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Diversity index of different syrphid flies from Pir Panjal biodiversity Park Baba Ghulam Shah Badshah University, (BGSBU campus) Rajouri

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Abstract
The present study revealed a total of 11 species of syrphid flies belonging to 9 genera. These species include *Episyrphus balteatus*, *Eristalis cerealis*, *Betasyrphus sereius*, *Syritta pipiens*, *Eristalis taeniops*, *Eristalis arbustorum*, *Eupeodes luniger*, *Syrphus ripsil*, *Eristalis tenax*, *Helophilus pendulus*, and *Simosyrphus scutellaris.* Most of the species were foraging on flowers of different plant species. During the present studies the maximum number of individuals of syrphid flies were found to be that of *Episyrphus balteatus* (580 individuals) followed by *Eristalis tenax* (410 individuals) and *Eristalis arbustorum* (300 individuals). It was observed that *Episyrphus balteatus* was the most abundant species and has the highest individual species observed during the study, and also *Simosyrphus scutellaris* had the least number of species observe respectively from the survey. The study showed a rich Syrphid fly diversity mainly attributed to the micro-habitats available within the eco-forest.

Keywords: Syrphid flies, diversity, distribution, survey, species

Introduction
Biodiversity has been defined as the variety and variability of living organisms and the ecosystems in which they occur. In other words, biodiversity is the total number of genetic information, species and ecosystems within a given region. Hence, biological diversity includes all species of plants, animals and micro-organisms as well as ecosystems they form. The true flies (Diptera) are large group insects with an approximate number of 1.6 million species, and thus form one of the largest assemblages of organisms on the planet (Hammond, 1992) [4]. There is a long term plant-pollinator interaction and they have been co-evolved through million of the years (Waser *et al*., 1996) [9]. The Syrphid family is one of the most geographically diverse families present in most regions of the world and in many aquatic ecosystems (Speight, 2003) [7]. Hover flies act as pollinators for spring flowering in oriental regions and very rare throughout the summer and winter in hot and dry parts of Asia (Sajjad and Saeed, 2010) [8].

Syrphid fly belongs to family Syrphidae, is one of the largest families of the order Diptera and includes the commonly known hover flies or Flower flies or sun flies or drone flies. This Syrphid fly family consists of small to medium sized flies about 6 to 18 mm long, mostly brightly coloured with black and yellow striped bodies resembling Wasps and Bees. Members of the family Syrphidae have a unique feature of vena spuria it is a vein like thickenings on the wing membranes (Khan *et al*., 2016) [5]. In the field, they can be recognised by hovering over flowers in bright sunshine, by making loud droning sound with their rapid vibrating wings.

The Syrphidae family is divided into three subfamilies viz., Syrphinae, Milesnae and Microdontinae. The feeding habits of adult flies are fairly uniform with almost all feeding on pollen and nectar, as well as on honeydew produced by some Homoptera. The Syrphidae is an important group of resources and natural enemy insects, while not only could be use for controlling aphids and pollinations, but also an important experimental, materials for bionics. Syrphid flies have great economic importance because of their role in pollination. Gharali *et al*., (2002) [4] studied the fauna of syrphid flies from Iran and reported that Syrphid flies are common pollinators almost everywhere flowers are found, and are absent only in wetter and polar regions. In some agro-ecosystems, such as orchards, they out-perform native bees in pollinating the fruits (Gilbert, 1981) [3].

Adult Syrphid flies usually feed on nectar and pollen from flowering plants. Syrphid flies as pollinators have a wide range of adaptations for visiting different types of flowers.

Material and Methods

1. Camera: Syrphid flies were photographed with a high resolution digital camera. Nikon DSLR D 7000.

2. Insect collection Net: The syrphid flies were collected through insect Collection Net with telescopic handle consisting of strong wire ring (diameter 30 cm).

3. Killing Bottle/ Jar: One of the easiest methods to kill syrphid flies is to use a killing jar. It was prepared by placing 1-2 inch thick layer of absorbent material (Plaster of Paris) on the bottom of the jar, pouring some ethyl acetate and allow it to soak. Blotter is placed over the absorbent materials, and has sealed tightly. The lower half of the Jar with masking tape to prolong the potency of the killing jar by protecting it from sunlight. The captured syrphid fly were placed in killing jar for a while until it died.

4. Paper Envelopes: The killed specimens with folded wings are placed in paper envelopes.

5. Entomological Pins: Insect pins vary in diameter and length and are numbered as 0, 1, 2, 3, 4, 5, etc. Needles of size 0-3 are mostly used, although longer pins of 37-39 mm in length are also used for larger insects.

6. Stretching board: Stretching board consists of a central groove in which body of the syrphid fly rests and varies in width depending on size of insects. Gently press the wings down to spread them out evenly. Then put a thin strip of paper over each wing and pin the ends of the board. This will keep the wings flat until they dry out. The drying process can take up to 2 weeks.

7. Ordinary pins: They were used to hold the paper strips over the wings.

8. Forceps: Forceps are used to expand the wings of the syrphid fly on the spreading board. It minimizes the damage while handling the wings.

9. Scissors: It was required to cut the strips of variable sizes.

10. Insect cabinet: They were used to preserve the killed specimen.

11. Ethyl acetate: It was used to kill, insects and also acts as a good preserving agent.

12. Naphthalene Balls and Phenol: These were used as preserving agents.

13. Labels: The following information was appended in the labels:

a) Location	b) Date of collection
c) name of collector	d) Environment from which specimen was collected

14. Field Dairy: Field dairy was maintained properly. It holds all the records of day to day activity.

Data Analysis

For making biodiversity analysis, the data from collected syrphid fly samples were grouped according to source. The averages were calculated. There are several ways to test the species diversity. The biodiversity count was made using the Shannon diversity index (Shannon, 1948) [10] to estimate species richness uniformity and species diversity.

Species Diversity

The species diversity index was calculated by using Shannon Wieners Diversity index formula.

$H = - £(Ni/N)\ln (Ni/N)$

Where
Ni = Number of individuals of species I and N = Total number of all the species.

Species Evenness: Evenness index was calculated as per Hill i.e.

$J = H/\ln S$

Where
S = Total number of species, N = Total number of individuals of all species, H= index of diversity.

Diversity index of different syrphid flies from Pir Panjal Biodiversity Park BGSBU Campus

The species diversity index was calculated by Shannon-Weiner index formula. *Episyrphus balteatus* showed the maximum species diversity index comprising (0.313), followed by *Eristalis tenax* (0.157), *Eristalis arbustorum* (0.83), *Eristalinus taeniops* (0.0206), *Syrphus ribesii* (0.0206), *Betasyrphus sererius* (0.0092), *Syritta pipiens* (0.0031), *Eupeodes luniger* (0.0022), *Helophilus pendulus* (0.00144), *Eristalis cerealis* (0.0014) and least species diversity index was observed in *Ichiodon scutellaris* (0.0009) (Table 1). Paray *et al.* (2012) [11] studies the diversity of syrphid flies of Kashmir Himalaya and reported the similar results during the study.

Table 1: Species Diversity index.

Genus	Species	No. of individuals	Shannon diversity index (H)
Episyrphus	*E. balteatus*	580	0.313
Betasyrphus	*B. sererius*	100	0.0092
Syritta	*S. pipiens*	60	0.00316
Eristalinus	*E. taeniops*	150	0.0206
Eristalis	*E. arbustorum*	300	0.0836
	E. cerealis	30	0.00073
	E. tenax	410	0.157
Eupeodes	*E. luniger*	50	0.0022
Syrphnus	*S. ribessi*	150	0.0206
Helophilus	*H. pendulus*	40	0.00144
Ichiodon	*I. ischiodon*	10	0.00927
= 1,880		0.61847	

Table 2: Species evenness, species richness of different syrphid fly species.

Species list	Diversity index	Total no. of species collected	No. of individuals collected	Species evenness (j)	Species richness (ma)
E. balteatus	0.313853	11	580	0.0285	0.017
B. sererius	0.009275		100	0.0008	0.1
S. pipiens	0.003162		60	0.0002	0.16
E. taeniops	0.017064		150	0.00155	0.66
E. arbustorum	0.083634		300	0.00803	0.033
E. cerealis	0.000735		30	0.000668	0.33
E. tenax	0.157178		410	0.014288	0.024
E. luniger	0.002236		50	0.000203	0.2
S. ribessi	0.020619		150	0.001874	0.066
H. pendulus	0.001449		40	0.000131	0.25
I. scutellaris	0.009275		10	0.000843	1

Results and Discussion

Diversity index of different syrphid flies from Pir Panjal Biodiversity Park BGSBU Campus

The species diversity index was calculated by Shannon-Weiner index formula, *Episyrphus balteatus* showed the maximum species diversity index comprising (0.313), followed by *Eristalis tenax* (0.157), *Eristalis arbustorum* (0.083), *Eristalinus taeniops* (0.0206), *Syrphus ribesii* (0.0206), *Betasyrphus sererius* (0.0092), *Syritta pipiens* (0.001), *Eupeodes luniger* (0.0022), *Helophilus pendulus* (0.00144), *Eristalis cerealis* (0.0014) and least species diversity index was observed in *Ichiodon scutellaris* (0.0009) (Table 1). Paray *et al*., 2012 [11] studies the diversity of syrphid flies of Kashmir Himalaya and reported the similar results during the study.

The *Episyrphus balteatus* shows maximum species evenness (0.0285) followed by *Eristalis tenax* (0.028), *Eristalis arbustorum* (0.014), *Eristalinus taeniops* (0.00008), *Syrphus ribessi* (0.0008), *Eristalinus taeniops* (0.0015), *Betasyrphus sereris* (0.0008), *Syritta pipiens* (0.0002), *Eupeodes luniger* (0.00203), *Helophilus pendulus* (0.000131), *Eristalis cerealis* (0.0066), *Ischiodon scutellaris* (0.00084).

The *Episyrphus balteatus* shows maximum value of species richness (0.017), followed by *Eristalis tenax* (0.024), *Eristalis arbustorum* (0.33), *Eristalinus taeniops* (0.006), *Syrphus ribessi* (0.006), *Betasyrphus sereris* (0.1), *Syritta pipiens* (0.16), *Eupeodes luniger* (0.2), *Helophilus pendulus* (0.25), *Eristalis cerealis* (0.33), *Ischiodon scutellaris* (1.0) (Table 2).

My studies are in accordance with Khan 2013 [12], who investigated the distribution, relative abundance, species diversity and richness of syrphid flies in Flower ecosystems of Kashmir Himalaya. Among 21 species observed, *E. tenax* (11.57%) has the highest average population, followed by *E. cerealis* (10.49%), *E. corolla* (9.12%) and *E. aeneus* (7.56%). Populations of *E. tenax* were highest among almost all floricultural crops including daffodils, roses and wild flowers, in various locations in Kashmir (Khan, 2013) [12]. My research is also consistent with Arif *et al*., 2014 [1]; Khan and Reyaz, 2017 [6]. They found the Shannon-wieners diversity index (H') showed large differences in regional diversity, i.e. syrphid flies were not sufficiently dispersed at all selected sites within the district. This is due to the different topography, types of orchards and aphid occurrence in Kashmir.

Conclusion

The study area supports a rich diversity of syrphid flies with a wide variety of plants which provide an ideal breeding environment for syrphid flies. It is estimated that there are more than 11 syrphid fly species on the BGSBU Campus as they are specific to different seasons and this survey was conducted for only six months. Therefore, it is difficult to collect, preserve, photograph and identity all species within the study area. The study is an attempt to provide a checklist for syrphid flies in the study area and will be continually updated for future reference. It was observed that *Episyrphus balteatus* was the most abundant species and has the highest individual species observed during the study, and also *Simosyrphus scutellaris* had the least number of species observe respectively from the survey. The study showed a rich Syrphid fly diversity mainly attributed to the micro-habitats available within the eco-forest. Changes in landscape, land use patterns, and loss of habitat vegetation can adversely affect syrphid fly diversity in terms of species richness, leading to a potential loss of endemism and threatened extinction. Syrphid fly diversity depends upon the floral diversity (among other factors).

Therefore, it is possible that syrphid flies can be protected by improving the vegetation composition of habitat around the study area.

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Conflict of interest: None.

References

1. Arif S, Khan MR, Shehzad A, Nazir N, Rahim J, Naz F, *et al*. Biodiversity of syrphid flies (Syrphidae; Diptera) from Poonch District of Azad Kashmir, Pakistan Journal of Agriculture Technology. 2014;10(6):1465-1472.
2. Gharali BM, Alichi GR, Radjabi. The new records of Syurphidflies (Diptera: Syrphidae). Proceeding of 14th Iranian Plant Prot. Congress; c2002. p. 348.
3. Gilbert FS. Foraging ecology of hoverflies: morphology of mouth parts in selection of feeding on nectar and pollen in some common urban Species. Ecology Environment. 1981;6(3):245-262.
4. Hammond PM. Uncharted realms of species richness, In: Groombridge B editors, Global Biodiversity: Status of the Earths Living Resources. World Conservation Monitoring centre, Chapman and Hall, London; c1992. p. 26-39.
5. Khan AA. Distribution, Relative Abundance, Species Diversity and Richness of Syrphid Flies in Floricultural Ecosystem of Kashmir, India. International Journal of Current Microbiology and Applied Sciences. 2016;6(9):1539-1552.
6. Khan AA, Reyaz S. Diversity and Distribution of syrphid Fly Communities in Temperate Fruit Orchard of

Kashmir, India. International Journal of Current Microbiology and Applied Sciences. 2017;6(7):2794-2805.
7. Speight MCD. Species account of Europe Syrphidae (Diptera) Speight MCD, Catella E, Sarlhou J.P, Montail C, editors, Syrphid. The database of European Syrphidae. syrphid flies Net publications, Dublin; c2003. p. 39.
8. Sajjad Saeed A. Floral host plant range of syrphid flies (Syrphidae: Diptera) under natural condition in Southern Punjab, Pakistan. Pakistan Journal of Botany. 2010;42(2):1187-1200.
9. Waser NW, Chittka L, Price MV, Willaims MN, Ollerton J. Generalization in pollination systems, and why is it matter. Ecology Journal. 1996;77(4):1043-1060.
10. Shannon CE. A mathematical theory of communication. The Bell system technical journal. 1948 Jul;27(3):379-423.
11. Bhat AA, Haniffa MA, Divya PR, Gopalakrishnan A, Milton MJ, Kumar R, *et al*. Molecular characterization of eight Indian Snakehead species (Pisces: Perciformes Channidae) using RAPD markers. Molecular Biology Reports. 2012 Apr;39(4):4267-4273.
12. Ali H, Khan E, Sajad MA. Phytoremediation of heavy metals—concepts and applications. Chemosphere. 2013 May 1;91(7):869-881.