

Mutualistic ants (Hymenoptera: Formicidae) associated with aphids in central and southwestern parts of Iran

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Abstract: Ants consume or store the honeydew which is secreted by aphids or other homopteran insects. Major benefit of ant attendance for aphids is protection against natural enemies. A study was carried out during 2009-2010, to determine the mutualistic association between ants and aphids on different host plants in some parts of Khuzestan and Esfahan provinces. A total of 20 ant species belonging to 12 genera and 3 subfamilies were collected and identified. Among them, four species are new to Iranian ant fauna as follows: *Monomorium libanicum* Tohme; *Monomorium qarahe* Collingwood & Agosti; *Monomorium mayri* Forel and *Lasius paralienus* Seifert. The collected myrmecophilous aphids were 33 species belonging to 3 families and 5 subfamilies. Details and mechanisms of such associations between ants and aphids are unknown to us. More detailed investigations are needed in each case to adequately understand them.

Keywords: mutualism, ant, aphid, Khuzestan, Esfahan, Iran.

Introduction

Aphids and ants are two abundant and highly successful insect groups which have mutualistic relationship where both partners may derive benefits from this association (Völkl *et al.*, 2007; Stadler and Dixon, 2005, Özdemir *et al.*, 2008). The ants gain access to an important source of nutrients and, by attacking all intruders into an aphid colony as potential competitors for the carbohydrate source, act as effective guards against the aphids' natural enemies (Völkl *et al.*, 1999; Völkl *et al.*, 2007) which results in the increase of aphid abundance (Depa and Wojciechowski, 2008). The ant provides protection from predators and parasitoids by building shelters around aphid colonies. Ants presence also stimulates the aphids to grow and mature more rapidly (Hölldobler and Wilson,

1990). Aphids frequently associated with ants tend to have poorly developed cornicles, a reduced cauda, and at most a thin coating of wax filaments (Hölldobler and Wilson, 1990).

The mutualistic relationship between ants and aphids has been the subject of many studies on various aspects of this phenomenon. Stadler and Dixon (2005) reviewed whole range of interactions between ants and aphids. Völkl *et al.* (1999) studied the honeydew composition and production in four aphid species and their mutualistic relationships with the ant *Lasius niger* L. Özdemir *et al.* (2008) collected 16 ant species associated with 19 aphid species in Ankara province (Turkey).

The Iranian ant fauna has been poorly investigated and many areas were sampled only sporadically. So far, 167 species belonging to 32 genera have been recorded from Iran (Paknia *et al.*, 2008; 2010; Radchenko and Paknia, 2010; Firouzi *et al.*, 2011; Mohammadi *et al.*, 2012; Gholami *et al.*, 2012; Hossein Nezhad *et al.*, 2012) with an area of more than 1.6 million km² containing a rich fauna and flora. As stated

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by Mohammadi *et al.* (2012), this number is far from complete (in comparison with Iran's adjacent countries such as Arabian Peninsula: 300 species in 2.1 million km² area).

There is no report on the ants fauna associated with myrmecophilous aphids in Iran. To fill this gap, we performed this study in some parts of Khuzestan and Esfahan provinces, to investigate the fauna of ants associated with aphids.

Material and Methods

This research was carried out from February 2008 to June 2010. Samplings were done in two provinces of Iran: Khuzestan province at southwest Iran and Esfahan province at central part of Iran. In the former province 11 different localities were visited and sampled, and in the latter province, Esfahan city and its vicinity were sampled (Fig. 1). Ants were collected from the aphid colonies on different plant species. Samples of aphids and ants were transferred to the laboratory in separate plastic bags. Ants

associations with aphids were confirmed in three ways by observing: 1) ant antennation for stimulating aphids to secrete honeydew droplets 2) honeydew collection by ants 3) ants trail for honeydew collecting which was followed and measured from nest to aphids' colony for some colonies.

In total, 3786 ant specimens were checked and sorted to morphospecies. Materials were identified preliminarily based on available resources (e.g. Bolton, 1994; Agosti and Collingwood, 1987; Collingwood and Agosti, 1996) and then sent to taxonomist, Dr. C. A. Collingwood from England for final identification or confirmation. All of the specimens were deposited at Insect and Mite Collection of Ahvaz (IMCA), Plant Protection Department, Shahid Chamran University of Ahvaz, Iran. Pictures were taken using an Olympus SZX12 stereomicroscope with attached Canon Power Shot SX40 HS, and were edited with Combine ZM software. Terminology follows Bolton (1994).

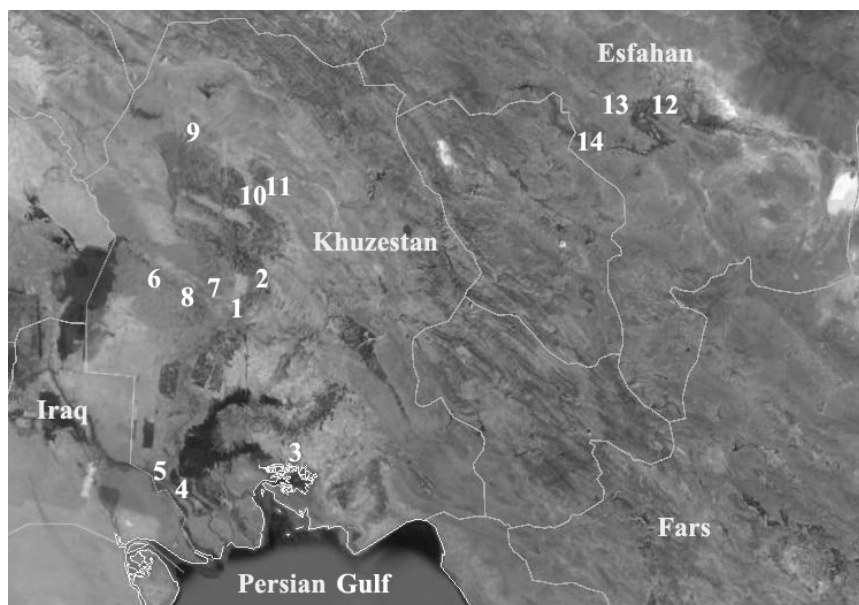


Figure 1 Sampling localities in this study: in Khuzestan province, 1. Ahvaz (31°19' N, 48°42' E) 2. Ramin (30°21' N, 48°53' E) 3. Mahshahr (30°32' N, 49°10' E) 4. Abadan (30°21' N, 48°16' E) 5. Khorramshahr (30°26' N, 48°10' E) 6. Susangerd (31°33' N, 48°11' E) 7. Albaji (31°30' N, 48°37' E) 8. Hamidieh (31°28' N, 48°26' E) 9. Dezful (32°23' N, 48°24' E) 10. Shushtar (32°25' N, 48°50' E) 11. Aghili (32°14' N, 48°48' E) and in Esfahan province, 12. Esfahan (32°40' N, 51°39' E) 13. Najaf abad (31°35' N, 48°16' E) 14. Baghe bahadoran (West Esfahan city), (32°22' N, 51°11' E).

Results

In this study, a total of 20 ant species from 12 genera and 3 subfamilies were collected in association with 33 aphid species of 14 genera from 3 families and 5 subfamilies on 83 host-plants. Among them, 4 species are new for the ant fauna of Iran, indicated by an asterisk (*). Identification characters are presented for the newly recorded species. Also, four ant species in Khuzestan province (†) as well as all ant species from Esfahan province (‡) were new for these provinces' fauna. Ant species belonged to Formicinae (10 species), Myrmicinae (8 species) and Dolichoderinae (2 species). They were listed alphabetically as follows:

Family Formicidae

Subfamily Formicinae

Camponotus libanicus Andre, 1881[†]

Material examined: IRAN, Khuzestan province: Dezful, 08.04.2010, 143 m, from *Aphis craccivora* Koch on *Rumex acetosa* L. (2 ♀).

Distribution: Jordan, Lebanon, occupied Palestine, Syria, Turkey (Radchenko, 1997b) and Iran (Paknia et al., 2010).

Camponotus oasisium Forel, 1890

Material examined: IRAN, Khuzestan province: Ahvaz, 13.04.2009, 18 m, from *Aphis gossypii* Glover on *Sylbium marianum* L. (6 ♀); Ahvaz, 05.02.2010, 18 m, from *A. craccivora* on *Medicago sativa* L. (6 ♀).

Distribution: African continent, Oman, Saudi Arabia, United Arab Emirates (Collingwood and Agosti, 1996) and Iran (Paknia et al., 2008).

Cataglyphis cinnamomeus (Karavaiev, 1910)[†]

Material examined: IRAN, Khuzestan province: Albaji, 04.03.2010, 22 m, from *Myzus persicae* Sulzer on *Beta maritima* L. (3 ♀).

Distribution: Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, southern Kazakhstan (Karavaiev, 1910), Afghanistan (Radchenko, 1997a), North African countries, Saudi Arabia, United Arab Emirates (Collingwood and Agosti, 1996) and Iran (Paknia et al., 2010).

Cataglyphis lividus (Andre, 1881)

Material examined: IRAN, Khuzestan province: Ahvaz, 14.02.2010, 18 m, from *Aphis fabae* Scopuli on *B. maritima* (3 ♀); Mahshahr, 15.03.2010, 3 m, from *A. fabae* on *S. marianum* (4 ♀).

Distribution: Kuwait, Oman, Saudi Arabia, United Arab Emirates, Yemen (Collingwood and Agosti, 1996) and Iran (Paknia et al., 2008).

Cataglyphis nodus (Brulle, 1832)

Material examined: IRAN, Khuzestan province: Ahvaz, 26.02.2010, 18 m, from *A. gossypii* on *Chrysanthemum* sp. (8 ♀).

Distribution: Albania, Bulgaria, former Yugoslavia, Greece, Turkey (Agosti and Collingwood, 1987) and Iran (Paknia et al., 2008).

Lasius paralienus Seifert, 1992* (Figs. 2, 3)

Material examined: IRAN, Esfahan province: Baghe bahadoran (West Esfahan city), 08.05.2009, 1900 m, from *M. persicae* on *Cydonia* sp. (5 ♀); Esfahan, 11.07.2009, 1570 m, from *A. gossypii* on *Rosa* sp. (18 ♀); Esfahan, 11.07.2009, 1570 m, from *Cinara palaestinensis* Hille Ris Lambers on *Pinus* sp. (46 ♀); Esfahan, 13.07.2009, 1570 m, from *Chaitophorus remaudierei* Pintera on *Salix petandra* L. (8 ♀); Esfahan, 19.07.2009, 1570 m, from *Chaitophorus populeti* Panzer on *Populus alba* L. (51 ♀); Najaf abad, 31.07.2009, 1650 m, from *Chaitophorus populiabae* Boyer de Fonscolombe on *P. alba* (51 ♀) and from *Pterochloroides persicae* Cholodovsky on *Prunus amygdalus* Batsch (68 ♀); Esfahan, 13.07.2009, 1570 m, from *Ch. populiabae* on *P. alba* (7 ♀); Esfahan, 10.08.2009, 1570 m, from *A. fabae* on *Solanum melogena* L. (33 ♀), from *A. gossypii* on *Cucumis sativa* L. (5 ♀) and from *A. gossypii* on *Ocimum basilicum* L. (16 ♀); Esfahan, 13.11.2009, 1570 m, from *A. gossypii* on *Capsicum annuum* L. and *Rosa* sp. (12 ♀) and from *Chaitophorus truncatus* Housman on *S. petandra* (5 ♀); Esfahan, 14.11.2009, 1570 m, from *Aphis umbrella* Börner on *Malva parviflora* L. (7 ♀). Khuzestan province: Ahvaz, 05.02.2010, 18 m, from *A. craccivora* on *M. sativa* (16 ♀). Esfahan province: Najaf abad, 20.04.2010, 1650 m, from *Hyalopterus pruni*

Geoffroy on *P. amygdalus* (27 ♀) and from *M. persicae* on *Cydonia oblonga* Miller (13 ♀); Esfahan, 30.04.2010, 1570 m, from *A. fabae* on *Chrysanthemum* sp. (20 ♀) and from *A. gossypii* on *Cydonia* sp. (8 ♀); Esfahan, 31.04.2010, 1570 m, from *A. fabae* on *Malus baccata* Borkhausen and *Viburnum opulus* (L.) (13 ♀).

Diagnostic characters: Occipital hairs distributed to hind margin of eye; area between propodeal spiracle and metapleural gland with 2-5 setae; head, mesosoma and gaster with profuse setae; hind tibia with 1-6 setae at proximal end; head, mesosoma, petiole, gaster and femora blackish or dark brown; tibia dark brown; scape, mandibles, distal femoral and proximal tibial end yellowish brown.

Distribution: Bulgaria, Egypt, France, Turkey, Italy (Bernadou *et al.*, 2010) and Slovenia (Bracko, 2007).

Lepisiota bipartite Smith, 1861^{††}

Material examined: IRAN, Khuzestan province: Ahvaz, 26.02.2009, 18 m, from *A. fabae* on *Vicia fabae* L. (5 ♀); Ahvaz, 26.02.2009, 18 m, from *Rhopalosiphom padi* L. on *Avena fatua* L. (4 ♀); Ahvaz, 27.02.2009, 18 m, from *Aphis nasturtii* Kalténbach on *Calendula officinalis* L. (8 ♀); Ahvaz, 28.02.2009, 18 m, from *M. persicae* on *B. maritima* (16 ♀); Ahvaz, 05.03.2009, 18 m, from *A. gossypii* and from *M. persicae* on *Citrus* sp. (8 ♀); Ahvaz, 06.03.2009, 18 m, from *M. persicae* on *Ipomoea batatas* (L.) (15 ♀); Ahvaz, 10.03.2009, 18 m, from *M. persicae* on *Convolvulus arvensis* L. (2 ♀) and from *A. gossypii* on *Hibiscus rosa-sinensis* L. (2 ♀); Ahvaz, 13.04.2009, 18 m, from *A. gossypii* on *Ptunia nyctaginiflora* Juss (8 ♀); Susangerd, 17.04.2009, 18 m, from *A. gossypii* on *Sonchus asper* L. (3 ♀); Ramin, 01.05.2009, 25 m, from *Aphis nerii* Boyer de Fonscolombe on *Nerium oleander* L. (63 ♀); Ahvaz, 28.04.2009, 18 m, from *A. nerii* on *N. oleander* (6 ♀); Ahvaz, 30.04.2009, 18 m, from *Aphis punicae* Passerini on *Punica granatum* L. (39 ♀); Ahvaz, 06.02.2010, 18 m, from *A. gossypii* on *Helianthus annuus* L. (9 ♀); Ahvaz, 15.02.2010, 18 m, from

A. craccivora on *Eucalyptus occidentalis* Endlicher (6 ♀); Ahvaz, 26.02.2010, 18 m, from *A. gossypii* and from *M. persicae* on *Citrus* sp. (13 ♀); Albaji, 04.03.2010, 22 m, from *Rhopalosiphom maidis* Fitch on *Hordeum vulgare* L. (11 ♀); Mahshahr, 15.03.2010, 3 m, from *A. craccivora* on *Ammi majus* L. and on *M. sativa* (21 ♀) and from *A. gossypii* on *Lactuca seriola* L. (16 ♀); Khorramshahr, 16.03.2010, 6.6 m, from *M. persicae* on *C. officinalis* (4 ♀) and from *A. umbrella* on *M. parviflora* (3 ♀) and from *A. fabae* on *S. marianum* (4 ♀); Ahvaz, 12.04.2010, 18 m, from *Chaitophorus euphraticus* Hodjat on *Populus euphratica* Olivier (7 ♀). Esfahan province: Baghe bahadoran (West Esfahan city), 08.05.2009, 1900 m, from *Aphis parietariae* Theobald on *parietaria judaica* (L.) (8 ♀); Najaf abad, 06.05.2009, 1650 m, from *P. persicae* on *Prunus armeniaca* L. (71 ♀); Esfahan, 10.09.2009, 1570 m, from *A. gossypii* on *Citrullus vulgaris* Schrader (65 ♀); Najaf abad, 18.09.2009, 1650 m, from *P. persicae* on *Prunus persica* L. and on *P. armeniaca* (75 ♀); Esfahan, 13.11.2009, 1570 m, from *Ch. truncates* on *S. petandra* (5 ♀); Esfahan, 14.11.2009, 1570 m, from *A. fabae* on *Chrysanthemum* sp. (4 ♀); Esfahan, 01.05.2010, 1570 m, from *A. gossypii* and from *M. persicae* on *Rosa* sp. (13 ♀) and from *H. pruni* on *P. armeniaca* (5 ♀); Esfahan, 30.07.2010, 1570 m, from *A. gossypii* on *Miralalis jalaya* (L.) (327 ♀); Esfahan, 02.06.2010, 1570 m, from *A. craccivora* on *Vitis vinifera* L. (7 ♀).

Distribution: Saudi Arabia (Collingwood and Agosti, 1996) and Iran (Paknia *et al.*, 2008).

Paratrechina longicornis (Latreille, 1802)[†]

Material examined: IRAN, Khuzestan province: Ahvaz, 03.03.2009, 18 m, from *A. craccivora* on *Melilotus officinalis* L. (23 ♀).

Distribution: Oman, Saudi Arabia, Yemen (Collingwood and Agosti, 1996) United Arab Emirates (Collingwood *et al.*, 1997) and Iran (Paknia *et al.*, 2008).

***Plagiolepis pallescens* Forel, 1889[‡]**

Material examined: IRAN, Khuzestan province: Dezful, 20.02.2009, 143 m, from *A. craccivora* on *Capsella bursa pastoris* L. (49 ♀); Dezful, 20.02.2009, 143 m, from *A. gossypii* on *Rubus anatolicus* Focke (30 ♀); Ahvaz, 10.04.2009, 18 m, from *A. fabae* on *Solanum nigrum* L. (5 ♀); Ahvaz, 30.11.2009, 18 m, from *Hyalopterus amygdali* (Blanchard) on *Phragmites australis* Cavanilles (9 ♀). Esfahan province: Esfahan, 07.05.2009, 1570 m, from *A. craccivora* on *Glycyrrhiza glabra* L. (12 ♀); Esfahan, 28.07.2009, 1570 m, from *A. craccivora* on *Hedera helix* L. (5 ♀); Esfahan, 01.05.2010, 1570 m, from *A. gossypii* on *Ulmus* sp. (20 ♀); Esfahan, 01.05.2010, 1570 m, from *Tinocallis platani* Kaltenbach on *Ulmus* sp. (14 ♀).

Distribution: Greece, Turkey (Agosti and Collingwood, 1987) and Iran (Paknia et al., 2008).

***Polyrhachis lacteipennis* Smith, 1839**

Material examined: IRAN, Khuzestan province: Ahvaz, 05.04.2009, 18 m, from *A. gossypii* on *Althaea rosae* L. (8 ♀); Ramin, 22.04.2009, 25 m, from *A. gossypii* on *H. Rosa-sinensis* (2 ♀); Ramin, 22.04.2009, 25 m, from *A. craccivora* on *Ciser* sp. (10 ♀) and from *R. maidis* on *Bromus* sp. (4).

Distribution: India, Oman, Saudi Arabia, Yemen (Collingwood and Agosti, 1996) and Iran (Paknia et al., 2008).

Subfamily Myrmicinae***Crematogaster antaris* Forel, 1894[‡]**

Material examined: IRAN, Esfahan province: Baghe bahadoran (West Esfahan city), 08.05.2009, 1900 m, from *A. craccivora* on *M. sativa* (5 ♀) and from *M. persicae* on *Cydonia* sp. (14 ♀); Esfahan, 22.07.2009, 1570 m, from *Aphis farinose* Gmelin on *S. petandra* (19 ♀) and from *Ch. truncates* on *S. petandra* (23 ♀); Esfahan, 28.07.2009, 1570 m, from *A. gossypii* on *Cucurbita maxima* Duchartre (5 ♀).

Distribution: Kuwait, Oman, United Arab Emirates, Yemen (Collingwood and Agosti, 1996) and Iran (Paknia et al., 2008).

As three *Monomorium* species were new to Iran, here we present a key to identification of four species records, collected in this study.

- 1- Body colour uniformly dark (Figs. 5, 7).....2
- Body colour yellow or bicoloured (Fig. 9).....3
- 2- Body colour dark brown (Figs. 6, 7), underside of head with few scattered hairs not forming a distinct psammophore, mandibles 2-toothed.....*M. mayri*
- Body colour entirely black (Figs. 4, 5), mandibles 4-toothed*M. libanicum*
- 3- Body colour uniformly yellow (Figs. 8, 9)*M. qarahe*
- Bicoloured, head and alitrunk yellowish and gaster dark brown*M. destructor*

***Monomorium destructor* (Jerdon, 1851)**

Material examined: IRAN, Khuzestan province: Ahvaz, 15.02.2010, 18 m, from *A. gossypii* on *Tecoma stans* L. (13 ♀); Ahvaz, 13.10.2009, 18 m, from *Ch. euphraticus* on *P. euphratica* (8 ♀); Mahshahr, 15.03.2010, 3 m, from *A. craccivora* on *S. marianum* (7 ♀); Hamidieh, 05.03.2010, 23 m, from *A. craccivora* on *Thamarix* sp. (5 ♀).

Distribution: Kuwait, Oman, Saudi Arabia, Yemen (Collingwood and Agosti, 1996) United Arab Emirates (Collingwood et al., 1997) and Iran (Paknia et al., 2008).

***Monomorium libanicum* Tohmé, 1980* (Figs. 4, 5)**

Material examined: IRAN, Khuzestan province: Mahshahr, 15.03.2010, 3 m, from *A. fabae* on *S. marianum* (3 ♀); Mahshahr, 15.03.2010, 3 m, from *A. gossypii* on *M. parviflora* (3 ♀); Khorramshahr, 16.03.2010, 6.6 m, from *A. fabae* on *S. marianum* (2 ♀).

Diagnostic characters: Propodeal spiracle circular; terminal funiculus segments form a distinct three segmented club; scape short, not reaching to occiput; body entirely black; mandibles 4-toothed.

Distribution: Lebanon and Syria (Tohme and Tohme, 1979).

Monomorium mayri* Forel, 1902 (Figs. 6, 7)

Material examined: IRAN, Khuzestan province: Ahvaz, 17.02.2009, 18 m, from *A. gossypii* on *Brassicae kaber* Wheeler (30 ♀); Ahvaz, 23.02.2009, 18 m, from *M. persicae* on *Eruca sativa* Lambers and *A. rosae* (48 ♀); Ahvaz, 27.02.2009, 18 m, from *H. amygdali* on *P. australis* (18 ♀); Ahvaz, 01.04.2009, 18 m, from *A. fabae* on *B. maritima* (40 ♀); Shushtar, 01.04.2009, 150 m, from *A. gossypii* on *B. maritima* (6 ♀); Shushtar, 01.04.2009, 150 m, from *A. nerii* on *N. oleander* (27 ♀); Shushtar, 01.04.2009, 150 m, from *M. persicae* on *M. parviflora* (48 ♀); Ahvaz, 07.04.2009, 18 m, from *A. gossypii* on *H. rosa sinensis* and *T. stans* (4 ♀); Ahvaz, 09.04.2009, 18 m, from *H. amygdali* on *P. australis* (12 ♀); Susangerd, 17.04.2009, 10 m, from *H. amygdali* on *P. australis* (6 ♀); Ahvaz, 22.04.2009, 18 m, from *R. maidis* on *Bromus* sp. (2 ♀); Ahvaz, 12.08.2009, 18 m, from *Ch. euphraticus* on *P. euphratica* (47 ♀); Ahvaz, 14.02.2010, 18 m, from *M. persicae* on *Urtica dioica* (L.) (26 ♀); Ahvaz, 15.02.2010, 18 m, from *A. gossypii* on *B. kaber* (40 ♀); Albaji, 04.03.2010, 22 m, from *Aphis polygonata* Nevsky on *Polygonum aviculare* L. (2 ♀); Ahvaz, 05.03.2010, 18 m, from *A. craccivora* on *Tamarix* sp. (46 ♀); Mahshahr, 15.03.2010, 3 m, from *A. craccivora* on *S. marianum* (16 ♀); Khorramshahr, 16.03.2010, 6.6 m, from *A. fabae* on *S. marianum* (24 ♀); Khorramshahr, 16.03.2010, 6.6 m, from *M. persicae* on *B. maritima* (3 ♀).

Diagnostic characters: Terminal funiculus segment shorter than the two preceding segments together; propodeal spiracle circular; the underside of head with few scattered hairs that do not form a distinct psammophore; mandibles 2-toothed; body dark brown.

Distribution: Oman, Saudi Arabia, Yemen (Collingwood and Agosti, 1996) and India (Bolton, 1987).

Monomorium qarahe* Collingwood & Agosti, 1996 (Figs. 8, 9)

Material examined: IRAN, Khuzestan province: Ahvaz, 02.03.2009, 18 m, from *A. gossypii* on *H. rosa-sinensis* (7 ♀); Mahshahr, 15.03.2010, 3 m, from *A. fabae* on *S. marianum* (5 ♀); Ahvaz, 22.04.2009, 18 m, from *R. maidis* on *Bromus* sp. (3 ♀).

Diagnostic characters: Terminal funiculus segment longer than the two preceding segments together; body bright yellow; propodeal dorsum round and the mesopropodeal break shallow; petiole a broadly rounded triangle.

Distribution: Saudi Arabia (Collingwood and Agosti, 1996).

***Pheidole pallidula* Nylander, 1889[‡]**

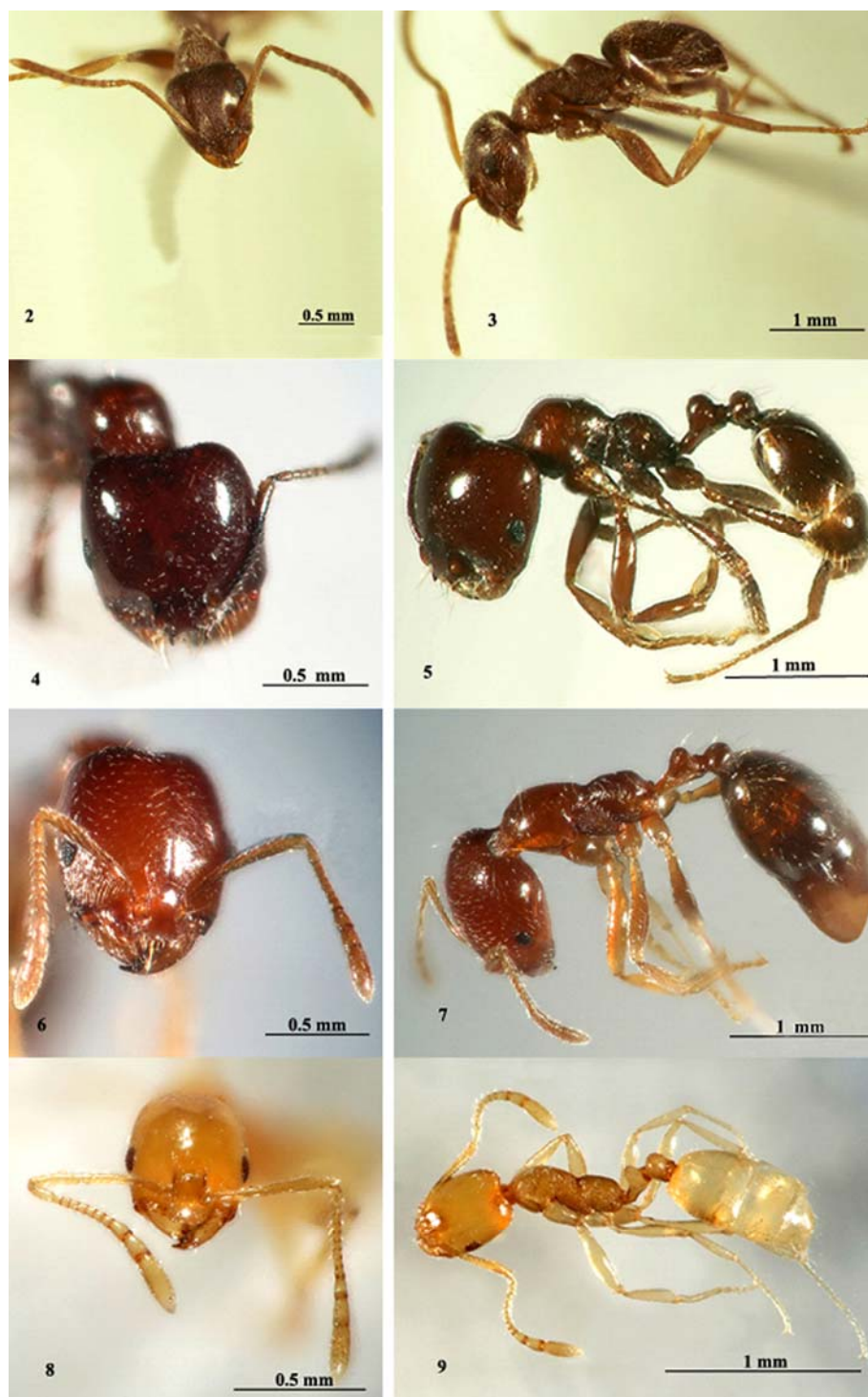
Material examined: IRAN, Khuzestan province: Ahvaz, 06.03.2009, 18 m, from *Aphis davletshinae* Hille Ris Lambers on *A. rosae* (9 ♀); Ahvaz, 27.01.2010, 18 m, from *A. umbrella* on *M. parviflora* (8 ♀) and from *A. gossypii* on *B. kaber* (6 ♀); Ahvaz, 05.02.2010, 18 m, from *A. gossypii* on *A. rosae* (39 ♀). Esfahan province: Baghe bahadoran (West Esfahan city), 08.05.2009, 1900 m, from *M. persicae* on *Cydonia* sp. (9 ♀); Esfahan, 30.07.2010, 1570 m, from *A. gossypii* on *M. jalaya* (17 ♀).

Distribution: Albania, Bulgaria, former Yugoslavia, Greece, Turkey (Agosti and Collingwood, 1987) France, Spain and Portugal (Collingwood, 1978) Slovenia (Bracko, 2007) and Iran (Paknia *et al.*, 2008).

***Pheidole teneriffana* Forel, 1893[‡]**

Material examined: IRAN, Khuzestan province: Ahvaz, 17.01.2010, 18 m, from *A. umbrella* on *M. parviflora* (20 ♀); Dezful, 08.04.2010, 143 m, from *A. craccivora* on *S. melogena* (18 ♀). Esfahan province: Esfahan, 28.07.2009, 1570 m, from *A. craccivora* on *H. helix* (7 ♀).

Distribution: Kuwait, Oman, Saudi Arabia, Yemen (Collingwood and Agosti, 1996) United Arab Emirates (Collingwood *et al.*, 1997) and Iran (Paknia *et al.*, 2008).



Figures 2-9 Morphological characteristics of newly recorded species of ants from Iran. 2-3 *Lasius paralienus* (worker): 2 Head in frontal view, 3 Alitrunk in profile view. 4-5 *Monomorium libanicum* (worker): 4 Head in frontal view, 5 Alitrunk in profile view. 6-7 *Monomorium mayri* (worker): 6 Head in frontal view, 7 Alitrunk in profile view. 8-9 *Monomorium qarahe* (worker): 8 Head in frontal view, 9 Alitrunk in profile view.

Table 1 Aphids and their ants visitor list, collected in Khuzestan and Esfahan provinces.

Aphid species	Ant species
<i>Aphis craccivora</i>	<i>Crematogaster antaris</i> , <i>Monomorium destructor</i> , <i>Monomorium mayri</i> , <i>Pheidole teneriffana</i> , <i>Tapinoma simrothi</i> , <i>Tapinoma</i> sp., <i>Camponotus libanicus</i> , <i>Camponotus oasium</i> , <i>Lasius paralienus</i> , <i>Lepisiota bipartite</i> , <i>Paratrechina longicornis</i> , <i>Plagiolepis pallescens</i> , <i>Polyrhachis lacteipennis</i>
<i>Aphis davletshinae</i>	<i>Tapinoma simrothi</i> , <i>Pheidole pallidula</i>
<i>Aphis fabae</i>	<i>Monomorium libanicum</i> , <i>Monomorium mayri</i> , <i>Monomorium qarahe</i> , <i>Tetramorium caespitum</i> , <i>Tapinoma simrothi</i> , <i>Tapinoma</i> sp., <i>Cataglyphis lividus</i> , <i>Lepisiota bipartite</i> , <i>Lasius paralienus</i> , <i>Plagiolepis pallescens</i>
<i>Aphis farinose</i>	<i>Crematogaster antaris</i>
<i>Aphis frangulae gossypii</i>	<i>Crematogaster antaris</i> , <i>Monomorium libanicum</i> , <i>Monomorium destructor</i> , <i>Monomorium mayri</i> , <i>Monomorium qarahe</i> , <i>Pheidole pallidula</i> , <i>Tapinoma simrothi</i> , <i>Camponotus oasium</i> , <i>Cataglyphis nodus</i> , <i>Lepisiota bipartite</i> , <i>Lasius paralienus</i> , <i>Plagiolepis pallescens</i> , <i>Polyrhachis lacteipennis</i>
<i>Aphis nasturtii</i>	<i>Tapinoma simrothi</i> , <i>Lepisiota bipartite</i>
<i>Aphis nerii</i>	<i>Monomorium mayri</i> , <i>Tapinoma simrothi</i> , <i>Lepisiota bipartite</i>
<i>Aphis parietariae</i>	<i>Lepisiota bipartite</i>
<i>Aphis polygonata</i>	<i>Monomorium mayri</i>
<i>Aphis punicae</i>	<i>Lepisiota bipartite</i>
<i>Aphis rumicis</i>	<i>Tapinoma simrothi</i>
<i>Aphis umbrellae</i>	<i>Pheidole pallidula</i> , <i>Pheidole teneriffana</i> , <i>Tapinoma simrothi</i> , <i>Tapinoma</i> sp., <i>Lepisiota bipartite</i> , <i>Lasius paralienus</i>
<i>Brachycaudus helichrysi</i>	<i>Tapinoma simrothi</i> , <i>Tapinoma</i> sp.
<i>Brachyonguis harmalae</i>	<i>Tapinoma simrothi</i>
<i>Brachyonguis tamaricophilus</i>	<i>Tapinoma simrothi</i>
<i>Capitophorus inulae</i>	<i>Tapinoma simrothi</i>
<i>Chaitophorus euphraticus</i>	<i>Monomorium destructor</i> , <i>Monomorium mayri</i> , <i>Lepisiota bipartite</i>
<i>Chaitophorus populeti</i>	<i>Lasius paralienus</i>
<i>Chaitophorus populialbae</i>	<i>Lasius paralienus</i>
<i>Chaitophorus remaudierei</i>	<i>Lasius paralienus</i>
<i>Chaitophorus truncatus</i>	<i>Crematogaster antaris</i> , <i>Lepisiota bipartite</i> , <i>Lasius paralienus</i>
<i>Cinara cedri</i>	<i>Tapinoma simrothi</i>
<i>Cinara palaestinaensis</i>	<i>Lasius paralienus</i>
<i>Colorado absinthiella</i>	<i>Tapinoma simrothi</i>
<i>Eulachnus tuberculostomata</i>	<i>Tapinoma simrothi</i>
<i>Hyalopterus amygdali</i>	<i>Monomorium mayri</i> , <i>Plagiolepis pallescens</i>
<i>Hyalopterus pruni</i>	<i>Lepisiota bipartite</i> , <i>Lasius paralienus</i>
<i>Myzus persicae</i>	<i>Crematogaster antaris</i> , <i>Monomorium mayri</i> , <i>Pheidole pallidula</i> , <i>Tapinoma simrothi</i> , <i>Cataglyphis cinnamomeus</i> , <i>Lepisiota bipartite</i> , <i>Lasius paralienus</i>
<i>Nearctaphis bakeri</i>	<i>Tapinoma simrothi</i>
<i>Pterochloroides persicae</i>	<i>Lasius paralienus</i> , <i>Lepisiota bipartite</i>
<i>Rhopalosiphom maidis</i>	<i>Monomorium mayri</i> , <i>Monomorium qarahe</i> , <i>Lepisiota bipartite</i> , <i>Polyrhachis lacteipennis</i>
<i>Rhopalosiphom padi</i>	<i>Tapinoma simrothi</i> , <i>Lepisiota bipartite</i>
<i>Tinocallis platani</i>	<i>Plagiolepis pallescens</i>

***Tetramorium caespitum* (L.), 1758[‡]**

Material examined: IRAN, Esfahan province: Baghe bahadoran (West Esfahan city), 08.05.2009, 1900 m, from *A. fabae* on *Tamarix* sp. (17 ♀).

Distribution: Bulgaria, Greece, Turkey, former Yugoslavia (Agosti and Collingwood, 1987) Slovenia (Bracko, 2007) and Iran (Paknia et al., 2008).

Subfamily Dolichoderinae***Tapinoma simrothi* Krausse, 1911[‡]**

It was most widespread species and was collected on more than half of the aphids (Table 1) in most of sampling localities.

Distribution: Greece (Agosti and Collingwood, 1987) Saudi Arabia, Kuwait, Oman, Yemen (Collingwood and Agosti, 1996) United Arab Emirates (Collingwood et al., 1997) Spain (Collingwood, 1978) and Iran (Paknia et al., 2008).

***Tapinoma* sp.[‡]**

Material examined: IRAN, Esfahan province: Esfahan, 07.05.2009, 1570 m, from *A. fabae* on *Lepidium latifolium* L. (4 ♀); Esfahan, 08.05.2009, 1570 m, from *Brachycaudus helichrisy* Kaltenbach on *Prunus* sp. (4 ♀); Esfahan, 22.07.2009, 1570 m, from *A. fabae* on *Dahlia excels* Benth (15 ♀); Esfahan, 22.07.2009, 1570 m, from *A. umbrella* on *M. parviflora* (6 ♀); Esfahan, 22.07.2009, 1570 m, from *A. craccivora* on *Robinia pseudoacacia* L. (29 ♀).

Discussion

The most frequent mutualist ant was *T. simrothi*, a common Mediterranean and Middle Eastern species, which was collected in all localities of both explored provinces and from 18 aphid species. This indicates that it is a widespread species adapted to various climates and environmental conditions of the study area.

Mossadegh et al. (2008) reported that all of the collected ants in the colony of *Nipaecoccus viridis* (Newstead) have a negative influence on

biological control of this pest, by preventing feeding and subsequently reproduction of the released Crypt beetles, *Cryptolaemus montrouzieri* Mulsant, in Dezful citrus orchards. Soleyman-Nejadian and Dezhakam (2001) also stated that the symbiotic ant *Crematogaster antaris* Forel, interfere the performance of two encyrtid parasitoids *Anagyrus agraensis* (Saraswat) and *A. dactylopii* (Howard) on *N. viridis*. However, there isn't such report in the case of myrmecophilous aphids from Iran. Details and mechanisms of ant-aphid associations in this study are unknown to us. More detailed investigations are needed in each case to adequately understand them.

Özdemir et al., (2008) collected the ant *P. pallescens* on aphids: *Staegriella necopinata*, *Onopordium* sp., *Brachycaudus tragopogonis* and *A. craccivora*; also the ant *Lasius paralienus* on aphids *A. fabae*, *A. craccivora*, *A. gossypii*, *A. galliscabri* and *B. cardui*. In this study, we also collected the above mentioned ants on *A. fabae*, *A. craccivora*, *A. gossypii* and *Hyalopterus amygdali* in Ahvaz and on *A. craccivora*, *A. gossypii* and *Tinocallis platani* in Esfahan.

Dezhakam and Soleyman-Nejadian (2002) in a study on symbiotic ants with the mealybug *N. viridis* on citrus in Khuzestan, collected 16 ant species, of which *Ph. teneriffana*, *Ph. pallidula*, *C. antaris*, *T. simrothi*, *P. lacteipennis*, *C. oasisium*, *P. pallescens*, *C. lividus* and *M. destructor* were also collected in our study, indicating that these ant species feed on both scale insect and aphid honeydew. Mossadegh et al. (2008) also reported 9 symbiotic ants with the above mentioned mealybug from Dezful citrus orchards, of which *Ph. teneriffana*, *Ph. pallidula*, *T. simrothi*, *P. lacteipennis*, *P. pallescens*, *C. lividus* and *M. destructor* were also collected in this study.

Three of the newly recorded species, *M. libanicum*, *M. qarahe* and *M. mayri* have previously been recorded from the hot deserts and subtropical areas of the Middle East and Arabian Peninsula. These species were also collected in western Khuzestan province, a dry

semi-desert lowland which is excessively hot and dry in the summer. The fourth new record, *L. paralienus*, was collected in Esfahan province, where its moderate climate is more or less similar to climate of the previously recorded localities for this species.

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References

- Agosti, D. and Collingwood, C. A. 1987. A provisional list of the Balkan ants (Hym. Formicidae) with a key to the worker caste. II. Key to the worker caste, including the European species without the Iberian. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft Bulletin de la Societe Entomologique Suisse*, 60: 261-293.
- Bernadou, A., Galkowski, Ch., Le Goff, A., Fourcassie, V. and Espadaler, X. 2010. First record of *Lasius paralienus* Seifert, 1992 (Hymenoptera: Formicidae) from France and Andorra. *Myrmecological News*, 13: 111-113.
- Bolton, B. 1987. A review of the *Solenopsis* genus-group and revision of Afrotropical *Monomorium* Mayr (Hymenoptera: Formicidae). *Bulletin of the British Museum Natural History (Entomology)*, 54: 263-452.
- Bolton, B. 1994. Identification guide to the ant genera of the world. Harvard University Press, Cambridge, Massachusetts.
- Bracko, G. 2007. Checklist of the ants of Slovenia (Hymenoptera: Formicidae). *Natura Sloveniae*, 9 (1): 15-24.
- Collingwood, C. A. 1978. A provisional list of Iberian Formicidae with a key to the worker caste (Hym. Aculeate). *Revista Espanol de Entomologia*, 52: 65-95.
- Collingwood, C. A. and Agosti, D. 1996. Formicidae (Insecta: Hymenoptera) of Saudi Arabia (Part 2). *Fauna of Saudi Arabia*, 15: 300-385.
- Collingwood, C. A., Tigar, B. J. and Agosti, D. 1997. Introduced ants in the United Arab Emirates. *Journal of Arid Environments*, 37: 505-512.
- Depa, L. and Wojciechowski, W. 2008. Ant-root aphid relations in different plant associations. *Polish Journal of Entomology*, 77: 151-163.
- Dezhakam, M. and Soleyman-Nejadian, E. 2002. Fauna of symbiotic ants with the southern mealybug *Nipaecoccus viridis* New. (Hom: Pseudococcidae), on citrus in Khuzestan. *Scientific Journal of Agriculture*, 24 (2): 75-100.
- Firouzi, F., Pashaei Rad, S., Hossein Nezhad, S. and Agosti, D. 2011. Four new records of ants from Iran (Hymenoptera: Formicidae). *Zoology in the Middle East*, 52: 71-78.
- Gholami, M., Afshari, A. and Mafi Pashakolaei, Sh. A. 2012. The fauna and frequency of cottony cushion scale (*Icerya purchasi* Maskell) related ants (Hymenoptera: Formicidae) community in citrus orchards of Sari region, northern Iran. *Proceedings of the 20th Iranian Plant Protection Congress*, 26-29 Aug., Shiraz, Iran. p. 175.
- Hölldobler, B. and Wilson, E. O. 1990. *The Ants*. Harvard University Press, Cambridge, Massachusetts.
- Hossein Nezhad, S., Pashaei Rad, S., Firouzi, F., and Agosti, D. 2012. New and additional records for the ant fauna from Iran. *Zoology in the Middle East*, 55: 65-74.
- Karavaiev, V. 1910. Nachtrag zu meinen "Ameisen aus Transcaspien und Turkestan". *Russkoye Entomologicheskoye Obozreniye*, 9: 72-268.
- Mohammadi, Sh., Mossadegh, M. S. and Esfandiari, M. 2012. Eight ant species

- (Hym.: Formicidae) new for the fauna of Iran. *Munis Entomology and Zoology*, 7 (2): 847-851.
- Mossadegh, M. S., Esfandiari, M. and Heidarynia, Z. 2008. The effects of symbiotic ants on biological control of *Nipaecoccus viridis* (New.) by *Cryptolaemus montrouzieri* Mul. in citrus orchards of north Khuzestan. *Proceedings of the 18th Iranian Plant Protection Congress*, 24-27 Aug., Hamedan, Iran. p. 36.
- Özdemir, I., Aktac, N., Toros, S., Kilincer, N. and Gurkan, M. O. 2008. Investigations of the association between aphids and ants on wild plants in Ankara province (Turkey). *Munis Entomology and Zoology*, 3: 606-613.
- Paknia, O., Radchenko, A. G., Alipanah, H. and Pfeiffer, M. 2008. A preliminary checklist of the ants (Hymenoptera: Formicidae) of Iran. *Myrmecological News*, 11: 151-159.
- Paknia, O., Radchenko, A. G. and Pfeiffer, M. 2010. New records of ants (Hymenoptera: Formicidae) from Iran. *Asian Myrmecology*, 3: 29-38.
- Radchenko, A. 1997a. Review of ants of the genus *Cataglyphis* Foerster (Hymenoptera: Formicidae) of Asia. [In Russian]. *Entomologicheskoye Obozreniye*, 76: 424-442.
- Radchenko, A. 1997b. Review of ants of the subgenus *Myrmentoma* genus *Camponotus* (Hymenoptera: Formicidae) of the Asian Palearctic. [In Russian.]. *Zoologicheskii Zhurnal*, 76: 11-703.
- Radchenko, A. and Paknia, O. 2010. Two new species of the genus *Cataglyphis* Foerster, 1850 (Hymenoptera: Formicidae) from Iran. *Annales Zoologici*, 60: 69-76.
- Soleyman-Nejadian, E. and Dezhakam, M. 2001. Investigation on the protection of *Nipaecoccus viridis* (NEW.) by *Crematogaster antaris* Forel (Hym.: Formicidae) against two wasp parasitoids on citrus in Dezful. *Scientific Journal of Agriculture*, 23 (2):53-69.
- Stadler, B. and Dixon, F. G. 2005. Ecology and evolution of aphid-ant interactions. *The Annual Review of Ecology, Evolution and Systematics*, 36: 345-372.
- Tohme, P. H. and Tohme, G. 1979. Le genre *Epixenus* Emery (Hymenoptera, Formicidae, Myrmicinae) et ses principaux representants au Liban et en Syrie. *Bulletin du Muséum National d'Histoire Naturelle, Paris Section A*, 4 (1): 1087-1108.
- Völkl, W., Mackauer, M., Pell, J. K. and Brodeur, J. 2007. Predators, Parasitoids and Pathogens. In: van Emden, H. F. and Harrington, R. (Eds.) *Aphids as Crop Pests*. CABI, Wallingford, pp. 187- 233.
- Völkl, W., Woodring, J., Fisher, M., Lorenz, M. W. and Hoffmann, K. H. 1999. Ant-aphid mutualisms: the impact of honeydew production and honeydew sugar composition on ant preferences. *Oecologia*, 118: 483-491.

مورچه‌های (Hymenoptera: Formicidae) همیار با شته‌ها در بخش‌هایی از مرکز و جنوب غربی ایران

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چکیده: مورچه‌ها از عسلک ترشح شده توسط شته‌ها یا سایر جوربالان تغذیه نموده یا آن را ذخیره می‌کنند. فایده اصلی حضور مورچه‌ها برای شته‌ها محافظت از آنها در برابر دشمنان طبیعی است. در سال‌های ۸۹-۱۳۸۸ به‌منظور تعیین ارتباط همیاری بین مورچه‌ها و شته‌ها مطالعه‌ای در مناطقی از استان‌های خوزستان و اصفهان روی گیاهان مختلف میزبان شته‌ها انجام شد. در مجموع ۲۰ گونه مورچه متعلق به ۱۲ جنس و سه زیرخانواده جمع‌آوری و شناسایی شد. در بین آنها چهار گونه برای فون ایران جدید بود که عبارتند از: *Monomorium qarahe*, *Monomorium libanicum* Tohme و *Lasius paralienus* Seifert و *Monomorium mayri* Forel, Collingwood & Agosti. شته‌های مورچه دوست جمع‌آوری شده نیز ۳۳ گونه متعلق به سه خانواده و پنج زیرخانواده از شته‌ها بودند. جزئیات و سازوکار همیاری‌های ثبت شده بین شته و مورچه در این مطالعه برای ما نامعلوم بوده و درک کامل آن نیاز به مطالعات دقیق‌تری دارد.

واژگان کلیدی: همیاری، مورچه، شته، خوزستان، اصفهان، ایران