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BIG-HEADED FLIES (PIPUNCULIDAE: DIPTERA) OF ŠÚR NATURAL RESERVE, THEIR HABITAT PREFERENCE AND PHENOLOGY

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Abstract: Extensive faunistic research of Šúr natural reserve performed in 2008-2009 resulted in extending the list of Pipunculidae recorded so far from this area to 52 species. *Claraeola melanostola* (Becker, 1897), *Eudorylas angustimembranus* Kozánek & Kwon, 1991 and *Eudorylas pannonicus* (Becker, 1897) were documented for the first time from Slovakia. Level of dominance, habitat preference and phenology were analyzed and discussed.

Key words: Faunistics, pipunculids, Slovakia

INTRODUCTION

Šúr natural reserve (Šúr NR) is large, well-preserved remain of boggy alder forest. It is assumed, that it is the last biotope of this type of alder forest in central Europe. In 1990, Šúr NR was included in the list of international key wetlands according to the RAMSAR convenience and is considered an area of European importance registered in NATURA 2000 (SKUEV0279 Šúr). Šúr NR is situated in close vicinity of Bratislava. Its current area is 654.959 ha, with an altitude of 128-132 msl. Despite negative anthropogenic factors influencing Šúr NR in last decades, resulting in the reduction of its natural values, it is still a place with unique flora and fauna (FŰRY 2010).

Šúr NR has been in the center of interest of botanists and zoologists since the middle of the 19th century, when KORNHUBER (1858) published the first comprehensive list on its flora. KOVÁČ (1994) summarized a list of 472 publications concerning the flora and fauna of Šúr NR. In 2008-2009, a team of zoologists from the Institute of Zoology, Slovak Academy of Sciences performed an extensive research of arthropodocoenoses in six collecting sites which were selected to analyze the recent biodiversity of Šúr NR. Most of the results were published in MAJZLAN & VIDLIČKA (2010), with additional arthropod groups getting gradually processed. The aim of this work was to complete our knowledge about big-headed flies occurring in Šúr NR, to study the structure of micro-communities living in the studied habitats and the dynamics of their seasonal occurrence.

COLLECTING SITES

Alnetum (48°13´55.62"/17°12´31.80") – western margin of native alder flood-plain forest Šurský les formed predominantly by black alder (*Alnus glutinosa*) with admixture of old poplars (*Populus* sp.). Malaise trap was placed in dense growth of stinging nettle in the years 2008-2009.

Phragmitetum (48°13´52.44"/17°12´23.04") – underflooding meadows with growth of ditch reed (*Phragmites australis*) gradually overgrown by willow trees (*Salix cinerea, Salix purpurea, Salix fragilis*) and other woody species (*Fraxinus excelsior, Prunus padus*). Malaise trap was placed at the margin of this biotope in the year 2009.

Quercetum (48°13´16.80"/17°13´07.02") – old oak forest (Panónsky háj) at present densely overgrown by young woody species mainly elms, maples, hornbeams and ash-trees. Malaise trap was installed on a small clearing in the middle of the forest in the years 2008-2009.

Salt marsh (48°13´12.72"/17°13´20.76") – xerothermic meadow with sparse small/young trees (*Ulmus laevis, Pirus communis*) and bushes (*Crataegus sp., Prunus spinosa*). Several rare halophyllous plant species occur here. Malaise trap was located at the meadow margin close to a group of black thorns and wild pear trees in the years 2008-2009.

Wet meadow (48°13´55.62"/17°12´31.80") – small wetland depression in an oak forest, overgrown by hygrophilous grasses and surrounded by *Prunus spinosus*. At early spring, this locality was flooded up to 30 cm. Malaise trap was installed in the middle of the meadow in the year 2008.

Biological station (48°13´40.08"/17°12´20.88") – area of the experimental biological station of the Faculty of Natural Sciences, Comenius University. Malaise trap was installed in the middle of a small meadow with sparse oaks and roses bushes in the years 2008-2009. Several small ponds were located nearby the trap.

MATERIAL AND METHODS

Altogether, 332 specimens of Pipunculidae collected in the framework of the Šúr NR extensive faunistic research program in 2008-2009 were included in this study. All specimens were collected by Malaise traps in 70% ethanol and subsequently dry mounted. The following identification keys were used: ALBRECHT (1990), DE MEYER (1989), FÖLDVÁRI & DE MEYER (1999), GROOTAERT & DE MEYER (1986), JERVIS (1992), KEHLMAIER (2005, 2006, 2008). All material is deposited in the Slovak National Museum, Bratislava. Habitat similarity was evaluated by a Detrended correspondence analysis (DCA) using the freeware PAST ver. 3 (HAMMER et al. 2001). For the dominant groups, we used the scale proposed by TISCHLER (1949) and completed by HEYDEMANN (1955).

RESULTS

Faunistics

Extensive faunistic research of arthropod communities was performed at the Šúr NR in the period of 2008-2009. Collected material contained 39 species of Pipunculidae belonging to 10 genera. Among them, 16 species and 2 genera (*Dasydorylas* and *Microcephalops*) were documented for the first time from this area. *Eudorylas angustimembranus, E. pannonicus*

and *Claraeola melanostola* are first findings from the territory of Slovakia. Altogether, 52 pipunculid species belonging to 13 genera are known from Šúr NR.

Faunistically interesting findings

Chalarus latifrons Hardy, 1943 – Šúr NR is the only locality in Slovakia, where this species was recorded so far (JERVIS 1992).

Cephalops (Beckerias) pannonicus (Aczél, 1939) – second finding from Slovakia. So far known only from Horné Plachtince (KOZÁNEK & KEHLMAIER 2004).

Cephalops (Semicephalops) perspicuus (de Meijere, 1907) – Šúr NR is the only locality in Slovakia, where this species was recorded so far (KOZÁNEK 1986).

Claraeola clavata (Becker, 1897) – Šúr NR is the only locality in Slovakia, where this species was recorded so far (KEHLMAIER 2005).

Claraeola melanostola (Becker, 1897) – first finding from Slovakia.

Eudorylas angustimembranus Kozánek & Kwon, 1991 – first finding from Slovakia.

Eudorylas okalii Kozánek & Kehlmaier, 2004 – rare species, one paratype was collected in Šúr NR.

Eudorylas pannonicus (Becker, 1897) – first finding from Slovakia. Specimens collected in Šúr NR belongs to the Form B in the sense of KEHLMAIER (2005).

Eudorylas triangularis Kehlmaier, 2005 – one paratype was collected in Šúr NR.

Dorylomorpha lautereri Albrecht, 1990 – second finding from the territory of Slovakia. So far recorded only from Lakšárska Nová Ves (ALBRECHT 1990).

Pipunculidae communities in studied habitats

The DCA analysis of pipunculid communities occurring in the studied habitats revealed, that they can be clustered into two main groups: communities of flat open habitats (Ph, Wm, Sm, Bs) and forest habitat communities (Qu, Al) with two exceptions: wet meadow 2008 and Alnetum 2008 (Fig. 1). The number of species recorded at any flat open habitat ranges between 19-21 species per habitat. The number of species present in forest habitats ranges from 4-8 and is thus distinctly lower than in flat open habitats (Tab. 1).

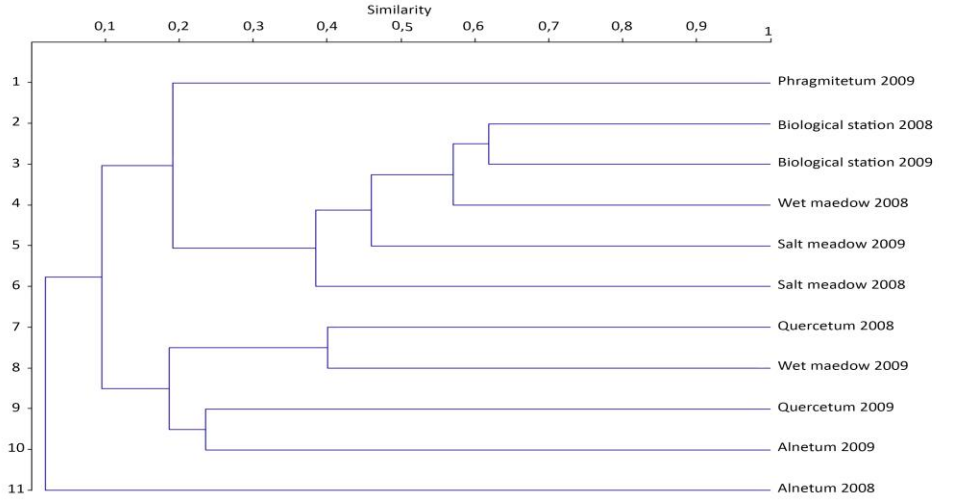

Fig. 1. Comparison of similarity of pipunculid communities in studied habitats.

Tab. 1. List of Pipunculidae species recorded in Šúr NR.

Species	Al	Bs	Ph	Qu	Sm	Wm	LS	Abbrev
Chalarus brevicaudis Jervis, 1992			x		x			
Chalarus fimbriatus Coe, 1966							x	
Chalarus indistinctus Jervis, 1992			x					
Chalarus latifrons Hardy, 1943							x	
Chalarus spurius (Fallén, 1816)			x					
Jassidophaga beatricis (Coe, 1966)							x	
Verrallia aucta (Fallén, 1817)							x	
Nephrocerus flavicornis Zetterstedt, 1844		x	x		x	x	x	
Nephrocerus scutellatus (Macquart, 1834)		x			x	x	x	
Cephalops aeneus Fallén, 1810						x	x	Cae
Cephalops pannonicus (Aczél, 1939)		x		x		x		Cpa
Cephalops perspicuus (de Meijere, 1907)			x	x			x	Cpe
Cephalops subultimus Collin, 1956				x			x	Csu
Cephalops ultimus (Becker, 1900)	x	x	x	x	x		x	Cul
Cephalops varipes (Meigen, 1824)		x	x		x	x	x	Cva
Cephalops vittipes (Zetterstedt, 1844)		x	x			x	x	Cvi
Claraeola clavata (Becker, 1897)							x	
Claraeola melanostola (Becker, 1897)						x		
Clistoabdominalis ruralis (Meigen, 1824)					x	x	x	
Dasydorilas horridus (Becker, 1897)		x	x		x			
Eudorylas angustimembranus Kozánek & Kwon, 1991	x							Ean
Eudorylas fuscipes (Zetterstedt, 1844)							x	
Eudorylas montium (Becker, 1897)							x	
Eudorylas obliquus Coe, 1966		x			x	x		Eob
Eudorylas okalii Kozánek & Kehlmaier, 2004							x	
Eudorylas pannonicus (Becker, 1897)		x			x	x		Epa
Eudorylas slovacus Kozánek, 1993			x	x	x	x	x	Esl
Eudorylas subfascipes Collin, 1956						x	x	Esu
? Eudorylas subterminalis Collin, 1956							x	
Eudorylas triangularis Kehlmaier, 2005							x	
Eudorylas zermattensis (Becker, 1897)		x	x		x	x	x	Eze
Eudorylas zonellus Collin, 1956		x		x			x	Ezo
Eudorylas zonatus (Zetterstedt, 1849)		x			x			Ezn
Microcephalops opacus (Fallén, 1816)			x	x	x			
Pipunculus campestris Latreille, 1802	x	x	x	x	x	x	x	Pca
Pipunculus elegans Egger, 1860		x	x		x	x	x	Pel
Pipunculus fonsecai Coe, 1966		x					x	Pfo
Pipunculus oldenbergi Collin, 1956							x	
Pipunculus omissinervis Becker, 1889						x		Pom
Pipunculus tenuirostris Kozánek, 1981		x	x			x	x	Pte
Pipunculus lenis Kuznetzov, 1991	x	x	x				x	Ple
Dorylomorpha extricata (Collin, 1937)			x		x			Dex
Dorylomorpha imparata (Collin, 1937)			x		x	x		Dim
Dorylomorpha rufipes (Meigen, 1824)			x					Dru
Dorylomorpha fennica Albrecht, 1990							x	
Dorylomorpha hungarica (Aczél, 1939)			x				x	Dhu
Dorylomorpha lautereri Albrecht, 1990		x						Dla
? Dorylomorpha xanthopus (Thomson, 1870)							x	
Tomosvaryella coquilletti (Kertész, 1907)							x	
Tomosvaryella geniculata (Meigen, 1824)		x			x	x	x	Tge
Tomosvaryella kuthyi Aczél, 1944)		x			x			Tku
Tomosvaryella sylvatica (Meigen, 1824)			x				x	Tsy
Together	**5**	**22**	**23**	**8**	**21**	**21**	**35**	

Abbreviations: Al - Alnetum, Bs - biological station, Ph - Phragmitetum, Qu - Quercetum, Sm - salt marsh, Wm - wet meadow, LS - literature sources.

The number of species directly correlates with the abundance of pipunculid associations in all studied habitats. The highest number of species and abundances were recorded in the Phragmitetum and salt marsh, the lowest in the Quercetum and Alnetum. The evaluation of the level of dominance in the forest habitats has only indicative value due to the low number of collected specimens. *Pipunculus campestris* was the only species with an eudominant level of dominance in more than one flat open habitat (Tab. 2).

The annual incidence of *Cephalops* species in 2008 was low, but substantially increased in 2009, when the Phragmitetum habitat was included as a collecting site. Captures of *C. ultimus, C. varipes,* and *C. vittipes* in the Phragmitetum were higher than in all other habitats combined (Fig. 2).

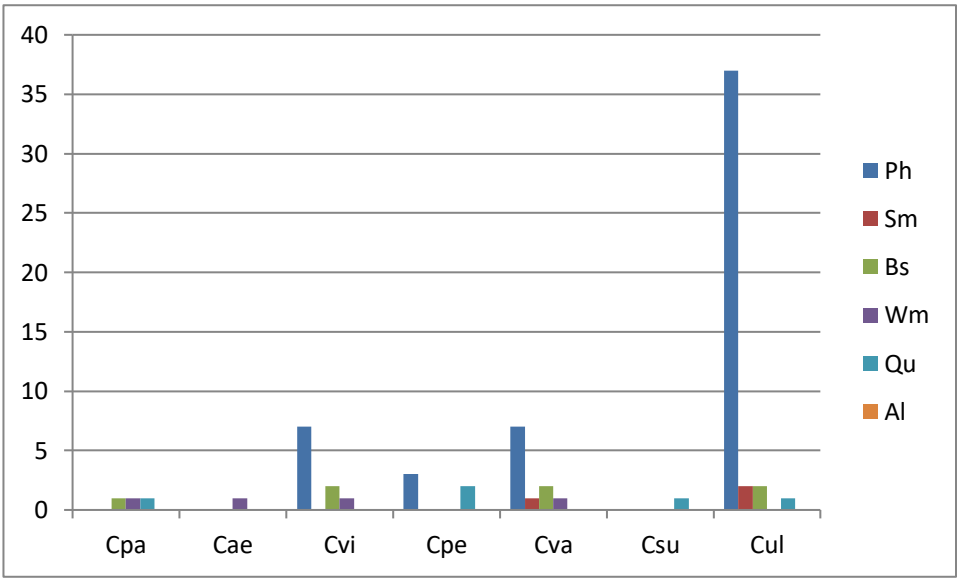

Fig. 2. The occurrence of *Cephalops* species in the studied habitats in 2009. For abbreviations see Tab. 1.

The highest number of collected *Eudorylas* species was at the salt marsh (*E. obliquus* 2008*, E. slovacus, E. zermattensis, E. zonellus*) and wet meadow (*E. obliquus* 2009*, E. pannonicus, E. zermattensis, E. zonatus*) (Fig. 3).

Pipunculus campestris was the eudominant species in the majority of habitats except for the Phragmitetum and Alnetum. The number of collected specimens of *Pipunculus* species per habitat was more or less equal with the exception of *P. campestris* at the salt marsh (2008) and *P. lenis* at the Phragmitetum (2009) (Fig. 4).

Tab. 2. The abundance and dominance level of Pipunculidae species at the studied habitats.

	Al	DL	Bs	DL	Ph	DL	Qu	DL	Sm	DL	Wm	DL
Chalarus brevicaudis					2	R			1	SR		
Chalarus indistinctus					2	R						
Chalarus spurius					4	SD						
Nephrocerus flavicornis			1	R	2	R			2	R	3	D
Nephrocerus scutellatus			1	R					5	SD	1	SD
Pipunculus campestris	1	D	18	ED	6	D	2	ED	28	ED	11	ED
Pipunculus fonsecai			1	R								
Pipunculus omissinervis											1	SD
Pipunculus elegans			2	SD	1	SR			1	SR	2	SD
Pipunculus tenuirostris			4	D	1	SR					1	SD
Pipunculus lenis	5	ED	1	R	15	ED						
Cephalops pannonicus			1	R			1	ED			1	SD
Cephalops aeneus											1	SD
Cephalops vittipes			2	SD	7	D					1	SD
Cephalops perspicuus					3	SD	2	ED				
Cephalops varipes			2	SD	7	D			1	SR	1	SD
Cephalops subultimus							1	ED				
Cephalops ultimus	3	ED	2	SD	37	ED	1	ED	2	R		
Microcephalops opacus					2	R	1	ED	2	R		
Clareola melanostola											1	SD
Clistoabdominalis ruralis									6	D	3	D
Dasydorilas horridus			1	R	1	SR			4	SD		
Eudorylas angustimembranus	2	ED										
Eudorylas obliquus			7	ED					5	SD	4	D
Eudorylas pannonicus			1	R					2	R	3	D
Eudorylas slovacus			1	R	3	SD	1	ED	11	ED	3	D
Eudorylas subfascipes											1	SD
Eudorylas zermattensis			2	SD	1	SR			3	SD	3	D
Eudorylas zonellus			1	R			1	ED				
Eudorylas zonatus			3	D					4	SD		
Dorylomorpha extricata					7	D			1	SR		
Dorylomorpha imparata					2	R			1	SR	1	SD
Dorylomorpha rufipes					4	SD						
Dorylomorpha hungarica					2	R						
Dorylomorpha lautereri			1	R								
Tomosvaryella geniculata			2	SD					11	ED	3	D
Tomosvaryella kuthyi			1	R					11	ED		
Tomosvaryella sylvatica					2	R						
Total species	**4**		**21**		**21**		**8**		**19**		**19**	
Total specimens	**11**		**55**		**111**		**10**		**101**		**45**	

Abbreviations: Al - Alnetum, Bs – biological station, Ph – Phragmitetum, Qu – Quercetum, Sm – salt marsh, Wm – wet meadow, ED – eudominant, D – dominant, SD – subdominant, R – recedent, S – subrecedent, DL – dominance level.

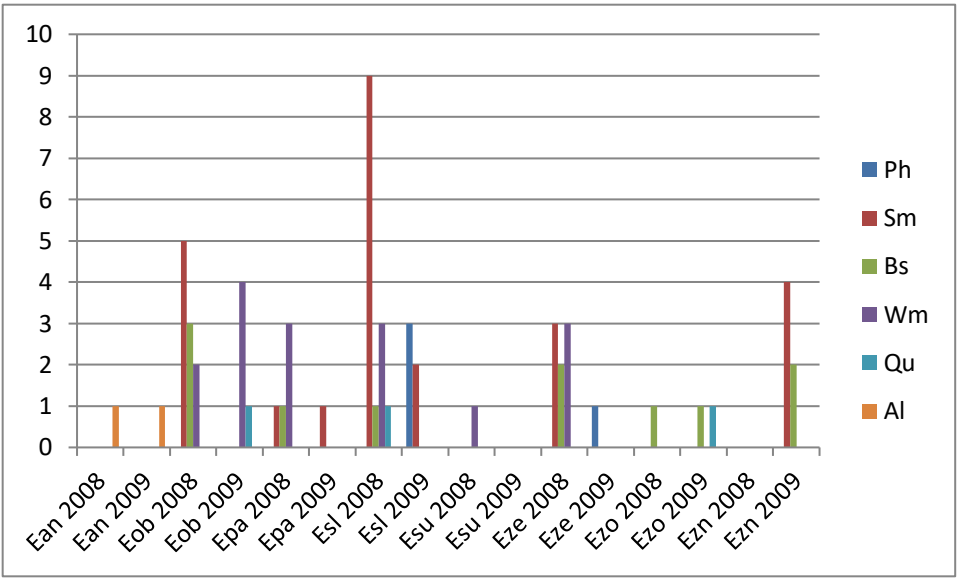

Fig. 3. The occurrence of *Eudorylas* species in the studied habitats. For abbreviations see Tab. 1.

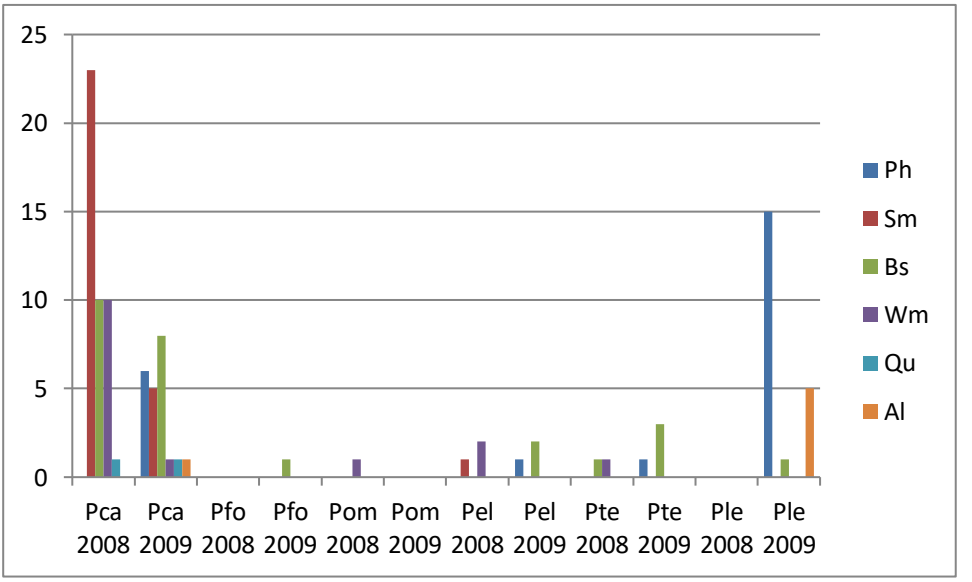

Fig. 4. The occurrence of *Pipunculus* species in the studied habitats. For abbreviations see Tab. 1.

Dorylomorpha species occurred mainly at at Phragmitetum, their captures at the remaining habitats were sporadic (Fig. 5).

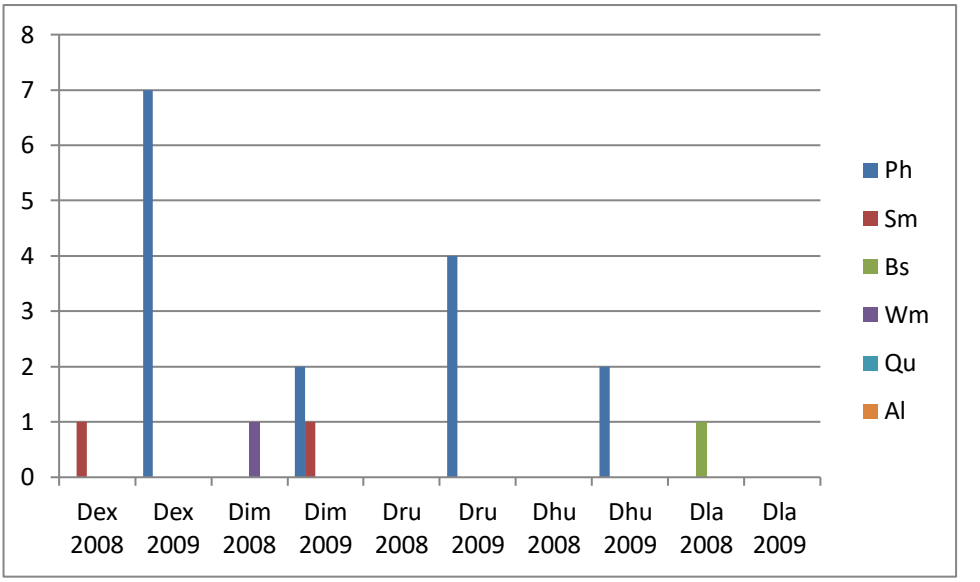

Fig. 5. The occurrence of *Dorylomorpha* species in the studied habitats. For abbreviations see Tab. 1.

The abundance of *Tomosvaryella* species was highest at the salt marsh, where they belonged to the eudominant species. *Tomosvaryella sylvatica* was recorded only at the Phragmitetum (Fig. 6).

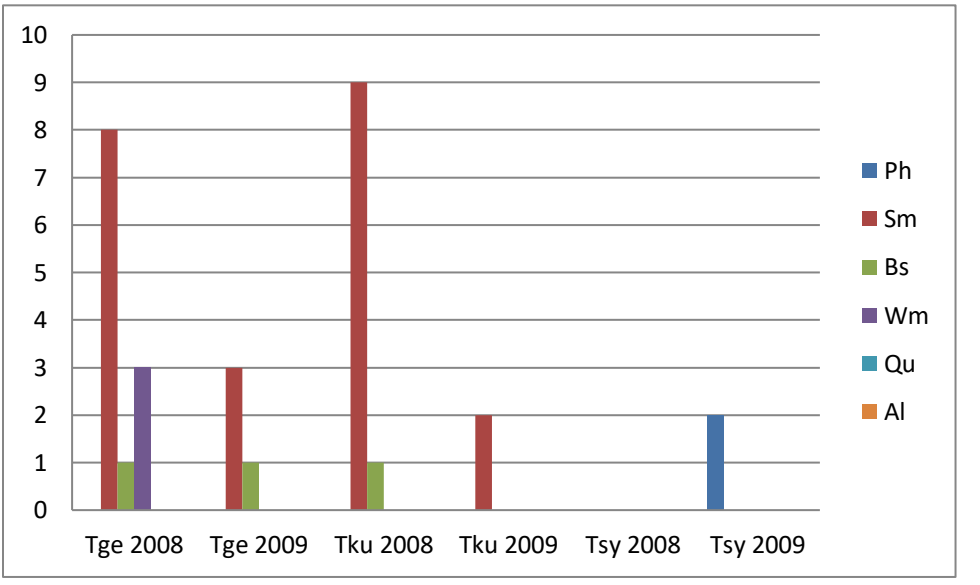

Fig. 6. The occurrence of *Tomosvaryella* species in the studied habitats. For abbreviations see Tab. 1.

Seasonal dynamics

The course of seasonal dynamics was evaluated for five eudominant species, where capture rate per year reached 10 or more specimens. *Pipunculus campestris* is the only species which exceeds this limit in 2008 and 2009 (Fig. 7).

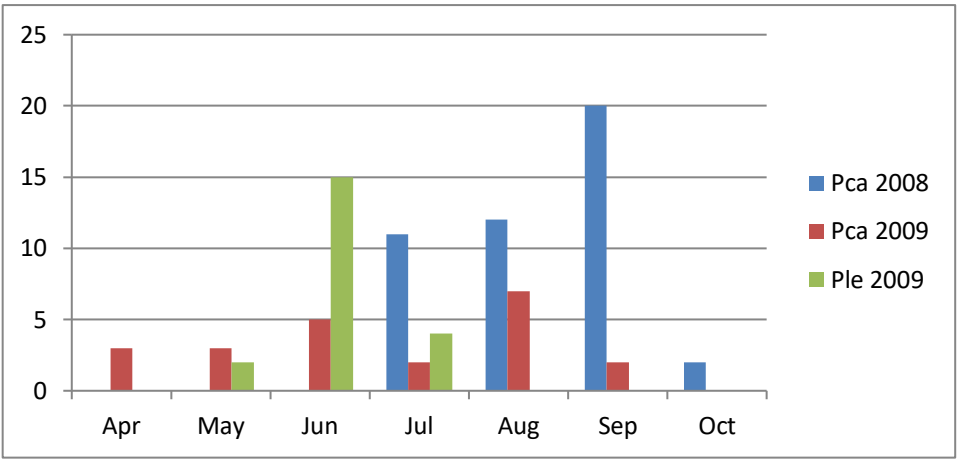

Fig. 7. Seasonal dynamics of *Pipunculus campestris* (Pca) and *P. lenis* (Ple).

In 2008, the first specimens of *P. campestris* were captured in early July, and its occurrence culminated in September. In 2009, the first individuals were captured in April, and its occurrence continued until September with two minor peaks in June and August. *P. lenis* was eudominant in the Phragmitetum in 2009 with an univoltine pattern of seasonal dynamics.

Cephalops ultimus was the most abundant *Cephalops* in 2009 recorded in all studied habitats, except for the wet meadow, where it was present from June till August with a distinct culmination in July (Fig. 8).

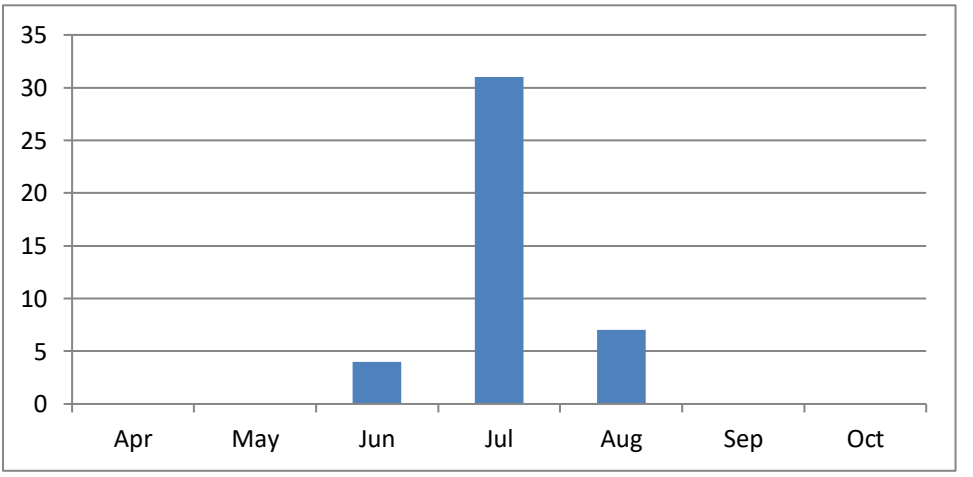

Fig. 8. Seasonal dynamics of *Cephalops ultimus* in 2009.

Tomosvaryella geniculata and *T. kuthyi* occurred in July and August. The capture rate of *T. geniculata* was identical in both months, whereas for *T. kuthyi* the collecting rate has a maximum in July (Fig. 9).

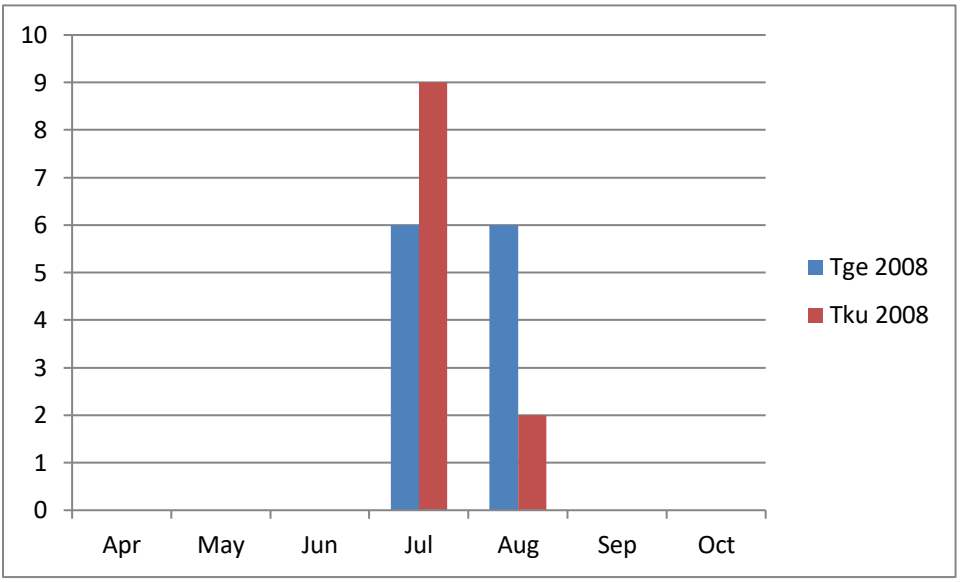

Fig. 9. Seasonal dynamics of *Tomosvaryella geniculata* (Tge) and *T. kuthyi* (Tku) in 2008.

DISCUSSION

The Pipunculidae fauna of the Šúr NR has been studied for almost 40 years and is one of the most intensively investigated insect groups at this locality. Partial information on Pipunculidae found in the Šúr NR was presented in several publications (DE MEYER 1989, JERVIS 1992, KEHLMAIER 2005, KOZÁNEK 1981, 1986, KOZÁNEK & LAUTERER 1987, KOZÁNEK & KEHLMAIER 2004, LAUTERER 1981, STRAKA & MAJZLAN 2010). The identification of Pipunculidae samples collected in the framework of extensive research carried out by a team of entomologists from the Institute of Zoology, Slovak Academy of Sciences in 2008-2009 expanded the list of big-headed flies from Šúr NR to 52 species. This represents half of all Pipunculidae species known from Slovakia. The occurrence of *E. subterminalis* and *D. xanthopus,* which are denoted in the species list by question mark, needs confirmation. Literature data on both species were published before the closely related and morphologically very similar *E. slovacus* and *D. lautereri* were described. The revision of *E. subterminalis* material collected by the first author in the Šúr NR before 1981 revealed that all specimens belong to *E. slovacus.*

Records of *D. xanthopus* published by LAUTERER (1981) are deposited in the Moravian Museum, Brno and were not re-examined. Nevertheless, *E. subterminalis* and *D. xanthopus* are common species and their occurrence in Šúr NR is possible. *Claraeola melanostola, E. angustimembranus* and *E. pannonicus* are reported from Slovakia for the first time. *Claraeola melanostola* is a rare species but at the same time widely distributed in Europe. *Eudorylas angustimembranus*, described on the basis of material that originated from the Korean peninsula, was also recorded from Finland, Germany, Italy, Slovenia and Switzerland. It is considered a rare species and there is no information on its bionomy available. *Eudorylas pannonicus* has a Mediterranean and southern European distribution, its northernmost record is from Budapest, Hungary (KEHLMAIER 2005). In Šúr NR, *E. pannonicus* (Form B in the sense of KEHLMAIER, 2005) was collected in three habitats (Sm, Bs, Wm). In the wet meadow it even belonged to the dominant species. It seems, that this species has recently expanded north due to global climatic changes. This presumption is also confirmed by the finding of this species (*E. pannonicus* Form B) in several localities of southern Slovakia (KOZÁNEK, unpublished data).

The high vegetation diversity in the Šúr NR provides good conditions to analyze the bonds between insect associations and habitats. ROLLER (2010) studied the fauna of sawflies (Symphyta) in the same habitats and years. He found the richest association of sawflies at the biological station (129 species) and in the Phragmitetum (83 species), which are flat open habitats with the highest vegetation diversity. On the contrary, the sawfly association of the Quercetum consisted of 53 species only. In general, species richness of sawfly associations was higher in flat open habitats compared to forest habitats. Similarly, in Pipunculidae associations we have observed higher species numbers in flat open habitats. Some species or species groups possess a distinct binding to a particular habitat. The Phragmitetum was preferred by *Cephalops* (*C. ultimus, C. varipes, C. vittipes*), *Dorylomorpha* (*D. extricata, D. imparata, D. hungarica*) and *P. lenis.* The salt marsh was preferred by *Eudorylas* (*E. obliquus, E. slovacus, E. zermattensis, E. zonatus*), *Tomosvaryella* (*T. geniculata, T. kuthyi*) and *P. campestris.* We can assume that bindings of big-headed flies to particular habitats are determined by bindings of their hosts to particular plants or plant associations occurring in these habitats.

Seasonal dynamics and voltinism have been studied in more than 50 European big-headed fly species. DE MEYER & DE BRUYN (1984) studied the phenology of nine pipunculid species collected by Malaise traps in three localities in Belgium. Five years later, DE MEYER & DE BRUYN (1989) published an extensive study on the phenology of 37 Belgian species based on data of 28 Malaise trap collecting site-year cycles. WALOFF & JERVIS (1987) summarized data on the voltinism of 28 European species completed with the data on the voltinism of

their hosts as well as specification of overwintering stages. In this study, we have analyzed the seasonal dynamics of five eudominant species from Šúr NR. The seasonal occurrence of *P. campestris* reached its peak in late summer. We have recorded a distinct unimodal curve of its seasonal occurrence in 2008, but this curve was bimodal in 2009. In 2008, first individuals of *P. campestris* were collected in the first half of July, whereas in 2009 the species was already on the wing at the end of April and beginning of May. It seems that the climatic conditions at the locality during the early months of spring determine an uni- or bimodal course of seasonal dynamics. A similar course of *P. campestris* seasonal dynamics in two ongoing years at the same locality (Mt. Ruggi, Belgium) was documented by DE MEYER & DE BRUYN (1989). The seasonal dynamics of further eudominant species (*P. lenis, C. ultimus, T. kuthyi, T. geniculata*) have a clear unimodal nature. Univoltine seasonality in *P. lenis* was presented also by WALOFF & JERVIS (1987) and DE MEYER & DE BRUYN (1989). Conversely, DE MEYER & DE BRUYN (1989) presented *T. geniculata* and *T. kuthyi* as bivoltine species in Belgium. The differences in voltinism of these species can be explained by geographic and climatic conditions present at different localities.

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