The Ladybeetle Community (Coleoptera: Coccinellidae) in North East of Iran

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Faunistical description of ladybird assemblages from the canopies of agricultural plants and orchard trees in northeastern Iran and determination of the indicator ladybird species that are representative of the region are the main goals of this survey. In total, 21 coccinellid species belonging to 16 genera were collected and identified. One previously recorded species (*Bulaea lichatschovii* (Hummel, 1827)) was not confirmed. Global distribution, list of known host plants, and prey species are provided for each species, along with latitude, longitude, altitude, and sampling methodology. Multivariate analysis of ladybird species assemblages composition and environmental variables (canonical correspondence analysis, CCA) showed that most ladybird species analysed did not express any strong preference for the environmental variables mainly because of intercorrelated characteristics of sampling localities. Seasonality was clear in three species; *Adalia decempunctata* was the earliest spring species while *Coccinella septempunctata* and *Vibidia duodecimguttata* were abundant at the end of season. Although analysis of food webs showed that twenty one collected ladybird species were directly connected to 30 host plant species, this does not represent specific food relationships because prey species of predatory ladybirds were not sampled and identified. Instead, this may probably be interpreted as choice of microhabitats.

Key words. Aphids, biogeography, coccinellids, distribution, fauna

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INTRODUCTION

The superfamily Coccinelloidea (Coleoptera, Polyphaga) comprises taxa formerly placed in the cerylonid series of the superfamily Cucujoidea. It includes 15 families: Bothrideridae, Teredidae, Euxestidae, Murmidiidae, Discolomatidae, Cerylonidae, Latridiidae, Akalyptoischiidae, Alexiidae, Corylophidae, Anamorphidae, Endomychidae, Mycetaeidae, Eupsilobiidae, and Coccinellidae (Robertson et al. 2015). The family Coccinellidae, colloquially known as ladybird beetles, is a well-known, abundant, and diverse family with about 6,000 species worldwide (Ślipiński &Tomaszewska 2010; Nedvěd & Kovář 2012).

According to current classification, coccinellids are divided into two subfamilies: Microweiseinae and Coccinellinae. The subfamily Microweiseinae consists of three tribes: Carinodulini, Microweiseini (including Sukunahikonini), and Serangiini (Escalona & Ślipiński 2012). The remaining taxa are placed in the subfamily Coccinellinae (Robertson et al. 2015).

Considering food preferences, Coccinellidae can be divided into two major groups: predaceous and phytophagous. Some species of Coccinellini visit flowers and feed on pollen and nectar, usually as a supplement to a predatory diet (Ślipiński 2007).

The first checklist of insects of Iran was published in 1961 by Farahbakhsh. In this checklist, 20 species of ladybirds were reported. Naim (1971) and Duverger (1983) listed 24 and 42 species of ladybirds in Iran, respectively. These initial studies were followed by numerous investigations, including theses and dissertations (Yazdani 1990; Moodi & Mossadegh 1995; Montazeri & Mossadegh 1995; Yaghmaei & Kharrazi Pakdel 1995; Bagheri & Mossadegh 1996; Bagheri & Mossadegh 1997; Zare Khormizi et al. 2013; Biranvand et al. 2014; Biranvand et al. 2016, Biranvand et al. 2017). Presently, 125 species of coccinellids have been recorded in Iran (Moddarres-Awal 2012).

Distribution of many coccinellid species in various habitats and on various host plants has been summarised by Honěk (2012). A list of host plants of individual ladybird species within Iran has been summarised by Moddarres-Awal (2012). A list of prey species and other food consumed by ladybirds has been summarised by Hodek & Evans (2012).

The first published records of Coccinellidae of North Khorasan province were provided by Naim (1971) and Malkeshi (1998), three (*Bulaea lichatschovi* (Hummel, 1827), *Coccinella septempunctata* Linnaeus, 1758, and *Hippodamia variegata* (Goeze, 1777)) and six species of ladybirds (*Adalia bipunctata* (Linnaeus, 1758), *Coccinella septempunctata* Linnaeus, 1758, *Hippodamia variegata* (Goeze, 1777), *Oenopia conglobata* (Linnaeus, 1758), *Scymnus* (*Scymnus*) *apetzi* Mulsant, 1846, and *Scymnus* (*Pullus*) *syriacus* (Marsuel, 1868)) were reported, respectively. This study is more comprehensive, including host plant associations and characteristics influencing species distribution.

MATERIAL AND METHODS

Study site

Samples were collected in a range of altitudes in the Bojnord district, located in the center of North Khorasan Province, Iran. This province is located in Northeastern Iran between 36°37' and 38°16'N and between 55°48' and 58°23'E. It covers an area of more than 28,400 km^2 and altitudes from 1,000 to 2,500 m above sea level. The province has a moderate climate with deserts and mountainous regions, and an average rainfall of 250 mm. The minimum and maximum temperatures recorded in the province are -15 and +40 degrees, respectively. There are snow-covered mountains, vast plains, forests, and deep river valleys. Coordinates and altitude of the sampling sites were obtained using GPSMAP 62s equipment.

Sampling methods, ecology and distribution

Adult specimens were collected by shaking branches into a standard sweeping net, by a hand-held aspirator or via hand-catch. Some collected specimens were stored in 70% ethanol and some in a freezer. Some specimens were pinned and tagged with information about host plants, locality, and date. Those specimens were deposited at Gorgan University of Agricultural Sciences and Natural Resources.

In this paper, we follow the higher classification of Coccinellidae by Seago et al. (2011). Taxonomy at the species level corresponds to Kovář (2007). Transfer of *Henosepilachna elaterii* to the genus *Chnootriba* follows Szawaryn et al. (2015). Beetles were identified to the species level with the help of available keys (Raimundo & van Harten 2000; Nedvěd 2015) and are arranged alphabetically for convenience.

Information on worldwide distribution is taken from Kovář (2007) and Canepari (2011). Previously known occurrence data of particular species in Iran are stated according to Moddarres-Awal (2012). Known species of host plants and of prey were compiled from the available literature and analysis of environmental factors.

Multivariate analysis of ladybird species assemblages composition and environmental variables (latitude, longitude, altitude, date, year of sampling, and host plant) was performed using Canoco software version 5 (Ter Braak & Đmilauer 2012).

Abundance data were logarithmically transformed and rare species down-weighted. There were 107 samples with 21 species and eight environmental variables (including locality and sampling method). DCA method was chosen, because the response variables had a gradient of 6.7 SD. Following analyses are described in the results section. Quantitative food webs including ladybirds and their host plants were reconstructed using the bipartite package (Dormann et al. 2008) of R (R Development Core Team 2014).

RESULTS

21 species belonging to 16 genera were recorded in this study:

***Adalia bipunctata* (Linnaeus, 1758)**

Material examined: Iran, North Khorasan Prov., Mahnan (37°21.171'N, 057°17.525'E), 1331 m, 7 individuals, aspirator, Pear, 28.VI.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°22.483'N, 057°17.110'E), 1130 m, 8 samples, shaking, Almond, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°24.726'N, 057°17.748'E), 1171 m, 6 individuals, shaking, Peach, 8.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Rashvanlu (37°22.475'N, 057°17.112'E), 1174 m, 4 samples, shaking, Greengage, 13.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.112'N, 057°15.648'E), 1240 m, 7 samples, shaking, Apricot, 27.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan

Prov., Mahnan (37°22.329'N, 057°17.321'E), 1343 m, 5 individuals, shaking, Sloe, 1.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Firozeh (37°21.531'N, 057°14.715'E), 1293 m, 3 individuals, shaking, Apple, 3.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Qarloq (37°30.245'N, 057°27.546'E), 943 m, 10 samples, shaking, Walnut, 5.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Qarah Bashlu (37°22.515'N, 057°17.117'E), 1279 m, 6 individuals, shaking, Sloe, 9.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.572'N, 057°21.177'E), 1094 m, 9 individuals, aspirator, Walnut, 14.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.349'N, 057°26.192'E), 1021 m, 7 individuals, shaking, Almond, 23.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Khodagholi (37°25.986'N, 057°19.223'E), 1122 m, 4 individuals, shaking, Greengage, 7.VIII.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Halgheh Sang (37°26.640'N, 057°18.761'E), 1100 m, 3 samples, aspirator, Sea-buckthorn, 12.VIII.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Aphis affinis* (Hemiptera: Aphididae), *Aphis nerii* (Hemiptera: Aphididae), *Aphis punicae* (Hemiptera: Aphididae), *Brachycaudus schwartzi* (Hemiptera: Aphididae), *Hyadaphis tataricae* (Hemiptera: Aphididae), *Hyalopterus pruni* (Hemiptera: Aphididae), *Myzus cerasi* (Hemiptera: Aphididae), *Ovatus mentharius* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Phenacoccus aceris* (Hemiptera: Pseudococcidae) (Kaydan et al. 2006), *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Calaphis juglandis* (Hemiptera: Aphididae), *Diuraphis noxia* (Hemiptera: Aphididae), *Euphyllura olivina* (Hemiptera: Aphididae), *Hyadaphis coriandri* (Hemiptera: Aphididae), *Myzus persicae* (Hemiptera: Aphididae), *Psylla pyricola* (Hemiptera: Psyllidae), *Therioaphis maculata* (Hemiptera: Aphididae) (Moddarres-Awal 2012), and other aphids, mites, Psyllidae (Hemiptera: Sternorrhyncha), and larvae of Chrysomelidae (Coleoptera) (Canepari 2011). It has been reported from Asia, Africa, Europe, and North America, introduced to South America and Australia (Bielawski 1975; Gordon 1985; Kovář 2007; Ślipiński 2007; Canepari 2011). Common in Iran (Farahbakhsh 1961; Naim 1971; Duverger 1983, Moddarres-Awal 2012). It was reported from a wide variety of host plants, including acacia, ash, cypress, elm, pine, *Platanus*, vine, walnut (Bagheri & Mossadegh 1996), medlar, pomegranate, plum, tomato (Hajizadeh et al. 2003), alfalfa, almond, apple, apricot, chrysanthemum, coriander, corn, cotton, fennel, oleander, poplar, poppy, parsley, peach (Moddarres-Awal 2012), Japanese quince, and nectarine (Ebrahimi 2013).

***Adalia decempunctata* (Linnaeus, 1758)**

Material examined: Iran, North Khorasan Prov., Mahnan (37°32.281'N, 057°17.650'E), 1331 m, 6 individuals, aspirator, Apricot, 28.VI.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.584'N, 057°17.154'E), 1084 m, 22 individuals, shaking, Almond, 1.IV.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°35.497'N, 057°19.115'E), 1128 m, 14 individuals, shaking, Plum, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°22.723'N, 057°17.739'E), 1175 m, 20 individuals, shaking, Greengage, 8.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Rashvanlu (37°25.496'N, 057°17.121'E), 1170 m, 15 individuals, shaking, Pear, 13.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.112'N, 057°15.648'E), 1240 m, 15 individuals, shaking, Greengage, 27.V.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Aphis fabae* (Hemiptera: Aphididae), *Aphis pomi* (Hemiptera: Aphididae), *Aphis nerii* (Hemiptera: Aphididae), *Aphis punicae* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Dysaphis plantaginea* (Hemiptera: Aphididae)

(Moddarres-Awal 2012). It has been reported from Mongolia (Bielawski 1975), Europe, North Africa, and Western Asia (Kovář 2007; Canepari 2011). Present in Iran (Naim 1971; Moddarres-Awal 2012). Reported from acacia, alfalfa, apple, box tree, cypress, elm, peach, oak, walnuts (Jafari & Kamali 2007), almond, *Althaea*, apricots, corn, pomegranate, *Tribulus terrestris*, wheat (Jafari et al. 2011), and pistachio (Salehi et al. 2011).

***Bulaea lichatschovii* (Hummel, 1827)**

Ecology and distribution: This species feeds on pollen and has a South Palearctic distribution. May become a pest of beet (Hodek & Evans 2012).
Not recorded during the present survey.

***Chilocorus bipustulatus* (Linnaeus, 1758)**
Material examined: Iran, North Khorasan Prov., Yenge Ghale (37°28.265'N, 057°22.227'E), 1059 m, 3 individuals, aspirator, Almond, 28.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yenge Ghale (37°28.280'N, 057°22.242'E), 1059 m, 5 individuals, aspirator, Plum, 28.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Charkharvar (37°27.169'N, 057°26.780'E), 1097 m, 1 individual, aspirator, Poplar, 17.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.014'N, 057°15.733'E), 1247 m, 3 individuals, aspirator, Walnut, 26.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.584'N, 057°17.154'E), 1084 m, 7 individuals, aspirator, Almond, 1.IV.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°25.492'N, 057°18.105'E), 1131 m, 2 individuals, shaking, Apricot, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yenge Ghale (37°28.280'N, 057°22.242'E), 1050 m, 9 individuals, shaking, Almond, 15.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yercheshmeh (37°28.541'N, 057°26.127'E), 1011 m, 3 individuals, shaking, Apple, 19.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°22.138'N, 057°17.615Ç), 1326 m, 5 individuals, aspirator, Poplar, 13.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Rashvanlu (37°22.426'N, 057°17.102'E), 1169 m, 6 individuals, aspirator, Oxalis, 17.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°22.257'N, 057°17.666'E), 1350 m, 4 individuals, shaking, Tamarisk, 13.VII.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Halgheh Sang (37°26.660'N, 057°18.808'E), 1101 m, 2 individuals, shaking, Plum, 12.VIII.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Aonidiella orientalis* (Hemiptera: Diaspididae), *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Chrysomphalus dictyospermi* (Hemiptera: Diaspididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Salicola kermanensis* (Hemiptera: Diaspididae), *Lepidosaphes malicola* (Hemiptera: Diaspididae), *Leucaspis pusilla* (Hemiptera: Diaspididae), *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae), *Ommatissus binotatus lybicus* (Hemiptera: Tropiduchidae), *Parlatoria blanchardi* (Hemiptera: Diaspididae), *Parlatoria oleae* (Hemiptera: Diaspididae), *Phloeomyzus passerinii* (Hemiptera: Aphididae), *Planococcus citri* (Hemiptera: Pseudococcidae), *Pseudaulacaspis pentagona* (Hemiptera: Diaspididae), *Psylla pyricola* (Hemiptera: Psyllidae) (Moddarres-Awal 2012), and other coccids, particularly armored scales (Hodek 1973; Stansly 1984). It has a Palearctic and African distribution; it has been introduced to North America (Gordon 1985; Canepari 2011), Mauritania (Gaillot 1967; Laudeho et al. 1970; Stansly 1984), and South America (González 2008) for biological control. Present in Iran (Farahbakhsh 1961; Naim 1971; Duverger 1983; Moddarres-Awal 2012). Reported from acacia, *Ailanthus*, apple, ash, elm, judas tree,milk vetch, oak, walnut (Bagheri & Mossadegh 1996), box tree, mulberry, olive, pear, sloe, willow

(Hajizadeh et al. 2003), apricot, peach, pomegranate (Jafari & Kamali 2007), alfalfa, almond, cherry, plum, pistachio, poplar, and tamarisk (Moddarres-Awal 2012).

***Chnootriba elaterii* (Rossi, 1794)**
Synonyms: *Epilachna chrysomelina* (Fabricius); *Henosepilachna elaterii* (Rossi, 1794)
Material examined: Iran, North Khorasan Prov., Mahnan (37°21.204'N, 057°17.554'E), 1339 m, 6 individuals, aspirator, Melon, 23.VIII.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species is phytophagous on Cucurbitaceae and Solanaceae plants (Raimundo & van Harten 2000; Canepari 2011). It has been reported from Europe, North Africa, and Western Asia (Kovář 2007; Canepari 2011), including Iran (Naim 1971; Duverger 1983; Moddarres-Awal 2012). Reported from cucumber, melon, squash, and watermelon (Moddarres-Awal 2012).

***Clitostethus arcuatus* (Rossi, 1794)**
Material examined: Iran, North Khorasan Prov., Mahnan (37°22.112'N, 057°17.651'E), 1328 m, 8 individuals, aspirator, Milkthistle, 17.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Azad university avenue (37°27.186'N, 057°19.455'E), 1135 m, 38 individuals, shaking, Willow, 8.VIII.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Siphoninus phillyreae* (Hemiptera: Aleyrodidae), *Tetranychus turkestani* (Acari: Prostigmata: Tetranychidae) (Moddarres-Awal 2012), Aphididae, Aleyrodidae (Hemiptera) and Tetranychidae (Acari) (Gourreau 1974; Canepari 2011). It has been reported from Europe, Africa, and Western Asia (Kovář 2007; Canepari 2011) as far as Iran (Yazdani 1990; Moddarres-Awal 2012). Reported from acacia, ailanthus (Bagheri & Mossadegh 1997), wild lettuce (Hajizadeh et al. 2003), ash, citrus, cotton, elm, pomegranate, tobacco, and some weeds (Moddarres-Awal 2012).

***Coccinella septempunctata* Linnaeus, 1758**
Material examined: Iran, North Khorasan Prov., Besh Ghardash (37°27.140'N, 057°17.085'E), 1152 m, 5 individuals, sweeping, Green been, 11.VII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Nahalestan (37°29.099'N, 057°19.245'E), 1054 m, 4 individuals, sweeping, Foxtail, 23.VII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°22.137'N, 057°17.664'E), 1329 m, 3 individuals, shaking, Pear, 19.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°29.455'N, 057°19.099'E), 1131 m, 7 individuals, sweeping, Wheat, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yenge Ghale (37°28.269'N, 057°22.275'E), 1056 m, 4 individuals, sweeping, Barley, 15.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Rashvanlu (37°22.613'N, 057°17.649'E), 1185 m, 2 individuals, aspirator, Oxalis, 17.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yercheshmeh (37°28.627'N, 057°26.086'E), 1055 m, 6 individuals, shaking, Tamarisk, 17.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.349'N, 057°26.192'E), 1021 m, 8 individuals, shaking, Almond, 23.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.123'N, 057°15.678'E), 1247 m, 4 individuals, shaking, Almond, 29.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Firozeh (37°21.435'N, 057°14.672'E), 1293 m, 10 individuals, shaking, Plum, 29.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Khodagholi (37°25.986'N, 057°19.223'E), 1122 m, 6 individuals, aspirator, Greengage, 7.VIII.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Halgheh Sang (37°26.640'N, 057°18.761'E), 1100 m, 6 individuals, aspirator, Sea-buckthorn, 12.VIII.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Aonidiella orientalis* (Hemiptera: Diaspididae), *Aphis craccivora* (Hemiptera:

Aphididae), *Aphis fabae* (Hemiptera: Aphididae), *Aphis gossypii* (Hemiptera: Aphididae), *Callaphis juglandis* (Hemiptera: Aphididae), *Chromaphis juglandicola* (Hemiptera: Aphididae), *Diuraphis noxia* (Hemiptera: Aphididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Hypera variabilis* (Coleoptera: Curculionidae), *Myzus persicae* (Hemiptera: Aphididae), *Ommatissus binotatus lybicus* (Hemiptera: Tropiduchidae), *Parlatoria oleae* (Hemiptera: Diaspididae), *Saissetia oleae* (Hemiptera: Coccidae), *Schizaphis graminum* (Hemiptera: Aphididae), *Siphoninus phillyreae* (Hemiptera: Aleyrodidae), *Sitobion avenae* (Hemiptera: Aphididae), *Therioaphis maculate* (Hemiptera: Aphididae) (Moddarres-Awal 2012), and other aphids, thrips, Aleyrodidae, Psyllidae, and Cicadellidae (Hemiptera), and Chrysomelidae (Coleoptera), also on pollen and nectar (Canepari 2011). It is widespread in the Palearctic and Oriental regions, introduced to North America. Common in Iran (Farahbakhsh 1961; Naim 1971; Duverger 1983; Moddarres-Awal 2012). Reported from a wide variety of plants: alfalfa, beans, clover, licorice, milk vetch, oak, *Platanus*, sainfoin (Bagheri & Mossadegh 1996), almond, black nightshade, corn, *Dahlia*, onion, poplar, pistachio, rose, screw bean, sugar beet, vetch, walnut, and wheat (Moddarres-Awal 2012).

***Coccinella undecimpunctata menetriesi* Mulsant, 1850**

Material examined: Iran, North Khorasan Prov., Besh Ghardash (37°24.717'N, 057°17.739'E), 1173 m, 3 individuals, aspirator, Alfalfa, 12.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°28.726'N, 057°23.034'E), 1019 m, 2 individuals, sweeping, Weed, 25.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yercheshmeh (37°28.514'N, 057°26.137'E), 1011 m, 12 individuals, shaking, Greengage, 25.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.105'N, 057°15.643'E), 1241 m, 11 individuals, shaking, Apricot, 27.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Hesar-e Garmkhan (37°30.717'N, 057°28.682'E), 935 m, 10 individuals, shaking, Peach, 5.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Aphis fabae* (Hemiptera: Aphididae), *Aphis frangulae* (Hemiptera: Aphididae), *Aphis gossypii* (Hemiptera: Aphididae), *Aphis nerii* (Hemiptera: Aphididae), *Hyalopterus pruni* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Aphis gossypii* (Hemiptera: Aphididae), *Hyadaphis coriandri* (Hemiptera: Aphididae), *Myzus persicae* (Hemiptera: Aphididae), *Ommatissus binotatus lybicus* (Homoptera: Tropiduchidae), *Schizaphis graminum* (Hemiptera: Aphididae), *Therioaphis maculata* (Hemiptera: Aphididae), *Thrips tabaci* (Thysanoptera: Thripidae) (Moddarres-Awal 2012) and various aphids (Canepari 2011). The subspecies has been reported from the Mediterranean, Central and Southern Asia (Kovář 2007; Canepari 2011), including Iran (Naim 1971). Reported from apple, almond, pistachio, cotton, and onion (Moddarres-Awal 2012).

***Exochomus quadripustulatus* (Linnaeus, 1758)**

Material examined: Iran, North Khorasan Prov., Yercheshmeh (37°28.596'N, 057°26.170'E), 1049 m, 3 individuals, shaking, Peach, 17.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yercheshmeh (37°28.627'N, 057°26.086'E), 1055 m, 1 individual, shaking, Tamarisk, 17.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.349'N, 057°26.192'E), 1021 m, 5 individuals, shaking, Almond, 23.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.518'N, 057°26.211'E), 1000 m, 5 individuals, aspirator, Tamarisk, 24.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Khodagholi (37°25.983'N, 057°19.233'E), 1122 m, 1 individual, shaking, Apple, 7.VIII.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Aonidiella orientalis* (Hemiptera: Diaspididae), *Aphis fabae* (Hemiptera: Aphididae), *Chromaphis juglandicola* (Hemiptera: Aphididae), *Callaphis juglandis* (Hemiptera: Aphididae), *Eriosoma lanigerum* (Hemiptera: Aphididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae), *Parlatoria oleae* (Hemiptera: Diaspididae), *Psylla pyricola* (Hemiptera: Psyllidae), *Saissetia oleae* (Hemiptera: Coccidae) (Moddarres-Awal 2012), other aphids, and Coccidae (Uygun1981; Ülgentürk & Toros 2001; Kaydan et al. 2006; Kaydan et al. 2012). It has a Palearctic distribution (Kovář 2007), including Iran (Farahbakhsh 1961). Introduced into North America. Reported from almond, apple, apricot, *Elaeagnus angustifolia*, oak, *Platanus*, vine, walnut (Bagheri & Mossadegh 1996), nectarine, and pomegranate (Jafari & Kamali 2007).

***Harmonia quadripunctata* (Pontoppidan, 1763)**

Material examined: Iran, North Khorasan Prov., Baba Aman (37°29.528'N, 057°26.381'E), 1005 m, 15 individuals, aspirator, Barley, 5.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°29.338'N, 057°26.123'E), 1018 m, 20 individuals, shaking, Almond, 23.VI.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species usually feeds on *Hyalopterus amygdali* (Hemiptera: Aphididae) (Aslan & Uygun 2005) and *Adelges* sp. (Hemiptera: Hemiptera) (Yu et al. 2000). It is distributed in Europe, Asia (Siberia included), the Oriental Region, and North America (Canepari 2011).

***Hippodamia variegata* (Goeze, 1777)**

Material examined: Iran, North Khorasan Prov., Nahalestan (37°29.099'N, 057°19.245'E), 1059 m, 4 individuals, aspirator, Foxtail, 23.VII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°30.190'N, 057°19.649'E), 1165 m, 9 individuals, sweeping, Alfalfa, 12.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yenge Ghale (37°28.290'N, 057°22.271'E), 1056 m, 6 individuals, sweeping, Alfalfa, 28.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°35.497'N, 057°19.115'E), 1128 m, 4 individuals, sweeping, Oat, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°22.153'N, 057°17.645'E), 1329 m, 6 individuals, aspirator, Thistle, 17.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Yercheshmeh (37°28.570'N, 057°26.188'E), 1011 m, 7 individuals, shaking, Apple, 25.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Arg (37°23.112'N, 057°15.648E), 1240 m, 5 individuals, shaking, Almond, 27.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Firozeh (37°21.531'N, 057°14.715'E), 1293 m, 5 individuals, sweeping, Alfalfa, 3.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Qarloq (37°30.245'N, 057°27.546'E), 943 m, 6 individuals, aspirator, Potato, 5.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.572'N, 057°21.177'E), 1094 m, 7 individuals, sweeping, Parsley, 14.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Callaphis juglandis* (Hemiptera: Aphididae), *Chromaphis juglandicola* (Hemiptera: Aphididae), *Diuraphis noxia* (Hemiptera: Aphididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Phenacoccus aceris* (Hemiptera: Pseudococcidae), *Sitobion avenae* (Hemiptera: Aphididae) (Moddarres-Awal 2012), and other aphids (Hodek 1973, Franzmann 2002), and when it does not have access to adequate aphids, it searches for alternative hosts such as mites of the family Tetranychidae (Acari) (Obrycki & Orr 1990). It is widespread in the Palearctic (Canepari

2011), South Africa (Aalbersberg et al. 1988), Kenya (Ogenga-Latigo 1994), India (Singh et al. 1991), China (Fan & Zhao 1988), Canada (Gordon 1987), USA (Wheeler 1996), Chile (Araya et al. 1997; González 2008), and Australia (Franzmann 2002). Common in Iran (Farahbakhsh 1961; Naim 1971; Moddarres-Awal 2012). Reported from *Acanthus*, acacia, barley, beans, clover, corn, dandelion, elm, *Lathyrus*, licorice, rice, sainfoin, walnut (Bagheri & Mossadegh 1996), alfalfa, almond, apple, cotton, peach, pistachio, pomegranate, and wheat (Moddarres-Awal 2012).

***Oenopia conglobata* (Linnaeus, 1758)**
Material examined: Iran, North Khorasan Prov., Firozeh (37°21.520'N, 057°14.720'E), 1289 m, 18 individuals, aspirator, Wen, 16.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Choghorbagh (37°25.452'N, 057°18.110'E), 1131 m, 23 individuals, shaking, Plum, 5.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°25.712'N, 057°18.745'E), 1175 m, 16 individuals, sweeping, Alfalfa, 8.V.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species usually feeds on *Aphis acetosae* (Hemiptera: Aphididae), *Aphis affinis* (Hemiptera: Aphididae), *Aphis nerii* (Hemiptera: Aphididae), *Aphis pomi* (Hemiptera: Aphididae), *Hyalopterus pruni* (Hemiptera: Aphididae), *Myzus cerasi* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Callaphis juglandis* (Hemiptera: Aphididae), *Chromaphis juglandicola* (Hemiptera: Aphididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), and *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) (Moddarres-Awal 2012). It has a Palearctic distribution (Kovář 2007; Canepari 2011), including Iran (Farahbakhsh 1961; Naim 1971; Moddarres-Awal 2012). Reported from acacia, apricot, ash, elm, pine (Bagheri & Mossadegh 1996), alfalfa, almond, apple, corn, peach, pistachio, and walnut (Moddarres-Awal 2012).

***Parexochomus nigromaculatus* (Goeze, 1777)**
Material examined: Iran, North Khorasan Prov., Yercheshmeh (37°28.561'N, 057°26.140'E), 1008 m, 30 individuals, aspirator, Tamarisk, 14.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.538'N, 057°26.441'E), 999 m, 55 individuals, shaking, Tamarisk, 5.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species usually feeds on *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Aonidiella orientalis* (Hemiptera: Diaspididae), *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Diuraphis noxia* (Hemiptera: Aphididae), *Eulecanium prunastri* (Hemiptera: Coccidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae), *Therioaphis maculata* (Hemiptera: Aphididae) (Moddarres-Awal 2012), and other aphids, and Coccidae (Uygun 1981; Atlihan & Özgökçe 2002; Kaydan et al. 2012). It has been reported from Europe and Asia (Kovář 2007), including Iran (Farahbakhsh 1961; Moddarres-Awal 2012). Reported from acacia, boxtree, olive, rose, willow (Hajizadeh et al. 2003), apple, apricot, cherry, peach, poplar, sloe (Ebrahimi 2013), *Acanthus*, alfalfa, almond, borage, *Echinops*, licorice, milk vetch, oak, parsnip, and poplar (Jafari & Kamali 2007).

***Pharoscymnus brunneosignatus* Mader, 1949**
Material examined: Iran, North Khorasan Prov., Baba Aman (37°29.349'N, 057°26.192'E), 1021 m, 2 individuals, shaking, Tamarisk, 23.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°29.518'N, 057°26.211'E), 1000 m, 3 individuals, shaking, Tamarisk, 24.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°22.257'N, 057°17.666'E), 1350 m, 2 individuals, shaking,

Tamarisk, 31.VII.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species feeds on diaspidid scale insects (*Parlatoria*, *Prodenia*). It has already been reported from Mongolia and China (Biranvand et al. 2016). First reported from Iran by Ebrahimi et al. (2014). Reported from tamarisk (Biranvand et al. 2016).

***Propylea quatuordecimpunctata* (Linnaeus, 1758)**

Material examined: Iran, North Khorasan Prov., Besh Ghardash (37°24.721'N, 057°17.742'E), 1173 m, 1 individual, sweeping, Alfalfa, 18.VIII.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Qarah Bashlu (37°22.509'N, 057°17.096'E), 1275 m, 2 individuals, shaking, Peach, 9.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°24.711'N, 057°17.682'E), 1172 m, 8 individuals, shaking, Peach, 15.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species feeds on *Aphis affinis* (Hemiptera: Aphididae), *Rhopalosiphum maidis* (Hemiptera: Aphididae), *Macrosiphoniella artemisiae* (Hemiptera: Aphididae), *Myzus cerasi* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Sitobion avenae* (Hemiptera: Aphididae) (Moddarres-Awal 2012), and other aphids (Canepari 2011). It has a Palearctic distribution. It has been introduced to North America. Common in Iran (Farahbakhsh 1961; Moddarres-Awal 2012). Reported from barley, *Echinops*, rice (Bagheri & Mossadegh 1996), almonds, lettuce, marshmallow, parsnip, sainfoin (Jafari & Kamali 2007), apricot, cereals, plum, pomegranate, sloe, walnut (Hajizadeh et al. 2003), alfalfa, clover, and cotton (Moddarres-Awal 2012).

***Psyllobora vigintiduopunctata* (Linnaeus, 1758)**

Material examined: Iran, North Khorasan Prov., Firozeh (37°21.524'N, 057°14.725'E), 1295 m, 1 individual, aspirator, Boxwood, 8.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Firozeh (37°21.520'N, 057°14.720'E), 1289 m, 4 individuals, aspirator, Blackberry, 16.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°21.284'N, 057°17.654'E), 1331 m, 2 individuals, shaking, Apple, 17.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°22.138'N, 057°17.615'E), 1326 m, 1 individual, shaking, Poplar, 13.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species usually feeds on fungi (powdery mildew - Erisyphaceae). It has been reported from the Palearctic region (Kovář 2007; Canepari 2011), including Iran (Naim 1971). Reported from alfalfa, almond, beet, grape, and parsnip (Jafari & Kamali 2007).

***Scymnus* (*Scymnus*) *apetzi* Mulsant, 1846**

Material examined: Iran, North Khorasan Prov., Arg (37°23.024'N, 057°15.853'E), 1247 m, 8 individuals, aspirator, Almond, 26.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Besh Ghardash (37°27.150'N, 057°19.134'E), 1150 m, 14 individuals, aspirator, Walnut, 30.IX.2012, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°33.325'N, 057°18.623'E), 1328 m, 6 individuals, shaking, Almond, 17.V.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Firozeh (37°21.524'N, 057°14.725'E), 1295 m, 4 individuals, aspirator, Thistle, 3.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Baba Aman (37°29.538'N, 057°26.441'E), 994 m, 12 individuals, shaking, Tamarisk, 5.VI.2013, lgt. Hamidi, det. Biranvand; Iran, North Khorasan Prov., Mahnan (37°22.112'N, 057°17.651'E), 1328 m, 10 individuals, aspirator, Barley, 13.VI.2013, lgt. Hamidi, det. Biranvand.

Ecology and distribution: This species usually feeds on *Aphis affinis* (Hemiptera: Aphididae), *Brachycaudus helichrysi* (Hemiptera: Aphididae), *Myzus persicae*

(Hemiptera: Aphididae), *Pterochloroides persicae* (Hemiptera: Aphididae) (Aslan & Uygun 2005), *Hyalopterus* sp. (Hemiptera: Aphididae) (Amin & Muhammad 2008), and other aphids (Canepari 2011). It has been reported from Central and Southern Europe and Western Asia (Canepari 2011), including Iran (Moddarres-Awal 2012). Reported from *Acanthus*, acacia, almond, lettuce, oak, parsnip (Jafari & Kamali 2007), grasses, and various plants of the family Fabaceae.

***Scymnus* (*Mimopullus*) *flagellisiphonatus* (Fürsch, 1969)**

Material examined: Iran, North Khorasan Prov., Mahnan (37°22.138'N, 057°17.615'E), 1326 m, 1 individual, shaking, Apricot, 17.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Qarloq (37°30.241'N, 057°27.544'E), 955 m, 2 individuals, shaking, Walnut, 5.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°29.325'N, 057°26.306'E), 1004 m, 2 individuals, shaking, Tamarisk, 23.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°29.518'N, 057°26.211'E), 1000 m, 3 individuals, shaking, Tamarisk, 24.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Arg (37°23.123'N, 057°15.678'E), 1247 m, 2 individuals, shaking, Almond, 29.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Arg (37°23.128'N, 057°15.668'E), 1249 m, 1 individual, shaking, Walnut, 29.VI.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species usually feeds on soft scale insects *Pseudococcus*: (Hemiptera: Pseudococcidae) (Yiğit & Telli 2013). It has been reported from Southeastern Europe and Southwestern Asia as far as Syria (Kovář 2007) and Yemen (Raimundo & van Harten 2000).

***Scymnus* (*Scymnus*) *pallipes* Mulsant, 1850**

Material examined: Iran, North Khorasan Prov., Yercheshmeh (37°28.570'N, 057°26.188'E), 1011 m, 13 individuals, shaking, Tamarisk, 25.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Qarah Bashlu (37°22.508'N, 057°17.110'E), 1277 m, 12 individuals, shaking, Cherry, 9.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Mahnan (37°22.111'N, 057°17.626'E), 1330 m, 5 individuals, shaking, Peach, 13.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.572'N, 057°21.177'E), 1094 m, 6 individuals, shaking, Walnut, 14.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Rashvanlu (37°22.426'N, 057°17.102'E), 1169 m, 3 individuals, shaking, Oxalis, 17.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Besh Ghardash (37°27.141'N, 057°19.091'E), 1152 m, 8 individuals, shaking, Milkthistle, 19.VI.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species feeds on aphids (Moddarres-Awal 2012). It has been reported from Central Asia and from Iran. Reported from acacia, *Ailanthus*, almond, alfalfa, apple, apricot, ash, mulberry, oak, *Platanus*, rice, and tamarisk (Bagheri & Mossadegh 1997).

***Scymnus* (*Pullus*) *syriacus* (Marsuel, 1868)**

Material examined: Iran, North Khorasan Prov., Yenge Ghale (37°28.293'N, 057°28.253'E), 1056 m, 2 individuals, aspirator, Apricot, 28.VIII.2012, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Arg (37°23.024'N, 057°15.853'E), 1247 m, 1 individual, aspirator, Almond, 26.IX.2012, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Besh Ghardash (37°27.711'N, 057°17.731'E), 1171 m, 8 individuals, shaking, Plum, 8.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Mahnan (37°33.325'N, 057°18.623'E), 1328 m, 5 individuals, shaking, Almond, 17.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Yercheshmeh (37°28.569'N, 057°26.150'E), 1009 m, 12 individuals, shaking, Tamarisk, 19.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Yercheshmeh (37°28.570'N, 057°26.188'E), 1011 m, 7 individuals, shaking, Tamarisk, 25.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman

(37°29.538'N, 057°26.441'E), 999 m, 5 individuals, shaking, Tamarisk, 5.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Yercheshmeh (37°28.596'N, 057°26.170'E), 1049 m, 10 individuals, shaking, Peach, 17.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Firozeh (37°21.431'N, 057°14.689'E), 1291 m, 3 individuals, shaking, Greengage, 29.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Baba Aman (37°22.257'N, 057°17.666'E), 1350 m, 11 individuals, shaking, Tamarisk, 31.VII.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Khodagholi (37°26.086'N, 057°19.213'E), 1121 m, 4 individuals, shaking, Greengage, 7.VIII.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Azad university avenue (37°27.184'N, 057°19.453'E), 1135 m, 3 individuals, shaking, Almond, 8.VIII.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species usually feeds on *Agonoscena pistaciae* (Hemiptera: Psyllidae), *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Euphyllura olivina* (Hemiptera: Psyllidae), *Tetranychus turkestani* (Acari) *(*Moddarres-Awal 2012*)*, and diverse aphids (Aslan & Uygun 2005; Sakaki & Sahragard 2011). It has been reported from Egypt (Kovář 2007), Southwestern Asia, and Iran (Duverger 1983). Reported from acacia, alfalfa, almond, apricot, apple, citrus, cotton, elm, fig, mulberry, oak, pagoda tree, peach, pine, pistachio, pomegranate, poplar, sloe, wake robin, walnut, and wild barberry (Hajizadeh et al. *2*003; Jafari & Kamali 2007; Jafari et al. 2011, Ebrahimi 2013).

***Stethorus gilvifrons* Mulsant, 1850**

Material examined: Iran, North Khorasan Prov., Khodagholi (37°25.986'N, 057°19.223'E), 1122 m, 15 individuals, shaking, Plum, 6.VIII.2012, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Arg (37°23.024'N, 057°15.853'E), 1247 m, 3 individuals, aspirator, Walnut, 26.IX.2012, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Rashvanlu (37°25.492'N, 057°18.112'E), 1171 m, 5 samples, shaking, Plum, 13.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Mahnan (37°22.153'N, 057°17.645'E), 1329 m, 5 individuals, shaking, Sloe, 17.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Yercheshmeh (37°28.229'N, 057°26.369'E), 1022 m, 8 individuals, shaking, Peach, 19.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Rashvanlu (37°22.436'N, 057°17.112'E), 1165 m, 12 individuals, shaking, Apple, 26.V.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Mahnan (37°22.329'N, 057°17.321'E), 1343 m, 10 individuals, shaking, Sloe, 1.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Firozeh (37°21.556'N, 057°14.769'E), 1290 m, 6 individuals, shaking, Apricot, 3.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Qarloq (37°30.245'N, 057°27.546'E), 943 m, 20 individuals, shaking, Walnut, 5.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Qarah Bashlu (37°22.508'N, 057°17.110'E), 1277 m, 5 individuals, shaking, Cherry, 9.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Shahrak Farhangian (37°27.572'N, 057°21.177'E), 1094 m, 25 individuals, shaking, Walnut, 14.VI.2013, lgt. Hamidi, det. Nedvěd; Iran, North Khorasan Prov., Besh Ghardash (37°27.141'N, 057°19.091'E), 1152 m, 6 individuals, shaking, Sloe, 19.VI.2013, lgt. Hamidi, det. Nedvěd.

Ecology and distribution: This species feeds on spider mites (*Panonychus*, *Tetranychus*). It has been reported from the Arabian Peninsula (Saudi Arabia, United Arab *Emirates, and* Yemen), the Mediterranean region (Raimundo et al. *2*008), the Oriental region (Canepari 2011), and Iran (Farahbakhsh 1961). Reported from almond, apricot, castor-bean, cherry, *Chrysanthemum*, corn, cotton, date palm, fig, lemon, pistachio, and white mulberry (Moddarres-Awal 2012).

***Vibidia duodecimguttata* (Poda, 1761)**

Material examined: Iran, North Khorasan Prov., Firozeh (37°21.541'N, 057°14.789'E), 1295 m, 7 individuals, aspirator, Apple,

8.IX.2012, lgt. Hamidi, det. Canepari and Nedvěd; Iran, North Khorasan Prov., Mahnan (37°21.284'N, 057°17.654'E), 1331 m, 6 individuals, shaking, Apple, 17.V.2013, lgt. Hamidi, det. Canepari and Nedvěd.

Ecology and distribution: This species usually feeds on fungi (powdery mildew - Erisyphaceae). It has been reported from the Palearctic region, including Iran (Bagheri & Mossadegh 1996). Reported from ash (Bagheri & Mossadegh 1996), blueberry, walnut, and some weeds (Mohammadi et al. 2013).

Multivariate analysis of environmental data

The first two axes of the full DCA each explained 6.3% of variability. Some plants showed a strong and unique community composition, because they hosted a single ladybird species that was not rare.

Second, constrained analysis (CCA) of the variable "host plant" with other variables as covariates was chosen. A significantly specific community was found on the following plants (all explaining 38.5% of total variability, following forward selection, four plants explaining 38% of the variability explained by all plants): melon (P=0.004), willow (P=0.002), tamarisk (P=0.006), and apple (P=0.012).

Third, CCA was again chosen, "host plant" as covariate, time and geographical variables as well as "sampling method" analysed through forward selection. All variables explained 12.4% of variability. The "sampling method (shaking versus aspirator, but not sweeping)" explained 18.9% of the variability thus explained. The "day within season" explained 18% while "longitude (eastern coordinates)" explained another 17.5% of variability.

"Latitude" was positively correlated to "longitude," and "altitude" was negatively correlated to both of these variables (Fig. 1). This was caused by the fact that the major valley in which beetles were sampled forms a downhill slope from southwest to northeast. The surrounding landscape is arid with sparse vegetation and no agricultural crops.
Sweeping as a sampling method was chosen in such situations as was individual collecting with an aspirator. Shaking was used in humid surroundings. The two years of sampling did not significantly differ from each other.

Harmonia quadripunctata and *Coccinella undecimpunctata* were found in the lower part of the valley, whereas *Vibidia duodecimguttata* and *Propylea quaturdecimpunctata* were found in the higher parts. *Adalia decempunctata* was the earliest spring species, whereas *Coccinella septempunctata* and *Vibidia duodecimguttata* were abundant at the end of season.

Food web characteristics

Twenty-one species of ladybirds were directly connected to 30 species of host plants. There were 1.863 links per species, Shannon diversity was 4.16, network specialisation (H2) 0.566, connectance 0.151, generality (HL) 4.66, and vulnerability (LL) 4.42 (Fig. 2).

DISCUSSION

The list of species of ladybirds (Coccinellidae) living in the Iranian province of North Khorasan was updated and now includes 22 species. When comparing the species richness between North Khorasan and the complete Iranian territory (125 species previously known) (Moddarres-Awal 2012), we are sure that future research will reveal many more species in this province. The unrecorded portion of the habitat-specific species pool, referred to as "dark diversity" (Pärtel et al. 2011), may include more than 22 species.

Surveys of the beetle fauna in North Khorasan were mainly performed in agricultural landscapes on field crops and in orchards. We supplied extensive lists of host plants for each species of ladybirds reported in the literature

and added many plant species during this survey. Characteristics of the new host plants meet previously known species requirements (Honěk 2012). However, wild plant species and natural vegetation must be surveyed more thoroughly to complete our knowledge on the fauna of Coccinellidae in this area. Some plants, such as melon, willow, tamarisk, and apple, may host specific species assemblages.

Most ladybird species analysed did not show any strong preference for the environmental variables checked, because the environment was restricted to a fertile river valley with a small range of intercorrelated characteristics of the sampling localities. The number of species in individual samples was small, thus not permitting the localisation of specific communities or groups of species inhabiting a similar niche. Seasonality was clear in three species, similar as in European studies (Honěk *et al.* 2015).

Species of ladybirds were directly connected to species of host plants. In predatory ladybirds, prey species were not sampled and identified. Therefore, this research does not establish specific food relationships but rather information on the microhabitat choice. Ladybird affinity to host plants has not yet been analysed using food web statistics, thus comparisons to the data given here cannot be complete with regard to other environments.

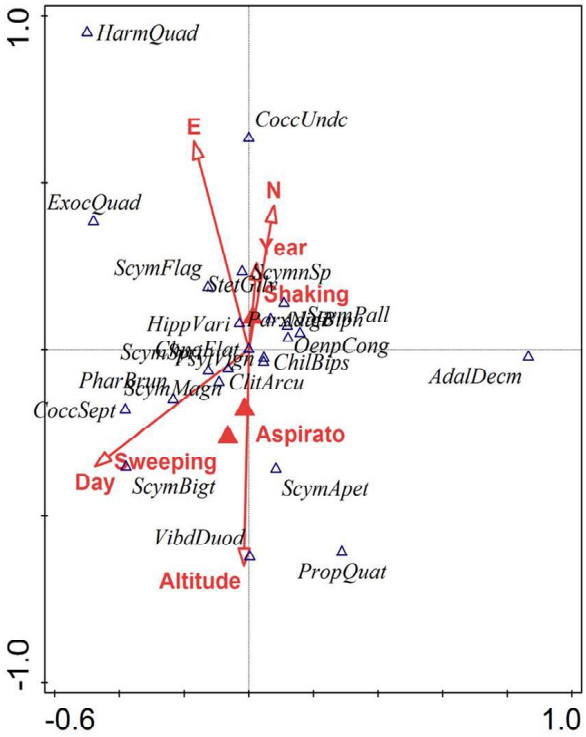

Fig. 1. Multivariate analysis (CCA) of species composition of samples with projection of environmental variables: N) latitude; E) longitude; Day: date during season; Sweeping, Shaking, and Aspirator - sampling methods. Abbreviations of species names are composed of four letters of the genus and four letters of the species

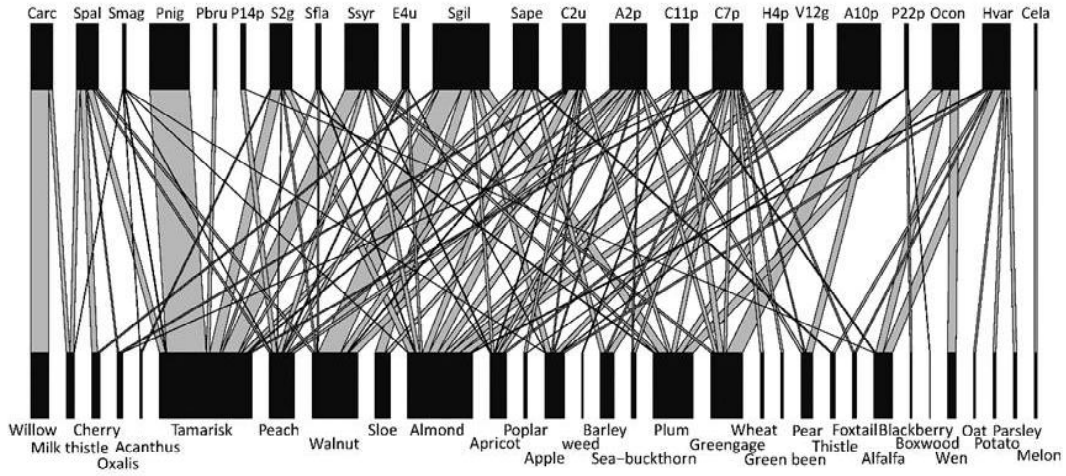

Fig. 2. Food web representation of occurrence of ladybird species on observed plant species in North Khorasan

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