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JOURNAL OF PLANT PROTECTION RESEARCH Vol. 53, No. 2 (2013)

DOI: 10.2478/jppr-2013-0017

DYNAMICS OF PREDATORY SYRPHIDAE IN THE APPLE ORCHARD AND NEIGHBOURING SHRUBBERIES

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Received: September 13, 2012
Accepted: March 15, 2013

Abstract: Shrubberies which neighbour on an orchard are among the significant structures enhancing agrocenoses. Such shrubberies maintain species diversity and stimulate self-control mechanisms in biocenoses. For these reasons, from 1999 to 2001, studies were conducted concerning predatory Syrphidae (Diptera) occurring in the orchard and shrubberies in the immediate vicinity. A quantity and quality analysis of predatory hoverflies (Diptera, Syrphidae) was performed. A total of 801 specimens were caught in both habitats. There were 20 species recorded there (12% of the national fauna of this predatory family).
The studies proved that the orchard and the neighbouring shrubberies can be alternative habitats for Syrphidae (Diptera). There is also a possibility of the predators migrating from the shrubberies to the orchard, enhancing the potential to control the abundant Hemiptera species in the orchard. The shrubberies then become an important element of the agrocenosis structure, due to their biocenotic functions.

Key words: orchard, predator, shrubberies, Syrphidae, Wielkopolska

INTRODUCTION

Shrubberies surrounding orchards are vital structures enhancing agrocenoses. They provide shelter, a place for wintering and breeding as well as dispersion of entomophages**.** They are the feeding place and habitat for prey. They maintain species diversity and stimulate self-control mechanisms in agrocenoses (Bianchi *et al*. 2006; Debras *et al*. 2006; Haenke *et al*. 2009). A positive impact of the shrubberies and wild greenery of orchard borders on predatory Syrphidae (Diptera) in the orchard, was presented in studies by Solomon *et al.* (2000), Bostanian *et al*. (2004), Debras *et al*. (2006) and Rossi *et al*. (2006). Some papers dealing with this topic have been published in Polish, however, they presented the impact of wild plants of cultivated fields on Syrphidae occurrence (Gałecka 1995; Kaczorowski and Dębek-Jankowska 1997; Garbarkiewicz and Trojanowski 1998; Bennewicz 2011). The preliminary results of research defining the influence of shrubberies which neighbour orchards, and the influence of the orchard itself on predators in those habitats, was presented in a paper by Trzciński and Piekarska (2009).

The first aim of our study was to describe the changes in the quantity and quality structure of the predatory Syrphidae (Diptera) species occurring in the orchard and shrubberies in its vicinity. The second aim was to compare the communities of predators in the studied habitats in terms of the quantity and quality.

MATERIALS AND METHODS

The study was carried out in the 1999–2001 time period, in the orchard of Przybroda in Poland (52°31′14′′N, 16°39′22′′E). Predators were caught from May to September in Moericke traps (Moericke 1953). Twelve traps were laid out in selected areas in the orchard and shrubberies and then checked every 10 days. The insects caught in 10 days, in one trap, constituted one sample.

The study area was divided into plots totalling 1.5 ha, where trees of the following fruit cultivars were grown: (a) apples: Primula, Novamac, Priam, Cortland, McIntosh; (b) sweet cherries: Red Bűttner, Hedelwińska, and (c) plums: Anna Späth, Cacańska Rodna and Węgierka Dąbrowicka. The shrubberies adjacent to the orchard, formed a belt which was about 1 km long and 7–8 m wide. They were mainly: blackthorn plum-tree (*Prunus spinosa* L.), common pear-tree (*Pyrus communis* L.), common elm (*Ulmus campestris* L.), European spindle tree (*Evonymus europaea* L.), hawthorn (*Crataegus monogyna* Jacq.), whitethorn (*C. oxyacantha* L.), elder (*Sambucus nigra* L.), dewberry (*Rubus caesius* L.), blackberry (*R. suberectus* Anders.), briarrose (*Rosa canina* L.), common carrot (*Daucus carota* L.), common yarrow (*Achillea millefolium* L.), common nettle (*Urtica dioica* L.) and couch-grass (*Agropyron repens* L.).

The orchard followed an integrated fruit production policy, with 5–8 disease-prevention procedures and 6–8 anti-pest procedures performed in various study years.

The Syrphidae communities were characterised on the basis of the following parameters: dominancy index,

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coefficient of the general species diversity – H' (Shannon and Weaver 1963), and uniformity index J' (Pielou 1966). The Syrphidae communities were compared in quantities with the Re index (Renkonen 1938) and in terms of quality with the QS index (Sørensen 1948)

RESULTS

In the 1999–2001 time period, 650 samples were collected from the orchard and 631 from the shrubberies. A total of 801 Syrphidae were caught in both habitats. There were more predators captured in the orchard. A total of 474 individuals were caught in the orchard and 327 in the shrubberies. In particular study years, similar fluctuations of the abundance of Syrphidae caught, were reported in both habitats. In 1999, the highest number reported was 273 from the orchard and 200 from the shrubberies. The lowest number were caught in 2000, with 62 and 24 specimens, respectively (Table 1).

In both habitats, 20 Syrphidae were reported in total, *i.e.* 12% of the national fauna of this predatory family.

A similar species diversity in orchard and shrubberies was found, as 12 species were caught in the orchard and 14 in the shrubberies. Lower fluctuations in the orchard than in shrubberies were recorded in the number of species in particular years. In 1999 and 2001, the numbers of species were 10 and 7. In 2000 there were only 5 species. In the shrubberies, the fluctuations in the number of species caught were higher than in the orchard. In 1999, the number of species was 13, while only 4 species were caught in 2000, and also only 4 in 2001. (Table 1).

Table 1. The list of and abundance of Syrphidae species caught in the orchard and shrubberies, in Przybroda, 1999–2001

Species	Environment							
	orchard			Total	shrubberies			Total
	1999	2000	2001		1999	2000	2001	
Baccha elongata (Fabrucius, 1775)	–	–	–	–	1	1	–	2
Dasysyrphus venustus (Meigen, 1822)	–	1	–	1	–	–	–	–
Epistrophe eligans (Harris, 1780)	1	–	–	1	–	–	–	–
E. nitidicollis (Meigen, 1822)	–	–	–	–	1	–	–	1
Episyrphus balteatus (De Geer, 1776)	258	58	105	421	175	21	100	296
Eupeodes corollae (Fabricius, 1794)	–	1	14	15	–	1	1	2
Leucozona lucorum (Linnaeus, 1758)	–	–	–	–	2	–	–	2
Melanostoma mellinum (Linnaeus, 1758)	2	–	3	5	1	–	1	2
M. scalare (Fabrucius, 1794)	–	–	2	2	10	–	–	10
Meliscaeva auricollis (Meigen, 1822	–	–	1	1	–	–	–	–
Platycheirus albimanus (Fabrucius, 1781)	1	-	1	2	1	–	–	1
P. peltatus (Meigen, 1822)	–	–	–	–	2	–	–	2
P. scutatus (Meigen, 1822)	–	–	–	–	1	–	1	2
Scaeva pyrastri (Linnaeus, 1758)	2	1	1	4	1	–	–	1
Sphaerophoria scripta (Linnaeus, 1758)	–	–	1	1	–	–	–	–
S. taeniata (Meigen, 1822)	–	–	–	–	3	–	–	3
Syrphus ribesii (Linnaeus, 1758)	3	–	3	6	–	–	–	–
S. torvus Osten-Sacken, 1875	–	–	–	–	1	–	–	1
S. vitripennis Meigen, 1822	6	1	8	15	–	–	–	–
Xanthandrus comtus (Harris, 1780)	–	–	–	–	1	1	–	2
Total of specimens	273	62	139	474	200	24	103	327
				801				
Total of species	7	5	10	12	13	4	4	14
				20				

Among the predatory Syrphidae, only one species *Episyrphus balteatus* (De Geer), was the definite dominant. It occurred in large numbers in both habitats, with 88.8% in the group of orchard predators, and 90.5% in the shrubberies (Fig. 1, 2). The domination structure of the predatory Syrphidae caught in the orchard besides the eudominant *E. balteatus*, was also made up of 2 subdominant species, *i.e. E. corollae* (3.2%) and *Syrphus vitripennis* (3.2%), and the recendent *S. ribesii* (1.3%). A simpler domination structure of predatory Syrphidae was found in the shrubberies, because apart from the eudominant *E. balteatus* only one subdominant was caught, namely *M. scalare* (3%). Other species occurred sporadically and were only caught as single specimens both in the orchard and in the shrubberies.

Such a quantity-quality structure shape of the predatory Syrphidae communities found in orchard habitat and neighbouring shrubberies corroborated the values of H' general species diversity coefficient. It reached very similar values. The H' coefficient of the Syrphidae community in the orchards was 0.82. The H' coefficient of the Syrphidae community in the shrubberies was 0.76.

One definite eudominant in the orchard and shrubbery Syrphidae communities was confirmed with the values of J' uniformity index. It was identical for both habitats: for the one in the orchard it reached 0.23 and for the shrubberies: 0.2.

A comparison of predatory Syrphidae communities in the orchard and neighbouring shrubberies in terms of quantity and the Re index proves that both communities were similar. The Re index reached a high value of 91%.

A quality comparison with the QS index shows that predatory Syrphidae communities in the orchard and shrubberies reached a 46.2% similarity in their species composition.

Only 6 predatory species were caught both in the orchard and shrubberies. They constituted 30% of the Syrphidae species composition and included the following species: *E. balteatus, E. corollae, M. mellinum, M. scalare, P. albimanus* and *S. pyrastri.*

In the orchard, 6 species only found in this habitat, namely: *D. venustus, E. eligans, M. auricollis, S. scripta, S. ribesii,* and *S. vitripennis.*

In the shrubberies, 8 species only found in this habitat, namely: *B. elongata, E. nitidicollis, L. lucorum, P. peltatus, P. scutatus, S. taeniata, S. torvus,* and *X. comtus.*

All the Syrphidae species fed on aphids (Aphidoidea) and Heteroptera larvae. *X. comtus* also feeds on Microlepidoptera larvae.

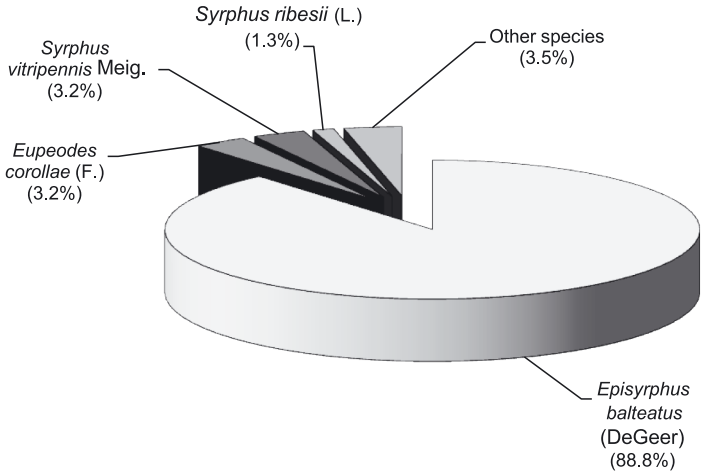

Fig. 1. The share of species dominant in the Syrphidae community in the orchard from 1999 to 2001

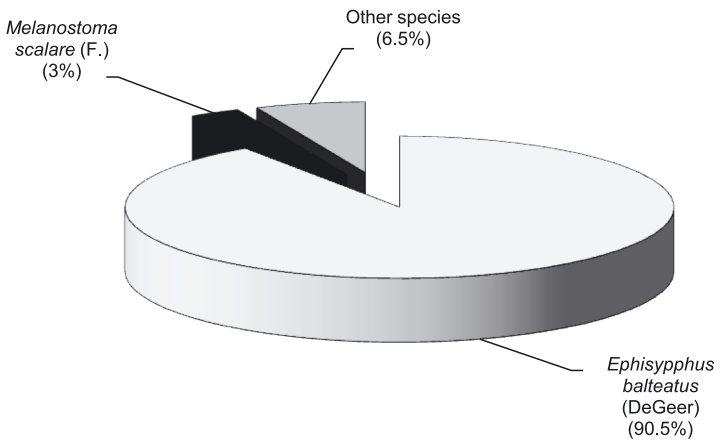

Fig. 2. The share of species dominant in the Syrphidae community caught in shrubberies from 1999 to 2001

DISCUSSION AND CONCLUSIONS

The 1999–2001 studies of the Syrphidae infesting an orchard located in the Wielkopolska region of Poland, found a higher abundance of predators in the apple orchard than in those shrubberies in the vicinity. There was a higher abundance of Syrphidae in the orchard because the orchard was considerably larger than the area of the shrubberies. The orchard was overgrown with apple trees and consequently it had a higher abundance of aphids than the shrubberies. The presence of aphids as prey for Syrphidae larvae thus became a factor attracting Syrphidae imagines to the orchard. The abundance fluctuations in both habitats in particular years were similar, as was the quantity structure of the Syrphidae communities of the orchard and the shrubberies. A similar species diversity in the orchard and the shrubberies was reported and half the species composition was identical in both Syrphidae communities. A lower fluctuation in the number of species was found in the orchard than in the shrubberies. Thus, the results obtained prove that an apple orchard is a more attractive habitat for predatory Syrphidae than neighbouring shrubberies, and that predators can migrate between the orchard and the shrubberies. Wyss (1995) came to a similar conclusion when he stated that more aphid entomophages occurred on apple trees in the vicinity of wild plants than on apple trees without such plant life. This resulted in a lower number of aphids in the orchard neighbouring on wild plant life. Trzciński *et al*. (2011) found that in apple orchards neighbouring on abundant greenery in the form of shrubberies and a road overgrown with trees and bushes, there was a higher abundance of predatory Syrphidae than in the orchard neighbouring on agricultural cultivations. This can be explained by the appealing influence of the blooming wild plants for Syrphidae imagines, according to papers by Gilbert (1981), Wnuk and Gut (1994), Bostanian *et al*. (2004), Branquart and Hemptinne (2000), Colley and Luna (2000), Carreck and Williams (2002) and Ambrosino *et al*. (2006).

The research corroborated a decisive domination of *E. balteatus* in the orchard habitat, as this species had been previously reported by Wnuk (1972) as a dominant in that habitat. Also Trzciński *et al*. (2011) reported this species as an abundant one in Wielkopolska apple tree orchards. Miňarro and Dapena (2001) stated that *E. balteatus* was one of dominant predators of *Dysaphis plantaginea* (Pass.) in tree orchards in Spain. Weigel (1997) found that *E. balteatus* was a common species of apple orchards in Germany, while Hartfield (1997) reported it as such, in plum orchards in England.

Concluding, the orchard and neighbouring shrubberies in agrocenoses can act as alternative habitats for predatory Syrphidae. Such a conclusion can be drawn from similar fluctuations of the abundance of predatory Syrphidae in the orchard and shrubberies, a similar quantity structure of predators in both habitats, and a similar species diversity of entomophages. These results indicate the possibility of predators migrating from shrubberies to orchard and increasing the potential to control the abundance of Hemiptera species in the orchard. Thus, the shrubberies, due to their biocenotic functions, become a vital element of the agrocenosis structure.

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