Complementary data on Graptoppia (Stenoppia) italica (Acari, Oribatida, Oppiidae) collected from Iran

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ABSTRACT. The oribatid mite of the family Oppiidae, Graptoppia (Stenoppia) italica (Bernini, 1973) (syn.: Oppia heterotricha Bernini, 1969) is redescribed based on females collected from soil in Sistan-o Baluchestan (Southeastern Iran) and South Khorasan (Central-Eastern Iran) provinces. Detailed descriptions of the gnathosoma and legs are also provided for the first time. The original description does not reflect the characters of the pubescence of the setae (cilia), characters on the lateral side of the ano-adanal region, as well as the true length of anal and adanal setae. Through the new finding of Graptoppia italica in Iran, the number of Oribatids in the family Oppiidae raised to 81 species.

Key words: Oppiid mite, redescription, morphology, systematics, soil, eastern Iran.

INTRODUCTION

The family Oppiidae Sellnick, 1937 (Acari, Acariformes: Oribatida) are the most diverse group of the oribatid mites, comprising 130 genera, 45 subgenera and 1084 described species (Subías, 2022). This family belongs to the superfamilly Oppioidea within apterogasterine group, one of the main groups of oribatid mites (Mirzaie & Akrami, 2012). Oppiid mites are generally about 200–600 μm in length and are characterized by the absence of prodorsal lamellae, tutorium, dorsophragma and pleurophragma, absence or presence of costula, diarthric subcapitulum, normal chelicerae, fused epimera III and IV, moniliform and monodactylous legs, 9–12 pairs of notogastral setae and 4–6 pairs of genital setae. They are most diverse in tropical regions, yet a great number of species have been found in temperate zones. Some oppiid species have worldwide distribution. They are common inhabitants of moss, humus, litter and pastures, in both moist and dry conditions and fungi make up a large part of oppiid diets with large masses of fungal spores being identified from their gut (Akrami, 2015b). According to the catalogue of Subías (2022), Graptoppia comprises three subgenera; Graptoppia (Graptoppia) Balogh, 1983, Graptoppia (Apograptoppia) Subías & Rodriguez, 1985, Graptoppia (Stenoppia) Balogh, 1983, 22 species and one subspecies. Graptoppia (Stenoppia) comprises 10 species, distributed in Nigeria, southern Neotropical, West...
Africa, Japan, western Mediterranean, Germany, Vietnam, Chile, South Africa and Sumatra. The main diagnostic characteristics of *Graptoppia (Stenoppia)* were summarized by Balogh (1983), Subías and Balogh (1989), and Balogh and Balogh (1992). An identification key to species of *Graptoppia (Stenoppia)* was presented by Ermilov and Frolov (2021). Members of the genus *Graptoppia (Stenoppia)* can be easily distinguished by the presence of well-developed costulae and transcostula, sensillus fusiform, short and unilaterally ciliate; rounded or tridentate rostrum, lamellar setae closer to interlamellar setae than to rostral setae, rostral setae far from each other, lyrifissure *iad* in adanal position, adanal setae *ad1* in postanal and *ad3* in preanal positions.

The genus *Graptoppia (Stenoppia)* belonging to the subfamily Multioppiinae Balogh, 1983 was proposed by Balogh (1983) with *Oppia heterotricha* Bernini, 1969 as the type species (now it is *Oppia italica* Bernini, 1973). Bernini was forced to change the name of *O. heterotricha* from Ravenna in 1973, because at the same time the same name was also used by Balogh and Mahunka (1969) for a South American entity. He proposed *O. italica* (Bernini, 1973) for the specimens collected from Ravenna. The same species was found in other localities, in Italy and Spain and redescribed (Subías & Arillo, 1991) from Portuguese. Both original (Bernini, 1973) and subsequent (Subías & Arillo, 1991) re-descriptions are suffering from an inadequate emphasis on the critical diagnostic characters, i.e. pubescence of the setae (cilia) and measurements. Our recent surveys in the Southeastern and Central–Eastern parts of Iran during 2018–2021 (Sistan-o Baluchestan and South Khorasan provinces) led to the collection of the oribatid mites in soil samples. Among them we found specimens run to *Graptoppia italica*, which herein redescribed and illustrated. A comparison of the Iranian specimens with the original description (intraspecific variabilities), was made and additional diagnostic characters are also provided.

**MATERIAL AND METHODS**

Soil samples were collected from Sistan-o Baluchestan province (Zahak county) and South Khorasan province (Birjand county) during 2018–2021. Each sample contained about two kilograms of soil taken from the surface to a depth of 15 cm. Mites in soil samples were extracted through Berlese-Tullgren funnels set to jars with 75% ethanol. Subsequently, mite individuals were removed, cleared in lactophenol fluid and permanently mounted on microscope slides using Hoyer’s medium. The slides were placed in an oven at 45°C for two weeks. The mites were examined under an Olympus BX41 phase contrast microscope. Figures were made using a drawing tube attached to the microscope. The examined material and data on their locality and habitat are given in the ‘material examined’ section. Only adults (female) were collected. Body length was measured from the tip of the rostrum to the posterior edge of the notogaster, and body width refers to the maximum width of the notogaster in dorsal aspect. All body measurements are presented in micrometres (μm). The length of some setae is given in parenthesis. Morphological terminology and abbreviations used in this paper follow Ermilov and Frolov (2021). Five specimens are deposited in the Collection of the Department of Plant Protection, College of Agriculture, University of Zabol, Iran, and one is deposited in the Acarological collection of the Department of Plant Protection, School of Agriculture, Shiraz University, Iran.

**RESULTS**

**Taxonomic hierarchy**

*Phylum Arthropoda* von Siebold, 1848

*Order Sarcoptiformes* Reuter, 1909

*Suborder Oribatida* Dugès, 1834

*Family Oppiidae* Sellnick, 1937

*Subfamily Multioppiinae* Balogh, 1983

*Genus Graptoppia* Balogh, 1983

*Subgenus Stenoppia* Balogh, 1983
**Graptoppia (Stenoppia) italic(a) (Bernini, 1973)**


*Oppia italic(a) Bernini, 1973, 3(1):421. (replacement name by Bernini, 1973)

*Graptoppia (Stenoppia) italic(a) Bernini, 1973. (new combination by Balogh, 1983)

**Material examined.** Four specimens: Zahak county, Chah-Nimeh recreational, Sistan-o Baluchestan province, southeastern Iran, soil under berry tree (*Morus* sp.), 30°50'39"N, 61°43'07"E, 483 m a.s.l., 11-V-2018; one specimen: Zabol county, Campus of the University of Zabol, Sistan-o Baluchestan province (Southeastern Iran) soil under tamarisk (*Tamarix* sp.), 31°02'26"N, 61°32'07"E, 475 m a.s.l., 22-VI-2021, coll.: F. Ordouni; one specimen: Birjand county, Waterfall Chahardeh village, South Khorasan province (Central-Eastern Iran), the soil under waterfall, 32°48'35"N, 59°14'26"E, 1686 m a.s.l., 7-V-2020, coll.: M. Kohansal.

**Diagnosis.** Body size: 196–285 (length) × 92–184 (width). Rostrum rounded and not incised, costulae and transcostula present, well-developed, basal part of costulae not developed. Rostral, lamellar, interlamellar and exobothridial setae setiform with 3, 2, 2, and 1 cilia respectively. Rostral setae slightly thicker and longer than lamellar and interlamellar setae. Bothridial setae fusiform with long ten branches. Interbothridial region with two pairs of clear muscle sigillae. Interbothridial tubercles absent. Longitudinal rows, comprising four pairs of muscle sigillae, present in front of the bothridia, nine pairs long, setiform with one branch notogastral setae, one pair (c) of minute, needle form without branch setae. Epimeral and anogenital setae thin and setiform and epimeral border IV semi-oval. Long lyrifissures *ia*, *im*, *iad*, *ad* and *ad* setae thicker and longer than other ano-adanal setae, *ad* setae with one branch and the others smooth, solenidionφ of tibia I very long, whip-like.

**Complementary description (Figs 1–8)**


**Integument (Figs 1).** Body colour light brownish. Body surface smooth but transcostular regions densely microgranulate.

**Prodorsum (Figs 1).** Prodorsum with rostrum rounded, undivided, costulae and transcostula. Lamella and translamella well-developed, basal part of costulae not developed. Rostral setae (*ro*, 19–21) setiform, with 3 cilia, lamellar (*le*, 10–15) and interlamellar (*in*, 10–13) setae setiform, slightly thinner than rostral setae, each with 2 cilia; rostral setae far from each other, longer than their mutual distance, *le* subequal to their mutual distance (*le–le*), interlamellar setae shorter than their mutual distance. Setae *le* nearer to setae *in* than to setae *ro*, originating on transcostula line. Exobothridial setae (*ex*, 9–15) setiform, thin with one cillum and inserted anterolateral to funnel-shaped bothridia. Bothridial setae (*bs*, 30) fusiform and unilaterally ciliate with long 10 branches to make the heads of the branches converge towards each other. Two pairs of interbothridial and four pairs of muscle sigillae present in front of the bothridia. Relative distances: (*ex–ex*) > (*in–in*) > (*le–le*) = (*ro–ro*).

**Notogaster (Figs 1).** Smooth with 10 pairs of setae developed. Setae *c* needle-form and much shorter than the others, directed laterally, other setae long, setiform with one short branch towards the apex (12–17). Opisthontonal gland openings and notogastral lyrifissures *ia*, *im* well visible; *ip*, *ih* and *ips* not observed. Circumgastric scissure and circumgastric sigillar band visible.

**Gnathosoma (Figs 2–4).** Subcapitulum shorter than wide. Three pairs of subcapitular setae (*a*, *m*, *h*) setiform, slightly barbed, *h* shorter than *m* and *a*. Two pairs of adversal setae (*or*, *or*) setiform, thin, smooth. Palps with typical setation 0-2-1-3-9(+1ω). Chelicerae with two setiform, barbed and ciliated setae, *cha* longer than *chb*. Trägårdh’s organ (*Tg*) of chelicerae narrowly triangular.

**Epimeral regions** (Fig. 2). With a number of round muscle sigillae. Epimeralseta formula 3-1-3-3. Setae setiform, thin, short, epimera II and IV fused and epimeral I and II narrower than epimers III and IV, epimeral border IV distinct, semi-oval. Discidia triangular, rounded distally.
**Anogenital region** (Fig. 2). Genital plates (21–30 × 20–40) with four pairs of genital ($g_1$–$g_4$) and one pair of aggenital ($a_g$) plates, two pairs of anal ($an_1$, $an_2$) and three pairs of adanal setae ($ad_1$–$ad_3$) setiform and thin; both genital and aggenital plates smaller than anal plates (30–51×30–52). Adanal setae longer than anal setae. Three pairs of well-developed genital papillae present. Long lyrifissures *iad* located close and parallel to anal plates, setae *ad*$_1$ in postanal and setae *ad*$_3$ in preanal position. Setae *ad*$_1$ and *ad*$_2$ thicker and longer than other ano-adanal setae. Setae *ad1* with one branch and *ad2* smooth.

**Legs** (Figs 5–8). All legs monodactylous, claws slender and smooth. Porose areas on femora and trochanters III and IV 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 listed in Table 1. Famulus of tarsi I erect, blunt-ended, inserted posterior to solenidion *ω*$_1$. Solenidion *φ*$_1$ of tibia I very long, whip-like. Solenidia *ω*$_1$ on tarsus I, *ω*$_1$ and *ω*$_2$ on tarsus II and *φ* on tibia II, III and IV and *σ* on genu III bacilliform, Solenidia *ω*$_2$ on tarsus I, *φ*$_2$ on tibia I, *σ* on genua I and II, slightly thickened, slightly blunt-ended.

**Distribution.** Western Mediterranean, Germany, Vietnam (Subías, 2022) and Iran (present study).

**Remarks.** Iranian specimens of this species differ from Italian, Spanish and Portuguese specimens (Bernini, 1969; Subías & Arillo, 1991) by having lamellar, interlamellar, exobothridial and notogaster setae with 2, 2, 1 and 1 branch respectively, adanal setae longer than anal setae, longer lyrifissures (Bernini, 1969; Subías & Arillo, 1991) by having lamellar, interlamellar, exobothridial and notogaster ano-adanal region, as well as the ano-adanal setae, so their true length was unclear. The lengths of setae *iad* made under small magnification, so that, the true pubescence of the setae is unclear. Furthermore, the original description does not reflect the characters of the lateral side of the ano-adanal region, as well as the anal adanal setae, so their true length was unclear. The lengths of lyrifissures are not an appropriate character for separating the species of *Graptoppia* (*Stenoppia*), but the position of the adanal lyrifissure is widely accepted.

**DISCUSSION**

The oribatid fauna of Iran is represented by 86 families, 191 genera and 380 species (Akrami, 2015a). Considering the new findings of *Graptoppia* (*Stenoppia*) _italica_ in Iran, the number of Oribatids in the family Opiliidae raised to 81 species. There was controversy on the number of cilia on setae made it difficult to use these characters for diagnosis. While the general differences were considered as the intraspecific variabilities, we believe both original (Bernini, 1973) and the subsequent redescription (Subías & Arillo, 1991) were made under small magnification, so that, the true pubescence of the setae is unclear. Furthermore, the original description does not reflect the characters of the lateral side of the ano-adanal region, as well as the anal adanal setae, so their true length was unclear. The lengths of lyrifissures are not an appropriate character for separating the species of *Graptoppia* (*Stenoppia*), but the position of the adanal lyrifissure is widely accepted.

**Table 1.** Leg setation and solenidia of adult *Graptoppia* (*Stenoppia*) _italica_ (Bernini, 1973).

<table>
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<th>Leg</th>
<th>Tr</th>
<th>Fe</th>
<th>Ge</th>
<th>Ti</th>
<th>Ta</th>
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<tr>
<td>I</td>
<td>$v'$</td>
<td>$d,(l),bv''$, $v''$</td>
<td>(l), $σ$</td>
<td>(l), (v), $φ_1$, $φ_2$</td>
<td>(ft), (tc), (it), (p), (u), (a), s, (pv), $v'$, (pl), $l''$, $ɛ$, $ω_1$, $ω_2$</td>
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<tr>
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<td>$v'$</td>
<td>$d,(l),bv''$, $v''$</td>
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<tr>
<td>III</td>
<td>$l'$, $v'$</td>
<td>$d, l'$, $εv'$</td>
<td>$l'$, $σ$</td>
<td>$l'$, (v), $φ$</td>
<td>(ft), (tc), (it), (p), (u), (a), s, (pv)</td>
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<tr>
<td>IV</td>
<td>$v'$</td>
<td>$d,εv'$</td>
<td>$d$, $l'$</td>
<td>$l'$, (v), $φ$</td>
<td>$f_l''$, (tc), (p), (u), (a), s, (pv)</td>
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**Note:** Tr, Fe, Ge, Ti, Ta - leg trochanter, femur, genu, tibia, tarsus, respectively. Roman letters refer to normal setae, Greek letters to solenidia (except $ɛ$ = famulus). 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.
AUTHOR’S CONTRIBUTION
The authors confirm their contribution in the paper as follows: F.O.: Sample collection, Initial identification; S.R.: Preparing the description and line drawings; M.A.A.: Confirmation of the identifications. All authors read and approved the final version of the manuscript.

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CONFLICT OF INTERESTS
The authors declare that there is no conflict of interest regarding the publication of this paper.

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اطلاعات تکمیلی گونه‌ی 

جمع‌آوری شده (Acari, Oribatida, Oppiidae) *Graptoppia (Stenoppia) italica* از ایران

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چکیده: کهنه گونه‌ی *Graptoppia* (Bernini, 1973) متعلق به خانواده Oppiidae می‌باشد که به‌سئولیت در ایتالیا گزارش شده است. این گونه در ایران به‌طور کمی در محیط‌های بارانی دیده می‌شود.

syn.: *Graptoppia (Stenoppia) italica* (Bernini, 1969) متعلق به خانواده Oppiidae می‌باشد که به‌سئولیت در ایتالیا گزارش شده است. این گونه در ایران به‌طور کمی در محیط‌های بارانی دیده می‌شود.

واژگان کلیدی: کهنه‌گونه، بارانی، سیستم‌اتیک، ناحیه شرق ایران.