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Classification of Water Bodies of the Lower Hron River Based on Chironomid Assemblages (Diptera: Chironomidae)

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Abstract: Chironomid assemblages of the lower Hron River and eight side arms were studied. The aim was to investigate if potamon types could be recognized and distinguished by chironomid assemblages. Therefore, 10 sampling sites were classified into 4 potamon types: eupotamon, parapotamon, plesiopotamon and paleopotamon. Within the eupotamon type, the main channel and the dammed channel section were compared. In total, 66 chironomid taxa were recorded in 2000–2002. In the main channel, rheophilic and rheobiontic taxa predominated, especially the subfamilies Tanypodinae and Orthocladiinae. The most frequent taxa recorded in the dammed section of the Hron River belonged to the tribe Chironomini. A characteristic feature of the studied side arms was the absence of rheophilic chironomids. The highest taxa richness was found in parapotamon type arms in comparison with the plesiopotamon and paleopotamon. Cluster analysis based on presence/absence data of chironomids separated the sites of the main channel (eupotamon) and side arms directly influenced by the main channel (parapotamon, plesiopotamon), from the side arms without direct influence of main channel (paleopotamon). Furthermore, eupotamon sites were well separated form the parapotamon and plesiopotamon type arms.

Key words: Chironomidae, larvae, Hron River, main channel, side arms, types of water bodies, fluvial hydrosystem

INTRODUCTION

A fluvial hydrosystem can be considered in several dimensions: longitudinal, lateral, vertical and temporal (Amoros et al., 1987, Amoros & Bornette, 2002). The present paper focuses on the lateral connectivity that links the main course of a river with floodplain waterbodies. There is a clear relationship between waterbody connectivity, distance from the river, and deposition conditions and the composition of the substratum. The character of sediment plays an important role in providing suitable habitat conditions for benthic macroinvertebrates (Amoros & Bornette, 2002).

Chironomids are excellent indicators of environmental conditions and constitute an important part of the biota of freshwater ecosystems. Therefore, a number of authors have typified water bodies using chironomids (e.g. Brundin, 1958, Aagard, 1986, Verdoschot et al., 1992).

The Hron River is a left-side tributary of the Danube. The 298 km long river has been heavily polluted during recent decades; however, water quality improved at the end of the 1980's (Bitušík et al., 2005, Krno, 2005). The biota of the lower Hron River has been studied by several authors (Kováčik et al., 1988, Elexová, 1998, Lisický et al., 2002, Krno, 2005, 2006, Čejka, 2006). Berczik (1959), Bitušík (1997) and Bitušík et al. (2005) focused on the longitudinal distribution of chironomid taxocenoses.

The aim of this paper is (1) to present the actual chironomid composition of the lower Hron and its side arms, and (2) to investigate if potamon types can be recognized and distinguished by chironomid assemblages.

STUDY AREA AND SAMPLING SITES

Research of the lower Hron River (the main channel and the dammed section), a sixth-order lowland river, as well as eight side arms, was carried out in 2000–2002 at the following localities:

The main channel of the Hron River by the Jur nad Hronom village (Jur). At this stretch, the river was widened and consisted mainly of cobbles and pebbles. Samples were taken from three habitat types representing the main channel: a turbulent section, a moderate stream and a lagoon (a shallow pool by the left bank filled with warm standing water and filamentous algae); samples were pooled together and considered as one sample.

The dammed section of the Hron River near the Turá village (Turá) represents a former river channel, which was dammed by hydraulic structures. To cover the whole heterogeneity of this site, macrozoobenthos was sampled at four different habitat types (different sediment, current, occurrence of macrophyta and filamentous algae) and the samples were pooled together. The above two sites – Jur and Turá – were eupotamon river types.

Side arms along the main channel. Eight side arms were observed, belonging to three classes: parapotamon type (Želiezovce, Vozokany – lower meander), plesiopotamon type (Bíňa, Timon) and paleopotamon type (Svodov – meander, Vozokany – upper meander, Nána, Svodov – gravel deposit). Measured physical-chemical characteristics of the study sites are shown in Table 1.

MATERIAL AND METHODS

Samples of zoobenthos were collected in June, August, October 2000 and May, August 2001 from the main channel; side arms were sampled in May, August, October 2001 and May 2002. Although simultaneous sampling from all sites was done only on two sampling dates, in both cases (main channel and side arms) the same 3 seasons (spring, summer and autumn) were recorded. Moreover, Verdonschot (1992) has demonstrated that for typological studies, seasonal differences as well as inconsistencies due to sampling technique and frequency are of little significance compared to differences in types. Within each sampling site, qualitative kick samples of zoobenthos were collected using a hand net (frame 25 × 25 cm, mesh size 300 μm) disturbing different riparian substrate types and

Table 1: List of the studied sites and their basic physical-chemical characteristics (Lisický et al., 2002). Values represent averages of measurements in 2000–2002. For abbreviations of site names see Fig. 1.

		Eupotamon		Parapotamon		Plesiopotamon		Paleopotamon			
		Jur	**Turá**	**Zeliez**	**Voz_B**	**Timon**	**Bina**	**Svod_A**	**Svod_B**	**Nana**	**Voz_A**
Latitude	N	48°07′46.3″	48°09′13″	48°02′19.1″	48°01′11.3″	48°05′52.1″	47°55′14.3″	48°05′27.9″	48°05′24.7″	47°49′49.7″	48°01′31.6″
Longitud	E	18°36′34.0″	18°35′24″	18°40′07.5″	18°39′43.1″	18°39′16.9″	18°38′39.7″	18°39′09.0″	18°39′04.5″	18°41′38.5″	18°40′35.7″
pH	Units	8.5	8.3	7.1	7.1	7.0	7.9	8.1	8.0	7.6	6.7
Cond	µS/cm	307.8	470.0	1339.1	1544.3	1847.0	2168.0	1513.0	1203.0	1673.0	556.7
Temp	°C	20.0	19.5	16.0	15.2	14.7	23.2	20.6	20.6	22.2	12.6
DO	mg/l	10.1	9.8	9.4	7.4	10.6	10.2	12.9	16.1	7.5	3.3
DO%	Sat	115.2	110.4	98.9	76.3	108.6	124.2	149.4	174.5	89.0	31.8

currents. Quantitative sampling from the medial part of the river was carried out by a Zabolocký grab sampler (100 cm^2). The collected material was preserved in 4% formalin. Organisms were hand-sorted under a stereoscopic microscope; larvae of chironomids were mounted on microscopic slides and identified using keys by Wiederholm (1983) and Bitušík (2000). Autecological characteristics of the taxa were determined according to Bitušík & Hamerlík (2003).

For data analyses, data from various sampling techniques and various sampling dates were pooled. Frequency was calculated as the percentage of occurrences of particular taxa in all samples. Hierarchical classification analysis was performed to find the main groups of sampling sites by the software package CAP (Seaby & Henderson, 2004). The complete linkage method with Jaccard similarity index was used to compare 10 sampling sites based on presence/absence data of a total of 61 chironomid taxa. Only taxa collected in two or more samples were taken into account.

RESULTS AND DISCUSSION

In total, 66 chironomid taxa were identified. The subfamily Chironominae dominated with 34 species, followed by the subfamilies Orthocladiinae (18 taxa), Tanypodinae (10 taxa), Diamesinae (3 taxa) and Prodiamesinae (1 taxon). Table 2 presents all recorded taxa.

The main channel and dammed section (eupotamon)

The first eupotamon type sampling site – the main channel by Jur nad Hronom (Jur) – was represented by 39 chironomid taxa. As expected, rheophilic and rheobiontic taxa predominated. Five taxa, *Thienemannimyia* sp., *Cricotopus bicinctus* gr., *Orthocladius* spp., *Paratrichocladius rufiventris* and *Microtendipes pedellus* gr. constituted up to 67% of the total abundance of chironomid larvae. The most frequent taxa were *Thienemannimyia* sp., *Cricotopus tremulus* gr., *Glyptotendipes* sp. and *M. pedellus* gr., occurring in all samples. A higher ratio of predators of the subfamily Tanypodinae (especially polyoxybiontic and rheophilic larvae of *Thienemannimyia* sp.) compared to the next site was found. In the lagoon – a shallow pool by the left bank – a higher proportion of larvae of the subfamily Chironominae (typical for lenitic habitats) and a lower proportion of rheophilic taxa was observed. However, similarly to the dammed section, rheophilic taxa become predominant in spring 2001.

Bitušík et al. (2005) considered this section of the river to be epipotamal based on 48 chironomid taxa recorded. They discovered a higher relative contribution of predator species in the lower reaches of the river in comparison with the rhitral zone. Krno (2005, 2006) also classified this part of the river as epipotamal based on Trichoptera and Ephemeroptera taxocenoses.

In total, 47 chironomid taxa were recorded at the second eupotamon site – the dammed section of the Hron by Turá village (Turá). The most frequent taxa belonged to the tribe Chironomini: *Cryptochironomus* sp., *Dicrotendipes nervosus*, *Glyptotendipes* sp., *Paratendipes albimanus*, and *Polypedilum scalaenum* gr. However, *Procladius* sp., *Cricotopus bicinctus* gr., *C. tremulus* gr., *Cladotanytarsus* sp. and *Tanytarsus* spp. also occurred with high frequency. Six taxa, *C. bicinctus* gr., *Orthocladius* spp., *D. nervosus*, *Microtendipes pedellus* gr., *Cladotanytarus* sp. and *Tanytarus* sp. had the highest abundances, constituting more than 60 % of all larvae collected. Some eurythermic and eurytopic taxa occurred only in this site (e.g. *Potthastia gaedii, P. longimana* and *Prodiamesa olivacea*). An increase in taxa characteristic for flowing waters (*Orthocladius* spp, *Cricotopus* spp, *Eukiefferiella* sp., *Brillia bifida* and *B. flavifrons*) was found at this site in May 2001. At the same time, the occurrence of the rheophilic Ephemeroptera *Potamanthus luteus* and *Caenis macrura* was noticed. This event could have been caused by increased spring flow, as both rheophilic chironomids and mayflies decreased in abundance or disappeared in the following samples (Lisický et al., 2002).

The higher taxonomic richness in comparison with the main stream was probably caused by higher habitat heterogeneity, i.e. the alternation of still and fast flowing sections, colonies of filamentous algae and occurrence of macrophyta.

Side arms (parapotamon, plesiopotamon and paleopotamon)

A total of 30 chironomid taxa were recorded in eight side arms; 19 of them occurred also in the main channel, 11 were found only in these sites. In particular, they were taxa with obvious affinity to eutrophicated water bodies (*Xenopelopia* sp., *Monopelopia tenuicalcar*, *Tanypus kraatzi*) and eurythermic taxa inhabiting small bodies of still water and the littoral of lakes (*Acricotopus lucens*). Also, taxa tolerating a high degree of eutrophication (*Psectrocladius sordidellus* gr.), larvae fixed to macrophyta (*Endochironomus* sp.) and species typical for small bodies of standing water (*Kiefferulus tendipediformis*) were recorded only in side arms. However, 60% of the total abundance was created by five taxa: *Procladius* sp., *Chironomus* cf. *plumosus* gr., *Paratanytarsus* sp., *Tanytarsus* sp. and *Cricotopus sylvestris* gr.

The characteristic feature of the studied side arms was the absence of rheophilic chironomid taxa. In general, higher taxa richness was recorded in the littoral in comparison with the medial zone of the arms. This could be due to the occurrence of macrophyta but also to different methods of sampling. The highest taxa richness was found in the parapotamon type arms (21 taxa) in comparison with the plesiopotamon and paleopotamon (13 and 19 taxa). However, taxa diversity in these two types varied widely (3 to 15 taxa). Lisický et al. (2002) found that sites with a surface connection with the river (parapotamon and plesiopotamon) were taxonomically richer than disconnected sites (paleopotamon). On the contrary, the most Trichoptera taxa were found in a paleopotamon type arm (Krno, 2005). Moreover, the highest richness of malacofauna was also found in paleopotamon type arms (Čejka, 2006). Krno (2005) noticed no significant differences in the taxonomic composition of Ephemeroptera of these particular side arms. The faunistic importance of these habitats is confirmed by the first records of two chironomid species (*Labrundinia longipalpis* and *Polypedilum nubifer*) in Slovakia (Hamerlík, 2002).

Classification of the sampling sites

Cluster analysis, based on presence/absence data, separated the investigated sites into two basic clusters (Fig. 1). The first cluster A is subdivided into two sub-clusters: A1 consists of the sites Turá and Jur, which represented the main channel of the Hron River (eupotamon). Differential taxa for this sub-cluster were mainly rheophilic taxa: *Thienemannimyia* sp., *Cricotopus bicinctus* gr., *C. tremulus* gr., *Eukiefferiella* sp., *Orthocladius* sp., *Chironomus* cf. *fluviatilis* gr., *Dicrotendipes nervosus*, *Paratendipes albimanus* and *Tanytarsus brundini*. Sub-cluster A2 contained parapotamon type sites (Zeliez and Voz_B); they are joined in dissimilarity of about 0.7 with Bina, which could be characterized as a plesiopotamon type arm. Their common taxa are *Procladius* sp., *Corynoneura scutellata* gr., *Cricotopus sylvestris* gr., *Chironomus* cf. *plumosus* gr., and *Glyptotendipes* spp.

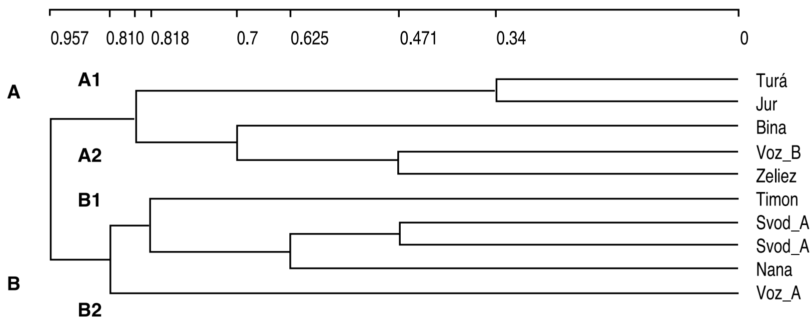

Fig. 1: Cluster analysis (Jaccard index, complete linkage) of sampling sites based on presence/absence data of Chironomidae taxa. Abbreviations of site names: **Turá:** Turá, **Jur:** Jur nad Hronom, **Bina:** Bíňa, **Voz_B:** Vozokany – downer meander, **Zeliez:** Želiezovce, **Timon:** Timon, **Svod_A:** Svodov – gravel deposit, **Svod_B:** Svodov – meander, **Nana:** Nána and **Voz_A:** Vozokany – upper meander.

The second cluster B contains five sites. Cluster B is divided into two sub-clusters: B2 consists of one separated paleopotamon type site (Voz_A); the characteristic feature of this site was very low species richness (3 taxa). Sub cluster B1 contains four sites: three paleopotamon type arms (Nana, Svod_A and Svod_B) and one plesiopotamon type arm (Timon). Classification of Timon into this group could be explained by its specific conditions which are typical for paleopotamon type arms (a very rare direct connection with the main channel, high density of macrophyta). Typical taxa for cluster B were *Acricotopus lucens*, *Paratanytarus* sp. and *Tanytarsus* spp.

Verdonschot et al. (1992) mentioned that most chironomid groups are widely scattered over water types. However, similarly to our results, the differences between running and stagnant water bodies were most striking.

Šporka (1998) performed a typology of water bodies of the middle Danube based on oligochaetes, and clearly distinguished eupotamon, parapotamon and plesiopotamon type water bodies. Unlike chironomid assemblages, oligochaete fauna of the plesiopotamon type side arms were taxonomically more diverse than in parapotamon type arms.

In general, cluster analysis separated sites of the main channel – eupotamon (which constitutes a separate group) and side arms directly influenced by the main channel (parapotamon, plesiopotamon), from side arms without direct influence of the main channel (paleopotamon).

Table 2: List of taxa recorded in sampling sites. For abbreviations of site names see Fig. 1.

Taxa name / site	**Jur**	**Turá**	**Zeliez**	**Voz_B**	**Timon**	**Bina**	**Svod_A**	**Svod_B**	**Nana**	**Voz_A**
Ablabesmyia monilis (Linnaeus, 1758)	+	+	–	–	–	–	+	+	–	–
Thienemannimyia sp.	+	+	–	–	–	–	–	–	–	–
Labrundinia longipalpis (Goetghebuer, 1921)	–	–	–	–	–	–	–	–	+	–
Monopelopia sp.	–	–	+	+	–	–	–	–	–	–
Procladius sp.	+	+	+	+	–	+	+	+	–	–
Tanypus kraatzi (Kieffer, 1912)	–	–	+	+	–	–	–	+	–	+
Tanypus punctipennis Meigen, 1818	–	+	–	–	–	–	–	–	–	–
Xenopelopia sp.	–	–	–	+	–	–	–	–	–	–
Zavrelimyia sp.	+	–	–	–	–	–	–	–	–	–
Tanypodinae gen.sp.	+	+	–	–	–	–	–	–	–	–
Diamesa sp.	+	–	–	–	–	–	–	–	–	–
Potthastia gaedii (Meigen, 1838)	–	+	–	–	–	–	–	–	–	–
Potthastia longimana (Kieffer, 1922)	–	+	–	–	–	–	–	–	–	–
Prodiamesa olivacea (Meigen, 1818)	–	+	–	–	–	–	–	–	–	–
*Acricotopus lucens (*Zetterstedt*, 1850)*	–	–	+	–	+	–	+	+	+	–
Brillia longifurca Kieffer, 1921	–	+	–	–	–	–	–	–	–	–
*Brillia modesta (*Meigen*, 1830)*	–	+	–	–	–	–	–	–	–	–
Chaetocladius dentiforceps gr.	–	–	–	–	–	–	+	–	–	–
Corynoneura scutellata gr.	–	+	+	+	+	+	+	–	–	–
Cricotopus spp.	+	+	–	–	–	–	–	–	–	–
Cricotopus bicinctus gr.	+	+	–	–	–	–	–	–	–	–
Cricotopus sylvestris gr.	+	+	+	+	+	+	+	+	–	–
Cricotopus tremulus gr.	+	+	–	–	–	–	–	–	–	–
Eukiefferiella sp.	+	+	–	–	–	–	–	–	–	–
Nanocladius bicolor (Zetterstedt, 1838)	+	+	–	–	–	–	–	–	–	–
Orthocladius spp.	+	+	–	–	–	–	–	–	–	–
*Paratrichocladius rufiventris (*Meigen*, 183–)*	+	+	–	–	+	–	–	–	–	–
Psectrocladius (Allopsectrocladius) sp.	+	–	–	–	–	–	–	–	–	–
Psectrocladius (*Mesopsectrocladius*) sp.	–	–	–	–	–	–	+	–	–	–
Psectrocladius sordidellus gr.	–	–	–	–	+	–	–	+	–	–
*Rheocricotopus fuscipes (*Kieffer*, 1909)*	+	+	–	–	–	–	–	–	–	–
*Synorthocladius semivirens (*Kieffer*, 1909)*	+	+	–	–	–	–	–	–	–	–
Cladopelma sp.	–	+	+	+	–	–	+	+	+	–
Cryptochironomus sp.	+	+	+	–	–	+	–	–	–	–
Chironomus cf. *fluviatilis* gr.	+	+	–	–	–	–	–	–	–	–
Chironomus cf. *plumosus* gr.	–	–	+	+	–	+	+	–	–	+
Chironomus cf. *reductus* gr.	–	+	–	–	–	–	–	–	–	–
Chironomus cf. *thummi* gr.	+	+	+	+	–	–	–	+	+	–
Demicryptochironomus vulneratus (Zetterstedt, 1838)	+	–	–	–	–	–	–	–	–	–
Dicrotendipes nervosus (Staeger, 1839)	+	+	–	–	–	–	–	–	–	–

Table 2: (continued)

Taxa name / site	Jur	Turá	Zeliez	Voz_B	Timon	Bina	Svod_A	Svod_B	Nana	Voz_A
Einfeldia /Chironomus sp.	+	+	–	–	–	–	–	–	–	–
Einfeldia cf. *pectoralis*.gr.	+	–	–	–	–	–	–	–	–	–
Endochironomus sp.	–	–	+	+	–	–	–	–	–	–
Glyptotendipes spp.	+	+	+	+	–	+	–	–	–	–
Harnischia cf. *fuscimana* Kieffer, 1921	–	+	–	–	–	–	–	–	–	–
Kiefferulus tendipediformis (Goetghebuer, 1921)	–	–	–	+	–	–	–	–	–	–
Microchironomus cf. *tener*	–	–	–	–	–	+	+	–	+	–
Microtendipes pedellus gr.	+	+	–	–	–	–	+	+	–	–
Microtendipes rydalensis gr.	–	+	–	–	–	–	–	–	–	–
Parachironomus arcuatus gr.	–	–	–	+	–	–	–	–	–	–
Paratendipes albimanus (Meigen, 1818)	+	+	–	–	–	–	–	–	–	–
Phaenopsectra sp.	+	+	–	–	–	–	–	–	–	–
Polypedilum convictum gr.	+	+	–	–	–	–	–	–	–	–
Polypedilum nubeculosum gr.	+	+	–	–	–	+	–	–	–	–
Polypedilum nubifer (Skuse, 1889)	+	–	+	+	–	–	–	–	–	–
Polypedilum pedestre gr.	+	+	–	+	–	–	–	–	–	–
Polypedilum scalaenum gr.	+	+	–	–	–	–	–	–	–	–
Polypedilum sp.	+	+	–	–	–	–	–	–	–	–
Stictochironomus sp.	–	+	–	–	–	–	–	–	–	–
Cladotanytarsus sp.	+	+	–	–	–	+	+	–	–	–
Micropsectra sp.	–	+	–	–	–	–	–	–	–	–
Paratanytarsus sp.	+	+	–	+	+	+	+	+	+	+
Rheotanytarsus sp.	+	+	–	–	–	–	–	–	–	–
Tanytarsus brundini	+	+	–	–	–	–	–	–	–	–
Tanytarsus cf. *mendax* Kieffer, 1925	+	+	–	+	–	–	+	–	–	–
Tanytarsus spp.	+	+	+	–	–	–	+	+	+	–

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