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A new species of the genus *Aulobia* Kethley (Acariformes: Syringophilidae) parasitizing *Daphoenositta chrysoptera* (Passeriformes: Neosittidae) in Australia

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Original research

ABSTRACT

The small passerine family Neosittidae has never been checked under the presence of ectoparasitic mites of the family Syringophilidae (Acariformes: Prostigmata). Herein, we describe a new species, *Aulobia sittellae* n. sp., collected from the Varied Sittella *Daphoenositta chrysoptera* (Latham). In addition to the first record of the syringophilid mites on a host representative of the family Neosittidae, it is also the first record of the genus *Aulobia* in the Australian region. Additionally, a key to all described *Aulobia* species is constructed, and the genus distribution on the hosts is briefly discussed.

Keywords Acari; birds; ectoparasites; quill mites; taxonomy
Zoobank http://zoobank.org/FFC631B3-BA77-4937-898E-DF2389DC7DBB

Introduction

Our knowledge of the quill mite fauna of the family Syringophilidae parasitizing birds of the order Passeriformes increases yearly due to intense research. Currently, birds belonging to the 64 passerine families are identified as the hosts for syringophilid mite species (Zmudzinski *et al.* 2021). Quill mites associated with birds of this order are grouped in the 12 genera belonging to the subfamily Syringophilinae Lavoipierre, 1953 and four genera of Picobiinae Johnston & Kethley, 1973 (Kethley 1970; Bochkov *et al.* 2004; Skoracki and Sikora 2005; Skoracki and Bochkov 2010; Skoracki 2005, 2011; Skoracki *et al.* 2016a, b).

The sittellas (Neosittidae), which has not been examined under the presence of syringophilid mites to date, is a small passerine bird family including only three non-migrant and compactly built species distributed in Australia and New Guinea (Jønsson *et al.* 2020). They live in forests and woodland and show convergent behavior to the nuthatches: they move up and down branches and tree trunks like the Sittidae of the Northern Hemisphere, even with more agility and lightness. Pairs live monogamously but breed cooperatively, with up to seven helpers (Noske 2007).

In this paper, we describe a new species of the quill mite found on one of them – the Varied Sittella *Daphoenositta chrysoptera* (Latham), which is widely distributed across Australia (Jønsson *et al.* 2020).

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Material and methods

We examined two specimens of the Varied Sittella deposited in the Bavarian State Collection of Zoology, Munich, Germany (ZSM – SNSB), and one of them was infested by quill mites. Before mounting, mites were softened and cleared in Nesbitt's solution at room temperature for three days, according to the protocol introduced by Walter and Krantz (2009) and Skoracki (2011). Then, mites were mounted on slides in Hoyer's medium and investigated using a light microscope (ZEISS Axioscope, Germany) with differential interference contrast (DIC) illumination. The drawings were made using a camera lucida drawing attachment. All measurements are in micrometers. Dimension ranges of the paratypes are given in parentheses following the data from the holotype.

In the description, the idiosomal setation follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The leg chaetotaxy follows that proposed by Grandjean (1944). Finally, the morphological terminology follows Skoracki (2011).

Specimen depositories are cited using the following abbreviations: AMU – Adam Mickiewicz University, Department of Animal Morphology, Poznan, Poland; ZSM–SNSB – Zoologische Staatssammlung München, Munich, Germany.

Taxonomy

Family Syringophilidae Lavoipierre, 1953

Subfamily Syringophilinae Lavoipierre, 1953

Genus *Aulobia* Kethley, 1970

Type species: *Aulobia dendroicae* (Clark, 1964)

Aulobia sittellae n. sp.

Zoobank: 7B889C89-D40D-49D3-ADAE-100D4F2128F9

(Figures 1A–D, 2A–D)

Description

Female — (Figure 1A–D). Total body length 830 in holotype (830–880 in seven paratypes).

Gnathosoma – Hypostomal apex with pair of finger-like protuberances and two pairs of hypostomal lips (Figure 1C). Infracapitulum sparsely punctate near bases of setae *n*. Stylophore rounded or slightly constricted posteriorly, 230 (210–225) long; exposed portion of stylophore apunctate, 185 (170–185) long. Movable cheliceral digits 150 (150–155) long. Each medial branch of peritremes with three or four chambers, each lateral branch with seven or eight chambers (Figure 1D).

Idiosoma – Propodonotal shield with concave anterior margin, apunctate. Popodonotal setae *vi*, *ve*, and *si* subequal in length. Bases of setae *c1* and *se* situated at same transverse level. Hysteronotal shield not fused to pygidial shield, apunctate, triangular in shape, bear bases of setae *d1* on anterior margin, posterior margin reach bases of setae *e2*. Setae *h1* and *f1* subequal in length. Pygidial shield apunctate. Agenital setae *ag2* shorter than *ag1* and *ag3*. Coxal fields sparsely punctate. Cuticular striations as in figure 1A, B.

Legs – Fan-like setae *p′* and *p″* of tarsi III and IV with eight or nine tines. Setae *l′* on trochanters III and IV subequal in length. Setae *tc″* of tarsi III and IV 1.4 times longer than *tc′III–IV*.

Lengths of setae – *vi* 50 (35–55), *ve* 65 (50–60), *si* 55 (40–60), *se* 245 (240–280), *c1* 255 (250–280), *c2* 240 (240–280), *d1* (260–270), *d2* 220 (220–280), *e2* 215 (220–290), *f1* 60 (50–70), *f2* 255 (250–295), *h1* 60 (45–60), *h2* 370 (420–445), *ag1* 180 (170–210), *ag2* 130 (135–155), *ag3* 230 (200–240), *g1* 50 (50–55), *g2* 50 (50–55), *ps1* (30), *ps2* 40 (30–35),

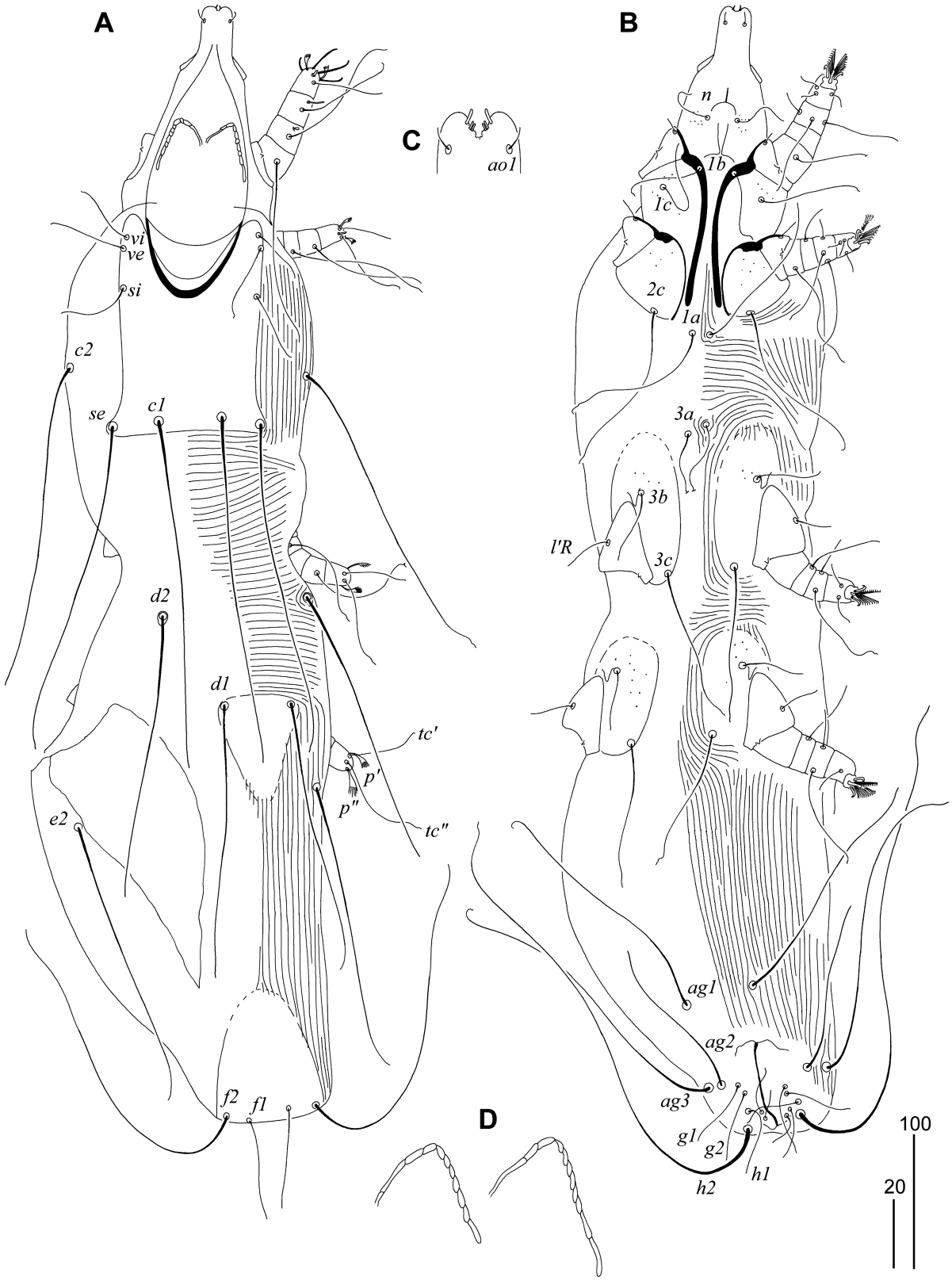

Figure 1 *Aulobia sittellae* **n. sp.**, female. A – dorsal view; B – ventral view; C – hypostome in dorsal view; D – peritremes. Scale bars A, B = 100 µm; C, D = 20 µm.

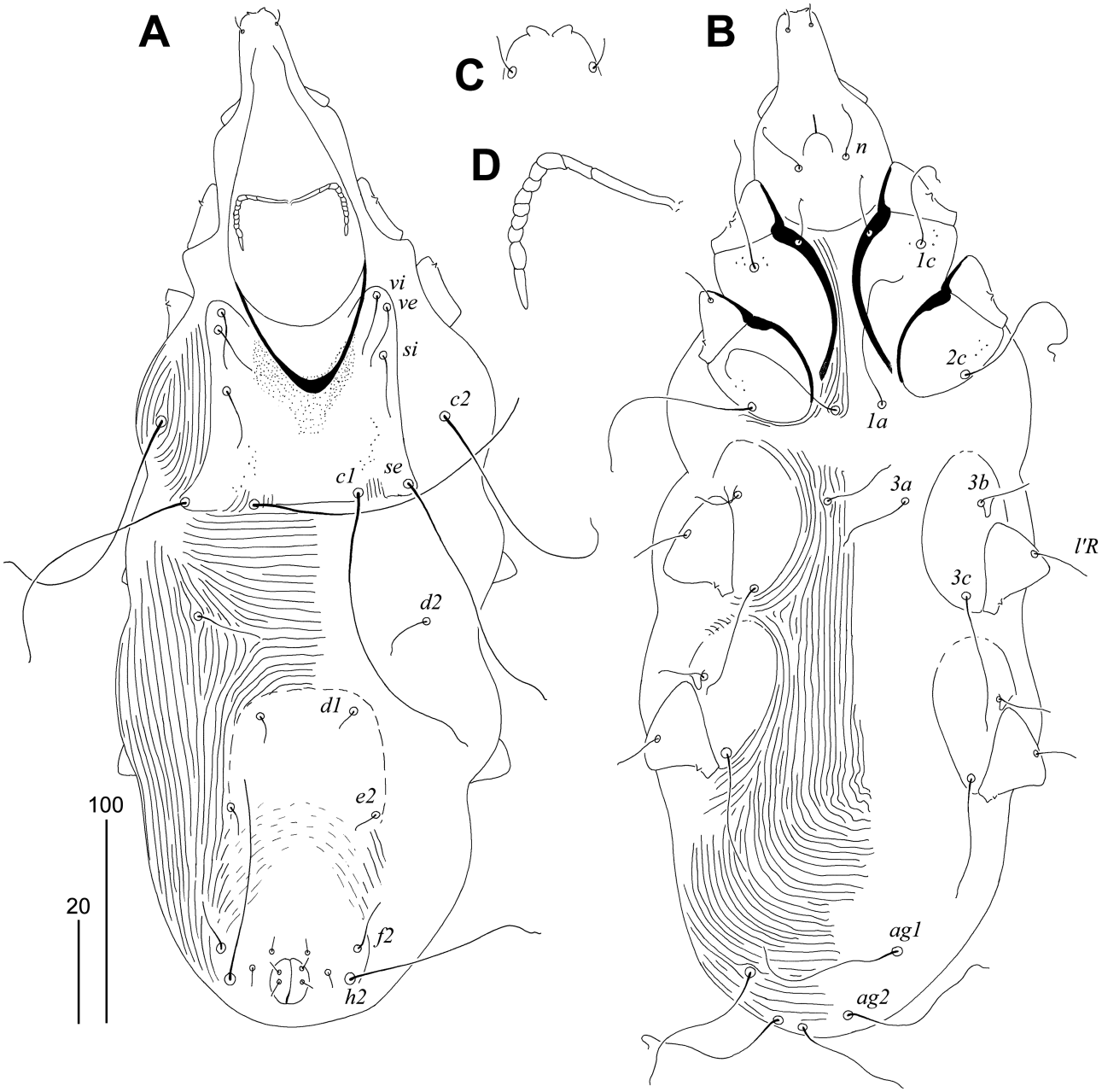

Figure 2 *Aulobia sittellae* **n. sp.**, male. A – dorsal view; B – ventral view; C – hypostome in dorsal view; D – peritreme. Scale bars A, B = 100 µm; C, D = 20 µm.

l'RIII 35 (35–40), *l'RIV* 35 (35–40), *3b* 55 (40–45), *3c* 120 (95–110), *4b* 40 (40), *4c* 100 (110), *tc'III–IV* 55 (40–55), *tc"III–IV* 75 (50–75).

Male — (Figure 2A–D). Total body length 500–570 in two paratypes.

Gnathosoma – Hypostomal apex with pair of blunt-ended protuberances (Figure 2C). Infracapitulum apunctate. Stylophore slightly constricted posteriorly, 185–190 long; exposed

portion of stylophore apunctate, 155–160 long. Movable cheliceral digits 150 (150–155). Each medial branch of peritremes with three chambers, each lateral branch with eight chambers (Figure 2D).

Idiosoma – Propodonotal shield with minute punctations. Propodonotal setae *vi*, *ve*, and *si* subequal in length. Bases of setae *c1* and *se* situated at same transverse level. Hysteronotal shield fused to pygidial shield, apunctate, medial part weakly sclerotized and with visible striae; bases of setae *d1*, *e2*, *f2*, and *h2* situated on margins of this shield. Setae *d2* 1.7–2 times longer than *d1* and *e2*. Setae *h2* variable in length, 2–3.7 times longer than *f2*. Coxal fields I and II sparsely punctate or apunctate, III and IV apunctate. Cuticular striations as in figure 2A, B.

Legs – Fan-like setae *p′* and *p″* of tarsi III and IV with six or seven tines. Setae *tc″III–IV* 1.3 times longer than *tc′III–IV*.

Lengths of setae – *vi* 30–40, *ve* 30–35, *si* 30–35, *se* 130–145, *c1* 145–170, *c2* 120, *d1* 15–20, *d2* 25–40, *e2* 15–25, *f2* 20–25, *h2* 45–85, *ag1* 60–100, *ag2* 60, *ag3* 75–95, *l′RIII* 30, *l′RIV* 30, *tc′III–IV* 35, *tc″III–IV* 45.

Type material

Female holotype, seven female and two male paratypes from the Varied Sittella *Daphoenositta chrysoptera* (Latham) (Passeriformes: Neosittidae); AUSTRALIA: no other data, coll. Parrot [host reg. no. SNSB-ZSM A266, female].

Type material deposition

Holotype and most paratypes deposited in the AMU (reg. no. AMU-MS 22-0401-001), except two female paratypes in the SNSB-ZSM (reg. no. SNSB-ZSM A20112133).

Differential diagnosis

Aulobia sittellae **n. sp**. is morphologically similar to *Aulobia dendroicae* Kethley, 1970 recorded from two species of the New World Warblers (Parulidae) of the genus *Dendroica* - *D. coronata* (Linnaeus) and *D. nigrescens* (Townsend), both from United States (Kethley 1970; Skoracki *et al.* 2010). Among all species of the genus, only *A. dendroicae* and *A. sittellae* have short and subequal in length propodonotal setae *vi*, *ve*, and *si*.

This new species differs from *A. dendroicae* by the following features: in females of *A. sittellae*, each lateral branch of the peritremes has seven or eight chambers; the stylophore is 210–230 long; the hysteronotal shield is not fused to the pygidial shield; hysteronotal setae *f2* are 250–295 long; and the lengths of agenital setae *ag1*, *ag2*, and *ag3* are 170–210, 130–155, and 200–240 respectively. In females of *A. dendroicae*, each lateral branch of the peritremes has 12–13 chambers; the stylophore is 170–180 long; the hysteronotal shield is fused to the pygidial shield; hysteronotal setae *f2* are 195–215 long; and the lengths of agenital setae *ag1*, *ag2*, and *ag3* are 75–80, 60–70, and 90–105 respectively.

Etymology

The name "*sittellae*" is taken from the common name of the host family - the sittellas (Neosittidae).

Key to females of *Aulobia* species

(based on Skoracki *et al.* 2016, modified)

1. Setae *vi* and *si* subequal in length 2
— Setae *si* 1.6–3 times longer than *vi* 3

2. Hysteronotal shield fused to pygidial shield . . . . . *A. dendroicae* (Clark, 1964)
— Hysteronotal shield not fused to pygidial shield . . . . . *A. sittellae* **n. sp.**

3. Each lateral branch of peritremes with 18–20 chambers . . . . . *A. cardueli* Skoracki, Hendricks and Spicer, 2010
— Each lateral branch of peritremes with max. 15 chambers 4

4. Agenital setae *ag2* shorter than 100 . . . . . *A. leucostictus* Skoracki, 2011
— Agenital setae *ag2* longer than 120 5

5. Setae *f1* longer than 90 . . . . . *A. virens* Skoracki and Dabert, 2001
— Setae *f1* shorter than 75 6

6. Length of setae *si* 85–105 7
— Length of setae *si* 150–260 8

7. Coxal fields I and II densely punctate. Lateral branch of peritremes with 14 chambers. Setae *ve* and *si* subequal in length . . . . . *A. stachyris* (Bochkov, Mironov and Skoracki, 2000)
— Coxal fields I and II sparsely punctate. Lateral branch of peritremes with eight to ten chambers. Setae *si* 1.5 times longer than *ve* . . . . . *A. nectariniae* Skoracki and Glowska, 2008

8. Length of setae *vi* 45–50 9
— Length of setae *vi* 65–130 10

9. Total body length 985–1,030. Each branch of peritremes with 13–15 chambers . . . . . *A. sylviae* Bochkov and Mironov, 1998
— Total body length 875. Each branch of peritremes with seven chambers . . . . . *A. sylviettae* (Fain, Bochkov and Mironov, 2000)

10. Posterior margin of hysteronotal shield not reaching bases of setae *e2* 11
— Posterior margin of hysteronotal shield reaching bases of setae *e2* 12

11. Infracapitulum punctate. Each branch of peritremes with 9–10 chambers. Coxal fields III and IV punctate. Setae *ve* 85–110 long . . . . . *A. erythroptera* Skoracki and Dabert, 2001
— Infracapitulum apunctate. Each branch of peritremes with 13 chambers. Coxal fields III–IV apunctate. Setae *ve* 180–220 long . . . . . *A. afroanthreptes* Skoracki and Zmudzinski, 2018

12. Length ratio of setae *ag3*:*f2* 1:1. Hysteronotal shield apunctate . . . . . *A. cisticolae* Skoracki and Sikora, 2003
— Length ratio of setae *ag3*:*f2* 1:1.6. Hysteronotal shield punctate . . . . . *A. anthreptes* Skoracki and Glowska, 2008

Detailed descriptions of the species included in the key are presented in the following papers: Kethley 1970; Bochkov and Mironov 1998; Bochkov *et al.* 2000; Fain *et al.* 2000; Skoracki and Dabert 2001; Skoracki and Glowska 2008; Skoracki *et al.* 2010, 2018; Skoracki 2011.

Discussion

The oscine passerines (Passeriformes: suborder Passeri) are divided into two infraorders, i.e., Corvida and Passerida. The position of the Neosittidae family in the oscine passerine tree is problematic. For many years, this family was regarded as closely related to the passerid family Sittidae, considering general body shape and behaviour (Jønsson *et al.* 2020). However, anatomical studies aligned Neosittidae with the Australian honeyeaters (Meliphagidae) belonging to the infraorder Passerida. In contrast, DNA-DNA hybridization (Sibley and

Ahlquist 1990), type of nest, egg coloration, and juvenile plumage characteristics (Noske 2007) suggested a relationship with the corvoid families of the whistlers (Pachycephalidae) and monarch-flycatchers (Monarchidae) (infraorder Corvida). Additional DNA data have equivocally established that the family belongs within the Corvides, although the exact phylogenetic placement remains uncertain (Jønsson *et al.* 2011; Aggerbeck *et al.* 2014).

Our finding of the representative of the genus *Aulobia* on the Varied Sittella is interesting because, to date, we have had no data about the presence of the members of the genus *Aulobia* on the bird representatives belonging to the infraorder Corvida. To date, the fauna of this genus comprises 11 described species associated exclusively with oscine passerines of the infraorder Passerida of the following families: Cisticolidae, Macrosphenidae, Sylviidae (superfamily Sylvioidea), Fringillidae, Nectariniidae, Parulidae, Timaliidae (superfamily Passeroidea) (Kethley 1970; Skoracki 2011; Skoracki *et al.* 2016). In our study, we broaden the host spectrum for the genus *Aulobia* and show that species of this genus can be associated not only with Passerides but also with Corvides.

Taking into consideration the zoogeography of this mite genus, up to now, *Aulobia* has been recorded from Palaearctic (Croatia, France, Poland, Kazakhstan, Russia), Nearctic (USA), Afrotropical (Cameroon, DR Congo, Kenya, Rwanda, Tanzania, Togo), Sino-Japanese (Nepal), Saharo-Arabian (Jordan), Oriental (SE Asia), and Oceanian (New Guinea) regions (Kethley 1970; Bochkov and Mironov 1998; Fain *et al.* 2000; Skoracki and Glowska 2008; Skoracki *et al.* 2010, 2018; Skoracki 2011). Herein, we broaden the distribution of this mite genus to one more– the Australian region.

Unfortunately, we cannot give any information about the frequency of infested birds in the host population because our sample includes only two specimens, and one of them was infested. And even though the prevalence in this sample is 50%, the confidence interval varies from 2.5 to 97.5. Nevertheless, it is worth noting that a cooperative breeding system with helpers in the Sitellas may be an evolutionary benefit - not only for the hosts but also for their quill mites. They have a larger number of hosts at their disposal than a monogamous couple and its offspring. It was recently shown that in wild social birds (e.g., European bee-eater *Merops apiaster* L.), the prevalence is relatively high and can reach up to 29% (see Skoracki *et al.* 2017). To define the prevalence of the infested bird in the population of Neosittidae, more detailed studies are needed.

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