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A contribution to the knowledge of heterostigmatic mites (Acari: Prostigmata) in western Mazandaran Province, Northern Iran

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ABSTRACT — Heterostigmatic mites (Acari: Trombidiformes: Prostigmata) are usually associated with arthropods, especially insects, and poorly studied in Iran. As a result of a study of beetle-associated heterostigmatic mites carried out in western Mazandaran Province, northern Iran, during spring and winter 2013, a total of 14 species and 11 genera of eight families were identified. Among them *Spatulaphorus vladimiri* Khaustov, 2005 (Pygmephoridae), *Archidispus conspicuus* Kurosa, 1978; *A. bembidii* (Karafiat, 1959), *A. armatus* (Karafiat, 1959) (Scutacaridae), and *Eutarsopolipus steveni* Khaustov, 2010 (Podapolipidae) are new records for mite fauna of Iran. The latter is also new for Asia. Eight new beetle host records are documented and the world distribution of the mites is reviewed. Moreover, beetles of the subfamily Cicindelinae (Coleoptera: Carabidae) are recorded for the first time as hosts of Caraboacarid mites.

KEYWORDS — Acari; Heterostigmata; beetle; new record; Mazandaran; Iran

INTRODUCTION

Mites of the cohort Heterostigmata include a large section of prostigmatic mites (Acari: Trombidiformes) with more than 180 genera and 2400 species that are classified into 16 families and seven superfamilies till 2011 (Zhang *et al.*, 2011). These mites manifest various attributes which have developed in the course of evolution in favor of a diversity of symbiotic ways of life in association with arthropods, especially insects (Kaliszewski *et al.*, 1995; Bochkov *et al.*, 2008). Most of them, namely many representatives of the Superfamilies Dolichocyboidea (except Crotalomorphidae), and Pygmephoroidae are fungivorous utilizing arthropods for phoretic dispersal but remained free-living in the nests or habitats of their host. (Kaliszewski *et*

al., 1995; Walter *et al.*, 2009). Some lineages of this cohort constitute the outstanding examples among the Acari, showing independently repeated, complete loss of a true free-living way of life in adaptation to parasitism and parasitoidism (Kalizewski *et al.*, 1995). The best example of parasitism is known for the family Podapolipidae Ewing, 1922, whose members are regarded as highly specialized ecto- and endoparasites of mainly variety of beetles, and less commonly some cockroaches, grasshoppers, bees and burrower bugs (Regenfuss, 1968; Husband and Li, 1993; Husband and O'Connor, 2003; Hajiqanbar and Joharchi, 2011; Husband and Husband, 2014). Some of the parasite and parasitoid heterostigmatic mites are in association with important agricultural pest insects. These mites have

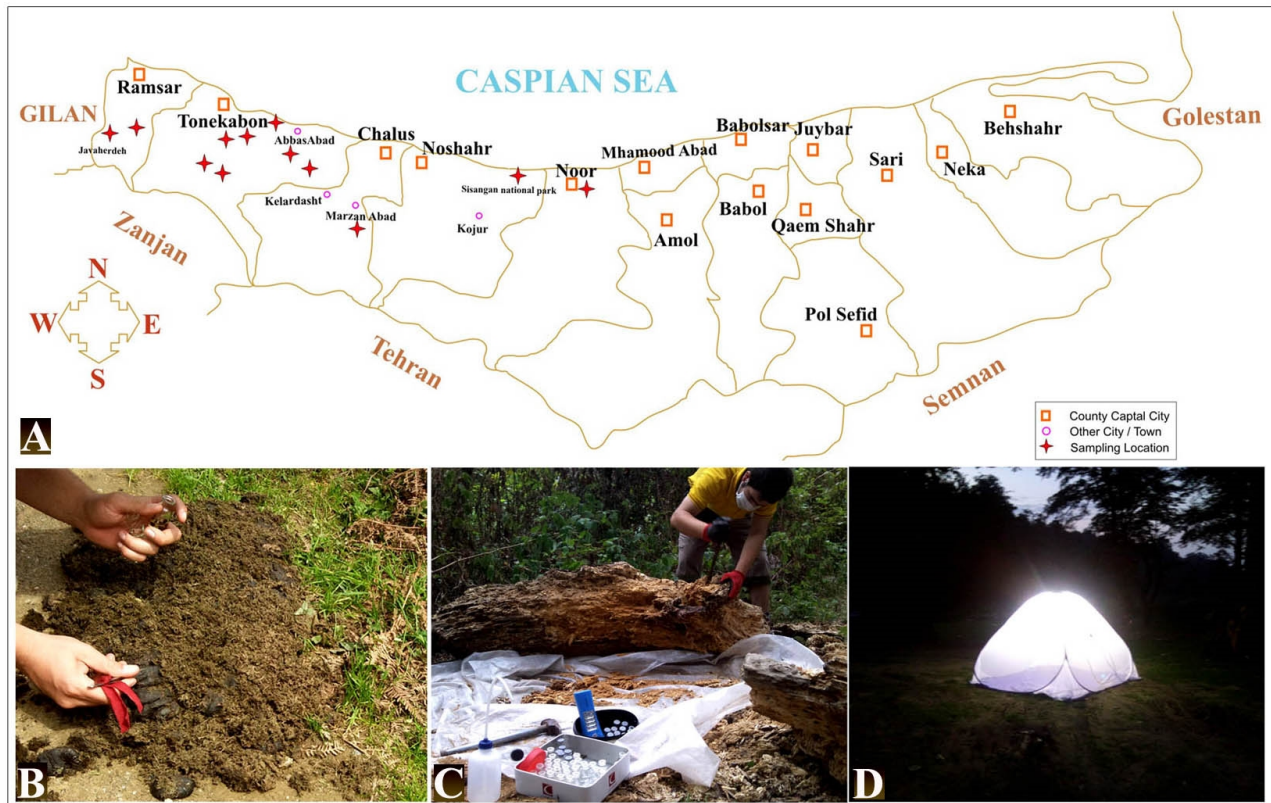


FIGURE 1: Samplings: A – Map of sampling locations in Western Mazandaran Province; B – Sampling from dung pad; C – Sampling from rotten stump; D – Light trap for night sampling.

lately come in for considerable scrutiny by entomologists to wonder whether they are potentially capable of being employed as biological control agents against some important pests in agroecosystems (e.g. Bruce and LeCato, 1980; Faroni *et al.*, 2000; Kenis *et al.*, 2008; Rhule *et al.*, 2010). Some of the dolichocybids and pymephoroids have known to be of economic importance by feeding on edible mushrooms or transferring pathogenic fungi to plants (Cross and Kaliszewski, 1988; Kantaratanakul *et al.*, 1989; Zou *et al.*, 1993; Navaro *et al.*, 2010; Moser *et al.*, 2010). The life strategies and biological aspects of many lineages of Heterostigmata have not yet been precisely ascertained. However, for some families such as Carabacaridae some hypotheses upon the occurrence of parasitism have been postulated (Nickel and Elzinga, 1969; Kaliszewski *et al.*, 1995; Katlav *et al.*, 2015). Due to the paucity of taxonomical and biological information about het-

erostigmatic mites, more collection and faunistic investigations in most part of the world are required to attain better understanding of these mites (Hajiqanbar 2011). Pursuant to this objective this study was performed in Western Mazandaran Province, northern Iran.

MATERIALS AND METHODS

The study was conducted during the period from April to late August 2013 in western Mazandaran Province, northern Iran (Figure 1A). The host insects were collected by attracting to a light trap, sweeping, or directly in their habitats including decaying logs and wood debris, under stones and dung pads (Figures 1B-D). Mite specimens were obtain from their hosts using an Olympus stereomicroscope, cleared in a mixture of Lactophenol and Nesbitt's solution (80:20, v/v) and mounted

in Hoyer's medium. The morphology of mites was studied using a light microscope (model BX51, Olympus, Tokyo, Japan) equipped with phase contrast illumination and identified using the related references. Photographs were taken with a microscope eyepiece camera (model AM7023B, Dino-Eye, Taiwan). The systematics of families and superfamilies follow that proposed by Kaliszewski *et al.* (1995) and Khaustov (2008). The carabid beetles were identified with the help of Dr A. Anichtchenko (Institute of Systematic Biology, Daugavpils University, Latvia). The scarabaeid and geotrupid beetles were identified with the help of Dr. G. V. Nikolaev (Al-Farabi Kazakh National University, Almaty, Kazakhstan). The cucujoid, hydrophyliid and scolytid beetles by Drs. A. Kirejtshuk (Zoological Institute, Academy of Sciences, St. Petersburg, Russia), V. Alekseev (Department of Zootechny, Kaliningrad State Technical University, Kaliningrad, Russia) and M. Mandelshtam (Saint-Petersburg State University, St. Petersburg, Russia.) respectively. All materials were collected by the first author (Alihan Katlav) and deposited in the Acarological Collection, Department of Entomology, Faculty of Agriculture, Tarbiat Modares University (AC-TMU), Tehran, Iran.

RESULTS

Superfamily Dolichocyboidea Mahunka, 1970

Family Dolichocybidae Mahunka, 1970

Genus *Pavania* Lombardini, 1949

Pavania tadjikistanica

Sevastianov, 1980

(Figure 2A)

Material examined — 84 ♀♀, Mazandaran Prov., Abbas Abad, Kazemkela village (36°41'N, 51°05'E, altitude 6 m a.s.l.), 8.VIII.2013, from cervical membrane (soft membranes between head and pronotum) of the beetle *Onthophagus taurus* (Schreber, 1759) (Col.: Scarabaeidae) collected from cowpad. 60 ♀♀, Mazandaran Prov., Noor, Noor Forest (36°34'N, 52°03'E, altitude 3 m a.s.l.), 9.VIII.2013, from cervical membrane of the beetle *O. taurus* collected from cowpad. 48 ♀♀, Mazandaran Prov., Ramsar, Dalikhani Forest (36°49'N, 50°37'E, altitude 950 m

a.s.l.), 18.VIII.2013, from cervical membrane of *Eu-oniticellus fulvus* (Goeze, 1777) (Col.: Scarabaeidae) collected from cowpad.

World distribution — Tajikistan, phoretic on *Onthophagus* sp. (Sevastianov, 1980); Iran, Isfahan province, phoretic on *Onthophagus* sp. (Tajodin, 2013), Mazandaran province (current study).

Remarks — Thus far mites of the genus *Pavania* have been recorded in association with dung beetles of the tribes Coprini, Scarabaeini, and Onthophagini (Bahramian *et al.*, 2015). This study has revealed the tribe Oniticellini as a new scarabaeid host tribe for this genus.

Genus *Dolichocybe* Krantz 1957

Dolichocybe silvani

Rahiminejad and Hajiqanbar, 2011

Material examined — 4 ♀♀, Mazandaran Prov., Abbas Abad-Kelardasht Road, Darasara Forest (36°37'N, 51°06'E, altitude 6 m a.s.l.), 7.VIII.2013, from under elytra of the beetle *Bitoma crenata* Fabricius, 1775 (Col.: Zopheridae) collected from under bark of logs. 3 ♀♀, Mazandaran Prov., Abbas Abad-Kelardasht Road, Darasara Forest (36°37'N, 51°06'E, altitude 6 m a.s.l.), 7.VIII.2013, from under elytra of the beetle *Uleiota planata* (L., 1761) (Col.: Silvanidae) collected from under bark of logs.

World distribution — Iran, Gorgan province, phoretic on *Silvanus* sp. (Col.: Silvanidae) (Rahiminejad *et al.*, 2011a); Mazandaran province (current study).

Remarks — New record of association between dolichocybid mites and beetles of the family Zopheridae. Association between this mite and beetles of the genus *Uleiota* Latreille, 1796 is new. All these mentioned hosts are saproxylic and confined to the superfamily Cucujoidea. These findings possibly reinforce the ideas suggested by Rahiminejad *et al.* (2011a) and Katlav *et al.* (2014) that many dolichocybid mites occupied subcortical habitats exploited by variety of saproxylic fungi, and can be found as phoretic on any beetles (or presumably insects) whose ecological niches overlapped those of these mites.

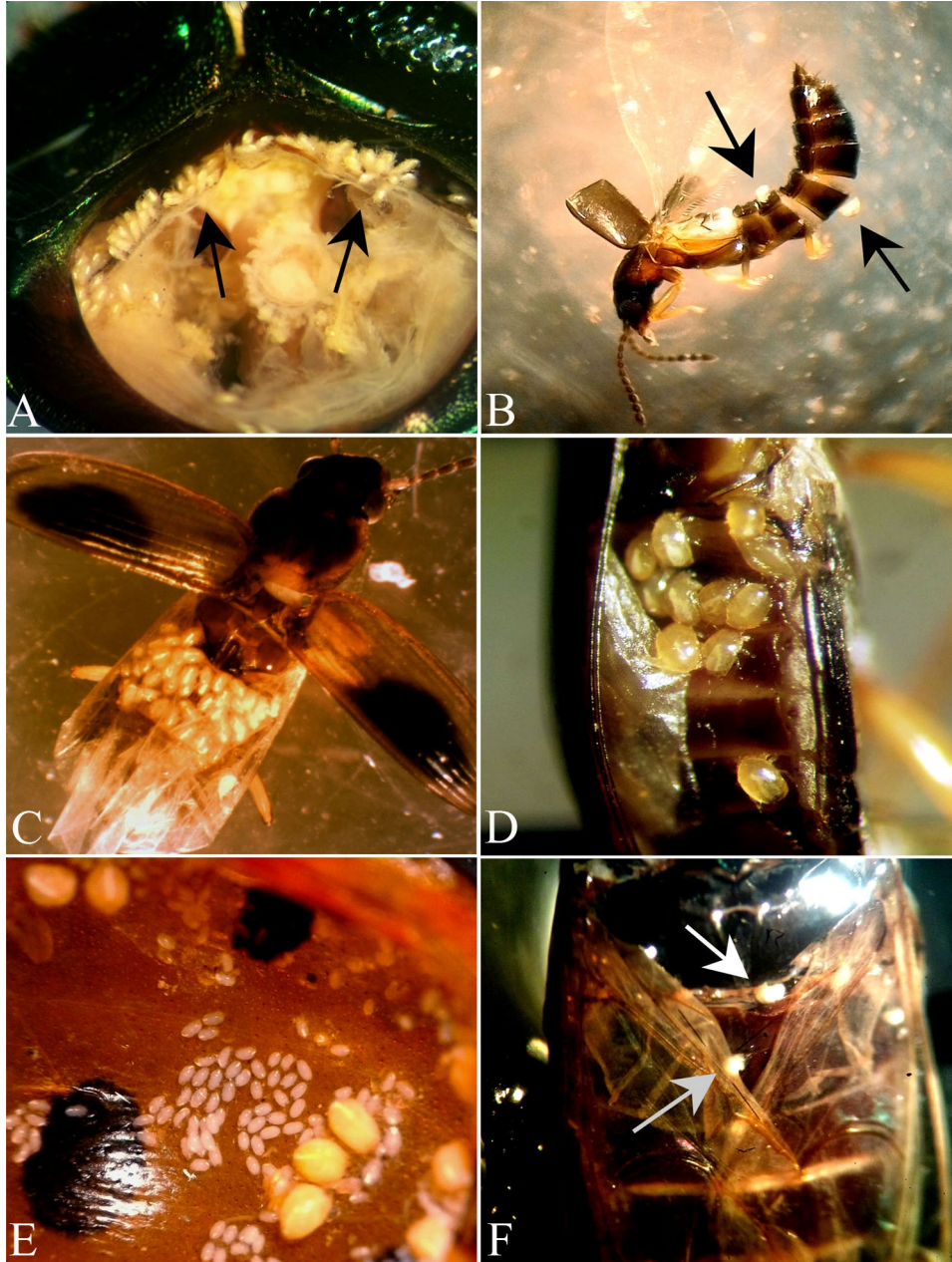


FIGURE 2: Heterostigmatic mites on their host beetles: A – Colony of *Pavana tajikistanica* attaching to the cervical membrane of *Onthophagus* sp.; B – *Archidispus armatus* attaching to the abdominal sternites and tergites of a staphylinid beetle; C-D – Colony of *Archidispus bembidii* under elytra of *Acuapalpus* sp.; E – *Coccipolipus macfarlanei* on elytral cavity of *Coccinella septempunctata*; F – Colony of *Eutarsopolipus steveni* under elytra of *Chlaenius coeruleus*.

Superfamily Trochometridioidea Mahunka, 1970
Family Caraboacaridae Mahunka, 1970
Genus *Caraboacarus* Krczal, 1959

Caraboacarus stammeri
 Krczal, 1959

Material examined — 7 ♀♀, Mazandaran Prov., Noshahr, Sisangan National Park (36°41'N, 51°05'E, altitude 33 m a.s.l.), 26.VII.2013, from under elytra of two specimens of *Amara* sp. (Col.: Carabidae) attracted to light trap. 30 ♀♀, Mazandaran Prov., Abbas Abad, Kazemkela village (36°34'N, 51°48'E, altitude 6 m a.s.l.), 8.VIII.2013, from under elytra of two specimens of *Harpalus* sp. (Col.: Carabidae) collected from under stones. 26 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, from under elytra of four specimens of *Anisodactylus signatus* (Panzer, 1796) (Col.: Carabidae) collected from under stones. 21 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, from under elytra of five specimens of *Diachromus germanus* (L., 1758) (Col.: Carabidae) collected from under stones. 2 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E altitude 11 m a.s.l.), 2.VII.2013, from under elytra of *Cicindela (Cylindera) germanica* (L., 1758) (Col.: Carabidae: Cicindelinae) attracted to light trap.

World distribution — Holarctic.

Remarks — Heretofore mites of the family Caraboacaridae have been recorded from carabid beetles of the seven subfamilies: Carabinae, Harpalinae, Pterostichinae, Platyninae, Trechinae, Scaritinae, and Brachininae, and in one case on beetles of the family Silphidae (Trach and Kaustov, 2012; Katlav *et al.*, 2015). This study revealed the association between caraboacarid mites and carabid beetles of the subfamily Cicindelinae as a first record.

Superfamily Pygmephoroidae Cross, 1965
Family Neopygmephoridae Cross, 1965
Genus *Allopygmephorus* Cross, 1965

Allopygmephorus persicus
 Khaustov & Hajiqanbar, 2005

Material examined — 8 ♀♀, Mazandaran Prov., Tonekabon, Sehezar Forest (36°41'N, 50°51'E, altitude 380 m a.s.l.), 26.VIII.2013, clinging to abdominal sternites of three specimens of *Cercyon laminates* Sharp, 1873 (Col.: Hydrophilidae) attracted to light trap. 5 ♀♀, Mazandaran Prov., Noor, Noor Forest (36°34'N, 52°02'E, altitude -33 m a.s.l.), 29.VII.2013, from vial containing *Enochrus bicolor* (Fabricius, 1792) (Col.: Hydrophilidae) attracted to light trap. 4 ♀♀, Mazandaran Prov., Noor, Noor Forest (36°34'N, 52°02'E, altitude -33 m a.s.l.), 29.VII.2013, from vial containing 8 specimens of an unidentified heterocerid beetle (Col.: Heteroceridae) attracted to light trap.

World distribution — Iran, Mazandaran province, phoretic on an undetermined hydrophilid beetle (Khaustov and Hajiqanbar, 2006).

Remarks — Thus far beetles of the families Heteroceridae and Dryopidae (superfamily Byrrhoidea), and Hydrophilidae (Superfamily Hydrophiloidea) have been documented as hosts of some *Allopygmephorus* spp. (Krczal, 1959; Khaustov and Hajiqanbar, 2006). Consistently, our study recorded beetles of the same superfamilies for *A. persicus*. Considering the fact that most of these beetles generally inhabit semi-aquatic habitats namely littoral banks, riverside debris swamps and etc. (Aleksiev, 2012), it can be elucidated that these mites are damp-loving and frequent in such habitats.

Family Pygmephoridae Cross, 1965
Genus *Elattoma* Mahunka, 1969

Elattoma abeskoun
 Rahiminejad and Hajiqanbar, 2011

Material examined — 8 ♀♀, Mazandaran Prov., Tonekabon, Chalkosh village (36°49'N, 50°45'E, altitude 115 m a.s.l.), 29.VIII.2013, clinging to abdominal sternites of an undetermined bostrichid beetle (Col.: Bostrichidae) attracted to light trap. 14 ♀♀,

Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53' E, altitude 11 m a.s.l.), 8.VIII.2013, in the vial containing *Xyleborus monographus* (Fabricius, 1792) (Col.: Curculionidae: Scolytinae) attracted to light trap.

World distribution — Iran, Golestan province, phoretic on *Morimus verecundus* (Col.: Cerambycidae) (Rahiminejad *et al.*, 2011b); Mazandaran province (current study).

Remarks — Hitherto, beetles of the families Curculionidae (Scolytinae) and Cerambycidae have been documented as hosts of *Elattoma* (Rahiminejad *et al.*, 2011b). In this study, beetles of the family Bostrichidae are recorded as a new host family for these mites. Moreover, association of *E. abeskoun* and beetles of the family Curculionidae (Scolytinae) is also new.

Genus *Spatulaphorus* Rack, 1993

Spatulaphorus vladimiri
Khaustov, 2005

Material examined — 53 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47' N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, from under elytra of *Geotrupes spiniger* (Marsham, 1802) (Col.: Geotrupidae) attracted to light trap. 44 ♀♀, Mazandaran Prov., Ramsar, Dalikhani Forest (36°49'N, 50°37'E, altitude 950 m a.s.l.), 18.VIII.2013, from under elytra of *G. spiniger* collected from cowpad.

World distribution — Ukraine, phoretic on *Geotrupes stercorarius* (L.) (Col.: Geotrupidae) (Khaustov, 2005); Iran (current study).

Remarks — This species is a new record for mite fauna of Iran. *G. spiniger* is also a new phoretic host for this species.

Spatulaphorus gorganica
Rahiminejad and Hajiqanbar, 2011

Material examined: 43 ♀♀, Mazandaran Prov., Abbas Abad, Kazemkela village (36°34'N, 51°48'E altitude 6 m a.s.l.), 8.VIII.2013, from under elytra of *G. spiniger* collected from cowpad.

World distribution: Iran, Golestan province, phoretic on *G. spiniger* (Rahiminejad *et al.*, 2011c);

Mazandaran province (current study); Ukraine, phoretic on *G. stercorarius* (Khaustov & Trach, 2012).

Family Scutacaridae Oudmans, 1916 Genus *Archidispus* Karafiat, 1959

Archidispus armatus
(Karafiat, 1959)
(Figure 2B)

Material examined — 4 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, attaching to the abdominal sternites and tergites of an unidentified staphylinid beetle attracted to light trap.

World distribution — Central Europe, associated with staphylinid beetles (Karafiat, 1959; Mahunka, 1967; Mahunka and Zaki, 1984; Ebermann, 1990, 1991); Iran (current study).

Remarks — This species is a new record for mite fauna of Asia.

Archidispus bembidii
(Karafiat, 1959)
(Figures 2C-D)

Material examined — 46 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, from under elytra of three specimens of *Acuapalpus* sp. (Col.: Carabidae) attracted to light trap. 35 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, from under elytra of *Pterostichus* sp. (Col.: Carabidae) attracted to light trap.

World distribution — Holarctic (Khaustov, 2008)

Remarks — This species is a new record for mite fauna of Iran.

Archidispus conspicuus
Kurosa, 1978

Material examined — 10 ♀♀, Mazandaran Prov., Tonekabon, Palhamdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 24.VI.2013, in the vial containing an unidentified carabid beetle attracted to light trap.

World distribution — Japan, in association with carabid genera *Anoplogeni*, *Stenolophus*, *Acupalpus*, all belonging to the tribe Harpalini (Kurosa, 1978); Iran (current study).

Remarks — This species is a new record for mite fauna of Iran.

Family Microdispidae Cross, 1965

Genus Paramicrodispus Khaustov, 2009

Paramicrodispus scarabidophilus

Hajiqaanbar and Rahiminejad, 2012

Material examined — 48 ♀♀, Mazandaran Prov., Tonekabon, Sehezar Forest (36°41'N, 50°51'E, altitude 330 m a.s.l.), 26.VIII.2013, under elytra of *Gnorimus subcostatus* (Ménétrières) (Col.: Scarabaeidae) collected from under bark of logs.

World distribution — Iran, Gorgan province, phoretic on *Oryctes nasicornis* L. (Col.: Scarabaeidae) (Hajiqaanbar *et al.*, 2012), Mazandaran province (current study).

Remarks — *G. subcostatus* is new host record for this mite.

Genus Premicrodispus Cross, 1965

Premicrodispus brevisetus

Khaustov, 2012

Material examined — 48 ♀♀, Mazandaran Prov., Tonekabon, Dohezar Forest (36°39'N, 50°40'E, altitude 578 m a.s.l.), 26.VIII.2013, under elytra of *Oryctes nasicornis* L. (Col.: Scarabaeidae) collected from under bark of logs.

World distribution — Ukraine, collected from soil (Khaustov, 2006); Iran, Gorgan province, phoretic on *Oxythyrea cinctella* Schaum (Col.: Scarabaeidae) (Rahiminejad *et al.*, 2010), Mazandaran province (current study).

Superfamily Tarsonemoidea Kramer, 1877

Family Podapolipidae Ewing, 1922

Genus Coccipolipus Husband, 1972

Coccipolipus macfarlanei

Husband, 1972

(Figure 2E)

Material examined — 11 ♀♀, 10 ♂♂ and 53 larval ♀♀ (larva), Mazandaran Prov., Marzanabad, Tovir village (36°25'N, 51°17'E altitude 1945 m a.s.l.), 13.VI.2013, from under elytra of three specimens of *Coccinella septempunctata* L. (Col.: Coccinellidae) collected by swiping in a pastureland.

World distribution — Trinidad and El Salvador, parasitizing *Cycloneda sanguinea* (L.) (Col.: Coccinellidae); Australia and New Hebrides, parasitizing *Coccinella transversalis* Fab. (Col.: Coccinellidae); USA, parasitizing *Coccinella transversoguttata* Fald (Col.: Coccinellidae); Ukraine and Poland, parasitizing *C. septempunctata*; and Iran, parasitizing following ladybirds *C. septempunctata* and *Oenopia conglubata* L. and *Coccinella undecimpunctata* L. (Hajiqaanbar *et al.*, 2011; Ceryngier *et al.*, 2012; Tajodin, 2013).

Genus Eutarsopolipus Berlese, 1913

Myzus species group Regenfuss (1968)

Eutarsopolipus steveni

Khaustov, 2010

(Figure 2F)

Material examined — 7 ♀♀, 4 ♂♂ and 14 larval ♀♀ (larva), Mazandaran Prov., Tonekabon, Palhmdash village (36°47'N, 50°53'E, altitude 11 m a.s.l.), 16.IV.2013, from under elytra of *Chlaenius (Stenochlaenius) coeruleus* (Steven, 1809) collected from under stone. 5 ♀♀, 3 ♂♂ and 15 larval ♀♀, Mazandaran Prov., Tonekabon, Vali Abad (36°46'N, 50°56'E, altitude -70 m a.s.l.), 14.V.2013, from under elytra of *C. coeruleus* collected from under stone. 5 ♀♀, 1 ♂ and 17 larval ♀♀, Mazandaran Prov., Tonekabon, Nemat Abad (36°44'N, 50°55'E, altitude 4 m a.s.l.), 20.V.2013, from under elytra of *C. coeruleus* collected from under stone.

World distribution — Abkhasia (Western Caucasus), parasitizing *Chlaenius coeruleus* (Khaustov, 2010); Iran (current study).

Remarks — This is the first record of occurrence of this parasitic mite in Asia.

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