Joint Danube Survey 2

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1 Introduction

Benthic macroinvertebrates are commonly applied for the quality assessment of rivers (BIRK & HERING, 2002). The good knowledge of their environmental needs, and of species' responses to various environmental factors, has led to these organisms being widely used as (bio)indicators in water management and in applied ecology (see DAVIS & SIMON, 1995; ROSENBERG & RESH, 1995). Numerous commonly used biological assessment systems for rivers and streams are based on so-called "metrics" or – synonymously used – "measures" or "biological attributes". The requirements of the European Water Framework Directive (EC, 2000/60; WFD) for an integrated assessment methodology to evaluate the ecological status of water bodies are a big challenge for the applied limnological sciences. To assess the ecological status of a water body selected attributes of the biological indicators have to be considered, and compared to relevant target values under reference conditions. As a consequence, new assessment systems and evaluation techniques had to be developed throughout Europe during the last few years. Among other approaches, the applicability of multi-metric techniques, i.e. combinations of several metrics and indices addressing different stressors or different components of the biocoenosis, has been tested (BRABEC et al., 2004; BUFFAGNI et al., 2004; LORENZ et al., 2004; OFENBÖCK et al., 2004; PINTO et al., 2004; SANDIN et al., 2004; VLEK et al., 2004).

Several earlier studies targeted the longitudinal survey of benthic macroinvertebrates along the entire Danube River prior to the implementation of the European Water Framework Directive (EC, 2000/60; WFD). The results of earlier significant expeditions organized by the IAD (1990) are available (RUSSEV 1998). The aim of the Equipe Cousteau sampling program was to measure sediment quality along 50 sampling sites in the Danube River detecting organic and inorganic micropollutants. Aquatic macroinvertebrates and Unionidae mussel species were also collected during the sampling program (EQUIPE COUSTEAU 1992). JDS1 was organized for taking into considerations the WFD requirements carrying out macroinvertebrate sampling. Data of grab samples were reported only taking the results gained by polyp grab of the Argus laboratory ship for sampling on hard rocky substrates (ICPDR 2002). The AQUATERRA 5th FP project included 30 sampling sites (both, left and right sides) providing detailed data set about the Danubian benthic community by both, kick & sweep, and, grabbing method, as well (SLOBODNIK et al. 2005; CSÁNYI & PAUNOVIC 2006).

For large rivers like the Danube appropriate sampling methods for the benthic invertebrate fauna are under discussion and WFD compliant assessment methods in terms of sampling methods and sampling size are still lacking. During JDS 2, benthic invertebrates were sampled using standardised methods and this data can be used to evaluate the ecological status of the Danube in a harmonised way. The following chapters describe the methods applied, the characteristics of the macroinvertebrate community along the Danube and show a possibility for the application of WFD compliant assessment methods for the Danube River.

2 Methods

2.1 Sampling

For the JDS 2 the Airlift technique and the Multicorer technique were used as standard methods; for both of them equipment mounted on the ship were used. Beside these standard methods the common kick & sweep sampling (K&S) was used for collecting benthic macroinvertebrates (EN 27828:1994) from the shallow bank zone of the Danube (on 74 sites) and the tributaries (on 9 sites) for the purpose of comparison of sampling efficiency regarding diversity and abundance, and usability in standard monitoring programmes, and for comparability with results from previous surveys.

Due to coincidental flooding and elevated water level after the 2nd Iron Gate reservoir, K&S was not a useful method anymore. Therefore on JDS65-JDS96 sites dredging was the alternative sampling tool. Altogether 32 cross sections were sampled by the dredge on the lower Danube (6 tributaries), 13 samples were taken additionally from the middle zone of the Danube. Some experimental dredging was applied on the middle Danube section too, in order to try out the application of the method in very deep water conditions (> 6 m).

A total of 96 sites have been sampled. At each site 6 sampling units, 3 on the left and 3 on the right riverside, were taken and pooled to one sample. At sites where substrate composition or water velocity varied largely between the banks, the samples from the left and the right side have been stored separately.

2.1.1 Airlift sampling technique

During JDS 2 benthic macroinvertebrates were sampled from the river bottom (depths between 1.2m and 11.5m; average 4.9m) by the Airlift sampling method (PEHOFER, 1998) at 81 sites.

The collecting cylinder is made of stainless steel (diameter 23 cm, height 40 cm) with a reinforced, serrated lower edge to facilitate penetration of the sediment by sideways rotating movements of the sampler controlled by the operator on the surface. Sampling area is 434 cm². The lowest part of the suction pipe (50 cm in length, inner diameter l0 cm) is also made of stainless steel. Its serrated lower edge ends 2cm above the low edge of the collecting cylinder. Six air outlets are situated 8 cm above the lower end, directed 45 degrees upwards and slightly out of axle alignment to provide for a twist in the rising air stream. The suction pipe can slide upwards for 10 cm enabling vertical movements (to prevent clogging and facilitate the uptake of sediment) while the outer cylinder stays in the substratum. The suction pipe consists of different lengths of aluminium pipes (200cm, 150cm, 100cm and 50cm sections). The tubes have flanged ends with rubber gaskets and are joined with clamp-chains. This provides for easy and rapid adjustment of the length of the suction pipe according to water depth at the sampling point. The top end contains a curved section. which ensures a smooth and undisturbed flow of the sample into the inclined discharge tube (diameter 15 cm) respectively the sampling net. Excess air and water is vented through an opening (covered by 100 µm steel mesh) in the underside of the discharge tube. The sampling net consists of two parts: The inner net with a metal ring at its mouth is made of 1 cm-mesh size fishing net to retain larger stones.

The outer net with a mesh size of 500µm to retain smaller sediment fractions and animals has a mouth diameter of 40cm and a length of 100cm, providing ample space to minimize clogging. The outer net is folded around the inner net. The nets are secured to the discharge tube by means of a web strap. A 4.3 kW generator powers an electric compressor, holding a 100-liter air-tank, from which compressed air is supplied to the air outlets near the lower end of the suction pipe via a pressure hose. Working pressure is 10 bar. On a pressure decrease to 7 bar the compressor automatically starts refilling the air-tank. No adjustments in air pressure are made for different water depths. Fully extended, the sampler weights around 60 kg.

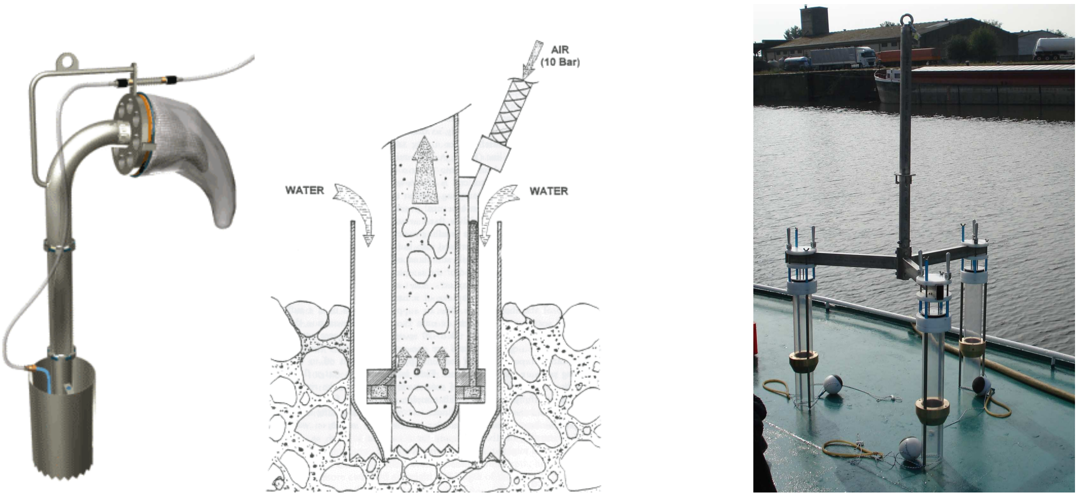


Figure 1. Left: Airlift device (from PEHOFER, 1998, modified), right: Multicorer (Photo P. Leitner)

2.1.2 Mulrticorer sampling technique

At sites dominated by fine sediments sampling was done by a multi-corer (6 sites). This sampling tool consists of 3 cores with a diameter of 9 cm each, mounted on a rack and was also moved by crane and again dependent on the ship. . Equivalent to the airlift method 3 sampling units on each bank were taken.

The sampling area of the multicorer is equivalent to a 6,5th part of the area of the air-lift and has to be projected in the evaluation. The extracted sediment was rinsed through a net with 500 µm mesh-size again. This sampling rack

On certain sites due to low water level or very fine sediments the Multi Habitat sampling method (9 sites, mostly tributaries) and the Multicorer sampling method (6 sites) respectively were applied.

2.1.3 Multi-Habitat-Sampling (MHS)

If the ship could not enter the mouth of tributaries or arms due to low water level and the water is wadeable, 6 single kick-samples were taken (9 sites). The proposed sampling gear to be applied in that case was the AQEM/STAR net sampler (Figure 2). This methodology may be used irrespective of any crane or ship. The sampling sites were cruised by motorboat.

The frame size of the sampler net is 25 x 25 cm, the mesh size of its net is again 500µm.

Figure 2. AQEM/STAR netsampler (Photo: UWITEC)

The MHS methodology is based on the Rapid Bioassessment Protocols (BARBOUR et al. 1999), the procedures of the Environment Agency of England and Wales (MURRAY-BLIGH 1999), the Austrian Guidelines for the Assessment of the Saprobiological Water Quality of Rivers and Streams (Moog et al. 1999), ISO 7828, the Aqem sampling manual (2002), the AQEM & STAR site protocol (2002), the German methodology as described in www.fliessgewaesserbewertung.de, and the Austrian Standards M 6232 and M 6119-2.

The original method focuses on a multi-habitat scheme designed for sampling major habitats in proportion to their presence within a sampling reach. A sample consists of 20 "sampling units" taken from all habitat types at the sampling site, each with a share of at least 5 % coverage.

As decided in the overall agreed outcome of the JDS2 Subgroup Meeting held on 15.05.2007 in Vienna and of the JDS2 Kick-off Meeting on 07. and 08.06.2007 in Belgrade each JDS2-sample consists of 6 sampling units only, comparable to both other methods.

2.1.4 Kick and sweep

The kick & sweep (K&S) sampling technique (EN 27828:1994) was used in the shallow bank zone of the Danube (on 74 sites) and the tributaries (on 9 sites). A hand net with 500µm mesh size was used for sampling up to a water depth of 1.5 m. The majority of habitat types at the bank zone were included in the sampling program.

2.1.5 Dredging

At sites due to deep water conditions dredging was applied parallel to the bank downstream direction from motor boat, pulling a triangular dredge on a long rope. The size of the forked opening of the dredge was 25 cm. The dredge was filled up with bottom material after few meters of pulling that made the samples semi-quantitative and comparable to each other.

Due to the elevated water levels downstream of the 2nd Iron Gate reservoir on the sites JDS65 to JDS96 dredging was used as alternative sampling technique - altogether 32 cross sections (including 6 tributaries) were sampled with a triangular dredge (opening of 25 cm). All of the sub-samples (Right, Middle and Left) were handled separately for later spatial analysis.

2.2 Sorting

The material collected by Airlift/Multicorer/MHS was rinsed through a net with 100 µm mesh-size. Samples were pooled and the material was preserved in formaldehyde (4%) on board and then stored for further determination in the laboratory at the BOKU in Vienna. After a curing time of at least 2 weeks the material of each sample was sorted completely. The animals were counted, separated into their specific orders, weighted and determined by taxonomic experts to the best level possible.

The material collected with K&S and dredging was rinsed through a net with 500 µm mesh-size. The collected material was preserved in formaldehyde (4%) on board. The samples were sorted completely at the VITUKI in Budapest, dividing the material into different taxonomic groups for further taxonomic determination by experts to the best level possible.

2.3 Analysis

To ensure harmonised data storage the species per site information was filled into the Access-based software ECOPROF 3.0.1 (Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 1995-2007), which is compatible with the ICPDR database. For the calculation of metrics and saprobic indices only WFD compliant (semi-)quantitative and area related approaches (Airlift and MHS) were used. Species list, diversity as well as cluster analyses for typological conclusions were based on all data collected during JDS 2 combining all methods.

2.3.1 Saprobic index and calculation of metrics

2.3.1.1 Saprobic Index

Saprobic indices based on the Fauna Aquatica Austriaca ed. by MOOG (1995) were calculated based on available national methods using the software packages ECOPROF 3.0.1. and ASTERICS/PERLODES (www.fliessgewaesserbewertung.de). For calculations based on the Makovinska-catalogue, a database has been created and linked with ECOPROF. For the calculation of saprobic indices based on German and Czech Standards, data have been exported to Excel and imported into the AQEM assessment software.

$$SI = \frac{\sum_{i=1}^{n} s_i \times A_i \times G_i}{\sum_{i=1}^{n} A_i \times G_i}$$

s_i = saprobic value of the ith taxon

A_i = abundance value of the ith taxon

G_i = indicative weight of the ith taxon

n = number of taxa

2.3.1.2 Calculation of metrics

More than 200 biological metrics were calculated based on the biological data on benthic invertebrates (taxa lists, abundance). For the calculation of metrics the software package ECOPROF 3.0.1 was used, for some additional metrics the assessment software ASTERICS/PERLODES was applied. For further statistical analysis and graphical visualisation of metric values the software package STATISTICA 7.1 (StatSoft. Inc., 2005) was used.

2.3.1.3 Identification of candidate metrics

All sampling sites were assigned to river reaches and roughly pre-classified to free flowing sites and impounded sites. Sites that were already classified as 'at risk' because of organic pollution were excluded from the analysis. All metrics were analysed concerning their ability to distinguish between free flowing sections and impounded sites. Descriptive statistics (central tendency, range, distribution, outliers) were used to characterize metric performance. Metrics with insufficient data or too many zero values as well as metrics that could not discriminate sufficiently among sites of different conditions were eliminated. The remaining metrics were chosen as possible candidates for assessing the ecological status of the Danube river.

2.3.1.4 WFD-compliant criteria for assigning the ecological status

Much information has already been compiled with respect to hydrobiological (reference) conditions in the Danube basin (e.g. 'WFD Roof Report' ANNEX 3: Typology of the Danube River and its reference conditions [ICPDR, 2005]). Nevertheless, currently no WFD-compliant metrics yet (officially) have been defined or agreed (Buijs 2006).

2.3.1.5 Organic pollution

For monitoring the organic pollution the saprobic system has a long tradition – the WFD compliant implementation of this system is based on the deviation of the Saprobic Index from saprobic reference conditions (STUBAUER & MOOG, 2003, OFENBÖCK et al., 2007, ROLAUFFS et al., 2003). BMWP and ASPT are alternative indices that are widely used for assessment.

For the indication of water quality classes the threshold values given in **Error! Reference source not found.** were applied (BUIJS, 2006). For the upper reach the existing national determinations are used. In Germany the reference values are 1.80 for national type 9.2 and 1.85 for type 10 respectively. In Austria the reference conditions are defined as 1.75 for ecoregion 9 (Stubauer & Moog 2003) and 2.0 for ecoregion 11. Stubauer & Moog suggested in their report "Integration of the Saprobic System into the Assessment Approach of the WFD – a Proposal for the Danube River" (Sommerhäuser et. al., 2003) a saprobic index of 2.0 as the highest threshold reference value for the Danube sections downstream. This value is consequently used as the saprobic basic condition for the middle and lower reach.

Table 1. Threshold values for the indication of water quality classes based on organic pollution.

Ecological status class	Saprobic reference condition (range of Saprobic index)			
I – High	1.65 – 1.80*	1.75 - 1.85*	≤ 1.75**	≤ 2.00**
II – Good	1.81 – 2.25	1.86-2.30	1.76 – 2.21	2.01 – 2.40
III – Moderate	2.26 – 2.85	2.31 – 2.90	2.22 – 2.68	2.41 – 2.80
IV – Poor	2.86 – 3.40	2.91 – 3.45	2.69 – 3.14	2.81 – 3.20
V – Bad	>3.40	>3.45	>3.15	>3.21

* reference conditions and class boundaries in Germany – for national types 9.2 and 10.
** reference conditions and class boundaries for the Danube in Austria.

2.3.1.6 General Degradation

Up to now the river quality was basically evaluated by assessing organic pollution. To achieve the demands for an integrated biological assessment for macroinvertebrates and to assess the ecological status of a water body the taxonomic composition, abundance, ratio of disturbance sensitive taxa to insensitive taxa, and the diversity of biological indicators, have to be considered and compared to respective target values under reference conditions. The aim of JDS2 was not to develop an assessment system but to find valuable measures that could be integrated into future assessment systems.

2.3.2 Multivariate analysis of Airlift/Multicorer/MHS data

2.3.2.1 Non-metric Multidimensional Scaling (NMS; KRUSKAL 1964):

For exploring similarities or dissimilarities in data, based on taxa composition in our case, the statistical technique non-metric multidimensional scaling (NMS) was used. It is a special case of ordination to verify the existing Danube sections. An NMS algorithm starts with a matrix of item-item similarities, then assigns a location of each item in a low-dimensional space, suitable for graphing or 3D visualisation. Similar objects are near each other and dissimilar sites are further from each other. The Sorensen (Bray-Curtis) -coefficient (SØRENSEN 1948) was used to determine the distance measure, the number of runs was 50 and the number of axes *k* was 3. The data are presence/absence transformed, the results presented as a scatterplot. According to KRUSKAL (1964, in HARTUNG & ELPELT 1999) stress values < 0.05 are described as good results, values between 0.1 und 0.15 as satisfying and values between 0.15 und 0.2 as sufficient.

2.3.2.2 Cluster analysis

The purpose of cluster analysis is to define groups of items based on their similarities (McCune et al. 1999). For determining the distance measure the Sorensen (Bray & Curtis) coefficient (SØRENSEN 1948) was used again. Group linkage method was Flexible Beta (Beta = 0.25). The data are presence/absence transformed. The results are presented as a dendrogram.

2.3.3 Multivariate analysis of K&S sample data

2.3.3.1 PCA analysis

In order to achieve different identical Danube sections, centred PCA was used from the SYN-TAX program package (PODANI 2001) analysing the faunal data set. The “Convex polygon” method was used to illustrate different sampling locations belonging to the similar section. Logarithmic individual numbers of individuals were used, the rare species set was omitted (except characteristic Danubian Odonata- and *Hydropsyche*-taxa) and the first cross section upstream Iller (JDS1) was not taken into consideration, as well.

3 Results and Discussion

3.1 Total taxa

In total 441 invertebrate taxa were documented by combining all methods (Airlift, Multicorer, MHS; Kick & Sweep and Dredging) during JDS 2 and listed in Table 2.

Table 2. List of all taxa found during JDS 2

TAXA	DANUBE: UPPER REACH	DANUBE: MIDDLE REACH	DANUBE: LOWER REACH	DANUBE: ARMS	TRIBUTARIES
PORIFERA					
Eunapius carteri			x		
Spongilla lacustris	x	x		x	
Spongillidae Gen. sp.	x	x	x	x	x
TURBELLARIA					
Dendrocoelum romanodanubiale		x			
Dugesia sp.	x				
Dugesia tigrina		x		x	
Planaria sp.				x	
NEMATODA					
Nematoda Gen. sp.	x	x	x		x
GASTROPODA					
Theodoxus danubialis ssp.		x	x		x
Theodoxus fluviatilis	x	x	x	x	x
Theodoxus transversalis			x		
Theodoxus sp. juv.			x		
Viviparus acerosus	x	x	x	x	x
Viviparus viviparus		x	x	x	
Lithoglyphus naticoides	x	x	x	x	x
Potamopyrgus antipodarum	x	x			x
Bithynia tentaculata	x	x	x	x	x
Esperiana esperi		x	x		
Holandriana holandrii		x	x		
Microcolpia acicularis		x	x		x
Borysthenia naticina	x	x		x	x
Valvata cristata	x				
Valvata piscinalis piscinalis	x	x	x		x
Acroloxus lacustris		x			
Radix ovata	x	x	x		x
Physa fontinalis		x			
Physella acuta			x		x
Ancylus fluviatilis	x	x			x
Anisus sp.	x				
Gyraulus albus	x				
Gyraulus sp.	x			x	
Planorbis carinatus	x				
Planorbarius corneus				x	
Planorbidae Gen. sp.	x				
BIVALVIA					
Corbicula fluminalis	x	x			
Corbicula fluminea	x	x	x	x	x
Anodonta anatina	x	x	x	x	x
Pseudanadonta complanata		x	x		x
Sinanodonta woodiana		x	x	x	x
Unio crassus ondovensis		x			x
Unio pictorum latirostris	x	x	x	x	x
Unio sp. juv.	x	x			x
Unio tumidus zelebori		x	x	x	x
Dreissena bugensis		x	x		
Dreissena polymorpha	x	x	x	x	x
Pisidiidae Gen. sp.		x			
Pisidium sp.	x	x		x	x
Musculium lacustre		x			
Pisidium nitidum	x	x		x	x
Pisidium casertanum ponderosa	x	x			
Pisidium henslowanum	x	x		x	
Pisidium (H.) supinum	x	x		x	x
Pisidium (O.) moitessieranum	x	x			
Pisidium (P.) amnicum	x	x	x	x	x
Pisidium (P.) subtruncatum	x	x		x	
Sphaerium corneum ssp.	x	x		x	x
Sphaerium rivicola	x	x	x	x	x
Sphaerium sp.	x	x			
Sphaerium solidum		x		x	x
POLYCHAETA					
Hypania invalida	x	x	x	x	x
Manayunkia caspica					x

TAXA	DANUBE: UPPER REACH	DANUBE: MIDDLE REACH	DANUBE: LOWER REACH	DANUBE: ARMS	TRIBUTARIES
OLIGOCHAETA					
Oligochaeta Gen. sp.	x	x	x		x
Haplotaxis gordioides		x	x		
Criodrilus lacuum	x	x	x	x	x
Eiseniella tetraedra	x	x	x		
Lumbricidae Gen. sp.			x		
Dero obtusa		x	x	x	x
Nais alpina		x			
Nais bretscheri		x			
Nais christinae			x		
Nais communis		x			
Nais pardalis			x	x	
Nais pseudobtusa		x			
Nais simplex		x			
Nais sp.		x			
Ophidonais serpentina		x	x		x
Piguetiella blanci					x
Stylaria lacustris	x	x	x		
Aulodrilus japonicus			x		x
Aulodrilus limnobius		x	x		x
Aulodrilus pluriseta	x	x	x		
Bothrioneurum vejdovskyanum			x		
Branchiura sowerbyi		x	x		x
Embolocephalus velutinus		x	x		
Isochaetides michaelseni	x	x	x		x
Limnodrilus claparedeianus	x	x	x	x	x
Limnodrilus hoffmeisteri	x	x	x	x	x
Limnodrilus profundicola	x	x	x		x
Limnodrilus sp.	x	x	x	x	x
Limnodrilus udekemianus	x	x	x	x	x
Potamothrix bavaricus	x				
Potamothrix danubialis	x	x	x	x	x
Potamothrix hammoniensis	x	x			
Potamothrix isochaetus	x	x	x	x	x
Potamothrix moldaviensis	x	x	x	x	x
Potamothrix sp.	x	x	x		x
Potamothrix vejdovskyi	x	x	x		
Psammoryctides albicola	x	x	x	x	x
Psammoryctides barbatus	x	x	x	x	x
Psammoryctides moravicus		x	x	x	x
Psammoryctides sp.	x	x		x	
Rhyacodrilus coccineus	x				
Tubifex ignotus		x			
Tubifex tubifex	x	x	x		x
Tubificidae Gen. sp.	x	x	x	x	x
Enchytraeidae Gen. sp.		x			x
Propappus volki	x	x	x		x
Bythonomus lemani	x				
Lumbriculidae Gen. sp.	x	x	x		x
Lumbriculus variegatus	x				
Rhynchelmis limosella	x				
Stylodrilus heringianus	x	x	x	x	x
Stylodrilus sp.		x			x
HIRUDINEA					
Hirudinea Gen. sp.	x	x	x		x
Piscicola geometra	x	x	x		
Glossiphonia complanata	x	x	x	x	x
Glossiphonia sp.	x	x		x	
Glossiphoniidae Gen. sp.		x		x	
Helobdella stagnalis	x	x	x		x
Dina punctata	x	x			
Dina sp.	x	x			x
Erpobdella octoculata	x	x	x	x	x
Erpobdella sp.		x		x	
Erpobdellidae Gen. sp.	x	x			
CLADOCERA					
Cladocera Gen. sp.			x		x

TAXA	DANUBE				
	UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES
COPEPODA					
Copepoda Gen. sp.			x		x
MYSIDACEA					
Hemimysis anomala	x	x	x		x
Katamysis warpachowsky		x			
Limnomysis benedeni	x	x	x		x
AMPHIPODA					
Corophium curvispinum	x	x	x	x	x
Corophium robustum	x	x	x	x	x
Crangonyx pseudogracilis	x				
Dikerogammarus sp.	x	x	x	x	x
Dikerogamm. bispinosus	x	x	x		x
Dikerogamm. haemobaphes	x	x	x		x
Dikerogamm. villosus	x	x	x	x	x
Echinogammarus ischnus	x	x	x	x	x
Gammaridae Gen. sp.	x	x	x	x	x
Gammarus fossarum	x				x
Gammarus pulex	x				
Gammarus roeselii	x				x
Obesogammarus obesus	x	x	x	x	x
Pontogammarus sarsi			x		
ISOPODA					
Isopoda Gen. sp.			x		
Asellus aquaticus	x	x	x		
Proasellus meridianus				x	
Jaera istri	x	x	x		x
DECAPODA					
Astacus leptodactylus		x	x		x
Orconectes limosus		x	x	x	x
HYDRACHNIDIA					
Hydrachnidia Gen. sp.					x
EPHEMEROPTERA					
Baetis buceratus	x				x
Baetis fuscatus	x	x			x
Baetis liebenauae	x				
Baetis muticus	x				
Baetis pentaphlebodes	x				
Baetis rhodani	x				
Baetis scambus	x				
Baetis vardarensis	x				
Baetis sp.	x				x
Baetis vernus	x				
Baetopus tenellus					x
Centroptilum luteolum	x				
Cloeon dipterum	x		x		
Procloeon bifidum					x
Procloeon sp.		x			
Ecdyonurus dispar	x				
Ecdyonurus sp.	x				
Ecdyonurus venosus					x
Ecdyonurus venosus-Gr.					x
Heptagenia coerulans	x				
Heptagenia flava	x				x
Heptagenia sp.	x				x
Heptagenia sulphurea	x	x			x
Heptageniidae Gen. sp.	x				x
Rhithrogena beskidensis	x				
Rhithrogena sp.	x				
Leptophlebiidae Gen. sp.					x
Paraleptophlebia submarginata	x				
Paraleptophlebia sp.	x				
Potamanthus luteus	x				x
Ephoron virgo	x				
Ephemera lineata					x
Ephemerella ignita	x				
Caenis beskidensis					x
Caenis horaria			x		

TAXA	DANUBE				
	UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES
Caenis luctuosa	x				x
Caenis luctuosa/macrura	x	x			x
Caenis macrura	x				
Caenis pseudorivulorum					x
Caenis robusta		x	x		
Caenis sp.	x		x		x
Palingenia longicauda					x
ODONATA					
Calopteryx splendens	x				x
Platycnemis pennipes		x	x	x	x
Ischnura elegans	x	x	x		
Coenagrionidae Gen. sp.		x			
Gomphus flavipes	x	x	x		x
Gomphus sp.			x		
Gomphus vulgatissimus	x	x	x		x
Onychogomphus forcipatus	x	x	x		
Orthetrum cancellatum		x	x		
PLECOPTERA					
Isoperla sp.					x
Perlodidae Gen. sp.					x
Leuctra geniculata	x				
Leuctra sp.	x				x
HETEROPTERA					
Ranatra linearis					x
Aphilocheirus aestivalis	x	x	x		x
Corixidae Gen. sp.	x				x
Micronecta sp.			x		x
MEGALOPTERA					
Sialis lutaria		x		x	x
Sialis nigripes					x
COLEOPTERA					
Platambus maculatus	x				
Coleoptera Gen. sp.	x				
Curculionidae Gen. sp.		x			
Elmidae Gen. sp.	x				
Elmis aenea					x
Elmis maugetii					x
Elmis sp.	x				x
Esolus sp.	x	x			x
Limnius sp.	x				
Limnius volckmari	x				x
Oulimnius tuberculatus	x				
Potamophilus acuminatus					x
Gyrinidae Gen. Sp.	x				
Orectochilus villosus	x				
Brychius elevatus	x				
Enochus sp.	x				
Laccobius sp.					x
TRICHOPTERA					
Rhyacophila dorsalis					x
Rhyacophila dorsalis/fasciata/nubila	x				
Rhyacophila s. str. sp.	x				
Agapetus ochripes	x				
Agraylea sexmaculata		x			
Hydroptila sp.	x				x
Cheumatopsyche lepida	x				
Hydropsyche angustipennis	x				
Hydropsyche bulgaromanorum		x	x		x
Hydropsyche contubernalis	x	x	x		x
Hydropsyche exocellata	x				
Hydropsyche incognita	x				
Hydropsyche pellucidula	x				
Hydropsyche sp.	x	x	x		x
Cyrnus trimaculatus	x	x	x		x
Neureclipsis bimaculata	x	x	x		
Plectrocnemia cospersa	x				
Lype reducta	x				

TAXA	DANUBE					TAXA	DANUBE				
	UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES		UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES
Polycentropus flavomaculatus	x					Cryptochironomus defectus		x			x
Psychomyia pusilla	x				x	Cryptochironomus obreptans					x
Ecnomus tenellus			x			Cryptochironomus obreptans-Gr.				x	
Brachycentrus subnubilus	x	x			x	Cryptochir. obreptans/supplicans	x	x	x		x
Anabolia furcata	x			x		Cryptochir. rostratus	x	x	x		x
Anabolia nervosa	x					Cryptochir. sp.	x	x			
Limnephilus rhombicus	x					Cryptotendipes usmaensis					x
Limnephilinae Gen. sp.					x	Diames insignipes	x				
Goera pilosa	x					Dicrotendipes modestus		x			
Athripsodes aterrinus	x					Dicrotendipes nervosus	x	x	x	x	x
Ceraclea dissimilis					x	Dicrotendipes notatus					x
Oecetis ochracea					x	Dicrotendipes pulsus					x
Oecetis sp.					x	Endochironomus sp.		x	x		
Setodes punctatus			x			Eukiefferiella clypeata	x				
Setodes sp.		x				Eukiefferiella devonica/ilkleyensis					x
Sericostoma sp.					x	Eukiefferiella gracei					x
LEPIDOPTERA						Eukiefferiella lobifera					x
Lepidoptera Gen. sp.		x	x			Glyptotendipes pallens		x		x	x
DIPTERA						Harnischia fuscimana		x			
Dicranota sp.	x				x	Harnischia sp.	x	x	x		x
Ablabesmyia (A.) longistyla	x		x		x	Heterotrissocladius marcidus					x
Beckidia zabolotzkyi		x	x		x	Limnophyes sp.			x		
Bryophaenocladius sp.		x				Lipiniella moderata		x	x		x
Chernovskiia macrocera			x			Microchironomus sp.	x	x			x
Chernovskiia orbicus		x	x		x	Microchironomus tener		x	x	x	x
Chironomidae Gen. sp.	x	x	x		x	Micropsectra atrofasciata-Agg.	x				
Chironominae Gen. sp.	x		x		x	Micropsectra sp.	x				x
Chironomini Gen. sp.	x	x	x		x	Microtendipes britteni	x				x
Chironomus sp.	x	x	x	x	x	Microtendipes pedellus	x				
Chironomus sp. "JDS2"					x	Microtendipes pedellus-Gr.	x	x			x
Chironomus (C.) acutiventris			x		x	Monodiamesa bathyphila	x				
Chironomus (C.) acutiventris/obtusidens					x	Monodiamesa sp.	x	x			x
Chironomus (C.) agilis/nudiventris	x	x			x	Nanocladius bicolor	x				x
Chironomus (C.) bernensis		x			x	Nanocladius distinctus		x			
Chironomus (C.) nudiventris	x	x		x	x	Nanocladius sp.			x		
Chironomus (C.) obtusidens		x				Nilotanypus dubius			x		
Chironomus (C.) plumosus				x		Orthocladiinae Gen. sp.	x	x	x		x
Chironomus (C.) plumosus-Gr.	x	x	x	x	x	Orthocladiini COP	x			x	x
Chironomus (C.) riparius		x				Orthocladius (Orthocladius) sp.					x
Chironomus (C.) riparius-Agg.	x	x	x		x	Orthocladius (O.) oblidens					x
Chironomus (L.) dissidens-Gr.			x			Orthocladius (O.) rubicundus					x
Cladopelma laccophila-Gr.			x	x		Orthocladius (S.) lignicola					x
Cladopelma sp.		x			x	Parachironomus arcuatus-Gr.		x		x	x
Cladopelma virescens					x	Parachironomus frequens-Gr.		x			
Cladotanytarsus sexdentatus		x				Parachironomus sp.		x			
Cladotanytarsus conversus			x		x	Paracladius conversus	x				
Cladotanytarsus mancus			x			Paralauterborniella nigrohalteralis		x		x	x
Cladotanytarsus mancus-Gr.			x	x	x	Parametriocnemus stylatus	x				
Cladotanytarsus nigrovittatus					x	Paratanytarsus dissimilis	x	x	x		
Cladotanytarsus sp.	x	x	x			Paratanytarsus dissimilis/inopertus		x			
Cladotanytarsus vanderwulpi	x	x			x	Paratanytarsus sp.	x		x		
Conchapelopia sp.	x	x			x	Paratendipes connectens			x		x
Cricotopus sp.			x			Parat. connectens/intermedius			x		
Cricotopus (C.) bicinctus	x	x	x		x	Parat. intermedius		x	x		x
Cricotopus (Cricotopus) curtus					x	Parat. albimanus	x				
Cricotopus (C.) festivellus-Gr.			x		x	Paratrichocladius rufiventris	x	x			x
Cricotopus (C.) flavocinctus			x			Pentaneurini Gen. sp.	x				
Cricotopus (C.) similis/trifascia	x					Phaenopsectra sp.					x
Cricotopus (C.) sp.	x				x	Polypedilum sp.		x	x		
Cricotopus (C.) tremulus					x	Polypedilum (Polyp.) albicorne					x
Cricotopus (C.) tremulus-Gr.	x				x	Polypedilum (P.) laetum					x
Cricotopus (C.) triannulatus			x		x	Polypedilum (P.) laetum-Gr.	x	x			
Cricotopus (C.) trifascia	x	x	x		x	Polypedilum (P.) nubeculosum	x	x	x	x	x
Cricotopus (I.) dobrogicus		x	x			Polypedilum (P.) nubifer			x		
Cricotopus (I.) dobrogicus/sylvestris-Gr.			x			Polypedilum (Tripodura) acifer		x			
Cricotopus (I.) obnixus-Gr.			x			Polypedilum (P.) pedestre	x	x			
Cricotopus (I.) sylvestris-Gr.	x	x	x		x	Polypedilum (T.) aegyptium		x	x		

TAXA	DANUBE					TAXA	DANUBE				
	UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES		UPPER REACH	MIDDLE REACH	LOWER REACH	ARMS	TRIBUTARIES
Polypedilum (T.) bicrenatum		x	x		x	Tanytarsus heusdensis	x				
Polypedilum (T.) bicrenatum-Gr.			x		x	Tanytarsus sp.	x	x	x		x
Polypedilum (T.) scalaenum-Gr.	x	x	x		x	Telopelopia fascigera			x		x
Polypedilum (T.) sp.					x	Thienemannimyia Gr., Gen. indet.	x				x
Polypedilum (U.) convictum	x				x	Thienemannimyia sp.	x				
Polypedilum (U.) cultellatum	x	x			x	Tvetenia calvescens	x				
Potthastia gaedii					x	Tvetenia discoloripes-Gr.	x				
Potthastia gaedii-Gr.	x	x				Tvetenia sp.			x		
Procladius sp.	x	x			x	Tvetenia verralli	x				x
Procladius (Holotanypus) sp.			x	x	x	Tvetenia vitracies					x
Procladius (H.) choreus	x	x	x	x	x	Virgatanytarsus sp.	x		x		x
Prodiamesa olivacea	x	x			x	Xenochironomus sp.					x
Psectrocladius sordidellus-Gr.	x					Xenochironomus xenolabis		x	x		x
Rheocricotopus (P.) chalybeatus	x	x			x	Simuliidae Gen. sp.					x
Rheocricotopus (P.) fuscipes	x					Simulium sp.	x				
Rheopelopia ornata					x	Diptera Gen. sp.			x		
Rheopelopia sp.	x		x		x	Atherix ibis	x				
Rheotanytarsus sp.	x	x				Ceratopogonidae Gen. sp.	x		x		x
Robackia demeijerei		x	x			Heleinae Gen. sp.				x	
Robackia sp.		x				Antocha sp.	x				
Stictochironomus sp.	x	x			x	Hexatoma sp.		x			
Synorthocladius semivirens	x				x	Limoniidae Gen. sp.					x
Tanypus punctipennis					x	Limnophora sp.	x				
Tanypus sp.	x	x		x		Stratiomyiidae Gen. sp.	x				
Tanytarsini Gen. sp.	x	x	x		x	Chrysops sp.					x
Tanytarsus aculeatus					x	Tabanidae Gen. sp.		x	x		x
Tanytarsus brundini	x					Tipula sp.		x			
Tanytarsus brundini/curticornis		x			x	Dolichopodidae Gen. sp.					x
Tanytarsus ejuncidus	x				x	Plumatella fungosa		x			
Tanytarsus eminulus		x			x						

Legend:

x…all methods
x…Airlift/Multicorer/MHS - samples
x…kick & sweep, dredge - samples

3.2 Diversity

The most heterogeneous groups were Diptera (174 taxa) and Oligochaeta (53 taxa) followed by Ephemeroptera (42 taxa), Trichoptera (35 taxa) and Molluscs (Bivalvia 26 taxa, Gastropoda 27 taxa, respectively). Coleoptera (17 taxa), Amphipoda (13 taxa) and Hirudinea (11 taxa) are as well noteworthy; other groups are important but less diverse. This overall characteristic in diversity does not change along the three reaches of the Danube, although the number of insects decreases considerably downstream (Figure 3).

Rare species found along the JDS 2 are the large burrowing Ephemeroptera *Palingenia longicauda* (Prut river) and the Gastropoda species *Theodoxus transversalis* (Lower Reach). Regarding Amphipoda the invasive species *Corophium robustum* was documented for the first time in Austria (PÖCKL, in litt.), *Crangonyx pseudogracilis* is new to the Fauna of the Danube (BERNERTH & STEIN, 2003; BERTHOLD & KAISER, 2005).

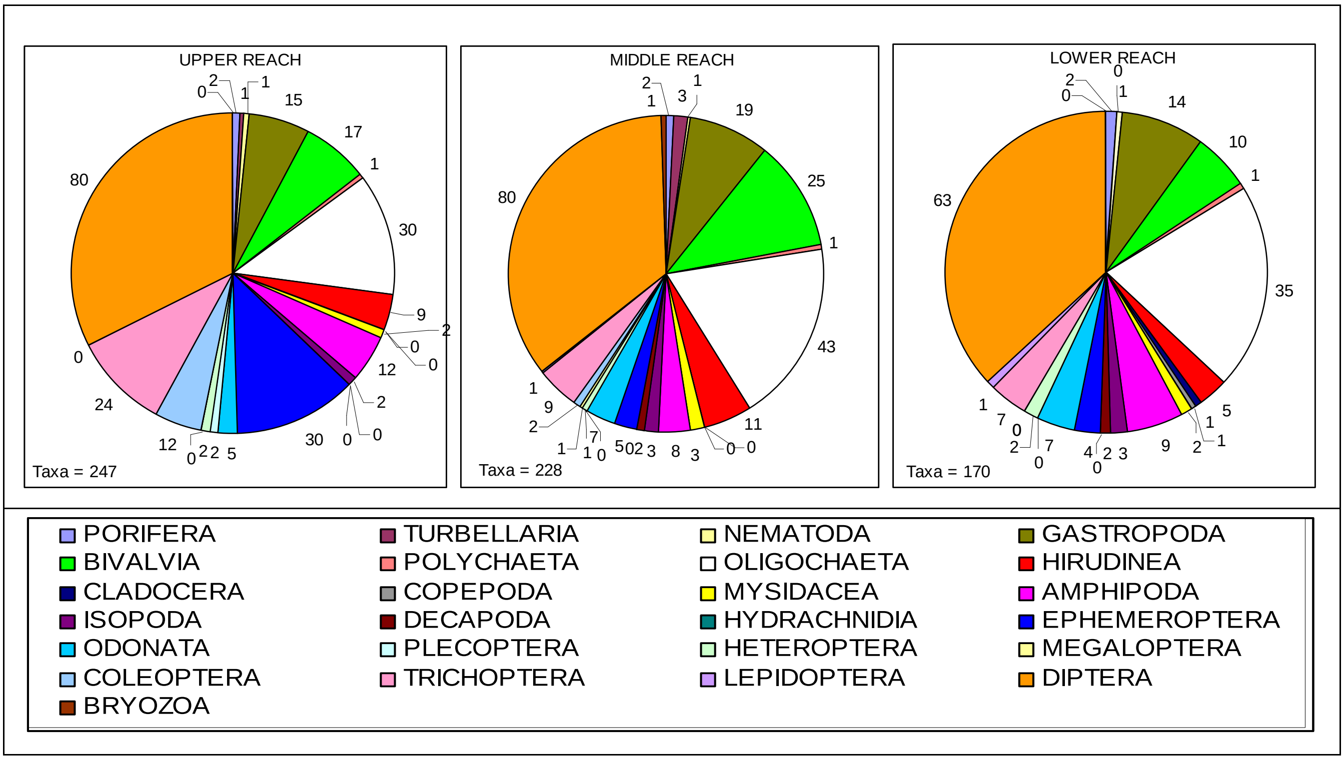


Figure 3. Number of taxa per taxagroup along the different reaches of the Danube

3.2.1 Comparison with JDS 1

Compared to the first survey JDS1 (2001) where a grab was used for sampling the number of identified species increased from 280 to 362. The main differences between the total taxa composition are within Oligochaeta and Chironomidae depending on different sampling techniques and the level of determination (Figure 4).

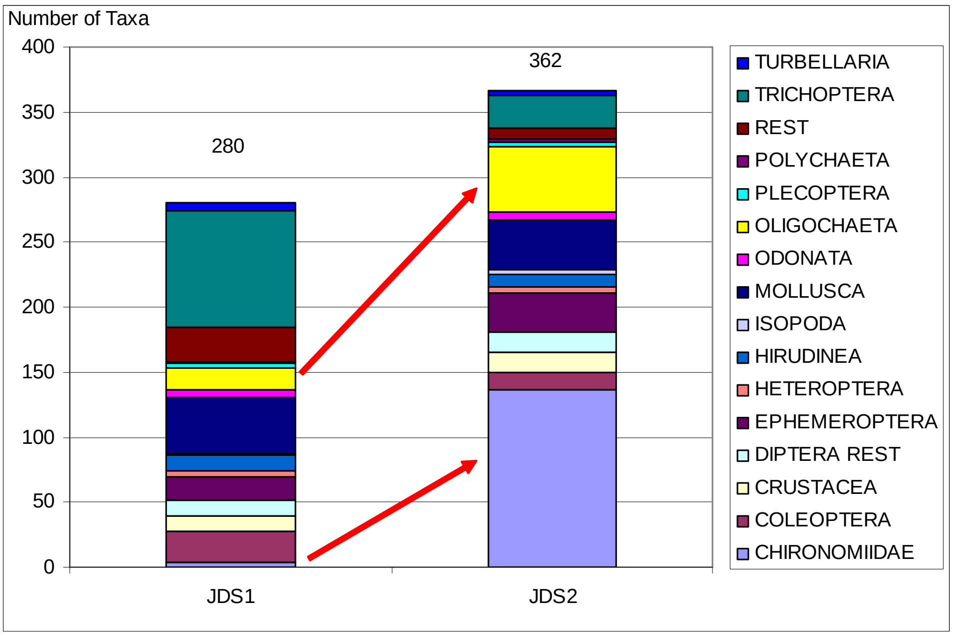


Figure 4. Number of taxa per taxagroup, results from JDS1 & JDS2

3.3 Abundance

Regarding abundance (ind./m²) Amphipoda are the dominant group in all Danube reaches and constitute up to 75 % while Isopoda (mainly *Iaera istri*) play an essential part in the Upper Reach and decrease downstream. Oligochaeta and Mollusca can be found in increasing numbers in the Lower Reach. EPT- Taxa (Ephemeroptera, Plecoptera and Trichoptera) were negligible – with the exception of the Upper Reach (sites 1 and 2). Within aquatic Insects only Chironomidae increasing downstream play a major role.

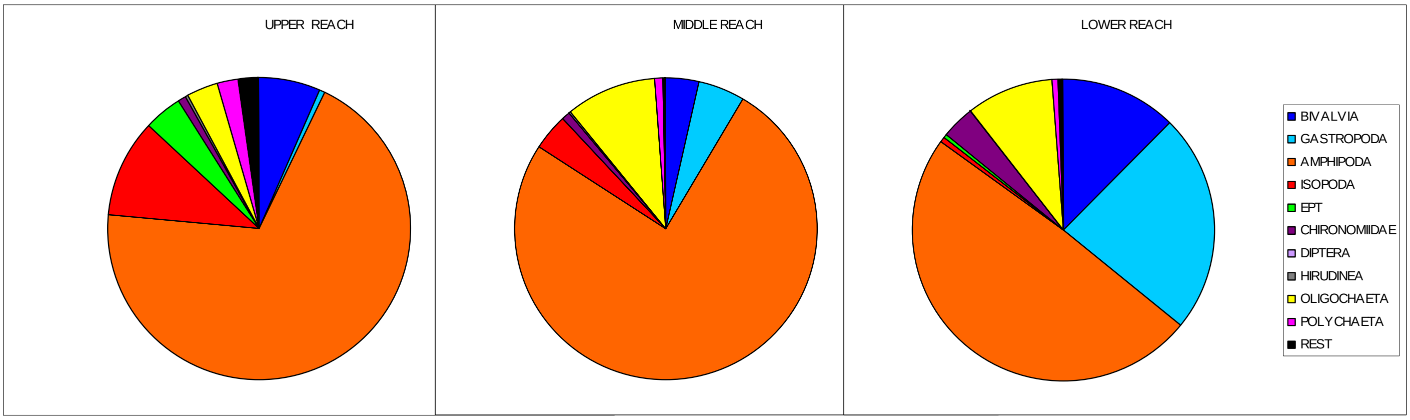


Figure 5. Abundance of Taxa per Taxagroup along the different reaches of the Danube

3.4 Biomass

In terms of biomass Mollusca are the most important organisms of the Danube and investigated tributaries. Due to their size Bivalvia make up more than 80% of the whole biomass, followed by Gastropoda (10% to 35%). Looking at the different reaches of the Danube (according to LITERÁTHY et al., 2002) the increasing dominance of Mollusca from the Upper to the Lower Reach becomes evident. Although Crustacea are the most abundant group, they play only a minor role regarding biomass.

The average biomass per sampling site was more than 1400 g/m², whereas a steadily increase in biomass from the Upper to the Lower Reach can be seen (average biomass Upper Reach: 208 g/m², Middle Reach: 1259 g/m², Lower Reach: 1854 g/m²; **Error! Reference source not found.**).The lowest value of the free-flowing Danube was 1.1 g/m² at site 88 (Giurgeni) where no Mollusca were found. The highest was 7969.9 g/m² at site 76 (downstream Turnu Magurele) where *Corbicula fluminea* represented 7906.9 g/m² (99%) of the total value. Regarding tributaries the average biomass was about 1500 g/m² with a minimum of 0 g/m² (no taxa) at site 84 (Arges) and a maximum value of 9689,2 g/m² at site 21 (Vah) where the biomass of Mollusca represented 97% dominated by *Unio tumidus* and *Unio pictorum* but also *Corbicula fluminea* and *Dreissena polymorpha*.

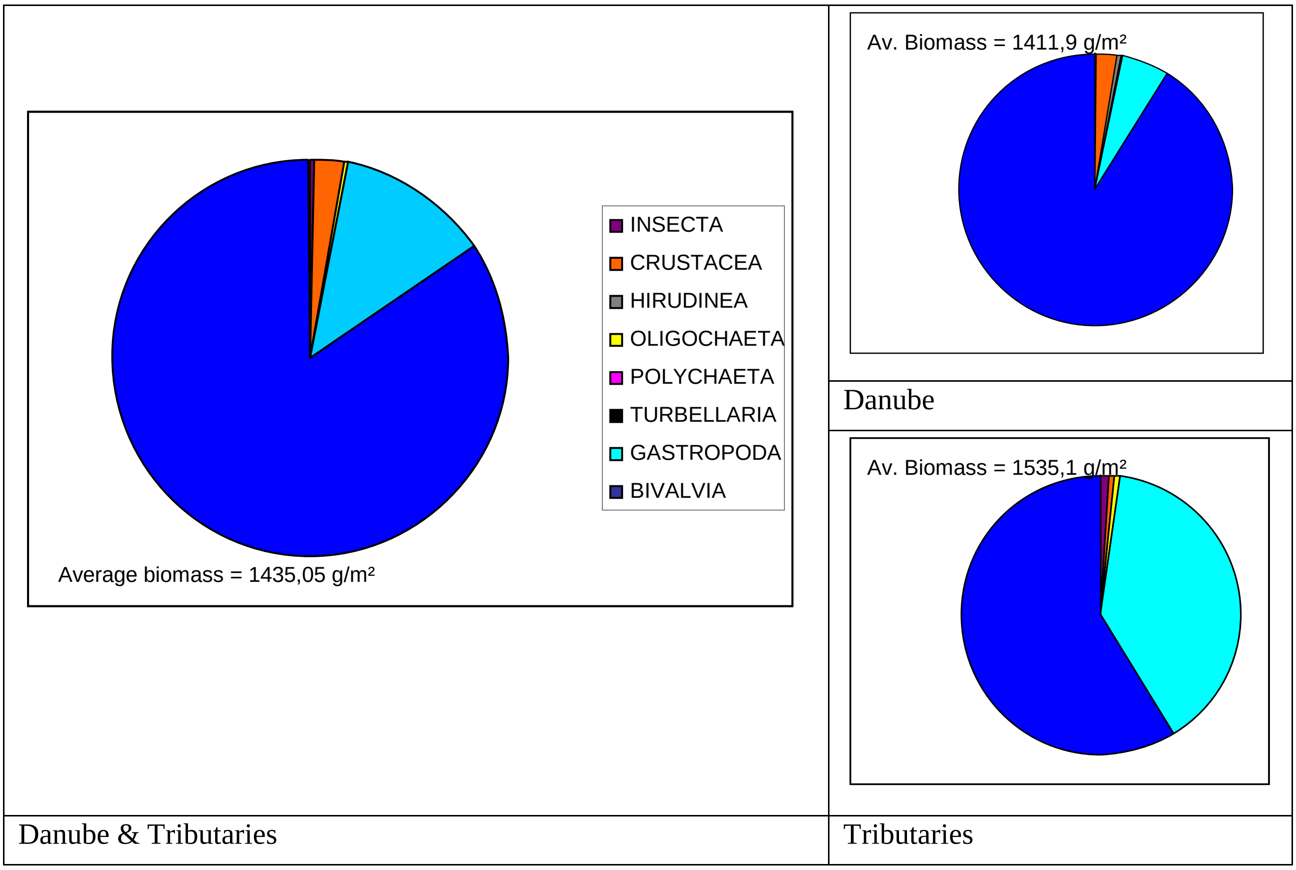


Figure 6. Biomass of Taxa per Taxagroup along the Danube & Tributaries

The considerable amount of data collected during JDS 2 from the river bottom and from the bank zone illustrated the longitudinal distribution patterns of characteristic Danubian macroinvertebrate taxa that are important regarding biodiversity and protection of species: e.g. the formerly widespread snail *Theodoxus transversalis* is living now in a very restricted section on the Lower Danube only (JDS sites 70-86). Detailed description see chapter 3.6 Faunal results – distribution of significant species.

3.5 Comparison of sampling methods

Sampling in non-wadeable, large rivers is an extremely tricky task. High water depth and current velocity inhibit an invasion of deeper parts of the river for which reason sampling is usually mostly done at the margins of the river. Macrozoobenthos-based results are strongly dependent on the used method (Airlift/Multicorer/MHS, kick & sweep and dredging).

The comparison of methods used from the ship (Airlift & Multicorer) with methods used at the bank zone (Kick & Sweep) is difficult because the two approaches are not only different in terms of technique but they also are sampling different spatial zones of the river.

The comparison of datasets reveals an extraordinary predominance of Oligochaeta and Diptera regarding Airlift/Multicorer and MHS. In addition most of the other groups are more effectively caught with these methods. On the other hand kick & sweep/dredging seems to be more effective in documenting Mollusca, Odonata, Mysidacea and Heteroptera taxa (Figure 7). Exclusive taxa found with one sampling method only are figured in Fig. 8. It underlines that, regarding diversity, a combination of both Airlift/MHS and kick & sweep/dredging is useful. In total 362 taxa were collected by Airlift/MHS, 202 taxa were found in the kick & sweep/dredging samples.

The presented results do not only reveal the sampling methods but also include inhomogeneity of sorting and determination between two working groups. An exact evaluation between methods can therefore hardly be done.

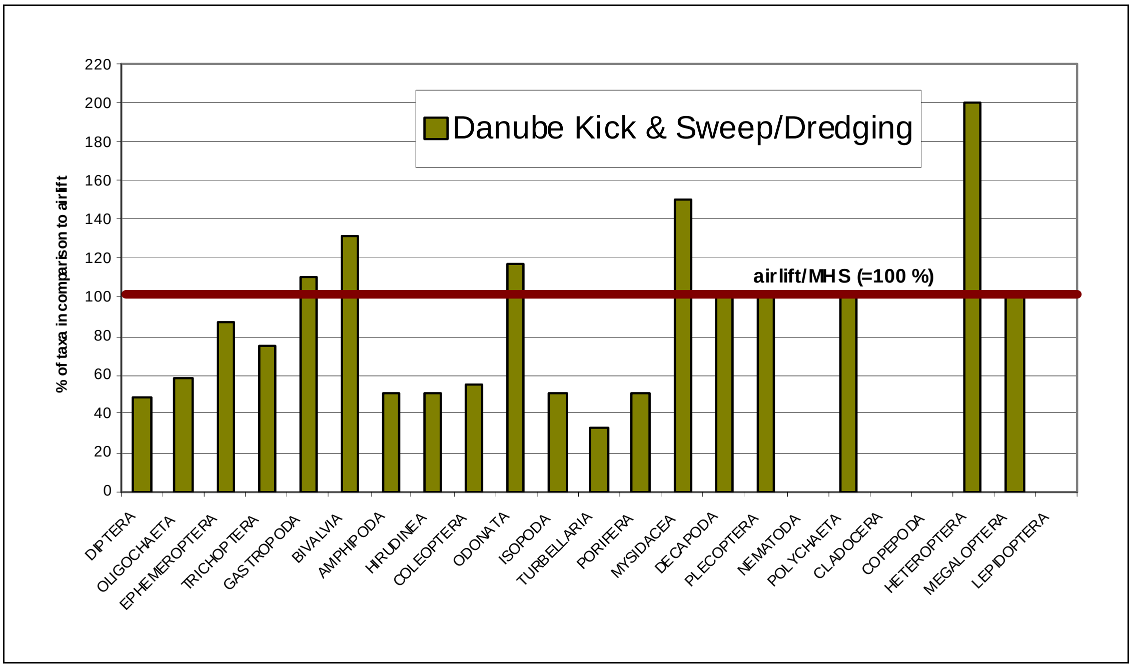


Figure 7. Sampling efficiency of the Kick&Sweep/Dredging method compared to Airlift/MHS sampling

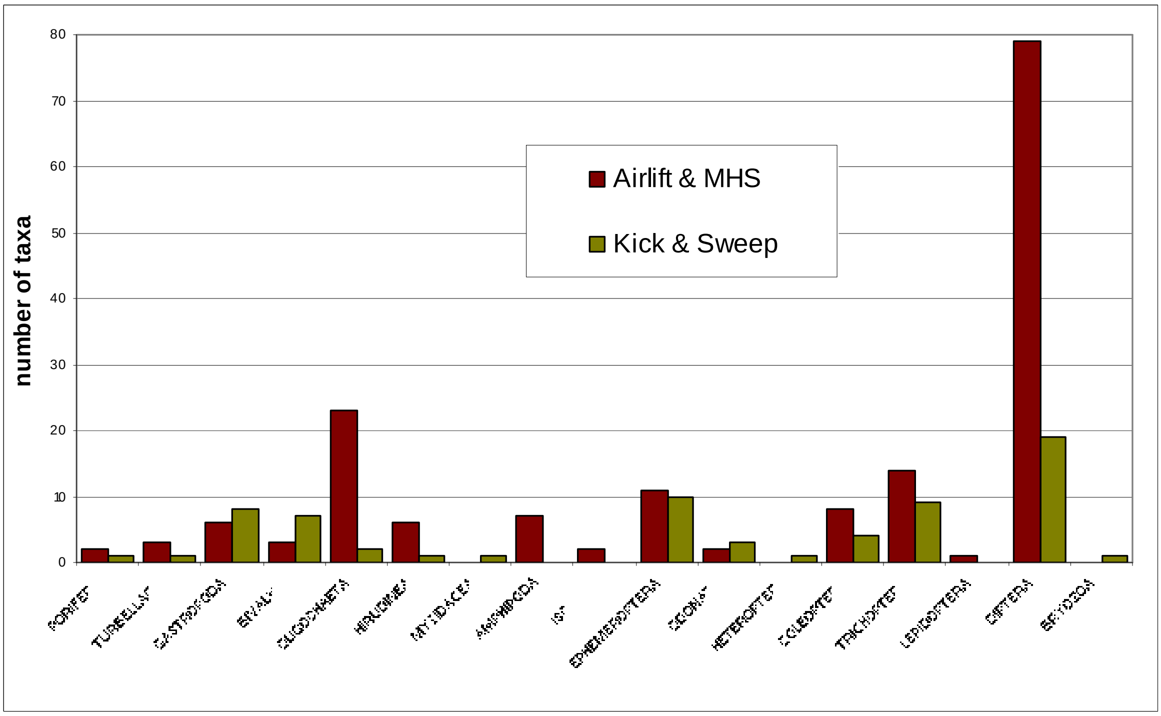


Figure 8. Exclusive taxa per sampling method

For the decision on methods for future WFD compliant monitoring programs the objective for the use of the biological quality element macrozoobenthos has to be considered:

For assessing the total ecosystem with representative sampling of all habitats in the Danube at a given site (which is not easily manageable with any method) the Airlift device seems to be appropriate to document the bottom fauna from higher depths in a standardized way. WFD compliant (semi-) quantitative and area relative approaches (Airlift and MHS) were taken to calculate metrics and saprobic indices as abundance is an essential part regarding these parameters. For an evaluation of bank zones and for a differentiation of conditions between right and left bank the Kick & Sweep technique is recommended.

The applicability and the efficiency of K&S sampling method used in case of large river research are very often questioned and underestimated. The classic K&S technique is frequently rejected because of its semi-quantitative character having in mind the preposition that the estimation of absolute individual numbers are the main figures characterizing the given sampling location. However, in case of very large rivers the huge spatial heterogeneity of habitats situated in shallow and very deep zones results in a large degree of uncertainty in terms of abundance per unit surface area. The statistically correct investigation of a given cross section and river stretch is very complicated. Therefore the design of stratified- and sub-sampling for the appropriate estimation should be carefully implemented in case of the large and very large river size category.

Due to large water level fluctuations and considerable changes of water discharge of the Danube the stable and representative macroinvertebrate community is developed only in a well defined zone near to the bank sides, just below that water line representing the yearly minimum water level. If there is no higher water layer above this zone than 1.5 m, what means that it could easily be reached by the hand net and kicking technique. Appropriate sweeping above the sediment surface results in very effective collection of macroinvertebrate samples where the relative abundance data could be regarded as semi-quantitative descriptors of the sampling location, and, making that possible to compare different samples to each other on a semi-quantitative basis.

However a combination of both methods would have the best sensitivity for research purposes. For the use of such a combined method for ecological status assessment (according to the WFD) the difficult challenge has to be overcome that reference conditions and sampling efficiency differ between river bottom and river banks. At present the adequate methodology for the investigation of large rivers is still under discussion.

During JDS2 three sampling methods were applied in every cross section of the Danube at the right (R) and at the left (L) sides: **air lift** (AL) as the basic sampling method was applied in the ***deeper region*** of the sampling cross section, the **"kick & sweep"** (K&S) sampling was done in the ***shallower litoral*** *zone* of the Danube, and **dredging** had to be used in a ***2-4 m deep zone*** downstream from the dam of the 2nd Iron Gate Reservoir, due to sudden increase of water discharge and water level (more than 1.5 m within three days). Apparently these methods were performed in *spatial different locations* at any particular cross section. This is the reason why it is not possible to carry out direct comparison of these methods in terms of which one is the better: ***various river habitats were sampled in different depths by different methods***.

Although comparing the total number of detected taxa using different sampling techniques is misleading, there are evident benefits coming from the use of more than one sampling technique: more taxonomic data are available to characterize the Danubian cross sections based on these separated habitat types in each sampling location. However, the appropriateness of the sampling techniques can be evidently seen in these different cases.

Altogether air lift was able to detect more taxa (362) than K&S and Dredging (202). Based on this *Total Number of Detected Taxa* only three main taxonomic groups contain much more than 20 taxa along the whole river length: Mollusca, Oligochaeta and Chironomidae seem to be the most significant and species rich invertebrate groups in the Danube River (Figure 9). Using the Airlift technique more species in these two taxonomic groups were detected than using K&S and dredging together because these animals are living in the deeper zone of the Danube. Mollusca (aquatic snails and mussels) are another very important group of invertebrates in the Danube. They can be found in a characteristic pattern in the river colonizing a special zone where the bottom conditions are relatively stable. Therefore K&S and Dredging detected more members of the group of Mollusca than Air Lift (41 snail and mussel species taxa versus 25 species and 8 genus taxa) due to the fact that this sampling covered more appropriate depth and habitat of them than the other one.

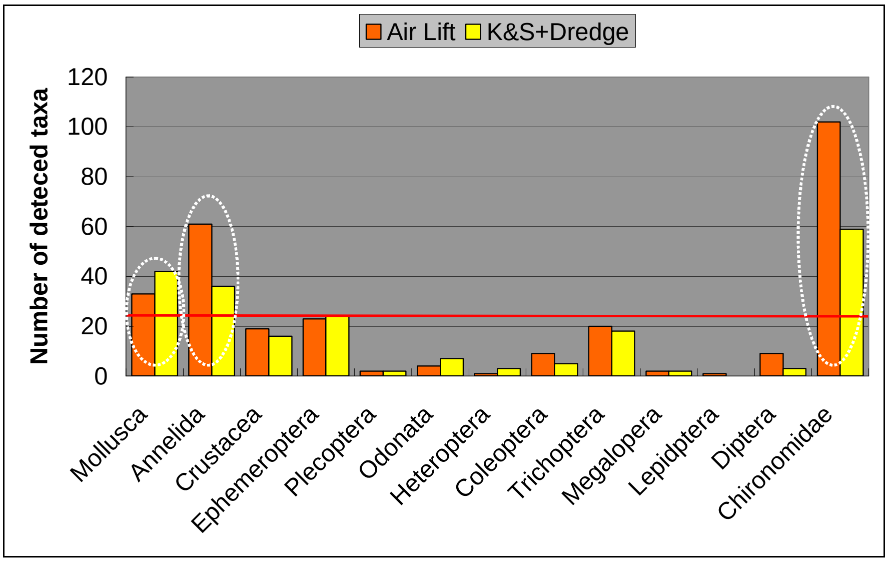


Figure 9. Total number of detected taxa by air lift and K&S/dredging along the Danube River during JDS2

It can be seen that there are no major differences among the results of AL and K&S detecting those groups that have around 20 or less taxa (Crustacea/Malacostraca and other Insecta).

Comparing the *numbers of detected taxa site by site*, the situation is a little bit different along the Danube. Usually more taxa were found by K&S until the 2nd Iron Gate Reservoir. Here K&S had to be replaced by dredging and from this section (JDS64) air lift sampler was more effective in terms of the number of detected taxa per site than dredging (Figure 10).

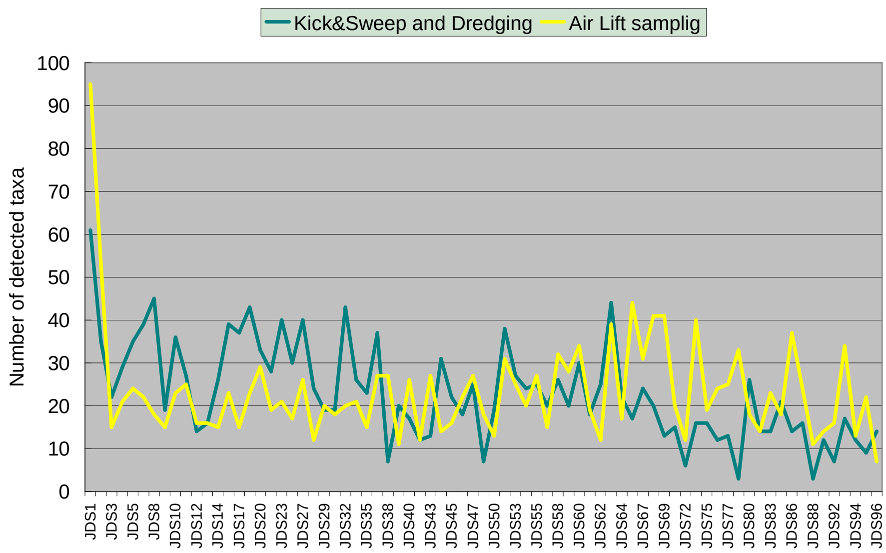


Figure 10. Detected taxon numbers at different sites by different sampling methods

The higher values using K&S method show that usually more invertebrate species are living the near bank zone than in the deeper river bed. Figure 11 illustrates that the combined use of K&S and Dredging can provide higher detected taxa numbers in case of several tributaries as well.

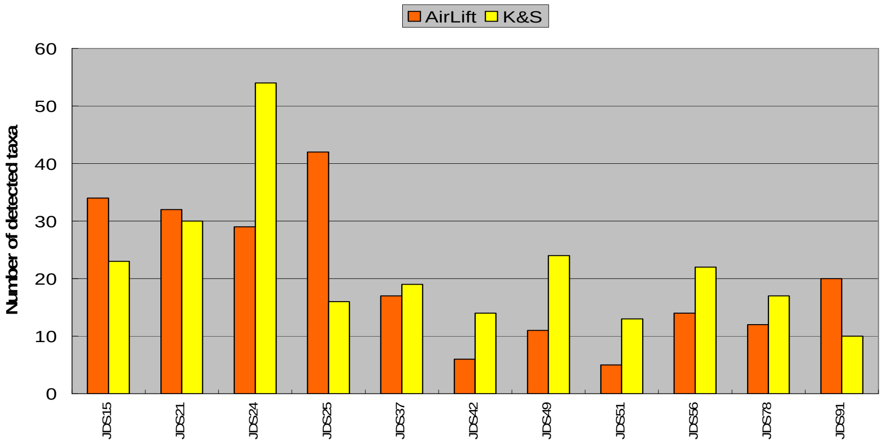
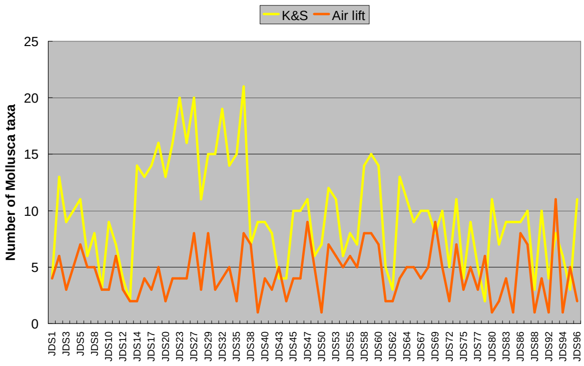
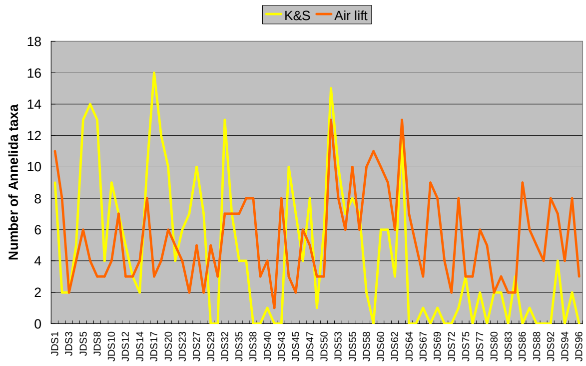


Figure 11. Detected taxon numbers by different sampling methods in tributaries near confluence

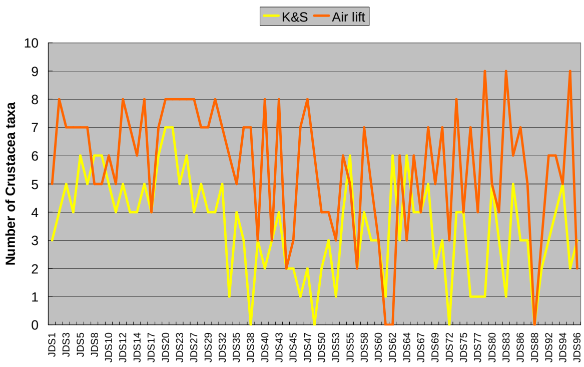
Summarizing how the different sampling methods detect the macroinvertebrate taxon groups along the Danube during JDS2 several diagrams of Figure 12 give an illustration.



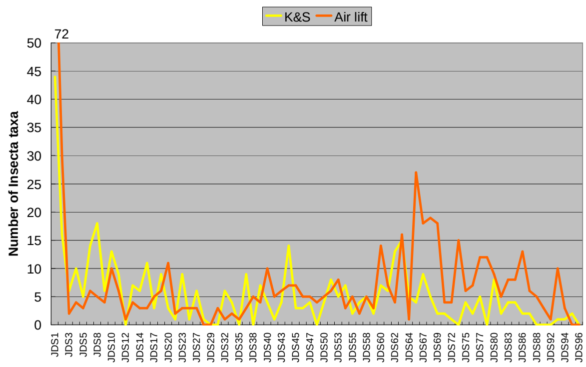
Number of Mollusca taxa



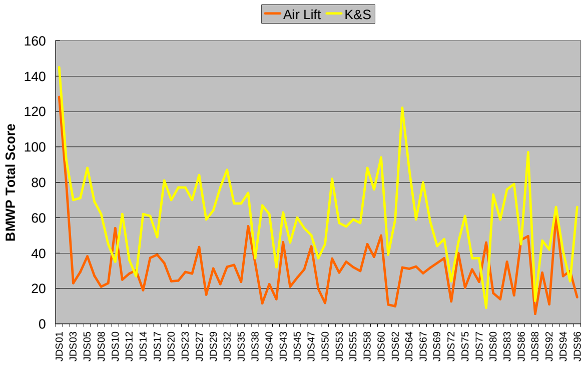
Number of Annelida taxa



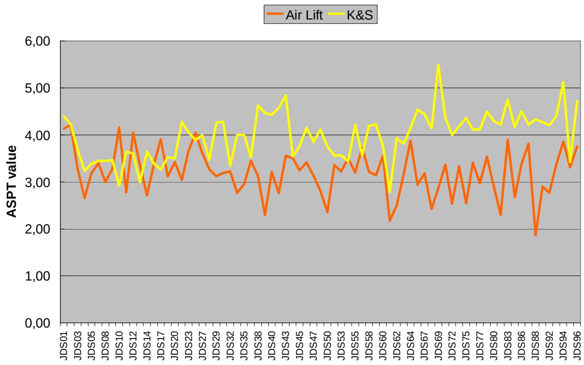
Number of Crustacea taxa



Number of Insecta taxa



BMWP total scores



ASPTHUmod values

Figure 12. Different descriptors of the detected macroinvertebrate community by air lift, K&S and dredging

It seems that K&S and dredging worked perfectly detecting the most characteristic Danubian taxon groups with good efficiency. The reason of that is that the sampling was carried out near to the shore line where these organisms are colonizing the river in higher abundance. Thus, it is also clear that the air lift was appropriately working in deep water conditions that usually cause many difficulties for sampling. In the planning phase K&S sampling was provided as an additional method in case of foreseen emerging hydrologic, navigational or any other local problem as previous Danubian experiences had shown that. During the sampling mission it was proved that any of these sampling methods alone is not able to give complete picture about the real natural colonization of the aquatic macroinvertebrate community around the total cross sections. Therefore the inclusion of data gained from different habitats by various sampling methods became evidently important and useful.

Statistical aspects of estimation theory indicates that there are several not clearly clarified questions in determining the necessary number of samples necessary to be taken per site along the reach and across the cross section in order to fulfill the requirements of representative sampling required by the EU WFD. These questions and problems still need further research using different approaches applied in future international co-operation along the Danube Basin.

3.6 Faunal results – distribution of significant species

3.6.1 Mollusca

Considerable amount of data collected during JDS2 illustrates the longitudinal distribution of characteristic Danubian macroinvertebrate taxa:

- *Unio pictorum* and *U. tumidus* are the most common large mussel taxa of the Danube. The first species occurs already in the uppermost section and both ones become very abundant on the Hungarian-Slovakian section until the Iron Gate I Reservoir (Golubac/Koronin). Another large density of their population exists on the lowest section of the Lower Danube forming characteristic "mussel-zone" along the banks ;
- The occasionally occurring *Anodonta anatina* on the upper Danube becomes abundant exactly in the Middle stretch from the Gabcikovo Reservoir (JDS17) till the Drava confluence. *Sinanodonta woodiana* is living between the Middle Danube and the Delta but the largest population was registered from Hungary to the Drava confluence, similarly to *A. anatina*;

- Two species of *Corbicula* were registered during JDS2: *C. fuminea* is predominant with huge population size in many stretches, colonising the middle river bed from the Serbian section downstream in many sites and in very thick layer, as well. However, *C. fluminalis* is extremely rare occurring only at JDS5 and 38.
- *Viviparus acerosus* and *V. viviparus* are replacing each other along the river, the former is common on the Upper and Middle Danube until Bazias, the later starts to be present from here to downstream;
- *Dreissena polymorpha* is abundant on the Upper and Middle Danube whereas *D.bugensis* as a new colonizing taxon was detected from the Iron Gate II (JDS64) until the Delta (JDS96). It was recorded already during a sediment sampling program from the Veliko Gradiste-Belobresca cross-section (1061 rkm) and from the Kazan Pass (971 rkm) in 2006 (CSÁNYI, unpublished);
- The populated section of Pisidium species (*P. supinum, P. amnicum, P. henslowanum* and the other 5 taxa, from Kelheim, JDS2) ends up suddenly at Paks where sand becomes to be predominant in the bed channel. This indicates well that a section type is changing in this stretch;
- The largest population of *Theodoxus fluviatilis* (became widespread in the last two decade) lives on the upper and the middle section with the peak in the Austrian, Slovakian and Hungarian Danube;
- The Danube Basin-specific *T. danubialis* has a stable stock in the Slovakian-Hungarian Danube upstream Budapest, occurs on the Serbian stretch with low abundance but downstream the Iron Gate II it is rather common in several Lower Danubian sites;
- The formerly widespread *T. transversalis* is living now in a **very restricted section** on the Lower Danube only (JDS70-86);
- *Holandriana holandrii* is one of the Balkanian fauna element of the Danube River. It has very special distribution pattern because it is only present at JDS58, and, between JDS65-77, mostly occurring on the right bank zone of the Danube.

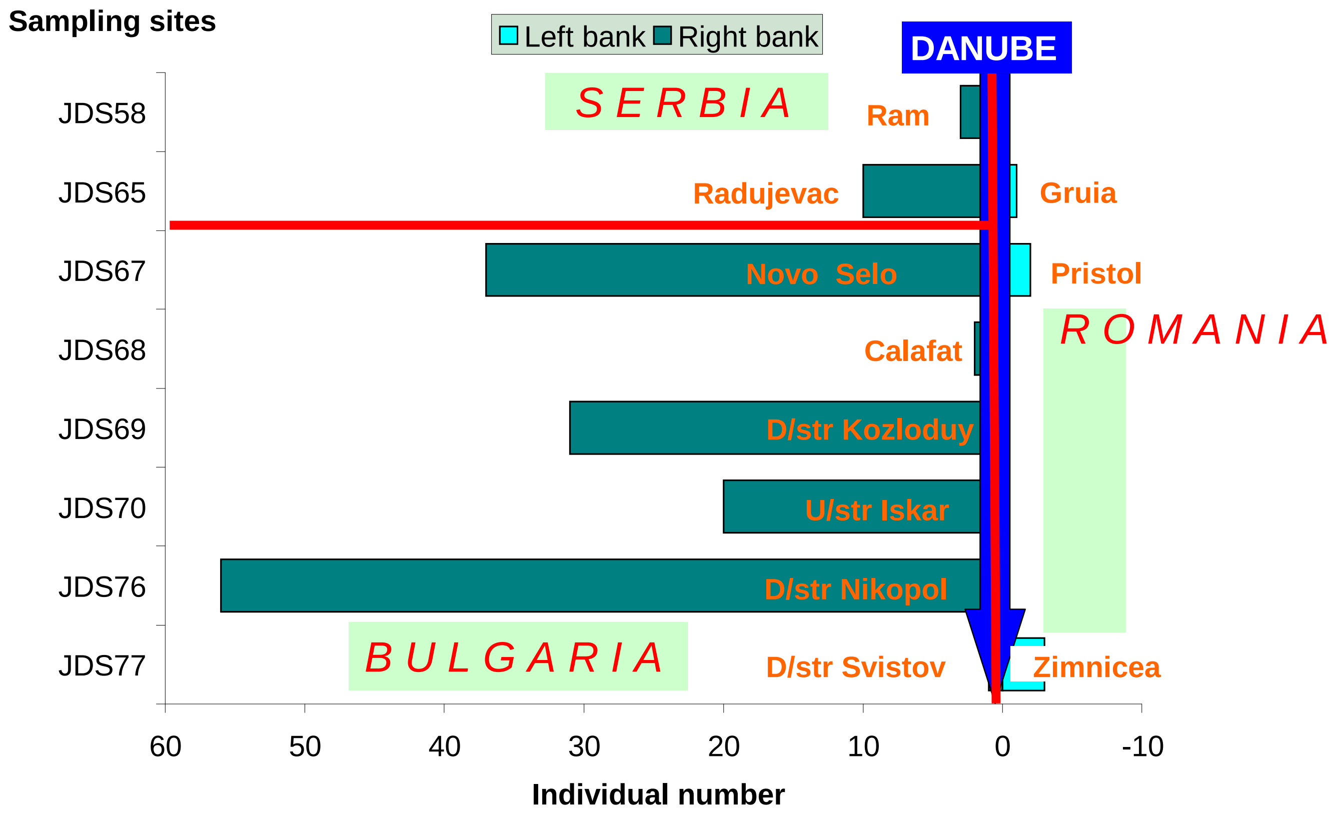
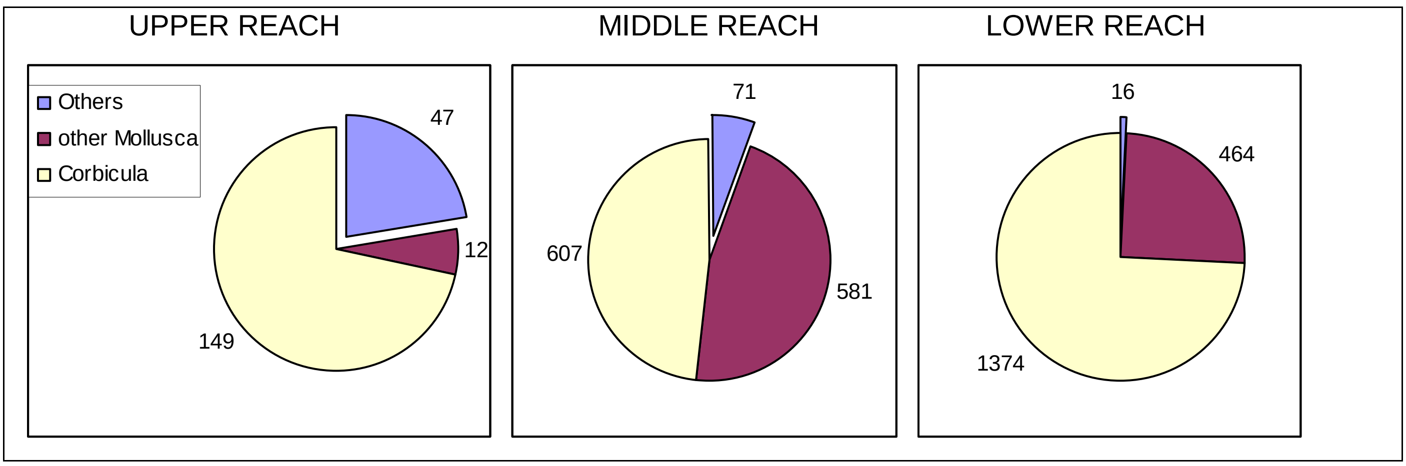


Figure 13. The occurrence of *Holandriana holandrii* along the Lower Danube

Figure 14 shows the average biomass and abundance of Mollusca along the different reaches of the Danube in relation to all the other organism groups. It can clearly be seen that the abundance and biomass of all mollusa increases downstreams and the share of *Corbicula* expand especially in the Lower Reach reaching more than 1 kg/m². Interestingly the average biomass of *Corbicula*-specimens is much higher within the Middle and Lower Reach than in the Upper Reach indicating a different development strategy downstreams.



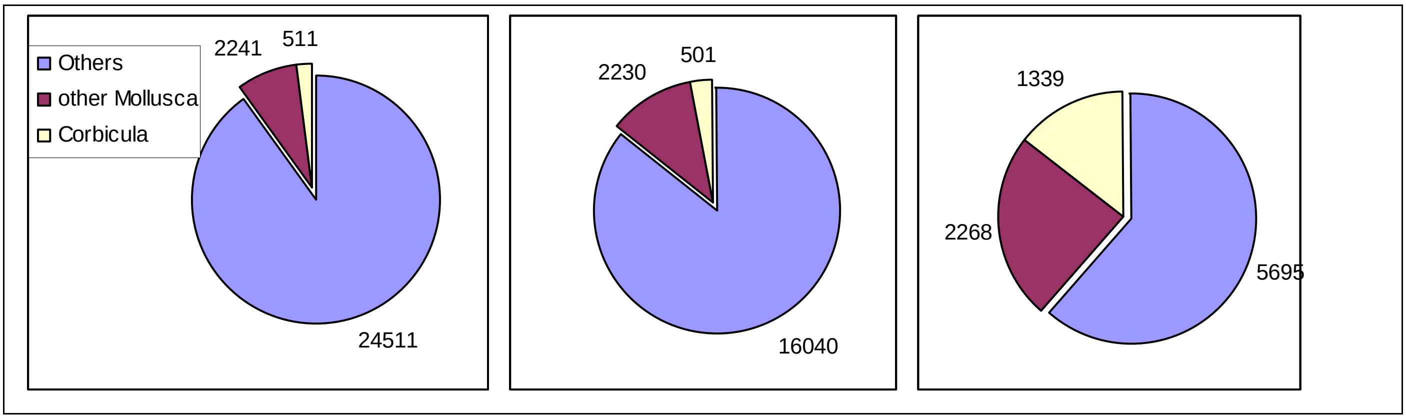


Figure 14. Average biomasses in g/m² (above) and average abundances in ind/m² (below) (Airlift/Multicorer/MHS)

3.6.2 Oligochaeta :Review of Oligochaeta assemblages in the Danube River sampled during JDS2

Ferdinand Šporka

3.6.2.1 Upper Reach of Danube

Main channel

In total 9 sites were sampled, three of them are located in impoundment sections. Oligochaeta were found at all sites, whereas 12 taxons were identified in total. The most dominant taxa concerning frequency and abundance were *Stylodrilus heringianus* (5/0)[1], *Limnodrilus hoffmeisteri* (2/2) and *Potamothrix moldaviensis* (1/2). The highest taxa richness was found in sampling site 1 (JDS1) were 8 species were recorded.

Tributaries

9 taxa were found in river Inn, which was the only tributary sampled within the Upper Reach, whereas *Limnodrilus hoffmeisteri* and *Potamothrix moldaviensis* were found to be the most abundant Oligochaeta - taxa.

3.6.2.2 Middle Reach of Danube (excluding Iron Gate)

Main channel

In the Middle Reach of the Danube 31 sites were sampled, Oligochaeta were recorded from 30 sites (two impounded sites). Altogether 21 taxa were identified, the most dominant taxa in terms of frequency and abundance were *Stylodrilus heringianus* (19/1), *Potamothrix moldaviensis* (15/1), *Psammoryctides barbatus* (10/1), *Criodrilus lacuum* (10/1) *Isochaetides michaelseni* (9/0), *Haplotaxis gordioides* (4/0) and *Limnodrilus hoffmeisteri* (3/1). Naididae were found only at few sampling sites and in low abundances.

[1] Occurence in natural sections – sampling sites/number of impoundment sections

Arms

In the samples from three side-arms, 12 taxa were recorded in total. The most abundant taxa were *Limnodrilus hoffmeisteri*, *Limnodrilus claparedeanus* and *Psammoryctides barbatus* which were found in two arms.

Tributaries

13 taxa were recorded from 9 tributaries investigated. Dominant taxa regarding frequency and abundance were *Branchiura sowerbyi* (5)[2], *Limnodrilus claparedeanus* (5), *Limnodrilus hoffmeisteri* (4) and *Psammoryctides moravicus*. (3).

3.6.2.3 Lower Reach of Danube (including Iron Gate)

Main channel

26 sites were sampled in the Lower Reach, whereas 12 sites were located in impounded sections. Oligochaeta were documented from all sampling sites. In total 39 taxa were identified, the most dominant taxa concerning frequency and abundance were *Isochaetides michaelseni* (21/4), *Limnodrilus hoffmeisteri* (6/8), *Limnodrilus claparedeanus* (6/8), *Criodrilus lacuum* (11/3), *Branchiura sowerbyi* (2/8), *Potamothrix danubialis* (6/4), *Psammoryctides moravicus* (4/5), *Potamothrix moldaviensis* (6/2), *Potamothrix vejdovskyi* (2/5), *Psammoryctides barbatus* (2/4), *Limnodrilus udekemianus* (2/3), *Potamothrix hammoniensis* (0/5), *Eiseniella tetraedra* (2/2) and *Propappus volki* (4/0). Naididae species analogous to Middle Reach were found but only at few sampling sites and in small numbers.

Tributaries

Samples were taken from 7 tributaries. Altogether 11 taxa were found, the highest frequency showed *Isochaetides michaelseni* (3) and *Limnodrilus hoffmeisteri* (3).

3.6.2.4 Summary

Upper Reach

The Upper Reach of Danube showed the lowest species richness of all reaches. Naididae species were completely absent and there are no specific species, which occurred exclusively in the Upper Reach. *Stylodrilus heringianus* which occurred in all free flowing sections was completely absent in impoundment sections.

Middle Reach

The Middle Reach of Danube is characterised by higher species richness than the Upper Reach. Impoundment sections showed poor species richness, in Greifenstein (JDS 11) 6 taxa were found, in Gabčíkovo (JDS 17) just 2 taxa. Only *Stylodrilus heringianus* was present in small abundance in both sites. In Grafenstein *Limnodrilus hoffmeisteri* (3085 ind/m^2), *Potamothrix moldaviensis* (2952 ind/m^2) and *Psammoryctides barbatus* (329 ind/m^2) were abundant, but all of them are specific species from impoundment section. A characteristic (typical) species which occurs only in the Upper and Middle Reach is *Stylodrilus heringianus*. On the other hand, characteristic species from Middle and also Lower reach of Main channel are *Criodrilus lacuum* and *Isochaetides michaelseni*.

Lower Reach

[2] Occurence in number of tributaries

The Lower Reach of Danube shows the highest species richness (39 taxa) typical species of the main channel were *Criodrilus lacuum*, *Branchiura sowerbyi*, *Isochaetides michaelseni*, *Limnodrilus claparedeanus*, *Limnodrilus udekemianus*, *Potamothrix danubialis* and *Potamothrix hammoniensis*. Rare species that were recorded only from one sampling site were *Bothrioneurum vejdovskyanum* (Iron Gate II – JSD 64 and *Potamothrix isochaetus* (Danube downstream Velika Morava – JDS 57).

A typical species for impounded sections in the Lower Reach was *Branchiura sowerbyi* which was also found in impounded sections in the Middle Reach. Other abundant taxa found in impounded sections were *Limnodrilus clapredeanus*, *Limnodrilus hoffmeisteri*, *Potamothrix vejdovskyi* and *Potamothrix hammoniensis*.

3.6.2.5 Conclusions

The most important factor influencing species composition of Oligochaeta assemblages in main channel of the river Danube is the structure of the bed sediments which is strongly linked to current velocity. This fact is illustrated by the cluster analysis diagram (Figure 15). Individual sampling sites were grouped to clusters according to the type of sediments. In the upper part, sampling sites were grouped in two clusters (A, B) with course (gravel) sediment, whereas in lower part sampling sites (groups C, D) are characterised by fine sediments (sand, mud and clay) (Figure 15). Impoundment sections are generally shifted lower than free-flowing sections due to fine sediments e.g D7 – D9, as well as all sampling sites set to impoundment sections (D52 – D64). A good example is *Stylodrilus heringianus* which prefers course – gravel sediments and therefore it is absent in the Lower Reach of Danube, where course sediments are lacking. Contrarily, *Isochaetides michaelseni* or *Criodrilus lacuum* are large species, which prefer fine sediments and therefore it occurs only in the Middle and Lower Reach. As a tolerant species in terms of organic pollution *Limnodrilus hoffmeisteri* occurs along the whole stretch of the Danube, but prefers fine sediments rich on organic matter. Hence this species is more abundant in all impoundment sections and in the stretches of the river Danube with fine sediments (downstream of JDS 38 [Baja]).

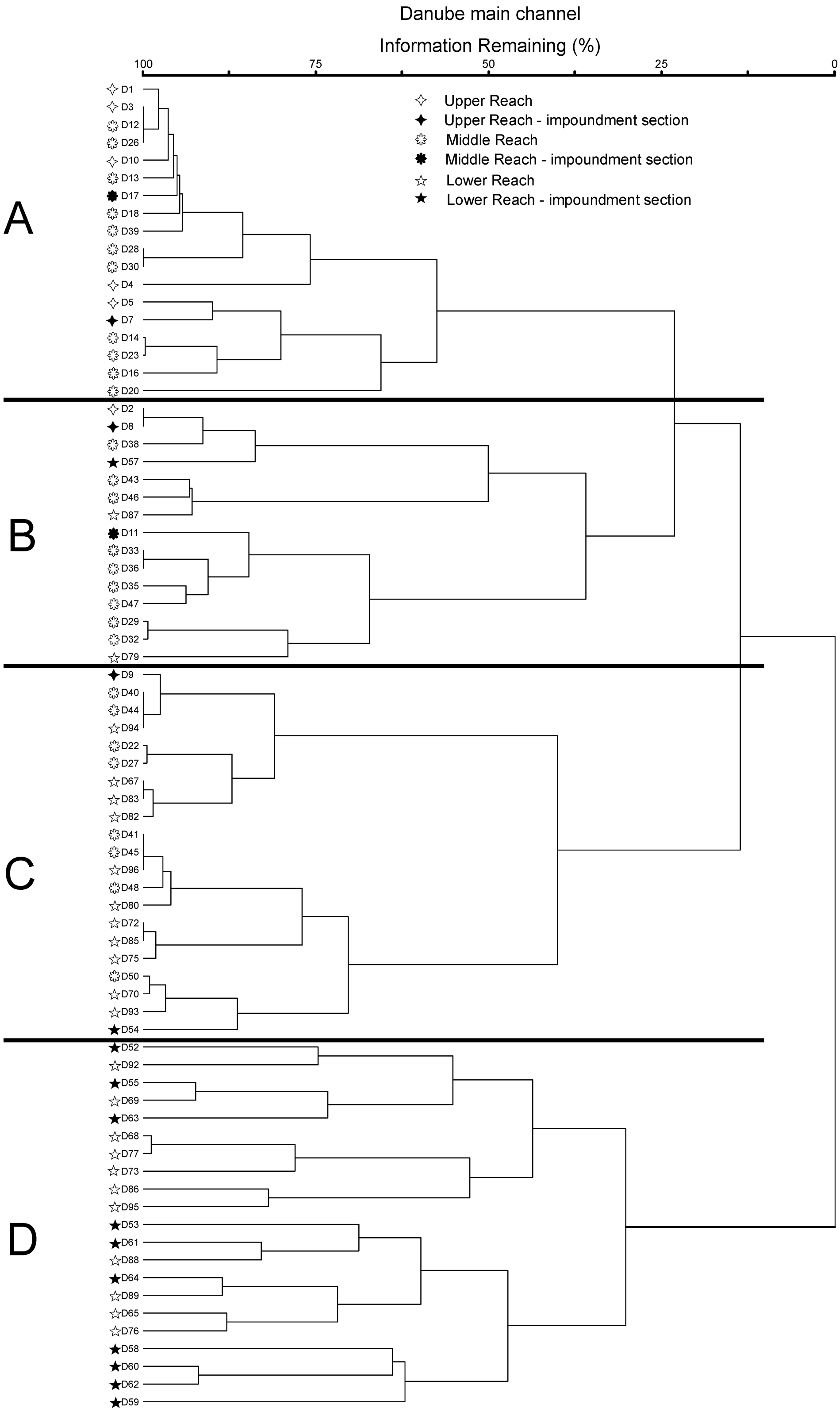


Figure 15. Cluster analysis dendrogram (Wards methods, Euclidean distance) from qualitative Oligochaeta species data. From data were remove species which occurred just in one or two sampling sites (D1-D96 represent JDS 1 – JDS 96)

The percentual distributions of Oligochaeta families and genera are summarized in Figure 16 and Figure 17.

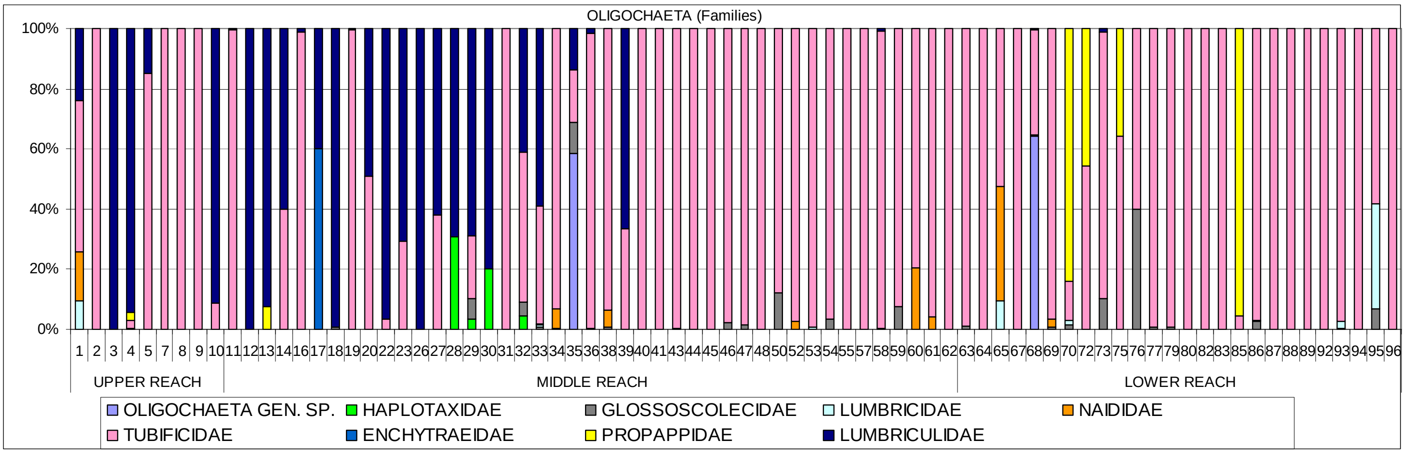


Figure 16. Percental distribution of Oligochaeta families along Danube sites (Airlift/Multicorer/MHS)

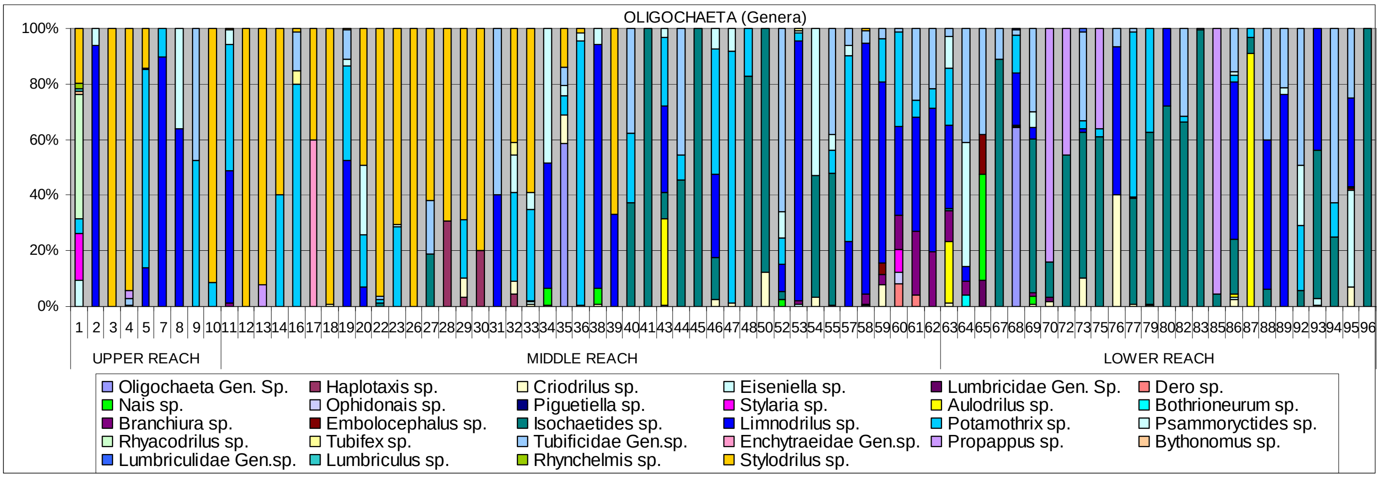


Figure 17. Percental distribution of Oligochaeta genera along Danube sites (Airlift/Multicorer/MHS)

3.6.3 Crustacea

The fauna of the river Danube is dominated by Crustacea (Amphipoda and Isopoda) in terms of abundance. Amphipoda are the dominant group in all Danube reaches and constitute up to 75 % of the total abundance while Isopoda (mainly *Jaera istri*) play an essential part in the Upper Reach and decrease downstream in density. While species of the genus *Dikerogammarus* are distributed all along the river and reach the highest percentages within Amphipoda in the Middle Reach, the genus *Gammarus* occurs at site 1 exclusively. The genus *Corophium* (*Chelicocorophium*) (with the species *C. curvispinum* and *C. robustum*) is quite abundant in the Upper as well as the Lower Reach. Within JDS2 *C. robustum*, another Ponto-Caspian element was found for the first time in Austria (det. M. Pöckl). More detailed investigations may reveal a contiguous distribution from the Iron Gate until the Austrian-German border. The species was already found in the River Main in Germany. The genus *Pontogammarus* (*P. sarsi*, det. S. Gottstein) is restricted to the Lower Reach up to now.

Amphipoda seem to be key elements within the fauna of large rivers. Due to their mobility, insensitivity and flexible feeding strategies they are able to build up huge populations in short periods and influence the indigenous fauna in a sustainable way. Documentation and monitoring of that group along the Danube is therefore a crucial task.

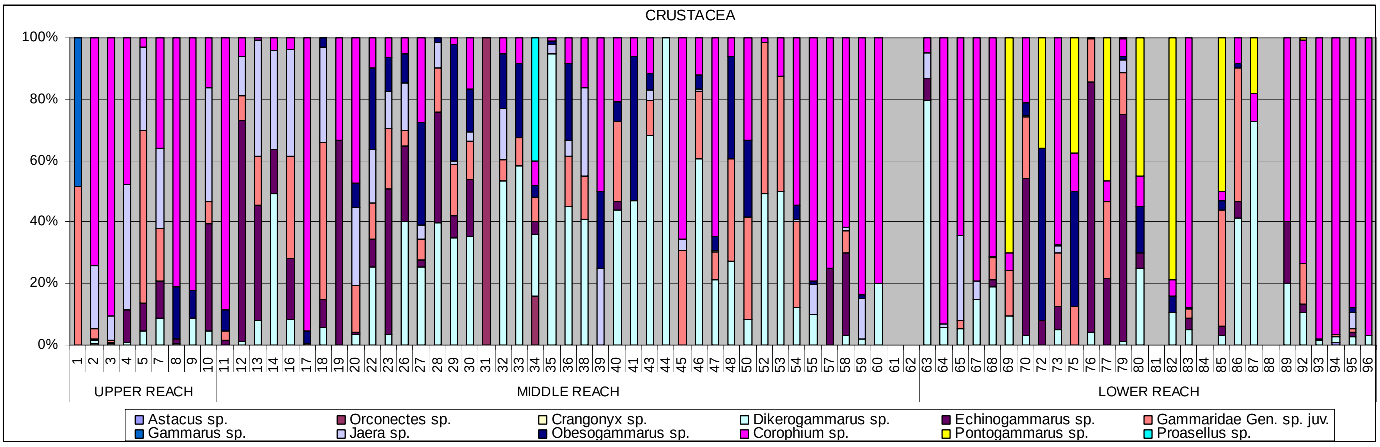


Figure 18. Percental distribution of Crustacea genera along Danube sites (Airlift/Multicorer/MHS)

3.6.4 Ephemeroptera, Plecoptera and Trichoptera (EPT)

Large European Rivers have undergone anthropogenic modifications and have lost a high share of their indigenous fauna, especially sensitive insects like Ephemeroptera, Plecoptera and Trichoptera. DEN HARTOG et al. (1992) documented a disappearance of 85% of these species in the Lower Rhine, MEY (2006) describes a similar phenomenon regarding Trichoptera and FITTKAU & REISS (1983) highlighted this fact in general.

The Danube River seems to be no exception. Regarding EPT 79 taxa were documented in total along the Danube by all methods, but only the upper two sites show a moderate diversity. Based on Airlift-data a clear decline of EPT-taxa can be seen downstreams. Among Trichoptera only the river-type specific *Hydropsyche contubernalis* and *H. bulgaromanorum* were found along all Reaches accompanied by local populations of *Setodes punctatus*. Other species of that group are more or less insensitive species typical for slow current velocity. Ephemeroptera were mainly represented by few species of the genus *Caenis* and *Heptagenia* only which occured sporadically. Plecopterans could not be found downstreams of site 10 and even upstream only 4 taxa were documented while RAUŠER (1957) reported a rich indigenous stonefly community for the Danube and listed the following species: *Brachyptera trifasciata*, *B. braueri*, *Oemopteryx loewii*, (*Rhabdiopteryx hamulata*), *Taeniopteryx araneoides*, *T. nebulosa*, *Capnia bifrons*, *Perlodes dispar*, *Isogenus nubecula*, *Isoperla obscura*, *Isoperla difformis*, *Marthamea vitripennis*, *Xanthoperla apicalis* and *Isoptena serricornis*.

The overall monotony in EPT-taxa may not only be caused by anthropogenic effects but certainly also to a certain degree by the sampling season. Summer species are rare and the seasonal aspect of the survey (sampling dates: August and September) together with its snapshot character does not allow the documentation of the whole community. Nevertheless, as pointed out earlier, the benthic assemblages are clearly dominated by non indigenous, invasive or cosmopolitan elements which probably have strong negative effects and disbalance the ecological functionability of the whole system.

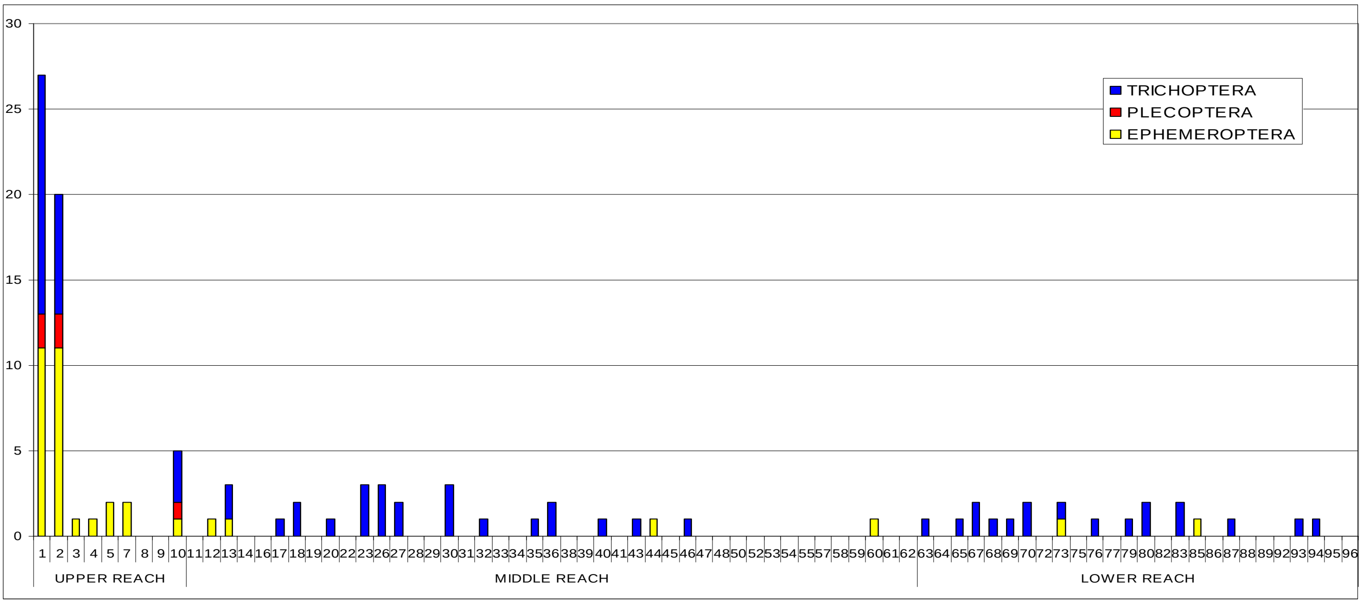


Figure 19. Distribution of EPT-taxa along Danube sites (Airlift/Multicorer/MHS)

3.6.5 Chironomidae

Introduction

The chironomid midges (Chironomidae, Diptera) are a family of aquatic insects very rich in species. There are also some marine and quite a lot of terrestrial species but the majority is living in freshwater habitats. In the Palaearctic faunal region (with Europe and Northern Asia) they have the highest number of species of all families of aquatic insects. 178 genera with at least 1290 species are known which come to 20% of the aquatic insect fauna (FITTKAU & REISS, 1978, ASHE & CRANSTON, 1990). A current faunistic list for Europe, the 'Fauna Europaea', compiled by leading specialists, contains 1194 Europaean species (SÆTHER & SPIES, 2004).

To start with Austria, in the 2nd edition of 'Fauna Aquatica Austriaca' 588 species are listed (MOOG ed., 2002).A clue to the number of Austrian Danube species are the 274 species (taxa) (of 513 Diptera) compiled in MOOG et al. (1995). That would be 47% of all Austrian chironomids but this list includes several repeated citings of larval groups and (a higher percentage) species living in the surrounding area of the Danube, especially in waterbodies of riverine forests. The 171 species listed in RUSSEV (1998) are not more than a minimal number of true Austrian Danube chironomids. This number is much higher than in any other of the Danube countries – and RUSSEV (1998) mentions only 254 Danube Diptera known in 1995. The relatively reliable facts that Ecoregion 9 (ILLIES) is richer in aquatic insect species than Ecoregions 11 or 12 and that the Austrian chironomid fauna might have been studied more extensively up to now than the chironomids of some other Danube countries contribute to this high species number.

Before we continue let me present some examples for the species richness of the chironomids: In backwaters of a riverine forest near Vienna ('Tullner Becken') 170 species were found (JANEČEK, in SCHMIDT-KLOIBER et al., 1998). During eight study years 168 species could be documented in Alte Donau which could not perpetuate its character of an old river branch of the Danube but at present seems to be a relatively uniform urban water body very much influenced by cultivation and human activities (JANEČEK & MOOG in DOKULIL (ed.), in prep.)

In the JDS2 samples more than one third of all macrozoobenthic organisms were Chironomidae; total taxa of MZB: 367. Chironomidae: 133 taxa. Additionally it should always be kept in mind that the animals come from the river bottom and depths of more than 6 m have been no exceptions. In contrast to the results of 2007 the Chironomidae - together with the whole Diptera - have been treated poorly in the 'Joint Danube Survey 1' (September 2002; 39). Only 3 chironomid taxa have been documented, namely Chironomidae, *Chironomus plumosus*-group and *Chironomus thummi*-group (*Ch. thummi* is a synonym of *Ch. riparius* MEIGEN which is by no means an important species of the Danube and was found only in one sample of JDS2. The main emphasis of the 1st JDS was laid on many other groups of benthic animals. Therefore the collections of chironomids within JDS2 are an important enlargement.

At any rate let this be enough for species richness of chironomids. In population density, biomass and production they can predominate even more especially in two types of water bodies: in different stagnant waters especially in lakes and – the Danube is a perfect example – in larger rivers.

The larvae of Chironomidae are excellent indicators for manifold ecological factors and environmental influences as for example oxygen content, water temperature, acidity, water current, sediment type, trophic level and saprobity. On the other hand many species of Central Europe can be distributed in large areas of Europe, the Palaearctic, the Holarctic region and even on larger ranges of distribution. However a plus of ecological variety compensates for this minus of biogeographical differentiation. A good ecological indicator is characterized that it is applicable on large geographical areas – which does not apply so well for some other groups of insects (JANEČEK in SCHMIDT-KLOIBER et al., 1999).

Besides the fact that in the international 'Directory of chironomid workers' (The Chironomid Home Page (http://insects.ummz.lsa.umich.edu/~ethanbr/chiro/Directory/direct_new.html) 540 chironomid workers are included (it could be mislead to a Viennese 'Giipt joo äh gmua!' – There are enough of them!), it must be admitted that chironomids are regarded as unpopular group by many people – a family for a few specialists. Here is room only for a short discussion. The Chironomidae seem to be difficult to identify, with only a few good keys and scattered taxonomic literature. An identification appears to depend on microscopic slides with elaborate procedures of preparation. All this must lead to the assumption that chironomids used for instance as bioindicators in an expert's opinion are a very expensive group. And it could be added that some identifications of larvae not even lead to a species but only to a larval group. In all fairness it must be countered that identification of some other groups is also not an easy task. Examples are Ephemeroptera, some Coleoptera (e.g. Elmidae, Hydraenidae) and other Diptera (e.g. Simuliidae). The most Plankton organisms and the groups of meiobenthos (e.g. Nematoda, Ostracoda) depend on the microscope even more. During the latest decades a number of good and extensive keys have been prepared, the most extensive for the present for pupal exuviae of which the advantages cannot be discussed here (LANGTON, 1991; LANGTON & VISSER 2003). Some taxonomic courses have been held, in Germany, for example, in the Gustav Stresemann Institute in Bad Bevensen - for instance 2006 with Claus ORENDT and the author. The course key of the author is an extract of many publications combined with own basal ecological knowledge (JANEČEK, 2002). And there remain still larval groups among other insects (E. g. Ephemeroptera, some Plecoptera) whereas important revisions (with keys) took place within the Chironomidae. A very new example is the revision of the popular *Micropsectra atrofasciata* Agg./or species group (STUR & EKREM, 2005).

The chironomid fauna of large rivers – and we shall find a lot of examples in the middle and lower section of the Danube – is very discrete and typical on the one hand, on the other hand its members can be extremely widespread even for Chironomidae, in many cases to the Eastern Palaearctic Region, sometimes even to the Nearctic or Oriental Region. One species which is new for the Danube fauna shall be pulled forward as an example of such a large areal: *Cladotanytarsus conversus* was described by JOHANNSEN (1932) from Sumatra. In the meantime it is known from Thailand, India, Greece and France (LANGTON & GARCIA, 2000). During the 'Assess-HKH-project' *C. c.* was found by the author in rivers of Bangladesh. There are unpublished Austrian findings from Danube and March. In the JDS2 samples we shall encounter the species in the lower section of the Danube, in Romania and Bulgaria.

Taxonomical and ecological investigations of this potamal group of Chironomidae has not started earlier than in the last quarter of the 20th century, at first because large rivers are physico-chemically and biologically extremely dynamic and therefore harder to investigate than the Rhithral zone or the comparatively statical stagnant waters (REISS, 1988b) and secondly, because the extreme human impacts which have started early in history have decimated the number of intact stretches of potamal by regulation, even canalization, transformation into impoundments, uprooting of riverine forests and contamination.

A short survey of chironomid research of the Danube

In the 'Sachregister' of THIENEMANN's (1954) 'Chironomus' there is no entry 'Donau'. THIENEMANN regrets the shortage of studies of larger rivers, of rivers on the plain (barbel region, bream region, ruffle zone) in general. He writes about some German/Central European studies (e.g. Kossau, Ems and Oder) and discusses Russian publications on chironomids of large rivers (e. g. Wolga, Oka and Ob) but mentions the fact that only larvae and pupae have been collected without rearing the animals to the adult. Aside from this disadvantage especially CHERNOVSKIJ's (1949) publication is valuable as it shows figures of many taxa which can be found in Danube too and helps to understand a lot of synonyma in older literature. THIENEMANN (1954) mentions the Danube when he writes about one of his older publications (THIENEMANN, 1932), the description of metamorphoses of *Cardiocladius congregatus* TÖM. (a nomen dubium: ASHE & CRANSTON 1990) (Hungarian Danube) and *Cardiocladius leoni* GOETGHEBUER (Romania, larva and pupa not known). Some sentences of TÖMÖSVÁRY (1883) shall be quoted because this is one of the oldest publications dealing with Chironomidae of the Danube: "Speciem hanc in turmis numerosissimis congregatam mensibus Aprili, Majo et Junio 1883 in Danubium inferiorem detexi et observavi, nempe: in Hungaria ad ripam sinistram Danubii …; in Serbio ad ripam dextram Danubii" (I discovered and watched this species [*C. congregatus*] gathering in very large swarms in April, May and June 1883 on the lower Danube namely: in Hungary on the left bank of the Danube …; in Serbia on the right bank of the Danube …) Incidential remark: If really a *Cardiocladius*-species had formed large swarms in the 19th century near the Hungarian or Serbian Danube this could be one hint for a different chironomid community. In the JDS2 samples no *Cardiocladius* was found. They are lithorheophilous Orthocladiinae belonging not even to the Austrian Danube list of MOOG et al. (1995). Orthocladiinae nowadays are mainly restricted to special (micro)habitats like periphyton (BERCZIK, 1969, JANKOVIĆ, 1973).

In his chapter of the monograph 'Plankton und Benthos der Donau' (KUSEL-FETZMANN et al., 1998) RUSSEV gives a very short review - a kind of collection of examples - about Chironomidae within faunistical, zoogeographical and biological results. Some species, mainly those with obsolete taxonomical names (e. g. some larval types) which – if the identifications have been correct - can nevertheless be assigned to valid names and have been used by some authors of older publications (e.g. JANKOVIĆ or CURE) are not contained in RUSSEV's list of organisms of makrozoobenthos of the Danube. Nevertheless RUSSEV's data have been enlisted into **Error! Reference source not found.**.

Germany

For Germany the only publications mentioned by RUSSEV (1998) deal with the macrozoobenthos as a whole without emphasis on Chironomidae, namely TITTIZER et al. (1994) and some others - the following are quoted in RUSSEV (1998): BRUCKMANN & MARTEN (1988-94), MAUCH et al. (1992), SCHMALZ & FALKNER and TITTIZER, LEUCHS & BANNING.

TITTIZER et al. (1995) write about the consequences of river impoundments for the macrozoobenthos. In the first year after the filling of the impoundment Geisling (1986) a massive appearance of chironomids occurred, an outbreak of [mainly] two chironomid species: *Chironomus plumosus*-Gr. and *Glyptotendipes paripes*. In 1989 it was observed that the focus of occurrence of the larvae (densities of 80.000 larvae/m²) was not in the immediate headwater of the weir but some 10 km upstream thereof. – During the JDS2 programme, besides a few *Dicrotendipes nervosus*, no chironomids could be found and in the bottom before the dam; *Corophium cuvispinum* was the dominant animal. This displacement of chironomids by neozoa in deeper parts of impounded sections is a typical event in many stretches of the Danube.

From the 526 taxa of species rank from the German Danube only 13 (2,5%) are Chironomidae. This number is much to low and shall be amplified by some faunistic studies from Bavaria. From the 'Donauried bei Mertingen' there exists a short species list with 11 chironomid species (FISCHER, 1936 – det F. PAGAST: in REISS, 1983). Chironomidae have been collected extensively in the riverine forst 'Donau-Auwald bei Ingolstadt'; 47 species are known (REISS, 1983). The studies of the chironomid communities on 'Unterer Inn', (containing the dissertation of KOHMANN (1982) and some light-trap catches), some kilometres distant from Passau surely shows affinities to the species of the German Danube and its wetland forests and, of course, to the random JDS2 sample of Lower Inn (REISS, 1983). SAMIETZ (1996) – at the end of these little paragraphs a current checklist shall be quoted to gain an impression how many chironomid species have been found in the Danube countries - does not only present a checklist of German Chironomidae (698 spp.) but his list of references also shows that there are only a few studies dealing with Chironomidae of the German Danube.

36 people from Germany are included in the 'Directory of chironomid workers' / Chironomid Homepage. The regional representative is Martin Spies. (http://insects.ummz.lsa.umich.edu/~ethanbr/chiro/)

Austria

For Austria BRETSCHKO & TOCKNER (1989) are singled out by RUSSEV (1998). They found 50 species down to a depth of 70 cm of sediments of the Danube bank and backwaters near Hainburg. There are many publications, a large number quoted in (the abovementioned) MOOG et al. (1995) who also include expert's reports and some unpublished dissertations. The Austrian stretch of River Danube (with floodplains) is divided by these authors into 15 parts mainly relating to power stations. The highest number of chironomid species of the survey, namely 104, are mainly species of floodplains from the east of Vienna to the Slovakian border and were partially identified by the author contributing to BIFFL et al. (1988; but compare this species number to JANEČEK, in SCHMIDT-KLOIBER et al., 1998). One example of a well-studied, though artificial, habitat shall be the riprap (JANEČEK & MOOG, 1994a, b; TOCKNER, 1991, 1993). SCHMID (1993) presents 'A key to the larval Chironomidae and their instars from Austrian Danube Region / Streams and rivers'.

The species number of the Austrian Danube and of the whole country has been dealt with in the introduction.

There are 10 Austrians in the 'Directory of chironomid workers'. Regional representative is Ruth CONTRERAS. (other facts -> Germany).

Slovakia

For Slovakia RUSSEV (1998) mentions only one (partly experimental) publication of ERTLOVÁ (1970a) who presents the distribution of 41 chironomid species on artificial substrates in the Danube exposed to three different velocities of flow. There are also other publications of ERTLOVÁ dealing with Danube Chironomidae, from a finding combined with ecological statements (ERTLOVÁ, 1971: *Eukiefferiella lutethorax* Goetghebuer is a synonym of *Eu. ilkleyensis* (Edwards)) to chironomids of algal aufwuchs (ERTLOVÁ, 1970a) and to chironomids from Bryozoa (ERTLOVÁ, 1974, see also JANEČEK, 2005). According to ELEXOVÁ (1998) 144 taxa of 18groups were recorded in the Slovak Danube river. 'Chironomidae with 50 taxa are considered the most diverse taxonomic group of the zoobenthos.' Important in connection with new findings is HAMERLÍK, who discovered for example *Kloosia pusilla* (L.) (pupal exuviae) for the first time in the Slovak Danube – a species which could not be detected in the JDS2 samples (HAMERLÍK, 2005). Up to now 356 chironomid species are known from Slovakia (BITUŠIK, 2004, 2005; HAMERLÍK 2005, HAMERLÍK & BOŠÁKOVÁ, 2005).

The only Slovak scientist in the 'Directory of Chironomid workers' is Petr BITUŠÍK. Of course he is the regional Representative too.

Hungary

Concerning the Hungarian Danube especially the older publications of BERCZIK (1964, 1965, 1966a, b, c, 1967, 1969a, b, 1971, 1978) have some old synonyms and, generally, relatively few species are discussed. For example chironomids of the periphyton of breakwater walls (BERCZIK, 1965), of pontoons and other artificial floating bodies (BERCZIK, 1966a) and, more generally, the benthic species of the banks are presented (BERCZIK, 1967, 1969a, 1969b). The change of zoobenthos according to human impacts is dealt with in BERCZIK (1978). Though loaded with old synonyms, a little bit old-fashioned and partly a translation from the Russian literature (many figures from 'CZERNOVSZKIJ' (1949), PANKRATOVA 1970 and 1977) the key of BIRÓ (1981, translated from Hungarian to German by DANECKER (1988)) should not be forgotten as source for Chironomidae of the Hungarian Danube. From BIRÓ (2000) are two new records (for Szigetköz, Old Danube, Hungary and for Serbia) of *Lipiniella moderata*, KALUGINA, a quantitatively very important species of the middle and lower section of the Danube as documented by JDS2-samples.

Incidental remark: *L. m.* up to now has not been found in Austria. But it has been detected (pupal exuviae) quite recently in an important tributary of the Danube, the Morava river, Czech Republic (HAMERLÍK, 2006). Data from the most recent Hungarian chironomid checklist (MORÁ, version 2007 11.15.: 312 species) have been enlisted into.

There are two Hungarian scientists included in the 'Directory of Chironomid workers', György Dévai (who is the Regional representative) and Arpad SZITÓ, who published for example about macrozoobenthos of the river Tisza and its backwaters with emphasis on Chironomidae (SZITÓ, 1974, SZITÓ and GYÖRFFY, 2006).

Croatia

According to SÆTHER & SPIES (2004) 54 chironomid species and 2 doubtful species

have been found in Croatia. There are only a few modern Croatian publications dealing with Chironomidae. This insect family is included in a study of macroinvertebrates on floating artificial substrates in the Sava river, an important tributary of the Danube and part of the JDS2 sampling programme. (MIHALJEVIC et al., 1998). Evidently there are no studies dealing with chironomid species of the Croatian Danube which has a length of only 137 km.

Zlatko MIHALJEVIĆ (Interests: Macrozoobenthic communities, use of chironomids in water quality assessment) is the only Croatian scientist in the 'Directory of Chironomid workers'.

Serbia

Coming to Serbia and to its stretch of the Danube we have to pay attention to the publications of JANKOVIĆ. RUSSEV (1998) quoted the following publications: JANKOVIĆ (1969a, b, 1973, 1975, 1978, 1979). Besides the sometimes obsolete taxonomy (partly based on CHERNOVSKIJ's (1949) larval groups) these are important studies, for example about the fauna of the periphyton of the 'Yugoslavian' stretch of the Danube (JANKOVIĆ 1973) or about the changes in the chironomid fauna caused by damming the Danube (Djerdap Reservoir – Iron Gate) (JANKOVIĆ 1975). In this publication we find some of the important, mainly psammophilous species of JDS2 samples, e.g. *Beckidia zabolotzskyi* (to use its valid name), *Paratendipes 'intermedius'* and *Paratendipes 'connectens No 3* LIPINA'. By the way these species and some others are not included in RUSSEV's (1998) list of macrozoobenthic organisms of the Danube. SÆTHER & SPIES (2004) list 81 (+ 1 doubtful) chironomid species of Yugoslavia (containing Serbia, Kosovo, Voivodina and Montenegro).

There is no Serbian scientist in the Directory of Chironomid workers. (-> Germany)

Bulgaria

Concerning Bulgaria RUSSEV (1995) mentions two publications of STOICHEV (1994, 1996) who communicates 32 chironomid species for the Bulgarian stretch of the Danube and analyses the faunistic similarity with some of its tributaries. According to RUSSEV (1995) there are at least 32 chironomid species in the Bulgarian Danube. DIMITROV (1966a, b) has likewise studied the Bulgarian Danube flatlands. Relatively well-studied are the chironomids of the river Maritsa which is no tributary of the Danube but flows into the Mediterranean Sea (Thrakian Sea) near Alexandrupolis in Greece (RUSSEV, 1966, 1967a; STOICHEV, 1996; UZUNOV & al., 1981). According to SÆTHER & SPIES (2004) 167 chironomid species have been detected in Bulgaria.

The only Bulgarian scientist in the Directory of chironomid workers (-> Germany) is Paraskeva MICHAILOVA (many publications; interests: Cytotaxonomy, speciation and evolution of Chironomidae)

Romania

The most important author dealing with Chironomidae of the Romanian Danube is CURE (1973, 1975, 1985, 1989). For the obsolete names within *'Cryptochironomus'* and unclear species within *Chironomus* in her publication of 1975 (we encounter some of these names in publications of JANKOVIĆ too) CURE is not responsible. Besides the slow scientific exchange between Western and Eastern Europe countries the revision of the '*Harnischia*-group' by SÆTHER was published 1977 and many good revisions and keys for larvae of *Chironomus* – completely a matter of course for modern chironomidologists - have not been published: e.g. GEIGER et al. (1978), KIKNADZE et al. (1991), VALLENDUUK & MOLLER PILLOT (1999) or WEBB & SCHOLL (1985). CURE (1975) presents the chironomid communities (91 spp. as a whole) before (1970) and four years after the formation of the impoundment at the iron gate. During the years of the study the species number dropped from 71 to 32. Especially many Orthocladiinae (+ a few Diamesinae and Prodiamesinae) – with the most rheophilous chironomids of the study area (e.g. genera *Eukiefferiella* and *Tvetenia*) disappeared: 1970: 26 (36,5%) – 1974: 4 (12,5%). In an extensive faunistical study CURE (1985) describes chironomids of Romania with special reference to those of the Danube's hydrographical area. 406 species and larval forms were identified belonging to 116 genera and 4 subfamilies. Data of this publication helped to enlarge the Deliverable No. 118 . of the European Commission (BRABEC et al., 2006) especially for Ecoregions 10 and 12 (ILLIES 1978).

The other very important Romanian chironomid research scientist, ALBU, has mainly worked as a taxonomist. Within the scientific book series 'Fauna Republicii Socialiste România' she wrote 'Volumul XI', dealing with the Subfam. Chironominae (♂ imagines) (ALBU, 1980). This is a very important book for example for a person who wants to use a light trap near the Romanian Danube.

BOTNARIUC & CURE (1959) published about Chironomidae of the Danube delta – but this is an old study with many obsolete larval groups in the taxalist and a nomenclature which is at least unfamiliar.

Important for the biology of a benthos animal living in the marine origin area of the Danube delta are the physiological investigations on *Propsilocerus danubialis* BOTNARIUC et ALBU (BOTNARIUC et al., 1982).

According to the checklist of TATOLE (without year, 1996 or later) 403 chironomid species have been detected in Romania.

Maria-Monica TUDORANCEA is the only Romanian scientist included in the Directory of chironomid workers (-> Germany).

Moldova

75 species of Chironomidae are known from Moldova (SÆTHER & SPIES, 2004). Only 340 m of Moldavian territory reach the Danube.

No Moldavian scientist is included in the 'Directory of chironomid workers')

Ukraine

96 (+ 1 doubtful) chironomid species have been collected from the territory of the Ukraine (SÆTHER & SPIES, 2004).

51 Russian scientists but no one from the Ukraine is included in the 'Directory of chironomid workers'.

Results

The minimal species numbers (of 106 species/taxa) detected in every country (Danube + tributaries):

Germany (7 sample locations, sample sites where the Danube is border were counted for both countries): 49 spp.

Austria (10 locations) : 40 spp.

Slovakia (10 locations): 35 spp.

Hungary (21 locations): 32 spp.

Croatia (6 locations): 8 spp.

Serbia (26 locations): 34 spp.

Romania (35 locations): 38 spp.

Bulgaria (29 locations): 29 spp.

Moldova: 4 spp. (*Paratendipes 'intermedius'*, *Paralauterborniella nigrohalteralis*, *Polypedilum scalaenum*-Gr., *Virgatanytarsus sp.*)

Ukraine: 7 spp. (*Cricotopus* cf. *dobrogicus*, *C. obnixus*-Gr., *C. bicinctus*, *C. sylvestris*-Gr., *Dicrotendipes nervosus*, *Limnophyes sp.*, *Paratendipes 'intermedius'*

The numbers of species (taxa) of the river sections are:

a) Danube only:

Upper Danube (r. s. 1-3 // 9 locations – without spp. collected only in river Inn): 50 spp. // 1: 31 spp., 2: 13 spp., 3: 14 spp.

Middle Danube (r. s. 4-7 // 43 locations – without spp. collected only in rivers Morava, Vah, Hron, Ipoly, Sio, Drava, Tisza, Sava or Velika Morava): 54 spp. // 4: 21 spp., 5: 21 spp., 6: 28 spp., 7: 14 spp.

Lower Danube: (r. s. 8-10 // 28 locations – without spp. collected only in rivers Timok, Iskar, Olt, Jantra, Siret or Prut): 57 spp. // 8: 52 spp., 9: 5 spp., 10: 9 spp.

The species numbers of the Chironomidae collected in the tributaries (near their river mouths) are the following: Inn: 26 // Morava: 11, Vah: 11, Hron: 13, Ipoly: 16, Sio: 6, Drava: 3 (*Beckidia zabolotzskyi*, *Chernovskiia orbicus* and *Paratendipes 'intermedius'*), Tisza: 1 (*P. 'intermedius'*, Sava: 1 (*Dicrotendipes nervosus*), Velika Morava: 2 (*Chironomus 'JDS2 sp.'* and *Chironomus sp.* // Timok: 1 (Chironomidae, *Gen. sp.*), Iskar: 4, Olt: 3 (*Cladotanytarsus conversus*, *Cricotopus bicinctus* and *C. festivellus*-Gr., Jantra: 6, Siret: 8, Prut: 5.

28 (32,9%) of the 85 species (taxa) found in those tributaries were not found in the Danube. 63 species (taxa) (74,1%) were collected only in one tributary.

The species (Danube + tributaries) divided into ecoregions (ILLIES, 1978):

9 – Central Highlands – 12 locations: 60 spp.

11 – Hungarian Lowlands – 45 locations: 57 spp.

5 – Dinaric Western Balkan – 1 location (Sava, rkm 7.0; Danube Km: 1,170): 1 sp. (*Dicrotendipes nervosus*)

10 – The Carpathians – 4 locations: 12 spp.

12 – Pontic Province: 52 spp.

Before a discussion of different ecological groups can start let us come to the question if the chironomid communities are useful for a longitudinal subdivision of the Danube. Qualitatively the following groups are distinguishable (some larval groups have not been counted here.):

A1 - The following 16 species (taxa) have only been collected in the Upper Danube:

Cladotanytarsus sp., *Cricotopus trifascia*, *C. trifascia/similis*, *Eukiefferiella clypeata*, *Micropsectra atrofasciata* (Agg.), *Microtendipes* cf. *pedellus*, *Paracladius conversus*, *Parametricnemus stylatus*, *Paratendipes albimanus*, *Rheotanytarsus sp(p.)*, *Synorthocladius semivirens*, *Tanytarsus brundini*, *T. heusdensis*, *Thienemannimyia sp.*, *Tvetenia calvescens*, *Virgatanytarsus* ?*arduennensis*

A2 - Some of the species (taxa) of Upper Danube (6 spp.) have not been found in Middle or Lower Danube, but in tributaries (near their river mouths). Such tributaries are noted together with river section type of the Danube (in bold type: species belonging to the Upper Danube and Inn)

Conchapelopia sp. (+ Inn, 2/3), *Microtendipes* cf. *britteni* (+ Hron: 5), ***Polypedilum convictum*** (+ Inn, 2/3), *P. cultellatum* (+ Inn: 2/3; Morava, 4), ***Synorthocladius semivirens*** (+ Inn 2/3), *Tanytarsus ejuncidus* (+ Hron: 5; Ipoly, 5), ***Tvetenia verralli*** (+ Inn: 2/3)

T1 - 18 spp. (taxa) have been found only in the Inn. Here they are:

Cricotopus cf. *curtus*, *C. sp.*, *C. tremulus*, *C. tremulus*-Gr., *Eukiefferiella devonica/ilkleyensis*, *Eu. gracei*, *Eu. lobifera*, *Heterotrissocladius marcidus*, *Orthocladius (O.) oblidens*, *O. (O.) obumbratus*, *O. (O.) rubicundus*, *O. (O.) sp.*, *O. (Symposiocladius) lignicola*, *Paratrichocladius rufiventris*, *Polypedilum albicorne*, *P. laetum*, *Potthastia gaedii*, *Tvetenia vitracies*

T2 – 12 spp. of the Inn have also been collected elsewhere (in **bold type** the species/taxa belonging to the Upper Danube too are repeated)

Conchapelopia sp. (+ 1), *Cricotopus bicinctus* (+ 7, 8, 10; Olt: 8), *C. triannulatus* (+ 8), ***C. trifascia*** (+ 1), *Monodiamesa sp.* (+ 3, 4), ***Polypedilum convictum*** (+ 1), *P. cultellatum* (+ 2, Morava, 4), *Stictochironomus sp.* (+ 3, 4, 5; Vah: 5), ***Synorthocladius semivirens*** (+ 1), *Tanytarsus brundini/curticornis* (+ 4; Hron: 5), ***Thienemannimyia*-Gr. *Gen. sp.*** (+ 1, 2, 3), ***Tvetenia verralli*** (+ 1)

B – The following 11 species (some of them are repeated here) have been found in the Upper Danube (or Inn) and in the Middle Danube (or one of the tributaries belonging to it):

Chironomus nudiventris/agilis (3-6; Morava: 5, Vah: 5, Hron: 5), *Cladotanytarsus vanderwulpi* (2, 4, 6; Hron: 5), *Microtendipes cf. britteni* (1; Hron: 5), *M. pedellus-Gr.* (1, 4; Ipoly: 5), *Monodiamesa sp.* (3, 4; Inn: 2/3), *Polypedilum laetum*-Gr. (3, 4), *P. cultellatum* (2; Morava: 4), *Prodiamesa olivacea* (1, 3, 4), *Stictochironomus sp.* (1; Inn: 2/3; Vah: 5), *Tanytarsus brundini/curticornis* (Inn: 2/3; 4; Hron: 5), *T. ejuncidus* (1; Hron, Ipoly: 5)

C – This group of 11 species has been found only in Middle Danube (**bold type**) and/or in tributaries belonging to this part of the Danube:

Chironomus 'JDS2 sp.' (Velika Morava), ***Cladotanytarsus sexdentatus*** (6 – JDS38, 40, 43), ***Nanocladius distinctus*** (5 – JDS 20), ***Chironomus*** cf. ***bernensis*** (6; Ipoly: 5), ***Ch.*** cf. ***obtusidens*** (6), ***Ch.*** cf. ***plumosus*** (4), ***Ch. riparius*** (6), *Cladopelma sp.* (Pu) (Ipoly: 5), *Cladopelma virescens* (Ipoly: 5), *Cladotanytarsus nigrovittatus* (Ipoly: 5), *Cryptochironomus obreptans* (Sio: 5), ***C. obreptans*-Gr.** (4), *Cryptotendipes usmaënsis* (Ipoly: 5), ***Harnischia fuscimana*** (Pu) (5), *Nanocladius* cf. *dichromus* (Morava: 4), ***Parachironomus arcuatus*-Gr.** (5; Morava: 4), *Phaenopsectra sp.* (Morava: 4; Ipoly:

5), ***Polypedilum acifer*** (6), *Rheopelopia ornata* (Morava: 4), ***Robackia sp.*** (6), ***Tanytarsus eminulus*** (5, 6; Morava: 4)

D – The following spp. were found in Middle Danube and Lower Danube (**bold type**) or in tributaries belonging to these parts of the Danube:

Beckidia zabolotzskyi (5, 6, 8; Drava: 6), ***Chernovskiia orbicus*** (5, 6, 8; Drava: 6), ***Lipiniella moderata*** (6, 8, 9; Vah: 5; Siret: 9), ***Paratendipes 'intermedius'*** (6, 8; Vah: 5, Drava: 6; Tisza: 6; Siret: 9; Prut: 9), ***Cricotopus*** cf. ***dobrogicus*** (7, 8, 10), *Chironomus acutiventris* (Hron: 5; 8, 9), ***Cladopelma laccophila*-Gr.** (4, 8), ***Cladotanytarsus mancus*-Gr.** (5, 8; Vah: 5; Hron: 5, Ipoly: 5; Jantra: 8), ***Cryptochironomus rostratus*** (5, 6, 8; Vah: 5, Hron: 5), *Glyptotendipes pallens* (5, 6; Siret: 9), ***Microchironomus tener*** (4, 6, 7, 8; Ipoly: 5, Sio: 5; Iskar: 8, Jantra: 8), *Paralauterborniella nigrohalteralis* (4, 6; Prut: 9), ***Polypedilum sp.*** (7, 8), *Polypedilum sp.* (Pu) (Hron: 5; 8), ***Polypedilum bicrenatum*** (7, 8, 10; Ipoly: 5), ***Robackia demeijerei*** (6; 8), *Tanypus punctipennis* (Sio: 5; Jantra: 8), *Telopelopia fascigera* (Morava: 4; 8), ***Xenochironomus xenolabis*** (6; 8; Vah: 5)

E – Only from Lower Danube (**bold type**) or tributaries of this part have been colleted:

Chernovskiia macrocera (8 – JDS 69), ***Paratendipes 'connectens'*** (8; Siret: 9), ***Cricotopus obnixus*-Gr.** (10), ***Chironomus ('Einfeldia') dissidens*-Gr.** (8), ***Cladotanytarsus conversus*** (8 – JDS65, 67; Iskar: 8, Olt: 8), ***C. mancus*** (Pu) (8), ***Cricotopus festivellus*-Gr.** (8; Olt: 8), ***C. flavocinctus*** (8), ***Limnophyes sp.*** (10), ***Nanocladius sp.*** (8), ***Nilotanypus dubius*** (8 – JDS65), ***Paratanytarsus sp.*** (8), ***Polypedilum nubifer*** (8, 9); ***P. aegyptium*** (8 – JDS85), ***P. bicrenatum*-Gr.** (8; Siret: 9); ***Virgatanytarsus sp.*** (8; Prut: 9)

F – 'Euryoecious group' with localities in all three sections of the Danube (**bold letters**) **-** or Upper and Lower Danube, tributaries …

Ablabesmyia longistyla (1, 8; Morava: 4), ***Chironomus plumosus*-Gr.** (3-8; Sio: 5), ***Cricotopus bicinctus*** (1, 7, 8, 10; Inn: 2/3; Olt: 8), *Cricotopus triannulatus* (Inn: 2/3; 8), *C. (Is.) sylvestris*-Gr. (1, 8, 10; Morava: 4), ***Dicrotendipes nervosus*** (2, 5-8, 10; Morava: 4, Sio: 5, Sava: 6), ***Harnischia sp.*** (3, 4, 6, 7, 9; Prut: 9), ***Paratanytarsus dissimilis*** (1, 7, 8), ***Polypedilum nubeculosum*** (1, 4, 5, 7, 8; Vah: 5, Ipoly: 5, Sio: 6; Jantra: 8), ***P. scalaenum*-Gr.** (2, 5, 6, 8, 9; Vah: 5, Hron: 5; Iskar: 8, Siret: 9, Prut: 9), ***Procladius (H.) choreus*** (3-8; Morava: 4, Ipoly: 5, Sio: 5), *Rheocricotopus chalybeatus* (1, 2; 6; Siret: 9).

Interpretation

The majority of Group A1, A2 (**bold letters**), T1 (Inn only) and T2 (**bold letters**) prefers the rhithral zone (MOOG, ed. 2002). The *Cricotopus* species occurring here, the *Eukiefferiella* species, *Orthocladius rubicundus*, *Rheotanytarsus spp.* (depending on the species) and the *Tvetenia* species can be characterized as lithorheophilous. In general we can say that they feed mainly as grazers. The exception are the *Rheotanytarsus* species which are passive filtrating collectors.

Heterotrissocladius marcidus is quite euryoecious, provided that the temperature is not too high and flow velocity is not to large. The species can also occur in the crenal and in the littoral of lakes (especially cooler lakes, in Central Europe often in the mountains) and ponds.

There are two species which even prefer the crenal zone: *Polypedilum albicorne* and *Tanytarus heusdensis*. That does not mean that they are not found in smaller ditches, brooks and even in some larger rivers. *Polypedilum convictum*, well-known to all who have identified Chironomidae of 'the average' Central European brook, shows a rhithral predominance too.

Orthocladius oblidens, Paracladius conversus, Paratrichocladius rufiventris, Polypedilum laetum and *Synorthocladius semivirens* are all quite euryoecious and can develop in the littoral zone too. A difference to the euyoecious chironomids of Group F seems to be that the species listed here have a preference for lower temperatures, a less muddy bottom and higher oxygen content.

Potthastia gaedii is the only species of Diamesinae found – but (e-s. g.:) *Diamesa hamaticornis* (cf. *D. cinerella-zernyi*-Gr.: Moog et al., 1995), *Diamesa insignipes* (JANKOVIĆ, 1973), *Potthastia longimanus* (CURE 1985) and *Sympotthastia macrocera* should also occur.

Because the samples have been taken from the river bottom the separation of this group seems to be too keen. Nevertheless the majority of these species cannot develop on sands of the Middle and Lower Danube. They would need special microhabitats: bioderma of stones, periphyton (JANKOVIĆ, 1973), even 'aufwuchs' of breakwater walls (BERCZIK, 1965), of pontoons and other artificial floating bodies (BERCZIK, 1966a).

A comparison with the species list and ecological results in CURE's 'Chironomids (…) of Romania with special reference to those of the Danube's hydrographical area is interesting (CURE, 1985). If we take species from our A1, A2, T1 (Inn only) and T2 lists we can distinguish chironomids which find microhabitats to develop also in the Romanian Danube (group a) and others of which an occurrence is rather unlikely (though not quite impossible) (group b):

Group a – *Cricotopus trifascia* (in bioderma of stones), *Eukiefferiella clypeata* (lithorheophilous), *Paracladius conversus* (Danube: Iron Gate), *Paratendipes albimanus* (psammophilous, Danube: 'Sulina-Arm'), *Synorthocladius semivirens* (lithophytophilous), *Polypedilum convictum*, *Orthocladius oblidens* (bioderma of stones), *Orthocladius rubicundus* (bioderma).

Group b - *Parametriocnemus stylatus* (in mosses of springs, brooks, ditches and lentic waters), *Tanytarsus heusdensis* (in cold mountain brooks, crenobiot, -philous, polyoxybiont), *Tvetenia calvescens* (rheophilous, phytophilous), *T. verralli* (mountain brooks!), *Cricotopus curtus* (rheophilous), *C. tremulus* (rheophilous, stones and mosses), *Eukiefferiella devonica* (rivers and lakes – probably in the shore), *Eu. lobifera* (brooks and shores of larger lakes, stones, moss), *Heterotrissocladius marcidus* (cold water bodies, brooks, rivers, oligotrophic lakes), *Polypedilum albicorne* (cold water, stenothermal), *P. laetum* (shores of lakes and banks of rivers), *Potthastia gaedii* (brooks, rivers and oligotrophic lakes). A special microhabitat is necessary for the development of *Orthocladius (Symposiocladius) lignicola* (Gura Zlata, Retezat mountains), namely dead wood.

These two groups with ecological notes by CURE (1985) should clarify that some of the chironomids which are able to develop on the bottom of the Upper Danube or the Lower Inn can be restricted to mountain brooks in Romania. Others can develop on different special habitats. We shall also keep in mind that the percentage of Diamesinae and Orthocladiinae, which died out in the impounded stretch of the Danube after the erection of the Iron Gate was highest among chironomids.

At the end of this part one species/larval type of the lower Inn – often overlooked in technical reports – shall be presented and shortly discussed: *Tvetenia vitracies* SÆTHER. Very probably the larva with its characteristic wreath of small bristles on the prothorax is also contained in PANKRATOVA (1970, as *Eukiefferiella tshernovskii sp. n.*) and in CRANSTON (1982, as *Tvetenia sp. A*). According to 'Fauna Europaea' this Nearctic species was found only in one Palaearctic country, in Austria! (SÆTHER & SPIES, 2004). Schmid (1993), who mentions the similarity of his *Tvetenia sp. A* with *Eu. tshernovskii* writes under 'distributional aspects': 'larvae occurred in the surface layer (0-10 cm) of bed sediments in the river Danube (km 1895-1920).' That means Middle Danube, Section Type 4, Hungarian Lowlands. In Austria the larvae of T. v. are known from the following rivers: Donau, Ager, Enns, Inn, March, Melk, Mur, Pielach, Piesting, Rhein, Traun and Ybbs (Data collection of our Working Group: Thomas OFENBÖCK). The saprobic valencies could be similar to *Tvetenia verralli* (G: 3, SI: 2,0 // grazer: 7, detritus feeder: 3: MOOG, ed.: 2002).

Among the species of <u>Group B</u> (which have been found in the Upper Danube (or Inn) as well as in the Middle Danube or one of its tributaries) there are quite common species of lotic habitats, neither so coldstenothermous and rheophilous to be restricted to the Rhithral nor true potamobionts. As sediment these larvae prefer microlithal to akal/psammal to larger stones. In our samples *Cladotanytarsus vanderwulpi*, *Polypedilum laetum*-Gr., *P. cultellatum*, *Tanytarus brundini/curticornis* and T. ejuncidus (one of the most common Central European *Tanytarsus*-species of running waters). The *Microtendipes*-species are more pelophilous and quite euryoecious. They can also develop in lentic water bodies.

Much more typical for the Danube and the mouth of its larger tributaries is *Chironomus nudiventris/agilis*. The pair of species is necessary because Ch. n. and Ch. a. distinguishable cytologically than in morphology (e. g. basal margin of the maxilla) (KIKNADZE et al., 1991) . *C. agilis* is 'Alleen bekend uit Rusland' (VALLENDUUK et al., 1999). *Ch. n./a.* has been found on 16 sampling sites. Its largest number (344 Lv./m²) it reaches in Hron. This is no high density for a chironomid but the 4th larval instar is more than 20 mm long and has almost the dimensions of *Chironomus plumosus*. The third largest density – after sampling site 44 (256/m²) the species has at sample site 11, upstream dam Greifenstein (River Km: 1950, AT): Here you can find the rest of a mixture of a Prodiamesinae community (typical for colder impoundments nearer to the Alps) and a community 'dominated' by *Chironomus* species. The quotation marks were used because much more important quantitatively are in this impoundment some other benthic invertebrates, *Pisidium* sp., *Hypania invalida*, some Oligochaetes and *Corophium curvispinum*. Nevertheless the few species/taxa of the chironomid community should be mentioned: *Chironomus sp.* (24/m²), *Chironomus plumosus*-Gr. (321/m²), *Monodiamesa sp.* (12/m²), *Prodiamesa olivacea* (28/m²) and *Stictochironomus sp.* (4/m²).

Monodiamesa sp. is quite typical upstream the dams of Austrian power plants:

7 (Jochenstein, Km: 2204, DE, AT): 48/m²; again together with *Chironomus plumosus*-Gr. (12/m²), *Prodiamesa olivacea* (32/m²) and *Stictochironomus sp.* (4/m²)

8 (Upstream dam Abwinden Asten, Km: 2120, AT): 108/m²; together with *Chironomus nudiventris/agilis* (44/m²), *Prodiamesa olivacea* (4/m²), *Stictochironomus sp.* (8/m²) and *Thienemannimyia*-Gr. Gen. sp. (4/m²)

9 (Upstream dam Ybbs-Persenbeug, Km: 2061, AT): 72/m²; together with *Chironomus sp.*(8/m²), *Harnischia sp.* (140/m²) and *Procladius choreus* (4/m²)

Psammorheophilous and psammorpelorheophilous species – potamobiont and potamophile

It would be the thing to discuss groups C to F together.

The most precious group are perhaps the true potamobionts. These species are either psammorheophil or psammopelorheophil. 'Some of them (…, *Cryptochironomus* [= *Robackia*] *demeijerei*, *Cryp. monstrosus* [= *Chernovskiia orbicus*], *Cryp.* [=*Beckidia*] *zabolotz[s]kyi*) clean river sand exposed to heavy water currents', writes JANKOVIĆ (1975, in German), 'and can therefore be found most frequently in the middle of the Danube bed.'

Beckidia zabolotzskyi has been found in Belarus, Bulgaria, Hungary, the Italian mainland, Poland, Romania, Russia, Yugoslavia (incl. Serbia, Kosovo, Voivodina, Montenegro), European Turkey and the East Palaearctic Region (SÆTHER & SPIES, 2004). From 22 (Iza/Szony) to 89 (Braila) it has been found on 16 sampling sites of Middle and Lower Danube and in the Drava (42 TB). It is a frequent and typical potamobiont, psammorheophilous species – but does not reach high densities: the highest at 45 (Ilok/Backa Balanka): 489/m², 83 (Upstream Arges): 160/m². As other psammorheophilous species *B. z.* avoids large parts of the Iron Gate dam section (50 (52)-64): 50 (Downstream Tisza/Upstream Sava): 128/m², 53 (Downstream Pancevo): 4/m² - - 72 (Downstream Iskar): 48/m². The same confirm the several years' studies of JANKOVIĆ (1975) and CURE (1975) although CURE's lists (pp. 513, 515) seem to be contradictory in this point.

Its thin, spindle-shaped body (like *Chernovskiia orbicus*, *Robackia demeijerei*, some Ceratopogonidae or even Nematoda) surely allows the larva to wind between the grains. The functional feeding group is unknown. Probably the larvae engulf Rotatoria or Roundworms.

Chernovskiia orbicus is known to occur in Romania, Russia, Yugoslavia, the Eastern Palaearctic Region and the Nearctic Region (SÆTHER & SPIES, 2004). It is also a frequent species of Middle and

Lower Danube (12 sampling sites between 22 and 80) and in the Drava (42 TB). The highest densities are at 40 (Batina), 225/m², and at 43 (Downstream Drava (Erdut/Bogojevo)): 160/m². Being psammorheophilous the larvae avoid the influence of the Iron Gate impoundment: 50 (Downstream Tisa …): 107/m² - - 69 (Downstream Kozloduy): 48/m². '…in the Đerdap Reservoir. The rheophilous forms disappeared first, primarily the scarce psammprheophilous species from the genus *Cryptochironomus* … writes JANKOVIĆ (1975).

Ch. o. often occurs together with *Beckidia orbicus*, (sampling sites 22, 39, 40, 42 (Drava), 45, 48, 50, 72, 80), has a similar form and probably a similar biology. Keeping in mind the findings of CHERNOVSKIJ (1949) in large Russian rivers I think that both species can also occur in the Argyllal.

Completely different in build, more like a short *Chironomus*, is *Lipiniella moderata*. Its known distribution is the following: Belarus, Hungary, The Netherlands, Norwegian mainland, Russia, Yugoslavia, Eastern Palaearctic region (SÆTHER & SPIES, 2004).

We have written of BIRO's (2000) findings. It is absent in the 'parallel' publications of CURE (1975) and JANKOVIĆ (1975). It remains unclear if this is a consequence of the improved methodology to collect benthic invertebrates from the deepest parts of the river or if the species has immigrated into the Danube during the latest decades.

The species seems to be psammorheophilous too, probably a little bit more psammopelorheophilous (ventral tubules VIII). It is even more frequent than the first two species (at some sample sites all 3 are living together: 40, 45, 72, 80) has – between 40 and 88 - 17 findings in the Middle and lower Danube and lives also in Vah (21 TB) and Siret (90 TB). It avoids large parts of the 'Iron Gate region' too: 54 (Grocka): 4/m² - - 67 (Pristol/Novo Selo harbour): 32/m². Its second largest density we calculated for 73 (Upstream Olt): 273/m². But at 79 (Downstream Jantra) it reaches an abundance of 1211/m² - one of the highest abundances for a chironomid in the JDS2 samples. Near this place must also be a lot of freshwater sponges, because their chironomid parasite, *Xenochironomus xenolabis* has a density of 209/m². Looking at the intestinal content of the *L. m.*-larvae the species seems to be detritivorous. The function of the mouthparts (e.g. the extremely broad ventromental plates) is unknown.

Chernovskiia macrocera is psammorheophilous too. It has been found in the Italian mainland, the Netherlands and Russia (SÆTHER & SPIES, 2004). The single finding at 69 (Downstream Kozloudy, River Km 685) seems to be the first finding for Bulgaria, Romania and the Danube.

Robackia demeijerei belongs to the psammorheophilous '*Cryptochironomus* species' (of older literature) too. It has been documented from Austria (OFENBÖCK, commun.: e.g.: March), Bulgaria, Germany, Finland (?), French mainland, Greek mainland, Hungary, Italian mainland, The Netherlands, Poland, Romania, Russia, European Turkey, Yugoslavia, , Eastern Palaearctic and Nearctic Region (SÆTHER & SPIES, 2004). Though mentioned by JANKOVIĆ (1975) there are only very sparse findings in the JDS2-series: 39 (Hercegszanto): 4/m², 40 (Batina): 32/m², 65 (Upstream Timok): 12/m² // 85 (Downstream Arges/Oltenita): 4/m².

The following *Cladotanytarsus*-species are psammophilous too. Probably some of them prefer more shallow water and a slower water current than the abovementioned species. Therefore the densities could be so low in the most cases.

Cladotanytarsus conversus was dealt with in the introduction. In Fauna Europaea we find the following provisional distribution: French mainland, Greek mainland; Near East and Oriental Region are the only data (SÆTHER & SPIES, 2004). Here are the first findings for (Lower) Danube and two of its tributaries: 65 (Upstream Timok, RS, RO, River Km 849): 32/m², 67 (Pristol, Novo Selo harbour, RO, BG, Km 834): 36/m²; 71 TB (Iskar, BG, Km (Danube): 637): 3/m², 74 TB (Olt, RO, Km (Danube) 605): 32/m². This species could belong to the Neozoa.

Cladotanytarsus 'sexdentatus' is a larval form of CHERNOVSKIJ (1949, p. 136, fig. 10: Tanytarsus sexdentatus, sp. n.) without taxonomic value. But nevertheless the mentum is very special for the genus. It occurred at three sampling sites: 38 (Baja, HU, River Km: 1481): 16/m², 40 (Batina, HR, RS, Km: 1424): 674/m²: Here it occurs together with *Beckidia zabolotzskyi*, *Chernovskiia orbicus*, *Robackia demeijerei*, *Lipiniella moderata* and *Paratendipes 'intermedius'* and is the dominant species among Chironomidae; 43 (Downstream Drava (Erdut/Bogojevo), HR, RS, Km: 1367): 32/m².

There are unpublished findings of this 'species' from Austria. In the Danube at Linz (Km (ca.) 2133,5) could occur as Neozoon. In Bulgaria 'Tanytarsus sexdentatus (TSCHERNOVSKIJ) was detected in the rivers Rositsa and Mesta (STOICHEV, 1996).

Cladotanytarsus mancus-Gr.: The group has some species. It is a rule of thumb that they are psammophilous but not so rheophilous as *C. vanderwulpi* (which was still found in Hron (24 TB and in the Danube down to 18, Medvedov, Medve, Km: 1806, SK, HU) or *C. conversus.* Between 34 and 86 they occur at 8 sampling sites of the Danube (highest density: 65 (Upstream Timok): 738/m².

Like many other chironomids do they (nearly) avoid the impounded section in the sphere of influence of the Iron Gate – There is a gap between 34 and 63 which is a sampling locality near the Iron Gate anyhow (Vrbica/Simija, Km: 926, RS, RO): 8/m². The larvae are known from 4 tributaries too: Vah (21 TB), Hron (24 TB), Ipoly (213 TB) and Jantra (78 TB).

A pupa of *C. mancus* was found at sample site 65, a pupa of *C. nigrovittatus* in the Ipoly (25 TB). According to CURE (1975) *C. m.* has been the most frequent of the Tanytarsini of the Romanian Danube.

The following two species are very important for the Middle (some individuals of *Paratendipes 'connectens'* could have been overlooked) and Lower Danube. They are even more slender than *Polypedilum aegyptium* and have a flat head capsule. They are psammopelophilous, but rheophilous.

Paratendipes 'intermedius' is one of CHERNOVSKIJ's larval types (1949, p. 162, Fig. 64). The larva has not been reared to the imago. Therefore it is not quite sure if the larva belongs to *P. nubilus* (MEIGEN) (BIRÓ and KLINK, 2005, MÓRA, 2007). The 'working name' is used by CURE (1975) as well as by JANKOVIĆ (1975).

After *Polypedilum scalaenum*-Gr. this is the most frequent chironomid of the JDS2-collections. Larvae have been found at 16 sampling sites (between 40 and 86) and in Drava (42 TB), Tisza (49 TB), Siret (90 TB: 1805/m²) and Prut (91 TB). As a consequence of the Iron Gate impounded region there is a wide gap of findings: 50: 128/m² - - 72: 8/m². This is the most numerous species of the samples. The sampling site with the highest density is 79 (Downstream Jantra): 2070/m². This is the highest abundance for alol chironomids of the samples Here (see above) *Lipiniella moderata* has its highest density too, but probably the location is too muddy for *Beckidia zabolotzskyi* or *Chernovskiia orbicus*. According to JANKOVIĆ (1975) the species prefers more shallow parts and a slower water currence than the abovementioned 'true' psammorheophilous species.

There are unpublished findings from the Danube at Linz (Austria: River Km (ca.) 2133,5) *P. 'i'* could occur there as Neozoon.

Paratendipes 'connectens No. 3 Lipina' (CHERNOVSKIJ, 1949, p. 162, fig. 63) was only found in the Lower Danube - 9 sampling sites between 69 and 86 – and in the Siret (90 TB). At almost all sampling sites of *P. 'c.'* the two *Paratendipes* 'species' are found together: 72, 75, 76, 77, 80, 82, 83, 86, Siret (90 TB). The larvae are very similar to *P. 'intermedius'* but have at the most sites lower densities (up to 72/m² - 76 (Downstream Turnu-Magurele/Nikopol and Siret).

Before we bring this block of (apart from some species of *Cladotanytarsus mancus*-Gr.) potamobiont Chironomidae to an end, some species of this ecological group shall be mentioned or got back which have not been found during the JDS2-programme but can, or could, also occur in Middle and Lower Danube:

Cryptochironomus rolli (CHERNOVSKIJ, 1949, p. 137, fig. 12; CURE, 1975: C. r. was never found in the Iron Gate impoundment since 1971; CURE 1985: psammorheophilous sp., in Romania in Sf. Georghe-Arm (Danube); Janković, 1975; Sæther, 1977), *Demicryptochironomus (Irmakia) latior*, *D. (I.) neglectus* (REISS, 1988a), *Kloosia pusilla* (HAMERLÍK, 2005, REISS, 1988b), *Saetheria reissi*

(JANECEK & MOOG, 1991), *Tanytarsus cretensis* (REISS, 1987), *T. volgensis* (known from (e.g.) BG, MD, RO, UA: SÆTHER & SPIES, 2004)

Polypedilum acifer: The species is known from 3 continents: Austria, Germany, French mainland, Greek mainland, Italian mainland, Macedonia, the Netherlands, Romania, Russia; East Palaearctic, North Africa, Nearctic region (SÆTHER & SPIES, 2004). It might be a little bit psammopelophil but is a true potamobiont. The longitudinal distribution in 'Fauna austriaca' is Epipotamal: 2, Metapotamal: 8 (MOOG, ed., 2002). Probably it prefers smaller rivers (JANECEK & MOOG, 1991: river Raab, Austria). CURE (1985) does not know a find directly from the Romanian Danube. In the JDS2 samples there are no findings in the tributaries, there is only one location: 50 (Downstream Tisza/Upstream Sava, River Km: 1200, begin of the dam Iron Gate, RS): 21/m².

Polypedilum aegyptium has a very large range of distribution too: Austria, Germany, Spanish mainland, French mainland, Northern Ireland, Greek mainland, Italian mainland, Portuguese mainland, Romania, Russia, Sweden, Slovakia, Ukraine, Yugoslavia; Afro-tropical region, North Africa, Near East, Oriental region (SÆTHER & SPIES, 2004). 'Streams and rivers. Lakes in the north' is the laconic ecological characteristic in LANGTON & VISSER (2003). In Central Europe the species is rheobiont to rheophilous (Hyporhitral: 1, Epipotamal: 5, Metapotamal: 3, Litoral: 1: MOOG, ed., 2002). CURE (1985) calls *P. ae.* a rheophilous species. There are no findings directly from the Danube. Therefore it does not surprise that P. ae. is only found at one sampling site in the JDS2 programme: 85 (Downstream Arges/Oltenita, River Km: 429, RO, BG): 4/m².

Telopelopia fascigera is known from Austria, Germany, Spanish mainland, Finland, French mainland, Greek mainland, Italian mainland, Macedonia, the Netherlands, Slovakia, Yugoslavia, North Africa and Near East. At least in Central Europe the species, belonging to the Tanypodinae, is potamobiont to potamophilous (JANECEK & MOOG, 1991: river Raab, Austria, but not in MOOG et al., 1995). It was found as very scarce species in Morava (15 TB) and at sampling site 73 (Upstream Olt, River Km 606, BG, RO): 8/m².

Cryptochironomus rostratus is widely distributed in Europe, North Africa, the Near East and the Oriental region (SÆTHER & SPIES, 2004). It is stroger rheophilous (psammopelo-rheophilous) than some other species of the genus. Its longitudinal distribution is the following: Hyporhithral: 2, Epipotamal: 5, MP: 1, HP: 1, Litttoral: 1. It could be the main *C.*-species of the Danube and is included in the list for the Austrian Danube (MOOG et al., 1995).

In the Danube the larvae (identified with the key of VALLENDUUK & MOROZOVA, 2005) occurred at 12 sample sites between 33 and 83. As many other chironomids do the species seems to avoid the dammed section in front of the Iron Gate: there is a gap between 46 and 65. Nowhere the species – mainly a predator - seems to be very numerous. The highest density was calculated for sampling site 65 (Upstream Timok): 205/m². Larvae occurred also in the rivers Vah (21 TB – 32/m²) and Hron (24 TB: 171/m²).

Harnischia sp.: Although there is a key (in Russian: p. 188-189) in PANKRATOVA (1983) it is not clear if the majority of the larvae belongs to *Harnischia fuscimana* (KIEFFER). A pupa of *H. fuscimana* was collected at sampling site 20 (Komarno/Komarom; River Km: 1768, SK, HU) The ecological 'shorthand note' by LANGTON and VISSER (2003) is: 'Moving water, slow flowing rivers.' In Fauna aquatica Austriaca lentic water bodies as habitat are probably overestimated: Hyporhitral: +, Epipotamal: 1, MP: 1, HP: +,Littoral: 8 (MOOG, ed. 2002). The larvae are found at 8 sampling sites in all 3 main sectors of the river. More than the previous psammopelophilic species, but mainly in very sparse populations the larvae tolerate the conditions of the dammed section in front of the Iron gate. But we must not go so far down. Upstream dam Ybbs-Persenbeug (Km: 2061, Austria), a sampling site dominated by *Lithoglyphus naticoides* the larvae (140/m²: this is the highest density calculated) seem to live in a community poor in chironomids. (*Chironomus sp., Monodiamesa sp., Procladius choreus*). The other sites are: 14 (Upstream Morava, River Km: 1881, Austria), 52 (Upstream Pancevo/downstream Save, Km: 1159, RS, begin dam Iron Gate): 4/m²; 54 (Grocka, Km: 1132, RS):

4/m²; 55 (Upstream Velika Morava, Km: 1107, RS): 8/m²; 61 (Donij Milanovac, Km: 991, RS, RO): 136/m²; 87 (Downstream Cernavoda, Km: 295, RO): 4/m², 88 (Giurgeni, Km: 235, Ro): 8/m².

Tanytarsus brundini(/*curticornis*) (MR: 1, HR: 2, EP: 2, MP: 1, HP: +, LIT: 4, PRO: +) , *T. ejuncidus* (the same longitudinal distribution) and *T. eminulus* (ER: +, mR: 3, EP: 3, MP: +, LIT: 1) belong to the relatively few rheophilic European Tanytarsini (MOOG, ed. 2002).

In a shallow lotic water body the can reach much higher densities than on the river bottom of the Danube.

T. b.[/*c.*] was found at 1 (178/m²), 6 TB (Inn: 1/m²) 13 (Wildungsmauer – here the only chironomid!) and 24 TB (Hron: 171/m²).

The sampling sites of *T. ej.* were 1 (21/m²), 24 TB (Hron: 171/m²) and 25 TB (Ipoly: 3/m²).

T. em. occurred at 15 TB (Morava: 3/m²), 20 (Komarno: 4/m²) and 38 (Baja: 16 – with 4 other chironomids).

Some Orthocladiinae

Cricotopus (Isocladius) cf. *dobrogicus* ALBU, 1964 is hitherto only known from Romania (ALBU, 1964, ASHE & CRANSTON, 1990, CURE, 1985, HIRVENOJA, 1973, SÆTHER & SPIES, 2004 [nec dobrogi**n**us], TATOLE, o. J.). The identification is not quite certain, because no larva of the JDS2-material has been reared to the adult. Nevertheless in some light-trap catches done as voluntary completion by W. GRAF and P. LEITNER near the sample sites of the larvae adult males of *C. d.* were sometimes quite numerous. According to ALBU (1964) the larvae probably do not develop directly on the river bottom but – as many *Cricotopus* species – could be phytophilous. The larvae supposed to be *C. d.* were found on 10 sampling sites, even in the impounded region near the Iron gate (60, 63, 64): 60 (Iron gate reservoir (Golubac/Koronin), River Km: 1040, RS, RO): 4/m²; 63 (Vrbica, Simijan, Km: 926, RS, RO): 8/m²; 64 (Iron Gate II, Km: 865, RS, RO): 232/m²; 65 (Upstream Timok, Km 849, RS, RO): 337/m²; 67 (Pristol/Novo Selo harbour, River Km 834, RO, BG): 16/m²; 68 (Calafat, Km: 795, RO, BG): 36/m²; 69 (Downstream Kozloudy, Km: 685, BG, RO): 160/m²; 76 (Downstream Turnu-Magurele/Nikopol, Km: 579, RO, BG): 8/m²; 80 (Upstream Ruse, Km: 500, RO, BG): 12/m²; 93 (Vilkova-Chilia arm/Kilia arm, Km 18, RO, UA): 36/m².

The Type locality is Crapina Jijila, floodplain of the Romanian Danube (ALBU, 1964). CURE (1985), who calls *C. d.* a phytophilous species too, gives some localities in Romania – even for larvae): Sulina-Arm, Sahalin-island, Razelmul Mare, C. J., S Taşaul and Chirnogi. It is unknown if the species could extend its range of distribution.

Cricotopus (C.) bicinctus belongs to 'Group F', the 'euryoecious group'. It has an almost worldwide distribution: Europe; Afro-Tropical region, Australian Region, East Palaearctic, North Africa, Nearctic regon, Neotropical region, Near East, Oriental region (SÆTHER & SPIES, 2004). The saprobic index is quite high (2,5; G: 1), the larvae can even occur in the polysaprobic zone. The longitudinal distribution (valid at least for Central European water bodies) is the following: Hypocrenal: +, Epirhithral: +, MR: 1, HR: 3, Epipotamal: 4, MP: 1, Littoral: 1.

In the JDS2-samples the species was not numerous. Between 1 and 93 it was found in 4 sampling sites, even in the dammed section before the Iron Gate (60: 32/m²). The highest density calculated were 261 larvae/m² (65). C. b. was also found in the rivers Inn (6 TB) and Olt (74 TB).

Nanocladius distinctus (MALLOCH) is known from Belarus, the Danish mainland, French mainland, the Netherlands; the East Palaearctic and the Nearctic region (SÆTHER & SPIES, 2004). The ecological notes of LANGTON & VISSER (2003), 'Large rivers: lower Rhine, Meuse and Rhone suggest a potamophilous species. In the Danube it has been found (larva and pupa) at a single sampling site. It is the first finding for Slovakia and Hungary: 20, Komarno/Komarom, River Km: 1768: 12/m². It is unclear if the larvae prefer the river bottom (average river depth at 20:

4,5 m) or if they are phytophilous.

Rheocricotopus chalybeatus: this is a rheobiotic (EUC: +, ER: +, MR: 1, HR: 2, EP: 4, MP: 2, HP: 1), a little bit phytophilous species which is, relatively to the other species of the genus more thermophilic. Therefore the situation at sampling site 1 (243/m² - among Chironomidae after *Microtendipes pedellus*-Gr. (290/m²) Nr. 2 in density) and 2 (261/m²: most abundant chironomid species) is comprehensible. Unclear is the occurrence at 46 (upstream Novisad: 32/m² - together with *Paratendipes 'intermedius'*, *Chironomus nudiventris/agilis* and *Cryptochironomus rostratus*) since the mean river slope there is only 0,03‰ and in the board protocol depths of 6,2 to 6,3 m are recorded, but no current velocity.

Two Tanypodinae of different ecology

Besides the quantitatively important *Procladius choreus* Tanypodinae have been found rarely on the bottom of the Danube. Each of the following two species has been found at only one sampling site. They have surely small populations on appropriate habitats.

Nilotanypus dubius: Maybe supported by the fact that the genus has only one European species which can be identified easily *N. d.* is well-known from many brooks and shallow little rivers (ER: 1, MR:2, HR: 3, EP: 2, LIT: 2: MOOG, ed., 2002). In the Danube it was found between 5,2-6,2 m depth in a density of 64/m². But at sampling site 65 the second largest number of chironomid species of the Danube was found (25) and relatively high water currents could be measured (0,5-0,7 m/sec.). The site is ca. 16 km after the Iron Gate II.

Tanypus punctipennis: This is a stagnopelophilic species (MP: 1, HP: 1, LIT: 8, PRO: +: MOOG, ed. 2002). During the JDS2 samples T. p. has only be found in river Sio (37 TB), in a low density of 27/m². Cure (1985) reports findings of larvae from the Romanian Danube and its delta and adults from the Iron Gate. JANKOVIC (1975) found the species 1971 in Đerdap impoundment but not in 1972. According to CURE (1975) the species has been a component of the impoundment fauna from 1971 to 1973. She did not find *P. p.* in 1974. The relatively low SI (2,2, W: 3) seems to have proved itself (MOOG, ed. 2002).

Psammopelophilous species which are not very rheophilic

The following examples can be given:

<u>*Microchironomus tener*</u> (= '*Cryptochironomus conju[n]gens* KIEFF.': JANKOVIĆ, 1975) has a vast range of distribution. It is known from many European countries, from the Afro-tropical region, from the Australian region, from Eastern Palaearctic region, from North Africa, from the Near East and from the Oriental region (SÆTHER & SPIES, 2004). The larvae can tolerate brackish as well as boggy water (FITTKAU und REISS in ILLIES, 1978; auctt. in JANECEK ,1985). They live in many kinds of lentic water bodies but can also develop in the Potamal zone (Epipotamal: +, MP: 1, HP: 1, Littoral: 8: MOOG, ed., 2002). They rather prefer open sandy sediments than a bottom with macrophytes. Between 19 and 77 the larvae occurred at 11 sample sites of the Danube, mainly in densities < 100/m². The impounded stretch before the Iron Gate is not avoided by them but has rather been beneficial (53: 36/m², 59: 32/m², 59: 32/m², 60: 32/m², 61: 272/m² - their largest density in Danube - and 62: 8/m²). *M. tener* was also detected in the mouths of some tributaries: Ipoly (25 TB), Sio (37 TB): 330/m², Iskar (71 TB) and Jantra (78 TB).

<u>*Polypedilum (Tripodura) scalaenum*-Gr.:</u> The majority of the larvae could belong to *P. scalaenum*. This species has been collected in many European countries, in the Eastern Palaearctic, in North Africa, in the Nearctic Region, in the Near East and in the Oriental region (SÆTHER & SPIES, 2004). With the exception of *Dicrotendipes nervosus* and *Chironomus sp(p.)* it is the most frequent chironomid in the Danube and occurs at 17 sample sites, between 5 and 92. CURE (1975) found out that '*Polypedilum breviantennatum*' is the most numerous chironomid species – spatially and temporally. Nevertheless the populations calculated from the JDS2 samples show quite low densities. Like *Microchironomus tener* the species does not avoid the Iron Gate impoundment (52: 257/m², 55:

257/m², 57: 10/m² and 63: 40/m²) – but it was not found in the mud upstream the Austrian power plants Jochenstein (7, DE, AT), Abwinden Asten (8), Ybbs-Persenbeug (9) or Greifenstein (11). Slightly higher densities than in the Iron Gate impoundment are reached in Lower Danube, at 65 (Upstream Timok, RS, RO): 320/m² and 68 (Calafat, RO, BG): 304/m². The species was also found in the mouths of Vah (21 TB), Hron (24 TB), Siret (90 TB) and Prut (91 TB).

Polypedilum bicrenatum-Gr.: *P. bicrenatum* leads into the stagnopelophilic group. Its ecology and population dynamics were studied by the author in an Austrian carp pond (JANECEK. 1985). There are findings in many European countries in the East Palaearctic, in North Africa and in the Near East (SÆTHER & SPIES), 2004. Between 61 and 94 it occurs in the Danube at 7 sampling sites. It does not avoid the impounded section before the Iron Gate (61, 62, 63), at 63 we even calculated the highest densities: 192/m². In low densities *P. b.*-Gr. occurred also in the mouths of two tributaries: Ipoly (25 TB) and Siret (90 TB).

The larvae of *Chironomus acutiventris* hava been identified – that is distinguished from *Ch. obtusidens* (*Ch.* cf. *obtusidens* was found at 53, in the impounded section upstream the Iron Gate) with the key of Vallenduuk et al. (1999). The species is an exception among the genus *Ch.* because the larvae are psammopelorheophilic and the SI is not so high: 2,7. Nevertheless small populations can even toleratwe polysaprobic conditions (MOOG, ed., 2002).

Ch. a. was only found in the Lower Danube, at 8 sampling sites between 65 (Upstream Timok) and 88 (Giurgeni). It was not found in the dammed section upstream the Iron gate. All populations were very sparse and < 100/m². At 73 (Upstream Olt) they reached 72/m2.

The (stagno)pelophilous species

Polypedilum nubeculosum is very euryoecious and can be found from the hyporhithral (if there is enough organic mud) down to the profundal of lakes (MOOG, ed., 2002). The species is known from Europe, the Eastern Palaearctic, North Africa, the Nearctic zone and the Near East (SÆTHER & SPIES, 2004). Between the first sampling site (Upstream Iller, rkm: 2613: 24/m²) and 86 (Chiciu/Silistra) P. n. was found at 13 localities. Small populations were also found in the impounded section upstream the Iron Gate (60: 40/m2, 61: 64/m2), but not upstream the Austrian power plants (Jochenstein, Abwinden Asten, Ybbs-Persenbeug, Greifenstein). The highest density – only *Paratendipes ‘intermedius’* and *Lipiniella moderata* reach higher values) – is calculated for sampling site 77 (Downstream Zimnicea/Svistov, Km: 550, RO, BG): 1196/m². In the board records we read: depth: 4,2-4,8 m; current velocity: 0,35- 0,6 m/sec. Left: Fine psammal // Right: Thanatocoenosis, detritus, black reduced *Corbicula*. – Nevertheless 12 chironomid species were found here. In scarce populations *P. n.* is also found in Vah (21 TB: 64/m²), in Ipoly (25 TB: 101/m²), in Sio (37 TB: 56/m²) and in Jantra (78 TB: 4/m²).

Polypedilum nubifer: The species is not rheophilic, but pelophilic, a little bit thermophilous and halotolerant (There are findings in inland saline pools in Eastern Austria (‘Seewinkel’); the species inhabits some islands). It has been found in Austria (leg. G. Wolfram), Bulgaria, Germany, the Spanish mainland, French mainland, Crete, Hungary, Italian mainland, Sardinia, Macedonia (?), Azores, Madeira, Portuguese mainland, Romania, Slovakia, Ukraine, Eastern Palaearctic, North Africa, Near East, Oriental region.

Surely tolerant for brackish water the species was only found (< 100/m²) in the Lower Danube, between 67 and 89. It could not be detected in one of the tributaries.

Stictochironomus sp.: Although the taxon (it could be *St. maculipennis* or (and) *St. pictulus*) was only found in the Upper and Middle section of the Danube, between 7 and 27, and in Inn (6TB) and Vah (21 TB), it has to be mentioned here despite of its low densities (< 40/m²), because it is a pelophilous, stable component of the impounded river stretches upstream the Austrian power plants – Jochenstein (7), Abwinden Asten (8) and Greifenstein (11)

Procladius (Holotanypus) choreus: The Larvae live at river or (more frequently) lake bottoms more or less rich in organic mud. The longitudinal distribution in Central Europe is the following: Epipotamal: 1, MP: 2, HP: +, Littoral: 5, Profundal: 2. The findings concentrate in the β- and α-mesosaprobic zones and occur only exceptionally in the oligo- or polysaprobic zone (SI: 2,5, W: 3). *P. ch.* is recorded from many European countries, from the East Palaearctic region, from North Africa, from the Near East and from the Oriental region (SÆTHER & SPIES, 2004). It was not found upstream one of the Austrian power plants but occurred between 9 and 68 at 11 sampling sites. 6 sites (53, 58, 59, 60, 61 and 62) are in the dammed section of the Iron Gate. The species is surely supported by the erection of the Iron Gate and reaches its highest densities at 61 (Donij Milanovac, river Km: 991, RS, RO): 722/m². Some of the larvae (partially 'ripe' L4 with pupal characteristics) were also found in tributaries: Morava (15 TB), Ipoly (25 TB: 272/m²) and Sio (37 TB: 341). From the JDS2 samples one can gain the impression that the larvae do not seem to advance a long distance into the Lower Danube. But CURE (1985) includes in her list of this 'eurybiontic species' sampling sites from the delta of the Danube and also from the coastal lakes Siutghiol, Taşaul and Gargalîc).

The genus *Procladius* (*Holotanypus*) (probably some other species) has been found at sample sites 73 and 77 – and in Velika Morava (56 TB).

An euryoecious species

Dicrotendipes nervosus has been found in many European countries, in the Eastern Palaearctic, in North Africa, in the Nearctic zone and in the Near East (SÆTHER & SPIES, 2004). Though it is an euroecious species it is more adapted to lotic water bodies – not with a strong water current - than some other species within the genus. It is also too thermophilic to live in mountain brooks and a little bit phytophilic. The longitudinal distribution in Fauna aquatica Austriaca is the following: HR: 2, EP: 3, MP: 1, HP: 1, LIT: 3, PRO: + (MOOG, ed. 2002). The bottom of the Danube offers quite good habitats for the species. At no site a density of > 400 could be calculated, but larvae were found, between 3 and 94 on 21 localities. So *D. n.* is the most frequent chironomid of the Danube. At 3, Geisling power plant, where in the year of the first filling of the impoundment, 1986, vast swarms of *Chironomus plumosus*-Gr. and *Glyptotendipes paripes* were a nuisance for the people (TITTIZER et al., 1995) it has been found 2007 as (perhaps) the only remaining chironomid species (4/m²) among a community of mainly neozoa dominated by *Corophium curvispinum* (40.754/m²) and *Jaera istri* (3594/m²). In the impoundment upstream the Iron gate, where the species has also been found by CURE (1975) in 1970 (the year before the erection of the Iron gate power plant) as well as 1971 to 1974, *D. n.* is quite frequent (52, 53, 58, 59, 60, 63). It reaches the highest density at 63 (Vrbica/ Simijan): 369/m². The species was also found in Morava (15 TB), Sio (37 TB) and Sava (51 TB: 257/m²), here again as the only chironomid species. Probably *D. n.* can withstand in sparse populations the Neozoa because some larvae can also develop upon macrophytes.

Because the rest of *Chironomus* species is better suited to characterize bad ecological conditions 3 should be the end of the long special part and discussed in short:

Glyptotendipes pallens lives in lentic and slow flowing water bodies. The larvae are phytophilous and even make holes into dead wood. On the bottom of the Danube the species was found under special conditions, at 31 (Rackeve-Soroksar Danube arm start – 0,3-1,2 m depth) and at 34 (Rackeve-Soroksar Danube arm end – 0,5-1,3 m depth). On the other hand the depth were between 3,2 and 6,8 m at 38 (Baja)

Paralauterborniella nigrohalteralis: In a slight contrast to Fauna aquatica Austriaca (LIT: 10 – MOOG, ed., 2002) and the terse 'lakes' in LANGTON & VISSER (2003) the species has been found in lotic water bodies too, in small populations, of course, and in rivers with a low water current. In Austria there are findings (ee. g.) from Bodensee, a Gießgang in an alluvial floodplain forest West of Vienna, in Marchfeldkanal an in the rivers Drau (Drava), Leitha (Lajta), March (Morava) and Schmida (OFENBÖCK, commun.).

In the Danube larvae had been collected at sample sites 19 and 44. The species was also found in Prut (91 TB). The densities were always lower than 25/m².

Xenochironomus xenolabis is a parasite of freshwater sponges. The larvae develop in standing and slowly flowing waters. In Austria it has been found in (ee. g.) Alte Donau and in the rivers Ager, Mattig, Schwechat, Traun and Trattnach. In the Danube one half of the findings (55, 58, 63) are upstream of the Iron Gate. The calculated densities in this dammed part lay between 16 and 128/m². The highest density (305/m²) was found at sample site 67 (Pristol).

The rest of the *Chironomus* species and a first attempt to evaluate sampling sites of the Danube with the help of Chironomidae

Some *Chironomus*-species can tolerate higher organic pollution than almost all other chironomids. The SI of *Chironomus bernensis* is 2,9 (20% of findings in polysaprobic zone), the SI of *Chironomus riparius* 3,5 (60% in p) and the SI of *Ch. plumosus* – a species capable of partial anoxibiosis – is 3,6 (70% in p). Such species should not occur in larger populations in ecologically tolerable lotic water bodies. They are always restricted to highly anthropogenic habitats such as the mud upstream of power plants. In newly flooded power plants they can be pioneer species. We have already discussed the example of Geisling (TITTIZER et al, 1995).

Ch. bernensis, *Ch.* (*'Einfeldia'*) *dissidens*-Gr., *Ch.* cf. *plumosus*, *Ch. plumosus*-Gr., *Ch. riparius* and *Ch. spp.* shall be used here to find out sampling sites with bad conditions for the majority of chironomids. But it is clear immediately that there are nowhere dense *Chironomus*-populations and the same stated view is valid for the whole family. The highest densities, quasi exceptions, shall be got back: *Paratendipes intermedius* (1805/m² in Siret), *Lipiniella moderata* (1211/m² at 79), *Polypedilum nubeculosum* (1196/m² at 76) and *Cladotanytarsus mancus*-Gr. (738/m² at 67). The abovementioned *Chironomus*-taxa never reach such densities. Their highest abundances are: *Ch. bernensis* (8/m²: 53), *Ch. dissidens*-Gr. (168/m²: 63), *Ch.* cf. *plumosus* (128/m²: 19), *Ch. plumosus*-Gr. (320/m²: 11), *Ch. riparius* (57/m²: 10) and *Ch. sp.* (224/m² in Hron, in Danube only 88/m²: 68).

At the most sampling sites especially species of Mollusca, Annelida and Crustacea (Amphipoda and Isopoda) are much more numerous – and the majority of them belong to the neozoa. There is only a slight possibility that a lot of chironomid species are swarming adults at the time of the JDS2-collections – parents of the overwintering generations. But in all probability they have been displaced by neozoa at many sampling sites (however this competition for space has taken place) and have almost died out or survive only in thinned-out populations. It is a platitude that a single collection is by far not enough to comprehend population dynamics of chironomids. Species of larger rivers have often more than one generation per year, and MACKEY (1977) has shown that some chironomid of the river Thames can pass their development in some weeks. To see at the least which species are adults in the moment of the larval collections it is necessary to make light-trap catches (as my colleagues W. GRAF and P. LEITNER did as additional work) or to collect pupal exuviae of which the advantages have been discussed in the introduction.

And now the sample sites, shortly discussed for each section type. A simple and arbitrary system (index) with the 'nature conservation potential' for each chironomid species is tried out:

Species either highly characteristic for the Danube (or one of its sections) or belonging to the typical potamal group, are counted as 3 per species. To this group belong also some rarely found chironomids or – exceptionally - species with a very low SI. For parts of the Middle Danube, for Lower Danube and for the changes which have taken place upstream the Iron Gate the publications of CURE (1975, 1985) and JANKOVIĆ (1975) are important.

It must be mentioned that 1970, before the power plant Iron gate was erected and 1971 the number of Orthocladiinae (and even Diamesinae) was much higher than today. CURE (1975) found 35 species of them whereas in the JDS2-samples only two Orthocladiinae species could be found: *Cricotopus bicinctus* and *C.* cf. *dobrogicus*.

Other rheophilic or rheotolerant species are counted as 2 per species.

Stagnopelophilic species – without the 'rest of *Chironomus*' are count as 1 per species.

Chironomus bernensis, *Ch. dissidens*-Gr., *Ch.* cf. *plumosus*, *Ch. plumosus*-Gr., *Ch. riparius* and *Ch. sp.* count as 0.

Neozoa are written with red colour. Possible, but unclear neozoa among Chironomidae (*Cladotanytarsus conversus*, *Cl.* '*sexdentatus*' or *Lipiniella moderata*) are written black with red initial letters. Numbers in brackets mean individuals/m². Chironomidae which have the highest density or a larger density than any other taxon at a sample site are written in **bold letters**. Nematoda, Cladocera and Copepoda are not included.

Section type 1: Upper course of the Danube:

Table 3 shows that the only species-rich sampling site of the whole Danube is 1 (upstream Iller, near Ulm): 33 of 95 (33/95 as it is written in the following examples) are the most species found in the Danube (chironomids as well as other animals) of all sampling sites – and the site has also the highest diversity. The chironomids with the highest densities (*Rheocricotopus chalybeatus*, *Tanytarsus brundini* and *Microtendipes pedellus*-Gr. are shown in **Error! Reference source not found.**. The animals with the highest densities are *Baetis sp.* (1365/m²), Gammaridae juv. (619/m² and *Gammarus roeselii* (434/m2). 'Nature protection chironomid index': 52

Section type 2: Western Alpine Foothills Danube:

2, 6/53: Chironomidae → **Error! Reference source not found.** / Most numerous other MZB organisms: *Corophium curvispinum (= Cor. curv.)* (44.990/m²), *Caenis sp.* (4.669/m²), *Limnodrilus hoffmeisteri (= Limn. hoffm.)* (4228/m²). **12**

4, 3/21: → **Error! Reference source not found.** / *Cor. curv.* (3759), *Corbicula fluminea (= Corb. fle.)* (2375), *Stylodrilus heringianus (= Styl. her.)* (1123). **6**

5, 1/26: *Polypedilum scalaenum*-Gr. (8) / Gammaridae *Gen. sp.*, juv. (14.890), *Jaera istri (= Ja. ist.)* (7.188), *Echinogammarus ischnus (= Ech. isch.)* (2343). **2**

3, 1/15: *Dicrotendipes nervosus* (4) / *Cor. curv.* (40.754), *Ja. ist.* (3594), *Styl. he.* (1.408). **1**

Section type 3: Eastern Alpine Foothills Danube:

10, 5/23: → **Error! Reference source not found.** / *Ja. ist.* (9.113), *Ech. isch.* (8.600), *Cor. curv.* (3.979). 7

8, 5/18: → **Error! Reference source not found.** / *Cor. curv.* (5231), *Obesogammarus obesus (= Obes. obes.)* (1103), *Hypania invalida (= Hyp. inval.)* (674). **6**

9, 4/15: *Harnischia sp.* (140), *Monodiamesa sp.* (72), *Chironomus sp.* (8), *Procladius choreus* (4) / *Lithoglyphus naticoides (= Lith. nat.)* (834), *Potamothrix moldaviensis (= Pot. moldav.)* (357), *Cor. curv.* (337). **4**

7, 4/12: *Monodiamesa sp.* (48), *Prodiamesa olivacea* (32), *Chironomus plumosus*-Gr. (12), *Stictochironomus sp.* (4) / *Hyp. inval.* (5.383), *Cor. curv.* (609) *Limn. hoffm.* (529). **3**

Section Type 4: Lower Alpine Foothills Danube:

19, 10/25: → **Error! Reference source not found.** / *Limnodrilus claparedeianus (= Limn. clap.)* (4.011), *Pot. moldav.* (4.011), *Limn. hoffm.* (2102). **11**

14, 3/15: *Harnischia sp.* (32), *Microtendipes pedellus*-Gr. (32), *Polypedilum laetum*-Gr. (32) / *Ja. ist.* (4.653), *Dikerogammarus bispinosus (= Dik. bisp.)* (4.629), *Ech. isch.* (2.102). **5**

18, 3/23: *Chironomus nudiventris/agilis* (8), *Cladotanytarsus vanderwulpi* (4), Orthocladiinae *Gen. sp.* (4) / Gammaridae *Gen. sp.* juv. (5.327), *Ja. ist.* (3.209), *Corb. fle.* (1.604). **5**

11, 6/25: → **Error! Reference source not found.** / *Cor. curv.* (3.787), *Pisidium sp.* (3.490), *Limn. hoffm.* (529). **4**

17, 3/20: *Chironomus nudiventris/agilis* (40), *Ch. sp.* (8), *Tanytarsus sp.* (8) / *Cor. curv.* (319.599), *Obes. obes.* (14.031), Gammaridae *Gen. sp.* juv. (1.027). **3**

16, 2/23: *Prodiamesa olivacea* (36), Chironomidae *Gen. sp.* (4) / *Ja. ist.* (6.931), Gammaridae *Gen. sp.* juv. (6.675), *Ech. isch.* (3.923). **2**

13, 1/16: *Tanytarsus brundini/curticornis* (4) / *Ja. ist.* (2.696), *Ech. isch.* (2.671), Gammaridae *Gen. sp.* juv. (1.123). **2**

12, 0/16: / *Ech. isch.* (11.179), *Ja. ist.* (2.021), *Cor. curv.* (939). **0**

Section Type 5: Hungarian Danube Bend:

20: 9/28: → **Error! Reference source not found.** / *Cor. curv*. (1.504), *Ja. ist.* (802), *Corb. fle.* (634). **17**

34: 8/45: → **Error! Reference source not found.** / *Dreissena polymorpha (= Dreiss. pol.)* (1.963), *Limnodrilus sp.* (853), *Dugesia tigrina* (411). **8**

22: 2/19: *Beckidia zabolotzskyi (= Beck. zab.)* (4), *Chernovskiia orbicus (= Chern. orb.)* (4) / *Obes. obes.* (894), *Dikerogammarus sp.* juv. (626), *Ja. ist.* (578). **6**

33: 2/21: = *Chern. orb.)* (4), *Cryptochironomus rostratus* (4) / *Corb. fle.* (1.155), *Hyp. inval.* (1.091), *Obes. obes.* (834). **5**

31: 4/11: *Chironomus plumosus*-Gr. (48), *Ch. sp.* (16), *Glyptotendipes pallens* (4), *Procladius choreus* (16) / *Sphaerium sp.* (1.280), Tubificidae *Gen. sp.* (384), *Viviparus acerosus* (144) – NO Cor. curv. and Ja ist. **2**

27: 1/16: *Stictochironomus sp.* (4) / *Obes. obes.* (1.957), *Corb. fle.* (1.861), *Cor. curv.* (1.604). **1**

36: 1/27: *Chironomus nudiventris/agilis* (4) / *Obes. obes.* (2.535), *Dikerogammarus villosus (= Dik. vill.)* (2.054), *Dik. sp.* juv. (1.829). **1**

23: 0/21: / *Ech. isch.* (9.952), Gammaridae *Gen. sp.* juv. (4.107), *Ja. ist.* (2.567). **0**

29: 0/20: / *Obes. obes.* (1.963), Gammaridae *Gen. sp.* juv. (875), Dik. vill. (725). **0**

32: 0/20: / *Theodoxus fluviatilis* (1.612), *Corb. fle.* (545), *Potamopyrgus antipodarum* (217). **0**

30: 0/18: / *Corb. fle.* (469), *Dik. vill.* (277), *Ech. isch.* (221). **0**

26: 0/17: / *Dik. bisp.* (3.209), *Ech. isch.* (2.567), *Ja. ist.* (1604). **0**

35: 0/15: / *Dik. bisp.* (317), Oligochaeta *Gen. sp.* (68), *Dik. sp.* juv. (44). **0**

28: 0/12: / Ech. isch. (4.236), Dik. bisp. (4.095), Cor. curv. (1.604). **0**

Section Type 6: Pannonian Plain Danube:

40: 8/26 → **Error! Reference source not found.** / *Corb. fle.* (1.797), *Dik. sp.* juv. (770), Gammaridae Gen. sp. juv. (642). **20**

45: 6/16: ***Beck. zab.*** (489) → **Error! Reference source not found.** / *Isochaetides michaelseni (= Iso. mich.)*, (385), *Pisidium sp.* (224), *Corb. fle.* (140). **15**

50: 5/13: *Beck. zab.* (128), *Paratendipes 'intermedius'* (= Par. 'int.') (128), *Chern. orb.* (107), *Dicrotendipes nervosus* (21), *Polypedilum acifer* (21) / *Corb. fle.* (192), *Iso. mich.* (173), *Cor. curv.* (85), Gammaridae Gen. sp. juv. (85). **13**

39: 4/11: ***Chern. orb.*** (44), *Beck. zab.* (4), *Par. 'int.'* (4), *Robackia sp.* (4) / *Corb. fle.* (28), *Styl. her.* (8), *Cor. curv.* (8). **12**

48: 5/19: ***Par. 'int.'*** (512), *Chern. orb.* (85), *Cladotanytarsus vanderwulpi* (21), Chironomidae *Gen. sp.* (3) / *Iso. mich.* (405), *Corb. fle.* (256), *Obes. obes.* (235), Gammaridae *Gen. sp. juv.* (235). **12**

47: 6/28 → **Error! Reference source not found.** / *Cor. curv.* (3.305), *Dreiss. pol.* (1.054) *Pot. modav.* (1.091). **10**

38: 5/27: *Chern. orb.* (16), *Cladotanytarsus 'sexdentatus'* (16), *Dicrotendipes nervosus* (16), *Tanytarsus eminulus* (16), *Glyptotendipes pallens* (8) / *Ja. ist.* (17.970), *Dik. sp.* juv. (11.039), *Dik. vill.* (10.525). **10**

53: 8/25 → **Error! Reference source not found.** / *Limn. hoffm.* (5.973), *Lith. nat.* (2.475), *Limn. clap.* (494). **9**

46: 4/22: *Cryptochironomus rostratus* (68), *Chironomus nudiventris/agilis* (36), *Rheocricotopus chalybeatus*

(32), *Par. 'int.'* / *Dik. vill.* (4.140), Dik. sp. juv. (4.268), Gammaridae *Gen. sp.* juv. (3.241). **8**

43: 4/28: *Chern. orb.* (160), *Cladotanytarsus 'sexdentatus'* (32), *Chironomus nudiventris/agilis* (32), *Ch. sp.*

(4) / *Dik. vill.* (3.947), *D. sp.* juv. (3.273), *Cor. curv.* (1.251), *Corb. fle.* (1.059). **7**

44: 4/13: *Chironomus nudiventris/agilis* (256), *Lipiniella moderata (= Lip. mod.)* (21), Chironomini *Gen. sp.* (21), *Paralauterborniella nigrohalteralis* (21) / *Lith. nat.* (1.024), *Corb. fle.* (235), *Iso. mich.* (107). **7**

55: 5/32: *Polypedilum scalaenum*-Gr. (257), *Xenochironomus xenolabis* (128), *Chironomus nudiventris/agilis* (16), *Ch. sp.* (8) / *Iso. mich.* (3.714), Tubificidae *Gen. sp.* (2.968), *Corb. fle.* (2.936), *Cor. curv.* (1.027). **7**

41: 3/10: *Beck. zab.* (64), *Par. 'int.'* (64), *Chironomus sp.* (32) / *Lith. nat.* (1.700), *Corb. fle.* (257), *Iso. mich.* (128). **6**

52: 5/31: *Dicrotendipes nervosus* (261), *Polypedilum scalaenum*-Gr. (257), *Chironomus plumosus*-Gr. (12), *Harnischia sp.* (4), Chironomidae *Gen. sp.* (4) / *Lith. nat.* (39.342), Tubificidae *Gen. sp.* (8.279),

Dreiss. pol. (1.929), *Limnodrilus udekemianus (= Limn. udek.)* (942). **6**

58: 5/41: *Xenochironomus xenolabis* (56), *Dicrotendipes nervosus* (48), *Chironomus plumosus*-Gr. (16), *Cryptochironomus sp.* (8), *Procladius choreus* (8) / *Cor. curv.* (17.769), Limnodrilus sp. (15.917), *Ech. isch.* (7.806). **5**

54: 2/21: *Lip. mod.* (4), *Harnischia sp.* (4) / *Psammoryctides alpicola*: 690, *Iso. mich.* (590), *Corb. fle.* (289). **5**

59: 3/27: *Microchironomus tener* (32), *Procladius choreus* (32), *Dicrotendipes nervosus* (16) / Cor. curv. (4.364), *Limnodrilus sp.* (754), *Ja. ist.* (706). **4**

57: 2/15: *Chironomus riparius* (57), *Polypedilum scalaenum*-Gr. (10) / *Lith nat.* (1.860) *Potamothrix isochaetus* (480), *Limn. clap.* (140). **2**

Section Type 7: Iron Gate Danube:

60: 11/34 → **Error! Reference source not found.** / *Limn. clap.* (1.400), *Potamothrix vejdovskyi* (1.071), *Branchiura sowerbyi* (602). **16**

61: 7/25: ***Procladius choreus*** (722) → **Error! Reference source not found.** / Tubificidae *Gen. sp.* (393), *Branchiura sowerbyi* (353), *Limn. hoffm.* (273). **7**

62: 4/15: *Polypedilum bicrenatum* (88), *Procladius choreus* (72), *Chironomus sp.* (8), *Microchironomus tener* (8). **4**

Section type 8: Western Pontic Danube:

65: 25/44: *Cladotanytarsus mancus*-Gr. (738) → **Error! Reference source not found.** / *Corb. fle.* (963), *Cor. curv.* (894), *Ja. ist* (385). **41**

69: 17/49 → **Error! Reference source not found.** / *Corb. fle.* (2.952), *Pontogammarus robustoides (= Pont. rob.)* (770), Iso. mich. (626). **31**

67: 17/33 → **Error! Reference source not found.** / Cor. curv. (4.878), Dik. sp. juv. (513), *Dik. haemobaphes (= Dik,. haem.)*. **31**

68: 19/58 → **Error! Reference source not found.** / *Cor. curv.* (1.404), Oligochaeta *Gen. sp.* (970), *Corb. fle.* (309). **29**

73: 13/47: *Lip. mod.* (273), *Cladotanytarsus mancus*-Gr. (96), *Polypedilum scalaenum*-Gr. (88), *Chironomus acutiventris* (72) \ *Xenochironomus xenolabis* (16) *Telopelopia fascigera* (8), *Virgatanytarsus sp.* (8) / *Corb. fle.* (9.883), *Cor. curv.* (9.250), *Lith. nat.* (4.557) *Ech. isch.* (1.043). **26**

86: 12/44: *Lip. mod.* (249), *Polypedilum scalaenum*-Gr. (176), *Cladotanytarsus mancus*-Gr. (152) \ *Par. 'int.'* (80), *Beck. zab.* (8), Par. *'connectens' (= Par. 'conn.')* / *Limn. clap.* (1.011), *Limn. hoffm.* (1.011), *Iso. mich.* (594). **25**

77: 12/29: *Polypedilum nubeculosum* (1.195), *Par. 'int.'* (216), *Beck. zab.* (128) \ *Polypedilum nubifer* (64), *Chironomus acutiventris* (24) *Par 'conn'* (8). / *Corb. fle.* (2.455), *Iso. mich.* (866), *Potamothrix danubialis* (521). **23**

63: 14/54: *Dicrotendipes nervosus* (369), *Polypedilum bicrenatum* (192), *Ch. dissidens*-Gr. (168) \ *P. scalaenum*-Gr. (40), *Xenochironomus xenolabis* (16), *Cricotopus* cf. *dobrogicus* (8) / *Aulodrilus japonicus* (1.797), *Potamothrix vejdovskyi* (1.300), *Branchiura sowerbyi* (899). **19**

83: 6/30: *Par. 'int'* (409), *Beck. zab.* (160), *Lip. mod.* (140), *Par. 'conn'* (88) \ *Cryptochironomus rostratus* (24). / *C. curv.* (42.623), *Ech. isch.* (1.877), *Corb. fle.* (1.837). **18**

76: 8/28: *Par. 'int.'* (184), *Beck. zab.* (136), *Par. 'conn.'* (72), *Cryptochironomus rostratus* (72) \ *Virgatanytarsus sp.* (64), *Cricotopus* cf. *dobrogicus* (8) / *Ech. isch.* (25.824), *Corb. fle.* (9.980), *Gammaridae Gen. sp.* juv. (4.372), *Theodoxus transversalis* (1893). **18**

80: 6/18: *Par. 'int.'* (52), *Chern. orb.* (28), *Par. 'conn.'* (20), *Lip. mod.* (12), *Cricotopus* cf. *dobrogicus* (12), *Beck. zab.* (8) / *Iso. mich.* (209), *Limnodrilus sp.* (80), *Corb. fle.* (64). **18**

72: 7/18: *Chern. orb.* (80), *Beck. zab.* (48), Chironomidae *Gen. sp.* (24), *Lip. mod.* (8), *Par. 'int.'* (8), *Par. 'conn.'* (8) / *Corb. fle.* (4.292), *Obes. obes.* (112), *Iso. mich..* (96). **18**

75: 6/21: *Par. 'int.'* (176), *Lip.* mod.. (60), *Par. 'conn.'* (52), *Beck. zab.* (4), *Cryptochironomus rostratus* (4), *Polypedilum scalaenum*-Gr. (4) / *Iso. mich.* (710), *Propappus volki* (417), *Corb. fle.* (189). **16**

79: 9/44: *Par. 'int.'* (2.070), *Lip. mod.* (1.211), *Xenochironomus xenolabis* (209) \ *Cryptochironomus rostratus* (16), *Polypedilum nubifer* (16) / *Ech. isch.* (13.862), *Corb. fle.* (5.487), *Iso. mich.* (4.091). **15**

82: 4/14: *Lip. mod.* (128), *Beck. zab.* (40), *Par. 'conn.'* (32), *Par. 'int.'* (28) / *Iso. mich.* (405), *Corb. fle.* (221), Tubificidae *Gen. sp.*(192). **12**

85: 2/13: *Polypedilum aegyptium* (4), *Robackia demeijerei* (4) / *Corb. fle.* (866), *Propappus volki* (337), *Pont. rob.* (64). **6**

64: 2/25: *Cricotopus* cf. *dobrogicus* (233), *Chironomus plumosus*-Gr. (8) / *Cor. curv.* (3.081), *Dreiss. pol.* (1.155), *Corb. fle.* (577). **3**

70: 23/20: *Polypedilum bicrenatum*-Gr. (64), *Rheopelopia sp.* (4) / *Ech. isch.* (6.831), *Cor. curv.* (2.832), Gammaridae *Gen. sp.* juv. (2.675). **3**

81: 1/7: Chironomidae *Gen. sp.* (5) / *Limn. clap.* (236), *Tubifex tubifex* (56), *Limn. hoffm.* (40). **1**

84: 0. **0**

Section Type 9: Eastern Wallachian Danube:

88: 5/11 → **Error! Reference source not found.**/ Tubificidae *Gen. sp.* (128), *Limn. ud.* (60), *Limn. clap.* (56), *Limn. prof.* (56). **11**

87: 4/25 → **Error! Reference source not found.**/ *Aulodrilus japonicus* (2.310), *Corb. fle.* (802), *Viviparus acerosus* (260). **8**

89: 1/17: *Polypedilum nubifer* (8) / *Lith. nat.* (100.377), *Limn. udek.* (3.658), Tubificidae *Gen. sp.* (1.027). **2**

92: 1/17: *Polypedilum scalaenum*-Gr. (16) / *Corb. fle.* (2.832), Tubificidae *Gen. sp.* (1.436), Cor. curv. (706). **2**

Section Type 10: Danube Delta:

93: 7/34 → **Error! Reference source not found.** / *Cor. curv.* (5.648), *Iso. mich.* (1.328), *Limn. prof.* (1.091). **14**

94: 2/21 → **Error! Reference source not found.** / *Cor. curv.* (1.155), *Hyp. inv.* (393), *Corb. fle.* (136). **2**

95: 0/20: / *Cor. curv.* (5.210), *Hyp. inv.* (915), *Ja. ist.* (321). **0**

96: 0/7 / *Cor. curv.* (369), *Iso. mich.* (241), *Corb. fle.* (56). **0**

Tributaries

For the 'nature protection chironomid index' Chironomus JDS2 sp counts 0.

6TB Inn (2-3): 29/78: *Potthastia gaedii* (51), *Monodiamesa sp.* (13), *Cricotopus sp.* (11) \ *C. curtus* (7), *Eukiefferiella devonica/ilkleyensis* 7), *Orthocladius (Symposiocladius) lignicola* (7), *Euk. gracei* (5), *Euk. lobifera* (3), *Polypedilum albicorne* (3), *C. tremulus* (1) / *Limn. hoffm.* (331), *Aulodrilus limnobius* (cosmopolitan), *Potamothrix moldaviensis* (220). **53**

21 TB Vah (5): 10/32: *Chironomus nudiventris/agilis* (193), *Xenochironomus xenolabis* (193), *Cladotanytarsus mancus*-Gr. (96) \ *Par. 'int.'* (64), *Cryptochironomus rostratus* (32), *Polypedilum scalaenum*-Gr. (4), *Lip. mod.* (4). / *Dreiss. pol.* 4.525), Gammaridae *Gen sp. j*uv. (4.075), *Dik. vill.* (2.535). **20**

24 TB Hron (5): 13/29: *Chironomus nudiventris/agilis* (344), *Cladotanytarsus mancus*-Gr. (344), Tanytarsini *Gen. sp.* (341) \ *Polypedilum scalaenum*-Gr. (173), *Clad.. vanderwulpi* (170), *Cryptochironomus rostratus* (170) / *Limnodrilus sp.* (1.237), *Psammoryctides barbatus* (531), *Caenis beskidensis* juv. (45). **20**

25 TB Ipoly (5): 16/40: *Procladius choreus* (272), *Cladotanytarsus mancus*-Gr. (213), *Polypedilum nubeculosum* (101) \ *Microchironomus tener* (21), *Polypedilum bicrenatum* (5), *Chironomus* cf. *bernensis* (3), *Cladotanytarsus nigrovittatus* (3), *Cryptotendipes usmaënsis* (3), *Phaenopsectra sp.* (3), *Tanytarsus ejuncidus* (3) / *Limnodrilus sp.* (2.109), *Limn. hoffm.* (549), *Sphaerium corneum* (61). **19**

90 TB Siret (9): 8/28: *Par. 'int.'* (1.805), *Lip. mod.* (225), *Polypedilum scalaenum*-Gr. (136), *Par. 'conn'* (72), *Pol. bicrenatum*-Gr. (16), Chironomidae Gen. sp. (8), *Glyptotendipes pallens* (8), *Rheocricotopus chalybeatus* (8) / *Cor. curv.* (13.373), *Iso. mich.*, *Hydropsyche sp.* (1.789). **16**

91 TB Prut (9): 5/20: *Harnischia sp.* (8), *Par. 'int'* (8), *Paralauterborniella nigrohalteralis* (4), *Polypedilum scalaenum*-Gr. (4) /Tubificidae *Gen. sp.* (943), *Cor. curv.* (104), *Hydropsyche sp.* (76). **11**

42 TB Drava (6): 3/6: ***Par. 'int.'*** (160), ***Chern. orb.*** (104), ***Beck. zab.*** (61) / *Corb. fle.* (3), *Iso. mich.* (3), *Cor. curv.* (3). **9**

71 TB Iskar (8): 4/10: *Polypedilum scalaenum*-Gr. (4), *Cladotanytarsus conversus* (3), Chironomidae *Gen. sp.* (1), *Microchironomus tener* (1) / Tubificidae *Gen. sp.* (15), *Branchiura sowerbyi* (6), *Pisidium sp.* (2), *Limn. hoffm.* (2), *Manayunkia caspia* (Polychaeta, Sabellidae) (1). **8**

37 TB Sio (5): 7/18: *Procladius choreus* (341), *Microchironomus tener* (331), *Crytochironomus obreptans* (235), *Dicrotendipes nervosus* (176), *Polypedilum nubeculosum* (56), *Chironomus plumosus*-Gr. (51), *Tanypus punctipennis* (27) / *Limn. clap.* (1.632), *Limn. hoffm.* (1.344), *Branchiura sowerbyi* (147). **7**

78 TB Jantra (8): 5/12: *Microchironomus tener* (6), *Cladotanytarsus mancus*-Gr. (4), *Polypedilum nubeculosum* (4), *Procladius sp.* (3), *Tanypus punctipennis* (3) / Tubificidae *Gen. sp.* (296), *Limn. clap.* (103), *Limn. hoffm.* (103), *Potamothrix moldavicus* (96). **7**

74 TB Olt (8): 3/8: ***Cladotanytarsus conversus*** (32), *Cricotopus bicinctus* (3), *C. festivellus*-Gr. (3) / *Limnomysis benedeni* (5), *Iso. mich.* (3). **5**

49 TB Tis[z]a (6): 1/10: *Par. 'int.'* / *Corb. fle.* (1.600), *Lith. nat.* (448), *Limn. udek.* (149). **3**

56TB Velika Morava (6): 4/13: *Chironomus* 'JDS2 *sp.*' (72), *Ch. sp.* (70), *Procladius sp.* (8), *Chironomus plumosus*-Gr. (3) / *Limnodrilus sp.* (2.632), *Limn. clap.* (586), Tubificidae *Gen. sp.* (280). **1**

51 TB Sava (6): 1/5: *Dicrotendipes nervosus* (257) / *Corb. fle.* (417), *Brachiura sowerbyi* (32), *Sphaerium corneum* (4), *Cor. curv.* (4). **1**

66 TB Timok (8): 1/4: Chironomidae *Gen. sp.* (8) / *Limnomysis bendeni* (4), Ceratopogonidae *Gen. sp.* (4). **1**

Table 3. Number of chironomid species at sampling sites of the Danube and in tributaries

Number of chironomid species	Sampling sites Danube (Nr(r.)) of site/ D. river section)	Sampling sites Tributaries of Danube (name(s)/ D. river section)
0	11	-
1	8	3 (Tisa/6, Sava/6, Timok/8)
2	9	-
3	6	2 (Drava/6, Olt/8)
4	10	2 (Iskar/8, Velika Morava/6)
5	9	2 (Jantra/8, Prut/9)
6	7	-

7	3	1 (Sio/5)
8	4	1 (Siret/9)
9	2	-
10	1 (19/4)	1 (Vah/5)
11	1 (60/7)	1 (Morava/4)
12	2 (77/8, 86/8)	-
13	1 (73/8)	1 (Hron/5)
14	1 (63/8)	-
15	-	-
16	-	1 (Ipoly/5)
17	2 (67/8, 69/8)	-
18	1 (68/8)	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	1 (65/8)	-
26		-
27		-
28		-
29		1 (Inn/2-3)
30	1 (1/1)	-

Table 4. Danube river sections (MOOG et al., 2008); most chironomid species

River section	Sample sites with most chironomid species (taxa)/ total taxa (3 most numerous chironomid species; ind./m²)	Sample(s) with most taxa (+ nr. of chir., if not in left box
1	1: 30/95 – (ee.g.:) Abl. longistyla [3], Cr. trifascia [21], Euk. clypeata [64], Micr. pedellus-Gr. (290), Par. dissimilis [3], Parate. albimanus [21], Pol. convictum [29], Rheocr. chalybeatus (243), Tanyt. brundini (178)	1: 95
2	2: 6/53: Orthocladiinae, Gen. sp., Param. stylatus, Polyp. cultellatum (257), Rh. chalybeatus (261), Rheopel. sp. (16), Thienmannimyia-Gr., Gen. sp. 4: 3/21: Cladot. sp. (4), C. vanderwulpi (4), Rheotanyt. sp (4).	2: 53 5: 24
3	10: 5/23: Chironominae, Gen. sp. (4), Cryptochir. sp. (4), Monodiamesa sp.	10: 23

	(8), Paracladius conversus (4), Polypedilum laetum-Gr (8). 8: 5/18: Chir. nudiventris/agilis (44), Monodi. sp. (108), Prodi. olivacea, Stictochir. sp. (8), Thienemannimyia-Gr., Gen. sp.	7:2 (4)
4	19: 10/25: Chironomus sp, Ch. nudiv./ag., Ch. cf. plumosus (128), Cladop. laccophila-Gr., Cryptochir. obreptans-Gr. (40), Microchir. tener, COP-Gr., Paralaut. nigrohalt. [16], Polyp. nubeculosum, Procl. choreus (88) 11: 6/25: Chironomus sp., Ch. nudiv./ag. (221), Ch. plumosus-Gr. (320), Monodi. sp. [12], Prodi. oliv. (28), Stictochir. sp.	19: 25 11: 25
5	20: 9/28: Cryptochir. sp., Dicrot. nervosus, Harn. fuscimana, Nanoclad. distinctus (12), Paratend. 'intermedius' (8), Polyp. scalaenum-Gr., Stictochir. sp. (8), Tanyt. eminulus [4], T. sp. 34: 8/45: Chironomus sp., Cladot. mancus-Gr. (171), D. nervosus (11), Glypt. pallens, Parachir. arcuatus-Gr. (173), Pol. nubeculosum, Procl. choreus, P. sp. [At 7 sites of 14 no chironomids were found; at 2 only one sp. (27: Stictochir. sp. (of 25 taxa), 36: Ch. nudiventris/agilis (of 27 taxa)!]	34: 45 20: 28
6	40: 8/26: Beck. zabolotzskyi [32], Chern. orbicus (224), Chir. nudiventris/agilis, Cladot. 'sexdentatus' (674), D. nervosus, Lip. moderata [32], Parat. 'intermedius' (160), Rob. demeijerei [32] 53: 8/25: B. zab. [4], Chironomus sp. (24), Ch. cf. bernensis, Ch. cf. obtusidens (12), Ch. plumosus-Gr., D. nerv., Microt. tener (36), Procl. choreus 45: 6/16: B. zab. (489), Chern. orbicus [36], Chir. nudiventris/agilis (52), Cryptochir. rostratus, L. moderata [8], P. ‚intermedius' (48) 47: 6/28: Chironomidae, Gen. sp., Chir. nudiventris/agilis (128), D. nerv. (128), P. 'intermedius' (64), M. tener (64), Polyp. scalaenum-Gr. (128)	55: 32 (5) 43: 28 (4) 47: 28 38: 27 (5)
7	60: 11/34: Chironomus sp., Cric. bicinctus, C. cf. dobrogicus [4], Dicr. nerv. (168), Microchir. tener, Paratanyt. dissimilis (64), P. dissimilis/inopertus, Polyped. nubec. (40), P. sp., Procl. choreus, Tanytarsini Gen. sp. 61: 7/25: Chironomus sp., Ch. plumosus-Gr., Harn. sp. (136), M. tener (273), P. nubec., P. bicrenatum, Procl. choreus (722)	60: 34 61: 25
8	65: 25 /44: Chironomus acutiventris, Ch. plumosus-Gr., Ch. sp., Chironominae Gen. sp., Chironomini Gen. sp., Cladotanyt. conversus [32], C. mancus, C. mancus-Gr. (738), C. sp., Cric. bicinctus [260], C. cf. dobrogicus (337), C. festivellus-Gr., C. triannulatus, Cryptochir. rostratus, Dicr. nerv., Nilotanyp. dubius [64], Orthocladiinae Gen. sp., Paratanyt. sp., Polyp. nubec., P. bicren., P. scalaenum-Gr. (320), Robackia demeijerei [12], Tanytarsini Gen. sp., Tanytarsus sp., Virgatanyt. sp. [64] 68: 18/58: Chironomus sp., Ch. acutiventris, Chironomidae Gen. sp.,	68: 58 63: 54 (14) 69: 49 73: 47 (13)

	Chironominae Gen sp., Chironomini Gen. sp., Cladop. laccophila-Gr., Cladot. mancus-Gr. (377), Cric. cf. dobrogicus [36], C. sylvestris-Gr., Cryptochir. rostratus, Dicr. nerv., Lip. moderata [44], Polyp. nubec. (272), P. nubif., P. scalaenum-Gr. (305), P. sp., Procl. choreus, Tanytarsus sp. 69: 17/49: Ablab. longistyla [8], Chern. orbicus [48], Chironomus sp., Ch. acutiventris, Cladotanyt. mancus-Gr., Cric. cf. dobrogicus (160), Cryptochir. rostratus, Dicrotend. nervosus, L. moderata [40], Paratend. 'connectens' [64], Polyped. nubec., P. nubif., P. scalaenum-Gr. (128), P. sp., Tanytarsini Gen. sp., Virgatanyt. sp. (120) 67: 17/33: Ch. acutiventris, Ch. dissidens-Gr., Chironomidae Gen. sp., Cladopelma laccophila-Gr., Cladotanyt. conversus, C. mancus-Gr. (213), Cric. cf. dobrogicus, C. flavocinctus, Cryptochir. rostratus (48), Dicr. nerv., L. moderata, Microchir. tener, Nanocladius sp., Orthocaldiinae Gen. sp., P. nubif.[16], P. scalaenum-Gr. (48), Xenochir. xenolabis (305)	
9	88: 5/11: Chir. acutiventris (12), Harnischia sp., Lip. moderata (108), Polyp. nubifer [4], P. scalaenum-Gr. (20) 87: 4/25: Chironomus sp. (8), Chironomidae Gen. sp. (4), Harn. sp. (4), L. moderata (8)	87:25 89: 17 (1: Polyp. nubifer)
10	93: 7/34: Cric. bicinctus (16), C. cf. dobrogicus (36), C. obnixus-Gr. [8], C. sylvestris-Gr. (12), C. sylv.-gr./cf. dobrogicus (16), C. sp. [4], Dicr. nerv. [4], Limnophyes sp. [4] 94: 2/21: Dicr. nerv. (8), Polyp. bicrenatum (16)	93: 34 94: 21

Table 5. List of Chironomidae species for each Danube country

Chironomidae species in JDS2-samples, Danube countries
Country (o: black colour: in Russev (1998) and JDS2-samples; o: red colour: JDS2-.samples, not in Russev (98); r: in Russev (98), not in JDS2-s
m = Móra (2007): Checklist for Hungary; t = Tatole; checklist for Romania
e: Fauna Europaea, without species-groups (YU: incl. Serbia, Kosovo, Voivodina, Montenegro); some new findings from Austria added

Red colour: not in Russev 199		D	A	SK	H	HR	SRB	RO	BG	MD	UA
Ablabesmyia (Ablabesmyia)	longistyla	o / e	o / e	o / e	m, e	e	e	o / t, e	o / e	e	e
Beckidia	zabolotzskyi			o	o / m, e	o	o / e	o / t, e	o / e		
Chernovskiia	orbicus			o	o	o	o / e	o / t, e	o		
Chironomus	"JDS2" sp.						o				
Cladotanytarsus	"sexdentatus"		X		o	o	o				
Lipiniella	moderata			o	m, e	o	o / e	o	o		
Nanocladius	distinctus			o	o						
Paratendipes	"intermedius"		X		m*	o	o	o / t	o	o	
Paratendipes	"connectens"							o**	o		
Cricotopus	cf. dobrogicus						o	o / t, e	o		o
Cricotopus	obnixus-Gr.							o			o
Chironomus (Chironomus)	acutiventris	e	r / e	o	m, e			o	o		
Chironomus (Chironomus)	cf. bernensis	e	r / e	o / e	o / m, e		o			e	e
Chironomus (Chironomus)	nudiventris	e	o	o	o / m, e	o	o				e
Chironomus (Chironomus)	cf. obtusidens (Russev 1998: C. obtusidens, C. gr. o.)	e	r / e		m, e		o		e		e
Chironomus (Chironomus)	cf. plumosus	r / e	r / e	e	o / m, e		e	t, e			e
Chironomus (Chironomus)	plumosus-Gr.	o	o		o / m		o	o / t	o		
Chironomus (Chironomus)	riparius	r / e	r / e	e	m, e	e	o / e	r / t, e	r / e		
Chironomus (Lobochironomus	dissidens-Gr.						o	o / t	o		
Cladopelma	laccophila-Gr.				o		o	o	o		
Cladopelma	virescens	e	r / e	o / e	o / m, e			t, e			
Cladotanytarsus	conversus		X				o	o	o		
Cladotanytarsus	mancus Pu.	e	r / e	e	m, e	e	o / e	o / t, e	e		
Cladotanytarsus	nigrovittatus Pu.	e	e	o	o						
Cladotanytarsus	vanderwulpi	o / e	r, e	o	o / m		o	t, e			
Conchapelopia	sp.	o	o		m			t			
Cricotopus (Cricotopus)	bicinctus	o / e	o / e	e	m, e	e	o / e	o / t, e	e	e	o / e
Cricotopus (Cricotopus)	cf. curtus	o / e	o / e	e	m			t, e	e		
Cricotopus (Cricotopus)	festivellus-Gr.		r		m		o	o / f			
Cricotopus (Cricotopus)	flavocinctus	e	r / e					o / f, e	o		
Cricotopus (Cricotopus)	tremulus	o / e	o / e	e	m, e			t, e	e		
Cricotopus (Cricotopus)	tremulus-Gr.	o	o		m			t			
Cricotopus (Cricotopus)	triannulatus	o / e	o / e	e	m, e	e		t, e		e	e
Cricotopus (Cricotopus)	trifascia	o / e	o / e	e	m / e		e	t, e	e	e	
Cricotopus (Isocladius)	sylvestris-Gr.	o	o	o	m			o / t	o		o
Cryptochironomus	obreptans	e	o / e	e	o / m, e						e
Cryptochironomus	rostratus	e	r, e	o / e	o / m, e		o	o / t, e	o		
Cryptotendipes	usmaensis Pu.	e	e	o	o			t, e			
Dicrotendipes	nervosus	o / e	o / e	o / e	o / m, e		o / e	o / t, e	o / e	e	o / e
Eukiefferiella	clypeata	o / e	r, e	e	m, e			t, e	r, e		
Eukiefferiella	devonica/ilkleyensis	o	o		m			t			
Eukiefferiella	gracei	o / e	o / e	e	e	e		t, e	r, e		
Eukiefferiella	lobifera	o / e	o / e	e	m			t, e	r, e	e	
Glyptotendipes	pallens	e	r, e	e	o / m, e		e	o / t, e	r, e		
Harnischia	fuscimana Pu.	e	r / e	o / e	o / m, e		e	t, e			
Heterotrissocladius	marcidus	o / e	o / e	e	m, e			t, e			

		D	A	SK	H	HR	SRB	RO	BG	MD	UA
Limnophyes	sp.				m			o / t			o
Microchironomus	tener	e	r, e	o / e	o / m, e		o	o / t, e	o		e
Micropsectra	atrofasciata-Agg.	o / e	r, e	e	m			t, e	e		
Microtendipes	cf. britteni	o / e	e	o							
Microtendipes	cf. pedellus	r / e	o / e	e	m	e		t, e	e		
Microtendipes	pedellus-Gr.	o	o	o	o / m			t			
Monodiamesa	sp. (Russev (98): M. bathyphila	o	o		m			t			
Nanocladius	cf. dichromus (Syn.: N. bicolor)	e	o / e	o / e	m, e		e	t, e		e	e
Nilotanypus	dubius	e	e	e			o	o / t, e			
Orthocladius (Orthocladius)	oblidens	o / e	o / e	e	m, e			t, e			
Orthocladius (Orthocladius)	rubicundus	o / e	o / e	e	m, e		e	t, e	e	e	e
Orthocladius (Symposiocladiu	lignicola	o / e	o / e	e	m			t, e	e		
Parachironomus	arcuatus-Gr.		o	o	o / m			t			
Paracladius	conversus	e	o / e	e	m, e			t, e			e
Paralauterborniella	nigrohalteralis	e	e		o / m, e	o	o	o / t, e		o	
Parametriocnemus	stylatus	o / e	r / e	e	m			t, e			
Paratanytarsus	dissimilis	o / e	r / e	e	m		o?	o?	o? / e		
Paratendipes	cf. albimanus	o / e	r / e	e	m, e	e		t, e	e		
Paratrichocladius	rufiventris	o / e	o / e	e	m, e	e	e	t, e		e	e
Polypedilum (Polypedilum)	albicorne	o / e	o / e	e	m		e	t, e			
Polypedilum (Polypedilum)	laetum	o / e	o / e	e	m, e		e	t, e			
Polypedilum (Polypedilum)	laetum-Gr.	o									
Polypedilum (Polypedilum)	nubeculosum	o / e	r / e	o / e	o / m, e	e	o / e	o / t, e	o / e	e	e
Polypedilum (Polypedilum)	nubifer	e	r	e	m, e			o / t, e	o / e		
Polypedilum (Tripodura)	acifer	e	e		m		o	t, e			
Polypedilum (Tripodura)	aegyptium	e	e	e				o / t, e	o		
Polypedilum (Tripodura)	bicrenatum	r / e	r / e	o / e	o / m		o	o / t, e	e		
Polypedilum (Tripodura)	bicrenatum-Gr.			o	o						
Polypedilum (Tripodura)	scalaenum-Gr. (Russev (98): P. scal'e'num; P. breviantennatum: RO)	o	r	o	o / m		o	o / t	o	o	o
Polypedilum (Uresipedilum)	convictum	o / e	o / e	e	m, e	e	e	t, e	r, e		
Polypedilum (Uresipedilum)	cultellatum	o / e	o / e	o / e	m, e			t, e			
Potthastia	gaedii	o / e	r / e	e	m			t, e	e	e	
Procladius (Holotanypus)	choreus	e	o / e	o / e	o / m, e	e	o / e	o / t, e	o / e	e	e
Procladius (Holotanypus)	sp.			o	o			o	o		
Prodiamesa	olivacea	o / e	o / e	o / e	m, e	e	e	t, e	e	e	
Rheocricotopus (Psilocricotop	chalybeatus	o / e	r / e	e	m		o	o / t, e			e
Rheopelopia	ornata	e	o / e	o / e	m, e			t, e			
Rheotanytarsus	spp.	o	r								
Robackia	demeijerei	e	X		m, e	o	o / e	o / t, e	o / e		
Stictochironomus	sp.	o	o	o	o / m			t			
Synorthocladius	semivirens	o / e	o / e	e	m / e		e	t, e	e	e	
Tanypus	punctipennis	e	X	e	o / m, e		e	t, e	o / e	e	e
Tanytarsus	brundini	o / e	r, e	e	m			t, e	e		
Tanytarsus	ejuncidus	o / e	e	o / e	o / m						
Tanytarsus	eminulus	e	o / e	o / e	o			t, e			
Tanytarsus	heusdensis	o / e	e	e	m			t, e			
Telopelopia	fascigera	e	o / e	o / e	m		e	o	o		
Thienemannimyia	sp. (Russev (98): 2 Species)	o	r		m			t	r		
Tvetenia	calvescens	o / e	r / e	e	m			t, e	e		
Tvetenia	verralli	o / e	o / e	e				t, e			
Tvetenia	vitracies	o	o / e								
Virgatanytarsus	spp.	o			m		o	o / t	o	o	
Xenochironomus	xenolabis	e	e	o / e	m, e		o	o / t, e	o		e
Minimal number of species in JDS2-samples		49	40	35	32	8	34	38	29	4	7

X…found but not published

* Paratendipes nubilus (Meigen, 1830), P. intermedius debatable Synonym

** From RO listed by Cure (1975)

Table 6. Chironomidae species per Reach & Section

		UPPER REACH			MIDDLE REACH				LOWER REACH		
	Section:	**1** (1)	**2** (2-6)	**3** (7-10)	**4** (11-19)	**5** (20-37)	**6** (37-58)	**7** (59-62)	**8** (63-86)	**9** (87-92)	**10** (93-96)
Ablabesmyia (Ablabesmyia)	longistyla	o			o				o		
Beckidia	zabolotzskyi					o	o		o		
Chernovskiia	macrocera								o		
Chernovskiia	orbicus					o	o		o		
Chironomus	"JDS2" sp.						o				
Cladotanytarsus	"sexdentatus"						o				
Cryptochironomus	obreptans/supplicans								o		
Lipiniella	moderata					o	o		o	o	
Nanocladius	distinctus					o					
Paratendipes	"intermedius"						o		o	o	
Paratanytarsus	dissimilis/inopertus							o			
Paratendipes	"connectens"								o	o	
Cricotopus	cf. dobrogicus							o	o		o
Cricotopus	obnixus-Gr.										o
Chironomus (Chironomus)	acutiventris					o			o	o	
Chironomus (Chironomus)	acutiventris/obtusidens					o					
Chironomus (Chironomus)	cf. bernensis					o	o				
Chironomus (Chironomus)	nudiventris			o	o	o	o				
Chironomus (Chironomus)	cf. obtusidens (Russev 1998: C. obtusidens, C. gr. o.)						o				
Chironomus (Chironomus)	cf. plumosus				o						
Chironomus (Chironomus)	plumosus-Gr.			o	o	o	o	o	o		
Chironomus (Chironomus)	riparius						o				
Chironomus (Lobochironomus	dissidens-Gr.								o		
Cladopelma	laccophila-Gr.				o				o		
Cladopelma	virescens					o					
Cladotanytarsus	conversus								o		
Cladotanytarsus	mancus Pu.								o		
Cladotanytarsus	mancus-Gr.					o			o		
Cladotanytarsus	nigrovittatus Pu.					o					
Cladotanytarsus	vanderwulpi		o		o	o	o				
Conchapelopia	sp.	o	o	o							
Cricotopus (Cricotopus)	bicinctus	o	o	o				o	o		o
Cricotopus (Cricotopus)	cf. curtus		o	o							
Cricotopus (Cricotopus)	festivellus-Gr.								o		
Cricotopus (Cricotopus)	flavocinctus								o		
Cricotopus (Cricotopus)	similis/trifascia Pu.	o									
Cricotopus (Cricotopus)	tremulus		o	o							
Cricotopus (Cricotopus)	tremulus-Gr.		o	o							
Cricotopus (Cricotopus)	triannulatus		o	o					o		
Cricotopus (Cricotopus)	trifascia	o	o	o							
Cricotopus (Isocladius)	sylvestris-Gr.	o			o				o		o
Cryptochironomus	obreptans					o	o				
Cryptochironomus	obreptans-Gr.				o						
Cryptochironomus	rostratus					o	o		o		
Cryptochironomus	sp.			o		o	o				
Cryptotendipes	usmaensis Pu.					o					
Dicrotendipes	nervosus		o			o	o	o	o		o
Eukiefferiella	clypeata	o									
Eukiefferiella	devonica/ilkleyensis		o	o							
Eukiefferiella	gracei		o	o							
Eukiefferiella	lobifera		o	o							
Glyptotendipes	pallens					o	o			o	
Harnischia	fuscimana Pu.					o					
Harnischia	sp.			o	o		o	o		o	
Heterotrissocladius	marcidus		o	o							
Limnophyes	sp.										o

	Section:	1 (1)	2 (2-6)	3 (7-10)	4 (11-19)	5 (20-37)	6 (37-58)	7 (59-62)	8 (63-86)	9 (87-92)	10 (93-96)
		UPPER REACH			MIDDLE REACH				LOWER REACH		
Microchironomus	tener				o	o	o	o	o		
Micropsectra	atrofasciata-Agg.	o									
Microtendipes	cf. britteni	o				o					
Microtendipes	cf. pedellus	o									
Microtendipes	pedellus-Gr.	o			o	o					
Monodiamesa	sp. (Russev (98): M. bathyphila		o	o	o						
Nanocladius	cf. dichromus (Syn.: N. bicolor)				o						
Nanocladius	sp.								o		
Nilotanypus	dubius								o		
Orthocladius (Orthocladius)	oblidens		o	o							
Orthocladius (Orthocladius)	rubicundus		o	o							
Orthocladius (Orthocladius)	sp.		o	o							
Orthocladius (Symposiocladius	lignicola		o	o							
Parachironomus	arcuatus-Gr.				o	o					
Paracladius	conversus			o							
Paralauterborniella	nigrohalteralis				o		o			o	
Parametriocnemus	stylatus	o	o								
Paratanytarsus	dissimilis	o						o	o		
Paratanytarsus	sp.								o		
Paratendipes	cf. albimanus	o									
Paratrichocladius	rufiventris		o								
Phaenopsectra	sp.				o	o					
Polypedilum	sp.							o	o		
Polypedilum (Polypedilum)	albicorne		o	o							
Polypedilum (Polypedilum)	laetum		o	o							
Polypedilum (Polypedilum)	laetum-Gr. ('flat head capsule')			o	o						
Polypedilum (Polypedilum)	nubeculosum	o			o	o	o	o	o		
Polypedilum (Polypedilum)	nubifer								o	o	
Polypedilum (Tripodura)	acifer						o				
Polypedilum (Tripodura)	aegyptium								o		
Polypedilum (Tripodura)	bicrenatum					o		o	o		o
Polypedilum (Tripodura)	bicrenatum-Gr.								o	o	
Polypedilum (Tripodura)	scalaenum-Gr. (Russev (98): P. scal'e'num; P. breviantennatum: RO)		o			o	o		o	o	
Polypedilum (Tripodura)	sp. Pu.										
Polypedilum (Uresipedilum)	convictum	o	o	o							
Polypedilum (Uresipedilum)	cultellatum		o		o						
Potthastia	gaedii		o	o							
Procladius	sp.								o		
Procladius (Holotanypus)	choreus			o	o	o	o	o	o		
Procladius (Holotanypus)	sp.					o	o		o		
Prodiamesa	olivacea	o		o	o						
Rheocricotopus (Psilocricotop	chalybeatus	o	o				o			o (90: Siret)	
Rheopelopia	ornata				o						
Rheopelopia	sp.		o						o		
Rheotanytarsus	spp.		o								
Robackia	demeijerei						o		o		
Robackia	sp.						o				
Stictochironomus	sp.			o	o	o					
Synorthocladius	semivirens	o	o	o							
Tanypus	punctipennis					o	o		o		
Tanytarsus	brundini	o									
Tanytarsus	brundini/curticornis		o	o	o	o					
Tanytarsus	ejuncidus	o				o					
Tanytarsus	eminulus				o	o	o				
Tanytarsus	heusdensis	o									
Tanytarsus	sp.	o			o	o			o		
Telopelopia	fascigera				o				o		
Thienemannimyia	Gr., Gen. indet.	o	o	o							
Thienemannimyia	sp. (Russev (98): 2 Arten)	o									
Tvetenia	calvescens	o									
Tvetenia	sp.								o		
Tvetenia	verralli	o	o	o							
Tvetenia	vitracies		o	o							
Virgatanytarsus	spp.	o							o	o	
Xenochironomus	xenolabis					o	o		o		
Minimal number of species per section		27	34	35	27	37	31	12	46	12	7
Minimal number of species per reach		61			65				53		

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3.7 Neozoa (Invasive Species)

Neozoa originating from the Ponto-Caspian area, Asia, Australia and North America are a crucial fact influencing the macrozoobenthic community of the Danube. The Danube is a part of the Southern Invasive Corridor (Black Sea-Danube-Main/Danube Channel-Main-Rhine-North Sea waterway), one of the four European most important routes for invasive species (GALIL et al., 2007). The river is exposed to intensive colonisation of Aquatic Invasive Species and further spreading in both (north-west and south-east) directions throughout the Danube Basin. With few exceptions the neozoa of the Danube belong to Crustacea and Mollusca.

Figure 20 shows the abundance and percentage of species of neozoa along the three reaches of the Danube indicating their essential importance for the ecosystem. Due to their tremendous abundance up to 90% within the Upper Reach or even 100% within the Middle Reach of the Danube and approximately 40% of all documented species at the Upper and Middle Reach their impact on each assessment system used becomes evident.

Neozoa dominate the Danube not only locally but they are distributed along the entire stretch. The highest frequency along the Danube River shows the mussel *Corbicula fluminea*. It occurs in 93% of the sites followed by the crustaceans *Corophium curvispinum* (90%) and *Dikerogammarus villosus* (69%).

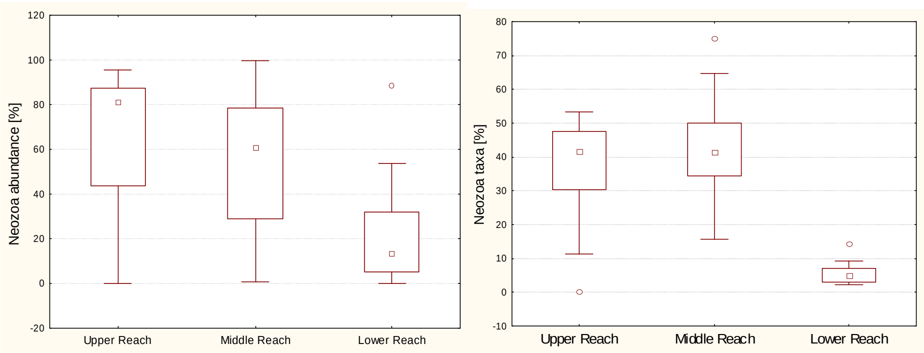
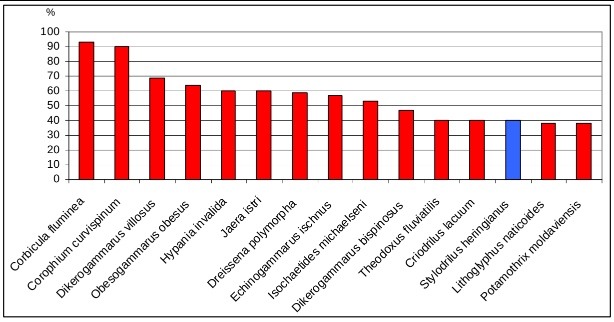


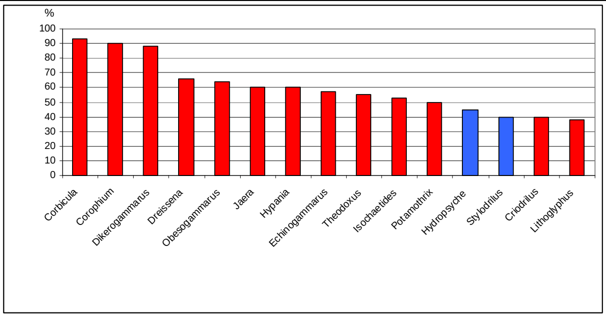
Figure 20. Box & whisker-plots of neozoa abundance and neozoa taxa

As Neozoa dominate the fauna their classification is a crucial point in assessing the ecological status. Most of them indicate ß-mesosaprobic water quality due to their national classification which results in an overall good ecological status due to their dominance (see also chapter “Organic Pollution”; Figure 27 and Figure 28). Omitting Neozoa from the analyses leads in some cases to zero-values of the saprobic index. The way how to consider neozoa (either as stressors or normal organisms) is still the object of many discussions in the EU member states. It is particularly essential to deal with the issue of invasive species in the Danube Basin and to consider their influence from the management point of view.

The highest frequency along the Danube River shows the mussel *Corbicula fluminea*. It occurs in 93% of the sites followed by the crustaceans *Corophium curvispinum* (90%) and *Dikerogammarus villosus* (69%). As shown in the Figure below the first 15 most frequent species are neozoa except the worm *Stylodrilus heringianus* found in 40% of the samples.



Most dominant species in the Danube River, excluding damsections & arms



Most dominant genera in the Danube River, excluding damsections & arms

Figure 21. Most dominant species in the Danube

3.8 Danube Typology

On the basis of the combined data-set of all methods used during JDS 2 the three main reaches proposed by LITERÁTHY et al. (2002) were confirmed by the macrozoobenthic community. Hence, the typology was used as prerequisite for the development of a type specific assessment system. Figure 22 gives a cluster analysis of undisturbed Danubian sites only, excluding dammed sections as well as sites with an SI> 2.4. Site 1 and Site 2 clearly form one cluster showing totally different hydromorphological (e.g. stream size, substrate, depth) and biological characteristics (taxa richness, abundance, taxa composition) compared to downstream sites. The present results regarding these two sites would suggest a separation from the rest of the Danubian reaches. The faunal composition is dominated by insects and by many taxa exclusively found there. This outcome may be of further relevance for future development of assessment methods that rely on one of the sampling methods of the JDS 2 or on a combination of them, respectively.

The remaining sites can be classified into two big compartments: one comprising the sites of the Middle Reach (including sites 3 to 5 and site 10 belonging to the Upper Reach), the other contains sites of the Lower Reach. Sites of the Upper Reach (3 to 5) are embedded in one well defined cluster within the Middle Reach-compartment indicating a transition zone between these two reaches.

Outliners are site 10 and site 95. Site 10 (Upper Reach) clusters within sites 13 to 16 (Middle Reach) and in fact it is 270 rkms from site 5 apart. The substrate of site 95 (Lower Reach) consisted of microlithal, a quite unusual fraction within the sandy bottom of the Lower Reach and this is probably why it is clustered within the Middle Reach, where these substrate (and the adjacent fauna) is more commonly found.

These evaluations clearly show that the Danube typology, especially the sub-division in three reaches is an important feature for developing a type specific assessment system.

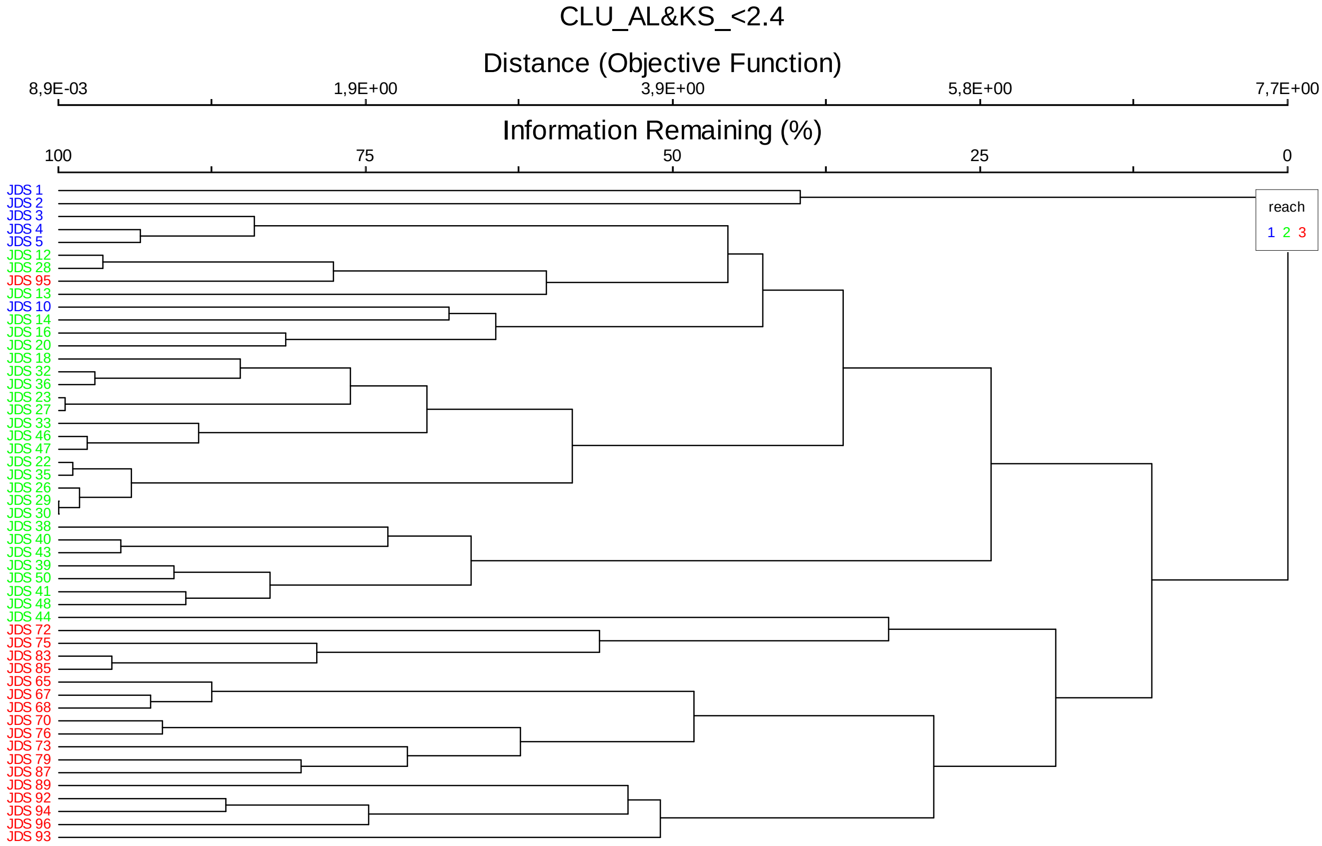


Figure 22. Cluster Dendrogram of all Danube sites excluding damsections & sites with an SI>2.4

Figure 23 shows the NMS scatterplot of all Danube sites excluding damsections & sites with an SI>2.4 which confirms the Cluster analysis. The scatters of the different reaches can be fairly defined from each other. Sampling site JDS1 is far apart from the rest of the sites followed by JDS2 as described above.

Due to a 3-dimensional presentation outliners like JDS 10 & 95 can not be discussed in detail but the classification into different reaches is in evidence.

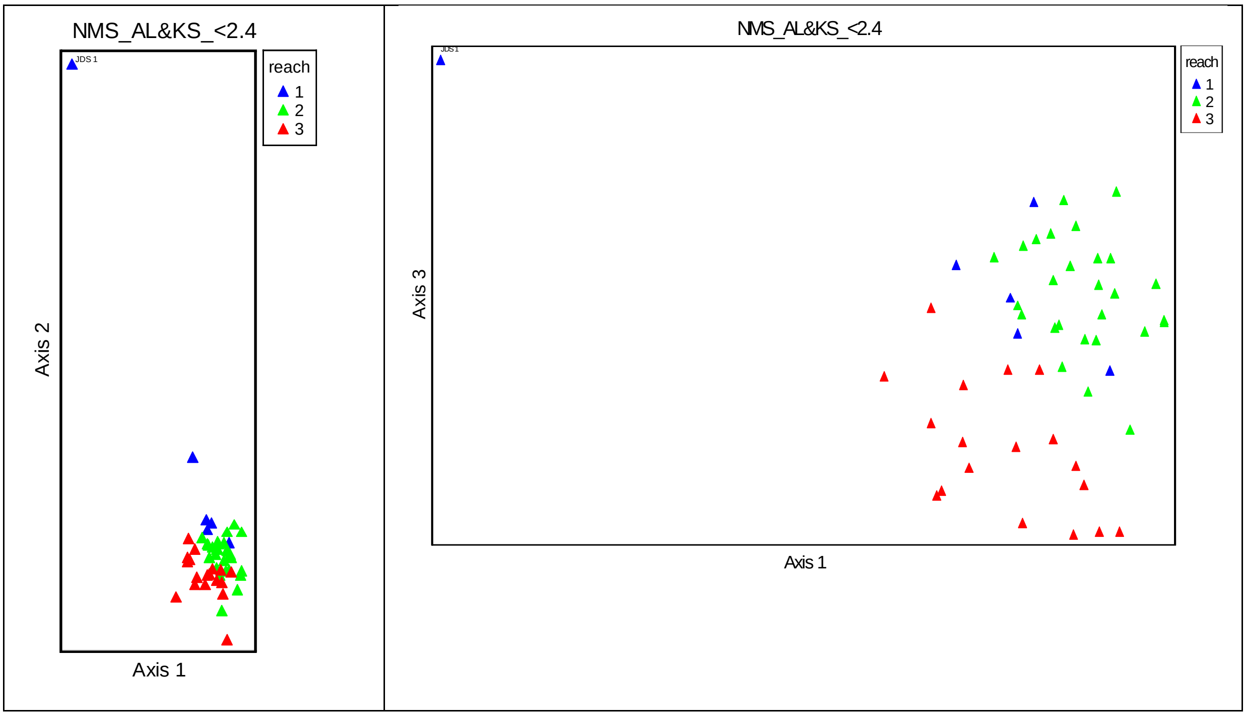


Figure 23. NMS; Airlift/Multicorer/MHS and Kick & Sweep; Danube excl. dams & arms <2.4

3.8.1 Revision of the Danube typology based on K&S /dredge data

Results of the centred PCA using transformed (logarithmic) individual values of the macroinvertebrates collected by K&S and Dredging showed five sections of the investigated Danube River. The sampling sites belonging to these sections are identified by convex polygon method. Practically the same grouping of JDS sites was received on the basis of Mollusca and Crustacea species only (Figure 24). The results illustrate the outstanding relevance of these taxonomic groups in case of the Danube River.

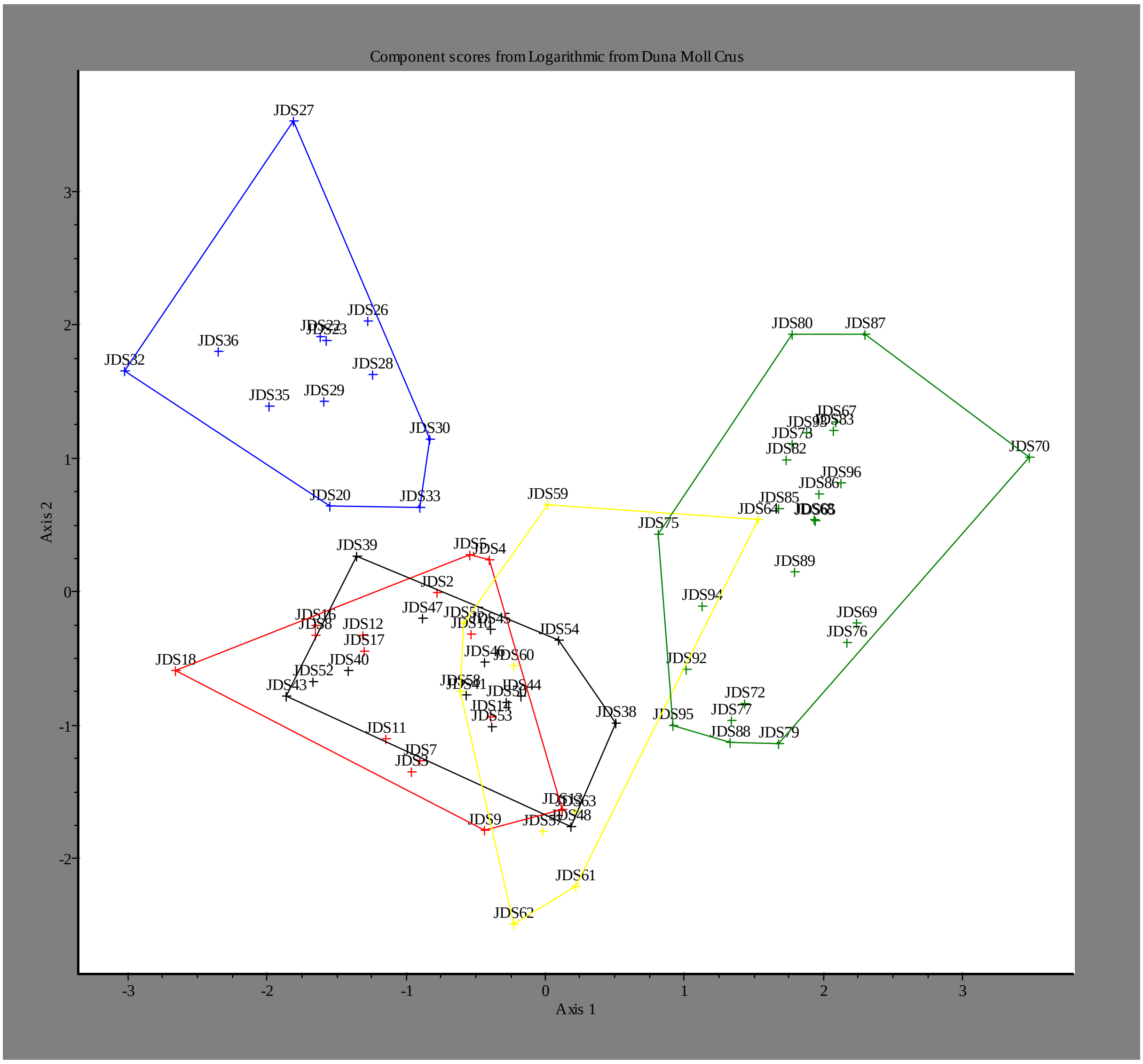


Figure 24. Plot of JDS sites using centred PCA with convex polygons for Mollusca and Crustacea taxa (red: German and Austrian sites; blue: Hungarian gravel-containing section; black: Hungarian-Croatian-Serbian reach with sand; yellow: inundated reservoir section of the Iron Gate stretch; green: Bulgarian-Romanian Lower Danube below the Iron Gate Reservoir I and II)

There are large overlaps between the upper and one of the middle reaches that might have a special common reason: the anthropogenic effect of the dams and elevated water level. However, the most clearly identical stretches are the gravel-rich free-flowing Middle (Slovakian-Hungarian) Danube that starts at the sudden decrease of bed slope after the Austrian section, and, the very large Lower Danube.

The free-flowing Middle section type is characterised mainly by Malacostraca taxa together with mussel (*Pisidium supinum*, *Sphaerium solidum*, *Unio Pictorum*, *U. tumidus*) and snail species (*Theodoxus fluviatilis*, *Borysthenia naicina*). The Lower Danube is characterised by alien and pontocaspic mussels (*Corbicula fluminea* and *Dreissena bugensis*, respectively) and several Danube-specific snails (*Theodoxus danubialis*, *T. transversalis*, *Esperiana acicularis*, *E. esperi*, *Viviparus viviparus*, *Holandriana holandrii*).

Further separation of the three overlapping sections was successful via Correspondence Analysis when the Lower Danube section was omitted from the multivariate analysis (Figure 25) because it was already clearly identified.

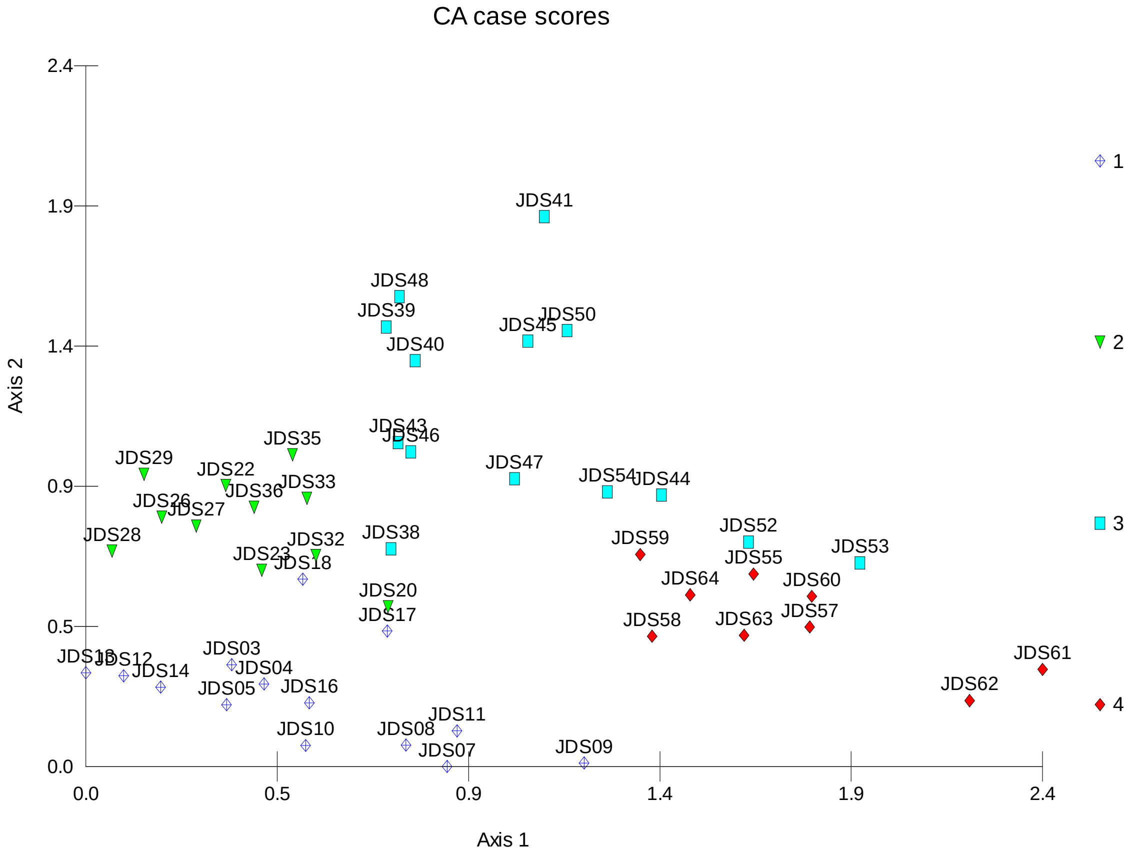


Figure 25. Plot of JDS sites (except the Lowr Danube) using detrended Correspondence Analysis with logn data of Mollusca and Crustacea taxa (blue: German and Austrian sites; green: Hungarian gravel-containing section; blue: Hungarian-Croatian & Serbian reach with sand; red: inundated reservoir section of the Iron Gate stretch)

Summarizing the results of centred PCA based on both the total macroinvertebrate data set collected by K&S/Dredge, and, the exclusively selected Mollusca-Crustacea group-data resulted in five distinguished section types of the Danube River between Geisling (JDS3) and the Delta estuary as follows:

1. Geisling – Bratislava: JDS3-JDS16;
2. Gabcikovo reservoir – Baja: JDS17-JDS38;
3. Mohács - downstream Tisa/upstream Sava (Belegis): JDS39-JDS52;
4. Upstream Pancevo/downstream Sava - Iron Gate II (Donji Milanovac & Tekija/Orsova are a little bit different): JDS 53-JDS64;
5. Upstream Timok (Radujevac/Gruia) – Sf.Gheorghe arm: JDS65-JDS96

This special outcome of multivariate analysis has to be controlled and revised by other investigations. For the near future it provides the basic structure of the Danubian sectioning that is particularly important step for the development of the WFD compliant ecological status determination.

However, more detailed analyses on basis of the whole macroinvertebrate community by Sommerhäuser et al. (2003) and Moog et al. (2008) led to a higher resolution and a subdivision in 10 homogenous Danube section types.

3.9 WFD-compliant criteria for assigning the ecological status

Much information has already been compiled with respect to hydrobiological (reference) conditions in the Danube basin (e.g. 'WFD Roof Report' ANNEX 3: Typology of the Danube River and its reference conditions [ICPDR, 2005]). Nevertheless, currently no WFD-compliant metrics yet have (officially) been defined or agreed (BUIJS, 2006). This lack of appropriate methods to assess the ecological status in large rivers like the Danube is a fundamental obstacle in implementing the WFD compliant monitoring (BIRK 2003). In the past the river quality was basically evaluated by assessing organic pollution. To achieve the demands of the WFD for an integrated biological assessment of macroinvertebrates and to assess the ecological status of a water body, further attributes of the species assemblage have to be considered and evaluated.

As already applied and proved in several EU member states a modular assessment system is recommended for the biological quality indicator 'benthic invertebrates' based on

1) the assessment of **organic pollution** (saprobic condition) and
2) the assessment of the **general degradation** (hydromorphological and hydrological impact like damming, impoundment etc.) e.g. using multimetric indices (MMI) or predictive models.

3.10 Application of an existing assessment methods for large rivers in the Danube basin – the Potamon-Typie-Index

The Potamon-Typie-Index (PTI) is part of the German assessment system applied to large rivers. It is based on the ranking of selected taxa according to their dependency on potamal conditions using a five class scheme. Additionally indicator weight and abundance are considered for the index calculation. The result of the index is directly assigned to a river quality class. More detailed information about the method is given in Schöll et al. (2005).

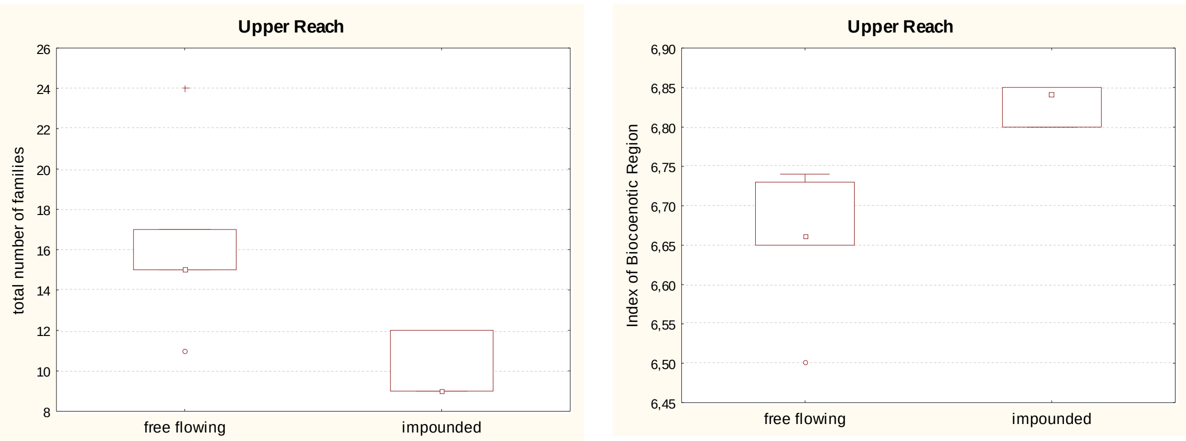
The PTI was calculated for all sites using the software ASTERICS/PERLODES. The results show that the PTI values continuously decrease from the Upper Reach to the Lower Reach indicating an improvement of the river quality in the free flowing sections. The increase of river quality clearly reflects the increasing potamal conditions from the upper to the lower reach of the Danube and most likely the decreasing impact on the hydromorphology of the river. Concerning the impact of impoundment sections due to power plants the method indicates better conditions for impounded sections in many cases. However, the method is originally based on a number of replicates along a waterbody and the results for single sampling sites are not reliable in almost all cases failing to meet the PTI validity criteria.

3.11 Evaluation of candidate metrics for assessing the ecological status of the Danube

Out of more than 200 metrics calculated about 20 metrics were selected as candidates for the use in assessment system in the Danube river in total. These metrics comprehend functional measures, sensitivity/tolerance measures, richness measures as well as composition/abundance measures. As the response of metrics to stressors differs between river sections, candidate metrics were selected river-type-specific. The most promising metrics are summarised in Table 7. Higher numbers of suitable metrics were found for the upper (15) and middle reach (12) of the Danube, where the main stressor is impoundment. For the lower reach, where organic pollution becomes a more important stressor and only two sites are affected by impoundment, a lower number (7) of applicable metrics was found. Examples of useful metrics are shown in Figure 26.

Table 7. Selected candidate metrics fort the three Danube reaches

Upper Reach	Middle Reach	Lower Reach
total number of taxa (families)	number of Diptera taxa (genera)	number of Oligochaeta taxa
number of EPT-taxa	number of Crustacea taxa	[%] of Oligochaeta taxa
total abundance	[%] of Diptera taxa	[%] of littoral+profundal preferences
abundance of Diptera	[%] of Oligochaeta taxa	[%] of filter feeders
abundance of Chironomidae	[%] of Diptera abundance	[%] of shredders
[%] of Diptera taxa	[%] of Oligochaeta abundance	[%] of detritivorous
[%] of Diptera abundance	[%] of Littoral	Index of Biocoenotic Region
[%] of profundal preferences	[%] of shredder	
[%] of littoral+profundal preferences	[%] of grazers	
[%] of grazers	[%] of detritivorous	
[%] of shredders	RETI ([%] shredder & grazer)	
[%] of passive filter feeders	Index of Biocoenotic Region	
[%] of detritivorous		
RETI ([%] shredder & grazer)		
Index of Biocoenotic Region		



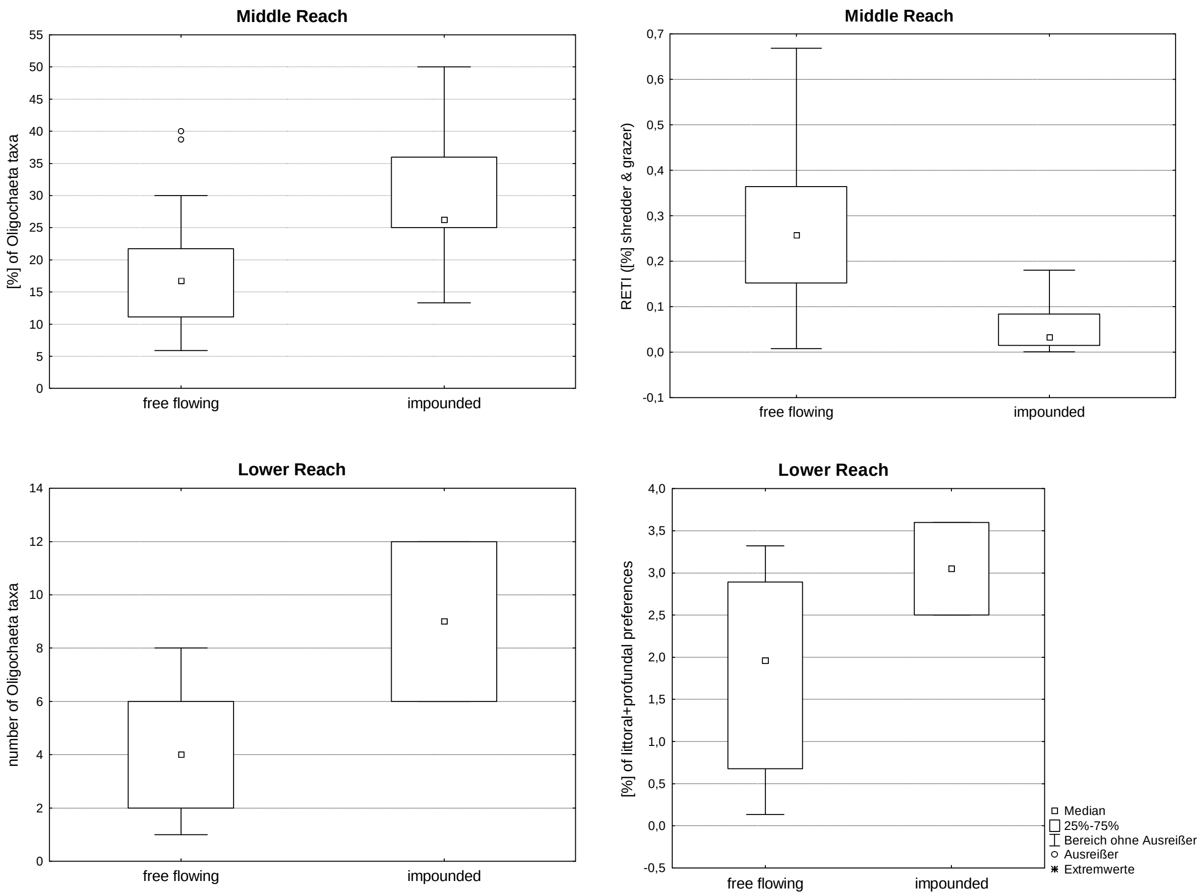


Figure 26. Some examples of Box & Whisker – plots of candidate metrics

3.12 Organic pollution

For monitoring the organic pollution the saprobic system has a long tradition in several Danube countries. The WFD compliant implementation of this system is based on the deviation of the Saprobic Index from saprobic reference conditions (STUBAUER & MOOG, 2003, OFENBÖCK et al., 2007, ROLAUFFS et al., 2003). BMWP and ASPT are alternative indices that are widely used for assessment. It has to be clearly pointed out that a WFD compliant assessment of the ecological status based exclusively on saprobic indices can provide only a rough indication of the status as several others pressures to the benthic invertebrate community are not evaluated with saprobic systems (see also the Overarching Chapter – Comments on the Ecological Status).

With the data gathered with the Airlift and the Multicorer method all available national systems of saprobic indices were calculated and transferred to an indication of the water quality class which are given for each single site investigated during the survey. The relevant results for all sites at the Danube are summarized in Table 8.

The highest values of Saprobic Indices indicating serious organic pollution were detected in the Danube downstream Pancevo and at Giurgeni. Regarding organic pollution most of the sites (58) can be classified as “indication of good ecological status” according to the WFD. For 8 sites the SI shows an “indication of moderate ecological status”, for 3 sites “poor ecological status” and for 9 a “high ecological status” is indicated.

The Saprobic Indices of the tributaries (near confluence with the Danube river) vary between 2.1 and 3.26 (Austrian SI). The rivers Sio, Jantra, and Russenski Lom achieve SI-values even higher than 3.0. The Arges river is excessively polluted and did not host any macroinvertebrate specimen. As no reference condition is known for the tributaries, a WFD-compliant assignment to ecological quality classes is not possible. Additionally to the JDS 2 sampling programme the tributaries were sampled by national teams, the results are published elsewhere.

Table 8. Saprobic indices and indication of water quality classes for all Danubian sampling sites. D-SI…German SI, A-SI…Austrian SI, SK-SI…Slovak SI, RO-SI…Romanian SI. Saprobic index values and indications of water quality based on less than 10 indicator taxa are scientifically questionable and written in *italic*.

Sampling Site	Method	Saprobic reference condition	Classified taxa	Saprobic Index	Indication of Water Quality Class	Sampling Site	Method	Saprobic reference condition	Classified taxa	Saprobic Index	Indication of Water Quality Class
JDS1 Donaurieden (bei Ulm)	D-SI	1,65	36	1,94	II	JDS47 downstream Novisad	RO-SI	2,0	14	2,15	II
JDS2 Kehlheim	D-SI	1,75	29	2,23	II	JDS48 upstream Tisa	RO-SI	2,0	*7*	*2,16*	*II*
JDS3 uh. KW Geisling	D-SI	1,75	*8*	*2,20*	*II*	JDS50 downstream Tisa	RO-SI	2,0	*2*	*2,11*	*II*
JDS4 Deggendorf	D-SI	1,75	11	2,18	II	JDS52 upstream Pancevo	RO-SI	2,0	14	2,22	II
JDS5 Niederalteich	D-SI	1,75	12	2,16	II	JDS53 downstream Pancevo	RO-SI	2,0	14	3,09	IV
JDS7 Jochenstein	A-SI	1,75	14	2,31	III	JDS54 Grocka	RO-SI	2,0	*9*	*2,29*	*II*
JDS8 oh. KW Abwinden	A-SI	1,75	12	2,12	II	JDS55 Danube up. Velika Morava	RO-SI	2,0	*9*	*2,26*	*II*
JDS9 Ybbs/Persenbeug oh. KW	A-SI	1,75	10	2,2	II	JDS57 Danube down. Velika Morava	RO-SI	2,0	10	2,27	II
JDS10 Oberloiben	A-SI	1,75	13	1,87	II	JDS58 Starapalankaram	RO-SI	2,0	15	2,43	III
JDS11 Greifenstein	A-SI	2,0	16	2,54	III	JDS59 Banatska Balanka	RO-SI	2,0	12	2,15	II
JDS12 Klosterneuburg	A-SI	2,0	11	1,84	I	JDS60 Goluback/Koronin	RO-SI	2,0	19	2,58	III
JDS13 Wildungsmauer	A-SI	2,0	10	1,83	I	JDS61 Donij Milanovac	RO-SI	2,0	11	2,69	III
JDS14 Hainburg	A-SI	2,0	*9*	*1,95*	*I*	JDS62 Tekjia/Orsova	RO-SI	2,0	*8*	*2,44*	*III*
JDS16 Bratislava	SK-SI	2,0	13	2,27	II	JDS63 Vrbica/Simijan	RO-SI	2,0	15	2,47	III
JDS17 Gabcikovo	SK-SI	2,0	*9*	*2,30*	*II*	JDS64 Iron Gate II	RO-SI	2,0	11	2,13	II
JDS18 Medvedov	RO-SI	2,0	*9*	*2,09*	*II*	JDS65 upstream of Timok	RO-SI	2,0	16	2,21	II
JDS19 Moson Danube	RO-SI	2,0	12	2,84	IV	JDS67 pristol	RO-SI	2,0	*8*	*2,13*	*II*
JDS20 Komarno	RO-SI	2,0	10	2,11	II	JDS68 Calafat	RO-SI	2,0	14	2,26	II
JDS22 Iza	RO-SI	2,0	*8*	*2,09*	*II*	JDS69 downstream Kozloduy	RO-SI	2,0	16	2,29	II
JDS23 Esztergom	RO-SI	2,0	12	2,12	II	JDS70 upstream Iska	RO-SI	2,0	*7*	*2,06*	*II*
JDS26 Szob	RO-SI	2,0	*9*	*2,11*	*II*	JDS72 downstream Iska	RO-SI	2,0	*2*	*1,78*	*I*
JDS27 Szentendre Island Mainchannal	RO-SI	2,0	11	2,11	II	JDS73 upstream Olt	RO-SI	2,0	12	2,14	II
JDS28 Szentendre Island Arm	RO-SI	2,0	*6*	*2,15*	*II*	JDS75 downstream Olt	RO-SI	2,0	*5*	*1,90*	*I*
JDS29 Budapest upstream	RO-SI	2,0	10	2,07	II	JDS76 downstream Turnu Magurele	RO-SI	2,0	*9*	*1,93*	*I*
JDS30 Budapest upstream side arm	RO-SI	2,0	*9*	*2,09*	*II*	JDS77 downstream Zimnicea	RO-SI	2,0	*7*	*2,38*	*II*
JDS31 Rackeve-Soroksar sidearm	RO-SI	2,0	11	2,31	II	JDS79 downstream Jantra	RO-SI	2,0	13	2,32	II
JDS32 Budapest downstream	RO-SI	2,0	11	1,94	I	JDS80 upstream Ruse	RO-SI	2,0	*3*	*2,18*	*II*
JDS33 Adony/Lorev	RO-SI	2,0	11	2,12	II	JDS82 downstream Ruse/Giugiu	RO-SI	2,0	*4*	*1,48*	*I*
JDS34 Rockere-Sorokser Arm-end	RO-SI	2,0	20	2,28	II	JDS83 upstream Arges	RO-SI	2,0	*9*	*2,10*	*II*
JDS35 Dunaföldvar	RO-SI	2,0	*7*	*2,06*	*II*	JDS85 downstr. Arges	RO-SI	2,0	*4*	*1,81*	*I*
JDS36 Paks	RO-SI	2,0	11	2,26	II	JDS86 Silistra	RO-SI	2,0	16	2,76	III
JDS38 Baja	RO-SI	2,0	13	2,35	II	JDS87 downstream Crnawoda	RO-SI	2,0	12	2,16	II
JDS39 Hercegszanto	RO-SI	2,0	*5*	*2,23*	*II*	JDS88 Giurgeni	RO-SI	2,0	*5*	*3,15*	*IV*
JDS40 Batina	RO-SI	2,0	*7*	*2,13*	*II*	JDS89 Braila	RO-SI	2,0	*7*	*2,23*	*II*
JDS41 upstream Drava	RO-SI	2,0	*2*	*2,20*	*II*	JDS92 Reni	RO-SI	2,0	*7*	*2,16*	*II*
JDS43 downstream Drava	RO-SI	2,0	15	2,17	II	JDS93 Vilkova	RO-SI	2,0	19	2,24	II
JDS44 Dalj	RO-SI	2,0	*5*	*2,20*	*II*	JDS94 Bystroye canal	RO-SI	2,0	*6*	*2,15*	*II*
JDS45 Ilok Backa Palanka	RO-SI	2,0	*6*	*2,13*	*II*	JDS95 Sulina	RO-SI	2,0	12	2,16	II
JDS46 upstream Novisad	RO-SI	2,0	11	2,25	II	JDS96 St. George arm	RO-SI	2,0	*3*	*2,11*	*II*

These results give an impression of the saprobic conditions in the Danube - however they may not be appropriate for all sites as national adaptations to the assessment system would be needed in some countries. Thus the results should be taken as a proposal and demonstration of an assessment that requires further plausibility checks by national experts. Additionally the calculations of the SI are based on pooled samples taken from the river bottom representing the cross section of the Danube. However at the banks the conditions can be different and even varying between right and left bank as was demonstrated by the analysis of the river banks.

Moreover, the results of saprobic indices show relatively high deviation in dependency of the system used. The comparison of the different national classification systems shows that a harmonisation of assessment systems or an intercalibrabtion exercise is urgently needed to make the national methods compareable.

A major problem in determining the saprobic stage of sites is the number of available indicators (taxa ranked according to their sensitivity to organic pollution). Therefore in Table 8 only those sites are mentioned where at least 10 indicator taxa were available.

For the WFD compliant standard monitoring of benthic invertebrates several different indices could be used as long as a scientific sound basis for the type specific identification of reference conditions is available. However, according to our study new or revised saprobic indicator values for species are needed for the Middle and Lower Danube.

Additionally, the high percentage and abundance of neobiota taxa (Figure 27 and Figure 28) within the indicating taxa is a critical point (see also chapter “Neozoa”). In many cases the indication of saprobic conditions are completely dominated by non-indigenous taxa which achieve in some cases more than 90 % of the total abundance. As most of these taxa are euryoecious, ranked as indicators close to water quality class 2, the resulting index is also strongly tending to this quality class. Figure 28 shows that at sites with a high percentage of neobiota the saprobic index is always close to 2. On the other hand the exclusion of neobiota from the calculation would mean to lose most of the indicators and leave a very high part of the fauna unconsidered. How to treat the non-indigenios fauna in large rivers for water quality assessment will be a crucial point for the development of future assessment methods.

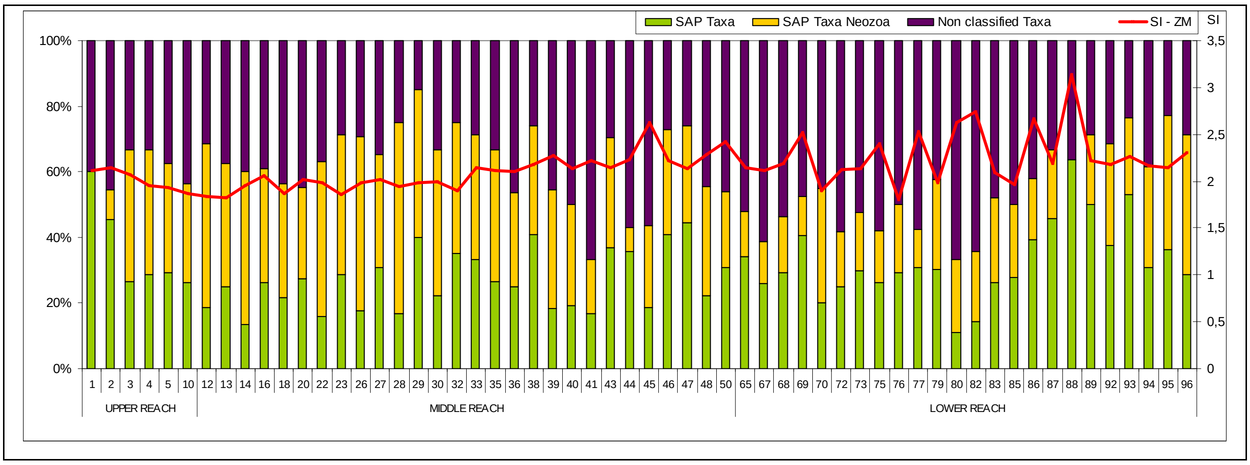


Figure 27. Saprobic index and percetages of taxa classified in terms of saprobic indication, considering classified and non classified taxa as well as classified indigenous taxa and classified non- indigenous taxa

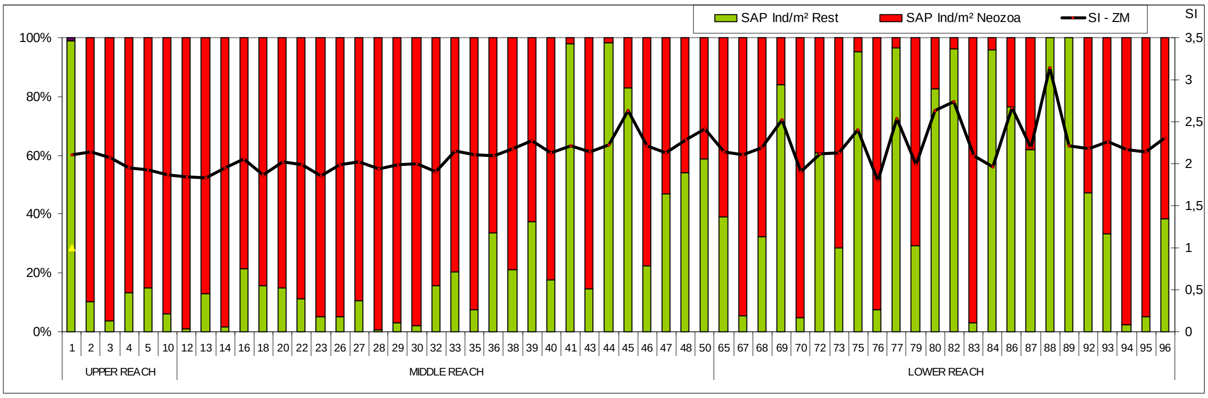


Figure 28. Saprobic index and percental share of indigenous taxa and non- indigenous taxa classified in terms of saprobic indication (abundance)

General Degradation

In addition to the assessment of organic pollution an integrated biological assessment of the benthic invertebrate fauna has to consider also a number of other characteristics of the species assemblages including taxonomic composition, abundance, ratio of disturbance sensitive taxa to insensitive taxa, and diversity. These attributes have to be integrated and compared to respective target values under reference conditions. Out of more than 200 metrics calculated about 20 metrics were finally selected as candidates for the use in assessment systems in the Danube River. These metrics comprehend functional measures, sensitivity/tolerance measures, richness measures as well as composition/abundance measures. As the response of metrics to stressors differs between river sections, candidate metrics were selected river type specific. Higher numbers of suitable metrics were found for the upper (15) and middle reach (12) of the Danube, where the main stressor is impoundment. For the lower reach, where organic pollution becomes a more important stressor and only two sites are affected by impoundment, a lower number (7) of applicable metrics was found. Results for the indication of the ecological status are not given here as the application of the MMI-method requires agreement on reference conditions and boundary values. More details and the metrics are given in the Full Report – this information could be used to implement a multimetric index in a national assessment method or within the Danube intercalibration process.

3.13 Proposal for assigning the ecological quality class

The evaluation of the overall ecological quality should be based on the results of both modules (organic pollution, general degradation), preferably using the worst case as shown in Figure 29.

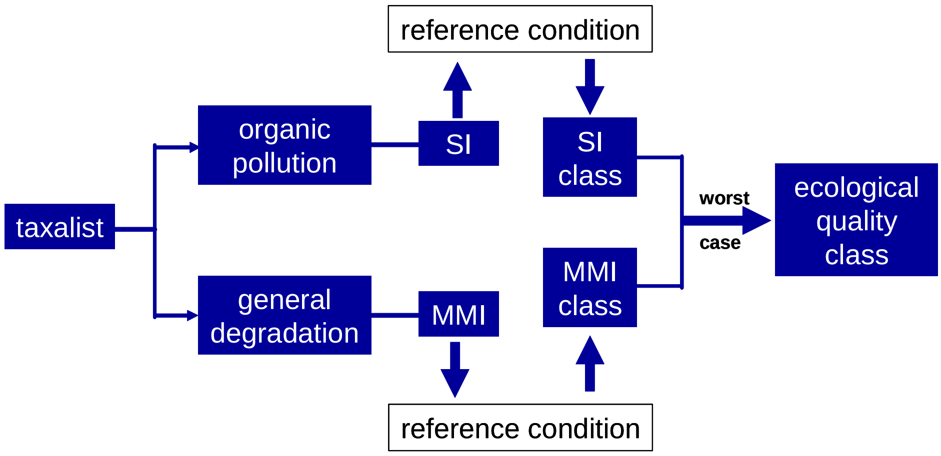


Figure 29. Evaluation of the river quality using two modules, for instance saprobic index and multimetric index (MMI)

3.14 Towards an Assessment of Ecological Status

A fundamental obstacle in implementing the WFD is represented by the lack of appropriate methods to assess the ecological watercourse status. The majority of schemes currently applied have been developed decades ago to detect the most significant impact at that time: organic pollution. With increasing awareness of other causes of reduction in watercourse quality (e.g. eutrophication or morphological degradation) different indicative parameters have been chosen. So systems have evolved which miss interconnections. Simple combination of existing methods covering diverse aspects of the river ecosystems can apparently not satisfy the premises of integrated ecological assessment.

Predictive modelling as conducted by the Czech PERLA system includes entire species assemblages. This enables assessment of ecosystems at community scale. However, the translation of biological data into precise conclusions concerning the cause of stress is not yet inherent to the system (WRIGHT 2000). Multimetric schemes offer decision support to water managers through stressor-specific appraisal. They aim at measuring diverse structural and functional aspects of the watercourse biota, but consider individual taxa to describe and evaluate a site’s condition.

As these two different procedures perform stream type-specific assessment based on reference conditions they represent appropriate methodologies in line with the requirements of the WFD. In the future integrated ecological appraisal could be ensured by linking both approaches: a multimetric system in which the reference values of individual metrics are predicted on the basis of environmental watercourse variables.

Both subjects outlined above represent major challenges for environmental quality control in the countries of the Danube River Basin. Cooperation of individual states in this multinational catchment area is indispensable. Here, governmental institutions like the ICPDR (International Commission for the Protection of the Danube River) as well as non-governmental organisations like the IAD (International Association for Danube Research) hold key roles for the corporate overcoming of these obstacles.

4 Conclusions

The macrozoobenthic community documented during JDS 2 comprises 441 taxa. Regarding diversity the most heterogeneous groups are Diptera and Oligochaeta. The fauna is dominated by Crustacea (Amphipoda and Isopoda) in terms of abundance while Mollusca are the predominant group regarding biomass. However aquatic insects, especially EPT-taxa, play only a minor role in the Danube River.

The three established typological reaches of the Danube (upper – middle – lower) can be confirmed with multivariate analysis of the macrozoobenthos data. Additionally the Danube typology could be revised at a smaller scale resulting in five distinguished section types of the Danube River.

Comparison between the methods Airlift/MHS/Multicorer and Kick & Sweep/Dredging is difficult because the two approaches are not only different in terms of technique but they also are sampling different spatial zones of the river. More taxa have been collected with Airlift/MHS/Multicorer compared to the Kick & Sweep/Dredging method (362 and 202 respectively). In general, Airlift/MHS/Multicorer seems to be more effective regarding a standardized documentation of benthic invertebrates as it is a quantitative method and covers the largest area of the river ecosystem. For the decision on methods for future WFD compliant monitoring programs the objectives for the use of the biological quality element macrozoobenthos have to be considered.

For the assessment of the ecological status a modular system is proposed consisting of an index for organic pollution and an index for general degradation. For the assessment of organic pollution most Danube states are already using an index based system (e.g. saprobic index). To cover hydromorphological degradation the development of a multi-metric approach is proposed.

Regarding organic pollution the Saprobic Indices for the JDS 2 sites in the Danube vary between 1.83 and 3.15. Most of the sites (58) can be classified as “indication of good ecological status” according to the WFD. For 8 sites the SI shows an “indication of moderate ecological status”, for 3 sites “poor ecological status” and for 9 sites a “high ecological status” is indicated. The comparison of the different national classification systems shows that the assessment systems need to be harmonised.

Tributaries (near confluence with the Danube) show Saprobic Indices between 2.1 and 3.26 (Austrian SI). The rivers Sio, Jantra, and Russenski Lom achieve SI-values higher than 3.0. The Arges river is excessively polluted and did not host any macroinvertebrate specimen. As no reference condition is known for the tributaries a WFD-compliant assessment procedure is not possible.

The bottom fauna of the upper and middle reach of the Danube is dominated by Ponto-Caspian Neozoa (mostly Crustacea and Mollusca). Their relative abundance averages between 60% and 80% and they represent up to 40% of the total number of taxa. Neozoa are not locally abundant but cover the whole Danube stretch. As Neozoa dominate the fauna their classification is a crucial point in assessing the ecological status. Most of them indicate ß-mesosaprobic water quality due to their national classification which results in an overall good ecological status due to their dominance. Omitting Neozoa from the analyses leads in some cases to zero-values of the Saprobic Index.

A more elaborate analysis of the JDS 2 results including further comments and conclusions can be found in the Full Report of the JDS 2.

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