Macrozoobenthos biomass in the back-waters with different water supply

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Introduction

The saving, protection and use of the natural powers have got more and more attention in Hungary in the past years, because it is important concerning both the economical and environment protection. Back-waters, in an optimal condition can be considered as natural powers which produce fish for food. Back-waters serve as flood control, recreation, sport, angling, and help irrigation.

It follows that the back-waters as ecosystems are unique according to the environmental effects. At the same time, the processes are determined by general rules. In spite of the importance of the back-waters in fishery, tourism, irrigation and in preventing flooding we have few data about their flora and fauna, and we have not got any correct knowledge about the Invertebrate living in the sediment. Determining the condition of the back-waters is necessary to solve the environmental problems and to do the tasks concerning it (Fekete, 1994). Detailed research of the living resource shows the condition of a back-water too. That is one of the goals of this work as well, as well as to estimate the macrozoobenthos biomass and production in the qualitatively different and restored ecosystems.

Keywords: back-waters, macrozoobenthos, biomass, production.

Material and methods

Examinations were made on back-waters of the River Hármas-Körös, near Szarvas and Öcsöd. The water was retained in the River Hármas-Körös. The Back-water at Szarvas was filled up and fed by syphons, because of water level difference.

Detailed sampling sites can be seen on Fig. 1. Three benthos samples were taken by an Ekman-Birge dredge each week on each sampling site of the examined areas from a surface of 12x12 cm a time. The total sampled surface was 432 cm^2 of each site.

Samples were washed through a metal screen with a mesh size of 250 μm immediately after collecting and the retained material was separated into groups of Oligochete, Chironomids and Gastropods were sorted by a Zeiss stereo microscope, with a 4 to sixfold magnification and then were preserved in 80% ethylic alcohol.

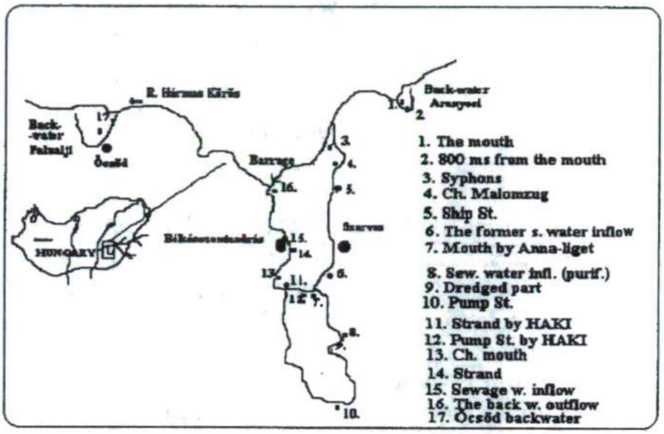

Fig. 1. Sampling sites

Abundance and dominance of macrozoobenthos species were examined and calculated to one square meter. Animal groups were dried at 105°C for 12 hours and measured by a Sartorius Micro XM 100P analytical balance, when the biomass in dry weight was bigger than 1 μg. Data were converted into a year's production calculated according to Lafont (1987), Liang (1984), Potter et al. (1974), Benke et al. (1979), Jónasson (1985), Sephton et al. (1986) and Grzybkowska (1989). For taxonomic identification the following works were used: Bíró 1981; Tsernovszkii 1949; Fittkau 1962; Hirvenoja 1973; Pinder and Reiss 1983.

Results and discussion

Species abundance and individual density

Seasonal changes were big both in the species and in the individual density. The density of the macrozoobenthos changed between 6000-8000 ind.m^{-2} in April and in May by different trophic level. The animal density decreased hard from the middle of June. Only some specimen of the groups were found on the sampling sites covered by deep sediment, because of the common or daily oxygen depletion on the water/sediment boundary layer.

The syphons pumping made a continuous water current in the Back-water at Szarvas, but the macrozoobenthos zoocoenose was similar to those in a standing water. Chironomids were abundant and this situation was typical of the communal water inflow of Szarvas, at an 8 km-long section (Fig. 2a,b). The number of species decreased by the polluted communal water effect, and Oligochaete (*Limnodrilus hoffmeisteri*) were dominant (Fig. 2c). The results were the same by the inflow of the sewage water station at Szarvas and in Békésszentandrás too (Fig. 2e, 3c). The communal water inflow stopped two years before, but the high trophic level of the sediment determined the former macrozoobenhos character. The sediment trophic level decreased at the sampling point of Anna-liget, 800 m downstream from the former sewage water inflow. Chironomid larvae were abundant here (Fig. 2d).

The dominance of Chironomid larvae was detected on the dredged part, both the species and specimen density increased here. *Procladius choreus* was dominant (Fig. 3a). The slow, but continuous water current washed out a part of the inorganic elements from the sediment, shown by the macrozoobenthos at the "Pump station of HAKI" (Fig. 3b). That result presented the other way of the reconstruction of back-waters. The water current may decrease the inorganic material level by both the solution and the washing out of the phytoplankton. The macrozoobenthos showed extreme ecological factors and environment by the standing water in the Back-water of Falualji and at the "outflow" of Back-water at Szarvas. The extreme environmental factors indicated the dominance of the Oligochaete by *Limnodrilus hoffmeisteri*. Oxygen depletion was common in summer, and some specimen were able to survive (Fig. 3d, 4a).

Chironomids by Procladius choreus were dominant in the mouth of the Back-water of Aranyosi with 600 ind.m^{-2}, because of the river effect. Six species were present. The weak water current in the Back-water of Aranyos was effective near the mouth only. Specimen density of Limnodrilus hoffmeisteri was 950 m^{-2}, and dominant 800 m from the mouth. The increasing of specimen density was detected by the other species too (Fig. 4c).

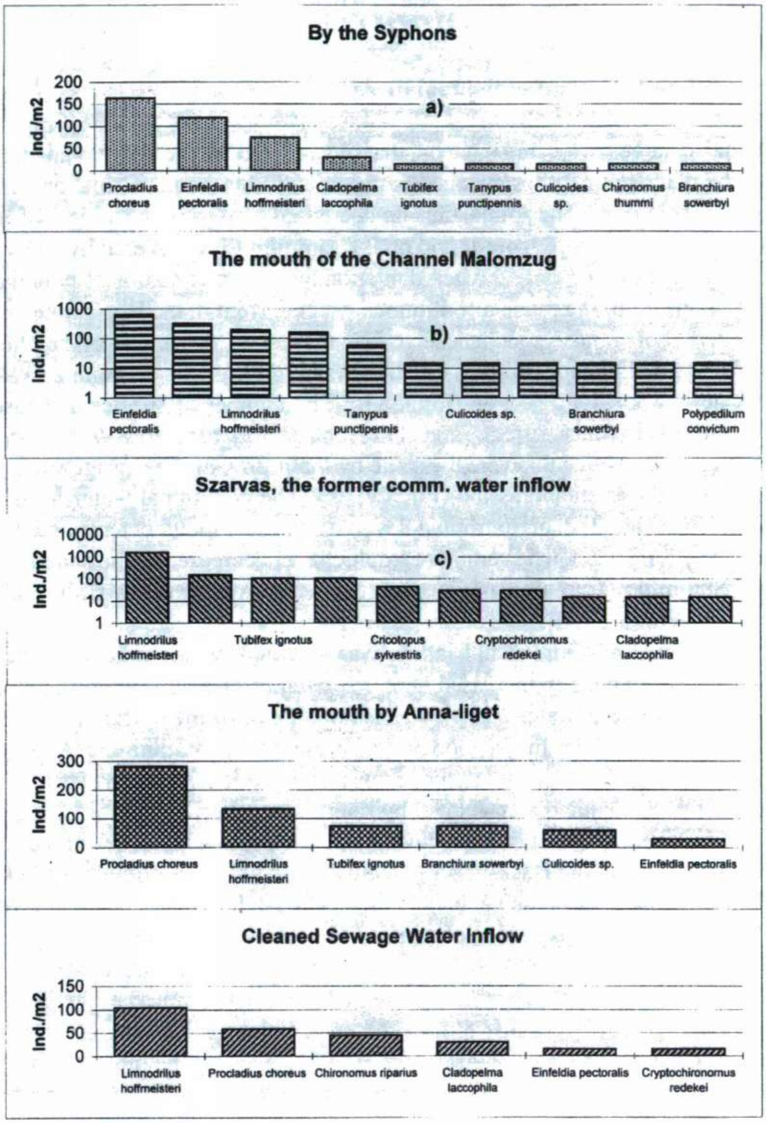

Fig. 2. Individual density of the Oligochaete, Chironomids and Gastropods

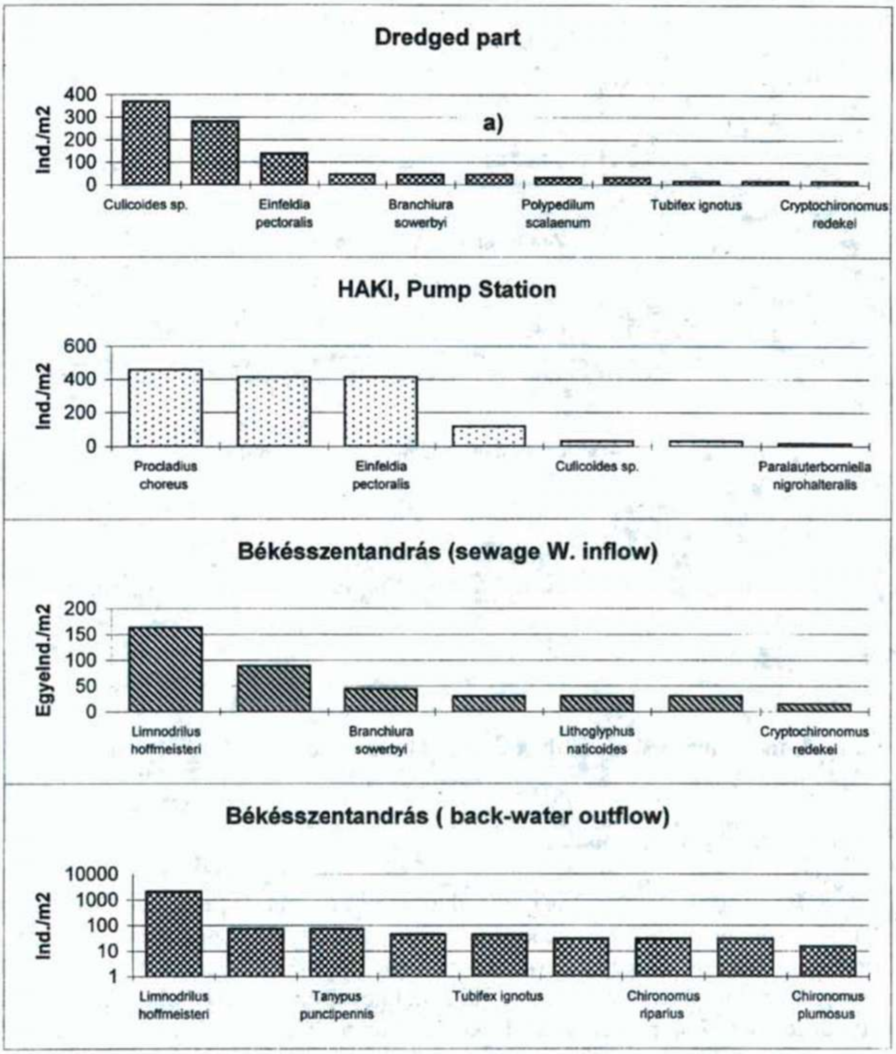

Fig. 3. Individual density of the Invertebrate on different sampling sites

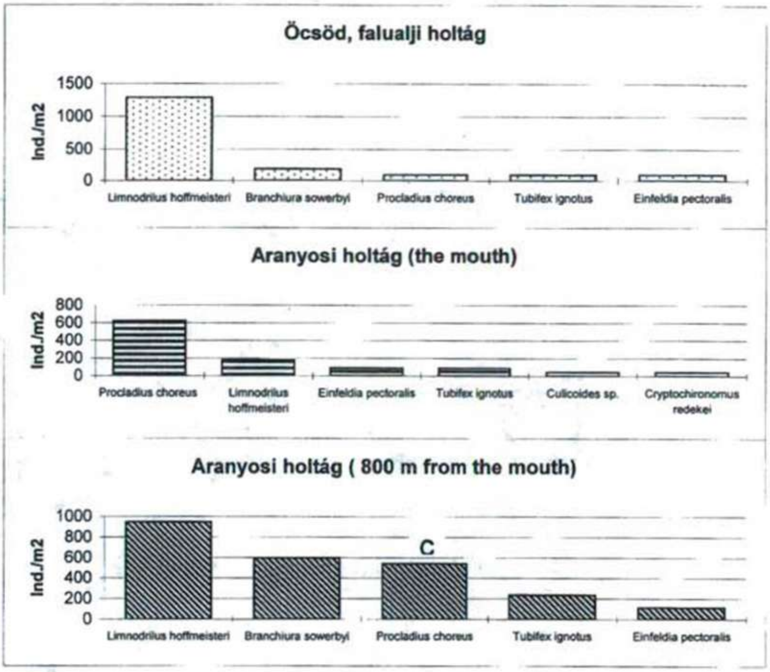

Fig. 4. Individual density in the examined back-waters

Biomass and production

The Oligochaete were typical for the eutrophic and hypertrophic back-waters, therefore their biomass was generally higher than Chironomids and Gastropods. Chironomids were dominant, and 3-10 times higher than the Oligochaete biomass, where the inorganic material was lower in the sediment like the mouth of the Channel Malomzug, the dredged part, Pump Station at Kákafok, Pump Station of HAKI (Fig. 5a). The macrozoobenthos biomass in the hypertrophic back-water near Öcsöd was lower than the estimated value. Temporary oxygen depletion was the main reason why the Oligochaet biomass decreased here. The Oligochaet biomass reached 200 mgm^{-2}, where some minimal dissolved oxygen was continuously because of the slow water current.

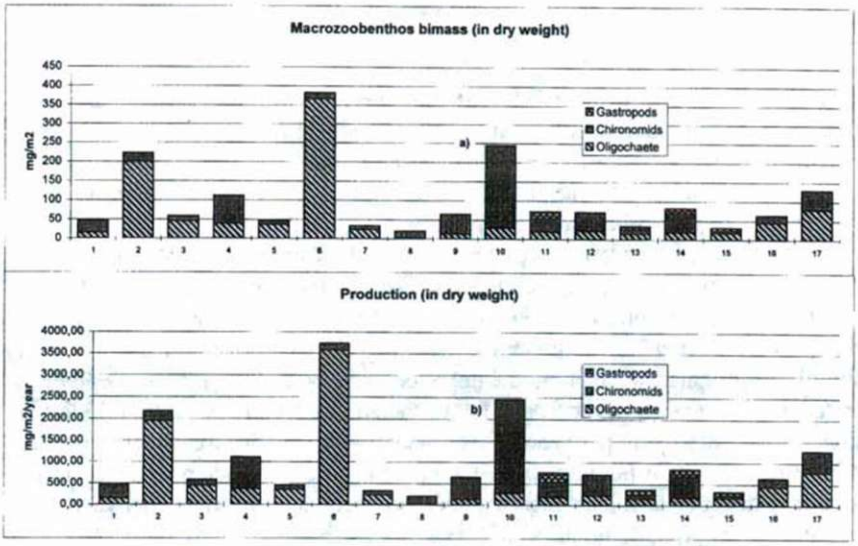

Fig. 5. The estimated macrozoobenthos biomass and production on the different sampling sites

Chironomids with more generations were more adaptable than Oligochaete, and were able to use the optimal periods of the season producing high specimen density and biomass. That was detected by their seasonal dynamics. The density of the Chironomid larvae increased a lot when they had no rivals. The Chironomid biomass was almost always higher than the Oligochaete.

The average macrozoobenthos production near Öcsöd was estimated 1300 mgm^{-2}year^{-1}, in the Back-water of Aranyosi 500 mgm^{-2}year^{-1} near the mouth, and 2100 mgm^{-2}year^{-1} 800 m from there. The average macrozoobenthos biomass in the Back-water of Szarvas varied between 500-800 mgm^{-2}year^{-1}. The estimated fish yield ha^{-1} was as follows: 18-20 kg in the Back-water of Falualji near Öcsöd, 7-10 kg and 18-20 kg in Aranyosi near Gyomaendrőd, and 7-10 kg in the Back-water of Szarvas, fed by macrozoobenthos.

The production of Oligochaete and the Chironomids together ranged between 250-3700 mgm^{-2}year^{-1}, but the average value was 500 mgm^{-2}year^{-1} in dry weight (Fig. 5.). That means that the biomass was 3000 mgm-2 produced alive during the season. We calculated 7-10 kgha^{-1} fish yield fed the macrozoobenthos in back-waters. The estimated production was different. The difference existed not only between them, but between the parts inside the ecosystem, like the Back-water at Szarvas.

Summary

The main goal was to obtain and to estimate the quantity of the macrozoobenthos biomass and production, as the natural fish food. Three types of ecosystems were investigated. The Back-water of Falualji (near Öcsöd) was hypertroph, its fill-up was possible at the rising of the water level. The Back-water of Szarvas was heavily polluted both in communal and industrial waste water and was partly recultivated. The Back-water of Aranyos (near Szarvas) was in connection with the former River Hármas-Körös in the lower part, therefore the water level depended on the river and often fluctuated (Fig. 1.). The abundance of the Chironomid larvae ranged between 6000-8000 ind.m^{-2} in April and in May. A hard decreasing of the abundance was detected in middle of June. Very low density of the animals was found in the deep sediment because of oxygen depletion on the water/sediment boundary layer from May to the end of August. Chironomid larvae were dominant on the eutrophic parts, and Oligochaete at the hypertrophic sampling sites. The effect of the communal pollution was indicated by the presence and dominance of the Limnodrilus hoffmeisteri. The macrozoobenthos production ranged between 2500 and 3700 mgm^{-2} in dry weight, but the average value was about 500 mg/m^{-2}, 7-10 kg/$ha^{-1}year^{-1}$. Fish production was estimated by the benthos feeding. Oligochaete and Chironomid larvae showed the degree of eutrophication and indicated qualitative changes in ecosystem after dredging.

The partial sediment take-out showed already positive changes in the macrofauna but this intervention will not be effective for a long time. The species number was low, ranged between 1-9, which showed extreme ecological factors and environment. The amelioration of the back-waters by decreasing their eutrophic stage — the regeneration — is up-to-date.

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