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HOVER FLIES (*DIPTERA, SYRPHIDAE*) OF MOIST MEADOWS ON THE MAZOVIAN LOWLAND

ABSTRACT

Syrphidae collected from several meadow plots in central Poland were quantitatively analysed. These meadows differed in the way of management, fertilization rate and exploitation intensity. The analysis was focused on species composition, abundance and structure of hover flies communities, and their zoogeographical and ecological characteristics. An attempt was made to differentiate hover fly communities depending on the type of meadow management. The fauna of moist meadows was compared with the fauna of the whole Mazovian Lowland.

INTRODUCTION

Hover flies represent a very diversified group of dipterans with respect to their ecology and bionomics. Some larvae are saprophages living in moist litter and in soil rich in decomposed organic matter, or in shallow eutrophic water bodies. Other larvae are phytophages mining tissues of vascular plants, leaves, stems, and often also tubers, bulbs, and rhizomes. Some other larvae are predators feeding mostly on aphides and other small insects. Due to these diverse habits they occur in almost all terrestrial ecosystems and in all coenotic layers. Adults are melitophages feeding on nectar and pollen of flowers, honeydew, and sap from injured plants.

Meadows are especially frequently visited and colonized by hover flies of many species. Some of them only search for food on flowers, others, e.g. aphidophages, lay eggs on plants attacked by aphides. Coprophages search for cattle manure, and phytophages for plant species suitable for the development of their larvae. All these relationships enhance a high species richness of hover flies in meadow habitats. But in contrast to submontane regions, in the Mazovian region meadows on the site of oak-hornbeam forests are rather rare. Moreover, they are usually

small and rather intensely utilized, this accounting for a reduced abundance and species richness of these dipterans (Bańkowska 1989a).

The purpose of this paper is a comparative analysis of hover flies occurring in moist meadows of central Poland. In addition to faunal and ecological characteristics, also the dominance structure of hover fly communities is analysed.

The study was conducted on four meadows differing in their sizes and the way of exploitation (Kotowska and Okołowicz 1989). The largest, 7-ha meadow situated at the Experimental Institute of the Academy of Agriculture at Chylice was characterized by a rich floral composition. For many years it has been exploited as a highly productive mown meadow, fertilized with high doses of NPK, and mown several times a year. This type of exploitation practically precludes flowering of herbaceous plants. The other three meadows were privately owned, and extensively utilized — mown only once in spring and then grazed by cattle. The meadow at Zbroszki was most intensely grazed and, as a result, its sward layer was dense and short, thus almost without flowers. The meadows at Klembów and Białołęka had richer vegetation. As they were rather infrequently grazed, many herbaceous plants could flower, and this was reflected in the richness of hoverfly fauna. Also the material from a meadow situated in the nature reserve "Cyganka" in the Kampinos National Park is analysed here. This was a heterogeneous meadow, wet in large fragments, where plant communities of the order *Molinietalia* bordered on the vegetation of the order *Arrhenatheretalia*. The material was collected in 1979–1980 on the meadow adjacent to a strip of a linden-oak-hornbeam forest, but the species composition of well-flying hover flies was largely affected by the species typical of wetlands, so this material was excluded from the analysis of the structure of hover fly communities associated with moist meadows.

For some comparisons, also the material collected in 1982–1983 from the lawns of the housing estate Brzeziny was used.

The basic method for quantitative material collecting was a standard entomological sweep-net. The supplementary methods comprised netting "per time", Moericke traps located in grass, window traps, and Malaise traps (Bańkowska 1989). The last three methods could have been applied only on the experimental meadow at Chylice. The whole material collected was not large. It consisted of slightly more than three thousand individuals.

RESULTS

SPECIES COMPOSITION

As already noted, meadows are a source of food for many hover fly species; not only for those, which are closely associated with grasslands and accomplish their whole developmental cycle there, but also for the species attracted from the surrounding habitats.

The group of species closely associated with meadows mainly consists of small aphidophagous species of the genera *Sphaerophoria* St. Farg. et Serv., *Melanostoma* Schin., *Pipiza* Fall., *Pipizella* St. Farg. et Serv., and *Pyrophaena* Schin. (Fig. 1). Among saprophages, the characteristic species are coprophagous *Syritta pipiens* and species of the genus *Rhingia* Scop. Phytophagous species are most abundantly represented by flies of the genus *Cheilosia* Meig. and *Eumerus* Meig. All saprophagous species, the larvae of which develop in water, migrate to moist meadows from surrounding habitats. These are mostly representatives of the genera *Eristalis* Latr. and *Helophilus* Meig., frequently caught on the study meadows.

In the paper on hover flies of typical landscape units of Poland, 94 species were classified to the community associated with meadows (Bańkowska 1980). In the study of moist meadows of Mazovia, 59 species were noted (Tab. 1). This simplification in the species composition can be due not only to the limited study area, but also to rather an intense management to these meadows.

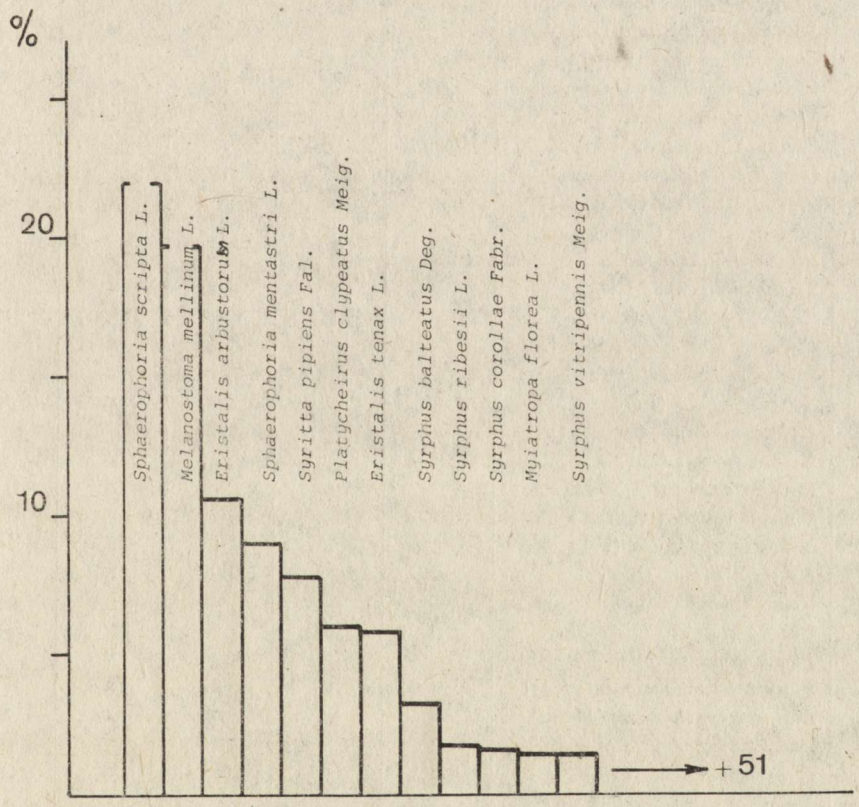

Fig. 1. Dominance structure of the hover fly community from moist meadows of the Mazovian Lowland

Table 1. Species composition of hover fly communities of moist meadows on the Mazovian Lowland (xxx — dominant species, xx — subdominant species, x — accessory species)

No.	Locality / Species	Cyganka	Klembów	Białołęka	Chylice	Zbroszki
1	2	3	4	5	6	7
1	*Eristalis tenax* (L.)	xxx	x	xxx	xx	x
2	*Eristalis arbustorum* (L.)	x	x	xxx	x	x
3	*Eristalis nemorum* (L.)	x	x		x	
4	*Eristalis pertinax* (Scop.)		x	x		
5	*Myiatropa florea* (L.)		x	xx	x	x
6	*Eurinomyia versicolor* (Fabr.)	x			x	
7	*Helophilus pendulus* (L.)	xxx	x	xx	x	x
8	*Helophilus hybridus* Lw.	x				
9	*Helophilus trivittatus* (Fabr.)	x			x	
10	*Helophilus affinis* Whalb.	x				
11	*Eristalinus sepulcralis* (L.)		x		x	
12	*Lathyrophtalmus aeneus* (Scop.)		x	x	x	
13	*Chrysogaster viduata* (L.)				x	
14	*Cheilosia vernalis* (Fall.)	x	x	x	x	x
15	*Cheilosia albitarsis* (Meig.)	x	xx	x	x	
16	*Cheilosia impressa* Lw.				x	
17	*Cheilosia cynocephala* Lw.			x		
18	*Cheilosia melanura* Beck.			x		
19	*Pipizella varipes* (Meig.)	x	x	x	x	x
20	*Pipiza lugubris* (Fabr.)		x	x		
21	*Pipiza noctiluca* (L.)				x	
22	*Triglyphus primus* Lw.				x	
23	*Eumerus strigatus* (Fall.)	x	x	x	xxx	x
24	*Eumerus tuberculatus* Rond.				x	
25	*Merodon equestris* (Fabr.)				x	
26	*Syritta pipiens* (L.)	x	x	xxx	xxx	x
27	*Xylota nemorum* (Fabr.)	x				
28	*Xylota florum* (Fabr.)	x				
29	*Rhingia campestris* Meig.		x		x	
30	*Rhingia rostrata* (L.)				x	
31	*Neoascia podagrica* (Fabr.)		x	x		
32	*Neoascia dispar* (Meig.)	x			x	
33	*Volucella inanis* (L.)			x		
34	*Baccha elongata* (Fabr.)		x	x		
35	*Platycheirus peltatus* (Meig.)	x	x		x	x
36	*Platycheirus albimanus* (Fabr.)		x	x	x	
37	*Platycheirus clypeatus* (Meig.)	x	xx	xx	xxx	xx
38	*Platycheirus angustatus* (Zett.)		x			
39	*Platycheirus scutatus* (Meig.)	x			x	x
40	*Pyrophaena rosarum* (Fabr.)				x	
41	*Pyrophaena granditarsa* (Först.)	x	x		x	

1	2	3	4	5	6	7
42	*Melanostoma mellinum* (L.)	xx	xxx	xxx	xxx	xxx
43	*Melanostoma ambiguum* (Fall.)			x		
44	*Melanostoma scalare* (Fabr.)		x			
45	*Scaeva pyrastri* (L.)	x			x	
46	*Scaeva selenitica* (Meig.)		x		x	
47	*Sphaerophoria scripta* (L.)	x	x	xxx	xxx	xxx
48	*Sphaerophoria menthastri* (L.)	x	x	x	xxx	x
49	*Sphaerophoria picta* (Meig.)		x		x	
50	*Sphaerophoria philanthus* (Meig.)			x	x	
51	*Sphaerophoria dubia* (Zett.)		x			
52	*Xanthogramma ornatum* (Meig.)		x	x		
53	*Chrysotoxum bicinctum* (L.)			x	x	
54	*Chrysotoxum festivum* (L.)			x		
55	*Syrphus balteatus* (Deg.)	xx	x	xx	xx	xx
56	*Syrphus ribesii* (L.)	x	x	xx	x	
57	*Syrphus vitripennis* Meig.	x		xx	x	
58	*Syrphus albostriatus* (Fall.)			x		
59	*Syrphus torvus* O.–S.			x	x	
60	*Syrphus venustus* Meig.	x	x			
61	*Syrphus corollae* Fabr.	x	x	x	x	x
62	*Syrphus latifasciatus* Macq.		x		x	
63	*Syrphus cinctus* (Fall.)				x	

The study plots differed in many respects, such as their size, soil moisture, types of cultivation and exploitation. Thus differences were expected in hover fly communities inhabiting them.

Sörensen index was used to assess the similarity of species composition for hover flies from different plots.

The hover fly communities from all the plots were largely similar (Fig. 2). The similarity index varied between 52 and 72%. The highest similarity was found for the hover fly communities at Klembów and Chylice. Some differences in species composition were observed between hover flies caught at Zbroszki and on the remaining meadows. This was probably due to the simplification of the community resulting from intense grazing. The lowest values of the similarity index (32–58%) were found for the community from lawns in housing estates of Warsaw as compared to those from meadows. The former community was very poor and characterized by the presence of ubiquitous and hemisynanthropic species. In spite of the diverseness of the linden-oak-hornbeam site, the hover fly communities ocurring there represented a distinct group of species different from other communities.

	Klembów	Chylice	Białołęka	Cyganka	Zbroszki	Warszawa
Klembów		72	67	62	58	54
Chylice	72		57	63	53	32
Białołęka	67	57		52	57	44
Cyganka	62	63	52		66	58
Zbroszki	58	53	57	66		51
Warszawa	54	32	44	58	51	

Fig. 2. Similarity of the species composition for hover fly communities from different meadow plots

ZOOGEOGRAPHICAL ANALYSIS

The hover flies of moist meadows in Mazovia have been ordered into six geographical elements (Tab. 2). They were very poor as compared to the hover fly fauna of Mazovia. On all the plots, the species with large geographical ranges such as Holarctic, Palaearctic, and cosmopolitan were most abundant. As compared to hover flies occurring in natural forest ecosystems of Mazovia, the fauna of moist meadows was heavily anthropogenized. The proportion of European and Euro-Siberian elements was markedly reduced, and the boreal and mountain elements were lacking. Particular plots were largely uniform with respect to the proportion of zoogeographical elements in hover fly communities, but slight differences were also observed. The proportion of the Holarctic element was lowest in

Table 2. Percentage of zoogeographical elements in hover fly communities from different meadows on the Mazovian Lowland

Element	Mazovia	Cyganka	Klembów	Białołęka	Chylice	Zbroszki
Cosmopolitan	1.0	6.9	5.7	6.0	4.5	12.5
Holarctic	28.0	55.2	40.0	39.0	52.0	50.0
Palaearctic	17.0	20.6	28.6	27.5	25.5	24.5
Euro-Siberian	28.0	13.8	20.0	15.5	13.5	6.5
European	23.0	3.5	5.7	9.0	4.5	6.5
Boreal	1.5	—	—	—	—	—
Submediterranean	1.0	—	—	3.0	—	—
Mountain	0.5	—	—	—	—	—
Number of species	193	29	35	33	44	16

the communities from Klembów and Białołęka. The same plots were characterized by a relatively high proportion of Euro-Siberian and European species. Most anthropogenic was the hover fly community found in the pasture at Zbroszki, as indicated by the highest proportion of species with very large ranges. These accounted for 87% of the community, as compared with 74 and 73% at Klembów and Białołęka respetively. On the streetside lawns in Warsaw, the proportion of species with large geographical ranges was even higher, amounting to 93% (Bańkowska 1982).

ECOLOGICAL CHARACTERISTICS

All the meadow plots were characterized by a high proportion of eurytopic species of wide ranges of distribution occurring in natural ecosystems, as well as on crop fields, and in human settlements. They include a large group of aphidophagous species visiting crop fields, orchards, and gardens, as well as saprophagous species adapted to anthropogenic habitats, such as *Eristalis tenax* and the related species.

There were some differences, however, in the ecological amplitude for hover fly communities from different meadows (Tab. 3). The highest proportion of eurytopic species was observed on the pasture at Zbroszki (68%). Stenotopic species were absent from this plot. This indicates a large simplification and anthropogenization of hover fly fauna at this plot. The fauna of intensely grazed pastures, both lowland and montane, is characterized by a simplified species composition and a high proportion of eurytopic and hemisynanthropic species. In this respect it reminds the hover fly communities of poor meadows of *Nardetalia* communities (Bańkowska 1980).

Similar relations are found on analysing the ecological activity of hover flies

Table 3. Percentage of ecological elements in hover fly communities from different meadows on the Mazovian Lowland

Group	Locality	Mazovia	Cyganka	Klembów	Białołęka	Chylice	Zbroszki
Ecological amplitude	Eurytopic	13.0	45.0	40.0	39.0	34.0	68.0
	Stenotopic	13.0	3.4	8.5	15.1	11.3	—
Expansiveness	Expansive	18.0	62.0	54.0	54.0	50.0	87.0
	Recessive	41.0	20.0	8.5	15.0	11.0	—
Degree of synanthropization	Hemisynanthropic	13.0	51.0	48.0	48.0	52.0	75.0
Number of species		193	29	35	33	44	16

of moist meadows. Majority of eurytopic species were noted for a high expansiveness in colonizing new habitats modified by man. An analysis of the species composition of hover flies revealed similar relationships in many communities on the particular plots (Tab. 3). The largest proportion of expansive species was observed at Zbroszki (87%). Also the proportion of recessive species, declining in man-modified habitats, is an indicator of the habitat quality and the degree of its anthropogenization. Among the studied meadows, the highest proportion of recessive species was found in the community at Cyganka, and then at Białołęka. Not a single, recessive species was found at Zbroszki.

Based on the species composition, a synanthropization index was also calculated. Hemisynanthropic species involve the species permanently adapted to co-existence with man and inhabiting human settlements and agrocoenoses. They form a "faunal background" for all hover fly communities in Poland (Bańkowska 1980). In the cited paper, 25 such species were identified for the whole fauna of hover flies. On the moist meadows under study, 23 species of this group have been found. The proportions of hemisynanthropes are shown in Table 3. Except for the community at Zbroszki, where the proportion of hemisynanthropic flies was high (75%), other communities are highly uniform (48–52% of hemisynanthropic flies).

Compared with the Mazovian fauna in general, moist meadows of Mazovia as a unit were noted for a high proportion of eurytopic and expansive species. A relatively high proportion was found of stenotopic species associated with meadow communities, such as *Pyrophaena rosarum*, *P. granditarsa*, or species of the genus *Pipiza*. The hover fly fauna of meadow communities was characterized by a low proportion of recessive species, as compared with the hover flies of Mazovia. Also the proportion of hemisynanthropic species was high on the study plots (Tab. 3). These results testify to anthropogenic origin of meadow communities, and, in addition, they reflect the present effect of their utilization by man.

The trophic structure of hover flies collected on moist meadows differed somewhat from that observed in whole Mazovia (Tab. 4). The proportion of species, the larvae of which are aquatic saprophages, was high. These were mostly flies of the genera *Eristalis* and *Helophilus*, partly synanthropized and very expansive, which find favourable living conditions not only in natural ecosystems but also in human settlements, small ponds, drainage ditches, etc. Their occurrence on moist meadows is limited to searching for food on flowers by adult forms, nevertheless their proportion in the collected material was high. Terrestrial saprophages were represented on these meadows mostly by coprophagous flies, the development of which depends on cattle droppings. As a part of these meadows was temporarily grazed, and the meadow at Chylice bordered on a few-hectare pasture, the coprophage abundance was high. They were mostly represented by *Syritta pipiens*, *Rhingia rostrata*, and *Rh. campestris*. Other terrestrial saprophages, associated with moist forest litter and humus, did not occur on these mea-

Table 4. Percentage of trophic groups in hover fly communities from different meadows on the Mazovian Lowland (N — number of species)

Trophic groups for larvae	Mazovia		Meadows									
			Cyganka		Klembów		Białołęka		Chylice		Zbroszki	
	N	%	N	%	N	%	N	%	N	%	N	%
Aquatic												
Saprophages	34	18.0	9	31.1	9	25.7	7	21.2	11	25.0	4	25.0
Terrestrial												
Saprophages	32	16.0	3	10.3	2	5.7	1	3.0	3	6.8	1	6.3
Phytophages	33	17.0	3	10.3	3	8.6	5	15.2	6	13.6	2	12.5
Zoophages	94	49.0	14	48.3	21	60.0	20	60.6	24	54.6	9	56.2
Total number of species	193		29		35		33		44		16	

dows almost at all. Only at Cyganka in Kampinos National Park, single individuals of the genus *Xylota* Meig. were noted.

Phytophagous species were rather scarce on the utilized meadows. This was related to the lack of herbaceous plants suitable for their development, and also to frequent mowing or grazing disturbing their development at different stages.

Many phytophagous hover flies of the genus *Cheilosia* Meig. are monophages or oligophages. The only abundant species of this group was *Eumerus strigatus*, the larvae of which feed on rhizome, tubers and bulbs of wild and cultivated plants. The proportion of zoophagous hover flies was the highest in the study meadows (Tab. 4). These were mostly small, aphidophagous flies of the genera *Platycheirus*, *Sphaerophoria*, *Melanostoma*, and *Pipizella*. Also flies of the genus *Syrphus* Fabr. were rather frequently caught. The proportion of zoophagous species was similar for different plots, and it did not differ much from the mean value for Mazovia as a whole.

COMMUNITY STRUCTURE

The structure of hover fly communities on moist meadows was analysed using the materials obtained by sweep-netting. The average sample size was similar for all the analysed plots. The sample size was highest at Chylice (0.32), then at Klembów (0.29), Białołęka (0.24), and Zbroszki (0.21).

In order to estimate the similarity of dominance structure for hover fly communities as objectively as possible Renkonen number (Re) was used. As can be seen from the resulting diagram (Fig. 3) similarity of various communities was high.

From the analysis of the dominance structure of hover fly communities from all the moist meadows under study (Fig. 1), it results that aphidophages were most abundant (65%). The first two positions were occupied by *Sphaerophoria scripta* and *Melanostoma mellinum* — expansive species, common not only on meadows but also in all kinds of crop fields and gardens. This group also included *Sph. menthastri* and *Platycheirus clypeatus*, and all the other species of the genus *Syrphus*. The second most abundant group was represented by aquatic

	Klembów	Chylice	Zbroszki	Białołęka
Klembów		77	72	51
Chylice	77		58	59
Zbroszki	72	58		45
Białołęka	51	59	45	

Fig. 3. Similarity of the dominance structure of hover fly communities from different moist meadows on the Mazovian Lowland

saprophages (18%). *Eristalis arbustorum*, *E. tenax*, and *Myiatropa florea* are typical eurytopic species, occurring in all terrestrial habitats, very expansive and with a high ecological amplitude.

Terrestrial saprophages were represented on moist meadows by a single dominant species, *Syritta pipiens*. Its high abundance (7.77%) can be accounted for cattle grazing on most of the study meadows. In the group of species dominant on moist meadows there were no phytophages.

Trophic structure of hover fly communities in moist meadows, calculated as percentage of all individuals caught in these meadows, is shown in Figure 4. Phytophages were very scarce, and they accounted for only 2.49% of the total material. The proportions of terrestrial and aquatic saprophages were slightly higher, 8.27 and 20.22% respectively. A highest proportion of 69.02% was recorded for zoophages. Similar results were obtained for moist meadows all over the country (Bańkowska 1980, Fig. 26). The abundance of phytophages in the study meadows was reduced as a result of intense exploitation of the study meadows, disturbing the development of these flies.

SEASONAL DYNAMICS OF HOVER FLIES

The timing of emergence of imagines and abundance dynamics are closely related with the cycles of larval development of different hover fly species. Differences even within the same genus can be large. Many species have only one generation a year. Larvae of instar III undergo a long diapause of 8–9 months. Imago flight is often limited to 2–3 weeks only. Typical representatives of this developmental pattern comprise *Syrphus bifasciatus* Fabr., *S. euchromus* Kow., *S. nitidicol-*

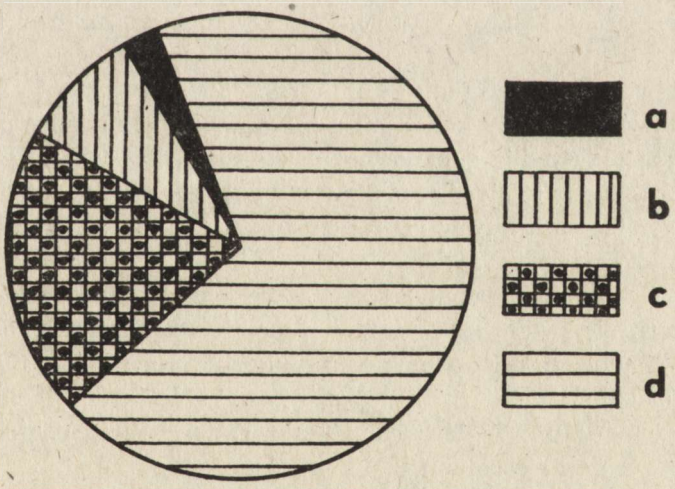

Fig. 4. Trophic structure of the hover fly community from moist meadows: a — phytophages, b — terrestrial saprophages, c — aquatic saprophages, d — zoophages

lis Meig. (Schneider 1948), and *Chrysogaster viduata* L. (Bańkowska 1961). Some hover flies, e.g. xylophages of the genera *Spilomyia* Meig. and *Temnostoma* St.-Farg. et Serv., are characterized by a very long larval development, taking even up to several years. But most species have a short developmental cycle. This is especially the case of predators, reaching maturity within 4–5 weeks from oviposition. When thermal conditions are favourable in the temperate zone, these flies can produce 3 or 4 generations a year. Such species include *Syrphus balteatus*, *Sphaerophoria scripta*, and *Melanostoma mellinum*.

As a result, these species can reach extremely high abundances and are able to promptly colonize new, artificial, man-formed coenoses. Some species, however, produce only two generations a year in the temperate zone. These are, for example, some species of the genus *Syrphus* Fabr. Also overwintering is differentiated in hover flies. Some of them, e.g. *S. luniger* Meig. overwinter in the pupal stage (Dusek and Láska 1974), others enter diapause as instars III, buried in soil or litter. They are represented by *Syrphus ribesii*, *Platycheirus peltatus*, *P. scutatus* and *Sphaerophoria scripta*. Many species overwinter as adult forms. Fertilized females hide in litter or under tree bark, and produce new generations in spring. They are represented by species of the genus *Scaeva* Fabr. and *Syrphus balteatus*.

Both overwintering females and adult flies emerging from pupae form a large group of species occurring on meadows in spring. Then follows a period of intense egg laying and larval development lasting throughout part of May and June. At the end of June and in July, adult forms appear in masses. Figure 5 illustrates the abundance dynamics of adult hover flies on the meadow at Chylice in the course of three years. Each year abundance peak falls on July. Only in 1983 the abundance curve was less regular, probably as a result of prolonged drought and hot weather that must have disturbed the development of their hygrophilous larvae.

In recent years, similar studies were carried out in Norway (Hägvar 1983). During the two-year study period on a meadow, the abundance peak of adult hover flies was observed in summer but it was somewhat delayed and shifted to August. Probably due to a cooler climate and later spring, the second generation of most hover flies in Norway reaches maturity two-three weeks later than in central Poland.

Seasonal changes in the abundance of aphidophagous hover flies in meadows are closely correlated with the occurrence of their hosts. These relations are shown in Figure 6. Abundance peak of aphids took place in June, and at that time larval hover flies had the largest supply of easily accessible food. When the aphides abundance curve drastically declines in summer, hover flies emerge from pupae, giving rise to a new generation.

The species composition of hover flies changed visibly in the course of the vegetation season. Some species appeared in spring for a short period, e.g. *Chryso-*

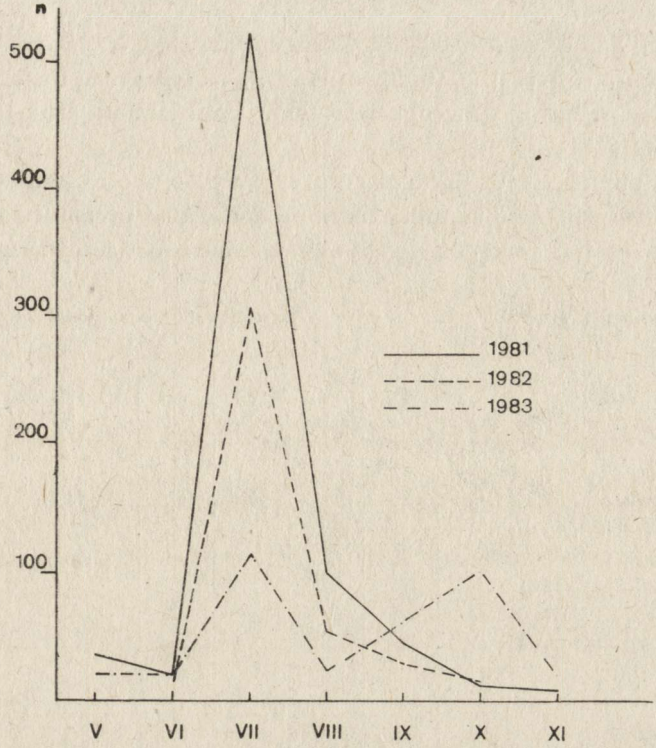

Fig. 5. Seasonal changes in hover fly abundance on the meadow at Chylice in 1981–1983 (n — number of individuals)

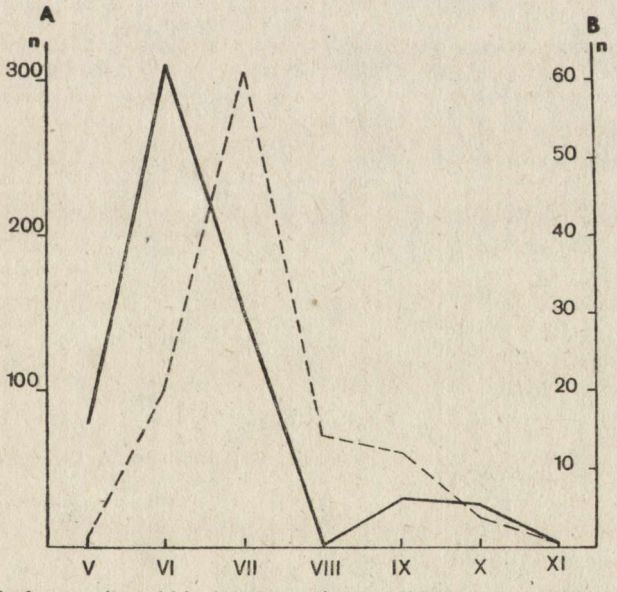

Fig. 6. Seasonal changes in aphid abundance (A — solid line) and aphidophagous hover flies (B — dashed line) on the meadow at Chylice in 1983 (n — number of individuals)

gaster viduata and *Syrphus venustus*. Other species, like *S. albostriatus* or *Baccha elongata*, occurred over the summer months. But a great majority of species emerged early in spring and continued flight until late autumn, to the onset of heavier frosts (Tab. 5).

Also the abundance of particular hover fly groups on meadows varied over the season. In spring and summer there predominated predatory and phytophagous species of the genera *Syrphus*, *Melanostoma*, *Sphaerophoria*, *Platycheirus*

Table 5. Phenological table for common hover fly species of moist meadows on the Mazovian Lowland

No.	Species	IV	V	VI	VII	VIII	IX	X	XI
1	*Syrphus venustus* Meig.	———	———	———					
2	*Cheilosia albitarsis* Meig	———	———	———					
3	*Cheilosia vernalis* Fall.	———	———	———	———	———			
4	*Chrysogaster viduata* L.		———	———					
5	*Platycheirus albimanus* Fabr.		———	———	———	———			
6	*Cheilosia impressa* Lw.		———	———	———	———			
7	*Xylota nemorum* Fabr.		———	———	———	———			
8	*Xanthogramma ornatum* Meig.		———	———	———	———	———		
9	*Sphaerophoria menthastri* L.		———	———	———	———	———		
10	*Platycheirus clypeatus* Meig.		———	———	———	———	———		
11	*Pipizella varipes* Meig.		———	———	———	———	———		
12	*Melanostoma mellinum* L.		———	———	———	———	———	———	
13	*Syritta pipiens* L.		———	———	———	———	———	———	
14	*Eristalis arbustorum* L.		———	———	———	———	———	———	
15	*Lathyrophtalmus aeneus* Scop.		———	———	———	———	———	———	
16	*Eumerus strigatus* Fáll.		———	———	———	———	———	———	
17	*Syrphus vitripennis* Meig.		———	———	———	———	———	———	
18	*Syrphus ribesii* L.		———	———	———	———	———	———	
19	*Sphaerophoria scripta* L.		———	———	———	———	———	———	———
20	*Helophilus pendulus* L.		———	———	———	———	———	———	———
21	*Baccha elongata* Fabr.			———	———				
22	*Neoascia dispar* Meig.			———	———	———			
23	*Pyrophaena granditarsa* Först.				———	———	———		
24	*Platycheirus peltatus* Meig.			———	———	———	———		
25	*Syrphus corollae* Fabr.			———	———	———	———	———	
26	*Syrphus balteatus* Deg.			———	———	———	———	———	———
27	*Chrysotoxum bicinctum* L.				———	———			
28	*Myiatropa florea* L.				———	———	———		
29	*Eristalis tenax* L.					———	———	———	———

and *Eumerus*, while late is summer and throughout autumn, the group of dominants consisted of aquatic saprophages mostly of the genera *Eristalis* and *Helophilus* (Fig. 7).

CONCLUSIONS

The type of exploitation of the meadows under study does not create favourable habitat conditions for melitophagous hover flies. Hence, their species composition is evidently simplified, as compared with that on flowering meadows still found on the lowland. Moreover, the meadows where the material had been collected were characterized by a very poor floral composition. An average meadow in central Europe should comprise about 60 species of herbaceous plants, while on the richest of the study meadows, at Białołęka, the number of species was much

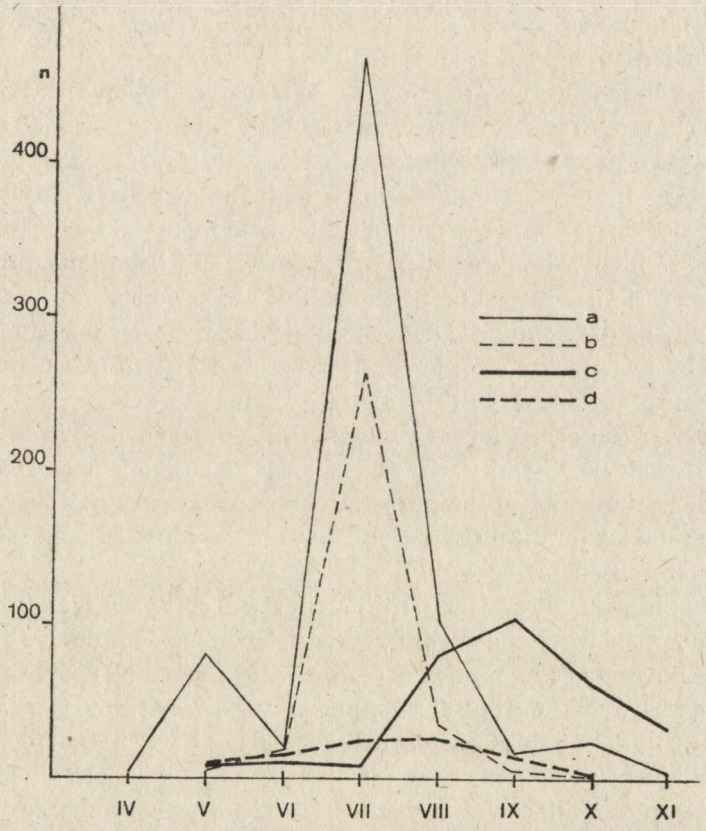

Fig. 7. Seasonal dynamics of different trophic groups of hover flies in the meadow at Chylice in 1983: a — zoophages, b — phytophages, c — aquatic saprophages, d — terrestrial saprophages; n — number of individuals

lower — only 37 species (Kotowska and Okołowicz 1989). In this respect, the study meadows resembled pastures, where the number of species fluctuated around 30. As a result, some hover fly species could not find food for their offspring there. Also not all mono- and oligophagous predators of aphids could develop in these meadows, therefore it is not surprising, that there were preferred mainly polyphagous, eurytopic species occurring in all types of grassland communities as well as in agrocoenoses.

The obtained results testify to a very similar species composition of hover fly communities on different plots (Fig. 2). The similarity index varied from 52 to 72%. The main part of the hover fly fauna on moist meadows consisted mainly of aphidophagous species such as *Sphaerophoria scripta*, *Sph. menthastri*, *Melanostoma mellinum*, *Platycheirus clypeatus*, *Pl. albimanus*, *Pipizella virens*, *Syrphus balteatus*, *S. corollae S. vitripennis*, and also a coprophagous species *Syritta pipiens*. Of the phytophagous flies, the most abundant species was *Eumerus strigatus*. Aquatic saprophages, abundantly visiting meadows in search of food on flowers, comprised ubiquitous species such as *Eristalis arbustorum*, *E. tenax*, *Helophilus pendulus*, and *Myiatropa florea*.

Both the abundance and the dominance structure of hover fly communities from different moist meadows were rather similar. All these meadows were predominated by two predatory species: *Sph. scripta* and *M. mellinum*. The fauna of all the studied meadows was noted for a high proportion of eurytopic species (Tab. 3). As compared with the fauna of the whole Mazovia, their proportion was three times as high. The proportion of expansive and hemisynanthropic species increased at a similar rate. The proportion of recessive species in the fauna of Mazovia reached 41% and on the moist meadow at the Cyganka nature reserve it was lower by half. It was even lower in intensely exploited moist meadows, and on the pasture at Zbroszki (Tab. 3) it was equal to zero.

Zoogeographical analysis of the fauna of moist meadows showed a high predominance of elements with large ranges such as cosmopolitan, Holarctic, and Palaearctic, as compared to the hover fly fauna of the whole Mazovia (Tab. 2). The European and Euro-Siberian elements were very limited, and the remaining elements were absent or sporadic.

The results concerning trophic differentiation of hover flies from different plots corroborated with the earlier results from moist meadows (Bańkowska 1980). The hover fly communities were clearly dominated by zoophagous species, while phytophages and terrestrial saprophages were very scarce (Fig. 4).

It follows from this short review that the fauna of hover flies of moist meadows bears a visible mark of anthropogenization manifested in the simplification of their species composition and in high proportions of eurytopic, expansive and hemisynanthropic species, and also of species with wide geographical ranges.

It should be noted that some differences in hover fly communities were related to the type of management and the intensity of exploitation of the study meadows.

The most strongly manifested anthropogenization process could be observed in the hover fly community on the pasture at Zbroszki. It was characterized by the lowest number of collected species (16), and the lowest relative abundance per sample (0.21). Moreover, in this community the proportion of eurytopic species was the highest, at the total absence of stenotopic species (Tab. 3). Similarly, a highest proportion of expansive species was observed (87%), as well as of the hemisynanthropic and cosmopolitan species (75%) (Tab. 2).

The simplicity of hover flies communities on pastures was already observed in montane areas of the Bieszczady and Pieniny (Bańkowska 1971, 1976), and also in the lowland (Bańkowska 1980). It results from intense exploitation of a pasture, constantly grazed throughout the growing season, and almost totally devoid of flowers which usually attract adult hover flies.

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BZYGOWATE (*DIPTERA, SYRPHIDAE*) ŁĄK ŚWIEŻYCH NIZINY MAZOWIECKIEJ

STRESZCZENIE

Praca zawiera analizę materiału ilościowego *Syrphidae*, zebranego na kilku powierzchniach łąkowych w Centralnej Polsce. Łąki te różnią się między sobą sposobem uprawy, intensywnością nawożenia i eksploatacji. Rozważania koncentrują się głównie na składzie gatunkowym, liczebności i strukturze zgrupowań faunistycznych *Syrphidae* oraz na ich analizie zoogeograficznej i ekologicznej.

Otrzymane wyniki przemawiają za sporym podobieństwem składu gatunkowego *Syrphidae* na badanych łąkach (rys. 2). Wartość współczynnika podobieństwa zawiera się w granicach 52–72%. Trzon fauny łąk świeżych stanowi zwarta grupa gatunków głównie mszycożernych: *Sphaerophoria scripta*, *Sph. menthastri*, *Melanostoma mellinum*, *Platycheirus clypeatus*, *Pl. albimanus*, *Pipizella varipes*, *Syrphus balteatus*, *S. corollae*, *S. vitripennis* oraz koprofag — *Syritta pipiens*. Z muchówek fitofagicznych najliczniej na łąkach jest reprezentowany *Eumerus strigatus*. Saprofagi wodne, licznie odwiedzające łąki w poszukiwaniu kwiatów, obejmują gatunki ubikwistyczne takie jak: *Eristalis arbustorum*, *E. tenax*, *Helophillus pendulus* i *Maiatropa florea*.

Zarówno liczebność, jak i stosunki dominacyjne są zbliżone w poszczególnych zgrupowaniach *Syrphidae* łąk świeżych (rys. 3). Fauna *Syrphidae* wszystkich badanych powierzchni charakteryzuje się dużym udziałem gatunków eurytopowych (tabl. 3); w stosunku do fauny całego Mazowsza występuje trzykrotny wzrost ich udziału. Podobny wzrost charakteryzuje udział gatunków ekspansywnych i hemisynantropijnych. Natomiast daje się zauważyć malejący udział gatunków recesywnych, aż do zupełnego ich braku na pastwisku (tabl. 3).

Analiza zoogeograficzna fauny *Syrphidae* badanych łąk wskazuje na dużą przewagę elementów kosmopolitycznych, holarktycznych i palearktycznych w stosunku do fauny całego Mazowsza. Natomiast bardzo ograniczone jest występowanie elementu europejskiego i euro-syberyjskiego, pozostałe elementy są nieobecne lub sporadyczne (tabl. 2).

Zróżnicowanie fagiczne fauny *Syrphidae* przejawia się na łąkach świeżych zdecydowaną przewagą form afidofagicznych, natomiast fitofagi i saprofagi lądowe są reprezentowane bardzo nielicznie (rys. 4).

Jak z tego krótkiego przeglądu widać, fauna *Syrphidae* łąk świeżych nosi piętno wyraźnej antropogenizacji, przejawiającej się między innymi ubóstwem składu gatunkowego, dużym udziałem gatunków eurytopowych, ekspansywnych i hemisynantropijnych, a także gatunków o szerokich zasięgach geograficznych.

Z kilku badanych powierzchni łąkowych, najwyższy stopień antropogenizacji wykazuje pastwisko w Zbroszkach. Charakteryzuje się ono najniższą liczbą złowionych gatunków, najniższą liczebnością oraz najwyższym udziałem gatunków eurytopowych, przy całkowitym braku stenotopów (tabl. 3). Ponadto występuje tam bardzo wysoki udział gatunków ekspansywnych i hemisynantropijnych, a także kosmopolitycznych (tabl. 2).

W dalszej części pracy przedstawiono fenologię i dynamikę liczebności *Syrphidae* w oparciu o materiały zebrane na łąkach świeżych (rys. 6 i 7).

ЖУРЧАЛКИ (*DIPTERA, SYRPHIDAE*) СВЕЖИХ ЛУГОВ МАЗОВЕЦКОЙ НИЗМЕННОСТИ

РЕЗЮМЕ

Работа содержит количественный анализ материала *Syrphidae*, собранного с нескольких площадок лугов в Центральной Польше. Исследованные луга отличались друг от друга способом культивации, интенсивностью удобрения и экслоатации. Особое внимание посвящено видовому составу, численности и структуре фаунистических сообществ *Syrphidae* рассматриваемых лугов, а также их зоогеографическому и экологическому анализу. В настоящей разработке предпринята также попытка выяснения различий между отдельными сообществами мух в зависимости от характера использования луга, а также произведен анализ всей фауны свежих лугов на фоне фауны Мазовии.