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Ontogeny of *Chenophila platyrhynchos* sp. nov. (Acari: Syringophilidae), an ectoparasite of the Mallard *Anas platyrhynchos* (Anseriformes: Anatidae)

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Abstract: The morphology of the postembryonic stages of a new quill mite species, *Chenophila platyrhynchos* sp. nov., parasitising the Mallard *Anas platyrhynchos* (Linnaeus) (Aves: Anseriformes) in Poland is described in detail. This species is morphologically very similar to *Ch. kanduli* Bochkov known from *Anas querquedula* Linnaeus in Russia and differs from it by the ornament of a propodonotal shield, the number of chambers in the lateral branch of the peritremes, and the lengths of the propodonotal setae.

Key words: Acari, *Anas platyrhynchos*, *Chenophila*, ectoparasites, Syringophilidae, quill mites

1. Introduction

The quill mites of the family Syringophilidae (Acari: Prostigmata: Cheyletoidea) are permanent, obligatory, and host-specific (mono- or oligoxenous) parasites associated with birds belonging to 21 orders (Skoracki et al., 2012c). They are found inside the quills of different types of feathers: primary, secondary, tertial, covert, tail, and body feathers (Kethley, 1970; Skoracki, 2011). The family includes 281 species of 54 genera described from all zoogeographical regions except Antarctica (Skoracki et al., 2012b, 2012c). This number of syringophilid species is only a small part of their biodiversity, because the wide spectrum of potential avian hosts is still unexplored.

The genus *Chenophila* was created by Kethley (1970) for the species *Ch. branta* Kethley, 1970. The revision of this genus was recently provided by Skoracki (2011). Our knowledge on the biodiversity, host associations, and distribution of *Chenophila* mites is still quite insufficient. Up to now, only 2 species have been described, *Ch. branta* Kethley, 1970, associated with the Canada Goose *Branta canadensis* (Linnaeus) in the United States (Michigan), and *Ch. kanduli* Bochkov, 1998, parasitising the Garganey *Anas querquedula* Linnaeus in Russia (Kaliningrad Province) and *Anas clypeata* Linnaeus, 1758 in the United States (Michigan) (Kethley, 1970; Bochkov and Mironov, 1998; Skoracki, 2011; Skoracki et al., 2011). Both taxa, as well as a new species described below, are found in

the wing feathers (secondaries) of the waterfowl birds (Anseriformes) of the family Anatidae. In this paper, we give a description of all stages of a new species, *Ch. platyrhynchos* sp. nov., parasitising the Mallard *Anas platyrhynchos* Linnaeus in Poland (Szczecin). It is the next step in our knowledge about the ontogeny of mites of the family Syringophilidae.

2. Materials and methods

The mite material used in the current study was collected from frozen birds housed in the Laboratory of Biology and Ecology of Parasites at the West Pomeranian University of Technology in Szczecin, Poland. All wing and body feathers were examined using a dissecting microscope. Mites were extracted using sharp, fine tweezers via a longitudinal cut made in the quill with a scalpel. For microscope study, mites were mounted on slides in Faure medium and investigated under a Olympus BH-2 light microscope with differential interference contrast illumination. All measurements are given in micrometres. Measurements (ranges) of paratypes are given in brackets following data of the holotype. The idiosomal setation follows that of Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The nomenclature for leg chaetotaxy follows that proposed by Grandjean (1944). Morphological terminology follows Skoracki (2011). Scientific names of birds follow Clements et al. (2012).

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3. Results

Family Syringophilidae Lavoipierre, 1953

Subfamily Syringophilinae Lavoipierre, 1953

Genus *Chenophila* Kethley, 1970

Type species: *Chenophila branta* Kethley, 1970 by original designation.

3.1. *Chenophila platyrhynchos* sp. nov. (Figures 1–5)

Type material: Female holotype and paratypes: 58 females, 10 males, 10 tritonymphs, 7 protonymphs, and 7 larvae from quills of secondaries of *Anas platyrhynchos* Linnaeus (Anseriformes: Anatidae); collected throughout hunting season (autumn) of 2008 from a midfield pond near the city of Szczecin, Poland (53°27'23"N, 14°26'37"E).

Type material deposition: All type material is deposited at AMU, except 2 female and 1 male paratypes at ZISP and 2 female and 1 male paratypes at ZSM.

Comparative material: 13 female paratypes and 1 male paratype from *Anas querquedula* Linnaeus (Anseriformes: Anatidae); Russia, Kaliningrad Prov., Kurish spit, Rybachi village, 9 June 1957, coll. V. Jygis.

Differential diagnosis: *Ch. platyrhynchos* sp. nov. is morphologically similar to *Ch. kanduli* Bochkov & Mironov, 1998. In females of both species, the hysteronotal shield is present and aggenital setae *ag1* and *ag3* are unequal in length. The new species differs from *Ch. kanduli* by the following characters: in females of *Ch. platyrhynchos* sp. nov., the propodonotal shield is distinctly punctate on the whole surface; each lateral branch of the peritremes has 13–16 chambers; the lengths of idiosomal setae *ve*, *se*, and *c2* are 80–100, 180–230, and 160–215, respectively; setae *si* 110–140, always longer than the distance between setal bases *si–se*. In females of *Ch. kanduli*, the propodonotal shield is sparsely punctate near bases of setae *vi*, *ve*, and *si*; each lateral branch of the peritremes has 10–13 chambers; the lengths of idiosomal setae *ve*, *se*, and *c2* are 45–65, 135–165, and 115–145, respectively; setae *si* 55–100, subequal or shorter than distance between setal bases *si–se* (based on comparative material).

Etymology: The epithet “*platyrhynchos*” is directly adopted from the specific name of the host.

Description

Female (holotype and 19 paratypes): Total body length 780 (670–830). *Gnathosoma*. Gnathosoma and palps with full complement of setae (Figures 1C and 1D). Palpal segments and infracapitulum punctate. Hypostomal apex rounded without protuberances. Stylophore apunctate with striae ornamentation, reaching anterior margin of propodonotal shield, 265 (255–275) long. Movable cheliceral digit with 3 apical teeth. Each medial branch of peritremes with 5 chambers; each lateral branch with 13–16 chambers (Figure 1E). *Idiosoma*. Idiosoma with full complement of setae. Propodonotal shield well sclerotised, punctate on whole surface, rectangular in shape, bearing

setae *vi*, *ve*, *si*, *se*, and *c1*. Length ratio of setae *vi:ve:si:c2* 1:1.1–1.3:1.4–2:2.2–2.8. Setae *se* situated posterior to level of setae *c1*, both pairs of setae subequal in length. Hysteronotal shield weakly sclerotised, punctate, and fused to pygidial shield, bearing setae *d1*, *e2* and terminal setae *f1*, *f2*, *h1*, *h2*. Setae *d1* subequal to *e2*. Length ratio of setae *ag1:ag2:ag3* 1.7–2.3:1.3:2–4.4. Cuticular striations as in Figures 1A and 1B. *Lengths of idiosomal setae:* *vi* 65 (65–85); *ve* 90 (80–100), *si* 120 (110–140), *se* 215 (180–230), *c1* 190 (165–240), *c2* 190 (160–215), *d1* 155 (130–170), *d2* 95 (85–150), *e2* 145 (130–185), *f1* 50 (35–60), *f2* 90 (70–110), *h1* 45 (25–50), *h2* 460 (360–480), *ps1* 45 (20–50), *ps2* 30 (20–45), *ag1* 100 (80–155), *ag2* 55 (40–75), *ag3* 215 (165–245), *g1* 65 (30–70), *g2* 70 (35–85). *Legs*. Legs with full set of setae and solenidia. Tarsal setae *a'*, *a''*, *tc'*, and *tc''* of legs I as eupathidia. All 4 pairs of legs subequal in thickness. Coxal fields and segments of legs densely punctate. Fan-like setae of legs III and IV with 7 tines (Figure 1F). Solenidia ω , φ , and σ of legs I as in Figure 1G. Length ratio of setae *tc'III–IV:tc''III–IV* 1:1.4.

Male (10 paratypes): Total body length 575–625. *Gnathosoma*. Chaetotaxy of gnathosoma as in female (Figures 2C and 2D). Each medial branch of peritremes with 4–5 chambers; each lateral branch with 13–15 chambers (Figure 2E). Length of stylophore 195–210. *Idiosoma*. Chaetotaxy of idiosoma as in females except absence of setae *f1* and *h1*. Propodonotal shield weakly sclerotised, punctate, bearing setae *vi*, *ve*, *si*, and *c1*. Setae *se* situated anterior to level of setae *c1*, near setae *c2*. Hysteronotal shield apunctate, fused to pygidial shield, weakly sclerotised, striae visible, bearing setae *d1*, *e2*, *f2*, *h2*. Setae *g1* and *g2* situated at same transverse level, both pairs subequal in length (Figure 2F). Cuticular striations as in Figures 2A and 2B. *Lengths of idiosomal setae:* *vi* 30–55, *ve* 35–60, *si* 15–45, *se* 60–85, *c1* 45–80, *c2* 90–130, *d1* 15–30, *d2* 20–35, *e2* 15–25, *f2* 25–35, *h2* 190–250, *ps1* 15–30, *ps2* 20–30, *ag1* 95–140, *ag2* 55–95, *ag3* 130–175, *g1* 5–10, *g2* 5–10. *Legs*. Chaetotaxy and solenidiotaxy of legs as in females.

Tritonymph (10 paratypes): Total body length 605–830. *Gnathosoma*. Chaetotaxy of gnathosoma as in females (Figures 3C and 3D). Hypostomal apex rounded without protuberances. Stylophore with weakly striae ornamentation, not reaching anterior margin of propodonotal shield, 200–220 long. Each medial branch of peritremes with 5 chambers; each lateral branch with 13 chambers (Figure 3E). *Idiosoma*. Chaetotaxy of idiosoma as in females, except absence of setae *g2* and *ag3*. Propodonotal shield weakly sclerotised, bearing setae *vi*, *ve*, *si*, *c1*, *se*; all these setae situated on margins of this shield. Setae *se* situated posterior to level of setae *c1* or both setae at same transverse level. Hysteronotal and pygidial shields absent. Cuticular striations as in Figures 3A and 3B. *Lengths of idiosomal setae:* *vi* 30–55, *ve* 30–65,

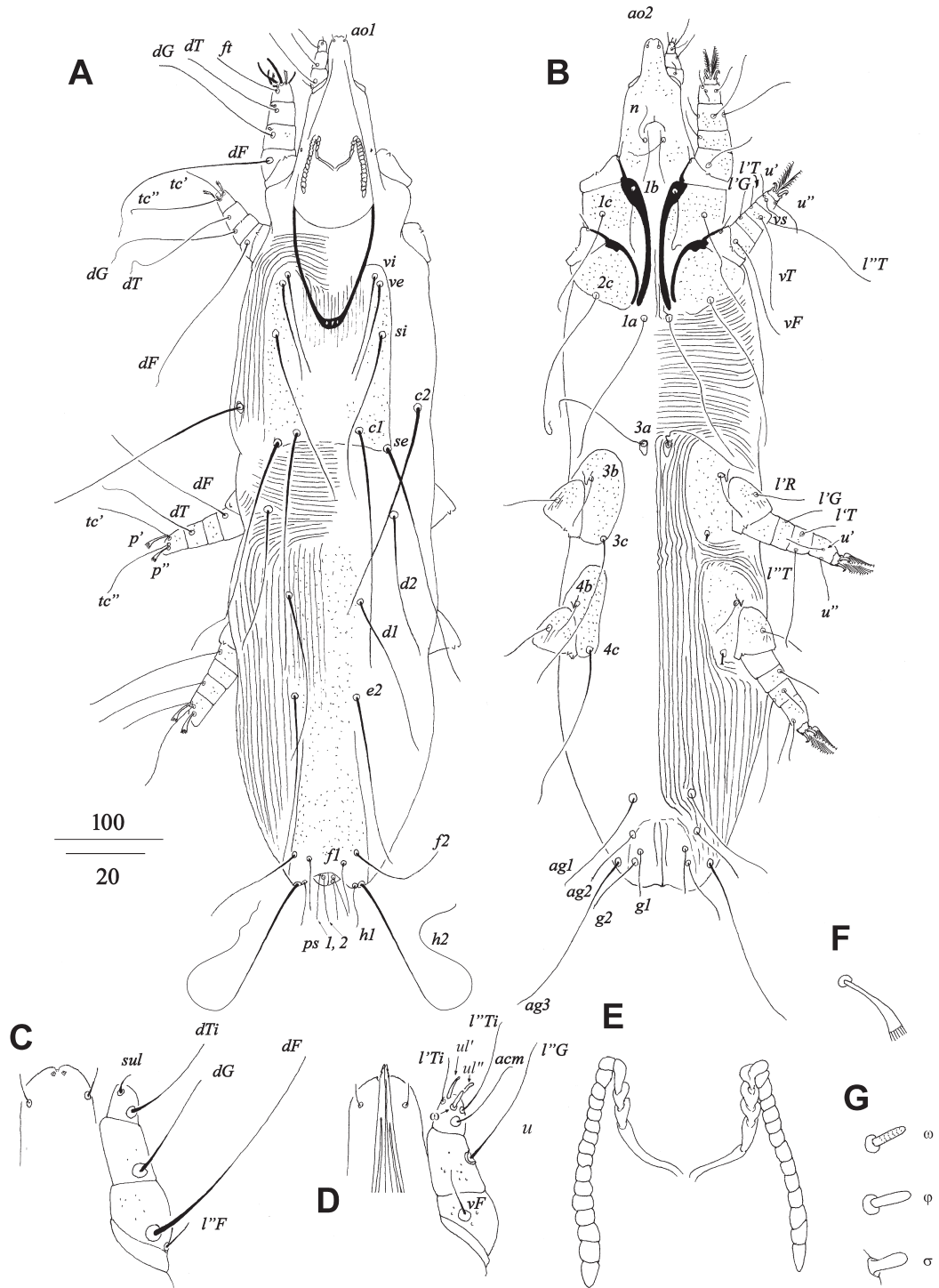


Figure 1. *Chenophila platyrhynchos* sp. nov., female: A) dorsal view, B) ventral view, C) gnathosoma in dorsal view, D) gnathosoma in ventral view, E) peritremes, F) fan-like seta *p'III*, G) solenidia of leg I.

si 45–65, *se* 50–80, *c1* 45–95, *c2* 55–75, *d1* 35–65, *d2* 40–65, *e2* 30–65, *f1* 25–35, *f2* 50–65, *h1* 20–45, *h2* 140–185, *ps1* 20–40, *ps2* 25–35, *ag1* 55–85, *ag2* 70–90, *g1* 40–55. *Legs.* Chaetotaxy of legs as in females except absence of setae *lR'IV*. Solenidia ω , ϕ , and σ of legs I as in Figure 3F.

Protonymph (7 paratypes): Total body length 465–640. *Gnathosoma.* Chaetotaxy of gnathosoma as in females except absence of palpal setae *vF* (Figures 4C and 4D). Hypostomal apex rounded without protuberances. Stylophore with striae ornamentation, not reaching

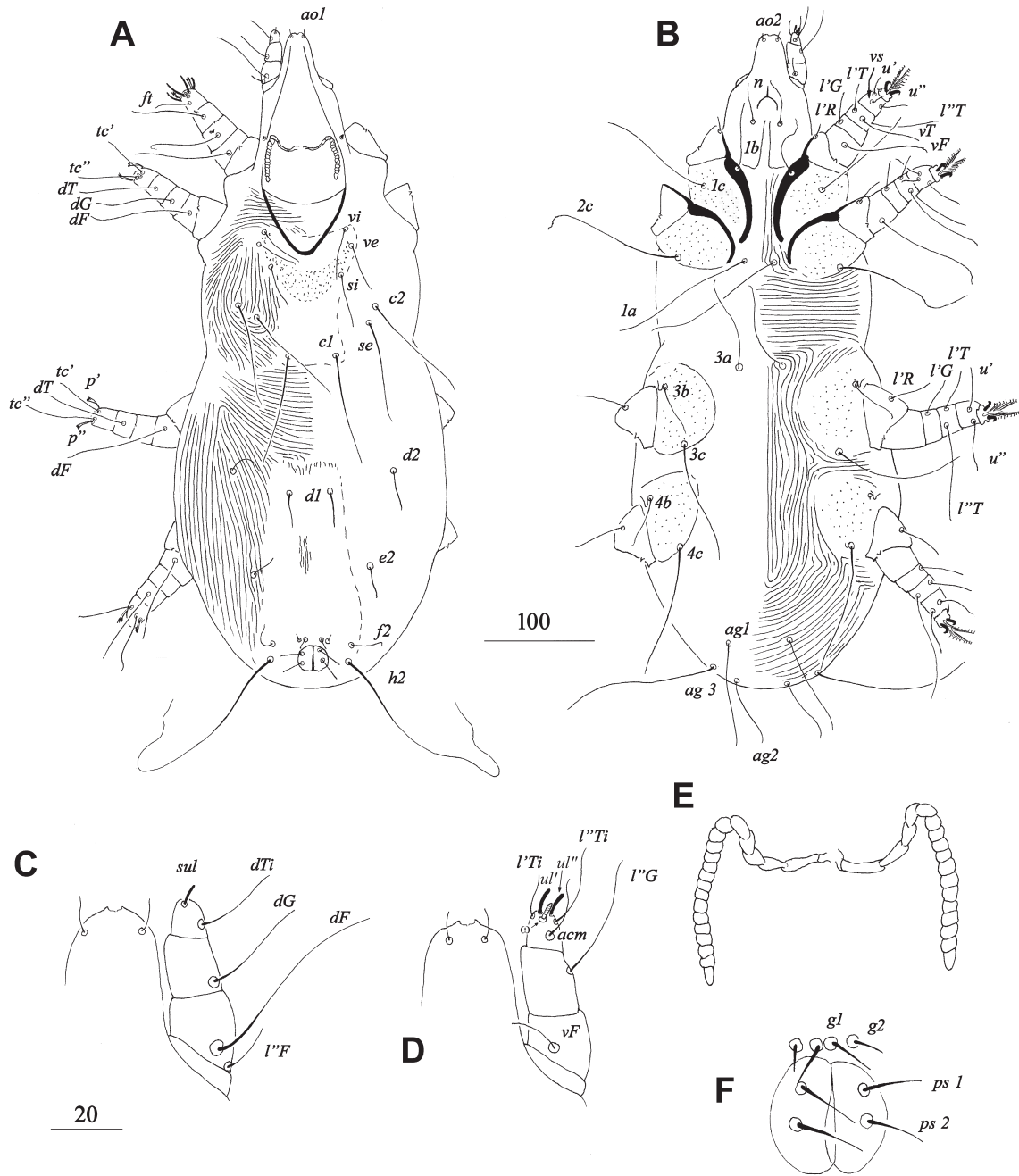


Figure 2. *Chenophila platyrhynchos* sp. nov., male: A) dorsal view, B) ventral view, C) gnathosoma in dorsal view, D) gnathosoma in ventral view, E) peritremes, and F) genito-anal region.

anterior margin of propodonotal shield, 175–185 long. Each medial branch of peritremes with 5 chambers, each lateral branch with 12–13 chambers (Figure 4E). *Idiosoma*. Chaetotaxy of idiosoma as in females, except absence of setae *ag2*, *ag3*, *g1*, *g2*, *h1*. Propodonotal shield weakly sclerotised, bearing setae *vi*, *ve*, *si*, *c1*, with setae *se* near this shield. Setae *se* situated posterior to level of setae *c1*, or both setae situated at same transverse level. Hysteronotal and pygidial shields absent. Cuticular striations as in

Figures 4A and 4B. *Lengths of idiosomal setae*: *vi* 25–40, *ve* 25–50, *si* 30–45, *se* 30–45, *c1* 30–55, *c2* 30–45, *d1* 20–35, *d2* 25–35, *e2* 15–30, *f1* 15–30, *f2* 25–50, *h2* 75–95, *ps1* 15–30, *ps2* 15–30, *ag1* 20–30. *Legs*. Chaetotaxy and solenidiotaxy of legs as in females except absence of setae *p'* of tarsi I, II, IV, *p'IV*, *l'GIV*, *l'RI–IV*, *4b*, and *4c*. Tarsus of legs I and II as in Figures 4F and 4G.

Larva (7 paratypes): Total body length of 355–440. *Gnathosoma*. Chaetotaxy of gnathosoma as in females

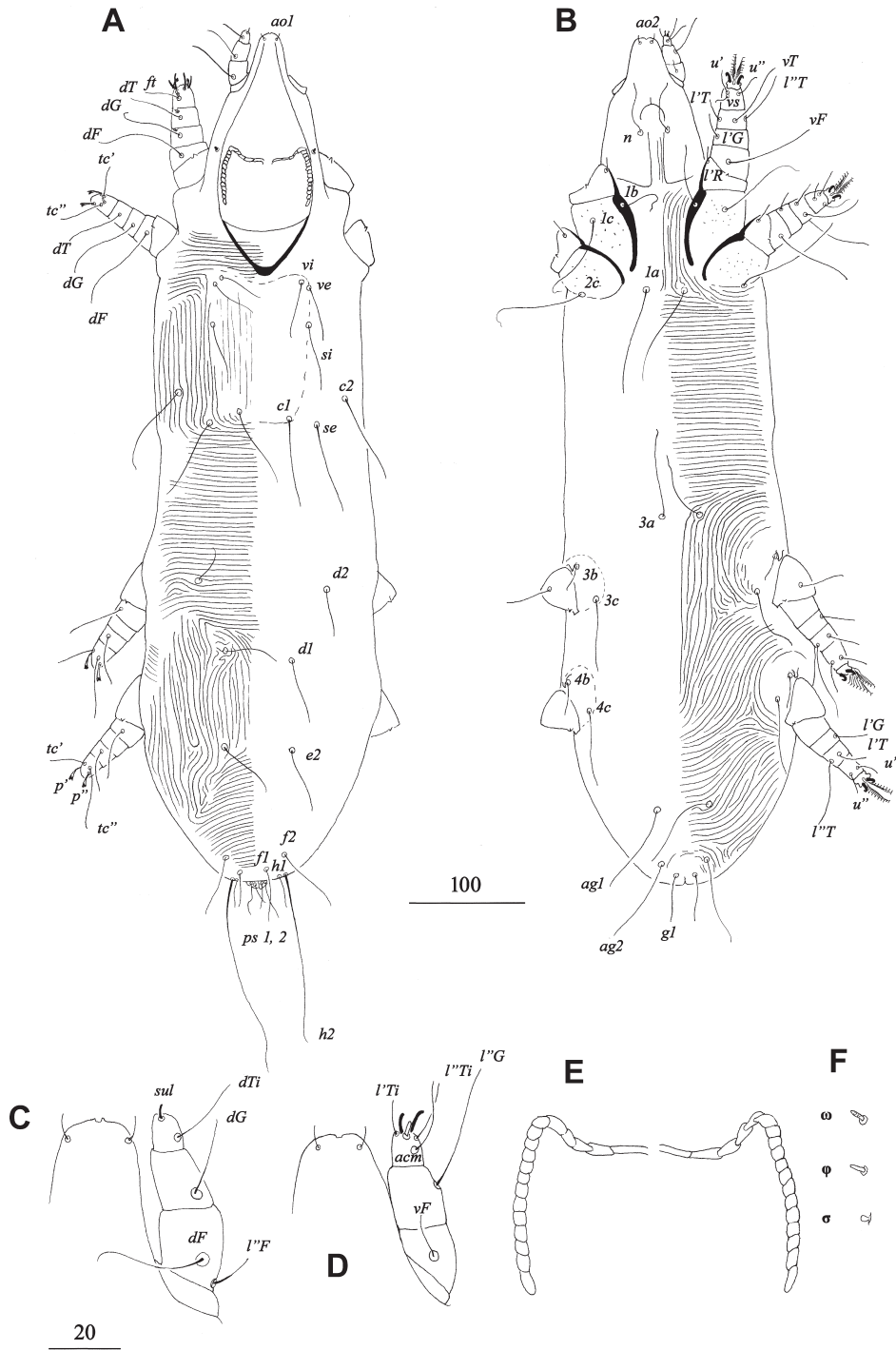


Figure 3. *Chenophila platyrhynchus* sp. nov., tritonymph: A) dorsal view, B) ventral view, C) gnathosoma in dorsal view, D) gnathosoma in ventral view, E) peritremes, F) solenidia of leg I.

except absence of infracapitular setae *n* and palpal setae *vF*, *l'G* (Figures 5D and 5E). Hypostomal apex rounded without protuberances. Stylophore, not reaching anterior margin of propodonotal shield, 150–155 long. Each medial branch of peritremes with 5 chambers; each lateral branch with 12–13 chambers (Figure 5G). *Idiosoma*. Chaetotaxy

of idiosoma as in females except absence of setae *h1*, *ag1–3*, *g1–2*. Propodonotal shield weakly sclerotised, bearing setae *vi*, *ve*, *si*, *c1*, with setae *se* on or near this shield. Setae *se* situated anterior to level of setae *c1*. Hysteronotal and pygidial shields absent. Cuticular striations as in Figures 5B and 5C. *Lengths of idiosomal setae*: *vi* 15–25, *ve* 20–30,

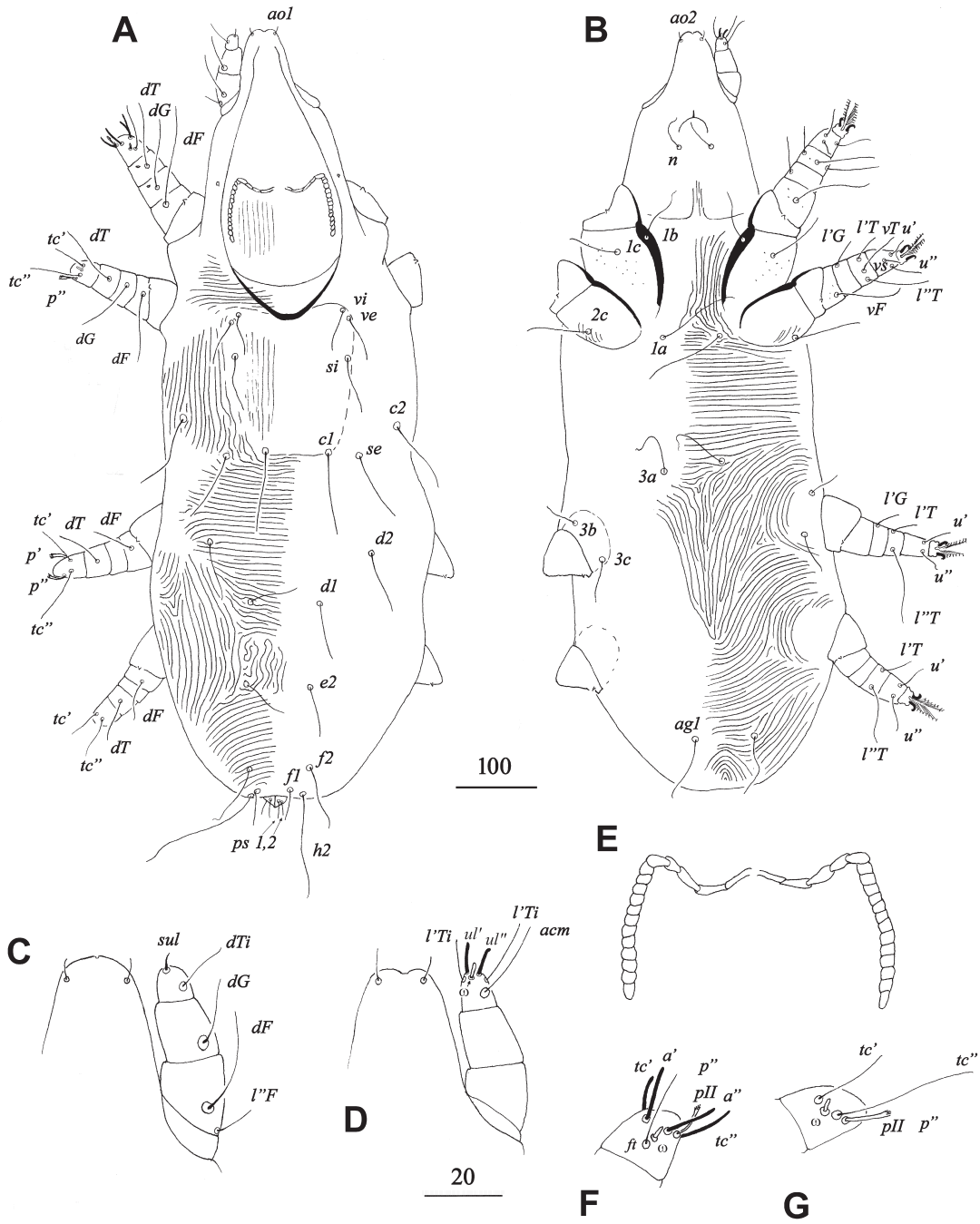


Figure 4. *Chenophila platyrhynchos* sp. nov., protonymph: A) dorsal view, B) ventral view, C) gnathosoma in dorsal view, D) gnathosoma in ventral view, E) peritremes, F) tarsus I in dorsal view, G) tarsus II in dorsal view.

si 20–30, *se* 25–35, *cl* 20–40, *c2* 20–40, *d1* 10–30, *d2* 10–35, *e2* 10–35, *f1* 20–45, *f2* 35–60, *h2* 70–105, *ps1* 10–20, *ps2* 10–20. *Legs.* Chaetotaxy and solenidiotaxy of legs as in females except absence of setae *p'* and *p''* of tarsi I–III, *dGI–II*, *l'RI–III*, *1b*, *2c*, *3b*, *3c*. All 3 pairs of legs subequal in thickness and length. Tarsal setae of legs I: *a'* and *a''* as eupathidia, setae *tc'* and *tc''* filiform (Figure 5F).

Egg: Oval in shape (Figure 5A). Length 335–340, width 205–210, whitish in colour and with smooth surface.

The comparison of the measurements for idiosomal setae in all postembryonic stages is presented in the Table.

3.2. Key to *Chenophila* species

(Females)

1. Aggenital setae *ag3* twice as long as *ag1*. Punctate hysteronotal shield fused to pygidial shield ... 2
- Aggenital setae *ag1* and *ag3* subequal in length. Hysteronotal shield absent ... *Ch. branta* Kethley, 1970

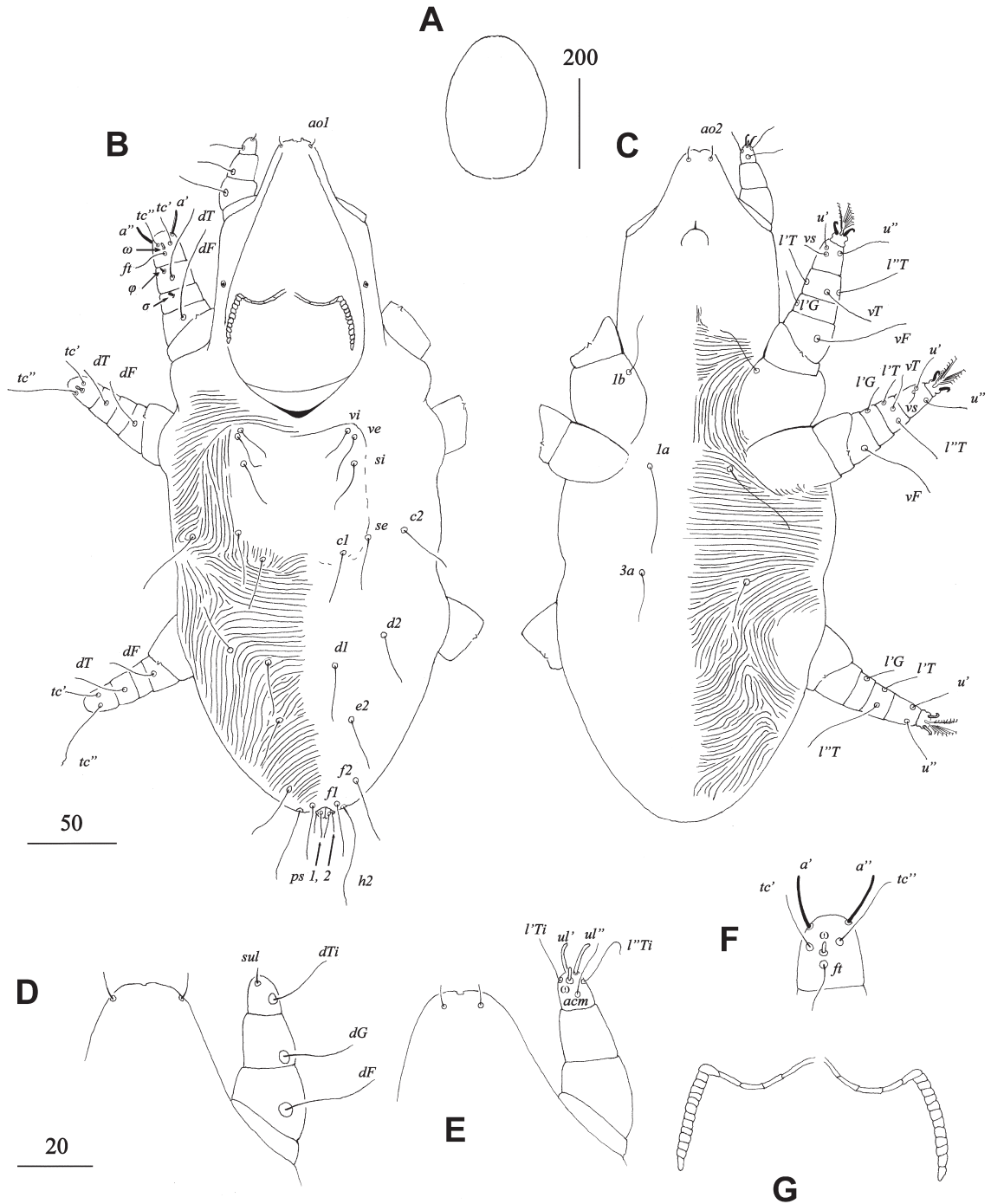


Figure 5. *Chenophila platyrhynchus* sp. nov.: A) egg; larva: B) dorsal view, C) ventral view, D) gnathosoma in dorsal view, E) gnathosoma in ventral view, F) tarsus I in dorsal view, G) peritremes.

2. Propodonotal shield distinctly punctate on whole surface. Length of stylophore 255–275. Each lateral branch of peritremes with 13–16 chambers. Lengths of idiosomal setae *ve*, *se*, and *c2* 80–100, 180–230, and 160–215, respectively; setae *si* 110–140, always longer than distance between setal bases *si*–*se* ... *Ch. platyrhynchus* sp. nov.

– Propodonotal shield rarely punctate and only near bases of setae *vi*, *ve*, and *si*. Length of stylophore 230–250. Each lateral branch of peritremes with 10–13 chambers. Lengths of idiosomal setae *ve*, *se*, and *c2* 45–65, 135–165, and 115–145, respectively; setae *si* 55–100, subequal or shorter than distance between setal bases *si*–*se* ... *Ch. kanduli* Bochkov, 1998

Table. The measurements (range and mean) of morphological characters of the postembryonic stages of *Chenophila platyrhynchos* based on the material from the Mallard *Anas platyrhynchos* from Poland.

	Larva (n = 7)	Protonymph (n = 7)	Tritonymph (n = 10)	Male (n = 10)	Female (n = 20)
Total body length	355–440; 398	465–640; 530	605–830; 762.9	575–625; 597.8	670–830; 765.2
Length of setae					
<i>vi</i>	15–25; 20	25–40; 31.5	30–55; 43.0	30–55; 43.8	65–85; 75.0
<i>ve</i>	20–30; 24.4	25–50; 36.3	30–65; 47.5	35–60; 47.5	80–100; 88.6
<i>si</i>	20–30; 26.1	30–45; 36.2	45–65; 58.1	15–45; 28.9	110–140; 123
<i>se</i>	25–35; 31.2	30–45; 40.8	50–80; 65.5	60–85; 75.3	180–230; 205.7
<i>c1</i>	20–40; 29.2	30–55; 42.3	45–95; 73.2	45–80; 58.8	165–240; 208.2
<i>c2</i>	20–40; 31.5	30–45; 38.9	55–75; 70.4	90–130; 109.4	160–215; 187.4
<i>d1</i>	10–30; 20.3	20–35; 25.5	35–65; 47.5	15–30; 23.2	130–170; 154
<i>d2</i>	10–35; 21.5	25–35; 28.4	40–65; 50.1	20–35; 27.0	85–150; 110.1
<i>e2</i>	10–35; 23.2	15–30; 23.3	30–65; 48.2	15–25; 20.5	130–185; 160
<i>f1</i>	20–45; 34.6	15–30; 23.5	25–35; 29.9	–	35–60; 51.7
<i>f2</i>	35–60; 46.4	25–50; 38.1	50–65; 56.3	25–35; 30.6	70–110; 91.7
<i>h1</i>	–	–	20–45; 33.2	–	25–50; 38.6
<i>h2</i>	70–105; 79.7	75–95; 85.1	140–185; 160.9	190–250; 224.2	360–480; 421.9
<i>g1</i>	–	–	40–55; 48.3	5–10; 8.8	30–70; 60.1
<i>g2</i>	–	–	–	5–10; 6.5	35–85; 62.7
<i>ps1</i>	10–20; 16.1	15–30; 22.2	20–40; 27.9	15–30; 21.4	20–50; 35.2
<i>ps2</i>	10–20; 16.0	15–30; 22.0	25–35; 28.7	20–30; 24.0	20–45; 34.0
<i>ag1</i>	–	20–30; 27.9	55–85; 69.3	95–140; 120.8	80–155; 116.0
<i>ag2</i>	–	–	70–90; 77.5	55–95; 73.2	40–75; 58.9
<i>ag3</i>	–	–	–	130–175; 154.2	165–245; 220.4

4. Discussion

The scheme of ontogenesis has been previously studied in 4 quill mite species: 1) *Syringophilus bipectinatus* Heller, 1880, an ectoparasite of *Gallus gallus* (Linnaeus) (Galliformes: Phasianidae); 2) *Mironovia lagopus* Bochkov & Skirnisson, 2011, an ectoparasite associated with *Lagopus muta* (Montin) and *Lagopus lagopus* (Linnaeus) (Phasianidae); 3) *Torotroglia merulae* Skoracki, Dabert & Ehrnsberger, 2000, an ectoparasite associated with 4 species of the true thrushes, *Turdus merula* Linnaeus, *T. philomelos* Brehm, *T. torquatus* Linnaeus, and *T. viscivorus* Linnaeus (Passeriformes: Turdidae); and 4) *Bubophilus aluconis* Skoracki, Kavetska, Ozminski & Sikora, 2012, an ectoparasite of *Strix aluco* Linnaeus and *Asio otus* Linnaeus (Strigiformes: Strigidae) (Kethley, 1970; Bochkov and Skirnisson, 2011; Skoracki, 2011; Skoracki et al., 2012a). Less detailed remarks about the chaetotaxy of the juvenile stages have been also presented for *Colinophilus wilsoni* Kethley, 1973, known to occur in *Colinus virginianus* (Linnaeus) (Galliformes: Odontophoridae), and for

Bubophilus ascalaphus Philips and Norton, 1978, an ectoparasite of *Bubo virginianus* (Gmelin) (Strigiformes: Strigidae) (Kethley, 1973; Philips and Norton, 1978). In the chaetotaxy of all the above-mentioned species, the larvae are devoid of the following setae: subcapitular setae *n*; palpal setae *vF* and *l''G*; idiosomal setae *h1*, *ag1–3*, and *g1–2*; and leg setae *p'* and *p''* of tarsi I–III, *dGI–II*, *l'RI–III*, *1b*, *2c*, *3b*, and *3c*. In the protonymphs, the following setae are absent: palpal setae *vF*; idiosomal setae *h1*, *ag2–3*, and *g1–2*; and leg setae *p'IV*, *p''IV*, *l'GIV*, *l'RI–IV*, *4b*, and *4c*. The tritonymphs are devoid of idiosomal setae *g2* and *ag3*, and leg setae *l'RIV* (Kethley, 1970, 1973; Philips and Norton, 1978; Bochkov and Skirnisson, 2011; Skoracki, 2011; Skoracki et al., 2012a; present paper). We think that this general scheme of development is present in all quill mite genera with a full set of leg setae in adults. The main difference in the chaetotaxy of the postembryonic stages in the above-mentioned and studied genera is the presence/absence of proral setae *p'* of tarsi I and II. Our studies of the juvenile stages of *Chenophila platyrhynchos* sp. nov.

show that the development of this species is similar to the scheme noted for the genera *Bubophilus* Philips and Norton, 1978, *Mironovia* Chirov & Kravtsova, 1995, and *Torotroglia* Kethley 1970. In this group of mites, the protonymphs are devoid of proral setae p^I , II while in the genera *Syringophilus* Heller, 1880 and *Colinophilus* Kethley, 1973, both pairs of setae p^I - II and p^{II} - II are present.

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