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THE RESPONSE OF BENTHIC MACROINVERTEBRATE AND FISH ASSEMBLAGES TO HUMAN IMPACT ALONG THE LOWER STRETCH OF THE RIVERS MORAVA AND DYJE (DANUBE BASIN, CZECH REPUBLIC)

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ABSTRACT

The lower Morava and Dyje rivers belong among the large lowland rivers on the southeast of the Czech Republic flowing into the Danube 69 km downstream of their confluence. Despite their high nature value and environment protection, both rivers suffered from heavy pollution from the sixties to the eighties of the last century. Significant improvement of their water quality during the last two decades resulted in the partial recovery of former assemblages of both benthic macroinvertebrates and fish. Recently, altogether 262 and 137 taxa of macrozoobenthos were recorded at the Dyje and Morava rivers, respectively. In the River Dyje, 3 and 21 non-native and threatened (according to IUCN categories) invertebrate species, respectively, were ascertained, whilst in the River Morava their numbers were 2 and 10, respectively. The fish assemblage consisted of 23 and 24 species, respectively, plus one hybrid in each of the rivers, bleak being by far the most abundant fish. In the sections under study, several rare and/or protected species were also recorded. Two of them, ide (*Leuciscus idus*) and burbot (*Lota lota*) belong among vulnerable fish species and four others, white-eye bream (*Abramis sapa*), striped ruffe (*Gymnocephalus schraetser*), streber (*Zingel streber*) and zingel (*Zingel zingel*), are considered as critically endangered species. Currently, both lower stretches of the rivers Morava and Dyje have been heavily invaded by round goby, *Neogobius melanostomus*.

INTRODUCTION

Large lowland rivers and their alluvial floodplains comprise a wide range of biotopes inhabited by many animal and plant species (Adámek and Sukop, 1992; Schiemer, 1999; Schomaker and Wolter, 2011). Rivers represent dynamic, continuously changing, systems, supported by an extensive ability to recover former and to create new biotopes. Natural, non-impacted lowland streams display a rich and diverse lateral and longitudinal zonation of a river and alluvial biotopes, with good hydrological and ecological interconnection of pools, riffles, side arms and oxbow lakes, riparian wetlands, flooded meadows and wooded alluvial land.

Under the framework of the Joint Danube Survey 2 (JDS2), an evaluation of ecosystem functioning along the River Morava and its main tributary, the River Dyje, took place in August 2007. JDS2 represented a unique coordinated research activity along the most international river basin in the world, in which scientists from fourteen Danubian countries actively participated. One of the basic objectives of JDS2 was to get a better view of specific water quality parameters and in-depth characterisation of river biology through the establishment of complementary monitoring activity along the Danube and its important tributaries. This is the first time that investigation of fish and river hydromorphology has been performed to such an extent within the Danube basin. Though the key aim of JDS2 was to produce a homogenous data set of specific water quality elements for the Danube, the results obtained by national teams along tributaries are also of great importance for overall documentation. The study has also provided a forum for riparian countries to develop and test evaluation methods for river health. In addition to its scientific results, a major contribution of JDS2 has been in the dissemination of information to the public and getting inhabitants more involved in water protection issues (Liška et al., 2008). The JDS2 concept has now been formally included into the EUs Water Framework Directive (WFD) monitoring strategy as a tool for investigative monitoring.

This manuscript presents results from a detailed assessment of biota in the rivers Morava and Dyje, belonging among the richest of European rivers as far as benthic macroinvertebrate and fish communities are concerned. Data from two TransNational Monitoring Network (TNMN) sites upstream of the Morava and Dyje confluence are also included, as well as a literature review evaluating changes that have occurred over recent decades.

GENERAL CHARACTERISTICS OF THE MORAVA RIVER BASIN

The catchment areas of three main European rivers occur within the Czech Republic - those of the River Elbe, which empties into the North Sea (65% of land surface); the River Odra, draining into the Baltic Sea (7%); and the River Morava, which flows into the Danube and on to the Black Sea (27%). Both the Morava and its main tributary, the Dyje, originally meandered through large floodplains; however, both these rivers have been regulated and channelised, to varying extent, over the last century.

The watershed of the River Morava on the territory of the Czech Republic (Fig.1) has an area of 20,692 km^2. However, 64.9% (13,419 km^2) of this area belongs to the River Dyje. The Morava River basin may be characterised as being densely populated (137 inhabitants per km^2) and highly exploited by both industry (machinery, food and chemical) and agriculture. Agricultural land represents around 60% of the basin surface, forests 32% and urbanised areas around 6%. Hydrologically, the Morava river basin is poor in water sources. Average annual precipitation is 635 mm and mean annual catchment runoff reaches 3,430 million m^3. The average annual discharge of only 1.16 m^3 for each of its 2.7 million inhabitants is only one third of the European average, and one sixth of the global average. The basin has 38 important storage reservoirs, with a total capacity amounting to approximately 568 million m^3.

Fig 1. The Morava River basin on the territory of the Czech Republic with the indication of JDS2 sites location

The qualitative state of running waters in the Morava river basin reflects a long-term development of landscape, municipalities, agriculture, industry, forestry, water management and other infrastructures. Although water quality has improved significantly over the past 20 years (e.g. all 34 towns with more than 10,000 inhabitants have been equipped with biological wastewater treatment plants), issues related to high nutrient and/or organic loading of surface waters still remain.

Historically, this river system was naturally inundated up to five times a year (Kux 1956) and the floodplains around the confluence provided extremely favorable conditions for reproduction and nursing of the majority of riverine fish (Jurajda and Peňáz, 1994, Jurajda, 1995, 1999, Jurajda et al., 2000, 2001). Between 1968 and 1982, however, the Morava was largely channelised and its meanders, disconnected from the main channel by levees, now exist as isolated oxbow lakes. Environmental protection and maintenance of plant and animal diversity is implemented through a network of protected areas and sites, particularly in the upper mountainous and lower lowland parts of the river basin. The territory around the confluence has been designed as a "Protected Landscape Area" (the Soutok PLA; 139 km^2) and mostly comprises floodplain forest with a rich system of canals, oxbow lakes, river side-arms and pools subject to controlled flooding over spring.

CURRENT SITUATION AS REGARDS HABITAT AND WATER QUALITY DEGRADATION ALONG THE LOWER MORAVA AND DYJE

Physical habitat degradation

Human activities had a significant impact on the hydromorphological status of both the Morava and Dyje river basin districts (RBDs), with natural stream processes being rare and aquatic biocenoses degraded at present. Around 80% of all water bodies have been modified, with stream channelisation, bank strengthening, channel hardening and cross barrier construction being the dominant factors. There are substantial differences between the hydrological characteristics of the two RBDs (summarised in Table 1). Despite having almost the same average annual precipitation (590 and 670 mm for the Morava and Dyje rivers, respectively), annual surface runoff for the Dyje is only half of that of the Morava (109 and 206 mm, respectively). As such, the number of reservoirs in the Morava River basin (upstream of the confluence) is one third of that in the Dyje basin (10 and 28, respectively), while total storage capacity in the Morava River basin is only one twelfth that of the Dyje River basin. Channel straightening has been implemented to a greater extent in the Morava RBD (ca. 57% of stream length), with barrier construction of greater importance in the Dyje basin (90% of streams). Overall, lack of fish passes has the greatest impact in the upper stretches of the rivers, with straightening and levee construction of greater importance in the lower stretches. Moreover, there is a clear difference in agricultural management for the two RBDs, with both area of arable land and number of animals bred (pigs, poultry) clearly higher in the Dyje RBD (Table 1).

Table 1. General characteristics of the Morava & Dyje river basin districts upstream of the TNMN sites

	TNMN site	
	Morava: Lanzhot	Dyje: Pohansko
Upstream river basin area (km2)	9,883	11,165
Altitude TNMN site (m a.s.l.)	150	155
Average discharge (m3.s-1)	61.1	37.5
Reservoirs (No.)	10	28
% stream straightened	58	36
No. inhabitants (ths)	1,363	1,395
Cities > 10,000 inhabitants (No.)	22	12
Arable land (%)	53.0	64.3
Number of pigs bred (ths)	373	652
Number of poultry bred (ths)	3,078	4,800

Water quality development

The present degraded environmental status of the lower Morava and Dyje reflects a whole range of historic anthropogenic pressures, including inadequately treated discharges from urban settlements and industry, the influence of diffuse pollution and hydromorphological alterations.

Effluent from sugar mills had a very destructive impact on benthic communities during the autumn months of each year (period of sugar beet processing) from the 1960s to the 80s. In the late 1970s, the results of saprobiological monitoring performed by the T.G.Masaryk Water research Institute (TGM WRI), Brno (unpublished), indicated very poor riverine community status along these rivers (these results have since provided a baseline for future water quality status assessments of important rivers in the basin). Because of the high levels of pollution, additional samples were collected along these rivers in addition to regular saprobiological monitoring and two Czech TNMN sites (Morava - Lanžhot and Dyje - Pohansko) have also been surveyed every 3-5 years. The extremely high organic pollution levels discharged into the river system each autumn from the sugar mills resulted in an alphameso-polysaprobic status of plant and animal communities along the Morava River. Starting in the late 1980s, wastewater treatment plants were constructed for all larger cities in the RBD, resulting in a gradual improvement in water quality, not only in autumn but throughout the year. In 2007, saprobic indices that had formerly reached values of 2.8 had decreased to 2.1 in the Morava; and an even greater improvement was attained in the Dyje, where an index of 3.4 was decreased to 1.8 between 1976 and 2007. Despite the great efforts focused on decreasing point source pollution discharges in the basins, negative influences of diffuse pollution and hydromorphological alteration on benthic macroinvertebrate and fish communities remain a problem.

HISTORY OF LIMNOLOGICAL RESEARCH

While some data on floodplain invertebrates of the lower reaches of the Dyje and Morava had been published even before 1900, they were mainly focused on temporary and/or permanent stagnant waters and were published in "grey literature". A similar priority was given to still waters until World War II with, for example, systematic studies of chironomids undertaken by Zavřel (1941, 1943) and of oligochaetes by Hrabě (1929). The first valuable information on macroinvertebrates along the lower reach of the Morava itself relates to the occurrence of the potamal mayfly *Palingenia longicauda* (Zavřel, 1905) and its later disappearance in the 1920s (Zavřel, 1934). Between 1950 and 1965, the running and still waters of southern Moravia were studied as part of an extensive research project supervised by the Czech Academy of Sciences and Masaryk University in Brno (Landa et al., 1997). In 1959, the lower Morava was monitored by Zelinka and Skalníková (1959) and has since been the subject of repeated studies throughout the 1990s (e.g. Soldán et al., 1998) and 2000s. Many of these projects also surveyed the River Dyje, though the study sites were situated further upstream of the JDS2 site.

Adámek and Sukop (1992) identified 118 taxa (mainly species) along the lower Dyje, while Zahrádková et al. (1995) identified 31 species or higher taxa at sites on the lower Morava. More recently, aquatic invertebrates were sampled and identified along the lower reach of the Dyje by Horsák (2001), who reported 143 taxa (not restricted to benthic fauna). Both JDS2 sites presented in this paper were included in a complex study of aquatic invertebrates of the Pálava Biosphere Reserve published by Opravilová et al. (1999), who identified 64 taxa. Větříček and Geriš (2003) reported the mayfly *Baetopus tennelus* (Albarda, 1878) as a new species for the Czech Republic from the River Morava near its confluence with the Dyje. Systematic research into benthic macroinvertebrates of the two river reaches near their confluence was initiated in the 1970s due the coordination of activities within (i) periodic sampling within the framework of the State Water Management (Water Quality) Balance, (ii) monitoring undertaken by the Morava River Basin Authority, (iii) project "Morava" of the TGM WRI Brno (1990-2010) and (iv) regular surveillance monitoring (2006-2010).

Fish assemblages in both running and still waters of the Morava and Dyje confluence area have been surveyed since the beginning of the 20th century (Mahen, 1927). Based on historical records, recent surveys and anglers' reports 2 cyclostomes and 55 fish species have been reported from the main channel of the Morava, 48 being indigenous and 9 exotic (Peňáz and Jurajda, 1993). Such species richness is exceptional compared with most other European rivers of similar size.

MATERIAL AND METHODS

Study sites

The JDS2 study of benthic macroinvertebrates was performed near the towns of Lanžhot (N 48° 41', E 16° 59') and Pohansko (N 48° 43', E 16° 53') on the rivers Morava and Dyje, respectively (Fig. 1), while the fish survey was performed along the shoreline between river km 79-76 on the River Morava (48'40''N, 16'59''E) and rkm 17-14 on the Dyje (48'42''N, 16'54''E). Channel width and depth on the Morava were 50-60 m and 0.8 m, respectively, and 30-40 m and 1.0-2.0 m on the Dyje. While the banks of the Morava consist primarily of rip-rap, the banks of the Dyje are mostly natural. Furthermore, the main channel of the Morava is completely isolated from its floodplain, whereas elements of floodplain and several backwaters remain connected along the Dyje.

Benthic macroinvertebrates

With respect to the importance of potamal river stretches and to the level of their anthropogenic alterations, all available data on benthic macroinvertebrates related to the studied river stretches, including historical ones, were exploited, namely: 1) saprobiological monitoring of the TGM WRI, Brno; 2) results from the River Morava Project undertaken by TGM WRI, Brno (Zahrádková et al., 1995); 3) monitoring of transboundary rivers (TGM WRI, Brno, unpublished); 4) monitoring of the Morava River Catchment Area (Morava River Authority, unpublished); 5) collection of the Department of Botany and Zoology, Masaryk University Brno; 6) results of Horsák (2001; 7) results of JDS2 (TGM WRI, Brno, unpublished); 8) results of Opravilová et al. (1999).

Long-term data from river km 79-76 and 17-14 on the Morava and Dyje, respectively, were summarised and the data divided into several time periods, the presence and/or absence of individual species allowing a general evaluation of biodiversity alteration of each stretch over the study period. The following periods were distinguished: 1976-1995 (data sources 1 and 5), 1996-2006 (data sources 1, 2, 3 and 6), 2007 (data sources 1, 4 and 7), 2010 (data source 3 for the River Dyje only). While it was not possible to assign data from source 8 to a specific time period, the information was included due to its faunistic value.

Several different methods were used for sampling benthic macroinvertebrates. The majority of data were obtained before 1995, the samples being collected according to Czech standard ČSN 757703 for the Czech saprobiological monitoring programme (data source 1 and 2). The goal of saprobiological biomonitoring is not the evaluation of ecological condition of a site but only an assessment of running water quality and oxygen condition (Forejtníková et al., 2006). A multihabitat sampling methodology, therefore, was not applied and segments with rapidly flowing water were sampled by hand sweep net preferentially, the segments with slowly flowing or standing water not being included.

Data obtained from sources 3, 4, and 7 were sampled and processed according to the Czech national multihabitat sampling method PERLA (ČSN 757701), using semi-quantitative 3-minute kick samples collected with a hand net (25 x 40 cm aperture and 500 µm mesh size). All mesohabitats (riffle, pool, macrophyte, woody debris, etc.) were sampled for a period corresponding to their total proportional area in the sampling section (Kokeš et al., 2006).

The metrics used were calculated according to formulas given in the AQEM Manual (AQEM consortium, 2002; http://www.aqem.de). The autecological characteristics used for calculation of the metrics were adopted from the online ARROW (2009) database.

According to the WFD, assessment of ecological status requires comparison with a reference status. Due to a lack of recent potamal reference localities, relevant historical data and difficulties associated with sampling methods suitable for non-wadeable rivers in the Czech Republic, assessment of respective stream types has not yet been finished. To a certain degree, this issue can be solved through the compilation of a list of taxa typical for potamal river stretches. Such a list has already been compiled for German streams (Schöll et al., 2005). This list is, however, regionally limited and cannot be applied to any other region (river/sea catchment area). For the purposes of this publication, an *ad hoc* list was compiled of taxa expected at the evaluated sites and the macroinvertebrates found were compared with this. The list of typical potamal species compiled by experts (Zahrádková et al., 2007) was adopted after partial modification. Species were selected according to their known autecological characteristics (e.g. stream zonation preference, altitude and habitat preference, etc.) or according to their documented occurrence at the studied river stretches in the past, or in similar undisturbed river types in Central Europe (only species with an appropriate area of distribution were taken into account). In addition, the total numbers of all expected EPT taxa in Moravian large lowland rivers (Zahrádková et al., 2007) were compared with the numbers found in the spring samples of 2007.

Non-indigenous species were classified according to Mlíkovský and Stýblo (2006) and Panov et al. (2008) who presented a "grey list" of species with unknown level of invasiveness, a "white list" of species with low level of invasiveness, and a "black list" of species of high invasiveness.

Fish

Fish were collected quantitatively at ten 300 m stretches along the right bank of the Morava and the left bank of the Dyje by electrofishing (one hand-held anode, EFKO FEG 13000, Honda 13 kW, ~ 300 V, 60 A, 50-80 Hz) from a drifting boat one to five metres from the bank. Stunned fish were collected by hand net (10 mm mesh size). Aside from bleak *Alburnus alburnus*, which were significantly dominant, all fish collected were measured and weighed individually. For bleak, 18-32 specimens were measured and weighed individually at each stretch and the rest bulk-weighed and counted. After surveying, all fish were released back into the river alongside the opposite bank. The F/C ratio (Holčík and Hensel, 1972), indicating the relationship between non-predatory and predatory fish, was calculated as a ratio between their biomass reported in survey catches.

Data on angling intensity and efficiency, fish species and size composition at the Dyje 2 and Morava 2 angling grounds (which correspond with the JSPD2 survey sections) were obtained from regularly summarised angling records available each year at the close of the angling season. Figures on stocking and angling catches for individual years were provided by the headquarters of the Moravian Anglers Union. As fish for stocking purposes are usually available in size and age categories that differ between years, and even between individual stocking events during one year, the appropriate ministerial instruction (Implementation Provision No.197/2004 of the Czech Fishery Law No. 99/2004) provides rules on how to convert individual size and age categories into one appropriate category, i.e. 2+ for carp and 0+ for other fish in this case study. Conversion rates were also supplied for mortality and survival rates for different species/categories compared to the fish category suggested by the stocking plan. Conversion to one age category enables comparability and an appropriate evaluation of stocking intensity and efficiency between years and individual water bodies. The ratio between number of fish stocked and caught is presented as a rate of return for individual species.

RESULTS

Benthic macroinvertebrates

Taxonomic composition

A list of taxa found since 1975 is provided in Appendix 1 (River Morava) and 2 (River Dyje). Altogether, 262 taxa were found at the Dyje River above the confluence with the Morava River (204 species, 58 taxa were identified at genera or higher taxonomic levels). Three non-indigenous species were ascertained: *Potamopyrgus antipodarum, Lithoglyphus naticoides* and *Dreissena polymorpha.* Twenty one species are categorised as threatened according to IUCN categories (see Appendix 1). Caddis fly, *Setodes punctatus*, considered regionally extinct, was found in 2007 and *Oecetis tripunctata*, critically endangered species was found in 2010. Additional species belonging to the categories "endangered" (10 species), "vulnerable" (6 species) or "nearly threatened" (3 species) were found within different periods, mainly after 1996.

The total number of taxa recorded at the Morava River stretch upstream the confluence with the Dyje River was 137 (95 species or species groups, 42 taxa identified at genera or higher taxonomic levels). The non-indigenous species *Dugesia tigrina* and *Dreissena polymorpha* were present. Ten species are categorised as "threatened" according to IUCN categories (see Appendix 2). One species of the category "critically endangered", mayfly *Baetopus tenellus*, was found in 2002. Additional species belonging to the categories "endangered" (3 species), "vulnerable" (4 species) or "nearly threatened" (2 species) were found after 1996, mainly in 2007.

Analyses of semiquantitative sampling campaign in spring 2007

The spring semiquantitative samples taken in 2007 were analysed in detail. Sixty two taxa (including 4 mayfly species and 8 caddis fly species) were found at the Dyje River (April 27) and 55 taxa (including 7 mayfly species, 1 stonefly and 12 caddis fly species) were found at the Morava River (May 2) (for species list of Ephemeroptera, Plecoptera and Trichoptera see Table 2). The lowland species slightly dominated in both samples (ca. 55% of taxa). The difference in zonation preferences was evident since the percentage of rhitral species was 21.7% and 7.7% at the Dyje and Morava rivers, respectively (the respective percentage of potamal species was 60.3% and 79.0%). Another difference was found in proportion of active and passive filtrators both in the Dyje River (6.3 and 1.6%, respectively) and the Morava River (13.5 and 0.5%, respectively). Concerning the microhabitat preferences, the species in the Dyje River evinced higher preferences to more course-grained substrate like akal and lithal (13.6 and 25.3%, respectively) in comparison with the Morava River (5.0 and 16.6%, respectively) where mainly the species preferring pelal (26.0%) and phytal (25.3%) occurred.

The indices of saprobity indicated middle beta-mesosaprobity at both sites (the Dyje River: 2.01, the Morava River: 2.15). A higher proportion of species occurring also in oligosaprobity was present in the Dyje River (23.4%) than in the Morava River (4.8%).

A comparison of species identified in the spring samples of 2007 with proposed list of typical potamal species was done (see Table 2). Of 18 expected mayfly species, 9 and 7 species were found in the Dyje River and Morava River, respectively. Ten stonefly species should be present at the respective stream type, however, only unidentified specimen of the genus *Leuctra* occurred in the Morava River. The occurrence of 16 potamal caddis fly species is assumed, only 6 (and unidentified species of genus *Hydroptila*) and 7 species were found in the Dyje River and Morava River, respectively.

In addition to the typical potamal species, the species with less specific requirements or even ubiquitous ones usually occur in the respective stream type. A total number of at least 15 EPT species (regardless of the typical potamal species) is expected in this stream type under the good river health condition in spring season. This number was not achieved at the Dyje River (12 species) but overcame at the Morava River (20 species).

Fish

Species composition

Altogether, 4396 and 2476 fish individuals (162.16 and 117.02 kg), respectively, were collected in the surveyed stretches of the Morava and Dyje rivers (Table 3). The respective numbers of species were 24 + 1 hybrid and 23 + 1 hybrid belonging to 6 identical families (Cyprinidae, Esocidae, Siluridae, Gadidae, Percidae and Gobiidae) in each river. With respect to the density, bleak was markedly the dominant fish species in both river stretches. Its proportions in the total fish numbers and biomass amounted to 75.02 and 16.71%, and 83.70 and 20.41% in the Morava and Dyje rivers, respectively.

Table 2. Typical potamal species expected along the river stretches studied. Note: + = species observed after 1975, * species found in spring 2007

Order	Species	River Dyje: Pohansko	River Morava: Lanžhot
EPHEMEROPTERA	*Baetis buceratus* Eaton, 1870	+	
	Baetis fuscatus (Linné, 1761)	+*	+*
	Baetis nexus Navás, 1918	+	
	Brachycercus harrisella		
	Caenis luctuosa (Burmeister, 1839)	+*	+*
	Caenis macrura Stephens, 1835	+*	+*
	Caenis pseudorivulorum Keffermueller, 1960	+	+
	Ecdyonurus aurantiacus (Burmeister, 1839)		
	Ecdyonurus insignis Thomas & Sowa, 1970		
	Ephemera vulgata Linné, 1758		
	Ephemerella mesoleuca (Brauer, 1857)		
	Ephoron virgo (Olivier, 1791)		
	Heptagenia coerulans Rostock, 1877	+	+
	Heptagenia flava Rostock, 1877	+	+*
	Choroterpes picteti (Eaton, 1871)		
	Isonychia ignota (Walker, 1835)		
	Palingenia longicauda (Olivier, 1791)		
	Potamanthus luteus (Linné, 1767)	+*	+*
PLECOPTERA	*Agnetina elegantula* (Klapálek, 1905)		
	Isoperla grammatica (Poda, 1761)		
	Isoperla obscura (Zetterstedt, 1840)		
	Isoptena serricornis (Pictet, 1881)		
	Leuctra fusca (Linné, 1758)		+* Leuctra sp.
	Marthamea vitripennis (Burmeister, 1839)		
	Perlodes dispar (Rambur, 1842)		
	Siphonoperla taurica (Pictet, 1841)		
	Taeniopteryx nebulosa (Linné, 1758)		
	Xanthoperla apicalis (Newman, 1836)		
TRICHOPTERA	*Brachycentrus subnubilus* Curtis, 1834		
	Ceraclea albimacula (Rambur, 1842)		
	Ceraclea alboguttata (Hagen, 1860)		
	Ceraclea annulicornis (Stephen, 1836)	+	+*
	Ceraclea dissimilis (Stephens, 1836)	+	+*
	Ceraclea nigronervosa (Retzius, 1783)		
	Hydropsyche bulgaromanorum Malicky, 1977	+	+
	Hydropsyche contubernalis McLachlan, 1865	+*	+*
	Hydropsyche exocellata Dufour, 1841		+*
	Hydropsyche guttata Pictet, 1834		
	Hydroptila angulata Mosely, 1922	+*Hydroptila sp.	
	Hydroptila sparsa Curtis, 1834		+*
	Cheumatopsyche lepida (Pictet, 1834)		
	Neureclipsis bimaculata (Linné, 1758)	+*	+*
	Psychomyia pusilla (Fabricius, 1781)		
	Setodes punctatus (Fabricius 1793)	+*	

Table 3. Fish assemblage composition upstream of the confluence between the rivers Morava and Dyje, as recorded during the JDS2 survey. Note: n = total individuals, W = fish biomass in g

	River Morava				River Dyje			
Species	**n**	**%**	**W**	**%**	**n**	**%**	**W**	**%**
B. barbus	163	3.71	27,181.7	16.76	71	2.87	31,975.4	27.33
A. alburnus	3,300	75.02	26,123.9	16.11	2,073	83.70	23,884.3	20.41
C. nasus	69	1.57	1251.2	0.77	9	0.36	5,020.0	4.29
C. gibelio	41	0.93	26,601.0	16.40	28	1.12	1,491.0	1.27
A. aspius	64	1.46	1,597.2	0.98	33	1.35	8,330.5	7.12
S. cephalus	213	4.85	17,597.3	10.85	13	0.54	4,762.0	4.07
L. idus					31	1.26	12,985.4	11.10
L. leuciscus	3	0.08	23.8	0.01				
R. amarus	147	3.33	338.1	0.21				
A. brama	11	0.25	7,998.7	4.93	46	1.84	14598.0	12.48
A. bjoerkna	22	0.51	520.9	0.32	94	3.81	3,777.9	3.23
A. sapa	1	0.03	320.0	0.20				
S. erythrophthalmus					1	0.04	46.0	0.04
R. rutilus	112	2.55	2,155.4	1.33	26	1.03	881.0	0.75
R. rutilus x A. bjoerkna	2	0.05	89.6	0.06	1	0.04	29.0	0.02
R. vladykovi	133	3.03	696,4	0.43	13	0.54	45.1	0.04
G. gobio	38	0.86	196.6	0.12	1	0.04	10.0	0.01
P. parva	1	0.03	7.0	0.04				
C. carpio	6	0.13	30,340.0	18.71				
V. vimba	2	0.05	29.4	0.02				
E. lucius	3	0.08	2,682.0	1.65	6	0.22	5,620.0	4.80
S. glanis	13	0.30	13,403.7	8.26	3	0.13	2,094.0	1.79
L. lota	32	0.73	1,569.0	0.97	1	0.04	16.7	0.01
P. fluviatilis	10	0.23	990.0	0.61	14	0.58	599.1	0.51
G. schraetser					6	0.22	175.0	0.15
S. lucioperca	8	0.18	369.0	0.23	1	0.04	290.0	0.25
Z. zingel	1	0.03	113.0	0.07	1	0.04	280.0	0.24
Z. streber					3	0.12	84.0	0.07
P. semilunaris	1	0.03	1.0	0.001	1	0.04	1.1	0.001

The proportion of other fish species in the total fish density in surveyed stretches of the Morava river did not exceed 5%, most numerous among them being chub, *Squalius cephalus*, barb, *Barbus barbus*, bitterling, *Rhodeus amarus*, and white-finned gudgeon, *Romanogobio vladykovi*, with 4.85, 3.71, 3.33 and 3.03%, respectively. Other important commercial and game fish species exceeded the level of numerical proportion of 1% only rarely (nase, *Chondrostoma nasus* and asp, *Aspius aspius* with 1.57 and 1.46%, respectively), however, some of them proved a significant proportion regarding the biomass. The highest figures were recorded for common carp, *Cyprinus carpio*, of which proportion in the total biomass was 18.71%, whilst only 0.13% in fish density (mean individual weight 5056.7 g), followed by barb and Prussian carp, *Carassius gibelio*, with 16.76 and 16.40%, respectively. Among 25 recorded fish species in the Morava River, 3 of them (Prussian carp, topmouth gudgeon, *Pseudorasbora parva*, and tubenose goby, *Proterorhinus semilunaris*) were non-indigenous. The F/C ratio of the whole fish community corresponded to 4.24 in the surveyed stretch of the Morava River.

Besides dominant bleak (83.7% of total fish density – see above), the proportion of other species occurrence was much lower in the Dyje River and only rarely exceeded the 2% threshold, like it happened in case of white bream, *Abramis bjoerkna*, and barb with 3.81 and 2.87%, respectively. The proportion of other important game fish was quite low with maximum values in common bream (*Abramis brama*), chub, ide (*Leuciscus idus*), asp and roach, *Rutilus rutilus*, with 1.84, 1.35, 1.26, 1.12 and 1.03%, respectively. With respect to biomass, the highest proportion belonged to barb (27.33%), followed by bleak, common bream and ide with 20.41, 12.48 and 11.10%. Two non-indigenous fish species were re-

Table 4. Stocking level, angling yield and rate of return (ind.) for the Dyje 2 (D2) and Morava 2 (M2) fishing grounds between 2006 and 2010. Note: *Herbivorous fish = grass carp, *Ctenopharyngodon idella*; silver carp, *Hypophthalmichthys molitrix*; bighead carp, *Aristichthys nobilis.* **Others = (*R. rutilus*, *S. erythrophthalmus*, *G. cernuus*, *C. auratus gibelio*, *C. carassius*, *A. alburnus*, *L. idus* and rarely others)

	Stocking rate				**Angling yield**					
	individuals		**kg**		**individuals**		**kg**		**rate of return (%)**	
Species	D2	M2	D2	M2	D2	M2	D2	M2	D2	M2
E. lucius	181	282	15	67	12	26	32	61	6.6	9.2
C. carpio	885	897	670	772	120	166	422	702	13.6	18.5
T. tinca					1	1	2	1		
A. brama					67	87	46	73		
L. cephalus	2,420		25		6	24	22	19	0.2	
B. barbus	1,000	920	10	10	8	71	17	133	0.8	7.7
C. nasus	1,800		18			6		6	<0.05	
V. vimba	1,500		15			3		3	<0.05	
*Herbivorous fish					4	28	34	217		
A. aspius		680		7	6	32	12	59		4.7
P. fluviatilis					3	3	1	1		
S. lucioperca		2210		22	35	39	94	74		1.8
S. glanis		463		10	12	30	147	247		6.5
A. anguilla					<1	6	<1	4		
L. lota		2040		62	<1	7	<1	6		0.3
**Others		200		20	216	308	50	130		154.0
TOTAL					489	835	862	1737		

corded – Prussian carp and tubenose goby. The F/C ratio of the whole fish community corresponded to 3.40 in the surveyed stretch of the Dyje River.

Angling yield

Both stretches, belonging to angling grounds of the Moravian Angling Union, are regularly stocked with commercial and game fish species. Common carp (2+ category) dominate with respect to stocking biomass. Carp average rates of return amount to 13.6 and 18.5% in the Dyje 2 and Morava 2 angling grounds, respectively. Predatory fish (pike, zander, *Sander lucioperca*, European catfish, *Silurus glanis*, asp) are usually released as 0+ age category, however, their rates of return do not exceed 10% (Table 4). Game fish (chub, barb, nase, burbot, *Lota lota*, and others) are also stocked for the angling purposes but their rates of return range just below 1%.

On average, altogether 489 fish (862 kg) are caught each year by anglers in the Dyje 2 angling ground, whilst in the Morava 2 angling ground these figures are twice as high (835 fish/1737 kg) (Table 4). Carp dominate in biomass comprising 49.0 and 40.4% of the total angling yield in the Dyje 2 and Morava 2, respectively. Despite low numbers of European catfish caught by anglers (12 and 30 individuals in Dyje 2 and Morava 2, respectively), their respective angling yield biomass is the second highest with 147 and 247 kg, which corresponds to the mean individual weight of 12.25 and 8.23 kg.

DISCUSSION

Benthic macroinvertebrates

Benthic macroinvertebrates have various functions in aquatic ecosystems. Analyses of some of them (e.g. an assessment of production or suitability as fish food) are difficult to evaluate without extensive quantitative data. This type of data is, however, not available. On the other hand, semiquantitative or sometimes even qualitative data generally can be exploited for bioindication and/or ecological status assessment. Also long-term changes of biotopes can be detected via comparison of taxonomic or functional structure of benthic assemblages. Nevertheless, sampling difficulties and incomplete ecological status assessment system of the Czech potamal rivers rather limited the exploration of accessible data.

The total number of taxa of certain localities is one of very simple biodiversity measures, assuming the comparable data sources. In the comparison of evaluated river stretches, the number of taxa of the Dyje River is nearly twice as that of the Morava River (262 and 137 taxa, respectively). However, the high number of taxa found at the Dyje River originated from a very precise investigation (Horsák, 2001). No such extensive and detailed study was performed at the Morava River. After excluding results of that study, the total number of taxa of the Dyje River was evidently lower (188). The total numbers of taxa found at both stretches in 2007 (monitoring of the Morava River Authority and JDS2 results) were nearly the same (105 and 108 taxa). The comparison of numbers of taxa between periods is possible taking into account that especially in the 1st period only the riffle parts of both rivers were sampled, so lower numbers of taxa within the period of 1976-1995 are caused by a specific sampling method, as well as a higher level of anthropogenic disturbances, especially organic pollution. The decrease of this type of pollution, especially disappearing of autumn peaks caused by sugar mill campaigns, leads to partial benthic macroinvertebrate assemblage reconstruction during the subsequent period (after 1995). The occurrence of species with higher proportion of preferences to oligosaprobity was found in detailed analyses of spring samples (2007) in the Dyje River. It is probably caused by rhithralisation (montanisation) of river stretches below large impoundments - reservoirs on the Dyje River and their tributaries, which partially changed character of rivers, mainly their temperature regime. The results correspond with a higher proportion of rhithral species in the Dyje River than in the Morava River.

The recovery of the river stretches was limited to the organic pollution decrease. No radical improvement of hydromorphological status has been performed and habitat diversity is still lost. The environment is unfavourable for species with special habitat requirements like burrowing larvae (e.g. mayfly *Ephoron virgo*). Very sensitive, rare and strictly potamal species such as *Isonychia ignota* and *Choroterpes picteti* are probably extinct in the area studied hence the re-occurrence of such species at the localites studied is very unlikely. The ratio of expected, typical potamal species and species observed in the spring season of 2007 (cf. Table 2) was very similar at both samples.

The presence of non-indigenous species is relatively low, both qualitatively and quantitatively, but the occurrence of invasive amphipods is expected in the near future because they are present in the near downstream stretch of the Morava and Dyje Rivers (Mišíková-Elexová et al., 2010). It is a paradox that the snail *Lithoglyphus naticoides,* which is considered as an invasive species according to the results of the project ALARM (Panov et al., 2008), is mentioned as endangered species in the Czech Red List (Farkač et al., 2005).

Summarised, the Morava and Dyje river stretches under study evinced similar character and history of disturbances. The Dyje River macroinvertebrate assemblages are more influenced by a high number of reservoirs within the basin, the Morava River assemblages were periodically destroyed by organic pollution in the past. Both rivers are influenced by changed river morphology. The species composition, regardless of the occurrence of some less sensitive potamal or IUCN category species, corresponds to the list of respective river type expected species only partially.

Fish

In lowland rivers and their floodplains, it is always problematic to find methods that provide accurate estimates of fish communities. For example, representative sampling of adult fish in larger lowland rivers is almost impossible. Since all Czech streams are managed as angling grounds, they have been regularly stocked with fish from aquaculture since the middle of the 20th century. However, ichthyological surveys proved that the key driver to formation and sustainability of original appropriate composition of riverine fish communities (particularly in lowland rivers) is their natural recruitment (Jurajda et al., 2010). In the lowest stretches of the Morava and Dyje rivers, fish originating from the natural recruitment made the vast majority of the density and biomass (Jurajda, 1995, 1999; Jurajda and Peňáz, 1994, 1996; Jurajda et al., 2000, 2001).

Altogether 24 fish species and 1 hybrid (*R. rutilus x B. bjoerkna*) were recorded in the Morava river section in the JDS2 survey campaign in 2007. Despite one-time survey, the number of species recorded is almost identical with the monitoring performed by Jurajda et al. (1998) who identified 26 species from 5 families in a four-year (1991-1994) survey below and within a rocky chute on the Morava River, the upper boarder-line site of the section surveyed in 2007. In opinion of Jurajda et al. (2008), fish species richness in the Morava River increased continuously over the years 1990-2000 as a result of substantial improvement of water quality and almost reached the situation that existed 100 years ago. The up-to-date assessment of the fish assemblage composition in the Morava River section under study presented 35 fish species in 1994, of which 23 were identical and one species (tubenose goby) was new. Fish assemblage composition comprising 26 species with the same species (chub and gudgeon *Gobio gobio*) dominating before and after the flood was recorded by Jurajda et al. (2006). According to their survey, exceptionally extensive flood in July 1997 with water discharge peaking at 2000% of long-term average and discharge >1000 m3.sec-1 lasting for 20 days had a minor effect on the assemblage structure.

Bleak was by far the most abundant fish in both surveyed river sections. Despite its high abundance amounting to 75.02 and 83.70% in the Morava and Dyje rivers, respectively, its respective contribution to the total fish biomass was quite low and corresponded to 16.11 and 20.41%. According to the survey performed by Sindilariu et al. (2006) in the Danube Delta, bleak and monkey goby (*Neogobius fluviatilis*) were most abundant and frequent, contributing together 61% to the total catch. Despite the fact that the rip-rap banks provide mesohabitat favored by gobids, their occurrence in this type of the Morava River bank armoring shoreline against water erosion was very rare in the survey monitoring in 1997 and actually it was limited just to sporadical record of tubenose goby individuals. Obviously, the efficiency of electrofishing in sampling gobids is quite low (Polacik et al., 2008) but their occurrence in interstitial rip-rap spaces was not very frequent anyhow. Currently, both tubenose goby and round goby (*Neogobius melanostomus*) are a regular part of fish assemblages both in the lower Morava and Dyje rivers, despite appearring there for the first time only in 1996 (tubenose goby, Prášek and Jurajda, 2005) and 2008 (round goby, Lusk et al., 2010), respectively.

Jurajda and Peňáz (1994) described fish community structure in the lower stretch of the Morava River in 1991-1992, ten years after the completion of regulation. Species richness and diversity depended mainly on the connectivity of the regulated section with a more natural section below the studied stretch. Bitterling, bleak, gudgeon, chub, roach and white-finned gudgeon were the most abundant species in all sections of the regulated main channel, with phytophilous species occurring in very low densities. They reported 27 fish species recorded in the section identical with our survey. Similarly, Valová et al. (2006) compared the 0+ fish communities in the regulated-channelized Morava River stretch without connection to the floodplain with non-interrupted stretches of the Morava and Dyje rivers connected with floodplains. Surprisingly, the total number of 0+ fish species in all of the three stretches recorded over three years was similar (22, 23, and 25 species, respectively), lowest diversity and highest density being documented in the regulated-channelized stretch.

In the Morava and Dyje river sections under study, also several rare and/or protected species were recorded. Two of them, ide and burbot belong among vulnerable fish species and four others, white-eye bream (*Abramis sapa*), striped ruffe (*Gymnocephalus schraetser*), streber (*Zingel streber*) and zingel (*Zingel zingel*) are considered as critically endangered species. Due to regular stocking into these two and associated angling grounds, ide and burbot occur quite regularly in the fish assemblages of the lower Morava and Dyje rivers and recently they have even been included into the list of fishes allowed for taking into possession in angling. The occurrence of streber on the Morava-Dyje confluence was recorded for the first time again after almost a century in 2003 (Lusk et al., 2004).

The proportion of non-predatory to predatory fish biomass (F/C ratio) is a simple expression of the balance in a particular fish community (Holčík and Hensel, 1972). Values for the F/C ratio between 3.0 and 6.0 indicate optimal values, whilst values >10 demonstrate undesirable condition of fish community with strong prevalence of non-predatory fish. The F/C ratio of the whole fish community in the surveyed stretch of the Morava River corresponded to 4.24 which is considered as a value within the optimal range. However, when excluding (rather) omnivorous chub from predatory species, its value increases to 7.87, which is already above the upper limit value of the optimal range 3.0 – 6.0 (Holčík and Hensel, 1972). In the Dyje River, the FC values amounted to 3.40 in the total community evaluation but when not considering omnivorous chub and ide as predators, it raised to 8.93 which is also above the upper limit value of the optimal range 3.0 – 6.0. It is obvious that the latter values reflect the actual situation in equilibrium of the Morava and Dyje fish assemblages more appropriately.

Anglers' statistics also document a substantial increase in fish catches as a result of considerable water quality improvement in the 90s of the last century (Jurajda et al., 2008). The data presented by Baruš et al. (2000) prove that the anglers´ catches in the lower Morava River (fishing ground Morava 2, 20.0 ha) rose from 23.5 to 131.0 tonnes in 1992 and 1998, respectively. Nevertheless, the rates of return in fish stocked are quite low being highest in carp as common phenomenon in the majority of fishing grounds in the Czech Republic. However, their figures are very low compared with other fishing grounds, probably due to the lotic environment and not easy accessibility (Protected Landscape Area, Czech-Austrian and Czech-Slovak border line rivers). Carp, as by far the most popular fish for Czech anglers, are usually subject to focused angling pressure resulting in considerably higher rates of return – e.g. 58.5% in the Brno reservoir (Adámek and Jurajda, 2011) or even 92.4% in the Svitava 1 angling ground located largely on the territory of the Brno City (http://brno3.momrs.cz/prehledy-ulovku). The rates of return are quite low also in predatory and game fish. Regarding predatory fishes, the reason for low rates of return is small fish size at stocking and poor accessibility of angling locations. Extremely low rates of game fish return are moreover caused by quite rare focus of anglers and widely applied catch-and-release approach regarding these species.

The area of the Morava – Dyje confluence represents a unique natural environment of floodplain forest and wetland meadows. The noticeable improvement of water environmental conditions particularly in the last two decades, however, concerned almost exclusively just the water quality issues, the physical habitat degradation (river chanelization, limited connectivity with side arms and oxbow lakes) being *de facto* unchanged. As a consequence of improved water quality, the diversity of benthic macroinvertebrate and fish assemblages has been considerably increased. Thus, continuous monitoring of this area of interest is highly desired and worthwhile also in the future.

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Sažetak

UTJECAJ ČOVJEKA NA MAKROZOOBENTOS I IHTIOFAUNU NA DONJIM TOKOVIMA RIJEKA MORAVE I DYJE (SLIV RIJEKE DUNAVA U ČEŠKOJ)

Donja Morava i rijeka Dyje pripadaju velikim nizinskim rijekama na jugoistoku Češke Republike te se 69 km nizvodno od svog ušća ulijevaju u rijeku Dunav. Unatoč njihovoj značajnoj prirodnoj vrijednosti i zaštiti okoliša, obje rijeke pretrpjele su teško zagađenje od 60-ih do 80-ih godina prošlog stoljeća. Značajan napredak kvalitete njihove vode u posljednja dva desetljeća rezultirao je djelomičnim oporavkom makrozoobentosa i ihtiofaune. Nedavno je zabilježeno ukupno 262 taksona makrozoobentosa u rijeci Dyje te 137 taksona u rijeci Moravi. U rijeci Dyje pronađene su 3 nove i 21 ugrožena vrsta beskralježnjaka (prema IUCN kategorijama), a u rijeci Moravi pronađene su 2 nove i 10 ugroženih vrsta. Rijeka Dyje ima 23, a rijeka Morava 24 vrste te se tom broju pridodaje po jedna hibridna vrsta u objema rijekama, dok je obična uklija najzastupljenija riba. U dijelu istraživanja također je zabilježeno nekoliko rijetkih i/ili zaštićenih vrsta. Dvije vrste, jez (*Leuciscus idus*) i manjić (*Lota lota*) spadaju u ugrožene vrste riba, a ostale četiri, crnooka deverika (*Abramis sapa*), prugasti balavac (*Gymnocephalus schraetser*), mali vretenac (*Zingel streber*) i veliki vretenac (*Zingel zingel*) smatraju se kritično ugroženim vrstama. Donjim tokovima rijeka Morave i Dyje trenutno prijeti invazija okrugle glavuče, *Neogobius melanostomus*.

Ključne riječi: makrozoobentosi, riba, raznolikost, zagađenje rijeke, riječni propisi, zajedničko ispitivanje sastava rijeke Dunava

REFERENCES

Adámek, Z., Sukop, I. (1992): Invertebrate communities of former Southern-Moravian floodplains (Czechoslovakia) and impacts of regulation. Regulated Rivers: Research & Management, 7, 181-192.

Adámek, Z., Jurajda, P. (2011): Indicative value of anglers' records for fis assemblage evaluation in a reservoir (Case study Brno reservoir, Czech Republic). pp. 345-353. In: Beard, T.D.Jr., Arlinghaus, R., Sutton, S.G. (eds), The Angler in the Environment: Social, Economic, Biological, and Ethical Dimensions. American Fisheries Society, Bethesda, Maryland, USA, 365 pp.

AQEM consortium (2002): Manual for the application of the AQEM method. A comprehensive method to assess European streams using benthic macroinvertebrates, developed for the purpose of the Water Framework Directive. Version 1.0.

ARROW (Assessment and Reference Reports of Water Monitoring) (2009). [online database]. Prague: Czech Hydrometeorological Institute, from: http://hydro.chmi.cz/isarrow/.

Baruš, V., Peňáz, M., Prokeš, M. (2000): What conclusions could be made on diversity of fish community in lower reaches of the Morava River from anglers´ fishing yields. (Co naznačují úlovky sportovním rybolovem o diverzitě společenstva ryb v dolním toku Moravy). 45-51. Biodiverzita ichtyofauny ČR (III), 204 pp.

Farkač, J., Král, D., Škorpík, M. (eds) (2005): List of threatened species in the Czech Republic. Invertebrates. (Červený seznam ohrožených druhů České republiky. Bezobratlí.), Agentura ochrany přírody a krajiny ČR, Praha, 760 pp. (In Czech)

Forejtníková, M., Heteša, J., Marvan, P. (2006): Comparison of phytobenthos and zoobenthos abilities to predict ecological status in rivers. In: Matoušek, V., Blažková, Š. (eds), T. G. Masaryk Water Research Institute Collection of Papers. T. G. Masaryk Water Research Institute, Prague, 116 pp.

Holčík, J., Hensel, K. (1972): Ichthyological handbook. (Ichtyologická príručka), SRZ Bratislava, 217 pp. (in Slovak)

Horsák, M. (2001): Contribution to our knowledge of macro-invertebrate fauna of the Dyje river downstream of the Nové Mlýny reservoir (Czech Rebublic). Scripta Facultatis Scientiarum Naturalium Universitatis Masarykianae Brunensis Biology, 27 (Suppl.), 41-62.

Hrabě, S. (1929): Contribution to the knowledge of Moravian tubificids and lumbriculids (Příspěvek k poznání moravských Tubificid a Lumbriculid). Biologické listy, 14, 1-6. (In Czech)

Jurajda, P. (1995): Effect of channelization and regulatione on fish recruitment in a floodplain river. Regulated Rivers: Research & Management, 10, 207-215.

Jurajda, P. (1999): Comparative nursery habitat use by 0+ fish in a modified lowland river. Regulated Rivers: Research & Management, 15, 113-124.

Jurajda, P., Peňáz, M. (1994): Fish community of the lower regulated stretch of the River Morava, Czech Republic. Folia Zoologica, 43, 57-64.

Jurajda, P., Penaz, M. (1996): Endangered fishes of the River Morava (Czech Republic). 99-110. In: Kirchhofer, A., Hefti, D. (eds), Conservation of Endagered Freshwater Fish in Europe, Basel, Boston, Berlin, Birkhauser Verlag, 360 pp.

Jurajda, P., Hohausová, E., Gelnar, M. (1998): Seasonal dynamics of fish abundance below a migration barrier in the lower regulated River Morava. Folia Zoologica, 47, 3, 215-223.

Jurajda, P., Reichard, M., Černý, J., Hohausová, E. (2000): Diversity of 0+ fish communities of two different stretches of the lower River Morava. 79-86. In: Biodiverzita ichtyofauny ČR (III), 204 pp.

Jurajda, P., Reichard, M., Hohausová, E., Černý, J. (2001): Comparison of 0+ fish communities between regulated-channelized and floodplain stretches of the River Morava. Archiv für Hydrobiologie, Supplement 135, 2-4, 187-202.

Jurajda, P., Reichard, M., Smith, C. (2006): Immediate impact of an extensive summer flood on the adult fish assemblage of a channelized lowland river. Journal of Freshwater Ecology, 21, 3, 493-501.

Jurajda, P., Peňáz, M., Reichard, M., Bernardová, I. (2008): Water quality improvements following political changes, enhanced fish communities, and fisheries in the Czech Republic. 845-850. In: Nielsen, J., Dodson, J. J., Friedland, K., Hamon, T. R., Musick, J., Verspoor, E. (eds), Reconciling Fisheries with Conservation. AFS Symposium 49, 1, 946 pp.

Jurajda, P., Slavík, O., White, S., Adámek, Z. (2010): Young-of-the-year fish assemblages as an alternative to adult fish monitoring for ecological quality evaluation of running waters. Hydrobiologia, 644, 89–101.

Kokeš, J., Zahrádková, S., Němejcová, D., Hodovský, J., Jarkovský, J., Soldán, T. (2006): The PERLA system in the Czech Republic: a multivariate approach to assess ecological status of running waters. Hydrobiologia, 566, 343-354.

Kux, Z. (1956): Fish community of the lower Morava and Danube rivers. (Příspěvek k ichtyofauně dolní Moravy a Dunaje). Časopis Moravského muzea, 41, 93-112. (In Czech with German summary)

Landa, V., Zahrádková, S., Soldán, T., Helešic, J. (1997): The Morava and Elbe river basins, Czech Republic: a comparison of long-term changes in mayfly (Ephemeroptera) biodiversity. 219-226. In: Landolt, P., Sartori, M. (eds), Ephemeroptera & Plecoptera: Biology-Ecology-Systematics. Mauron, Tinguely & Lachat, CH-Fribourg, 569 pp.

Liška, I., Wagner, F., Slobodník, J. (2008): Joint Danube Survey 2. Final Scientific Report, ICPDR Secretariat Vienna, 242 pp.

Lusk, S., Halačka, K., Lusková, V., Vetešník, L. (2004): Re-occurrence of *Zingel streber* (Teleostei: Pisces) in the Czech Republic. Folia Zoologica, 53, 4, 417-422.

Lusk, S., Luskova, V., Hanel, L. (2010): Alien fish species in the Czech Republic and their impact on the native fish fauna. Folia Zoologica, 59, 1, 57-72.

Mahen, J. (1927): Partial revision of fishes of the Danubian region (Částečná revise ryb dunajské oblasti). Sborník Klubu přírodovědného v Brně (za r.1926), 9, 56-59. (In Czech)

Mišíková-Elexová, E., Haviar, M., Lešťaková, M., Ščerbáková, S. (eds) (2010): List of taxa found on monitored sites of surface water bodies of Slovakia. Part 1, Benthic invertebrates. (Zoznam zistených taxónov na monitorovaných lokalitách vodných útvarov povrchových vôd Slovenska. Časť 1, Bentické bezstavovce). Acta Environmentalica Univistatis Comenianae (Bratislava), 18, 1, 278-282. (In Slovak)

Mlíkovský, J., Stýblo, P. (eds) (2006): Non-indigenous species of fauna and flora of the Czech Republic. (Nepůvodní druhy fauny a flóry České republiky). ČSOP, Praha, 496 pp. (In Czech)

Opravilová, V., Vaňhara, J., Sukop, I. (1999): Aquatic invertebrates of the Pálava Biosphere Reserve of UNESCO. Folia Facultatis .Scientiarum Naturalium Universitatis Masarykianae Brunensis, Biologia, 101, 279 pp.

Panov, V. E., Alexandrov, B., Arbaciauskas, K., Binimelis, R., Copp, G. H., Faunus, D., Gozlan, R. E., Grabowski, M., Lucy, F., Leuven, R. S. E. W., Mastitsky, S., Minchin, D., Monterroso, I., Nehring, S, Olenin, S., Paunović, M., Rodriguez-Labajos, B., Semenchenko, V., Son, M. (2008): Interim protocols for risk assessment of aquatic invasive species introductions via European inland waterways. Project ALARM - Assessing LArge scale environmental Risks for biodiversity with tested Methods. Deliverable 4.1.3.10, Annex 6: Invasive Alien Species (IAS) as significant water management issue for Danube River basin.

Peňáz, M., Jurajda, P. (1993): Fish assemblages of the Morava River – longitudinal zonation and protection. Folia Zoologica, 42, 4, 317-328.

Polacik, M., Janac, M., Jurajda, P., Vassilev, M., Trichkova, T. (2008): The sampling efficiency of electrofishing for *Neogobius* species in a riprap habitat: a field experiment. Journal of Applied Ichthyology, 24, 5, 601-604.

Prášek, V., Jurajda, P. (2005): Expansion of *Proterorhinus marmoratus* in the Morava river basin (Czech Republic, Danube R. watershed). Folia Zoologica, 54, 1-2, 189-192.

Schiemer, F. (1999): Conservation of biodiversity in floodplain rivers. Archiv für Hydrobiologie, 115, 3, 423-438.

Schöll, F., Haybach, A., König, B. (2005): Das erweiterte Potamontypieverfahren zur ökologischen Bewertung von Bundeswasserstraßen (Fließgewässertypen 10 und 20: kies- und sandgeprägte Ströme, Qualitätskomponente Makrozoobenthos) nach Maßgabe der EU-Wasserrahmenrichtlinie. Hydrologie und Wasserwirtschaft, 49, 5, 234-247.

Sindiliaru, P. D., Freyhof, J., Wolter, C. (2006): Habitat use of juvenile fish in the lower Danube and the Danube Delta: implications for ecotone connectivity. Hydrobiologia, 571, 51-61.

Schomaker C., Wolter C. (2011): The contribution of long-term isolated water bodies to floodplain fish diversity. Freshwater Biology, 56, 8, 1469-1480.

Soldán, T., Zahrádková, S., Helešic, J., Dušek, L., Landa, V. (1998): Distributional and quantitative patterns of Ephemeroptera and Plecoptera in the Czech Republic: a possibility of detection of long-term environmental changes of aquatic biotopes. Folia Facultatis .Scientiarum Naturalium Universitatis Masarykianae Brunensis, Biologia, 98, 305 pp.

Valová, Z., Jurajda, P., Janáč, M. (2006): Spatial distribution of 0+ juvenile fish in differently modified lowland rivers. Folia Zoologica, 55, 3, 293-308.

Větříček, S., Geriš, R. (2003): Predatory mayfly *Baetopus tennelus* (Albarda, 1878). (Dravá jepice *Baetopus tennelus* (Albarda, 1878). Acta Faultatis Ecologiae Zvolen, 10, Suppl. 1, 310. (In Czech with English summary)

Zahrádková, S., Fiala, M., Zahrádka, J. (1995): The Morava River - benthic macroinvertebrates and water quality. Folia Facultatis .Scientiarum Naturalium Universitatis Masarykianae Brunensis, Biologia, 91, 159-172.

Zahrádková, S., Opatřilová, L., Tajmrová, L., Kvardová, H., Marvan, P., Heteša, J., Grulich, V., Slavík, O., Horký, P. (2007): Stanovení referenčních podmínek ekologického stavu povrchových tekoucích vod pro potřeby implementace Směrnice 2000/60/ES v ČR. Zpráva pro MŽP ČR. (In Czech)

Zavřel, J. (1905): *Palingenia longicauda* from Moravia. (*Palingenia longicauda* z Moravy). Časopis Československé společnosti entomologické, 2, 97-98. (In Czech)

Zavřel, J. (1934): Zoological memories from Hodonín (Zoologické vzpomínky na Hodonín). Hodonín, 5 pp. (In Czech)

Zavřel, J. (1941): Chironomidarum Larvae et Nymphae IV. (Genus *Metriocnemus* v.d. Wulp). Acta Societatis Scientiarum Naturalium Moraviensis, 13, 7, 1-28.

Zavřel, J. (1943): Chironomidarum Larvae et Nymphae VI. (Genus *Ablabesmyia* John). Rozpravy Československé Akademie Věd, 53, 16, 1-14.

zelinka, M., Skalníková, J. (1959): To the knowledge of mayflies (Ephemeroptera) of the Morava river basin. (K poznání jepic (Ephemeroptera) z povodí řeky Moravy). Spisy Přírodovědecké fakulty University Brno, 401, 89-96. (In Czech)

Appendix 1. List of macroinvertebrate taxa recorded at the Morava River stretch upstream of the confluence with the Dyje River

Taxon	IUCN categories	Data sources			
		Periods of research (year)			
		1976-1995	1996- 2006	2007	without time specification
Dugesia tigrina (Girard, 1850)				4	
Nematoda g. sp. div.				4	
Bithynia tentaculata (Linnaeus, 1758)		1,2			
Galba truncatula (O. F. Müller, 1774)				4	
Radix auricularia (Linnaeus, 1758)				7	
Unio pictorum (Linnaeus, 1758)			1	1	
Pisidium sp.				4	
Pisidium henslowanum (Sheppard, 1823)				4	
Pisidium supinum A. Schmidt, 1851	NT			4	
Dreissena polymorpha (Pallas, 1771)*[3]				4	
Nais sp.		2		4	
Nais behningi Michaelsen,1923				4	
Tubificidae gen. sp.				4	
Bothrioneurum vejdovskyanum Štolc, 1886		2		4	
Tubifex sp.			1		
Tubifex tubifex (O. F. Műller, 1773)		2			
Psammoryctides barbatus (Grube, 1861)				4,7	
Limnodrilus sp.				4,7	
Limnodrilus claparedeanus Ratzel, 1868			1	4,7	
Limnodrilus hoffmeisteri Claparède, 1862			1	4,7	
Eiseniella tetraedra (Savigny, 1826)		2		4	
Propappus volki Michaelsen, 1905		2		4	
Glossiphonia complanata (Linné, 1758)			1		
Helobdella stagnalis (Linné, 1758)			1		
Piscicola geometra (Linné, 1758)			1		
Erpobdella sp.		1,2			
Erpobdella nigricollis (Brandes, 1900)			1		
Erpobdella octoculata (Linné, 1758)		1,2	1	4,7	
Erpobdella testacea (Savigny, 1822)		1,2	1		
Acari, Acarina				4	
Asellus aquaticus (Linné, 1758)		1,2	1		
Gammarus fossarum Koch, 1836			1		
Gammarus roeselii Gervais, 1835			1	1,4	
Baetis sp.		1,2		4	
Baetis fuscatus (Linné, 1761)			1	4,7	
Baetis rhodani Pictet, 1843 - 1845		1,2			8
Baetis scambus Eaton, 1870			1		8
Baetis vernus Curtis, 1834			1	1,4	
Cloeon dipterum s. lat. (Linné, 1761)			1		
Procloeon bifidum (Bengtsson, 1912)				4	
Procloeon ornatum Tshernova, 1928	NT			7	
Baetopus tenellus (Alabarda, 1878)	CR			4	
Heptagenia sp.				4	
Heptagenia coerulans Rostock, 1877	EN		1	1	
Heptagenia flava Rostock, 1877		2	1	1,4	8
Heptagenia sulphurea (Mueller, 1776)			1	1	
Potamanthus luteus (Linné, 1767)				4	8

Appendix 1. Continued

Taxon	IUCN categories	Data sources			
		Periods of research (year)			
		1976-1995	1996- 2006	2007	without time specification
Caenis sp.				7	
Caenis horaria (Linné, 1758)				4	8
Caenis luctuosa (Burmeister, 1839)				4	
Caenis macrura Stephens, 1835		1		4,7	
Caenis pseudorivulorum Keffermueller, 1960				4,7	
Calopteryx splendens (Harris, 1782)				4	8
Platycnemis pennipes (Pallas, 1771)				4	
Gomphidae g. sp.				4	
Gomphus vulgatissimus (Linnaeus, 1758)	VU		1	4	
Ophiogomphus cecilia (Fourcroy, 1785)	EN			4,7	
Leuctra sp.				4	
Micronecta sp.				4	
Sigara striata (Linnaeus, 1758)			1		
Aphelocheirus aestivalis (Fabricius, 1794)	VU			4,7	
Sialis lutaria (Linné, 1758)				4	
Rhyacophila nubila (Zetterstedt, 1840)				4	
Hydroptila sp.				4	
Hydroptila sparsa Curtis, 1834				4	
Hydropsyche sp.		2	1	1,4	
Hydropsyche angustipennis (Curtis, 1834)		1,2		4	
Hydropsyche bulgaromanorum Malicky, 1977				4	
Hydropsyche contubernalis McLachlan, 1865		1,2	1	1,4	8
Hydropsyche exocellata Dufour, 1841	VU			4	
Hydropsyche modesta Navas, 1925		1,2	1	4	8
Hydropsyche pellucidula (Curtis, 1834)			1		
Neureclipsis bimaculata (Linné, 1758)				4,7	
Ecnomus tenellus (Rambur, 1842)				4	
Athripsodes sp.				4	
Athripsodes cinereus (Curtis, 1834)				4	
Ceraclea annulicornis (Stephen, 1836)				4	
Ceraclea dissimilis (Stephens, 1836)				4	
Oecetis sp.				4	
Oecetis notata (Rambur, 1842)				4	
Hexatoma sp. Latreille, 1809				4,7	
Hexatoma bicolor (Meigen, 1818)	EN				
Tipula sp.				4	
Chironomidae g. sp. div.				4.7	
Conchapelopia sp.				4	
Natarsia sp.				4	
Procladius (*Holotanypus*) sp.				7	
Thienemannimyia sp.				7	
Cricotopus sp.				4	
Cricotopus bicinctus-Gr.				4	
Cricotopus sylvestris-Gr.		1,2			
Cricotopus tibialis (Meigen, 1804)		2			
Cricotopus tremulus-Gr.				4	
Eukiefferiella sp.				4	
Metriocnemus sp.		2			

Appendix 1. Continued

Taxon	IUCN categories	Data sources			
		Periods of research (year)			
		1976-1995	1996- 2006	2007	without time specification
Nanocladius bicolor (Zetterstedt, 1838)				4	
Orthocladius sp.			1	4	
Rheocricotopus fuscipes (Kieffer, 1909)				4	
Tvetenia calvescens (Edwards, 1929)				4	
Cladopelma sp.				4	
Cryptochironomus sp.				7	
Cryptochironomus defectus (Kieffer, 1913)		1,2			
Dicrotendipes nervosus (Staeger, 1839)				7	
Glyptotendipes sp.				4	
Glyptotendipes cauliginellus (Kieffer, 1913)		2			
Chironomus plumosus-Gr.				7	
Chironomus reductus-Gr.				4	
Chironomus thummi-Gr.		1,2			
Microtendipes chloris (Meigen, 1818)		2			
Microtendipes chloris-Gr.		1		7	
Parachironomus sp.				4	
Parachironomus varus (Goetghebuer, 1921)		1,2			
Polypedilum aegyptium Kieffer, 1925				7	
Polypedilum convictum-Gr. (Goetghebuer, 1931)		1,2			
Polypedilum cultellatum (Kieffer, 1916)				7	
Polypedilum nubeculosum-Gr.				7	
Polypedilum scalaenum-Gr.		2		4,7	
Robackia demeijerei (Kruseman, 1933)				4	
Stictochironomus sp.				4	
Cladotanytarsus sp.				4,7	
Cladotanytarsus mancus (Walker, 1856)		2		7	
Cladotanytarsus vanderwulpi-Gr.				7	
Micropsectra junci (Meigen, 1818)			1		
Rheotanytarsus sp.		2			
Tanytarsus sp.				7	
Tanytarsus brundini/curticornis				7	
Pseudorthocladius sp.		2			
Simulium sp.				4	
Simulium equinum (Linnaeus, 1758)				4	
Simulium erythrocephalum (De Geer, 1776)				4	
Simulium galeratum Carlsson, 1962				4	
Simulium ornatum Meigen, 1818		1,2	1		
Simulium paramorsitans Rubtsov, 1956				4	
Atrichops crassipes (Meigen, 1820)	VU			4	
Chrysopilus erythrophthalmus Loew, 1840				4	
Chrysops sp.				4	
Hemerodromia sp.				4	
Limnophora sp.				4	

Legend: IUCN categories: according to Farkač et al. 2005 (RE - regionally extinct, CR - critically endangered, EN - endangered, VU - vulnerable, NT - near threatened); non indigenous species: * - according to Mlíkovský and Stýblo (2006), [1,2,3] Panov et al. (2008); data sources: 1 - saprobiological monitoring of the TGM WRI TGM Brno, 2 - monitoring within the Morava River Project, 3 - monitoring of transboundary rivers (TGM WRI Brno), 4 - monitoring of the Morava River Authority, 5 - collection of the Dept. of Botany and Zoology Masaryk University Brno, 6 - Horsák (1999), 7 - JDS2 results, 8 - Opravilová et al. (1999).

Appendix 2. List of macroinvertebrate taxa recorded at the Dyje River stretch upstream of the confluence with the Morava River

Taxon	**IUCN categories**	**Data sources**				
		Periods of research (year)				
		1976-1995	**1996-2006**	**2007**	**2010**	**without time specification**
Ephydatia fluviatilis (Linnaeus, 1758)			6			8
Spongilla lacustris (Linnaeus, 1758)			6			8
Dugesia polychroa (O. Schmidt, 1861)			1,2,6		3	
Dugesia tigrina (Girard, 1850)			1.2	7	3	
Nematoda g. sp. div.				4	3	
Potamopyrgus antipodarum (Gray, 1843)*[3]			1.2			
Lithoglyphus naticoides (C. Pfeiffer, 1828)[3]	EN		1,2,6		3	8
Bithynia tentaculata (Linnaeus, 1758)		1	1,2,6	4.7	3	8
Valvata piscinalis (O. F. Müller, 1774)			6			8
Galba truncatula (O. F. Müller, 1774)			2.6	4.7		
Radix sp.					3	
Radix auricularia (Linnaeus, 1758)			6	7	3	
Radix ovata (Draparnaud, 1805)					3	8
Ancylus fluviatilis O. F. Müller, 1774)			1,2,6	4		8
Physella acuta (Draparnaud, 1805)			6	4.7	3	8
Unio crassus Philipsson, 1788)	EN		6			8
Unio pictorum (Linnaeus, 1758)			6			8
Unio tumidus Philipsson, 1788)	VU		1,2,6			8
Anodonta anatina (Linnaeus, 1758)			6			8
Anodonta cygnea (Linnaeus, 1758)	VU		6			8
Pseudanodonta complanata (Rossmaessler, 1835)	EN		6			8
Sphaerium sp.				4		
Sphaerium corneum (Linnaeus, 1758)			1,2,6	4		8
Sphaerium rivicola (Lamarck, 1818)				4		
Musculium lacustre (O. F. Müller, 1774)	NT		2			
Pisidium sp.			1.2	4	3	
Pisidium casertanum (Poli, 1791)				4		
Pisidium henslowanum (Sheppard, 1823)			6	7	3	8
Pisidium nitidum Jenyns, 1832			6			
Pisidium subtruncatum Malm, 1855			6		3	8
Pisidium supinum A. Schmidt, 1851	NT		6	4.7	3	
Dreissena polymorpha (Pallas, 1771)*[3]				4		8
Chaetogaster sp.					3	
Chaetogaster diastrophus (Gruithuisen, 1828)			6			8
Ophidonais serpentina (O.F. Műller, 1773)			1,2,6	4	3	8
Nais sp.					3	
Nais alpina Sperber, 1948			1,2,6			8
Nais barbata O. F. Műller, 1773			6			
Nais behningi Michaelsen,1923			6			8
Nais bretscheri Michaelsen, 1899			6	4		8
Nais communis Piguet, 1906			6	7		8
Nais elinguis O. F. Műller, 1773			6	4		8
Nais pseudoobtusa Piguet, 1906			6			8
Nais simplex Piguet, 1906			6			8
Nais variabilis Piguet, 1906			6			
Slavina appendiculata (Udekem, 1855)	EN				3	
Stylaria lacustris (Linné, 1767)			1.6	4	3	8

Appendix 2. Continued

Taxon	IUCN categories	Data sources				
		Periods of research (year)				
		1976-1995	1996-2006	2007	2010	without time specification
Dero digitata (O. F. Műller, 1773)			6			
Pristina foreli (Piguet, 1906)			6			
Pristinella menoni (Aiyer 1929)			6			
Pristinella rosea (Piguet, 1906)			6			
Tubificidae g. sp.				4	3	
Rhyacodrilus coccineus (Vejdovský, 1875)			6	4	3	
Rhyacodrilus falciformis Bretscher, 1901			6			
Bothrioneurum vejdovskyanum Štolc, 1886			6	4	3	
Potamothrix hammoniensis (Michaelsen, 1901)			2.6	4		
Potamothrix moldaviensis Vejdovský-Mrázek, 1902					3	
Tubifex ignotus (Štolc, 1886)				4		
Tubifex tubifex (O. F. Műller, 1773)		1	6			
Spirosperma ferrox (Eisen, 1879)				4		
Psammoryctides albicola (Michaelsen, 1901)	EN		1,2,6			8
Psammoryctides barbatus (Grube, 1861)			1,2,6	4.7	3	
Limnodrilus sp.				4	3	
Limnodrilus claparedeanus Ratzel, 1868				4		
Limnodrilus hoffmeisteri Claparcde, 1862			6	4		8
Limnodrilus udekemianus Claparcde, 1862				4	3	
Criodrilus lacuum Hoffmeister, 1845	EN		6	4		
Eiseniella tetraedra (Savigny, 1826)			1.6	4		
Propappus volki Michaelsen, 1905				4	3	
Enchytraeidae g.. sp.				4		
Enchytraeus sp.			6			
Stylodrilus heringianus Claparcde, 1862			1.2			
Rhynchelmis limosella Hoffmeister, 1843			2			
Glossiphonia complanata (Linné, 1758)			6			8
Glossiphonia nebulosa (Kalbe, 1864)			6			
Helobdella stagnalis (Linné, 1758)		1	1.6			
Caspiobdella fadejewi (Epstein, 1961)			6			8
Piscicola geometra (Linné, 1758)			1,2,6	4	3	
Piscicola respirans Troschel, 1850			1.2			
Erpobdella sp.					3	
Erpobdella nigricollis (Brandes, 1900)			2			8
Erpobdella octoculata (Linné, 1758)		1	1,2,6	4	3	8
Erpobdella vilnensis Liskiewicz, 1927		1				
Acari, Acarina					3	8
Asellus aquaticus (Linné, 1758)		1	1,2,6	4	3	
Proasellus coxalis Dollfus, 1892*			6		3	8
Gammarus roeselii Gervais, 1835		1				8
Siphlonurus aestivalis (Eaton, 1903)			6			
Baetis buceratus Eaton, 1870		1				8
Baetis fuscatus (Linné, 1761)		1		4.7	3	
Baetis nexus Navás, 1918	VU		6			
Baetis scambus Eaton, 1870		5				
Baetis vernus Curtis, 1834		1				
Cloeon dipterum s. lat. (Linnaeus, 1761)		1	6	7		8
Heptagenia coerulans Rostock, 1877	EN	1	6			

Appendix 2. Continued

Taxon	IUCN categories	Data sources				
		Periods of research (year)				
		1976-1995	1996-2006	2007	2010	without time specification
Heptagenia flava Rostock, 1877		1	2	4.7	3	
Heptagenia sulphurea (Mueller, 1776)		1				
Potamanthus luteus (Linné, 1767)		5	1,2,6	4.7	3	8
Caenis sp.					3	
Caenis horaria (Linné, 1758)			6			
Caenis luctuosa (Burmeister, 1839)			6	4		
Caenis macrura Stephens, 1835		1	1,2,6	4	3	8
Caenis pseudorivulorum Keffermueller, 1960				7	3	
Caenis robusta Eaton, 1884			6			
Calopteryx splendens (Harris, 1782)					3	8
Calopteryx virgo (Linnaeus 1758)		1				
Platycnemis pennipes (Pallas, 1771)			2.6	4	3	8
Coenagrion puella (Linnaeus, 1758)			6			8
Ischnura elegans (Vander Linden, 1820)			6			
Gomphus flavipes (Charpentier, 1825)	EN		6			
Gomphus vulgatissimus (Linnaeus, 1758)	VU		1,2,6		3	
Onychogomphus forcipatus (Fourcroy, 1785)	EN		1.2			
Ophiogomphus cecilia (Fourcroy, 1785)	EN			7		
Nepa cinerea Linnaeus, 1758			6			8
Micronecta sp.				4	3	
Micronecta scholtzi (Fieber, 1860)			6			8
Sigara sp.					3	
Sigara falleni (Fieber, 1848)			6			8
Sigara lateralis (Leach, 1817)			6		3	8
Sigara striata (Linnaeus, 1758)			6		3	8
Ilyocoris cimicoides (Linnaeus, 1758)			6			8
Aphelocheirus aestivalis (Fabricius, 1794)	VU	1	1,2,6	4.7	3	8
Plea minutissima Leach, 1817			1.2			
Hydrometra stagnorum (Linnaeus, 1758)			6			8
Aquarius paludum (Fabricius, 1794)			6		3	8
Gerris lacustris (Linnaeus, 1758)			6			8
Sialis lutaria (Linné, 1758)			6			
Haliplus sp. Ad.					3	
Haliplus sp. Lv.				4		
Haliplus fluviatilis Lv. Aubé, 1836			6			
Hydroglyphus geminus Ad. (Fabricius, 1792)			6			
Laccophilus sp. Ad.					3	
Laccophilus hyalinus Lv. (De Geer, 1774)			6			
Platambus maculatus Lv. (Linné, 1758)			6	4		
Orectochilus villosus Lv. (O. F. Müller, 1776)			1.2			
Helophorus sp. Ad.				4		
Hydrobius fuscipes Lv. (Linné, 1758)			6			
Limnoxenus niger Lv. (Zschach, 1788)	NT		6			
Laccobius minutus Lv. (Linné, 1758)			6			
Berosus signaticollis Lv. (Charpentier, 1835)			6			
Hydrochara flavipes Ad. (Steven, 1808)					3	
Scirtes sp. Lv.			6			
Oulimnius tuberculatus Ad. (P. W. J. Müller, 1806)					3	

Appendix 2. Continued

Taxon	**IUCN categories**	**Data sources**				
		Periods of research (year)				
		1976-1995	**1996-2006**	**2007**	**2010**	**without time specification**
Hydroptila sp.			6	4	3	
Hydropsyche sp.			1	7	3	
Hydropsyche angustipennis (Curtis, 1834)		1	1,2,6	4		8
Hydropsyche bulgaromanorum Malicky, 1977			6		3	
Hydropsyche contubernalis McLachlan, 1865			1,2,6	4.7	3	8
Hydropsyche modesta Navas, 1925			1,2,6	4.7	3	
Hydropsyche pellucidula (Curtis, 1834)			1.2			
Neureclipsis bimaculata (Linné, 1758)			1,2,6	4.7	3	8
Plectrocnemia conspersa (Curtis, 1834)			1.2			
Ecnomus tenellus (Rambur, 1842)			1.2	4		
Anabolia furcata Brauer, 1857			1,2,6	4	3	8
Athripsodes bilineatus (Linné, 1758)			1.2			
Athripsodes cinereus (Curtis, 1834)				4	3	8
Ceraclea annulicornis (Stephen, 1836)			1.2			
Ceraclea dissimilis (Stephens, 1836)			6	4	3	
Mystacides nigra (Linné, 1758)			6		3	
Oecetis sp.			2			
Oecetis notata (Rambur, 1842)				4	3	
Oecetis ochracea (Curtis, 1825)			6			
Oecetis tripunctata (Fabricius, 1793)	CR				3	
Setodes punctatus (Fabricius, 1793)	RE			4.7		
Hexatoma sp,			1.2	4.7	3	
Neolimnomyia nemoralis (Meigen, 1818)			6			
Pilaria discicollis (Meigen, 1818)			6			
Ellipteroides alboscutellatus (Roser, 1840)				7		
Erioptera sp.				7		
Rhypholophus haemorrhoidalis (Zetterstedt, 1838)			6			
Scleroprocta sp. Edwards, 1938			1.2			
Antocha vitripennis (Meigen, 1830)			2			
Dicranomyia modesta (Meigen, 1818)			6			
Tipula sp.				4.7	3	
Tipula lateralis Meigen,			6	7		
Jungiella sp.			6			
Psychoda sp.			6			
Culex pipiens pipiens Linné, 1758			6			
Ceratopogonidae g. sp.			2			
Probezzia seminigra (Panzer, 1796)			6			
Mallochohelea setigera (Loew, 1864)			6			
Dasyhelea modesta (Winnertz, 1852)			6			
Chironomidae g. sp.				4.7	3	
Conchapelopia sp.				4	3	
Macropelopia nebulosa (Meigen, 1804)			6			
Procladius sp.			1,2,6			
Procladius (Holotanypus) sp.					3	
Thienemannimyia sp.			6	7		
Diamesa sp.			1,2,6			
Potthastia longimana (Kieffer, 1922)			1			
Prodiamesa olivacea (Meigen, 1818)		1	6			

Appendix 2. Continued

Taxon	IUCN categories	Data sources				
		Periods of research (year)				
		1976-1995	1996-2006	2007	2010	without time specification
Cardiocladius fuscus Kieffer, 1924				4		
Corynoneura celeripes Winnertz, 1852			6			
Cricotopus sp.			6	4		
Cricotopus albiforceps (Kieffer, 1916)			1.2	4.7		
Cricotopus bicinctus-Gr.				4	3	
Cricotopus patens Hirvenoja, 1973					3	
Cricotopus sylvestris-Gr.				4		
Cricotopus tremulus (Linnaeus, 1758)			1.2			
Cricotopus tremulus-Gr.				4		
Metriocnemus sp.			6			
Nanocladius bicolor (Zetterstedt, 1838)			1.2		3	
Orthocladius sp.		1	2			
Orthocladius rubicundus (Meigen, 1818)			6			
Orthocladius wetterensis Brundin, 1956			6			
Rheocricotopus chalybeatus (Edwards, 1929)			1,2,6	4	3	
Rheocricotopus fuscipes (Kieffer, 1909)			6			
Synorthocladius semivirens (Kieffer, 1911)			1,2,6	4	3	
Tvetenia sp.			1			
Tvetenia calvescens (Edwards, 1929)				4		
Tvetenia discoloripes (Goetghebuer in Thienemann, 1936)			1.2			
Cryptochironomus sp.			1.2	7		
Cryptochironomus defectus (Kieffer, 1913)				4		
Dicrotendipes sp.			1.2	4	3	
Einfeldia gr. *pectoralis*			6			
Glyptotendipes sp.			1.2	4	3	
Glyptotendipes cauliginellus (Kieffer, 1913)			6			
Glyptotendipes palens				7		
Harnischia sp.			2			
Harnischia fuscimana Kiefffer, 1921			6			
Chironomus sp.			1.2			
Chironomus plumosus-Gr.				7		
Chironomus reductus-Gr.				4		
Chironomus riparius Meigen, 1804			6			
Microtendipes chloris-Gr.			6	4.7	3	
Microtendipes pedellus-Gr.			1.2			
Parachironomus sp.			1,2,6			
Parachironomus vitiosus (Goetghebuer, 1921)					3	
Phaenopsectra sp.			2	4		
Phaenopsectra flavipes (Meigen, 1818)			6			
Polypedilum sp.		1	2		3	
Polypedilum albicorne (Meigen, 1938)					3	
Polypedilum cultellatum (Kieffer, 1916)				7		
Polypedilum nubeculosum-Gr.			1,2,6	4		
Polypedilum scalaenum-Gr.			1,2,6	4.7	3	
Cladotanytarsus sp.			1.6			
Cladotanytarsus mancus (Walker, 1856)			2	4	3	
Cladotanytarsus vanderwulpi-Gr.				4	3	
Micropsectra junci (Meigen, 1818)			1			

Appendix 2. Continued

Taxon	**IUCN categories**	**Data sources**				
		Periods of research (year)				
		1976-1995	**1996-2006**	**2007**	**2010**	**without time specification**
Neozavrelia luteola Goetghebuer, 1941			1			
Paratanytarsus sp.			1.2		3	
Rheotanytarsus sp.			1,2,6		3	
Tanytarsus sp.			2.6	4.7	3	
Thienemannia sp. Kieffer, 1909		1	1.2			
Saetheria sp.				4		
Simulium sp.			1.2	4.7		
Simulium equinum (Linnaeus, 1758)			6	7		
Simulium erythrocephalum (De Geer, 1776)				4	3	
Simulium galeratum Carlsson, 1962				4		
Simulium lineatum (Meigen, 1804)				4		
Simulium ornatum Meigen, 1818		1				
Chrysops sp.				4	3	
Chrysops caecutiens (Linné, 1758)			6			8
Atylotus latistriatus (Brauer, 1880)					3	
Tabanus sp.			2			
Hemerodromia sp.			6			
Liancalus virens (Scopoli, 1763)			6			
Syntormon sp.				7		
Scatella sp.			6			
Lispe sp.				7		
Cristatella mucedo Cuvier, 1798			6			
Paludicella articulata (Ehrenberg, 1831)			6			

Legend: IUCN categories: according to Farkač et al. 2005 (RE - regionally extinct, CR - critically endangered, EN - endangered, VU - vulnerable, NT - near threatened); non indigenous species: * - according to Mlíkovský and Stýblo (2006), [1,2,3] Panov et al. (2008); data sources: 1 - saprobiological monitoring of the TGM WRI Brno, 2 - monitoring within the Morava River Project, 3 - monitoring of transboundary rivers (TGM WRI Brno), 4 - monitoring of the Morava River Authority, 5 - collection of the Dept. of Botany and Zoology, Masaryk University Brno, 6 - Horsák (1999), 7 - JDS2 results, 8 - Opravilová et al. (1999).