COMPARATIVE ANALISYS MORPHOMETRIC PARAMETERS BROWN TROUT (*SALMO TRUTTA* MORPHA *FARIO*) FROM LOCALITIES OF RIVERS PLIVA AND VRBANJA

RADOJKA PAJČIN[1], SMILJANA PARAŠ[1], NEBOJŠA SAVIĆ[2], IVICA RADOVIĆ[3], SLAVEN FILIPOVIĆ[4], DRAGAN MILAVICA[2]

[1]Faculty of Natural Sciences and Mathematics, University of Banja Luka, dr Mladena Stojanovića 2, 78000 Banja Luka, Republic of Srpska; [2]Faculty of Agriculture University of Banja Luka, Bulevar vojvode Petra Bojovića 1A, Banja Luka, Republic of Srpska; [3]University of Belgrade - Faculty of Security, Gospodara Vučića 50, 11000 Belgrade, Serbia; [4]High school in Kotor Varošu, Kotor Varoš, Republic of Srpska

Corresponding author: e-mail: srpskiitebej@gmail.com

UPOREDNA ANALIZA MORFOMETRIJSKIH PARAMETARA POTOČNIH PASTRMKI (*SALMO TRUTTA* MORPHA *FARIO*) SA LOKALITETA REKE PLIVE I VRBANJE

Apstrakt

U ovom radu uporedno su analizirani morfometrijski parametri potočnih pastrmki (*Salmo trutta* morpha *fario*) sa dva lokaliteta: izvora reke Plive i reke Vrbanje u avgustu 2010. god. Paralelno sa ovom analizom urađena je i analiza makrozoobentosa kojim su se ribe hranile. Izlovljavanje riba je obavljeno sportskoribolovnom tehnikom, pri čemu je ulovljeno i analizirano ukupno 66 jednki, 33 iz izvora reke Plive i 33 iz reke Vrbanje. Morfometrijska analiza je obuhvatala određivanje: totalne dužine, standardne dužine i mase potočnih pastrmki, kao i dužine i mase digestivnog sistema istih, a ovi paramtri su poslužili za izračunavanje Fultonovog koeficijenta uhranjenosti. Istraživanje je pokazalo promenu u vrednostima parametara potočnih pastrmki sa ova dva lokalitela, kao i promenu istih između polova. Analiza makrozoobentosa koji je služio kao hrana ribama, pokazala je da je najveći udeo u plenu bio iz reda: Ephemeroptera, Trichoptera i Diptera. Larve Diptera iz familije Simuliidae su najčešći plen riba iz rijeke Plive, dok su se ribe iz rijeke Vrbanje najradije hranile larvama Chironomidae. Nije pronadjen ni jedan prazan digestivni sistem potočnih pastrmki u istraživanju. Svi rezultati su statistički obradjeni u programu ANOVA, a razlike izmedju grupa odredjene su stepenom značajnosti pomoću Fiserovog i t-testa.

Ključne riječi: potočna pastrmka, makrozoobentos, morfometrija
Key words: brown trout, macrozoobenthos, morphometric

INTRODUCTION

Natural food plays an important role in the pace fish growth and it depends on the qualitative and quantitative composition of organisms of lower systematic categories in aquatic ecosystems. Very important natural nutritional component of the fish food have organisms from environmental benthic communities, animal organisms belonging to zoobenthos, who settled ichthyofaunal habitats of fish populations. Type *Salmo trutta* morph *fario*, brown trout is wide spread in the waters of Bosnia and Herzegovina. Brown trout lives in the upper reaches of the streams in terms of clean, fast and cold water, rich in oxygen. The values of water temperature at the time of sampling ranged from 8.3°C in the upper reaches of Pliva, to 10.2°C in the upper reaches of the Vrbanja. Concentration of dissolved oxygen is in direct correlation with water temperature, because at higher values of water temperature lower value of dissolved oxygen were recorded. The concentration of oxygen was measured 11.7 gm^{-3}, at Pliva, where was recorded the lowest water temperature. The concentration of oxygen in the river Vrbanja was 11.0 g m^{-3}. The optimum temperature of water for brown trout ranges from 8 to 12 degrees Celsius, and the concentration of oxygen should be at least 10.0 g m^{-3} (Piria, 2007).

Great attention was paid to studying morphological and meristic characteristics of the digestive tract of fishes, brown trout (Bakrač-Bećiraj, 2008; Piria, 2007). Results that were obtained by the Pavlović et al. (2011) give data about diet of brown trout in the upper reaches of Pliva, and give data about state of zoobenthic taxas in source of Pliva. The goal of the research is to determine the basic morphometric characteristics, the mass ratio and Fulton's condition coefficient as well as the analysis of the diet of brown trout from the river Pliva and Vrbanja.

MATERIAL AND METHODS

Brown trouts specimens were collected on rivers Pliva and Vrbanja in the early morning and late evening hours by sport-fishing technique. Dissection, morphometric measurements and determination of sexes of all of 66 brown trouts were performed in the laboratory of Faculty of Natural Sciences and Mathematics, University of Banja Luka. Measured morphometric parameters in fishes were: total body length of fish-TDT, standard body length of fish-SDT, the mass of the fish-MT, the length of the digestive tract-LDT, the weight of the digestive tract-WDT and Fluton's condition coefficient - CF (Markovic, 2012). Morphometric parameters of length were determined by a fixed millimeter scale, and morphometric parameters of body mass with analitic libras with accuracy up to 0.01 grams. Condition factor (CF) is calculated according to the formula:

$$CF=\frac{W*100}{TL^3}$$, where are: W-total mass of fishes (g), TL- total length of fishes (cm).

Qualitative and quantitative analysis gastro-intestinal of samples of collected macrozoobenthos were performed by stereomicroscope Leica EZ4D. Observed organisms were selected and determined by applying the appropriate keys and manuals (Walace et al., 2003;). Representatives of invertebrates that inhabit the land and which are also found in the digestive tract of collected trouts were also determined (Markovic, 2012). All results are summarized in tables, statistically processed in program ANOVA, presented graphically and discussed.

RESULTS AND DISCUSSION

The mean total body length (TL) in brown trouts (Table, 1.) from the river Pliva was higher than the value of the same parameter for fish that are caught in the river Vrbanja. The difference in the value of this parameter was not statistically significant. The mean standard body length (SL) of brown trouts caught in river Pliva was also higher than those caught in the river Vrbanja, and as well as the previous parameter, nor this difference in values had any statistically significance. Weight of fish specimens found at both locations, in other words the mean body weight (W) shows the difference between fish caught in river Pliva in relation to river Vrbanja and this difference was statistically significant.. Next analyzed morphometric parameter of brown trouts from two locations was the mean total length (LDT) and the weight (WDT) of the digestive system of this fishes. Values of both these parameters were different, and were higher in fishes inhabited river Pliva in relation to fishes from river Vrbanja. The last analyzed parameter was Fulton's coefficient, which also showed the difference between fishes from river Pliva, where it was lower than the coefficient from river Vrbanja, and difference was not statistically significant.

Table. 1. Summary values review of morphometric parameters of trouts from localities Pliva and Vrbanja

PARAMETERS		TL	SL	W	WDT	LDT	CF
PLIVA	□	20,40	17,95	95,54	8,20	18,77	1,04
	MIN	14	12,5	29,72	3,09	9,3	0,86
	MAX	29	25,5	224,27	17,33	27,5	1,22
	SD	4,081	3,519	51,482	3,489	4,049	0,099
	KV	13,92	17,06	158,83	12,05	12,39	0,16
VRBANJA	□	18,05	15,88	71,35	5,42	16,81	1,17
	MIN	13,3	11,1	24,16	1,78	8,9	0,93
	MAX	23,9	21,3	163,3	12,04	21,7	1,99
	SD	2,713	2,662	32,713	2,492	3,389	0,166
	KV	6,86	8,21	66,51	6,95	7,776	0,021
	FTEST	0,2370	0,1193	0,0123*	0,0613	0,3187	0,2046
	STEST	0,1075	0,109	0,0261*	0,0741	0,0865	0,1030

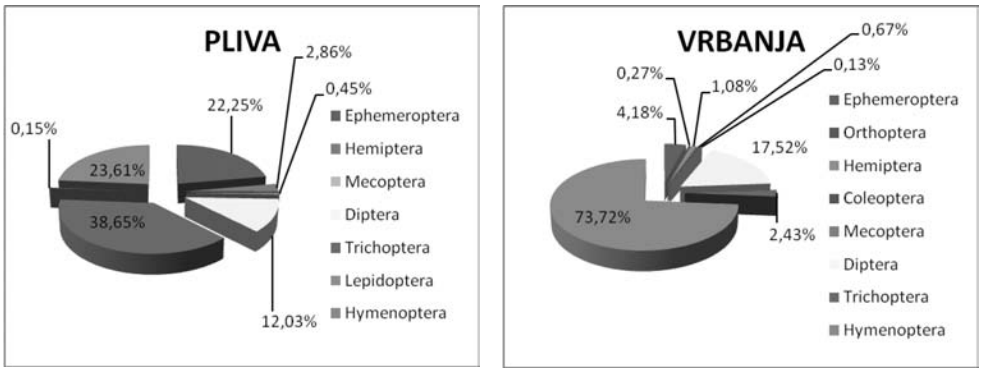
* $p \leq 0,05$ statistically significant

From river Pliva has been collected 14 females and 19 males, and from the river Vrbanja has been collected 18 females and 15 males fishes and they were analyzed.. Analysis of the selected parameters of morphometric measurements by sex can be seen from Table. 2. Brown trouts that were collected from river Pliva had higher values of all parameters except Fulton's coefficient in relation to the trouts from river Vrbanja in correlation with sex.

Table 2. Summary values review of morphometric parameters of trouts from localities Pliva and Vrbanja in correlation with sex fishes

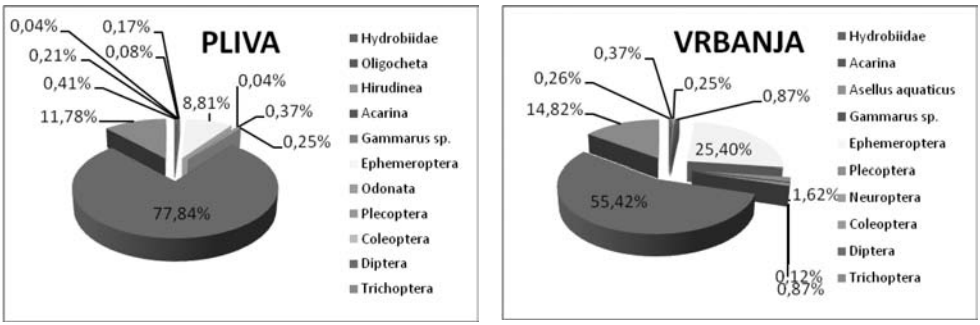
PARAMETRI		TL	SL	MT	WDT	LDT	CF
PLIVA	M□	22,61	19,83	121,13	9,73	19,90	1,01
	F□	18,78	16,57	76,68	7,07	17,94	1,07
VRBANJA	M□	18,43	16,25	75,37	6,17	17,79	1,21
	F□	17,58	15,45	66,523	4,53	15,62	1,12

As in the previous measurement (Tab. 1) difference is in a change of Fulton's coefficient, more exactly it is higher in brown trouts that were collected from river Vrbanja, and while other morphometric parameters were lower than those in fishes from Pliva.



Graphic 1. Comparative overview of the diversity and presence of terrestrial insects in the gastrointestinal content of brown trouts from rivers Pliva and Vrbanja

Results of the analysis of the gastrointestinal contents, were divided into two categories: terrestrial insects (Graph. 1) and macrozoobenthos (Graph. 2), which brown trouts from Pliva and Vrbanja were fed. From Graph. 1., which shows the diversity and representation of terrestrial insects, it can be seen that the fish that lived in river Pliva mostly chose Trichoptera, Hymenoptera and Ephemeroptera, while those from river Vrbanja mostly chose Hymenoptera and Diptera for their food.



Graphic 2. Comparative overview of the diversity and presence of macrozoobenthos in the gastrointestinal content of brown trouts from rivers Pliva and Vrbanja

Diptera, *Gammarus sp.* and Ephemeroptera larvas were most common prey of brown trouts from river Pliva, and Diptera, Ephemeroptera larvas and *Asellus aquaticus* were also most common prey of trouts from river Vrbanja. Graph. 1. Other taxons are equally represented as food of brown trouts from rivers Pliva and Vrbanja. After comparing the qualitative composition of invertebrate gastro-intestinal content of stream trouts from rivers Pliva and Vrbanja obtained results showed that digestive tract of the fishes from the river Pliva did not contain shrimp species *Asellus aquaticus* and Neuropteras,while that from fishes from river Vrbanja did. Diptera larvas from the family Simulidae were most common prey of the fishes from the river Pliva, while in stomac of fishes that were collected in river Vrbanja Simuliidae were not found. Similar data in the literature came from (Bakrač-Bećiraj et al., 2008).

CONCLUSION

After finishing experimental part in which stream trouts were collected from two locations, the rivers Pliva and Vrbanja, morphometric measurements of the same, analysis of macrozoobenthos that trouts have been fed with, as well as from all the obtained data we can draw the conclusion that the fishes from these two locations, do not differ to a large extent. Water quality at the source of the river Pliva and in the upper reaches of the river Vrbanja is no different, and it was no difference in composition of macrozoobenthos from the bottom of these two rivers as well as in the composition of terrestrial invertebrates which have been feeding component of stream trouts. For this reason, the morphometric parameters of these fishes from two mentioned locations, upon analysis did not differ.

REFERENCES

Bakrač-Bećiraj, (2008): Fiziologija ishrane i prirasta vrste *Thymallus thymallus* (Linnaeus, 1758) u prirodnim i eksperimentalnim uslovima. Doktorska disertacija. Prirodno-matematički fakultet Univerziteta u Banjoj Luci.

Marković, Z. (2012): Izvori brdsko-planinskih područja Srbije. Ekološka studija makrozoobentosa. Biološki fakultet Univerziteta u Beogradu.

Pavlović, N., Pavlović, P. B., Filipović, S., Pajčin, R., Dimitrović, D. (2011): Stanje taksocena zoobentosa izvora Pliva i Ribnik. *Glasnik Republičkog zavoda za zaštitu prirode u Podgorici, 31-32*: 163-178.

Piria, M., (2007): Ekološki i biološki čimbenici ishrane ciprinidnih vrsta riba iz rijeke Save. Doktorski rad. Agronomski fakultet Sveučilišta u Zagrebu.

Wallace, I. D., Wallace, B., Philipson, G. N. (2003): Keys to the Case-bearing Caddis Larvae of Britain and Ireland. Freshwater Biological Association, Ambleside.