

UDC: 597.554.3:591.53
original scientific paper



Acta Agriculturae Serbica, Vol. VIII, 16 (2003) 75-81

The diet of *Leuciscus cephalus* L. in the reservoir Medjuvrsje (Western Morava, Serbia)

Markovic, G.

Faculty of Agronomy, Cacak, Serbia and Montenegro

Simic, V., Ostojic, A., Snezana Simic

Centre of Biology, Kragujevac, Faculty of Sciences, Serbia and Montenegro

Abstract: Chub, *Leuciscus cephalus* L. representing an abundantly present fish species in the Balkan watercourses indicated a good adaptation to the environmental conditions existing in the most of reservoirs. The fish species is also abundant in the reservoir Medjuvrsje situated on the river Zapadna Morava as the only predator found here. In the period from 1996-1999, the intestinal content of 58 individuals of different age. The zoo-phytophage character of diet was found to be largely shared with plant components all the year round. Also, the differences in the trophic spectrum over the various seasons existed between the individuals of different age with high individual variations being found, too.

Key words: *Leuciscus cephalus*, diet, reservoir Medjuvrsje, variation

Introduction

As one of the oldest reservoirs of Serbia, Medjuvrsje was erected in 1953 by erecting a concrete dam across the Western Morava (Danube river basin) 31 m high and 182 km long in the downstream river course. In 1955, hydroelectric plant Medjuvrsje of the power 6,9MW was built. The reservoir under consideration is 9,312 km long, 1,5 km² large, 292 m at widest point, and 12 m at deepest point immediately under the dam. Originally, the reservoir had the volume of 15.4 x 10⁶ m³. However, more than 70% of the original dam has been drifted. Its current annual flowing power is roughly 34 m³/s. The reservoir's banks are steep and its bottom silty. The major river course is near the right bank causing its being pooled while the left bank is intensely being drifted and shallowed. This has brought about a gradual protrudence of some small islands

covered in hydrophilous macrophytae vegetation (Simovic et al., 2000). Water transparency in summer has been found to range from 0.5-0.8 m, and in winter 4.3 m. Now and then, unionised ammonium, iron and phenols may appear in the reservoir waters.

The ichthyofauna of the Medjuvrsje reservoir was reported to contain 20 fish species from 7 families, with an expressed dominance of *Alburnus alburnus* (25.86%), subdominance of *Chondrostoma nasus* (13.85%), *Carassius auratus gibelio* (11.42%) an abundance of *Rutilus rutilus* (9.43%), *Leuciscus cephalus* (8.30%), *Abramis brama* (7.27%) and of *Pseudorasbora parva* (6.46%). The eutrofised ecosystem of the reservoir has favoured lowly ranked trash fish species along with a constantly increasing number of the allochthonous ones accounting for 20.45% total of the caught fish. The decrease in the economically significant fish species accounts for worsened ecological conditions in the reservoir (Markovic, 2002). This is also due to an overcatch over spawning and disobedience of the fishermen despite existing fish care takers who are keeping an eye on them.

Specifically, the ecosystem ichthyofauna has a huge abundance of *C. nasis* and *L. cephalus*, originally reophilous species exhibiting a high adaptability to conditons intrinsic to lake. *L. cephalus* is the only abundantly present predator within the ecosystem, hence the trophic spectrum of such a European species has been focused on.

Materials and Method

The ichthyological studies on the Western Morava sector lasted from 1996 to 1999, the fish being caught by nets and fishing devices various by size.

The fish trophic spectrum determinations were based on analysing the intestinal content taken from their front side and fixed in the 4% formaline. Binoculars MBS-2 and MBDS-10 and the microscope »Studar« were used as the differing magnifying needs might have been. Semi-quantitative (per cent) presence of single components in the intestinal content was also determined. Fishes were identified up to higher taxons (order, family, strain), rarely to the level of species, several pincers (Grandi 1960; Streble; Krauter 1973; Hindak 1978; Jezek et al., 1980; APHA 1985; Kerovec 1986) being used. After being analysed, the intestinal content could help show the seasonal diet spectrum.

Results

The intestinal content analysed in 58 samples of the fish caught in the Medjuvrsje reservoir denoted that animal (55.7%) dominated over the plant components (31.0%) and detritus (13.3%).

Speaking about chub diet belt over the s p r i n g s e a s o n the larvae Odonata of 25.5% seemed the most abundant (tab.1.). Of the diverse fauna of this inherently insect order (*Lestes* sp. *Aeshna* sp. *Anax imperator*, *Gomphus vulgatissimus*), the finding on larvae *Brachytron pratense*, protected as the natural rarity of Serbia (Herald RS 50/93), seemed interesting. Fish are an

important component of the spring diet (20.0%) of the larger chubs (age 6+ and older ones), found in the aquatic *Coleoptera* (primarily *Ilybius fuliginosis*) in abundant amounts in their intestines of up to 10.5%. Plant material accounted for 27.9% intestine content characterised by an abundance of filamentous *Chlorophyta* (12.2%) and *Bacillariophyta* (10.0%).

Over the s u m m e r period, the intestines had the larvae *Odonata* (18.5%) most, the fish share being decreased (10.0%). Among the animal components of diet, the presence of aquatic *Coleoptera* (5.2%), larvae *Diptera*, mainly *Tipulidae*, (4.6%) and amphibians (4.5%) was detected. The plant material occupied one third of the intestine content characterised by a frequently encountered macrophyta (15.7%) and filamentous *Chlorophyta* (12.5%).

Tab.1. The analysis of intestinal content in chub (%) in the Medjuvsje profile (n=58)

Group	Spring	Summer	Fall	Total
<i>Cyanobacteriophyta</i>	< 0.1	0.5	1.5	0.5
<i>Pyrrhophyta</i>	< 0.1	-	< 0.1	< 0.1
<i>Bacillariophyta</i>	10.0	4.5	5.5	6.2
<i>Chlorophyta</i>	12.2	12.5	14.2	12.6
Macrophyta vegetation	5.5	15.7	10.7	11.6
<i>Rotatoria</i>	0.1	0.5	0.1	0.3
<i>Nematoda</i>	0.1	-	-	< 0.1
<i>Mollusca</i>	-	3.5	8.5	3.5
<i>Oligochaeta</i>	0.1	0.5	0.1	0.3
<i>Cladocera</i>	0.1	0.1	0.1	0.1
<i>Copepoda</i>	< 0.1	-	-	< 0.1
<i>Odonata</i>	25.5	18.5	5.5	17.2
<i>Heteroptera</i>	0.5	1.0	-	0.5
<i>Coleoptera</i> (akvatic)	10.5	5.2	2.5	6.1
<i>Diptera</i> – <i>Chironomidae</i>	0.5	0.1	0.1	0.2
<i>Diptera</i> – <i>Tipulidae</i>	0.5	4.5	2.5	2.6
<i>Insecta</i> (terrestrial)	4.0	3.0	7.5	4.2
<i>Pisces</i>	20.0	10.0	13.5	16.6
<i>Amphibia</i>	-	4.5	10.5	4.5
Detritus	10.1	15.4	17.1	13.3

Vertebra fish and amphibians, respectively, were found to highly exist (13.5 and 10.5%, respectively) in the f a l l in the chub diet . Their presence along with land insects (7.5%) was identified in the early fall, with an abundance of *Mollusca* (*Anodonta* sp.) with 8.5% and plant material full of filamentous *Chlorophyta* (12.6%) and macrophyta components (11.6%).

Annually, chub diet belt within the ecosystem under way denoted the dominance of macrozoobenthos (23.9% (Fig.1.) with larvae *Odonata* being the most present (17.2%). The littoral of the reservoir covered in macrophyta paves

the way for growing juveniles of this insect order representative so spreading the trophic belt of chub.

Further, vertebra, particularly those fish significantly sharing the diet of older chubs over a longer period of the year (from the end of March to the beginning of November) accounted for 16.6%. Also, an abundant presence of other animal groups in the intestines is mainly connected with some of the periods (*Coleoptera* in the spring, *Mollusca* in late fall).

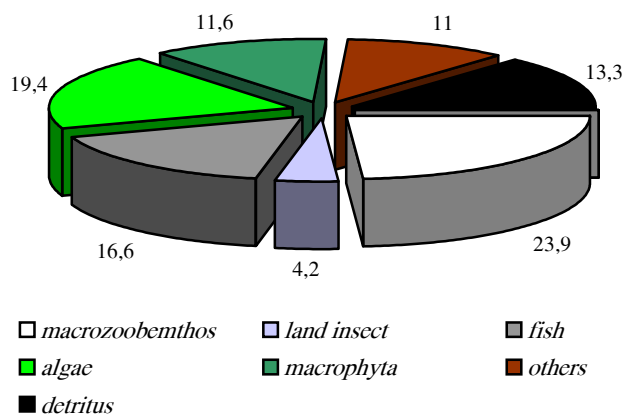


Fig. Fundamental intestinal content of the chub in the Medjuvsje reservoir

The specificity of chub diet within this biotope is that the organisms of the lake bottom being edible within macrozoobenthos (*Oligochaeta* and *Chironomidae*) community are barely contained in the chub intestines. The presence of *Bacillariophyta* (6.2%) found in all the samples was found to be the highest in colder intervals of the year (early spring and late fall).

Discussion

Numerous researchers have been discussing in favour of omnivory of *L. cephalus* in the lake ecosystems of Europe simultaneously suggesting a high variability in such a presence when components are taken individually.

The characteristics of the fish diet on Skadar Lake (Monte Negro) showed an enormously wide trophic belt classifying chub as a member of euryphage and zoo-phytophage sets (Jankovic, Trifunovic, 1978). Basically, chubs eat insects (land ones, larvae, Trichoptera, Hemiptera and Trichoptera) then, higher crabs, shells, snails and fish largely appearing in the fall, winter and in the early spring. All year around, the algae (*Chlorophyta*, *Cyanobacteriophyta* and *Bacillariophyta*) were present in the chub intestinal content as well as the plant parts and detritus. A steady competition between *L. cephalus* and *Cyprinus*

carpio was manifested in light of *Trichoptera*, snail, shell and detritus consuming.

Re-researches made on the same biotope corroborated a high diversity in diet of the species under consideration (Stankovic-Trivunac 1981). In the samples caught over the winter and early spring, there were *Trichoptera* and other insects and crabs in large numbers. Over summer and fall months, algae and detritus were dominating, Crustaceans and mollusks highly frequently appearing in the late spring and fall. The intestinal content of chub indicated that its diet went on throughout the whole year with no component being typical of the particular period, but it could have appeared for a longer while.

A wide eury-phage features chub diet in the reservoir Dalesice on the river Jihlava (Adamek et al., 1987). Its peculiarity high presence of small rodents (*Rodentia*), falling into the water from the steep banks.

Chub diet in the Medjuvsje reservoir went on from 1984-1985 indicating chub to have a longer trophic spectrum than *R. rutilus*, *Ch. nasus*, *A. brama*, *B. barbus* (Veljovic et al., 1986). Fundamentally, chub diet consists of the larvae *Chironomidae* and other insects with presence of the *Bacillaryphyta* (*Melosira granulata*, *M. varians* and *Synedra acus* representatives. Neither other organisms in chub diet nor the relationships among its single components have been stated in the literature so far except for certain species *Bacillaryophyta*, hence, the results did not essentially coincide with analyses on dietary characters we have been concerned above.

Zoo-phytophage character of the chub diet was also noticed with a significant share of the plant component all the year round, particularly in the intestinal content over the summer and fall months.

The analysis of the juvenile individual intestinal content pointed to a relative uniformity of the diet. Thus, at the age of 0+ the highest portion of the intestinal content was consisted of *Bacillaryophyta*, with scarcely present *Chlorophyta* and individual zooplankton forms (plankto-phytophage diet). The intestinal contents of the older juveniles (age 1+), apart from silicate algae, were abundant in filamentous green algae (particularly *Cladophora* sp.), but also in other types of diet (macrophyta vegetation, larvae *Diptera*). Juvenile chubs of ages 2+ and 3+ were found to largely consume animal diet. In addition to the insect larvae, land insects and other organism groups were also present. Characteristically, the diet of the sexually immature individuals was, in one word, plankto-phyto-zoo-phage.

When an adult individual intestinal content was analysed, a progressive increase in carnivorousness was observed with aging of the samples caught. Younger adults (age 3+, 4+ and 5+) largely consumed insect larvae and land representatives *Odonata*, *Trichoptera*, *Diptera* and *Ephemeroptera*. Piscivorousness was expressed in the chubs of age 6+ and in the older ones, with the remaining diet components (*Mollusca*, *Amphibia* and others) being equally present in the individuals of different ages. A huge heterogeneity in chub diet within the same biotype was noted. The samples of the same age and approximate dimensions were caught at the same profile, with some of them having intestinal content entirely filled with filamentous green algae, whereas the

others and larger in number consumed insects, fish or other animal component. The diet of adult individuals had an expressed zoo-phytophage character.

Conclusion

Taken on the whole, the analysis of the intestinal content in 58 specimens of the species *L. cephalus* caught in the reservoir Medjuvrsje on the Western Morava (western Serbia, the Danube basin) is in favour of the zoo-phytophage type of the diet. High variations in chub diet existed over different seasons with different ages, but also in the diet of the individuals of the same age. The results once more confirmed not only the euryphage characteristic of the species existing in the analysed ecosystem, but also its getting accustomed to certain diet resources.

References

- Adamek, Z., Jirasek, J., Sukop, I. (1987): The food biology of the economically important fishes in the Dalesice reservoir. *Zivoc.Vyroba*, 32 (10), 909-920.
- APHA (1985): Standard methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC 16th eds., pp.1481.
- Hindak, F. (1978): Slatkovodne riasy. Slovenske pedagogicke nakladatelstvom, Bratislava, pp.579.
- Jezek, J., Knor, J., Kramar, J., Krampfl, F., Kubicek, F., Lellak, J., Pokorny, P., Rauser, J., Raskosny, R., Sedlak, E., Spackova, V., Sturak, J., Zeleny, J., Zelinka, J., Zelinka, M. (1980): Klic larev vodnikho kmyru. Ceskoslovenska akademie ved. Praha, pp. 524. (in chek.)
- Kerovec, M. (1986): Prirucnik za upoznavanje beskraljesnjaka nasih potoka i rijeka. Liber, Zagreb, s. 125. (in slovakian)
- Markovic, G. (2002): Uporedna ispitivanja najvaznijih ekoloskih obelezja vrste *Leuciscus cephalus* L. reke Zapadne Morave i akumulacije Medjuvrsje. Univerzitet u Beogradu, Bioloski fakultet, Doktorska disertacija, s.122. (in serbian)
- Simovis, S., Marković, G., Milovanović, Z. (2000): Ekološko stanje akumulacije Medjuvršje. *Vodoprivreda* 32 (183-185), 220-225. (in serbian)
- Stankovic-Trivunac, M. (1981): Food and age of *Leuciscus cephalus albus*, from lake Skadar. In Karaman, G. (Eds): The biota and limnology of lake Skadar. Univerzitet "Veljko Vlahovic" Titograd, 334-335.
- Streble, H., Krauter, D. (1973): Das Leben im Wassetropfen. Mikroflora und Mikrofauna des Süßwassers. Kosmos, Gesellschaft der Naturfreunde Franckh'sche Verlagshandlung, V. Keller & Co., Stuttgart, pp. 336..
- Veljovic, P., Djukic, D., Grgincevic, M., Maletin, S., Ratajac, R., Djukic, N., Kostic, D. (1986): Ishrana nekih vrsta ciprinidnih riba u akumulaciji Medjuvrsje. II Kongres o vodama Jugoslavije, Knjiga III, 1141-1148. (in serbian)

**ISHRANA VRSTE *Leuciscus cephalus* L. U AKUMULACIJI
MEDJUVRŠJE (REKA ZAPADNA MORAVA, SRBIJA)**

- originalni naučni rad -

Markovic, G.

Agronomski fakultet, Čačak

Simic, V., Ostojic, A., Snezana Simic

Institut za biologiju PMF, Kragujevac

Rezime

Analiziran je crevni sadržaj klena (*Leuciscus cephalus* L.) iz akumulacije Međuvršje na reci Zapadnoj Moravi. Na uzorku koji je obuhvatio 58 jedinki različite starosti, ustanovljena je velika varijabilnost trofičkog spektra vrste u pojedinim sezonama, uzrastima, ali i individualna raznovrstnost. Semikvantitativna analiza crevnog sadržaja ukazuju na zoo-fitofagni tip ishrane.

Iako su dobijeni rezultati potvrda eurifagnosti vrste uočena je specijalizaciju na pojedine prehrambene resurse. Kako je reč o jedinoj masovno zastupljenoj grabljivici u ribljem naselju, proučavanja prehrambenih svojstava vrste doprinosi upoznavanju trofičkih relacija u ovom antropogeno formiranom ekosistemu.