

## PRESENCE OF THE MOST ECONOMICALLY IMPORTANT FISH SPECIES IN THE RIVER DANUBE AND ITS FLOOD ZONES IN SERBIA

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### Summary

On the basis of the data published between 1983 and 2008, this paper shows presence of tench (*Tinca tinca*), carp (*Cyprinus carpio*), pike (*Esox lucius*), catfish (*Silurus glanis*), zander (*Sander lucioperca*) and sterlet (*Acipenser ruthenus*) in the *Gornje Podunavlje* and *Koviljsko-Petrovaradinski Rit* Special Nature Reserves and the *Begečka Jama* Nature Park, as well as in the part of the Danube's bed between river kilometre 1249- and 1255.

The number of these fish species in the River Danube and its flood zones in this part of the Pannonian Basin is decreasing due to the use of inappropriate "tools", electric current, uncontrolled agricultural and industrial waste dumps, degradation of the habitat.

The above mentioned species deserve attention because, according to the *Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi* of 2010, in Serbia, *T. tinca* is a strictly protected species, while *C. carpio*, *E. lucius*, *S. glanis*, *S. lucioperca* and *A. ruthenus* are listed as protected.

On the basis of the 2009 Fisheries Law in Serbia, permanently closed fishing season was introduced for tench, and closed season in certain periods and fishing ban for individuals under the prescribed size for the rest of the above mentioned species.

*A. ruthenus* is subject to the Law on Ratification of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ANNEX II and is listed in the category of species that may be in danger of extinction. Furthermore, it can be found on the IUCN Red List of Endangered Species of the International Union for Conservation of Nature – VU, which means that it is marked as vulnerable.

**Key words:** economically important fish species, the River Danube, flood zones, threatened fish species

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## INTRODUCTION

On the territory of Vojvodina, in the last several decades, complex hydrobiological and ichthyological researches have been done. According to the numerous references, of which Budakov et al. (1997) and Simonović (2001) should be singled out, in this part of the Danube flow through Vojvodina, especially in its floodplains (Gornje Podunavlje and Koviljsko-Petrovaradinski Rit), 55 fish species from 13 families and 2 superorders were registered.

For the last twenty years, both foreign and domestic legislations have been implemented in order to protect plants and animals, including ichthyofauna. Within the scope of domestic legislation, the list of cyclostomes and fish protected as “natural rarities” was made in 1993 (Official Journal of the Republic of Serbia, 1993) and the first degree of protection was assigned for these species. Furthermore, a certain number of cyclostomes species and fish are listed in *Preliminary list of species for the Serbian red list of vertebrates* (Janković and Krpo-Ćetković, 1995). Legislation continued and in 2010 the *Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi* (Official Journal of the Republic of Serbia, No. 5, 2010) came into force. Closely related to this Rulebook is the Fisheries Law published in the Official Journal of the Republic of Serbia, 2009.

On the basis of the presence of species that deserve appropriate degree of protection, many areas on the territory of Vojvodina received certain status by the end of the last and at the beginning of this century.

Along the Danube flow through Vojvodina, there are three Special Nature Reserves: Gornje Podunavlje, Dunav II – Karadorđevo and Koviljsko-Petrovaradinski Rit, as well as the Begečka jama Nature Park. These protected ecosystems should receive attention in order to preserve biodiversity, because endangerment or extinction of certain species makes gene pool of a particular area poorer.

On the basis of published data, this paper will show the presence of economically important fish species in the last thirty years in the Gornje Podunavlje and Koviljsko-Petrovaradinski Rit Special Nature Reserves, and the Begečka Jama Nature Park, as well as in the part of the Danube’s bed between river kilometre 1249 and 1255.

The Gornje Podunavlje Special Nature Reserve is located on the edge of the Pannonian Plain in the Danube’s flooded zone, on its upper flow through the Republic of Serbia and AP of Vojvodina. It lays on the Danube’s left bank from river kilometre 1433 to 1367 and it occupies a surface of 19,648 ha (Panjković et al. 2004). The territory of the reserve is a complex structure of aquatic and terrestrial ecosystems. It was declared a Special Nature Reserve in 2001 by the decision of the Government of the Republic of Serbia.

The Koviljsko-Petrovaradinski Rit Special Nature Reserve is located on the Danube’s left bank, between river kilometre 1228 and 1239, near the town of Kovilj. It covers the surface of circa 5.000 ha. It consists of numerous meanders, branches, oxbow lakes, river islands, ridges and sand dunes which were created as a result of a sudden drop in the Danube water levels. Koviljsko-Petrovaradinski Rit is a forest complex intersected with fields, rushes, reed-patches, marshes with aquatic marsh vegetation (Bukurov, 1951). By the regulation of the Government of the Republic of Serbia, and after proposal by the

Institute for Nature Conservation of Serbia (Budakov, 1995), this area was declared a Special Nature Reserve in 1998.

The Begečka jama Nature Park is located upstream from the town of Begeč. It is connected to the Danube by the channel at river kilometre 1276.2. It was naturally created by the formation of the former Danube branch, the water surface of which is in direct relationship with the Danube water levels. During high water levels, the surface of Begečka Jama is ca. 250 ha. Due to specific plant and animal species, it was declared a Nature Park in 1999.

## *MATERIAL AND METHODS*

The ichthyological material was collected in the periods of high, low and medium water levels with standard electrofishing devices and nets of various mesh diameters.

The sampling started in 1980 in the Gornje Podunavlje and Koviljsko-Petrovaradinski Rit Special Nature Reserves, Begečka Jama Nature Park, as well as in the part of the Danube's bed between river kilometre 1249 and 1255. The ichthyological material was determined using the keys by Vuković and Ivanović (1971) and Simonović (2001).

Table 1 shows qualitative and quantitative presence of the economically important fish species in the River Danube and its flood zones (between river kilometre 1228 and 1433) in the period from 1980 to 2008. Quantitative presence includes proportional contribution of each economically important fish species in the total fish number or presence and absence of those species in the catch.

## *RESULTS AND DISCUSSION*

### *Gornje Podunavlje Special Nature Reserve*

The first thorough ichthyofauna research in this area was done in 1980s when 18 fish species from six families were registered (Maletin and Kostić, 1988). It is admirable that some ten years later, probably due to the manner of fishing and water levels, there was a significantly greater ichthyofauna diversity. The presence of 55 fish species was recorded, which comprised almost all fish species found in the waters of Vojvodina (Budakov et al., 1997). Furthermore, the proportional contribution of economically important fish in the overall catch was shown in the first research paper (Maletin and Kostić, 1988). Table 1 shows that, in the fishing period 1986-1987, sterlet (*A. ruthenus*) had dominant proportion in the catch of economically important fish with 20.83% during high water levels and 10.69% during low water levels. Zander (*S. lucioperca*) was present with the same proportional contribution during low water levels, catfish (*S. glanis*) had a significant contribution during both high and low water levels, while pike (*E. lucius*) was significantly present during the low water levels. This proportional contribution of pike, catfish and zander is significant, given the fact that they are predators and thus at the top of food chain.

Table 1. Qualitative and quantitative presence (proportional contribution in the total fish number (%) or just presence (+)) of the economically important fish species in the River Danube and its flood zones (between river kilometre 1228 and 1433) in the period from 1980 to 2008.

Tablica 1. Kvalitativna i kvantitativna prisutnost (proporcionalan doprinos u ukupnom broju riba (%) ili samo prisutnost (+)) od gospodarski značajnih vrsta u Dunavu i njegovim poplavnim zonama (između 1228. i 1433. Rijeke kilometru) u razdoblju od 1980 do 2008.

Site Postaja istraživanja	Point Punkt	Month or/and year of the catch Mjesec i/ili godina ulova	Author and the year of publication Autor i godina objave	<i>Tinca</i> <i>tinca</i>	<i>Cyprinus</i> <i>carpio</i>	<i>Esox</i> <i>lucius</i>	<i>Silurus</i> <i>glanis</i>	<i>Sander</i> <i>luciopeca</i>	<i>Acipenser</i> <i>ruthenus</i>
River Danube's Bed		1986-1987	Maletin and Kostić, 1988	4.56	6.31	1.75	0.35	0.70	38.95
Korito reke Dunav		1996	Maletin et al., 1997	-	0.5	3.48	0.5	0.5	5.72
Gornje Podunavlje (Apatin marsh/ apatinski rit)		1986-1987	Maletin and Kostić, 1988	-	-	-	9.37	3.12	20.83
		1996	Budakov et al., 1997	+	+	+	+	+	10.69
Begečka Jama		1996-1997	Maletin et al., 1997	-	0.37	0.37	0.74	0.74	-
		1999	Budakov, 1999	+	+	+	+	+	-
		1999	Vučković et al., 2002	0.23	3.26	9.32	-	0.93	3.5

	II 1980	Budakov et al., 1983	4.22	-	30.98	-	-	-
	III 1980	Budakov et al., 1983	0.67	-	1.34	-	0.67	-
	IV 1980	Budakov et al., 1983	-	2.0	-	8.0	-	-
	V 1980	Budakov et al., 1983	-	-	1.06	-	-	-
	VI 1980	Budakov et al., 1983	0.36	-	2.90	2.90	0.72	-
	total II-VI 1980	Budakov et al., 1983	0.52	0.08	3.35	1.03	0.34	-
	1986-1987	Maletin and Kostić, 1988	0.82	-	1.49	-	-	-
	1996	Maletin et al., 1997	0.06	3.28	24.59	0.82	10.11	-
	1999	Popović et al., 2000	-	3.28	3.22	0.06	0.38	-
	2000	Maletin et al., 2001	-	0.47	0.47	-	-	-
	2000	Maletin et al., 2001	-	-	17.59	-	-	-
	2000	Maletin et al., 2001	-	6.66	-	-	-	-
	2000	Maletin et al., 2001	-	-	2.69	-	-	-
	2000	Maletin et al., 2001	-	0.24	6.49	-	-	-
	2006	Popović et al., 2006	-	-	7.32	-	-	-
	2006	Popović et al., 2006	-	-	9.02	-	-	-
	2006	Popović et al., 2006	-	-	9.75	-	-	-
	VI 2007	Popović et al., 2007	-	-	2.56	-	1.46	-
	XI 2007	Popović et al., 2007	-	-	49.52	-	-	-
	VI 2007	Popović et al., 2007	-	-	1.83	-	-	-
	VII 2008	Popović et al., 2008	-	0.66	5.3	-	-	-
	X 2008	Popović et al., 2008	-	20.83	5.55	-	-	-
	VII 2008	Popović et al., 2008	-	-	5.46	-	-	-
	X 2008	Popović et al., 2008	-	-	12.5	-	-	-
	X 2008	Popović et al., 2008	-	-	3.04	-	0.68	-

Koviljsko-  
petrovaradinski Rit

### *Begečka Jama Nature Park*

Since the middle of 1990s, Begečka Jama attracts attention of researchers (Maletin et al., 1997; Vučković et al., 2002). During the 1996 research (Maletin et al., 1997), 16 fish species from 6 families were registered. The following economically important fish species had low proportional contribution: common carp (*C. carpio*), pike and zander (Table 1).

Three years later, 17 species from 5 families were registered in total (Vučković et al., 2002). Among economically important species there was no catfish, but sterlet and tench (*T. tinca*) were present and pike was dominant with 9.32% (Table 1).

### *Koviljsko-Petrovaradinski Rit Special Nature Reserve*

This marsh, as well as Gornje Podunavlje, a marsh near Apatin, is the last remaining flood area of the River Danube on its flow through Serbia and is the remainder of once vast marsh biotopes. This is an important fish spawning area, and in the last thirty years, as a part of complex hydrobiological and ichthyological researches, researches of ichthyofauna composition were also conducted (Budakov et al., 1983; Maletin and Kostić, 1988; Maletin et al., 1997; Popović et al., 2000; Maletin et al., 2001; Popović et al., 2006; 2008).

Pike was the only economically important fish species that was constantly present during this thirty-year period. Significant proportional contribution of this predator (30.98%) was registered in 1980 (Budakov et al., 1983), also between 1986 and 1987 during low water levels (24.59%) (Maletin and Kostić, 1988), in 2000 at Šlajz (17.59%) (Maletin et al., 2001) and in November 2007 at Arkanj (Popović et al., 2007) (Table 1).

During the 1980s and 1990s, common carp was present with low proportional contribution (Budakov et al., 1983; Maletin and Kostić, 1988; Maletin et al., 1997; Popović et al., 2000; Maletin et al., 2001), then it disappears and is registered again in October 2008 at Arkanj with significant proportional contribution (20.83%) (Popović et al., 2008) (Table 1).

The results for zander are similar since the presence of this species was registered in catches between 1980 and 1996 (Budakov et al., 1983; Maletin and Kostić, 1988 and Maletin et al., 1997). The most prominent presence was in the period 1986-1987 during the low water levels (10.11%). This predator was registered again in June 2007 at Arkanj (Popović et al., 2007) and October 2008 at Šlajz (Popović et al., 2008), both times with low proportional contribution (Table 1).

The situation with tench and catfish is much worse. These species were present in catches only during the 1980s and 1990s (Budakov et al., 1983; Maletin and Kostić, 1988; Maletin et al., 1997), after which they disappear (Table 1).

During the thirty-year research at this site, sterlet has never been registered (Table 1).

### *River Danube's bed*

In the periods of high and low water levels in the River Danube in Vojvodina in the mid-1980s, the total of 29 fish species from 9 families were recorded (Maletin and Kostić, 1988). In the given period, during high water levels, a significant proportional contribu-

tion of sterlet was recorded (38.95%). Concerning economically important fish species, apart from sterlet, tench, carp, pike, catfish and zander were also present, but it should be noted that proportional contribution of pike and zander in the periods of low water levels was significant (8.45% and 7.08%, respectively) (Table 1).

About a decade later, the condition drastically changed since the number of species and families was reduced by half (15 fish species from 5 families) (Maletin et al., 1997). Tench had vanished and economically important species that appeared in the previous period, although present in this period also, had significantly smaller proportional contribution (0.5% per each species) (Table 1).

Presented results indicate that the number of economically important fish species in the Danube and its flood zones in Vojvodina is decreasing and that they are endangered due to irrational fishery, degradation of the habitat and prominent anthropogenic influence which is most visible in the Koviljsko-Petrovaradinski Rit Special Nature Reserve, especially in the late 1990s. Irrational fishery includes disrespect of fishing seasons and excessive fishing of mostly juvenile individuals, which can be seen from the results on age, weight, length and sex structure over the past decades. Degradation of the habitat is manifested in destruction of areas in which fish spawn. Moreover, it should be pointed out that the presence of introduced species is also a significant factor. Among introduced species that have changed the composition of the indigenous ichthyofauna to a great extent, Prussian carp (*Carassius gibelio*) is singled out. It is one of the 5 species that have been introduced into the waters of Serbia from the Far East. Due to gynogenesis which is a specific form of propagation, it populated the waters very fast, and since it is very resilient to oxygen deficit and increased pollution, in competition for food, it suppressed the predominant carp, as well as crucian carp. Therefore this introduced species was until recently the most dominant in the waters of Vojvodina. In the homeland of Prussian carp in the Far East, the sex ratio is 1:1, while in most waters in Vojvodina by the middle 1990s, females were mostly predominant. Since then, it has been noticed that the balance between sexes was being restored. In some watercourses, the sex ratio is almost 1:1 (Kostić et al., 1997; 1998; Popović and Kostić, 2002). The significant increase in Prussian carp male population coincides with a decrease in proportional contribution of this species in the waters of Vojvodina (Popović et al., 2000; Maletin et al., 2001; Vučković et al., 2002). On the basis of thorough research on Prussian carp conducted on the territory of Vojvodina, it can be concluded that the process of its acclimatisation is over, and that it has reached the phase of naturalisation.

Economically important fish species discussed in this paper deserve attention because, according to the *Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi* (Official Journal of the Republic of Serbia, 2010), tench is a strictly protected species, while carp, pike, catfish, zander and sterlet are listed as protected. On the basis of the Fisheries Law published in the Official Journal of the Republic of Serbia, No. 17, 2009, the permanently closed fishing season was introduced for tench, and closed season in certain periods and fishing ban for individuals under the prescribed size for the rest of the above mentioned species. Given that tench, on the basis of the presented data, was last recorded in 1996 (Maletin et al., 1997), and that it is present in very small numbers or has disappeared from other watercourses of the south Pannonian region, the Ministry of Science of Serbia and Provincial Secretariat

for Science of AP Vojvodina support the project of repopulation of this important indigenous species, both in fish ponds and open waters.

In the *Preliminary list of species for the Serbian red list of vertebrates* among the analysed species are: common carp, pike, zander and sterlet, because there is danger of their extinction (Janković and Krpo-Četković, 1995; Budakov, 2000; Simonović, 2001).

Beside this, sterlet is subject to the Law on Ratification of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ANNEX II and is listed in the category of species that may be in danger of extinction. Furthermore, sterlet is found on the IUCN Red List of Endangered Species of the International Union for Conservation of Nature – VU, which means that it is marked as vulnerable.

The presented data on the economically important fish species in this part of the River Danube and its flood zones should, among other things, once again stress that the above mentioned sites require attention in order to protect biodiversity.

## CONCLUSIONS

On the basis of the data published between 1983 and 2008, this paper shows presence of tench (*T. tinca*), carp (*C. carpio*), pike (*E. lucius*), catfish (*S. glanis*), zander (*S. lucioperca*) and sterlet (*A. ruthenus*) in the Gornje Podunavlje and Koviljsko-Petrovaradinski Rit Special Nature Reserves, and the Begečka Jama Nature Park, as well as in the part of the Danube's bed between river kilometre 1249 and 1255. The number of these fish species in the River Danube and its flood zones in this part of the Pannonian Basin is drastically decreasing and they are endangered due to irrational fishery, degradation of the habitat, prominent anthropogenic influence and presence of introduced fish species.

The above mentioned species deserve attention because, according to the *Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi* of 2010, in Serbia, *Tinca tinca* is a strictly protected species, while *C. carpio*, *E. lucius*, *S. glanis*, *S. lucioperca* and *A. ruthenus* are listed as protected.

*A. ruthenus* is subject to the Law on Ratification of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ANNEX II and is listed in the category of species that may be in danger of extinction. Furthermore, it is found on the IUCN Red List of Endangered Species of the International Union for Conservation of Nature – VU, which means that it is marked as vulnerable.



## Sažetak

# PRISUTNOST NAJVAŽNIJIH GOSPODARSKI ZNAČAJNIH VRSTA RIBA U DUNAVU I NJEGOVIH POPLAVNIM ZONAMA U SRBIJI

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Na temelju objavljenih literaturnih podataka u razdoblju od 1983 do 2008. godine, u radu je prikazana zastupljenost linjaka (*Tinca tinca*), šarana (*Cyprinus carpio*), štuke (*Esox lucius*), soma (*Silurus glanis*), smuđa (*Sander lucioperca*) i kečige (*Acipenser ruthenus*) u Specijalnim rezervatima prirode "Gornje Podunavlje" i "Koviljski-Petrovaradinski rit", Parku prirode "Begečka jama", kao i dijelu korita Dunava između 1249. i 1255. rkm. Brojnost ovih vrsta riba u Dunavu i njegovim plavnim zonama u ovom dijelu Panonskog basena opada uslijed upotrebe neodgovarajućih "alata", nekontroliranog ubacivanja poljoprivrednog i industrijskog otpada, kao i degradacije staništa. Navedene vrste zaslužuju iznimnu pozornost jer prema "Pravilniku o proglašenju i zaštiti zaštićenih i strogo zaštićenih divljih vrsta biljaka, životinja i gljiva" iz 2010. godine, u Srbiji je *Tinca tinca* strogo zaštićena vrsta, dok su *Cyprinus carpio*, *Esox lucius*, *Silurus glanis*, *Sander lucioperca* i *Acipenser ruthenus* na listi zaštićenih. Na temelju "Zakona o ribarstvu" iz 2009. godine u Srbiji je za linjaka je uveden trajni lovostaj, a za ostale spomenute vrste, lovostaj u određenom vremenskom periodu, kao i zabrana lova ispod propisane veličine. *Acipenser ruthenus* podliježe Zakonu o potvrđivanju Konvencije o međunarodnom prometu ugroženih vrsta divlje flore i faune (CITES) DODATAK II i spada u vrste kojima može zaprijetiti opasnost od izumiranja. Također se nalazi na IUCN crvenoj listi ugroženih vrsta međunarodne unije za zaštitu prirode - VU, što znači da se vodi kao ranjiva.

**Ključne riječi:** gospodarski značajne vrste riba, rijeka Dunav, poplavne zone, ugrožene vrste riba

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