EFFECTS OF WATER POLLUTION AND GLOBAL WARMING ON THE FISH FAUNA OF THE ROMANIAN TRIBUTARIES OF THE RIVER TISZA

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Abstract. In the summer of 2000, we conducted fish faunistical samplings in the Romanian reach of Upper Tisza River and its left tributaries. As a result, we found one new species (*Oncorhynchus mykiss* Walbaum, 1792) in the Szaplonca/Săpânța Brook and two new species (*Vimba vimba* Linné, 1758, *Gobio kessleri* Dybowski, 1862) in the Iza River. The fauna of the Iza is rich in natural values – 13 of its 23 fish species are legally protected in Hungary. But in the Visó/Vişeu the number of fish species (17) and their density (the number of fish samples caught in the Visó is just about 20 % of that found in the Iza) bear marks of the frequent heavy metal pollutions.
Studying the river zones, we noticed, in their fish communities, species normally inhabiting lower zones as well. This change increasingly observable in other zones of other rivers as well, which can be caused by the warming of the rivers. Numerous factors are likely to contribute to this phenomenon, but the main cause is most probably the warming that increased the surface temperature of the Northern Hemisphere by an average of 0.6 ^{0}C and that of Hungary by 0.67 ^{0}C in the 20th century.

Key words: Máramaros/Maramureş, zonation of rivers, expansion of gobiid species, water-system of Danube

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Introduction

The rivers surveyed are on the territory of Máramaros/Maramureş county, the fauna of which was first summarized by Frivaldszky (1871). He mentioned four fish species of the Iza — to which Herman (1887) added a new species —, and described six species from the Visó and its floods. Most of these species are listed by Vutskits (1904) with reference to the data of Mocsáry, and these are mentioned in the later published Fauna Regni Hungariae, in the chapter relating the fish (Vutskits 1918). These references do not mention the tributary brooks of the rivers and neither the fish fauna of the smaller Szaplonca.

The researches in the 20th century were started by Vladykov, respectively by Bănărescu. Vladykov (1931) has surveyed the right hand tributaries and the Upper Tisza, identifying 44 species of the above. Bănărescu (1964, 1969) summarized his own and the previous experiences, and pointed out the presence of 9 species in the Szaplonca, 12 in the Iza and 23 in the Visó. After that the fish fauna of the Máramaros rivers were searched by the team of the Antipa Museum, Bucharest. Bacalu (1997) has found 13 species in the Iza, 7 of which were unknown here previously. In the water system of the Visó Staicu *et al.*(1998) have found 13 species also, although they observed a very important deficiency compared to the previous very rich species-list.

Harka *et al.* (1999) described 14 species in the Tisza, between Rahó and Huszt, and 22 respectively in the Rahó–Tiszabecs reaches. The researches of Györe and collaborators on the Upper Tisza reaches have also enriched our knowledge: they have completed the fauna-list of the Szaplonca with 1, that of the Iza with 3 new species (Györe *et al.* 1999), and later that of the Visó with 1 new species (Györe *et al.* 2001). Finally, we have to mention the work of Ardelean and Béres (2000), who summarize the recent researches on the vertebral fauna of the Máramaros Basin, listing 38 fish species of the Tisza, 11 of the Szaplonca, 33 of the Iza riversystem and 28 of the Visó basin.

While the water of the Szaplonca and the Iza can be declared clean, the Visó is often polluted and this represents a danger to the Tisza, which receives it. We can remember that in March 2000, 20-28 thousand m^3 of muddy sewage containing heavy metals has flown into the Visó from the industrial sewage lake of the Borsabánya (Baia Borşa) lead and zinc mine, which was followed by two more pollutions, which fortunately were of lower intensity (Szőke and Imre 2000, Hamar 2001).

Immediately after the events there were not apparent biological losses, but the damage in the living world is often shown later. Thus, during our researches we payed attention upon the changes in qualitative and quantitative distribution of the fish fauna which can be due to relatively diluted, but repetitive pollutions.

Localities and methods

The Máramaros reaches of the Tisza River present the characteristics of hilly country rivers. Its slope between the mouth of the Visó and 16 km lower at the mouth of the Iza is 2-3 m/km, but it is not smaller than 1-1.5 m/km between the mouthes of the Iza and Szaplonca on a reach of 20 km. Its current is strong, thus the bed of the river is composed by rounded rocks and rough pebbles, or gravel with different size grains, sedimental bed appearing just occasionally. The water is spread, usually not deeper than 1 m, it has lots of curves between the reefs in its way to the Lowlands.

The Szaplonca is about 20 km long with its source at 1100 m, and flows into the Tisza at 240 m above sea-level. In spite of its shortness, it is abounding in water, its average water output is 3.6 m^3/s. Its current is strong, while its drop on the upper reaches is 80-90 m/km and even at the mouth it reaches 20 m (Ujvári 1972).

The Iza has its source on Nagy Pietrosz, at 1200 m a.s.l., and it is an important tributary of the Upper Tisza. It is 83 km long and it reaches its recipient river at Máramarossziget, at 264 m height above sea-level. Its water output at the mouth is 16 m^3/s in average, but it can decrease to 0.58 at low water level, and it increases to 660 in time of great floods occuring prospectively in every 100 years. Its largest tributary is the Mára/Mara River, with the source at 1050 m a.s.l., having an average output of 9 m^3/s, and a length of 40 km (Ujvári 1972, Lászlóffy 1982).

The Visó is the first important left tributary of the Upper Tisza. Its source is in the Radna Mountains at 1693 m a.s.l., and after covering 80 km, it flows into the Tisza at 338 m a.s.l. It has a strong current with a water output of 20-50 m/km on its upper reaches, and of 2-8 m even at the mouth. Its average water output is 30 m^3/s at the lower reaches, which is just a few m^3 lower than the output of the Tisza. At low water level it carries just one tenth of this value, but its output can reach 1020 m^3 in time of a great flood expected every 100 years (Ujvári 1972, Lászlóffy 1982). Its most important tributaries are: the Vasér/Vaser and the Oroszi/Ruscova Brook. Both of them are approximately 40 km in length, with an average output of 10 m^3 (Fig. 1.).

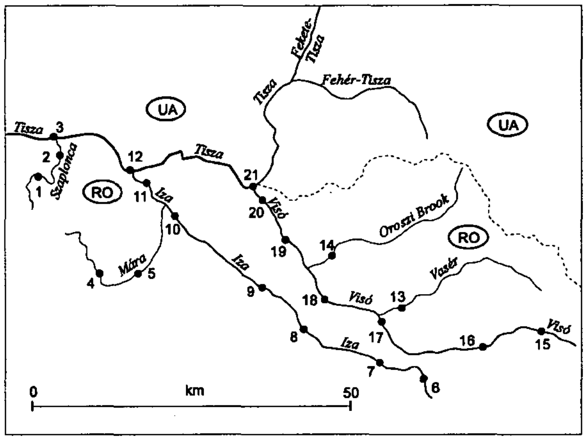

Fig. 1. A sketch map of the study area, showing the sampling sites

The fish fauna of these waters was studied between 5 and 15th of August 2001. As gathering devices we used electrical research fishing machine and — when the bed made it possible — small mesh net.

Our studies were conducted at 6-6 gathering points on the Iza and the Visó, respectively, 3 on the Tisza, 2-2 on the Szaplonca, resp. Mára and one on the Vasér and Oroszi Brook, each fishing took approximately two and a half hours. Our 21 gathering points are marked with numbers on the map of Fig. 1.

In the Szaplonca valley, including the reach of the Tisza around the Szaplonca mouth, our gathering points were: 1–Szaplonca, upper reaches, 2–Szaplonca, above Szaplonca/Săpânţa village, 3–Tisza, at the mouth of the Szaplonca.

In the Iza valley – including the Mára and the Tisza near the mouth of the Iza – our studies took part at: 4–Mára, above Karácsfalva (Mara) village, 5–Mára, at Hernécs (Hărniceşti), 6–Iza, above Izaszacsal (Săcel), 7– Iza, under Izaszacsal (Săcel), 8–Iza, at Izakonyha (Bogdan Voda), 9–Iza, at Rozália (Rozavlea), 10–Iza, at Farkasrév (Vadu Izei), 11–Iza, at Máramarossziget (Sighetu Marmaţiei), 12–Tisza, at Máramarossziget (Sighetu Marmaţiei).

Our fishing points on Visó riversystem and its recipient river: 13–Vasér, above Felsővisó (Vişeu de Sus), 14–Oroszi Brook, above Visóoroszi (Ruscova), 15–Visó, near the source, 16–Visó, at Borsafüred (Staţiunea Borşa), 17–Visó, at Felsővisó (Vişeu de Sus), 18–Visó, at Alsóvisó (Vişeu de Jos), 19–Visó, at Petrova, 20–Visó, at Visóvölgy (Valea Vişeului), 21–Tisza, at Visóvölgy (Valea Vişeului).

After taxonomic identification, the collected individuals were let free. Individual number of each species was recorded exactly under 10, and approximately, rounded if their number exceeded 10. The temperature, pH and oxygen-concentration of the water were measured with a HORIBA combined water-quality assessing machine for local determinations.

Results

At our first two gathering points the temperature of the water of the Szaplonca was 17.3 and 18.1 ^{0}C respectively, the oxygen-concentration was 6.58 and 6.33 mg/l resp., and the pH values were 7.37 and 7.38 resp.

We have caught more than 400 fish samples from the Szaplonca and the Tisza around the mouth of the Szaplonca, which included 8 species regarding the Szaplonca, and 17 regarding the Tisza. Considering the species found in both, the total number is 20. These results are shown in details in Table 1.

In the period of our studies, the water temperature of the Iza varied between 12.2 and 26.6 ^{0}C. The first value was measured at the spring, and the other at the mouth. The concentration values of disolved oxygen were 6.88 and 5.65 mg/l, respectively, at the same places. The later one was the minimum value, while the maximum was measured at Bogdan Voda, 7.51 mg/l at a water temperature of 22.6 ^{0}C. The pH varied between 8.05 and 8.81 as the water becoming a little more alkaline from top to bottom. Regarding the two gathering points of the tributary Mára, our data were: 15.7 and 18.6 ^{0}C, 1.67 and 6.53 mg/l oxygen concentration, 7.62-8.32 pH.

In the Iza basin – including the Mára and the Tisza reaches around the mouth of the Iza – we could gather more than 1700 specimen. We have found 23 species in the Iza, 11 in the Mára and 13 in the Tisza, the total number of species were 25 (Table 2).

Table 1. Numbers of specimens caught in the Szaplonca/Săpânţa Brook and in the recipient River Tisza at estuary of the Szaplonca/Săpânţa Brook

Species	Szaplonca		Tisza
Localities	1.	2.	3.
Eudontomyzon danfordi			1
Leuciscus leuciscus			1
Leuciscus cephalus			25
Leuciscus souffia		1	4
Phoxinus phoxinus	9	70	2
Alburnoides bipunctatus		2	130
Chondrostoma nasus			4
Barbus barbus			6
Barbus petenyi		10	20
Gobio gobio			10
Gobio uranoscopus			10
Gobio kessleri			2
Barbatula barbatula	1	30	40
Cobitis taenia			1
Sabanejewia aurata			15
Oncorhynchus mykiss		10	
Cottus gobio			25
Cottus poecilopus	6	10	
Zingel streber			2

The temperature of the Visó varied between 13.5 and 22.7 degrees. Its oxygen concentration near the spring was 6.78, at the mouth 6.04 mg/l, but the minimum value was taken at Felsővisó: at a water temperature of 20.1 ^{0}C the oxygen-concentration was 4.55 mg/l. This was the point wiht the lowest pH (8.13), while on the other reaches it varied between 8.4 and 8.6.

In the Visó riversystem and in the Tisza reaches around the Visó mouth we collected about 700 fish individuals. We gathered 6 species in the Vasér, 8 in the Oroszi Brook, 17 in the Visó and 10 in the Tisza. We did not found any species in the tributaries and in the Tisza that were not present in the Visó, so the total number of species is 17. These results are shown in Table 3.

The temperature of the Tisza River, which gathers the mentioned tributaries, was 19.4 at the mouth of the Visó, while at the mouth of both the Iza and the Szaplonca was 23.5 ^{0}C, and these two last points showed almost the same pH: 8.53 and 8.59, resp. However, a considerable difference appeared in

Table 2. Numbers of specimens caught in the Iza riversystem and in the recipient River Tisza at estuary of the River Iza (+ : catch of angler)

Species	Mára		Iza						Tisza
Localities	4.	5.	6.	7.	8.	9.	10.	11.	12.
Eudontomyzon danfordi		1	1						1
Rutlilus rutilus							1		
Leuciscus leuciscus					2	1			
Leuciscus cephalus		7			10	40	200	1	8
Leuciscus souffia		2			40	1	40		4
Phoxinus phoxinus	1	80			200	80			15
Alburnus alburnus					2		25		3
Alburnoides bipunctatus		30			20	10	40	40	50
Vimba vimba							1		1
Chondrostoma nasus					3	5	9		
Barbus barbus							3		
Barbus petenyi	8	25			40	30	80		2
Gobio gobio		1			6	15	80	3	8
Gobio uranoscopus					1	6	2		
Gobio kessleri						4	10	1	
Barbatula barbatula		30		1	30	3	20	1	2
Cobitis taenia					1	1	7	1	
Sabanejewia aurata		20			30	50	200	30	15
Salmo trutta m. fario	1			+					
Lota lota								1	
Cottus gobio	8							1	15
Cottus poecilopus			30	40					
Perca fluviatilis							4		1

Table 3. Numbers of specimens caught in the Visó/Vişeu riversystem and in the recipient River Tisza at estuary of the River Visó/Vişeu

Species	Vasér	Oroszi	V i s ó						Tisza
Localities	13.	14.	15.	16.	17.	18.	19.	20.	21.
Eudontomyzon danfordi		2				3			
Leuciscus leuciscus							1		
Leuciscus cephalus							2		3
Leuciscus souffia	1	1				2	7	1	6
Phoxinus phoxinus	200	60			15	20	30		2
Alburnus alburnus							1		
Alburnoides bipunctatus					1	2	5	6	10
Chondrostoma nasus								1	4
Barbus barbus							1		3
Barbus petenyi	2	1			1	7	7	7	15
Barbatula barbatula	10	50			40	40	50	10	20
Sabanejewia aurata								10	8
Thymallus thymallus		10				2			
Salmo trutta m. fario	1		3						
Lota lota								2	
Cottus gobio		1					1	3	30
Cottus poecilopus	2	4		15	1	1			

the oxygen-concentration, which was 4.87 mg/l at the mouth of the Iza compared to the mouthes of the the two rivers with values of 6.58 and 6.67, resp. The low value taken at the mouth of the Iza can be due to the communal pollution of Máramarossziget and its organic components, the decomposition of which needs much oxygen consumption. The fact that at the mouth of the Szaplonca the value was similar to the previous one, shows the self cleaning process of the river.

From the Tisza we could gather 10 species at the mouth of the Visó, 13 at the mouth of the Iza, while at the mouth of the Szaplonca we caught 17 species. Considering the same species in the different points, the total number is 20.

Discussion

Although in recent years others have also studied the fish fauna of these rivers, our work has brought results regarding the fauna too. We have shown the presence of new species, the Rainbow trout *(Oncorhynchus mykiss)* in the Szaplonca, and we have found that the majority of the previously described species are still living either in the stream, or in the Tisza near the mouth.

Regarding the Iza River, we have identified two species that were previously not found: the Vimba *(Vimba vimba)*, and the Sand gudgeon *(Gobio kessleri)*. We have also stated that the fauna of the river represents a great natural value. From the 23 species found 13 is legally protected in Hungary (2 of them being greatly protected), regarding the European standards (Lelek 1987) the majority of them are rare or endangered. The 13 protected species also increase the natural value of the river, and most of these species are represented by a nice and large population. For example, the Blageon *(Leuciscus souffia* Risso, 1826*)*, the Minnow *(Phoxinus phoxinus* Linné, 1758*)*, the Schneider *(Alburnoides bipunctatus* Bloch, 1782*)* and the Golden spined loach *(Sabanejewia aurata* Filippi, 1865*)*, and also the greatly protected Petenyi's barbel *(Barbus petenyi* Heckel, 1847*)*. The richness of the Iza is well clearly shown by the fact, that 80 % of the 1.5 thousand samples caught was legally protected in Hungary.

We have not found any previously not identified fish in the Visó. Although we captured four species not listed in the 13 one reported by Staicu *et al.* (1998), these were mainly swimming up from the lower reaches of the Tisza, like the Dace *(Leuciscus leuciscus* Linné, 1758*)*, the Bleak *(Alburnus alburnus* Linné, 1758*)* or the Barbel *(Barbus barbus* Linné, 1758*)*. The total lack of *Gobio*-species was surprisin, because they were caught in great quantity in the Iza River conditions of which are very similar to those of Visó.

The difference is well demonstrated by the fact that compared to the 23 species of the Iza, we could only find 17 in the Visó. Besides the number of species, the number of individuals also show a great difference in the two rivers. Although we have studied the same gathering points, spending the same time with fishing, the number of fish specimens caught in the Visó were just about 20 % of that found in the Iza. We can get the same results if we make the comparison with the water system. In the two tributaries – although we surveyed just one gathering point on the Vasér and Oroszi Brook – we have caught 30 % more fish, than from the whole reach of the Visó.

In conclusion, the fish community of the Visó is greatly damaged. The geogrephical site, the size and ecological conditions of the river are similar to he Iza, but its output is much greater, so it would be able – in natural circumstances – to support a richer fish fauna than the latter one. It is absolutely sure that regular heavy metal pollution plays an important role in the fact that the river holds just a small number of fish, and we have to find a solution urgently in the favour of its recipient river, the Tisza too. The fact that there is such a small number of fish at all in this frequently polluted water, is mainly due to the tributary streams. During great pollutions a fraction of the population can get shelter in these, and the river is repopulated by them.

None of the 22 species gathered in the Tisza were new. Although we have found some, which were caught only on the lower reaches during the previous study (Harka *et al.* 1999), these were also found in the tributaries, so we will mention them relating the latter ones.

The studied waters have the same characteristics as a mountain running water source of more than 1000 m a.s.l. While the Szaplonca reaches its recipient river as a stream, the Tisza, the Iza and the Visó become smaller rivers when arriving to this region. The differences in their fish fauna are due to the differences in their size.

The Szaplonca – along almost its whole reach – shows the characteristics of the trout-zone and the composal of its fish species equivalent to this. Although the Brown trout *(Salmo trutta m. fario* Linné, 1758*)*, which is typical of this river zone, was found just in the trout-pond built near the stream, we have caught lots of samples of it settled relative, the Rainbow trout *(Oncorhynchus mykiss)*. We could also find lots of specimen of the Minnow *(Phoxinus Phoxinus)*, the Petenyi's barbel *(Barbus petenyi)*, the

Stone loach *(Barbatula barbatula* Linné, 1758*)*, the Siberian bullhead *(Cottus poecilopus* Heckel, 1836*)*, which make the trout-zone name obvious. The only exception is the reach around the mouth, which shows more the characteristics of the grayling-zone.

However, some species appear in the stream, which are not typical of these river zones. These are the Vimba *(Vimba vimba)* related by Ardelean and Béres (2000) and the Danubian salmon *(Hucho hucho* Linné, 1758*)*. However, the contradiction is apparent, because these fish do not live in the stream, they only swim up there occasionally. Thus they aren't the determinants, just the colouring elements of the fish population for the water, however it was surprizing that we did not find any specimen of Brown trout in the stream. On August the 9th for example – on the reach above the foresters' house – we were trying to catch it for two and a half hours, without any success, although in the previous years it was frequently caught here. Its lack should be due to the unusual heat, which characterised the weather of the Carpathian Basin at that time, where the water temperature increased up to 17.3 °C even at this height. Afterwards, we thought the possiblity that the Brown trouts withdraw till near the spring because of the heat, because in the Upper Visó we could catch them only in the uppermost reaches where the water temperature was under 14 ^{0}C. During our fishing on the Szaplonca, we haven't thought about this possibility, that's why we didn't look for proof about this idea.

The Iza — in contrast to the Szaplonca — is not a stream, but a small river, thus its fish fauna is more varied. The upper reach is a trout-zone, but the Brown trout *(Salmo trutta m. fario)* which gives the name of the zone is rare, its presence is proved only by the catch of a fisherman. However the Siberian bullhead *(Cottus poecilopus)* is frequent, a speciman of which was found in our net together with a Carpathian lamprey *(Eudontomyzon danfordi* Regan, 1911*)*, feeding from the previous.

The trout zone turns into the grayling-zone between Izaszacsal (Sacel) and Izakonyha (Bogdan Voda). We can state this, although the Grayling *(Thymallus thymallus* Linné, 1758*)* was not found, and the presence of it — to our best knowkedge — was not demonstrated. However, besides the species present in the trout-zone, like the Minnow *(Phoxinus phoxinus)*, the Petenyi's barbel *(Barbus petenyi)* and the Stone loach *(Barbatula barbatula)*, there appear numerous specimens of the Souffia chub *(Leuciscus souffia)* and the Golden spined loach *(Sabanejewia aurata)*, which are strangers in the upper zones, and disappears the Siberian bullhead *(Cottus poecilopus)* frequent in the previous zone. Under Farkasrév (Vadu Izei) the Rifle minnow *(Alburnoides bipunctatus)* appears in great quantity and other species typical to lower zones *(Rutilus rutilus* Linné, 1758, *Vimba vimba, Perca fluviatilis* Linné, 1758*)*, showing that the lower reaches of the river take part of the nase-zone.

Previously Bănărescu (1964, 1969) has shown 23 species in the Visó, but Staicu *et al.* (1998) have found the presence of 57%, while our study has shown 74% of them. However the river-zones are recognizable. Although the Brown-trout *(Salmo trutta m. fario)* was only found close to the spring, the trout-zone is extending till Felsővisó. There is the mouth of the Vasér, which – except the transitional part around the mouth – is a trout-water with a great Minnow *(Phoxinus phoxinus)* population. After the mouth of the Vasér the trout-zone turns into the grayling-zone, which extends approximately till the mouth of the Oroszi Brook. The name of this zone is given by the Grayling *(Thymallus thymallus)* of which we have found just two specimens in the river, but there were more in the Oroszi Brook, the lower reach of which is greayling-zone too. The mouth-reach of the Visó, under Petrova is a nase-zone, which is well shown by the change from the Siberian bullhead *(Cottus poecilopus)* to the Bullhead *(Cottus gobio* Linné, 1758*)* and the appearance of the Barbel *(Barbus barbus)*.

The Máramaros reach of the Tisza has recently been described as a grayling-zone (Harka *et al.* 1999), but our data suggest that it is a nase-zone. This is supported by the fact that we have found numerous species which were caught during the previous research only in the lower zones, for example the Vimba *(Vimba vimba)*, the Barbel *(Barbus barbus)*, the Kessler's gudgeon *(Gobio kessleri)*, the Pearch *(Perca fluviatilis)*. However we can also state that the partly different species-spectrum of the small and large rivers described by Bănărescu (1964) are becoming more and more similar, and the differences amongst the fish populations of the neighbouring river-zones are also decreasing.

These are supported by the presence of foreign elements in the grayling-zone of the Iza, like the Bleak *(Alburnus alburnus)*, the Nase *(Chondrostoma nasus)* and the Kessler's gudgeon *(Gobio kessleri)*. The Pearch *(Perca fluviatilis)* is also a stranger in the mentioned zone of both the Iza and the Tisza.

The occurrence of one or two species in a foreign environment can be occasional, but we have found several individuals of several species. Thus this is a marked tendency which needs to be explained.

It is well known that the different fish-zones of a river, following each-other are distinguished by the fish populations composed by characteristic species to that river-zone, which are determined by the dominating ecological relations. The most important environmental factors are: the speed, the temperature and the oxygen-concentration of the water and the material and the quality of the bed. In our case one of these differed from the usual grayling-zone: the temperature of the water. Thus the explanation is obvious: the phenomenon was caused by the fact that the temperature of the water was higher than usual – due to the hot weather at that time.

At first this seems to be a satisfactory explanation, but in our opinion it needs a detailed survey, as it is not a single case. Bacalu (1997) and Györe *et al.* (1999) have searched the Iza at different times and they have also remarked the presence of the Bleach *(Alburnus alburnus)* and the Barbel *(Barbus barbus)*. Ardelean *et al.* (2000) as well as Györe *et al.* (2001) have observed the expansion towards the upper reaches of the Carp *(Cyprinus carpio* Linné, 1758*)*, the Crucian carp *(Carassius carassius* Linné, 1758*)*, the Pike *(Esox lucius* Linné, 1758*)*, the Perch *(Perca fluviatilis)*, the Bream *(Abramis brama* Linné, 1758*)* and the Brown bullhead *(Ictalurus nebulosus* Le Sueur, 1819*)*, while the Chub *(Leuciscus cephalus* Linné, 1758*)*, the Nase *(Chondrostoma nasus* Linné, 1758*)* and the German carp *(Carassius auratus* Linné, 1758*)* were found right up to the mountain streams. The same results were shown by some Slovakian researches (Harka *et al.* 2000) which noted the presence of the Nase *(Chondrostoma nasus)* and the Barbel *(Barbus barbus)* in the grayling-zone of the Laborc (Laborec) River. The upwards-expansion – as a phenomenon – is not limited just to the nase- and grayling-zones, it can be observed on the middle and lower reaches of our rivers. At the end of the 19^{th} century the Tubenose goby *(Proterorhinus marmoratus* Pallas, 1811*)* reached only up to Bratislava on the Danube, by now it has reached Germany and it gets upper and upper in the Dráva, Tisza and Körös too (Harka 1990). A similar phenomenon is observable concerning the Monkey goby *(Neogobius fluviatilis* Pallas, 1811*)* which has conquered several new waters in the Carpathian Basin (Harka 1993, 1997, Ahnelt *et al.* 1998, Sallai 2000). The Bighead goby *(Neogobius kessleri* Günther, 1861*)*, the Syrman's goby *(Neogobius syrman* Nordmann 1840*)*, the Round goby *(Neogobius melanostomus* Pallas, 1811*)* and the Racer goby *(Neogobius gymnotrachelus* Kessler, 1857*)*, previously found only around the mouth of the Danube, have appeared in the last ten years in the middle, Hungarian-Slovakian-Austrian reaches of the river (Zweimüller *et al.* 1996, Erős and Guti 1997, Guti, 1999, Wiesner *et al.* 2000, Ahnelt *et al.* 2001).

Regarding the way of this expansion there are only speculations. There is a possibility of illegal introduction of these species by aquarists, and also the importation of these by ballast water of the ships. But neither of these speculations give a reassuring explanation why these changes have just occurred recently, although both aquaristics and shipping look back on a long past. Certainly there is the possibility of active migration, but the „Why exactly now?" question is still not answered.

If we consider that the appearance and expansion of the Black Sea-origin gobiid species towards our rivers is the same phenomenon of striving of the fishes from lower to upper reaches, has probably the same reason as in the Máramaros rivers: warming. Considering that this is not an oscillating phenomenon, but it has a strict direction, we have to look for a tendency-like changing of the weather. And this is not a change of the weather, but of the climate. The so-called global warming means that the temperature of the surface of the Earth has increased with 0.6 ^{0}C, while that of Hungary with 0.67 ^{0}C in the 20^{th} century (Szalai and Szentimrey 2001). This has become more evident in the last ten years, which was the warmest decade of not just the century but also the millennium. Corresponding to this, we have observed the expansion of the Tubenose goby (*Proterorhinus marmoratus*) in the last 100 years, the Monkey goby (*Neogobius fluviatilis*) has conquered our waters in the last 20-30 years, while the appearance of the other gobiid species has occurred in the last decade.

Thus we consider that different species of the fish communities of the river-zones and the immigration of the Ponto-Caspian species into Central Europe are both due to the warming of the waters. This may be due to several reasons – like the building of water-reservoirs, the communal pollution, the warm coolants of the power stations, etc. – but the main factor is the global warming, the accelerated warming of the surface temperature of the Earth. This means that there will be more changes in the composal and dominancy relations of the species of the fish community in the different river-zones and new species will appear from South to the Carpathian Basin in the future too.

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