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# CONTRIBUTION TO THE TAXONOMY OF THE ORIBATID MITE GENUS *GRAPTOPPIA* BALOGH 1983 (ACARI, ORIBATIDA, OPPIIDAE)

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The oribatid mite genus *Graptoppia* (Oribatida, Oppiidae) is recorded from Cuba for the first time. One new species of the subgenus *Graptoppia* (*Graptoppia*) – *G. (G.) trapezoides* sp. n. – is described, based on adults collected from leaf litter in a riparian mixed forest. The generic and subgeneric traits of *Graptoppia* are summarized. An identification key to the known species of *Graptoppia* (*Graptoppia*) is presented.

**Keywords:** oppiid mites, taxonomy, generic diagnosis, morphology, identification key, Neotropical region

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The oribatid mite genus *Graptoppia* of the family Oppiidae (Acari, Oribatida) comprises three subgenera with 23 species and one subspecies (Subías, 2022; Seniczak et al., 2023), which are distributed in the tropical and the subtropical regions (Subías, 2022). The three subgenera include: *G. (Graptoppia)* Balogh 1983 – 12 species and one subspecies; *G. (Apograptoppia)* Subías et Rodríguez 1985 – one species; *G. (Stenoppia)* Balogh 1983 – 10 species. Representatives of the genus are typical inhabitants of soil-litter in tree plantations and forests; some species are actively phoretic (Ermilov, 2019; Ermilov, Frolov, 2021).

The main goals of our paper are as follows: describe a new species of *Graptoppia* (*Graptoppia*) collected from Cuba; revise the generic and subgeneric diagnoses; provide an identification key to the known species of *Graptoppia* (*Graptoppia*). An identification key to the species of *Graptoppia* (*Stenoppia*) has been presented by Ermilov and Frolov (2021).

Prior to this study, no representatives of *Graptoppia* have been registered in Cuba.

## METHODS

**Observation and documentation.** For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. All measurements are in micrometers. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster; other structures were oriented to avoid parallax errors. Notogastral width refers to the maximum width in dorsal aspect. Setal lengths were measured perpendicular to their long axes, accounting for curvature. 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.

**Terminology and conventions.** General morphological terminology used in this paper mostly follows that of Grandjean (see Trávě and Vachon (1975) for references), Norton (1977), and Norton and Behan-Pelletier (2009).

**Abbreviations.** *Prodorsum*: *r* = ridge; *cos* = costula; *tcos* = transcostula; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively. *Notogaster*: *c*, *la*, *lm*, *lp*, *h*, *p* = setae; *ia*, *im*, *ip*, *ih*, *ips* = lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *v*, *cm*, *ul*, *su*, *vt*, *sup*, *inf*, *lt* = palp setae;  $\omega$  = palp solenidium; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a–1c*, *2a*, *3a–3c*, *4a–4c* = epimeral setae; *PdI* = pedotectum I; *dis* = discidium. *Anogenital region*: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal seta, respectively; *iad* = adanal lyrifissure; *p.o.* = preanal organ. *Legs*: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, tarsus, respectively;  $\omega$ ,  $\phi$ ,  $\sigma$  = solenidia;  $\varepsilon$  = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *p**v*, *pl* = leg setae.

## TAXONOMY

### Generic diagnosis of *Graptoppia* (adult)

**Adult:** *Size.* Small, body length: 164–405. *Integument.* Surface smooth or microsculpturing granulate; lateral side of body with or without tubercles; some-

times prodorsum with some rugosities. *Prodorsum*. Rostrum rounded or tripartite, or intended. Transcostula and both costulae usually present, forming trapezoid structure; rarely, either costulae or transcostula absent; in some specimens, both costulae and transcostula are completely reduced. Rostral seta medium-sized, lamellar, interlamellar and exobothridial setae short, all setiform; *ro* inserted dorsolaterally on prodorsum, *le* inserted on transcostula or on prodorsal surface behind transcostula. Bothridial seta medium-sized or long, clavate or disk-like, or unilaterally dilated, pointed apically; head usually ciliated. Interbothridial region with two pairs of muscle sigillae, rarely with one pair; in some species muscle sigillae absent. Interbothridial and postbothridial tubercles present or absent. *Notogaster*. Elongate oval, anterior notogastral margin rounded or narrowed medially. Humeral region without humeral tooth and strong crista. Notogastral seta *c* reduced or represented by alveolus, or minute; the other notogastral setae (nine pairs) short or medium-sized, setiform or branch-shaped. *Gnathosoma*. Subcapitulum diarthric; adoral seta present. Palp setation: 0–2–1–3–9(+10); solenidion long, bacilliform, located in mediodistal part of tarsus and pressed to it. Chelicera chelate-dentate. *Epimeral and lateral podosomal regions*. Epimeral border IV present. Epimeral setal formula: 3–1–3–3; all setae short, setiform. Ventrosejugal tubercle absent. Pedotectum I represented by small lamina. Discidium rounded or pointed distally. *Anogenital region*. Four or five pairs of genital, one pair of aggenital, two pairs of anal, and three pairs of adanal setae; short or partially medium-sized. Adanal seta *ad*<sub>1</sub> posterior to, *ad*<sub>2</sub> lateral to, and *ad*<sub>3</sub> anterolateral to anal plate; distance *ad*<sub>3</sub>–*ad*<sub>3</sub> usually longer than *ag*–*ag* and *ad*<sub>2</sub>–*ad*<sub>2</sub>. Adanal lyrifissure located close to anal plate or removed from it, paraanal or direct apoanal. *Legs*. Tarsus II with two solenidia; tibia I with dorsoanterior apophysis.

### Subgeneric diagnoses

#### 1. Subgenus *Graptoppia* (*Graptoppia*) Balogh 1983

Type species: *Graptoppia paraanalis* Subías et Rodríguez 1985

Five pairs of genital setae. Adanal lyrifissure located close and parallel to anal plate (paraanal).

#### 2. Subgenus *Graptoppia* (*Apograptoppia*) Subías et Rodríguez 1985

Type species: *Dameosoma foveolatum* Paoli 1908

Five pairs of genital setae. Adanal lyrifissure removed from anal plate, distinctly inverse diagonal (direct apoanal).

#### 3. Subgenus *Graptoppia* (*Stenoppia*) Balogh 1983

Type species: *Oppia italica* Bernini 1973

Four pairs of genital setae. Adanal lyrifissure located close and parallel to anal plate (paraanal).

#### *Graptoppia* (*Graptoppia*) *trapezoides* Ermilov sp. n. (Figs 1, 2)

**Material.** Holotype (♂) and two paratypes (1♂, 1♀): Cuba, 22°6' N, 81°6' W, leaf litter in a riparian (200 m from the Ocean) mixed forest (unknown date and collector; collection of the Tyumen State University Museum of Zoology, Tyumen, Russia).

The holotype and three paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

**Diagnosis.** Body length: 165–180. Rostrum medially indented. Costulae and transcostula forming trapezoid structure, their junctions forming protruding acute angles. Rostral seta medium-sized, setiform, slightly barbed; lamellar, interlamellar and exobothridial setae short, setiform, smooth. Bothridial seta long, with unilaterally dilated and ciliated head. Notogastral seta *c* vestigial, other notogastral setae medium-sized, setiform, slightly roughened; *la* and *lm* slightly removed from each other, *la* located posterolaterally to *lm*. Epimeral, genital, aggenital, and anal setae short, setiform, smooth; adanal setae medium-sized, setiform, slightly roughened; adanal seta *ad*<sub>3</sub> located posteriorly to aggenital seta. Discidium rounded distally.

**Description. Measurements.** Very small species. Body length: 165 (holotype), 165 (male paratype), 180 (female paratype); body width: 82 (holotype), 82 (male paratype), 90 (female paratype).

**Integument.** Body color light brown. Body surface microsculpturing granulate. Lateral part of body between bothridium and acetabula I–IV partially densely tuberculate (diameter of tubercle up to 2).

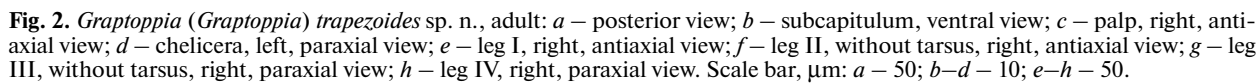
**Prodorsum.** Rostrum with small medial indentation. Costulae and transcostula lineate, forming trapezoid structure, their junctions forming protruding acute angles. Rostral seta (15) setiform, slightly barbed; lamellar, interlamellar and exobothridial setae (6) setiform, smooth; *le* located behind transcostula; *ex* located on tubercle; transverse ridge located between insertions of *ro*. Bothridial seta (32–34) with long stalk and shorter, unilaterally dilated and ciliated, pointed apically head; number of bothridial ciliae about 13–16. Interbothridial region with two pairs of muscle sigillae. Postbothridial tubercle slightly developed.

**Notogaster.** Anterior border complete, convex medially. Notogastral seta *c* (1) vestigial, others (15) setiform, slightly roughened; *la* and *lm* slightly removed from each other, *la* located posterolaterally to *lm*. Opisthonotal gland openings and all lyrifissures distinct; *im* located anteromedially to *h*<sub>3</sub>; *gla* located close and posteromedially to *im*.

**Gnathosoma.** Subcapitulum size: 37–41 × 26–30; all subcapitular (7) and adoral (3) setae setiform,



**Fig. 1.** *Graptopia (Graptopia) trapezoides* sp. n., adult (not shown: gnathosoma, legs): *a* – dorsal view, *b* – ventral view, *c* – right lateral view. Scale bar 50  $\mu$ m.



**Table 1.** Leg setation and solenidia of adult *Graptoppia* (*Graptoppia*) *trapezoides* sp. n.

| Leg | Tr     | Fe                | Ge     | Ti                                        | Ta                                                                                          |
|-----|--------|-------------------|--------|-------------------------------------------|---------------------------------------------------------------------------------------------|
| I   | v'     | d, (l), bv'', v'' | (l), σ | (l), (v), φ <sub>1</sub> , φ <sub>2</sub> | (fi), (tc), (it), (p), (u), (a), s, (pv), (pl), l'', v', ε, ω <sub>1</sub> , ω <sub>2</sub> |
| II  | v'     | d, (l), bv'', v'' | (l), σ | (l), (v), φ                               | (fi), (tc), (it), (p), (u), (a), s, (pv), l'', ω <sub>1</sub> , ω <sub>2</sub>              |
| III | l', v' | d, l', ev'        | l', σ  | l', (v), φ                                | (fi), (tc), (it), (p), (u), (a), s, (pv)                                                    |
| IV  | v'     | d, ev'            | d, l'  | l', (v), φ                                | (fi), (tc), (p), (u), (a), s, (pv)                                                          |

Note. Roman letters refer to normal setae, Greek letters – to solenidia (except ε = 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.

smooth. Palp length: 30–34; setation: 0–2–1–3–9(+1ω); postpalpal seta (2) spiniform. Chelicera length: 37–41; cheliceral setae (*cha*: 13; *chb*: 7) setiform, barbed.

**Epimeral and lateral podosomal regions.** Epimeral setal formula: 3–1–3–3; setae (*3c*, *4c*: 9; others: 6) setiform, smooth; *3c* located on tubercle; *4c* located on discidium. Discidium distinct, rounded distally.

**Anogenital region.** Genital (4), aggenital (9) and anal (7–9) setae setiform, smooth; adanal seta (15) setiform, slightly roughened; adanal seta *ad*<sub>3</sub> located posteriorly to aggenital seta (distance *ag*–*ag* similar to *ad*<sub>3</sub>–*ad*<sub>3</sub>). Adanal lyrifissure located parallel to or indistinctly inversely diagonal to anal plate.

**Legs.** Claw of each tarsus smooth. Porose area on all femora and on trochanters not observed. Formulas of leg setation and solenidia: I (1–5–2–4–20) [1–2–2], II (1–5–2–4–16) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Famulus short, erect, slightly swollen distally, inserted medially to solenidion ω<sub>1</sub>; seta *p* setiform on tarsi I versus thorn-like on tarsi II–IV; *s* on tarsus I eupathidial, located between paired setae *u* and *a*. Solenidion φ<sub>1</sub> on tibia I subflagellate; ω<sub>1</sub> on tarsus I, ω<sub>1</sub> and ω<sub>2</sub> on tarsus II, φ on tibiae II, III, σ on genu III bacilliform, φ on tibia IV setiform, others rod-like.

**Remarks.** *Graptoppia* (*Graptoppia*) *trapezoides* sp. n. is distinguishable from other species of the subgenus by the presence of the following combination of character states: 1) rostrum indented medially; 2) junction of costula and transcostula forming a protruding acute angle; 3) notogastral seta *c* vestigial, other notogastral setae medium-sized, setiform, slightly roughened; *la* and *lm* slightly removed from each other; 4) adanal setae medium-sized, setiform, slightly roughened; 5) adanal seta *ad*<sub>3</sub> located posteriorly to aggenital seta; 6) discidium rounded distally. Characters which distinguish the new species from other members of *Graptoppia* (*Graptoppia*) can be found in the identification key below.

**Etymology.** The species name *trapezoides* refers to the costulae and the transcostula forming a trapezoid structure on the prodorsum.

## DISCUSSION

1. *Graptoppia sundensis acuta* was described by Ayyildiz (1989) as a subspecies of *Graptoppia sundensis* (Hammer 1979), which is known from the Oriental region. The former may be distinguished from the latter by: the presence (versus absence) of well-developed transcostula; the presence of protruding acute angles at the junctions of transcostula and costulae; distinctly observed notogastral seta *c* (versus represented by alveolus). In my opinion, these differences are sufficient to support the independence of *G. sundensis acuta* at the species level. Therefore, instead of the existing subspecies status, I propose to assign a species status to this taxon: *Graptoppia acuta* Ayyildiz 1989 **stat. n.**

2. *Graptoppia parva* was described by Kok (1967) based on materials from South Africa. Subías and Rodríguez (1985) redescribed this species based on materials from Spain. However, species in the original description and the redescription differ in the morphology of the costular-transcostular complex. Therefore, I do not use the redescription data in the key below.

3. *Graptoppia mussardi* was described by Mahunka (1992). Subías (2022) included this species in the subgenus *Ramusella* (*Insculptoppia*) Subías 1980 based on the presence of three pairs of muscle sigillae in the interlamellar region (versus two pairs in the typical *Graptoppia*). Although provisionally I support his opinion, an additional study is needed.

## KEY TO KNOWN SPECIES OF GRAPTOPPIA (GRAPTOPPIA)

- 1 Notogastral setae (except *c*) branch-shaped ..... 2
  - Notogastral setae (except *c*) setiform ..... 4
- 2 Adanal seta *ad*<sub>3</sub> located laterally to aggenital seta; head of bothridial seta with 5–8 ciliae; body length: 196–208 ..... *G. (G.) arenaria* Ohkubo 1993
  - Distribution: Japan.
  - Adanal seta *ad*<sub>3</sub> located posterolaterally to aggenital seta; head of bothridial seta with more than 10 ciliae ..... 3
- 3 Notogastral seta *la* located posterolaterally to *lm*; notogastral seta *c* developed; body length: 202 ..... *G. (G.) exigua* (Mahunka 1983)
  - Distribution: Neotropical.

- Notogastral seta *la* located laterally to *lm*; notogastral seta *c* not developed; body length: 260 ..... *G. (G.) pentagona* (Alzuet 1981)  
Distribution: Argentina.
- 4 Transcostula not observed, costulae developed ... 5
- Transcostula and costulae developed ..... 7
- 5 Notogastral seta *la* located laterally to *lm*; interlamellar region with two tubercles; discidium rounded distally; body length: 245–274 ..... *G. (G.) alzueta* Martínez et Palacios-Vargas 2006  
Distribution: Argentina.
- Notogastral seta *la* located posterolaterally to *lm*; interlamellar region without tubercles; discidium pointed distally ..... 6
- 6 Lateral part of transcostula developed; notogastral seta *c* developed; body length: 210 ... *G. (G.) sundensis* (Hammer 1979)  
Distribution: Oriental.
- Transcostula absent completely; notogastral seta *c* not developed; body length: 203–208 ... *G. (G.) neominata* Subías 2004  
Distribution: Afrotropical, Mexico.
- 7 All adanal setae medium-sized, about half the anal plate length ..... 8
- All adanal setae *ad*<sub>1</sub> and *ad*<sub>2</sub> short, distinctly shorter than half the anal plate length ..... 9
- 8 All notogastral setae (except *c*) medium-sized, similar to adanal setae in length; rostrum indented; discidium rounded; distance *ag–ag* similar to *ad*<sub>3</sub>–*ad*<sub>3</sub>; body length: 165–180 ..... *G. (G.) trapezoides* sp. n.  
Distribution: Cuba.
- All notogastral setae (except *c*) short, shorter than adanal setae; rostrum rounded; discidium pointed; distance *ag–ag* distinctly shorter than *ad*<sub>3</sub>–*ad*<sub>3</sub>; body length: 212 ..... *G. (G.) paradoxa* Ivan et Vasiliu 1997  
Distribution: Romania.
- 9 Head of bothridial seta with less than 10 ciliae ... 10
- Head of bothridial seta with more than 10 ciliae ..... 11
- 10 Epimeral border IV straight; anal and adanal setae similar in length; body length: 198–205 ... *G. (G.) nukusia* (Shtanchaeva 1984)  
Distribution: central Western Asia.
- Epimeral border IV concave; anal seta shorter than adanal seta; body length: 205–244 ... *G. (G.) granadiensis* S. et A. Seniczak 2023  
Distribution: Spain.
- 11 The junction of costulae and transcostula forming protruding acute angles; body length: 240–250 ..... *G. (G.) acuta* Ayyildiz 1989.  
Distribution: eastern Mediterranean, Iran.
- The junction of costulae and transcostula not forming protruding acute angles ..... 12
- 12 Adanal seta *ad*<sub>3</sub> located laterally to aggenital seta; apodemal border IV absent; body length: 210–220 ..... *G. (G.) tanaitica* Karppin-

en et Poltavskaya 1990

Distribution: eastern Mediterranean.

– Adanal seta *ad*<sub>3</sub> located posterolaterally to aggenital seta; apodemal border IV present ..... 13

13 Adanal seta *ad*<sub>3</sub> located slightly posterolaterally to aggenital seta; transcostula slightly observed; body length: 209–225 ..... *G. (G.) jyotikanae* Sanyal, Saha et Chakraborty 2006

Distribution: India.

– Adanal seta *ad*<sub>3</sub> located distinctly posterolaterally to aggenital seta; transcostula clearly observed; body length: 232–270 ..... *G. (G.) paraanalis* Subías et Rodríguez 1985

Distribution: western Palaearctic.

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## ТАКСОНОМИЧЕСКОЕ ИЗУЧЕНИЕ ПАНЦИРНЫХ КЛЕЩЕЙ РОДА *GRAPTOPPIA* BALOGH 1983 (ACARI, ORIBATIDA, OPPIIDAE)

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Род панцирных клещей *Graptoppia* (Oribatida, Oppiidae) зарегистрирован впервые на Кубе. Описан один новый вид подрода *Graptoppia* (*Graptoppia*) – *G. (G.) trapezoides* sp. n.; описание базируется на имаго, собранных в листовом опаде прибрежного смешанного леса. Суммированы родовой и под-родовые признаки *Graptoppia*. Предложен идентификационный ключ для определения известных видов *Graptoppia* (*Graptoppia*).

**Ключевые слова:** клещи опииды, таксономия, родовой диагноз, морфология, идентификационный ключ, Неотропическая область