The crude oil pollution effect on the macrozoobenthos in the river Barcău/Berettyó[1]

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Abstract

Our main goal was to explain how the macrozoobenthos responded to the crude oil pollution. A long term effect was detected on different animal groups.

Oligochaete had a long body, therefore the feeding was possible under "oil film" in the sediment and the respiration over the film, from the water body. That was the reason why they did not indicate the oil pollution. The predator Chironomid larvae, like *Tanypus punctipennis, Procladius choreus* and *Cryptochironomus redekei* were not sensitive to the oil pollution. *Polypedilum scalaenum*, a phytophagous species was good to indicate the oil pollution. Deformities were not detectable on the organs of the Chironomid larvae.

Keywords: oil pollution, river, macrozoobenthos.

Introduction

Chironomid larvae are used widely in monitoring systems on population, association and ecosystem level, as well as by toxicological tests in the laboratory and the field. The role of the Chironomids is important in the saprobiological qualification of the ecosystems (Rosenberg, 1991), but their importance is similar in the ecosystem monitoring too (Cushman, 1984; Cushman and Goyert, 1984; Warwick, 1988).The River Berettyó was polluted by crude oil near Marghita in the months of November and December of 1994. The oil ran out from an damaged refinery to the river in Romania and spread to Hungary on the River Hármas-Körös and the River Tisza. Our main goals were to detect what the degree of the damage in the macrozoobenthos was, how the regeneration took place and what groups (species) were found alive. We have tried to find species for monitoring and deformities of the organs made by the oil pollution.

1 The first name is Romanian, and the second Hungarian.

Material and methods

Sediment samples were taken in April, June and August on different sampling sites (Fig. 1.). Qualitative samples were taken from the surface of the stone and gravel piece by washing into a drifting net in each profiles. Sampling sites were at various distances from the left, the right bank and when it was possible in the main current as well.

Each sample was washed through a metal screen with a pore mesh size of 250 µm and preserved in 3-4% formol solution. The retained material was separated into groups of Oligochaete, Chironomids and other groups of animals by a Zeiss stereo microscope in the laboratory, with 4 to sixfold magnification. Animals were preserved in 80% ethylic alcohol.

For taxonomic identification the following works were used: (Bíró, 1981; Brinkhurst and Jamieson, 1971; Cranston et al. 1983; Ferencz, 1979, Fittkau, 1962; Fittkau et al. 1983; Pinder et al. 1983; Pop, 1943, 1950).

Fig. 1. Sampling sites

Results and discussion

The sediment was full of oil near the bank of the river in April and it went up to the surface when the sediment was sampled, and covered the water. The quantity of oil was high near Pocsaj (at the border between Hungary and Romania), and decreased downstream. Some patches were found at the River Hármas-Körös near Szarvas, when sampling the sediment.

The oil was not present in the profundal zone, only in the littoral regions. The water current, the high water level and the low temperature were the main reasons why the big part of the oil swam away. The water current and speed was lower near the banks of the river than in the main current, and the oil was absorbed in the clay.

The zoocoenoses were different on sampling sites. The Oligochaete were dominant during the season near Pocsaj, where the oil pollution was the biggest in the Hungarian section. Their rate was 95%. Chironomid larvae, living in sediment, were predators almost in 100 per cent. Some larvae of the *Orthocladius saxicola* were present in the snails that moved from the sediment to the surface, climbing on the tecton only. The endobenthos was absent. Snails were not found in April here, but the rate of the dragonfly larvae was high and increased during the season (Fig. 2a-3a).

The rate of Oligochaete fluctuated at about 40% at Szeghalom in April, Chironomids at 10%, and snails (*Lithoglyphus naticoides*) were present in 35%. Dragonflies (Odonata) were abundant too (Fig. 2b). The presence of the snails was evident in the early phase of the season in the polluted river, it is important to remark, because of their diapause during the Winter season and early Spring. They were absent near Pocsaj, but present on the other sampling sites at the beginning of the sampling time. It may be shown that they were not able to survive the oil pollution effect near the border, but their tolerance was enough to survive downstream, the pollution effect decreasing. This tendency was detected from Szeghalom (Fig. 2a-d). With the increase of the temperature, plants, gravels and other materials, fed the phytoplankton. That was the reason why they were not found on the sediment surface.

The rate of Oligochaete was 30% both in Gyomaendrőd and Szarvas sampling sites. The abundance increased to 60% during the season continuously. The rate of the Chironomid larvae increased to 40% at the end the vegetation season (Fig. 2c-d).

Regarding species resistance, Limnodrilus udekemianus was the most tolerant to the oil pollution (Fig. 2a), but Limnodrilus hoffmeisteri was dominant on the River Berettyó and River Hármas-Körös from Szeghalom (Fig. 3b-d).

Larvae of two Chironomid species were present in April near Pocsaj only, and Cricotopus algarum appeared in June. Population dynamics of these species showed seasonal changes, but indicated an environmental purification downstream from Szeghalom. The River Hármas-Körös was dammed near Szarvas, and the water was used for irrigation. That was the reason why there was a standing water during the season.

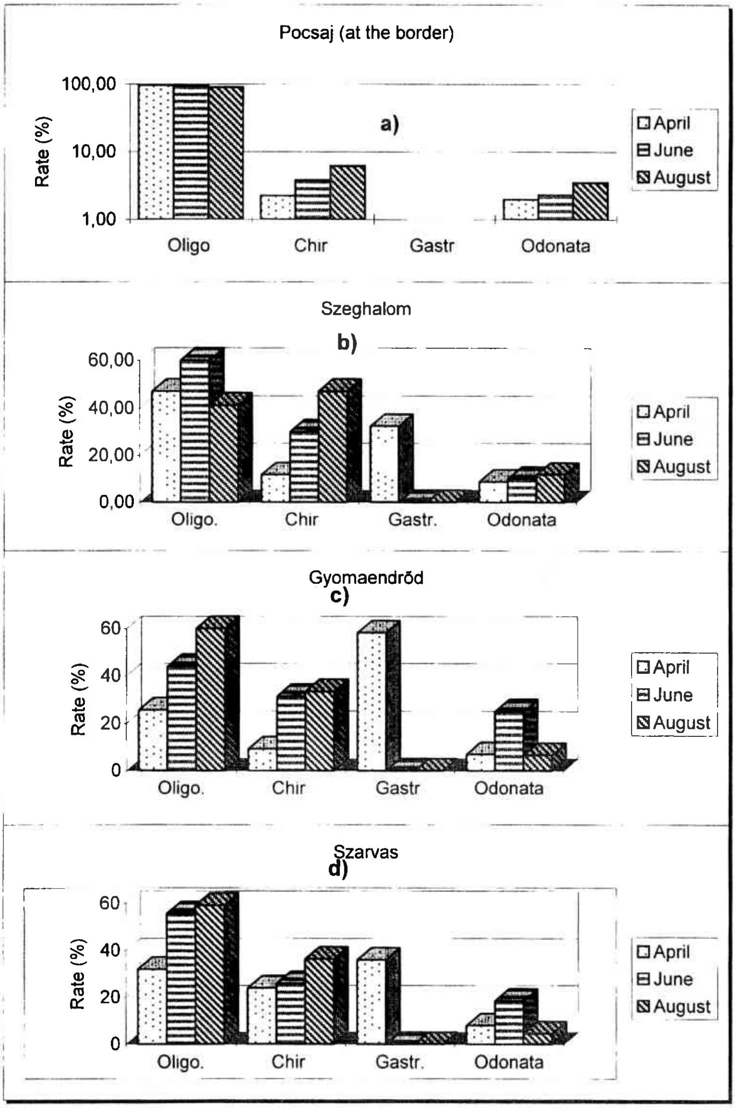

Fig. 2. The rate of the animal groups in the River Berettyó during the season

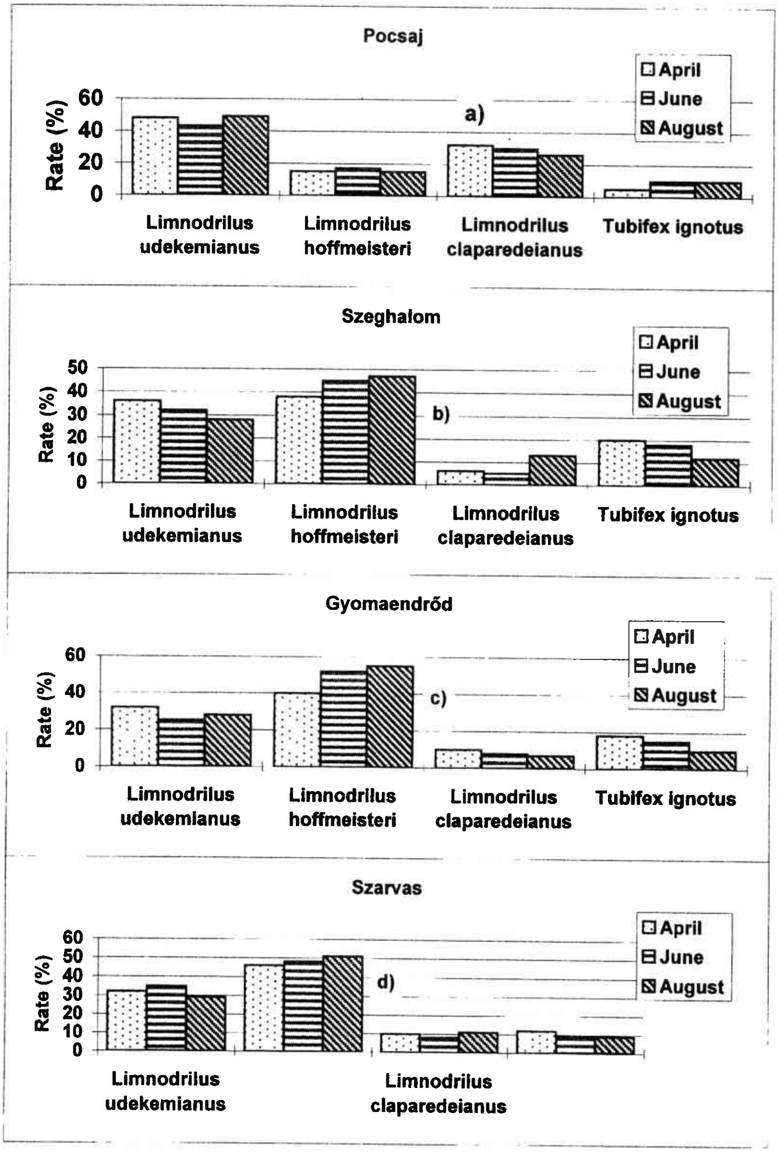

Fig. 3. Changes of the Oligochaeta species dominance on the sampling sites

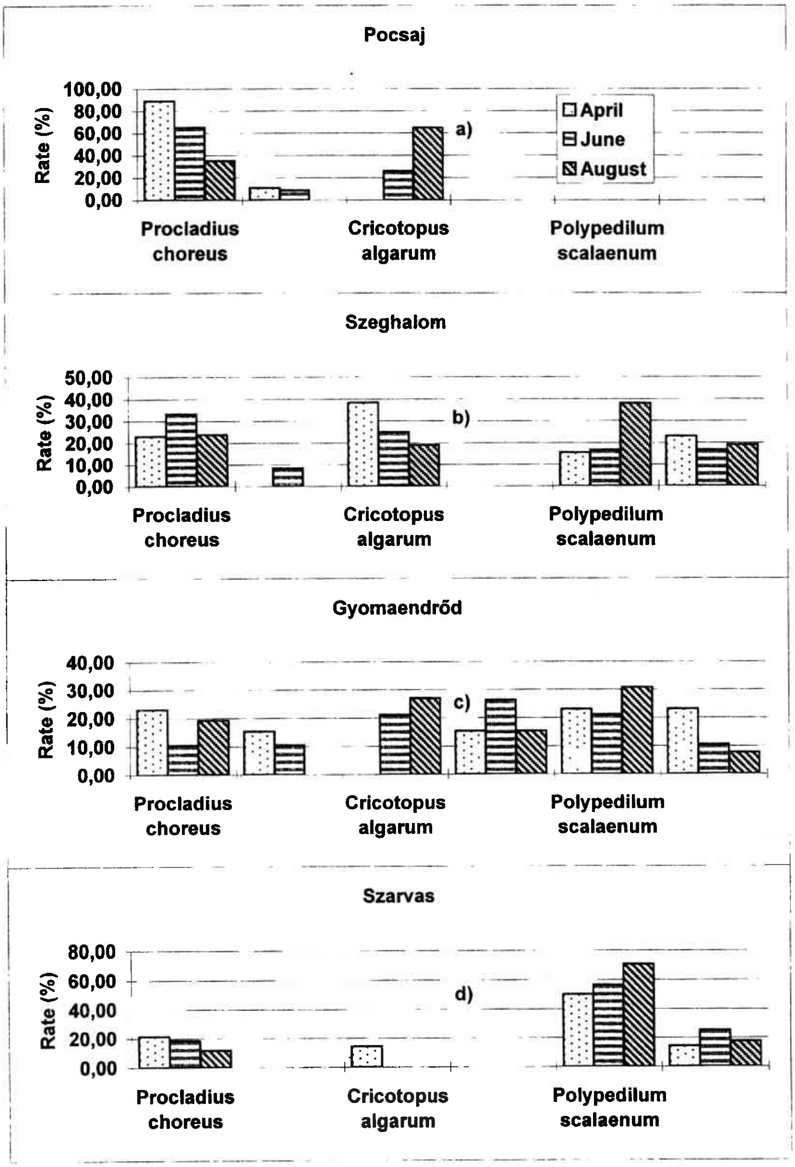

Fig. 4. Dominance of the Chironomid species during the season

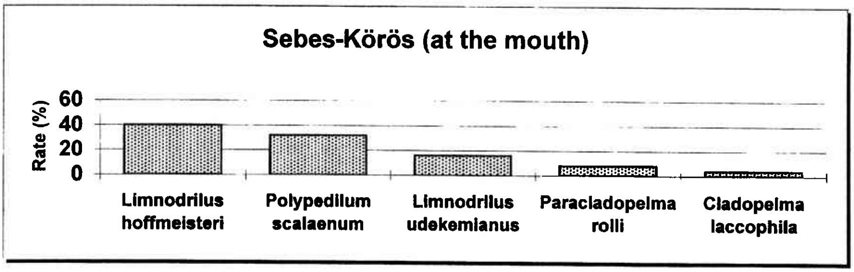

Fig. 5. Mutual species and their dominance

The macrozoobenthos showed the same condition too. It was surprising how Polypedilum nubeculosum was absent by Pocsaj only, but it was present on the other sampling sites. The rate of its larvae ranged between 38-70%, and was dominant. The situation originated from the oil pollution (Fig. 4b-d).The effect of the oil pollution to the zoocoenoses was presented by differences between River Berettyó and River Sebes Körös. That same species were present mostly in both rivers, but the rates were different from Limonodrilus hoffmeisteri, L. udekemianus, and Polypedilum nubeculosum (Fig. 5.).

The common species in the River Berettyó and in the River Sebes Körös were as follows: Limnodrilus hoffmeisteri, L. udekemianus, Polypedilum scalaenum (Fig. 3. and 5.). Cryptochironiomus redekei was the only common species in the River Berettyó and the River Kettős Körös (Fig. 4. and 6.).The big (40%) dominance of the predator larvae of Macropelonia notata was surprising (Fig. 6).

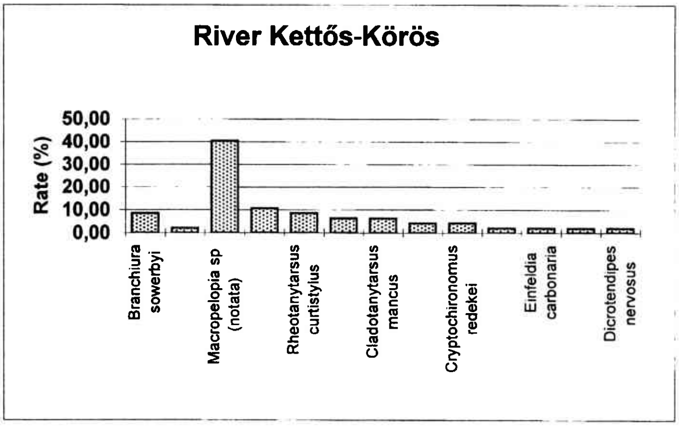

Fig. 6. Oligochaeta and Chironomid species in River Kettős-Körös

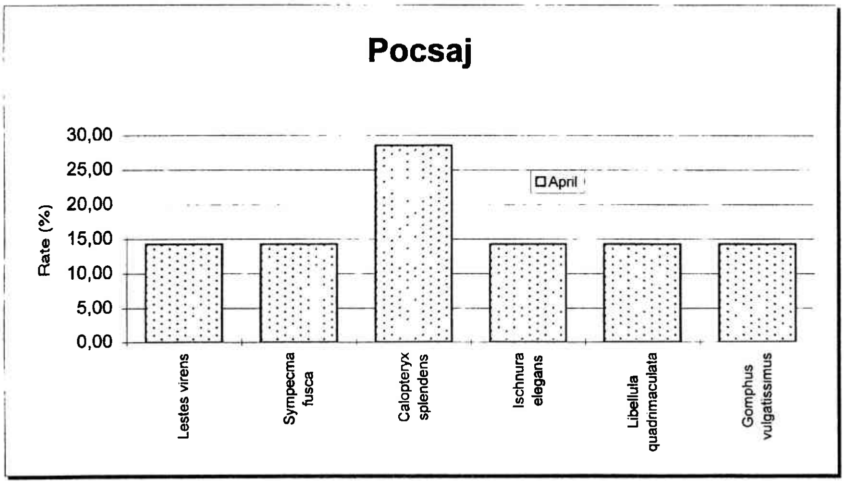

Fig. 7. Dragonfly (Odonata) species in River Berettyó at the beginning of the season

Dragonfly species near Pocsaj (the border area) were as follows: Lestes virens, Sympecma fusca, Calopteryx splendens, Ischnura elegans, Libellula quadrimaculata and Gomphus vulgatissimus. There was no information about the resistance to environmental pollution, but they were very tolerant in the present situation (Fig. 7.).The water body was already free of the oil pollution during the sampling time. The prey of the dragonfly larvae were present, therefore the food source and the respiration of the predators were given for them, as the most important environmental factors.

The Chironomid species richness was 2-4 times higher at the source of the River Berettyó, than at other sampling sites, because the river had a low water quantity, and the concentration of both the communal and industrial pollution was high continually.

The slow water currency resulted ineffective selfpurification. The situation was indicated by the decrease of the Chironomid species from the source to the mouth of the river (Table 1). Regarding the Chironomid species presence, Polypedilum scalaenum was absent at the most polluted sites only. The species had a good tolerance to the environmental factors from the source to the river mouth, but it was sensitive for the different oil pollution level. Tanypus punctipennis, Procladius choreus, and Cryptochironomus redekei were predators. Their food were usually Oligochaete, therefore the abundance depended on the food quantity. The predator Chironomid larvae were tolerant against the low dissolved oxygen concentrations too (Szító, 1994, 1995). Procladius choreus was one of the predator Chironomus species, appeared by Pocsaj and was subdominant (Table 1.).

Table 1.The rate of the Chironomid species of the River Berettyó (Barcău) and Körös Rivers (August. 1995)

	Berettyó (Barcău)						R. S. Körös	River Hármas-Körös	
	Source	Boghiş	Suplacu	Marghita	Sântimreu	Pocsaj	Szeghalom	Gyomaendrőd	Szarvas
Ablabesmyia monilis	3,23								
Cricotopus algarum						64,86	19,05	26,92	
Cryptochironomus redekei		20	60		100		19,05	7,69	17,65
Gymnometriocnemus subnudus		20							
Lauterborniella gracilenta	16,13								
Microtendipes chloris		20							
Polypedilum laetum	16,13								
Polypedilum nubeculosum	6,45								
Polypedilum scalaenum	12,90	40	40				30,77	38,1	70,59
Procladius choreus						35,14	23,81	19,23	11,76
Prodiamesa olivacea	32,26								
Propsilocerus paradoxus	3,23								
Psectrocladius psilopterus	3,23								
Tanypus punctipennis				100					
Zavrelemyia sp.	6,45								

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