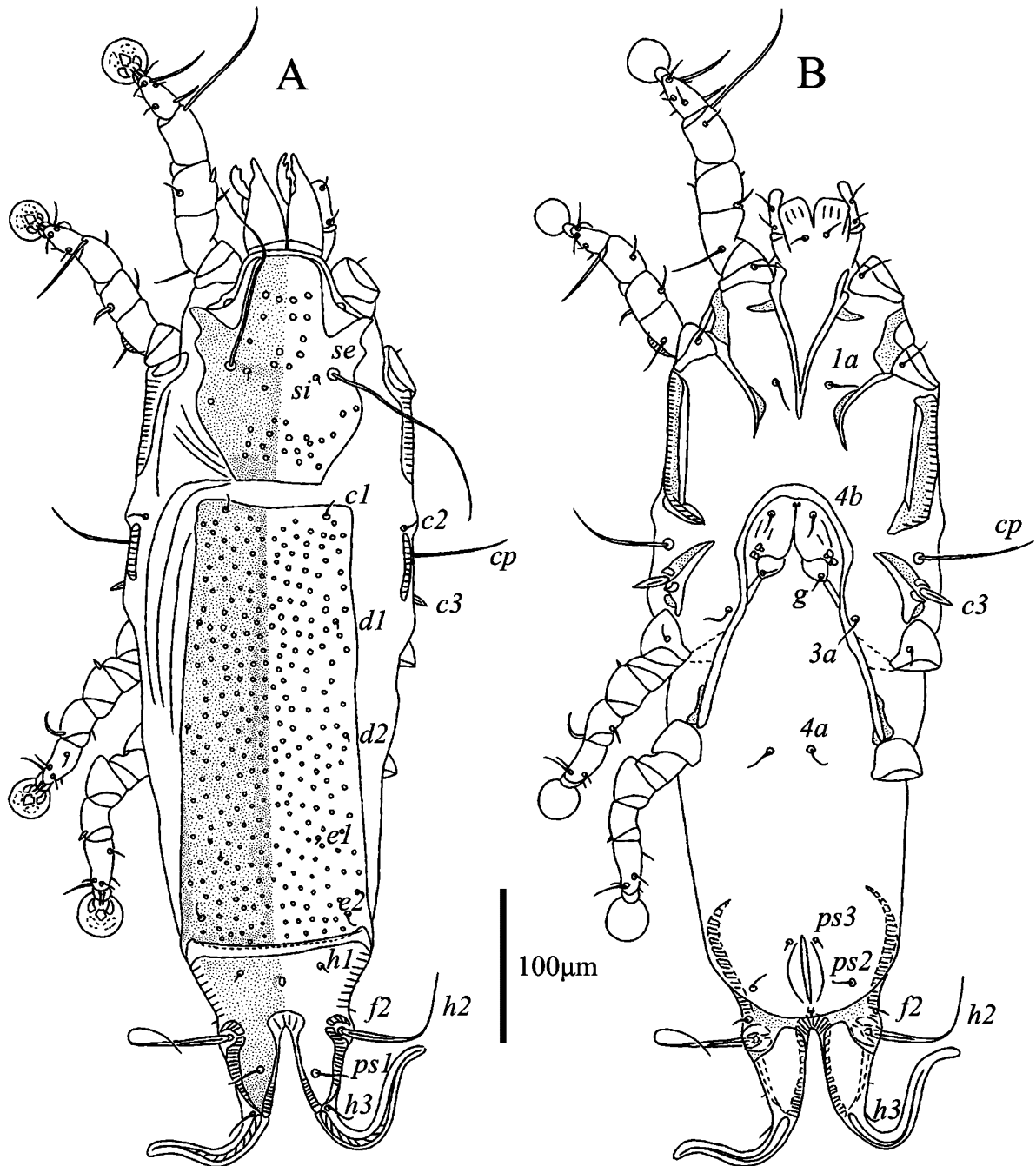


Figure 7 *Proterothrix disulcatus* sp. n., details of female. A – dorsal view, B – ventral view.

by macrosetae, length 207 (188–207), width 4 (3–4). Setae *h2* wider and shorter than setae *h3*, length 178 (178–181), width 5 (5–6). Setae *ps1* spiculiform, length 21 (20–23), situated at midlevel between setae *h2* and *h3*, slightly closer to inner margin than to outer margin of opisthosomal lobes. Setae *ps2* setiform, length 31 (29–31) (Fig. 5A). Dorsal measurement: *c2–d2* 114 (107–119), *d2–e2* 90 (89–101), *e2–h3* 95 (97–102), *d1–d2* 61 (56–61), *e1–e2* 24 (24–27), *h1–ps2* 19 (18–20), *h2–h2* 49 (49–54), *h3–h3* 32 (33–35), *ps2–ps2* 59 (59–65).

Epimerites I fused into a Y with long stem, posterior end of stem connected with middle part of epimerites II by transverse sclerotized bands. Epimerites II strongly elongated, their

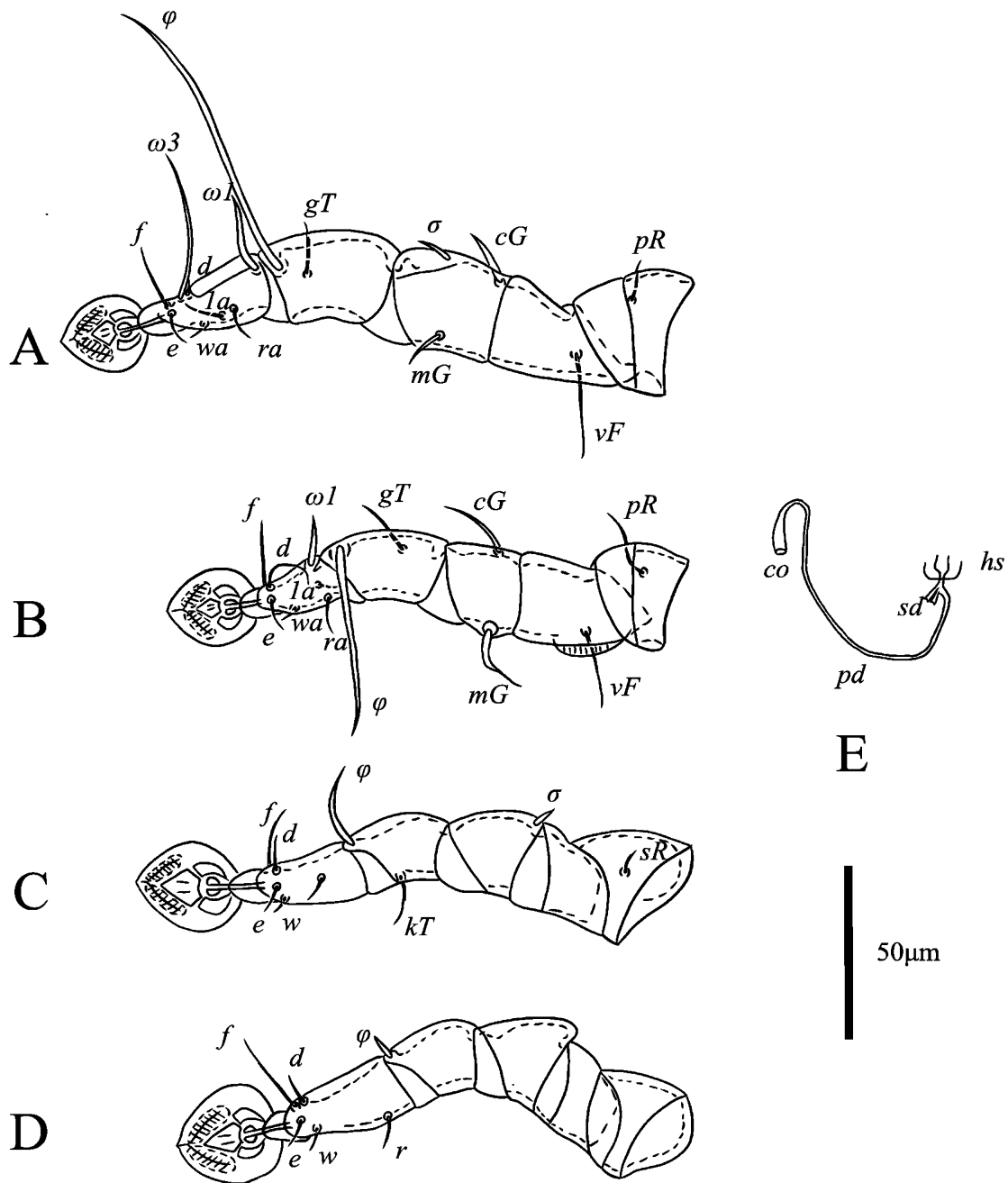


Figure 8 *Proterothrix disulcatus* sp. n., details of female. A – leg I, B – leg II, C – leg III, D – leg IV, E – spermatheca and spermatheca.

posterior tips almost fused to each other forming a closed pentagonal structure in median area of propodosoma; posterior ends of epimerites II fused with corresponding epimerites IIa and almost touching inner tips of epimerites III and IIIa (Fig. 5B). Coxal fields I, II closed, coxal fields III with small gap between tips of epimerites III and IIIa. Epimerites IVa well developed, setae 4a situated on their inner tips. Lateral areas of coxal fields IV between corresponding epimerites IV and IVa heavily sclerotized. Pregenital sclerite present, long stick-like, not connected with inner tips of epimerites IVa, length 53 (49–55), width 2 (2–3). Genital arch of moderate size, length 19 (16–22), width 29 (28–30). Aedeagus long whip-shaped, directed

anteriorly from genital arch and immediately bent backward, not extending to apices of opisthosomal lobes, length from bend to apex 189 (177–186). Genital papillae anterolateral to genital arch, their bases contiguous. Paragenital apodemes shaped as small longitudinal sclerites lateral to genital arch. Adanal suckers 17 (17–18) in diameter; corolla with 7–8 denticles. Setae *ps3* situated anterior to adanal suckers (Fig. 6E). Ventral measurements: *3a–4b* 6 (7–5), *4b–4a* 66 (66–76), *4a–g* 59 (58–61), *g–ps3* 37 (38–41), *ps3–ps3* 23 (24–25), *ps3–h3* 82 (83–87).

Legs I longer and thicker than legs II. Femur II with ventral crest. Genu I with dorsal and lateral longitudinal crest. Tarsus I with thumb-like dorsal process. Tarsus II with narrow lateral crest. Solenidion σ of genu I stick-like, 9 (7–9) long, situated at base of segment. Setae *cGI*, *cGII* filiform, setae *cGII* longer than setae *cGI*. Setae *mGI* lanceolate, 25 (21–30) long; setae *mGII* thickened, with filiform terminal part, 53 (49–55) long. Setae *e* of tarsus I lanceolate, 14 (12–17) long (Fig. 6A, B). Seta *d* of tarsus II slightly longer than corresponding seta *f*. Seta *d* of tarsus III shorter than corresponding seta *f*. Leg III, IV similar in size. Tarsus IV long 28 (27–30), without apical claw, with small apicoventral extension bearing seta *w*. Setae *d*, *e* button-like, situated in basal and apical parts of this segment, respectively (Fig. 6D). Lengths of solenidia: ω II 16 (15–16), ω III 14 (11–13), ϕ I 89 (84–90), ϕ II 55 (50–56), ϕ III 16 (23–25), ϕ IV 30 (22–29).

Female — (range for 5 paratypes) (Figs. 7, 8). Idiosoma length 540–557, width 176–188, hysterosoma length 377–385. Prodorsal shield: entire, anterolateral extensions acute, lateral margins without incisions, posterior half strongly attenuate posteriorly, posterior angles not expressed, posterior margin straight; anterior half with numerous medium-sized circular lacunae, posterior half with numerous small circular lacunae, length 140–150, width of posterior part 104–114. Distance between scapular setae *se* 63–73. Scapular shields narrow, with hook-like anteromesal extensions. Humeral shields well developed, separated from outer sclerotization of epimerites III. Setae *cp* situated on soft tegument near ventral margins of humeral shields. Setae *c2* situated dorsally on soft tegument near anterior ends of humeral shields. Subhumeral setae *c3* lanceolate, 19–22 \times 7–8. Distance between prodorsal and hysteronotal shields 13–18. Hysteronotal shield separated into anterior and lobar parts by narrow band of soft tegument. Anterior hysteronotal shield: anterior margin slightly concave, surface with small circular lacunae, median area with narrow heavily sclerotized band, length 282–291, width at anterior margin 100–103. Length of lobar region 104–107, width at level of setae *h2* 89–91. Terminal cleft V-shaped, anterior end rounded, length 54–61, greatest width at level of setae *h3* 23–29. Supranal concavity clearly outlined, circular. Setae *h1* situated on lobar shield slightly anterior to level of supranal concavity. Setae *h2* spindle-shaped, with terminal filaments, 82–95 \times 6–8. Setae *ps1* close to inner margin of opisthosomal lobes, approximately equidistant from levels of setae *h2* and *h3*. Setae *h3* 18–20 long, about 1/6th the length of terminal appendages (Fig. 7A). Dorsal measurements: *c2–d2* 122–136, *d2–e2* 114–127, *e2–h2* 69–76, *h2–h3* 49–54, *d1–d2* 63–65, *e1–e2* 40–48, *h1–h2* 37–41, *h2–ps1* 21–24, *h1–h1* 50–51, *h2–h2* 70–72.

Epimerites I fused as a short-stemmed Y. Coxal field I, II without heavily sclerotized areas. Epimerites IVa absent. Translobar apodemes of opisthosomal lobes present, fused to each other anterior to terminal cleft. Epigynum horseshoe-shaped, greatest wide 72–78 (Fig. 8). Most part of primary spermaduct narrow, distal 1/7–1/8 of primary spermaduct enlarged forming bursa copulatrix; secondary spermaducts short; copulatory opening situated ventrally at anterior margin of fused translobar apodemes (Fig. 8E). Distances between pseudanal setae: *ps2–ps2* 59–71, *ps3–ps3* 18–21, *ps2–ps3* 28–34.

Legs I slightly thicker and longer than legs II. Femur II with wide ventral crest. Solenidion σ of genu I 7–10 long, situated closer to distal margin of this segment. Setae *cGI*, *cGII*, *mGI* setiform; *mGII* strongly thickened in basal part, 14–36 long. Seta *e* of tarsus I short filiform (Fig. 8A, B). Setae *d*, *f* of tarsus II subequal in length. Setae *d* of tarsi III, IV much shorter than corresponding setae *f*. Genu IV slightly inflated dorsally, with narrow longitudinal crest. Solenidion ϕ of tibia IV much shorter than on tibia III (Fig. 8D). Lengths of solenidia: ω II 17–19, ω III 11–13, ϕ I 80–83, ϕ II 56–59, ϕ III 18–23, ϕ IV 5–7.

Etymology

The specific name *disulcatus* is a contraction of *dis* (Gr., two, twice) and *sulcus* (L., groove) and refers to two long and narrow lacunae on the anterior half of the prodorsal shield in male.

Differential diagnosis

The new species, *Proterothrix disulcatus* sp. n. belongs to the *paradoxornis* species group due to having lanceolate seta *e* of tarsus I in males. Among six previously known species of this group, the new species is most similar to *P. sarabushae* in having the following characteristics: in males, the scapular shields have hook-like anteromesal extensions, the lateral hysteronotal sclerites are present, the aedeagus almost extends to the level of lobar apices, tarsus I has a thumb-like dorsal process, and setae *mGI* are lanceolate; in females, setae *mGII* are narrowly lanceolate. *Proterothrix disulcatus* sp. n. differs from *P. sarabushae* in having the following features: in males, the anterior half of the prodorsal shield has two long and narrow lateral lacunae and a pair or one short and narrow median lacuna, the pregenital sclerite is not connected with the inner tips of epimerites IVa, the adanal shields are absent, and thickened setae *mGII* have filiform apical part; in females, setae *c2* are situated on soft tegument, the posterior margin of the anterior hysteronotal shield have very short incisions not extending to setae *e2*, and setae *mGI* are filiform. In males of *P. sarabushae*, the anterior part of the prodorsal shield has large circular lacunae arranged in several transverse rows, the pregenital sclerite is connected with the inner tips of epimerites IVa, two pairs of adanal shields are present, and setae *mGII* are simple spiniform; in females, setae *c2* are situated in the anteromesal angles of humeral shields, the posterior margin of the anterior hysteronotal shield has a pair of narrow incisions extending beyond the level of setae *e2*, and setae *mGI* are spiniform.

Proterothrix ianthocinclae sp. n.

Zoobank: [4DA2A498-3B4B-472D-B9CC-CD3B1BC7D4A9](https://doi.org/10.24349/y1xh-2eq2)

(Figs. 9–12)

Type Material

Holotype — Male holotype, 4 male and 5 female paratypes from Spotted Laughingthrush, *Ianthocincla ocellata* (Vigors, 1831) (Leiothrichidae), China, Sichuan Province, Tangjiahe Nature Reserve, 32°60'N, 104°69'E, 25 September 2021, collectors Shu-Xiang He and Li-Hua Sun.

Depository. Holotype and one paratypes — Chinese Academy of Sciences, other paratypes — College of Plant Protection, Southwest University.

Description

Male — (holotype, range for 4 paratypes in parentheses) (Figs. 9, 10). Length of idiosoma 406 (405–423), width 151 (141–146), length of hysterosoma 277 (272–288). Prodorsal shield: entire, anterolateral extensions acute, lateral margins with deep incisions encircling bases of setae *se*, posterior margin slightly convex medially, length 119 (119–129), width 102 (99–108), surface with numerous small circular and ovate lacunae. Distance between scapular setae *se* 52 (48–53). Scapular shields narrow. Humeral shields narrow, separated from epimerites III. Setae *cp* situated on ventral margin of humeral shields. Setae *c2* situated on anterior end of humeral shields. Subhumeral setae *c3* lanceolate, 23 (21–25) × 7 (7). Hysteronotal shield with anterior margin strongly concave, length from anterior margin to setae *h3* on lobar apices 281 (276–290), greatest width 78 (80–88), surface with numerous small circular lacunae. Distance between prodorsal shield and hysteronotal shield 22 (14–19). Lateral hysteronotal shields absent. Opisthosomal lobes elongated, attenuate apically, lobar apices rounded, setae *h3* situated near apices. Terminal cleft narrowly V-shaped, with membranous edges, length 43 (39–45), width at the level of *h3* 17 (12–19). Supranal concavity clearly outlined, shaped

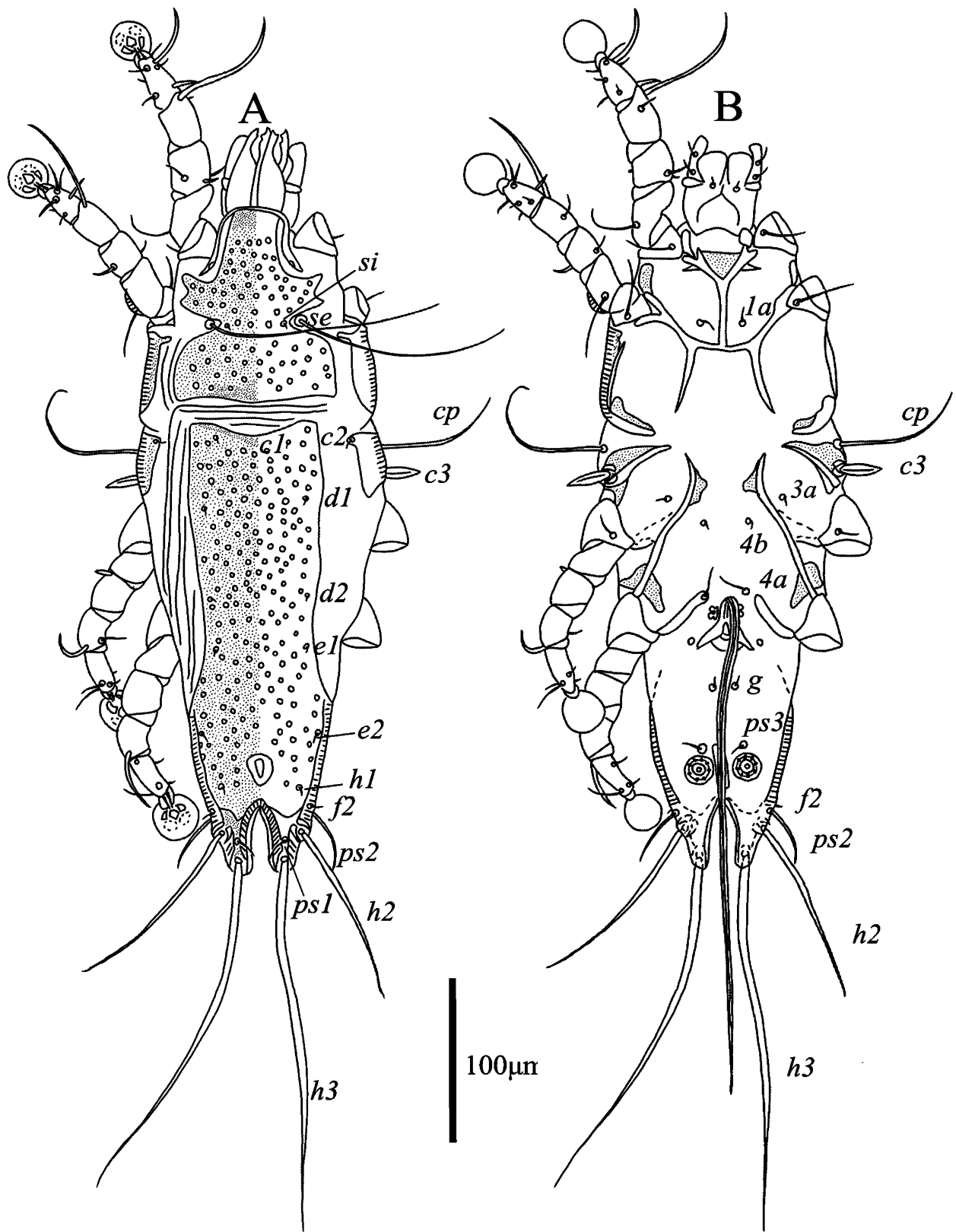


Figure 9 *Proterothrix ianthocinclae* sp. n., male. A – dorsal view, B – ventral view.

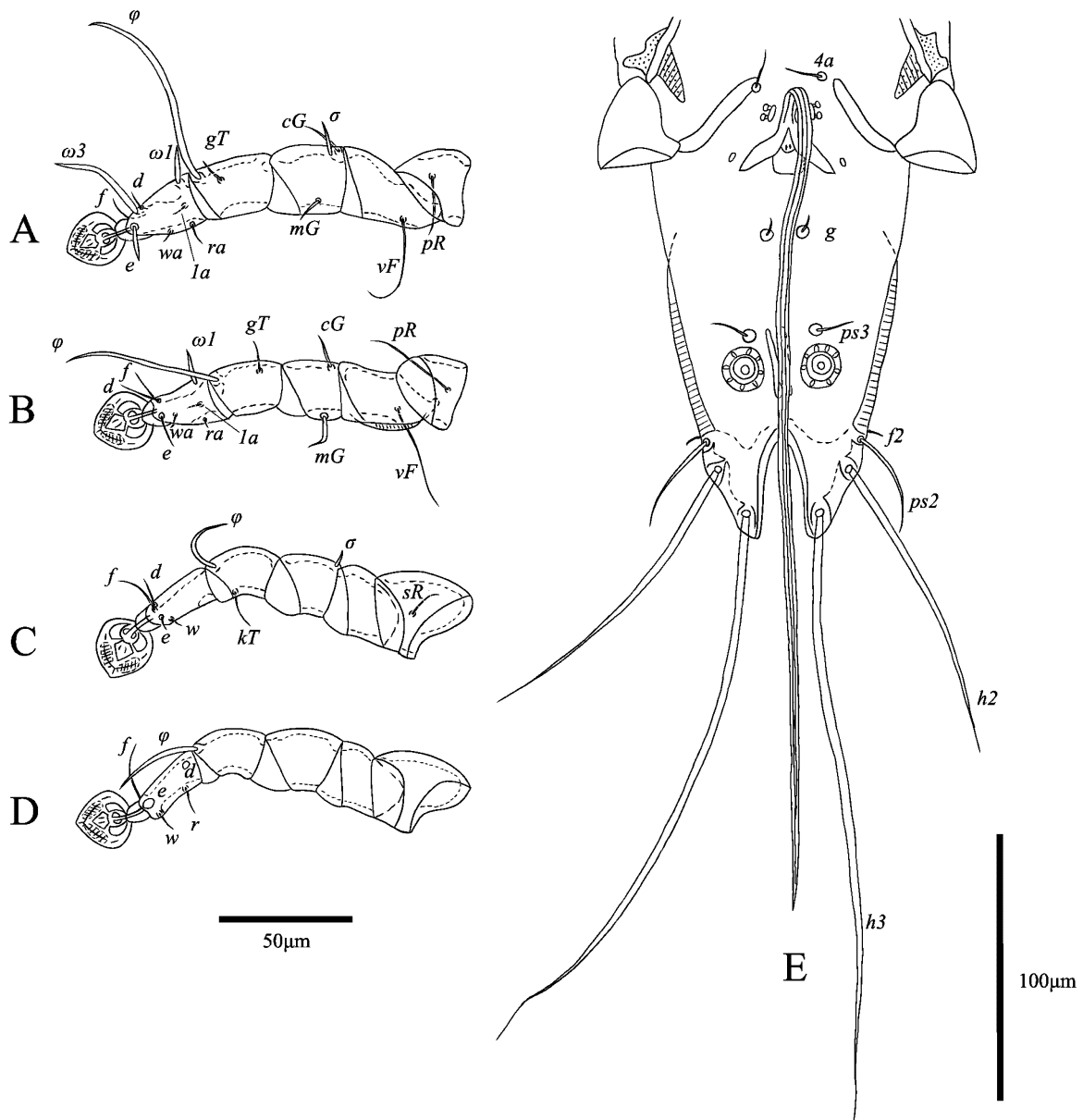


Figure 10 *Proterothrix ianthocinclae* sp. n., details of male. A – leg I, B – leg II, C – leg III, D – leg IV, E – details of opisthosoma.

as inverted teardrop, not connect with terminal cleft. Setae *h1* posterior to level of supranal concavity, much closer to level of setae *f2* than of setae *e2*. Setae *h3* represented by macrosetae, length 231 (215–240), width 3 (2–5). Setae *h2* shorter than *h3*, length 126 (131–158), width 4 (3–4). Setae *ps1* filiform, length 13 (8–10), situated closer to inner margins of opisthosomal lobes than outer ones, approximately equidistant from levels of setae *h3* and *h2*. Setae *ps2* setiform, close to setae *f2*, length 38 (32–44) (Fig. 9A). Dorsal measurements: *c2–d2* 97 (99–102), *d2–e2* 90 (90–97), *e2–h3* 69 (62–77), *d1–d2* 62 (50–61), *e1–e2* 26 (28–36), *h1–ps2* 19 (18–20), *h2–h2* 50 (47–52), *h3–h3* 28 (24–29), *ps2–ps2* 59 (58–65).

Epimerites I fused into a Y with long stem, posterior end of stem connected with middle parts of epimerites II by transverse sclerotized bands. Epimerites II long, extending to sejugal

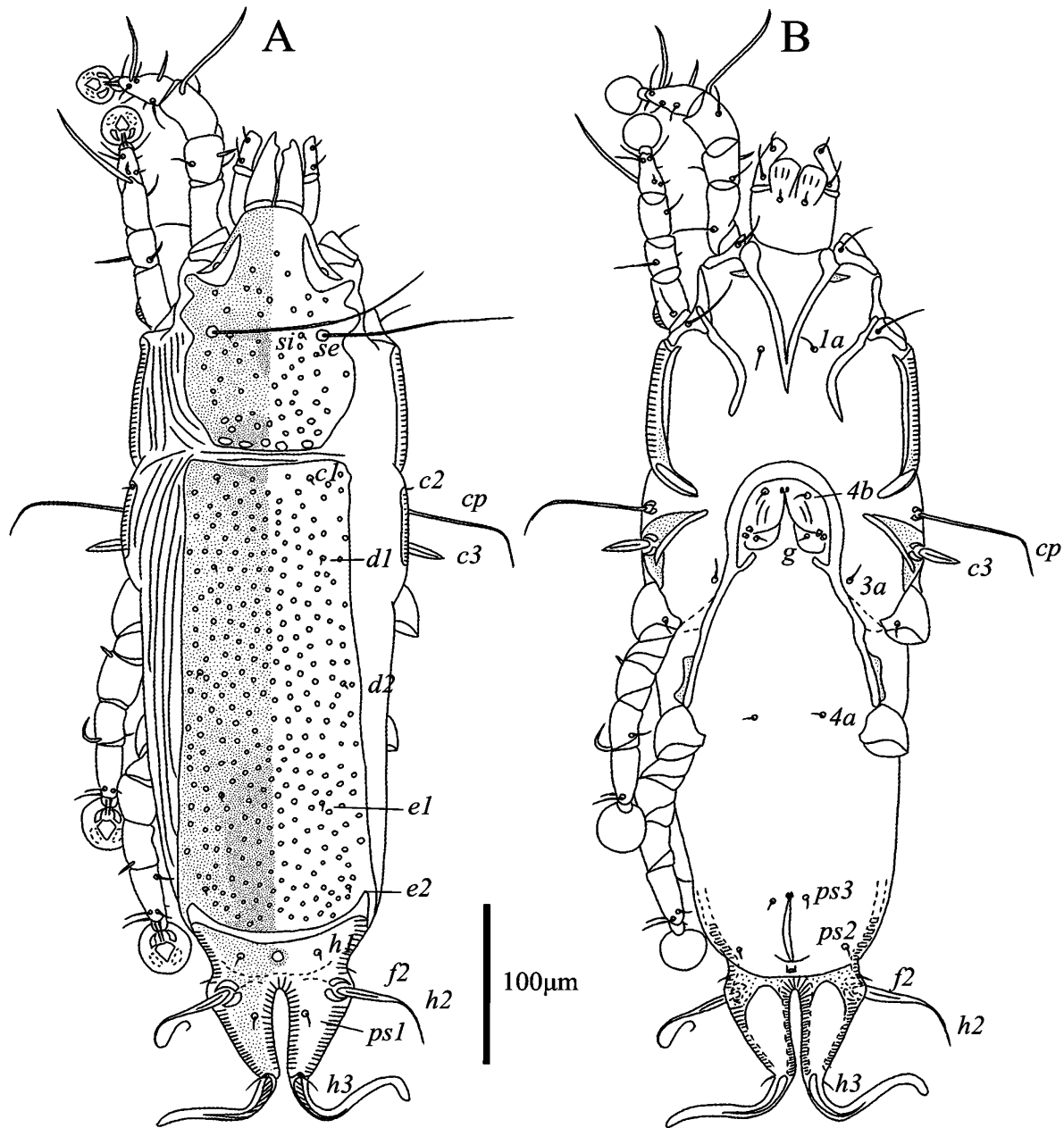


Figure 11 *Proterothrix ianthocinclae* sp. n., details of female. A – dorsal view, B – ventral view.

area, posterior ends free. Epimerites IIIa elongated, extending to level of inner tips of epimerites III. Coxal fields I closed, coxal fields II, III open, without wide sclerotized areas. Rudimentary sclerites rEpIIa absent. Epimerites IVa well developed, setae 4a situated near or on their inner tips. Coxal fields IV with triangle-shaped sclerotized area at bases of trochanters IV (Fig. 9B). Pregenital sclerite absent. Genital arch of moderate size, length 24 (23–29), width 35 (32–34). Aedeagus long whip-shaped, directed anteriorly from genital arch, immediately bent backward and extend beyond lobar apices approximately by distal half, length from bend to apex 319 (318–324). Genital papillae anterolateral to genital arch, their bases contiguous. Adanal suckers 17 (15–17) in diameter, corolla with 7–8 denticles. Adanal shields absent, ps3 situated anterior to adanal suckers (Fig. 10E). Ventral measurements: 3a–4b 13 (7–15), 4b–4a

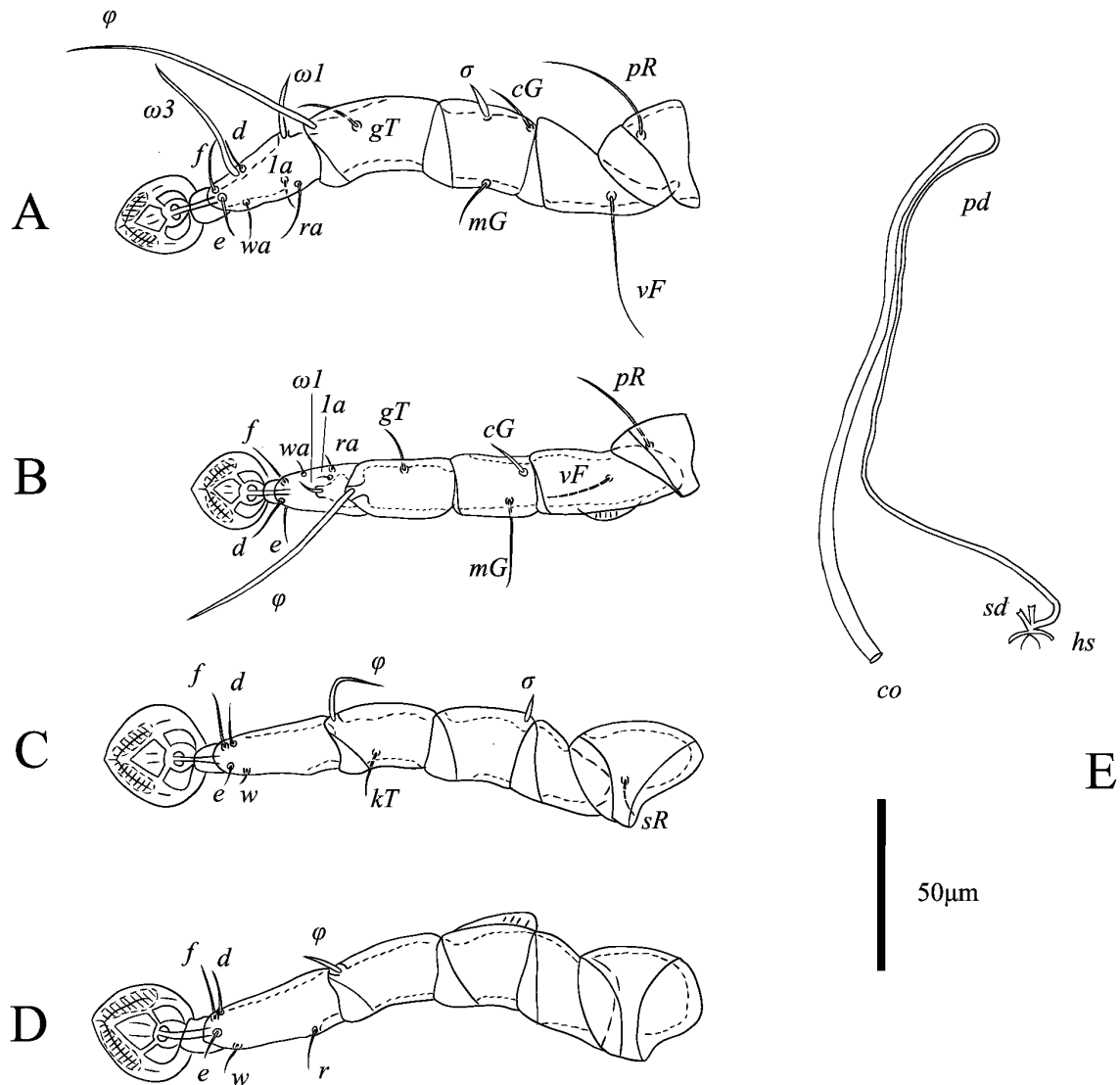


Figure 12 *Proterothrix ianthocinclae* sp. n., details of female. A – leg I, B – leg II, C – leg III, D – leg IV, E – spermatheca and spermatheca.

59 (60–61), 4a–g 56 (52–59), g–ps3 37 (36–38), ps3–ps3 24 (26–27), ps3–h3 68 (66–73).

Legs I longer and thicker than legs II; femur II with ventral crest, Solenidion σ of genu I stick-like, 10 (7–8) long, situated at base of segment. Setae *cG* I, *cG* II setiform; seta *mG* II thickened with filiform apex, 14 (14–18) long, seta *mG* I spiculiform, 11 (10–12) long; seta *cG* II longer than seta *cG* I. Seta *e* of tarsus I thick spiniform, 15 (9–17) long. Setae *d*, *f* of tarsus II subequal in length (Fig. 10A, B). Setae *f* of tarsus III approximately 2 times longer than setae *d*. Leg III, IV similar in size. Tarsus IV 28 (26–30) long, without apical claw, with a small apicoventral extension bearing seta *w*; setae *d*, *e* button-like, situated in basal and apical parts of this segment, respectively (Fig. 10D). Lengths of solenidia: ω II 13 (10–12), ω III 10 (7–11), ϕ I 79 (72–81), ϕ II 57 (54–59), ϕ III 22 (21–27), ϕ IV 30 (24–28).

Female — (range for 5 paratypes) (Figs. 11, 12). Idiosoma length 535–580, width 176–189, hysterosoma length 368–409. Prodorsal shield: entire, anterolateral extensions acute, lateral margin without incisions, posterior half slightly narrowed posteriorly, posterior angles not express, posterior margin straight; surface with numerous small circular lacunae and with a

row of larger ovate lacunae at posterior margin; length 149–157, width 104–114. Distance between scapular setae *se* 66–73. Scapular shields narrow. Humeral shields narrow, connected with epimerites III. Setae *cp* situated on soft tegument near ventral margin of humeral shield. Setae *c2* situated dorsally on anterior ends of humeral shields. Subhumeral setae *c3* lanceolate, 21–26 × 7–8. Distance between dorsal and hysteronotal shield 8–11. Hysteronotal shield split into anterior and lobar parts by narrow band of soft tegument. Anterior hysteronotal shield: anterior margin slightly concave, entire surface with small circular and ovate lacunae, length 291–311, width 102–110. Length of lobar region 102–110, width at level of setae *h2* 90–102. Terminal cleft narrow U-shaped, length 52–61, greatest width at level of setae *h3* 8–14. Supranal concavity clearly outlined, circular. Setae *h1* situated on lobar shield at level of supranal concavity. Setae *h2* spindle-shaped, with terminal filaments, 67–91 × 7–9. Setae *ps1* close to inner margin of opisthosomal lobes, approximately equidistant from levels of setae *h2* and *h3*. Setae *h3* 24–42 long, about 1/3 the length of terminal appendages (Fig. 11A). Dorsal measurements: *c2–d2* 121–134, *d2–e2* 123–138, *e2–h2* 64–78, *h2–h3* 51–58, *d1–d2* 61–72, *e1–e2* 49–58, *h1–h2* 25–34, *h2–ps1* 25–28, *h1–h1* 47–57, *h2–h2* 67–81.

Epimerites I fused in a short-stemmed Y. Coxal field I, II without heavily sclerotized areas. Epimerites IVa absent. Translobar apodemes of opisthosomal lobes present, fused to each other anterior to terminal cleft. Epigynum horseshoe-shaped, greatest wide 72–79 (Fig. 11B). Proximal half of primary spermaduct narrow, distal half approximately 3 times wider than proximal half; secondary spermaducts short; copulatory opening ventral, situated at anterior margin of translobar apodeme (Fig. 12E). Distances between pseudanal setae: *ps2–ps2* 63–67, *ps3–ps3* 25–26, *ps2–ps3* 24–28.

Legs I slightly thicker and longer than legs II. Femur II with wide ventral crest. Solenidion σ of genu I long 10–13, situated slightly closer to distal margin of this segment. Genual setae *cGI*, *mGI*, *mGI* filiform, *cGII* spiculiform. Seta *e* of tarsus I filiform. Setae *d*, *f* of tarsus II subequal in length; setae *d* of tarsi III, IV slightly shorter than corresponding setae *f*. Genu IV slightly inflated dorsally, with narrow longitudinal crest. Solenidion ϕ of tibia IV much shorter than of tibia III (Fig. 12A–D). Lengths of solenidia: ω II 12–17, ω III 6–13, ϕ I 84–89, ϕ II 56–65, ϕ III 25–29, ϕ IV 6–11.

Specific name

The specific name *ianthocinclae* is derived from the generic name of the type host and is a noun in the genitive case.

Differential diagnosis

Among six previously known species of the *paradoxornis* group, the new species is most similar to *P. longicaula* Mironov & Proctor, 2009 described from the Grey-headed Parrotbill *Psittiparus gularis* (Gray, GR, 1845) (Paradoxornithidae) in having the following characteristics in males: the surface of prodorsal shield has numerous small circular and ovate lacunae, coxal fields II, III are open, the aedeagus extends far beyond the apices of opisthosomal lobes, and femur II has ventral crest. *Proterothrix ianthocinclae* sp. n. differs from *P. longicaula* in the following features: in males of *P. ianthocinclae*, the lateral margins of the prodorsal shield have angular incisions encompassing bases of setae *se*, the posterior end of stem formed by fused epimerites I is connected with the middle parts of epimerites II by transverse sclerotized bands, coxal fields I are closed; in females, setae *h2* have terminal filaments, and the terminal cleft is parallel-sided. In males of *P. longicaula*, the lateral margins of prodorsal shield are shallowly concave, the stem formed by fused epimerites I is not connected with epimerites II and coxal fields I are open; in females, setae *h2* are spindle-like without terminal filaments, and the lateral margins of the terminal cleft are divergent posteriorly.

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ORCID

Zi-Ying Wang  <https://orcid.org/0000-0001-7722-7842>

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