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Hover flies (Diptera: Syrphidae) of the coastal and marine habitats of Poland. Part II – ecological characteristics

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ABSTRACT. The results of a continuation of research on Syrphidae of the saline habitats of the Polish coast are reported. In the paper, 14 hover fly species new to the beaches and coastal brackish areas are presented. Moreover, based on the previous (KACZOROWSKA 2004) and the present research, undertaken in years 2004-2005, trophic communities of Syrphidae and the degree of similarity of types of biotopes of the Polish Baltic coast are discussed.

KEY WORDS: Diptera, Syrphidae, trophic community, degree of similarity, cliff, sandy beach, brackish area of the coastal type, Poland.

INTRODUCTION

The Syrphidae represents one of the better studied families of Diptera in Poland. As hover fly adults and their larvae can feed on different food, they can inhabit various types of biotopes, including saline ecosystems. Unfortunately, so far the syrphid fauna of the beaches and brackish areas of the coastal type has not been well known. On account of this, research on hover flies and other families of Diptera of these biotopes was started in 1999. The first results were published in 2004 (KACZOROWSKA 2004), and the present ones are their continuation.

MATERIAL AND METHODS

Material was collected once a week, from the beginning of May to the end of October, in the years 2004-2005. Flies were caught by sweeping (using the entomological net) in

twelve localities, representing cliffed and sandy beaches and brackish area of the coastal type. Cliffed beaches were situated near Gdynia - Wzgórze Św. Maksymiliana, Gdynia – Orłowo and Hel. Sopot, Gdańsk - Brzeźno, Gdańsk - Jelitkowo, Sobieszewo, Krynica Morska, Stegna and Jastarnia, where flies were also collected, belonged to sandy beaches. The brackish area of the coastal type was represented by Gdańsk – Górki Wschodnie and Puck. Almost all these localities are situated near the Gulf of Gdańsk, only Puck being situated on the Bay of Puck.

The ecological part of this paper is also based on research undertaken in years 1999-2003, in twelve study localities, among which four are different from those mentioned above (KACZOROWSKA 2004).

On the beaches, flies were collected under soil, plants overgrowing dunes and cliffs, whereas in brackish areas, Diptera was caught in halophyte communities of marshes, meadows and bulrushes along the waterside.

All flies are stored pinned and deposited at the Department of Invertebrate Zoology, University of Gdańsk.

Based on results of five-year study (1999-2003) (KACZOROWSKA 2004) and this undertaken in years 2004-2005, the trophic communities of Syrphidae and the degree of similarity of types of saline habitats of the Polish Baltic coast are analyzed. In order to attain a description of the degree of similarity of types of habitats, index Pxy was used:

$$Pxy = (2c/a+b-c) \times 100\%$$

where:

a - number of species in habitat type A;

b - number of species in habitat type B;

c - number of species common for both types of habitats (SZADZIEWSKI 1983).

RESULTS AND DISCUSSION

During the two-year study (2004-2005), 702 specimens, belonging to 38 species of hover flies were collected. Among them, 14 species (reported below) are new to the fauna of Syrphidae of saline habitats of the Polish coast. Therefore, the check-list of hover flies of these types of biotopes includes 72 species (Table 1). *Dasysyrphus pinastri*, *Sphaerophoria interrupta* and *Platycheirus fulviventris*, found earlier only in brackish areas of the coastal type, were collected on the beaches for the first time.

1. Systematic review of new species

Subfamily Syrphinae

Epistrophe (Epistrophe) eligans (HARRIS, [1780])

Material examined

1♀, Sopot, 6.07.2005.

Distribution, ecology

Europe; former USSR: North and South European Territories, Transcaucasus, Middle Asia (PECK 1988).

In Poland this species is observed from May to August and it occurs in Pomerania, Silesia and central and southern parts of our country (BAŃKOWSKA 1963).

E. (*E.*) *eligans* is mesophilous, preferring medium values (LASKA & MAZANEK 1998) and its larvae are aphidophagous (WNUK 1972).

Epistrophe (Epistrophe) grossulariae (MEIGEN, 1822)

Material examined

1♂, Jelitkowo, 2.08.2005.

Distribution, ecology

Europe; former USSR: North, South and Central European Territories, Transcaucasus, West and East Siberia, Far East; Asia: Mongolia, Japan; Nearctic Region (PECK 1988).

In Poland it is observed from June to August and known in Pomerania, Silesia and central and southern parts of country. The larvae are aphidophagous (BAŃKOWSKA 1963).

Platycheirus immarginatus (ZETTERSTEDT, 1849)

Material examined

1♂, Górki Wschodnie, 23.06.2004; 3♂♂, 1♀, Jastarnia, 22.07.2004; 3♂♂, 2♀♀, Górki Wschodnie, 29.07.2004.

Distribution, ecology

Europe; former USSR: North and Central European Territories, Transcaucasus, West and East Siberia, Far East (Sakhalin); Nearctic Region (PECK 1988). Besides *P. immarginatus* is known in dune zone of the coast of Norway (ARDÖ 1957).

In Poland this species is collected in Pomerania, from June to August. Its larvae are aphidophagous (BAŃKOWSKA 1963).

Platycheirus podagratus (ZETTERSTEDT, 1838)

Material examined

3♂♂, Jastarnia, 22.07.2004.

Distribution, ecology

Europe; former USSR: North and Central European Territories, Middle Asia, West and East Siberia, Far East; Asia: Mongolia; Nearctic Region (PECK 1988).

In Poland it is common in Pomerania and central and southern parts of the country. This species is observed from May to August and its larvae are aphidophagous (BAŃKOWSKA 1963).

Subfamily Milesiinae

Trichopsomyia flavitarsis (MEIGEN, 1822)

Material examined

1♀, Górki Wschodnie, 29.07.2004.

Distribution, ecology

Europe; former USSR: North and Central European Territories, Kazakhstan, West and East Siberia, Far East (PECK 1988).

In Poland *T. flavitarsis* is known in Pomerania and observed from May to August (BAŃKOWSKA 1963). The larvae are aphidophagous (LASKA & MAZANEK 1998).

Cheilosia albitarsis (MEIGEN, 1822)

Material examined

2♂♂, Brzeźno, 28.06.2005.

Distribution, ecology

Europe; former USSR: North, South and Central European Territories, Transcaucasus, West Siberia; North Africa: Tunisia (PECK 1988).

In Poland this species is very common and noticeable from May to July (BAŃKOWSKA 1963). *Ch. albitarsis* is hygrophilous, its larvae are phytophagous and observed on flowers of *Ranunculus* (LASKA & MAZANEK 1998).

Cheilosia illustrata (HARRIS, [1780])

Material examined

1♂, 4♀♀, Jelitkowo, 2.08.2005.

Distribution, ecology

Europe; former USSR: North and Central European Territories, Kazakhstan, West and East Siberia (PECK 1988).

In Poland *Ch. illustrata* is found in Pomerania, Silesia, Tatra and Sudeten Mts. It is observed from April to August and its larvae are phytophagous (BAŃKOWSKA 1963, 1971).

Cheilosia laticornis RONDANI, 1857

Material examined

1♀, Górki Wschodnie, 29.07.2004; 2♂♂, 7♀♀, Jelitkowo, 2.08.2005.

Distribution, ecology

Europe; former USSR: South European Territory, Transcaucasus, Middle Asia; Asia: Turkey, Afghanistan; North Africa: Algeria (PECK 1988).

In Poland *Ch. laticornis* is collected in Pomerania and Białowieża Primeval Forest. It is collected from May to July and its larvae are phytophagous (BAŃKOWSKA 1963).

Cheilosia latifrons ZETTERSTEDT, 1843

Material examined

1♀, Jastarnia, 22.07.2004.

Distribution, ecology

Europe; former USSR: North, South and Central European Territories, Transcaucasus, West Siberia; North Africa: Morocco (PECK 1988).

In Poland this species in known in Pomerania, Silesia, Warsaw district and Białowieża Primeval Forest. It is observed from May to August and its larvae are phytophagous (BAŃKOWSKA 1963).

Cheilosia loewi (BECKER, 1894)

Material examined

1♂, 1♀, Brzeźno, 22.06.2005; 1♀, Brzeźno, 28.06.2005.

Distribution, ecology

Europe (PECK 1988).

Until now, in Poland this species has been known in Silesia (BAŃKOWSKA 1963). The larvae are phytophagous (LASKA & MAZANEK 1998).

Pelecocera tricincta (MEIGEN, 1822)

Material examined

7♀♀, Brzeźno, 28.06.2005; 1♂, 4♀♀, Jelitkowo, 2.08.2005.

Distribution, ecology

Europe; former USSR: Central European Territory, Transcaucasus, Kazakhstan, East Siberia (PECK 1988).

This species is xerophilous and typical for dune zone, overgrown with *Calluna vulgaris*. In Poland *P. tricincta* is observed from May to September, in Pomerania and central part of the country (BAŃKOWSKA 1959, 1963). In saline habitats it was noticed by KARL (1930). Its biology is unknown (BAŃKOWSKA 1963).

Orthonevra intermedia (LUNDBECK, 1916)

Material examined

2♀♀, Górki Wschodnie, 12.07.2005.

Distribution, ecology

Europe; former USSR: Central European Territory, West and East Siberia, Far East (PECK 1988).

In Poland this species is know in Pomerania and observed from June to July. The adults live in xerothermic habitats, whereas their larvae are aquatic (BAŃKOWSKA 1963) and phytophagous (LASKA & MAZANEK 1998).

***Sphegina (Sphegina) verecunda* (COLLIN, 1937)**

Material examined

1♂, Orłowo, 11.06.2004.

Distribution, ecology

Europe; former USSR: Central and South European Territories, Transcaucasus (PECK 1988).

Until now, in Poland this species has been observed in Bieszczady (BAŃKOWSKA 1971). The larvae are saprophagous (LASKA & MAZANEK 1998).

***Xylota abiens* (MEIGEN, 1822)**

Material examined

1♀, Górki Wschodnie, 12.07.2005.

Distribution, ecology

Europe; former USSR: Central and South European Territories, Transcaucasus, Kazakhstan, West and East Siberia, Far East (PECK 1988).

In Poland *X. abiens* is found in central and southern parts of our country. It is observed from June to July, and its larvae live in tree holes, under bark and in decaying wood (BAŃKOWSKA 1963).

2. Ecological characteristics

2.1. The trophic communities in fauna of the Syrphidae of the Polish Baltic coast

Hover flies represent a very diversified group of Diptera with respect to their ecology and bionomics (BAŃKOWSKA 1989). They can be divided into trophic groups and the criterion to distinguish particular communities is the substrate required for the development of larvae (GÓRSKA 1979). Based on this criterion and the literature data, communities of phytophages, saprophages, coprophages, predators-saprophages-parasites and predators are recognized. The last group is composed of aphidophages and zoophages, mainly entomophages. Adults are melitophages, feeding on nectar and pollen of flowers. Also, they can use as food honeydew and sap from injured plants. Due to these habits, adult hover flies and their larvae occur in almost all terrestrial ecosystems (BAŃKOWSKA 1989), including the saline habitats of marine coasts.

Generally, in saline habitats of the Polish Baltic coast, the dominant trophic groups are: aphidophages (1044 specimens, making up 85.09% of the whole collection), saprophages

(73 flies, e.g. 5.95%) and phytophages (65 specimens, e.g. 5.30%) (Table 2). These trophic communities are represented respectively by 39 species of aphidophages (e.g. 54.17% of the whole syrphid species), 14 phyto- and 14 species of saprophages (Table 3).

A very similar situation is observed in particular types of biotopes. On the cliffed beaches, hover flies, which have aphidophagous larvae, are the most variable and represented by 248 specimens (80.52% of Syrphidae of this type of biotope) (Table 2) and 30 species (Table 3). Among them, the most abundant are: *E. balteatus* (84 specimens, e.g. 27.27% of hover flies on cliffs), *Sph. scripta* (34 flies, e.g. 11.04%) and *S. vitripennis* (21 exx., e.g. 6.82% of material collected in this type of biotope) (Table 1). All these species are recognized as eurytopic with very wide habitat tolerance (LASKA & MAZANEK 1998). Besides, they are characterized by a short developmental cycle, the production of 3-4 generations a year and their occurrence during the whole vegetative season (BAŃKOWSKA 1989). On cliffs, flies belonging to the saprophagous community are also very abundant. In the material, they are represented by 34 specimens (11.04%) (Table 2) of 8 syrphid species (Table 3). The most numerous is *E. tenax*, which was collected in the number of 17 specimens, e.g. 5.52% of cliff hover flies (Table 1). As this species is eurytopic and hemisynanthropic (LASKA & MAZANEK 1998), its high abundance in the study areas, e.g. on beaches numerously visited by tourists, was expected. On cliffed beaches, the high occurrence of Syrphidae with phytophagous larvae mining tissues of vascular plants is also observed. In material, this trophic community is represented by 13 specimens (4.22% of material) (Table 2) and 7 species, e.g. 14.89% of syrphid species collected in this type of biotope (Table 3). This is the result of biotic conditions of the Polish coast. The seaside cliffs are overgrown with many species of herbaceous plants, shrubs and trees, so the melitophagous adults are attracted by surrounding habitats and their sapro- and phytophagous larvae have the largest supply of easily accessible food.

On sandy beaches, the hover flies with aphidophagous larvae were collected in the number of 407 specimens (84.79% of material from this type of biotope) (Table 2) belonging to 20 species (Table 3). As on the cliffed beaches, the most abundant are the eurytopic species. Among them the most numerous are: *Sph. scripta* (249 specimens, e.g. 51.88%), *E. balteatus* (55 flies, 11.46%) and *Sph. interrupta* (28 specimens, e.g. 5.83% of hover flies collected on the sandy beaches) (Table 1). The phytophagous trophic group is represented by 45 flies (9.38%) (Table 2) and 11 species (28.21%) (Table 3) and the saprophagous community – by 7 syrphids (e.g. 1.46%) (Table 2) and 4 species (10.26% of material of this type of biotope) (Table 3). The high abundance of hover fly species with phytophagous larvae is connected with the occurrence of *Rosa rugosa* and *Salix daphnoides*, which are results of protective plantings of the dune zones of Polish sandy beaches. The Syrphidae, whose larvae are saprophages, are attracted by organic material thrown by the sea or left behind by tourists. Very interesting is the high abundance of *P. tricincta*, whose biology is unknown so far. During the research undertaken in 2004-2005, 12 specimens of this hover fly were collected, making up 2.5% of Syrphidae caught on the sandy beaches (Table 1).

Table 1. Check-list of Syrphidae collected in years 1999-2003 and 2004-2005, their abundance and percentage in the types of saline habitats of the Polish coast.
* - species new to fauna Syrphidae of the Polish Baltic coast
** - species collected by SZADZIEWSKI (1983) and in years 2004-2005
ap - aphidophagous
ent - entomophagous

	Species	Trophic relations	Cliff	%	Sandy beach	%	Brackish areas	%	**Total**	**%**
1.	*Dasysyrphus albostriatus* (FALL.)	Predatory (ap)	3	0.97	-	0.00	-	0.00	**3**	**0.24**
2.	*Dasysyrhus hilaris* (ZETT.)	Predatory (ap)	2	0.65	-	0.00	-	0.00	**2**	**0.16**
3.	*Dasysyrphus pinastri* (DEG.)	Predatory (ap)	-	0.00	5	1.04	1	0.23	**6**	**0.49**
4.	*Dasysyrphus tricinctus* (FALL.)	Predatory (ap)	3	0.97	-	0.00	-	0.00	**3**	**0.24**
5.	*Didea alneti* (FALL.)	Predatory (ap)	2	0.65	-	0.00	-	0.00	**2**	**0.16**
6.	*Epistrophe* (*Epistrophe*) *eligans* (HARR.) *	Predatory (ap)	-	0.00	1	0.21	-	0.00	**1**	**0.08**
7.	*Epistrophe* (*Epistrophe*) *grossulariae* (MEIG.) *	Predatory (ap)	-	0.00	1	0.21	-	0.00	**1**	**0.08**
8.	*Episyrphus balteatus* (DEG.)	Predatory (ap)	84	27.27	55	11.46	90	20.50	**229**	**18.66**
9.	*Melangyna umbellatarum* (FABR.)	Predatory (ap)	1	0.32	-	0.00	-	0.00	**1**	**0.08**
10.	*Meligramma cincta* (FALL.)	Predatory (ap)	2	0.65	-	0.00	-	0.00	**2**	**0.16**

	Species	Trophic relations	Cliff	%	Sandy beach	%	Brackish areas	%	**Total**	**%**
11.	*Meliscaeva auricollis* (MEIG.)	Predatory (ap)	2	0.65	1	0.21	1	0.23	**4**	**0.33**
12.	*Eupeodes corollae* (FABR.)	Predatory (ap)	7	2.27	11	2.29	6	1.37	**24**	**1.96**
13.	*Eupeodes latifasciatus* (MACQ.)	Predatory (ap)	4	1.30	3	0.63	1	0.23	**8**	**0.65**
14.	*Eupeodes nitens* (ZETT.)	Predatory (ap)	1	0.32	-	0.00	-	0.00	**1**	**0.08**
15.	*Parasyrphus nigritarsis* (ZETT.)	Predatory (ap)	-	0.00	-	0.00	4	0.91	**4**	**0.33**
16.	*Scaeva pyrastri* (L.)	Predatory (ap)	2	0.65	1	0.21	3	0.68	**6**	**0.49**
17.	*Scaeva selenitica* (MEIG.)	Predatory (ap)	1	0.32	1	0.21	-	0.00	**2**	**0.16**
18.	*Sphaerophoria interrupta* FABR.	Predatory (ap)	1	0.32	28	5.83	24	5.47	**53**	**4.32**
19.	*Sphaerophoria loewi* ZETT.	Predatory (ap)	-	0.00	-	0.00	1	0.23	**1**	**0.08**
20.	*Sphaerophoria rueppellii* (WIED.)	Predatory (ap)	2	0.65	1	0.21	5	1.14	**8**	**0.65**
21.	*Sphaerophoria scripta* (L.)	Predatory (ap)	34	11.04	249	51.88	45	10.25	**328**	**26.73**
22.	*Sphaerophoria taeniata* (MEIG.)	Predatory (ap)	2	0.65	-	0.00	1	0.23	**3**	**0.24**
23.	*Syrphus ribesii* (L.)	Predatory (ap)	11	3.57	1	0.21	3	0.68	**15**	**1.22**
24.	*Syrphus torvus* O.-S.	Predatory (ap)	8	2.60	2	0.42	2	0.46	**12**	**0.98**
25.	*Syrphus vitripennis* MEIG.	Predatory (ap)	21	6.82	4	0.83	10	2.28	**35**	**2.85**
26.	*Baccha elongata* (FABR.)	Predatory (ap)	3	0.97	1	0.21	-	0.00	**4**	**0.33**
27.	*Chrysotoxum cautum* (HARR.)	Predatory (ap)	1	0.32	-	0.00	-	0.00	**1**	**0.08**
28.	*Melanostoma mellinum* L.	Predatory (ap)	2	0.65	25	5.21	49	11.16	**76**	**6.19**

	Species	Trophic relations	Cliff	%	Sandy beach	%	Brackish areas	%	**Total**	**%**
29.	*Melanostoma scalare* (FABR.)	Predatory (ap)	14	4.55	-	0.00	4	0.91	**18**	**1.47**
30.	*Xanthandrus comtus* (HARR.)	Predatory (ap)	1	0.32	-	0.00	1	0.23	**2**	**0.16**
31.	*Platycheirus albimanus* (FABR.)	Predatory (ap)	-	0.00	-	0.00	1	0.23	**1**	**0.08**
32.	*Platycheirus angustatus* (ZETT.)	Predatory (ap)	6	1.95	-	0.00	7	1.59	**13**	**1.06**
33.	*Platycheirus clypeatus* (MEIG.)	Predatory (ap)	17	5.52	10	2.08	94	21.41	**121**	**9.86**
34.	*Platycheirus fulviventris* (MACQ.)	Predatory (ap)	2	0.65	-	0.00	19	4.33	**21**	**1.71**
35.	*Platycheirus immarginatus* (ZETT.) *	Predatory (ap)	-	0.00	4	0.83	6	1.37	**10**	**0.81**
36.	*Platycheirus peltatus* (MEIG.)	Predatory (ap)	6	1.95	-	0.00	8	1.82	**14**	**1.14**
37.	*Platycheirus podagratus* (ZETT.) *	Predatory (ap)	-	0.00	3	0.63	-	0.00	**3**	**0.24**
38.	*Platycheirus scutatus* (MEIG.)	Predatory (ap)	3	0.97	-	0.00	2	0.46	**5**	**0.41**
39.	*Trichopsomyia flavitarsis* MEIG. *	Predatory (ap)	-	0.00	-	0.00	1	0.23	**1**	**0.08**
40.	*Cheilosia albitarsis* (MEIG.) *	Phytophagous	-	0.00	2	0.42	-	0.00	**2**	**0.16**
41.	*Cheilosia canicularis* (PANZ.)	Phytophagous	1	0.32	-	0.00	-	0.00	**1**	**0.08**
42.	*Cheilosia chrysocoma* (MEIG.)	Phytophagous	2	0.65	1	0.21	-	0.00	**3**	**0.24**
43.	*Cheilosia frontalis* LW.	Phytophagous	-	0.00	2	0.42	-	0.00	**2**	**0.16**
44.	*Cheilosia illustrata* (HARR.) *	Phytophagous	-	0.00	5	1.04	-	0.00	**5**	**0.41**
45.	*Cheilosia laticornis* ROND.*	Phytophagous	-	0.00	9	1.88	1	0.23	**10**	**0.81**
46.	*Cheilosia latifrons* ZETT.*	Phytophagous	-	0.00	1	0.21	-	0.00	**1**	**0.08**

	Species	Trophic relations	Cliff	%	Sandy beach	%	Brackish areas	%	**Total**	**%**
47.	*Cheilosia loewi* BECK. *	Phytophagous	-	0.00	3	0.63	-	0.00	**3**	**0.24**
48.	*Cheilosia melanopa* (ZETT.)	Phytophagous	1	0.32	1	0.21	-	0.00	**2**	**0.16**
49.	*Cheilosia mutabilis* (FALL.)	Phytophagous	2	0.65	2	0.42	-	0.00	**4**	**0.33**
50.	*Cheilosia pagana* (MEIG.)	Phytophagous	3	0.97	18	3.75	4	0.91	**25**	**2.04**
51.	*Cheilosia variabilis* (PANZ.)	Phytophagous	2	0.65	-	0.00	-	0.00	**2**	**0.16**
52.	*Cheilosia vulpina* (MEIG.)	Phytophagous	2	0.65	1	0.21	-	0.00	**3**	**0.24**
53.	*Pelecocera tricincta* MEIG. *	Unknown	-	0.00	12	2.50	-	0.00	**12**	**0.98**
54.	*Volucella inanis* (L.)	Predatory - saprophagous-parasitic	4	1.30	-	0.00	-	0.00	**4**	**0.33**
55.	*Volucella pellucens* (L.)	Predatory (ent)	-	0.00	1	0.21	-	0.00	**1**	**0.08**
56.	*Volucella zonaria* (PODA)	Predatory (ent)	-	0.00	2	0.42	-	0.00	**2**	**0.16**
57.	*Lejogaster tarsata* (MEIG.) **	Saprophagous	-	0.00	-	0.00	1	0.23	**1**	**0.08**
58.	*Orthonevra intermedia* (LUNDB.) *	Phytophagous	-	0.00	-	0.00	2	0.46	**2**	**0.16**
59.	*Sphegina* (*Sphegina*) *verecunda* COLL.*	Saprophagous	1	0.32	-	0.00	-	0.00	**1**	**0.08**
60.	*Eristalinus* (*Eristalinus*) *sepulchralis* (L.)	Saprophagous	-	0.00	-	0.00	18	4.10	**18**	**1.47**
61.	*Eristalinus* (*Lathyrophthalmus*) *aenus* (SCOP.)	Saprophagous	-	0.00	-	0.00	2	0.46	**2**	**0.16**

	Species	Trophic relations	Cliff	%	Sandy beach	%	Brackish areas	%	**Total**	**%**
62.	*Eristalis* (*Eoseristalis*) *pertinax* (SCOP)	Saprophagous	3	0.97	-	0.00	-	0.00	**3**	**0.24**
63.	*Eristalis* (*Eristalis*) *tenax* (L.)	Saprophagous	17	5.52	2	0.42	1	0.23	**20**	**1.63**
64.	*Anasimyia lineata* (FABR.)	Saprophagous	-	0.00	-	0.00	1	0.23	**1**	**0.08**
65.	*Helophilus* (*Helophilus*) *pendulus* (L.)	Saprophagous	4	1.30	3	0.63	6	1.37	**13**	**1.06**
66.	*Helophilus (Helophilus*) *trivittatus* (FABR.)	Saprophagous	4	1.30	1	0.21	1	0.23	**6**	**0.49**
67.	*Myathropa florea* (L.)	Saprophagous	2	0.65	1	0.21	-	0.00	**3**	**0.24**
68.	*Syritta pipiens* (L.)	Coprophagous	9	2.92	6	1.25	11	2.51	**26**	**2.12**
69.	*Tropidia fasciata* MEIG.	Saprophagous	-	0.00	-	0.00	1	0.23	**1**	**0.08**
70.	*Xylota abiens* MEIG. *	Saprophagous	-	0.00	-	0.00	1	0.23	**1**	**0.08**
71.	*Xylota segnis* (L.)	Saprophagous	2	0.65	-	0.00	-	0.00	**2**	**0.16**
72.	*Xylota sylvarum* (L.)	Saprophagous	1	0.32	-	0.00	-	0.00	**1**	**0.08**
			308	**100.00**	**480**	**100.00**	**439**	**100.00**	**1227**	**100.00**

In brackish areas of the coastal type, the aphidophagous hover fly fauna is represented by 389 specimens, e.g. 88.61% of syrphids collected there (Table 2) and 26 species (Table 3). In this material the most numerous are: *Pl. clypeatus* (94 specimens, e.g. 21.41%), *M. mellinum* (49 flies, 11.16%) and *Sph. scripta* (45 exx., e.g. 10.25%) (Table 1). All these species are eurytopic and hygrophilous (LASKA & MAZANEK 1998), so they have favourable places for feeding and breeding in the study localities. In this collection, the next most common are saprophages and coprophages. The hover flies of the saprophagous trophic community were collected in the number of 9 species (Table 3) and 32 specimens, e.g. 7.29% of caught syrphids in brackish areas (Table 2). The coprophages are represented by 11 specimens (e.g. 2.51% of material) (Table 2) recognized as *S. pipiens* (Table 1). The occurrence of flies belonging to this last trophic group is strictly connected with pastures of grazing cattle and rural settlements, situated near the brackish areas.

Table 2. Number of specimens and percentage of Syrphidae of particular trophic groups.

ap – aphidophagous
ent – entomophagous

Trophic relations	Cliffs		Sandy beaches		Brackish areas		Total	
	No of specimens	%	No of specimens	%	No of specimens	%	No of specmens	%
Predatory (ap)	248	80.52	407	84.79	389	88.61	**1044**	**85.09**
Predatory (ent)	0	0.00	3	0.63	0	0.00	**3**	**0.24**
Phytophagous	13	4.22	45	9.38	7	1.59	**65**	**5.30**
Predatory - saprophagous-parasitic	4	1.30	0	0.00	0	0.00	**4**	**0.33**
Saprophagous	34	11.04	7	1.46	32	7.29	**73**	**5.95**
Coprophagous	9	2.92	6	1.25	11	2.51	**26**	**2.12**
Unknown	0	0.00	12	2.50	0	0.00	**12**	**0.98**
Total	**308**	**100.00**	**480**	**100.00**	**439**	**100.00**	**1227**	**100.00**

Table 3. Number of species and percentage of Syrphidae of particular trophic groups.

ap – aphidophagous
ent – entomophagous

Trophc relatioins	Cliffs		Sandy beaches		Brackish ares		Total	
	No of species	%	No of species	%	No of spcies	%	No of spcies	%
Predatory (ap)	30	63.83	20	51.28	26	66.67	**39**	**54.17**
Predatory (ent)	0	0.00	2	5.13	0	0.00	**2**	**2.78**
Phytophagous	7	14.89	11	28.21	3	7.69	**14**	**19.44**
Predatory - saprophagous-parasitic	1	2.13	0	0.00	0	0.00	**1**	**1.39**
Saprophagous	8	17.02	4	10.26	9	23.08	**14**	**19.44**
Coprophagous	1	2.13	1	2.56	1	2.56	**1**	**1.39**
Unknown	0	0.00	1	2.56	0	0.00	**1**	**1.39**
	47	**100.00**	**39**	**100.00**	**39**	**100.00**	**72**	**100.00**

In all types of biotopes, the high abundance of hover flies, whose larvae are aphidophagous is observed. It is the result of the attraction of these species by aphids breeding and feeding on varied, mainly halophilous and herbaceous vegetation, overgrowing the study localities.

2.2. Quantitative and qualitative comparison of hover fly fauna of the saline habitats of the Polish Baltic coast

Based on Jaccard's formula, the degree of similarity of syrphid species composition in types of habitat (Pxy) was recognized (Table 4).

The closest similarity is observed between hover fly fauna of cliffed beaches and brackish areas of the coastal type. As in both types of habitats 25 syrphid species are common, 22 are observed on cliffs and 14 species – only in coastal brackish areas (Table 5), the degree of similarity amounts to 81.97% (Table 4). Such high value is a result of similarity of biotic conditions observed in both biotopes. Both cliffs and coastal brackish areas are overgrown with rich vegetation, attracting melitophagous adults. Besides, from the taking into account rich flora, these study areas are comfortable places of breeding and feeding of larvae of hover fly species belonging to all trophic communities.

The same high value of the degree of similarity (81.97%) (Table 4) is noticed in a comparison of dipterous fauna of cliffed and sandy beaches. In these study localities 25 species are common, 22 are noticed on cliffs, and 14 species – only on sandy beaches

(Table 5). This similarity results from the geomorphologic configuration of the Polish coast. Both types of beaches merge mutually and they turn without distinct borders one into the other, so the insects fly freely from one type of habitat into the other one. Moreover, cliffs and dunes zones of the majority of the sandy beaches are overgrown with bushes of *Rosa rugosa* and *Salix daphnoides*, which attract similar groups of hover fly species.

Table 4. The degree of similarity (%) of Syrphidae species composition in types of saline habitat of the Polish Baltic coast.

	Cliff	Sandy beach	Brackish area
Cliff	-	81.97	81.97
Sandy beach	81.97	-	73.68
Brackish area	81.97	73.68	-

The lowest value of the degree of similarity (73.68%) (Table 4) is observed in the case of the syrphid fauna of sandy beaches and the extensive brackish areas of the coastal type. In both types of biotopes, 21 species are common, whereas only on beaches or brackish areas, in each case 18 species are noticed (Table 5). These types of habitats are least similar to respect to biotic conditions. The saline areas of the coastal type, comprising bulrushes, brackish marshes and brackish meadows, are moist, partially shady and overgrown with halophytes. Due to this, the study localities may be a habitat of preimaginal stages and adults of many representatives of Diptera families, including Syrphidae of the whole trophic communities. Dry, strongly sunlit sandy beaches, with scrubs which are result of artificial planting, present places less convenient for accomplishing the fly's whole developmental cycle. Therefore, it can be assume that syrphid fauna of this type of biotope probably depend on the presence of feeding adults.

Table 5. Syrphidae collected on cliffed and sandy beaches and extensive brackish areas – comparison.

	Species	Cliff	Sandy beach	Brackish area
1.	*Dasysyrphus albostriatus* (FALL.)	+		
2.	*Dasysyrhus hilaris* (ZETT.)	+		
3.	*Dasysyrphus pinastri* (DEG.)		+	+
4.	*Dasysyrphus tricinctus* (FALL.)	+		

	Species	Cliff	Sandy beach	Brackish area
5.	*Didea alneti* (FALL.)	+		
6.	*Epistrophe* (*Epistrophe*) *eligans* (HARR.)		+	
7.	*Epistrophe* (*Epistrophe*) *grossulariae* (MEIG.)		+	
8.	*Episyrphus balteatus* (DEG.)	+	+	+
9.	*Melangyna umbellatarum* (FABR.)	+		
10.	*Meligramma cincta* (FALL.)	+		
11.	*Meliscaeva auricollis* (MEIG.)	+	+	+
12.	*Eupeodes corollae* (FABR.)	+	+	+
13.	*Eupeodes latifasciatus* (MACQ.)	+	+	+
14.	*Eupeodes nitens* (ZETT.)	+		
15.	*Parasyrphus nigritarsis* (ZETT.)			+
16.	*Scaeva pyrastri* (L.)	+	+	+
17.	*Scaeva selenitica* (MEIG.)	+	+	
18.	*Sphaerophoria interrupta* FABR.	+	+	+
19.	*Sphaerophoria loewi* ZETT.			+
20.	*Sphaerophoria rueppellii* (WIED.)	+	+	+
21.	*Sphaerophoria scripta* (L.)	+	+	+
22.	*Sphaerophoria taeniata* (MEIG.)	+		+
23.	*Syrphus ribesii* (L.)	+	+	+
24.	*Syrphus torvus* O.-S.	+	+	+
25.	*Syrphus vitripennis* MEIG.	+	+	+
26.	*Baccha elongata* (FABR.)	+	+	
27.	*Chrysotoxum cautum* (HARR.)	+		
28.	*Melanostoma mellinum* L.	+	+	+
29.	*Melanostoma scalare* (FABR.)	+		+
30.	*Xanthandrus comtus* (HARR.)	+		+
31.	*Platycheirus albimanus* (FABR.)			+
32.	*Platycheirus angustatus* (ZETT.)	+		+
33.	*Platycheirus clypeatus* (MEIG.)	+	+	+
34.	*Platycheirus fulviventris* (MACQ.)	+		+

	Species	Cliff	Sandy beach	Brackish area
35.	*Platycheirus immarginatus* (ZETT.)		+	+
36.	*Platycheirus peltatus* (MEIG.)	+		+
37.	*Platycheirus podagratus* (ZETT.)		+	
38.	*Platycheirus scutatus* (MEIG.)	+		+
39.	*Trichopsomyia flavitarsis* MEIG.			+
40.	*Cheilosia albitarsis* (MEIG.)		+	
41.	*Cheilosia canicularis* (PANZ.)	+		
42.	*Cheilosia chrysocoma* (MEIG.)	+	+	
43.	*Cheilosia frontalis* LW.		+	
44.	*Cheilosia illustrata* (HARR.)		+	
45.	*Cheilosia laticornis* ROND.		+	+
46.	*Cheilosia latifrons* ZETT.		+	
47.	*Cheilosia loewi* BECK.		+	
48.	*Cheilosia melanopa* (ZETT.)	+	+	
49.	*Cheilosia mutabilis* (FALL.)	+	+	
50.	*Cheilosia pagana* (MEIG.)	+	+	+
51.	*Cheilosia variabilis* (PANZ.)	+		
52.	*Cheilosia vulpina* (MEIG.)	+	+	
53.	*Pelecocera tricincta* MEIG.		+	
54.	*Volucella inanis* (L.)	+		
55.	*Volucella pellucens* (MEIG.)		+	
56.	*Volucella zonaria* (PODA)		+	
57.	*Lejogaster tarsata* (MEIG.)			+
58.	*Orthonevra intermedia* (LUNDB.)			+
59.	*Sphegina* (*Sphegina*) *verecunda* COLL.	+		
60.	*Eristalinus* (*Eristalinus*) *sepulchralis* (L.)			+
61.	*Eristalinus* (*Lathyrophthalmus*) *aenus* (SCOP.)			+
62.	*Eristalis* (*Eoseristalis*) *pertinax* (SCOP.)	+		
63.	*Eristalis* (*Eristalis*) *tenax* (L.)	+	+	+
64.	*Anasimyia lineata* (FABR.)			+

	Species	Cliff	Sandy beach	Brackish area
65.	*Helophilus* (*Helophilus*) *pendulus* (L.)	+	+	+
66.	*Helophilus* (*Helophilus*) *trivittatus* (FABR.)	+	+	+
67.	*Myathropa florea* (L.)	+	+	
68.	*Syritta pipiens* (L.)	+	+	+
69.	*Tropidia fasciata* MEIG.			+
70.	*Xylota abiens* MEIG.			+
71.	*Xylota segnis* (L.)	+		
72.	*Xylota sylvarum* (L.)	+		
	Total	**47**	**39**	**39**

CONCLUSIONS

It is concluded, based on the results of research undertaken in the years 1999-2003 (KACZOROWSKA 2004) and 2004-2005, that fauna of Syrphidae of saline habitats of the Polish Baltic coast includes 72 species. 47 species are recorded on the cliffed beaches, whereas on sandy beaches and in brackish areas – 39 in each type of biotope. The hover fly species belonging to the aphidophagous trophic group are the most abundant in all study localities. Among them, the most numerous are syrphids, which are recognized as eurytopic, e.g. with wide tolerance of environmental conditions. Comparing Syrphidae of the three types of biotopes, the highest value of the degree of similarity was noticed in the case of fauna of cliffed beaches and brackish areas of the coastal type, e.g. biotopes with rich and varied vegetation. Same subsequent result was received from habitable similarities in case of fauna of two types of beaches.

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