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Diversity of Syrphidae Family (Diptera) in Different Habitat Types in Zanjan Province, Iran

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Abstract: Diversity of Syrphidae family was studied in four different habitat types (River side, Woodland, Fruit garden and Rice field) in the years of 2008 and 2009. Syrphid flies were collected from different habitants in Zanjan Province. A total of 31 species with 750 individual of Syrphid flies were collected. Records from these four sites were used in the diversity analysis.

Key words: Diversity, Syrphidae, different habitats, Zanjan, Iran

INTRODUCTION

The Syrphidae family, commonly named hover flies or flower flies, comprises almost 6000 species worldwide and is one of the largest families of Diptera (Kuzentsov, 2002). The adult feed on nectar and pollen of flowering plants. They are considered an important group of insects in agriculture and play a major role as pollinators (Speight, 2008).

Compared with the adult, larvae have heterogeneous alimentary habits. Larval feeding modes of Syrphidae includes phytophagous (*Eumerus meigen* and *Merodon meigen*), mycetophagous (*Chelosia meigen*), saprophagous (most Milesiinae), zoophagous (Syrphinae and Pipizini). Aphidophagous hoverflies are important as biological control agents of various aphids (Sommaggio, 1999).

Hover flies can be found everywhere except in dry area. Habitats of adult and larvae can be variate. Adult Syrphid flies can be collected where they feed on flowers some in places where they oviposit and where they hover in sunlight or rest on foliage (Stubbs and Falk, 1996).

In general, insect diversity is highest in habitats with the most plant diversity and is lowest in shrub, grass and open areas (De Vries, 1992). Because the Syrphidae larvae can be found in a broad range of land cover types and the adults are mostly found in areas with flowers, a very heterogeneous land cover type will contain most of the (a) biotic factors needed by the majority of the syrphids. This will implicate that when the heterogeneity of the land cover type will increase, this will have a positive effect on the biodiversity of the Syrphids. Due to dependence on flowers in their adult stage areas with a large amount of different flowers (mostly of the Umbelliferae family) will increase locally the syrphid species diversity. The majority of the syrphids can be found within diverse habitats like forests, woodlands, marches, bogs, gardens peat land and residential areas (Van Veen, 2004). Due to highly diversified habitat requirements of their larvae Syrphidae are particularly negatively affected by reduction in landscape diversity. They can function as good biological indicators of environmental stress and of loss of landscape diversity. Heterogeneous land cover types will increase Syrphidae species (Buchs, 2003). This study aims to present the diversity of Syrphidae family in four habitat types that had small-scale vegetation type patterns.

MATERIALS AND METHODS

Zanjan Province in Northwest of Iran is located in 35°35'-37°15'N; 47°15'-49°25'E with varying altitude from 270-3400 m. This region has a highland climate characterized by cold snowy weather in the mountains and moderate climate in the plains in Winter time. In the Summers, the weather is warm. The average maximum temperature of Zanjan is around 27°C whereas the average minimum temperature stands at -19°C. Meanwhile, the temperature rises to 32°C on hot days whereas it drops to -27°C below zero on icy days. The average annual rainfall in the first month of spring stands at 72 mm while in the second month of Summer, it slips to a meager 3.6 mm. The rate of humidity in the morning stands by average at 74% and at noon at 43%. In order to study on diversity of Syrphidae in four different habitat types (River side, Woodland, Fruit garden and Rice field) adult specimens were collected with sweep net in different periods between May and September 2008 to 2009 and identified.

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The collected materials were determined by different keys especially Stubbs and Falk (1996) and Bei-Bienko (1988). The identified samples were sent to Dr. Barkalov (Siberian Zoological Museum) and were confirmed. Geographical characterizes of sampling stations was determined by GPS (Table 1). For data analysis, indices of diversity, evenness and species richness of Syrphiade family were assessed for each habitat type and calculated using Ecological Methodology Software (Krebs, 1989). The similarity of species composition between habitat types (Bray-Curtis similarity) was analyzed with cluster analysis using Past 1.88 Software (Hammer *et al*., 2001). If the number of individuals in different habitats were same, researchers were able to calculate species richness by directly accounting. But since the number of individuals were not same in different habitats, therefore researchers generated an average species accumulation curve based on 180 randomizations and calculated rarefied species richness at equal sampling effort (number of samples) among sites (rarefied richness; Gotelli and Graves, 1996). Rarefaction is a statistical method for estimating the number of species expected in a random sample of individuals taken from a collection.

So, researchers used the same curves to estimate the extrapolated total species richness using a Michaelis-Menten equation (extrapolated richness; Colwell and Coddington, 1994).

Table 1: Geographical and vegetation characteristics of sampling stations

Locality	Vegetation	Latitude	Longitude	Altitude
River side	Shrub and grass habitats around Zanjanrood river	36°38'N	48°32'E	1637 m
Woodland	Almost salix trees near taham dam	36°47'N	48°33'E	1875 m
Rice field	Rice field and around grassland	36°49'N	49°05'E	350 m
Fruit garden	Apricot and apple trees	36°16'N	48°42'E	2015 m

RESULTS AND DISCUSSION

A total of 31 different species with 750 individuals of hover flies were recorded in four different habitat types in the studied period in 2008 to 2009. The hover flies list and their abundance are presented in Table 2. The three most abundant species are *Sphaerophoria script* (204 individuals), *Eristalis arbustorum* (94 individuals) and *Eristalis tenax* (83 individuals). The greatest number of individuals of *Sphaerophoria script* occurred in rice filed with 71 individuals while most of the individuals of *Eristalis arbustorum* are found in the fruit garden and woodland with 38 and 31 individuals, respectively.

Table 2: List of Syrphid species with general trophic level of larvae from Rotheray (1993)

	Habitat				
Species	River side	Woodland	Fruit garden	Rice field	Larval trophic category
Eristalis arbustorum	25	31	38	0	Aquatic saprophgous
Eristalis tenax	28	21	34	0	Aquatic saprophgous
Eristalis similis	2	0	0	0	Aquatic saprophgous
Eristalinus megacephalus	1	0	0	0	Aquatic saprophgous
Eristalinus sepulchralis	15	0	0	0	Aquatic saprophgous
Eristalinua aeneus	9	0	4	0	Aquatic saprophgous
Eristalinus taneniops	2	2	0	0	Aquatic saprophgous
Helophilus continuus	1	0	0	0	Aquatic saprophgous
Eumerus strigatus	4	2	0	0	Phytophagous
Eumerus sogdianus	5	3	0	0	Phytophagous
Syritta pipiens	15	12	17	0	Terrestrial saprophagous
Pipizella divicoi	12	0	2	0	Predator
Neoascia podagrica	6	0	0	0	Semi-aquatic
Paragus quadrifasciatus	0	0	3	2	Predator
Paragus compeditus	0	0	0	7	Predator
Paragus abrogans	0	0	0	3	Predator
Paragus bicolor	6	3	5	0	Predator
Paragus albifrons	0	0	0	1	Predator
Ischiodon scutellaris	0	0	0	7	Predator
Scaeva pyrastri	0	0	1	0	Predator
Scaeva albamaculata	0	2	0	0	Predator
Sphaerophoria scripta	31	44	58	69	Predator
Sphaerophoria turkmenica	0	5	12	0	Predator
Sphaerophoria ruppelli	4	0	2	29	Ppredator
Eupeodes corolla	21	14	8	20	Predator
Eupeodes nuba	0	17	0	0	Predator
Meliscaeva auricollis	0	1	0	0	Predator
Spazigaster ambulans	0	2	0	0	Predator
Melanostoma mellinum	8	0	5	19	Predator
Episyrphus balteatus	18	18	9	15	Predator
Platycheirus sp.	0	0	1	0	Predator

Table 3: Diversity of Syrphidae in four different habitat types in Zanjan Province

Habitat types	Species number (S)	Individual number (N)	Species richness index	E(Sn) Evenness index E(1/D)	Diversity index (H')
River side	19	210	18.40	0.593	3.695
Woodland	15	177	14.86	0.480	3.130
Fruit garden	15	199	14.40	0.398	2.948
Rice field	10	164	9.97	0.397	2.400

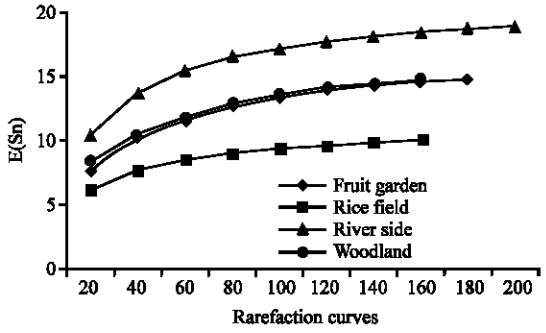

Fig. 1: Species richness curves in four different habitat types

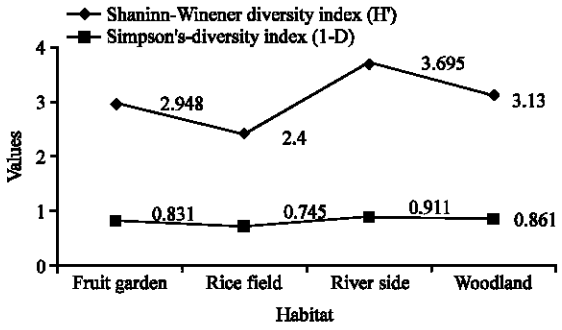

Fig. 2: Diversity indices in four different habitat types

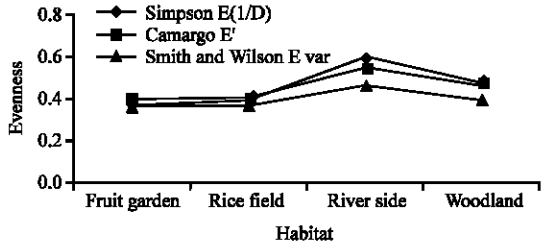

Fig. 3: Evnnes indices in four different habitat types

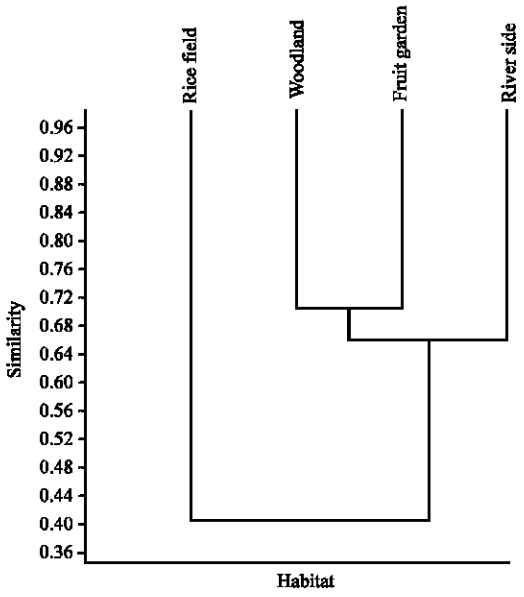

Fig. 4: Cluster of similarity between habitats based on the hoverflies species

The diversity of Syrphidae family in four different habitat types in Zanjan Province is presented in Table 3. The river side has the greatest species number (19 species) and the rice field has the least (10 species). The river side has the greatest individual number (210 individuals); the rice field has the least individual number (164 individuals). For compression species richness was used rarefaction method. As Fig. 1 is showed in spatial scale, based on 180 randomizations, river side and rice field showed the highest and lowest species richness, respectively. The Simpson and Shannon Wiener diversity index were calculated for different habitats. As Fig. 2 showed the river side has highest diversity indices. Finally evenness index calculated. The evenness index is very high in river side (Fig. 3). The high evenness index of the river side leads the high diversity index. The similarity of Syrphidae family between habitats is displayed in Fig. 4. Bray-Curtis analysis established the similarity of hoverflies among habitats is divided into 3 groups. One group is the fruit garden and woodland and the other group is similarity between first group and river side. There is less similarity among first, second groups and rice field (Fig. 4).

The result indicated in the study areas the more abundant species are *Sphaerophoria script*, *Eristalis arbustorum* and *Eristalis tenax*. They are the most abundant, widely distributed and active in the most seasons and have long-flight period. *Sphaerophoria script* is more abundant in rice field because this species has aphidophagous larvae. Predatory taxa were much more in corps and can be related to the occurrence of high densities of ophids population in fields (Francis *et al*., 2002).

The rice field consists of very simple vegetations, mostly rice bunches. The less diversity of vegetation

results with less diversity of hoverflies. Studies show that the more divers plants are the more diverse butterflies and insects are. The fruit garden has fewer hoverfly species than the river side. River side has more species than the woodland. Rice field has the least species number. Living environment of river side is no homogeneous with a variety of land cover type in the intermediate procession.

The river side has greatest abundance of hoverflies and species. The living environment of the river side is diversified with vegetation, shrub, grass, mud and water that attract more hoverflies as they land taking water and feed on flowers. Also, river side is suitable place for their larva because 9 species of 19 species were collected in this area have aquatic and semi-aquatic larvae. Large saprophages larvae are mostly restricted to water during their development. Large relative surfaces of water may support larger populations which are less prone to extinction. This may subsequently cause higher species richness in areas with more wetlands (Keil *et al*., 2008). So, there is greater insect diversity in the wet sites than in the dry sites. Along the river, shrub and grass with flowering plants also support more hoverflies. The Syrphid flies usually inhabit in humid areas in forests in high mountains as well as habitats on river banks in forests where flowering plants grow (Saribiyik, 2008). Also, woodland and fruit gaden have high species diversity after river side, respectively. The majority of the Syrphid fauna in Atlantic Europe use woodlands as shelter. With an increase in land cover types woody plants and trees will be included which presumably will lead to an increase in Syrphid species.

A study carried out by Humphrey showed that syrphid diversity within pine and spruce diversity forests in the UK, showed a high correlation with landscape complexity. Due to a need of different habitats during their life and the diversity of different larvae situations the diversity of land cover could play a more important role in diversity of Syrphidae so, the rice filed is monoculture place and the lack of habitat diversity will lead to a decrease in syrphid species. Jeanneret *et al.* (2003) found a similar positive relation between butterflies assemblages and plant species richness.

In addition, the diverse variety of larval development habitats allows occupation of a wide spectrum of forest habitats (De Meyer, 2001). This is reflected in the differences in syrphid fauna composition at the four different habitats. Romero-Alcaraz and Avila (2000) concluded that habitat heterogeneity at a landscape scale explains the diversity of epigaeic beetles of a Mediterranean ecosystem.

Finally, the research carried out by Magagula and Samways (2001) pointed out the positive influence landscape heterogeneity (variety of habitats) has on plant diversity and by this on the coccinellid diversity. The more heterogeneous the landscape is, the higher habitat heterogeneity will be and this could lead to more species diversity (Rottenberry and Wiens, 1980).

Species composition was dissimilar among habitats but rather similar between the fruit garden and woodland habitats and there is similarity between in these two habitats and river side. Also, rice filed is rather dissimilar with them.

CONCLUSION

The results indicated that river side and rice field showed the highest and lowest degree of species richness and species diversity also, river side and rice field showed the highest and lowest species evenness, respectively.

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