

**A NEW GENUS OF THE FEATHER MITE FAMILY
PROCTOPHYLLODIDAE (ACARIFORMES: ANALGOIDEA)
FROM WOODCREEPERS (PASSERIFORMES: FURNARIIDAE:
DENDROCOLAPTINAE) IN THE NEOTROPICS**

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ABSTRACT: A new feather mite genus *Dendrocolaptobius* gen.n. belonging to the *Nycteridocaulus* generic group (Proctophyllodidae: Proctophyllodinae) is described. The genus includes two species associated with woodcreepers (Furnariidae: Dendrocolaptinae): *Dendrocolaptobius cuneiformis* (Mironov, 2017) comb.n. previously described from *Sittasomus griseicapillus* (Vieillot) in Costa Rica; and *D. lepidocolapti* sp.n. described herein from *Lepidocolaptes souleyetii* (Lafresnaye) in Panama. The new genus *Dendrocolaptobius* is clearly distinguished from the other genera of the *Nycteridocaulus* group in having an inverted genital arch and enlarged bow-shaped basal sclerite in males and the copulatory opening situated dorsally on the lobar region in females.

KEY WORDS: Analgoidea, Proctophyllodidae, *Dendrocolaptobius*, systematics, Dendrocolaptinae, Panama.

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INTRODUCTION

Woodcreepers (Furnariidae: Dendrocolaptinae) are a subfamily of arboreal suboscine passerines widely distributed throughout the Neotropical region. This bird group was previously considered a distinct family Dendrocolaptidae (e.g., Howard and Moore 1991), but the recent research places them as a monophyletic subfamily of the ovenbirds (Passeriformes: Furnariidae) (Irestedt *et al.* 2009; Moyle *et al.* 2009; Derryberry *et al.* 2011). The dendrocolaptines currently contain around 57 species in 16 or more genera (Gill and Donsker 2018). They superficially resemble treecreepers (Passeriformes: Certhiidae) and woodpeckers (Piciformes: Picidae) both morphologically and ecologically, but these similarities are due to convergent evolution.

The feather mite fauna associated with this group of passerines is almost completely unexplored, except for the representatives of the family Proctophyllodidae (Acariformes: Analgoidea). In a series of taxonomic papers, Kudon (1982a–e) described the new proctophyllodid genus *Platyacarus* Kudon, 1982 (Proctophyllodinae) with 12 new species from the representatives of Dendrocolaptinae and analyzed their host associations. Subsequent investigations by other researchers produced descriptions of seven more *Platyacarus* species, among which five were also from woodcreepers, and two were from a different furnariid subfamily—the leaflossers (Sclerurinae) (Hernandes *et al.* 2007; Hernandez and Valim 2014; Mironov *et al.* 2017).

The genus *Platyacarus* represents one of two major lineages (generic groups) of proctophyllodines associated with suboscine passerines in the Neotropical region (Klimov *et al.* 2017). This generic group, also including the genera *Tanyphyllodes* Atyeo, 1966 and *Tyranniphyllodes* Hernandez, Valim and Mironov, 2007, is restricted to birds of the clade Furnariida (Atyeo 1966a; Hernandez *et al.* 2007; Mironov and González-Acuña 2009).

The second major lineage is the *Nycteridocaulus* generic group, which currently includes 31 species in seven genera: *Anisophyllodes* Atyeo, 1967, *Atrichophyllodes* Hernandez, Pedroso and Mironov, 2007, *Armophyllodes* Mironov and Bermúdez, 2018, *Diproctophyllodes* Atyeo, 1966, *Hemipterodectes* Berla, 1959, *Nycteridocaulus* Atyeo, 1966, and *Rupicolacarus* Atyeo, 1972 (Berla 1959; Atyeo 1966b, 1967, 1969, 1972; Atyeo and Gaud 1968; Hernandez *et al.* 2007; Hernandez and Valim 2014; Mironov *et al.* 2017; Mironov and Bermúdez 2018). In contrast to the *Platyacarus* group, the majority of representatives of the *Nycteridocaulus* group are associated with suboscines of the clade Tyrannida, with a few species known from oscine passerines of the families Parulidae and Troglodytidae. Only one species of the second group—*Anisophyllodes cuneiformis* Mironov, 2017—was described from a representative of Dendrocolaptinae, the Olivaceous Woodcreeper, *Sittasomus griseicapillus* (Vieillot) in Costa Rica.

In the present paper we establish a new proctophyllodine genus *Dendrocolaptobius* gen. n. belonging to the *Nycteridocaulus* group and including two species: *A. cuneiformis* and one newly described species from the Streak-headed Woodcreeper, *Lepidocolaptes souleyetii* (Lafresnaye), in Panama.

MATERIALS AND METHODS

The material used in the present work was collected during our parasitological survey in central and western Panama (Colón and Chiriquí Provinces) in April 2016. The birds were captured with mist-nets placed near the edge of tropical rainforest, identified and checked for the presence of ectosymbionts. The feather mites were taken from live birds under a stereomicroscope (magnification $\times 10$ – 20) with a preparation needle or fine forceps and placed in tubes with 96% ethanol. After this processing taking 5–10 minutes, the captured birds were released into the wild. In the laboratory, the feather mites were mounted on slides in Hoyer's medium according to the standard technique for small acariform mites (Krantz and Walter 2009). The investigation of mite specimens and drawings were made using a Leica DM 2500 light microscope equipped with differential interference contrast (DIC) and a camera lucida.

The description of the new species and techniques for measuring morphological structures follow the current formats elaborated for proctophyllodid mites (Mironov 2006, 2012, 2017; Hernandez *et al.* 2007; Mironov and González-Acuña 2009; Hernandez 2014; Mironov *et al.* 2017). General morphological terms and idiosomal chaetotaxy follow Gaud and Atyeo (1996) with minor corrections for coxal setation by Norton (1998), and the leg chaetotaxy follows Grandjean (1939). All measurements are in micrometers (μm). The taxonomic system and both common and scientific names of birds follow Gill and Donsker (2018).

The abbreviations used in collection numbers and depository designations are as follows: BMO and UMMZ—Museum of Zoology of the University of Michigan (Ann Arbor, USA); ZISP—Zoological Institute of the Russian Academy of Sciences (Saint-Petersburg, Russia).

SYSTEMATICS

Family **Proctophyllodidae** Trouessart and Mégnin, 1884

Subfamily **Proctophyllodinae** Trouessart and Mégnin, 1884

Genus ***Dendrocolaptobius*** Mironov and Bermúdez sp. n.

Type species: *Anisophyllodes cuneiformis* Mironov, 2017 (in: Mironov *et al.* 2017).

Diagnosis. *Both sexes.* Moderately elongated proctophyllodines. Prodorsal shield entire, covering almost the entire surface of the prodorsum, with anterolateral extensions, and with posterior obliquely angled. Vertical setae *ve* rudimentary, represented by alveoli. Scapular setae *si* and *se* situated on prodorsal shield and arranged in transverse line. Humeral shields well-developed dorsally, encompassing bases of setae *cp*, setae *c2* on margin of these shields. Subhumeral setae *c3* lanceolate. Epimerites I free, with posterior ends slightly divergent. Full set of hysterosomal setae occurring in proctophyllodines present. Solenidion σ of genu I longer than solenidion $\omega 3$ of tarsus I. Tarsi I and II with 3 ventral setae, seta *wa* slightly anterior to setae *la* and *ra* on these tarsi. Segments of legs I and II without processes or other modifications.

Male. Hysteronotal shield covering almost all hysterosoma. Opisthosoma strongly attenuate posteriorly, roughly triangular in shape (Fig. 1A). Opisthosomal lobes small, represented by small semi-ovate extensions on the posterior end of opisthosoma, separated by very narrow terminal cleft, with narrow terminal lamellae along posterolateral margin of lobes. Supranal concavity present. Setae *h3* shorter than macrosetae *h2*. Setae *h1* close to transverse levels of setae *ps2* and *h2*. Coxal fields I–IV open, without extensive sclerotized areas. Genital organ at level of trochanters IV; genital arch inverted (i.e. its apex in normal position directed posteriorly), with thick bow-shaped branches; aedeagus sword-shaped and longer than genital arch; basal sclerite thick, bow-shaped, comparable in width to width of genital arch, occupying anterior position in genital apparatus (Figs. 1B, 4A, B). Genital papillae situated on a pair of bow-shaped plates (derivatives of paragenital apodemes) at anterior margin of genital apparatus. Pregenital apodemes present, situated between epimerites IIIa and genital apparatus. Opisthoventral shields present. Adanal apodemes present, fused to posterior margins of opisthoventral shields. Adanal shields variable in form, situated anterolateral to adanal suckers. Adanal suckers cylindrical, corolla dentate. Legs IV much thicker than legs III. Tarsus IV with apical claw-like process, without ventral extension at base of seta *w*, modified setae *d* and *e* button-like.

Female. Lobar region of opisthosoma clearly separated from remaining part of hysterosoma,

opisthosomal lobes well developed, with terminal appendages. Anterior hysteronotal and lobar shields separated by narrow band of striated tegument. Lobar shield entire. Supranal concavity absent. Macrosetae *h2* strongly thickened basally, with filiform apex. Epigynum thick, semicircular, free from epimerites IIIa. Translobar apodemes present, fused to each other anterior to terminal cleft. Copulatory opening dorsal, situated on lobar shield or on striated tegument between hysteronotal and lobar shields (Figs. 2A, 3E). Solenidion ϕ of tibia IV distinctly shorter than ϕ of tibia III.

Differential diagnosis. The new genus *Dendrocolaptobius* gen.n. belongs to the *Nycteridocaulus* generic group (Klimov *et al.* 2017) characterized by free epimerites I with divergent or rarely almost parallel posterior ends in both sexes. In the general appearance and especially by the form of the body, males of *Dendrocolaptobius* resemble those of the genus *Anisophyllodes* in having the hysterosoma strongly attenuate posteriorly and having a pair of small opisthosomal lobes. Nevertheless, mites of the new genus are readily distinguished from all other genera of the *Nycteridocaulus* generic group by unique features of genitalia, both in males and females. In males of *Dendrocolaptobius* species, the genital arch in normal position is inverted, i.e. its apex is directed posteriorly (Fig. 4A–D). Additionally, in males, the basal sclerite of the genital apparatus is strongly developed and represented by a big thick bow, which is comparable in width to the genital arch. In males of the other members of the *Nycteridocaulus* group, the genital arch is shaped as a common short or a double recurved bow and with its apex directed anteriorly. The basal sclerite in males of these genera is a small trapezoidal sclerite barely distinct between or behind the branches of the genital arch (Fig. 4F–H). In females of *Dendrocolaptobius* species, the copulatory opening is situated dorsally on the lobar region of opisthosoma, while in females of the other genera, this opening is situated terminally in the anterior end of the terminal cleft or subterminally, on the ventral side of opisthosoma between the anal opening and the anterior margin of the cleft.

Hosts. Furnariidae: Dendrocolaptinae.

Species included. *Dendrocolaptobius cuneiformis* (Mironov, 2017) comb.n. and *D. lepidocolapti* sp.n.

Etymology. The name is a contraction of the host subfamily Dendrocolaptinae and *bios* (Gr. *life*).

Dendrocolaptobius lepidocolapti

Mironov and Bermúdez sp.n.

(Figs. 1–3, 4A and B)

Type material. Male holotype (BMOC 20-0303-014), 2 male and 10 female paratypes from *Lepidocolaptes souleyetii* (Lafresnaye, 1849) (Passeriformes: Furnariidae), Panama, Chiriquí Province, La Amistad International Park, Las Nubes Ranger Station, 8°53'38"N, 82°36'54"W, 29 April 2016, coll. S. V. Mironov.

Depository. Depository. Holotype, 1 male and 5 female paratypes—UMMZ, remaining paratypes (ZISP 8803-8808)—ZISP.

Description. *Male* (holotype, range for 2 paratypes in parentheses). Idiosoma, length×width, 335 (340–345)×185 (185–190), length of hysterosoma 215 (215–220). Prodorsal shield: antero-lateral extensions short and acute, lateral margins without incisions, posterior angles obliquely angled, posterior margin almost straight, setae *ve* rudimentary, anterior part with numerous longitudinal dash-like lacunae, length along midline 95 (95–105), width at posterior margin 125 (125–145). Scapular setae *se* separated by 80 (75–80). Setae *c2* in antero-mesal angles of humeral shields. Setae *cp* on humeral shield. Setae *c3* lanceolate, 22 (20–22) long, about 5 width. Distance between prodorsal and hysteronotal shields along midline 35 (35–40). Hysteronotal shield: 210 (210–215) long, 125 (125–130) wide; anterior margin straight or slightly concave; anterior angles acute, surface with numerous longitudinal dash-like and narrowly triangular lacunae in anterior three quarters and with ovate lacunae in posterior quarter (Fig. 1A). Setae *c1* on anterior margin of hysteronotal shield. Opisthosoma noticeably attenuate posteriorly, roughly triangular in general shape; opisthosomal lobes small, with oblique and slightly convex posterolateral margins bearing narrow and rounded terminal lamellae, about 5 in greatest length and about 20 in width. Terminal cleft between lobes slit-shaped, anterior end of the cleft not extending to level of setae *h3*, length from anterior end to posterior margin of terminal lamellae 15 (15–16), greatest width 4 (3–4). Supranal concavity closed, shaped as inverted teardrop, distance from anterior end of this concavity to bottom of terminal cleft 32 (28–35). Setae *h2* situated on small lateral extensions of opisthosoma, setae *h3* posterior to them on small lateral convexities. Setae *ps1* minute spiculiform, situated on lateral margins of terminal cleft, noticeably posterior to level of setae *h3*.

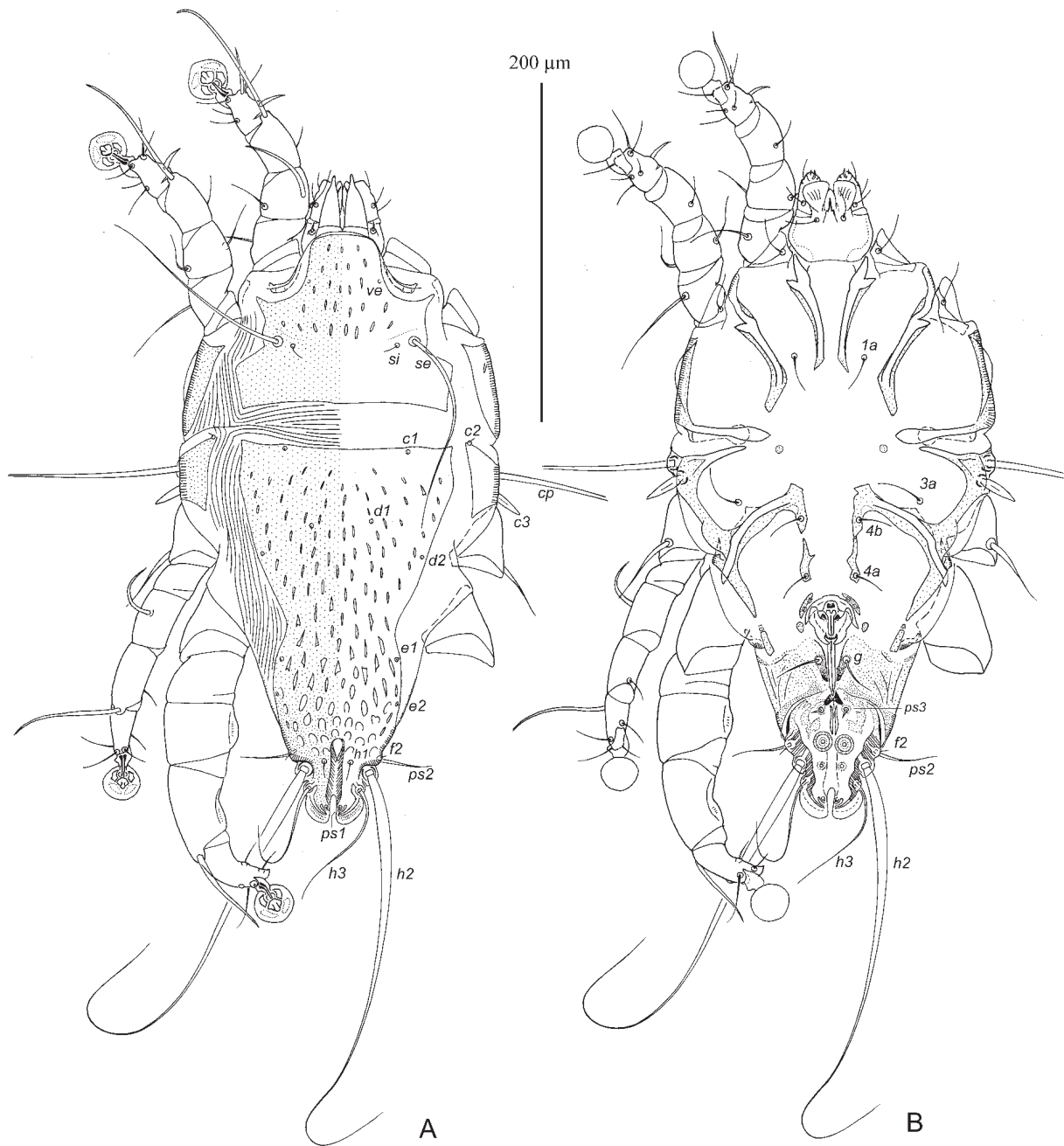


Fig. 1. *Dendrocolaptobius lepidocolapti* sp.n., male. A—dorsal view, B—ventral view.

Distance between dorsal setae: $c2:d2$ 62 (65–70), $d2:e2$ 70 (70–78), $e2:h3$ 55 (52–55), $h2:h2$ 37 (38–40), $h3:h3$ 30 (27–32), $ps2:ps2$ 50 (50–52), $h1:h2$ 5 (5–8), $h3:ps1$ 10 (10–12), $d1:d2$ 20 (18–20), $e1:e2$ 18 (20–24).

Epimerites I free, well separated, with posterior tips slightly divergent, without large sclerotized areas around them; epimerites II with narrow sclerotized fields (Fig. 1B). Epimerites IVa small, rudimentary sclerite rEpIIa present. Genital arch inverted (directed posteriorly), with pair of rounded hook-like apical extensions, 20 (20–22) long

and 25 (25–28) wide; basal sclerite thick, bow-shaped (crescent-shaped), 30 (30–33) wide (Fig. 4A). Aedeagus sword-shaped, 32 (30–32) long, with tip reaching anterior end of anal opening. Distance from anterior margin of genital apparatus to lobar apices 120 (120–125). Genital papillae of each side on small bow-shaped plates (paragenital apodemes) at anterior margin of basal sclerite. Pregenital apodemes represented by a pair of longitudinal sclerites (one or both of them can be interrupted), with anterior ends fused with inner tips of epimerites IIIa, and with posterior ends extending

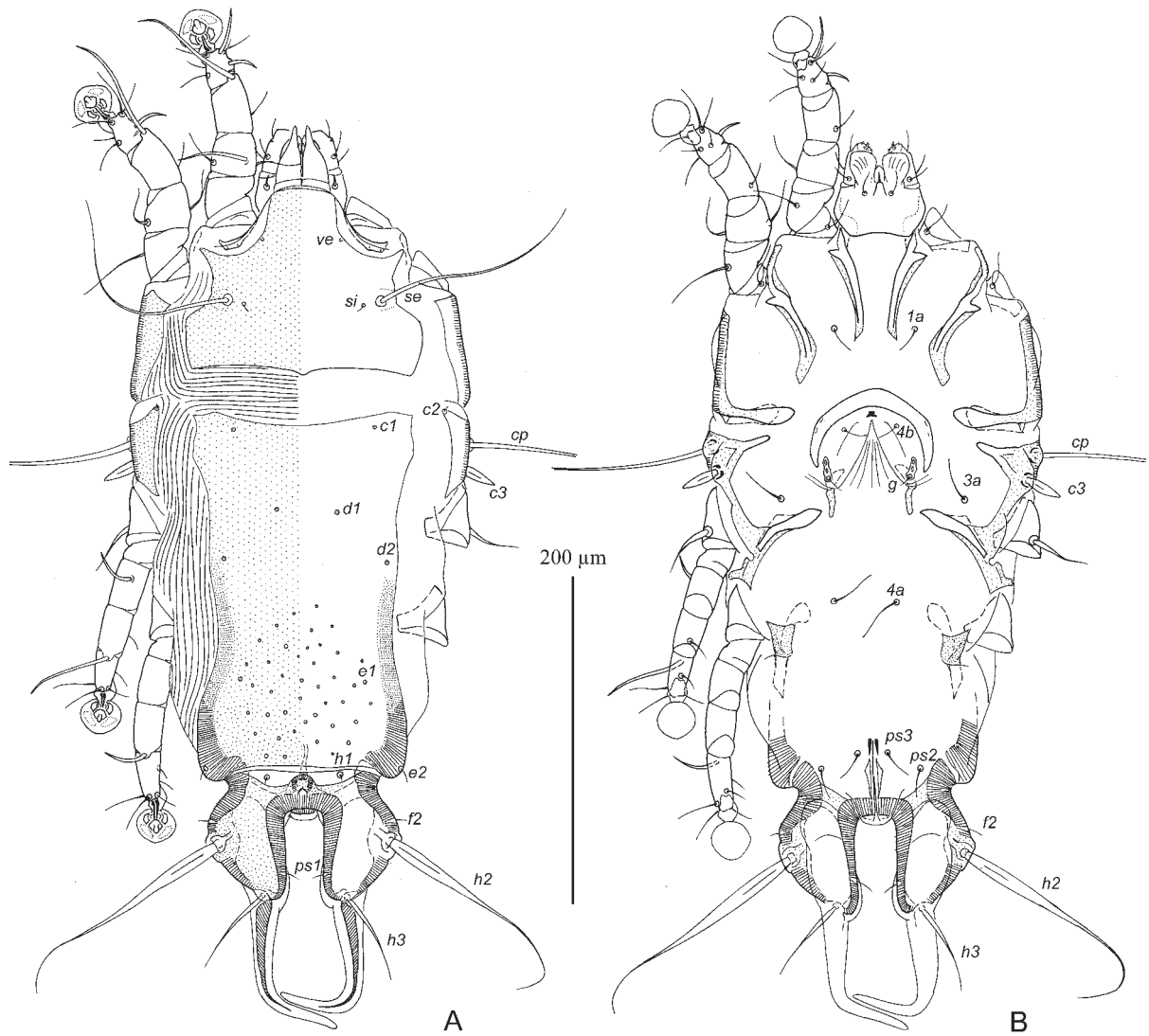


Fig. 2. *Dendrocolaptobius lepidocolapti* sp.n., female. A—dorsal view, B—ventral view.

to bases of setae *4a*; setae *4b* situated on anterior parts of these apodemes. Additional paragenital sclerites ovate, situated near tips of basal sclerite. Opisthoventral shields occupying most lateral areas of opisthosoma, fused at midline to each other and posteriorly with adanal apodemes forming entire shield between genital apparatus and anal field; anterior margin of this complex shield with deep U-shaped incision encompassing aedeagus. Adanal membranes narrow. Adanal suckers 11 (10–11) in diameter, corolla with 12–15 barely distinct denticles. Adanal shields of complicated uneven form, fused anteriorly with adanal apodemes; one unpaired median fragment of triangular form heavily sclerotized. Setae *ps3* short spiculiform, situated on small ovate fragments of adanal shields. Cupules *ih* situated at level of setae *h2* and surrounded by sclerotized areas. Distance between

ventral setae: *3a:4b* 13 (10–13), *4b:4a* 32 (30–32), *4a:g* 48 (42–48), *g:g* 15 (15–16), *g:ps3* 28 (28–30), *ps3:ps3* 15 (15–18), *ps3:h3* 40 (40–42).

Femora I and II without distinct ventral ridge. Solenidion σ I 2–2.5 times longer than genu I and situated at midlevel of this segment (Fig. 3A, B). Solenidion σ of genu III situated at midlevel of segment. Legs IV much thicker than legs III, with tarsus and distal part of tibia IV extending beyond level of terminal lamellae. Femur IV with distinct ventral ridge, and tibia IV with narrow ventral ridge. Tarsus IV 36 (36–38) long, with rounded apex and apicoventral claw-like process near base of seta *w*; modified setae *d* button-like, situated in distal half of this segment (Fig. 3D, E). Setae *d*, *f* of tarsi II and III subequal in length. Length of solenidia: σ I 40 (35–38), σ III 30 (30–32), ϕ IV 42 (38–42).

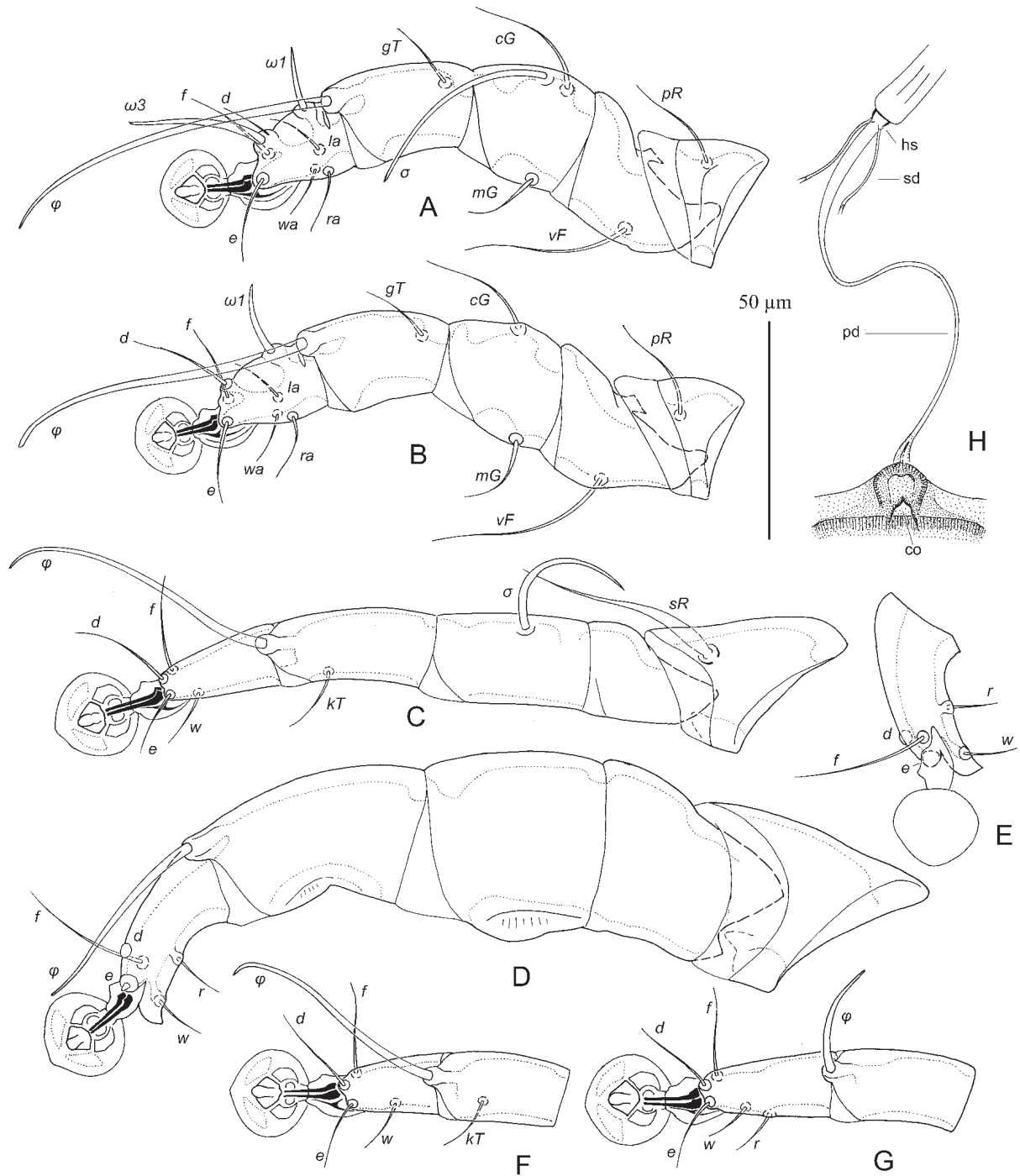


Fig. 3. *Dendrocolaptobius lepidocolapti* sp.n., details. A–D—dorsal view of legs I–IV of male, respectively; E—tarsus IV of male, ventral view; F and G—tibia and tarsus III and IV of female, respectively; H—spermatheca and spermaducts. Abbreviations: co—copulatory opening, hs—head of spermatheca, pd—primary spermaduct, sd—secondary spermaduct.

Female (range for 10 paratypes). Idiosoma, length×width, 400–415×195–205, length of hysterosoma 270–290. Prodorsal shield: anterolateral extensions acute, lateral margins entire, posterior margin with blunt-angular median extensions and with a pair of wide and shallow concavities, surface without ornamentation, 100–110 in length and 135–145 in width. Setae *ve* rudimentary. Setae *se*

separated by 85–95. Setae *c2* in antero-mesal angles of humeral shields. Setae *c3* lanceolate, 20–24 long, about 5 wide. Setae *cp* on humeral shields. Distance between prodorsal and hysteronotal shields along median line 30–35. Hysteronotal shield completely split into anterior and lobar parts. Anterior hysteronotal shield: 195–215 long and 120–135 wide; anterior margin concave, anterior angles acute,

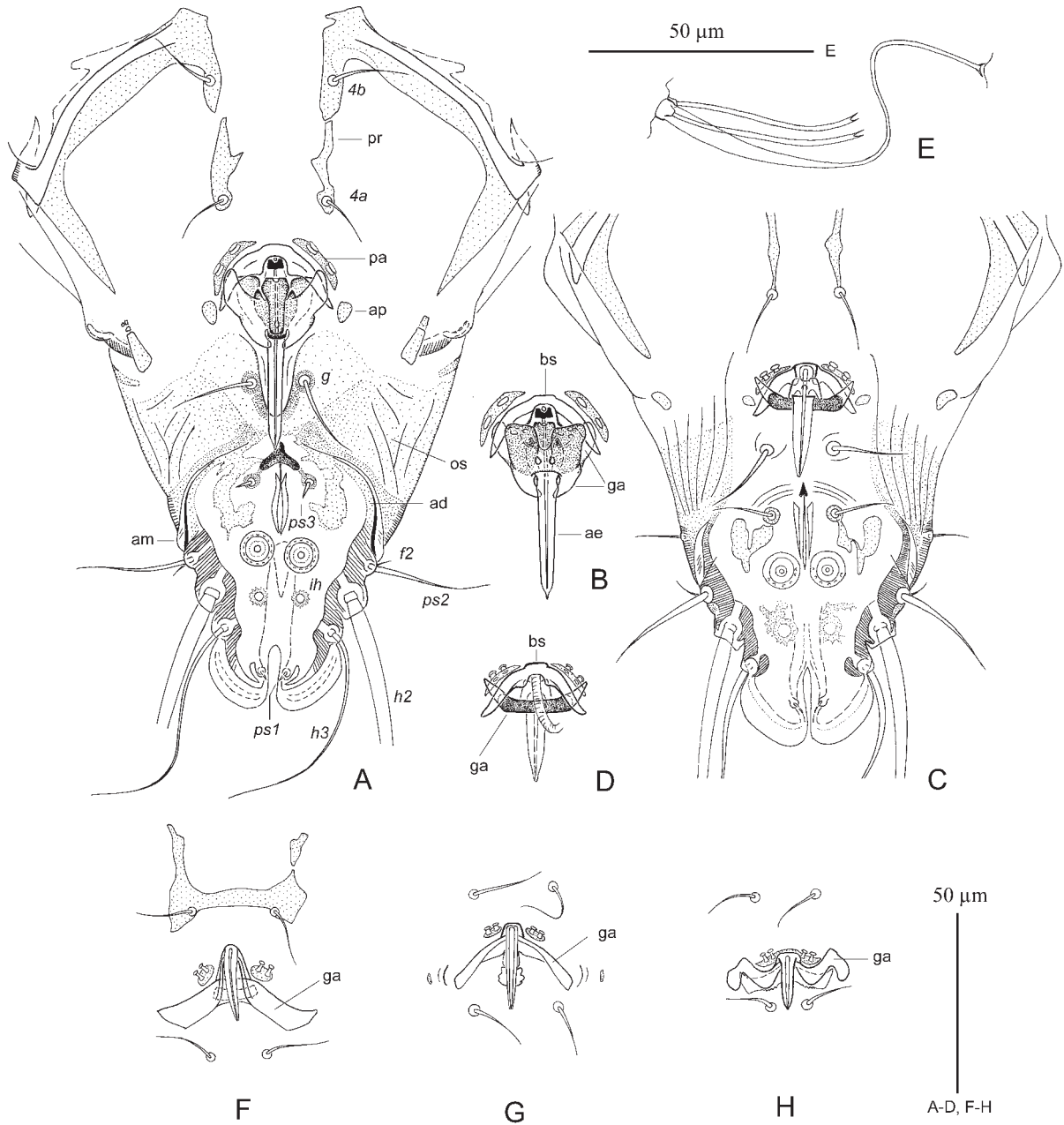


Fig. 4. Details of genital structures in the *Nycteridocaulus* generic group. A—*Dendrocolaptobius lepidocolapti*, sp.n. ventral view of male opisthosoma; B—same, dorsal view of male genital apparatus, C—*D. cuneiformis* (Mironov, 2017) ventral view of male opisthosoma; D—same, dorsal view of male genital apparatus; E—same, spermatheca and spermaducts; F—*Anisophyllodes pipromorphae* Atyeo, 1967, ventral view of male genital apparatus; G—*Nycteridocaulus hylophylax* Mironov, 2017, ventral view of male genital apparatus; H—*Nycteridocaulus attila* Mironov, 2017, ventral view of male genital apparatus. Abbreviations: ad—adanal apodeme, ae—aedeagus, am—adanal membrane, ap—additional paragenital sclerite, bs—basal sclerite, ga—genital arch, pa—paragenital apodeme, pr—pregenital apodeme.

posterior margin straight, posterior half with numerous small, sparsely disposed, circular lacunae (Fig. 2A). Setae *c1* on anterior margin of hysteronotal shield. Lobar region: anterior margin with median convexity, bearing heavily sclerotized tubercle with copulatory opening; greatest length of region 70–75, greatest width 110–120 (Fig. 3H). Terminal cleft parallel-sided, almost rectangular in shape, 45–55

in length and 25–32 in width. Setae *h1* inserted on striated tegument between the anterior hysteronotal and lobar shields. Setae *h2* strongly thickened basally, with filiform apical part, 110–130 in length, 6–7 in width; setae *h3* 52–55 in length. Setae *h1* and *f2* in trapezoidal arrangement. Distance between dorsal setae: *c2:d2* 84–88, *d2:e2* 110–120, *e2:h2* 41–48, *h2:h3* 30–34, *h1:h2* 38–43, *d1:d2*

24–30, *e1:e2* 46–50, *h1:h1* 40–45, *h2:h2* 100–110, *h2:ps1* 17–20.

Epimerites I as in male; epimerites I and II with narrow sclerotized fields. Epimerites IVa present, with long anterior and posterior subtegumental apodemes. Epigynum semicircular, thick, without lateral extensions, 43–50 in length, 70–80 in width, tips extending to level of posterior pair of genital papillae (Fig. 2B). Genital papillae and seta *g* of each side on small ovate sclerite. Setae *ps2* at level of anterior half of anal opening. Translobar apodemes fused to each other anterior to terminal cleft. Posterior flaps of anal opening slightly extending into terminal cleft. Head of spermatheca short, proximal part of primary spermaduct with ampuliform enlargement, secondary spermaducts 25–30 long (Fig. 3H). Distance between pseudanal setae: *ps2:ps2* 52–57, *ps3:ps3* 18–20, *ps2:ps3* 8–10.

Legs I and II as in male. Solenidion σ of genu III situated in basal part of this segment. Legs IV with ambulacral disc extending to level of setae *h2*. Solenidion ϕ of tibia IV slightly shorter than corresponding tarsus. Setae *d* of tarsi II–IV subequal in length to corresponding setae *f*. Length of solenidia: σ I 38–42, σ III 22–27, ϕ III 48–52, ϕ IV 26–28.

Differential diagnosis. *Dendrocolaptobius lepidocolapti* sp.n. differs from the type species of the genus—*D. cuneiformis* (Mironov, 2017) (see below)—by several features: in males, the posterior part of the prodorsal shield lacks any ornamentation, the anterior part of hysteronotal shield bears longitudinal dash-shaped lacunae, the opisthoventral shields are fused to each other along midline into an entire ventral shield with deep U-shaped incision on the anterior margin, the aedeagus is 30–32 long, setae *g* are spiculiform, and femur IV has a well-developed ventral ridge; in females, the prodorsal shield and anterior half of hysteronotal shield lack ornamentation, and the copulatory opening is situated on the heavily sclerotized tubercle of the lobar shield. In males of *D. cuneiformis*, the entire surface of the prodorsal shield bears small elongated and polygonal lacunae, the anterior part of hysteronotal shield bears triangular and polygonal lacunae, the opisthoventral shields are not fused, the aedeagus is 20–24 long, setae *g* are filiform, and femur IV does not have a ventral ridge; in females, the entire surface of the prodorsal shield and hysteronotal shields bears small ovate and dash-like lacunae, and the copulatory opening is situated on the soft tegument near the posterior margin of the hysteronotal shield.

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

***Dendrocolaptobius cuneiformis*
(Mironov, 2017) comb.n.**

(Fig. 4C–E)

Anisophyllodes cuneiformis Mironov, 2017, in: Mironov *et al.* 2017: 67, fig. 37–39.

Material examined. Male holotype (ZISP 6400), 7 male and 7 female paratypes from *Sittasomus griseicapillus* (Vieillot, 1818) (Furnariidae), Costa Rica, Tapantí National Park, Sector Tapantí, Cordillera de Talamaca Mts., 09°46'N, 83°47'W, 2 August 2009, coll. I. Literak, O. Sychra and M. Capek.

This species, originally described as a member of the genus *Anisophyllodes*, is known only from the Olivaceous Woodcreeper, *Sittasomus griseicapillus*, in Costa Rica (Mironov *et al.* 2017).

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