

## A new species of *Lohmannia* from the Maldives

(Acari, Oribatida, Lohmanniidae)

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The oribatid mite family Lohmanniidae is recorded for the first time in the Maldives. A new species of the genus *Lohmannia* is described from soil-litter of the Maafushi Island, based on the adult and tritonymphal instar. *Lohmannia maldivesensis* sp. nov. differs from *Lohmannia embrionalis* by the larger body size and number of long branches on bothridial seta, and more widened phylliform epimeral setae and subcapitular setae  $m_2, h$ . An identification key to known tritonymphs of *Lohmannia* is provided.

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### Introduction

The main goal of our paper is to describe and illustrate one new species of oribatid mites of *Lohmannia* Michael, 1898 (Acari, Oribatida, Lohmanniidae) based on adults and tritonymphs collected from Maldives. Earlier, no lohmanniids species have been registered in this country.

*Lohmannia* was proposed by Michael (1898) with *Michaelia paradoxa* Haller, 1884 as type species. At present, the genus comprises 31 species and one subspecies belonging to two subgenera (*L. (Lohmannia)* Michael, 1898: 29 species and one subspecies; *L. (Carolohmannia)* Norton, Metz & Sharma, 1978: two species), which are distributed collectively in the tropics and subtropics (Subías 2004, online version 2021). The main generic/subgeneric traits were summarized by Balogh (1961), Grandjean (1950), Norton et al. (1978). The identification keys to adults of selective species of *Lohmannia* were presented by Balogh (1961), Balogh & Balogh (2002), Iglesias & Palacios-Vargas (2017), Ermilov & Liao (2018). Data on the morphology (completely or partially) of juvenile instars of *Lohmannia* are known for 10

identified species (Norton & Ermilov 2014, Ermilov 2017, Ermilov et al. 2017), and a comparative morphological analysis for some of these species was provided by Ermilov et al. (2014). The known larvae of *Lohmannia* are morphologically very similar (Norton et al. 1978, Schatz 1993, Ermilov et al. 2014), but nymphs (especially tritonymphal instar) are more clearly distinguished, therefore, the additional goal of our paper is to present an identification key to known tritonymphs of *Lohmannia*.

### Methods

**Observation and documentation.** Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body length was measured in dorsal view, from the tip of the rostrum to the posterior edge of the notogaster. Notogastral width refers to the maximum width of the notogaster in dorsal view. Lengths of body setae were measured in lateral view. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-

genu-tibia-tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus. Drawings were made with a camera lucida using a Leica transmission light microscope "Leica DM 2500".

**Terminology.** Morphological terminology used in this paper mostly follows that of Grandjean (e.g. 1933, 1950).

**Abbreviations.** Prodorsum: *ro, le, in, bs, exa, exp* = rostral, lamellar, interlamellar, bothridial, anterior exobothridial, and posterior exobothridial seta, respectively;  $S_6$  = prodorsal postbothridial band. Notogaster: *c, d, e, f, h, p* = setae; *S* = band; *ia, im, ip, ih, ips* = lyrifissures;  $S_{var}, S_{vp}$  = anterior and posterior ventral band, respectively. Gnathosoma: *a, m, h* = subcapitular setae; *or* = adoral seta; *inf, d, l, cm, acm, ul, su, vt, lt* = palp setae;  $\omega$  = palp solenidion; *cha, chb* = cheliceral setae. Epimeral and lateral podosomal regions: *1a-1c, 2a, 3a-3c, 4a-4d* = epimeral setae. Anogenital region: *g, an, ad* = genital, aggenital and adanal seta, respectively. Legs: *Tr, Fe, Ge, Ti, Ta* = trochanter, femur, genu, tibia, and tarsus, respectively;  $\omega, \varphi, \sigma$  = solenidia;  $\varepsilon$  = famulus; *d, l, v, bv, ev, ft, tc, it, p, u, a, s, pv, xt* = setae.

## Taxonomy

Family Lohmanniidae

Genus *Lohmannia* Michael, 1898

Type species: *Michaelia paradoxa* Haller, 1884

*Lohmannia (Lohmannia) maldivesensis* sp. nov.

Figs 1-3

**Diagnosis.** Adult and tritonymphal instar. Body length: 1211-1277 (adult), 1145-1162 (tritonymphs). Prodorsum and notogaster with reticulate (macropolygonal) ornamentation. Rostral and lamellar setae widely phylliform mediobasally, with elongate triangular tip; interlamellar and anterior exobothridial setae narrowly phylliform; posterior exobothridial seta widely phylliform, rounded distally; bothridial seta pectinate, with about nine branches. All notogastral setae narrowly phylliform;  $c_1, c_2, d_1, d_2, e_1, e_2, f_1, h_1$  shorter than others. Dorsal transverse notogastral bands present ( $S_2-S_6$  in adult,  $S_2-S_3$  in tritonymph);  $S_2$  complete, others interrupted medially. Subcapitular seta *a* setiform,  $m_1$  narrowly phylliform,  $m_2$  and *h* widely phylliform, rounded distally. All epimeral setae widely phylliform, rounded distally. Genital setae setiform (four pairs in adult, two pairs in tritonymph) and slightly phylliform (six pairs in adult and six pairs in tritonymph). Anal and adanal setae narrowly phylliform. Many leg setae widely phylliform.

## Adult

Figs 1, 2

## Description

**Measurements.** Very large species. Body length: 1277 (holotype), 1211, 1245 (two paratypes); notogaster width: 555 (holotype), 514, 547 (two paratypes).

**Integument.** Body colour yellow-brownish. Body surface (including subcapitulum mentum, genae, palps, genital, anal and adanal plates) and legs with dense microfoveolae forming mostly micropolygonal ornamentation. Also, prodorsum and notogaster with slight tubercles forming distinct reticulate (macropolygonal) pattern.

**Prodorsum.** Roughly triangular in dorsal view, occupying about 2/3 of dorsal length. Rostrum and lateral side of prodorsum undulate. Rostral (188-200) and lamellar (131-143) setae widely phylliform mediobasally, with elongate triangular tip, barbed. Interlamellar (131-143) and anterior exobothridial (123-131) setae narrowly phylliform, barbed; *exa* specifically bent anteromedially. Posterior exobothridial seta (69-77) widely phylliform, rounded distally, barbed. Bothridial seta (123-135) pectinate, with about nine branches on one side and several short barbs on opposite side. Lateral tubercle of prodorsum (anterolateral to *exa*) slightly developed. Postbothridial band present, interrupted behind bothridium.

**Notogaster.** Sixteen pairs of notogastral setae ( $c_1, c_2, d_1, d_2, e_1, e_2, f_1, h_1$ : 82-90; others: 151-164) narrowly phylliform, barbed. Five transverse bands (others not visible) present dorsally;  $S_2$  complete,  $S_3-S_6$  interrupted medially. Lyrifissures *ia, im, ih*, and *ip* distinct, *ips* not observed. Two pairs of ventral bands present ventrally.

**Gnathosoma.** Subcapitulum size: 302-306 × 233-237. Subcapitular seta *a* (65-73) setiform, smooth;  $m_1$  (69-77) narrowly phylliform, barbed;  $m_2$  and *h* widely phylliform, rounded distally, barbed. Adoral seta  $or_1$  (57-61) lobe-shaped, slightly roughened distally;  $or_2$  (65-69) thick, blunt-ended, with one small barb in distal part;  $or_3$  (53-57) thickened, with attenuate tip, smooth. Palp length: 131-147. Palp setation: 0-1-0-3-10 (+ $\omega$ ); three distal setae of tarsus connected basally. Postpalpal seta (20-22) thorn-like, smooth. Chelicera size: 314-318. Cheliceral seta *cha* (8) needleform, smooth; *chb* (73-77) setiform, barbed.

**Epimeral and lateral podosomal regions.** Epimeral setal formula: 3-1-3-4. All setae widely phylliform, rounded distally, barbed.

**Anogenital region.** Genital setae  $g_{1r}, g_{4r}, g_{6r}, g_{8r}$  (45-57) setiform, barbed;  $g_{2r}, g_{3r}, g_{5r}, g_{9r}$  (41-53),  $g_7$  (53-61),  $g_{10}$  (73-82) slightly phylliform, barbed. Transverse

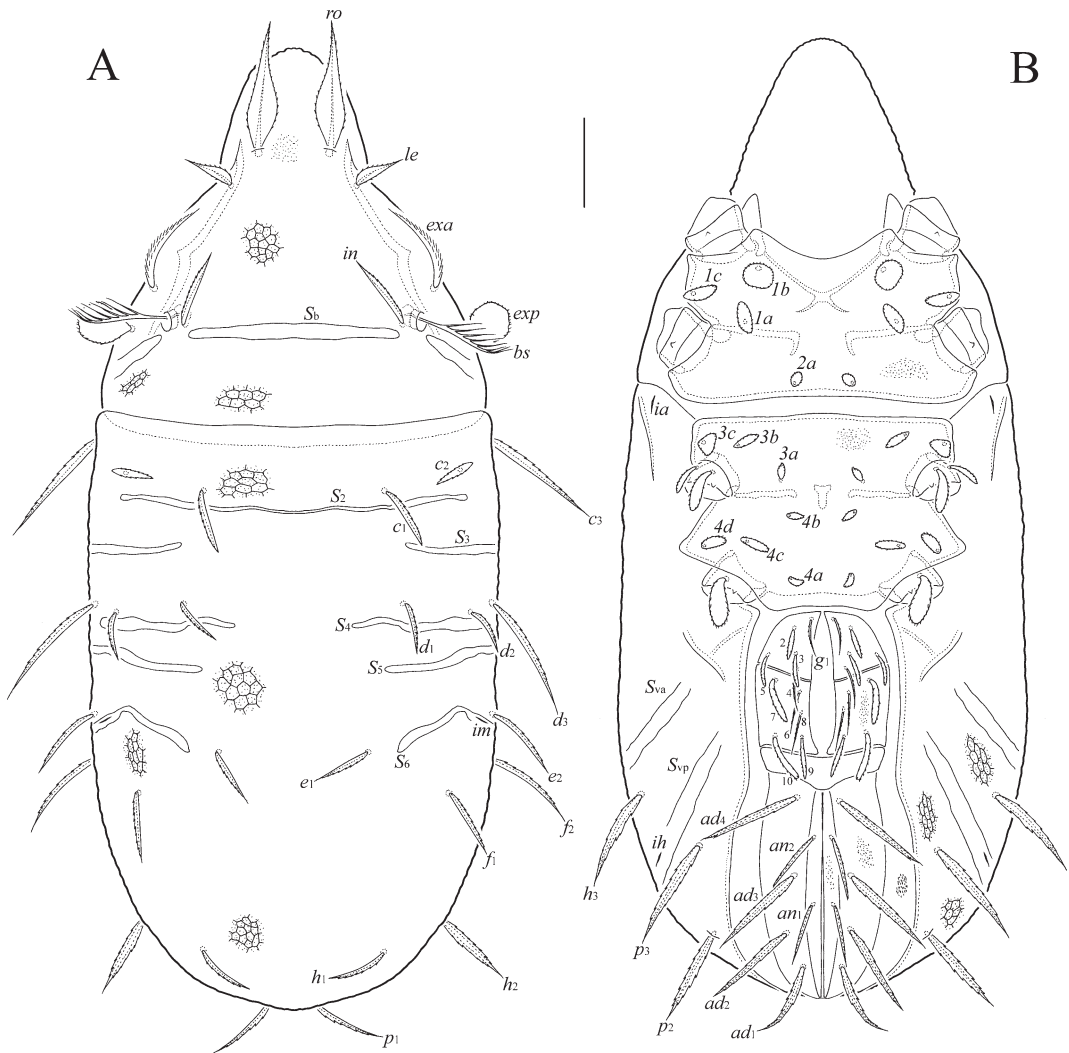


Fig 1. *Lohmannia maldivesensis* sp. nov., adult: A. Dorsal view; B. ventral view (not shown: gnathosoma and legs). Scale bar 100  $\mu$ m.

furrow of genital plate distinct. Anal (82–94) and adanal (123–143) setae narrowly phylliform, barbed. Lyrifissures *ian* and *iad* not observed.

Legs. Claw of each leg smooth; claw I with tooth proximoventrally. Femora III and IV with keel-like ventral side forming triangular process proximoventrally. Formulas of leg setation and solenidia: leg I (0-5-3-5-17) [2-1-2], leg II (0-6-3-5-13) [1-1-1], leg III (2-3-2-3-12) [1-1-0], leg IV (2-3-2-2-11) [1-0-0]; homology of setae and solenidia indicated in Table 1. Solenidia  $\omega_1$  on tarsus I,  $\omega$  on tarsus II and  $\varphi$  on tibia III bacilliform; other solenidia setiform. Solenidion

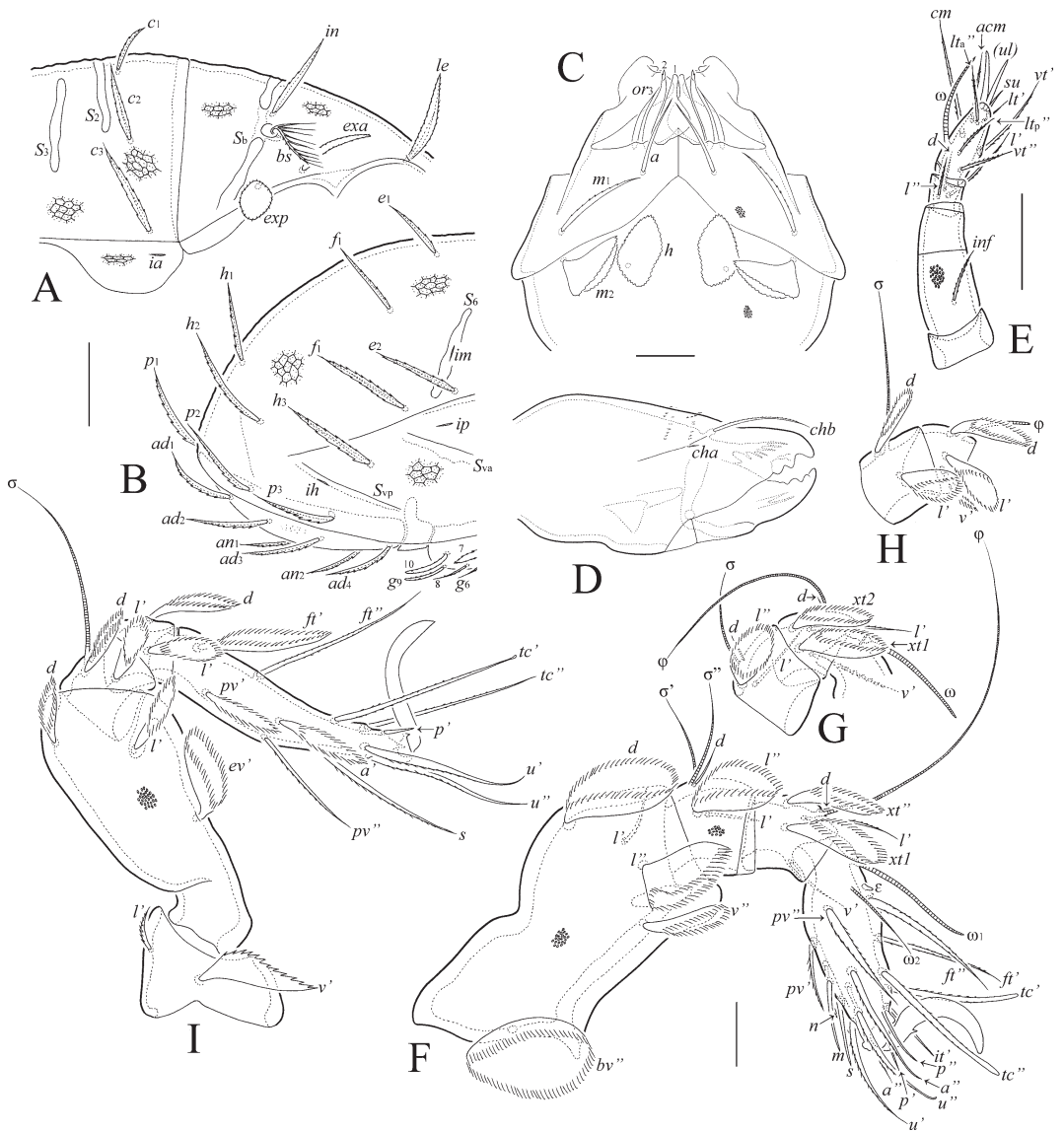
$\omega_2$  on tarsus I free, not coupled with seta. Famulus tubercle-like, inserted posterior or posterolateral to seta *ft*". Many leg setae widely phylliform.

### Tritonymph

Fig. 3

### Description

Measurements. Body length: 1145–1162 (three tritonymphs); gastronomy width: 464–514 (three tritonymphs).



**Fig. 2.** *Lohmannia maldivesensis* sp. nov., adult: **A.** Basal part of prodorsum and anterior part of notogaster, right lateral view; **B.** posterior part of body, right lateral view; **C.** subcapitulum (not shown: basal part), ventral view; **D.** chelicera (not shown: basal part), right, antiaxial view; **E.** palp, right, antiaxial view; **F.** leg I (not shown: trochanter), right, antiaxial view; **G.** genu, tibia and basal part of tibia of leg II, right, antiaxial view; **H.** genu and tibia of tibia of leg III, left, antiaxial view; **I.** leg IV, left, antiaxial view. Scale bar 100  $\mu$ m (**A**, **B**), 50  $\mu$ m (**C**-**I**).

**Integument.** Body colour light grey. Surface similar to adult, but anterior part of notogaster densely transversely striate.

**Prodorsum.** Similar to adult, but setae shorter: *ro*: 155-164; *le*: 114-123; *in*: 114-123; *exa*: 114-123; *exp*: 57-65; *bs*: 114-123.

**Notogaster.** Similar to adult, but setae shorter:

*c*<sub>1</sub>, *c*<sub>2</sub>, *d*<sub>1</sub>, *d*<sub>2</sub>, *e*<sub>1</sub>, *e*<sub>2</sub>, *f*<sub>1</sub>, *h*<sub>1</sub> 65-73; others: 135-143. Also, eight (instead five) transverse bands present dorsally; *S*<sub>7</sub>-*S*<sub>8</sub> added, all interrupted medially; lyrifiss ure *ips* distinct.

**Gnathosoma.** Similar to adult, but sizes of subcapitulum, palp, chelicera, and all setae smaller: subcapitulum size: 213-225  $\times$  180-188; *a*: 53-61;

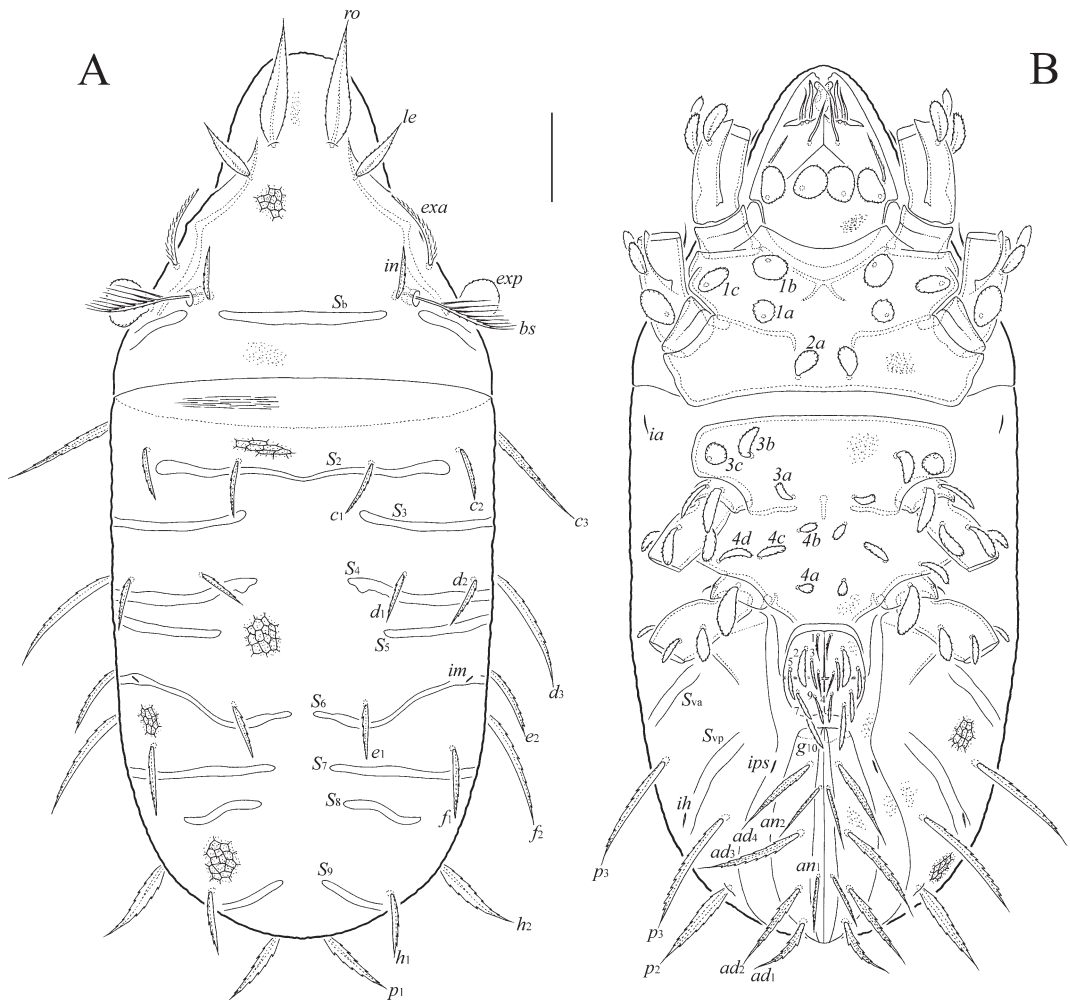


Fig. 3. *Lohmannia maldivesensis* sp. nov., tritonymph: A. Dorsal view; B. ventral view (not shown: legs except basal parts). Scale bar 100  $\mu$ m.

$m_1$ : 61–69;  $or_1$ : 45–49;  $or_2$ : 49–53;  $or_3$ : 41–45; palp length: 123–131;  $ep$ : 16; chelicera length: 258–270;  $cha$ : 6;  $chb$ : 61–65.

Epimeral and lateral podosomal regions. Similar to adult.

**Table 1.** Leg setation and solenidia of adult and tritonymph *Lohmannia maldivesensis* sp. nov. Roman letters refer to normal setae, Greek letters to solenidia (except  $\epsilon$  = famulus); single quotation mark (') designates setae on the anterior and double quotation mark (") setae on the posterior side of a given leg segment; parentheses refer to a pair of setae.

Leg	Tr	Fe	Ge	Ti	Ta
I	-	$d, (l), bv'', v''$	$d, (l), \sigma'', \sigma'$	$d, xt_1, xt_2, l', v', \varphi$	$(ft), it', (tc), (p), (u), (a), s, m, n, (pv), \epsilon, \omega_1, \omega_2$
II	-	$d, l', la'', lp'', bv'', v''$	$d, (l), \sigma$	$d, xt_1, xt_2, l', v', \varphi$	$(ft), (tc), (p), (u), (a), s, (pv), \omega$
III	$l', v'$	$d, l', ev'$	$d, l', \sigma$	$d, l', v', \varphi$	$(ft), (tc), (p), (u), a', s, (pv)$
IV	$l', v'$	$d, l', ev'$	$d, l', \sigma$	$d, l'$	$(ft), (tc), p', (u), a', s, (pv)$

Anogenital region. Similar to adult, but genital plate with eight setae and setae shorter:  $g_{10}$ : 53–61; other genital setae: 36–41;  $an_1$ ,  $an_2$ : 73–82;  $ad_1$ – $ad_4$ : 114–127.

Legs. Similar to adult.

**Material examined.** Holotype and two female paratypes: Maldives, Maafushi Island, 3°56'40.5" N 73°29'35.2" E, soil-litter samples under the Indian Almond Tree near the coast, 25.XII.2021 (leg O. Joharchi). Three tritonymphs: the same data as for the holotype and paratypes.

**Type deposition.** The holotype is deposited in the collection of the Senckenberg Museum of Natural History, Görlitz, Germany; two paratypes and three tritonymphs are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in ethanol with a drop of glycerol.

**Etymology.** The species name *maldivesensis* refers to the place of origin, Maldives.

**Remarks.** In having reticulate (polygonal) ornamentation on prodorsum and notogaster, widely phylliform posterior exobothridial seta and all epimeral setae, and medium-sized and long, narrowly phylliform notogastral setae, *Lohmannia maldivesensis* sp. nov. is most similar to *Lohmannia embrionalis* Mahunka, 1978 from Reunion Island (Afrotropical region). However, the new species can be distinguished from the later by the larger body size (1211–1277 × 514–555 versus 820–1104 × 348–486), the number of long branches on bothridial seta (about nine versus four to five), and the morphology of epimeral setae and subcapitular setae  $m_2$ ,  $h$  (widely phylliform versus distinctly narrower phylliform).

#### Key to known tritonymphs of *Lohmannia*

At present, the tritonymphal instar is known in details for 10 identified species of *Lohmannia*: *L. banksi* Norton, Metz & Sharma, 1978 (see Norton et al. 1978), *L. jornoti* Mahunka, 1985 (see Schatz 1993), *L. lerellana* Ermilov, Hugo-Coetzee & Khaustov, 2017 (see Ermilov et al. 2017), *L. maldivesensis* sp. nov. (see data of this paper), *L. paradoxa* (Haller, 1884) (see Ermilov et al. 2014), *L. pseudoturcmenica* Ermilov, 2017 (see Ermilov 2017), *L. similis* Balogh, 1962 (see Schatz 1993), *L. turcmenica* Bulanova-Zachvatkina, 1960 (see Ermilov et al. 2014), *L. vulcania* Schatz, 1993 (see Schatz 1993), and *L. (Carolohmannia) carolensis* Norton, Metz & Sharma, 1978 (see Norton et al. 1978). Nymphal instars in the same species are generally

similar within Lohmanniidae, therefore, the key also can be applied to the proto- and deutonymphal instars in majority traits.

1. Posterior exobothridial seta elongate phylliform, acute distally; all gastronotic setae long, similar in length; one pair of anal setae; body length: 819–899 ..... *L. carolensis*  
Distribution: U.S.A. (South Carolina)
- Posterior exobothridial seta widely phylliform, rounded distally; medial gastronotic setae comparatively short, lateral gastronotic setae medium-sized or long; two pairs of anal setae ..... 2
2. Prodorsum and gastronotum with reticulate (macropolygonal) ornamentation; body length: 1145–1162 ..... *L. maldivesensis*  
Distribution: Maldives
- Prodorsum and gastronotum without reticulate (macropolygonal) ornamentation ..... 3
3. Prodorsum and gastronotum with tubercle- and rugoa-like sculpturing; body length: 730–763 ..... *L. pseudoturcmenica*  
Distribution: Vietnam
- Prodorsum and gastronotum without tubercle- and rugoa-like sculpturing ..... 4
4. Prodorsum and gastronotum with distinct, sparse foveolae ..... 5
- Prodorsum and gastronotum without distinct, sparse foveolae ..... 6
5. Posterior gastronotic seta  $p_1$  widely phylliform, distinctly shorter and wider than lateral gastronotic setae; genital plate with simultaneously phylliform and setiform setae; body length: 398–415 ..... *L. paradoxa*  
Distribution: Southern Palaearctic region
- Posterior gastronotic seta  $p_1$  narrowly phylliform (nearly setiform), similar in length to lateral gastronotic setae; genital plate only with setiform setae; body length: 763–792 ..... *L. lerellana*  
Distribution: South Africa
6. Gastronotic setae comparatively widely phylliform; body length: 763–792 ..... *L. banksi*  
Distribution: U.S.A. (North Carolina, Texas), northern Neotropical region
- Gastronotic setae narrowly phylliform (nearly setiform) ..... 7

7. Posterior gastronotic seta  $p_1$  widely phylliform, distinctly shorter and wider than lateral gastronotic setae; genital plate with simultaneously phylliform and setiform setae ..... 8
- Posterior gastronotic seta  $p_1$  narrowly phylliform (nearly setiform), similar in length to lateral gastronotic setae; genital plate only with setiform setae ..... 9
8. Anterior exobothridial seta distinctly longer than wide; body length: 870–945 ..... *L. jornoti*  
Distribution: Neotropical region
- Anterior exobothridial seta nearly round; body length: 940 ..... *L. vulcania*  
Distribution: Galápagos Islands
9. Subcapitular seta  $m_2$  setiform,  $h$  narrowly phylliform; epimeral region with simultaneously phylliform and setiform setae; body length: 685–745 ..... *L. similis*  
Distribution: Neotropical region
- Subcapitular setae  $m_2$  and  $h$  widely phylliform; epimeral region only with phylliform setae; body length: 630–730 ..... *L. turcmenica*  
Distribution: tropics and subtropics

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