New genus and three new species of quill mites (Acari: Syringophilidae: Picobiinae) parasitising puffbirds (Aves: Piciformes)

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Abstract: Three new species, belonging to the newly proposed genus *Pseudopicobia* gen. n., inhabiting body quill feathers of puffbirds (Piciformes: Bucconidae), are described: *P. nonnula* sp. n. from *Nonnula frontalis* (Sclater) in Colombia, *P. malacoptila* sp. n. from *Malacoptila panamensis* Lafresnaye in Colombia and *P. hapaloptila* sp. n. from *Hapaloptila castanea* (Verreaux) in Ecuador. The new genus differs from morphologically similar genus *Picobia* Heller, 1878 by the absence of the genital setae, absence of the genital lobes, solenidia ♂ represented by microsetae, and by the presence of setiform solenidia ♂. Syringophilid mites are recorded from birds of this family for the first time.

Keywords: Acari, *Pseudopicobia*, new genus, ectoparasites, birds, Bucconidae

The quill mites of the family Syringophilidae (Acari: Prostigmata: Cheyletoidea) are diverse group of permanent and highly specialized ectoparasites of birds inhabiting the feather quills. They live and reproduce inside the flight and body feathers feeding on the soft tissue fluids of their hosts by piercing the calamus wall with their long and flexible chelicerae (Kethley 1971). Transmission of these mites is mainly vertical, from parents to their offspring, but occasionally horizontal transfer, from one adult host to another, is also possible (Nattress 2011). Although we have little data on the pathogenicity of these mites and their negative impact on condition of birds, some authors suggest that they may play a role as potential enzootic vectors for pathogens (Skoracki et al. 2006).

Syringophilids are mono- or oligoxenous parasites associated with birds of different orders throughout the world. To date this family includes more than 269 species in 53 genera recorded from more than 180 bird species belonging to 69 families of 21 orders (Skoracki and O'Connor 2010, Skoracki 2011, Skoracki et al. 2011, 2012).

The subfamily Picobiinae Johnson et Kethley, 1975 is a taxonomically diverse group as it was estimated based on the number of their potential host species (Johnston and Kethley 1973). To date, it comprises only 35 species grouped in five genera. Members of this subfamily inhabit a wide spectrum of avian hosts. The monotypic genus *Calamincola* Casto, 1977 is known from cuculiform birds. Five species of *Columbiphilus* Kivganov et Sharafat, 1995 were collected from birds of the orders Columbiformes, Galliformes, and Pteroclidiformes. The

most diverse genus *Picobia* Haller, 1878 includes 19 species found on Passeriformes, Piciformes, and Upupiformes. Ten species of the genus *Neopicobia* Skoracki, 2011 are associated with bird orders Passeriformes, Psittaciformes, Piciformes, and Columbiformes (Casto 1977, Kivganov and Sharafat 1995, Skoracki 2011). The monotypic genus *Rafapicobia* Skoracki, 2011 is known only from passerines. All members of the subfamily Picobiinae occupy exclusively body feathers, except enigmatic species *Calamincola lobatus* Casto, 1977 collected from various flight feathers of *Crotophaga sulcirostris* Swainson (Casto 1977).

In the current study we propose a new genus of syringophilid mites to accommodate three new species that were collected from quill feathers of birds belonging to the family Bucconidae (Aves: Piciformes).

MATERIALS AND METHODS

Specimen collection and preparation. The mite materials used in the present study were collected in the ornithological collection of the Bavarian State Collection of Zoology, Munich, Germany (ZSM) from dry bird skins. Before mounting, mites were softened and cleared in Nessbitt Solution at 60 °C for 1–2 hours. For light microscope study mites were mounted on slides in Faure medium and investigated under the light microscope Olympus BH-2 with differential interference contrast (DIC) illumination. Drawings were made using a drawing attachment. All measurements are given in micrometres. Measurements (ranges) of paratypes are given in brackets following data of holotype.

Terminology. The idiosomal setation follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). Nomen-

clature of leg chaetotaxy follows that proposed by Grandjean (1944). The application of these chaetotactic schemes to Syringophilidae was recently provided by Bochkov et al. (2008). Morphological terminology follows Skoracki (2011). The scientific names of the birds follow Clements (2007).

Abbreviations. Specimen depositories and reference numbers are cited using the following abbreviations: AMU – A. Mickiewicz University, Department of Animal Morphology, Poznan, Poland; IPCAS – Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic; ZSM – Bavarian State Collection of Zoology, Munich, Germany; ZISP – Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.

RESULTS

Family: **Syringophilidae** Lavoipierre, 1953

Subfamily: **Picobiinae** Johnston et Kethley, 1973

Genus: **Pseudopicobia** gen. n.

Type species: **Pseudopicobia nonnula** sp. n.

Diagnosis

Female. Medium to large-sized syringophilids (total body length 485–845). *Gnathosoma*: Hypostomal apex rounded. Lateral hypostomal teeth absent. Peritremes M-shaped, with clearly visible chambers in each branch. Movable cheliceral digits edentate. Stylophore rounded posteriorly. *Idiosoma*: Dorsal propodonal setae beaded. Six pairs of propodonal setae present, arranged 2–1–1–2. Propodonal shield divided longitudinally, forming two narrow shields bearing bases of setae *ve*, *si* and *se*; unpaired shield between these shields absent. Hysteronotal shield absent. Hysteronotal setae long. Setae *d1* situated closer to *e2* than to *d2* or located equidistant between *d2* and *e2*. Pygidial shield present or absent. Terminal setae *f1*, *f2* short, setae *h2* long. Bases of setae *1a–1a* coalesced, *3a–3a* not coalesced. Pseudanal series represented by two pairs of setae. Genital setae absent. Aggenital series with three pairs of setae. Aggenital plate absent. Genital plate present. Genital lobes absent. *Legs*: Legs I and II thicker than III and IV. Apodemes I parallel with thorn-like protuberances in middle part. Legs with full complement of solenidia, solenidia ϕ I represented by microsetae, solenidia σ I setiform. Antaxial and paraxial members of claw pair of legs III and IV unequal in size and shape.

Male. Features as in females except: small-sized mites (total body length 300); hypostomal apex rounded; propodonal setae arranged 2–1–1–2; hysteronotal shield present, not fused to pygidial shield; hysteronotal setae *d2* long; setae *d1* and *e2* short; pseudanal series represented by two pairs of setae; genital series with two pairs of setae; aggenital series with two pairs of setae.

Etymology: The name of the new genus reflects its resemblance to the genus *Picobia*.

Differential diagnosis. This new genus is morphologically similar to *Picobia*. In both genera females have clearly visible chambers in each branch of the peritremes;

the propodonal shield is divided longitudinally, forming two narrow shields bearing bases of setae *ve*, *si* and *se*; the hysteronotal shield is absent; setae *1a–1a* are coalesced; the apodemes I are parallel and with thorn-like protuberances in middle part; the legs have a full complement of solenidia. Females of this new genus differ from females of *Picobia* by the following characters: in females of *Pseudopicobia* gen. n., genital setae are absent; genital lobes are absent; differentiation between physogastric form and non-physogastric form is difficult; solenidia ϕ I are represented by microsetae, solenidia σ I are setiform. In females of *Picobia*, a pair of genital setae is present, genital lobes are present, physogastric forms are vermiform in outline and are about 2–3 longer than non-physogastric form; solenidia ϕ I are not reduced to minute structures, solenidia σ I are bulb-like.

Habitat, host range and distribution. Mites of this genus inhabit quills of body feathers and are associated with puffbirds (Piciformes: Bucconidae) in the Neotropical region.

Pseudopicobia nonnula sp. n.

Figs. 1–13

Female, holotype. Total body length 700 (605–680 in four paratypes). *Gnathosoma*: Infracapitulum sparsely punctate. Movable cheliceral digit 115 (115) long. Each medial branch of peritremes with 3–4 chambers, each lateral branch with 5–6 chambers. Stylophore 160 (155–165) long. *Idiosoma*: Two narrow propodonal shields sparsely punctate near bases of setae *si*. Length ratio of setae *vi* : *ve* : *si* 1 : 1.1–1.3 : 1.2–1.4. Bases of setae *vi* situated posterior to level of setae *ve*. Setae *vi*, *ve* and *si* lightly beaded, other idiosomal setae smooth. Setae *se* situated posterior to level of setae *c1*. Hysteronotal shield absent. Setae *d2* slightly (1.1–1.2 times) longer than *d1* and *e2*. Pygidial shield present. Setae *f2* 1.6–1.8 times longer than *f1*. Setae *h1* 2–3.5 times longer than *f1*. Aggenital setae *ag1* situated anterior to level of setae *ag2*. Length ratio of setae *ag1* : *ag2* : *ag3* 1.9–2 : 1 : 2.2. Genital plate present. Both pairs of pseudanal setae subequal in length or setae *ps2* slightly longer than *ps1*. All coxal fields well sclerotized, I densely punctate, II sparsely punctate, III and IV apunctate. Setae *3c* about twice as long as *3b*. *Legs*: Setae *l'RIII* reach to tarsus. Setae *tc'* and *tc''* of legs III and IV subequal in length. *Lengths of setae*: *vi* 130 (100–115), *ve* (120–130), *si* 155 (120–145), *se* 200 (180–195), *c1* 220 (180–205), *c2* (150–160), *d1* 140 (150–155), *d2* 170 (160–165), *e2* 130 (125–140), *f1* 50 (50–55), *f2* 80 (80–90), *h1* 140 (110–170), *h2* (335), *ag1* 130 (125), *ag2* 65 (65), *ag3* 140 (140–145), *ps1* 20 (20), *ps2* (20–30), *tc'III–IV* and *tc''III–IV* (50–60), *l'RIII* 60 (60–70), *l'RIV* (45), *3b* 50 (45–50), *3c* 100 (90–100).

Male. Total body length 300 in one paratype. *Gnathosoma*: Infracapitulum apunctate. Each medial branch of peritremes with 3–4 chambers, each lateral branch with six chambers. Stylophore 80 long. *Idiosoma*: Propodono-

Figs. 1, 2. *Pseudopicobia nonnula* sp. n., female. 1 – dorsal view; 2 – ventral view.

tal shield divided into two lateral shields, densely punctate between bases of setae *ve* and *si*. Length ratio of setae *vi* : *ve* : *si* 1 : 1.3 : 1.8. Bases of setae *vi* situated posterior to level of setae *ve*. Setae *vi*, *ve* and *si* lightly beaded, other idiosomal setae smooth. Setae *se* situated posterior to level of setae *c1*. Hysteronotal shield entire, apunctate, bearing bases of setae *d1* and *e2*. Setae *d2* 5.5 times longer than *d1* and *e2*. Pygidial shield apunctate. Aggenital setae *ag1* about twice as long as *ag2*. Aggenital plate absent. All coxal fields well sclerotized, I densely punctate, II sparsely punctate, III and IV apunctate. *Lengths of setae*: *vi* 40, *ve* 50, *si* 70, *se* 110, *c1* 110, *c2* 100, *d1* 10, *d2* 55, *e2* 10, *f2* 10, *ag1* 55, *ag2* 25.

Type host: Grey-cheeked nunlet *Nonnula frontalis* (Sclater, 1854) (Piciformes, Bucconidae).

Locality: Colombia, Bogota (4°35'53.00"N, 74°04'33.00"W), no other data. Host specimen deposited in the ZSM. Mites removed by M. Skoracki.

Site of infection: Quills of body feathers.

Type material: Female holotype, two female paratypes and one male paratype are deposited in the AMU (Reg. No. AMU-SYR.366), one female paratype in the ZSM (Reg. No. ZSM20112030), one female paratype in the IPCAS-2032.

E t y m o l o g y: The name of this new species refers to the generic name of the host – *Nonnula*.

Differential diagnosis: *Pseudopicobia nonnula* sp. n. is morphologically similar to *P. hapaloptila* sp. n. In fe-

Figs. 3–7. *Pseudopicobia nonnula* sp. n., female. 3 – peritremes; 4 – genital region in ventral view; 5 – propodonotal seta *ve*; 6 – tarsus of leg III in ventral view; 7 – solenidia of leg I.

Figs. 8–13. *Pseudopicobia nonnula* sp. n., male. 8 – dorsal view; 9 – propodosoma in ventral view; 10 – opisthosoma in ventral view; 11 – gnathosoma in ventral view; 12 – peritremes; 13 – genito-anal region.

Figs. 14, 15. *Pseudopicobia malacoptila* sp. n., female. **14** – dorsal view; **15** – ventral view.

males of both species the pygidial shield is present and well sclerotised. This new species differs from *P. hapaloptila* by the following characters: in females of *P. nonnula* the length ratios of setae *vi* : *si* and *ag1* : *ag2* are 1 : 1.2–1.4 and 1.9–2 : 1, respectively; leg setae *l'R/III* reach to the tarsus; setae *h1* 2.1 times longer than *ag2*. In females of *P. hapaloptila* the length ratios of setae *vi* : *si* and *ag1* : *ag2* are 1 : 1 and 1.2–1.3 : 1, respectively; leg setae *l'R/III* reach, at most, to genu; setae *h1* and *ag2* are subequal in length.

***Pseudopicobia malacoptila* sp. n.** Figs. 14–23

Female, holotype. Total body length 570 (485–765 in six paratypes). **Gnathosoma:** Infracapitulum apunctate. Movable cheliceral digit 125 (120–125) long. Each medial branch of peritremes with three chambers, each lateral branch with seven chambers. Stylophore 170 (165–170) long. **Idiosoma:** Propodonotal shield divided into two nar-

row and apunctate lateral shields. Length ratio of setae *vi* : *ve* : *si* 1 : 1.1–1.2 : 1.3. Bases of setae *vi* situated slightly posterior to level of setae *ve*. Setae *vi*, *ve* and *si* lightly beaded, other idiosomal setae smooth. Setae *se* and *c1* situated at same transverse level. Pygidial shields absent. Setae *d1* and *d2* subequal in length, both slightly longer (1.3 times) than *e2*. Setae *f2* 1.4–1.9 times longer than *fl*. Setae *fl* 1.3–1.6 times longer than *h1*. Aggenital setae *ag1* situated anterior to level of setae *ag2*. Length ratio of setae *ag1* : *ag2* : *ag3* 1.3–1.7 : 1 : 1.5–2. Genital plate present. Both pairs of pseudanal setae subequal in length. All coxal fields well sclerotized, I and II punctate, III and IV apunctate. Setae *3c* 3.5 times longer than *3b*. **Legs:** Setae *tc'* and *tc''* of legs III and IV subequal in length. **Lengths of setae:** *vi* 160 (150–175), *ve* 180 (175–180), *si* (setae *si* are broken in the holotype) (200–215), *se* 235 (215–225), *c1* 235 (220–250), *c2* 240 (215–230), *d1* 195 (180–195), *d2* 220 (190–205), *e2* 145 (140–150), *fl* 45

Figs. 16–23. *Pseudopicobia malacoptila* sp. n., female. **16** – gnathosoma in ventral view; **17** – peritremes; **18** – posterior part of movable cheliceral digit; **19** – propodonotal seta *ve*; **20** – solenidia of leg I; **21** – genital region in ventral view; **22** – tarsus of leg I in dorsal view; **23** – tarsus of leg III in ventral view.

(45–55), *f2* 70 (65–85), *h1* 35 (25–30), *h2* (300–320), *ag1* 125 (120–140), *ag2* 95 (80–90), *ag3* 140 (145–165), *ps1* and *ps2* (20), *tc'III–IV* 55 (55), *tc''III–IV* 60 (50–55), *l'RIII* 25 (25), *l'RIV* 25 (25), *3b* 25 (25), *3c* 90 (85–90).

Male. Not found.

Type host: White-whiskered puffbird *Malacoptila panamensis* Lafresnaye, 1847 (Piciformes: Bucconidae).

Locality: Colombia, Antioquia, Mutatá (7°14'59.96"N, 76°25'59.68"W), 08.08.1966, coll. J. Haffer. Host specimen deposited in the ZSM (Reg. No. 67.386). Mites removed by M. Skoracki.

Site of infection: Quills of body feathers.

Type material: Female holotype and five female paratypes are deposited in the AMU (Reg. No. AMU–SYR.364), one female paratype in the ZSM (Reg. No. ZSM20112029), one female paratype in the ZISP (Reg. No. ZISP AVB 011–2908–029), and one female paratype in the IPCAS-2033.

Etymology: Named after the generic name of the host – *Malacoptila*.

Differential diagnosis: Females of this new species are distinguished from other species of this genus by the absence of the pygidial shield.

Pseudopicobia hapaloptila sp. n.

Figs. 24–29

Female, holotype. Total body length 845. **Gnathosoma:** Infracapitulum sparsely apunctate. Movable cheliceral digit 120 (120 in two paratypes) long. Each medial branch of peritremes with 5–6 chambers, each lateral branch with seven chambers. Stylophore 170 (175) long. **Idiosoma:** Pair of narrow propodonotal shields apunctate. Length ratio of setae *vi* : *ve* : *si* 1 : 1 : 1. Bases of setae *vi* situated posterior to level of setae *ve*. Setae *vi*, *ve* and *si* lightly beaded, other idiosomal setae smooth. Setae *se* situated posterior to level of setae *c1*. Hysteronotal shield absent. Setae *d1*, *d2* and *e2* subequal in length. Pygidial shield present. Setae *h1* 1.4–1.8 times longer than *f1*. Setae *f2* about twice as long as *f1*. Aggenital setae *ag1* situated anterior to level of setae *ag2*. Length ratio of setae *ag1* : *ag2* : *ag3* 1.2–1.3 : 1 : 1.8. Genital plate present.

Figs. 24, 25. *Pseudopicobia hapaloptila* sp. n., female. **24** – dorsal view; **25** – ventral view.

Figs. 26–29. *Pseudopicobia hapaloptila* sp. n., female. **26** – peritremes; **27** – propodonotal seta *ve*; **28** – genital region in ventral view; **29** – solenidia of leg I.

Both pairs of pseudanal setae subequal in length. All coxal fields well sclerotized, I punctate, II–IV apunctate. Setae *3c* about twice as long as *3b*. *Legs*: Antaxial and paraxial members of claws unequal in size. Setae *l'RIII* reach, at most, to genu. Setae *tc'''III–IV* slightly (1.2 times) longer than *tc'''III–IV*. *Lengths of setae*: *vi* 135 (140), *ve* 135 (145), *si* 150 (160), *se* 230 (220–235), *cl* 265 (265), *c2* 230 (245), *d1* 190 (180), *d2* 210 (220), *e2* 185 (195), *fl* 40 (40), *f2* 75 (80), *h1* 70 (55–65), *h2* 345 (350–360), *agl* 105 (115), *ag2* 80 (95), *ag3* 145 (170), *ps1* 20 (20), *ps2* 20 (20), *tc'''III–IV* (55–65), *tc'''III–IV* (70–80), *l'RIII* 45 (35–40), *3b* 40 (45), *3c* 85.

Male. Not found.

Type host: White-faced nunbird *Hapaloptila castanea* (Verreaux, 1866) (Piciformes: Bucconidae).

Locality: Ecuador, Riobamba (1°40'24.45"S, 78°38'52.86"W), coll. E. Feyer. Host specimen deposited in the ZSM. Mites removed by M. Skoracki.

Site of infection: Quills of body feathers.

Type material: Female holotype and two female paratypes are deposited in the AMU (Reg. No. AMU–SYR.363).

Etymology: The name of this new species refers to the generic name of the host – *Hapaloptila*.

Differential diagnosis: See differential diagnosis for *P. nonnula* sp. n.

Key to the genus *Pseudopicobia* gen. n. – females

1. Pygidial shield absent. Setae *se* and *cl* situated at same transverse level *P. malacopectila* sp. n.
- Pygidial shield present. Setae *se* situated posterior to level of setae *cl* 2
2. Length ratio of setae *vi* : *si* 1 : 1.2–1.4. Setae *h1* 2–3.5 times longer than *fl*. Length ratio of setae *agl* : *ag2* 1.9–2 : 1. Leg setae *l'RIII* reach to tarsus *P. nonnula* sp. n.
- Length ratio of setae *vi* : *si* 1 : 1. Setae *h1* 1.4–1.8 times longer than *fl*. Length ratio of setae *agl* : *ag2* 1.2–1.3 : 1. Leg setae *l'RIII* reach, at most, to genu ... *P. hapaloptila* sp. n.

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