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## Article

### The first record of *Ghilarovus humeridens* Krivolutsky (Acari, Oribatida, Zetomotrichidae) from Iran with a supplementary description

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#### ABSTRACT

The oribatid mite *Ghilarovus humeridens* Krivolutsky, 1966 (Oribatida, Zetomotrichidae), the type species of the genus originally described from Turkmenistan, is recorded in Iran for the first time. A supplementary description of this species is given with detailed illustrations based on Iranian materials. The main morphological traits of *G. humeridens* are summarized.

**KEYWORDS:** Fars province, morphology, new record, oribatid mite, Zetomotrichinae.

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#### INTRODUCTION

The oribatid mite genus *Ghilarovus* (Acari, Oribatida, Zetomotrichidae) was established by Krivolutsky (1966), with *Ghilarovus humeridens* Krivolutsky, 1966 from Turkmenistan as type species. *Ghilarovus* is a small genus, comprised of 15 nominal species and representatives of this genus seem to be relatively rare and have restricted distribution. Thirteen species have been described from the Palearctic region (Southwestern Europe: Spain; Central Asia: Turkmenistan and Kazakhstan; Western Asia-Eastern Europe: Armenia, Georgia; Eastern Asia: Japan, Mongolia and China) and two are known from the Nearctic region (Mexico and USA) (Bayartogtokh and Smelyansky 2007; Subías 2004, updated 2023).

The main generic traits of the genus were summarized by Behan-Pelletier and Knee (2019), and they provided an expanded diagnosis for adults of *Ghilarovus*. The identification keys to known species of the genus *Ghilarovus* were presented by Bayartogtokh and Smelyansky (2007), and later revised by Behan-Pelletier and Knee (2019). Features, such as denticulation of rostrum (number and size of dents), bothridial seta (shape, size and number of branches), anal (1 or 2 pairs) and adanal (2 or 3 pairs) setation, the conditions of posterior tectum of notogaster (divided or undivided), and of the pyriform organs and humeral sac of notogaster (presence or absence) are used to differentiate the species in this genus.

According to Krivolutsky (1966, 1975), Karppinen *et al.* (1986), and Wang *et al.* (2003), *G.*

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*humeridens* has been recorded only from Turkmenistan (from dark brown soil under walnut-fruit forests composed by walnut, maple and apple trees), Uzbekistan (soil-litter of juniper forest) and in eastern part of China (soil and litter of deciduous forests), and there were no further records until now in spite of comprehensive studies conducted in these regions.

In the course of taxonomic studies of the oribatid mite fauna in Fars province, Southern Iran, we found *Ghilarovus humeridens* in two localities: Shiraz and Sepidan counties. Prior to this study, there was only one record of this genus from Iran: *Ghilarovus hispanicus* Subías & Pérez-Íñigo, 1977 (Akrami 2015), thus it is the first finding of *Ghilarovus humeridens* in Iran. *Ghilarovus humeridens* was poorly described by Krivolutsky (1966) and the original description was too brief and not illustrated completely, providing only figures of dorsal view of body, and lacking some important morphological features such as ventral view of body, measures of some morphological structures, leg setation and solenidia, and the morphology of gnathosoma; furthermore, there is no redescription or detailed figures in the other literatures. It is therefore warranted to provide an additional description of this species. The goals of the present work are to present a supplementary description and illustrate the morphology of *G. humeridens*, adding new information about some morphological structures and their measurements, putative homology of leg setae and solenidia and morphology of the gnathosoma, based on adult specimens (females and males) from Iran, and to summarize the main morphological traits, which will assist the identification of this species in the future.

## MATERIALS AND METHODS

Specimens were collected by M. Behmanesh (in 2009) and J. Shahvand (in 2021), the former graduate students at the Shiraz University. Samples of soil and litter were taken from upper layer to a depth of nearly 15 cm under plants. Mites were extracted in the laboratory using Berlese funnels, cleared in lactophenol and mounted in Hoyer's medium on permanent glass microscope slides. Some specimens mounted in lactic acid on temporary cavity slides for drawing and illustration of the lateral aspect. The examined material and data on their locality and habitat are presented in the 'material examined' section. Mites were studied using a light microscope (Zeiss Standard 20) and drawing tube attached to the microscope.

Body length was measured from the tip of the rostrum to the posterior edge of the notogaster as seen in dorsal view; body width refers to the maximum width of the notogaster in dorsal aspect. All body measurements are presented in micrometers ( $\mu\text{m}$ ). The length of some body setae is given in parentheses.

General morphological terminology used in this paper mostly 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.

The following abbreviations are used: *ro*, *le*, *in*, *ex*, *bs* = rostral, lamellar, interlamellar, exobothridial, and bothridial setae, respectively; *bo* = bothridium; *tu* = tutorium; *Am* = humeral porose area; *hu* = humeral sac; *c*, *la*, *lm*, *lp*, *h*, *p* = notogastral setae; *im*, *ip*, *ih*, *ips* = notogastral lyrifissures; *gla* = opisthonotal gland opening; *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *v*, *l*, *d*, *cm*, *acm*, *ul*, *sul* = palp setae;  $\omega$  = palp and leg solenidium; *ep* = postpalpal seta; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ; *RU* = rutellum; *Pd I*, *Pd II* = pedotecta I and II, respectively; *p.a.* = porose area; *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *3c*, *4a*, *4b*, *4c* = epimeral setae; *dis* = discidium; *cus* = custodium; *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal setae, respectively; *iad* = adanal lyrifissure; *p.o.* = preanal organ;  $\sigma$ ,  $\phi$  = leg solenidia;  $\epsilon$  = leg famulus; *v*, *ev*, *bv*, *l*, *d*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *p**v*, *p**l* = leg setae;  $\psi$ ,  $\tau$  = eugenital setae; L1–L3 = ovipositor lobes; bDp = base of distal portion of ovipositor.

### Taxonomy

#### Family Zetomotrichidae Grandjean, 1934

#### Genus *Ghilarovus* Krivolutsky, 1966

#### *GHILAROVUS HUMERIDENS* FROM IRAN

*Ghilarovus humeridens* Krivolutsky, 1966 (Figs. 1–4)

*Diagnosis*

**Adult** – Total length 402–482. Rostrum with slightly protruding median part having four teeth of subequal size and about 10 small lateral dentations on each side. Rostral, lamellar and interlamellar setae long, barbed; bothridial seta filiform, with 9–11 pectinations on one side. Posterior notogastral tectum divided, with overlapping lobes. Notogaster with numerous minute pores scattered irregularly. Notogastral setae thin, acuminate, except  $c_2$  thick, finely barbed, tapered. Humeral sac extending posteriorly almost to level of lyrifissure *im*. Pyriform organ absent. Custodium long, strongly tapered, extending to base of pedotectum I.

**Juveniles** – Unknown.

*Supplementary description*

**Measurements** – Body length: female (n = 1) 410; males (n = 3) 408 (range 402–416). Notogastral width: female (n = 1) 263; males (n = 2) 260 (249–271). No differences between females and males in body size.

**Integument** – Body color light brown to yellowish brown. Body surface finely and densely punctate.

**Prodorsum (Figs. 1A, 1C, 3E)** – Rostrum dentate, median part having four teeth, subequal in size and spacing, about 3 in length, separated from anterolateral margins by deep indentations, and with about 10 pairs of lateral small dentations. Lateral dents more closely adjacent than medial ones. Rostral seta (51–64) long, acuminate, curved anteromedially; mutual distance 45–50. Lamellar seta (92–104) longest prodorsal setae, moderately barbed, extending well beyond rostrum to tip of rostral seta, mutual distance about 58. Interlamellar seta (62–68) extending beyond insertions of rostral setae, but not reaching rostral tip, mutual distance 79–83. Exobothridial seta (18–23) short and fine, weakly barbed, inserted laterally to bothridium, its insertion situated under anterior part of notogaster. Bothridial seta 75–83 long, directed posterolaterally, with 9–11 pectinations on one side, each about 7–10 in length. Bothridium (16 × 18) small, cup-shaped, its posterior half covered by notogaster, mutual distance about 95.

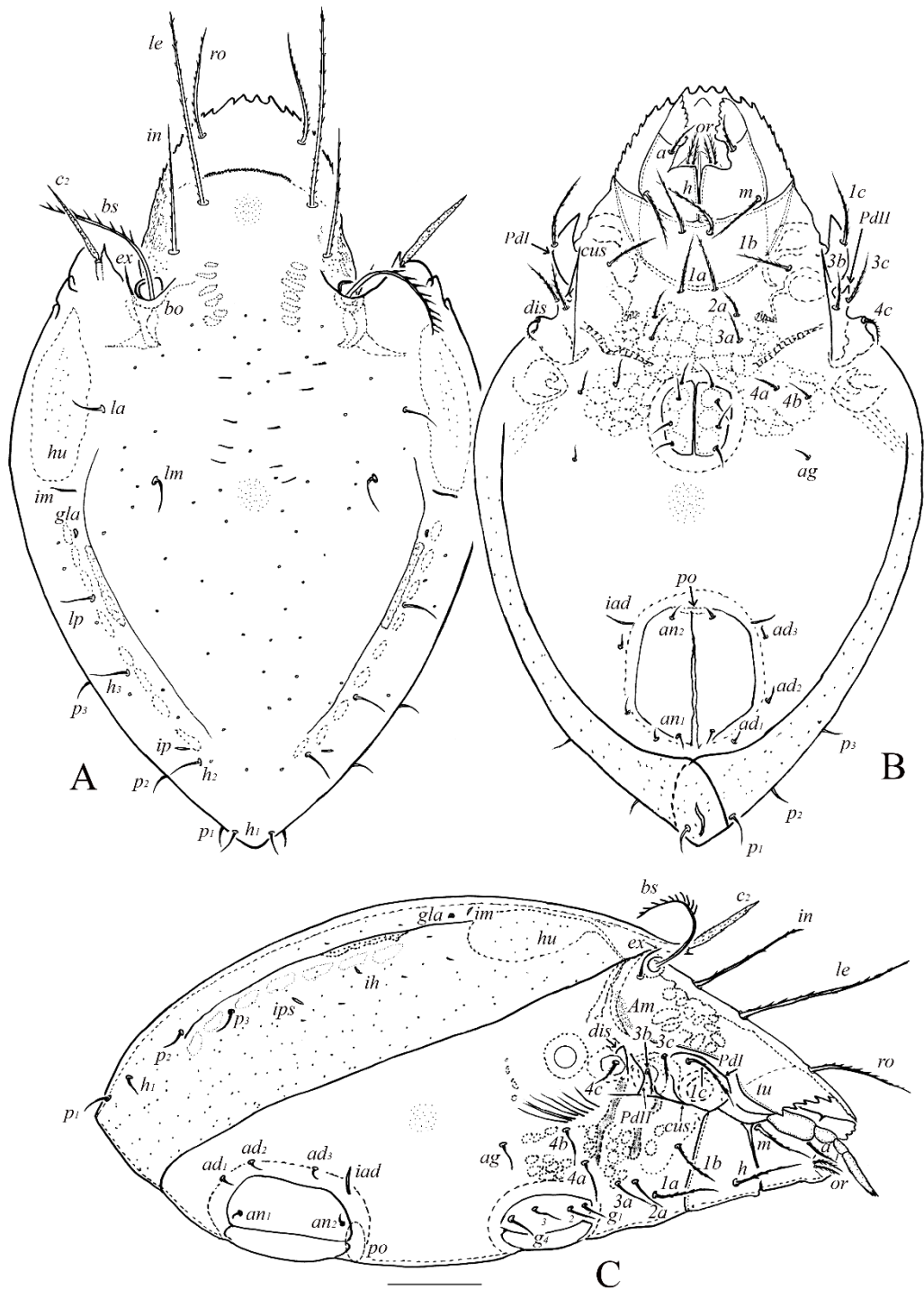
A weakly developed transverse line anteriorly to insertion of lamellar seta present. No pores present on prodorsal surface. Six pairs of relatively large muscle sigillae in dorsosejugal and interbothridial regions, and some smaller ones anterior to each bothridium.

**Notogaster (Figs. 1A, 1C, 3D)** – Notogaster oval, broad anteriorly, conspicuously narrower posteriorly. Posterior margin divided, with lobes overlapping medially, visible in ventral view. Humeral projection accompanied posteriorly by a nearly round triangular projection; humeral seta  $c_2$  45–55 long, thickened and weakly barbed, tapered (slightly dilated in median part), positioned dorsally on humeral tubercle. Other notogastral setae setiform, thin, acuminate, 16–22 long. Seta *lm* positioned medially, in longitudinal alignment with bothridial seta, other setae inserted laterally. Humeral sac (*hu*) large, about 90 long, sac-like, extending to vicinity of lyrifissure *im*. Pyriform (pear-shaped) organ absent.

Lyrifissure *ia* not evident; *im* longest notogastral lyrifissure, as long as 2/3 notogastral setae, situated posterior to humeral sac, lateral of seta *lm*, aligned transversely. Lyrifissure *ip* medium-sized, situated anterior to seta  $h_2$ ; *ih* and *ips* short but well developed, situated anterior to seta  $p_3$ , visible only in lateral view. Numerous minute notogastral pores scattered irregularly on notogastral surface. Opening of opisthonotal gland (anterolaterally to seta *lp*) between *im* and seta *lp*. Circumgastric sigillar band visible.

**Epimeral and lateral podosomal regions (Figs. 1B, 1C, 2A, 3C)** – Acetabulum IV situated adjacent to acetabulum III. Pedotectum I *PdI* long. Notogastral lyrifissures *ih* and *ips* distinct, short. Epimeral region with numerous muscle sigillae, creating illusion of reticulate pattern. Apodemata sejugal *apo.sj* and II *apo.II* well developed, aligned obliquely, other apodemes not evident. Epimeral

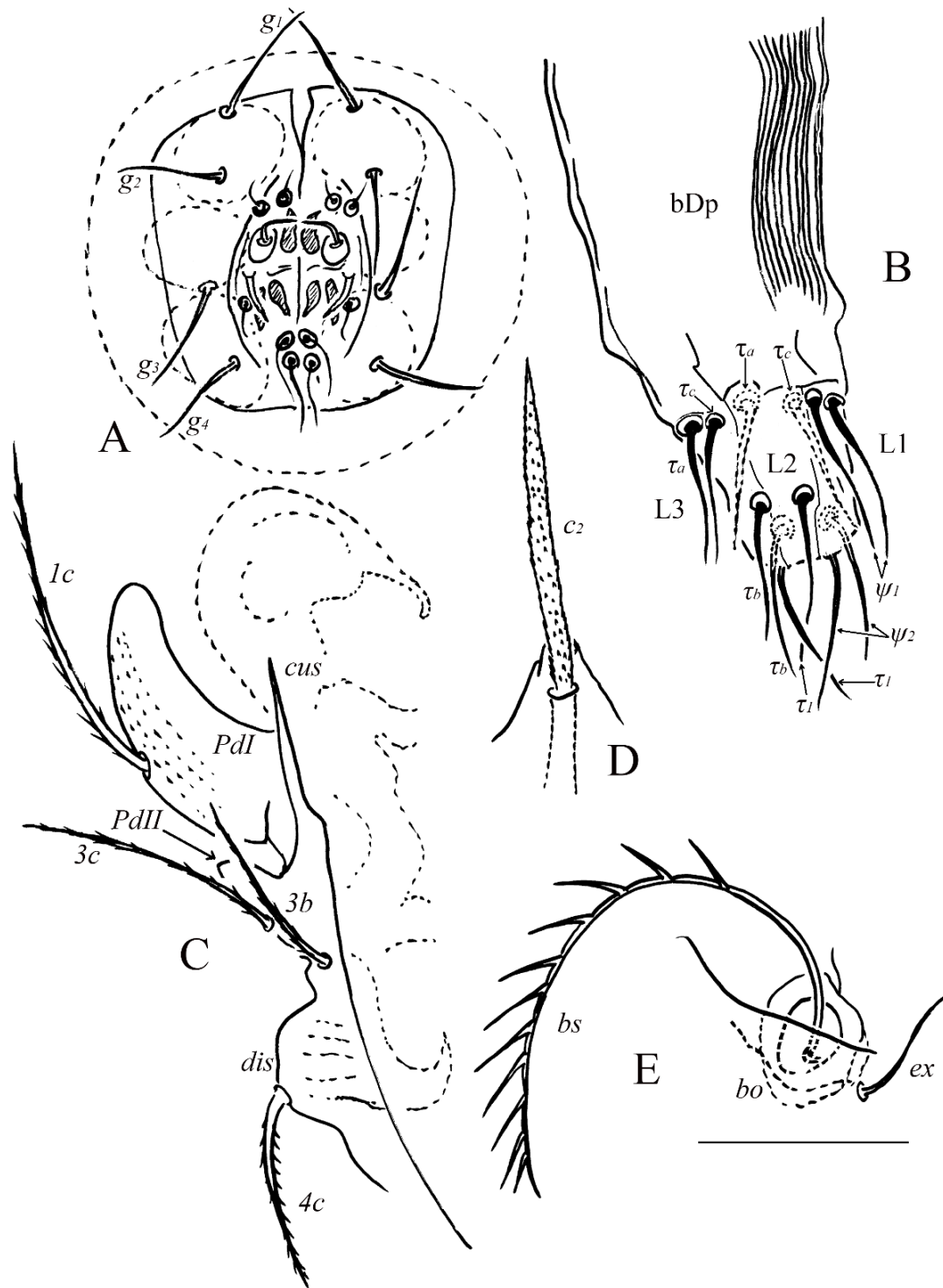
setae relatively long, conspicuously barbed, setal formula 3-1-3-3. *1a* (30–40) long and thick, almost reaching insertion of hypostomal seta *h*, directed anteriorly. *1c* (40–48), *3b* (37), *3c* (27–32), *1b* (27), *4c* (21–24), *2a*, *3a*, *4a*, *4b* (15–18). Custodium strongly tapered, extending to base of *PdI*. Pedotectum I relatively large, bearing seta *1c*, pedotectum II smaller, bearing setae *3b* and *3c*. Discidium weakly triangular, bearing seta *4c*.



**Figure 1.** *Ghilarovus humeridens* Krivolutsky, 1966, (adult, legs not shown) – **A.** Dorsal view of body; **B.** Ventral view of body; **C.** Lateral view (palpal setae not shown; only some posterolateral setae of notogaster are shown). Scale bar = 50  $\mu$ m.



No specialized strong setae on legs and acetabulum not dorsally displaced, so not adapted for jumping. On tarsus I solenidion  $\omega_2$  approximately triple as long as solenidion  $\omega_1$ . Solenidia  $\phi_1$  of tibia I and  $\phi$  of tibia II very long, setiform, located on dorsodistal apophyses. Famulus  $\varepsilon$  of tarsi I short, blunt-ended. All tarsal setae barbed, setae on ventral side of tarsi I–IV robustly barbed.



**Figure 3.** *Ghilarovus humeridens* Krivolutsky, 1966 (adult) – A. Genital region, showing genital setae and male organ; B. Ovipositor (part of bDp is shown); C. Part of ventral plate, showing pedotecta I and II, discidium and custodium; D. Notogastral seta  $c_2$ ; E. Bothridium, bothridial and exobothridial setae. Scale bar = 25  $\mu\text{m}$ .



**Table 1.** Leg setation and solenidia of adult *Ghilarovus humeridens* Krivolutsky, 1966.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv'', v''	(l), σ	(l), (v), φ <sub>1</sub> , φ <sub>2</sub>	(ft), (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	(ft), (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	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	l', (v), φ	ft'', (tc), (p), (u), (a), s, (pv)

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

### Material examined

Specimens of *G. humeridens* were collected in two counties in Fars province, southern Iran: Locality 1- Shiraz county, nine specimens, collected by M. Behmanesh, 2.XI.2009: Dasht-e Arjan, soil of oak trees, *Quercus* sp. (Fagaceae) and azarole hawthorn, *Crataegus azarolus* L. (Rosaceae), 29° 34' N, 52° 57' E, 2042 m a.s.l.; Khanezenyan, soil of prickly thrift, *Acantholimon* sp. (Plumbaginaceae), 29° 40' N, 52° 08' E, 1953 m a.s.l.; Qalat, soil of mountain almond, *Amygdalus scoparia* Spach (Rosaceae) on the top of the mountain, 29° 48' N, 52° 18' E, 2431 m a.s.l.; Locality 2- Sepidan county, three specimens, collected by J. Shahvand: Komehr village, soil of cypress trees, *Cupressus* sp. (Cupressaceae), 2.VII.2021, 30° 41' N, 51° 89' E, 2334 m a.s.l.; Ardakan, soil of sweet almond trees, *Amygdalus communis* L. (Rosaceae), 18.IX.2021, 30° 16' N, 51° 58' E, 2299 m a.s.l.

### Material deposition

The specimens are deposited in the Acarological Collection of the Department of Plant Protection, School of Agriculture, Shiraz University, Shiraz, Iran.

### Ecology

This species has relatively wide distribution in the Palaearctic region and is a typical inhabitant of the soil-litter of various dry forests and mountain soils in the arid environments (Krivolutsky 1966, 1975; Karppinen *et al.* 1986; Chen *et al.* 1992; Wang *et al.* 2003).

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***Ghilarovus humeridens* Krivolutsky (Acari, Oribatida, نخستین گزارش کنه اریباتید، همراه با توصیف تکمیلی Zetomotrichidae) از ایران،**

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**چکیده**

کنه اریباتید *Ghilarovus humeridens* Krivolutsky, 1966 از خانواده Zetomotrichidae (Acari: Oribatida) که گونه‌تایپ جنس بوده و از کشور ترکمنستان توصیف شده، برای نخستین بار از ایران گزارش می‌شود. توصیف تکمیلی این گونه با تصاویر همراه با جزئیات بر اساس نمونه‌های جمع‌آوری شده از ایران ارائه شده است. ویژگی‌های اصلی ریخت‌شناسی این گونه به صورت خلاصه بیان شده است.

**واژگان کلیدی:** استان فارس، ریخت‌شناسی، گزارش جدید، کنه اریباتید، زیرخانواده Zetomotrichinae

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