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Ichthyofauna Composition and Population Parameters of Fish Species from the Special Nature Reserve "Koviljsko-Petrovaradinski Rit" (Vojvodina, Serbia)

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Abstract

Qualitative and quantitative ichthyofauna composition, morphometric characteristics, sex ratio, age and growth for fish species from Koviljsko-Petrovaradinski Rit were examined. A total of 1715 individuals which were classified into 18 species, from 7 families, were caught between August 2006 and October 2008. The greatest proportional contribution in total number of fish had *Rutilus rutilus*, while the greatest mass contribution had *Carassius gibelio*. Diversity and richness indices showed the highest values in the Dunavac locality. Female:male sex ratio varied from 1:0.33 in *Sander lucioperca* to 1:3.67 in *Leuciscus idus* and could not be observed in *Aspius aspius*, *Neogobius fluviatilis* and *Cobitis taenia* due to presence of only juvenile individuals. According to the scale readings, age distribution varied from I to VII year. The von Bertalanffy equation and growth performance index were determined by FiSAT II software in *Esox lucius*, *Perca fluviatilis*, *Lepomis gibbosus*, *R. rutilus*, *L. idus*, *C. gibelio* and *Alburnus alburnus*. Finally, distribution and population parameters of an invasive *C. gibelio* were discussed. Slightly poorer ichthyofauna diversity, low presence of economically significant species and reduced presence of individuals from higher age categories can point to irrational fishing, degradation of habitat, destruction of spawning areas and pronounced anthropogenic influence.

Keywords: Age, diversity, growth, morphometric characteristics, sex ratio.

Introduction

Koviljsko-Petrovaradinski Rit is a forest landscape intersected with fields, rushes, reed-patches and marshes with aquatic marsh vegetation. Together with another marsh near Apatin (Gornje Podunavlje), it is the last remaining flood area of the Danube River on its flow through Serbia and is the remainder of once vast marsh biotopes. The marsh territory is a flood plain and is exposed to the affects of Danube floods. The consequence of sudden drop in the Danube water levels are numerous meanders, branches, oxbow lakes, river islands, ridges and sand dunes. By the regulation of the Government of the Republic of Serbia, and after proposal by the Institute for Nature Conservation of Serbia (Budakov, 1995), Koviljsko-Petrovaradinski Rit was declared a Special Nature Reserve in 1998.

In the last 30-year period, within ichthyological research, the following researches were conducted: ichthyofauna composition research (Budakov *et al.*, 1983; Maletin and Kostić, 1988), fish growth and diet (Maletin *et al.*, 1991) and fish sex structure (Popović and Kostić, 2002).

Taking into account the long period of research of this site and the claim that, in earlier period, changes have occurred in physical-chemical and biological characteristics, the aim of the paper was to show, as a part of complex research conducted in the period between 2006 and 2008, if the qualitative and quantitative ichthyofauna characteristics have changed. Furthermore, the objective of this study was to examine morphometric characteristics, sex ratio, age and growth of caught fish species. This study presents the first data on growth parameters (L_∞, K, t_0, and ø') of certain fish species from the Koviljsko-Petrovaradinski Rit. Finally, population parameters of the highly invasive Prussian carp were discussed. These analyses can link with previous and continue ichthyological research started over 30 years ago.

Materials and Methods

Koviljsko-Petrovaradinski rit is located on the Danube's left bank, near the town of Kovilj (Figure 1). It covers the surface of 4000 ha, and its total length is 22 km. Ichthyological material was collected between August 2006 and October 2008 with standard

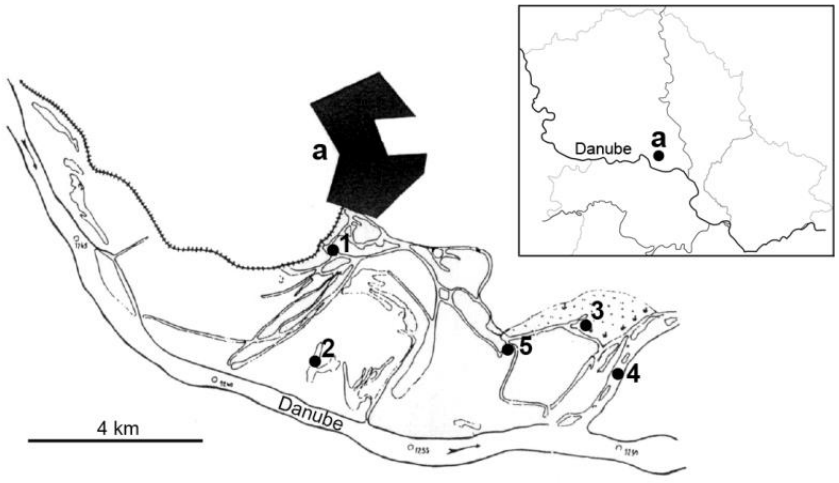

Figure 1. Map of the Koviljsko-Petrovaradinski Rit with respective sampling sites. a - Town of Kovilj. 1 - Šlajz. 2 - Tonja. 3 - Okruglica. 4 - Dunavac. 5- Arkanj.

electrofishing device. In 2006, ichthyological research was conducted from August to October in the period of medium water levels at the following sites: Arkanj, Dunavac and Tonja. In 2007, ichthyological material was collected in the period of medium water levels at Arkanj and Okruglica in June, and at Arkanj in November. In 2008, the research was conducted in periods of low water levels at Arkanj and Dunavac in July, and at Arkanj, Okruglica and Šlajz in October.

Determination of fish was done by using the key Simonović (2001). Fish were measured for total length (TL) and standard length (SL) to the nearest 1 mm and weighted for body weight (BW) to the nearest 1 g.

The analysis of qualitative and quantitative composition of the ichthyofauna was used to calculate the Shannon's index α-diversity (H) according to the formula (Marković and Veljović, 2005):

$$H = -\sum (n_i/N) * \ln (n_i/N)$$

where n_i presents the number of individuals of one species and N presents the total number of individuals caught. Furthermore, Margelef's richness index (d) was calculated according to the formula (Marković and Veljović, 2005):

$$d = (S-1) / \ln(N)$$

where S presents the total number of species and N presents the total number of individuals caught.

Sex of individuals was determined by macroscopic observation of gonads. After omission of juvenile fish, mature fish were used to calculate female : male (F:M) sex ratio. Chi-square (x^2) test was used to test deviations from the expected sex ratio (1:1). One-way ANOVA was used to determine difference in length (TL and SL) and body weight between sexes.

Scales from the left side of the body between the lateral line and dorsal fin were used to determine the age of fish. The scales were examined under a low power microscope and year rings have been counted for age determination.

Growth was determined by fitting the von Bertalanffy growth function to length-at-age data using FiSAT II (version 1.2.2) software (Gayanilo *et al.*, 2005). This allowed a non-linear estimation of growth parameters L_∞ and K where L_∞ is the asymptotic length and K is the growth coefficient. The hypothetical time at which the length equals zero (t_0) was subsequently calculated from the known length-at-age data and estimated L_∞ and K according to the von Bertalanffy plot based on linear regression (Sparre and Venema, 1998):

$$-\ln (1-L_t/L_\infty) = - K*t_0 + K*t$$

where $-\ln (1-Lt/L_\infty)$ is the dependent variable and age (t) is the independent variable. The growth performance index (ø') was calculated using FiSAT II (version 1.2.2) software according to the equation (Sparre and Venema, 1998):

$$ø' = \log_{10}(K) + 2 \log_{10}(L_\infty)$$

where K is the growth coefficient and L_∞ is the asymptotic length.

Results

During the three-year research period, 1751 individuals, which were classified into 18 species from seven families, were caught (Table 1). The biggest family was the cyprinid family with nine species. Northern pike - *Esox lucius* and Prussian carp - *Carassius gibelio* were the only species present at all above mentioned sites during the three-year research period. The greatest proportional contribution in total number of fish had roach - *Rutilus rutilus* (Table 1)

Table 1. Ichthyofauna composition and proportional contribution (%) of fish species from the Koviljsko-Petrovaradinski Rit per locality and year

Species	Sampling years and sites											Total
	2006			June 2007		November 2007	July 2008		October2008			
	Arkanj	Dunavac	Tonja	Arkanj	Okruglica	Arkanj	Arkanj	Dunavac	Arkanj	Okruglica	Šlajz	
Fam. Esocidae												
Esox lucius – northern pike	7.32	9.02	9.75	2.56	1.83	49.52	5.30	5.46	5.55	12.5	3.04	8.22
Fam. Percidae												
Perca fluviatilis – European perch	-	7.58	16.52	0.73	0.92	1.90	0.66	2.18	1.39	-	0.34	4.11
Sander lucioperca – pike-perch	-	-	-	1.46	-		-	-	-	-	0.68	0.34
Gymnocephalus cernua - ruffle	-	-	-	-	-	1.90	-	-	-	-	-	0.11
Fam. Gobiidae												
Neogobius fluviatilis – monkey goby	-	-	-	-	-	-	-	2.18	-	-	-	0.23
Fam. Centrarchidae												
Lepomis gibbosus – pumpkinseed	-	1.44	7.63	1.46	-	-	18.54	6.01	26.39	12.50	37.16	11.13
Fam. Cyprinidae												
Rutilus rutilus – roach	51.22	44.76	27.97	73.26	60.05	-	50.33	9.29	9.72	-	-	32.92
Leuciscus idus – ide	-	6.14	0.85	1.46	0.92	20.95	-	0.55				2.68
Cyprinus carpio – common carp	-	-	-	-	-	-	0.66	-	20.83	-	-	0.91
Blicca bjoerkna – white bream	-	2.53	-	2.56	21.10	-	1.99	1.64	-	-	-	2.46
Abramis brama – freshwater bream	-	1.44	3.39	0.37	-	-	2.65	1.64	-	-	-	1.14
Carassius gibelio – Prussian carp	31.72	10.83	21.61	6.96	3.67	18.09	7.95	3.28	20.83	37.50	3.72	10.45
Alburnus alburnus – bleak	-	15.88	4.24	8.79	10.09	6.67	9.27	14.75	9.72	-	10.81	10.05
Aspius aspius – asp	-	0.36	0.85	0.37	-	-	-	0.55	-	-	-	0.29
Scardinius erythrophthalmus – rudd	9.76	-	5.08	-	-	-	0.66	2.73	-	-	1.69	1.54
Fam. Cobitidae												
Cobitis taenia – spined loach	-	-	2.12	-	-	-	-	1.09	-	-	-	0.40
Misgurnus fossilis - weatherfish	-	-	-	-	-	0.95	-	-	-	-	-	0.06
Fam. Ictaluridae												
Ameiurus nebulosus - brown bullhead	-	-	-	-	0.92	-	1.99	48.63	5.55	37.50	42.57	12.91
Number of families	2	4	5	4	5	4	5	7	5	4	5	7
Number of species	4	10	11	11	8	7	11	14	8	4	8	18
Individuals caught	41	277	236	273	109	105	151	183	72	8	296	1751
Shannon's index α-diversity	1.125	1.712	1.971	1.077	1.190	1.360	1.587	1.800	1.839	1.255	1.323	2.108
Margelef's richness index	0.808	1.600	1.830	1.783	1.492	1.289	1.993	2.495	1.637	1.443	1.230	2.276

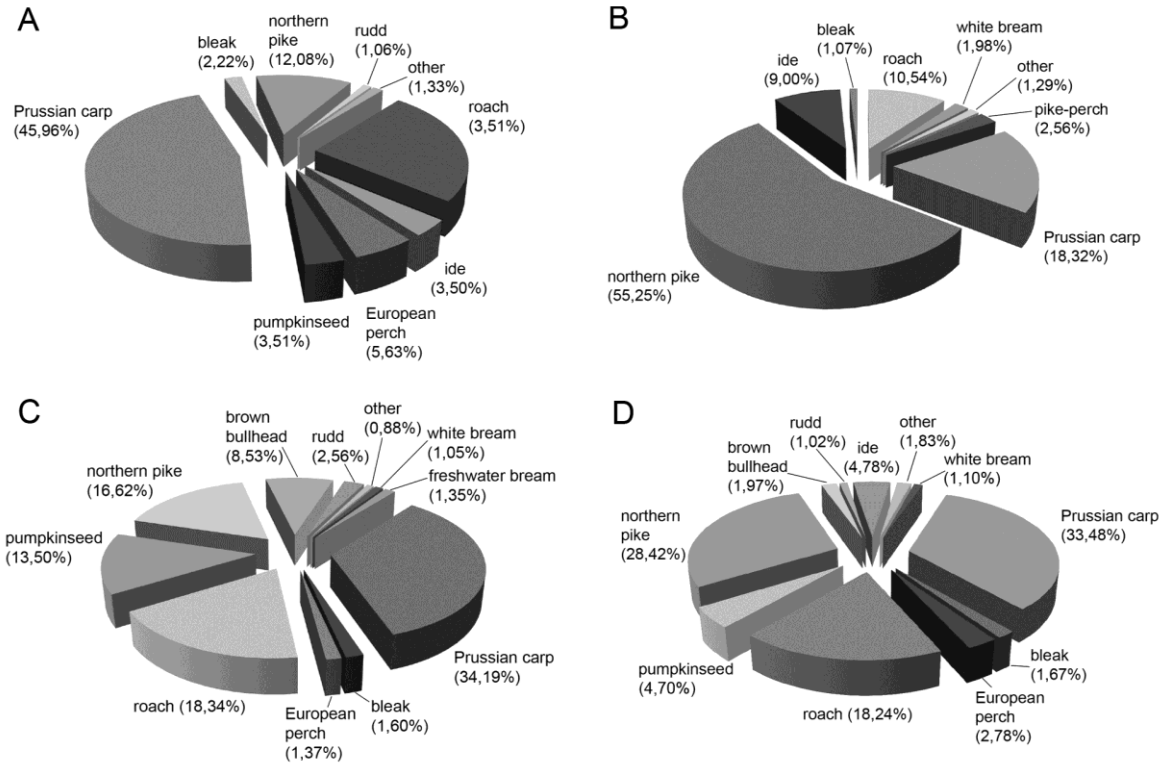

Figure 2. Mass contributions of species from the Koviljsko-Petrovaradinski Rit. A) Mass contribution for 2006; other – white bream (0.385%), freshwater bream (0.708%), asp (0.201%), spined loach (0.033%). B) Mass contribution for 2007; other-European perch (0.323%), freshwater bream (0.266%), pumpkinseed (0.479%), asp (0.123%), weatherfish (0.016%), brown bullhead (0.082%). C) Mass contribution for 2008; other – ide (0.556%), asp (0.205%), monkey goby (0.07%), spined loach (0.045%). D) Total mass contribution; other – freshwater bream (0.698%), asp (0.174%), monkey goby (0.016%), spined loach (0.024%), pike-perch (0.907%), weatherfish (0.006%).

while the greatest mass contribution had Prussian carp (Figure 2D). In addition, mass contributions of fish species in all investigated years are presented in Figure 2. Although ichthyological research was not conducted on a continuous basis at all sites, the diversity indices showed the highest values in the Dunavac site (Table 1).

Out of the total number of registered species, 15 species were indigenous while three species, pumpkinseed - *Lepomis gibbosus*, brown bullhead - *Ameiurus nebulosus* and Prussian carp were allochthonous. Research indicates low presence of economically significant fish species, because only northern pike, pike-perch - *Sander lucioperca* and common carp - *Cyprinus carpio* were registered.

Mean ± S.E. values for total length, standard length, body weight and sex ratio in caught fish species are presented in Table 2. One-way ANOVA showed that differences in total length, standard length and body weight between sexes were statistically significant in Prussian carp (P=0.002, P=0.029, P=0.039, respectively) and white bream (P=0.039, P=0.039, P=0.027, respectively). Chi-square (x^2) analysis showed that female : male sex ratio was significantly different from the expected sex ratio (1:1) in ide - *Leuciscus idus* (x^2 = 9.14, P<0.05), Prussian carp (x^2 = 8.8, P<0.05) and bleak - *Alburnus alburnus* (x^2 = 5.44, P<0.05). Sex ratio could not be observed in asp - *Aspius aspius*, monkey gobi - *Neogobius fluviatilis* and spined loach - *Cobitis taenia*, due to presence of only juvenile individuals.

According to the scale readings, age distribution varied from I (first year) to VII (seventh year) (Table 3). The most dominant age groups for most species were III and IV.

Growth parameters were observed in northern pike, European perch, pumpkinseed, roach, ide, Prussian carp and bleak (Table 4). Length-at-age data could not be fit to von Bertalanffy growth curve in the rest of the species due to small sample size and deficiency of higher age groups. Fitted von Bertalanffy curves in northern pike, Prussian carp and bleak are presented in Figure 3.

Discussion

When comparing to earlier research at the Koviljsko-Petrovaradinski Rit, it can be stated that the data from the present study, with respect to the number of fish species, are similar to the findings of Budakov *et al.* (1983) and Maletin and Kostić (1988) (Table 5), but are somewhat poorer when compared to results from Maletin *et al.* (1997) that lists 20 fish species, although the diversity indices show no

Table 2. Length and weight (mean ± S.E.) by sex and female : male (F:M) sex ratio in fish species from the Koviljsko-Petrovaradisnki Rit

Species	Sex	N	BW	TL	SL	Sex ratio
Northern pike	♀	44	202.93±22.79	299.14±9.92	263.55±8.94	1:1.29
	♂	57	153.75±12.99	282.19±7.25	245.53±6.92	
	juv	43	43.93±4.6	186.47±6.31	162.49±5.61	
	Σ	144	135.99±10.19	258.78±6.05	226.24±5.48	
European perch	♀	20	34.95±5.37	136.05±6.83	115.85±5.52	1:1.5
	♂	30	30.27±3.65	132.5±4.82	112.8±3.82	
	juv	17	18.12±3.41	105±8.27	87.76±6.93	
	Σ	67	28.58±2.54	126.58±3.90	107.36±3.23	
Pumpkinseed	♀	77	20.19±1.66	100.84±2.05	82.56±1.86	1:0.9
	♂	69	23.25±1.75	104.9±1.92	85.99±1.73	
	juv	9	6.67±0.88	74.11±3.85	59.33±2.72	
	Σ	155	20.77±1.17	101.10±1.45	82.74±1.30	
Roach	♀	83	28.84±2.57	133.96±3.14	109.28±2.56	1:1.16
	♂	96	29.01±1.74	137.21±2.51	112.34±2.18	
	juv	88	10.3±0.74	106.39±1.43	86.22±1.22	
	Σ	267	22.79±1.17	126.04±1.64	102.78±1.38	
Ide	♀	6	97.5±29.05	201.5±19.15	166.17±16.2	1:3.67*
	♂	22	91.95±11.64	204.95±7.45	165.23±6.3	
	juv	19	36.11±2.35	157.79±3.97	129±3.1	
	Σ	47	70.09±7.66	185.45±5.55	150.70±4.54	
White bream	♀	7	23.71±6.82	128.57±10.5	101.86±8.23	1:1.14
	♂	8	54.37±11.52	161.87±12.4	129.37±10.3	
	juv	22	4.68±0.36	89.32±1.78	69.77±1.52	
	Σ	37	19.03±4.26	112.43±5.99	88.73±4.92	
Freshwater bream	♀	3	32.33±15.38	141.67±21.9	113.33±18.5	1:2
	♂	6	42.17±12.04	152±17.75	120.33±13.8	
	juv	11	11.91±1.49	113.27±5.37	87.73±4.27	
	Σ	20	24.05±5.08	129.15±7.59	101.35±6.17	
Prussian carp	♀	101	150.61±7.12	203.61±3.67	167.84±3.1	1:0.62*
	♂	63	112.56±8.47	188.86±3.77	155±2.98	
	juv	18	4.67±0.49	72.06±2.35	58.67±1.82	
	Σ	182	126.47±5.83	185.49±3.73	152.61±3.1	
Bleak	♀	11	8.91±1.25	117.45±3.37	96.36±2.96	1:2.27*
	♂	25	9.12±0.83	118.64±1.97	97.16±1.63	
	juv	64	5.08±0.36	94.14±2.6	76.98±2.17	
	Σ	100	6.51±0.38	102.83±2.12	84.16±1.76	
Rudd	♀	5	38.2±10.03	145.8±9.01	120.6±7.61	1:2.2
	♂	11	34.09±7.68	141±9.64	116±7.95	
	juv	13	10.77±1.79	104.69±4.47	85.62±3.83	
	Σ	29	24.34±4.06	125.55±5.58	103.17±4.67	
Brown bullhead	♀	12	38.17±5.07	146.25±5.15	123.33±4.9	1:0.67
	♂	8	40.75±7.25	137.5±5.82	118.75±4.5	
	juv	16	6.69±1.17	75.75±3.91	63.69±3.55	
	Σ	36	24.75±3.57	112.97±6.26	95.81±5.43	

*N - number of individuals. BW - body weight (g). TL - total length (mm). SL - standard length (mm). juv - juveniles. Σ - total. * statistical significance, $P<0.05$

significant distinction. Present study indicates a higher diversity than in the study of Popović *et al.* (2000) which may be caused by a lower research-span in the mentioned study.

Out of 15 indigenous species that were registered, according to the "Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi" (Službeni glasnik Republike Srbije 5/10, 2010), eight species (northern pike, European perch, pike-perch, ide, white bream, asp, common carp and spined loach) are listed as protected, while one (weatherfish) is listed as strictly protected.

It is important to stress out the low presence of economically significant species in this research. Their number is drastically decreased due to irrational fishing (nonobservance of the closed season and amount and size of individuals caught), degradation of habitat, destruction of spawning areas, pronounced anthropogenic influence and presence of introduced species (Simonović, 2001).

Morphometric data did show differences when compared to previous research (Budakov *et al.*, 1983; Maletin *et al.*, 1985) of this investigated area. Lower values in standard length and body weight were observed in northern pike, roach, pumpkinseed and

Table 3. Length and weight (mean ± S.E.) by age categories in fish species from the Koviljsko-Petrovaradisnki Rit

Species		Age categories						
		I	II	III	IV	V	VI	VII
Northern pike	N	11	21	28	57	9	-	-
	BW	24.82±2.32	61.86±5.83	98.82±6.66	194.53±13.01	399±57.63	-	-
	TL	157.27±5.89	213.14±6.3	251.86±5.48	307.04±5.88	380.56±16.4	-	-
European perch	N	6	17	30	9	2	-	-
	BW	3.67±0.99	16.88±2.68	31.73±2.04	51.11±5.53	91±7	-	-
	TL	63.17±4.51	113.82±4.64	137.67±2.84	156.11±5.88	188.5±3.5	-	-
Pike-perch	N	-	-	1	3	-	-	-
	BW	-	-	70	185±23.63	-	-	-
	TL	-	-	240	293.33±8.82	-	-	-
Pumpkin-seed	N	2	17	115	21	-	-	-
	BW	2.5±0.5	9.06±0.75	17.67±0.69	48.95±3.64	-	-	-
	TL	56±1	81.47±1.7	99.24±1.1	131.43±2.86	-	-	-
Roach	N	-	1	173	80	11	2	-
	BW	-	4	12.84±0.55	34.85±1.08	75.73±3.25	120±20	-
	TL	-	87	111.20±1.1	147.7±1.7	189.09±1.91	216±6	-
Ide	N	-	1	28	17	-	1	-
	BW	-	18	47.89±3.6	97.35±12.68	-	280	-
	TL	-	140	168.36±3.93	209.88±9.13	-	294	-
White bream	N	-	25	11	7	-	-	-
	BW	-	5.08±0.47	17.91±4.34	62.14±10.65	-	-	-
	TL	-	90.84±1.81	120.27±6.9	172.14±10.29	-	-	-
Freshwater bream	N	-	4	14	2	-	-	-
	BW	-	7.75±1.89	22.71±5.32	66±3	-	-	-
	TL	-	94±4.64	131.21±7.55	185	-	-	-
Prussian carp	N	18	-	22	106	31	5	1
	BW	4.67±0.49	-	71.91±4.61	127.86±5.14	206.29±15.04	241±8.12	245
	TL	72.06±2.35	-	166.27±6.69	192.94±2.83	225.81±5.51	246.2±4.49	262
Bleak	N	10	46	39	2	-	-	-
	BW	2.8±0.36	4.96±0.22	9.03±0.57	18.5±3.5	-	-	-
	TL	68±5.22	99.37±1.89	117.72±1.39	140.5±4.5	-	-	-
Asp	N	-	1	4	-	-	-	-
	BW	-	8	28±2.71	-	-	-	-
	TL	-	116	158±6.38	-	-	-	-
Rudd	N	-	13	10	5	-	-	-
	BW	-	8.23±1.06	25.5±3.27	50.8±7.32	-	-	-
	TL	-	100.46±3.52	134.2±6.62	161.6±4.7	-	-	-

*N – number of individuals. BW – body weight (g). TL – total length (mm).

Table 4. Growth parameters in the most abundant fish species from the Koviljsko-Petrovaradinski Rit

Species	L_∞	K	t_0	ø’
Northern pike	49.55	0.25	-0.01	2.788
European perch	20.20	0.39	0.53	2.202
Pumpkinseed	18.69	0.26	-0.07	1.958
Roach	44.40	0.10	0.33	2.295
Ide	46.20	0.15	0.08	2.505
Prussian carp	32.29	0.23	-0.05	2.380
Bleak	14.09	0.61	0.42	2.083

*L_∞ - asymptotic length (cm). K – growth coefficient ($year^{-1}$). t_0 – hypotethical time at which length equals zero (year). ø’ – growth performance index.

rudd. These differences are mainly caused by differences in age categories, where less intividuals of higher age groups (VI and VII) and more individuals of the lower age groups (I and II) were caught in the present study. This distinction might have been caused by seasonal differences between the research periods as well as differences in water level and spawning periods. Furthermore, the distinction in results was caused by ommision of juvenile individuals in the research of Budakov *et al.* (1983).

Sex ratio is an important characteristic of fish populations, given that this relationship depends on reproduction, growth or stagnation of certain species (Budakov *et al.*, 1983). Under normal conditions, the generation usually has equal number of individuals of different sexes, and therefore the sex ratio is 1:1. This

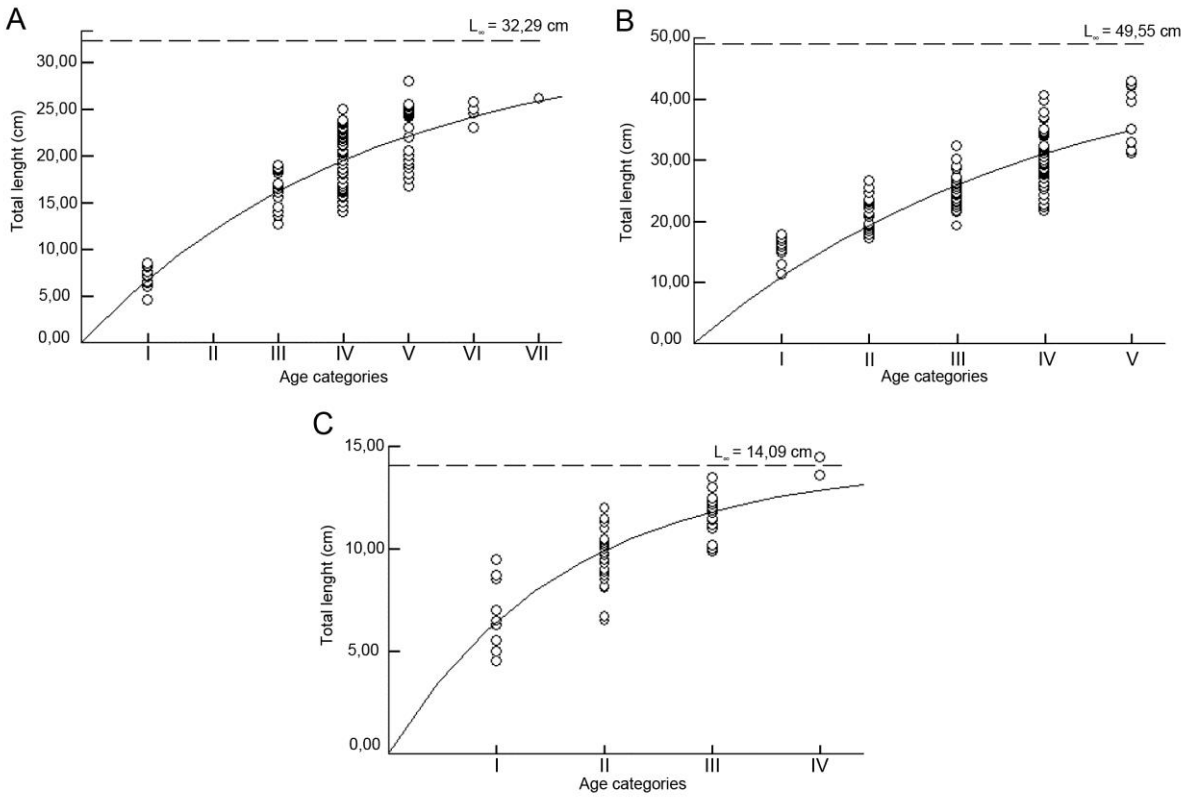

Figure 3. Fitted von Bertalanffy growth curve for: (A) Prussian carp; (B) northern pike; (C) bleak.

Table 5. Composition and characteristics of ichthyofauna from the Koviljsko-Petrovaradinski Rit from the previous research periods

Research period	N_I	N_S	N_F	H	d	Reference
1980	1163	18	5	2.109*	2.408*	Budakov *et al*., 1983
1986-1987	-	17	6	-	-	Maletin and Kostić, 1988
1996	3447	20	7	1.757*	2.333*	Maletin *et al*., 1997
1999	214	12	5	0.808*	2.050*	Popović *et al*., 2000
2006-2008	1751	18	7	2.108	2.276	Present study

*N_I - total number of individuals. N_S - number of species. N_F - number of families. H - Shannon's index α-diversity. d - Margelef's richness index. *Values are calculated using data from the cited references.

ratio can be changed under different environmental factors, as well as in different periods of the year due to spawning.

When comparing present sex ratio data with results of Maletin *et al.* (1985) and Budakov *et al.* (1983), significant differences are observed. These differences are most likely caused by sampling periods. Mentioned authors conducted researches during spawning periods while the current research was conducted outside the spawning period and therefore there were no significant differences in sex ratio in northern pike, roach, pumpkinseed and rudd.

Although a statistical significance in sex ratio in Prussian carp was observed, male individuals have a large contribution in the total number (34.61%). These findings differ from results given by Budakov *et al.* (1983) for Koviljski rit, Sari *et al.* (2008) for Buldan Dam lake, Şaşi (2008) for the South Aegean sea, Liasko *et al.* (2010) for Lake Pamvotis, Tsoumani *et al.* (2006) for lakes Koronia, Doirani and Pamvotis and Vetemaa *et al.* (2005) for waters of Estonia where only small amount of males (up to 7% of total catch) was observed. This lack of males in Prussian carp populations indicates that they reproduce gynogenetically (Bănărescu and Paepke, 2001). In mid-1990s contribution of male individuals increased considerably in waters of Serbia, which was also the case for waters of Hungary (Tóth *et al.*, 2005), Ukraine (Liasko *et al.*, 2010), Czech Republic (Halačka *et al.*, 2003; Luskovà *et al.*, 2010) and Turkey (Emiroğlu *et al.*, 2012). The increase in proportion of males and restoration of balance between sexes in current research and research conducted by Popović and Kostić (2002) indicate that the process of acclimatisation is over and that Prussian carp populations are now in naturalisation

phase.

Significant differences in weight between sexes in Prussian carp are most likely caused by portional spawning. Differences between sexes in common bream are caused by differences in number of individuals per age category.

When comparing the von Bertalanffy parameters for given species with data from the literature, results obtained in northern pike stand out. The asymptotic length (L_∞) and growth performance index (ø') are one of the smallest recorded when compared to available data on FishBase (Froese and Pauly, 2009) so far. There is a significant difference between asymptotic length obtained in the present study (L_∞ = 49.55 cm) and results reported by Treasurer *et al.* (1992) as 66.1 cm (FL), Przybylski (1996) as 54.3, 66.2 and 72.7 cm for different parts of a river basin, Johnson (1966) as 75.0 cm (TL), Hickley and Sutton (1984) as 110 cm (SL) and Treer *et al.* (1998) as 142 cm (TL). Given differences are most likely caused by a lack of older individuals in the present study since the oldest individuals belong to only V age category.

Values of growth parameters observed in Prussian carp were slightly smaller when compared to research conducted by Balik *et al.* (2004) and Leonardos *et al.* (2008). These differences in growth might be caused by differences in food supplies, competition for food between species, differences in water temperature, length, age and other (Ricker, 1975, cited from Okgerman *et al.*, 2010).

Growth coefficient (K) indicates how fast fish approach their asymptotic lengths (Sparre and Venema, 1998). A high growth coefficient of 0.61 in bleak indicates that this fish species attains asymptotic lengths in the first few years. This is one of the highest recorded growth coefficient when compared to available data on FishBase (Froese and Pauly, 2009) so far. Growth curve shows that bleak has reached 48.26% in the first, and 70.78% of the asymptotic length in the second year, therefore that growth of this fish species predominantly happens in the first two years.

To conclude, slightly poorer ichthyofauna diversity when compared to previous researches of this locality, low presence of economically significant species and reduced presence of individuals from older age categories can imply irrational fishing, degradation of habitat and pronounced anthropogenic influence. This is the reason why this Special Nature Reserve should receive great attention in order to protect and preserve its biodiversity.

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