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# Article

## New records of the genus *Allopygmephorus* (Acari: Neopygmephoridae) with a list of the species of the family Neopygmephoridae in Iran

**Amin Navabi, Hamidreza Hajiqanbar* and Abdolazim Mortazavi**

*Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, 14115-336, Tehran, Iran; E-mails: aminnavabi17@gmail.com, hajiqanbar@modares.ac.ir*

* Corresponding author

**ABSTRACT**
A survey was carried out to investigate heterostigmatic mites associated with insects in Borujerd, Lorestan province, western Iran, in 2016. Insects were captured using light traps in the areas. Two species of the family Neopygmephoridae including *Allopygmephorus spinisetus* Khaustov & Sazhnev, 2016 and *A. punctatus* Khaustov & Sazhnev, 2016 were identified associated with beetles *Drasterius bimaculatus* (Rossi, 1790) (Coleoptera: Elateridae) and *Augyles* sp. (Col.: Heteroceridae). Both species are new records for mite fauna of Iran with the former being also new for Asia. Moreover, the association between mites of *Allopygmephorus* and elaterid beetles is new. A list of Iranian neopygmephorid mites is also provided.

**KEY WORDS:** *Allopygmephorus spinisetus*; *A. punctatus*; *Drasterius bimaculatus*; Heterostigmatina; host record; phoresy.

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## INTRODUCTION

Mites of the cohort Heterostigmatina comprise over 2000 described species and are one of the largest groups of prostigmatic mites (Acari: Trombidiformes) (Zhang *et al*. 2011). Heterostigmatic mites showcase various symbiotic associations with arthropods, especially insects, displaying phoretic relationship and parasitic way of life (Kaliszewski *et al.* 1995; Walter *et al.* 2009; Mortazavi *et al*. 2018). Most members of the superfamily Pygmephoroidea are free-living fungivores and are mostly phoronts of various insects (Kaliszewski *et al.* 1995; Walter *et al.* 2009). This superfamily encompasses four families, namely Scutacaridae, Microdispidae, Pygmephoridae and Neopygmephoridae, with the latter containing 25 genera and more than 250 species (Zhang *et al*. 2011; Khaustov and Frolov 2018; Khaustov and Minor 2018). Many members of the family Neopygmephoridae are rarely associated with non-insect arthropods (Chilopoda and Aranei) (Cross 1965) or insect orders including Hymenoptera, Coleoptera and Isoptera (Khaustov and Mandelshtam 2017).

Mites of the genus *Allopygmephorus* Cross, 1965 are more likely to occupy wet lands and are associated with beetles inhabiting such habitats, e.g. Hydrophilidae and Heteroceridae (Khaustov and Hajiqanbar 2006; Khaustov and Sazhnev 2016). This genus includes 12 species: *Allopygmephorus matthesi* (Krczal, 1959), *A. nanhuiensis* Gao, Zou & Ma, 1989, *A. baoshanensis* Gao, Zou & Ma, 1989, *A. tuberosus* (Mahunka, 1969), *A. curiae* (Mahunka, 1970), *A. brasiliensis*

(Mahunka, 1970), *A. heterodactylus* Mahunka, 1973, *A. chinensis* Mahunka, 1975, *A. orimtahs* Mahunka & Mahunka -Papp, 1988, *A. persicus* Khaustov & Hajiqanbar, 2006, *A. spinisetus* Khaustov & Sazhnev, 2016 and *A. punctatus* Khaustov & Sazhnev, 2016 (Khaustov and Hajiqanbar 2006; Khaustov & Sazhnev, 2016). Of this genus, only *A. persicus* has been recorded from Iran, reportedon some unidentified hydrophilid and heterocerid beeltes and also on two hydrophilids namely *Cercyon laminates* Sharp, 1873 and *Enochrus bicolor* (Fabricius, 1792) (Khaustov & Hajiqanbar, 2006; Katlav *et al*. 2015).

Following a study on heterostigmatic mites associated with insects carried out in Borujerd, western Iran, two species of the genus *Allopygmephorus* were found and identified as associates of beetles *Drasterius bimaculatus* (Rossi, 1790) (Col.: Elateridae) and *Augyles* sp. (Col.: Heteroceridae). These species are new to mite fauna of Iran, and so is the association between them and elaterid beetles. A list of all recorded species of the family is also provided.

## MATERIALS AND METHODS

The study was conducted in August 2016, in Borujerd, western Iran. The host insects were captured using light traps. After being transferred to laboratory, mites were directly separated from their hosts and the ethanol sediments containing hosts via an Olympus stereomicroscope, cleared in Nesbitt's solution, mounted in Hoyer's medium and studied with a phase contrast microscope (model BX51, Olympus). The elaterid beetles were identified with the help of Dr. Alexey V. Kovalev (Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia). All material was collected by the first author (AN) and deposited in the Acarological Collection, Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran.

## RESULTS

### Superfamily Pygmephoroidea Cross, 1965
### Family Neopygmephoridae Cross, 1965

**Genus *Allopygmephorus* Cross, 1965**
Type species: *Pygmephorus matthesi* Krczal, 1959, by original designation.

#### *Allopygmephorus spinisetus* Khaustov & Sazhnev, 2016

**World distribution –** RUSSIA, associated with *Heterocerus fenestratus* (Thunberg, 1784) (Col.: Heteroceridae) (Khaustov & Sazhnev 2016); IRAN, associated with *Drasterius bimaculatus* (Rossi, 1790) (Col.: Elateridae) and *Augyles* sp. (Col.: Heteroceridae) (current study).

**Material examined –** Borujerd, western Iran, 10 and three females from ventral body surfaces of two *Drasterius bimaculatus* and one *Augyles* respectively. The host insects attracted to light traps during an overnight sampling around pasture plants and apple gardens of the Sheykh Miri-ye Sadat village, near Borujerd, 2 August 2016.

*Remarks*

New record for mite fauna of Asia including Iran. Also, it is a new association between this genus and beetles of the family Elateridae. So far, beetles of families Hydrophilidae (superfimily Hydrophiloidea), Dryopidae (superfamily Byrrhoidea) and Heteroceridae have been reported as hosts of some *Allopygmephorus* spp. (Krczal 1959; Khaustov & Hajiqanbar 2006; Katlav *et al*. 2015; Khaustov & Sazhnev 2016). Some references mention the presence of *D. bimaculatus* on

herbaceous plants near streams (Sert & Kabalak 2011) and it almost confirms association of *Allopygmephorus* spp. with host beetles living near wetlands.

### *Allopygmephorus punctatus* Khaustov & Sazhnev, 2016

**World distribution –** RUSSIA, associated with *Heterocerus fenestratus*; KAZAKHSTAN, associated with *Heterocerus flexuosus* Stephens, 1828 (Khaustov & Sazhnev 2016); IRAN, associated with *Drasterius bimaculatus* (Elateridae) and *Augyles* sp. (current study).

**Material examined –** Borujerd, western Iran, 16 and nine females from ventral body surfaces of five *Drasterius bimaculatus* and four *Augyles*, respectively. The host insects attracted to light traps during an overnight sampling around pasture plants and apple gardens of the Sheykh Miri-ye Sadat village, near Borujerd, 2 August 2016.

*Remarks*

This species is recorded from Iran for the first time. Also, it is a new association between this mite and beetles of the family Elateridae.

## DISCUSSION

Taking into account the two reported species of *Allopygmephorus* in this paper, 26 neopygmephorid species from eight genera have been recorded from Iran (see Table 1). These eight genera (with number of species recorded) are *Acinogaster* (one species), *Allopygmephorus* (three species), *Bakerdania* (three species), *Kerdabania* (four species), *Parapygmephorus* (four species), *Petalomium* (nine species), *Pseudopygmephorus* (one species), and *Troxodania* (one species). The most speciose genus of Iranian neopygmephorids is *Petalomium*, members of which are associated with ants or their nests. Of about 45 species of this genus in the world, nine have been recorded from Iran, constituting about 20% of all described species. The genera *Kerdabania* and *Parapygmephorus*, each with four species, hold the second rank of neopygmephorid genera in the country. The former (with 13 species) usually inhabits soil (Khaustov 2014) and the latter (with eight species) is associated with bees and/or their nests (Fan *et al*. 2014). Until now, *Kerdabania* and *Parapygmephorus* in Iran account for the 23 and 50 percent of world fauna, respectively. Next place belongs to two other genera (*Bakerdania* and *Allopygmephorus*) including three species each. The *Bakerdania* (with about 100 species) is the largest genus of Neopygmephoridae (Khaustov 2010) however, considering its habitat in soil and association of some with insects, it is not well addressed in the country (only about 3% of world fauna of the genus). Iranian *Allopygmephorus* now rise to 25% of world fauna of the genus. The rest of neopygmephorid genera in Iran (*Acinogaster*, *Pseudopygmephorus* and *Troxodania*) have only one representative in the country. The ant-associated genus *Acinogaster* (with 11 species) has less distribution than another ant-associated genus, *Petalomium*. The low number of identified *Pseudopygmephorus* species in Iran could be partly related to imperfect species descriptions of this genus. Finally, members of the genus *Troxodania* with at least five species in the world are associated with scarab beetles (Khaustov and Trach 2014), 20% of world fauna of the genus in Iran.

The above data reveal that more neopygmephorid mites could be found if more soil samples and insect hosts (particularly beetles, ants and bees) are collected in rich ecological regions of the Iran.

**Table 1.** List of neopygmephorid mites and their host/habitat in Iran.

| Mite species | Host/Habitat | Reference |
|---|---|---|
| *Acinogaster microchaetosus* (Sevastianov, 1967) | *Tetramorium* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al.* (2016); Sobhi *et al.* (2017b) |
| *Allopygmephorus persicus* Khaustov & Hajiqanbar, 2006 | Undetermined hydrophilid beetle (Col.: Hydrophilidae); *Cercyon laminates* Sharp, 1873 (Col.: Hydrophilidae); *Enochrus bicolor* (Fabricius, 1792) (Col.: Hydrophilidae); unidentified heterocerid beetle (Col.: | Khaustov & Hajiqanbar (2006); Katlav *et al*. (2015) |
| *Allopygmephorus punctatus* Khaustov & Sazhnev 2016 | *Drasterius bimaculatus* (Rossi, 1790) (Col.: Elateridae); *Augyles* sp. (Col.: Heteroceridae) | This study |
| *Allopygmephorus spinisetus* Khaustov & Sazhnev 2016 | *Drasterius bimaculatus* (Rossi, 1790) (Col.: Elateridae); *Augyles* sp. (Col.: Heteroceridae) | This study |
| *Bakerdania delanyi* (Evans, 1952) | Soil | Haddad Irani-Nejad *et al.* (2005) |
| *Bakerdania graciloides* Sevastianov, 1974 | Soil | Kazemi & Khaustov (2008) |
| *Bakerdania tenuispina* Sevastianov, 1974 | *Pleurophorus anatolicus* Petrovitz, 1961 (Col.: Scarabaeidae) | Khaustov & Hajiqanbar (2004) |
| *Kerdabania inconspicuous* (Berlese, 1904) | Soil | Mirjamali *et al*. (2008) |
| *Kerdabania minuta* Khaustov, 2009 | *Ophion obscuratus* Fabricius, 1798 (Hym.: Ichneumonidae) | Loghmani *et al.* (2014) |
| *Kerdabania quadrata* (Ewing, 1917) | Soil | Haddad Irani-Nejad *et al.* (2005) |
| *Kerdabania variabilis* Khaustov, 2009 | Soil | Filekesh *et al*. (2014) |
| *Parapygmephorus crossi* Mahunka, 1974 | *Halictus* (*Halictus*) *resurgens* Nurse, 1903 (Hym.: Halictidae) | Azhari *et al*. (2018) |
| *Parapygmephorus delyorum* Mahunka, 1980 | Unidentified halictid bees (Hym.: Halictidae) | Hajiqanbar & Rakhshani (2011) |
| *Parapygmephorus khorasanicus* Hajiqanbar & Khaustov, 2011 | *Halictus quadricinctus* (Fabricius, 1776) (Hym.: Halictidae) | Hajiqanbar *et al*. (2011b) |
| *Parapygmephorus magnisetosus* Khaustov & Zalozhnaya, 2011 | *Amigella* sp. (Hym.: Apidae); *Lasioglossum* sp. (Hym.: Halictidae) | Hajiqanbar *et al.* (2011a); Loghmani *et al.* (2014); Sobhi *et al.* (2017b) |
| *Petalomium camponoti* Hajiqanbar & Khaustov, 2013 | *Camponotus buddhae* Forel, 1892 (Hym.: Formicidae) | Hajiqanbar & Khaustov (2013) |
| *Petalomium fimbrisetum* Ebermann & Rack, 1982 | *Lasius* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |
| *Petalomium gottrauxi* Mahunka, 1977 | *Camponotus aethiops* (Latreille, 1798); *Camponotus* sp. (Hym.: Formicidae) | Hajiqanbar & Khaustov (2013); Sobhi *et al*. (2017b) |
| *Petalomium heterotrichus* Mahunka, 1970 | *Camponotus* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |
| *Petalomium mazandaranicum* Abbasi-Moqadam & Hajiqanbar, 2018 | *Aphaenogaster* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |
| *Petalomium pseudomyrmecophilus* Mahunka, 1970 | *Lasius umbratus* (Nylander, 1846) (Hym.: Formicidae) | Sobhi *et al*. (2017b) |
| *Petalomium rarus* (Sevastianov, 1967) | *Camponotus* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |
| *Petalomium sawtschuki* (Sevastianov, 1967) | *Tetramorium* sp. (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |
| *Petalomium scyphicum* (Sevastianov, 1967) | *Lasius emarginatus* (Hym.: Formicidae) | Abbasi-Moqadam *et al*. (2018) |

**Table 1.** Continued.

| Mite species | Host/Habitat | Reference |
|---|---|---|
| *Pseudopygmephorus tarsalis* (Hirst, 1921) | Soil | Haddad Irani-Nejad *et al.* (2005); Mirjamali *et al*. (2008) |
| *Troxodania decumanus* (Krczal, 1959) | *Onthophagus furcatus* Fabricius (Col.: Scarabaeidae) | Sobhi *et al.* (2017a) |

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# گزارش‌های جدید از کنه‌های جنس *Allopygmephorus* (Acari: Neopygmephoridae) همراه با فهرستی از گونه‌های خانوادهٔ Neopygmephoridae از ایران

**امین نوابی، حمیدرضا حاجی قنبر* و عبدالعظیم مرتضوی**

*گروه حشره‌شناسی کشاورزی، دانشکده کشاورزی، دانشگاه تربیت مدرس، تهران، ایران؛ رایانامه‌ها: aminnavabi17@gmail.com، hajiqanbar@modares.ac.ir*

* نویسندهٔ مسئول

**چکیده**

پژوهشی به منظور بررسی کنه‌های هترواستیگمای مرتبط با حشرات در بروجرد، استان لرستان در غرب ایران در سال ۱۳۹۵ انجام گرفت. حشرات با استفاده از تله‌های نوری در منطقهٔ فوق جمع آوری شدند. دو گونه از کنه‌های خانواده Neopygmephoridae شامل *Allopygmephorus spinisetus* Khaustov & Sazhnev, 2016 و *A. punctatus* Khaustov & Sazhnev, 2016 در ارتباط با سخت‌بالپوشان *Drasterius bimaculatus* (Rossi, 1790) (Coleoptera: Elateridae) و *Augyles* sp. (Col.: Heteroceridae) شناسایی شدند. هر دو گونه برای فون کنه های ایران جدید بوده و گونه نخست نیز برای آسیا جدید است. افزون بر این، رابطهٔ بین کنه‌های جنس *Allopygmephorus* و سخت‌بالپوشان خانواده Elateridae جدید است. فهرستی از کنه‌های خانوادهٔ Neopygmephoridae در ایران نیز تهیه شده است.

**واژگان کلیدی:** *Allopygmephorus spinisetus* ؛ *A. punctatus* ؛ *Drasterius bimaculatus* ؛ هترواستیگماتینا؛ گزارش میزبانی؛ همسفری.

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