

**ONTOGENETIC INSTARS OF *PHYLLHERMANNIA FALKLANDICA*
(ACARI, ORIBATIDA, HERMANNIIDAE)**

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ABSTRACT: The oribatid mite *Phyllhermannia falklandica* Balogh, 1988 is recorded for the first time in Chile, based on a collection from mosses (*Sphagnum* sp.) in a swamp in the vicinity of Punta Arenas. Adult and juvenile instars from this material are described and illustrated in detail, and an updated diagnosis of *Phyllhermannia* juveniles is proposed, after a comparison with ontogenetic data from other species.

KEY WORDS: oribatid mites, new record, *Phyllhermannia falklandica*, juveniles, ontogeny, morphology, supplementary description, generic diagnosis, moss, Chile

INTRODUCTION

The oribatid mite species *Phyllhermannia falklandica* (Acari, Oribatida, Hermanniidae) was described by Balogh (1988) based on two specimens (holotype and damaged paratype) from litter in the Falkland Islands. Since 1988, this species has been known only from the type locality. In the course of taxonomic studies of the oribatid mites of Chile, we found adults and all juvenile instars of *P. falklandica* in mosses in a swamp in the vicinity of Punta Arenas. This represents the first record of this species from Chile, as well as from mainland South America.

The original description (Balogh 1988) of *P. falklandica* is brief, incomplete (lacking information about measurements of morphological structures, leg setation and solenidia, morphology of gnathosoma), and based only of adults. The primary goal of our paper is to present a supplementary description of adults on the basis of the Chilean specimens, and to fully describe the developmental instars.

The morphology of juveniles in *Phyllhermannia* is known for only four species (data summarized by Norton and Ermilov 2014): *P. bandabanda* Colloff, 2011 (only tritonymph described; see Colloff 2011), *P. gladiata* Aoki, 1965 (only nymphal instars described; see Ermilov et al. 2012), *P. lemanna* Colloff, 2011 (all instars described; see Colloff 2011) and *P. sauli* Colloff 2011 (all instars described; see Colloff 2011). Our secondary goal is to compare the ontogenetic data for these species with those of *P. falklandica*, and from this to develop a new diagnosis for juveniles of the genus.

MATERIALS AND METHODS

Specimens (eight adults, four larvae, four proto-, three deuto- and six tritonymphs) of *P. falkland-*

ica were collected in Chile: vicinity of Punta Arenas, 53°38'02.8"S, 65°31'01.6"W, swamp, in *Sphagnum* sp., 18 November 2014 (V.A. Stolbov, L.V. Kuzmin, S.A. Ivanov, R.V. Latyntsev).

Adults and juveniles were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate (gastronotic region in juvenile instars). Notogastral width (gastronotic region in juvenile instars) refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (femulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus. General terminology used in this paper follows that of Norton and Behan-Pelletier (2009). Drawings were made with a drawing tube using a Carl Zeiss transmission light microscope “Axioskop-2 Plus”.

All studied specimens of *P. falklandica* are stored (ethanol) in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

REDESCRIPTION OF *PHYLLHERMANNIA FALKLANDICA* BALOGH, 1988

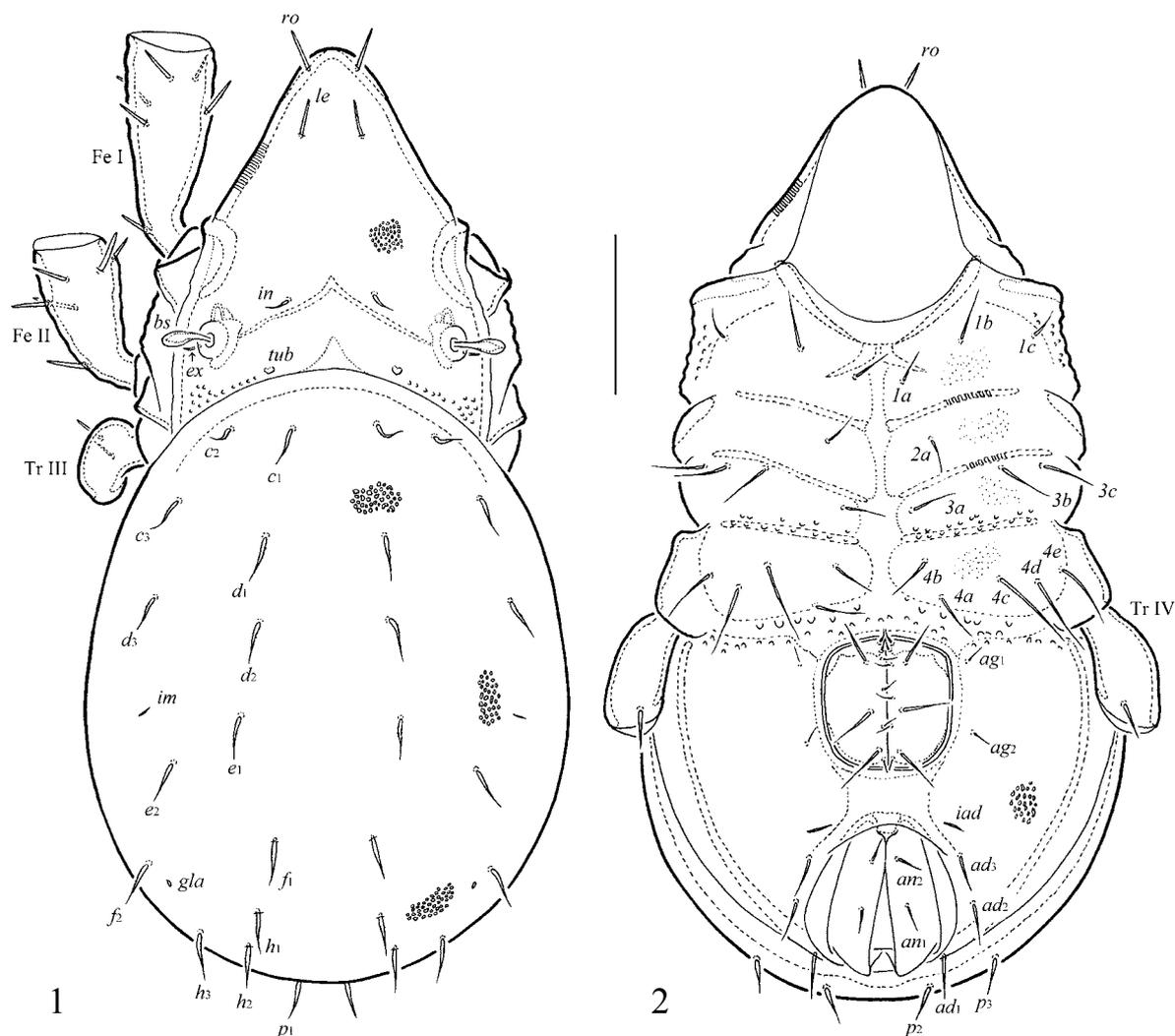
Adult

Figs 1–11

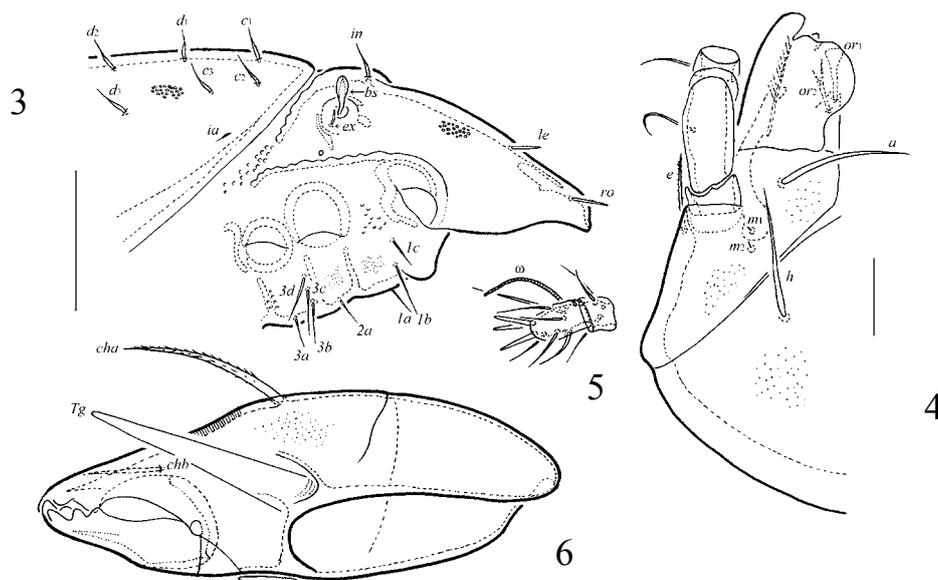
Measurements. Body length: 498–614 (n = 8); notogastral width: 232–298 (n = 8). Females (n = 5) larger than males (n = 3): 564–614 × 282–298 vs. 498–531 × 232–249.

Integument (Figs 1–4, 6, 7, 9–11). Body color light brown to dark brown. Dorsal and lateral parts of body, and anogenital region porose, covered by

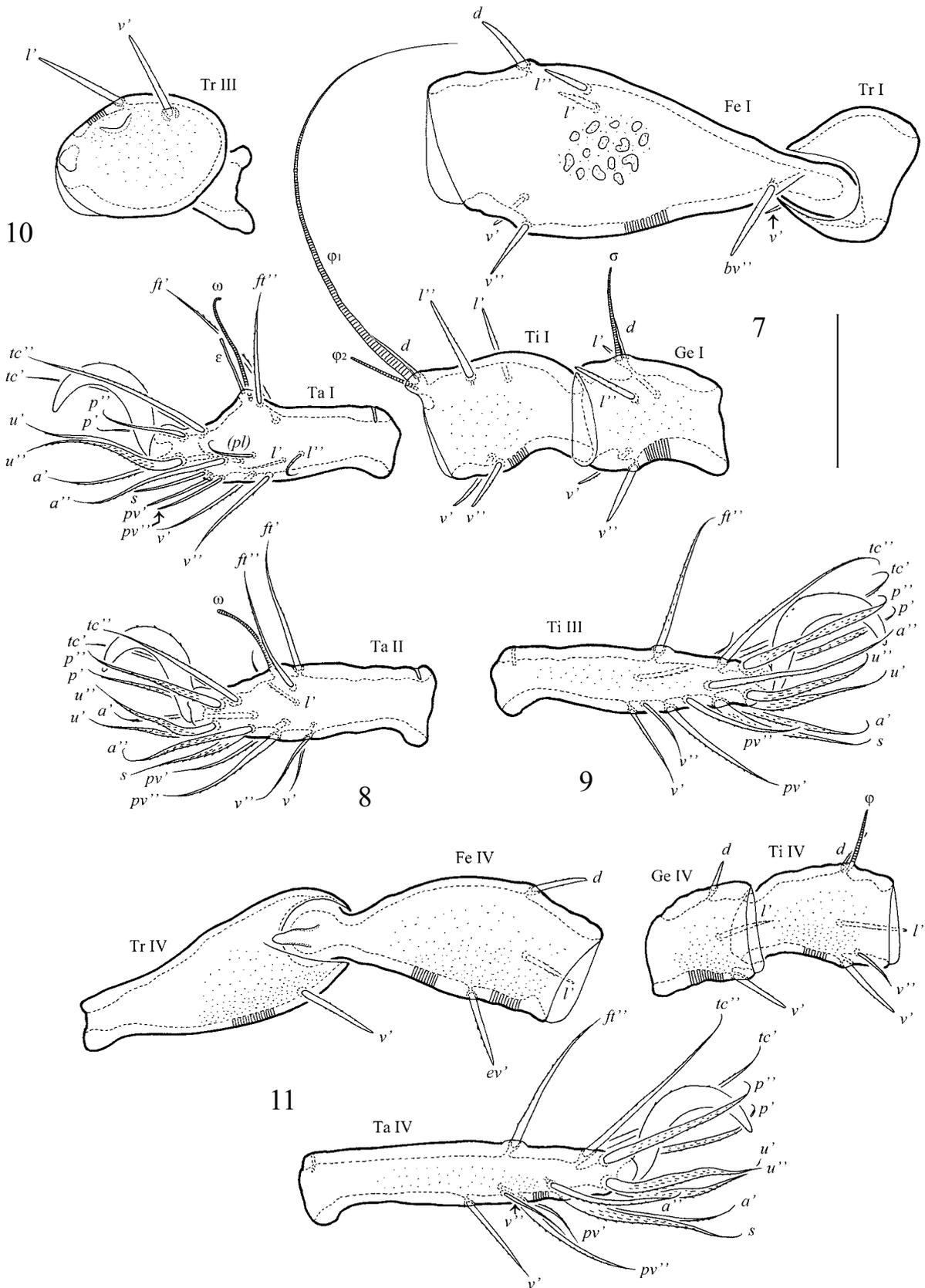
Ontogenetic instars of *Phyllhermannia falklandica*



Figs 1–2. *Phyllhermannia falklandica* Balogh, 1988, adult from Chile: 1 — dorsal view (legs except left trochanters I–III, left femora I, II, and right trochanter I not illustrated); 2 — ventral view (gnathosoma and legs except trochanters IV not illustrated). Scale bar 100 μ m.



Figs 3–6. *Phyllhermannia falklandica* Balogh, 1988, adult from Chile: 3 — lateral view of anterior part of body (legs I–III not illustrated); 4 — subcapitulum, right half, ventral view, and genu, femur and trochanter of right palp; 5 — tarsus and tibia of palp, left, ventro-antiaxial view; 6 — chelicera, right, paraxial view. Scale bars 100 μ m (3), 20 μ m (4–6).



Figs 7–11. *Phyllhermannia falklandica* Balogh, 1988, adult from Chile: 7 — leg I, left, antiaxial view, fragmented; 8 — tarsus of leg II, left, antiaxial view; 9 — tarsus of leg III, right, paraxial view; 10 — trochanter of leg III, left, antiaxial view; 11 — leg IV, right, paraxial view (trochanter slightly twisted), fragmented. Scale bar 50 μ m.

dense, granular (or tuberculate in latero-basal part of prodorsum and epimeral region) cerotegument (diameter of granules up to 4, tubercles up to 6). Gnathosoma, epimeral region and leg segments

Table 1.

Setal and solenidial counts on legs of *Phyllhermannia falklandica* Balogh, 1988 during ontogeny

	Formula of setae	Formula of solenidia
Leg I		
Larva	0-2-3-4-16	1-1-1
Protonymph	0-3-4-4-16	1-1-1
Deutonymph	1-6-5-5-16	1-2-1
Tritonymph	1-6-5-5-16	1-2-1
Adult	1-6-5-5-20	1-2-1
Leg II		
Larva	0-2-3-4-13	1-1-1
Protonymph	0-3-4-4-13	1-1-1
Deutonymph	1-6-5-5-13	1-1-1
Tritonymph	1-6-5-5-13	1-1-1
Adult	1-6-5-5-17 [16]	1-1-1
Leg III		
Larva	0-2-2-3-13	1-1-0
Protonymph	1-2-2-3-13	1-1-0
Deutonymph	2-2-2-3-13	1-1-0
Tritonymph	2-3-3-4-13	1-1-0
Adult	2-3-3-4-15	1-1-0
Leg IV		
Protonymph	0-0-1-0-7	0-0-0
Deutonymph	1-2-2-3-12	0-1-0
Tritonymph	1-3-3-4-12	0-1-0
Adult	1-3-3-4-14	0-1-0

also porose, but without cerotegument; leg femora with rounded, elongated or irregular foveolae.

Prodorsum (Figs 1, 3). Rostrum rounded. Lateral ridges on each side strong, distinctly visible in dorsal view. Interbothridial region with slightly developed, inverted V-shaped ridge and one pair tubercles (*tub*). Rostral (*ro*, 28–30) and lamellar (*le*, 22–24) setae slightly thickened, straight, indistinctly barbed. Rostral setae divergent, directed antero-laterally. Interlamellar setae (*in*, 24–28) broadened basally, slightly barbed, directed postero-laterally. Bothridial setae (*bs*, 41–49) with short stalk and slightly fusiform head, covered by cerotegumental scales. Exobothridial setae (*ex*, 10–12) slightly thickened, straight, smooth.

Notogaster (Figs 1–3). Anterior margin convex, rounded, smooth. Sixteen notogastral setae similar in length (24–28), broadened basally, slightly barbed. Lyrifissures distinct, *im* located lateral to setae *e*₁. Opisthonotal gland openings (*gla*) small, located posteromedial to setae *f*₂.

Gnathosoma (Figs 4–6). Subcapitulum little longer than wide: 123–131 × 110–118. Subcapitu-

lar setae *a* and *h* similar in length (32–36), setiform, smooth; *m*₁ and *m*₂ (often absent) minute (2); *e* (20) straight, barbed. Two pairs of adoral setae (16–20) present (*or*₃ absent): *or*₁ expanded distally, truncate; *or*₂ bifurcate. Palps (65–73) with setation 0-1-1-3-9(+ω); solenidia longer than palptarsi, thickened, blunt-ended. Chelicerae (131–139) with two setiform setae; *cha* (45–53) barbed, *chb* (20–24) smooth; Trägårdh's organ (*Tg*) long, tapered.

Epimeral and lateral podosomal regions (Figs 2, 3). Epimeres well bordered. Setal formula: 3-1-4[3]-5. All setae straight, smooth; *1a*, *1c*, *2a*, *3a*, *4a*, *4b* (24–28) shorter than *1b*, *3b*, *3c*, *3d* (sometimes absent), *4c*, *4d*, *4e* (41–49).

Anogenital region (Figs 2, 3). Six pairs of medial genital setae (10–12) thin, smooth; three pairs of lateral genital setae (24–28) straight, smooth. Two pairs of aggenital (*ag*₁, *ag*₂, 16), two pairs of anal (*an*₁, *an*₂, 12–16) and three pairs of adanal (*ad*₁–*ad*₃, 24–32) setae straight, smooth. Adanal lyrifissures (*iad*) located antero-laterally to genital plates. Ovipositor, elongated (102 × 73), lobes

Table 2.
Development of leg setation of *Phyllhermannia falklandica* Balogh, 1988

	Trochanter	Femur	Genu	Tibia	Tarsus
Leg I					
Larva	–	d, bv''	$(l), d\sigma$	$(l), v', d\phi_1$	$(ft), (tc), (p), (u), (a), s, (pv), (pl), \varepsilon, \omega_1, \omega_2$
Protonymph	–	v''	v''	–	–
Deutonymph	v'	$v', (l)$	v'	v'', ϕ_2	–
Tritonymph	–	–	–	–	–
Adult	–	–	–	–	$(l), (v)$
Leg II					
Larva	–	d, bv''	$(l), d\sigma$	$(l), v', d\phi$	$(ft), (tc), (p), (u), (a), s, (pv), \omega$
Protonymph	–	v''	v''	–	–
Deutonymph	v'	$v', (l)$	v'	v''	–
Tritonymph	–	–	–	–	–
Adult	–	–	–	–	$(l), (v)$
Leg III					
Larva	–	d, ev'	$l', d\sigma$	$l', v', d\phi$	$(ft), (tc), (p), (u), (a), s, (pv)$
Protonymph	v'	–	–	–	–
Deutonymph	l'	–	–	–	–
Tritonymph	–	l'	v'	v''	–
Adult	–	–	–	–	(v)
Leg IV					
Protonymph	–	–	l'	–	$ft'', (p), (u), (pv)$
Deutonymph	v'	d, ev'	d	$l', v', d\phi$	$(tc), (a), s$
Tritonymph	–	l'	v'	v''	–
Adult	–	–	–	–	(v)

Roman letters refer to normal setae, Greek letters refer to solenidia (except ε — famulus), $d\phi$ and $d\sigma$ — seta and solenidion coupled. One apostrophe (') marks setae on anterior and double apostrophe (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae. Setae are listed only for the stage in which they first appear.

(41) shorter than length of distal section (beyond middle fold; 61). All setae strong, straight, smooth, $\psi_1 \approx \tau_1$ (36) longer than $\psi_2 \approx \tau_a \approx \tau_b \approx \tau_c$ (12–16) and six coronal setae (k , 12–16).

Legs (Figs 7–11). Claw of each leg slightly serrate dorsally. Ventro-paraxial region of femora and trochanters III and IV with porose areas. Setal formulas and homology of setae and solenidia indicated in Tables 1 and 2. Famulus ε on tarsi I short, straight, dilated distally, blunt-ended. Setae p and u ribbon-shaped medio-basally (except p simple on tarsi I). Setae d on tibiae and genua I–III short, straight, coupled to longer solenidia. Solenidion ϕ_1 on tibiae I longer than tarsi I, setiform; other solenidia short, thickened, blunt-ended, solenidion ω on tarsi II slightly dilated distally.

Remarks. *Phyllhermannia falklandica* differs from all other species of this genus by the following combination characters: body covered by dense, granular cerotegument; rostral setae divergent; interlamellar and notogastral setae basally

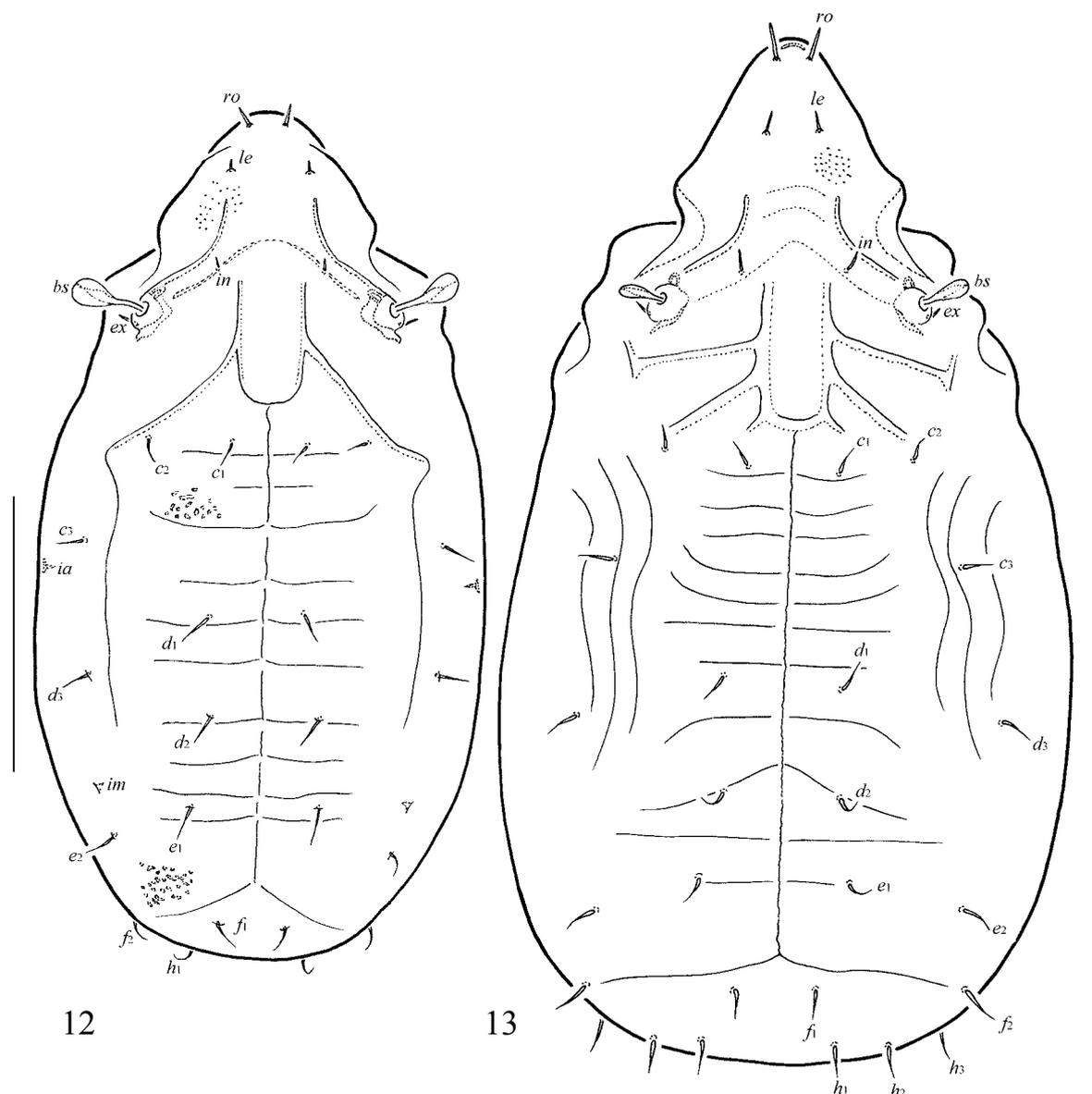
broadened and slightly barbed; bothridial setae comparatively short, fusiform; epimeral setal formula: 3–1–4[3]–5.

The specimens of *P. falklandica* from Chile are morphologically very similar to those from the Falkland Islands (Balogh 1988). Only two small differences are noted: (1) specimens from Chile are smaller ($498\text{--}614 \times 232\text{--}298$ vs. 623×340) and (2) they have longer interlamellar setae (similar in length to notogastral setae vs. shorter than notogastral setae). We believe these differences represent intraspecific (perhaps geographical) variability, therefore, these data should be considered in any future identification of adult *P. falklandica*.

Juvenile instars

Figs 12–25

Measurements. Total length of larva 282–315 (n=4), protonymph 365–398 (n=4), deutonymph 431–464 (n=3), tritonymph 298–614 (n=6). Total



Figs 12–13. *Phyllhermannia falklandica* Balogh, 1988, juveniles from Chile: 12 — dorsal view of larva (legs not illustrated); 13 — dorsal view of tritonymph (legs not illustrated). Scale bars 100 μ m (12), 200 μ m (13).

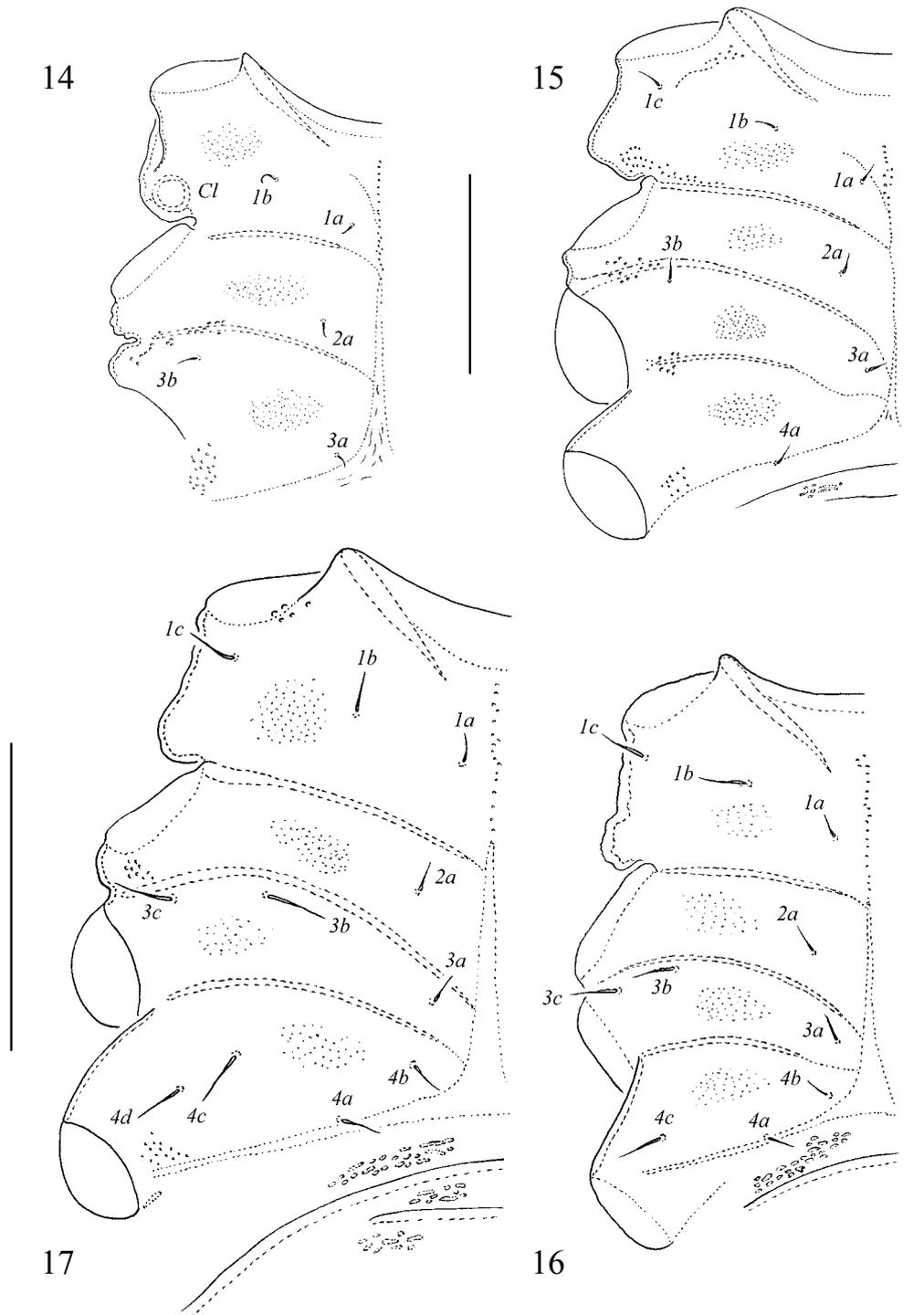
width of larva 149–166 (n=4), protonymph 182–199 (n=4), deutonymph 232–249 (n=3), tritonymph 265–315 (n=6).

Integument (Figs 12–25). Body cuticle light brownish (larval and protonymphal instars) to brown (deuto- and tritonymphal instars), covered by dense, granular cerotegument; granules rounded, elongated or forming large irregular patches. Basal part of prodorsum with distinct U-shaped structure, consisting of folds. Gastronotic and anogenital regions folded, epimeral region porose. Leg segments with slightly developed, rounded, elongated or irregular foveolae.

Prodorsum (Figs 12, 13). Triangular, about 1/2 length of gastronotic region. Rostrum round-

ed. Rostral and lamellar setae (and interlamellar setae in larva) straight, indistinctly barbed. Rostral setae divergent. Interlamellar setae in nymphs slightly broadened basally, indistinctly barbed. Bothridial setae short, fusiform. Exobothridial setae slightly thickened, straight, smooth. Relative length of prodorsal setae: $bs > ro \approx in > le \approx ex$. Setae lengths during ontogeny presented in Table 3.

Gastronotic region (Figs 12, 13, 18–21). Imperceptibly merged with prodorsum: anterior margin not distinguishable. Posterior part rounded. Larva with 13 pairs of setae, all (except vestigial h_3) setiform, indistinctly barbed. Nymphs with 16 pairs of setae, all slightly broadened basally,



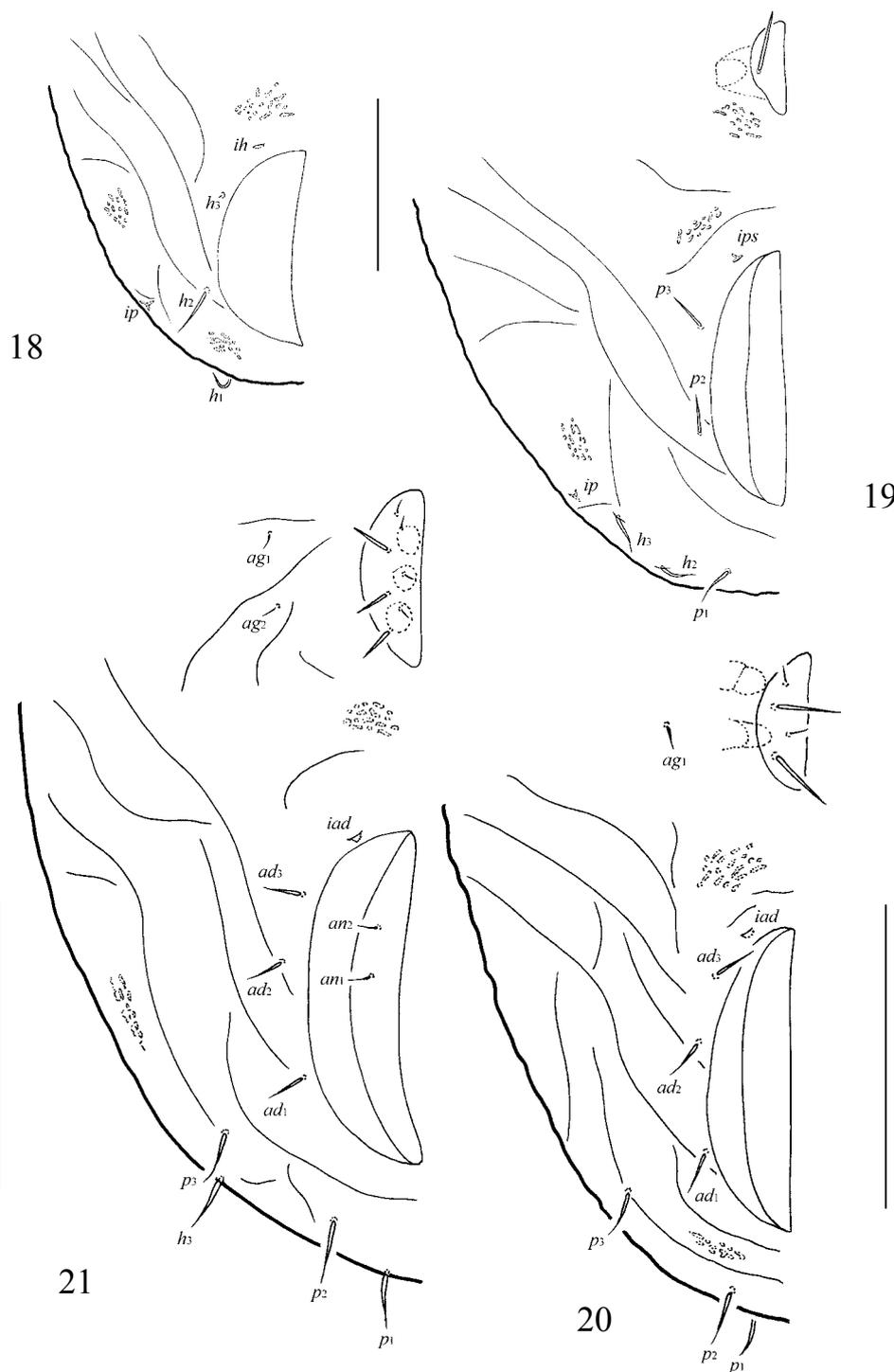
Figs 14–17. *Phyllhermannia falklandica* Balogh, 1988, right half of epimeral regions of juveniles from Chile: 14 — larva; 15 — protonymph; 16 — deutonymph; 17 — tritonymph. Scale bars 50 μ m (14–16), 100 μ m (17).

barbed. Cupules *ia*, *im*, *ip* and opisthonotal gland openings present, but often visible only in dissected specimens. Setae lengths during ontogeny presented in Table 3.

Gnathosoma. Generally, typical to adult. Subcapitulum little longer than wide. Subcapitular setae *a* and *h* of medium size, setiform, smooth; *m*₁ (*m*₂ often absent, if present – added in deutonymph)

minute; *e* straight, barbed. Two pairs of adoral setae in all instars: *or*₁ expanded distally, truncate; *or*₂ bifurcate. Palps with setation 0–1–1–3–9(+ ω). Chelicerae with two setiform setae; *cha* barbed, longer than smooth *chb*. Trägårdh's organ long, tapered.

Epimeral region (Figs 14–17). Setal formulas for epimeres: larva 3–1–2 (third seta of first epimere forms protective scale over respective



Figs 18–21. *Phyllhermannia falklandica* Balogh, 1988, right half of anogenital regions of juveniles from Chile: 18 — larva; 19 — protonymph; 20 — deutonymph; 21 — tritonymph. Scale bars 50 μ m (19, 20), 100 μ m (21, 22).

Claparède's organ (*Cl*); protonymph 3–1–2–1; deutonymph 3–1–3–3, tritonymph 3–1–3–4. Epimeral setae setiform, thin, smooth. Setae lengths during ontogeny presented in Table 3.

Anogenital region (Figs 18–21). Ontogeny of genital, aggenital, adanal, anal setal formulas, larva to tritonymph, 0–1–4–7, 0–0–1–2, 0–0–3–3, 0–0–0–2, respectively. All setae setiform, smooth.

Cupules *ih*, *ips*, *iad* appearing in normal ontogenetic pattern; becoming less conspicuous when shifted away from anal aperture. Setae lengths during ontogeny are presented in Table 3.

Legs (Figs 22–25). Generally, similar to adult. Single claw of each leg serrate dorsally. Formulas and homology of leg setae and solenidia indicated in Tables 1 and 2.

Table 4.

Morphological differences of known larvae of *Phyllhermannia* species

Character	<i>P. falklandica</i>	<i>P. lemanna</i>	<i>P. sauli</i>
Direction of <i>ro</i>	Antero-laterally	Antero-medially	Antero-laterally
Morphology of <i>le</i>	Setiform	Phylliform	Thickened
Morphology of <i>in</i>	Setiform	Phylliform	Thickened
Morphology of <i>bs</i>	Short, fusiform, smooth	Long, thickened, smooth	Long, thickened, barbed
Morphology of dorsal notogastral setae	Setiform	Phylliform	Phylliform
Number of notogastral setae	13 (h_3 present)	12 (h_3 absent)	12 (h_3 absent)

Data for *P. lemanna* and *P. sauli* from Colloff (2011).

Table 5.

Morphological differences of known nymphs of *Phyllhermannia* species

Character	<i>P. bandabanda</i>	<i>P. falklandica</i>	<i>P. gladiata</i>	<i>P. lemanna</i>	<i>P. sauli</i>
Direction of <i>ro</i>	Antero-medially	Antero-laterally	Antero-medially	Antero-laterally	Antero-laterally
Morphology of <i>le</i>	Setiform	Setiform	Thickened	Phylliform	Thickened
Morphology of <i>in</i>	Phylliform	Slightly broadened basally	Phylliform	Phylliform	Phylliform
Morphology of <i>bs</i>	Long, setiform, smooth	Short, fusiform, smooth	Long, thickened, smooth	Long, thickened, smooth	Long, thickened, barbed
Morphology of dorsal notogastral setae	Phylliform	Slightly broadened basally	Phylliform	Phylliform	Phylliform
Position of c_3	Posteromedial to c_2	Posterolateral to c_2	Posterolateral to c_2	Posterolateral to c_2	Posterolateral to c_2
Epimeral formula of tritonymph	3-1-2-4	3-1-3-4	3-1-4-5	3-1-3-5	3-1-3-4
Formula of leg IV in protonymph	Data absent	0-0-1-0-7	0-0-1-1-9	Data absent	Data absent

Data for *P. bandabanda*, *P. lemanna* and *P. sauli* from Colloff (2011), data for *P. gladiata* from Ermilov et al. (2012). Data for *P. bandabanda* based only on tritonymph.

Remarks. Juvenile instars of *Phyllhermannia falklandica* can be well distinguishable from those *P. bandabanda*, *P. gladiata*, *P. lemanna* and *P. sauli* (see Colloff 2011; Ermilov et al. 2012) by the short, fusiform bothridial setae (vs. long, setiform or thickened in the other species) and basally broadened notogastral setae (vs. setiform or phylliform in the other species).

Larvae of known *Phyllhermannia* species can be distinguished from each other by the direction of rostral setae, morphology of prodorsal and notogastral setae and number of notogastral setae (see Table 4). Nymphs can be distinguished from each other by the direction of rostral setae, morphology of prodorsal and notogastral setae, position of notogastral setae c_3 , epimeral formula in tritonymph and setal formula of leg IV in protonymph (see Table 5).

DIAGNOSIS OF JUVENILE INSTARS OF THE GENUS *PHYLLHERMANNIA*

(Updated from Ermilov et al. 2012)

Basal region of prodorsum with one pair parallel folds, usually connected posteriorly by transverse fold, forming U-shaped structure. Cuticle of gastronomic and anogenital regions with long, well-separated folds. Longitudinal cleavage line in centrodorsal part of notogaster distinct. Exobothridial setae short, inserted near bothridia. Larva with 12 or 13 pairs of notogastral setae. Gastronomic setae c_3 inserted posterolateral to level of setae c_1 and c_2 ; setae d_2 inserted posterior to d_1 . Palp femora with one seta. Genital formula: 0-1-4-6[7]. Leg tarsi I and II with one solenidion. Legs IV of protonymph with various setations: tibiae and/or genua with seta(e), tarsi with 7 or more number of setae.

ACKNOWLEDGEMENTS

We cordially thank Prof. Dr. Roy A. Norton (State University of New York, Syracuse, U.S.A.) for the valuable comments, Dr. V.A. Stolbov, I.V. Kuzmin, S.A. Ivanov and R.V. Latyntcev (Tyumen State University, Tyumen, Russia) for collecting mites in Chile. The present study was supported by the Russian Science Foundation (project 14-14-01134).

REFERENCES

Balogh, P. 1988. Some oribatid mites (Acari) from the Falkland Islands. *Opuscula Zoologica Budapest*, 23: 11–116.

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: 1–60.

Ermilov, S.G., Ryabinin, N.A. and Anichkin, A.E. 2012. Morphology of juvenile instars of two oribatid mite species of the family Hermanniidae (Acari, Oribatida). *Zoologichesky Zhurnal*, 91 (6): 657–668. [in Russian; English version: *Entomological Review*, 92 (7): 815–826]

Norton, R.A. and Behan-Pelletier, V.M. 2009. Oribatida. Chapter 15. *In*: G.W. Krantz and D.E. Walter (eds.). *A Manual of Acarology*. Texas Tech University Press, Lubbock: 430–564.

Norton, R.A. and Ermilov, S.G. 2014. Catalogue and historical overview of juvenile instars of oribatid mites (Acari: Oribatida). *Zootaxa*, 3833: 1–132.