



Taxonomic contribution to knowledge of the oribatid mite genus *Lunoribatula* (Acari, Oribatida, Oribatulidae)

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ABSTRACT

The genus *Lunoribatula* (Oribatida, Oribatulidae) is known from Ethiopia. The generic diagnosis is revised. The redescription of the type species, *Lunoribatula polygonata* Mahunka, 1982, is presented, based on the specimens collected from branches of *Erica trimera* and *Acacia mearnsii* in southeastern and central Ethiopia. Remarks on habitat of *L. polygonata* are provided.

KEYWORDS

Arboreal habitat, Ethiopia, morphology, oribatulid mites, taxonomy

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INTRODUCTION

The oribatid mite genus *Lunoribatula* Mahunka, 1982 (Acari, Oribatida, Oribatulidae) was proposed by Mahunka (1982), with *Lunoribatula polygonata* Mahunka, 1982 as type species, based on adults from central Ethiopia. Currently, the genus is monotypic, comprising only the type species distributed in Ethiopia. Although to Subías' catalogues (2004, 2022) record *L. polygonata* in Chile, we could not find no confirmation of this information.

The sampled oribatid mite materials from trees in Ethiopia, included more than 30 specimens of *L. polygonata*. Although the type material was not examined, the species possesses a set of morphological characters that make it easy to be distinguished from other representatives of Oribatulidae. The original description was incomplete; in particular, there is no information on the gnathosoma, legs, lateral body features, and setae measurements is lacking (Mahunka 1982). Furthermore, the generic diagnosis of *Lunoribatula* is brief (Mahunka 1982).

The main goals of the paper are: to revise a generic diagnosis of *Lunoribatula*; to present a redescription of *L. polygonata* on the basis of the material from southeastern and central Ethiopia; to summarize the species' main morphological traits; and to compile the species' habitat.

METHODS

Mites from tree branches were extracted via high-pressure flushing followed by heptane flotation in laboratory conditions. Detailed descriptions of the arboreal acarofauna collection and extraction



techniques are presented in Salavatulin (2019).

For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Maximum body width was measured in dorsal aspect. Setae were measured from the side to avoid foreshortening. All measurements are in micrometers (μm). 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 DM 2500 light microscope. For SEM microscopy alcohol-preserved mites were coated with gold and scanned using a TESCAN Mira3 LMU SEM microscope. Images were obtained with an AxioCam ICC3 camera using a Carl Zeiss transmission light microscope Axio Lab.A.

Terminology – Morphological terminology used in this paper follows that of F. Grandjean (see Travé and Vachon (1975) for references), Norton (1977) for leg setal nomenclature, and Norton and Behan-Pelletier (2009) for overview.

Abbreviations – *Prodorsum*: *lam* = lamella; *r* = ridge; *Al* = sublamellar porose area; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial setae, respectively; *bo* = bothridium; *D* = dorsophragma; *P* = pleurophragma. *Notogaster*: *len* = lenticulus; *la*, *lm*, *lp*, *b₁–b₃*, *p₁–p₃* = setae; *Aa*, *A1*, *A2*, *A3* = porose areas; *ia*, *im*, *ip*, *ib*, *ips* = lyrifissures; *gla* = opisthonotal gland opening; *cer* = cerotegument. *Gnathosoma*: *SM* = subcapitular mentum; *a*, *m*, *h* = anterior, middle seta of gena and hypostomal seta of mentum, respectively; *or* = adoral seta; *d*, *l*, *cm*, *acm*, *ul*, *su*, *lt*, *vt*, *inf*, *sup* = palp setae; ω = palp tarsal solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *ap2* = apodeme 2; *apsj* = sejugal apodeme; *ap3* = apodeme 3; *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *4a*, *4b* = setae; α = aperture of supracoxal gland; *PdI*, *PdII* = pedotecta I and II, respectively; *dis* = discidium. *Anogenital region*: *GP* = genital plate; *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal setae, respectively; *iad* = adanal lyrifissure; *po* = preanal organ. *Legs*: *pa* = porose area; ω , φ , σ = solenidia; *e* = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv* = setae.

RESULTS

TAXONOMY

Family Oribatulidae Thor, 1929

Genus *Lunoribatula* Mahunka, 1982

Type species: *Lunoribatula polygonata* Mahunka, 1982

Generic traits (adult) of *Lunoribatula*

With character states of Oribatulidae (Balogh and Balogh 1984; Norton and Behan-Pelletier 2009). *Measurements* – Medium-sized. *Integument* – Notogaster and anogenital region tuberculate. Epimeral region with thin ridges. *Prodorsum* – Rostrum rounded. Lamella short, lineate, without cusp, directed to insertion of lamellar seta. Sublamella, translamella, prolamella, tutorium, and dorsosejugal porose area absent. Sublamellar porose area present. Rostral seta long, setiform. Lamellar seta short, setiform or vaguely dilated distally. Interlamellar seta bacilliform, heavily barbed. Bothridial seta short, globose. Bothridium covered by anterior margin of notogaster in dorsal view. Bothridium cup-shaped. Exobothridial seta absent. Dorsophragmata small, well separated. *Notogaster* – Anterior margin of notogaster distinct, convex medially. Lenticulus slightly defined. Pteromorph and pleural carina completely absent. Octotaxic system with four pairs of rounded porose areas. Nine pairs of short, simple notogastral setae located in marginal position. Humeral region without setae (*c* absent). *Gnathosoma* – Subcapitulum diarthric. Palp setation: 0-2-1-3-9(+ ω). Solenidion attached to eupathidium. Axillary saccule absent. Chelicera chelate-dentate, with two setae. *Epimeral and lateral podosomal regions* – Epimeral setal formula: 3-1-2(3)-2(3). Humeral porose areas *Am* and *Ab* absent. Pedotectum I represented by medium-sized lamina, pedotectum II represented

by small lamina. Discidium present. Circumpedal carina absent. *Anogenital region* – Five pairs of genital, one pair of aggenital, two pairs of anal, and three pairs of adanal setae. Adanal lyrifissure located anterior to anal aperture. Postanal porose area absent. *Legs* – All legs tridactylous. Porose area present on tarsi I–IV, femora I–IV, and on trochanters III, IV. Leg chaetome partially reduced.

Lunoribatula polygonata Mahunka, 1982 (Figs 1–25)

Material examined

Five adults (three males and two females): southeastern Ethiopia, Oromia Region, Bale Mountains National Park, 6° 47' 43.6" N, 39° 48' 45.3" E, 3966 m a.s.l., branches with leaves from shrub-like *Erica trimera* (Engl.) Beentje (Ericaceae), 17 December 2025 (collected by V.M. Salavatulin).

Twenty-seven adults (11 males and 16 females): central Ethiopia, Addis-Ababa, Park in Russian Embassy, 9° 02' 15.1" N, 38° 47' 06.5" E, 2389 m a.s.l., branches from a freshly cut *Acacia mearnsii* De Wild. (Fabaceae) tree, 29 December 2025 (collected by V.M. Salavatulin).

All specimens are in the personal collection of the first author (preserved in 70% solution of ethanol with a drop of glycerol).

Supplementary description

Measurements – Males usually smaller than females. Total length 375–405 (males), 405–435 (females). Maximum width 240–255 (males), 255–270 (females).

Integument (Figs 16–20, 22–25) – Body color brown. Notogaster (Figs 16, 17, 22, 24, 25) and anogenital region (Figs 19, 23) with elongate and simple tubercles, forming partially polygonate pattern. Epimeral region (Figs 18, 23) partially with elongate tubercles and thin ridges. Lateral side of body with dense microgranulate cerotegument. Posterior part of notogaster with thick layer of gel-like cerotegument (Figs 20, 23).

Prodorsum (Figs 1, 3, 12–15, 22, 24, 25) – Rostrum rounded. Lamella half as long as 1/3 of prodorsum, simple, not visible in lateral view. Interlamellar region with one pair of oblique ridges. Sublamellar porose area nearly circular (4–6). Rostral seta (60–67) setiform, barbed. Lamellar seta (19–22) setiform, thin, barbed in distal half, sometimes appearing to be slightly expanded distally due to strong barbs. Interlamellar seta (49–56) bacilliform, heavily barbed. Bothridial seta (24–26) globose, barbed, partially covered by anterior margin of notogaster in dorsal view. Exobothridial seta and dorsosejugal porose area absent.

Notogaster (Figs 1, 3, 4, 17, 22, 24, 25) – Anterior margin of notogaster well developed. Nine pairs of notogastral setae (*la*, *lm*, *lp*, *b₁–b₃*, *p₁–p₃* 7–9) setiform, thin, vaguely roughened in distal half. Four pairs of porose areas circular (5–7). Lenticulus without clear boundaries. Opisthonotal gland and all lyrifissures distinct.

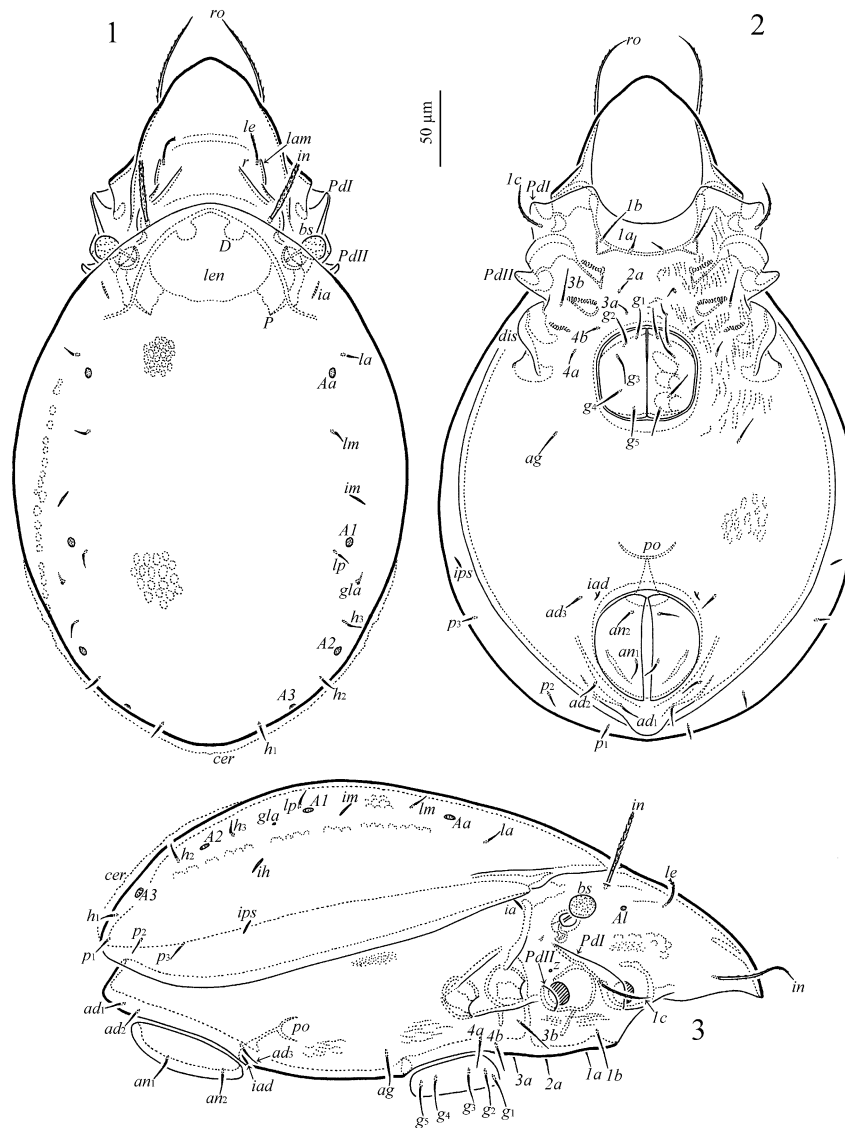
Gnathosoma (Figs 5–7, 23) – Subcapitulum size 94–97 × 75–79. Three pairs of subcapitular setae (*a*, *m* 19; *b* 26–30) and two pairs of adoral setae (11) setiform thin, roughened, *m* thinner than *a* and *b*. Palp length 71–79. Palp setal formula 0-2-1-3-9(+ω). Postpalpal seta (7) spiniform. Chelicera length 101–105. Cheliceral setae (*cha* 26–28; *chb* 19–22) setiform, barbed.

Epimeral and lateral podosomal regions (Figs 2, 3, 23) – Epimeral setal formula 3-1-2-2. Setae (*1a*, *2a*, *3a* 13–15; *4a*, *4b* 15–17; *1b*, *3b* 22–26) setiform thin, roughened, *1c* (26–34) frequently thicker, barbed.

Anogenital region (Figs 2, 3, 4, 23) – Five pairs of genital (15–19), one pair of aggenital (15–19), two pairs of anal (11–15), and three pairs of adanal (11–15) setae setiform, thin, roughened in distal half. Adanal seta *ad₁* posterior, *ad₂* posterolateral, *ad₃* anterolateral to anal plate. Adanal lyrifissure located close and anterolateral to anal plate. Arch-like ridge (visible in ventral view) behind anal aperture.

Legs (Figs 8–11, 21–25) – Median claw slightly thicker than lateral claws. All claws barbed on dorsal side. Porose area on tarsi I–IV, femora I–IV, and on trochanters III, IV well visible. Formulas of leg setation and solenidia: I (0-3-2-3-16) [1-2-2], II (0-3-2-2-15) [1-1-1], III (1-2-0-1-15) [1-1-0], IV (0-2-

0-1-12) [0-1-0]. Homology of setae and solenidia indicated in Table 1. Setae p' , p'' , and s of tarsus I eupathidial. Setae of tarsi I–IV (except p and s of tarsus I and sometimes setae ft) faintly swollen apically.



Figures 1–3. *Lunoribatula polygonata* Mahunka, 1982 (adult, gnathosoma and legs omitted) – 1. Dorsal view; 2. Ventral view; 3. Right lateral view.

Remarks

Our adults of *L. polygonata* from the Bale Mountains National Park and Adis-Ababa are morphologically similar to those described by Mahunka (1982) from Adis-Ababa, except for the morphology of the genital plate (nearly smooth versus with some longitudinal ridges) and the epimeral formula (3-1-2-2 versus 3-1-3-3 according to page 327, or 3-1-3-2 according to Fig. 109 in Mahunka 1982). Since the compared adults are very similar in other morphological characters, we believe that these differences represent intraspecific morphological variations within *L. polygonata*.

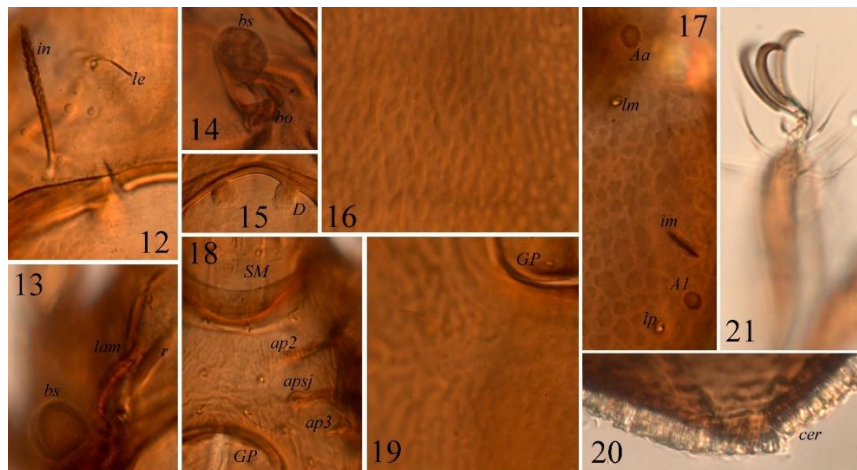
Based on the present study and the original description, the following diagnosis for adults of *L. polygonata* is proposed. Body length 375–435. Notogaster and anogenital region tuberculate. Posterior part of notogaster with thick layer of gel-like cerotegument. Interlamellar region with one pair of oblique ridges. Rostral seta long, setiform, barbed. Lamellar seta short, setiform, thin, barbed in distal half. Interlamellar seta long, bacilliform, heavily barbed. Bothridial seta short, globose, barbed. All notogastral setae short, setiform, roughened in distal half. Four pairs of porose areas circular. Leg chaetome reduced (Table 1). Many setae of tarsi I–IV faintly swollen apically.

Lunoribatula polygonata exhibits a reduction in leg chaetotaxy; for example, the setal formula of trochanters (I to IV) is 0-0-1-0 (instead of the common formula 1-1-2-1), genera I and II bear three setae (with *l'* and *v''* absent), genera III and IV lack setae *l'* and *d, l'*, respectively, the setal formula of tibiae (I to IV) is 3-2-1-1 (instead of the common formula 4-4-3-3), and tarsus II lacks the second solenidion. Such a striking reduction in the setae of the leg segments is sometimes unique (as in *Lunoribatula*) and serves as a diagnostic character for certain supraspecies taxa within Oripodoidea; it is also characteristic of some arboreal species (Behan-Pelletier *et al.* 2002; Ermilov *et al.* 2017; Ermilov 2026).

Table 1. Leg setation and solenidia of adult *Lunoribatula polygonata* Mahunka, 1982.

Leg	Tr	Fe	Ge	Ti	Ta
I	–	<i>d, l', bv''</i>	(<i>l</i>), σ	(<i>l</i>), <i>v'</i> , φ_1 , φ_2	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>), <i>e</i> , ω_1 , ω_2
II	–	<i>d, l', bv''</i>	(<i>l</i>), σ	<i>l', v'</i> , φ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>), ω
III	<i>v'</i>	<i>d, ev'</i>	σ	<i>v'</i> , φ	(<i>ft</i>), (<i>tc</i>), (<i>it</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>)
IV	–	<i>d, ev'</i>	–	<i>v', \varphi</i>	<i>ft''</i> , (<i>tc</i>), (<i>p</i>), (<i>u</i>), (<i>a</i>), <i>s</i> , (<i>pv</i>)

Note: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively. Roman letters refer to normal setae, Greek letters to solenidia. Single prime (') marks setae on the anterior and double prime (') setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

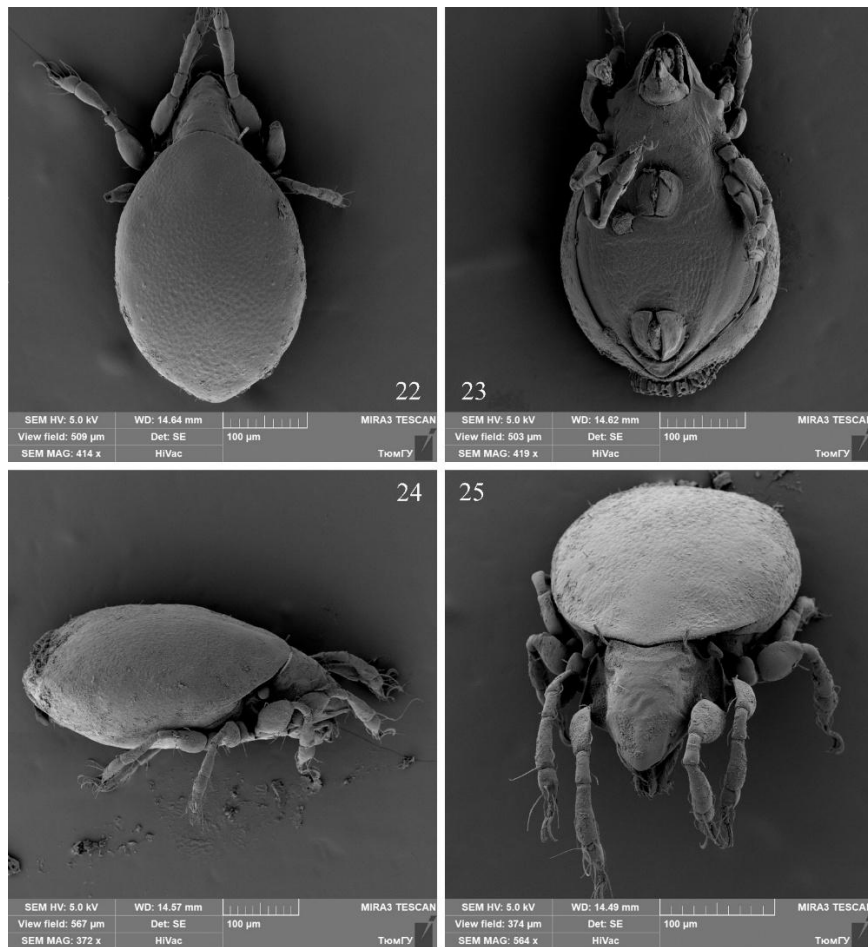


Figures 12–21. *Lunoribatula polygonata* Mahunka, 1982 (microscope images, dissected adult) – **12.** Left lamellar and interlamellar setae, dorsal view; **13.** Left lamella and bothridial seta, dorsal view; **14.** Bothridial seta and bothridium, lateral view; **15.** Dorsosphragmata; **16–17.** Notogastral sculpturing; **18.** Part of epimeral region; **19.** Sculpturing in aggenital region; **20.** Gel-like cerotegument on posterior part of notogaster; **21.** Distal part of leg IV, left, ventral view.

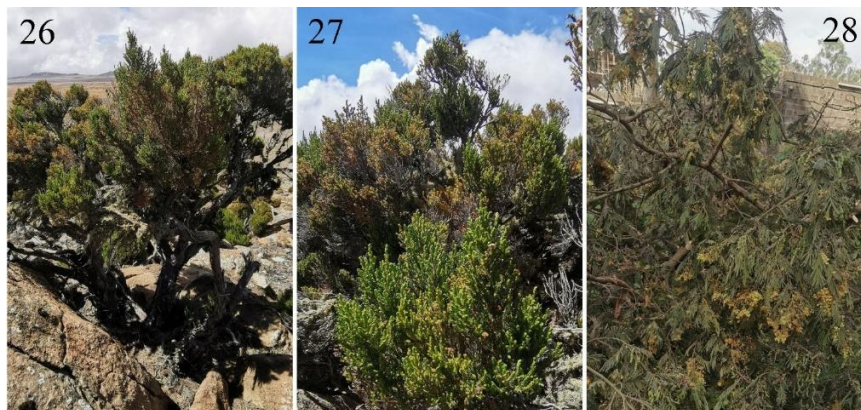
HABITAT

The description of *L. polygonata* was based on the holotype and two paratypes collected from litter in a forest with *Eucalyptus* sp. and *Juniperus* sp. in the vicinity of Adis-Ababa, central Ethiopia (Mahunka 1982; the sample is incorrectly numbered). Later, the species was recorded from litter (1 exemplar) in a forest with *Juniperus procera* (Ermilov and Rybalov 2025a) in the Amhara region, central Ethiopia, and from litter (1 exemplar) in a forest with *Acacia tortilis* and deciduous trees (Ermilov and Rybalov 2025b) in southern Ethiopia. In the present research, the species was found on tree branches with leaves of *Erica trimera* (five exemplars) in the Oromia region, southeastern Ethiopia (Figs 26, 27), and on tree branches of *Acacia mearnsii* (27 exemplars) in Addis-Ababa, central Ethiopia (Fig. 28).

Although some specimens of *L. polygonata* have been recorded in litter, we believe this species is mainly an arboreal dweller, as evidenced by its relatively high abundance on trees and the presence of distally swollen leg setae, which is often characteristic of arboreal mites. However, further studies into the ecology of *L. polygonata* are needed.



Figures 22–25. *Lunoribatula polygonata* Mahunka, 1982 (SEM micrographs, adult) – 22. Dorsal view; 23. Ventral view; 24. Right lateral view; 25. Dorsoanterior view.



Figures 26–28. Photos of investigated trees with *Lunoribatula polygonata* Mahunka, 1982 – 26–27. Shrub-like *Erica trimera*; 28. Freshly cut *Acacia mearnsii* tree.

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Ethics approval and consent to participate: This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

Consent for publication: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Competing interests: The authors declare no conflict of interest.

Generative AI statement: The authors declare that AI was not used at any stage of the manuscript development.

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اطلاعات آرایه‌شناختی هرناهی اربیاتید جنس *Lunoribatula* (Acari, Oribatida, Oribatulidae)

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چکیده

جنس *Lunoribatula* (Oribatida, Oribatulidae) از اتیوپی گزارش می‌شود. مشخصات جنس بازمینی شد. باز توصیف گونه تپ *Lunoribatula polygonata* Mahunka, 1982 بر اساس نمونه‌های جمع‌آوری شده از شاخه‌های *Erica* و *Acacia mearnsii* و *trimera* از جنوب شرقی و مرکز اتیوپی آرایه می‌شود. در مورد زیستگاه *L. polygonata* بحث شده است.

واژگان کلیدی: زیستگاه درختی، اتیوپی، ریخت‌شناسی، هرناهای اربیاتولید، آرایه‌شناسی

دریافت

۶ بهمن ۱۴۰۴

پذیرش

۱۴ اسفند ۱۴۰۴

انتشار

۲۶ فروردین ۱۴۰۵

دبیر تخصصی

/. جوهرچی



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