FAUNISTIC PARTICULARITIES OF THE CHIRONOMID ASSEMBLAGES (DIPTERA: CHIRONOMIDAE) OF THE UPPER-TISZA, NE HUNGARY

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With 3 figures and 2 tables

ABSTRACT: We explored the chironomid fauna of Hungarian section of Upper-Tisza. 23 403 exuviae were sorted, 85 taxa belonging to four subfamilies were identified. In comparison with five other European large rivers, we found the chironomid assemblages of River Tisza to be diverse and relatively original, based on their species composition (presence/absence) and dominance relations of the species.

RESUMO: Estudamos a fauna de quironomídeos da região superior do rio Tisza. Foram amostrados 23 403 exuvios, tendo sido identificados 85 taxa pertencentes a quatro subfamílias. Encontaram-se 27 novos taxa para a fauna Húngara, onde mais de 20 taxa são novos para a fauna do rio Tisza. Comparando o rio Tisza com outros rios Europeus de grandes dimensões (Garonne, Loire, Rhine, Rhône, Vistula), podemos considerar as comunidades de quironomídeos do rio Tisza variadas e relativamente originais.

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INTRODUCTION

The Carpathian Basin is a special biogeographical region in Europe (Illies 1978). The most representative river for this region is the Tisza, since its entire drainage area lies within the Carpathian Basin. Most European large rivers are disturbed by human activities resulting in loss of their original fauna. The flood protection system of Tisza is one of the largest in Europe with strong river bed regulation. As a result of this, the Hungarian section of the Upper-Tisza is characterized by large habitat heterogeneity (e.g. spurs, safety paving along the bank, sandbanks, alternation of slow-flowing and fast-flowing reaches). In addition, the river is endangered by heavy metal pollution from mines in its catchment-area. Despite these conditions the fauna of Tisza remained close-to-natural. Due to this uncommon situation for a large river in Europe, the Tisza is one of the most investigated rivers in Hungary, but its chironomid fauna is poorly known with only about 80 species having been recorded (Móra & Dévai 2004).

The aims of our study were to explore the chironomid fauna of the Hungarian section of Upper-Tisza, and to compare the chironomid communities of this peculiar river with other large European rivers.

MATERIALS AND METHODS

The River Tisza (1358 km length, 157 186 km² catchment) is one of the major rivers of Central Europe, and the second largest river in Hungary. It originates in Ukraine and passes through Romania, Slovakia, Hungary, and Serbia. The study was conducted at one cross-section of the Hungarian reach of the Upper-Tisza between Tiszamogyorós and Lónya, NE Hungary (N 48º19'03", E 22º15'03"), at a sandy section of the river.

Chironomid pupal exuviae were collected by drift net (opening 48×25 cm, mesh size 250 ìm) suspended from a pontoon bridge in the main channel for 10 minutes at midday and at midnight over a 20-day period in July 2003 and during June, July and August 2005, resulting in 58 samples. Because of the high density of exuviae, subsamples ranging from 1/2 to 1/32 of the whole sample (about 200–250 exuviae per sample) were taken. The specimens were identified to species level using keys by Langton & Visser (2003), and Sæther *et al*. (2000). The nomenclature follows Sæther & Spies (2004).

Although it was not easy to select large rivers studied in Europe for comparison due to differences in methodology (e.g. sampling methods, portion of river sampled, number of samples, sampling frequencies) we selected the following rivers to compare their chironomid fauna with River Tisza: Garonne (France) (Garcia & Laville 2001); Loire (France) (Garcia & Laville 2000); Rhine (Germany) (Caspers 1991); Rhône (France) (Franquet & Pont 1996); Vistula (Poland) (Kownacki 1995). Qualitative data were used to compare the species composition and quantitative data (where they were available)

to compare the abundance distribution. The rivers were classified by hierarchical cluster analysis using Jaccard index and complete linkage for binary data, and Chebychev index and complete linkage for number of species belonging to the subfamilies occurred.

RESULTS

Taxonomic composition of Upper-Tisza

About 53,000 pupal exuviae were collected, from which 23,403 exuviae were sorted and identified. A total of 85 taxa belonging to four subfamilies were found (Table 1): 7 Tanypodinae, 1 Diamesinae, 15 Orthocladiinae and 62 Chironominae. A total of 27 new taxa were found for the Hungarian fauna, and a further 20 taxa proved to be new to the River Tisza. It is interesting to note that 3 of the newly recorded species, *Rheotanytarsus rhenanus* Klink, 1983 (8.7%), *Kloosia pusilla* (Linnaeus, 1767) (7.2%) and the *Rheocricotopus chalybeatus* (Edwards, 1929) (2.5) were dominant in the assemblage. Simultaneously the frequency of 66 species was less than 1%.

Subfamily species richness was highest in the Chironominae (Chironomini and Tanytarsini) with 74% (51% and 23% respectively). The most abundant species were *Beckidia zabolotzskyi* (Goetghebuer, 1938) (31.1%), *Rheotanytarsus rhenanus* (8.7%), *Cryptochironomus rostratus* Kieffer, 1921 (8.1), *Kloosia pusilla* (7.2%), *Lipiniella moderata* Kalugina, 1970 (6.2%), *Paracladopelma laminatum* (Kieffer, 1921) (4.3%), and *Chironomus nudiventris* Ryser, Scholl et Wülker, 1983 (4.3%). Orthocladiinae represented 17% of the total species number, but the frequency of only two species was higher than 1%: *Rheocricotopus chalybeatus* (2.5%) and *Nanocladius dichromus* (Kieffer, 1906) (1.7%). Few species of Tanypodinae and Diamesinae were found (8% and 1% of the total number of species respectively) of which only *Rheopelopia ornata* (Meigen, 1838) (1.3%) was relatively frequent.

Uniqueness of chironomid fauna of Tisza

The River Tisza chironomid community was distinct compared to other in European large rivers in several respects. The relative proportion of the Chironominae was highest in Tisza (74%), followed by Rhône (61%), and by the four other rivers (23–51%). Furthermore, the relative proportion of subfamily Orthocladiinae was lowest in Tisza (only 17%), but ranged between 28–62% in the other rivers (Fig. 1).

We also compared the number of unique species (Fig. 2), of each river. The number of unique species of Tisza was relatively high (n=20), the same number as the Loire, and higher only in the case of Rhine (n=24). Three of the frequent species of Tisza, *Beckidia zabolotzskyi, Paracladopelma laminatum* and *Chironomus nudiventris* only occurred in this river, and two of them, *Kloosia pusilla* and *Lipiniella moderata* were found only in one other river. In addition, only *Rheotanytarsus rhenanus* was abundant in one other river (Rhine). In contrast, most of the frequent species of other rivers were also found in Tisza

TABLE 1. List of species found in Tisza with their frequency

	number of individuals			frequency %
	2003	2005	total	
Tanypodinae				
Ablabesmyia longistyla Fittkau, 1962	4	12	**16**	0.07
Conchapelopia hittmairorum Michiels et Spies, 2002	0	1	**1**	0.00
Conchapelopia melanops (Meigen, 1818)	0	1	**1**	0.00
Hayesomyia sp.	0	4	**4**	0.02
Procladius (Holotanypus) sp.	14	0	**14**	0.06
Rheopelopia ornata (Meigen, 1838)	219	78	**297**	1.27
Telopelopia fascigera (Verneaux, 1970)	65	74	**139**	0.59
Diamesinae				
Potthastia gaedii (Meigen, 1838)	13	1	**14**	0.06
Orthocladiinae				
Brillia longifurca (Kieffer, 1921)	0	14	**14**	0.06
Cricotopus bicinctus (Meigen, 1818)	18	18	**36**	0.15
Cricotopus curtus Hirvenoja, 1973	0	3	**3**	0.01
Cricotopus Pe8 Langton, 1991	0	1	**1**	0.00
Cricotopus sylvestris (Fabricius, 1794)	0	1	**1**	0.00
Cricotopus tibialis (Meigen, 1804)	0	2	**2**	0.01
Cricotopus tristis Hirvenoja, 1973	0	1	**1**	0.00
Eukiefferiella claripennis (Lundbeck, 1898)	0	1	**1**	0.00
Nanocladius dichromus (Kieffer, 1906)	223	166	**389**	1.66
Nanocladius rectinervis (Kieffer, 1911)	0	8	**8**	0.03
Orthocladius rubicundus (Meigen, 1818)	0	1	**1**	0.00
Paracricotopus niger (Kieffer, 1913)	0	1	**1**	0.00
Rheocricotopus chalybeatus (Edwards, 1929)	220	362	**582**	2.49
Synorthocladius semivirens (Kieffer, 1909)	3	0	**3**	0.01
Tvetenia calvescens (Edwards, 1929)	0	6	**6**	0.03
Chironominae				
Beckidia zabolotzskyi (Goetghebuer, 1938)	6447	822	**7269**	31.06
Chernovskiia sp.	206	44	**250**	1.07
Chironomus (Chironomus) bernensis Klötzli, 1973	155	9	**164**	0.70
Chironomus (Ch.) nuditarsis Keyl, 1961	44	1	**45**	0.19
Chironomus (Ch.) nudiventris Ryser, Scholl et Wülker, 1983	995	3	**998**	4.26
Chironomus (Ch.) plumosus (Linnaeus, 1758)	8	0	**8**	0.03
Chironomus (Ch.) riparius Meigen, 1804	254	3	**257**	1.10
Chironomus (Lobochironomus) dorsalis Meigen, 1818	5	0	**5**	0.02
Cladopelma virescens (Meigen, 1818)	15	0	**15**	0.06
Cryptochironomus obreptans (Walker, 1856)	3	1	**4**	0.02
Cryptochironomus rostratus Kieffer, 1921	1700	185	**1885**	8.05
Cryptochironomus supplicans (Meigen, 1830)	10	1	**11**	0.05
Cryptotendipes pseudotener (Goetghebuer, 1922)	192	7	**199**	0.85
Cyphomella Pe1 Langton, 1991	4	0	**4**	0.02
Demicryptochironomus vulneratus (Zetterstedt, 1838)	0	2	**2**	0.01
Dicrotendipes nervosus (Staeger, 1839)	112	10	**122**	0.52
Dicrotendipes notatus (Meigen, 1818)	6	0	**6**	0.03
Einfeldia pagana (Meigen, 1838)	33	66	**99**	0.42
Fleuria lacustris Kieffer, 1924	2	0	**2**	0.01
Glyptotendipes pallens (Meigen, 1804)	4	0	**4**	0.02
Harnischia fuscimana Kieffer, 1921	603	216	**819**	3.50
Kiefferulus tendipediformis (Goetghebuer, 1921)	3	2	**5**	0.02
Kloosia pusilla (Linnaeus, 1767)	1557	127	**1684**	7.20
Lipiniella moderata Kalugina, 1970	1430	16	**1446**	6.18
Microchironomus tener (Kieffer, 1918)	2	0	**2**	0.01
Microtendipes chloris (Meigen, 1818)	9	5	**14**	0.06
Paracladopelma laminatum (Kieffer, 1921)	991	12	**1003**	4.29
Paracladopelma Pe2 Langton, 1991	24	14	**38**	0.16
Paralauterborniella nigrohalteralis (Malloch, 1915)	143	5	**148**	0.63
Paratendipes nubilus (Meigen, 1830)	57	115	**172**	0.73
Phaenopsectra flavipes (Meigen, 1818)	2	11	**13**	0.06
Polypedilum acifer Townes, 1945	41	14	**55**	0.24
Polypedilum laetum (Meigen, 1818)	2	0	**2**	0.01
Polypedilum nubeculosum (Meigen, 1804)	92	52	**144**	0.62
Polypedilum pedestre (Meigen, 1830)	54	21	**75**	0.32
Polypedilum cf. *scalaenum*	625	71	**696**	2.97
Robackia demeijerei (Kruseman, 1933)	311	531	**842**	3.60
Saetheria reissi Jackson, 1977	0	1	**1**	0.00
Stenochironomus gibbus (Fabricius, 1794)	0	7	**7**	0.03
Stenochironomus Pe3 Langton, 1991	0	10	**10**	0.04
Stictochironomus crassiforceps (Kieffer, 1922)	11	19	**30**	0.13
Xenochironomus xenolabis (Kieffer, 1916)	6	0	**6**	0.03
Cladotanytarsus Pe9 Langton et Visser, 2003	24	0	**24**	0.10
Cladotanytarsus vanderwulpi (Edwards, 1929)	0	2	**2**	0.01
Micropsectra atrofasciata (Kieffer, 1911)	0	1	**1**	0.00
Paratanytarsus dissimilis (Johannsen, 1905)	0	4	**4**	0.02
Rheotanytarsus pellucidus (Walker, 1848)	0	2	**2**	0.01
Rheotanytarsus photophilus (Goetghebuer, 1921)	37	50	**87**	0.37
Rheotanytarsus rhenanus Klink, 1983	1706	324	**2030**	8.67
Stempellina almi Brundin, 1947	5	0	**5**	0.02
Stempellina bausei (Kieffer, 1911)	8	1	**9**	0.04
Stempellinella brevis (Edwards, 1929)	0	1	**1**	0.00
Tanytarsus brundini Lindeberg, 1963	4	1	**5**	0.02
Tanytarsus curticornis Kieffer, 1911	29	1	**30**	0.13
Tanytarsus ejuncidus (Walker, 1856)	414	9	**423**	1.81
Tanytarsus heusdensis Goetghebuer, 1923	232	6	**238**	1.02
Tanytarsus mendax Kieffer, 1925	0	7	**7**	0.03
Tanytarsus signatus (van der Wulp, 1859)	0	3	**3**	0.01
Tanytarsus sylvaticus (van der Wulp, 1859)	2	0	**2**	0.01
Tanytarsus volgensis Miseiko, 1967	70	11	**81**	0.35
Virgatanytarsus arduennensis (Goetghebuer, 1922)	350	3	**353**	1.51
total number of individuals	19818	3585	**23403**	100

(Table 2). The results of the hierarchical cluster analysis further highlight that the Tisza chironomid community is distinct from the other rivers on the basis both of their species composition and number of species belonging to the subfamilies identified (Fig. 3).

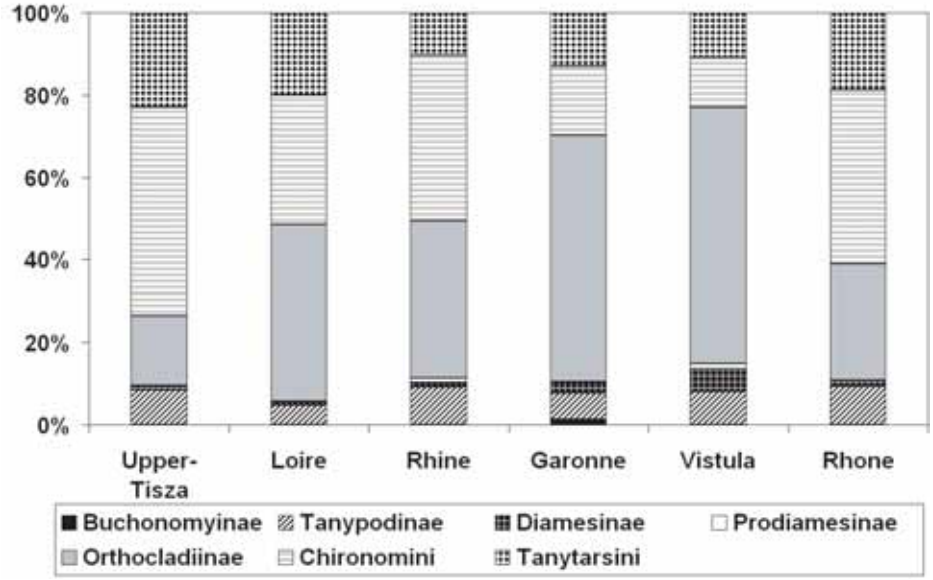

Fig. 1. Subfamily composition of Chironomidae in six European large rivers.

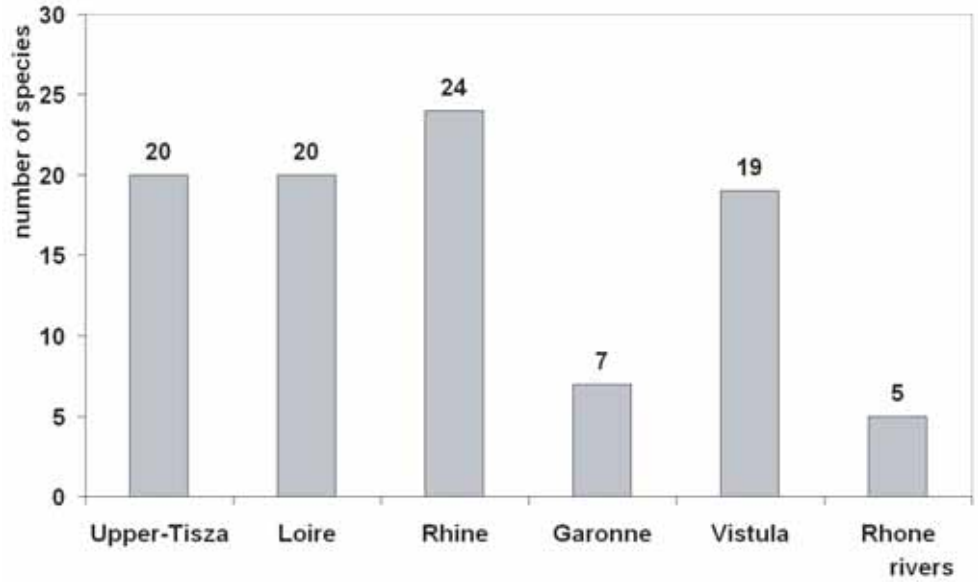

Fig. 2. Number of unique species of Chironomidae in six European large rivers (i.e. species which occurred in only one of the six examined rivers).

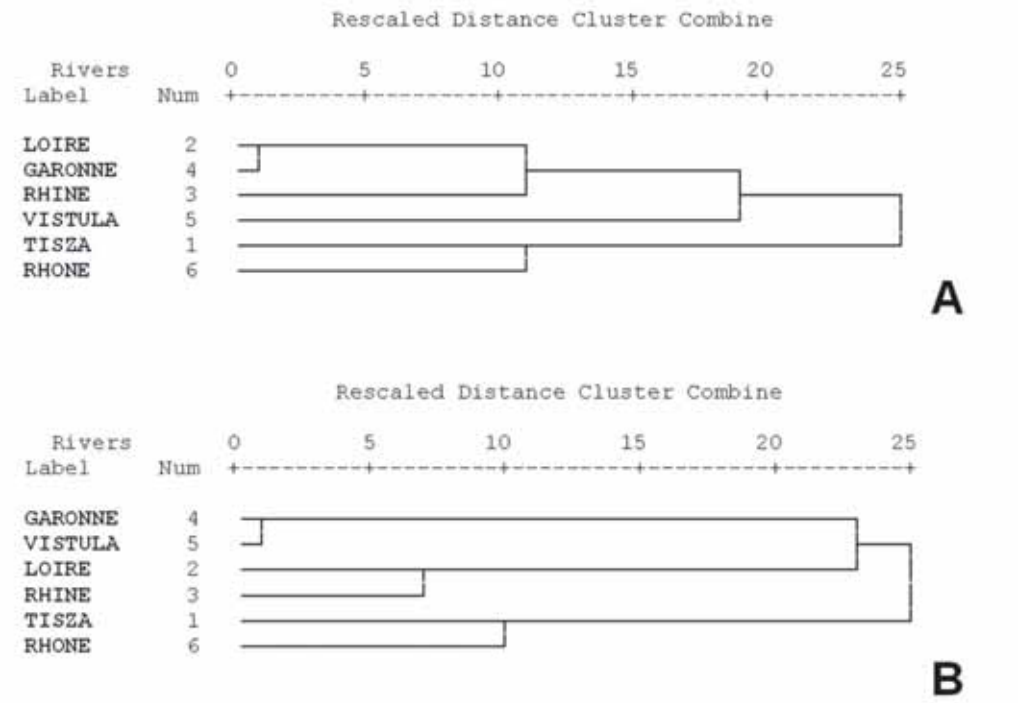

Fig. 3. Hierarchical cluster analysis of the chironomid fauna in six European large rivers. (A) species composition (Jaccard index, complete linkage); B: number of the species belonging to the occuring subfamilies (Chebychev index, complete linkage).

TABLE 2. Occurrence (●) and frequency of dominant species in Tisza and the five other European rivers (Caspers 1991; Franquet & Pont 1996; Garcia & Laville 2000, 2001; Kownacki 1995).

	Upper-Tisza	Loire	Rhine	Garonne	Vistula	Rhone
Cricotopus bicinctus (Meigen, 1818)	●	●	●	9.64	●	●
Cricotopus triannulatus (Macquart, 1826)		6.99	●	●	●	●
Nanocladius dichromus (Kieffer, 1906)	●	7.5	8.1	●	●	●
Orthocladius rivicola Kieffer, 1911		●	●	10.10	●	
Rheocricotopus chalybeatus (Edwards, 1929)	●	●	8.8	5.94	●	
Synorthocladius semivirens (Kieffer, 1909)	●	●	●	22.08	●	●
Beckidia zabolotzskyi (Goetghebuer, 1938)	31.06					
Chironomus nudiventris Ryser, Scholl et Wülker, 1983	4.26					
Cryptochironomus rostratus Kieffer, 1921	8.05	●	●	●		●
Kloosia pusilla (Linnaeus, 1767)	7.20					●
Lipiniella moderata Kalugina, 1970	6.18	●				
Paracladopelma laminatum (Kieffer, 1921)	4.28					
Polypedilum acifer Townes, 1945	●	17.81				
Saetheria reissi Jackson, 1977	●	8.79				
Cladotanytarsus vanderwulpi (Edwards, 1929)	●	22.12				
Rheotanytarsus photophilus (Goetghebuer, 1921)	●		27.1			●
Rheotanytarsus rhenanus Klink, 1983	8.67	●	24.8	●		●

DISCUSSION

In comparison with other European large rivers we found that chironomid fauna of Upper-Tisza to be varied and relatively unique with high species richness and a high proportion of unique species. Members of the subfamily Chironominae dominated and only a relatively low number of orthoclad species occurred in this system. Most of the dominant species found are absent from the other European rivers studied or only occurred in one other river, while frequent species in other rivers also occurred in Tisza. The distinct nature of the Tisza chironomid fauna is probably a result of the special biogeographical situation of this river system and should be taken into account when water quality assessment methods (e.g. AQEM, BMWP, etc.) developed river systems in European regions other than the Carpathian Basin are introduced to the national water quality assessment system.

Sandy sections of European large rivers are characterized by high species richness, primarily due to morphological complexity of the river bed (Garcia & Laville 2000). In the River Tisza this complexity is coupled with strong human impact and highly dynamic hydrological factors resulting in higher habitat heterogeneity and a wide range of ecological conditions, shown by large representation of rare species. The chironomid fauna of European sandy rivers is characterized by the dominance of psammophilous taxa, such as *Polypedilum acifer* Townes, 1945, *Saetheria reissi* Jackson, 1977, and *Robackia demeijerei* (Kruseman, 1933). Among these species only *R. demeijerei* occurred with some frequency (3.6% frequency) in the Tisza, whereas the other two species occurred only occasionally. Another psammophilous species, *Beckidia zabolotzskyi*, was highly dominant in the Tisza, representing one third of the individuals found.

The high proportion of rare species in the rivers studied highlights the importance and notable role of these systems not only in contributing to regional biodiversity (Garcia & Laville 2000) but also as useful descriptors of changes in water quality due to their narrow ecological preferences.

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