The Effects of Collection Methods on Species Diversity of Family Syrphidae (Diptera) in Neyshabur, Iran

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ABSTRACT

A faunistic list of Syrphidae sampled in the agroecosystems of Neyshabur (Khorasan-Razavi Province) through Malaise, yellow water traps and hand net is hereby presented for the first time. A total of 22 species were collected, including 13 species through Malaise trap, 5 through yellow water trap as well as representatives of all species sampled through hand net. Among the species collected, 8 including phytophagous ones were exclusively sampled through hand net. In the case of Malaise trap the hover fly population was strongly dominated (73%) by 3 common species of: Sphaerophoria scripta, Episyrphus balteatus, and Eupeodes corollae while, in the yellow water trap, Episyrphus balteatus was the key species representing about 45% of all specimens. Shannon-Weiner index of biodiversity found out for Malaise trap (H= 1.86) was higher than that calculated for yellow water trap (H= 1.39). The relative efficiency of the three collection methods is discussed.

Keywords: Biodiversity, Hand net, Hover flies, Malaise trap, Yellow water trap.

INTRODUCTION

Hover flies (flower flies (Syrphidae) comprise an attractive group of insects which with about 6,000 species worldwide [15] form one of the largest families of Diptera. Syrphids are common and easy to find in almost all terrestrial ecosystems, especially around flowering plants. They are excellent fliers, exhibiting an outstanding ability to hover. Some species can fly very long distances [8]. Many of them resemble Hymenoptera species providing a clear example of Batesian mimicry. While almost all the adult syrphids feed on pollen or nectar, syrphid larvae show a great variation in their feeding habits as phytophages, mycophages, saprophages and zoophages. Among them, the larvae of subfamily Syrphinae are considered the specialized aphidophagous predators which along with other aphidophagous insects (e.g., Coccinellidae), play an important role in the reduction of aphid populations in agroecosystems. Differences in larval feeding habits along with other features [15] make Syrphidae good candidates as bioindicators [4] for environmental evaluation. Therefore, they are the subjects of many scientific investigations. A review of literature suggests that the effectiveness of the employed sampling method has a strong effect on the quantification of an ecological community [3, 14]. In a faunistic survey, one might expect more than representatives of all the existent taxa of interest in a given site. In that case, the sampling method should be able to reveal the relative abundance of species as well as their diversity. In faunistic surveys of Syrphidae associated with agricultural crops, various collection methods

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including yellow water trap, Malaise trap, hand net or rearing of adults from immature stages have been employed, depending on the aims of the study [3, 5, 14 and 21]. Of these, the more commonly employed method is hand net, considered a qualitative method, while Malaise and pan traps, are useful for quantitative studies of hover flies. These methods have been widely used to evaluate the abundance and diversity of hover flies, but no study has been carried out to compare the efficacy of these 3 methods for collecting Syrphidae in an agroecosystem. Of the few comparative collection methods of insects, Burgio and Sommaggio [3] studying the syrphid fauna in an organic farm, using a hand net as well as a Malaise trap, made a comparison between these two techniques. Sobota and Twardowski [14] compared the species spectrum of hover flies collected by different methods including, yellow water trap, sweeping net, direct collection and rearing of adults from pupae collected from field. Only in one study, Campbell and Hanula [5], compared the performance of Malaise traps and colored pan traps for collecting flower visiting insects in forest systems. Based on these studies, it seems that the species composition of Syrphidae in a given area largely depends on the applied method of collection. In Iran, there is a lack of knowledge surrounding Syrphidae family. According to the recent Syrphidae checklist of Iran by Dousti and Hayat [7], about 124 syrphid species have been recorded from Iran. This figure comes from a few regional faunistic investigations carried out in recent years. Thus there is much work to be done to develop a more complete list of Syrphidae fauna of the country. The aims in the present study were: (a) to study the species diversity of Syrphidae in agroecosystems of Neyshabur; (b) to compare the efficiency of the two more common passive collection methods namely Malaise and yellow water trap in studying Syrphidae fauna.

MATERIALS AND METHODS

Study Area

The study was conducted in the agricultural areas of Neyshabur (58° 48' E, 36° 12' N), a city located in center of Khorasan-Razavi Province with an area of 930,859 sq kilometers (Figure 1).

Figure 1. Map of Iran. The dot specifies the investigation (Malaise and yellow water traps) site in Baghshan Gach County in Neyshabur (Khorasan-Razavi Province).

Table1. List of syrphid species caught by different collection methods in Neyshabur (Khorasan-Razavi Province). The number indicate the total sampled specimens. M=Malaise trap; YW= yellow water trap; Hn= hand net. + = only representatives collected. General trophic level of larvae from Rotheray(11) and Speight(20).

Species	M	YW	Hn [a]	Larval trophic category
Chrysotoxum intermedium (Meigen)	4	0	+	predator
Helophilus trivitattus (F.)	7	0	+	aquatic saprophgous
Episyrphus balteatus (DeGeer)	184	56	+	predator
Eristalis tenax (L.)	22	11	+	aquatic saprophgous
Eristalis arbustorum (L.)	23	0	+	aquatic aprophgous
Eristalinus taeniops (Wiedmann)	1	0	+	aquatic saprophgous
Eristalinus aeneus (Scopoli)	8	0	+	aquatic saprophgous
Eumerus jacobsonii (Becker)	0	0	+	phytophagous
Eumerus strigatus (Fallen)	0	0	+	phytophagous
Eumerus tricolor (F.)	0	0	+	phytophagous
Eupeodes corollae(F.)	180	23	+	predator
Eupeodes nuba (Wiedmann)	78	0	+	predator
Melanostoma mellinum (L.)	0	0	+	predator
Myathropa florea (L.)	0	0	+	aquatic saprophagous
Paragus haemorrhous (Meigen)	28	0	+	predator
Paragus bicolor (F.)	12	0	+	predator
Paragus quadrifasciatus (Meigen)	19	0	+	predator
Paragus tibialis (Fallen)	0	0	+	predator
Scaeva pyrastri (L.)	0	0	+	predator
Sphaerophoria scripta (L.)	208	25	+	predator
Syritta pipiens (L.)	0	9	+	terrestrial saprophagous
Syrphus vitripennis Meigen	0	0	+	predator

[a] Due to differences in areas sampled and a longer time of sampling, we think the data of hand net is not comparable with those of Malaise or yellow water traps, so these data are not given in the Table.

Collection Methods

In the comparison study, the following passive collection traps, supposed to be neutral, depending entirely on chance were employed: (a) Malaise trap, an erect mesh panel guyed and supported by two poles at ends of the panel; panel asymmetrical with one end higher than the other and collecting head at the higher end [22]. (b) Yellow water trap, a plastic bowl of 10 cm depth and 35 cm in diameter, filled with water and a few drops of liquid soap. The trap was placed on a platform, the position of which from above the ground was adjusted relative to growth of the surrounding plants. The traps were installed in an open area surrounded by an alfalfa field on the one side and wheat and sugar beet fields on others at Baghshan Gach County, approximately 12 km east of Neyshabur city. One trap of each model at a distance of 10 meters from the other were installed. Both trap types were emptied twice a week during the sampling period (from beginning of May to the end of September 2007). (c) Hand net, employed to complete the region's faunistic list of Syrphidae family, additional data being collected from other agricultural areas between April and September during years 2006 and 2007. Using a standard entomological net [2], the observed syrphid species were captured. The collected specimens were preserved in 75% ethanol and brought to the laboratory for identification [12, 16, 18, 19 and 21]. Identifications were confirmed by Drs. A. Vujic (Serbia), J.

Smit (The Netherlands), and D. Doczkal (Germany).
To assess the biodiversity index of traps, Shannon-Weiner index, H was employed. This index accounts for both abundance and consistency of the species present. The proportion of species i relative to the total number of species (pi) is calculated, and then multiplied by the natural logarithm of this proportion (ln pi). The resulting product is summed up across species, and then multiplied by -1:

$$H = -\sum_{i=1}^{s} p_i \ln_i p_i$$

Overlap of syrphid species captured by the two trap types was compared using Peterson's homogeneity index as: I= 1-0.5 ∑│ai - bi│, where ai is the proportion of species i in trap A and bi the proportion of species i in trap B [1]. This index takes into consideration both diversity and abundance of species. Also, overlap of species between trap types were compared using Sorenson's quotients of similarity, namely: SQ= 2J/(a+ b), where J is the number of common species to both trap types, a is the number of species caught by trap A and b the number of species caught by trap B [17]. Sorenson's index was employed to calculate values between 0 (no overlap) and 1 (complete overlap).

RESULTS AND DISCUSSION

A list of the collected Syrphidae is given in Table 1. In Malaise trap the hover fly population was strongly dominated (73%) by 3 common species namely: *Sphaerophoria scripta* L., *Episyrphus balteatus* (deGeer), and *Eupeodes corollae* F. while, in the yellow water trap *E. balteatus* was the most abundant species, representing about 45% of all specimens. A group of species, mainly phytophagous species: *Eumerus jacobsonii* (Becker), *Eumerus strigatus* (Fallen), *Eumerus tricolor* F., *Myathropa florea* L., *Syritta pipiens* L., *Melanostoma mellinum* L., *Paragus tibialis* (Fallen), *Scaeva pyrastri* L. and *Syrphus vitripennis* (Meigen) were sampled only through hand net. In fact, the species spectrum of the family Syrphidae caught by this method was broader than those caught through the other two methods. On the other hand, it seems that both Malaise and yellow water traps are less effective in collecting adults of syrphid species as represented by their low populations. It should be noted that more Eristalis species were caught in Malaise trap than in yellow water trap. Shannon-Weaver index of biodiversity found out for Malaise trap (H= 1.86) was higher than that calculated for yellow water trap (H= 1.39), but this difference was not so pronounced as differences found in species richness of the two trap types. Out of 22 syrphid species collected through the three collection methods, 13 species were caught through Malaise and 5 ones through yellow water trap. In fact, in yellow water trap, species' richness was much lower than that in Malaise trap, but the relative abundance of species caught through yellow water trap showed a higher degree of consistency. Similarity of trap catches among trap types as evaluated through Sorenson's index, and Peterson'n homogeneity index was low at the study site where Malaise trap and yellow water trap revealed a similarity of 0.44 (Sorenson's index) and 0.63 (Peterson's homogeneity index). Why the similarity of trap catches was low is unclear but it might be due to the low number of syrphid species caught by yellow water trap, probably caused by it's small size as compared with Malaise trap. The results indicate that yellow water trap was inefficient for evaluating syrphid fauna within the agroecosystem in the region. Several factors have been cited as to influencing the collection of syrphids through yellow water trap. For example, the presence or abundance of flowering plants in the study site might have influenced the number of syrphid species caught through yellow water trap. According to Schneider [13], the attractiveness of yellow water trap to insects might increase when the availability of surrounding flowers decreases. Fluctuating nutritional requirements also may affect the response of syrphid species to yellow water trap. As Hickman et al. [10] noticed most often only the hungry syrphids flied around yellow water trap. On the other hand, when syrphids are not hungry there is no reason for them to be attracted by yellow water trap. Probably for this reason, Haslett [9] found that the syrphid, E. balteatus did not show any preference to yellow color. Our results about yellow water trap are in agreement with those of Cane et al. [6] who cautioned that pan traps may not accurately reflect the pollinator's fauna. In contrast, Campbell and Hanula [5] found that pan traps were easy, effective and inexpensive methods as compared with Malaise traps for sampling flower visitors. The latter authors found that color of pan trap is an important parameter that influences insect pollinator catches, blue pan traps shown having caught more pollinators than the other colored pan traps. Sobota and Twardowski [14] suggest that syrphid species caught by yellow water trap positioned at plant tops' level are in many cases accidental species in a given crop. It seems that a big drawback to the use of passive traps is that they are not very effective in collecting species of low population densities. On the other hand, they give a biased estimate of the diversity and abundance. Finally, it seems that a method that captures all the species of family Syrphidae with the same effectiveness does not exist. The results of this study are in agreement with those obtained by Sobota and Twardowski [14] who suggest that more than one collection method must be applied if a full spectrum of syrphidae in a given area is intended to be determined.

ACKNOWLEDGEMENTS

The authors are thankful to Ante Vujic (Serbia), John Smit (The Netherlands) and Dieter Doczkal (Germany) for their help with identifications. This study was financially supported by College of Agriculture, Ferdowsi University of Mashhad, for which the authors are grateful too.

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تاثیر روش های جمع آوری بر تنوع گونه ای دو بالان خانواده سیرفیده در نیشابور، ایران

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چکیده

فهرستی از فون سیرفید های بوم نظام های کشاورزی شهرستان نیشابور (استان خراسان رضوی) با استفاده از تله مالایز، تله زرد- آبی و تور دستی برای اولین بار ارائه می گردد. مجموعاً ۲۲ گونه سیرفید جمع آوری گردید که ۱۳ گونه آنها بوسیله تله مالایز، ۵ گونه بوسیله تله زرد-آبی و نمونه هایی از ۲۲ گونه با تور دستی شکار شدند. در میان گونه های جمع آوری شده، ۸ گونه شامل سیرفید های گیاهخوار فقط با تور دستی شکار شدند. در میان گونه های جمع آوری شده با تله مالایز، سه گونه بنام های *Episyrphus balteatus*, *Sphaerophoria scripta*، *Eupeodes corollae* با ۷۳ درصد جمعیت گونه های غالب بودند. در حالیکه در میان گونه های جمع آوری شده با تله زرد-آبی، گونه *E. balteatus* با ۴۵ درصد جمعیت گونه کلیدی بود. در این مطالعه شاخص شانون- وینر برای تله مالایز(H=1.86) و بیشتر از مقدار بدست آمده برای تله زرد-آبی(H=1.39) بود. کارایی نسبی روش های جمع آوری مورد مقایسه قرار می گیرد.