The assessment of lotic ecosystems from the hydrographical unity Criş/Körös[1] river system, according to the benthic associations

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Abstract

Hydrobiological research of the rivers Crişul Alb/Fehér-Körös, Crişul Negru/Fekete-Körös and Crişul Repede/Sebes-Körös continues the assessment of the biological state of the tributaries of the river Tisza. The analysis of the fauna shows the presence of some species spread all over the rivers, as well as species with a limited distribution.

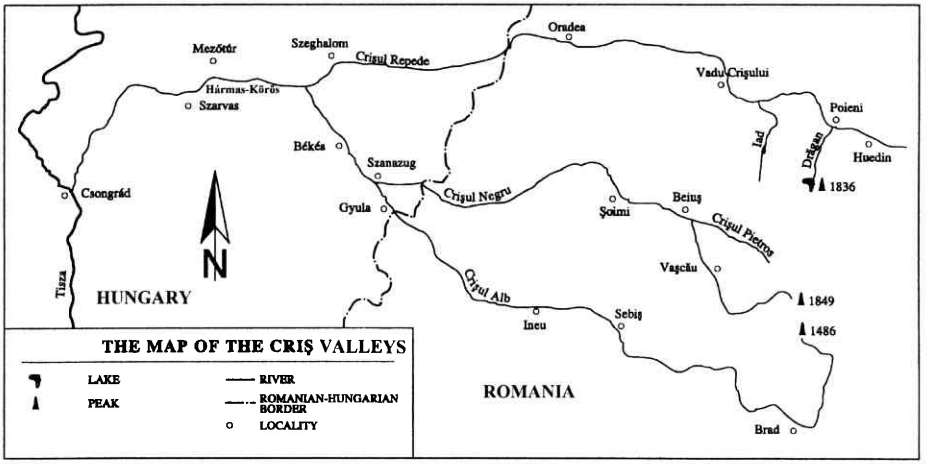
Keyword: lotic ecosystem, trophic categories.

Introduction

Hydrobiological research of the rivers Crişul Alb, Crişul Negru and Crişul Repede continues the studies that began in 1991 which deal with the estimation of the biological state of some tributaries of the Tisza River: Mureş (Hamar et Sárkány, editis., 1994), Someş (Găldean, 1994). The research was carried out by a team of Romanian and Hungarian biologists within a common working program. Studies did not follow the dynamics of aquatic flora and fauna, but rather the observing of the state of the lotic ecosystem at one point in time.

Crişul Alb and Crişul Negru belongs to the category of the rivers of a middle size of Romania, at 240 km and 160 km respectively (up to the border with Hungary). Hydrographical basins have a surface of 4155 sq. km (Crişul Alb) and 3880 sq. km (Crişul Negru) and form, together with the basin of Crişul Repede (2545 sq. km) the hydrographical unity Crişuri, placed in western Romania (see Map). The Criş Rivers form the most important natural drainage area in Western Romania.

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



Materials and Methods

Biological material was collected by dredge, a fine net and with the benthometer from 26 sampling stations (20 from Romania and 6 from Hungary). Fish species for which we captured a large number of specimens were used (for the specimens captured in Crişul Negru and Alb) for the study of intestine content in order to establish their part within the ecosystem: *Gobio albinnatus, Alburnus alburnus, Alburnoides bipunctatus, Gobio kessleri, Gobio gobio obtusirostris, Barbus barbus, Barbus peloponnesius petenyi, Phoxinus phoxinus.*

When we analyzed the intestinal content we took into consideration the following:

a) the establishment of some main trophic sources according to the criterion presence/absence or the quantitative estimations (for example, the number of chironomid larvae remade according to the cephalic capsules or specimen number, mayflies larvae remade according to the pterothecae);

b) "detritus" category represents the organic remains (especially the vegetal ones) taken directly from the environment as a food source; during digestion (observed in different moments) a detritus-like material results but referring to the reconstitute specimen number (larvae) it has no important share.

The biological material, collected either qualitatively or quantitatively was checked in the laboratories of "Grigore Antipa" Museum and preserved in alcohol 70%.

The identified taxons were classified in trophic categories (sensu Vannote et al.,1980; Cummins et al., 1984).

Results and Discussions

1. The main benthic associations of the river Crişul Alb

Downstream springs, in the front of Criş village, the river flow on the bed of coarse gravel and boulders fixed into a fine clay. On the stones there is a clayey pellicle, with algae and moss.

The river is only partially shadowed, this permitting the temperature to increase during every summer season. Fauna is dominated by larvae of the rheophilic insects (stoneflies , caddisflies and mayflies larvae). On the underside of the stones are chironomids, in tubes of coarse sand. Stoneflies (Perlidae) are more frequent in the small waterfalls behind the boulders and are absent in the muddy areas.

Mayflies are represented especially by Heptageniidae and Baetidae, this showing the submontane nature of the area. It is interesting that genus Rhithrogena is absent; especially the species Rhithrogena semicolorata, which is sensitive to the variations in the water temperature.

Ten kilometres downstream (Station 1) the river is strongly affected a dam. Boulders and gravel are covered by a thick stratum of algae and bacteria. The river flow is completely exposed to the sun, hence the water has a high temperature in the summer. Yet, in the areas of high slopes the stoneflies survive (but species of Perlidae don't!) as well as Baetidae, Heptageniidae and Caenidae (Ephemeroptera). The carnivorous stoneflies are replaced by the larvae of dragonflies. Among the roots left in the clayey mud some specimens of Astacus astacus were found, indicating good water quality.

Among the boulders a prevalent association can be noticed; that of the Hydropsychidae caddisflies.

Downstream at Brad the influence of some industrial residue can be easily observed. The river bed is covered with a stinking brownish stratum. Yet, due to the section with high slopes and high speed currents, mayflies (Baetis, Ephemerella) can be found among stones. Fauna is dominated by caddisflies larvae of the family Hydropsychidae, chironomids and oligochaetes. When water input is high, the level of the river increases by 1-1.5m, providing satisfactory washing of the sediment.

At Aciuţa the river bed is formed by boulders and coarse gravel covered with an organic pellicle. The association of Hydropsychidae caddisflies larvae is also prevalent and mayflies of the Heptageniidae appear again(genera Ecdyonurus and Heptagenia).

Downstream at Almaş (Station 5), diversity reaches its highest point. Mayflies are represented by Siphlonuridae, Heptageniidae, Baetidae and Ephemerellidae. Stoneflies are represented by Nemouridae, but the main carnivorous invertebrates are dragonfly larvae. The river has a very rich vegetation on the banks and the river bed is formed of sand and gravel.

Upstream at Ineu, the structure of the river bed is completely different; most of the surfaces consisting of clay mixed with gravel elements (as a conglomerate), full of hollows and oval spaces with Hydropsychidae caddisflies larvae. In places with mud accumulations there are many unionid molluscs; Myriophyllum bushes with Baetidae; gravel with a stratum of bioderma, with Heptageniidae (genus Heptagenia).

At Chişineu-Criş (Station 7), river bed is composed of uniform coarse gravel poor in fauna. On the left bank, on the boulders left there after the dam building, larvae of Heptagenia flava and Caenis moesta were found.

On the Hungarian side, the Crişul Alb is embanked, having a lake aspect. Floating and submerged vegetation shelter a characteristic phytophillous fauna: oligocates, gastropods, insects larvae.

2. The main benthic associations of the river Crişul Negru

The upper part of the river has a montane aspect, with a stony bed with gravel and sand. In fact, this is the section that serves as a passage way to hilly area. Like Crişul Alb, Crişul Negru is mostly a hilly and lowland river. Fauna consists of numerous reophilic elements (Perlidae stoneflies, Heptageniidae mayflies, genus Ecdyonurus) and dipterans of the family Blepharoceridae (net-winged midges), but also has a rich population of Ephemerella ignita.

At Station 9 the prevalent association of caddisfly larvae of family Hydropsychidae is already formed. Fauna diversity is represented by: Oligochaeta ,Amphypoda, stoneflies (genus Perla), mayflies (besides Heptageniidae and Baetidae, species of the family Caenidae also appear), Elmidae (Coleoptera), Chironomidae.

At Stei, due to the quantities of organic material of urban origin, the larvae of Baetis fuscatus and Hydropsyche are favored and the number of rheophilic and oxiphilic species decreases. The river bed consists of gravel and boulders, with small, muddy, slightly deep sections.

From Borz to Tinca (Station 11 and 12), boulders and gravel are covered with mud or with a pellicle of algae and bacteria. Fauna is differentiated according to two elements: benthos and macrophytes (Myriophyllum). Benthos is dominated by the caddisfly larvae (Hydropsyche) and molluscs(Unio), to which we can add oligochets and chironomids.

At Tinca, vegetation diversifies and develops on large surfaces (Myriophyllum, Potamogeton, Chara).

At Borz, Station 11 was separated into 3 subzones: 11a (vegetation and mud, with numerous Chironomidae); 11b (boulders with bioderma); 11c (gravel washed by water, with many Hydropsychidae caddisflies larvae).

Zerind (Station 13) was marked by a rich association of molluscs, Unionidae, on a bed of muddy sand and gravel. Near the banks, the boulders left after the dam building forms the habitat of the mayfly larvae (Heptagenia flava) and of Hydropsychidae caddisfly larvae. Near them there are specimens of Astacus astacus, this showing a good water quality. After entering into the Hungarian territory, Crişul Negru has the same aspect as Crişul Alb: it is rather a lake rich in submerged vegetation, with a diverse "phytophillous fauna."

Farther on, after the two rivers join, the ecosystem become similar to the channels of the Danube Delta, with a lot of submerged vegetation. Fauna is completely changed due to the biotopic changes. Thus, here Baetidae mayfly larvae are represented by the species Cloeon dipterum which replace the species of Baetis. The large number of gastropods, typical for the lake ecosystems, must be noted. Water is of a good quality and well oxygenated. At its mouth at the Tisza, The Criş River formed from the union of Crişul Alb,

Crişul Negru and Crişul Repede carry mud and a lot of floating vegetation (Lemna). On the clayey-muddy bank a rich mollusc association develops (Unio, Theodoxus, Lithoglyphus).

3. The main benthic associations of the river Crişul Repede

The general aspect of the river in the sector downstream from the springs at Şaula village (Station 5), is that of a plain. The tendency of eutrophycation increases as a consequence of the releasing of domestic waste into the water. Chironomids dominate the benthic community; there are also mayfly larvae (Baetidae, Baetis vernus), leeches (Erpobdella octoculata) and oligochaetes. The presence of Astacus astacus crustaceans and Limnephilidae caddisfly larvae was somewhat unexpected; this indicates a relative equilibrium of the system despite the organic loading.

In the sector downstream at Ciucea (Station 11) the river bed changes becoming broader and deeper. The stratum of boulders, cobble and pebble is covered with a thick layer of moss and algae. Despite the stony substrata the mayflies of Heptageniidae (Ecdyonurus, Rhithrogena or Heptagenia species) are missing, the benthic community being dominated by the caddisfly larvae of the Hydropsychidae. As in the sector downstream from the springs the system responds to the increasing eutrophication. Populations of Hydropsyche, Baetis vernus and Ephemerella ignita exist as a consequence of eutrofication. However, some sensitive species like Siphonoperla negleta, Baetis scambus, B. niger are kept unchanged. Up to this sector the lotic system concentrates the allocthonous trophic resources (especially organic particulate matter, originated from the neighboring terrestrial ecosystems).

The sector from Bologa (Station 6), before entering the gorges, is quite different. The river bed is uniform (decreased heterogeneity) and the benthic fauna is less diverse than expected. In this case, the direct relation among diversity of the substrata and diversity of the fauna (Evrard and Mischa, 1995) is not functional: the sector is a transitional one, with an increasing reophilic condition. Hence, the Hydropsyche population has a low numeric level but the Baetis vernus and Ephemerella ignita ones are maintained at the same level.

We presume that the main controlling condition is the velocity of the current; the water moves on stony, equal substrata without forming bubbles.

The sector of the gorges, downstream at Stâna de Vale (Station 8) points out another change of the abiotic conditions: velocity of the current is 0.6-0.8 m/s, water temperature is about 14.5 C, and there is heterogeneity of substrata with many boulders covered with moss clumps.

Between the Bologa and Stâna de Vale sectors the deposition of coarse particulate organic matter (CPOM) can be observed; in this way the conditions for the filtering collectors are rather unfavorable; the number of the gathering collectors and shredders increases.

Between the sampling areas 11 and 6 the river received the tributaries Iad and Drăgan. Both of them are very typical mountain rivers, with a stony bed and high current velocity. They both have dams and reservoirs which periodically determine changes of the flow. The releasing of the cold water from those reservoirs forms very high floods which influence the Crişul Repede river. Therefore, the stenothermic species have good conditions.

Upstream of the gorges, the quantity of water may dissipate more than usual, when the valley is sufficiently wide.

Downstream from the gorges (station 9) it is a stony riverbed; at the right border, stone pieces and boulders allow the deposition of silt and fine detritus. At the left border there are small pebble beeches. Only in this microhabitat are some benthic species found, such as Ecyonurus dispar and gammarids ones.

At area 9, in the sector of Aleşd, the characteristic benthic species are Oligoneuriella rhenana, Baetis rhodani, Ecdyonurus dispar, Ephemerella ignita, Caenis luctuosa, Pothamantus luteus, Ancylus fluviatilis, Hydropsyche, chironomids, oligocaetes, gammarids.

The overflow of the water (as a consequence of the clearing of the reservoirs) is significant in this sector, yet it gathers the coarse detritus and mud, forming special habitats:

a) there are many dragonfly larvae that replace the stonefly ones as predator; there are also Baetis rhodani, Ecyonurus insignis, Ephemerella ignita, Caenis luctuosa. The population of Hydropsyche larvae is numerous. An equilibrium of the filtering and gathering collectors can be observed.

b) in the center of the flow, it is a stony substrata (boulders, cobble, pebble). The most characteristic species is Oligoneurilla rhenana. The system has the capacity to preserve some of the pristine conditions despite the existence of disturbing factors (the untypical variations of temperature, the high quantities of mineral nutrients).

The local benthic community may be named a "stress community" and reflects the carrying capacity of the lotic system by diversifying the trophic categories depending on the resources (mineral or organic). The community seems to be very stable, so far, and its existence can be decided by the quality of the water.

Downstream at Aleşd, a dam forms a reservoir which interrupts the flow of the river.

The sector downstream from the reservoir (Station 13) is totally dependent on the releasing of water. The reservoir warms in the summer and the conditions for algal blooming are present (information from some natives).

The sampling area was situated on a natural branch: here, the boulders are covered with a thick layer of algae and moss. The characteristic species are Aselus aquaticus, Caenis macrura and Hydropsyche. The group of predators includes hidracarians, larvae of Plectronemia conspersa and coelenterates (Hydra species).

The sector upstream at Oradea (Station 12, near Fughiu) is very different. The valley is wide (30-40m) and the riverbed is composed of boulders, cobbles and pebbles which are covered with a thin layer of periphyton.

The characteristic species can be correlated with some microhabitats:

- plate boulders with Oligoneuriella rhena, Ancylus fluviatilis and chironomids in sandy tubes;

- cobbles with Heptagenia sulphurea, Electrogena lateralis, Ephemerella ignita, Hydropsyche sp., Elmidae;
- the spaces between boulders, with fine mud and detritus, with chronomids and oligochaetes;
- the moss clumps with Potamanthus luteus, Baetis scambus, chironomids, hydracarians;
- clay border with galleries of Ephoron virgo.

The species Ecdyonurus are missing, being replaced by other species of Heptageniidae. The filtering collectors are numerically reduced, in comparison with scrapers of gathering collectors; the latter are depending on the productivity of periphyton.

The sector at Cheresig (Station 10) presents a sandy riverbed; the slow current allows the development of submerged macrophytes. The left bank is clayey and muddy, with an important population of Anodonta woodiana. The waste released into the river determines the increase of eutrophy. The system exhibits a specific reaction by promoting the functional compartment of macrophytes-phytophillous fauna.

The significance of the compartment of submerged macrophytes-phytophillous fauna

In the lower sector of the lotic system, the presence of this compartment is very significant for the content of mineral nutrients in the water.

In the Crişul Repede system, some species of maccrophytes, especially in the Cheresig sector, were identified: Potamogeton fluitans. P.crispus, P. pectinatus. The plants have an important retention capacity for some biogenic elements, the time of retention being dependent of the vegetation period. P.pectinatus, having a short vegetation period, releases those elements into the water in the July-August.

The analysis of phytophillous revealed some interesting aspects:

- downstream at Ciucea, mayflies and chironomids were dominant (gathering collectors and detritivorus, in general);
- near Cheresig, due to the increase of eutrophy, chironomids and simunliids larvae become dominant (detritivorous and filtering collectors). These taxonomic groups contribute to the biological cleaning of the water.

It can be asserted that in this type of lotic system the submerged macrophytes represent an accessory compartment, characteristic for a certain level of eutrophy. The functionality of the phytophillous fauna is very difficult to estimate: many species can be found in the benthos, too (Fig. 2).

The biocenosis "use" this compartment to increase the internal diversity of the lotic system with the help of the newly obtained third dimension; the macrophytes being a support for phytophillous fauna and periphyton.

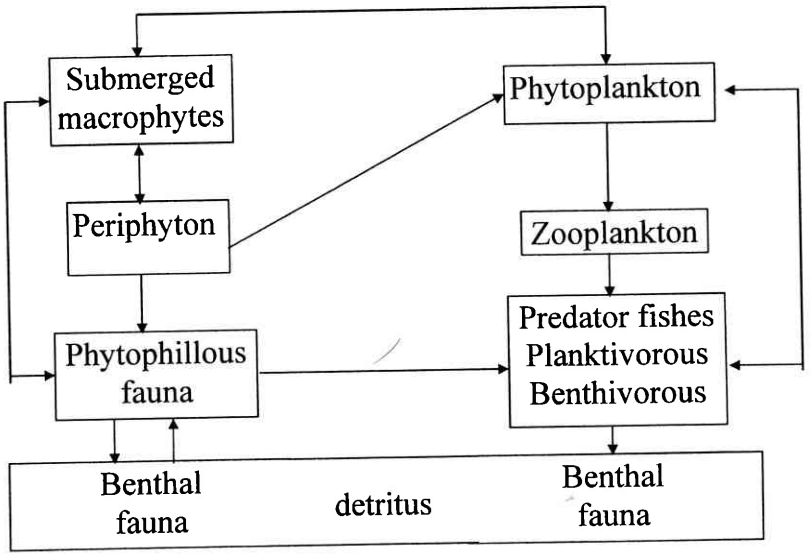


Fig. 1. The integration of the submerged macrophytes- phytophillous fauna compartment in the lotic ecosystem.

4. Consideration of the ichthyofauna

The diversity of the ichthyofauna of Crişul Alb and Crişul Negru is almost equivalent with that which was expected. The collecting, done during short periods of time, confirmed the presence of most of the species that were theoretically thought to be present in this area. The species which surely occur here but which couldn't be captured (Lota lota, Silurus glanis, Exos lucius) require specific fishing methods and more time. In addition to this remarkable diversity, population dimensions are impressive. The species with the largest population are Alburnus alburnus and Alburnoides bipunctatus. Also, a large number of Gymnochephalus schraezer and Gymnocephalus baloni can be found.

The presence, in large numbers, of Zingel zingel and Zingel streber is a very good sign, considering that these fish are very sensitive regarding water quality, becoming, for this reason, very rare or extinct from other rivers.

The characteristic division of the ichtyofauna into zones occurs on both rivers: a trout area, one of the Barbus peloponnesius petenyi (maybe the grayling is missing from the Criş rivers), of the broad snout, of the barbelll and of the carp. General tendency of the past few decades is the shifting of these areas upstream. The Criş rivers are not an exception, as proven by the presence of Gobio albipinnatus in the same locality with Barbus pelopennsius petenyi, at the Station Aciuţa (Crişul Alb). It is interesting to note the presence of all four species of Gobio in the same locality (Station 11, Borz, Crişul Negru), each of these species being adapted to different water speeds. Downstream at Brad (Crişul Alb), was identified the single zone with a slightly troubled ichthyofauna, the result owing to the great numbers of villages in the area.

5. Some population part in the control of the benthic fauna

5.1 Gobio albipinnatus (Figs. 2, 3). In our analysis of the intestinal content of samples collected from Crişul Alb, from Almaş (Station 5) and Ineu (Station 6) we noticed that chironomids are prevalent (57.9% and 62.8%).

Food is completed with detritus (33.3%) and small quantities of mayflies, caddisflies and Elmidae (Coleoptera). The prevalent trophic resources used in Crişul Negru are: detritus (75%) in Station 11 (Borz) and chironomids (76.5%), Station 13 (Zerind).

5.2 Alburnoides bipunctatus (fig. 4). For the specimens captured from Crişul Alb, at Almaş (Station 5) we recorded a balanced distribution of food categories (insect larvae). At Ineu, Alburnoides bipunctatus "exploit" the main resource, detritus (50%) and the caddisfly larvae of Hydropsychidae (31.5%). The population from Ştei, Crişul Negru (Station 10) feeds more on detritus (50%) but also on caddisfly larvae (40.7%), especially on Baetis fuscatus. So we can do the same mention as for Gobio albipinnatus: its tendency for using the prevalent trophic resource .

5.3 Alburnus alburnus (Fig. 5). The specimens from Almaş, Crişul Alb (Station 5) are feeding with: chironomids (53.7%) and detritus (33.3%) to which we can add the mayflies (11.2%) and caddisflies (1.8%). At Chişineu-Criş, Crişul Alb (Station 7) these two main categories are still maintained to which coleopterans are added (17.4%). At Zerind, Crişul Negru (Station 13), the food consists of detritus and chironomids but the detritus proportion increase to 75%.

5.4 Gobio kessleri (Fig. 6 A). Chironomids are prevalent in food (94.5%); mayflies, caddisflies and other insects are also found.

5.5 Gobio gobio obtusirostris (Fig. 6 B). The captured specimens have a trophic spectrum obviously dominated by detritus (66.7%) and chironomids (32.4%).

5.6 Barbus barbus (Fig. 7 A). Food consists mostly of chironomids (53.4%) and detritus (33.3%).

5.7 Barbus peloponnesius petenyi (Fig. 7 B). For the specimens from Ştei, Crişul Negru (Station 10) food consists of detritus (50%), chironomids (30.3%), Baetidae (Ephemeroptera) (15.9%).

5.8 Phoxinus phoxinus (Fig. 8 A). The food of the specimens collected from Crişul Negru, at Ştei (Station 10) consists of detritus (50%), mayflies (29.8%) and chironomids (19.0%). It has the same trophic spectrum as Barbus peloponnesius petenyi but the proportion between mayflies and chironomids is inverted.

5.9 Cottus gobio (Fig. 8 B). The specimens collected from the upper sector of Crişul Negru, at Poieni (Station 8) have a trophic spectrum represented especially by the rheophilic caddisfies larvae (42.5%), mayflies (33.3%) and chironomids (21.7%) and a small number of Blepharoceridae (2.5%).

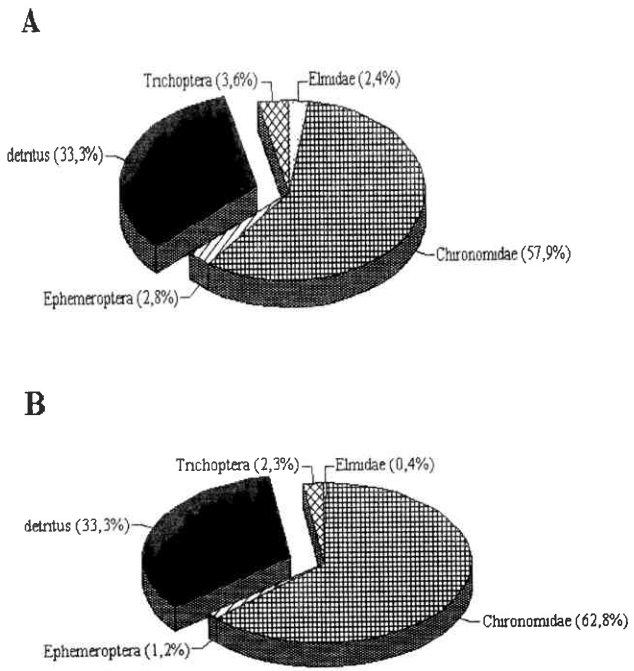
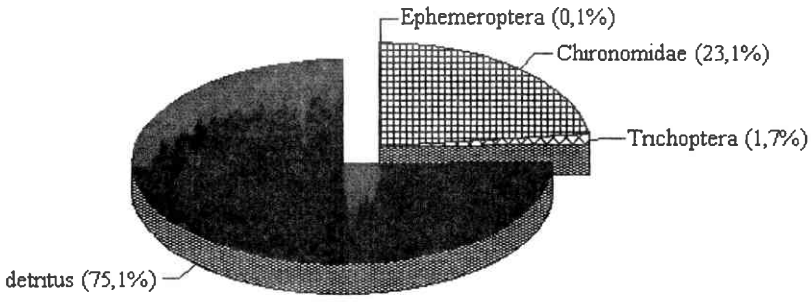


Fig. 2. Trophic spectrum in Gobio albipinnatus; A - Crişul Alb at Almaş; B - Crişul Alb at Ineu.

A



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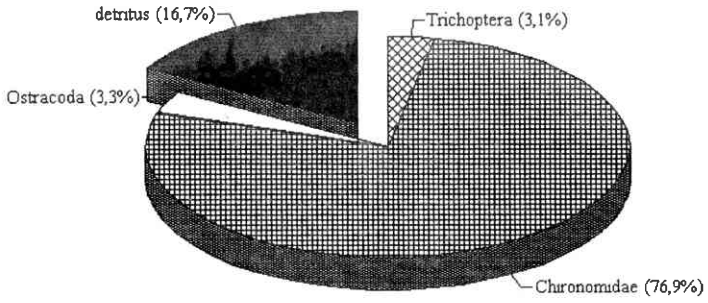


Fig. 3. Trophic spectrum in Gobio albipinnatus; A - Crişul Negru at Borz; B - Crişul Negru at Zerind.

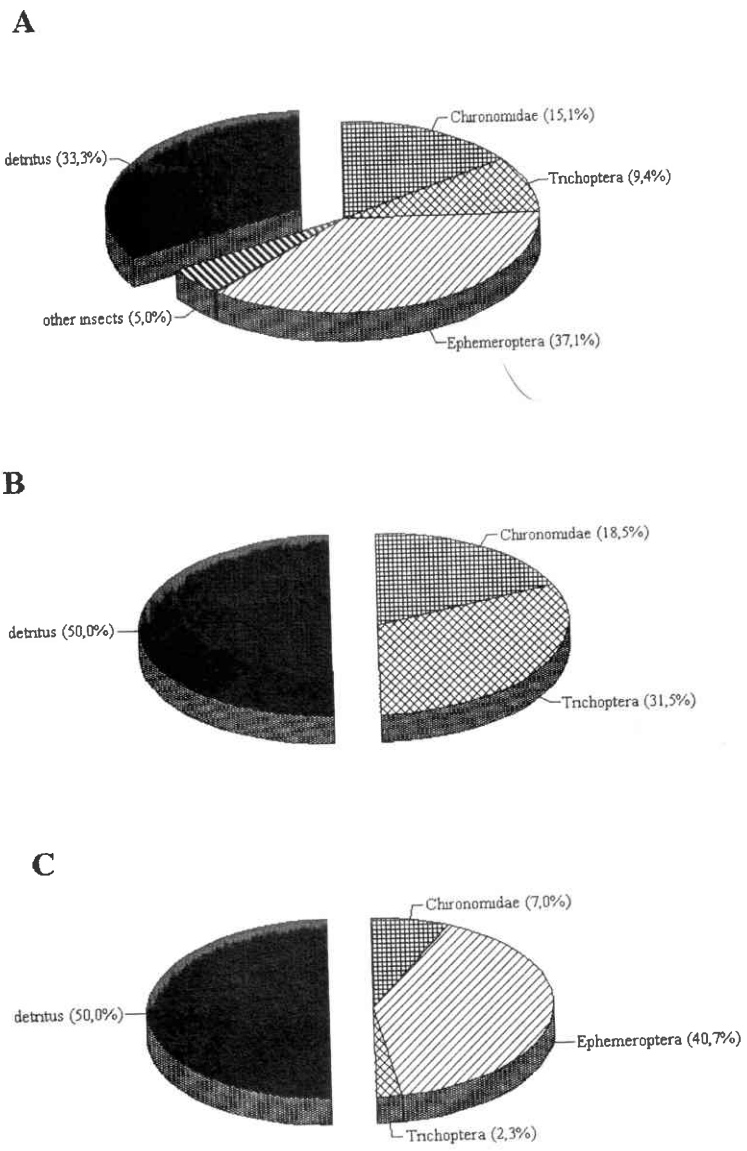


Fig. 4. Trophic spectrum in Alburnoides bipunctatus; A - Crişul Alb at Almaş; B - Crişul Alb at Ineu; C - Crişul Negru at Ştei.

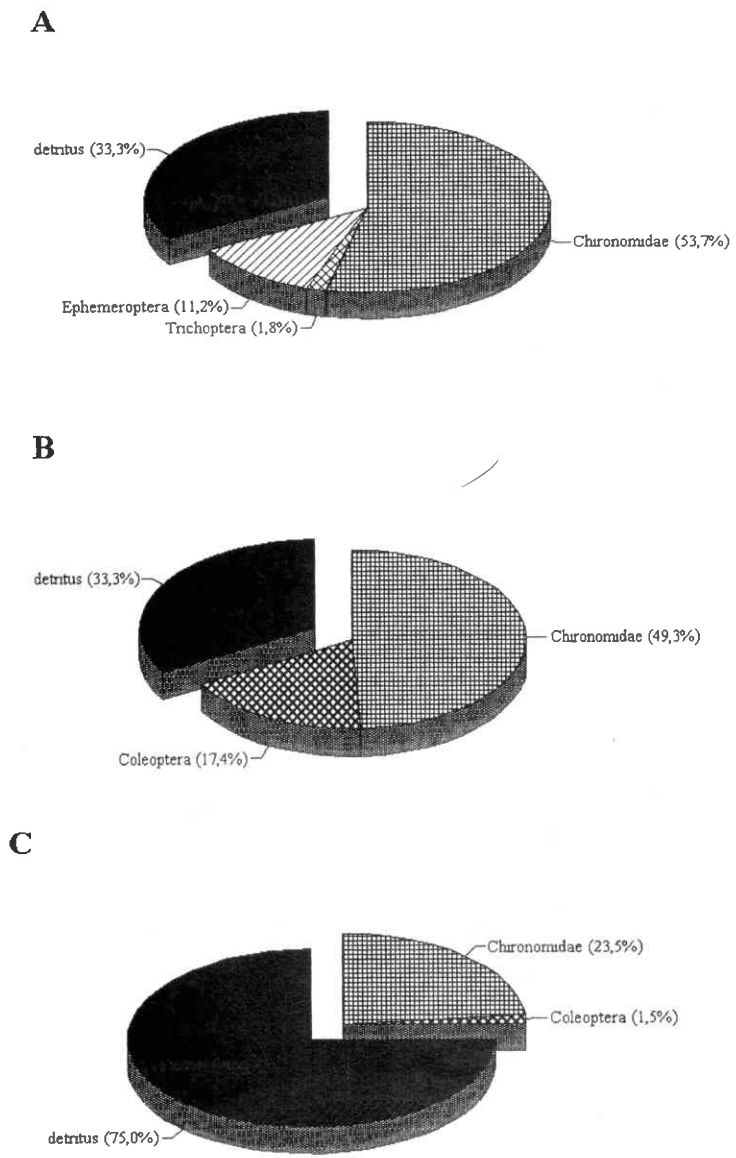
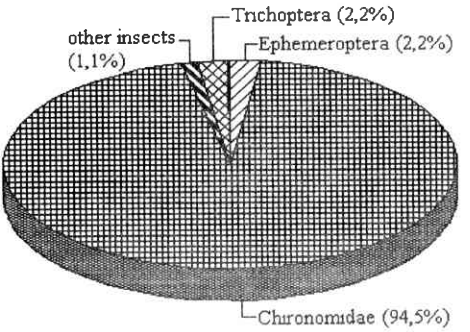


Fig. 5. Trophic spectrum in Alburnus alburnus; A - Crişul Alb at Almaş; B - Crişul Alb at Chişineu-Criş; C - Crişul Negru at Zerind.

A



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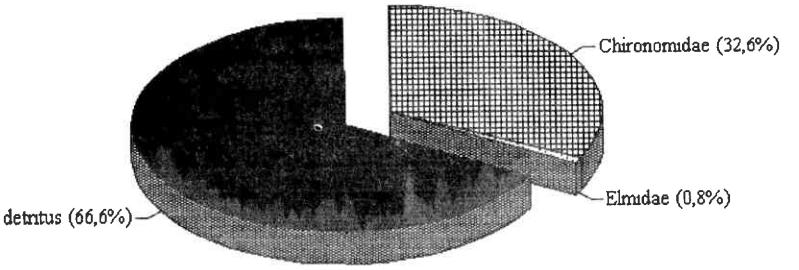

Fig. 6. Trophic spectrum in A - Gobio kessleri, Crişul Alb at Almaş; B - Gobio gobio obtusirostris, Crişul Negru at Borz.

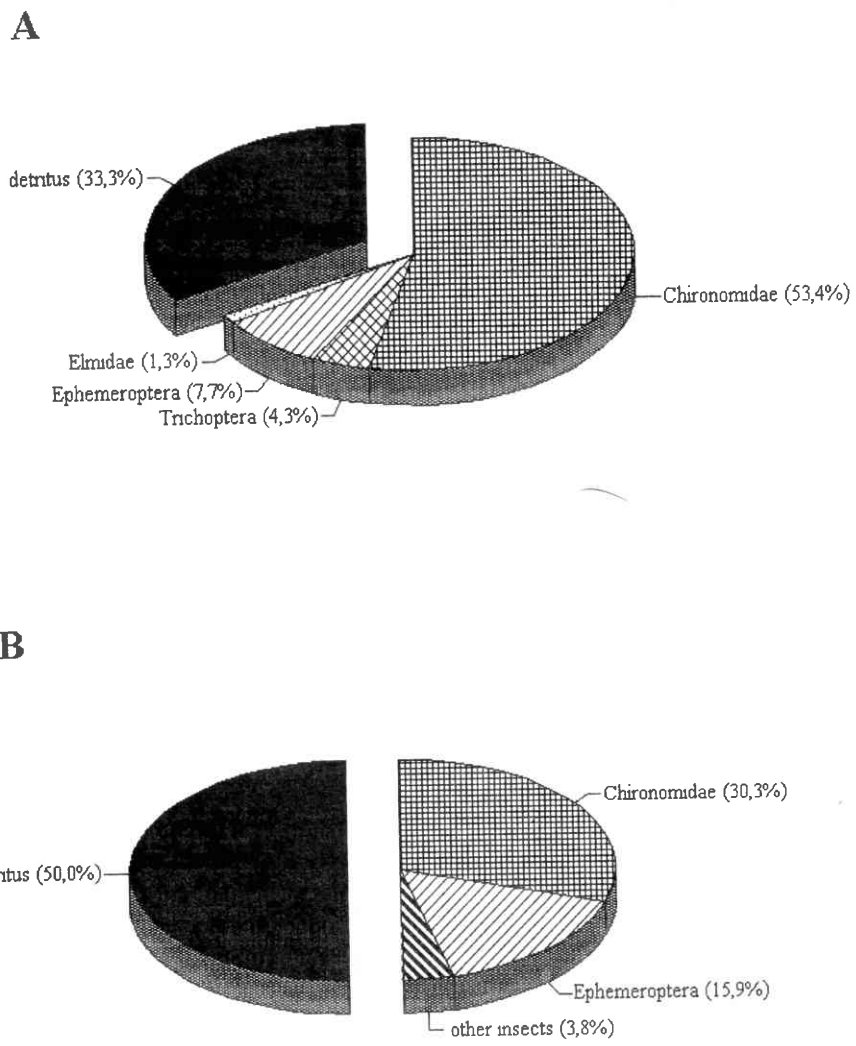

Fig. 7. Trophic spectrum in A - Barbus barbus, Crişul Alb at Aciuţa; B - Barbus peloponnensius petenyi, Crişul Negru at Ştei.

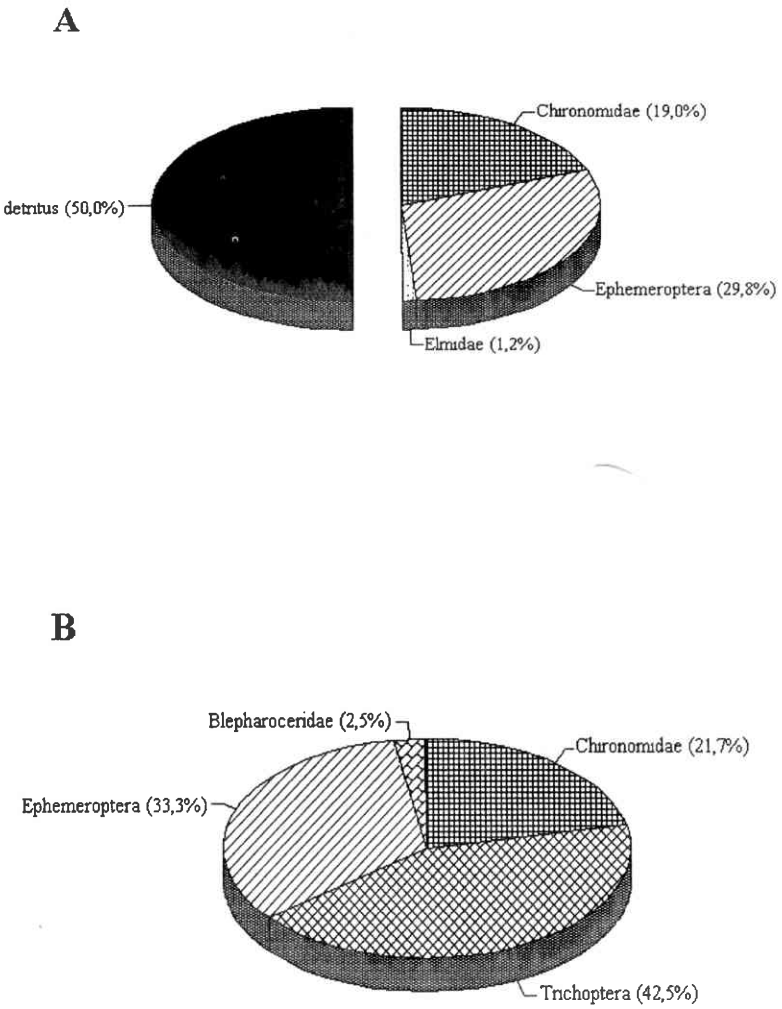

Fig. 8. Trophic spectrum in A - Phoxinus phoxinus, Crişul Negru at Stei; B - Cottus gobio, Crişul Negru at Poieni.

An analysis of the data obtained from every station gives us the following records:

a) food of the fish reflects only partially the abundance of benthic populations. Thus, at Almaş, chironomids are preferred by Gobio albipinnatus, Alburnus alburnus,Gobio kessleri. Although they are not prevalent, Alburnoides bipunctatus feeds not only on chironomids but also on other insect larvae. At Ştei (Station 10) it was noted that Alburnoides bipuctatus and Barbus peloponnesius petenyi feed on larvae of Baetis fuscatus (numerous!).
b) detritus represents an important percentage of the food of many species. This leads us to the idea that ichthyofauna has the possibility of using an important source which appears especially within the conditions generated by the water eutrophication.

Ichthyofauna creates an efficient control on benthic populations and, at the same time, may determine the ratio of the detritus. In this way, at Almaş (Crişul Alb, Station 5) we remarked a different diet in Gobio kessleri, Gobio albipinnatus, Alburnus alburnus and Alburnoides bipuctatus (Figs 2-6). Gobio kessleri prefers chironomids in a proportion of 94.5% while Gobio albipinnatus and Alburnus alburnus in a proportion of 57.9% and 53.7% respectively, completing their food with detritus and other insect larvae. As regards mayfly larvae, Alburnoides bipunctatus and Alburnus alburnus prefers them in a proportion of 37.1% and 11.2% respectively. Although caddisflies of family Hydropsychidae are frequent in the benthos from Almaş, their proportion in fish food doesn't exceed 9.4% (in Alburnoides bipunctatus).

The same differences appear at Ineu (Crişul Alb, Station 6): Gobio albipinnatus uses chironomids in a proportion of 62.8% and Hydropsychidae caddisflies only 2.3% while Alburnoides bipunctatus "balances" these proportions (18.5% for chironomids and 31.5% for caddisflies).

At Ştei, water eutrophication generates the accumulation of large quantity of detritus which appears as an important element (50%) in the food of the species Alburnoides bipunctatus, Phoxinus phoxinus and Barbus peloponnesius petenyi. The percentage of mayflies larvae (up to 40.7% on Alburnoides bipuncatatus) must be pointed out.

At Zerind (Crişul Negru, Station 13) the two main fish populations (Alburnus alburnus and Gobio albipinnatus) control the two main food sources: detritus (75% for the first species) and chironomids (76.9% for the second one).

Conclusions

The presence of caddisflies larvae along the rivers Crişul Alb and Crişul Negru allows us to use them as an indicator of division into zones. Unlike Someş (Găldean, 1994), Crişul Alb and Crişul Negru has less mayflies species with a more irregular distribution. Thus, only Caenis moesta and Ephemerella ignita are present in almost all sampling stations.

This is due to the "division" of the biotopic conditions as a result of the punctual sources of the organic loading (Fig. 3).

Both Criş rivers (Alb and Negru) flow at a low altitude in a field area and have at least two major influences:

a) an important increase of the temperature during summer, especially within the past few years, and extreme drought, correlated with the decreasing on the water flow;
b) the effect, accumulated in time (without being well distinguished), of the draining of organic fertilizers in the river bed. Even during the past few years when the conditions were favorable (the lack of fertilizers or their prohibitive price), the ecosystem reacted on the organic loading, developing those associations which could consume the excess (associations with Hydropsychidae larvae, hirudineans).

Ichthyofauna has a very important part especially within the areas affected by the pollution of an urban origin, consuming a part of the accumulated detritus.

The preservation of the ichthyofauna diversity is vital for maintaining the equilibrium of these two rivers. At Borz (Station 11) on the Crişul Negru, the 4 species of Gobio have particular habitats (Fig. 11), but, at the same time, they depend on the maintenance of the benthic fauna.

Concerning the Crişul Repede, it wasn't possible to realise a biological division into zones.

Despite the geographical conditions of the river flowing through a densely populated region, the biological state of the system is rather satisfactory! Up to the Cheresig sector (Station 10), two main factors can be taken into account:

a) the variations of the flow, induced by the releasing of the water from the dam reservoirs;
b) the missing of the protective effect the floodplain (disappeared as a consequence of impoundment).

By the faunistical analysis, it can be concluded that some taxa may be considered significant enough: Baetis vernus, Ecdyonurus dispar, Ephemerella ignita, species of Hydropsyche. The absence of E.insignis larvae in some sampling areas is significant, too.

The lotic system reacts to these factors by some strategies:

a) preponderance of the species who can use the periphyton or particulate organic matter;
b) the increasing of diversity in stations 7 and 12, substrata being heterogeneous;
c) the developing of the submerged macrophytes-phytophillous fauna compartment, in order to use the exceed of mineral nutrients.

In comparison with the Crişul Alb and Crişul Negru, the lotic system of the Crişul Repede seems to be more influenced by the dams:

- the missing of stoneflies larvae in almost all sampling areas.
- the missing of mayflies of the family Siphlonuridae.

On the other hand the sector Fughiu and Aleşd are more diverse and the presence of Oligoneuriella rhenana larvae is relevant for the quality of the water.

There is a pattern strategy as a response to stress factors and for maintaining an optimum number of species.

The tendency of simplifying the structure of lotic biocenosis is evident. This phenomenon is common for many Romanian rivers.

References

Bănărescu, P. (1957): Analiza zoogeografică a faunei ihtiologice a R.P:Române.-Probl. geogr. Bucureşti, 1,: 199-215.

Cocean, P. (1988): Chei şi defilee din Munţii Apuseni.- Edit.Acad.R.S:R, Bucureşti: 137-146.

Cummins, K.W., Minshall, G.W., Sedell, J.R., Cushing, C.E., Petersen, R.C. (1984): Stream ecosystem theory. - Verh. Internat. Verein. Limnol. Stuttgart, 22 (3): 1811-1818

Găldean, N. (1994): Biological division of the Someş River into zones according to the mayflies fauna (Insecta: Ephemeroptera). Trav. Mus. Hist. nat. "Grigore Antipa". Bucureşti, 34,: 435-454.

Găldean, N., Bacalu, P., Staicu (Gabriela). (1995): Biological division of the rivers Crişul Alb and Crişul Negru into zones according mayflies fauna and of the ichthyofauna. - Trav. Mus. Hist. nat."Grigore Antipa". Bucureşti, 35,: 567-592.

Găldean, N., Staicu (Gabriela). (1996): The carrying capacity assessment of the lotic system Crişul Repede (Tisa area catchement, Romania), based on faunistical analysis. - Trav. Mus. Hist. nat. "Grigore Antipa". Bucureşti. (in press)

Grigore M. (1989): Defileuri, chei şi văi de tip canion în Romania. - Ed.Ştiinţifică şi Enciclopedică, Bucureşti: 72-80.

Hamar, J., Sárkány-Kiss, E. (edits), (1995): The Maros/Mureş River Valley. A study of the geography, hydrobiology and ecology of the river and its environment. - TISCIA monograph series. Szolnok-Szeged-Târgu-Mureş, 257 pp.

Ujváry, I. (1959): Hidrografia R:P:R.- Edit. Acad.R:P:R. Bucureşti,: 1-287

Vannote, R:L:, Minshall, G:W:, Cummins, K.W., Sedell, J.R., Cushing, C.E. (1980): The River Continuum Concept. - Can. J. Fish. Aquat. Sci. Canada, 37,: 130-137.

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