

NUTRITION OF CHUB *Leuciscus cephalus* (Linnaeus, 1758) FROM THE RIVER BABUNA

R. Nastova-Gjorgjioska, V. Kostov, S. Georgiev

Summary

On the total number of 550 fish being caught in 1978 on three parts of the river Babuna there was investigated quantitative composition of the food seasonally and on the age classes. Chub from the river Babuna is omnivorous with the predominance of the floristic compound in his nutrition. The main mass of the food has autochthonous character. In the spring time the main component are algae from *Chrysophyceae* plant group and *Ephemeroptera* by the animal part, along all the habitat of *L. cephalus* when *Plecoptera* are present in the upper and middle part of the river. In the summer period, the dominant plant group is *Conjugatophyceae* different animal component from the river. *Chrysophyceae* are dominant also in the autumn period from the plant composition, groups by the animal composition vary from part to part, while *Pisces* can be found in the middle part. In the winter time, dominant plant particles are *Bacillariophyceae*. Animal particles are also different from part to part. *Pisces* are present in the middle part, too. Young fish are fed by *Diatomeae* and *Chironomidae*. Fish older than 1+ principally take the food of plant origin and *Conjugatae*, also insects larvae, partially detritus, and the oldest age classes are fed by *Pisces*.

Key words: nutrition, leuciscus, river, Macedonia

INTRODUCTION

Chub, *Leuciscus cephalus* (Linnaeus, 1758) is a species with a wide ecological valence, it is vital and resistant to unfavorable natural factors (Kosoric and Kacanski, 1959). It equally settles both the flowing and the standing waters, enduring well the high summer temperatures in the

shallow pools and the smallest streams. Also, chub can be found in the oligotrophical region of the wood streams and the cold lakes till 1000 m. altitude above sea-level (Bulgurkov, 1958). It easily endures even in the most contaminated waters in which the existence of the fish is still possible. There is a great number of works concerning the nutrition of the chub in waters large into its areal.

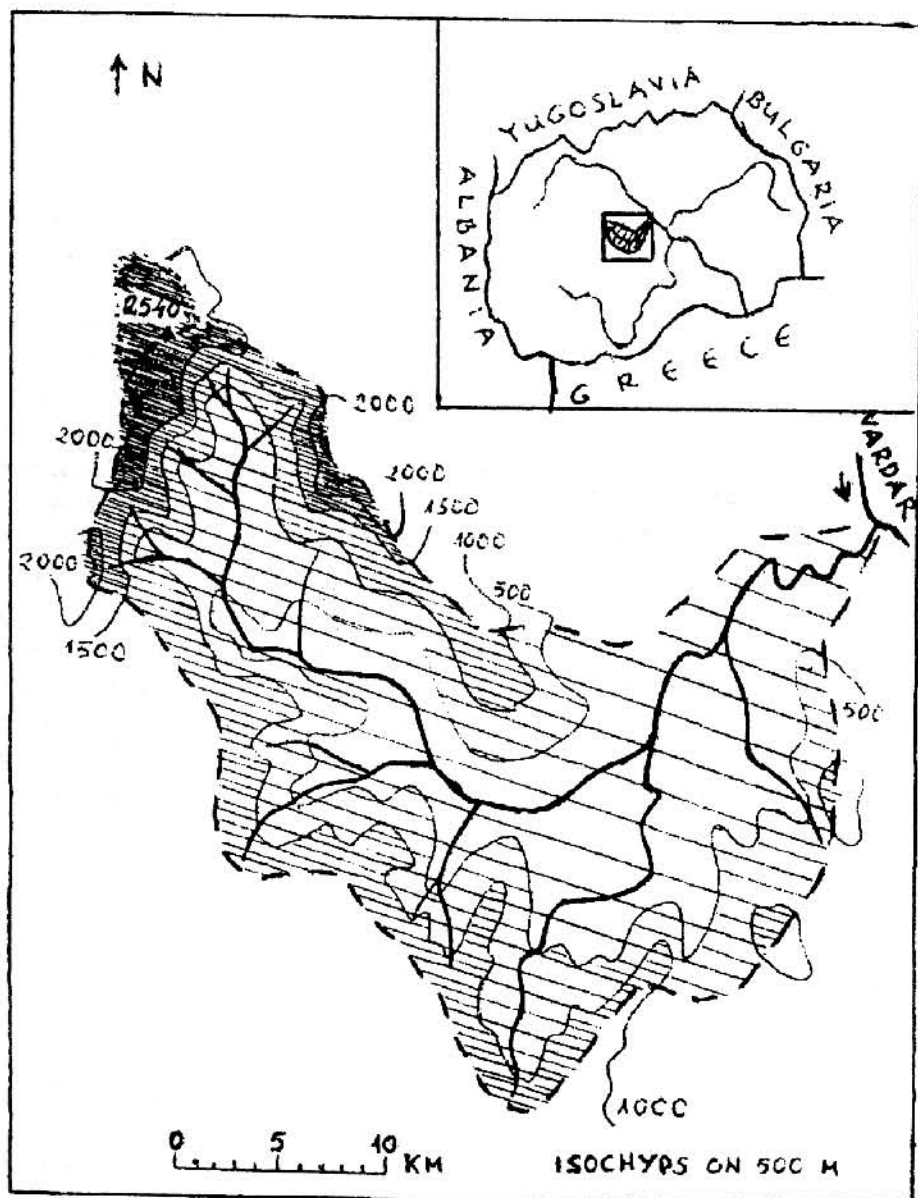


Fig. 1. River Babuna, the flow and the flow position in the state.
Slika 1. Tok rijeke Babune i njezin pložaj u Makedoniji

According to the available literature, the nutrition of chub from the flow of the Vardar has not been studied so far, and the studying of the nutrition of the chub from the Babuna (Fig. 1.) was our first step in this direction.

MATERIAL AND METHODS

The material for this work is gathered upon in seasons during the year 1978, and it is taken from three parts of the river flow, as follows: upper, at about 15–17 km from the spring (source), middle, at about 35–40 km down from the spring, and lower, at about 2–4 km up from where the Babuna pours into the Vardar. In autumn and winter, the material is gathered by an electropower, while in spring and summer—by a fish-hook. Immediately after catching the fish, they are preserved in 4% formaldehyd solution. There were 588 samples altogether. An analysis of the nutrition is carried out at all gathered 588 samples at the age of 0+ to 5+, when the nutrition could be observed during their whole life. There were in all 36 empty stomachs, on 6.12%. When determining the quantitative structure of the food, the method of subjective quantitative visual determination with a firestep gradation scale (+++1961) is applied for determining the level of the filled up intestine. More precise results are obtained by working out the general index of the fullness of the intestine, which shows the relation between the body mass of the fish and the mass of the food in the digestive tract, and it is expressed in %.

The determination of the quality structure of the food is carried out by classifying the components of the food to systematic classes: species and families.

RESULTS

1) *Quality structure by the nutrition of chub*

The nutrition of chub comes out of its biology. The very position, size and construction of the oral aperture leads us to the fact that chub is zoopfitop-fagus, while the plant component predominates in volume in all seasons. As the chub does not choose food at all, most different groups of living organisms from plant and animal origin can be found in its digestive tract what makes a certain difficulty when determining all the components of food till the lowest systematic category.

The general index of the fullness of the intestines of chub from the Babuna is shown at Fig. 2.

As far as the quality is concerned, although the food of the chubs is pretty variable, upon seasons and ages, with an exception of the spring period, at all the three parts of the river flow, it is rather equalized.

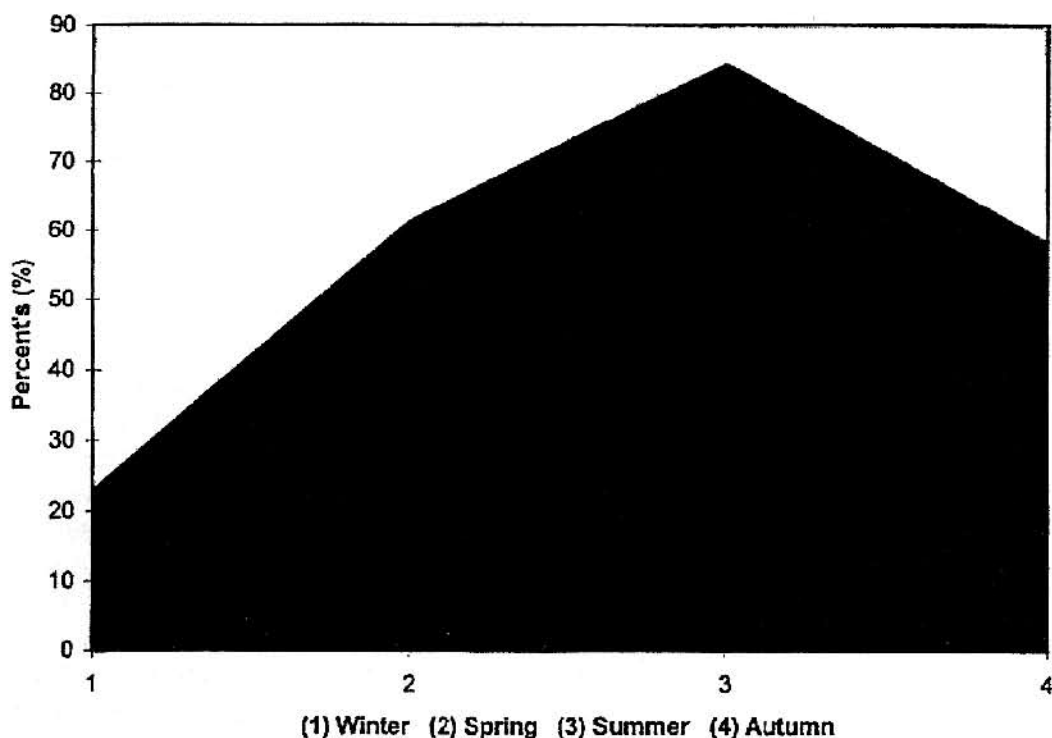


Fig. 2. Index of fullness of the intestines of chub from the river Babuna.
Slika 2. Indeks ispunjenosti probavnog sustava klena iz rijeke Babune

The quality structure of the food of the chubs from the Babuna is shown at Tab. 1.

Tab. 1. Quality structure of food for chubs from the river Babuna
Tablica 1. Struktura prehrane klena iz rijeke Babune

<u>Conjugatophyceae</u>	<i>Spirogyra</i> sp.
	<i>Mougeotia</i> sp.
<u>Chrysophyceae</u>	<i>Hidrurus foetidus</i>
<u>Desmidiaceae</u>	<i>Cosmarium</i> sp.
	<i>Closterium</i> sp.
<u>Cyaonophyceae</u>	<i>Oscillatoria limosa</i>
<u>Bacillariophyceae</u>	<i>Diatoma vulgare</i>
	<i>Cocconeis placentula</i>
	<i>Synedra ulna</i>
	<i>Melosira varians</i>
	<i>Cymbella lanceolata</i>
	<i>C. ventricosa</i>

	<i>C. prostrata</i>
	<i>Amphora ovalis</i>
	<i>Nitzchia sigmoidea</i>
	<i>Cyclotella</i> sp.
	<i>Melosira roseana</i>
	<i>Gomphonema olivaceum</i>
	<i>Surirella ovata</i>
	<i>Cymatopleura solea</i>
	<i>Achnanthes giberula</i>
	<i>Ceratoneis arcus</i>
	<i>Fragillaria virescens</i>
	<i>Caloneis</i> sp.
<u>Pteridophyta</u>	<i>Equisetum arvense</i>
<u>Phanaerogamae</u>	<i>Arctium</i> sp. (grains)
	<i>Scorcium</i> sp. (grains)
	<i>Cornus mas</i> (fruit)
<u>Oligochaeta</u>	<u>Lumbricidae</u> ind
<u>Plecoptera</u> ind. (larvae)	
<u>Empemeroptera</u> ind. (larvae, puppae, nymphae, imago)	
<u>Diptera</u>	<u>Simulidae</u>
	<i>Simulium</i> sp. (puppae, nymphae, imago)
	<u>Tabanidae</u>
	<i>Tabanus</i> sp. (larvae, imago)
	<i>Chironomidae</i> ind. (larvae)
	<i>Tipulidae</i> ind. (larvae)
<u>Coleoptera</u> ind. (imago)	
<u>Saltatoria</u> ind.	
<u>Lepidoptera</u> ind. (larvae)	
<u>Trichoptera</u> ind. (larvae)	
<u>Hydracarina</u> ind.	
<u>Aracnoidea</u> ind.	
<u>Crustacea</u>	<i>Gammarus</i> sp.
<u>Myriapoda</u>	<u>Julidae</u> ind.
<u>Amphybia</u>	<i>Rana</i> sp.
<u>Pisces</u>	<u>Cyprinidae</u>
	<i>Barbus meridionalis</i>
	<i>Alburnoides bipunctatus</i>
birds' fluff	
mammals' pills	
things of mineral origin (sand pieces)	

2) Structure of the food upon seasons

The seasonal variety of the food of the chub is in close relation with the seasonal cycles and the changes of the plant and animal structure in the Babuna. The main mass of food, both from plant and animal origin is from autochthonous origin.

The aspects of the seasonal food of the chubs are shown at Fig. 3.

a) Spring period

The basic component of the nutrition of chub in this period at all the three parts from the flow is *Hidrurus foetidus* from the group *Chrysophyceae*, which is dominant especially in the middle flow. In this period, the group *Ephemeroptera* is also present and it dominates in the lower flow. The group *Plecoptera* is present in the upper and in the middle flow, but it dominates in the upper one. In this period, detritus, unbroken mass mainly of higher plants, can always be found in the intestines of the chub from the Babuna.

The group *Diptera* (phase of a larva from the family *Simuliidae* and fam. *Chironomidae* in the upper and lower flow and leaves of higher plants in the middle flow plays the important role in the nutrition of the chub in this period of year.

b) Summer period

Dominant role in the nutrition of the chub from the Babuna in the summer period has the group *Conjugatophyceae*, especially the kind *Spirogyra*. Also, *Diatomeae* are present, and detritus can be found in limited quantities.

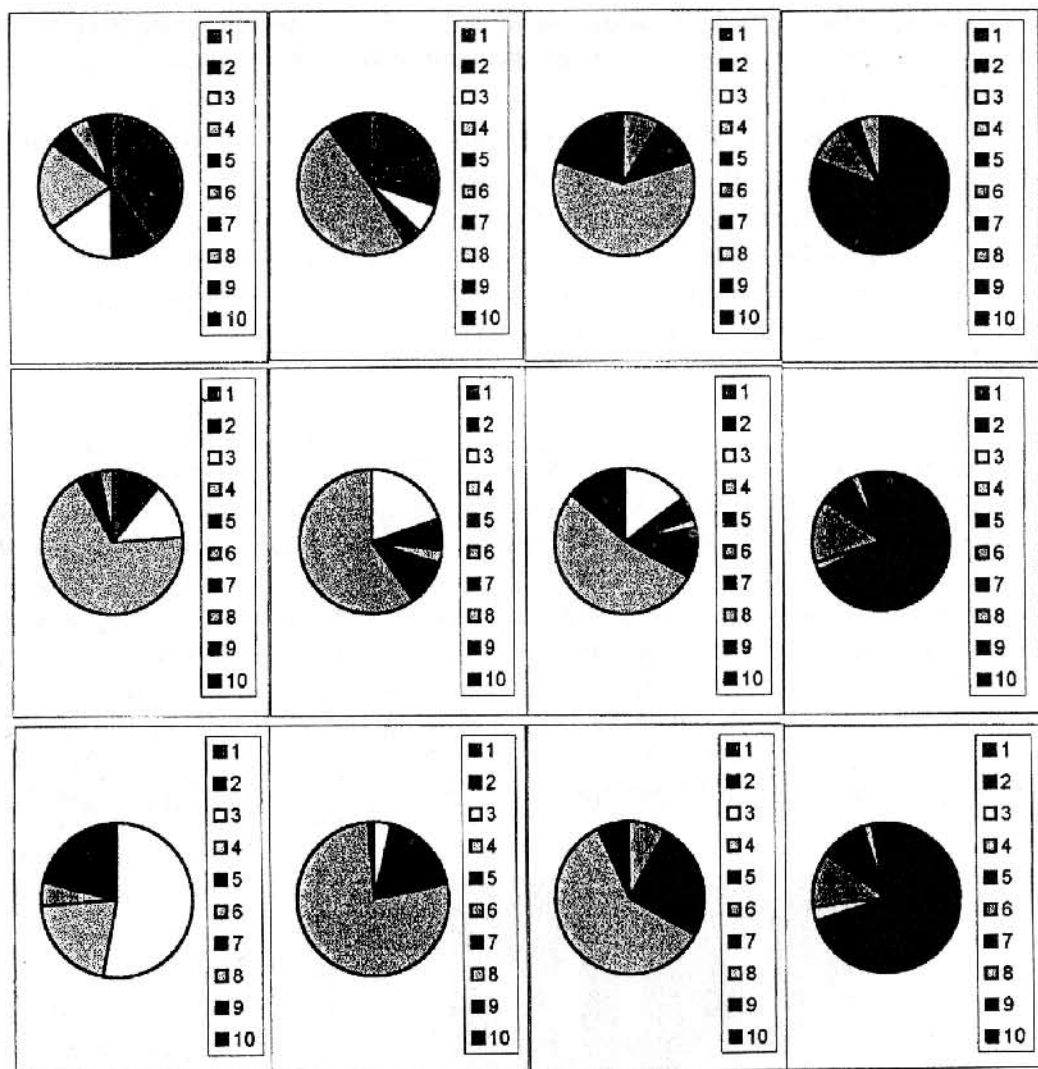
From the food of animal origin, the presence of the group *Plecoptera* is important, also the group *Ephemeroptera* is somewhat present, while the group *Diptera* with family *Chironomidae* is present in totally insignificant quantities.

In the middle part of the Babuna flow, the group *Ephemeroptera* is dominant in the nutrition of the chub. Also, in this part of the flow, the presence of the fam. *Chironomidae* is enlarged, and at the same time, one can notice fish in the nutrition of the chub. Also, leaves of higher plants are present. In the summer period, the group *Conjugatophyceae* has three quarters from the nutrition of the chub in the lower flow, and the higher plants are present in limited quantities. Dominant family of animal origin is *Chironomidae*, while the group *Ephemeroptera* is present only symbolically.

c) Autumn period

In this period, as far as the plant component is concerned, the nutrition of the Babuna chub is identical with the nutrition during the summer, i. e. representatives from the group *Conjugatophyceae* dominate.

Also, detritus and larvae of *Chironomidae*, which are equally found in all the parts of the river flow, can be found in the digestive tract of the chub in this period.



Plecoptera	1
Bacilariophyceae	2
Ephemeroptera	3
Chrysophyceae	4
Phanerogameae	5
detritus	6
Diptera	7
Conjugatophyceae	8
other	9
Pisces	10

Fig. 3. Seasonal aspects of feeding chubs from the Babuna on the separate parts of longitudinal distribution of chub in the river Babuna

Slika 3. Prehrana klena rijeke Babune prema lokacijama i sezonama

In the middle flow, the nutrition is a bit more variable systematically, because there can be found the group *Ephemeroptera* and *Pisces*.

d) *Winter period*

In the winter period, food of plant origin i. e. representatives of the group *Diatomeae* dominate in the nutrition of the chub.

The representatives of the group *Diptera-Chironomidae*

are present in all the three parts of the flow, and in the middle and lower flow even representatives of the group *Ephemeroptera*. The representatives of the group *Pisces* are found in the middle flow.

3) *Nutrition according to age classes*

Thanks to the bulky material of all aged classes, the change of the nutrition of the chubs during their life can be fully analyzed (Fig. 4). From the supplement, one can see that the juvenile samples equally feed themselves with plant and animal food, i. e. with *Diatomeae* and larvae of *Chironomidae*. In the period of sexual maturity, the chubs most intensively consume food of plant origin i. e. representatives of the *Spirogyra* species. Starting from the fourth year of age, representatives of the class *Pisces*, primarily *Barbus meridionalis* Riss, are increasingly taking part in the nutrition of the chubs. This species together with the chub consist the main mass of the fish settlement of the Babuna. Representatives as well as husks from other fish

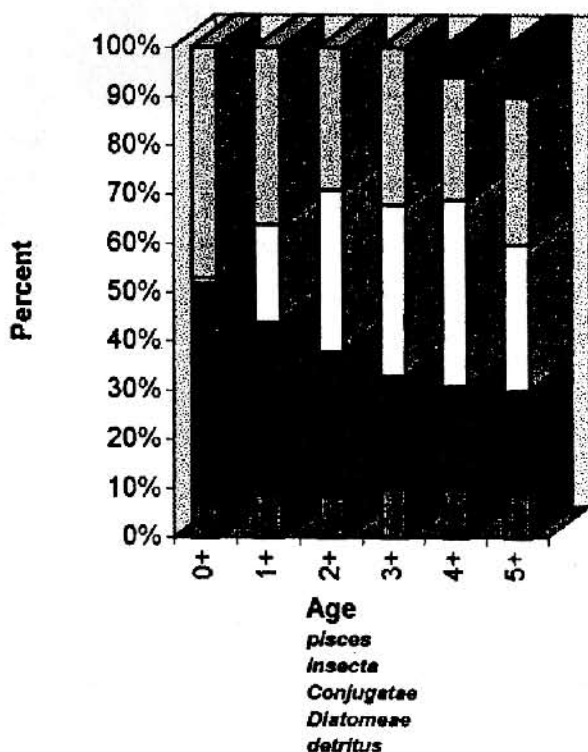


Fig. 4. Changing of chub nutrition along the age in the river Babuna.
Slika 4. Promjena prehrane klena iz rijeke Babune prema starosti

are not found at all in the digestive tracts of the chubs, and also the phenomenon of cannibalism is not stated.

DISCUSSION

The main mass of the chub's food from the river Babuna, both from plant and animal origin, is of autochthonous origin. The presence of autochthonous component in the nutrition of the chub confirms Stankovic's (1968) statement that the flowing waters as open systems are in close relations with the surrounding dryland and other water systems.

The nutrition of the chub in the spring period in the river and the accumulation of Turia has been studied by Djinova (1976) and she stated that the chubs are fed by the group *Diptera* (*Chironomidae*, *Simuliidae* and *Tipulidae*), and those in the accumulation with lower crawfish (*Cladocera*) and *Diptera*. In the spring period, dominant part of the crawfish in the nutrition of the young chubs in Scadar lake in Jugoslavia has been found by Stankovic-Trifunac (1981), while the older ones feed themselves with larvae of *Trichoptera* and other insects.

Also, Jankovic and Trifunac (1978) have found dominant part of *Trichoptera* in the Scadar lake in the spring period. At the same time, the chub from this lake has also fed itself with other insects, higher crawfish, snails and plants. Jankovic (1965) has stated that main food of the chubs of the Studencica is the group *Trichoptera*.

Mihailova (1964) has stated that main food of the chubs from the Struma river in Bulgaria is the plant component represented by the groups *Cyanophyceae* and *Conjugatae*.

Difference between the nutrition of the chubs from lotic and standing systems in the summer period has also been stated by Djinova (1976) for the river and accumulation of Turia. The chubs in the river have fed themselves with larvae of *Diptera*, and those in the accumulation with *Cladocera*.

According to Jankovic (1965), the chub of the Studencica feeds itself with soil insects during the summer.

Mixed structure of the chub's food during the summer has been established by Mihajlova (1964). There were insects represented by the groups *Coleoptera* and *Diptera*, and the plant component was represented by the groups *Cyanophyta* and *Conjugatae*.

The dominant component in the nutrition of the chub from the Scadar lake in the summer period has been the plant component according to the investigation of Stankovic-Trifunac (1981).

In the autumn period, in the oligotrophical salmonide river Studencica, the chubs have mostly fed themselves with larvae and puppae of *Trichoptera*

(Jankovic, 1965) while in the contaminated river Struma — with plant component: *Chlorophyta*, *Conjugatae* and leaves of higher plants (Mihailova, 1964).

Parts of plants and detritus are the food of the chubs in the autumn period and in the standing waters such as the Scadar lake, but this kind of food is only a secondary component. Main food of the chubs in this period of this ecosystem is the animal component represented primarily by the crawfish *Cladocera*, the insects (*Trichoptera*, *Hemiptera*, *Ditiscus*) according to Jankovic and Trifunac (1978).

During the autumn and winter months, the chubs from the lake of Scadar, according to Stankovic-Trifunac (1981) have fed themselves *Mollusca* i. e. equally with both *Gastropoda* and *Lamellibranchiata*.

The plant component as food in the digestive tracts of the chubs in the winter period in the lake of Scadar has been presented with stalks (Jankovic and Trifunac, 1978), and the animal component has been presented with *Chironomidae* and *Trichoptera*.

Trichoptera as a main component of the food in the winter period, in the same lake has been found by Stankovic-Trifunac (1981), and also, *Trichoptera* (larvae and puppae) as a dominant component in the nutrition of the chubs in this period has been found in the Studencica-Jankovic (1965).

According to Djinova (1976), the group *Plecoptera* shows up as main food of the chubs in the river Turia in the winter period.

Studying the results obtained by analysis of the chubs food in different types of living surroundings and different regions of areas, according to the mentioned authors, and the results from other authors who have analysed the nutrition of the chubs, one can get the impression that although the chubs are omnifages, and can easily find food in every environment, yet they consume more food of animal origin, which is richer with high energetic compounds and easily digestive, and in absence of this kind of food, they consume more plant food.

This statement is supported with the results obtained by Grubic and others (1982), analysing the nutrition of the chubs and the remaining fish in uncontaminated and contaminated part of the river Resava.

The influence of the quality structure of chub nutrition upon the rate of the length growing can be noticed through the comparison of the rate of the length growing of the chubs from the Babuna and the stream Pinarbasi in Turkey on one hand, and the rate of the length growing of the chubs from other waters, as well as the nutrition of these two populations with the nutrition of the chub from localities where the chubs grow faster. So, according to our results, as well as the results of Geldiay and Balik (1973), the chubs from these two waters with their length growing are significantly behind in comparison to the growing of the chubs from other

localities. Both in their nutrition consume a great deal of *Diatomeae* and other lower plants.

Concerning the nutrition of the chub from Babuna, we could add that the absence of the representatives of the group *Gastropoda* is inexplicable, which are especially present in the summer period. They, together with the species *Spyrogira*, cover the bottom of the Babuna. So, according to this group, the nutrition of the chub is selective. The tendency towards selection of some groups was confirmed by the presence of many small yields of land plants *Arctium* sp. and *Scortium* sp. in the winter period. Although in small number, just one or two, these representatives were present in the stomach of almost all individuals.

Another thing in the nutrition of the chub that deserves attention in the unequal presence of some groups in samples that originate from the same part of the flow and in the same period of the year.

Observing the enclosed graphs that refer to the whole material, one can notice a relative equality of the plant and animal component in the nutrition of the chub.

But, the single (individual) analysis has shown that the individuals caught in the same part of the flow, in the same time have not fed themselves with the same groups, i. e. while the food of plant origin with some representatives of the fauna was dominant for some individuals, for other — the whole content of the intestine was full with representatives of the group *Insecta*.

CONCLUSIONS

The nutrition of chub in the flow of the Vardar has not been studied so far and these are the first attempts in this direction. According to the nutrition, the chub belongs to the group zoophitophagus. In the intestinal tracts of the chubs from the Babuna, a number of representatives of the flora and fauna of the Babuna are found. Also, representatives of the kinds that inhabit the living area of the river Babuna are found as well as extinct remainders from plant and animal origin—detritus. The spectrum of the nutrition is subjected to seasonal change which is in close correlation to the fluctuation of single plant and animal kinds in different seasons during the year. Also, the spectrum of nutrition changes during the life and it is considered to be one of the reasons of the slow length growing of the Babuna chub, in comparison to the rate of length growing of the chub in other regions. So, the plant component, represented by the groups *Diatomeae* and *Conjugatae* has the greatest part in the nutrition of the young aged classes, when the fish grow fastest. The main component in the nutrition of the aged classes 4+ and 5+, when the fish have reached sexual maturity, is of animal origin.

The main mass of food of the group *Pisces* is represented by individuals of the stream barb which are most numerous species in the Babuna. This

shows the competition between the chub and the stream barb on one hand, and on the other hand, the manifestation of the facultative predatory in absence of one real predator in this river.

Sažetak

PREHRANA KLENA *Leuciscus cephalus* (Linnaeus, 1758) IZ RIJEKE BABUNE

Godine 1978. na trima lokacijama u rijeci Babuni ulovljeno je 550 klenova. Kvantitativni sastav njihove hrane proučen je prema sezonama i dobnim razredima. Klen je u rijeci Babuni omnivoran, pri čemu prevladava floristička komponenta u njihovoj prehrani. Glavnina je njegove hrane autohtonog podrijetla. U cijelom području rijeke u proljeće u prehrani klena od biljaka prevladavaju alge Chrysophyceae, a od životinja Ephemeroptera. U gornjem i srednjem toku rijeke prisutni su Plecoptera. Ljeti od biljaka prevladavaju Conjugatophyceae, a životinje su različite u pojedinim dijelovima rijeke. Raznolikost životinja prevladava i u jesen, kada se u srednjem dijelu rijeke mogu naći u ribljoj ishrani. Tada su od biljaka prevladavale Chrysophyceae. Životinjska komponenta u hrani bila je slična i zimi, a od biljaka je uočena dominacija Bacillariophyceae. U prehrani mladih riba prevladavaju Diatomeae i Chironomidae, dok se prehrana ribe starije od 1+ sastoji ponajprije od Conjugatophyceae, zatim ličinki kukaca, djelomično detritusa, au najstarijim razredima i od riba.

Ključne riječi: prehrana, leuciscus, rijeka, Makedonija

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Received 4th June, 1997