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# WATER & FISH

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## DIET COMPOSITION OF BROWN TROUT (*SALMO TRUTTA* L., 1756) FROM THREE RIVERS WITHIN SPECIAL NATURAL RESERVE «UVAC»

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## SASTAV ISHRANE POTOČNE PASTRMKE (*SALMO TRUTTA* L., 1756) IZ TRI REKE NA PODRUČJU SPECIJALNOG REZERVATA PRIRODE „UVAC”

### Apstrakt

Ispitivana je ishrana potočne pastrmke iz tri vodotoka na području Specijalnog rezervata prirode „Uvac”: Mali Uvac (gornji deo toka Uvca); Tisovica i Zlošnica. Aparatom za elektroribolov ulovljeno je ukupno 29 primeraka pastrmke (14 iz Uvca, 11 iz Tisovice i 4 iz Zlošnice). Pregled crevnog sadržaja obuhvatio je identifikaciju konzumiranih kategorija plena i njihovu brojnu zastupljenost. Na osnovu dobijenih podataka izračunati su indeksi učestalosti, abundantnosti i značajnosti za svaku od utvrđenih kategorija plena. Utvrđeno je da pastrmke iz istraživanih voda, u pogledu diverziteta plena, odlikuje relativno širok spektar ishrane. Generalno, pastrmke iz ovih voda pretežno se hrane akvatičnim beskičmenjacima, pri čemu larve Trichoptera predstavljaju najznačajniji element ishrane. Kao vizuelni predator, pastrmka ispoljava jasan afinitet ka krupnijem i mobilnijem plenu. Dobijeni rezultati, budući da se radi o relativno malim uzorcima prikupljenim tokom jednog mesečnog izlaska (septembar), mogu se smatrati preliminarnim i iziskuju dalja istraživanja.

**Ključne reči:** *pastrmka, ishrana, sastav ishrane, akvatični beskičmenjaci*

**Keywords:** *brown trout, feeding, diet composition, aquatic invertebrates*

### INTRODUCTION

The brown trout (*Salmo trutta* Linnaeus 1756) inhabits almost all rivers and streams running through the area of Special Natural Reserve «Uvac» (southwest of Serbia). In some of them it represents the only present fish species, and studies of its diet are important issue to understand its biology. Analysis of its diet provides information on its trophic require-

ments, interactions with other species, and habitat use in the investigated ecosystem (Oscoz et al., 2005; Ruginis, 2008). There are numerous studies concerning feeding of brown trout in European waters and elsewhere (Kara and Alp, 2005; Osoz et al., 2005; Montori et al., 2006; Ruginis, 2008; and references therein). On the contrary, such studies are scarce in Serbia and, to the best of our knowledge, in last 25 years only one paper concerning this matter was published (Skorić et al., 2012). The aim of this study is to describe diet composition of brown trout in the three rivers within the area of the Special Natural Reserve «Uvac».

## MATERIAL AND METHODS

Fish were collected in September 2016 in the three rivers within Special Nature Reserve «Uvac»: Mali Uvac (upper course of the Uvac River), Tisovica River (upper course), and Zložnica River (middle course). General information on the sampling sites for each stream is given in Table 1.

**Table 1.** Positions of the sampling sites and their basic characteristics: A. - altitude; A. W. – average width; A. D. – average depth; S. – substratum.

| River     | Latitude N  | Longitude E | A.(m) | A. W.(m) | A. D.(cm) | S.     |
|-----------|-------------|-------------|-------|----------|-----------|--------|
| Mali Uvac | 43° 17.521' | 19° 55.184' | 1058  | 4        | 25        | gravel |
| Tisovica  | 43° 29.027' | 19° 57.955' | 1023  | 3        | 50        | gravel |
| Zložnica  | 43° 27.495' | 19° 50.350' | 944   | 3        | 40        | gravel |

An area of approximately 100 m<sup>2</sup> has been fished at each sampling site (profile length 25-35 m). The studied areas in Mali Uvac and Zložnica were lotic, while in Tisovica were combined lotic and lentic conditions (pool presence). Fish sampling was conducted by electrofishing device (Honda, 1.2 kW; 6 A). In total 29 brown trout were caught, of which 14, 11, and 4 in Mali Uvac, Tisovica and Zložnica, respectively. Immediately after capture, they were frozen for later study. In the laboratory, after melting, for each fish total and standard length in millimeters ( $\pm 0.1$  mm), weight ( $\pm 0.1$  g) and sex were recorded. For dietary analyses a complete digestive tract was examined. Dietary analyses were performed using stereomicroscope for the determination (mainly order level was observed) and counting of ingested organisms. The percentage of occurrence (F) and percentage of abundance (A) were calculated as:  $\%F = (N_i/N_t) \times 100$ ;  $\%A = (\sum S_i / \sum S_t) \times 100$ ; where  $N_i$  is the number of fish with food item  $i$ ,  $N_t$  is the total number of fish in the sample with stomach content;  $S_i$  is the number of food item  $i$ , and  $S_t$  the total number of food items in the entire sample (Amundsen et al., 1996). The percentages of occurrence and abundance were used to calculate the index of prominence (PV) (Hickley et al., 1994; Lorenzoni et al., 2002):  $PV = A \sqrt{F}$ ;  $\%PV = (PV / \sum PV) \times 100$ . Basic water quality indicators (temperature, dissolved oxygen, pH, conductivity) were measured using portable WTW instruments.

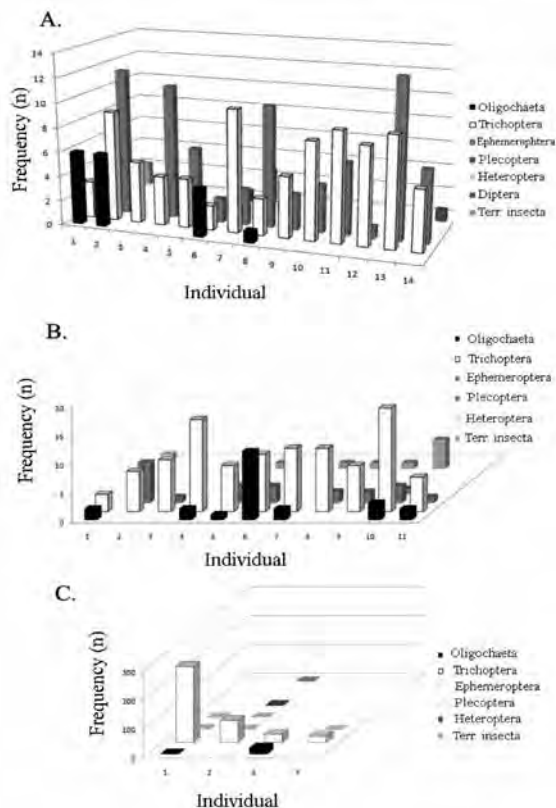
## RESULTS AND DISCUSSION

Table 2 contains data on water quality indicators for three investigated rivers based on physical and chemical parameters. Recorded values indicate favorable conditions for salmonids.

**Table 2.** Water quality parameters recorded at sampling sites.

| Parameter             | Mali Uvac | Tisovica | Zložnica |
|-----------------------|-----------|----------|----------|
| T (°C)                | 12.4      | 11.3     | 11.7     |
| C (μS/cm)             | 271       | 251      | 350      |
| pH                    | 7.1       | 6.7      | 7.1      |
| O <sub>2</sub> (mg/l) | 10.94     | 10.47    | 10.53    |
| O <sub>2</sub> (%)    | 116.1     | 108      | 108.9    |

The only found fish species in investigated stretches of Mali Uvac and Zložnica was the brown trout (*Salmo trutta*). In investigated stretch of Tisovica, the brown trout and bullhead (*Cottus gobio*) were found. According to their morphological, abiotic and biotic characteristics, studied waters represent typical upper salmonid region. The ranges of total length and mean length of examined fish were: 80.5–151.6 mm,  $101.2 \pm 22.18$  mm; 65–153 mm,  $115.2 \pm 31.24$  mm; 168–254 mm,  $217 \pm 40.8$  mm; for Mali Uvac, Tisovica and Zložnica, respectively. Regarding weight data the corresponding values were: 5–31.5 g,  $10.5 \pm 8.05$  g; 2.6–42.8 g,  $19.1 \pm 13.25$  g; 43.9–212.8 g,  $135.9 \pm 77.64$  g; for Mali Uvac, Tisovica and Zložnica, respectively. For all examined fish, there were no empty guts found. Figure 1 depicts diet composition for each individual trout from three investigated rivers.



**Figure 1.** Gut contents of examined brown trout from three investigated rivers: A-Mali Uvac; B-Tisovica; C-Zložnica.



A total of 198 aquatic and terrestrial prey items were found in the diets of the trout from Mali Uvac River (Fig. 1, inset A; Tab. 3). The number of ingested items varied in 8-27 range within examined fish. The most frequent prey were Trichoptera larvae (100%), followed by Ephemeroptera larvae (92.9%), also both were the most abundant prey constituting 46.6% and 43.5% of diet composition, respectively. According to %PV they represent 90% of the diet, with almost equal participation. In total, 98% of prey items were benthic aquatic organisms, while participation of terrestrial organisms was very low.

In guts of trout from Tisovica River a total of 155 aquatic and terrestrial prey items were detected, and the number of consumed prey varied in 5-31 range per individual (Fig. 1, inset B). Trichoptera larvae were detected in gut content of all examined fish and represented the most frequently consumed prey (Tab. 3). Moreover, high values of %F were noted for Ephemeroptera (72.7%) and Oligochaeta (63.6%). By abundance, Trichoptera represented the largest proportion of the diet, while the contribution of Oligochaeta and Ephemeroptera reached significantly high proportion. The index of prominence value reveals that previously mentioned three food categories represent about 95% of the diet, with Trichoptera being the most important (69.8%). The contributions of remainder food items in the diet of trout from Tisovica River were of low rate.

**Table 3.** Diet composition of trout from three investigated streams: %F-occurrence; %A-abundance; %PV-index of prominence.

| Prey category                | Mali Uvac |      |      | Tisovica |      |      | Zložnica |      |      |
|------------------------------|-----------|------|------|----------|------|------|----------|------|------|
|                              | %F        | %A   | %PV  | %F       | %A   | %PV  | %F       | %A   | %PV  |
| <b>Aquatic organisms</b>     |           |      |      |          |      |      |          |      |      |
| Oligochaeta                  | 28.6      | 8.6  | 5.08 | 63.6     | 14.4 | 12.5 | 50       | 6.1  | 4.42 |
| Ephemeroptera larvae         | 92.9      | 40.9 | 43.5 | 72.7     | 13.2 | 12.3 | 75       | 1.7  | 1.51 |
| Plecoptera larvae            |           |      |      | 9.1      | 0.6  | 0.2  | 25       | 0.2  | 0.1  |
| Heteroptera                  | 28.6      | 2.5  | 1.48 | 18.2     | 1.8  | 0.84 |          |      |      |
| Diptera                      | 35.7      | 3.5  | 2.31 |          |      |      |          |      |      |
| Trichoptera larvae           | 100       | 42.4 | 46.6 | 100      | 64.1 | 69.8 | 100      | 91.7 | 93.9 |
| <b>Terrestrial organisms</b> |           |      |      |          |      |      |          |      |      |
| Insecta (unidentified)       | 21.4      | 2    | 1.02 | 45.5     | 6    | 4.41 | 25       | 0.2  | 0.1  |

A total of 424 food items were detected in the diets of trout from river Zložnica (Fig. 1, inset C). The number of consumed prey varied greatly among examined fish, ranging in 22-272 prey items. In terms of all assessed indices the most important food item were species from order Trichoptera (Tab. 3).

Stream dwelling brown trout is known as generalist and opportunistic species with potential to utilize all kinds of habitat and food resources in a river (Kara and Alp, 2005; Osoz et al., 2005; Montori et al., 2006; Ruginis, 2008). Within the 29 specimens in which gut contents were analyzed, 8 individuals were identified as fed on aquatic and terrestrial organisms and 5 of them were caught in the river Tisovica. However, the low contributions of terrestrial organisms in diets indicate that trout from studied rivers feed mainly on aquatic invertebrates, which is in concordance with reported data from studies elsewhere (Osoz et al., 2005; 2005; Montori et al., 2006; Ruginis, 2008). Diet composition was

characterized by relatively wide food spectrum, which was similar to reported findings, especially in comparison with literature data concerning trout diet from different European rivers (Osoz et al., 2005; Montori et al., 2006; Ruginis, 2008; Skorić et al., 2013). The diet of brown trout in studied rivers principally consists of caddis fly larvae, while relative importance of other food items varies among the investigated rivers. Observed differences most probably reflect differences in prey availability, types of habitat and fish size among the rivers. In terms of relative prominence of consumed prey, it is obvious that examined fish showed affinity towards larger and mobile prey, what was expected as a trout is a visual predator (Osoz et al., 2005). Finally, we have to point out that our results are based on relatively small number of examined fish collected in one month and further studies are needed.

## CONCLUSION

Results on diet composition showed that brown trout in the investigated rivers feed mainly on aquatic invertebrates with Trichoptera larvae as the most important food item.

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