

# Four new species of *Aulonastus* Kethley, 1970 (Acari: Syringophilidae) from North American passerines

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**Abstract** Four new species belonging to *Aulonastus* Kethley, 1970 (Acari: Prostigmata: Syringophilidae), which are found inside the quills of body feathers of North American passerines (Aves: Passeriformes), are described and figured: *A. emberizicus* n. sp. from *Ammodramus sавanarum* (Gmelin) (Emberizidae) (type-host) in Texas, *Zonotrichia atricapilla* (Gmelin) (Emberizidae) in California and *Passerculus sandwichensis* (Gmelin) (Emberizidae) in Texas; *A. euphagus* n. sp. from *Euphagus cyanocephalus* (Wagler) (Icteridae) in California; *A. pirangus* n. sp. from *Piranga ludoviciana* (Wilson) (Cardinalidae) in California; and *A. sturnellus* n. sp. from *Sturnella magna* (Linnaeus) (Icteridae) in Texas. A key to females of the known species of *Aulonastus* is presented.

## Introduction

Syringophilid mites (Acari: Prostigmata: Cheyletoidea) are obligatory and permanent parasites of birds.

They dwell inside the quills of various types of feathers (flight and body feathers). Quill mites feed on fluids from the surrounding soft tissue of their avian hosts by piercing through the quill wall with their long and flexible chelicerae (Kethley, 1971). The transmission between hosts appears to be mainly vertical from parents to their offspring during the reproductive period. Syringophilids enter the quill during the growth of the feather, and only adult, fertilised females disperse, while the males reproduce locally and then die (Casto, 1974a, b).

At present, the family is subdivided into two subfamilies: Syringophilinae Lavoipierre, 1953 with 37 genera and the Picobiinae Kethley & Johnson, 1973 with two genera. Syringophilids are widely distributed on their hosts and have previously been noted from representatives of 19 bird orders (Bochkov et al., 2004; Skoracki & Sikora, 2008).

Members of *Aulonastus* Kethley, 1970 are the smallest mites (females 500–600 µm long; males 300–380 µm) in the subfamily Syringophilinae. The biodiversity of this genus is still poorly investigated, with only six species having been described. Four of them were recorded from the areas of the Palaearctic region: Poland (*A. albus* Skoracki, 2002 and *A. buczekae* Skoracki, 2002), Slovakia (*A. lusciniiae* Skoracki, 2002) and Russia (*A. prunellae* Bochkov & Mironov, 1999); one from the Neotropic region (*A. galbulicus* Skoracki, 2008), and one from the Nearctic region (*A. pipili* Kethley, 1970) (Bochkov & Mironov, 1999; Kethley, 1970; Skoracki, 2002, 2008). Mites of the

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genus *Aulonastus* are known to parasitise passerine hosts of the families Sturnidae, Motacillidae, Turdidae, Prunellidae and Emberizidae, plus the jacamar birds (Piciformes: Galbulidae) (Skoracki, 2002, 2008).

Prior to this paper, representatives of *Aulonastus* were only known to inhabit the quills of secondaries, rectrices and covert feathers (Kethley, 1970; Skoracki, 2002). However, all of the species described here were found inside the quills of body feathers. It is worth noting that previously the only quill mites known from body feathers were species of *Picobia* Haller, 1878 (subfamily Picobiinae) (Skoracki et al., 2004).

In this paper, we describe four new species of *Aulonastus* found on passerines in the USA and present a key to females of the known species.

## Materials and methods

Birds examined in this study were collected in California and Texas, USA. Mites were mounted on microslides in Hoyer's medium and examined using DIC optics on an Olympus BH2 light microscope. The nomenclature of the idiosomal setation follows Grandjean (1939), as adapted for the Prostigmata by Kethley (1990), and for the leg chaetotaxy it follows that proposed by Grandjean (1944). The application of these chaetotaxic schemes to the Syringophilidae was recently introduced by Bochkov et al. (2008). Bird taxonomy follows Dickinson (2003). All measurements, including the scale-bars of the figures, are given in micrometres. Abbreviations for institutions where the materials are deposited are as follows: NMNH – Smithsonian National Museum of Natural History, USA; AMU – Department of Animal Morphology, Adam Mickiewicz University, Poznan, Poland.

### Family Syringophilidae Lavoipierre, 1953 Subfamily Syringophilinae Lavoipierre, 1953 Genus *Aulonastus* Kethley, 1970

#### *Aulonastus emberizicus* n. sp.

*Type-host*: *Ammodramus savanarum* (Gmelin) (Passeriformes: Emberizidae).

*Site*: Quills of body feathers.

*Type-locality*: Jeff Davis Co., Texas, USA; 14 April 2005; coll. G. Spicer; GSS#1601b.

*Type-material*: Female holotype and paratypes: 3 females, 2 males, 4 nymphs and 1 larva. Deposited in the AMU (Reg. no. AMU – SYR.275.1–9), except for 1 female and 1 male paratypes in the NMNH (Reg. no. AMU–SYR.275.10–11).

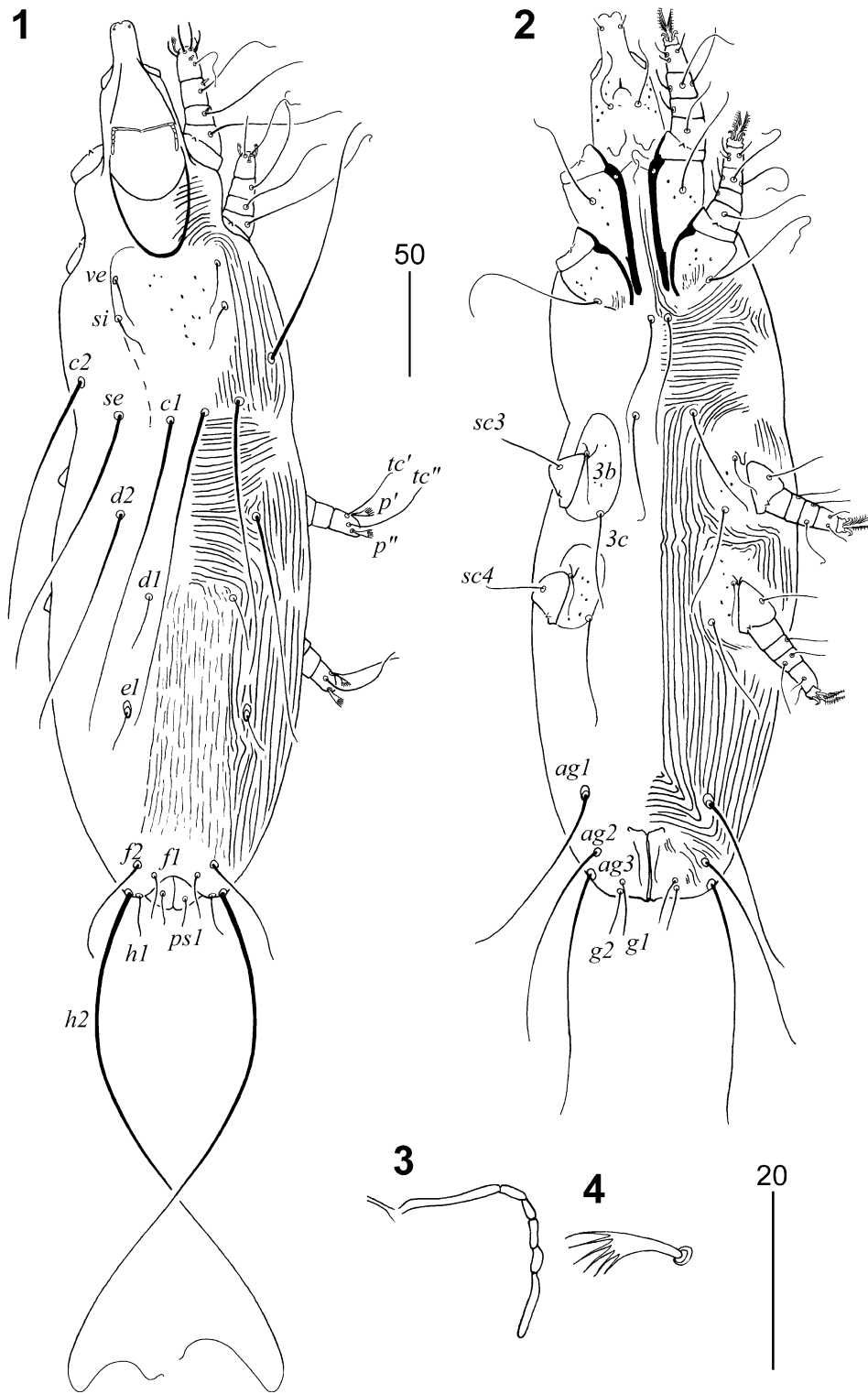
*Additional material*: From quill of body feathers of *Zonotrichia atricapilla* (Gmelin) (Emberizidae): 2 females, 4 males, 3 nymphs and 1 larva; Lake Co., California, USA; 11 March 2005; coll. G. Spicer; GSS#1411b. This material is deposited in the AMU (Reg. no. AMU–SYR.276.1–8), except for 2 females in the NMNH. (Reg. no. AMU–SYR.276.9–10).

From quill of body feathers of *Passerculus sandwichensis* (Gmelin) (Passeriformes: Emberizidae): 6 females, 3 males and 4 nymphs; Johnson Co., Texas, USA; 21 March 2004; coll. G. Spicer; GSS#1388b. This material is deposited in the AMU (Reg. no. AMU–SYR.277.1–11), except for 2 females in the NMNH (Reg. no. AMU–SYR.277.12–13).

*Etymology*: The name is derived from the family name of the hosts, Emberizidae, and is treated as a noun.

#### Description (Figs. 1–9)

*Female* (holotype). Total body length 445 (435–445 in 3 paratypes). *Gnathosoma*. Infracapitulum punctate. Each transverse branch of peritremes with 2 chambers; each longitudinal branch with 4–5 chambers (Fig. 3). Stylophore apunctate, 120 (115–120). Movable cheliceral digit 80 (80) long. *Idiosoma*. Propodonal shield weakly sclerotised, punctate, bearing bases of setae *ve*, *si* and *c1*. Setae *c1* 1.2–1.4 times longer than *se* and 1.3–1.5 times longer than *d2*. Striated, weakly discernible hysteronotal shield fused to pygidial shield. Bases of setae *d1* situated slightly closer to *d2* than to *e1*. Setae *e1* 1.5–2 times longer than *d1*. Setae *f2* about twice length of *f1* and *h1* and 5.3–5.8 times shorter than *h2*. Genital setae subequal in length. Aggenital setae *ag1* and *ag2* subequal in length, both about 1.5 times shorter than *ag3*. Cuticular striations as in Figs. 1 and 2. *Legs*. Fan-like setae *p'* and *p* of legs III and IV with 6–7 tines (Fig. 4). Setae *tc''* of legs III and IV 1.7–1.8 times longer than *tc'III–IV*. Setae *3c* twice length of *3b*. Coxal fields I–IV punctate. Lengths of setae: *ve* 30 (20–25); *si* 30 (20–25); *se* 120 (100–125); *c1* 155 (135–145); *c2* 115 (105–120); *d1* 10 (10–15); *d2* 105 (90–105); *e1* 20 (20–25); *f1* 25 (25); *f2* 50 (50–55);



**Figs. 1–4** *Aulonastus emberizicus* n. sp. Female. 1. Dorsal view. 2. Ventral view. 3. Peritreme. 4. Fan-like seta *p'III*

*h1* 25 (25); *h2* 270 (270–290); *ps1* 20 (15–20); *g1* and *g2* 25 (20–25); *ag1* 70 (70–80); *ag2* 80 (65–80); *ag3* 115 (105–115); *sc3* 30 (25–35); *sc4* 20 (20–25); *tc'''III–IV* (25–30); *tc'''III–IV* (45–50); *3b* 20 (20–25); *3c* 40 (40–50).

**Male.** Total body length 305 in 2 paratypes. Lengths of stylophore and movable cheliceral digit 90 and 65 respectively. *Gnathosoma*. Infracapitulum punctate. Each transverse branch of peritremes with 1 chamber; each longitudinal branch with 4–5 chambers (Fig. 8). *Idiosoma*. Propodonal shield weakly sclerotised, with indistinct margins. Setae *ve* and *si* subequal in length. Bases of setae *se* and *c1* situated at same transverse level. Setae *c1*, *c2* and *se* subequal in length. Hysteronotal shield absent. Setae *d2* twice longer than setae *d1* and *e1*. Setae *f2* 2–3 times longer than *h2*. All body setae shorter than 40. Setae *g1* located anteriorly to level of setae *g2* (Fig. 7). Aggenital setae *ag1* and *ag2* subequal in length. Setae *3c* 2–2.5 times longer than *3b*. Coxal fields I–IV sparsely punctate. Cuticular striations as in Figs. 5 and 6. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 4 tines (Fig. 9). Lengths of setae: *ve* 10–15; *si* 10–15; *se* 30; *c1* 30; *c2* 25–30; *d1* 10; *d2* 15–20; *e1* 8–10; *f2* 10–15; *h2* 25–30; *ag1* 30; *ag2* 30; *3b* 10–15; *3c* 25–30.

#### Differential diagnosis

This species is morphologically similar to *A. prunellae* Bochkov & Mironov, 1999 described from *Prunella modularis* (Linnaeus) (Prunellidae) in Russia (Bochkov & Mironov, 1999). In females of both species: setae *h2* are longer than *f2*; setae *d2* are distinctly longer than *d1* and *e1*; and setae *c1* are longer than *se*. *A. emberizicus* n. sp. is distinguished from the above-mentioned species by the presence of the following characters: in females of *A. emberizicus*, each transverse branch of the peritremes has two chambers; a pygidial shield is present; the lengths of setae *ag1* and *ag2* are 70–80 and 65–80  $\mu\text{m}$ , respectively; and the coxal fields of legs III and IV are punctate. In females of *A. prunellae*: each transverse branch of the peritremes has a single chamber; a pygidial shield is absent; the lengths of setae *ag1* and *ag2* are 45–56 and 45–51  $\mu\text{m}$ , respectively; and the coxal fields of legs III and IV are not punctate.

#### *Aulonastus euphagus* n. sp.

**Type-host:** *Euphagus cyanocephalus* (Wagler) (Passeriformes: Icteridae).

**Site:** Quills of body feathers.

**Type-locality:** Mono Co., California, USA; July 2007; coll. G. Spicer; GSS#2228.

**Type-material:** Female holotype, and paratypes: 7 females, 3 males, 1 nymph and 1 larva.

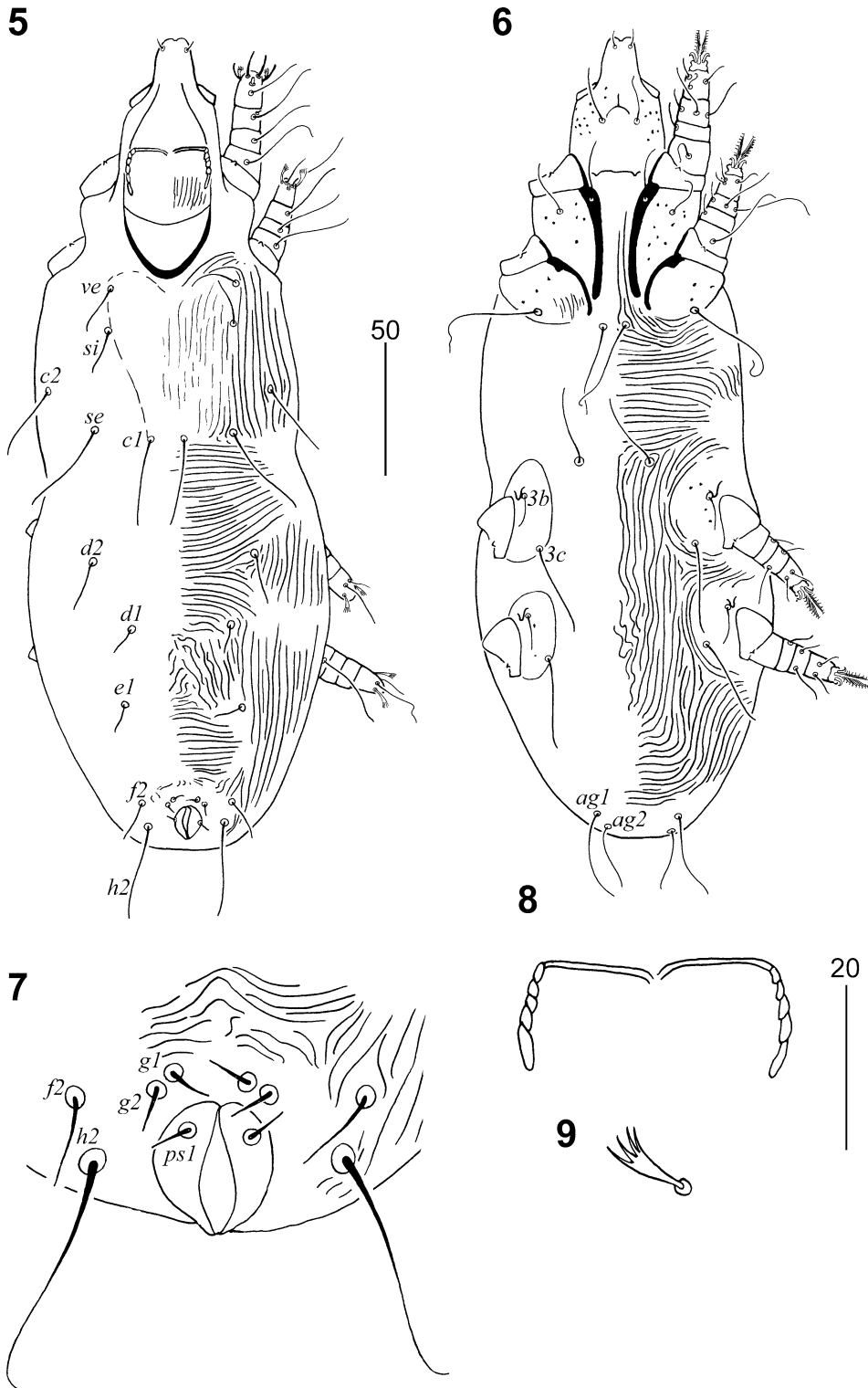
Deposited in the AMU (Reg. no. AMU–SYR.278.1–11), except for 1 female and 1 male paratypes in the NMNH (Reg. no. AMU–SYR.278.12–13).

**Etymology:** The name is derived from the generic name of the host and is treated as a noun.

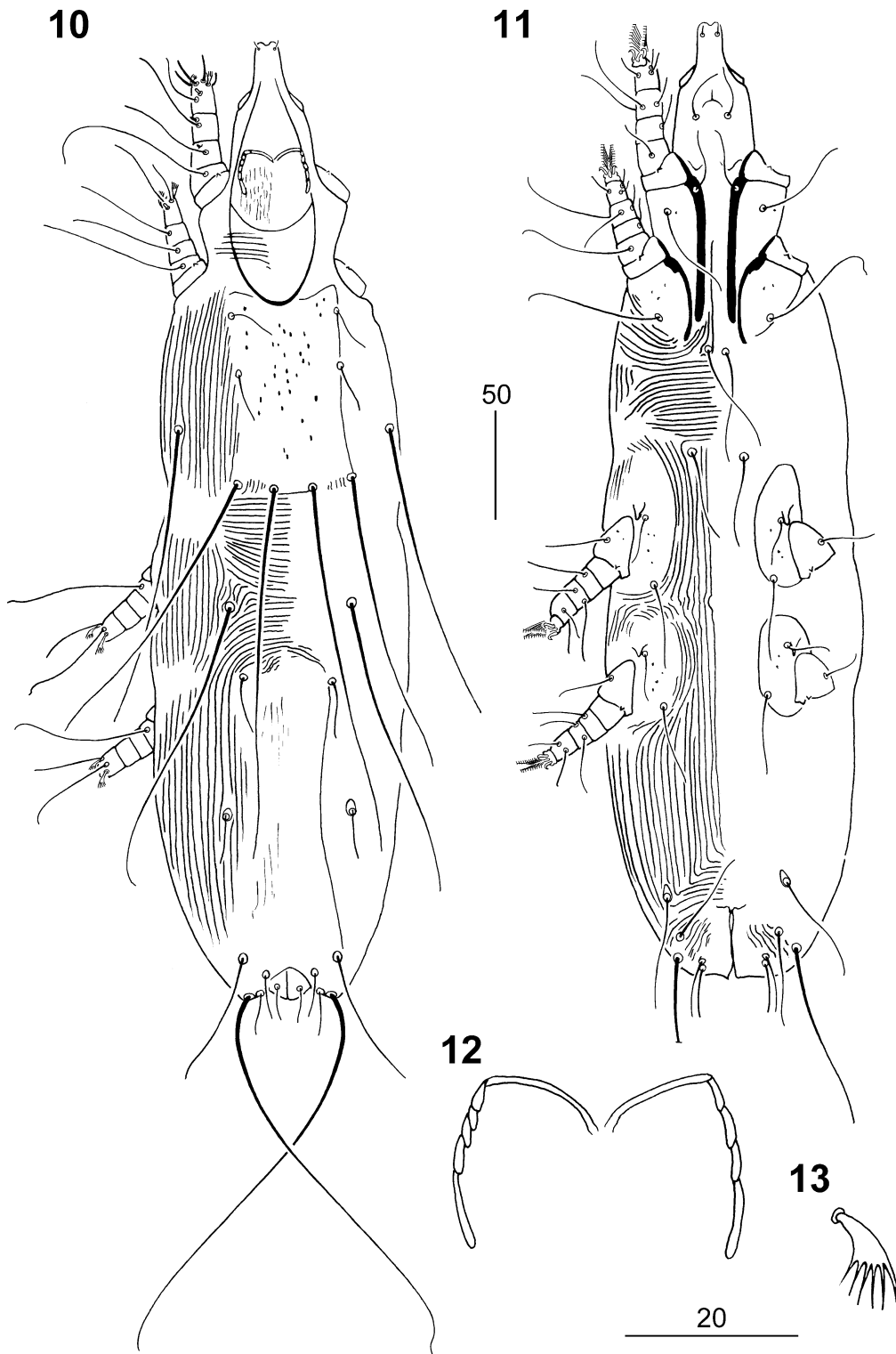
#### Description (Figs. 10–17)

**Female** (holotype). Total body length 455 (460–470 in 4 paratypes). *Gnathosoma*. Infracapitulum apunctate. Each transverse branch of peritremes with 1 chamber; each longitudinal branch with 4–5 chambers (Fig. 12). Stylophore apunctate, 120 (120–125). Movable cheliceral digit 85 (85) long. *Idiosoma*. Propodonal shield readily discernible, punctate, bearing bases of setae *ve*, *si*, *se* and *c1*. Setae *c1* 1.2–1.3 times longer than *se* and *d2*. Unstriated, apunctate and readily discernible hysteronotal shield fused to pygidial shield. Bases of setae *d1* situated closer to *d2* than to *e1*. Setae *e1* and *d1* subequal in length. Setae *f2* 3.3 times longer than *f1* and *h1* and 3 times shorter than *h2*. Genital setae subequal in length. Length ratio of aggenital setae *ag1:ag2:ag3* 1.2–1.4:1:2. Setae *3c* 1.5 times longer than *3b*. Coxal fields I–IV sparsely punctate or without punctations. Cuticular striations as in Figs. 10 and 11. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 6 tines (Fig. 13). Setae *tc''* of legs III and IV 1.5 times longer than *tc'III–IV*. Lengths of setae: *ve* 25 (20–25); *si* 25 (20–25); *se* 140 (140–145); *c1* 175 (165–175); *c2* 130 (140–170); *d1* 25 (20–25); *d2* 145 (140–145); *e1* 25 (25–30); *f1* 20 (20–25); *f2* 65 (65); *h1* 20 (20–25); *h2* (195); *ps1* 15 (15); *g1* and *g2* 25 (25); *ag1* 55 (55–65); *ag2* 40 (40–45); *ag3* 85 (80–90); *sc3* 25 (25–35); *sc4* 20 (20); *tc'III–IV* (25–30); *tc''III–IV* (40–45); *3b* 20 (15–20); *3c* 30 (25–30).

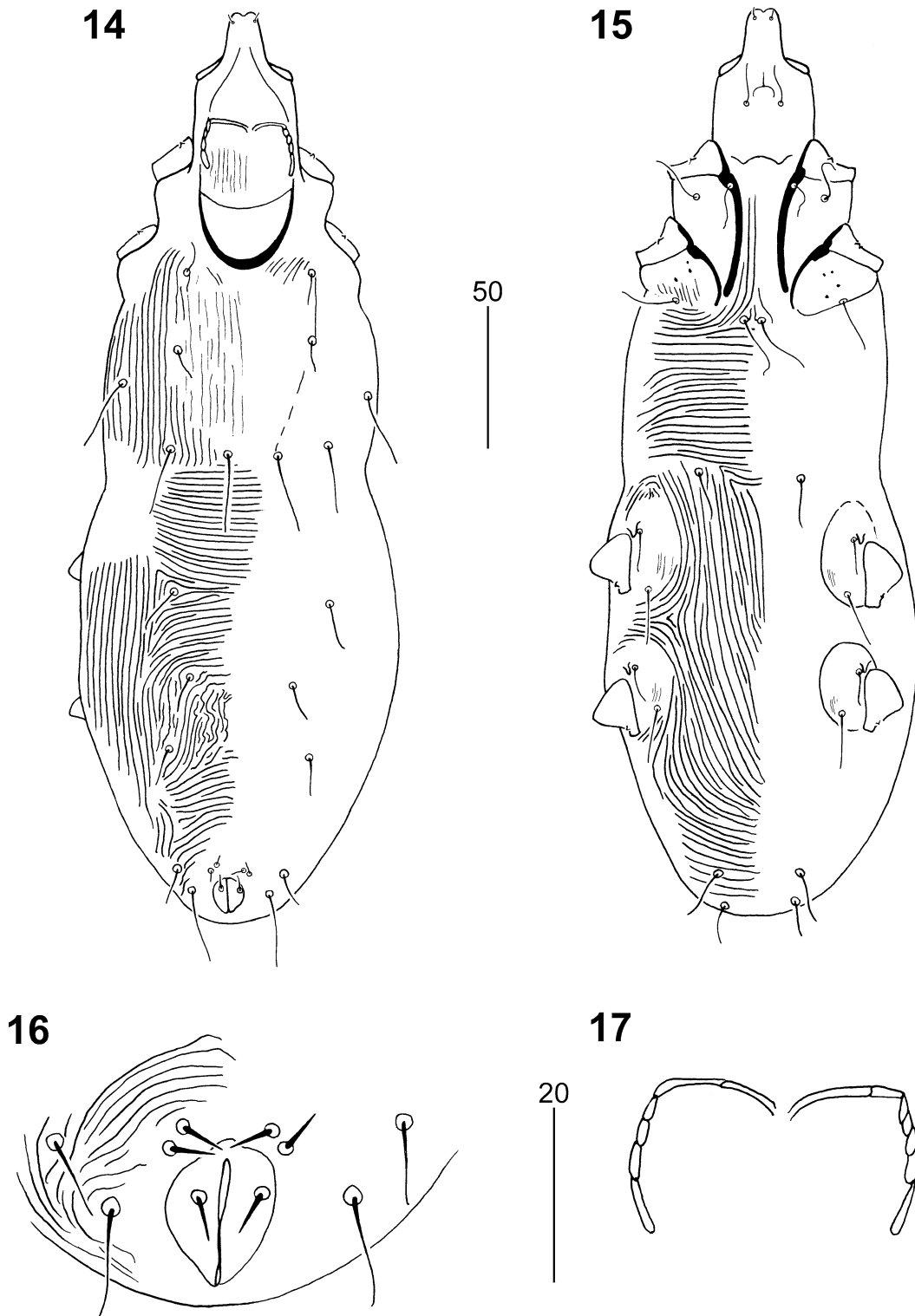
**Male.** Total body length 320 in 2 paratypes. Stylophore 90 long. *Gnathosoma*. Infracapitulum apunctate. Each transverse branch of peritremes with 2 chambers; each longitudinal branch with 4–5 chambers (Fig. 17).



**Figs. 5–9** *Aulonastus emberizicus* n. sp. Male. 5. Dorsal view. 6. Ventral view. 7. Genito-anal region. 8. Peritremes. 9. Fan-like seta p'III



**Figs. 10–13** *Aulonastus euphagus* n. sp. Female. 10. Dorsal view. 11. Ventral view. 12. Peritremes. 13. Fan-like seta *p'III*



**Figs. 14–17** *Aulonastus euphagus* n. sp. Male. 14. Dorsal view. 15. Ventral view. 16. Genito-anal region. 17. Peritremes

*Idiosoma*. Propodonal shield weakly sclerotised, with indistinct margins. Setae *ve* and *si* subequal in length. Bases of setae *se* and *c1* situated at same transverse level. Setae *c1*, *c2* and *se* subequal in length. Hysteronotal shield absent. Setae *d2* 1.7 times longer than setae *d1* and *e1*. Setae *f2* 1.7 times longer than *h2*. All body setae < 40 in length. Setae *g1* located anteriorly to level of setae *g2* (Fig. 16). Aggenital setae *ag1* and *ag2* subequal in length. Cuticular striations as in Figs. 14 and 15. *Legs*. Setae *3c* 1.7 times longer than *3b*. Coxal fields I–IV apunctate. Lengths of setae: *ve* 15; *si* 15; *se* 25; *c1* 35; *c2* 30; *d1* 9; *d2* 15; *e1* 9; *f2* 15; *h2* 25; *ag1* 15; *ag2* 15; *3b* 9; *3c* 15.

#### Differential diagnosis

*A. euphagus* n. sp. is morphologically similar to *A. albus* Skoracki, 2002 described from *Motacilla alba* Linnaeus (Motacillidae) in Poland (Skoracki, 2002). In females of both species: setae *h2* are longer than *f2*; setae *d2* are distinctly longer than *d1* and *e1*; and setae *c1* are longer than *se*. This new species is distinguished from *A. albus* by the presence of the following characters: in females of *A. euphagus*, setae *f2* are 3.3 times longer than *f1*; the lengths of setae *c1* and *se* are 165–175 and 140–145  $\mu\text{m}$ , respectively; and setae *3c* are 1.5 times longer than *3b*. In females of *A. albus*: setae *f2* are 4 times longer than *f1*; the lengths of setae *c1* and *se* are 140–150 and 125  $\mu\text{m}$ , respectively; and setae *3c* are twice as long as *3b*.

#### *Aulonastus pirangus* n. sp.

*Type-host*: *Piranga ludoviciana* (Wilson) (Passeriformes: Cardinalidae).

*Site*: Quills of body feathers.

*Type-locality*: Sierra Co., California, USA; 27 July 1997; coll. G. Spicer; GSS#2630b.

*Type-material*: Female holotype and paratypes: 1 female, 6 males, 2 nymphs and 2 larvae. Deposited in the AMU (Reg. no. AMU–SYR.279.1–12).

*Etymology*: The name is derived from the generic name of the host and is treated as a noun.

#### Description (Figs. 18, 26)

*Female* (holotype). Total body length 455 (470 in 1 paratype). *Gnathosoma*. Infracapitulum sparsely punctate. Each transverse branch of peritremes with

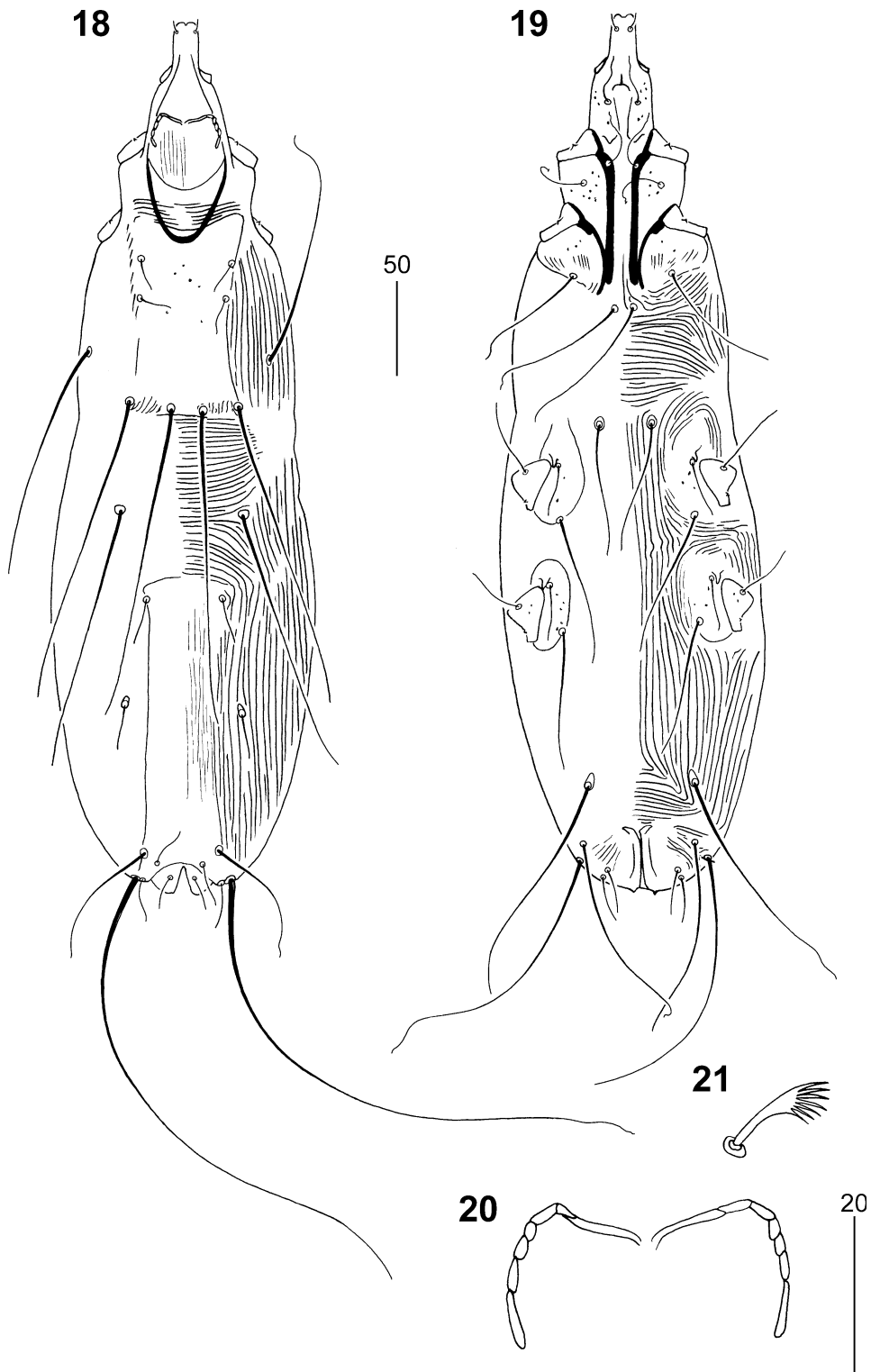
2 chambers; each longitudinal branch with 5 chambers (Fig. 20). Stylophore apunctate, 120 (120). Movable cheliceral digit 75 (75) long. *Idiosoma*. Propodonal shield readily discernible, concave on lateral margins, sparsely punctate, bearing bases of setae *ve*, *si*, *se* and *c1*. Setae *c1* and *se* subequal in length, both slightly (1.2 times) longer than *d2*. Indistinct hysteronotal shield, apunctate, fused to pygidial shield. Bases of setae *d1* situated slightly closer to *d2* than to *e1*. Setae *e1* and *d1* subequal in length. Setae *f2* 2.8 times longer than *f1* and *h1* and about 4 times shorter than *h2*. Genital setae subequal in length. Aggenital setae *ag1* and *ag2* subequal in length, both slightly (1.2–1.3 times) longer than *ag3*. Setae *3c* 2–3 times longer than *3b*. Coxal fields I–IV sparsely punctate. Cuticular striations as in Figs. 18 and 19. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 8 tines (Fig. 21). Setae *tc''* of legs III and IV 1.4–1.6 times longer than *tc'''*–*IV*. Lengths of setae: *ve* 15 (15); *si* 15 (15); *se* 155 (140); *c1* 155; *c2* 125 (110); *d1* (20); *d2* 125 (120); *e1* (25); *f1* 25 (25); *f2* (70); *h1* 20 (25); *h2* (290); *ps1* 15 (15); *g1* and *g2* 30 (30); *ag1* 120 (105); *ag2* (115); *ag3* 130 (145); *sc3* 45 (45); *sc4* (40); *tc'''*–*IV* 30 (40); *tc''*–*III*–*IV* 45 (55); *3b* 20 (30); *3c* 60 (60).

*Male*. Total body length 320–325 in 4 paratypes. Stylophore 90 long. *Gnathosoma*. Infracapitulum apunctate. Each transverse branch of peritremes with 1 chamber; each longitudinal branch with 4–5 chambers (Fig. 25). *Idiosoma*. Propodonal shield weakly sclerotised, with indistinct margins. Setae *ve* and *si* subequal in length. Bases of setae *se* situated slightly anterior to level of setae *c1*. Setae *c1*, *c2* and *se* subequal in length. Hysteronotal shield absent. Setae *d2* about twice longer than setae *d1* and *e1*. Setae *f2* 2.5–3 times longer than *h2*. All body setae shorter than 45. Setae *g1* located anteriorly to level of setae *g2* (Fig. 24). Aggenital setae *ag1* 1.6–1.8 times longer than *ag2*. Setae *3c* 3 times longer than *3b*. Coxal fields I–IV apunctate. Cuticular striations as in Figs. 22 and 23. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 4 tines (Fig. 26). Lengths of setae: *ve* 7–9; *si* 7–9; *se* 15–20; *c1* 15–20; *c2* 15–20; *d1* 10; *d2* 20; *e1* 10; *f2* 10–15; *h2* 30–40; *ag1* 35–40; *ag2* 20–25; *3b* 10; *3c* 30.

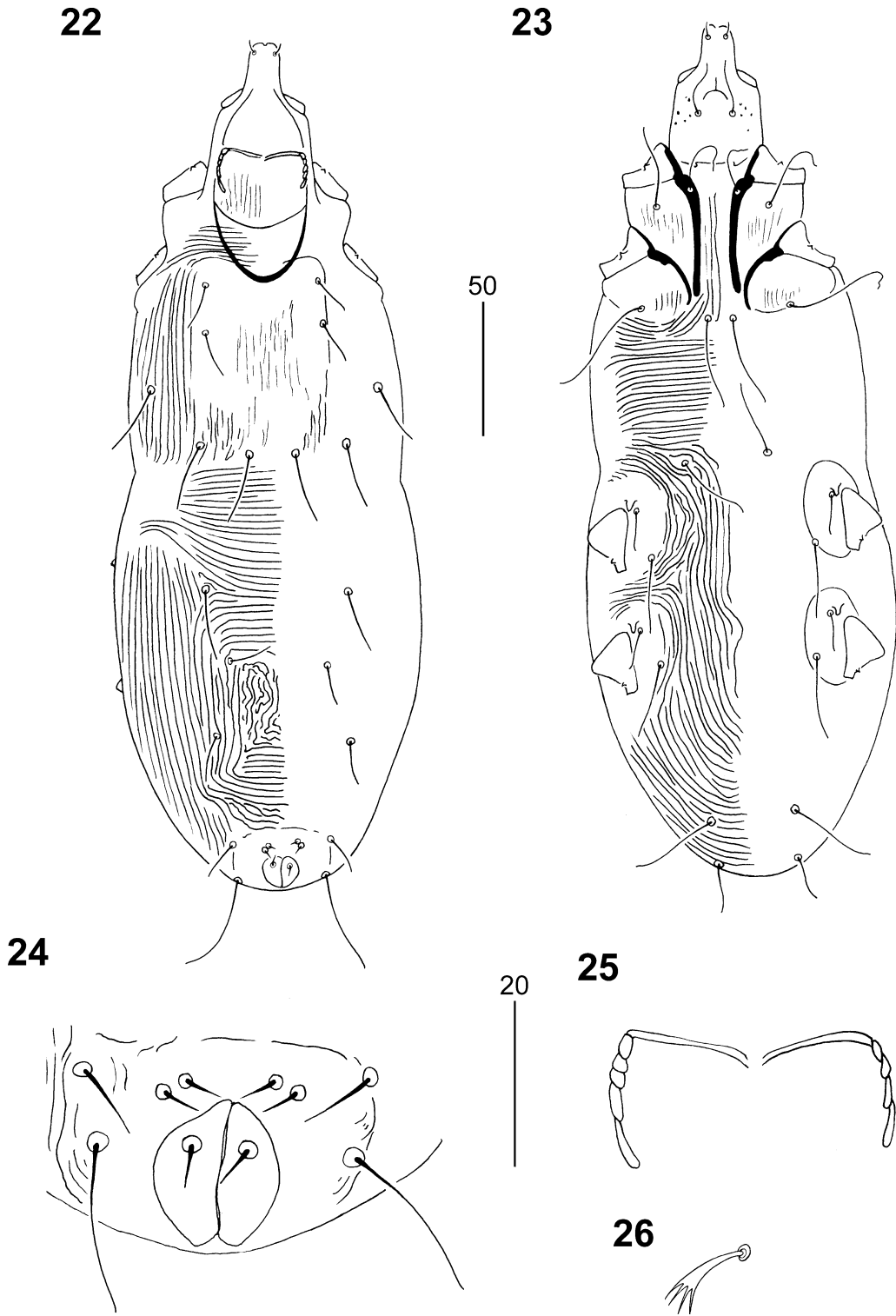
#### Differential diagnosis

This species is morphologically similar to *A. pipili* Kethley, 1970 described from *Pipilo erythrophthalmus*





**Figs. 18–21** *Aulonastus pirangus* n. sp. Female. 18. Dorsal view. 19. Ventral view. 20. Peritremes. 21. Fan-like seta *p'III*



**Figs. 22–26** *Aulonastus pirangus* n. sp. Male. 22. Dorsal view. 23. Ventral view. 24. Genito-anal region. 25. Peritremes. 26. Fan-like seta *p'III*

(Linnaeus) (Emberizidae) in the USA (Kethley, 1970). Females of both species have: setae *c1* and *se* subequal in length; setae *h2* are longer than *f2*; and setae *d2* distinctly longer than *d1* and *e1*. *A. pirangus* n. sp. differs from above-mentioned species in the following characters: in females of *A. pirangus*, terminal setae *h2* are 11–12 times longer than *h1*; setae *c1* are longer than *d2*; and each transverse branch of the peritremes has two chambers and each longitudinal branch five chambers. In females of *A. pipili*, terminal setae *h2* are > 20 times longer than *h1*; setae *c1* and *d2* are subequal in length; and each transverse branch of the peritremes has a single chamber and each longitudinal branch six chambers.

### *Aulonastus sturnellus* n. sp.

*Type-host*: *Sturnella magna* (Linnaeus) (Passeriformes: Icteridae).

*Site*: Quills of body feathers.

*Type-locality*: Johnson Co., Texas, USA; 20 March 2004; coll. G. Spicer; GSS#1559b.

*Type-material*: Female holotype and paratypes: 3 females, 5 males and 1 nymph. Deposited in the AMU (Reg. no. AMU-SYR.276.1–12).

*Etymology*: The name is derived from the generic name of the host and is treated as a noun.

### Description (Figs. 27, 35)

*Female* (holotype). Total body length 480 (480–495 in 2 paratypes). *Gnathosoma*. Infracapitulum sparsely punctate. Each transverse branch of peritremes with 2 chambers; each longitudinal branch with 5–6 chambers (Fig. 29). Stylophore apunctate, 130 (130). Movable cheliceral digit 95 (95) long. *Idiosoma*. Propodonal shield readily discernible, with parallel lateral margins, densely punctate, bearing bases of setae *ve*, *si*, *se* and *c1*. Setae *c1* situated posteriorly to level of setae *se*. Setae *c1* slightly (1.1–1.2 times) longer than *se* and *d2*. Hysteronotal shield indistinct, fused to pygidial shield, apunctate. Bases of setae *d1* situated equidistant between setae *d2* and *e1*. Setae *e1* 1.5–2 times longer than *d1*. Setae *f2* and *h2* subequal in length, both > 14 times longer than *f1* and *h1*. Genital setae subequal in length. Length ratio of setae *ag1:ag2:ag3* 1.1:1.2–1.5. Setae *3c* 3.2 times longer than *3b*. Coxal fields I–IV punctate. Cuticular

striations as in Figs. 27 and 28. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 6–7 tines (Fig. 30). Lengths of setae: *ve* 25 (15); *si* 25 (20); *se* 190 (190–210); *c1* 220 (220–225); *c2* 220 (195–215); *d1* 30 (15–30); *d2* 175 (175–190); *e1* 45 (40–45); *f1* 15 (20–25); *f2* 255 (285); *h1* 25 (20–25); *h2* 310 (280–310); *ps1* 20 (15–20); *g1* and *g2* 30 (30); *ag1* 125 (160); *ag2* 115 (150); *ag3* 175 (180); *sc3* 60 (45–55); *sc4* 50 (50–70); *3b* (25); *3c* (80).

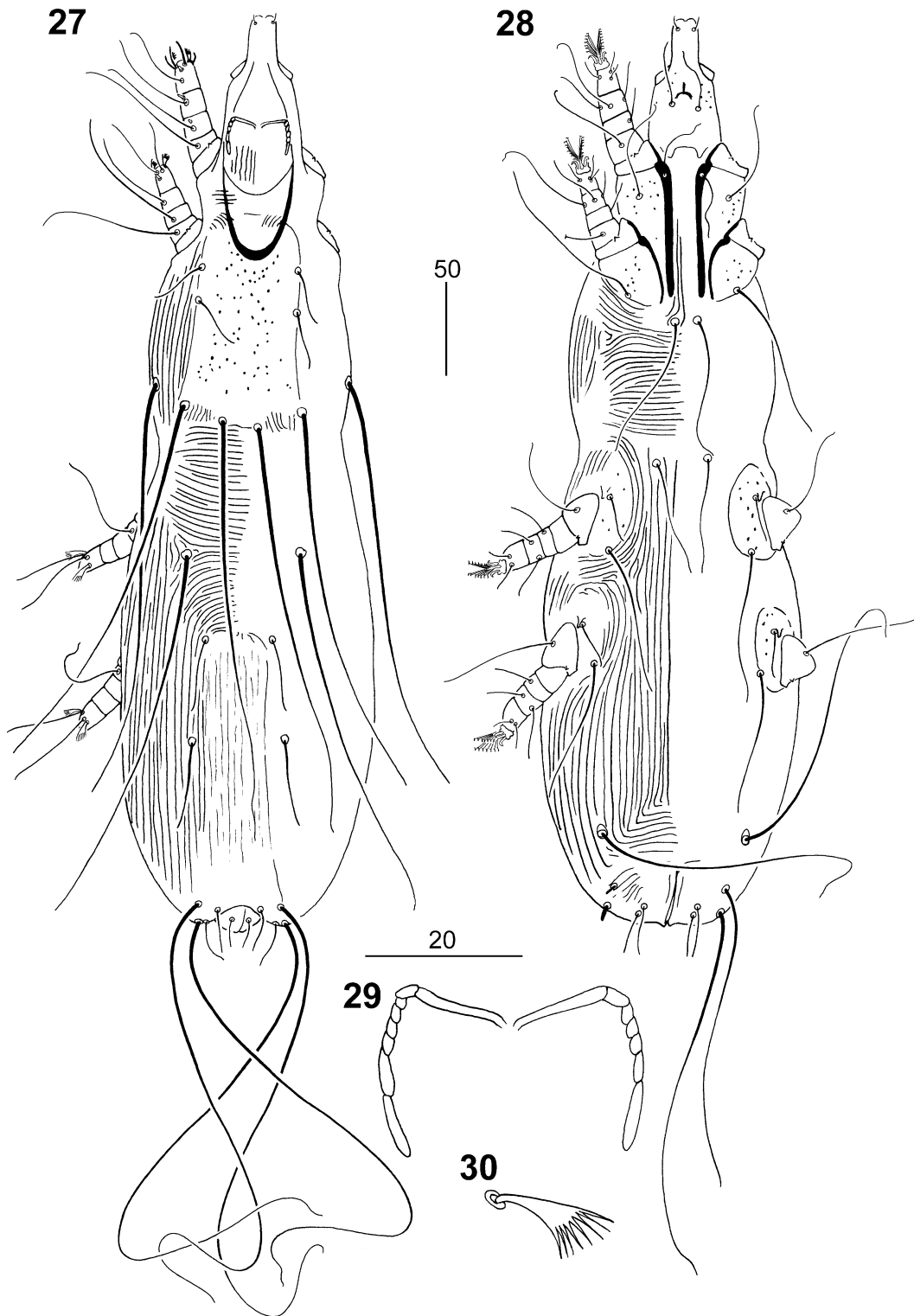
*Male*. Total body length 330–345 in 2 paratypes. Stylophore 100–105 long. *Gnathosoma*. Infracapitulum apunctate. Each transverse branch of peritremes with 2 chambers; each longitudinal branch with 4–5 chambers (Fig. 34). *Idiosoma*. Propodonal shield weakly sclerotised, with indistinct margins. Bases of setae *se* situated anteriorly to level of setae *c1*. Setae *c1*, *c2* and *se* subequal in length. Hysteronotal shield absent. Setae *d2* twice as long as setae *d1* and *e1*. Setae *f2* twice as long as *h2*. All body setae < 45 in length. Setae *g1* located anteriorly to level of setae *g2* (Fig. 33). Setae *ag2* variable in length, subequal in length to setae *ag1* or 1.6 times shorter than setae *ag1*. Setae *3c* 2.5 times longer than *3b*. Coxal fields I–IV apunctate. Cuticular striations as in Figs. 31 and 32. *Legs*. Fan-like setae *p'* and *p''* of legs III and IV with 4 tines (Fig. 35). Lengths of setae: *ve* 10; *si* 10–15; *se* 30; *c1* 30–35; *c2* 30; *d1* 10; *d2* 20; *e1* 10; *f2* 15–20; *h2* 30–40; *ag1* 40–45; *ag2* 25–40; *3b* 10; *3c* 25.

### Differential diagnosis

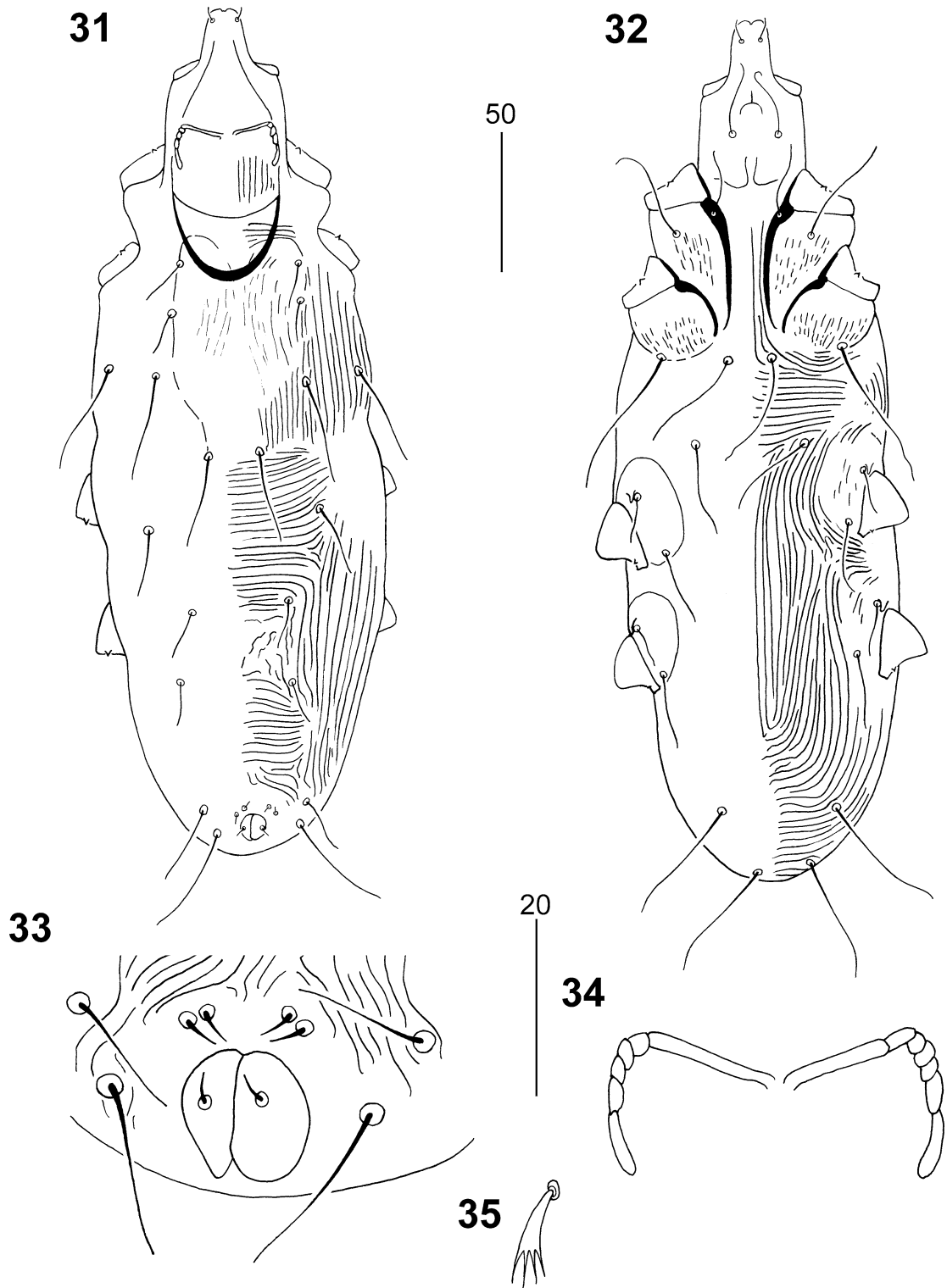
This species differs from all known species of this genus by the presence of subequal terminal setae *f2* and *h2* in females.

### Key to the species of *Aulonastus* Kethley, 1970 (females)

1. Setae *f2* and *h2* long and subequal in length ..... *A. sturnellus* n. sp.
- Setae *h2* three times longer than *f2* ... .. 2
2. Setae *d1*, *d2* and *e1* subequal in length ..... 3
- Setae *d2* four times longer than *d1* and *e1* ..... 4



**Figs. 27–30** *Aulonastus sturnellus* n. sp. Female. 27. Dorsal view. 28. Ventral view. 29. Peritremes. 30. Fan-like seta  $p'III$



**Figs. 31–35** *Aulonastus sturnellus* n. sp. Male. 31. Dorsal view. 32. Ventral view. 33. Genito-anal region. 34. Peritremes. 35. Fan-like seta p'III

3. Aggenital setae *ag2* slightly (1.2 times) shorter than *ag3*. Each lateral and longitudinal branch of peritremes with three chambers .....  
..... *A. galbulicus* Skoracki, 2008
- Aggenital setae *ag3* twice as long as *ag2*. Each lateral branch of peritremes with two chambers; each longitudinal branch with four or five chambers ..... *A. buczekae* Skoracki, 2002
4. Setae *c1* and *se* subequal in length ..... 5
- Setae *c1* longer than *se* ..... 7
5. Length ratio of setae *fl:f2* 1:2.8–3 ..... 6
- Length ratio of setae *fl:f2* 1:1.4–2 .....  
..... *A. luscinae* Skoracki, 2002
6. Setae *h2* 21 times longer than *h1* and *fl*. Setae *c1* and *d2* subequal in length. Each transverse branch of peritremes with one chamber; each longitudinal branch with six chambers .....  
..... *A. pipili* Kethley, 1970
- Setae *h2* 11–12 times longer than *h1* and *fl*. Setae *c1* 1.2 times longer than *d2*. Each transverse branch of peritremes with 2 chambers, each longitudinal branch with 5 chambers .....  
..... *A. pirangus* n. sp.
7. Setae *f2* twice length of *fl* ..... 8
- Setae *f2* three or four times longer than *fl* ..... 9
8. Each transverse branch of peritremes with one chamber. Pygidial shield absent. Length of setae *ag1* and *ag2* 45–56 and 45–51  $\mu\text{m}$ , respectively. Coxal fields of legs III and IV not punctate .....  
..... *A. prunellae* Bochkov & Mironov, 1999
- Each transverse branch of peritremes with two chambers. Pygidial shield present. Length of setae *ag1* and *ag2* 70–80 and 65–80  $\mu\text{m}$ , respectively. Coxal fields of legs III and IV punctate .....  
..... *A. emberizicus* n. sp.
9. Length ratio of setae *fl:f2* 1:3.3. Lengths of setae *c1* and *se* 165–175 and 140–145  $\mu\text{m}$ , respectively .....  
..... *A. euphagus* n. sp.
- Length ratio of setae *fl:f2* 1:4. Lengths of setae *c1* and *se* 140–150 and 125  $\mu\text{m}$ , respectively .....  
..... *A. albus* Skoracki, 2002

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## References

- Bochkov, A. V., Fain, A., & Skoracki, M. (2004). New quill mites of the family Syringophilidae (Acari: Cheyletoidea). *Systematic Parasitology*, *57*, 135–150.
- Bochkov, A. V., & Mironov, S. V. (1999). New quill mite species of the family Syringophilidae (Acari: Cheyletoidea) from European part of Russia. *Acarina*, *7*, 35–45.
- Bochkov, A. V., OConnor, B. M., & Wauthy, G. (2008). Phylogenetic position of the family Myobiidae within the Prostigmata (Acari: Acariformes). *Zoologischer Anzeiger*, *247*, 15–45.
- Casto, S. D. (1974a). Quill wall thickness and feeding of *Syringophiloides minor* (Berlese) (Acarina: Syringophilidae). *Annals of the Entomological Society of America*, *67*, 824.
- Casto, S. D. (1974b). Entry and exit of syringophilid mites (Acarina: Syringophilidae) from the lumen of the quill. *The Wilson Bulletin*, *86*, 272–278.
- Dickinson, E. C. (2003). *The Howard and Moore complete checklist of the birds of the world*. [3rd Edit.] London: Christopher Helm, 1040 pp.
- Grandjean, F. (1939). Les segments postlarvaires de l'hysterosoma chez les oribates (Acariens). *Bulletin de la Société Zoologique de France*, *64*, 273–284.
- Grandjean, F. (1944). Observations sur les acariens de la famille des Stigmaeidae. *Archives des Sciences Physiques et Naturelles*, *26*, 103–131.
- Kethley, J. B. (1970). A revision of the family Syringophilidae (Prostigmata: Acarina). *Contributions of the American Entomological Institute*, *6*, 1–76.
- Kethley, J. B. (1971). Population regulation in quill mites (Acari: Syringophilidae). *Ecology*, *52*, 1113–1118.
- Kethley, J. B. (1990). Acarina: Prostigmata (Actinedida). In: D. L. Dindal (Ed.) *Soil biology guide*. New York: Wiley and Sons, pp. 667–754.
- Skoracki, M. (2002). Three new species of quill mites of the genus *Aulonastus* Kethley, 1970 (Acari, Prostigmata, Syringophilidae) from passerine birds. *Acta Parasitologica*, *47*, 300–305.
- Skoracki, M. (2008). Description of two new quill mite species (Acari: Syringophilidae). *Acarina*, *16*, 45–50.
- Skoracki, M., Bochkov, A. V., & Wauthy, G. (2004). Revision of the quill mites of the genus *Picobia* Haller, 1878 (Acari: Syringophilidae) with notes on their host-parasite relationships. *Insect Systematics & Evolution*, *35*, 155–176.
- Skoracki, M., & Sikora, B. (2008). *Blaszakia*, a new genus of quill mites (Acari: Syringophilidae) parasitizing turacos (Aves: Musophagiformes). *Annales Zoologici*, *58*, 327–332.