Longitudinal patterns of fish assemblages in the Mosoni-Danube, Hungary

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Introduction

The Danube and its sidearm system including the Mosoni-Danube play a significant role in the environmental development concept of the Szigetköz region. The state of the river habitats influences the region's economy, in particular: tourism, agriculture, flood protection, environmental protection and water resource protection. Improvement of the ecological status of the whole Szigetköz region became more and more the determined aim in the regulatory efforts of the water management (BERCZIK & GUTI 2003). Problems caused by the state of the river habitats require a complex solution, therefore a hydro-ecological research project (ECONTACT) was established by the North Transdanubian Environment Protection and Water Directorate in 2004. Its main object was to analyse the habitats of the heavily modified Mosoni-Danube according to the EU Water Framework Directive (WFD) for development of management plans of habitat rehabilitations.

The habitat evaluation of the Mosoni-Danube was based on a fish biological survey among other things. This preliminary ichthyological study was aimed to explore the fish fauna of the Mosoni-Danube and characterize the typical fish assemblages. Fish of the Szigetköz region has been observed on several occasions since the end of the 1980s (JANCSÓ & TÓTH 1987, GUTI 1993, 1996, 1998, 2002), for all that the ichthyological survey of the Mosoni-Danube was neither elaborated nor regular, only a few samples and catch statistics of commercial fishermen (JANCSÓ & TÓTH 1987) were available. The first extensive longitudinal sampling was completed in the frame of the recent project. This paper describes the fish fauna and spatial pattern of fish assemblages throughout a broad scale in the Mosoni-Danube.

Methods

The Mosoni-Danube is a 124 km long meandering side arm on the margin of the alluvial talus in the Szigetköz floodplain. It has two major right bank tributaries: the Lajta River at Mosonmagyaróvár and the Rába River at Győr. The 15 km long downstream of Győr was widely regulated for navigation in the beginning of the 20th century. Floods of the Danube have locked out by a sluice constructed at the upper mouth of the side arm since 1908. The restricted discharge was 30 $m^3 s^{-1}$ in the upper section and it increased to 40-160 $m^3 s^{-1}$ at the Lajta tributary. Since 2001, the water supply of the Mosoni-Danube has been controlled by an effluent of the impoundment of the Gabčikovo barrage system.

Three main parts (different water bodies according to WFD) are distinguishable along the Mosoni-Danube: 1) The upstream of Mosonmagyaróvár (Lajta tributary) is a 33 km long meandering section with relatively high slope (mean: 21 ‰, min. 5 ‰, max. 50 ‰) and without flood events. Its morphology is scantly regulated. 2) The 72 km long middle part is between the Lajta and the Rába tributaries. Its channel pattern is meandering and its slope is moderate (mean: 10 ‰, min. 2.5 ‰, max. 32 ‰). Flood events from the Lajta River are regular in this scantly regulated section. 3) The downstream of Győr (Rába tributary) is 15 km

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long. It has a sinuous channel pattern and low slope (3-4 ‰). Flood events from the Rába River and the Danube are typical in this area (HULLÁMVONAL Ltd. 2004).

The Mosoni-Danube was surveyed from r.km 118 to r.km 5 between Rajka and Vének. Sampling was undertaken using different methods. All sites were single-pass fished near the shoreline by electric fishing boat with booms according to standardised method as it described in the CEN document No.EN14011 (CEN 2003). The boat was equipped with generator-powered PDC electrofisher (10 kW). At each site a distance between 600 and 1500 m was sampled depending on width of bed and habitat structure. The following site characteristics were recorded: length, depth, temperature, gradient and type of shoreline. Depth, length and temperature were surveyed by an echo sounder in combination with a GPS and a thermometer. Gradient data were provided by the HULLÁMVONAL Ltd.

Fish were identified according to species, counted, measured (standard length to the nearest 0.5 cm) and then released to the river. Relative fish abundance (percentage of total catch) and density (ind.ha^{-1}) were calculated. Species richness of fish assemblages was compared using rarefaction analysis (individual-based). Similarity in taxonomic composition between sampling sites was assessed by hierarchical cluster analysis (between-groups linkage of Euclidean distances) of relative abundance of all species. Statistical analysis was performed with SYN-TAX (PODANI 1993) and PAST (HAMMER et al. 2001) software packages.

Results

Fish sampling was carried out on 20 sites of the upper part of the Mosoni-Danube in 27-30 April and May 25, on 25 sites of the middle part in 26-28 May and 28 June and on 5 sites of the lower section in 30 June and 1 July 2005. Altogether 5478 fish were collected and 25 species were identified. The samples were dominated by bleak (*Alburnus alburnus*) and roach (*Rutilus rutilus*), followed by asp (*Aspius aspius*), nase (*Chondrostoma nasus*), ide (*Leuciscus idus*), bream (*Abramis brama*), barbel (*Barbus barbus*), etc. (Fig. 1). The percentage of bleak in total catch was 83 %.

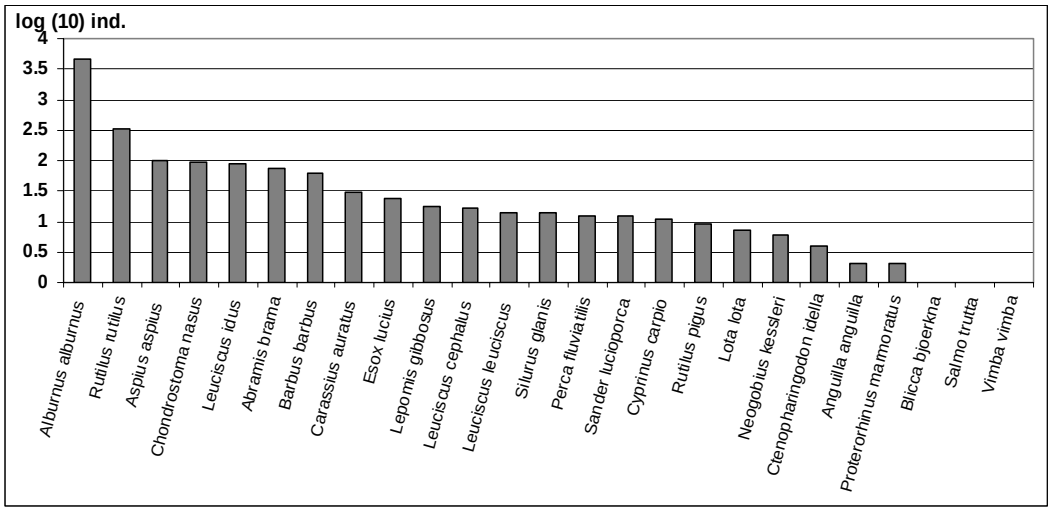

Fig.1: Frequency distribution of fish species collected by electric fishing boat. The last three species was represented only one specimen.

There were no significant differences between means of fish density throughout a broad spatial scale: 205 ind.ha^{-1} with standard error 27.4 in the upper section; 189 ind.ha^{-1} with standard error 21.5 in the middle section and 262 ind.ha^{-1} with standard error 110.5 in the lower section. Species richness of fish assemblages was similar in the upper and middle part

of the river, however the taxonomic diversity in the lower part was considerably higher (Fig. 2).

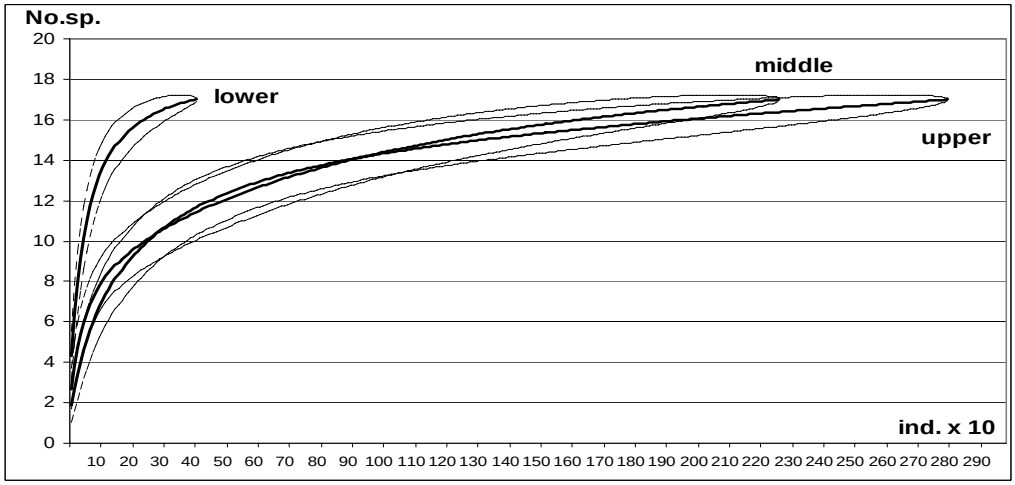

Fig. 2: Individual-based rarefaction curves calculated from the fish samples of the upper, middle and lower part of the Mosoni-Danube. Confidence limits are indicated by scattered lines.

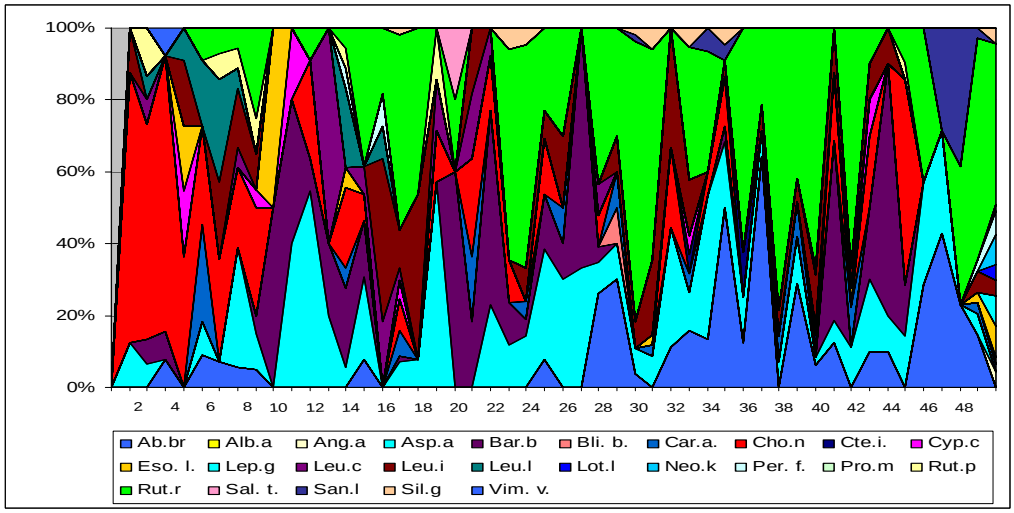

Fig. 3: Variation of relative abundance of fish (without *Alburnus alburnus*) along the Mosoni-Danube. Upper part: site 1-20, middle part site 21-45, lower part site 46-50.

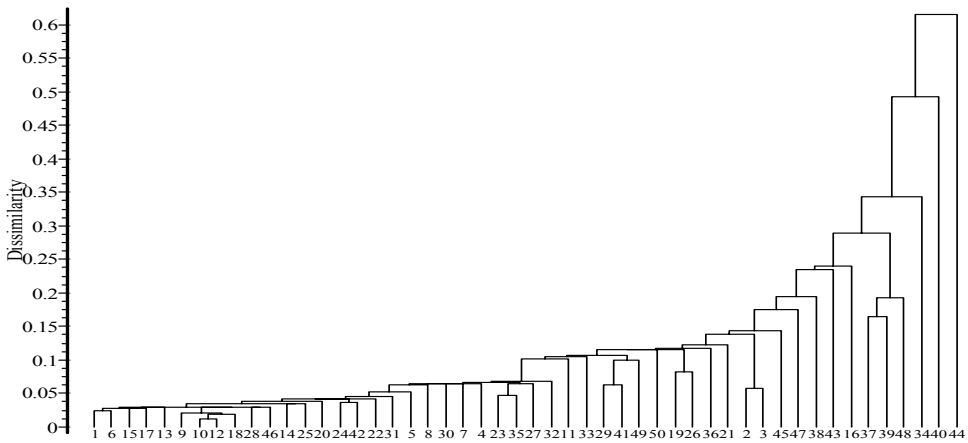

Fig. 4: Dendogram of cluster analysis, revealing similarities in relative abundance of fish species at sampling sites. Code number of sites increases downstream.

Fish assemblages were highly variable along the Mosoni-Danube (Fig. 3). The hierarchical cluster analysis of relative abundance of fish species revealed small differences between the main parts of the Mosoni-Danube, however two sites (code number: 40 and 44) in the middle section showed large deviation (Fig. 4). The local gradient of the channel was very high at both sites and their fish assemblages were dominated by barbel (40%) and nase (55%), respectively.

Comparison of means of relative abundance of the most abundant fish species (number of collected specimens was minimum 30) indicated some characteristic differences in the fish distributions along the three main sections (Fig. 5). Nase and barbel were not collected in the lower part. Relative abundance of bleak was the highest in the upper section; however distribution of roach and bream changed adversely. Relative abundance of asp and barbel was significantly higher in the middle section, etc.

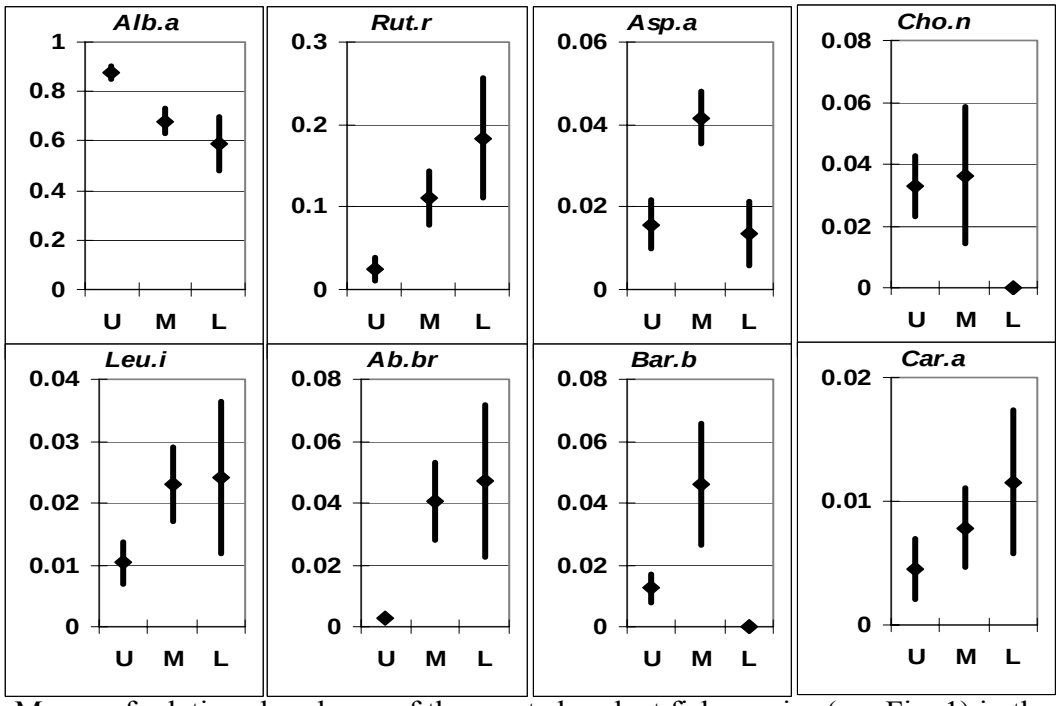

Fig. 5. Means of relative abundance of the most abundant fish species (see Fig. 1) in the upper (U), middle (M) and lower (L) sections of the Mosoni-Danube. Lines mark standard error.

Discussion

Samples collected by electric fishing boat included 25 fish species, less than half of elements of the fish fauna of the Mosoni-Danube (GUTI 1997). The electric fishing boats have better capture efficiency than conventional electric fishing with hand held electrodes, however sampling results in the Mosoni-Danube indicated its moderate efficiency for collecting smaller shore-line and benthic species. The bleak was a dominant species in the samples because of it inhabits the surface layer of the water and more vulnerable to electric fishing than benthic species.

Distribution of fish assemblages throughout a broad scale in the Mosoni-Danube indicated a longitudinal variation: relative abundance of some rheophilic species (nase) decreased to downstream direction and some eurytopic species (roach, bream) showed opposite trends. The highest species richness was observed in lower section of the river, however it particularly influenced by human impacts. Sampling results demonstrated the rip-rap embankments in the

vicinity of Győr provided an available habitat for some small benthic fish species. The longitudinal patterns of fish assemblages had a considerable variation at mesohabitat level according to the local changes of the river slope and channel morphology.

The experiences of the presented study indicated the importance of the preliminary surveys and careful planning of sampling (partial sampling method) for assessment of the ecological status of the fish fauna by species composition and abundance or the metrics of the European Fish Index (FAME CONSORTIUM 2004).

Summary

Spatial distribution of fish assemblages were investigated along a 110 km long section of the Mosoni-Danube in 2005. Longitudinal distribution of fish assemblages showed differences of species richness and species composition. The highest relative species richness was observed in the lower 15 km long section. Relative abundance of rheophilic species versus limnophilic ones slightly decreased from upstream to downstream. Structure of fish assemblages was highly variable at mesohabitat level according to channel morphology. The experiences of the survey indicated the importance of the careful sampling design for assessment of the ecological status of the fish fauna.

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