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Diversity and distribution of Coccinellidae (Coleoptera) in Lorestan Province, Iran

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ABSTRACT The present study was conducted from April to September 2012 to assess biodiversity and distribution of Coccinellids (Coleoptera Coccinellidae) in five regions of the west of Lorestan Provine, Iran. Specimens of coccinellid beetles were collected by netting and hand picking from Shorab, Veisian, Sarabdore, Teshkan and Kashkan. Identification of these beetles showed twenty-two different species. *Oenopia conglobata* (Linnaeus, 1758) (n = 386, 24%) was recorded as the most abundant species as well as widely distributed on all over the regions. When distributions of all the areas were compared, it was concluded that Coccinellidae was mostly distributed in the Shorab area. The maximum and minimum species diversity indices were obtained in Shorab (Simpson's diversity index = 0.90) and Kashkan (Simpson's diversity index = 0.67) regions, respectively. Maximum similarity index (0.89) was observed between Sarabdore and Kashkan regions.

KEY WORDS Ladybirds; biodiversity; Coleoptera; Iran.

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INTRODUCTION

About 6000 species of Coccinellids, Ladybird beetles, (Coleoptera Coccinellidae) are known worldwide (Vandenberg, 2002). They are of great economic importance as predators both in their larval and adult stages on various important crop pests such as aphids, coccids and other soft bodied insects (Hippa et al., 1978; Kring et al., 1985). Coccinellids undergo complete metamorphosis with distinct egg, larval, pupal and adult stages. Their life cycle is completed in one month depending upon prey, location and temperature; two or three generations are generally produced in a year. Adults overwinter in sheltered locations such as tree holes and other natural hiding places (Majerus & Kearns, 1989). The coccinellidae are an important group of beetles from both an economic standpoint in their use as biological control agent and in their diversity and adaptation to a number of differing habitats. The coccinellid beetles are considered to be of a great economic importance in agro-ecosystems thanks to their successful employment in biological control of many injurious insects (Agarwala & Dixon, 1992). The observed degree of their adaptation as well as their efficiency in controlling aphid populations varies with the species and the environmental conditions (Dixon, 2000). Indeed, Coccinellidae are extremely diverse in their habits: they live in all terrestrial ecosystems (Skaife, 1979). They are also regarded as bioindicators (Iperti, 1999) and provide more general information about the ecosystem in which they occur (Andersen, 1999). Iran is an ecologically diversified country which includes rich

agricultural areas, deserts, marshes, rivers and mountain habitats. Because of these specialized geographic and vegetative zones, Djavanishir (1976) grouped the Iranian vegetation coverage into five zones, including the Irano-Touranian floristic zone that encompasses the most extensive area of Iran. In the confluence of these different climatic and geographic zones, a rich faunal assemblage is expected for the country. Unfortunately, there are very few references in the literature about distribution and diversity of ladybird beetles in Iran. The objectives of the present study were to explore the predatory ladybird fauna of Lorestan Province (Iran), to estimate the species richness, species evenness and species diversity of Coccinellids in agro-ecosystems and to know about the role of Coccinellids as bioindicators.

MATERIAL AND METHODS

The Chegeni (west of Lorestan province) is located between longitude 48°02' East, latitude 31°32' North of Iran. It has moderate weather, with the average temperature in summer reaching 35 °C and average annual rainfall of about 350 mm, which is sufficient to keep the soil very fertile. This area consists of a lot of fruit orchards. The study area was divided in five sampling regions, namely: Shorab, Veisian, Sarabdore, Teshkan and Kashkan. Collection of beetles was done from different parts of these regions during 2012, from early spring to the autumn season. Each locality was frequently visited weekly. All the available trees were selected for the sampling and it continued for the total duration of 6 months. The adult ladybird specimens on the trees, crops and weeds were collected randomly by netting, hand picking and light trapping. The specimens were collected daily and were preserved in vials containing 75% ethanol, and then pinned and placed in collection boxes. Each specimen was labeled noting the place of collection, date of collection, pray name and host plant species and brought to the laboratory of Islamic Azad Borujerd University, Borujerd for biodiversity count. All specimens were manually stored and identified to species level with the help of available literature and already identified specimens which are preserved in the insect Museum of Islamic Azad Borujerd University. Collected data were employed for stastistical analyses to calculate species diversity, abundance and similarity in different places, crops and periods by applying Simpson's diversity index and Sorenson index.

Simpson's index (D) is a measure of diversity. The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

where n_i = the total number of organisms of each individual species, N = the total number of organisms of all species and 1-D= Simpson's diversity index, 1/D= Simpson's reciprocal index.

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and 1 no diversity. That is, the bigger the value the lower the diversity. This does not seem intuitive or logical, so some texts use derivations of the index, such as the inverse (1/D) or the difference from 1 (1-D) (Magurran, 1988).

Species similarity

Species similarity between two communities was calculated by Sorenson's index (SQ)

$$SQ = \frac{2J}{(a+b)}$$

where J = number of similar species in both communities; a = total number of species in community A, b = total number of species in community B.

The value of SQ ranges from 0 to 1. With this index, 0 represents no similarity and 1 complete similarity. That is, the bigger the value the higher the similarity (Southwood & Henderson, 2000).

RESULTS

The present study was conducted from April to September 2012. Table 1 shows the list of Coccinellid species captured in the examined regions. The maximum and minimum numbers of species were found in subfamilies Coccinellinae and Chilochorinae respectively. Among genera, *Exochomus* Redtenbacher, 1843 and *Scymnus* Kugelann, 1794 were the most abundant. *Oenopia conglobata*, *Coccinella septempunctata*, *Adalia decimpunctata*, *Scymnus apetzi*, *Scymnus syriacus* and *Hippodamia variegata* were found in all places of sampling.

Regions Species	Shorab	Veisian	Sarab-doreh	Teshkan	Kashkan	Total number
Coccinella septempunctata Linnaeus, 1758	+	+	+	+	+	265
Hippodamia variegata (Goeze, 1777)	+	+	+	+	+	332
Adalia bipunctata (Linnaeus, 1758)	+	-	+	+	-	35
Adalia decimpunctata (Linnaeus, 1758)	+	+	+	+	+	53
Oenopia conglobata (Linnaeus, 1758)	+	+	+	+	+	386
Oenopia oncina (Olivier, 1808)	+	-	-	-	-	81
Psyllobora vigintidupunctata (Linnaeus, 1758)	+	+	-	-	-	3
Propylea quatuordecimpunctata (Linnaeus, 1758)	+	-	-	-	-	56
Scymnus syriacus (Marseul, 1868)	+	+	+	+	+	90
Scymnus apetzi Mulsant, 1846	+	+	+	+	+	45
Scymnus araraticus Iablokoff-Khnzorian, 1969	+	-	-	-	-	8
Scymnus pallipes Mulsant, 1850	+	-	-	-	-	3
Scymnus nubilus Mulsant 1850	+	-	-	-	-	8
Stethorus punctillum Weise, 1891	+	-	-	-	-	4
Stethorus gilvifrons (Mulsant, 1850)	+	+	+	+	+	44
Exochomus melanocephalus (Zoubkoff, 1833)	+	-	-	-	-	4
Exochomus nigromaculatus (Goeze, 1777)	+	+	-	-	-	10
Exochomus quadripustulatus (Linnaeus, 1758)	+	+	-	-	-	34
Exochomus pubescens Küster, 1848	+	-	+	-	-	71
Exochomus undulatus Weise, 1878	+	+	+	-	+	11
Chilocorus bipustulatus Linnaeus, 1758	+	+	-	-	-	12
Tyttaspis sedecimpuntata (Linnaeus, 1758)	-	+	-	-	-	2

Table 1. Distribution and total number of Coccinellids species collected in sampling localities.

Among them, *Oenopia conglobata* was eudominant in all sites under study, as it numbered 386 specimens, which made up 34% of all individuals. The second most abundant species was *H. variegata* (21%) and the next *C. septempunctata* (17%); Shorab showed the maximum species richness (21 species) and Veisian was the second one (13 species). As far as concerns the species abundance, *C. septempunctata* had maximum abundance in Veisian region and *H. variegata* in Sarabdoreh region. All percentages are listed in Table 2. Diversity and reciprocal indices in different places were calculated by Simpson's index. This index considers both the number of species and the distribution of individuals among species. Simpson diversity and reciprocal indices of all examined places are reported in Table 3.

Regions Species	Shorab	Veisian	Sarab-doreh	Teshkan	Kashkan
Coccinella septempunctata Linnaeus, 1758	12.7	29.3	13.2	15.8	20.7
Hippodamia variegata (Goeze, 1777)	7.9	20.5	35.6	35.5	8.5
Adalia bipunctata (Linnaeus, 1758)	3.2	-	3.5	1.9	-
Adalia decimpunctata (Linnaeus, 1758)	1.5	2.1	5.4	3.8	6.4
Oenopia conglobata (Linnaeus, 1758)	24.7	21.9	15.9	25	53.5
Oenopia oncina (Olivier, 1808)	15.6	-	-	-	-
Psyllobora vigintidupunctata (Linnaeus, 1758)	0.38	0.36	-	-	-
Propylea quatuordecimpunctata (Linnaeus, 1758)	10.8	-	-	-	-
Scymnus syriacus (Marseul, 1868)	2.3	7.3	7.3	10	3.5
Scymnus apetzi Mulsant, 1846	1.7	2.5	4.6	3.8	1.4
Scymnus araraticus Iablokoff-Khnzorian, 1969	1.5	--	-	-	-
Scymnus pallipes Mulsant, 1850	1.5	-	-	-	-
Scymnus nubilus Mulsant 1850	0.77	-	-	-	-
Stethorus punctillum Weise, 1891	0.77	-	-	-	-
Stethorus gilvifrons (Mulsant, 1850)	2.7	2.5	3.5	3.8	1.4
Exochomus melanocephalus (Zoubkoff, 1833)	0.77	-	-	-	-
Exochomus nigromaculatus (Goeze, 1777)	1.3	1	-	-	-
Exochomus quadripustulatus (Linnaeus, 1758)	2.9	6.5	-	-	-
Exochomus pubescens Küster, 1848	0.96	-	1.6	-	-
Exochomus undulatus Weise, 1878	3.6	3.6	9.2	-	5.7
Chilocorus bipustulatus Linnaeus, 1758	1.7	1.09	-	-	-
Tyttaspis sedecimpuntata (Linnaeus, 1758)	-	0.73	-	-	-

Table 2. Abundance percentage of Coccinellids in sampling localities.

Regions of sampling Index of diversity	Shorab	Veisian	Sarabdoreh	Teshkan	Kashkan
Simpsons diversity index (1-D)	0.90	0.81	0.81	0.77	0.67
Simpsons reciprocal index(1/D)	10.01	5.36	5.29	4.42	3.39

Table 3. Simpsons diversity indices of Coccinellids in examined regions.

Regions of sampling	Shorab	Veisian	Sarabdoreh	Teshkan	Kashkan
Shorab	1	0.7	0.64	0.55	0.55
Veisian	0.69	1	0.69	0.6	0.76
Sarabdoreh	0.64	0.69	1	0.87	0.89
Teshkan	0.54	0.6	0.87	1	0.87
Kashkan	0.55	0.76	0.89	0.87	1

Table 4. Similarity indices of ladybird species in examined regions of sampling.

As shown, the highest and lowest values were obtained in Shorab (0.90) and Kashkan (0.67) regions, respectively (Table 3). The Minimum value of similarity index (0.54) was found comparing Teshkan and Shorab; and the maximum value (0.89) was between Sarabdoreh and Kashkan (Table 4).

DISCUSSION AND CONCLUSIONS

A previous similar survey of predatory Coccinellid beetles at Lorestan provinces (Iran) was conducted by Jafari & Kamali (2007). Present results (Table 1) confirm that Coccinellids are the most important group among crops and orchards predators in Iran (Modarres-Awal, 1997). Farahbakhsh (1961) reported the dominance of *P. quatrodecimpunctata*. According to Hodek & Honek (1996) and Majerus & Majerus (1996), *C. septempunctata* is the pronest to a sudden population growth as its number largely depends on the number of aphids. Generally, Coccinellids are density-dependent predators, i.e. their number rises as the prey number increases (Dixon, 2000). All species, belonging to the Scymnini, can be potential predators of pseudococcids, at least in the adult stage (Magro, 1992). Most of these species were recorded in Iran on a variety of plants by Borumand (2000). Jafari (2011) reported that *H. variegata* had rapidly established itself throughout the west of Iran (Lorestan Provinces) thanks to a successful feeding. The present work shows the extreme richness of the Coccinellid fauna in Lorestan. Dixon (2000) believes that the number of species largely depends on the number of preys. For example, in September most of pests yield great populations, thus the amount of feeding for Coccinellids increases too. The predaceous role of Coccinellids benefits from the maintenance of field diversity, which supports the population of prey such as aphids, thrips and mites (Iperti, 1999). Ladybird beetles migrate between various crop fields throughout the season depending upon the availability of prey and habitat disturbance (Maredia et al.,1992). We hope that this inventory of Coccinellid species in the Lorestan areas will contribue to improve Integrated Pest Management in crops and orchards in Iran by reducing or selecting pesticides for less impact on animal and botanical species and, above all, rearing and releasing those ladybird species which are recognized to be effective in pest control.

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