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ICHTHYOFAUNA OF MIDLLE COURSE OF THE IBAR, TRIBUTARY OF THE ZAPADNA MORAVA (THE DANUBE SYSTEM) AND COMPARATIVE REVIEW OF ICHTHYOFAUNA OF OTHER TRIBUTARIES WITH SPECIAL RETROSPECTIVE VIEW ON TAXONOMIC STATE OF SPECIES

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distribution, abundance, structure, ichthyofauna, taxonomic status of species

SYNOPSIS

The structure of ichthyofauna and predomination of species in middle course of the Ibar River were studied. The presence of 17 species and a hybrid of fish from families *Cyprinidae, Cobitidae, Nemacheilidae,* and *Percidae* was recorded. The family *Cyprinidae* predominates. *Squalius cephalus* and *Barbus balcanicus* are eudominant and *Gobio obtusirostris (syn. Gobio gobio)* is dominant. *Alburnus alburnus* and *Alburnoides bipunctatus* are subdominant. The other cyprinids and species from other families belong to recedent and subrecedent. These investigations indicate that the ichthyofauna of the Zapadna Morava River system is represented with 39 fish species, the reciprocal hybrids between *Squalis cephalus* and *Alburnus alburnus* and one lamprey, *Eudontomyzon mariae*. The current taxonomic status of members of the analysed ichthyofauna is accomplished.

INTRODUCTION

This long-term study gives new data about the ichthyofauna of the Ibar River system in regard to the hitherto known dispersal of fish species in the Ibar River, and also about the changes due to anthropogenic influence that raised meanwhile.

The Ibar River (272 km) is located in Eastern part of Montenegro, on declivities of Hajla and Mokra, and it rills from that place to delta of its tributary the Sitnica River throughout Kosovska basin, in West-East direction (fig. 1). Then, it deviates towards North to its delta in the Zapadna Morava River, at the city of Kraljevo. Average flow rate is Q = 34.6 - 63.2 m^3/sec. During period of investigation average depth of the river in its middle course varies from 0.2 to 2.5 m, but there are whirlpools up to 13 m

in depth. The river is 12 to 30 m wide. The water attains a temperature maximum (19^0C) in July and August. The canyon of the Ibar is about 40 km long, and it starts below Rožaje, and ends at Ribarić village in Serbia. After the canyon, the river-bed of Ibar becomes wider, to 40 km. On the right side of the Ibar River, about 1.5 km north of Kosovska Mitrovica, the Sitnica River inflows. The middle of the riverbed is pebbly and rocky, but deposits of fine sand and sludge are present along the banks. Sources of pollution of the Ibar River are the Koparić, Žuta Prljina, and Belo Brdo lead and zinc mines, whose tailings are washed into the river. Also, in direct proximity to it, there is a flotation of the ''Trepča'' plant, whose waste waters are loaded with heavy metals, and the ''Kosovo'' thermoelectric power plant, which through the Sitnica River constantly pollutes the Ibar River with a high concentration of phenols - MPC, chemical and biological consumption O_2 (CHCO, BCO) and derivates oils (1999, ZZZZ). These factors probably caused devastation of ichthyofauna of middle course of the Ibar River.

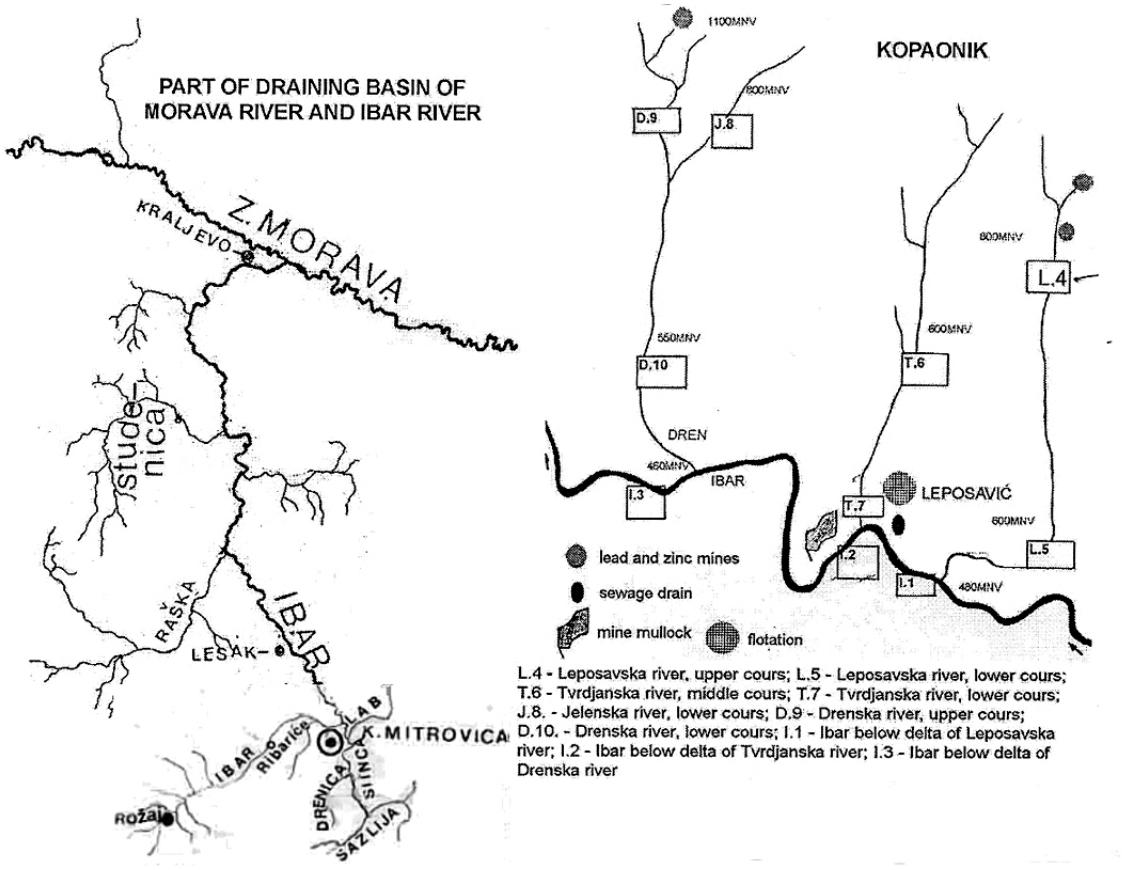

Fig. 1. Map of investigated area.

MATERIAL AND METHODS

Data from this paper are based on the field investigations, sampling and processing in period 1995-1996. Catch of fish was performed on Kosovo from the Ibar River and the tributaries: Leposavska River, Tvrdjanska River and Drenska River, each year during May and August. Samples of fish were caught with various nets and electro fishing gear of 2.5 kW of output power. Samples were fixed in 8% solution of formaldehyde and deposited in the Laboratory of Biology and Ecology in Kragujevac city. Identification of species was worked out using the keys of Wheeler (1978) and Holcik (1989). The biotic index of predominance (ŠORIĆ, 1996) was calculated after the data on fish abundance: eudominant (ED) > 20%, dominant (D) 10-20%, subdominant (SD) 4-10%, recedent (RD) 1-3% and subrecedent (SR) <1%. Also, this method was applied on ichthyofauna of the Zapadna Morava River (Veljović et, al. 1985) and its tributaries (the Gruža River, 1996. and 2004; the Rasina River, 1990). In addition to that, in one of the tables, the taxonomic status of species was given using the International Code of Zoological Nomenclature (ICZN). Subspecies are not recognised under the species concept used here (Kottelat, 1997; Kottelat & Frezhof, 2007).

RESULTS AND DISCUSSIONS

The ichthyofauna of the middle course of the Ibar River is composed of common elements that are also present in other waters of the Zapadna Morava River system (tab. 1 and 2). The Ibar River is a typical cyprinid river, with eudominant species *Squalis cephalus* and *Barbus balcanicus,* and dominant species *Gobio obtusirostris (Gobio gobio obtusirostris)*. The *Alburnus alburnus* and *Alburnoides bipunctatus* are subdominant. Other species are to be considered recedent and subrecedent. In the middle course of the Ibar River and its tributaries 21 species of fish and one hybrid were recorded. The icthtyofauna in tributaries of the Ibar River is scarce in number of species, while quantitatively and qualitatively its structure is similar to that one in the Ibar River (tab 1 and 2). The tributary of the Ibar River, the Leposavska River (localities 4 and 5, upper and lower courses), was inhabited by *Barbus balcanicus* (35) 44.3%, *Squalis cephalus* (24) 30.4%, *Gobio obtusirostris* (13) 16.4% and *Alburnoides bipunctatus* (7) 8.9%. In the Tvrdjanska tributary River (T6 and T7, middle and lower courses) *Barbus balcanicus* (33) 45.8%, *Squalius cephalus* (21) 29.2%, *Barbatula barbatula* (9) 12.5 %, *Gobio obtusirostris* (4) 5.5 %, *Alburnoides bipunctatus* (4) 5.5% and *Alburnus alburnus* (1) 1.4% were recorded. In the tributary Drenska River (localities D9 and D10, upper and lower corses) *Barbus balcanicus* (56) 53.3%, *Squalis cephalus* (32) 30.5 %, *Alburnoides bipunctatus* (12) 11.4% and *Gobio obtusirostris (*5) 4.8% were recorded.

Tab. 1. Qualitative and quantitative composition of ichthyofauna of the Ibar River on profiles I.1, I.2 and I.3

SPECIES	Number of caught specimens on profiles				
	I.1	I.2	I.3	I_1- I_3	%
Barbus barbus	/	/	14	14	2.28
Barbus balcanicus	34	80	63	177	28.78
Gobio obtusirostris(Syn. Gobio gobio)	40	22	16	78	12.68
Squalius cephalus	65	28	111	204	33.17
Alburnus alburnus	20	15	16	51	8.29
Alburnoides bipunctatus	21	3	9	33	5.36
Cobitis taenia	2	1	6	11	1.79
Scardinius erythrophtalamus	/	/	1	1	0.16
Sabanejewia balcanica	1	/	/	1	0.16
Rhodeus amarus	4	4	1	9	1.46
Rutilus rutilus	/	5	4	9	1.46
Carassius gibelio	/	2	9	11	1.79
Chondrostoma nasus	/	/	16	16	2.60

The ichthyofauna of middle course of the Ibar River is now poor in regard to the ichthyofauna of the remaining part of this river basin and particularly of the ichthyofauna of the the Rasina River and lower course of the Gruža and the Zapadna Morava rivers. It seems probable that ichthyofauna of the Ibar River is impoverished because of the very strong pollution. The middle course of the Ibar River is polluted by lead and zinc mines, whose tailing are constantly washed into the river and can be one of the significant causes of hybridization between *Squalius cephalus* x *Alburnus alburnus* (Šorić, 2004).

These investigations indicate that the ichthyofauna of the Zapadna Morava River system is unique for its 39 fish species, reciprocal hybrids between *Squalius cephalus* and *A. alburnus* and one lamprey species, *Eudontomyzon mariae* (tab.2), which can be found in all the parts of the basin where the ecological conditions are appropriate.

By these investigations, we established that the Ibar River, together with its tributaries, lay under different kinds of pollution. Particularly, zones of oligosaprobic waters are decreased, and their places were substituted by mesosaprobic waters. Dislocation of mesosaprobic waters out of their natural scope into high hill area induces changes at fish populations, that is, the ritronic cyprinids of mesosaprobic type take their positions. Changes in water quality in domain alpha and beta do not influence more substantially on structure of ichthyofauna. This could be explained by the fact that fish are very mobile organisms, which in case of coming of pollution wave pull back in tributaries or downstream so far until achieving concentration of pollutant that is tolerant, or autopurification starts. Often, because of that, remarkable oscillations in number and presence of fish species in different parts of water course

in dependence on type, dynamics and concentration of pollutant material could be observed.

Tab. 2. Ichthyofauna in the Zapadna Morava system. Localities: I – Middle Ibar River and its tributaris - our data, II – the Gruža River – Šorić, 1996 and new investigation, 2004; III – the Rasina River – Šorić, 1990; IV – the Zapadna Morava River - Veljović et. al, 1985.

PISCES/Localities	I – Middle Ibar River and its tributaris	II – Gruža River	III – Rasina River	IV – Zapadna Morava River and r. "Medjuvrsje"
CYPRINIDAE				
Phoxinus phoxinus		+RD		
Squalius cephalus	+ED	+ED	+ED	+D
Leuciscus leuciscus				+SR
Leuciscus delineatus				+SD
Leuciscus idus				*+SR*
Barbus barbus	+ RD		+SR	+SR
Barbus balcanicus	+ED	+D	+ED	+SD
Gobio obtusirostris	+D	+RD	+D	+SD
Romanogobio kessleri		+SR		
Romanogobio vladykovi		+SR		
Alburnus alburnus	+SD	+D	+D	+RD
Alburnoides bipunctatus	+SD	+SD		+SR
Chalcalburnus chalcoides				+RD
Abramis brama				+ED
Ballerus ballerus				+SD
Rutilus rutilus	+RD	+D	+RD	+RD
Rhodeus amarus	+RD	+RD	+RD	
Carassius carassius	+RD			+SD
Carassius gibelio	+RD	+SR		
Tinca tinca	+RD		+SR	+RD
Chondrostoma nasus	+SR	+SD	+SR	+D
Scardinius erythrophtalamus	+SR		+RD	
Vimba vimba	+SR			
COBITIDAE				
Cobitis taenia	+SD	+RD	+SR	
Cobitis elongata		+RD		
Sabanejewia balcanica	+SR	+SD	SR	
Misqurnus fossilis	+SR			+SR
NEMACHEILIDAE				
Barbatula barbatula	+RD	+RD	+SD	
COTIDAE				
Cottus gobio				+SR
PERCIDAE				
Perca fluviatilis	+RD	+SR	+RD	+RD
Zingel streber				+SR

Zingel zingel				+SR
Acerina schraetser			+SR	+SR
Stizostedion luciperca			+RD	
ESOCIDAE				
Esox lucius		+SR		+RD
SILURIDAE				
Silurus glanis	+SR		+SR	+RD
SALMONIDAE				
Hucho hucho	+ SR			
PETROMYZONTIDAE				
Eudontomyzon mariae		+SR		
HYBRIDS				
	Squalius cephalus x *Alburnus alburnus*	*Alburnus alburnus* x *Squalius cephalus*		
INTRODUCED SPECIES				
Pseudorosbora parva	+			
Lepomis gibbosus		+		

The special retrospective new on taxonomic state of species, to present in tab. 3

Tab. 3. Review of described species presented in the river basins of the Ibar and the Zapadna Morava

PREVIOUS NOMENCLATURE	NEW NOMENCLATURE (according to Kottelat and Freyhof, 2007)
Barbus peleponnesius	*Barbus balcanicus* (Kotlik at. al., 2002)
Leuciscus cephalus	*Squalius cephalus* (Heckel, 1843)
Gobio gobio obtusirostris	*Gobio obtusirostris* (Valenciennes, 1842)
Gobio kesslerii	*Romanogobio kesslerii* (Dybonski, 1862)
Gobio albipinatus vladykovi	*Romanogobio vladykovi(Fang,1943)*
Romanogobio albipinatus	
Rhodeus amarus sericeus	*Rhodeus amarus* (Block, 1782)
Alburnus chalcoides	*Chalclaburnus chaleoides* (Güldenstadt, 1772)
Abramis ballerus	*Ballerus ballerus* (Linnaeus,1758)
Cobitis taenia	*Cobitis taenia (Linnaeus,1758)*
Cobitis taenia danubialis	
Sabanejewia aurata balcanica	*Sabanejewia balcanica* (Karaman, 1922)
Noemachilus barbatulus	*Barbatula barbatula (Linnaeus,1758)*
Orthrias barbatulus	
Carassius auratus gibelio	*Carassius gibelio* (Bloch, 1782)
Stizostedion luciperca	*Sander luciperca* (Linnaeus,1758)
Aspro streber	*Zingel streber* (Siebold, 1863)

Aspro zingel	*Zingel zingel* (Linnaeus,1776)
Acerina schraester	*Gymnocephalus schraester* (Linnaeus,1758)
Lampetra mariae	*Eudontomyzon mariae* (Berg, 1931)

Analyzing the paper of Kotlik et al., 2002, a conclusion can be made that the barbel *Barbus balcanicus* populates the greatest part of waters of Balkan.

Danubian salmon - *Hucho hucho* (Linnaeus, 1758) was recorded in the middle course of the Ibar River, in the area of the Gazivoda Lake reservoir (Šorić, 1996). Its presence in mentioned reservoir was known earlier, with respect that its area of distribution was in the canyon of the Ibar River.

In addition to autochthonous species, the introduced fish species are *Pseudorsbora parva* recorded by Bianco (1988) in middle part of the Ibar River, at Kosovska Mitrovica, while *Lepomis gibbosus* was transferred from east part of North America into Europe, where it is widely distributed. In our country, it is very numerous in the Gruža River.

The ichthyofauna of middle course of the Ibar River is now poor as compared to the ichthyofauna of the remaining part of this river basin and particularly to the ichthyofauna of the Rasina River and lower course of the Gruža River and the Zapadna Morava River. It is likely, that ichthyofauna of the Ibar River is impoverished because of the very strong pollution. The middle course of the Ibar River is polluted by lead and zinc mines, whose tailing are constantly washed into the river and can be one of the significant causes of hybridization between *Squalius cephalus* x *Alburnus alburnus* (Šorić, 2004).

The Rasina resevoir „Ćelije“ was stocked with *Abramis brama, Ballerus sapa, Blica bjoerkna, Cyprinus carpio, Tinca tinca, Carassius gibelio, Esox lucius* and *Stisostedion luciperca* (Janković, 1996). The same process was commited in Gruža reservoir with *Perca fluviatilis, Silurus glanis, Esox lucius, Cyprinus carpio, Hypophthalamichthys molitrix, Ctenopharyngodon idella*, and *Stisostedion lucipercą* (Marković, 2004) and *Sqalius cephalus* (weight to 1.3 kg), *Esox luceus* (to 3 kg), *Cyprinus carpio* (1 kg), *P. fluviatilis* (0.75 kg), *Chondrostoma nasus* (0,7 kg) (Šorić, 2004). The Western Morava reservoir “Medjuvršje” was stocked with *Abramis brama, Perca flaviatilis, Chondrosto manosus, Sqvalius cephalus,Cyprinus carpio, Silurus glanis, Aspius aspius, Rutilis rutilis, Perca fluviatilis* and *Esox lucius* (Janković 1996). Some of these species came into rivers system (mark for introduced species).

These investigations indicate that the ichthyofauna of the Zapadna Morava River system is unique for its 39 fish species, reciprocal hybrids between *squalius cephalus* (S.*L. cephalus)* and *A. Alburnus* (Šorić,1986 and 2004) and one lamprey species, *Eudontomyzon mariae* (Šorić, 2002), which can be found in all the parts of the basin where the ecological conditions are appropriate.

The tributary of the Ibar River, the Sitnica River, is the greatest pollutant of electro energetic and chemical pollutions (heavy metals: lead, zinc, cadmium, 525 tons of SO_2 in the year). There are the greatest settlements (Priština, Vučitrn and

Kosovska Mitrovica), with the following economic capacities: the total amount of the waste water is evaluated on about 3500 l/s, and industrial waste water about 2500 l/s. In coastal rivers, there is about 6 m^3 of plastic and glass package that is not recycled. In addition, there is agricultural pollution. The Sitnica is hydrologically a champaign River, slow and rich in water. It springs up from Sazlije pond, northeast from Urosevac. Length of the river course is about 110 km. In upper part, the river is wide 6-7 m, and its depth is about 0.45 m. In its lower course, it is to 3m wide, and it imports 8 cubic meters of water per second into the Ibar River. Depth of the River is about 7m below the Vučitrn. Fish fund of the Sitnica River is very rich, and composed exclusively of cyprinid species. The Secretariat of Economy of AOKM, in order to improve and further develop fisheries as economy branch, made an arrangement with sample station of fisheries NRS. The investigations were performed in period from 16 to 24 June 1953. Team for each fishing water analysed its fish population apart from water source to its delta, in respect of density of population, age relation of individual classes, as well as organic production of the Sitnica River, its right tributary the Lab River and left tributaries the Crnoljeva, the Batlava and the Drenica rivers. Organic production of the Sitnica River and its tributaries was very rich, but it was not in agreement with density of fish population of those waters. It means that the fish population was decreased, and the presented number of species could not use total organic production, and because of that it declines. Also, it was found that the composition of fish population was represented with younger individuals, without stem specimens.

It was determined that all the rivers of Black Sea basin of Kosmet are carp areas. Except for the Lab River with salmonide area, and on some few kilometers from springs, all other waters did not have salmonide area. Middle courses of the Lab and the Drenica rivers had barbel area, and simply carp area down to the delta. The rivers Batlava and Crnoljeva had only barbel area.

By trial fishing, the presence the following fish was determined: bleak *Alburnus alburnus*, chub *Squalius cephalus* (Syn. *Leuciscus cephalus*), carp *Cyprinus carpio*, gudgeon *Gobio obtusirostris* (Syn. *Gobio gobio obtusirostis*), river barbel *Barbus barbus*, brook barbel *Barbus balcanicus* (Syn. *Barbus pelaponnesius*), nase *Chondrostoma nasus*, bream *Abramis brama*, bitterling *Rhodeus amarus* (Syn. *Rhodeus sericeus*), vimba bream *Vimba vimba*, rudd *Scardinius erythrophthalmus*, roach *Rutilis rutilis*, wels catfish *Silurus glanis*, pike *Esox lucius* (Ristić at al, 1953; Marković, 1962).

Ristić with colleagues (1953) found that the Drenica River has a large number of big wels catfishes and pikes, which are unused in respect of economy, and they present a direct danger for fish progeny of that River.

Mentioned pollutions, unreasonable usage, unorganized control and guardian services led to devastation of ichthyofauna of these rivers. Before all, it refers to the big stem specimens of all species of fish in the Sitnica River, and specially on the carp

Cyprinus carpio (that had weight to 10 kg, earlier), river barbel *Barbus barbus*, wels catfish *Silurus glanis* (with weight to 50 kg), pike *Esox lucius* (with weight over 4 kg) and other fish species.

So, until now, our investigations of carp region involves other sparse cyprinids: gudgeon *Gobio obtusirostris* (Syn. *Gobio gobio optusirostris*),brook barbel *Barbus balcanicus* chub *Squalius cephalus* (Syn. *Leuciscus cephalus*), roach *Rutilis rutilis*, bleak *Alburnus alburnus*, prussian carp *Carassius gibelio* (Syn. C. *auratus gibelio*), Cobitidae weatherfish *Misgurnus fossilis*, pike *Esox lucius*.

The salmonide area of the Lab is destroyed, and from other species there is *Barbatula barbatula* (Syn. *Orthrids barbatulus*), the presence of which indicates salmonide region. The middle course of Lab is barbel zone with the following species: river barbel Barbus barbus, bleak *Alburnus alburnus*, spirlin *Alburnoides bipunctatus,* nase *Chondrostoma nasus*, carp *Cyprinus carpio*, prussian carp *Carassius gibelio*, rudd *Scardinius erythrophthalmus*, chub *Squalius cephalus*, brook barbell *Barbus balcanicus* spined loach *Cobitis taenia*, ide *Leuciscus idus* and tench *Tinca tinca*.

From the left side of the Lab River, short (10 km) Batlava River inflows. Upper part of the river is without vegetation, with rocky and pebbly river bed. In the lower part, it is a champaign river, with water speed about 1m/s. There are the following fish species: bleak *Alburnus alburnus*, chub *Squalius cephalus*, brook barbel *Barbus balcanicus*, gudgeon *Gobio obtusirostris* (Syn. *Gobio gobio*) and nase *Chondrostoma nasus*.

Also, left tributary of the Sitnica River, the Crnoljeva River belongs to the Black Sea basin of Kosmet, and the length of its course is about 29 km. In the upper part, it flows through the dense forest. The bottom of this part is rocky-pebbly, while in its lower part it is sludgy. Trial fish catching in the upper part showed that fish is not present there. In lower course, at Crnoljero village, gudgeon *Gobio obtusirostris* (Syn. *Gobio gobio*) is very sparse. From the mountain with the same name, Crnoljeva, the Drenica River (left tributary of Sitnica River) sources. Length of this river is about 43 km, and its average depth is about 0.5 m, while its whirlpools are 3-6 m deep, and it is overgrown by boscage and water lilies. Mainly, it is a champaign river, with water speed about 1m/s. During summer, the water level decreases, so the fish retain in the whirlpools. Generally, fish fund is made of cyprinid species, such as bleak *Alburnus alburnus*, nase *Chondrostoma nasus*, bream *Abramis brama*, gudgeon *Gobio obtusirostris* (Syn. *Gobio gobio*), carp *Cyprinus carpio*, as well as pike *Esox lucius* and wels catfish *Silurus glanis*. The last two species attain mean weight. From such data it can be concluded that the ichthyofauna is even more devastated in relation to the data Ristic at all. 1954 and Markovic, 1962, and it consists of mostly young, sexually immature age, class of fish.

We studied the ichthyofauna of the River Gruza, 1996 and 2004 (tab .2). The Gruza springs from Rapaj-hill from the mountain mines and inflows in the Zapadna Morava. Springs are enclosed. Amount of water is 120 l/s, and speed of the flow 1.2

m/s. Average water width beds at the top, while the bottom is small 3-5m, rarely 8-10m. Depth of the river was, on average, 0.75 to 1.5 m. In its upper course the Gruža receives the waters of the Kamnicka rijeka. On the enclosure below the River Gruža we can find the fish *Barbutula barbutula (sun.Nemahaelus barbatulus)*. Since B. barbatula is a reofil species, it determines the border of the lower part of salmonid region. This species is important as an indicator for determination of the border of salmonid region from the waters where presently there are no salmonids (Karaman, Šoric, 1997). In the Kamenička River fish *Phoxinus phoxinus is* present. Presence of this species also indicates the salmonid region. P. phoxinus settles in the upper and the middle ritron zone of the Gruža, and border of this zone is by the village Grivac. *Rutilus rutilus* dominated in lower part of the river Gruža. In the Gruža River, immediately above its influx to the lake there is the main spawning area for *Chondrostoma nasus*. The Gruža Lake and mouth of the Gruža River to the Zapadna Morava are the main area for carp. In addition to species of the family Cyprinidae and Cobitidae there are Esocidae, too.

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