Biodiversity Conservation of Coccinellidae (Insecta: Coleoptera)

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Abstract—The present study was conducted in the south of Isfahan (51°26' E and 30°43' N), Iran to assess biodiversity and distribution of ladybird beetles (Coleoptera: Coccinellidae) on seven regions during April-Sept., 2013. Specimens of coccinellid beetles were collected by netting and hand picking from Ataabad, Baghsorkh, Boan, Honjan, Podan, Sephrehbad and Sfarjan. Identification of these beetles showed that fourteen different species belonging to three sub-families: Coccinellinae, Chilocorinae and Scymninae. Hippodamia variegata 34% (n = 543) and Coccinella septempunctata 28% (n = 446) were recorded more abundant species as well as widely distributed on all the regions. When distribution of all the areas were compared, it was concluded that the coccinellidae was most distribution in the Seprehbad area than other areas. The maximum and minimum diversity species were obtained in Sfarjan (Simpson’s diversity index = 0.83) and Honjan (Simpson’s diversity index = 0.64) regions respectively. Among periods Jun (Simpson’s diversity index = 0.80) constituted more abundant and more diverse coccinellids. Maximum of similarity indices (0.46) were observed between Seprehbad and Sfarjan regions.

Keywords—Ladybird, fauna, biodiversity, Biological control.

I. INTRODUCTION

Biodiversity is a contraction of ‘biological diversity’ and is used to describe the variety of life. It refers to the number and variety of organisms within a particular area and has three components: species diversity; ecosystem diversity and genetic diversity. Biodiversity is often used as a measure of the health of biological systems. Ladybugs 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). Their life cycle is completed in one month depending upon prey, location and temperature; two or three generations are generally produced in a year. (Majerus and Kearns, 1989). The coccinellid beetles are considered to be a great economic importance in agro-ecosystem through their successful employed in the biological control of many injurious insect (Agarwala and Dixon 1992, Dixon 2000). Coccinellidae is extremely diverse in their habitats. They live in all terrestrial ecosystems: tundra, forest, grassland agroecosystems and from the plains to mountains (Skaife, 1979). Coccinellids are also regarded as bioindicators (Iperti and Paoletti, 1999) and provide more general information about the ecosystem in which they occur (Andersen, 1999). Iran is an ecologically diverse country which includes rich agricultural areas, deserts, marshes, rivers and mountain habitats. Because of these specialized geographic and vegetative zones, Javanshir (1976) grouped the Iranian vegetation coverage into five zones, including the Iran o-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 as to their distribution and diversity of ladybeetles in Iran. The objectives of the present study were to explore the predatory ladybeetle fauna of Isfahan Province (Iran), to estimate the species richness, species evenness and species diversity of coccinellids in agro-ecosystem and to know about the role of coccinellids as bioindicators.

II. MATERIALS AND METHODS

The south of Isfahan consists of three regions (shahreza, dehaghan and semirum) is located between longitude 51°26’ East, latitude 30°43’ North, with an area of 9494 km2 in the center of Iran. They have moderate weathers, with the average temperature in summer reaching 38 degree Celsius and average annual rainfall is about 300mm, that is sufficient to keep the soil very fertile. This area consist a lot of horticulture and agriculture. The study area divided in seven sampling regions, namely: Ataabad, Baghsorkh, Boan, Honjan, Podan, Seprehbad and Sfarjan. Collection of beetles was done from different parts of these regions during 2013, from early spring to the autumn season. Each locality was frequently visited weekly. All the available cultivations 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 the vials containing 75% ethanol, and then pinned and placed in a collection box. Each specimen was labeled noting the place of collection, date of collection, pray name and host plant species and brought to laboratory of Islamic Azad Arak University, Arak 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 Arak University. The data collected was analysis statistically to calculate.

The diversity, abundance and similarity species in different places, crops and periods by applying Simpson’s diversity index and Sorenson index. Simpson’s index (D) is a measure

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of diversity. The formula for calculating $D$ is presented as: $D = \sum(n_i-1)/N(N-1)$. $D = \text{Simpson’s index}$, $n_i = \text{the total number of organisms of each individual species}$, $N = \text{the total number of organisms of all species}$. $1-D = \text{Simpson’s reciprocal index}$. 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 ($1-1/D$). (Maguran, 1988). Similar species in two communities calculated from both of two areas by Sorexson’s index ($SOQ$), $SQ = 2J/(a+b)$. $J = \text{numbers of similar species in both community}$, $a = \text{total numbers of species in community A}$, $b = \text{total numbers of species in community B}$. 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 and Henderson 2000). The number of species of a particular group of organism increases approximately as the fourth root of the area (MacArthur and Wilson 1967). In other words, the number of species can be predicted as. Estimated number of species = Constant x (Area)$^{0.25}$

### III. RESULTS

The research study was conducted from April to September in 2013. Table 1 presents the list of coccinellid species captured in this regions. A total of 1611 specimens belonging to three subfamilies, six tribes, nine genera and 14 species in seven places throughout the sampling period were collected and identified. The maximum and minimum numbers of species were found in subfamilies coccinellinae and chilochaerinae respectively. Among genera, *Exochomus* was the most abundant. Both the species *Coccinella septempunctata* and *Hippodamia variegata* found in all of the places of sampling. we can find the distribution of species in table 2. Among the referred species, *Hippodamia variegata* was *aneudominant* in total research sites, as it numbered 543 specimens. The single species *H. variegata* made up 34% of all individuals. The second most abundant species was *C. septempunctata* (28%) and the next *Oenopia conglobata* (20%). Among the collected species, *Hyperaspis quadrimaculata* showed narrow range of habitat and were capture only in one place. Sepehrabad and Sfarjan were comprised maximum richness (12 species) and Boan was recorded second more richness (7 species). Abundance percent of ladybird species through sampling period showed in table 3. The months June- July were found more favorable for the family coccinellidae. Total species (fourteen species) were recorded in month June- July. Two species *Adalia decimpunctata* and *H. quadrimaculata* were recorded only during the month of June- July. Twelve species not only abundant during the months June-July but also during April- May and August – September were collected too (table 3). In during sampling from April to September *H. variegata* had greatest abundance, specially through August- September (43.3 %) which has highest abundance. The least abundant were belonged to tribe Chilocorinae. Dixon (2000) believes numbers species largely depends on the number of prays. In month June most of pests (specially aphids, psylls, and coccids) have high population, thus amount of feeding ladybirds increased too. The predaceous role of lady beetles benefit from the maintenance of field diversity, which supports the population of prey such as aphids, thrips and mites (Iperiti and Paolotti, 1999). The ladybird beetles migrated between various crop fields throughout the season depending upon the availability of prey and habitat disturbance (Maredia et al.,1992). Abundance percent of ladybird species in different localities showed in table 4. The *Coccinella septempunctata* had greatest and least abundance percent in Honjan (54.7 %) and Podan (24.1 %) regions respectively. *H. variegata* greatest and lowest abundance percent observed in Boan(41.1 %) and Baghsorkht (17.3 %) regions respectively. Abundance percent of ladybird species in different hosts were survived. The numbers of species in grassy and woody plants, were 7 and 14 species of coccinellidae respectively( table 5). In grassy plants greatest and least abundance percent of species were observed at *C. septempunctata* (37.9 %) and *Exochomus nigrmaculatus* (0.61 %) respectively. Whereas in woody plants greatest and least abundance percent were found at *H. variegata* (33.3 %) and *H. quadrimaculata* (0.15 %) respectively. Seven species collected from both grassy and woody hosts. Diversity and reciprocal index in different places were calculated by simpson’s index. This index considers both the number of species and the distribution of individuals among species. It was concluded that the diversity indices are not same for the seven areas. Simpson diversity and reciprocal index in different places showed in table 6. Base on data in table 6, highest and lowest diversity species were obtained in Sfarjan (0.83) and Honjan (0.64) regions respectively. Simpson diversity and reciprocal index in through sampling periods showed in table 7. This index showed that in June – July (0.8) ladybirds species were more diverse over other periods ( table 7). It was concluded that the diversity indices are not same for the sampling periods. Simpson diversity and reciprocal index in different hosts showed in table 8. Base on data in table 8, highest and lowest diversity species in woody (0.77) and grassy (0.7) plants were calculated respectively. This index showed that in woody plants were more diverse over grassy plants. Similarity index of species in places was calculated on Sorexson’s index. Minimum of similarity indices (0.28) in different places were founded between Ataabad and Sepehrabad (table 9). Whereas maximum of similarity indices (0.46) in different places between Sfarjan and Sepehrabad were calculated.

### IV. DISCUSSION

Previously similar survey of predatory coccinellid beetle showed been conducted by Jafari (2007) at Lorestan provinces in Iran. The results presented in Table 1 confirm that coccinellids are the most important group among crops and orchards predators in Iran(Modarres-Awal 1997). Research by Farahbakhsh (1961) confirmed the dominance of *C. septempunctata*. According to Hodek and Honek (1996); Majerus and Majerus (1996) *C. septempunctata* is most prone to a sudden population growth. Its number largely depends on
the number of aphids. The important place occupied by species which food preferences. Ladybirds are density dependent predators, their numbers rise as the prey numbers increase (Dixon 2000). The prey population, thus there by determines the ladybird beetle population. All species, belonging to the Scymnini, can be potential predators of pseudococcids, at least in the adult stage (Magrow 1992). The most of these species was recorded in Iran on a variety of plants by Borumand (2000). Jafari (2011) reported that most of these species was recorded in Iran on a variety of pseudococcids, at least in the adult stage (Magrow 1992). Belonging to the Scymnini can be potential predators of pseudococcids in regulating green bugs on Texas grain sorghum. Journal of Economic Entomology, 78 (1): 269–273. http://dx.doi.org/10.1093/geo/78.1.269


REFERENCES


