Mussel fauna (Corbiculidae, Dreissenidae, Sphaeriidae) in the water-system of the Hungarian Danube

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Introduction

The filter-feeding mussels have a significant role in the matter and energy flow in freshwaters. The importance of small-sized but abundant mussels, especially in large rivers, is hardly known. These species of the Hungarian mussel fauna belong to three families: Corbiculidae, Dreissenidae and Sphaeriidae. The first two families are represented by only three species in Hungary, while the family Sphaeriidae has higher species richness (19). Data about these mussels is insufficient because their identification is problematic due to their tiny body and simple shell architecture.

Methods

In 1998 and 2001 collections were carried out at 71 sampling sites in different water bodies as follows: Danube main arm from Dunakiliti (1843 fkm) to Mohács (1446,5 fkm) 43 sites; Szigetköz area active alluvial flood plain 4 sites, protected area 4 sites; Mosoni-Danube 10 sites; Szentendrei-Danube 6 sites; Soroksári-Ráckevei-Danube 5 sites (Figure 1). In the period of 1996-2004 within the hydrobiological monitoring of the Szigetköz area collections were carried out in 15 places affected especially by the hydrological changes due to the diversion of the Danube (7 sites in the abandoned main arm, 4 sites in the active alluvial flood plain and 4 sites in the protected area). The detailed description of sampling sites was published in previous articles (BÓDIS & OERTEL 2005, BÓDIS 2006).

To reveal the mussel fauna as accurate as possible several sampling techniques were used such as sampling by hand and forceps, hand net, “kicking & sweeping” by ISO 7828 type net, triangular dredge. Samples were fixed in situ in 4 % formaldehyde solution. Simultaneously several environmental parameters (bottom texture, current velocity) were recorded. After separation mussels were preserved in 70% ethanol. Only the living individuals were identified, empty shells were omitted. Evaluation of data was made by principal component and redundancy analyses with the help of SYNTAX 2000 program package (PODANI 2001).

Results and discussion

Faunistical investigations

Regarding all of the sampling sites altogether 16 small-sized mussel species of 3 families were found, which presents 72,7% of the nationwide fauna. Among them two species (*Corbicula fluminea*, *Dreissena polymorpha polymorpha*) are invasive mussels and four (*Pisidium amnicum, Pisidium milium, Sphaerium rivicola, Sphaerium solidum*) are rare species in Hungary. The most wide-spread 5 species were in order: *Dreissena polymorpha polymorpha, Pisidium subtruncatum, Sphaerium corneum, Pisidium henslowanum, Pisidium nitidum*. The most wide-spread mussel species of the different Danube sections and water bodies of Szigetköz are presented in Figure 1.

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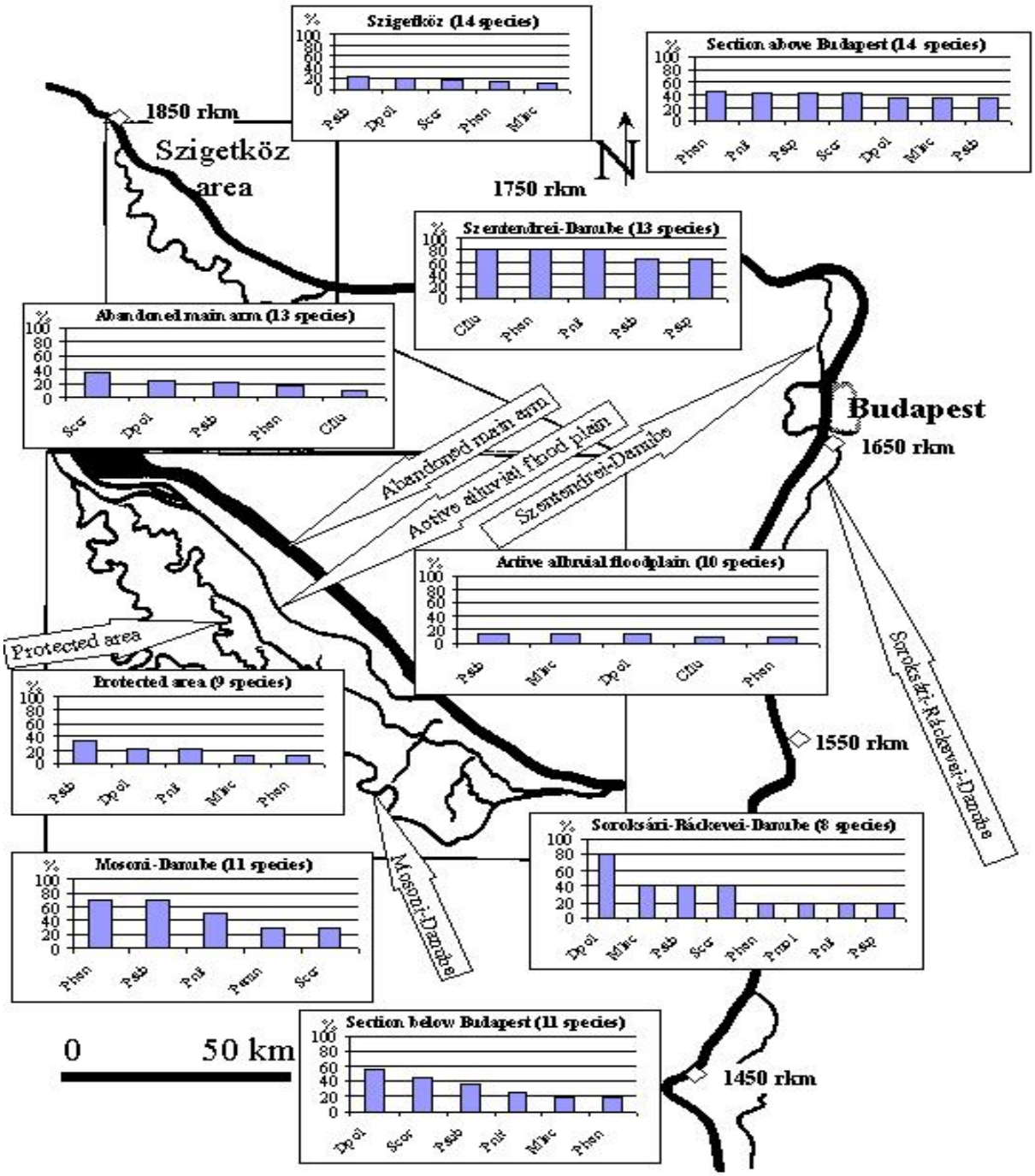

Figure 1: The relative occurrence of the most wide-spread mussel species in the different water bodies and Danube sections. Legends: C.flu – *Corbicula fluminea*, Dpol – *Dreissena polymorpha polymorpha*, Mlac – *Musculium lacustre*, Pamn – *Pisidium amnicum*, Pcas – Pisidium casertanum, Pcap – *Pisidium casertanum var. ponderosum*, Phen – *Pisidium henslowanum*, Pmil – *Pisidium milium*, Pmoi – *Pisidium moitessierianum*, Pnit – *Pisidium nitidum*, Pper – *Pisidium personatum*, Psub – *Pisidium subtruncatum*, Psup – *Pisidium supinum*, Scor – *Sphaerium corneum*, Sriv – *Sphaerium rivicola*, Ssol – *Sphaerium solidum*

The occurrence pattern of the mussel species is shown in Figure 2. On the right side of the figure are the frequent, on the left side are the rare species. The most frequent mussel in the Hungarian Danube section, the introduced, invasive *Dreissena polymorpha polymorpha* separates from the other species. *Sphaerium corneum,* the most cosmopolitan species among the fingernail clams is the third most frequent mussel and can be found in the whole Hungarian Danube section with a steady distribution. *Musculium lacustre* is the second most wide-spread species among the fingernail clams, was bulky in the environ of the atomic power station of Paks, which could refer to its termophil feature and is in harmony with its "r-strategist" life-style (HEARD 1997). The most frequent pea clams create a distinct group. *Pisidium subtruncatum* is the second most frequent mussel, *Pisidium henslowanum, Pisidium nitidum* stand in the fourth and fifth position, and the *Pisidium supinum* is the sixth. *Pisidium casertanum* is an euryoec mussel, the most wide-spread species in the genus: it can be found from the ponds to the large waters (RICHNOVSZKY & PINTÉR 1979), but is rare in the Hungarian Danube section. The invasive *Corbicula fluminea*, first record of which in the Hungarian Danube section was published in 1998 (CSÁNYI 1998-1999) and the native *Sphaerium rivicola* live in the same habitat conditions. The number of *Sphaerium rivicola* populations decreased recently. This native mussel became endangered, because the invasive competitor *Corbicula fluminea* could replace it to a final disappearance.

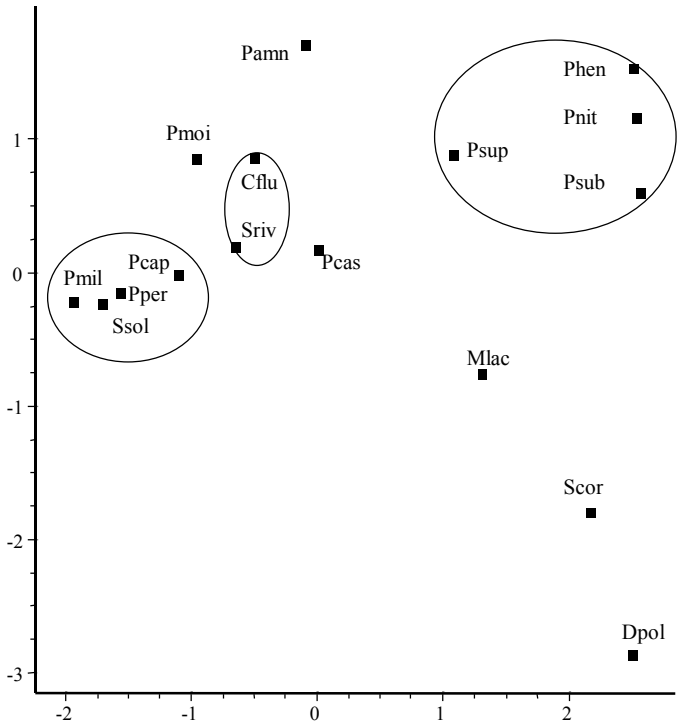

Figure 2: The ordination of mussel species based on all of the sampling sites (Euclidean distance). Legends: see Figure 1.

Pisidium amnicum, *Pisidium moitesserianum* are rare species, *P. amnicum* was present in the Mosoni-Danube while *P. moitessierianum* in the Soroksári-Ráckevei-Danube. *Pisidium casertanum var. ponderosum, Pisidium milium, Pisidium personatum, Sphaerium solidum* are very rare species in the Hungarian Danube section, the first two live in standing waters, the third is bound to smaller streams, while *Sphaerium solidum* appeared in Hungary only some years ago (VARGA & JUHÁSZ 2002).

Habitat preference investigations

The majority of mussels prefer the soft bottoms (consists of silt and detritus) and the slow current velocity or standing waters, so they could be regarded as limnophil organisms (Figure 3). However *Dreissena polymorpha polymorpha* can also cope with greater current velocity and live on hard substrates (concrete, stone or gravel) due to its sessile life-style.

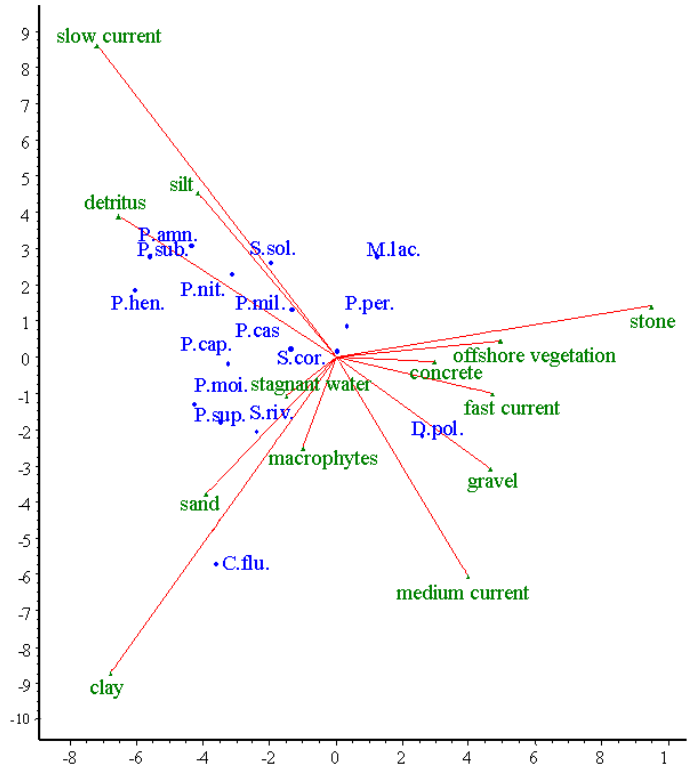

Figure 3: The ordination of mussel species and environmental parameters (current velocity and substrate quality) based on all of the sampling sites (RDA triplot). Legends: see the Figure 1.

Long term changes in the Szigetköz area

Between 1996 and 2004 the composition of mussel fauna has been considerably changed (Figure 4). In the period before 2000 the small-sized mussel fauna contained 11 species, but in the period after 2000 the fauna increased with 2 fingernail clams (*Sphaerium rivicola, Sphaerium solidum*) and one pea clam (*Pisidium casertanum var. ponderosum*).

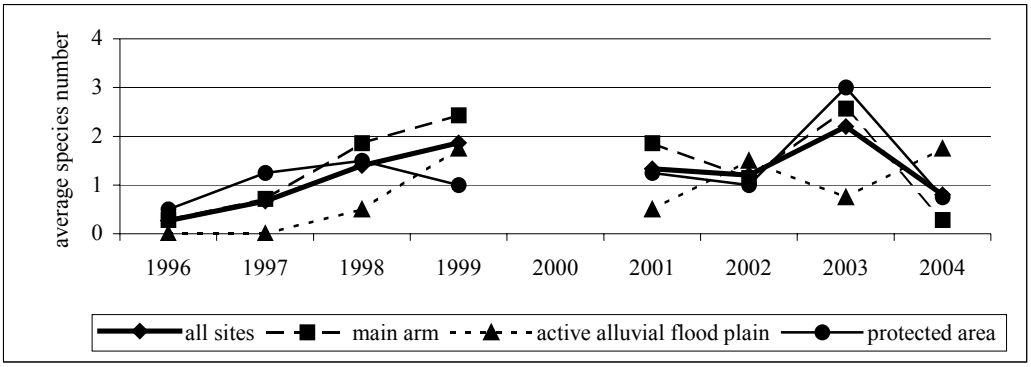

Figure 4: The fluctuation of average species number per year from 1996 to 2004 in the sampling sites of Szigetköz

Before the 1990s the water regime of Szigetköz was governed by the water regime of River Danube. The main arm, active alluvial flood plain and protected area differed from each other

both in hydrology and aquatic biota. The radical alteration in the hydro-morphology of the Szigetköz was caused by the diversion of the Danube to the operation channel of the Bős/Gabčikovo hydroelectric power plant was followed by the impoverishment of the mussel fauna, too. In 1996 an increase began in species number. The average species number per year increased till the end of nineties in all of the water bodies. From 2001 the increase slowed down, the fluctuations were similar in the main arm and protected area, while the active alluvial flood plain represented opposite tendency. The highest average number of species was recorded in the main arm until 2002, but from 2003 it appeared in the protected area, where the *Pisidium casertanum var. ponderosum* also occurred. Beside the increase in the species a process to uniformity could be detected, since the ratio of species occurred only in one water body gradually decreased, while species number in more than one water body increased until the beginning of 2000s. The spatial pattern of the mussels, which were characteristic for the previous flood prevention classification of the Szigetköz area, could be found less and less typical. At the end of the nineties lenitic species occurred in the main arm and lotic species appeared in the protected area. Due to the water recharging system the former physical barriers of the distribution practically disappeared, the mussels can spread the whole water system of the Szigetköz. This kind of "inner" migration is the cause of the appearance of species in water bodies where they were not present earlier.

Acknowledgement

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