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Article

# New reports of caraboacarid mites (Acari: Trochometridioidea) from Iran, with some notes on their host specificity

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**ABSTRACT**
During a comprehensive survey of heterostigmatic mites associated with ground beetles and soil samples in northern and northeastern Iran, several colonies of caroboacarid mites, including three species of the genus *Caraboacarus* Krczal, 1959, *C. stammeri* Krczal, 1959, *C. karenae* Nickel & Elzinga, 1969, and *C. krczali* Eidelberg, 1994 as well as *Minicaraboacarus quadridiscalis* Hajiqanbar & Khaustov, 2008 and *Intercaraboacarus clivinus* Katlav & Hajiqanbar, 2015, were extracted from soil samples and ground beetles of the genera *Calosoma* Weber, *Harpalus* Latreille, *Amara* Bonelli and *Scarites* Fabricius in the sampling area. The world distribution and host specificity are examined.

**KEYWORDS:** Carabidae, Caraboacaridae, Heterostigmata, host preference, new record.

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## INTRODUCTION

Caraboacaridae Mahunka, 1970 (Acari: Heterostigmata) has been poorly studied (Trach and Khaustov 2012). Members of this family are rarely found in soil samples and are only associated with different carabid beetles, except for one association record of *Caraboacarus stammeri* Krczal, 1959 and a silphid beetle (Hajiqanbar *et al*. 2008; Mortazavi *et al*. 2011; Trach and Khaustov 2012). The relationship between caraboacarid mites and their host is controversial, but parasitism has been suggested based on enlarged chelicerae inserted into the veins of carabid's hind wings (Cross 1965; Nickel and Elzinga 1969). However, this is doubtful, because only adult females have been found, and no other instars have been discovered until now (Kaliszewski *et al.* 1995). The association between caraboacarid mites and carabid beetles is more than a simple phoresy; it seems that the mites live in the soil below the areas where these carabids exist and crawl on their bodies (Hajiqanbar *et al*. 2008). Furthermore, parasitoidism is also a possibility (Kaliszewski *et al*. 1995). These factors have affected the systematic status of the family. After multiple displacements (Krczal 1959; Cross 1965; Mahunka 1970; Lindquist 1986; Kaliszewski *et al*. 1995; Walter *et al*. 2009), the family

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Caraboacaridae along with two other families, Athyreacaridae Lindquist, Kaliszewski & Rack, 1990 and Trochometridiidae Mahunka 1970 constitute a controversial superfamily Trochometridioidea (Klimov *et al*. 2017; Rahiminejad *et al*. 2023; Khaustov *et al.* 2024).

The family includes three genera, two monotypic, *Minicaraboacarus* Hajiqanbar & Khaustov, 2008, *Intercaraboacarus* Katlav & Hajiqanbar, 2015 and *Caraboacarus* Krczal, 1959 with eight described species (Hajiqanbar *et al*. 2008; Mortazavi *et al*. 2011; Katlav *et al*. 2015). The best-known species *Caraboacarus stammeri*, is the type species of the type genus of the family. More than 30 species of carabid beetles, and one predatory silphid beetle *Ablattaria laeviga laevigata* (Fabricius, 1775) (Col.: Silphidae) are recorded as hosts of this species in the Palearctic region (Eidelberg 1993; Trach and Khaustov 2012). Seven other species, *C. karenae* Nickel & Elzinga, 1969, *C. towsleyi* Husband & Husband, 1984, *C. calosomae* Husband, 1986, *C. bernardi* Haitlinger, 1990, *C. krczali* Eidelberg, 1994, *I. clivinus* Katlav & Hajiqanbar, 2015 and *M. quadridiscalis* Hajiqanbar & Khaustov, 2008 were recorded from various carabid beetles (Eidelberg 1993, 1994; Krantz and Walter 2009, Katlav *et al*. 2015). In Iran, the Caraboacaridae was first recorded in Alborz province (Mirjamali *et al*. 2008). Since then, three genera and five species of Caraboacaridae have been recorded from north, northwestern and central parts of Iran (Rahiminejad *et al*. 2023).

During a study of heterostigmatic mites in Gorgan, northern Iran, several colonies of all caraboacarid genera, including five species, were found from various host carabid beetles. The study aims to examine the host range of species and reports new host specificity.

## MATERIAL AND METHODS

The mite specimens, under a stereomicroscope (Olympus® SZ, Tokyo, Japan), were either detached from host beetles or extracted from jar jams containing ethanol and the sediments of soil samples extracted by Berlese funnels. The soil samples and host beetles were collected as a result of several collecting trips in Sari, Mazandaran province (A'ali-Kola, Zar'rin-Abad forests and agricultural and horticultural areas around Lak-Dasht village) and Gorgan, Golestan province (Alangdareh and Ziarat forests and Aq-Qala), northern Iran in 2023. All mite species were detached from carabid beetles. Host beetles were captured by direct sampling and soil samples.

For the preparation of specimens, the mites were cleared in Nesbitt's fluid and then mounted in Hoyer's medium. A light microscope (model BX51, Olympus, Tokyo, Japan) equipped with phase-contrast illumination and a camera lucida was used for the study of morphology of mites. The taxonomic system of Caraboacaridae follows the opinion of Kaliszewski *et al*. (1995). All collected specimens were adult females. Details of geographical position have been recorded with using a global positioning system (GPS mobile device). The materials have been deposited in the Arthropods Collection, Acari section, Department of Plant Protection, Faculty of Plant Production, Gorgan University of Agricultural Sciences and Natural Resources, Golestan, Iran.

*Notes*

The mites are arranged alphabetically by genera and species within the genus.
**World distribution –** Country(ies), host(s) [as given in source publication], source publication(s).
**Material examined –** All available data about species, host(s), sampling method(s) and location(s).
**Remarks –** Any relevant information [new record for fauna of Iran and/or new host record(s)].

## SYSTEMATICS

### Family CARABOACARIDAE Mahunka, 1970

### Genus *Caraboacarus* Krczal, 1959

**Type species:** *Caraboacarus stammeri* Krczal, 1959, by original designation.

### *Caraboacarus karenae* Nickel and Elzinga, 1969

**Material examined –** Ninteen females were detached from a single specimen of *Scarites* Fabricius, 1775, attracted to a light trap in Alangdareh forest, Gorgan, Golestan Province, 36.45° N, 54.27° E, and altitude 301 m a.s.l., July 28, 2023, coll. Vahid Rahiminejad; As well as, seven females were obtained from soil samples, in A'ali-Kola forest, Sari, Mazandaran province, 36.21° N, 53.65° E, and altitude 112 m a.s.l., July 13, 2023, coll. E. Yahyapour.

**World distribution and Host specificity –** This species was described and reported from North America and Asia (Nickel and Elzinga 1969; Rahiminejad *et al*. 2010, 2023; Katlav *et al*. 2015).

**Remarks –** Nickel and Elzinga (1969) described *C. karenae* from Kansas, USA and vaguely separated from *C. stammeri* mainly by following characters: first dorsal shield of hysterosoma tripartite (first dorsal shield of hysterosoma single plate in *C. stammeri*), tibia of first leg with two solenidia (tibia with one solenidion in *C. stammeri*) and some other characters that are not trustworthy. According to original descriptions and drawings and also the drawings prepared by Hajiqanbar *et. al.* (2008), it seems length and position of setae *c*1 and *d* are the best differential characters between these species; therefore setae *c*1 and *d* are blunt-ended and never reaches to posterior border of their tergites in *C. karenae* while setae *c*1 and *d* are pointed and extend beyond posterior border of their tergites in *C. stammeri*, also seta *c*2 more than four times longer than *c*1 in *C. karenae* while seta *c*2 almost three times longer than *c*1 in *C. stammeri*.

### *Caraboacarus krczali* Eidelberg, 1994

**Material examined –** Two specimens were extracted from soil sample collected from Alangdareh forest, Gorgan, Golestan Province, 36.46° N, 54.26° E, and altitude 236 m a.s.l., June 19, 2023, by V. Rahiminejad.

**World distribution and Host specificity –** The species first described from Russia and Ukraine and after that was reported from Senegal and Iran phoretic on *Calosoma* spp. and *Calosoma auropunctatum dsungaricum* Gebler, respectively (Mortazavi *et al*. 2011; Mortazavi and Hajiqanbar 2012).

**Remarks –** This species has been observed living freely in soil samples for the first time.

### *Caraboacarus stammeri* Krczal, 1959

**Material examined –** Three large colonies were obtained under the elytra of ground beetles of *Calosoma* and *Harpalus*. The host beetles were collected by direct sampling in vicinity of Ziarat village, Gorgan, Golestan Province, 36.71° N, 54.48° E, and altitude 1511 m a.s.l., August 3, 2023, Shast-Kola, Baran-Koh waterfall, Gorgan, Golestan Province, 36.70° N, 54.36° E, and altitude 157 m a.s.l., June 11, 2023 and Alangdareh forest, 36.46° N, 54.26° E, and altitude 337 m a.s.l., July 27, 2023, coll. Vahid Rahiminejad. Furthermore, more than 30 specimens were extracted from various soil samples from A'ali-Kola, Zar'rin-Abad forests and agricultural and horticultural areas around Lak-Dasht village, Mazandaran province, during spring of 2023 were collected by E. Yahyapour.

**World distribution and Host specificity –** The species recorded from three continents (Asia, Europe and North America) and has least host specificity among all caraboacarid mites (Katlav *et. al*. 2015). Until now, various carabid beetles, including *Amara* spp., *Harpalus* spp., *Calosoma* spp., *Anisodactylus signatus* (Panzer, 1796), *Diachromus germanus* (Linnaeus, 1758) (Col.: Carabidae) and *Cicindela* (*Cylindera*) *germanica* (Linnaeus, 1758) (Col.: Cicindelidae) have been recorded as hosts for *C. stammeri* (Rahiminejad *et al*. 2023). Also, Trach and Khausov (2012) surprisingly reported *C. stammeri* under elytra and on the wings of *Ablattaria laevigata* (Fabricius, 1775) (Col.: Silphidae) (Rahiminejad and Hajiqanbar 2020; Rahiminejad *et al*. 2023).

## Genus *Intercaraboacarus* Katlav & Hajiqanbar, 2015

**Type species:** *Intercaraboacarus clivinus* Katlav & Hajiqanbar, 2015, by original designation.

### *Intercaraboacarus clivinus* Katlav & Hajiqanbar, 2015

**Material examined –** Thirteen specimens were collected from sediments of a vial containing two specimens of *Amara* spp. (Col.: Carabidae). The host beetles sampled directly from Naharkhoran heights, Gorgan, Golestan Province, 36.75° N, 54.45° E, and altitude 762 m a.s.l., September 12, 2023, coll. Vahid Rahiminejad.

**World distribution and Host specificity –** Previously, the mites were only collected from under elytra, on the membranous hind wings of *Clivina ypsilon* Dejean, 1829 (Col.: Carabidae) that were captured by attracting to a light trap in Noor Forest, Mazandaran Province, Iran (Katlav *et al*. 2015).

**Remarks –** The species is recorded from Golestan province for the first time.

## Genus *Minicaraboacarus* Hajiqanbar & Khaustov, 2008

**Type species:** *Minicaraboacarus quadridiscalis* Hajiqanbar & Khaustov, 2008, by original designation.

### *Minicaraboacarus quadridiscalis* Hajiqanbar & Khaustov, 2008

**Material examined –** Two specimens were extracted from under elytra of *Scarites* sp. (Col.: Carabidae) collected from Aq-Qala, Golestan Province, 37.07° N, 54.53° E, and altitude 3 m a.s.l., April 29, 2023, by V. Rahiminejad.

**World distribution and Host specificity –** Firstly, the mites were collected under elytra of *Cymbionotum semelederi* (Chaudoir, 1861) (Col.: Carabidae), from Feizabad of Torbat Heidariyeh, Razawi Khorassan Province, Iran (Hajiqanbar *et al*. 2008). Then, Mortazavi and Hajiqanbar (2012) reported it from Rafsanjan, Kerman Province, in association with *Scarites* (*Scarites*) *procerus eurytus* Fischer von Waldheim.

**Remarks –** This is the first record of the species from Golestan province.

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# گزارش‌های جدید از کنه‌های Caraboacaridae (Acari: Trochometridioidea) از ایران، همراه با نکاتی در مورد تخصص میزبانی آنها

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**چکیده**

طی پژوهش جامعی در مورد ناجورسُفتیان مرتبط با سوسک‌های زمینی و نمونه‌های خاکی جمع‌آوری‌شده از شمال و شمال‌شرق ایران، چندین کلنی از کنه‌های خانوادهٔ Caraboacaridae، شامل سه گونه از جنس *Caraboacarus* Krczal, 1959، *C. stammeri* Krczal, 1959، *C. karenae* Nickel & Elzinga, 1969 و *C. krczali* Eidelberg, 1994 جمع‌آوری شدند، همچنین گونه‌های *Minicaraboacarus quadridiscalis* Hajiqanbar & Khaustov, 2008 و *Intercaraboacarus clivinus* Katlav & Hajiqanbar, 2015، از نمونه‌های خاک و سوسک‌های زمینی جنس‌های *Calosoma* Weber، *Harpalus* Latreille، *Amara* Bonellian و *Scarites* Fabricius از مناطق نمونه‌برداری‌شده، به‌دست آمدند. همچنین پراکنش جهانی و تخصص میزبانی کنه‌های جمع‌آوری‌شده، مورد بررسی قرار گرفت.

**واژگان کلیدی:** Carabidae، Caraboacaridae، ناجورسُفتیان، ترجیح میزبانی، گزارش جدید.

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