

## **Morphological ontogeny of *Platynothrus troendelagicus* sp. nov. (Acari, Oribatida, Camisiidae) from Norway**

Authors: Seniczak, Anna, Seniczak, Stanisław, Hassel, Kristian, and Flatberg, Kjell Ivar

Source: Systematic and Applied Acarology, 27(9) : 1702-1722

Published By: Systematic and Applied Acarology Society

URL: <https://doi.org/10.11158/saa.27.9.2>

---

The BioOne Digital Library (<https://bioone.org/>) provides worldwide distribution for more than 580 journals and eBooks from BioOne's community of over 150 nonprofit societies, research institutions, and university presses in the biological, ecological, and environmental sciences. The BioOne Digital Library encompasses the flagship aggregation BioOne Complete (<https://bioone.org/subscribe>), the BioOne Complete Archive (<https://bioone.org/archive>), and the BioOne eBooks program offerings ESA eBook Collection (<https://bioone.org/esa-ebooks>) and CSIRO Publishing BioSelect Collection (<https://bioone.org/csiro-ebooks>).

Your use of this PDF, the BioOne Digital Library, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/terms-of-use](http://www.bioone.org/terms-of-use).

Usage of BioOne Digital Library content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

---

BioOne is an innovative nonprofit that sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

## Morphological ontogeny of *Platynothrus troendelagicus* sp. nov. (Acari, Oribatida, Camisiidae) from Norway

ANNA SENICZAK<sup>a\*</sup>, STANISŁAW SENICZAK<sup>b</sup>, KRISTIAN HASSEL<sup>c</sup> & KJELL IVAR FLATBERG<sup>c</sup>

<sup>a</sup>Department of Natural History, University Museum of Bergen, University of Bergen, Bergen, Norway

<sup>b</sup>Department of Evolutionary Biology, Faculty of Biological Sciences, Kazimierz Wielki University, Bydgoszcz, Poland

<sup>c</sup>Department of Natural History, NTNU University Museum, Norwegian University of Science and Technology, Trondheim, Norway

\*Corresponding author: [Anna.Seniczak@uib.no](mailto:Anna.Seniczak@uib.no)

### Abstract

The morphological ontogeny of *Platynothrus troendelagicus* A. et S. Seniczak sp. nov. is described and illustrated. This species was found in two Atlantic raised bogs in Trøndelag, Norway, and based on comparison of cytochrome oxidase I (COI) nucleotide sequences, it also occurs in Ireland and Canada. It is the most similar to *P. punctatus* (L. Koch, 1879) as adult, but differs from it mainly by having more genital setae, longer seta  $f_2$ , alveolar seta *exp* and only one pair of hypostomal setae *m*. In all juveniles of *P. troendelagicus*, the bothridial seta and exobothridial seta *exa* are short, and *exp* is alveolar. In the larva, seta  $f_1$  is setiform, but in the nymphs it is alveolar. Most prodorsal and gastrontal setae are short and smooth, except for longer and barbed  $f_2$  and  $h_1$  in the larva, and longer and finely barbed  $f_2$ , and *h*- and *p*-series in the nymphs. In all instars, one pair of hypostomal setae *m* is present, and palp femur has one seta. In the ontogeny of this species, many *l* setae appear on trochanter III and femora I–III, and *l* and *v* setae on tarsi, and the number of setae on femora of deutonymph to adult is diagnostic. Both species differ also by COI nucleotide sequence.

**Keywords:** oribatid mites, juveniles, leg setation, ecology, COI, Atlantic raised bog

### Introduction

While working on the oribatid mites from two Atlantic raised bogs in Trøndelag, Central Norway, we found one species of *Platynothrus* Berlese, 1913, which is similar, but slightly smaller than *P. punctatus* (L. Koch, 1879) and is new to science. Systematic problems of *Platynothrus* were discussed by Seniczak *et al.* (2022), which also gave the diagnosis of this genus as follows: species of medium size to large (595–1220), with bacilliform bothridial seta and thickened head; number of hypostomal setae *m* varies within species and developmental stages; notogaster with 1–3 longitudinal ridges and 15 pairs of setae ( $f_1$  absent, only alveolus of this seta remains), posterior setae without distinct apophyses; epimeres IV separated from each other and epimeres III separated from each other in half of diameter; epimere IV with three or four setae, 11–38 pairs of genital setae present, leg tarsi with one or three claws. Seniczak and Seniczak (2022) also gave the diagnosis of juveniles of *Platynothrus*: prodorsal setae *ro*, *le* and *in* of medium size or long, *exa* short and *exp* alveolar. Bothridium small, rounded, bothridial seta short or minute. Number of hypostomal setae *m* and length of gastrontal setae varies between species and developmental stages, seta  $f_1$  setiform in larva, and alveolar in nymphs. Posterior gastrontal setae of nymphs without distinct apophyses. Number of genital setae and setae on femora of deutonymph and tritonymph varies between nymphs and species. According to Subías (2004, updated electronic version 2022), Seniczak *et al.* (2022) and

Seniczak and Seniczak (2022), *Platynothrus* comprises 26 nominative species and two subspecies, from which one is considered by Subías (2004, updated electronic version 2022) *species inquirenda*.

The morphology of juveniles of *Platynothrus* is insufficiently known. According to Norton and Ermilov (2014) and further literature (Seniczak *et al.* 2022; Seniczak & Seniczak 2022), the full morphological ontogeny of *P. altimontanus* Hammer, 1958, *P. bicarinatus* (Jacot, 1938), *P. coulsoni* A. *et* S. Seniczak, 2022, *P. peltifer* C.L. Koch, 1839 and *P. punctatus* (L. Koch, 1879) is only known, which constitutes 21% of *Platynothrus* species.

This paper aims to describe the morphological ontogeny of *Platynothrus troendelagicus* A. *et* S. Seniczak **sp. nov.** and compare it with congeners.

## Material and methods

The adults and juveniles of *P. troendelagicus* A. *et* S. Seniczak **sp. nov.** used in this study were collected on June 29<sup>th</sup> and 30<sup>th</sup> 2020 by A. Seniczak, K.I. Flatberg and K. Hassel from *Sphagnum* mosses in two Atlantic raised bogs located in Trøndelag, Central Norway (Hitra, 63°29'20.4"N, 8°52'26.4"E, 49 m a. s. l. and Høstadmyra 63°24'18.0"N, 10°07'12.0"E, 107 m a. s. l.).

The Hitra island is characterised by mild oceanic climate, with the following data in the year of study (2020): a mean annual temperature of 8.1°C, annual precipitation of 1436.2 mm, the lowest temperature was -4.9°C, and the highest was 31.3°C. Høstadmyra has slightly colder and drier climate, comparing to Hitra, with a mean annual temperature of 6.6°C and annual precipitation of 1192.8 mm (both in 2020). The minimum temperature was -13.2°C and the maximum temperature was 30.8°C. Climatic data were taken from Norwegian Centre for Climate Services (available at <https://seklima.met.no/>).

In total 64 samples of *Sphagnum* mosses, each of 500 cm<sup>3</sup> were collected, including 28 samples in Hitra and 36 in Høstadmyra. Samples were transported in plastic bags in cool boxes for four days and extracted with Tullgren funnels in the Department of Natural History (University Museum of Bergen, University of Bergen, Norway) for ten days. The type specimens originate from a sample of *Sphagnum compactum* Lam. *et* DC. collected in a poor fen carpet site in Høstadmyra.

We investigated the density and stage structure of mites and based on 20 randomly selected adults we measured the body length and width, determined the sex ratio and number of gravid females and carried eggs. We measured total length (tip of rostrum to posterior edge of notogaster) in lateral aspect and width (widest part of notogaster) of mites in dorsal aspect, and size of anal and genital openings and setae perpendicularly to their length in  $\mu\text{m}$ . In a similar way we measured the morphological characters given in Table 1. Apical part of notogastral and gastronotal setae of *P. troendelagicus* is fragile, so we measured these setae, which looked undamaged.

The illustrations are limited to the body regions that show substantial differences between instars and were prepared from individuals mounted temporarily on slides in lactic acid. We used the following abbreviations in the text and figures: rostral (*ro*), lamellar (*le*), interlamellar (*in*) and exobothridial (*exa*, *exp*) setae, bothridium (*bo*), bothridial seta (*bs*), notogastral or gastronotal setae (*c*-, *d*-, *e*-, *f*-, *h*-, *p*-series), lyrifissures or cupules (*ia*, *im*, *ip*, *ih*, *ips*, *iad*, *ian*), cheliceral setae (*cha*, *chb*), Trägårdh organ (*Tg*), palp setae (*sup*, *d*, *l*, *cm*, *acm*, *lt*, *ul*, *su*) and solenidion  $\omega$ , epimeral setae (*1a-c*, *2a*, *3a-c*, *4a-d*), genital setae (*g*), aggenital setae (*ag*), adanal and anal setae (*ad*-, *an*-series), leg solenidia ( $\sigma$ ,  $\phi$ ,  $\omega$ ), famulus ( $\epsilon$ ) and setae (*bv*, *ev*, *d*, *l*, *v*, *ft*, *tc*, *it*, *pv*, *pl*, *a*, *s*, *p*, *u*). The leg setae *l* on femora, and *l* and *v* on tarsi were labelled according to their appearance in the ontogeny. Terminology used follows that of Grandjean (1939, 1953, 1971, 1972, 1974) and Norton and Behan-Pelletier (2009). The species nomenclature follows partly Subías (2004) and Norton and Ermilov (2014).

**TABLE 1.** Some morphological characters of instars of *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, (mean measurements of 2–10 specimens in  $\mu\text{m}$ ); nd—not developed.

Morphological characters	Larva	Protonymph	Deutonymph	Tritonymph	Adult
Body length	314	400	494	578	709
Body width	139	185	225	286	397
Length of prodorsum	120	145	165	198	234
Length of: seta <i>ro</i>	17	20	24	27	40
seta <i>le</i>	21	23	32	61	79
seta <i>in</i>	22	28	37	41	63
seta <i>bs</i>	2	2	3	3	53
seta <i>c</i> <sub>1</sub>	18	21	24	25	45
seta <i>c</i> <sub>2</sub>	16	17	22	24	38
seta <i>c</i> <sub>3</sub>	26	28	32	36	62
seta <i>cp</i>	19	21	24	26	54
seta <i>d</i> <sub>1</sub>	17	23	28	32	42
seta <i>d</i> <sub>2</sub>	18	26	35	38	56
seta <i>e</i> <sub>1</sub>	19	24	30	34	45
seta <i>e</i> <sub>2</sub>	24	34	38	43	42
seta <i>f</i> <sub>1</sub>	16	lost	lost	lost	lost
seta <i>f</i> <sub>2</sub>	27	42	55	64	96
seta <i>h</i> <sub>1</sub>	32	45	59	82	85
seta <i>h</i> <sub>2</sub>	17	36	56	80	82
seta <i>h</i> <sub>3</sub>	nd	38	58	82	86
seta <i>p</i> <sub>1</sub>	nd	38	57	81	71
seta <i>p</i> <sub>3</sub>	nd	27	42	56	59
genital opening	nd	35	54	75	145
anal opening	64	89	99	148	185

For scanning electron microscopy (SEM), the mites were air-dried and coated with Au/Pd in a Polaron SC502 sputter coater and placed on Al-stubs with double-sided sticky carbon tape. Observations and micrographs were made with a QUANTA FEG 450 scanning electron microscope.

#### DNA barcoding

Six specimens of *P. troendelagicus* (three from Hitra and three from Høstadmyra) were used in this study. They were compared with *P. punctatus* from two sites: submerged mosses growing at the edge of a pool in Finse (Vestland, Western Norway, 60°34'48.0"N, 7°28'19.2"E, 1341 m a. s. l., 22.09.2019, leg. Anna Seniczak) and from *Sphagnum* mosses in peatland on Lydehorn (Bergen, Vestland, Western Norway, 60°22'12.0"N, 5°14'38.4"E, 293 m a. s. l., 05.10.2018, leg. Anna Seniczak). We used species of putatively close genera as outgroups, *Capillonostrus thori* (Berlese, 1904) (collected in peatland Borreguil de la Virgen in Sierra Nevada, Spain, 37°05'13.2"N, 3°22'26.4"W, 2494 m a. s. l., 18.08.2017, leg. Anna Seniczak and Emilia F. Ondoño), *Heminostrus targionii* (Berlese, 1885) (collected in Hitra together with *P. troendelagicus*, see above for details), and *Camisia foveolata* Hammer, 1955 (collected in Vestland, Hardanger, Finse, 60°35'34.8"N, 7°25'55.2"E, 1356 m a. s. l., 07.09.2018, leg. Anna Seniczak) (Table 2).

**TABLE 2.** Information about specimens used in this study; labels correspond to specimen numbers in BOLD database; ad—adult, juv—juvenile, NA—not available.

Species	Label	Stage	GeneBank access No	Locality	Coordinates	Elevation (m a. s. l.)	Sampling date
<i>P. troendelagicus</i> A. et S. Seniczak <b>sp. nov.</b>	MARBN222-21_ <i>P. troendelagicus</i>	ad	ON964459	NO: Trøndelag, Høstadmyra	63°24'18.0"N, 10°07'12.0"E	107	30.07.2020
	MARBN223-21_ <i>P. troendelagicus</i>	ad	ON964457	NO: Trøndelag, Høstadmyra	63°24'18.0"N, 10°07'12.0"E	107	30.07.2020
	MARBN224-21_ <i>P. troendelagicus</i>	ad	ON964456	NO: Trøndelag, Høstadmyra	63°24'18.0"N, 10°07'12.0"E	107	30.07.2020
	MARBN225-21_ <i>P. troendelagicus</i>	ad	ON964453	NO: Trøndelag, Hitra	63°29'20.4"N, 8°52'26.4"E	49	29.07.2020
	MARBN226-21_ <i>P. troendelagicus</i>	ad	ON964455	NO: Trøndelag, Hitra	63°29'20.4"N, 8°52'26.4"E	49	29.07.2020
	MARBN227-21_ <i>P. troendelagicus</i>	ad	ON964458	NO: Trøndelag, Hitra	63°29'20.4"N, 8°52'26.4"E	49	29.07.2020
	MARBN347-21_ <i>Platynothrus</i>	ad	ON964454	IR: Leinster, Lullymore	53°16'48.0"N, 6°57'00.0"W	80	09.12.2014
SSFDA3509-14_ <i>Platynothrus</i>	NA	MF911250	CA: New Brunswick, Fundy NP	45°37'30.0"N, 65°03'36.0"W	336	30.05.2013	
<i>P. punctatus</i>	MARBN096-21_ <i>P. punctatus</i>	juv	OL671030	NO: Vestland, Hardanger, Finse	60°34'48.0"N, 7°28'19.2"E	1356	22.09.2019
	MARBN097-21_ <i>P. punctatus</i>	ad	OL671034	NO: Vestland, Hardanger, Finse	60°34'48.0"N, 7°28'19.2"E	1356	22.09.2019
	MARBN098-21_ <i>P. punctatus</i>	ad	OL671021	NO: Vestland, Hardanger, Finse	60°34'48.0"N, 7°28'19.2"E	1356	22.09.2019
	MARBN144-21_ <i>P. punctatus</i>	ad	OL671029	NO: Vestland, Bergen, Lydehorn	60°22'12.0"N, 5°14'38.4"E	210	05.10.2018
	MARBN145-21_ <i>P. punctatus</i>	ad	OL671037	NO: Vestland, Bergen, Lydehorn	60°22'12.0"N, 5°14'38.4"E	210	05.10.2018
	MARBN146-21_ <i>P. punctatus</i>	ad	OL671031	NO: Vestland, Bergen, Lydehorn	60°22'12.0"N, 5°14'38.4"E	210	05.10.2018
<i>Cam. foveolata</i>	MARBN342-21_ <i>C. foveolata</i>	ad	OL671028	NO: Vestland, Hardanger, Finse	60°35'34.8"N, 7°25'55.2"E	1356	07.09.2018
<i>Cap. thori</i>	MARBN185-21_ <i>C. thori</i>	ad	OL671033	SP: Andalusia, Borreguil de la Virgen	37°05'13.2"N, 3°22'26.4"W	2502	18.08.2017
<i>Hem. targionii</i>	MARBN320-21_ <i>H. targionii</i>	ad	OL671022	NO: Trøndelag, Hitra	63°29'20.4"N, 8°52'26.4"E	48	29.07.2020

Each specimen was photographed, and the photos are the vouchers that are available at Barcode of Life Data System (BOLD, <http://boldsystems.org>). The specimens were subsequently placed in a well containing 50 ml of 90% ethanol in a 96-well microplate and send to the Canadian Centre for DNA Barcoding (CCDB 2021). Mites were sequenced for the barcode region of the COI gene according to standard protocols at CCDB ([www.ccdb.ca](http://www.ccdb.ca) 34), using either LepF1/LepR1 (Hebert *et al.* 2003) or LCO1490/HCO2198 (Folmer *et al.* 1994) primer pairs. The DNA extracts were placed in archival storage at -80°C at the Canadian Centre for DNA Barcoding. The sequences are available in GenBank (accessions numbers in Table 2).

COI sequences (sequence length  $\geq 407$  bp) were blasted against GenBank in order to detect and exclude possible contaminations. In blast search two sequences of *Platynothrus* from other countries turned out to be very similar to those of *P. troendelagicus*, so they were included in the analyses. One of them was from Ireland (Leinster, Lullymore, 53°16'48.0"N, 6°57'00.0"W, 80 m a. s. l., 09.12.14, leg. Anna Seniczak and Thomas Bolger) and another one from Canada (Fundy National Park, New Brunswick, (45°37'30.0"N, 65°03'36.0"W, 336 m a. s. l., GenBank Accession number MF911250, Young *et al.* 2019). Sequence variation within *P. troendelagicus* specimens and between-species was

calculated in BOLD using Kimura 2 Parameter distance model, pairwise deletion, and BOLD Aligner (Amino Acid based HMM). The sequences were aligned by eye and Neighbor joining trees were constructed using MEGA6 (Tamura *et al.* 2013). Joint neighborhood topologies were visualized in FigTree 1.4.2 (available at <http://tree.bio.ed.ac.uk/software/figtree>).

***Platynothrus troendelagicus* A. et S. Seniczak sp. nov.**

(Figs. 1–21)

*Diagnosis*

Adult of medium size (length 663–722), with characters of *Platynothrus* given by Seniczak *et al.* (2022). Prodorsal setae *in* thin and of medium size, alveolar seta *exp* present. Bothridial seta of medium size, bacilliform, with thickened, barbed head. Notogastral setae (15 pairs) of medium size, setae  $f_2$  longer than  $e_2$ . Adult with one pair of hypostomal setae *m*, palp femur with one seta. Three pairs of adanal setae and two pairs of anal setae present. Leg tarsi with one claw.

Juveniles with characters of *Platynothrus* given by Seniczak and Seniczak (2022). Most prodorsal and gastronal setae short and smooth, except for longer and barbed  $f_2$  and  $h_1$  in larva, and longer and finely barbed  $f_2$  and *h*- and *p*-series in nymphs. All juveniles with one pair of hypostomal setae *m*, palp femur with one seta.

Formula of genital setae of species 2-4-9-14 (protonymph to adult), and segments AD (protonymph to adult)—0333 and AN (deutonymph to adult) – 022. Formula of setae on femora I–IV of deutonymph 6-6-3-2, tritonymph 7-8-3-2 and adult 8-9-5-3.

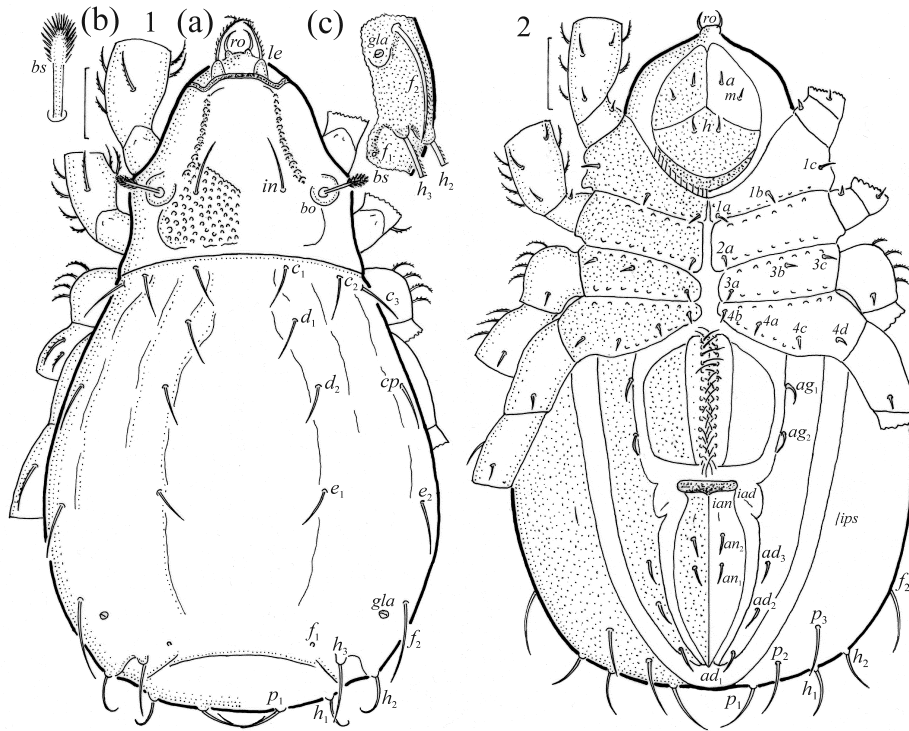
*Morphology of adult*

*Measurements*: body length (and range) of females  $693.6 \pm 20.0$  (663–722,  $n = 20$ ) and width  $418.9 \pm 12.2$  (377–436), males absent.

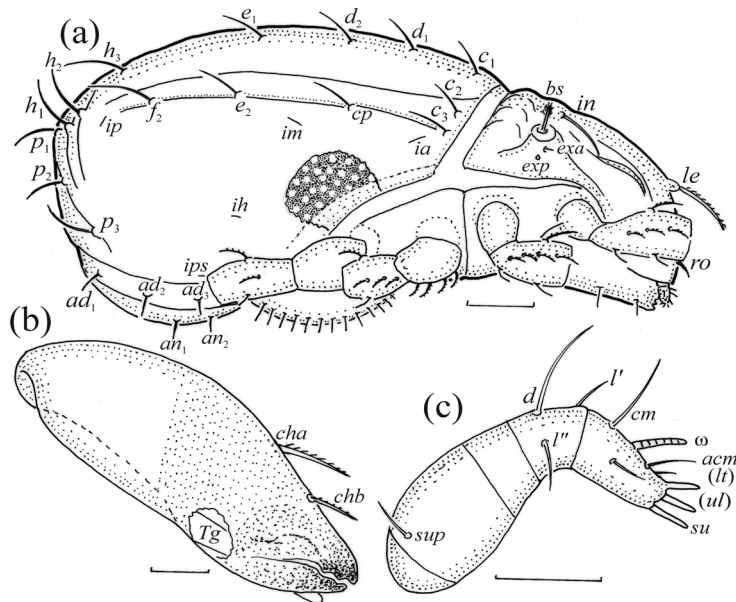
*Cerotegument*. Brown with light spots and microporose.

*Prodorsum*. Rostrum rounded, with rostral setae short (*ro*, 39–41) and smooth (Figs. 1a, 2, 3a, 4, 5a, 6a, 6b, 7c, 7d), lamellar setae longer (*le*, 77–82) and finely barbed, inserted posterior to setae *ro* on large apophyses and transverse ridge; interlamellar setae *in* longest (*in*, 91–95), but thinner than *le* and smooth. Setal pair *ro* inserted close to each other, mutual distance between setal pair *le* about two times longer than between setal pair *ro*, and between setal pair *in* about four times longer than between setal pair *ro*. Bothridium (*bo*) small and rounded, located on large tubercle, bothridial seta (*bs*) of medium size (99–105), bacilliform, with thickened, barbed head (Figs. 1a, 1b, 3a, 4a–c, 5a, 5b, 6, 7a). Exobothridial seta *exa* short (18) and smooth, inserted lateral to *bo*, alveolar *exp* present. Central and anterior part of prodorsum with foveae (Figs. 1a, 4a–c, 5a, 5b, 6a–c).

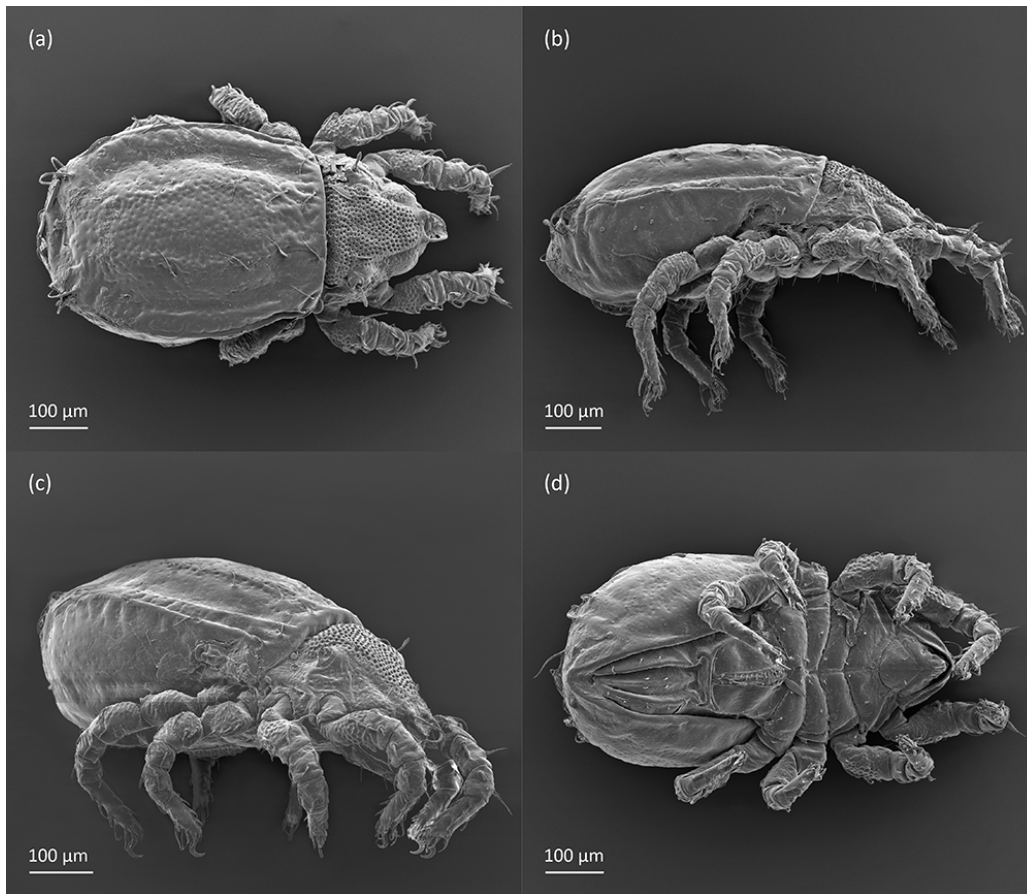
*Notogaster*. Longer (444–484) than wide (377–436), with three pairs of longitudinal ridges, inner ridges better formed and longest, medial ridges shortest (Figs. 1a, 4a–c, 5c, 5d). Most notogastral setae (15 pairs, excluding alveolar  $f_1$ ) relatively short or of medium size (38–86, Table 1) and smooth. Seta  $f_2$  longer than  $e_2$ . Opisthonotal *gla* opening posteromedial to seta  $f_2$  (Figs. 1a, 1c, 5c, 5d, 7b). Transverse ridge present posterior to setal pair  $h_3$ , alveolar seta  $f_1$  anteromedial to seta  $h_3$ . Lyrifissure *ia* posterolateral to seta  $c_3$ , *im* posterolateral to seta *cp*, *ip* anterolateral to seta  $h_2$ , *ian* anterior to seta  $an_2$ , *iad* lateral to anterior part of anal plate, *ips* and *ih* displaced anterolateral to seta  $ad_3$  (Figs. 2, 3a).



**FIGURES 1–2.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, legs partially drawn, scale bars 50  $\mu$ m. 1. (a) Dorsal aspect, (b) bothridial seta, (c) region of *gla* opening (b, c, enlarged). 2. Ventral aspect.



**FIGURE 3.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult. (a) Lateral aspect, legs partially drawn, scale bar 50  $\mu$ m; mouthparts, scale bars 20  $\mu$ m. (b) chelicera, right side, antiaxial aspect, (c) palp, lateral aspect.



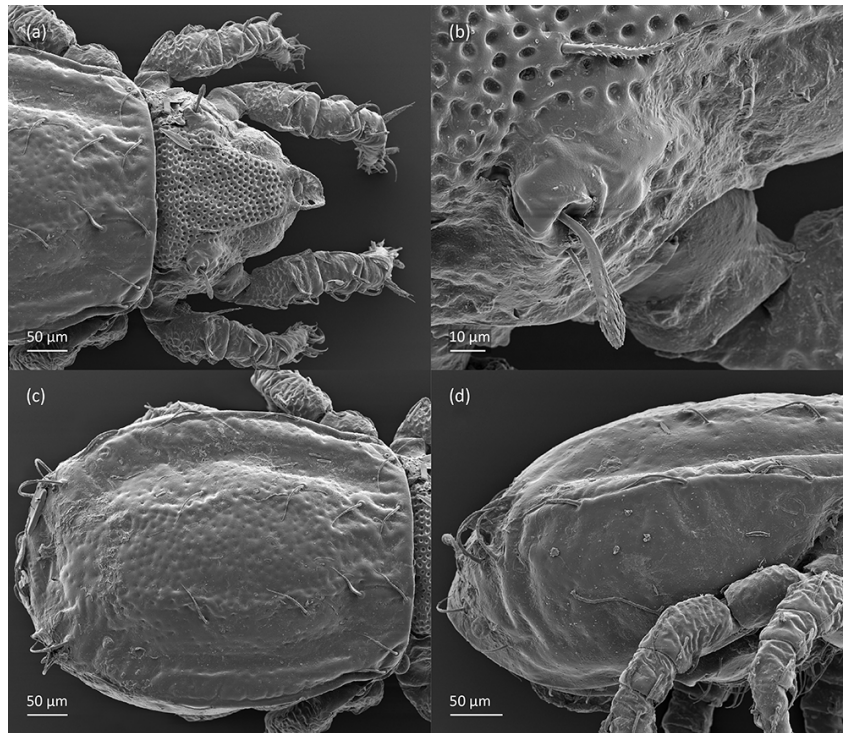
**FIGURE 4.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. (a) Dorsal view, (b) lateral view, (c) frontolateral view, (d) ventral view.

*Gnathosoma.* Subcapitular setae *h*, *m* and *a* short (5) and smooth, one pair of setae *m* present (Figs. 2, 7c, 7d). Chelicera (length 149, width 53) with short (23–25), barbed setae, *cha* slightly longer and thicker than *chb* (Fig. 3b). Palp short (length 61–63), with most setae short and smooth, except for slightly longer *d* and *cm* (Fig. 3c). Formula of palp setae (trochanter to tarsus + solenidion  $\omega$ ): 0-1-0-3-7(1).

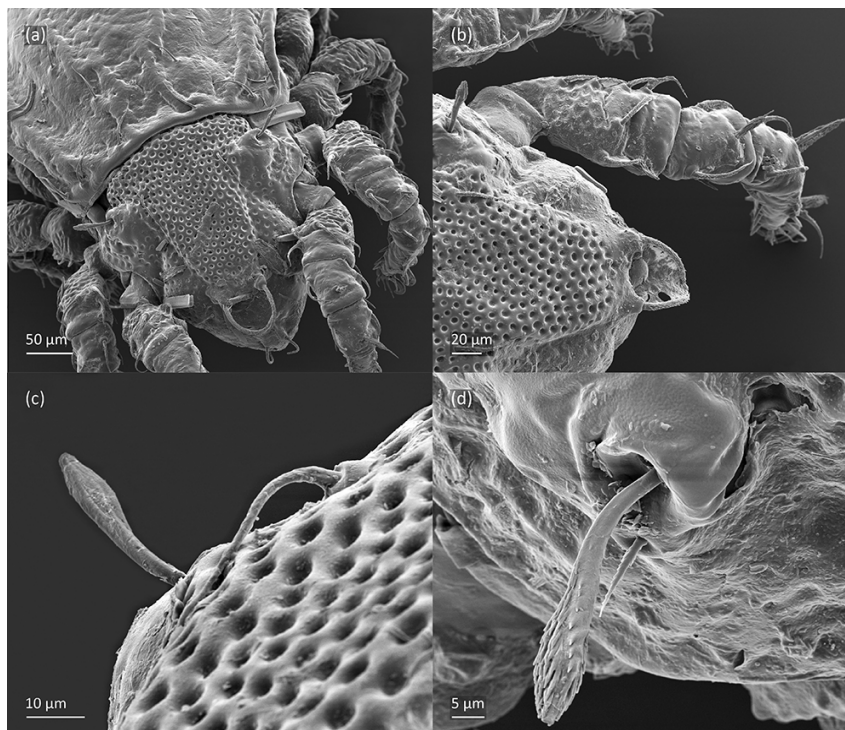
*Ventral aspect.* All epimeral setae short (7–10) and smooth (Figs. 2, 4d, 7c, 8a, 8b), formula of epimeral setae 3-1-3-4. Aggenital setae (2 pairs) longer (17–19) than epimeral setae, genital setae (14 pairs) longest (38–42) and inserted on inner part of genital plates (Figs. 2, 8a, 8b); all smooth. Adanal setae (3 pairs) and anal setae (2 pairs) short (16–19), all smooth (Figs. 2, 8a, 8c).

*Legs.* Femora with reticulate integument (Figs. 4, 5, 6a, 6b, 7c, 8d, 9a, 10b). Most leg setae relatively thick, finely barbed, or smooth, except for longer setae on distal part of tarsi (Figs. 4, 5a, 5c, 5d, 6a, 6b, 7c, 8a, 8b, 8d, 9, 10). Seta *d* coupled to solenidion present on all genua and tibiae. Formulae of leg setae (and solenidia), trochanter to tarsus: I—1-8-5(1)-5(2)-23(3); II—1-9-5(1)-5(1)-21(2); III—5-5-4(1)-4(1)-21; IV—1-3-4(1)-4(1)-18 (Table 3). Leg tarsi monodactylous.

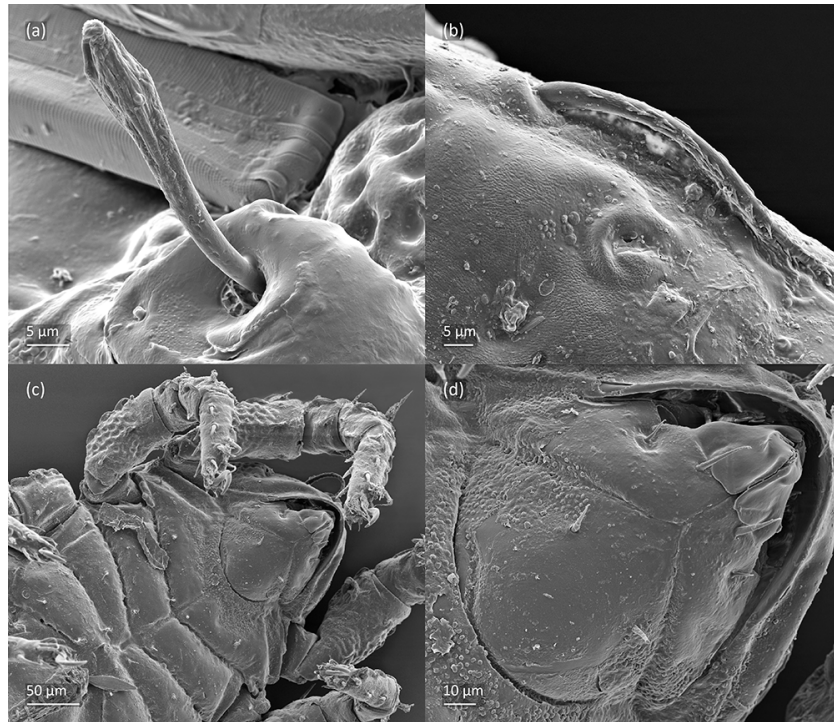




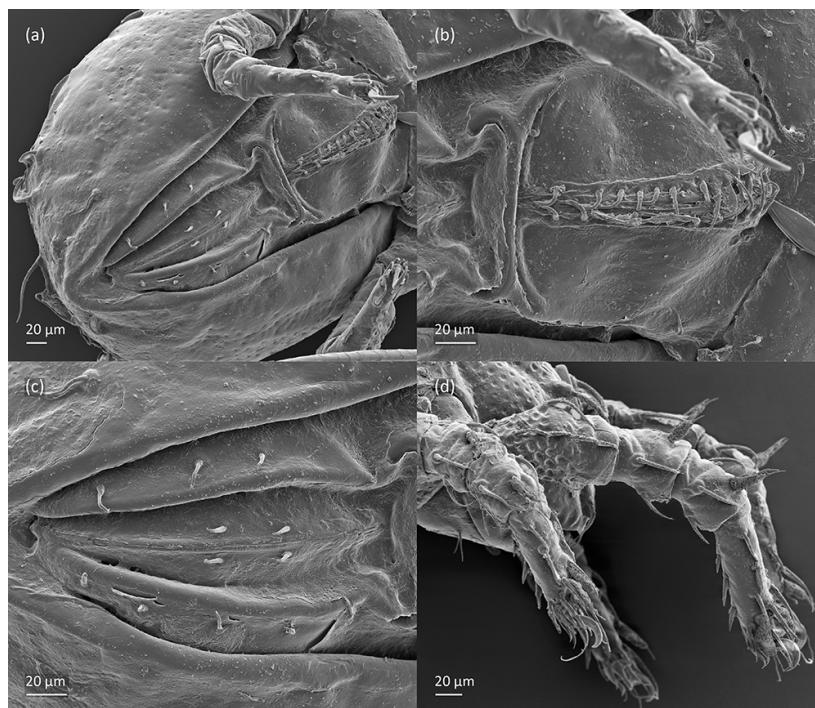
**FIGURE 5.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. Dorsal view, (a), (b) anterior part, (c) posterior part; (d) posterior part, lateral view.



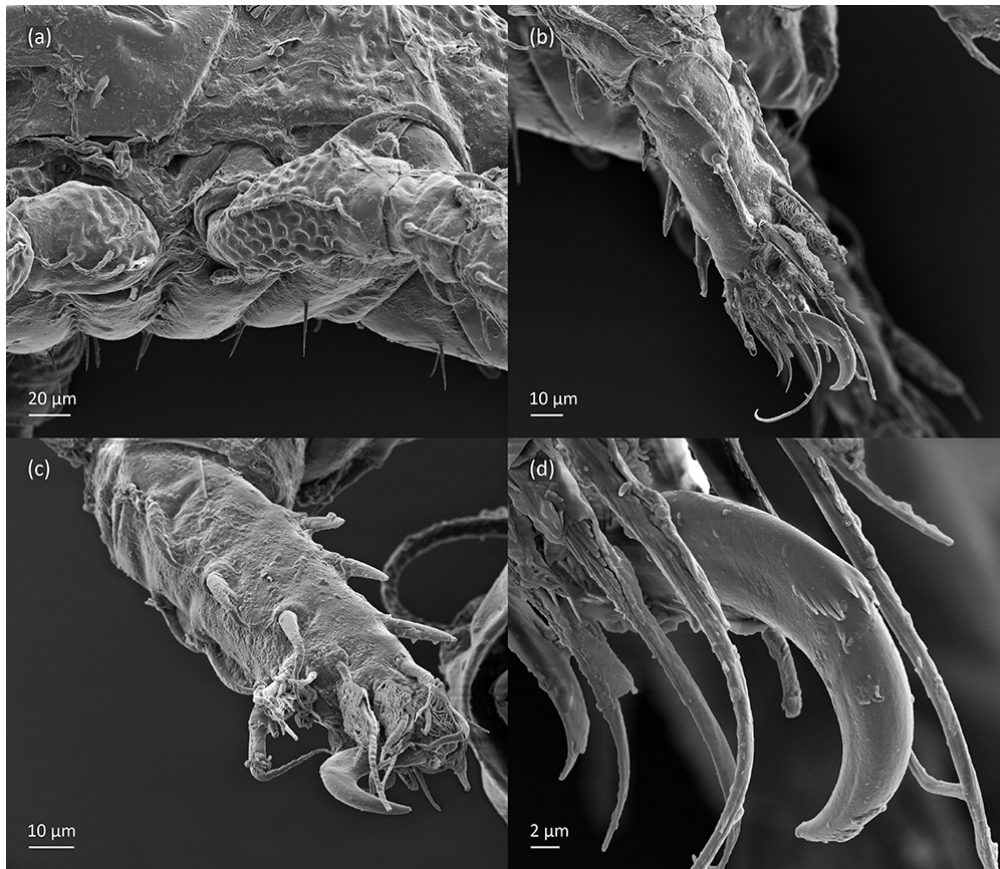
**FIGURE 6.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. Dorsal view, (a), (b) anterior part, (c), (d) bothridium and bothridial seta, dorsal view.



**FIGURE 7.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. Bothridium and bothridial seta, dorsal view; (b) opisthotal *glia* opening, dorsal view; (c), (d) anterior part, ventral view.



**FIGURE 8.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. Posterior part of body, ventral view (a), (b) genital plates, (c) anal plates; (d) legs I and II, lateral view.

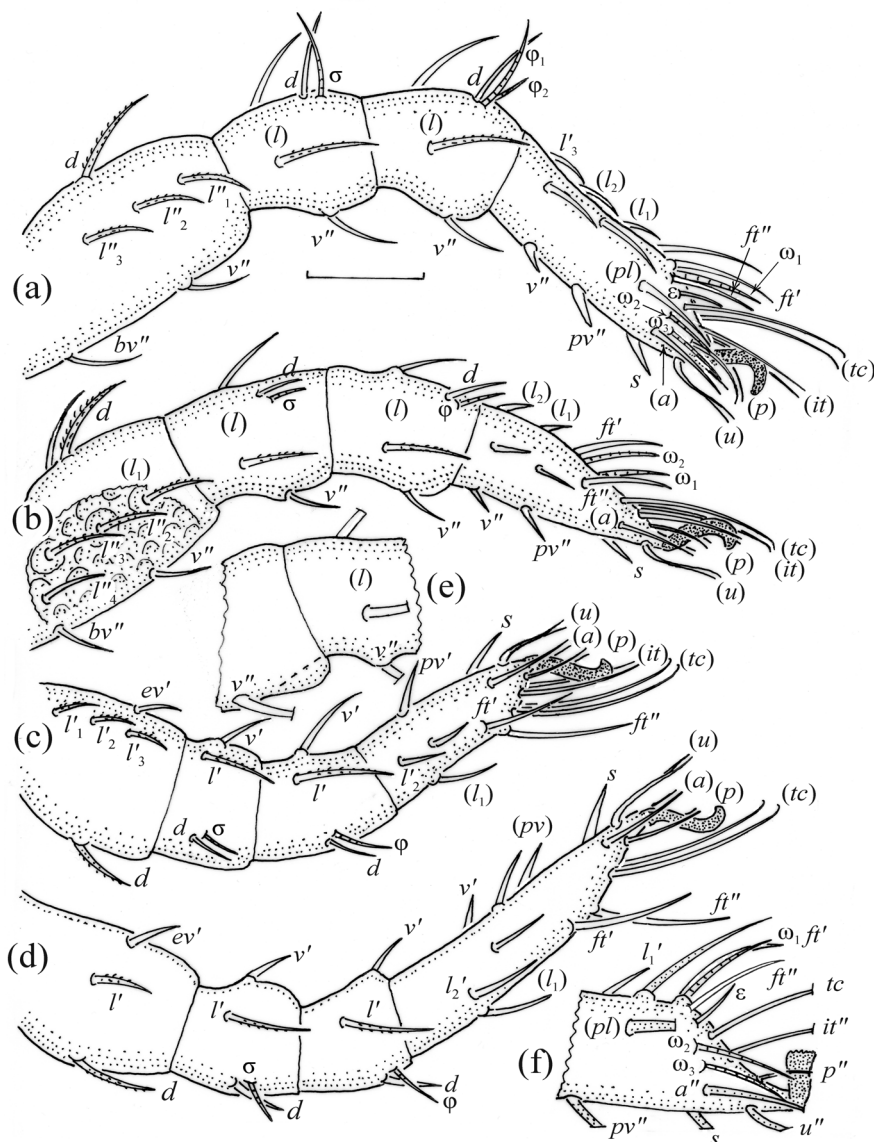


**FIGURE 9.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, adult, SEM micrographs. (a) Femora II and III, lateral view; leg I, (b) lateral view, (c) tarsus, frontolateral view, (d) claw I, lateral view.

#### *Description of juvenile stages*

Larva stocky (Figs. 11, 12a, 13a), unpigmented, prodorsum, epimeres and legs light brown. Prodorsum subtriangular, central part punctate, with small pits. Prodorsal setae *ro* inserted close to each other on rostrum, pair *le* inserted posterior to *ro* on transverse ridge, pair *in* inserted in central part, posteromedial to bothridial setae (*bs*); *ro* and *exa* short, *le* and *in* of medium size (Table 1), seta *exp* alveolar, *le* finely barbed, other setae smooth. Ridge present anterior to seta *exa* in direction of seta *le* and posterior to seta *exa* in direction of seta *c*<sub>1</sub>. Mutual distance between setal pair *le* about five times longer than between setal pair *ro*, and between setal pair *in* about eight times longer than between setal pair *ro*, setae *le* inserted closer to *ro* than to *in* (Figs. 11, 13a). Opening of bothridium small, rounded, bothridial seta minute. One pair of hypostomal setae *m* present.

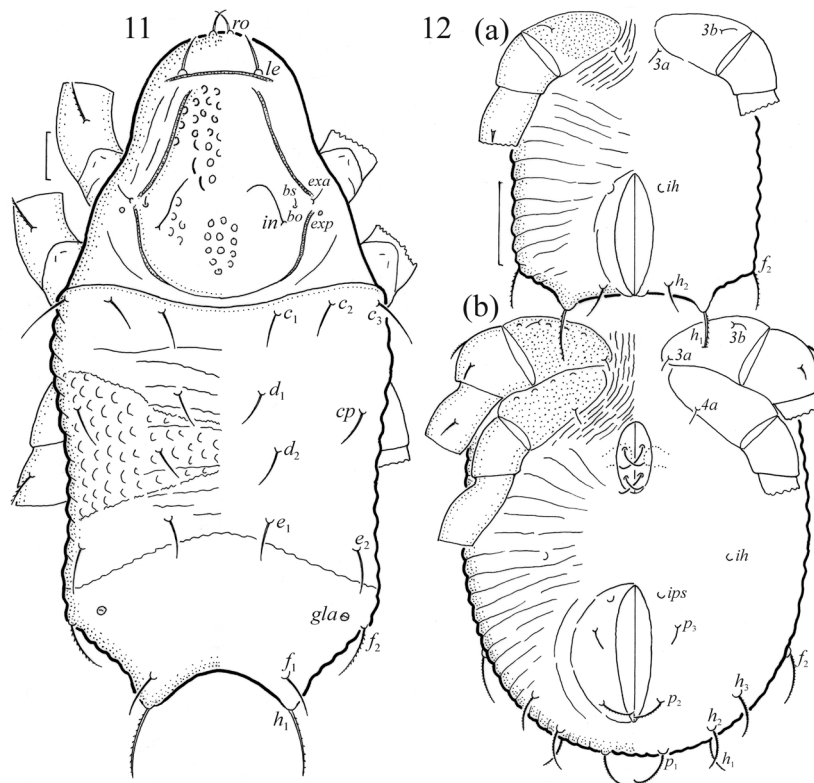
Gastronotum of larva with transverse folds and lateral tubercles and 12 pairs of setae, including *f*<sub>1</sub> placed anterior to seta *h*<sub>1</sub>, and *h*<sub>2</sub> inserted lateral to posterior part of anal valves (Figs. 11, 12a, 13a); most setae of medium size and smooth, except for longer and barbed *f*<sub>2</sub> and *h*<sub>1</sub> (Table 1). Cupule *ia* posterior to seta *c*<sub>3</sub>, *im* anterior to seta *e*<sub>2</sub>, *ip* not observed between folds, *ih* lateral to anterior part of anal valves (Figs. 12a, 13a). Opisthosomal gland opening anteromedial to seta *f*<sub>2</sub>. Anal valves of larva (segment P) glabrous. Leg segments relatively thick, and most leg setae relatively thick and short or conical, except for longer apical setae on tarsi (Fig. 14). Seta *d* coupled to solenidion present on all genua and tibiae.



**FIGURE 10.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, leg segments of adult (part of femur to tarsus), right side, antiaxial aspect, setae on the opposite side not illustrated are indicated in the legend, scale bar 20  $\mu$ m. (a) Leg I, femur ( $l'$ ,  $v'$ ), genu ( $v'$ ), tibia ( $v'$ ), tarsus ( $v'$ ,  $pv'$ ); (b) leg II, femur ( $v'$ ), genu ( $v'$ ), tibia ( $v'$ ), tarsus ( $v'$ ,  $pv'$ ); (c) leg III, genu ( $v''$ ), tibia ( $v''$ ), tarsus ( $pv''$ ); (d) leg IV, genu ( $v''$ ), tibia ( $v''$ ), tarsus ( $v''$ ); (e) connection of femur I with genu I, (f) part of tarsus I (e, f enlarged).

Shape and color of protonymph and prodorsal setae of nymphs as in larva, but in central part of prodorsum pits denser than in larva. Bothridium weakly developed, rounded, bothridial seta short, *exa* short and *exp* alveolar. One pair of hypostomal setae *m* present. Gastronotum of protonymph with folds and small pits and 15 pairs of setae because seta  $f_1$  lost and alveolus of seta remaining and present in other instars, and setae  $h_3$  and *p*-series appearing and remaining in deutonymph and tritonymph, most setae relatively short and smooth, except for longer finely barbed  $f_2$  and *h*- and *p*-series, but in protonymph  $p_3$  short and smooth (Fig. 12b, Table 1). In protonymph, two pairs of setae appearing on genital valves, and two pairs added in deutonymph and five pairs in tritonymph (Figs.

12b, 15a, 15b). In deutonymph, one pair of aggenital setae appearing, and one pair added in tritonymph, all short and smooth. Anal valves of protonymph (segments AD) and deutonymph (segments AN) glabrous, in tritonymph two pairs of short and smooth setae present (Figs. 12a, 15a, 15b). In all nymphs, posterior setae on small apophyses. In tritonymph, cupules *ia* and *im* placed as in larva, *ip* not observed between folds, cupule *ian* anterior to seta *an*<sub>2</sub>, *iad* lateral to anterior part of anal valves, cupules *ips* and *ih* pushed anterolateral to seta *ad*<sub>3</sub> (Figs. 15b, 16). Opisthotal gland opening medial to seta *f*<sub>2</sub> and alveolus of seta *f*<sub>1</sub> anterior to seta *h*<sub>1</sub>. In all nymphs, central and anterior part of prodorsum with foveae (Figs. 16, 17a, 17b, 18b). Leg segments relatively thick (Figs. 17a–c, 18–20), and femora with reticulate integument (Figs. 17a, 17b, 20b). Most leg setae of tritonymph short or of medium size, relatively thick and smooth, except for longer apical setae on tarsi (Fig. 20). Seta *d* coupled to solenidion present on all genua and tibiae.



**FIGURES 11–12.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, legs partially drawn, scale bars 20  $\mu$ m. 1. Larva, dorsal aspect. 2. Ventral aspect of hysterosoma, (a) larva, (b) protonymph.

**Remarks.** Neighbor-joining tree based on cytochrome oxidase I (COI) nucleotide sequences confirmed morphological observations that *P. troendelagicus* differs from *P. punctatus* also on the molecular level (Fig. 21). The sequences of *P. troendelagicus* were identical (distance 0%), the maximum mitochondrial DNA variation within *P. punctatus* was 2.62%, while the minimum distance to compared representatives within the genus was 28.69%.

#### Summary of ontogenetic transformations

In all instars of *P. troendelagicus*, the prodorsal setae *ro*, *le* and *in* are short or of medium size, and *exp* is alveolar. In all juveniles, the bothridium is weakly developed, and the bothridial seta is short, whereas in the adult the bothridium is large, located on large tubercle, with small, rounded

opening, and bothridial seta is bacilliform, with thickened, barbed head. The larva has 12 pairs of gastronotal setae, including  $f_1$  and  $h_2$ , whereas the nymphs and adult have 15 pairs (in protonymph  $f_1$  is lost and only alveolus of this seta remains, and setae  $h_3$  and  $p$ -series are added). Formula of gastronotal setae of *P. troendelagicus* is 12-15-15-15-15 (larva to adult, excluding alveolar  $f_1$ ). Formulae of epimeral setae are 3-1-2 (larva, including scaliform  $lc$ ), 3-1-3-1 (protonymph), 3-1-3-3 (deutonymph) and 3-1-3-4 (tritonymph and adult). In all instars, one pair of hypostomal setae  $m$  is present. Formula of genital setae is 2-4-9-14 (protonymph to adult), aggenital setae is 1-2-2 (deutonymph to adult), and setae of segments PS–AN is 03333-0333-022. The ontogeny of leg setae and solenidia is given in Table 3.

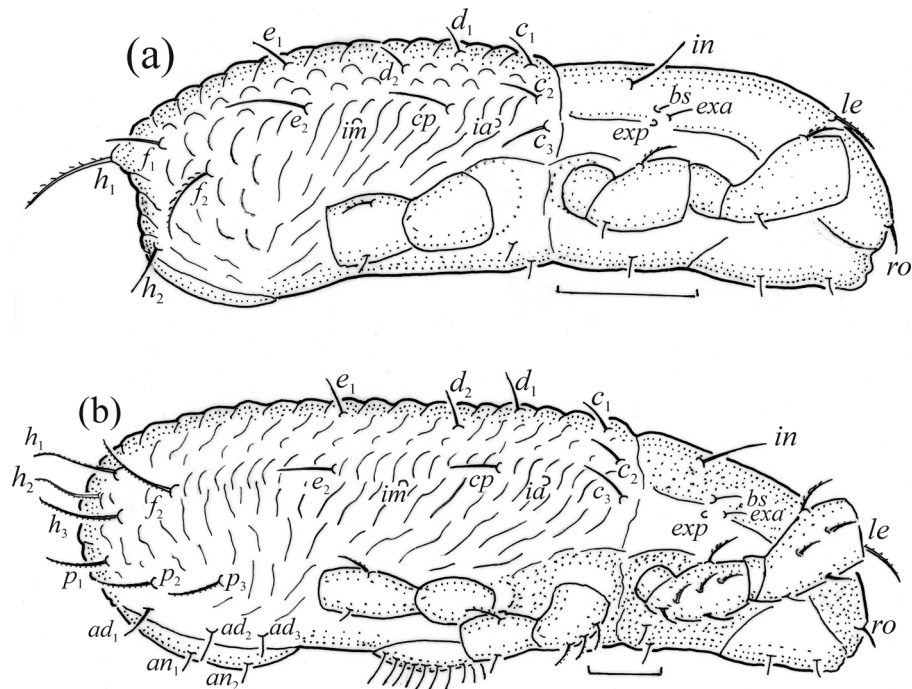
**TABLE 3.** Ontogeny of leg setae (Roman letters) and solenidia (Greek letters) in *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
<b>Leg I</b>					
Larva	–	$d, bv''$	$(l), d, \sigma$	$(l), v', d, \varphi_1$	$(ft), (tc), (p), (u), (a), s, (pv), \varepsilon, \omega_1$
Protonymph	–	–	–	–	$\omega_2$
Deutonymph	$v'$	$(l'_1), l'_2, v''$	$(v)$	$v'', \varphi_2$	–
Tritonymph	–	$v'$	–	–	$\omega_3, (v_1), (it)$
Adult	–	$l'_3$	–	–	$(l_1), (l_2), l'_3$
<b>Leg II</b>					
Larva	–	$d, bv''$	$(l), d, \sigma$	$(l), v', d, \varphi$	$ft), (tc), (p), (u), (a), s, (pv), \omega_1$
Protonymph	–	–	–	–	–
Deutonymph	$v'$	$(l'_1), l'_2, v''$	$(v)$	$v''$	$\omega_2$
Tritonymph	–	$l'_3, v'$	–	–	$(l_1), (it)$
Adult	–	$l'_4$	–	–	$(l_2), (v_1)$
<b>Leg III</b>					
Larva	–	$d, ev'$	$l', d, \sigma$	$l', v', d, \varphi$	$(ft), (tc), (p), (u), (a), s, (pv)$
Protonymph	$l'_1$	–	–	–	–
Deutonymph	$l'_2, v'$	$l'_1$	$v'$	$v''$	–
Tritonymph	$l'_3$	–	$v''$	–	$l'_1, (it)$
Adult	$l'_4$	$l'_2, l'_3$	–	–	$l''_1, (l_2), (v_1)$
<b>Leg IV</b>					
Protonymph	–	–	–	–	$ft'', (pv), (p), (u)$
Deutonymph	$v'$	$d, ev'$	$v', l', d, \sigma$	$v', l', d, \varphi$	$ft', (tc), (a), s$
Tritonymph	–	–	$v''$	$v''$	$l'_1$
Adult	–	$l'$	–	–	$l''_1, l'_2, (v_1)$

Note: structures are indicated where they are first added and are present through the rest of ontogeny; pairs of setae in parentheses, dash indicates no additions.

#### *Distribution, ecology and biology*

*Platynothrus troendelagicus* was found in ten samples (out of the total of 64 samples) collected in Hitra and Høstadmyra, only in the moist habitats. It was the most abundant and represented by all developmental stages in a sample of *Sphagnum compactum* Lam. et DC. collected in a poor fen carpet site in Høstadmyra, where the density of this species was 69 individuals/500 cm<sup>3</sup>. The adults dominated in extracted sample, constituting 51% of population. The stage structure of *P. troendelagicus* was the following: 3 larvae, 10 protonymphs, 19 deutonymphs, 2 tritonymphs and 35 adults. Among 20 individuals investigated, 50% of females were gravid, carrying 1–5 large eggs (each 155 x 80), constituting 22% of the length of females.



**FIGURE 13.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, lateral aspect, legs partially drawn, scale bars 20  $\mu\text{m}$ . (a) Larva, (b) tritonymph.

The species was also found in samples collected from lawns and carpets in Hitra and Høstadmyra: in *Sphagnum medium* Limpr., *S. cuspidatum* Ehrh. ex Hoffm., *S. rubellum* Wilson, and at the pond with a mixture of *Sphagnum* species [*S. inundatum* Russow, *Sphagnum papillosum* Lindb. and *Sphagnum tenellum* (Brid.) Brid.]. Based on COI nucleotide sequences, the species also occurs in the peatlands in Ireland (Lullymore, Leinster) and Canada (Fundy National Park, New Brunswick, Young *et al.* 2019) (Table 2, Fig. 21).

#### Type material

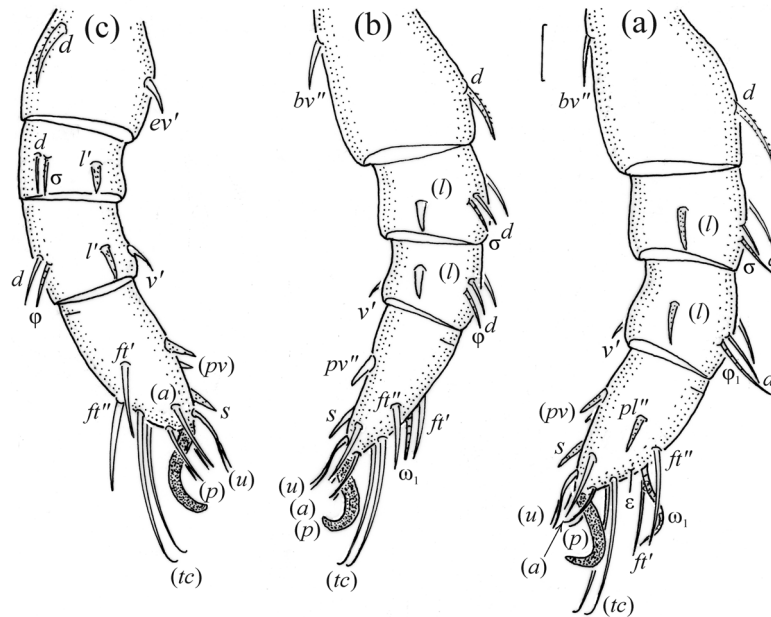
The holotype (female) and five paratypes (females) with the above collection data are deposited in the University Museum of Bergen, University of Bergen, Bergen, Norway (ZMUB).

#### Etymology

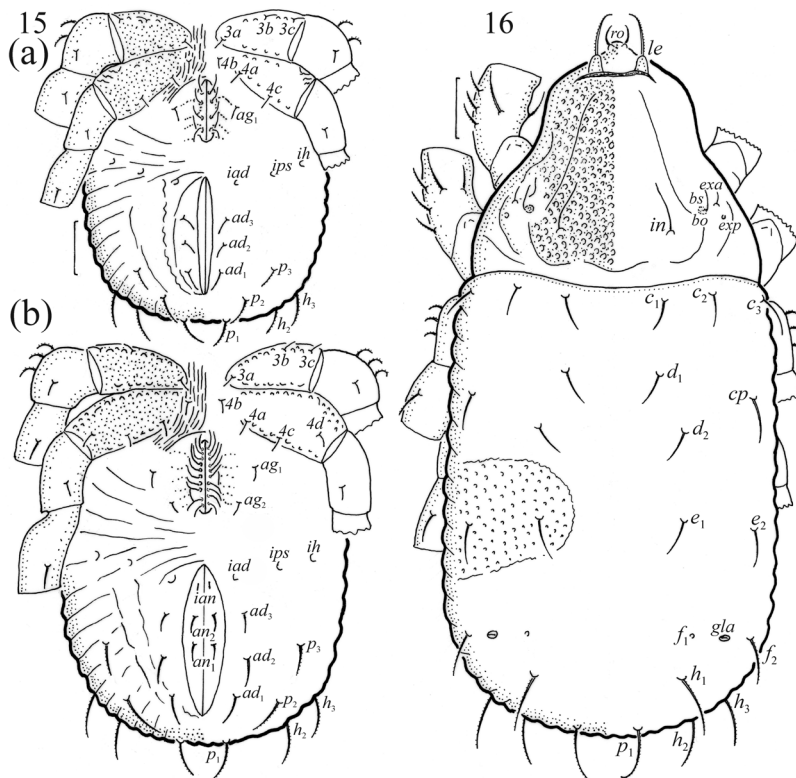
This species is named after the county Trøndelag in the central part of Norway where it was discovered.

#### Comparison of morphology of *Platynothrus troendelagicus* A. et S. Seniczak sp. nov. with congeners and remarks

Seniczak and Seniczak (2022) compared the morphology of adults of *Platynothrus* species with most gastronotal setae short or of medium size, and *P. troendelagicus* is the most similar to *P. punctatus* but differs from it mainly by slightly smaller body size, larger number of genital setae, presence of alveolar seta *exp*, which in *P. punctatus* is absent, presence of only one pair of hypostomal setae *m* (vs. 1, 2, 3, 4, 5 pairs of this setae in larva, protonymph, deutonymph, tritonymph and adult of *P. punctatus*, respectively). It differs also by COI nucleotide sequence.

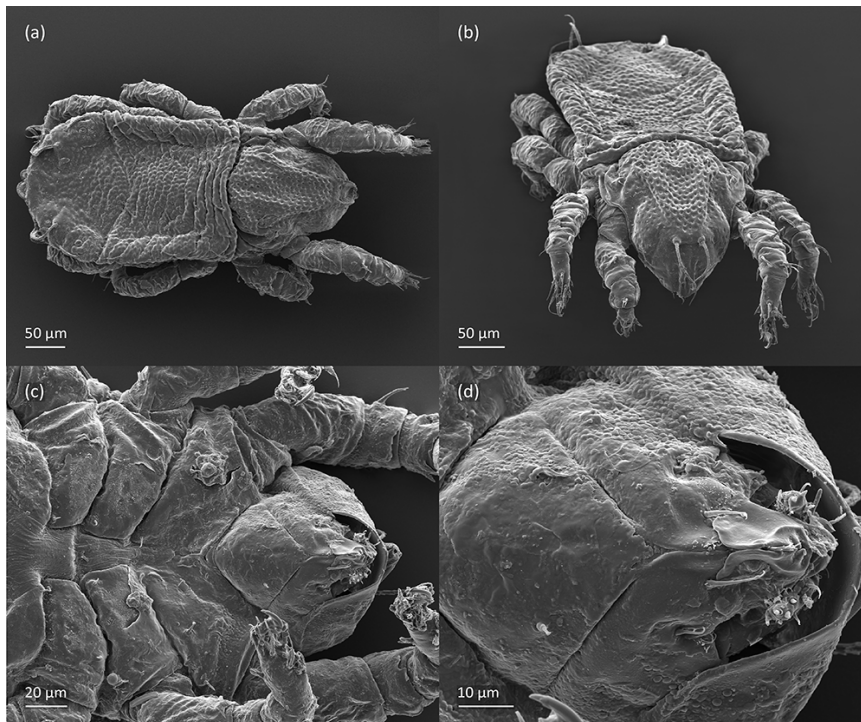


**FIGURE 14.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, leg segments of larva (part of femur to tarsus), right side, antiaxial aspect, setae on the opposite side not illustrated are indicated in the legend, scale bar 20  $\mu$ m. (a) Leg I, tibia (*pl'*); (b) leg II, tarsus (*pv'*); (c) leg III.

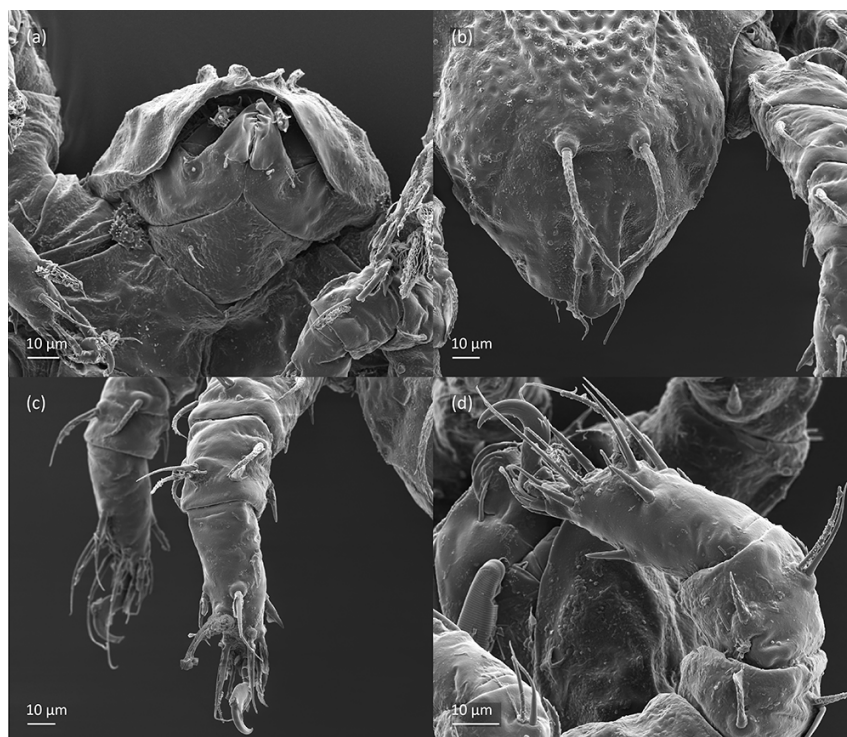


**FIGURES 15–16.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, legs partially drawn, scale bars 50  $\mu$ m. 15. Ventral aspect of hysterosoma, (a) deutonymph, (b) tritonymph. 16. Tritonymph, dorsal aspect.





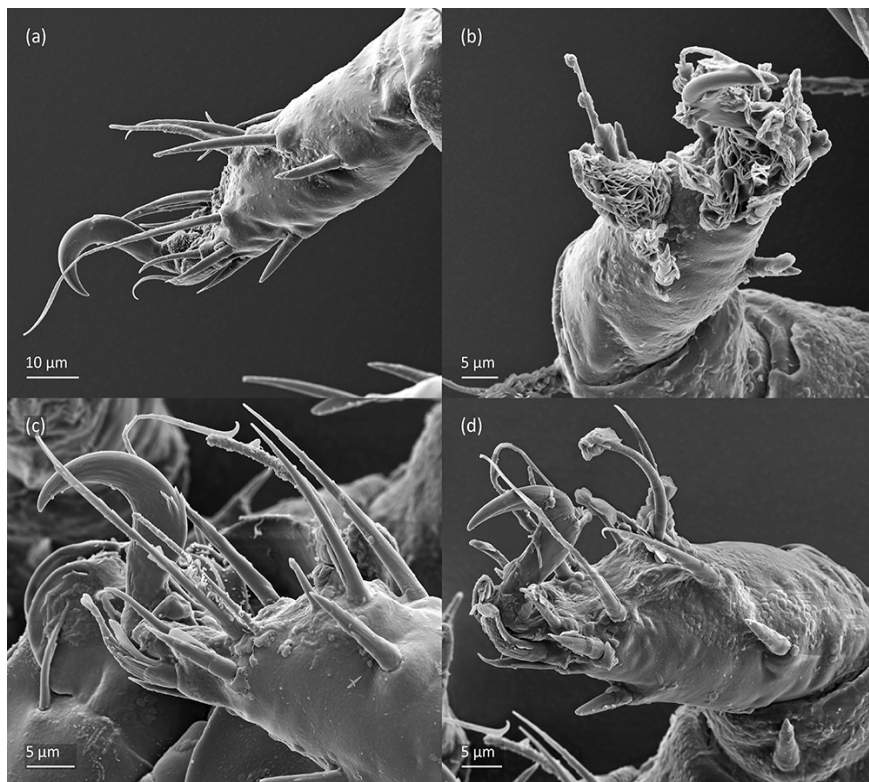
**FIGURE 17.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, deutonymph, SEM micrographs. (a) Dorsal view, (b) frontal view, (c), (d) anterior part, ventral view.



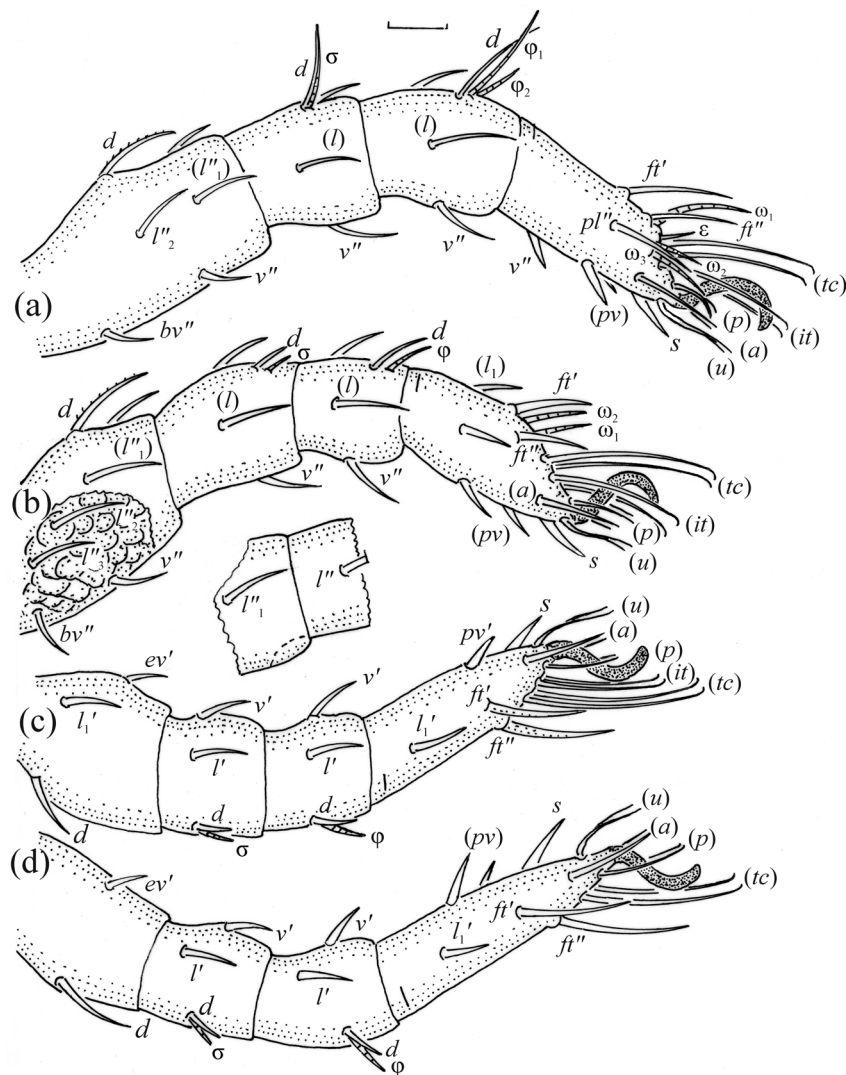
**FIGURE 18.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, deutonymph, SEM micrographs. Anterior part, (a) ventral view, (b) dorsal view; (c) leg I and II, frontal view; (d) leg I, lateral view.

In the juveniles of *P. troendelagicus*, the number, shape and distribution of setae are similar to those of other species of Camisiidae (Seniczak 1990a, b, 1991a–c; Seniczak & Klimek 1990; Seniczak & Seniczak 2022; Seniczak *et al.* 2022). In all species, the larva has seta  $f_1$ , but this seta is lost in the protonymph and only alveolus of this setae remains. However, in the nymphs of *Platynothrus*, the posterior gastronotal setae are inserted on small apophyses (Seniczak 1990a; Seniczak & Klimek 1990; Seniczak & Seniczak 2022; Seniczak *et al.* 2022), whereas in the other genera of this family, such as *Heminothrus* Berlese, 1913 and *Camisia* Heyden, 1826 these apophyses are clearly larger (Seniczak 1990b; Seniczak 1991a–c). In the nymphs of other genera of Crotonioidea, such as *Hermannia* Nicolet, 1855, *Phyllhermannia* Berlese, 1916 and *Nothrus* C.L. Koch, 1836, seta  $f_1$  is present (Seniczak 1992; Seniczak & Żelazna 1992; Seniczak & Norton 1993; Colloff 2011; Seniczak *et al.* 2017a, b).

The morphology of successive developmental instars of *P. troendelagicus* is generally similar to those of *P. coulsoni* and *P. punctatus*, but the morphological ontogeny of these species differs by formulae of hypostomal setae, genital, adanal, and anal setae and the number of leg setae on femora and tarsi (Table 4). Moreover, the successive developmental instars of these species differ in the body size (*P. coulsoni* is larger than other species) and length of some setae. Generally, these species are most similar to each other in the larva, and their differentiation of morphology increases during the ontogeny (Table 4, Seniczak & Seniczak 2022; Seniczak *et al.* 2022). Based on Table 4, the larvae of compared species differ clearly in one morphological character, protonymphs in two characters (formulae of hypostomal and genital setae) and deutonymphs, tritonymphs and adults at least in six morphological characters, on the main body (number of hypostomal, palpal, genital, adanal and anal setae), and on leg segments (the number of setae on femora and tarsi, at least on legs I–III). In the adults, the cuticle is better sclerotized than in the juveniles, with more morphological characters.



**FIGURE 19.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, deutonymph, leg I, SEM micrographs. (a) Dorsal view, (b) ventral view, (c), (d) lateral view.



**FIGURE 20.** *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, leg segments of tritonymph (part of femur to tarsus), right side, antiaxial aspect, seta on the opposite side not illustrated are indicated in the legend, scale bar 20  $\mu$ m. (a) Leg I, femur ( $v''$ ), genu ( $v''$ ), tibia ( $v''$ ), tarsus ( $pl'$ ,  $v'$ ); (b) leg II, femur ( $v'$ ), genu ( $v'$ ), tibia ( $v'$ ); (c) leg III, genu ( $v''$ ), tibia ( $v''$ ), tarsus ( $pv''$ ); (d) leg IV, genu ( $v''$ ), tibia ( $v''$ ); (e) connection of femur and genu I.

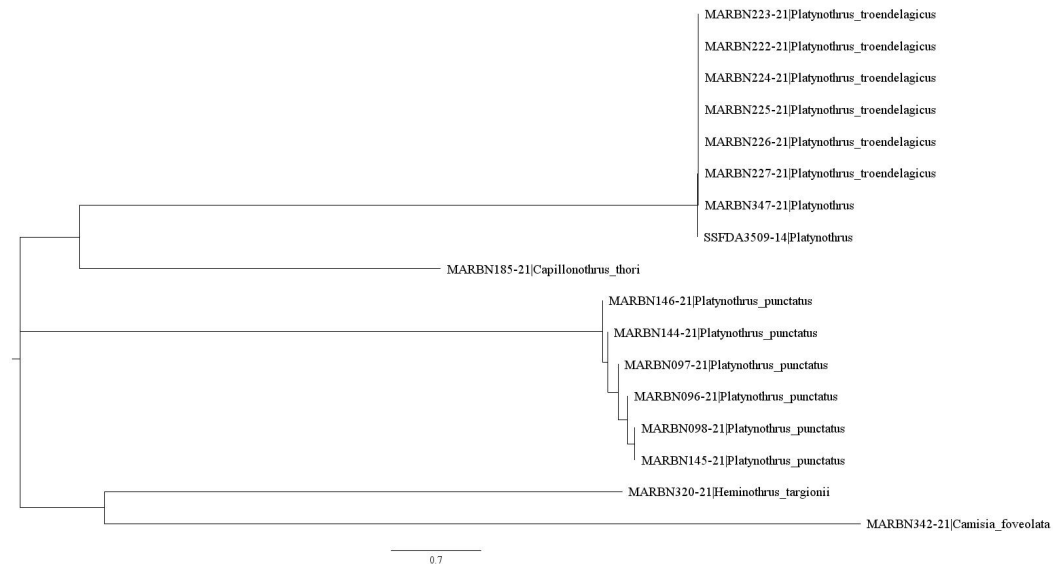
The ontogeny of leg setae and solenidia of *P. troendelagicus* differs from that of *P. coulsoni* and *P. punctatus*, but in all species many  $l$  setae are present on trochanter III and at least on femora I–IV, and setae  $l$  and  $v$  on tarsi. In these species, typical tarsal setae ( $ft$ ,  $pl$ ,  $tc$ ,  $p$ ,  $u$ ,  $a$ ,  $s$ ,  $pv$ ) are inserted on 1/3 apical part of tarsi, but nevertheless in *P. troendelagicus* fewer setae  $v$  appear on all tarsi than in other species.

The chelicera of the adult of *P. troendelagicus* is similar to that of *P. punctatus*, by having well-developed Trägårdh organ that protrudes beyond the line of chelicera in lateral aspect. In both species, cheliceral setae are of similar length and barbed, as in other species of *Platynothrus* (Trägårdh 1910; Lee 1985; Olszanowski 1996). The palp of adult of *P. troendelagicus* is similar to that of *P. punctatus*, except for absence of seta  $inf$  on femur, which in *P. punctatus* is present.

**TABLE 4.** Comparison of some morphological characters of *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.**, *P. coulsoni* and *P. punctatus*.

Characters	<i>P. troendelagicus</i>	<i>P. coulsoni</i> <sup>1</sup>	<i>P. punctatus</i> <sup>2</sup>
<b>All instars</b>			
Formula of: hypostomal setae <i>m</i>	1-1-1-1-1	1-1-1-1-1	1-2-3-4-5
palp setae	0-1-0-3-7(1)	0-1-0-3-7(1)	0-2-0-3-7(1)
genital setae	2-4-9-14	1-5-11-(16-17)	2-4-9-(12-13)
segments AD	3333	03(3-4)(3-4)	3333
segments AN	022	0(2-3)(2-3)	022
Length of seta <i>f</i> <sub>2</sub>	Longer than <i>e</i> <sub>2</sub>	About as long as <i>e</i> <sub>2</sub>	About as long as <i>e</i> <sub>2</sub>
<b>Adult</b>			
Formula of femora I–IV	8-9-4-3	(8-9)-9-(4-5)-4	(8-9)-(8-9)-(4-5)-3
Formula of tarsi I–IV	23-21-21-18	(27-28)-(26-27)-(22-23)-21	(23-24)-(22-23)-(21-22)-(19-20)
<b>Tritonymph</b>			
Formula of femora I–IV	7-8-3-2	7-7-3-(2-3)	7-7-3-2
Formula of tarsi I–IV	23-21-21-18	24-22-21-19	23-22-21-19
<b>Deutonymph</b>			
Formula of femora I–IV	6-6-3-2	5-5-2-2	5-5-2-2
Formula of tarsi I–IV	14-13-13-13	18-17-15-13	15-13-13-13
<b>Larva</b>			
Seta <i>h</i> <sub>1</sub> inserted on	large apophyse	large apophyse	small apophyse

<sup>1</sup>According to Seniczak *et al.* (2022); <sup>2</sup>Seniczak and Seniczak (2022).



**FIGURE 21.** Neighbor-joining tree showing relationships among cytochrome oxidase I (COI) nucleotide sequences of *Platynothrus troendelagicus* A. et S. Seniczak **sp. nov.** and *P. punctatus*; *Camisia foveolata*, *Capillonothus thori*, and *Heminothrus targionii* are outgroups.

## Acknowledgements

We express our gratitude to Dr. Steffen Roth (University Museum of Bergen, Bergen, Norway) for assistance with field work, to anonymous reviewers for helpful comments and suggestions that improved the quality of this paper, and to Mr. Jian-Feng Liu for nice editorial work. The study was partly supported by the grant to the University Museum of Bergen from the Norwegian Taxonomy Initiative "Mites of Atlantic Raised Bogs" (Grant No. 6-20, 70184243). The sequencing was financed by Norwegian Barcode of Life (NorBOL).

## References

- Berlese, A. (1885) Acari, Myriapoda et Scorpiones hucusque in Italia reperta. *Portici*, Padova, Fascicolo XVII, N. 1–10.
- Berlese, A. (1904) Acari nuovi. Manipulus II. *Redia*, 1 (1903), 258–280.
- Berlese, A. (1913) Acari nuovi, Manipoli VII–VIII. *Redia*, 9(1), 77–111 [pls. I–VIII].
- Berlese, A. (1916) Centuria prima di Acari nuovi. *Redia*, 12, 19–67.
- CCDB (2021) The Canadian Centre for DNA Barcoding website. Available: [www.ccdb.ca](http://www.ccdb.ca) (Accessed in April 2022).
- Colloff, M.J. (2011) New species of the oribatid mite genus *Phyllhermannia* Berlese, 1916 (Acari, Oribatida, Hermanniidae) from wet forests in south-eastern Australia show a high diversity of morphologically-similar, short-range endemics. *Zootaxa*, 2770(1), 1–60.  
<https://doi.org/10.11646/zootaxa.2770.1.1>
- Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3(5), 294–299.
- Grandjean, F. (1939) Les segments post-larvaires de l'hystérosoma chez les Oribates (Acariens). *Bulletin de la Société zoologique de France*, 64, 273–284.
- Grandjean, F. (1953) Essai de classification des Oribates (Acariens). *Bulletin de la Société zoologique de France*, 78(5–6), 421–446.
- Grandjean, F. (1971) Caractères anormaux et vertitionnels rencontrés dans des clones de *Platynothrus peltifer* (Koch). Première partie. *Acarologia*, 13(1), 209–237.
- Grandjean, F. (1972) Caractères anormaux et vertitionnels rencontrés dans des clones de *Platynothrus peltifer* (Koch). Chapitres I a VI de la deuxième partie. *Acarologia*, 14(3), 454–478.
- Grandjean, F. (1974) Caractères anormaux et vertitionnels rencontrés dans des clones de *Platynothrus peltifer* (Koch). Chapitres VII a XIII de la deuxième partie. *Acarologia*, 15(4), 759–780.
- Hammer, M. (1955) Alaskan oribatids. *Acta Arctica*, 7, 5–36.
- Hammer, M. (1958) Investigations on the oribatid fauna of the Andes Mountains. I. The Argentine and Bolivia. *Biologiske Skrifter udgivet af det Kongelige Danske Videnskabernes Selskab*, 10(1), 1–129.
- Hebert, P.D.N., Cywinska, A., Ball, S.L. & de Waard, J.R. (2003) Biological identifications through DNA barcodes. *Proceedings of the Royal Society B: Biological Sciences*, 270, 313–321.  
<https://doi.org/10.1098/rspb.2002.2218>
- Heyden, C. von (1826) Versuch einer systematischen Eintheilung der Acariden. *Isis*, Oken, 1.
- Jacot, A.P. (1938) Some new Western North Carolina moss-mites. *Proceedings of the Entomological Society of Washington*, 40(1), 10–15.
- Koch, C.L. (1836) *Deutschlands Crustaceen, Myriapoden und Arachniden*. Friedrich Pustet, Regensburg, Volume 4–9.
- Koch, C.L. (1839) *Deutschlands Crustaceen, Myriapoden und Arachniden*. Friedrich Pustet, Regensburg, Volume 28–30.
- Koch, L. (1879) Arachniden aus Sibirien und Novaja Semlja, eingesammelt von der Schwedischen Expedition im Jahre 1875. *Kongl. Svenska vetenskaps-akademiens handlingar*, Stockholm, 16(5), 1–136.
- Lee, D.C. (1985) Sarcoptiformes (Acari) of South Australian soils. 4. Primitive oribate mites (Cryptostigmata) with an extensive, unfissured hysteronotal shield and aptychoid. *Records of the South Australian Museum*, 19(4), 39–67.
- Nicolet, H. (1855) Histoire naturelle des Acariens qui se trouvent aux environs de Paris. *Archives du Museum d'Histoire Naturelle*, 7, 381–482.

- <https://doi.org/10.5962/bhl.title.66066>
- Norton, R.A. & Behan-Pelletier, V.M. (2009) Suborder Oribatida. *In*: Krantz, G.W. & Walter, D.E. (Eds.), *A Manual of Acarology*. Texas Tech University Press, Lubbock, pp. 430–564.
- Norton, R.A. & Ermilov, S.G. (2014) Catalogue and historical overview of juvenile instars of oribatid mites (Acari: Oribatida). *Zootaxa*, 3833(1), 1–132.  
<http://doi.org/10.11646/zootaxa.3833.1.1>
- Norwegian Centre for Climate Services, <https://seklima.met.no> (accessed in April 2022)
- Olszanowski, Z. (1996) A monograph of the Nothridae and Camisiidae of Poland (Acari: Oribatida: Crotonioidea). *Genus*, Supplement, Wrocław, 201 pp.
- Seniczak, A. & Seniczak, S. (2022) Morphological ontogeny of *Platynothrus coulsoni* spec. nov. (Acari, Oribatida, Camisiidae) from Spitsbergen (Norway). *Systematic & Applied Acarology*, 27(7), 1436–1453.  
<https://doi.org/10.11158/saa.27.7.10>
- Seniczak, S. (1990a) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari, Oribatida). II. *Zoologischer Anzeiger*, 225, 151–160.
- Seniczak, S. (1990b) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari, Oribatida). III. *Zoologischer Anzeiger*, 225, 311–323.
- Seniczak, S. (1991a) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari: Oribatida). IV. *Zoologischer Anzeiger*, 226, 267–279.
- Seniczak, S. (1991b) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari: Oribatida). V. *Zoologischer Anzeiger*, 227, 173–184.
- Seniczak, S. (1991c) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari: Oribatida). VI. *Zoologischer Anzeiger*, 227, 331–342.
- Seniczak, S. (1992) The morphology of juvenile stages of moss mites of the family Nothridae (Acari: Oribatida). I. *Zoologischer Anzeiger*, 229, 134–148.
- Seniczak, S. & Klimek, A. (1990) The morphology of juvenile stages of moss mites of the family Camisiidae (Acari, Oribatida). I. *Zoologischer Anzeiger*, 225, 71–86.
- Seniczak, S. & Norton, R.A. (1993) The morphology of juvenile stages of moss mites of the family Nothridae (Acari: Oribatida). III. *Zoologischer Anzeiger*, 230, 19–33.
- Seniczak, S., Seniczak, A. & Coulson, S.J. (2017a) Morphological ontogeny, distribution, and descriptive population parameters of *Hermannia reticulata* (Acari: Oribatida: Hermannidae), with comments on Crotonioidea. *International Journal of Acarology*, 43(1), 52–72.  
<http://doi.org/10.1080/01647954.2016.1229812>
- Seniczak, S., Seniczak, A. & Coulson, S.J. (2017b) Morphological ontogeny and distribution of *Hermannia scabra* (Acari: Oribatida: Hermannidae) in Svalbard and descriptive population parameters. *Acarologia*, 57(4), 877–892.  
<http://doi.org/10.24349/acarologia/20174214>
- Seniczak, S., Seniczak, A., Kaczmarek, S., Marquardt, T., Fernández Ondoño, E. & Coulson, S.J. (2022) Morphological ontogeny and ecology of *Platynothrus punctatus* (Acari, Oribatida, Camisiidae), with comments on *Platynothrus* Berlese. *Systematic & Applied Acarology*, 27(3), 551–580.  
<https://doi.org/10.11158/saa.27.3.12>
- Seniczak, S. & Želazna, E. (1992) The morphology of juvenile stages of moss mites of the family Nothridae (Acari: Oribatida). II. *Zoologischer Anzeiger*, 229, 149–162.
- Subías, L.S. (2004, updated 2022) Listado sistemático, sinónimo y biogeográfico de los Ácaros Oribátidos (Acariformes, Oribatida) del mundo (1758–2002). *Graellsia*, 60 (número extraordinario), 3–305. 16ª actualización, 532 pp. (accessed in April 2022).  
<http://doi.org/10.3989/graellsia.2004.v60.iextra.218>
- Tamura, K., Stecher, G., Peterson, D., Filipowski, A. & Kumar, S. (2013) MEGA6: Molecular evolutionary genetics analysis version 6.0. *Molecular Biology and Evolution*, 30, 2725–2729.  
<https://doi.org/10.1093/molbev/mst197>
- Trägårdh, I. (1910) Acariden aus dem Sarekgebirge. *Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland*, Zoology, Stockholm, 4, 375–586.
- Young, M.R., Proctor, H.C., deWaard, J.R. & Hebert P.D.N. (2019) DNA barcodes expose unexpected diversity in Canadian mites. *Molecular Ecology*, 28(24), 5347–5395.  
<https://doi.org/10.1111/mec.15292>

Submitted: 22 Apr. 2022; accepted by Maka Murvanidze: 3 Jul. 2022; published: 22 Aug. 2022