

## NUTRITION OF SOME FISH FROM MAVROVO RESERVOIR

### HRANIDBA NEKIH RIBA U AKUMULACIJSKOM JEZERU MAVROVO

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#### ABSTRACT

In the period 1990-1995 two aspects were investigated of the ecology of *S. trutta*, *O. Mykiss*, *A. alburnus*, *L. cephalus*, *R. rubilio*, *B. meridionalis* and *Ph. phoxinus* - the condition coefficient and nutrition from the artificial stagnant water ecosystem of the Mavrovo reservoir, created in the early fifties of this century for electric power production. In the first 30 years of existence, the reservoir was inhabited only by autochthonous *S. trutta* population, artificially supported from the hatchery builds on the main reservoir confluence. Other species were introduced later and with the exception of *O. mykiss* whose presence was the escape from the cages installed for market production, are autochthonous for the flow of the Crni Drim where the reservoir belongs but had never before reached area because of inconvenient ecological conditions in the fast waters of the River Radika - a recipient of the slow high mountain brook the Mavrovo Radika. Most of the fish feed on the biocenosis component, flora and fauna, including *S. trutta* and younger age classes of *O. mykiss*, while the older age classes of *O. mykiss* are the only predator.

Key words: nutrition, fish, Mavrovo reservoir.

#### INTRODUCTION

The Mavrovo artificial lake is a typical mountain lake which was created some 20 years ago. Its storage water mainly comes from the Radika river affluents which are also mountain rivers. At maximum water level this lake covers an area of some 1200 ha and holds about 340000000 m<sup>3</sup> storage water. Through a system of power stations, the lake is primarily used for power generation.

During the first years of its formation and existence, the accumulation was an object of investigation carried out by the Fishing Institution of the Republic of Macedonia. The aim was to follow the conditions and the formation of animal com-

munities in the accumulation, in order to improve the sports fishing, and possibly economic fishing. The first works resulting from those investigations refer to the ichthiofauna (Karaman, 1957, Sidorovski, 1955, 1960 and 1971), to the zoobentosat (Stojkovski, 1960) and to the zooplankton (Popovska - Stankovič, 1963) from the accumulation.

The results of the investigations into the nutrition of some species of fish from the Mavrovo accumulation are given in this work.

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The aim of the investigations was to establish the regime of nutrition of some species of fish from the Mavrovo accumulation.

### MATERIAL AND METHODS

The material for this work was caught with a fish-hook in the period from 1990 to 1993. All essential parameters were taken from material fixed in the 4% formaldehyd solution.

The nutrition of the fish was investigated by determining the qualitative structure and by visual determinatin of the quantitative relation of the separated components of the feed.

The coefficient of the condition was calculated according to the equation  $C=kW/L^3$  by Vibert and Lagler, 1961.

The condition of the nutrition in the period from January till March remains unknown because of deficiency of material. In this time, the accumulation is usually covered with ice.

\* W - fish mass

L - length of fish body

k - number 100 so that the obtained number is larger than zero

### RESULTS AND DISCUSSION

The gathered material, whose number is shown in table 1, for some enabled species, by the planned investigations, a full unerstanding of the

**Table 2. Presence of aged classes in the population of particular species**  
**Tablica 2. Prisutnost dobnih skupina u populaciji određenih vrsta**

Aged classes - Starosna skupina	0+	1+	2+	3+	4+	5+	6+	7+	n
Salmo trutta		1	3	2	2	3		2	13
S. marmoratus								1	1
Oncorhynchus mykiss		1	9	11	2	2			25
Leuciscus cephalus	38		8	12	2				60
Barbus meridionalis		1	1	1	1	2	2		8
Rutilus rubilio		1	2	5	8	11	4		31
Alburnus alburnus	63	15	29	47	51	15	5		225
Phoxinus phoxinus		2	4						6
Entirety - Skupno									369

actual condition of the species in the investigated ecosystem, while for some other species of the investigations could be done only partly.

**Table 1. Whole gathered material upon species**  
**Tablica 1. Sakupljeni materijal po vrstama**

Species - Vrsta	Year - Godina				
	1990	1991	1992	1993	Entirety
Salmo trutta	14	5			19
S. marmoratus	1				1
Oncorhynchus mykiss	26	3	7		36
Leuciscus cephalus		32	15	40	87
Alburnus alburnus	12	119	116	44	291
Rutilus rubilio	3	25	17	7	52
Barbus meridionalis	1	7	1	1	10
Phoxinus phoxinus		2	4		6
	57	193	160	92	502

From the table, one can see that most of the samples (almost half of them) belong to the species A. alburnus, while the authochtonous species S. trutta is represented with 19 caught variants, which is about 4% of the material gathered altogether.

The age structure of the available material is shown im Table 2. The results of the investigation into the nutrition of the fish from the Mavrovo accumulation are shown in Table 3.

**Table 3. Regime of nutrition of the fish from the Mavrovo accumulation**  
**Tablica 3. Režim hranidbe ribe u akumulacijskom jezeru Mavrovo**

<b>S. trutta</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>	<b>XII</b>
Chironomidae - (l.)	x								x
Insecta - (i.)	x								
Odonata - (l.)	x								
Pisces	x								
Ephemeroptera - (l.)	x								
Trichoptera - (l.)	x								
Diptera - (l.)					x			x	
<b>O. mykiss</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>	<b>XII</b>
A. alburnus									x
Tabanidae - (l.)	x								
Trichoptera - (l.)	x								
Coleoptera	x					x		x	
Gastropoda	x								
Ephemeroptera - (l.)	x								
Lepidoptera - (l.)	x						x		
Oligochaeta	x								
Diptera - (l.)	x							x	
Pentatomidae						x			
Pisces indet							x		
Vespidae - (i.)							x		
Formicidae - (i.)							x	x	
Arachnoida								x	
A. alburnus								x	x
Chironomidae - (l.)								x	
<b>A. alburnus</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>	<b>XII</b>
Diaptomus		x	x				x		x
Chironomidae - (l.)		x						x	x
Daphnia		x	x	x	x	x	x		
Oscillatoria		x	x						
Ephemeroptera - (l.)			x						
Diptera - (l.)			x						
Cyclops			x						
<b>L. cephalus</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>	<b>XII</b>
Diptera - (l.)	x								

Trichoptera - (l.)	x								
Coleoptera - (l.)	x								
Oligochaeta			x						
Oscillatoria			x						
Diaptamus							x		
Rotatoria					x		x		
Cormophyta					x				
Empty									
<b>R. rubilio</b>	IV	V	VI	VII	VIII	IX	X	XI	XII
Chironomidae - (l.)	x								
Empty		x					x		x
<b>B. maridionalis</b>	IV	V	VI	VII	VIII	IX	X	XI	XII
Chironomidae - (l.)	x								
<b>Ph. phoxinus</b>	IV	V	VI	VII	VIII	IX	X	XI	XII
Chironomidae - (l.)					x				

Although in the available material there is no sample of each species every month, it is possible to get a satisfactory picture of the regime of the nutrition of the ihtiofauna in the Mavrovo accumulation, and especially to see the chain of nutrition.

So, as far as the stream trout is concerned, one can see the seasonal rate of changing the feed.

In all the four seasons, the stream trout feeds on larvae of insects, primarily Diptera, while the other groups are present only in spring. Although a predator and has some smaller species of fish at its disposal, they are in the stomachs of the stream trout in spring and winter, when the fish (which serves as a prey) is not very active. This indicates that maybe in the summer period the stream trout stays in the deeper and colder parts of the accumulation where most probably there are not cyprinide species. The comparison between these results and those of Popovska-Stankovič and Georgiev, 1973. gives an opportunity to state that the regime of the nutrition of this species has not suffered important changes after additional (as for as the-fats and calories are concerned) more variable feed (Pisces) was included.

Despite the autochthonous stream trout (and the added generation of stream trout from other deltas) the introduced California trout shows as a

much more rational user of the feed that is available. A larger number of stomachs of this species was analysed even of five months, so the conclusions are somewhat more realistic.

In addition to the more variable spectrum of consumed organisms from the aquatic environment, one can observe a considerable presence of land insects which are brought from the surrounding meadows during the rains by the streams that get into the accumulation.

In the older age classes, i.e. individuals with larger mass, the food is composed of almost only *A. alburnus*. An impressive picture was observed in certain samples whose stomachs were deformed by a too large quantity of swallowed little fish, especially in periods and places where they get together to spend the winter.

Most material gathered was from the species *A. alburnus* L. and practically in all the months when the accumulation was not covered with ice and fishing was possible. Empty stomachs of this species were found only in winter, while in spring the spectrum was the richest, and besides feed of animal origin composed of plankton Crustacea and forms of aquatic insects which are fished at their eclosion, in their stomachs one could find thread alga *Oscillatoria*. In the period of most intensive nutrition, during the summer and autumn, the feed

of the *A. alburnus* L. was uniform, composed of almost only water lice *Daphnia* and some *Diatomus*, but very bulky in quantity, because in every stomach there were hundreds of individual plankton crawfish. In is obvious that this mountainous and cold water accumulation with its ecological characteristics does not agree with the species *L. cephalus* which favours warmer waters, and although by the character of its biology, it eats everything, and somewhere occurs as a halfpredator, here according to the feed found in the digestive tract, it behaves as a typical calm water fish with modest needs and satisfied with any feed. So, in the six months of investigation in the four seasons, the stomachs of the fish caught in the summer and in the winter were entirely empty.

In spring, the feed consists of only larvae of small water insects; while in the autumn - it is mainly of plant origin of modest feed value - *Diatomeae* and thread alga. In July, besides the identical feed of vegetation origin, some microscopic plankton forms of *Rotatoria* were also found.

In only one of the spring catch components of animal origin of high feed value - *Oligochetae* were found. Although the stomachs of the fished samples of the first age group were empty, the results obtained from representatives of the group *Rotatoria*, from the older age classes of the species, indicate that maybe this group is the main feed of the chub from the Mavrovo accumulation, and because the representatives of this group are of very small individual dimensions, it would be an explanation for the very slow growth of the chub during the first year of life.

The species *R. rubilio* is even more modest in its nutrition requirements and more specialized to a narrow ecological ring of feed. Only a modest number of this species, is available and only in four months, with an exception of May, when only one sample was fished with an empty stomach.

In the remaining three months the feed was only of animal origin from larvae of the group *Chironomidae*, while only in April, besides the larvae, the presence of detritus was also found but it can not be said with certainty whether the detritus was fished purposely or it was accidentally found in the intestines of the fish, together with the eaten larvae.

**Table 4. Coefficient of condition of the fish from the Mavrovo accumulation**

**Tablica 4. Koeficijent stanja ribe iz jezera Mavrovo**

	IV	V	VI	VII	VIII	IX	X	XI	XII
<i>S. trutta</i>									
1+	-	-	-	-	1.92	-	-	-	-
2+	-	-	-	-	-	-	-	-	1.50
3+	-	-	-	-	-	-	-	-	1.54
4+	1.64	-	-	-	1.51	-	-	-	-
5+	1.64	-	-	-	1.70	-	-	-	-
7+	-	-	-	-	-	-	-	1.62	-
<i>O. mykiss</i>									
1+	-	-	-	-	-	-	-	-	1.32
2+	1.74	1.49	-	-	-	-	-	1.63	1.85
3+	1.81	1.82	-	-	-	-	-	1.71	1.61
4+	-	-	-	-	-	1.64	1.66	-	-
5+	-	-	-	-	1.96	-	-	1.73	-
<i>R. rubilio</i>									
1+	-	-	-	-	2.07	-	-	-	-
2+	-	2.08	2.04	-	-	-	-	-	-
3+	-	1.88	-	-	-	-	-	-	-
4+	2.77	2.27	-	-	-	-	-	-	2.18
5+	2.84	-	-	-	-	-	2.25	-	2.20
6+	-	-	-	-	-	-	-	-	2.32
<i>L. cephalus</i>									
0+	-	-	-	-	1.77	-	1.64	-	-
2+	-	-	2.41	1.48	1.82	1.68	1.59	-	-
3+	2.11	1.66	-	-	-	-	-	-	1.82
4+	-	1.96	-	-	-	-	-	-	1.77
5+	-	1.74	-	-	-	-	-	-	-
<i>A. alburnus</i>									
0+	-	-	-	-	1.07	1.31	-	-	-
1+	-	-	1.48	-	-	1.36	-	-	1.44
2+	-	1.30	1.44	1.53	1.23	1.49	1.25	-	1.38
3+	-	1.49	1.45	1.19	1.41	1.52	1.39	1.54	-
4+	-	1.63	1.64	1.76	1.57	1.46	1.40	-	-
5+	-	1.53	1.61	1.41	-	1.45	1.61	-	-
6+	-	-	-	-	-	1.46	1.60	-	-
<i>B. meridionalis</i>									
1+	-	-	1.88	-	-	-	-	-	-
2+	2.00	-	-	-	-	-	-	-	-
3+	1.76	-	-	-	-	1.37	-	-	-
4+	1.92	-	-	-	-	-	-	-	-
<i>Ph. phoxinus</i>									
1+	-	-	-	1.82	-	-	-	-	-
2+	-	2.15	-	-	1.90	-	-	-	-

The remaining species, *B. meridionalis* and *Ph. phoxinus* feed only on the organisms *Chironomidae*. Samples of the former species were fished singly. The only fished had an empty stomach, which is quite normal sample of *S. marmoratus* considering it was the period of spawning when fished.

### CONCLUSION

Generally it could be concluded that, in all the seven species, the presence of mainly larvae, rarely other stages of growth, of the group *Chironomidae* was established. Thus the group mentioned in the whole cycle of the circulating materials in the accumulation.

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### SAŽETAK

U razdoblju od 1990. do 1995. istraživana su dva ekološka aspekta *S. trutta*, *O. mykiss*, *A. alburnus*, *L. cephalus*, *R. rubilio*, *B. meridionalis* i *Ph. phoxinus* - uvjeti i hranidba u mirnoj vodi ekosistema akumulacijskog jezera Mavrovo, načinjenog ranih pedesetih godina ovog stoljeća za proizvodnju električne energije. U prvih 30 godina postojanja u jezeru je živjela samo autohtona populacija *S. trutta*, umjetno održavana iz mrijestilišta sagrađenog na glavnom pritoku jezera. Ostale su vrste unesene kasnije i osim *O. mykiss* što je došla u jezero bježanjem iz kaveza postavljenih za trgovačku proizvodnju, autohtone vrste toka Crnog Drima, kojem jezero pripada, ali nisu nikad prije došle do ovog područja zbog nepovoljnih ekoloških uvjeta u brzim vodama rijeke Radike - u koju utječe polagana planinska rječica Mavrovska Radika. Većina se hrani biocenoznim sastojcima, flore i faune, uključujući *S. trutta* i mlađe dobne skupine *O. mykissa*, dok su starije skupine *O. mykissa* jedini predatori.