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The Oribatid Mite Genus *Lopholiodes* (Acari, Oribatida) with Description of a New Species

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**Abstract**

A new species of oribatid mites, *Lopholiodes tolstikovi* n. sp., is described from soil litter of the Atlantic forest of Rio de Janeiro, Brazil. This species differs from all the representatives of the genus by relatively long setae *h*₁ and *h*₂, and the antero-lateral orientation of *h*₂. Data on geographical distribution as well as habitat ecology of known species are given. An identification key to all known species of *Lopholiodes* is provided.

**Keywords**

Brazil, key, new species, oribatid mites, Plateremaeoidea, systematics

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Edited by Raphael de C Castilho – UNESP

Received 29 December 2014 and accepted 9 June 2015

Published online: 4 September 2015

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**Introduction**

The oribatid mite genus *Lopholiodes* is one of five genera in the family Pheroliodidae, which was erected by Paschoal (1987a) with the type species *Lopholiodes micropunctinatum* Paschoal (see Subías 2004a, b, c). Further, in the same paper, Paschoal (1987a) described the genus *Octoliodes* with *Octoliodes luteomarginatus* Hammer as type species. However, there is no significant distinctive generic characters between *Lopholiodes* and *Octoliodes*, and therefore, Subías (2004a, b, c) considered *Octoliodes* as a junior synonym of *Lopholiodes*.

The main generic characters of *Lopholiodes* are (based on data from Paschoal 1987a, including our additions): exuviae on notogaster absent in adults; reticulate cerotegument on prodorsum and notogaster usually present; rostral setae inserted laterally and lamellar setae dorsally on prodorsum; five pairs of notogastral setae present, *p*₂ and *p*₃ inserted postero-laterally to *p*₁; dorsal part of notogaster convex, bordered by circummarginal furrow; seven pairs of genital and three pairs of anal setae developed; legs tridactylous, median claw slightly thicker than lateral claws; and setae it present on tarsi IV. Currently, the genus *Lopholiodes* comprises five species, namely *Lopholiodes diamantei* Fernández & Cleva described from Argentina, *Lopholiodes luteomarginatus* (Hammer) from New Zealand, *Lopholiodes micropunctinatum* Paschoal from Brazil, *L. micropunctinatum* Paschoal from Brazil, and *Lopholiodes rotoruensis* (Hammer) from New Zealand.

During the taxonomic identification of plateremaeoid oribatid mites from Brazil, we found one new species belonging to *Lopholiodes*. The primary purpose of this paper is to describe and illustrate this species under the name *Lopholiodes tolstikovi* n. sp. The secondary purpose of this paper is to provide data on diversity, geographical distribution as well as habitat ecology of all known species, and present an identification key to the world-wide species of *Lopholiodes*.

**Material and Methods**

Nine specimens (holotype: male; eight paratypes: six males and two females) from Brazil, 22°57'S, 43°09'W, Rio de...
Janeiro, Morro do Leme, Forte Duque de Caxias, 91 m a.s.l., Atlantic forest, in soil litter. Unknown date and collector (mites previously deposited in the Museum of Zoology of Tyumen State University, Russia).

All specimens were studied in lactic acid, mounted in temporary cavity slides for the duration of the study, and then stored in 70% ethanol vials. Body measurements are presented in micrometers. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. Formulas of leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulas of leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus. Terminology used in this paper mostly follows that summarized by Norton & Behan-Pelletier (2009).

Line drawings were prepared with the aid of a drawing tube using a Carl Zeiss compound microscope “Axioskop-2 Plus.” Images were obtained by an AxioCam ICc3 camera using a Carl Zeiss transmission light microscope “AxioLab.A1.” SEM micrographs were obtained with a Jeol JSM-6510 LV scanning electron microscope.

**Description of new species**

*Lopholiodes tolstikovi* n. sp. (Figs 1–7)

**Diagnosis (adult)**

Body size: 547–597×332–365. Notogaster and anterior part of prodorsum covered by reticulated cerotegument. Surface of dorsal part of notogaster foveolate. Rostral and lamellar setae thick, barbed. Bothridial setae with long stalk and slightly expanded elongate head, densely covered by small scales. Centro-dorsal part of notogaster convex, bordered by circummarginal furrow (deep depression). Posterior longitudinal furrow absent. Notogastral setae $h_1$, $h_2$, and $p_1$ fairly long, thick, barbed, $h_3$ directed clearly antero-laterally; $p_2$ and $p_3$ short, thin, barbed. Enantiophyses $S$ represented by triangular tubercles. Genital (except $g_1$) and anal setae smooth, other setae of ventral plate slightly barbed.

![Fig 1](image1.png)  
**Fig 1.** *Lopholiodes tolstikovi* n. sp., adult: dorsal view.

![Fig 2](image2.png)  
**Fig 2.** *Lopholiodes tolstikovi* n. sp., adult, SEM micrograph: dorsal view.
Description

Measurements. Body length: 597 (holotype), 547–581 (eight paratypes: six males and two females); notogaster width: 365 (holotype), 332–365 (eight paratypes).

Integument (Figs 1–4). Body color yellowish-brown to dark-brown. Surface of prodorsum, ventral plate, and lateral sides of notogaster smooth; dorsal part of notogaster foveolate (foveoles rounded or slightly elongated; diameter and length up to eight; Fig 5a). Body surface and legs covered by cerotegument: rostrum, posterior part of prodorsum, ventral plate, and legs with granular, columnar, or vermicular structures (Fig 5b); notogaster and anterior part of prodorsum with reticulate pattern (Fig 5c); legs also covered by thick gel-like layer (Fig 5d). All body setae without cerotegument.

Prodorsum (Figs 1, 2, and 6a). Rostrum widely rounded. Dorsolateral sides with strong longitudinal ridges, forming X-like structure. Prodorsal enantiophyses (E) distinct, represented by anterior broad and posterior elongate conical tubercles. Transverse ridge (r) thick, bordered by narrow furrow (fₚₐ) anteriorly and broad furrow (fₚₚ) posteriorly. Rostral (ro, 73–82) and lamellar (le, 57–69) setae thick, barbed, directed antero-medially (Fig 6b). Interlamellar setae (in) short (8), spiniform, directed postero-medially. Bothridial setae (ss, 127–135) clavate (Fig 5e), directed postero-laterad, its head elongated, densely covered by small scales. Bothridia connected to anterior margin of notogaster. Exobothridial setae (ex, 28–36) simple, slightly barbed. Propodilateral apophyses (P) well developed, triangular in dorsal view, and elongated, scale-like in lateral view. Notogaster almost round in dorsal view, very slightly longer than wide, but flattened in lateral view. Centro-dorsal part convex, about 1/2 length of notogaster, bordered by circummarginal furrow (cmf), represented by deep depression. Posterior longitudinal furrow absent. Five pairs of notogastral setae well developed: h₁, h₂ (82–90), and p₁ (53–61) thickened, heavily barbed; p₂ and p₃ (32–41), thin, barbed (Fig 6c). Setae h₂ directed antero-laterally (Fig 5f). Lyrifissures ia, im, ip, ih, ips, and opisthronotal gland openings (gla) well developed.

Gnathosoma. Subcapitulum longer than wide (114–123×102–106). Subcapitular setae setiform, barbed; a (30–32) shorter than m and h (41–45). Two pairs of adoral setae (orₐ, orₐ, 20–24) simple, barbed (Fig 6d). Palps (90) with setation a2–1–3–9 (+ω) (Fig 6e). Solenidion short, thickened, blunt-ended.
pressed to tubercle, which has eupathidium. Chelicerae (123–127) with one thin tooth (t, 4) and two barbed setae (Fig 6f); cha (45–49) longer than chb (24–28). Trägårdh’s organ (Tg) short, tapered.


Anogenital region. Seven pairs of genital (g1, 24–26; g2–g7, 14–16) (Fig 7a), one pair of aggenital (ag, 20–24), three pairs of anal (an1–an3, 16–20), and three pairs of adanal (ad1–ad3, 24–28) (Fig 7b) setae setiform, thin; genital (except g1) and anal setae smooth, others slightly barbed. Adanal setae located in paraanal position. Lyrifissures iad not evident. Ovispositor elongated (130–135 × 41–45), blades (53) shorter than length of cylindrical distal part (77–82). Each of three blades with four thin, smooth setae, ψ1 ≈ τ1, (69–73) flagellate, longer than straight ψ2 ≈ τ2 ≈ τ3 (24–28). Six coronal straight, smooth setae (k, 28–32) present (Fig 7c).

Legs (Fig 7d, e). Three claws of each leg indistinctly barbed on dorsal side. Medial claw slightly thicker than lateral ones. Femora with large antero-ventral ledges (Fig 5d). Morphology of leg segments, setae, and solenidia typical for Lopholiodes (see Fernández & Cleva 1999, Hunt 1996). Formulas of leg setation and solenidia: I (1–5–4–4–20) [1–2–2], II (1–5–4–5–16) [1–1–1], III (2–3–3–4–15) [1–1–0], and IV (1–2–3–4–14) [0–1–0]; homology of setae and solenidia indicated in Table 1. Famulus sunken.

Type deposition

The holotype and one paratype (preserved in ethanol) are deposited at Collection of Apterous Arthropod Vector of Community Health Importance, section Acari (CAVAISC...
ACA), Fundação Oswaldo Cruz, Instituto Oswaldo Cruz (FIOCRUZ-IOC), Rio de Janeiro, Brazil; seven paratypes (in ethanol) are deposited at Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name is dedicated to our friend and colleague, acarologist, Dr. Andrei V. Tolstikov (Tyumen State University, Tyumen, Russia).

Differential diagnosis

*Lopholiodes tolstikovi* n. sp. differs from all representatives of *Lopholiodes* by relatively long notogastral setae *h*₁ and *h*₂ (versus shorter), and the antero-lateral orientation of seta *h*₂ (versus backwards). Additional distinctive characters of the new species from other *Lopholiodes*-species can be found in the identification key given below.

Discussion

The oribatid mite superfamily Plateremaeoidea is known to be rather diverse in both the Northern and Southern Hemispheres. However, the diversity of *Lopholiodes* is not high, as all the species were recorded only in the Southern Hemisphere.

Besides the more distinct families, such as Gymnodamaeidae, Licnodamaeidae, Plateremaeidae, among others, there are several other families (e.g., Hammeriellidae, Lyrifissellidae, Nooliodidae, and others) erected by Paschoal (1987a, b, 1989a, b, c), which status are still unclear. The diagnoses and definition of the latter families are too restrictive, and insufficient for creating family group taxa, as the erection of some families were based on insufficient descriptions of type species or genera. Hence, the status of the majority of those families established by Paschoal (1987a, b, 1989a, b, c) has

Fig 6  *Lopholiodes tolstikovi* n. sp., adult: a lateral view of prodorsum (except anterior part) and anterior part of notogaster, b rostrum, rostral and lamellar setae, frontal view, c posterior view, d right half of subcapitulum, ventral view, e palp, f chelicera.
been rejected (see Woas 1992, Bayartogtokh 2001). One such family is Pheroliodidae, and the characters given by Paschoal (1987a) cannot distinguish it from Plateremaeidae. In our opinion, a further phylogenetic analysis is required to clarify whether these are independent families, but this is not the goal of the present work.

The generic status of *Lopholiodes* is also arguable. In the partial revision of Plateremaeoidea, Woas (1992) synonymized this genus with *Pheroliodes* Grandjean, but later Fernández & Cleva (1999), Subías (2004a, b, c) accepted it as a valid genus. Therefore, in the present work, we tentatively followed the latter authors’ concept, but, in our opinion, further investigation is required and the genus should be reassessed based on both adult and juvenile stage features.

As mentioned earlier, current *Lopholiodes* comprises six species, including the new species described here. Hunt (1996) combined *Pheroliodes robustus* (Hunt & Lee) to the genus *Octoliodes* (see Introduction section on taxonomic status of *Octoliodes*) and Subías (2004a, b, c, online version 2008) combined *Neonooliodes ceroplastes* (Hunt) to the

### Table 1 Leg setation and solenidia of *Lopholiodes tolstikovi* n. sp.

<table>
<thead>
<tr>
<th>Leg</th>
<th>Trochanter</th>
<th>Femur</th>
<th>Genu</th>
<th>Tibia</th>
<th>Tarsus</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>v</td>
<td>d, (l), bv'</td>
<td>d, (l), v', σ</td>
<td>(l), (v), φ, ω₂</td>
<td>(ft), (tc), (it), (p), (a), s, (pv), (pl), r', v', e, ω₁, ω₂</td>
</tr>
<tr>
<td>II</td>
<td>v</td>
<td>d, (l), bv'</td>
<td>d, (l), v', σ</td>
<td>d, (l), (v), φ</td>
<td>(ft), (tc), (it), (p), (a), s, (pv), r', ω₁, ω₂</td>
</tr>
<tr>
<td>III</td>
<td>'v, v'</td>
<td>d, 'f, ev'</td>
<td>d, 'f, v', σ</td>
<td>d, 'f, (v), φ</td>
<td>(ft), (tc), (it), (p), (a), s, (pv)</td>
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<tr>
<td>IV</td>
<td>v</td>
<td>d, ev'</td>
<td>d, 'f, v'</td>
<td>d, 'f, (v), φ</td>
<td>ft', (tc), (it), (p), (a), s, (pv)</td>
</tr>
</tbody>
</table>

Roman letters refer to normal setae (ε to famulus), Greek letters to solenidia. Single prime (') marks setae on anterior and double prime (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.
genus Lopholiodes. However, adults of P. robustus and N. ceroplastes have exuviae on notogaster (exuviae absent in Lopholiodes); therefore, the inclusion of these species to Lopholiodes seems to be problematic. Further detailed studies on both species are necessary to clarify their generic placement.

All species of Lopholiodes have restricted distributions in the Southern Hemisphere, i.e., in the Neotropical and Australian regions. The three South American species, L. macropunctinatum, L. micropunctinatum, and L. tolstikovi n. sp. are known only from Brazil (Paschoal 1987a, Oliveira et al. 2005), and L. diamantei is reported from Argentina (Fernández & Cleva 1999). Two further species, L. luteomarginatus and L. rotoruensis, are known only from New Zealand (Hammer 1966, Spain & Luxton 1971, Luxton 1985). Thus, the representatives of this genus are totally restricted to the tropics and New Zealand (Hammer 1966, Paschoal 1987a, Woaś 2002).

Concerning the habitat ecology of Lopholiodes, most species are inhabitants of the forest litter, mosses, decaying wood, and organic horizons of soil, but some of them are arboral or distributed in soil of arid habitats (Hammer 1966, Paschoal 1987a, Fernández & Cleva 1999). Thus, L. diamantei, L. macropunctinatum, L. micropunctinatum, and L. tolstikovi n. sp. are inhabitants of various types of tropical forest litters and soils (gallery forests along rivers or wetlands, rainforests), whereas L. luteomarginatus is an inhabitant of bryophytes growing on dead tree branches in tree-fern forest (Hammer 1966, Paschoal 1987b). Lopholiodes rotoruensis is known only from the thermal area in Rotorua, New Zealand. Although Hammer (1966) did not indicate the substrate, we suspect that this species might be an inhabitant of either lichen, moss, or soil litter substrates of the forest growing around geothermal pond or stream.

World-wide key to the adults of Lopholiodes

1. Anterior part of prodorsum with reticulate and/or areolate ornamentation............................................................2
2. Anterior part of prodorsum without reticulate and areolate ornamentation.................................................................5
3. Notogastral setae $h_2$ relatively long, directed anterolaterally; body size: 547–597×332–365………………………………..3
   - Notogastral setae $h_2$ short, directed backward……………………………………4
4. Head of bothridial setae broadly dilated; interlamellar setae short; body length: 750...............................................................
   - Head of bothridial setae indistinctly dilated; interlamellar setae minute; body length: 870......................................................
5. Head of bothridial setae broadly dilated, flattened; body length: 530–752........................................................................
   - Head of bothridial setae narrowly dilated, clavate; body size: 605–704×357–412...........................................................

Acknowledgments

We cordially thank three anonymous reviewers for the valuable comments and Dmitry V. Zhuravsky (Laboratory of Electron and Scanning Probe Microscopy, Tyumen State University, Russia) for help with SEM. An additional logistic support by the National University of Mongolia is highly appreciated.

References

