# Composition and long-term changes of the invertebrate macrofauna in two streams of the Pilis Mountains, Hungary

By

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**Abstract.** This study surveys the changes occurred in the latest 45 years in the invertebrate macrofauna of two mountain streams formerly under regular examination. Changes detected in the composition of the fauna indicate the degradation of the stream habitats. Cluster analysis revealed that the fauna is similar in both streams.

The Hungarian Danube Research Station of the Hungarian Academy of Sciences in Göd has been investigating the streams running into the Danube from a hydrobiological point of view for several years. Within this program, I have studied the invertebrate macrofauna of two permanent streams in the Pilis Mountains: the Bükkös Stream and the Malom Stream (Csörgits, 1996). Hereby I want to show some series of data and results taken from this research.

Research of the workgroup initiated by Sebestyén was a pioneering work among the studies of Hungarian small streams, by which they started the comprehensive hydrobiological survey of waters flowing into Lake Balaton (Entz, 1958; Entz et al., 1954; Lukacsovics, 1958a, 1958b). With leadership of Ábrahám they also conducted successful research on the small streams and standing waters primarily of the Bükk Mountains and their surroundings (Ábrahám et al., 1951, 1952; Ábrahám, Horváth & Megyeri, 1956; Ábrahám, Biczók & Megyeri, 1960). Publication showing the hydrobiological situation of the Vörösvári Valley to the north of Budapest (Ponyi & Dvihally, 1956) describes not only the physiographic characteristics of the stream but also its phyto- and zooplankton coenoses, while research conducted on the Mánfa Stream in the Mecsek Mountains is of utmost importance from the viewpoint of research of interstitial fauna (Ponyi & Ponyi J-né, 1962).

UNESCO has founded the Pilis Biosphere Reserve in the Pilis- and the Szentendre-Visegrádi Mountains on 23,000 hectare territory of the Pilis State

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Forestry and the landscape-protection area in 1981, which stimulated comprehensive, regular series of studies in its territory (Berczik, 1984). Gróf (1967) reports the results of a zoological and hydrobiological survey of the Bükkös Stream. He describes the specific, hydro-ecologically different bed reaches from an ecological and zoological point of view, the latter mainly based on species spectrum of typical stream organisms (Ephemeroptera, Plecoptera, Trichoptera). Later studies have been done on the same sampling sites, including the collection of samples used for this paper.

Berky (1979) strove to trace the spatial and temporal changes of the hydrochemical conditions in the Malom- and the Bükkös Stream. The registered changes of state allow us to draw conclusions regarding the buffer capacity of the water. She found that water pollution can be detected *via* hydrochemical analyses, but components indicating pollution vary in time and space.

Barótiné Albert (1986) examined the chemical circumstances in the water and the sediment of the Malom Stream of Dömös and the valley of the Szőke Spring; in that paper a detailed plant coenological description of the area can also be found. The hydrochemical analysis showed that the Malom Stream is undisturbed till its mouth, where it is polluted by sewage influx.

Publications of Andrikovics (1988, 1991) are of high importance, in which he surveyed the insect fauna (Ephemeroptera, Plecoptera, Trichoptera) of streams in the Pilis Mountains. In his 1991 study he not only processed his samples but also samples of some earlier collections (Berczik & Wolf in 1951 and Oertel & Nosek in 1979), with which he created an opportunity to make long term surveys. Comparative part of my work is based on data series of this study.

The work describing the typical winter macrofauna of the Bükkös Stream (Andrikovics & Kéri, 1991) is pointing out to the connection between the pollution identifiable with hydrochemical investigations and the change in the species composition.

A study by Nógrádi, Uherkovich and Andrikovics (1991) gives a detailed picture of the Trichoptera fauna of the streams in the region, describing abundance and species pattern by the sampling sites of 59 Trichoptera species found in the area of the Visegrádi Mountains.

Study by Simonyi (1981) makes an important attempt to depict the ecological circumstances of another Pilis stream (Apátkúti Stream) on map. This work, well combining the detailed geographical description of the area with the surveyed hydroecological factors, reinforces that habitats of small streams are characterized by mosaic patterns.

Connection between the spatial and temporal hydrochemical patterns and Trichoptera species distribution was also shown (Csutákné, 1973) on a stream of similar type and size (the Morgó Stream in Börzsöny Mountains) to the ones I studied. Importance of long term surveys is reinforced by the results of

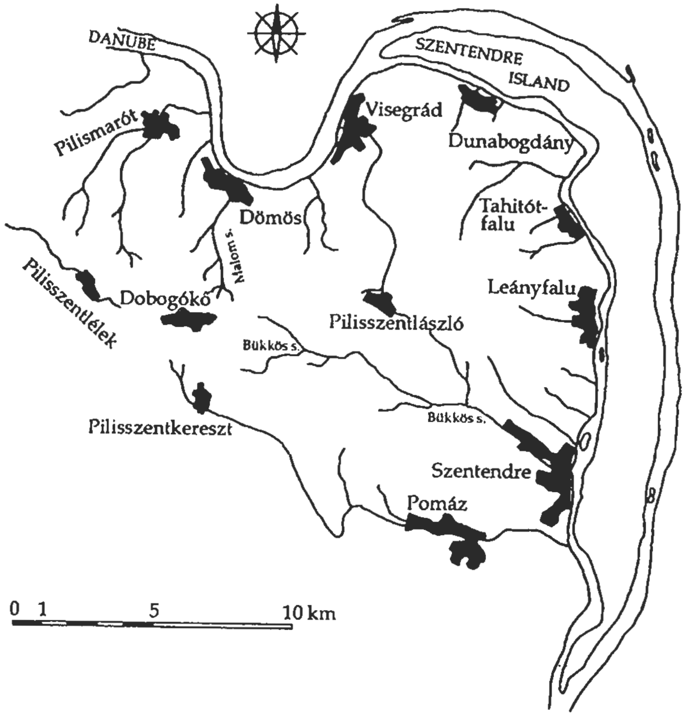


Fig. 1. The streams of the Pilis-Visegrádi Mountains

a research done on this stream 10 years later: the area became subject to heavy tourist activity, which was well reflected by the changes in the stream fauna: for example, only 6 Trichoptera species could be found out of the 20 found a decade earlier (Berczik & Pham Ngoc, 1988).

## Description of the research area

Geologically and geomorphologically the Pilis-Visegrádi Mountains can be divided into two parts: the Pilis in the Southwest, made up of Triassic dolomite and limestone and the Visegrádi Mountains in the Northeast, which is of volcanic origin (primarily andesite). Highest peak of the latter (called Dobogó-kő) is 700 m high; average annual precipitation is 690 mm. The volcanic Visegrádi Mountains are significantly more abundant in surface water streams, the ones surveyed in this paper are situated here, too (Fig. 1).

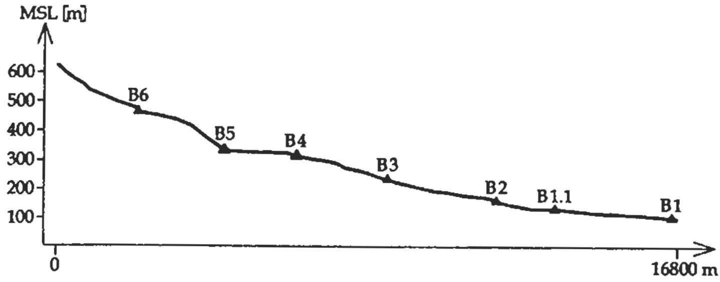


Fig. 2. Long section of the Bükkös Stream (B6–B1: sampling sites)

*The Bükkös Stream*

The Bükkös Stream is one of the longest and most water-abounding stream of the Visegrádi Mountains (its watershed area is approximately 39.2 square km). Length of its northwest-southeast directed valley is 16.8 km, fall of the bed is 525 m from the spring to the mouth. Average fall per km is 31 m, but reach characteristics is changing due to the varied fall (Fig. 2). The spring is on the southern part of the Dobogó-kő and the stream reaches the Danube in Szentendre.

The Bükkös Stream is of upper reach characteristics from its spring until the Sikáros Basin, where its narrow erosive valley changes into a middle reach bed from the northwestern part of the basin to the Schubert János Spring. From this part, it is again of upper reach type till Dömörkapu, where it changes to middle reach until the mouth.

Rate of flow and water level of the Bükkös Stream is not steady, it depends primarily on the quantity of rainfall and its distribution throughout the year. There is high water after the early spring melting of snow (March/April) and due to heavy rainfall in the early summer (May/June) and the late autumn (October/November) periods. When water is low (in summer: July/August, in autumn: September/October and in winter: December/January), the stream dries out above the Sikáros Basin. Width of the bed is 1.5–3 m at middle water. Depth becomes significant only at the erosive dips, at some sites of this kind a basin deeper than 1 m is formed, but characteristic sections are quick running ones of 10–30 cm depth. Material of

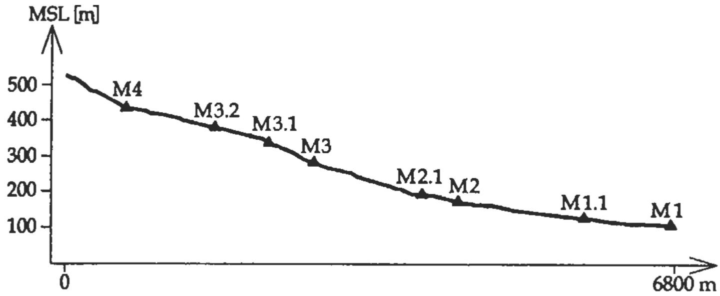


**Fig. 3.** Long section of the Malom Stream (M4–M1: sampling sites)

the streambed is almost everywhere smaller-bigger andesite stone blocks, but at the upper reach at some places the water runs between more sizable rocks.

Valley of the Bükkös Stream is made varied by different plant communities. Besides the communities typical of the upper reach (Melittio-Fagetum - beech-wood with hornbeam and some spots of Piceetum excelsae - spruce-wood with beech), others can also be found along the stream, namely Querco robori-Carpinetum (oak-wood with hornbeam), Corno quercetum pubescenti-petreae (wood of oak species preferring warmth) and Quercetum petreae-cerris (oak-wood with Turkey oak). The trees of the alder grove (Aegopodio-Alnetum), which accompanies the stream up until Szentendre, have their roots often stretching right into the bed. Within Szentendre, only weed communities (primarily Lolio-Alopecuretum) border the stream being directed by concrete dams, in its mouth it flows across a softwood grove (Salicetum albae-fragilis) and reaches the Danube.

Berky (1979) in the most detailed way provided summary of the hydrochemical characteristics of the Bükkös Stream.

### *The Malom Stream of Dömös*

The Malom Stream of Dömös is situated in the northern part of the Visegrádi Mountains, in the valley of the Szőke Spring. Its watershed area is approximately 14.2 square km. It rises from several smaller seasonal springs in the surroundings of the Királykúti Saddle and reaches the Danube in Dömös. At the end of the 6.8 kilometer long valley zero point of the Danube is between 98 and 102 m above sea level, so fall of the stream is approximately 430 m, average fall by kilometer is around 63 m (Fig. 3).

At the uppermost part of the valley, the stream has hardly any water in its bed, even in the wet periods, while at lower parts it is typically of upper reach characteristics: in the V-shaped narrow valley the stream runs through several rapids, flowing around huge blocks of rock. After the Rám Cleft the valley becomes wider, the stream slower and the bed more muddy; and also the forest is not dense any more. After the Lukács Ditch feeds in, the stream is of middle reach characteristics, and reaches Dömös through a meadow with groves, then at the back of the gardens and gets polluted by sewage influx. In the area of Dömös the stream bed is almost completely open and its fall is very limited, so the water warms up in the summer to a high extent. Close to the mouth, the bed is pebbly and at some places heavily muddy, which is probably due to the periodic damming effect of the Danube.

Characteristics of water levels of the stream are quite similar to that of the Bükkös Stream. When there is low water in the summer and in the autumn, the upper section of the stream is dry, we can only find some stagnating ponds. At middle water the average width is 1.5-2 m, average depth is 10-20 cm. Erosive dips are less often found than in the bed of the Bükkös Stream.

There is Querco robori-Carpinetum (*Carex pilosa*-type oak-wood with hornbeam) along the Malom Stream up until the boundary of Dömös. This type of forest is dominating mostly on the more gentle slopes with eastern exposure. Beyond the Rám Cleft, in the widening valley the close forest becomes rather a grove. The streambed bordered with alder grove mixed with some willow and robinia trees (Aegopodio-Alnetum) reaches its mouth in the residential area of Dömös.

Berky (1979) in the most detailed way provided summary of the hydrochemical characteristics of the Malom Stream.

## Description of sampling sites and their timings

When choosing sampling sites, those of earlier studies were also taken into consideration to allow comparisons between data of different origin. Sampling sites were numbered starting from the mouth, names of the streams are referred to by their initials. Sampling work was done at all sites in the spring, summer and autumn period.

### *The Bükkös Stream*

- B6: at 465 m above sea level, 14.6 km from the mouth (there is 160 m fall between the highest point of the valley and the sampling site). The bed is dried up in the summer and in the autumn and is made terraced by huge amphibole-andesite rocks, therefore places of very different fall can be found even within a short section. At this site the valley is deep, V-shaped, upper reach-like. Rocks are covered by *Fontinalis antipyretica* at several places.
- B5: at 335 m above sea level, 12.3 km from the mouth (there is 130 m fall between sites B6 and B5). The bed is usually dried up in the summer and in the autumn. At

the sampling site an erosive dip has been formed - in the 6-7 m long, 2-3 m wide and 50-70 cm deep pond the water is only very slowly flowing. Near the sampling site, the stream is of middle reach characteristics.

- B4: at 315 m above sea level, 10.3 km from the mouth (there is 20 m fall between sites B5 and B4). The bed is 2-2.5 m wide, the shallow, slow-running sections are coupled with ponds. Bigger rocks form the bottom. At summer low water, the stream starts from this area.
- B3: at 235 m above sea level, 7.8 km from the mouth, at the pond of the Dömörkapu Waterfall (there is 80 m fall between sites B4 and B3). Erosive force of the water cascading down has formed the pond, being 5-6 m in diameter and its depth exceeds even 1 m. The bed is rocky everywhere, in the pond bigger rocks can also be found. Between them, some floating plant material (branched, leaves) are trapped in every season. Rocks of the waterfall are covered by *Fontinalis antipyretica*.
- B2: at 160 m above sea level, approximately 5 km from the mouth, near the Dömörkapu-Pilisszentlászló road fork (there is 75 m fall between sites B3 and B2). A ford is situated above the sampling site. The streambed is covered with rocks of different size, width is 2-2.5 m, depth is 5-25 cm. *Cladophora* and diatoms coat the bottom.
- B1.1: sampling site being at 133 m above sea level, 3.3 km from the mouth (there is 27 m fall between sites B2 and B1.1). The bed is 2-2.5 m wide, 10-20 cm deep at the quick-running places. Depths of the few ponds exceed even 50 cm at some places. There is litter in the bed.
- B1: at 101 m above sea level, 150 m from the mouth (there is 32 m fall between sites B1.1 and B1). The stream runs between dams, the bottom is rocky and muddy. Width is approximately 1-2.5 m, depth is 30-70 cm, and the current is slow. The bank is covered only with weedy grass, there is no shadow. The water is sometimes troubled, warm and smells badly from pollution. There is litter in the streambed. Damming effect of the Danube is sometimes significant. On the rocks at the bottom, sometimes *Cladophora*-coating or diatom periphyton can be found.

Dates of sampling

- 19 July 1995. After a several week-long very hot period, some days before the day of sampling there were some showers of rain, but these could increase the rate of flow only slightly and for a short period. It was warm and cloudless on the very day of the sampling. At the upper reach of the stream there was no water in the bed, so samples could not be taken from sites B6 and B5.
- 25 October 1995. Upper reach of the stream dried up due to the long, dry period, so sampling again could not happen at the two uppermost sites. Morning temperature was around zero, while until noon air temperature reached 6-7 $^{o}C$. Edge of the ponds with slow-running water were covered by thin ice due the cold. At many places in the stream bed there was a big amount of leaves trapped.
- 30 April 1996. Due to late melting of the snow and frequent rains, water was running all along the stream. Sunshine made the air warm in a short time. At the mouth, section the water was turbid and smelt of chemicals.

- M4: at 435 m above sea level, 6.1 km from the mouth (there is approximately 95 m fall between the sampling site and the highest point of the valley). The stream flows in a narrow, deep valley with bigger stone blocks. Water can be found here for a longer time only in the spring period.
- M3.2: at 380 m above sea level, approximately 5.1 km from the mouth there are rapids formed by huge rocks, with a pond beneath. (Fall between sites M4 and M3.2 is 55 m). At low water, the stream usually dries up.
- M3.1: at 336 m above sea level, 4.5 km from the mouth (there is 44 m fall between sites M3.2 and M3.1). In summer and autumn the stream starts from here, at this
- time there is hardly any water in it. The bed is narrow, there is *Fontinalis antipyretica* growing in it; in the autumn there is a big amount of fallen leaves at the bed bottom.
- M3: sampling site at 280 m above sea level, 4 km from the mouth, under a stone bridge (fall is 56 m between sites M3.1 and M3). Small ponds and a few rapids characterize the stream. Width of the bed is 1.5-2 m. Depth of the stream at the flowing places is around 10 cm, that of the ponds is 20-30 cm, but the big pond under the stone bridge can be 1 m deep in spring.
- M2.1: at 190 m above sea level, 2.8 km from the mouth. The tourist path crosses the stream here. (Fall between sites M3 and M2.1 is 110 m.) Flowing parts alternate with smaller ponds, there are no rapids.
- M2: sampling site at 170 m above sea level, 2.4 km from the mouth, at the car park. (Fall between sites M2.1 and M2 is 20 m.) The bed is wide and shallow with banks being out of the water. Its width is 1-2 m, depth is 10-30 cm. The bottom is pebbly, with some bigger pieces of stone, there is some litter scattered.
- M1.1: at 123 m above sea level, approximately 1 km from the mouth. (Fall of the streambed between sites M2 and M1.1 is 47 m.) Water runs here slower, no rapids. The bed is shallow, 2-2.5 m wide, 5-10 cm deep. Water is muddier than at the upper parts.
- M1: 60-70 m from the mouth, 103 m above sea level, under the small wooden bridge (there is 20 m fall between sites M1.1 and M1). The bed is shallow, 1.5-2 m wide, and 10-35 cm deep. The slowly running water is definitely warm in the summer, there is a lot of *Cladophora* on the surface of stone pieces. The bed is often polluted with different kinds of litter.

Dates of sampling

- 8 July 1995. A typical warm, summer day. Samples were taken at the upper reach of the stream. Five days had passed since the latest bigger rain, the bed dried up at the uppermost part. Due to lack of water, I could not take a sample at the site M4, only at M3.2 and M3.1.
- 9 July 1995. Similar to the previous day. Lower reach of the stream was surveyed.
- 2 November 1995. Upper reach of the stream dried up due to the long, dry period, so I could only start taking samples at site M3.1. Air temperature reached only 6-7 °C. There were a lot of fallen leaves in the clean water.
- 17 April 1996. It was cold for the season. Air temperature went up from 9 °C at dawn to 14 °C in the afternoon. There was a lot of water in the stream everywhere, which was quite muddy at some places.

*Table 1. Temperature data of the sampling sites*

Bükkös Stream

| Sampling | B6 | B5 | B4 | B3 | B2 | B1.1 | B1 |
|---|---|---|---|---|---|---|---|
| Date | 07. 19, 1995 | | | | | | |
| Time | $8^{30}$ | $9^{h}$ | $10^{h}$ | $11^{15}$ | $12^{h}$ | $13^{h}$ | $13^{30}$ |
| Water T. | - | - | 12.6 | 13.8 | 15.4 | 16.9 | 20.5 |
| Air T. (C°) | 24.2 | 24.0 | 25.3 | 26.0 | 27.8 | 27.3 | 29.0 |
| Date | 10. 25, 1995 | | | | | | |
| Time | $9^{h}$ | $9^{30}$ | $10^{h}$ | $11^{h}$ | $12^{h}$ | $13^{h}$ | $13^{30}$ |
| Water T. | - | - | 0.2 | 1.5 | 1.1 | 3.7 | 3.5 |
| Air T. (C°) | -1.1 | 0.0 | 0.0 | 1.7 | 4.0 | 6.6 | 6.2 |
| Date | 04. 30,1996 | | | | | | |
| Time | $9^{h}$ | $10^{15}$ | $11^{h}$ | $12^{h}$ | $13^{15}$ | $14^{h}$ | $14^{30}$ |
| Water T. | 9.7 | 9.9 | 11.2 | 12.2 | 11.0 | 13.5 | 15.3 |
| Air T. (C°) | 13.1 | 13.6 | 14.9 | 16.2 | 18.4 | 17.5 | 18.6 |

Malom Stream

| Sampling | M4 | M3.2 | M3.1 | M3 | M2.1 | M2 | M1.1 | M1 |
|---|---|---|---|---|---|---|---|---|
| Date | 07. 08-09, 1995 | | | | | | | |
| Time | $9^{45}$ | $10^{h}$ | $10^{30}$ | $11^{15}$ | $12^{h}$ | $14^{h}$ | $14^{45}$ | $15^{30}$ |
| Water T. | - | 13.8 | 11.0 | 11.3 | 13.3 | 15.1 | 18.2 | 24.6 |
| Air T. (C°) | 21.2 | 21.8 | 21.6 | 22.2 | 23.1 | 24.5 | 28.1 | 31.0 |
| Date | 11. 02, 1995 | | | | | | | |
| Time | $8^{30}$ | $9^{30}$ | $10^{30}$ | $11^{20}$ | $12^{15}$ | $13^{h}$ | $14^{15}$ | $15^{15}$ |
| Water T. | - | - | 8.8 | 9.0 | 9.8 | 10.2 | 11.6 | 13.3 |
| Air T. (C°) | 5.5 | 5.6 | 6.9 | 7.2 | 7.4 | 7.3 | 6.6 | 8.9 |
| Date | 04. 17, 1996 | | | | | | | |
| Time | $9^{h}$ | $9^{30}$ | $10^{10}$ | $11^{25}$ | $12^{h}$ | $13^{h}$ | $14^{h}$ | $14^{45}$ |
| Water T. | 5.1 | - | - | 5.1 | 5.9 | 6.6 | 9.8 | 13.5 |
| Air T. (C°) | 8.9 | 9.1 | 9.0 | 10.2 | 9.8 | 11.0 | 14.2 | 16.1 |

## Methods

Width of the bed and depth of the water was measured by a measuring rule. Temperature of the water and the air was recorded by a mercurial thermometer of 0.1 °C accuracy (Table 1).

Zoological sampling at the sites designated before was conducted (at a 2 m long section) from the bed bottom, from the coated stones and the tree roots hanging down into the water. Water plants and leaves found at the bottom were washed into a net. Living coating of stones and roots were removed with a brush and filtered through the dipping net. Caddisflies, leeches and part of the beetles and water bugs were collected with tweezers (with a singling method).

Throughout the collection phase always the same sampling method was used, and equal time was spent at all survey sites, therefore the semi-quantitative results can be compared within these studies. Sampling sites

*Table 2. Extreme hydrochemical values of the investigated streams (Berky, 1979)**

| | Bükkös Stream | Malom Stream |
|---|---|---|
| Conduct. ($\mu Scm^{-1}$) | 470 - 1355 | 305 - 715 |
| pH | 7.58 - 8.43 | 6.60 - 8.28 |
| Total hardness (nk°) | 12.1 - 32.0 | 9.6 - 11.8 |
| $Ca^{2+}$ (mg/l) | 12.5 - 80.7 | 21.1 - 64.5 |
| $Mg^{2+}$ (mg/l) | 18.0 - 60.1 | 10.9 - 19.5 |
| $HCO_3^-$(mg/l) | 70.0 - 444.8 | 20.7 - 187.1 |
| $Cl^-$ (mg/l) | 4.4 - 23.2 | 4.7 - 7.4 |
| $NH_4^+$ (mg/l) | 0.20 - 1.83 | 0.54 - 1.01 |
| $NO_2^-$ (mg/l) | 0.0 - 0.145 | 0.0 - 0.057 |
| $NO_3^-$ (mg/l) | 0.7 - 5.3 | 0.9 - 2.7 |
| $O_2$ consumption (mg/l) | 2.4 - 4.4 | 2.7 - 3.9 |

** Samplings: April – November 1978, three times in each streams; sampling sites: Bükkös Stream: B4-B3-B2-B1, Malom Stream: M4-M3-M2-M1*

were classified based on the characteristic species composition. Cluster analysis was conducted with the help of the SYN-TAX 5.0 software using the WPGMC algorithm and the Sørensen index (Sørensen, 1948).

## Conclusions

Water temperature goes very high at the mouth section of both streams in the spring and summer, and furthermore, at the Bükkös Stream temporary heat pollution of human origin was also detected (Table 1). Warmth basically stems from the lack of macro-vegetation that would provide shadow, decreased speed of flow and heat pollution from sewage influx. Hydrochemical data show a picture typical of Hungarian mountain streams (with regards of concentration of $Ca^{2+}$ and $HCO_3^-$, water hardness, pH, $O_2$ consumption and $O_2$ saturation), however, anthropogenous influence strongly modifies them at certain periods (Table 2). Out of the two streams, the Malom Stream of Dömös is the less disturbed. Concentrations of most of the chemical ingredients indicative of pollution ($NH_4^-$, $NO_2^-$, $NO_3^-$, $Cl^-$) signal the worsening quality of the water only near the mouth (Berky, 1979). Anthropogenous influence is significant at the middle and lower reach of the Bükkös Stream. Due to the high level of organic pollution, at times the stream is completely dead, only some Diptera larvae can be found.

As a result of this survey, 2 Nemathelminthes, 4 Annelida, 5 Mollusca and 91 Arthropoda taxa could be shown. Highest numbers of taxa are the larvae of hemihydrobiont (Berczik, 1973) insect orders: 19 Ephemeroptera, 10 Plecoptera and 33 Trichoptera taxa were identified. The above orders, especially the *Gammarus fossarum* and the Simuliida larvae represent the highest numbers of individuals. In the summer, in quiet ponds of the middle reach, several Coleoptera taxa were also found.

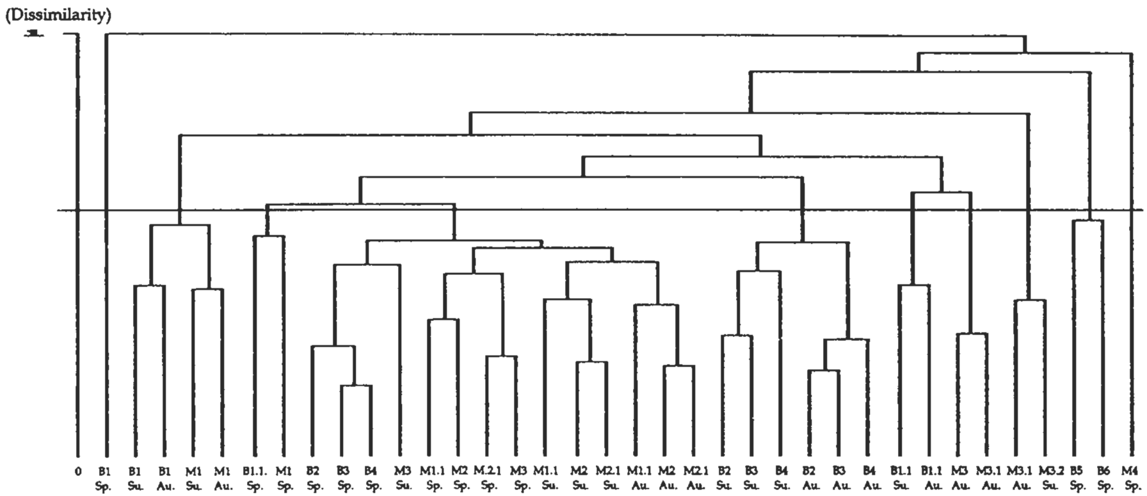


Fig. 4. Dendrogram of the macroinvertebrates based on cluster analysis (Sørensen index). (B1–B6: sampling sites in Bükkös Stream; M1–M4: sampling sites in Malom Stream; Sp. = spring, Su. = summer, Au. = autumn

*Table 3. Species collected from Bükkös Stream*

| Sampling sites and dates of samplings<br>Taxa: | B6 | B5 | B4 | B3 | B2 | B1.1 | B1 | '95. 07. 19. | '95. 10. 25. | '96. 04. 30. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Tubifex* sp. | - | - | - | - | - | - | 19 | 7 | 12 | - |
| *Erpobdella octoculata* L. | - | - | - | - | - | - | 2 | 2 | - | - |
| *Erpobdella monostriata* G. | - | - | - | - | - | - | 3 | 2 | 1 | - |
| *Bythinia tentaculata* L. | - | - | - | - | - | - | 3 | - | 3 | - |
| *Physa fontialis* L. | - | - | - | - | - | - | 4 | - | 4 | - |
| *Ancylus fluviatilis* O. F. Müller | - | - | 78 | 4 | 13 | - | - | 3 | 32 | 60 |
| *Pisidium* sp. | - | - | - | - | - | - | 62 | 35 | 27 | - |
| *Astacus torrentium* Schrank | - | - | - | 2 | 1 | - | - | 2 | 1 | - |
| *Gammarus fossarum* L. | - | - | 419 | 959 | 661 | 215 | 5 | 462 | 610 | 118 |
| *Gammarus roeseli* Gerv. | - | - | - | - | - | 1 | - | - | 1 | - |
| *Ephemera danica* Müll. | - | - | - | 3 | 2 | - | - | 2 | - | 3 |
| *Baetis* sp. | - | - | 62 | 80 | 107 | 23 | 16 | 30 | 67 | 191 |
| *Cloeon dipterum L.* | - | - | 1 | 1 | 4 | 9 | 1 | 8 | 6 | 2 |
| *Cloeon rufulum* Müll. | - | - | 12 | 10 | 14 | 3 | 4 | 2 | 6 | 35 |
| *Procloeon bifidum* Bgtss. | - | - | 2 | 2 | 1 | - | - | 2 | - | 3 |
| *Caenis macrura* Steph. | - | - | - | 5 | 14 | 3 | - | 12 | - | 10 |
| *Habrophlebia fusca* Curt. | - | - | 4 | 1 | 1 | - | - | 2 | - | 4 |
| *Habrophlebia lauta* Mc.L. | - | - | 2 | 2 | - | 1 | - | 2 | - | 3 |
| *Habroleptoides modesta* Hag. | - | - | 3 | 2 | 1 | - | - | 3 | 3 | - |
| *Ephemerella ignita* Poda | - | - | 6 | 1 | 3 | - | - | 8 | - | 2 |
| *Epeorus assimilis* Etn. | - | - | 2 | 7 | 4 | 1 | - | - | - | 14 |
| *Ecdyonurus fluminum* Pict. (?) | - | - | 2 | 3 | 2 | - | - | 1 | 4 | 2 |
| *Ecdyonurus venosus* Fabr. | - | - | 51 | 42 | 35 | 12 | - | 26 | 110 | 4 |
| *Ecdyonurus subalpinus* Klp. (?) | - | - | 7 | 4 | 3 | - | - | 4 | 9 | 1 |
| *Ecdyonurus* sp. | - | - | 18 | 8 | 5 | 2 | - | 7 | 25 | 3 |
| *Heptagenia lateralis* Curt. | - | - | - | 3 | 2 | - | - | - | - | 5 |
| *Heptagenia* sp. | - | - | - | 3 | 2 | - | - | 2 | - | 3 |
| *Rhitrogena semicolorata* Curt. | - | - | 3 | 41 | 64 | 12 | - | - | 3 | 117 |
| *Rhitrogena* sp. | - | - | 3 | 19 | 23 | 3 | - | 3 | 5 | 40 |
| *Nemoura flexuosa* Aub. | 8 | 22 | 14 | 29 | 8 | 1 | - | 2 | - | 80 |
| *Nemoura* sp. | 6 | 10 | 7 | 20 | 3 | 2 | - | 1 | 3 | 44 |
| *Leuctra digitata* Kempny | - | 1 | 4 | 1 | - | - | - | 1 | - | 5 |
| *Leuctra hippopus* Kempny | - | 2 | 1 | 4 | - | - | - | - | 1 | 5 |
| *Leuctra* sp. | 2 | 3 | 3 | 6 | 1 | - | - | 2 | - | 13 |
| *Capnia bifrons* Newm. | - | 2 | 13 | 12 | 1 | - | - | - | - | 28 |
| *Chloroperla* sp. | - | - | 4 | 2 | 7 | 1 | - | - | - | 14 |
| *Isoperla* sp. | - | - | 2 | 4 | 3 | - | - | - | - | 9 |
| *Perla burmeisteriana* Claass. | - | - | 8 | 4 | - | - | - | 1 | - | 11 |
| *Gerris paludum* F. | - | - | - | 5 | 4 | - | - | - | - | 9 |
| *Sialis fuliginosa* Pict. | - | - | 3 | 3 | 1 | - | - | 3 | 4 | - |

*Table 3. (Continued)*

| Sampling sites and dates of samplings<br>Taxa: | B6 | B5 | B4 | B3 | B2 | B1 1 | B 1 | '95. 07. 19. | '95. 10. 25. | '96. 04. 30. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Platambus maculatus* L. | - | - | 3 | 2 | 2 | - | - | 6 | - | 1 |
| *Hydaticus transversalis* Pontopp. | - | - | 1 | - | - | - | - | 1 | - | - |
| *Gaurodytes bipustulatus* L. | - | - | - | - | 2 | - | - | 2 | - | - |
| *Dytiscus marginalis* L. | - | - | - | - | 1 | - | - | 1 | - | - |
| *Dytiscus* sp. | - | - | 3 | 1 | 1 | - | - | 2 | 2 | 1 |
| *Gyrinus substriatus* L. | - | - | 13 | 9 | 12 | - | - | 22 | 12 | - |
| *Orectochilus villosus* Fbr. | - | - | 1 | - | - | - | - | 1 | - | - |
| *Rhyacophila tristis* Pict. | - | - | 1 | - | 1 | - | - | - | 2 | - |
| *Rhyacophila fasciata* Hag. | - | - | 4 | 9 | 5 | 1 | - | 3 | 5 | 11 |
| *Glossosoma vernale* Pict. | - | - | 1 | - | - | - | - | 1 | - | - |
| *Cyrnus trimaculatus* Curt. | - | - | 1 | - | - | - | - | - | 1 | - |
| *Polycentropus flavomaculatus* Pict. | - | - | 5 | 7 | 4 | 1 | - | 3 | 11 | 3 |
| *Plectronemia conspersa* Curt. | - | 2 | 15 | 7 | 5 | - | - | 11 | 11 | 7 |
| *Plectronemia* sp. | - | 1 | 2 | 3 | - | - | - | - | 3 | 3 |
| *Lype reducta* Hag. | - | - | - | 1 | - | - | - | - | 1 | - |
| *Ecnomus tenellus* Ramb. | - | - | 3 | 2 | 3 | - | - | - | - | 8 |
| *Hydropsyche angustipennis* Curt. | - | - | 11 | 22 | 35 | 6 | - | 7 | 9 | 58 |
| *Hydropsyche pellucidula* Curt. | - | - | 1 | 6 | 7 | 1 | - | 1 | 2 | 12 |
| *Hydropsyche instabilis* Curt. | - | - | - | 2 | 2 | - | - | - | 1 | 3 |
| *Hydropsyche* sp. | - | - | 3 | 9 | 8 | 1 | - | 2 | 5 | 14 |
| *Grammotaulius nigropunctatus* Retz | - | 13 | 9 | 17 | 39 | 6 | - | - | - | 84 |
| *Chaetopteryx fusca* Brau. | - | - | 12 | 2 | 3 | - | - | - | 17 | - |
| *Limnephilus lunatus* Curt. | - | 1 | 1 | 2 | - | - | - | 1 | - | 3 |
| *Limnephilus affinis* Curt. | 4 | 3 | 16 | 5 | 2 | 1 | - | 3 | 1 | 27 |
| *Limnephilus extricatus* Mc.L. | 1 | - | 1 | 1 | - | - | - | - | - | 3 |
| *Limnephilus vittatus* Fabr. | 3 | 2 | - | - | - | - | - | - | - | 5 |
| *Limnephilus griseus* L. | 7 | 14 | 9 | 11 | 3 | - | - | 2 | - | 42 |
| *Limnephilus ignavus* Mc.L. | - | - | 4 | 1 | 3 | - | - | 8 | - | - |
| *Limnephilus* sp. | 8 | 24 | 44 | 38 | 16 | 1 | - | 16 | 1 | 114 |
| *Ironoquia dubia* Steph. | - | 4 | 12 | 3 | - | - | - | - | - | 19 |
| *Mycropterna nycterobia* Mc.L. | - | - | 1 | 3 | 1 | - | - | - | - | 5 |
| *Mycropterna* sp. | - | - | 2 | 1 | - | - | - | - | - | 3 |
| *Stenophilax permistus* Mc.L | - | 1 | 9 | 7 | 1 | - | - | - | - | 18 |
| *Halesus digitatus* Schr. | - | - | 13 | 10 | 3 | - | - | - | - | 26 |
| *Sericostoma personatum Spence* | - | - | 11 | 8 | 6 | - | - | - | - | 25 |
| Tipulidae | 4 | 1 | 5 | - | - | - | - | 2 | 2 | 6 |
| Simuliidae | 5 | 8 | - | 3 | 3 | 56 | 43 | 72 | 21 | 25 |
| Tanypodinae | - | - | 3 | 5 | 4 | - | - | 3 | 6 | 3 |
| Chironominae | 3 | - | 26 | 13 | 17 | 66 | 77 | 100 | 37 | 65 |
| Orthocladiinae | - | - | 14 | 14 | 19 | 8 | - | 16 | 8 | 31 |
| *Hydrachna* sp. | - | - | - | 22 | 36 | - | - | - | - | 58 |

*Table 4. Species collected from Malom Stream of Dömös*

| Sampling sites and dates of samplings<br>Taxa: | M 4 | M3. 2 | M3. 1 | M 3 | M2. 1 | M 2 | M1. 1 | M 1 | '95 07. 08-09. | '95 11. 02. | '96 04. 17. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Gordius aquaticus* L. | - | 4 | - | - | - | - | - | - | 4 | - | - |
| *Parachordodes tolosanus* (Duj.) | - | 1 | - | - | - | - | - | | 1 | - | - |
| *Tubifex* sp. | - | 11 | - | - | - | - | - | 38 | 20 | 19 | 10 |
| *Trocheta bykowskii* G. | - | 4 | 1 | 1 | - | - | - | - | 6 | - | - |
| *Erpobdella octoculata* L. | - | - | - | - | - | - | - | 7 | 2 | 2 | 3 |
| *Erpobdella monostriata* G. | - | - | - | - | - | - | - | 1 | - | - | 1 |
| *Bythinia tentaculata* L. | - | - | - | - | - | - | - | 10 | 3 | 5 | 2 |
| *Radix peregra* O. F. Müller | - | - | - | - | - | - | - | 16 | 8 | 7 | 1 |
| *Physa fontialis* L. | - | - | - | - | - | - | - | 3 | - | 3 | - |
| *Ancylus fluviatilis* O. F. Müller | - | - | - | - | - | - | - | 1 | - | - | 1 |
| *Astacus torrentium* Schrank | - | - | - | 5 | 10 | 3 | - | - | 11 | 5 | 2 |
| *Gammarus fossarum* L. | - | 37 | 85 | 224 | 281 | 304 | 600 | 32 | 323 | 1098 | 142 |
| *Gammarus tatrensis* Wrzejn. | - | - | - | - | 1 | 6 | 9 | - | 11 | 3 | 2 |
| *Gammarus roeseli* Gerv. | - | - | - | - | - | - | 1 | - | - | 1 | - |
| *Ephemera danica* Müll. | - | - | - | - | 2 | 5 | 2 | - | 2 | 4 | 3 |
| *Baetis* sp. | - | - | 1 | 25 | 14 | 21 | 16 | 22 | 28 | 32 | 39 |
| *Cloeon dipterum* L. | - | - | - | 4 | 3 | 3 | 5 | 3 | 13 | 3 | 2 |
| *Cloeon rufulum* Müll. | - | - | - | 6 | 5 | 1 | 11 | 3 | 7 | 13 | 6 |
| *Procloeon bifidum* Bgtss. | - | - | - | 4 | 6 | 2 | - | 3 | - | - | 15 |
| *Caenis macrura* Steph. | - | - | - | 4 | 17 | 7 | 1 | 1 | 25 | 4 | 1 |
| *Habrophlebia fusca* Curt. | - | - | - | 1 | 1 | - | - | - | 2 | - | - |
| *Habrophlebia lauta* Mc.L. | - | - | - | 1 | 1 | - | - | - | 2 | - | - |
| *Habroleptoides modesta* Hag. | - | - | - | 2 | 4 | 2 | 5 | 1 | - | 4 | 10 |
| *Ephemerella ignita* Poda | - | - | - | - | 1 | 1 | 1 | - | 3 | - | - |
| *Epeorus assimilis* Etn. | - | - | - | 6 | 4 | 5 | 89 | 1 | - | 90 | 15 |
| *Ecdyonurus venosus* Fabr. | - | 2 | 8 | 46 | 24 | 17 | 9 | 29 | 75 | 55 | 5 |
| *Ecdyonurus* sp. | - | - | 2 | 19 | 8 | 8 | 3 | 11 | 20 | 17 | 14 |
| *Heptagenia lateralis* Curt. | - | - | 5 | 8 | 17 | 16 | 5 | - | 24 | 11 | 16 |
| *Heptagenia* sp. | - | - | 6 | 9 | 9 | 10 | 3 | - | 19 | 3 | 15 |
| *Rhitrogena semicolorata* Curt. | - | - | 18 | 60 | 31 | 32 | 31 | 16 | 5 | 90 | 93 |
| *Rhitrogena* sp. | - | - | 2 | 21 | 12 | 17 | 11 | 7 | 3 | 19 | 48 |
| *Calopteryx virgo* L. | - | - | - | - | - | - | - | 6 | - | 6 | - |
| *Nemoura flexuosa* Aub. | - | - | 1 | 8 | 22 | 15 | 19 | 10 | 7 | 10 | 58 |
| *Nemoura* sp. | 2 | - | - | 5 | 13 | 10 | 8 | 3 | 3 | 6 | 32 |
| *Leuctra digitata* Kempny | - | - | - | 4 | 6 | 2 | 3 | 1 | - | 5 | 11 |
| *Leuctra hippopus* Kempny | - | - | - | 1 | 5 | 2 | 3 | 1 | - | 5 | 7 |
| *Leuctra* sp. | - | - | 1 | 6 | 21 | 6 | 6 | 6 | 1 | 17 | 28 |
| *Capnia bifrons* Newm. | - | - | - | 1 | 7 | 2 | 2 | - | 3 | 3 | 6 |
| *Chloroperla* sp. | - | - | - | - | - | 8 | 10 | 1 | - | 7 | 12 |
| *Isoperla grammatica* Poda | - | - | - | 1 | 2 | 1 | - | - | - | - | 4 |
| *Isoperla* sp. | - | - | - | 1 | 2 | 1 | - | - | - | - | 4 |
| *Perla burmeisteriana* Claass. | - | - | - | 3 | - | - | 6 | - | - | - | 9 |
| *Nepa cinerea* L. | - | - | - | - | - | - | - | 12 | 11 | 1 | - |
| *Sialis fuliginosa* 7 | - | - | - | 1 | 4 | - | 1 | - | 3 | 2 | 1 |

*Table 4. (Continued)*

| Sampling sites and dates of samplings<br>Taxa: | M 4 | M3. 2 | M3. 1 | M 3 | M2. 1 | M 2 | M1. 1 | M 1 | '95. 07. 08-09. | '95. 11. 02. | '96. 04. 17. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dytiscus* sp. | - | 1 | 1 | 3 | - | - | - | - | 2 | 2 | 1 |
| *Gyrinus substriatus* L. | - | - | - | 3 | 1 | - | - | - | - | 4 | - |
| *Hydroporus planus* Fbr. | - | 7 | 2 | 1 | - | - | - | - | 10 | - | - |
| *Hydrobius fuscipes* L. | - | - | 1 | - | - | - | - | - | 1 | - | - |
| *Helodes minuta* L. | - | - | 1 | - | 2 | - | - | - | 1 | - | 2 |
| *Helmis maugei* Bedel. | - | - | - | 1 | - | - | - | - | 1 | - | - |
| *Rhyacophila tristis* Pict. | - | - | - | - | - | 1 | 1 | - | - | - | 2 |
| *Rhyacophila fasciata* Hag. | - | - | - | - | - | 2 | 8 | - | 2 | - | 8 |
| *Glossosoma vernale* Pict. | - | - | - | - | - | - | 284 | 37 | - | - | 321 |
| *Agapetus* sp. | - | - | - | - | - | 2 | 16 | 3 | - | - | 21 |
| *Synagapetus* sp. | - | - | - | - | - | 1 | 11 | 4 | - | - | 16 |
| *Hydroptila* sp. | - | - | - | - | - | - | 2 | 1 | 3 | - | - |
| *Philopotamus montanus* Donov. | - | - | 1 | - | - | 1 | 1 | - | 1 | - | 2 |
| *Polycentropus flavomaculatus* Pict. | - | - | - | - | 1 | 1 | - | - | - | 2 | - |
| *Plectronemia conspersa* Curt. | - | - | 1 | 3 | 2 | 2 | 4 | 1 | 6 | 4 | 3 |
| *Plectronemia* sp. | - | - | - | 1 | 2 | 1 | - | - | - | 2 | 2 |
| *Ecnomus tenellus* Ramb. | - | - | - | - | 1 | - | - | - | - | - | 1 |
| *Hydropsyche angustipennis* Curt. | - | - | 3 | 11 | 11 | 6 | 23 | 7 | 10 | 12 | 39 |
| *Hydropsyche pellucidula* Curt. | - | - | - | 2 | 3 | 4 | 3 | 1 | 3 | 3 | 7 |
| *Hydropsyche instabilis* Curt. | - | - | - | - | 1 | - | 1 | - | - | - | 2 |
| *Hydropsyche* sp. | - | 1 | 5 | 12 | 10 | 9 | 9 | 2 | 19 | 8 | 21 |
| *Grammotaulius nigropunctatus* Retz | 11 | 4 | 1 | 14 | 6 | 16 | 35 | 40 | 11 | - | 116 |
| *Chaetopteryx fusca* Brau. | - | - | - | - | - | 4 | 8 | - | - | - | 12 |
| *Limnephilus flavicornis* Fabr. | - | - | - | 7 | 4 | 3 | 2 | - | 4 | - | 12 |
| *Limnephilus vittatus* Fabr. | - | - | - | 1 | - | - | - | - | - | - | 1 |
| *Limnephilus griseus* L. | - | - | 3 | 5 | 2 | 1 | 1 | - | 7 | - | 5 |
| *Limnephilus ignavus* Mc.L. | 8 | - | - | 9 | 11 | 5 | 6 | 1 | 9 | - | 31 |
| *Limnephilus* sp. | 3 | 1 | 2 | 21 | 16 | 21 | 11 | 13 | 33 | - | 55 |
| *Mycropterna nycterobia* Mc.L. | - | - | - | 1 | 1 | - | 3 | - | 2 | - | 3 |
| *Mycropterna* sp. | - | - | - | - | - | - | 7 | 2 | - | - | 9 |
| *Stenophilax permistus* Mc.L. | - | - | - | 1 | 3 | - | 5 | - | 3 | - | 6 |
| *Halesus digitatus* Schr. | - | - | - | - | - | - | 9 | - | - | - | 9 |
| *Goera* sp. | - | - | 5 | 3 | - | 2 | - | - | 10 | - | - |
| *Silo pallipes* Fabr. | - | - | - | - | 5 | 12 | 8 | - | 11 | - | 14 |
| Tipulidae | 3 | - | 4 | - | 5 | - | - | 1 | 3 | 4 | 6 |
| *Aedes* sp. | - | - | - | - | - | - | - | 13 | 13 | - | - |
| *Culex* sp. | - | - | - | - | - | - | - | 7 | 7 | - | - |
| Simuliidae | - | - | - | 2 | 28 | 51 | 454 | 458 | 699 | 58 | 194 |
| Tanypodinae | 2 | - | - | 3 | 1 | 5 | 1 | - | 7 | - | 5 |
| Chironominae | 8 | 12 | 1 | 19 | 4 | 5 | 11 | 45 | 41 | 47 | 24 |
| Orthocladiinae | 1 | 2 | 1 | 8 | 6 | 20 | 8 | - | 18 | 9 | 19 |
| *Crysops* sp. | - | - | - | - | - | - | - | 1 | - | - | 1 |

*Table 5. Presence of holohydrobiont taxa*

Bükkös Stream

| Sampling sites → | B6 | B5 | B4 | B3 | B2 | B1.1 | B1 |
|---|---|---|---|---|---|---|---|
| Date of sampling → | 07. 19, 1995 | | | | | | |
| Number of total taxa | - | - | 22 | 26 | 21 | 10 | 7 |
| Holohydrobiont taxa | - | - | 7 | 5 | 6 | 1 | 4 |
| Holohydrobiont % | - | - | 31.8% | 19.2% | 28.6% | 10.0% | 47.1% |
| Date of sampling → | 10. 25, 1995 | | | | | | |
| Number of total taxa | - | - | 22 | 18 | 17 | 8 | 10 |
| Holohydrobiont taxa | - | - | 4 | 3 | 3 | 1 | 6 |
| Holohydrobiont % | - | - | 18.2% | 16.7% | 17.6% | 12.5% | 60.0% |
| Date of sampling → | 04. 30, 1996 | | | | | | |
| Number of total taxa | 6 | 10 | 31 | 37 | 32 | 16 | 2 |
| Holohydrobiont taxa | 0 | 0 | 4 | 3 | 2 | 1 | 0 |
| Holohydrobiont % | 0% | 0% | 12.9% | 8.1% | 6.3% | 6.3% | 0% |

Malom Stream

| Sampling sites → | M4 | M3.2 | M3.1 | M3 | M2.1 | M2 | M1.1 | M1 |
|---|---|---|---|---|---|---|---|---|
| Date of sampling → | 07. 08-09, 1995 | | | | | | | |
| Number of total taxa | - | 13 | 15 | 26 | 24 | 19 | 18 | 18 |
| Holohydrobiont | - | 5 | 4 | 4 | 2 | 2 | 1 | 6 |
| Holohydrobiont % | - | 38.4% | 26.7% | 15.4% | 8.3% | 10.5% | 5.6% | 33.3% |
| Date of sampling → | 11. 02, 1995 | | | | | | | |
| Number of total taxa | - | - | 10 | 15 | 22 | 17 | 17 | 15 |
| Holohydrobiont | - | - | 1 | 4 | 3 | 2 | 1 | 7 |
| Holohydrobiont % | - | - | 10.0% | 26.7% | 13.6% | 11.8% | 5.9% | 46.7% |
| Date of sampling → | 04. 17, 1996 | | | | | | | |
| Number of total taxa | 7 | - | - | 21 | 27 | 30 | 29 | 25 |
| Holohydrobiont | 0 | - | - | 3 | 2 | 1 | 1 | 7 |
| Holohydrobiont % | 0% | - | - | 14.3% | 7.4% | 3.3% | 3.4% | 28.0% |

Vast majority of the collected animals (Table 3 and 4) were of reophilous species, characteristic of fluvial communities, though at some sites and at some times there were typical standing water (limnophilous) organisms found in higher numbers. These latter appeared either in the ponds of widened bed sections (e.g. Chironominae, *Grammotaulius nigropunctatus*) or in the slower-flowing water of the mouth sections (e.g. *Tubifex* sp., *Nepa cinerea, Culex* spp.), sometimes in large numbers. Reophilous species can always be found in the ponds: there is satisfactory oxygen supply, not limiting the presence of sensitive, stream dweller organisms. At the undisturbed middle reaches of the streams, it is the local rate of flow that primarily determines the structure of the communities. Fauna of sections with a higher rate of flow (0.5-1 m/s) is characterized mostly by euryceleric species (e.g. *Rhyacophila fasciata, Epeorus assimilis, Rhitrogena semicolorata, Nemoura* sp., etc.), but species

*Table 6. Numbers of species of the most numerous animal groups*

| Taxa: | Bükkös Stream | Malom Stream | Similar species |
|---|---|---|---|
| Hirudinoidea | 2 | 3 | 2 |
| Gastropoda | 3 | 4 | 3 |
| Decapoda | 1 | 1 | 1 |
| Amphipoda | 2 | 3 | 2 |
| Ephemeroptera | 15 | 13 | 13 |
| Plecoptera | 5 | 6 | 5 |
| Coleoptera | 6 | 6 | 1 |
| Trichoptera | 20 | 24 | 17 |

apparently not sensitive to the rate of flow also appear at some periods of time (e.g. *Ecdyonurus* ssp., *Isoperla grammatica*; Andrikovics & Kéri, 1991).

There are few taxa found in the slowly flowing, warm and often polluted water of the mouth areas, usually Diptera larvae (e.g. Simuliidae, Chironominae) are dominant. Influence of the Danube is also significant: several taxa characteristic of the Danube (e.g. *Erpobdella* spp., *Pisidium* sp., *Bythinia tentaculata*) were found at the lower part of both streams. Only once, at the mouth of the Malom Stream were a middle reach community found (17 April 1996), which was most probably due to the longer term abundance of water.

Uppermost part of the streams is not populated by many species either, reason for which can be the fact that the bed dries up quickly. These parts have water only in the spring, so only some hemihydrobiont organisms (e.g. *Nemoura* spp., *Limnephilus* spp.) are able to dwell here. Presence of holohydrobiont taxa is strongest at the middle reach and at the mouth (Table 5). The more sensitive holohydrobiont stream-dweller organisms (e.g. *Trocheta bykowskii, Gammarus fossarum*) are probably not able to tolerate the worse water quality at the lower reach.

Fauna compositions of the two surveyed streams are similar (Table 6). Results of the cluster analysis (Fig. 4) indicate that stream habitats are present along the stream according to the mosaic principle, which corresponds with the results of earlier studies (Andrikovics, 1991; Gróf, 1967; Simonyi, 1981). Isolation of the clusters supports the findings written above. Summer and autumn samples from the mouth sites of the two streams, summer and autumn samples from the middle reach of the Bükkös Stream and spring samples from the upper reach represent separate clusters. The biggest cluster is made up of the samples taken from the middle reach of the Malom Stream, only 3 spring sampling sites of the Bükkös Stream (B2, B3, and B4) belong to this cluster. Interestingly, the spring sample from the M1 site was put to the

*Table 7. Long-term changes: Ephemeroptera species*

| Investigations | Bükkös Stream | | | | | Malom Stream | |
|---|---|---|---|---|---|---|---|
| | 1951 | 1965 | 1978-9 | 1985-8 | 1995-6 | 1985-8 | 1995-6 |
| Species | A* | A* | A* | A** | Cs* | A** | Cs* |
| *Ephemera danica* Müll. | - | - | ++ | ++ | + | + | + |
| *Baetis* sp. | + | + | ++ | + | ++ | ++ | ++ |
| *Centroptilum luteolum* Müll. | - | - | + | ++ | - | + | - |
| *Centroptilum pennulatum* Etn. | - | - | + | - | - | - | - |
| *Cloeon dipterum* L. | + | - | - | ++ | ++ | + | + |
| *Cloeon rufulum* Müll. | - | - | - | - | + | - | ++ |
| *Procloeon bifidum* Bgtss. | - | - | + | - | + | + | + |
| *Caenis macrura* Steph. | - | - | ++ | ++ | ++ | + | ++ |
| *Paraleptophlebia submarginata* Steph. | + | - | + | + | - | - | - |
| *Habrophlebia fusca* Curt. | - | + | - | + | + | + | + |
| *Habrophlebia lauta* Mc.L. | - | ++ | + | + | + | + | + |
| *Habrophleptoides modesta* Hag. | - | + | + | + | + | - | + |
| *Ephemerella ignita* Poda | - | ++ | ++ | ++ | + | + | + |
| *Siphlonurus lacustris* Etn. | - | + | + | + | - | - | - |
| *Epeorus assimilis* Etn. | - | - | ++ | ++ | + | ++ | ++ |
| *Ecdyonurus fluminum* Pict. (?) | + | - | + | + | + | - | - |
| *Ecdyonurus venosus* Fabr.. | - | - | + | + | ++ | + | ++ |
| *Ecdyonurus subalpinus* Klp. (?) | - | + | + | + | + | - | - |
| *Ecdyonurus* sp. | - | ++ | ++ | ++ | + | + | ++ |
| *Heptagenia lateralis* Curt. | - | + | + | + | + | + | ++ |
| *Heptagenia* sp. | + | ++ | ++ | ++ | + | + | + |
| *Rhitrogena semicolorata* Curt. | - | - | + | + | ++ | + | ++ |
| *Rhitrogena* sp. | ++ | ++ | ++ | ++ | ++ | + | ++ |

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv. ++ frequent*

same cluster with the B1.1 site. Pollution of the Bükkös Stream is most probably the main cause behind the occasional low number of species in the mouth area. The two clusters with only one element are the ones with the least number of species (B1 Sp, M4 Sp).

Information collected on the Bükkös Stream and the Malom Stream of Dömös can be compared easily to the results of earlier studies, making it possible to register and evaluate the long-term changes, which are in the focus of research nowadays. These studies were made at the same sites in most of the cases, and were primarily focusing on the most frequent hemihydrobiont insect orders (Ephemeroptera, Plecoptera and Trichoptera), so comparisons are limited to these taxa. To demonstrate these long-term changes, these results were fit to the tables published by Andrikovics (1991; Tables 7, 8, 9).

*Table 8. Long-term changes: Plecoptera species*

| Investigations | Bükkös Stream | | | | | Malom Streem | |
|---|---|---|---|---|---|---|---|
| | 1951 | 1965 | 1978-9 | 1985-8 | 1995-6 | 1985-8 | 1995-6 |
| Species | A* | A* | A* | A** | Cs* | A** | Cs* |
| *Brachyptera risi* Mort. | - | - | + | + | - | + | - |
| *Protonemura intricata* Ris | - | - | + | + | - | - | - |
| *Protonemura praecox* Mort. | - | - | + | + | - | - | - |
| *Nemoura flexuosa* Aub. | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| *Nemoura cambrica* Steph. | - | - | - | + | - | - | - |
| *Nemoura* sp. | + | + | + | + | ++ | + | + |
| *Nemurella picteti* Klap. | - | - | + | ++ | - | + | - |
| *Leuctra pseudosignifera* Aub. | - | - | - | + | - | - | - |
| *Leuctra digitata* Kempny | - | - | + | ++ | ++ | + | + |
| *Leuctra hippopus* Kempny | - | - | + | + | + | - | + |
| *Leuctra* sp. | + | + | + | + | + | + | ++ |
| *Capnia bifrons* Newm. | - | - | ++ | ++ | ++ | ++ | + |
| *Isoperla grammatica* Poda | - | - | + | + | + | + | + |
| *Isoperla* sp. | - | - | + | + | + | + | + |
| *Perla burmeisteriana* Claass. | + | - | ++ | ++ | ++ | - | + |
| *Perla marginata* Panz. | - | - | - | + | - | - | - |
| *Chloroperla* sp. | - | - | ++ | ++ | ++ | + | + |

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv. ++ frequent*

Surveys done by Andrikovics between 1985 and 1988 included collection of imagoes with light trap, so processed results contain several species that can be classified only as imagoes. Furthermore, we cannot exclude the possibility that representatives of some species did not swarm from the streams. Data make it clear that the mass species (with relatively low number of individuals) of the material collected in 1951 correspond to the overall picture of the current fauna. It is also instructive to notice that at that time sensitive rhitron organisms dwelt all along the streams, however, according to latest surveys there are scarcely any Ephemeroptera, Plecoptera and Trichoptera living at the upper parts of the two streams having water only temporarily and at the polluted lower reach of the Bükkös Stream (Andrikovics, 1991).

Out of the Ephemeroptera species collected with my samples, only 3 were missing from the area in the latest decade, while I several times managed to collect *Cloeon rufulum*, which did Gróf (1967) only find here. 7 out of the listed Plecoptera taxa were not detected in the streams with my samplings, however, 3 species of these were only represented by imagoes collected with the light trap. On the other hand, I did not detect 19 out of the Plecoptera taxa

*Table 9. Long-term changes: Trichoptera species*

| Investigations | Bükkös Stream | | | | | Malom Stream | |
|---|---|---|---|---|---|---|---|
| | 1951 | 1965 | 1978-9 | 1985-8 | 1995-6 | 1985-8 | 1995-6 |
| Species | A* | A* | A* | A** | Cs* | A** | Cs* |
| *Rhyacophila tristis* Pict. | + | + | ++ | ++ | + | - | + |
| *Rhyacophila fasciata* Hag. | + | ++ | ++ | ++ | ++ | + | + |
| *Glossosoma vernale* Pict. | - | - | - | - | + | - | ++ |
| *Agapetus* sp. | - | + | - | + | + | - | + |
| *Synagapetus* sp. | - | + | ++ | ++ | + | - | + |
| *Hydroptila* sp. | + | + | - | + | + | + | + |
| *Philopotamus montanus* Donov. | - | - | - | + | + | - | + |
| *Cyrnus trimaculatus* Curt. | - | - | - | + | - | - | - |
| *Polycentropus flavomaculatus* Pict. | + | + | + | ++ | ++ | + | + |
| *Plectronemia conspersa* Curt. | - | - | + | ++ | ++ | + | + |
| *Plectronemia* sp. | - | - | + | + | + | + | + |
| *Neureclipsis bimaculata* L. | - | - | + | + | - | - | - |
| *Ecnomus tenellus* Ramb. | - | - | - | ++ | + | - | + |
| *Lype reducta* Hag. | - | - | - | + | + | - | - |
| *Tinodes rostocki* Mc.L. | - | - | - | ++ | - | + | - |
| *Hydropsyche angustipennis* Curt. | + | + | + | + | ++ | + | ++ |
| *Hydropsyche instabilis* Curt. | + | + | + | + | + | + | + |
| *Hydropsyche pellucidula* Curt. | - | - | + | + | + | + | + |
| *Hydropsyche fulvipes* Curt. | - | - | - | + | - | - | - |
| *Hydropsyche* sp. | + | + | + | + | ++ | + | ++ |
| *Cheumatopsyche lepida* Pict. ☆ | - | - | - | - | - | - | - |
| *Phryganea grandis* L. ☆☆ | - | - | - | - | - | - | - |
| *Athripsodes bilineatus* L. | - | - | - | ++ | - | + | - |
| *Trianodes bicolor* Curt. | - | - | - | + | - | - | - |
| *Glyphotaulius pellucidus* Retz. | - | - | - | + | - | + | - |
| *Grammotaulius nigropunctatus* Retz. | ++ | + | + | + | ++ | + | ++ |
| *Chaetopteryx fusca* Brau. | - | + | ++ | ++ | + | ++ | + |

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv ++ frequent*
*☆ Dömös, 1928 ☆☆ Esztergom, 1961*

that have been registered in the area, the cause of which can be again that the previous survey was partly done by using a light trap. In the case of thecaddisflies, species composition and numbers of individuals have definitely changed in the latest 10 years. Apart from the species not found, *Glossoma vernale* has appeared, which was mostly detected in this area in the streams of the Börzsöny Mountains up until now. *Chaetopteryx fusca, Silo pallipes* and some species of the genus *Limnephilus* became less frequent, while *Grammotaulius nigropunctatus* and *Hydropsyche angustipennis*

*Table 9. (Continued)*

| Investigations | Bükkös Stream | | | | | Malom Stream | |
|---|---|---|---|---|---|---|---|
| | 1951 | 1965 | 1978-9 | 1985-8 | 1995-6 | 1985-8 | 1995-6 |
| Species | A* | A* | A* | A** | Cs* | A** | Cs* |
| *Limnephilus flavicornis* Fabr. | - | - | - | ++ | ++ | + | + |
| *Limnephilus lunatus* Curt. | - | - | - | ++ | + | + | - |
| *Limnephilus affinis* Curt. | - | + | - | ++ | ++ | + | - |
| *Limnephilus bipunctatus* Curt. | - | - | - | + | - | - | - |
| *Limnephilus extricatus* Mc.L. | - | - | - | + | + | - | - |
| *Limnephilus sparsus* Curt. | - | - | - | + | - | - | - |
| *Limnephilus vittatus* Fabr. | - | - | - | ++ | + | + | + |
| *Limnephilus griseus* L. | - | - | - | + | ++ | + | + |
| *Limnephilus auricula* Curt. | - | - | - | ++ | - | + | - |
| *Limnephilus ignavus* Mc.L. | - | - | - | + | ++ | + | ++ |
| *Limnephilus* sp. | + | ++ | ++ | ++ | ++ | ++ | ++ |
| *Ironoquia dubia* Steph. | - | - | - | + | + | - | - |
| *Mycropterna testacea* Gmel. | - | - | - | + | - | - | - |
| *Mycropterna sequax* Mc.L. | - | - | - | + | - | + | - |
| *Mycropterna nycterobia* Mc.L. | - | - | ++ | ++ | ++ | ++ | + |
| *Anabolia furcata* Brau. | - | - | + | ++ | - | + | - |
| *Anabolia nervosa* Leach | - | - | - | + | - | - | - |
| *Stenophylax permistus* Mc.L. | + | + | + | ++ | ++ | + | + |
| *Halesus digitatus* Schr. | + | ++ | ++ | ++ | ++ | + | + |
| *Sericostoma personatum* Spence | - | - | - | ++ | + | + | - |
| *Goera pilosa Fabr.* | - | - | - | ++ | - | - | - |
| *Goera* sp. | - | - | - | + | + | + | + |
| *Silo pallipes* Fabr. | - | - | - | ++ | + | + | + |
| *Lithax obscurus* Hag. | - | - | - | ++ | - | - | - |
| *Crunoecia irrorata* Curt. | - | - | - | + | - | - | - |

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago . + 1-2 indiv. ++ frequent*

became frequent. This latter appeared in mass also in the Morgó Stream in the Börzsöny (Berczik & Pham Ngoc, 1988).

Results of the survey, changes detected in the fauna composition indicate that increasing degradation of habitats is extremely strong at the polluted parts. Due to the habitats degrading and being destroyed even the species composition deform: the diverse, sensitive species disappear and only 1-2 taxa with broad tolerance take their place, therefore more regularly conducted surveys would give us more chance to reveal the dynamics of such processes.

Almost the whole of the Malom Stream of Dömös and the middle reach of the Bükkös Stream is characterized by diverse fauna community, which give a place for the sensitive rhitron organisms that became less frequent all over Europe, therefore definitely deserving protection.

## Closing thoughts

As it was already shown by several other studies done in Hungary, there is a characteristic invertebrate fauna bound to the diverse habitats of streams of low mountains. Besides studying the diverse living conditions and varied animal communities, question of protecting biodiversity came into focus nowadays. Fauna changes of these small streams must be tracked by repeated surveys, analyzing the changes of the various anthropogenous influence (pollution, streambed control, etc.) in parallel. After the reference survey covering a whole year, at least in every 8-10 years control surveys are needed on the more important streams.

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