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FEEDING OF *Carassius auratus gibelio* (BLOCH) IN SKADAR LAKE (MONTENEGRO) AND COMPETITIVE RELATIONS WITH AUTOCHTHONOUS CYPRINID SPECIES

A b s t r a c t

Study of nutrition of introduced German carp - *Carassius auratus gibelio* (Bloch, 1783) in Skadar Lake has vealed its intensive and versatile nutrition during the entire year. The Skadar Lake population belongs to euryphagous or omnivorous group with a signifcant participation of detritus (30-90%) in its diet. It demonstraties a clear seasonal dynamics as well as the dependending of the site. There were records of certain selectivity, while the differences as regards their age have not been found. Spectrum of diet of Skadar's population differs signifcantly from the nutrition of populations from continental water bodies. In addition, a significant competition with autochthonous cyprinids, especially *Cyprinus carpio* was established.

Key words: *Carassius auratus gibelio* (Bloch), Lake Skadar, feeding, competition

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INTRODUCTION

German carp - *Carassius auratus gibelio* (Bloch) was brought into the Albanian part of Skadar Lake and back in 1973 it was recorded in the Yugoslav part (VUKOVIC ET AL. 1975). In addition to this subspecies, another five species from the so called "Chinese complex" were introduced into the Skadar Lake. In subsequent period a number of other species was introduced into the lake. With some formerly introduced ones (*Gambusia afinis, Thymallus thymallus, Oncorchynchus mykiss*) the total number of introduced species of fishes amounts 14. Only a few species have achieved their full adaptation (MARIC & KRIVOKAPIC, 1997).

Introduced species have not been studied in details, thus it is not known what were all the consequences of their introduction. The objective of this paper is to study the nutrition of *Carassius auratus gibelio* in Skadar Lake and its competitive relation with autochthonous cyprinid species.

AREA AND HABITAT STUDY

Skadar Lake is a karstic lake created by inundation of a karstic field. It is situated between 19^0 15' of eastern geographical longitude and $40^0$10' of northern geographical latitude, at the very south of the Republic of Montenegro, respectively Yugoslavia, on the border with Albania to which belongs 1/3 of the Lake. The lake extends in the direction north-northeast, it is 44 km long. Its shape is elongated oval with peak width of circa 14 km at average water level (Figure I). At average water levels the surface of the lake is on 5 m altitude; total surface of the lake is 370 km^2. At maximum water level the surface of the lake reaches to around 600 m^2 and it increases to the elevation of 9 m above the sea level (KARAMAN & BEETON, 1981).

Waters from the watershed reach the lake by ground or underground water courses, through a number of sublacustrine springs ("oka"). The largest tributary of Skadar Lake is the Moraca River which brings around 62 % of water, while the waters flow away from the lake into the sea by the Bojana River; its average flowing through is over 300 m^3/sec. The Moraca River has the greatest influence, not only to the

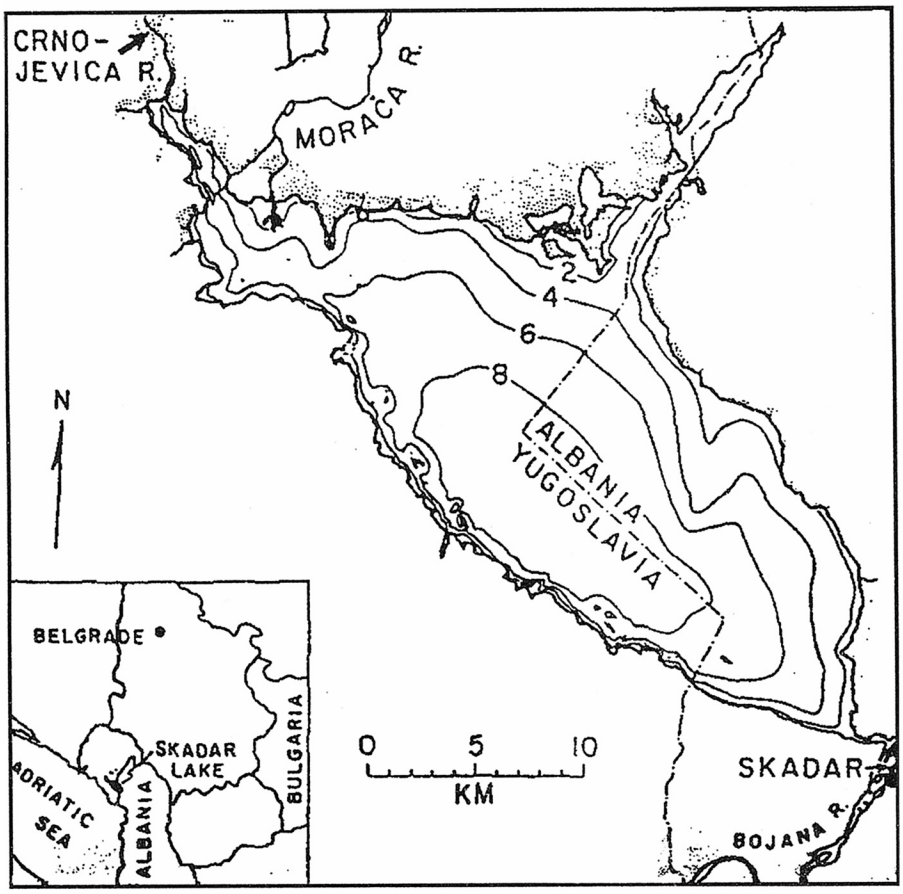


Fig. 1. Map of Skadar Lake, Yugoslavia
Depth contours are 2 m intervals.

temperature regime, and its influence is particularly significant in the central part. Average monthly water temperatures range 5-7^{0}C in winter, to 25-28^{0}C in summer. Temperature stratification in Skadar Lake is weakly pointed due to strong and frequent winds, as well as due to a small depth, of 8 m in average. During the summer the transparency of lake waters is 2-3 meters, but in winter it increases reaching up to 5 meters. Besides, the waters of this lake are characterized by a high contents of dissolved oxygen ($>$ 8 mg/dm^3) BOD5 usually $>$ 3, etc. For its saprobity index (KOLWITZ and MARSSON, 1908) it belongs

to the beta mesosaprobic waters (KARAMAN & BEETON, 1981; FILIPOVIC, 1997).

Northern and northwestern coast is overgrown by submersive and emerse vegetation (*Myriophyllum sp., Ceratophyllum sp., Potamogeton sp., Phragmites sp., Trapa sp., Nymphea sp., Numphar sp.* etc.), which tend to extend (VIZI, 1997).

MATERIAL AND WORK METHODS

Study of the nutrition of German carp was done on the material sampled in 1984 with some additions made in 1992. Material for nutrition studies was collected so that the specimens of German carp were dissected immediately after being caught and their intestines were flxed in 4 % form aldehyde. All analysed specimens (n=193) belonged to age groups 0+(l) to 7+. For the analysis of qualitative-quantitative composition of nutrition, intestine contents from the intestine segment 6-8 cm long was taken. This segment was being taken from the front part of the intestine which was rather well fulfilled; it was mainly on 3-5 cm after the esophagus.

Nutrition of German carp was studied through four seasons. In spring period their nutrition was studied for specimens (n=63) which were caught during the spawning period, in March, April and May, in summer period (36) in July and August, in autumn period (58) at the end of September and beginning of November and in winter period (n= 38) in December, Januaiy and the beginning of February. In every season a number of specimens from different sites was analysed; the fsh were mainly caught in the littoral part with luxuriant submersive and emerse vegetation.

Parallel with the investigation of qualitative and quantitative composition of intestinal contents the level of intestinal tract fling up (full, semi-full, and empty) during every season were studied. Choice of three levels of the intestinal tract filling up, not fve, as generally done, was done because of higher accuracy, as it was shown that the differences among the five levels were scarcely visible. Quantitative composition was established by volumetrical method (Rukovodstvo po izucheniu pitnia ryb. . . 1961).

In graphs 1 through 16 the most numerous groups were presented:

Detritus (Detr.), *Algae* (Al.), Vegetation (Veg.), *Mollusca* (Mol.), *Chironomidae* (Chir.), *Copepoda and Cladocera* (Co+Cl), *Oligochaeta* (Olig), *Ostracoda* (Ostr.), another (An.).

RESULTS AND DISCUSSION

Amount of feed in intestinal tract

By monitoring the quantity of feed in the intestines it was established that this species in Skadar Lake feeds intensively throughout the year (table l.). Demonstrated data indicate that the number of specimens with empty intestines is very low and that according to this indicator there are no significant differences among some seasons, especially summer and spring and autumn and winter.

Table 1. Seasonal dynamics of filing out of the intestinal tract in 1984.

Stuffedness	Season (months)			
	Winter (I)	Spring (IV)	Summer (VII)	Autumn (XI)
Full gut	40,5 %	52,8 %	78,6 %	62,3 %
Semi-empty gut	47,2 %	44,1 %	18,8 %	28,6 %
Empty gut	12,3 %	3,1 %	2,8 %	7,1 %

Greater differences are noted in complete stuffedness of the intestinal tract between the winter and early spring period and summer, respectively autumn. From this table 1 may see that the German carp in Skadar Lake feeds intensively both during winter and during the spawning period. In waters of the Amur's region, the nutrition of German carp suddenly decreases in September and from October to March it does not feed (NIKOL'SKII, 1956). In the waters of Belorussia this subspecies does not feed during the winter (ZHUKOV, 1965). In some species from Skadar Lake it was also reported that they do not feed during the winter (IVANOVIC, 1968), and weaker intensity of nutrition was established also in fish from the surrounding regions (POPOVSKA-STANKOVIC, 1968 and 1971; SORIC, 1982 etc.). Nutrition of German carp during the winter is the adjustment to very mild and favourable water conditions (temperature) of Skadar Lake, which differ signifcantly from the conditions in Siberia and the continental areas it settles. Although

it is intensively fed during the winter the growth of the subspecies in that period is low as one may observe on growing zones on the scales (paper in press). This is the consequence of smaller caloric value of consumed diet (detritus), relatively low temperatures and an intensive process of gametogenesis.

Quantitative-qualitative diet composition

From the table 1. as well as from the graphic surveys (graph 1-16) demonstrating the quantitative nutrition structure one can see a clear seasonal character. Also, the share of some nutrition elements during the season may be established. At analysis of the intestinal tract the individuals aged 0+ (1) to 5+ there was no notice of some greater difference in diet structure. Analysing the nutrition of individual specimens it was noted that there were significant differences in qualitative feed structure, depending of the site and time of catch of the individual specimens. The nutrition of juvenile specimens has not been studied until the late autumn period due to the difficulties of catching these specimens (they stay in inaccessible dense vegetation). NIKOL'SKII (1956) reports that the German carp from the Amur, as they reach size of 40 mm have the same structure of feed like the adults, but that seasonal character is clearly pointed. Also ZHUKOV (1965) reports that there are no differences in nutrition between the juvenile and adult population, but that there also are no seasonal differences, nor the variations from one year to the other. Opposite to this, in German carp from South Sakhalin significant differences were recorded in different age classes (KL'IUCHAREVA et al. 1964). German carp at Skadar Lake has a significant seasonal variability of quantitative and qualitative feed structure.

Winter period

Stuffedness of the intestines and intestinal contents analysis indicaties that this species actively feeds during the entire winter, too (tab. 1. and 2.). In this period in all analysed specimens the largest portion in the nutrition belongs to detritus 50-95% of the total contents. The share of detritus in this period is most commonly above 70% and it is composed of macrophytes and microphytes plants. Plant component sometimes consists of fragments up to 2 cm long; these are most probably the fragments of *Miriophyllum and Ceratophyllum.* From the zoo component the diet in this period consists of various groups, and their numerosity significantly varies in individual cases (Graph 1.-5.). Since

Table 2. Diet composition of German carp (*Carassius auratus gibelio*, Bloch) in Skadar Lake

Species (group)	Season			
	Winter	Spring	Summer	Autumn
Chlorophyceae		+	+	+
Conjuugatophyceae				
Spirogyra sp.		+	+ + +	+ + +
Zygnema ssp.		+	+ + +	+ + +
Cyanophyceae				
Merismopedia sp.		+	+	+
Sphaerocystis sp.		+	+	+
Bacillariophyceae	+ +	+ +	+ + +	+ + +
Fragilaria sp.		+	+	+
Nitzschia sp.		+ +	+	+
Chromatophyteae				
Ceratophyllum sp.	+ + +	+ +	+	+
Myriophyllum sp.	+ + +	+ +	+	+
Protozoa				
Testacea			+	+
Difflugia sp.			+	+
Hidrozoa (statoblast)	+			
Rotatoria				
Testudinella patina		+		
Euchlanis sp.		+		
Cladocera				
Iliocryptus sordidus		+	+	
Chydorus sphaericus	+	+ +	+	+ + +
Alona sp.	+ + +	+ + +	+ + +	+ + +
Monospilus sp.		+	+	
Pleuroxus sp.		+	+	
Bosmina sp.	+ + +	+	+	+ +
Copepoda				
Eucyclops serrulatus	+	+ +	+ +	+ +
Canthocamptus sp.	+ +	+		
Ostracoda	+ + +	+ + +	+ + +	+ + +
Amphipoda	+			
Oligochaeta	+ +	+ +	+	+
Chironomidae	+ + +	+ + +	+ + +	+ + +
(other Insects)	+	+	+	+
Bivalvia	+		+ + +	+ +
Dreissena polymorpha	+ +	+	+	+
Valvata piscinalis	+ + +			+ + +
Mollusca				
Pyrgula annulata	+ +			
Pisidium sp.	+	+	+	+
Detritus	+ + +	+ + +	+ + +	+ + +

+ - very rare, + + - rare, + + + - abundant.

the specimens studied originate from various sites this versatility in nutrition have probably been caused by different structure of biota

on those spots. So, for instance, the best presented zoo components in some specimens are *Chironomidae* (to 45 %), while in others that is the case with *Cladocera* (to 45 %). In some cases predominating are *Mollusca* (over 30 %), sometimes it is *Ostracoda,* although their numerosity varies from only a few to 15 %. It was noted that in cases of high *Chironomidae* numerosity the number of other organisms is low or they are completely absent, what is the case with *Mollusca.* From the remainders of *Mollusca* four species were determined: *Valvata piscinalis, Pyrgula annulata, Dreissena polymorpha and Pisidium sp.* Besides, it was noted that *Cladocera* are more abundant then *Copepoda* and that the species of genus *Alona* are prevailing. lt has already been pointed out that the greatest number of specimens (n=14) has a high detritus rate, while the specimens with high rate of one zoo component were less frequently found. The highest number of specimens have a high portion of *Chironomidae* (n=9), the next to come is *Mollusca* (n=7), while there is the same number of those with higher rate of *Cladocera + Copepoda and Ostracoda* (n=4). Intensive nutrition of German carp in Skadar Lake during the winter, different from the northern populations which do not feed in this period, is the adjustment to favourable abiotic conditions and offered feed.

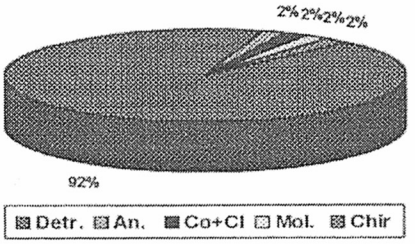
Spring period

The analysis of digestive tract of specimens caught at spawning spots, but also elsewhere, indicaties that German carp feeds also in Spring, when it spawns. The main component of the nutrition in this period is detritus (>50 %) and in early spring its portion rates from 70 to 90 %. Qualitative composition of the contents of intestinal tract during the spawning indicaties mainly the absence of better quality components (graph. 6) and it does not signifcantly differ from the one in winter period. Numerosity of *Ostracoda* declines, numerosity of algae increases; those are mainly the various species of diatomea like *Nitscia sp.* which is the most numerous. Benthos forms *Copepoda and Cladocera* (except of *Alona* sp.) occur only individually in this period, but only larger specimens in some genera were recorded (*Eucyclops serrulatus*). In this period also the filamentous green algae are rare. Similar to the winter period the specimens with significant share of zoo component are rare. Their share later in Spring increases; thus, a specimen with greater presence of *Chironomidae* has got around 15 %, and with higher share

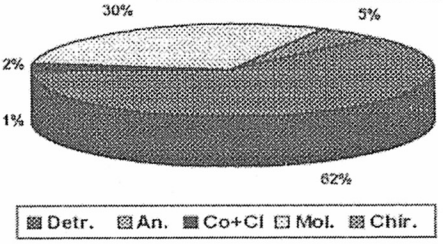
of *Cladocera* around 20 %. Different from the nutrition of German carp in Skadar Lake in Baykal basin the ratio of plant and animal component in diet is 1:3. Animal component is mainly composed of *Chironomidae,* than *Mollusca* (TUGARINA and EL'COVA, 1974).

Summer Period

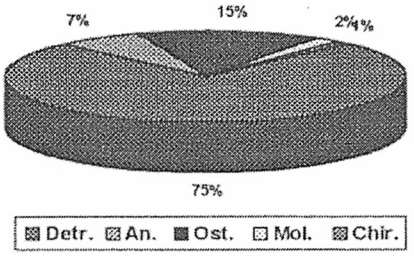
A great versatility of German carp diet is observed in this period. The differences are noted among the specimens from the same site, but also from different sites. Share of detritus is the lowest in this period, although in some instances it is over 35 %. As compared to the other periods the share of *Chironomidae* in this one is very high, sometimes exceeding 50 %. The rate of fllamentous green algae is commonly high, reaching sometimes as much as 80 %. In the Baykal basin in this period the rate of *Chironomidae* in nutrition of German carp reaches the average of circa 25 %, the total animal component amounting 77 % (TUGARINA and EL'COVA,1974). In nutrition of specimens from Skadar Lake, besides high rate of flamentous algae, with the exception of detritus, there are practically no other organisms, that is they occur only sporadically. Also in samples in which *Chironomidae* predominate in addition to detritus, filamentous algae and diatomea, significant numerosity belongs to *Ostracoda* only. The representatives of the group *Copepoda* and *Cladocera* occur also in individual cases with a very high number of specimens, but than *Chironomidae* are less presented in the nutrition. It was noted that *Copepoda* occur in significante lower number than *Cladocera,* usually 2-10 specimens in studied intestinal tract (length of 6-8 cm). In addition to species from genus *Alona* other species of *Cladocera* are rarely reported. According to data by TUGARINA and EL'COVA (1974) the best represented organism from this group in nutrition of German carp from the Baykal basin is *Bosmina longirostris.* Rate of species from the genus *Alona* at age group 1+ composes sometimes even 70 % of the intestinal contents of Skadar's population (two specimens from the same locality by the end of summer period), with adult individuals it is up to 25 %. It may be stated that *Chironomidae* are predominating in the samples from midsummer period, and that filamentous algae and sometimes *Cladocera (Alona sp.)* have greater numerosity in the samples at the end of summer. Due to the above mentioned conditions it is difficult to establish which group of organisms is predominant in the summer



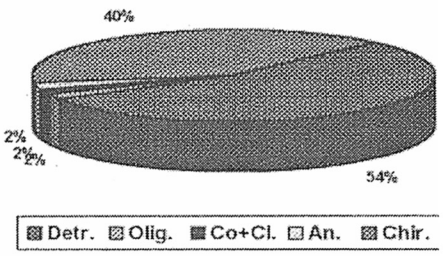
Graf. 1. Winter



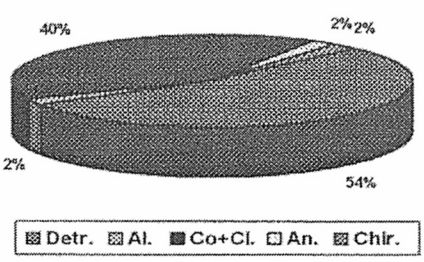
Graf. 2. Winter



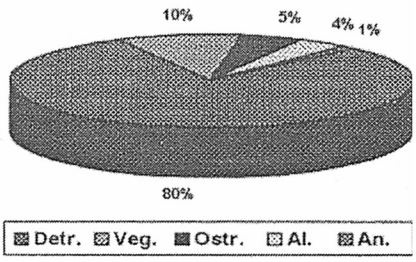
Graf. 3. Winter



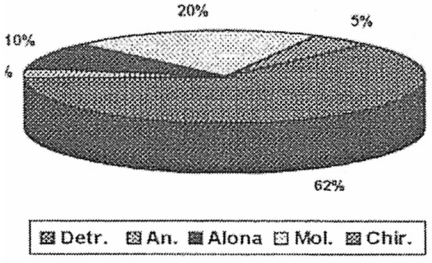
Graf. 4. Winter



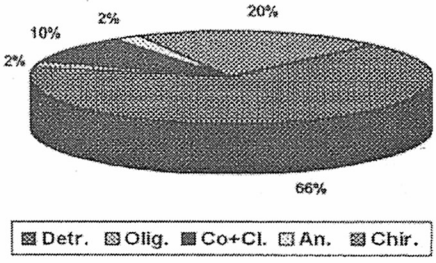
Graf. 5. Winter



Graf. 6. Spring - May

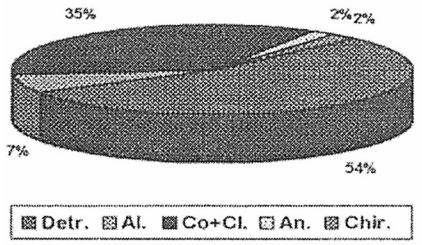


Graf. 7. Spring (April).

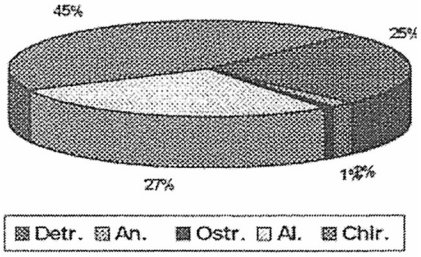


Graf. 8. Spring (April)

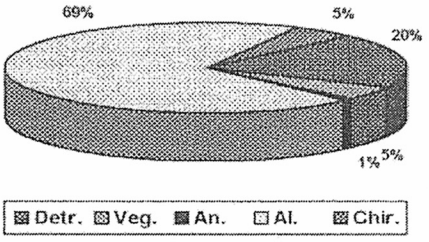
Graf. 1-16. Presence of predominant nutrition components in *C.a.gibelio* annual cicle



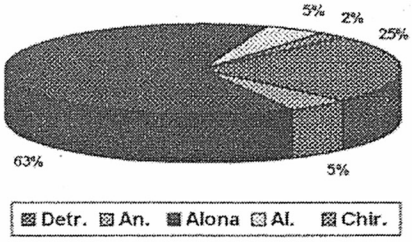
Graf. 9. Spring (May).



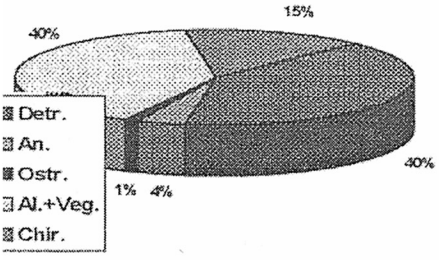
Graf. 10. Summmer.



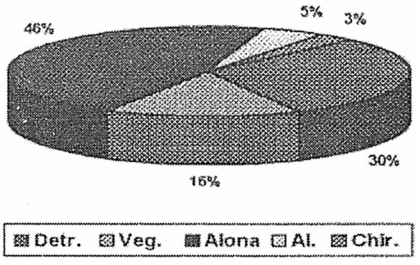
Graf. 11. Summer (August).



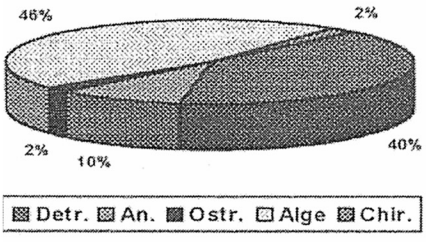
Graf. 12. End of Summer



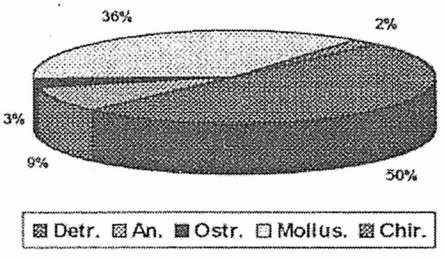
Graf. 13. Beginning of Autumn



Graf. 14. Oktober



Graf. 15. Oktober



Graf. 16. November

Graf. 1-16. Presence of predominant nutrition components in *C.a.gibelio* annual cicle (continued)

period diet. As three groups of organisms occur as the predominating ones (graph. 10-12), and as a rule, at that time, there is no greater occurrence of other organisms, the diet in this season is also specific for that. More signifcant increase of *Copepoda* and *Cladocera* is recorded at the end of the summer, while some regularity has not been established for the other groups.

Autumn Period

Nutrition of German carp in autumn period is similar to the summer one. In addition to detritus, which is predominating in some cases, a significant share in nutrition belongs to various groups of organisms (Graphs 13-16). Sometimes various algae species are predominant, most frequently the filamentous algae, next coming is the macrophytic vegetation, and in some cases also *Cladocera (Alona).* In this period, too, the particles of macrophytes are as big as 2 cm. In some cases in addition to detritus a significant share may belong to *Gastropoda* and in this period four formerly mentioned species were registered. Portion of other groups in the nutrition in this period is relatively low, therefore the *Ostracoda* are found in some cases only sporadically. In autumn period a versatile structure of benthos population *Copepoda* and *Cladocera* could be observed. A number of genera is represented but with a few specimens (with the exception of genus *Alona*). The best represented is genus *Chidorus.* Genus *Eucyclops* occurs with large forms and it is five times less numerous than *Chidorus,* and for around fifty than *Alona* sp. Different composition of zoo component and different ratio of detritus in this period in specimens caught at the same site in short time interval (end of October and beginning of November 1992), but at different water transparency, brought to a conclusion that German carp in turbid water (after ample rains) feeds mainly on benthos organisms (*Mollusca*) and at that time it takes in a rather high quantity of mud (graph 16). Therefore, these differences may be caused by micro locality but also the factor so called "reaction distance", which was proved by many investigators (GILIAROV, 1987). In fall period, German carp from the area of the Baykal basin has in its diet the animal component (around 90 %), plants being much less present (10 %). Animal component in this period is composed of the representatives of the two groups only, *Chironomidae* (62 %) and *Mollusca* (26 %) (TUGARINA and EL'COVA, 1974).

On basis of the investigation of German carp nutrition its seasonal character may be observed, as well as the versatility of diet during one season and variability depending on micro locality. Comparing the nutrition of Skadar's German carp with data from literature similarities and some differences may be observed. The greatest similarity is in high rate of detritus (85-90 % for scope NIKOL'SKII, 1956; for frequency 100 % TUGARINA and EL'COVA, 1974). KL'IUCHAREVA ET AL. (1964) report that the rate of detritus may be up to 87 % and they observe German carp from the lake of South Sakhalin and from the Amur region as a typical detritophagous one. NIKOL'SKII (1956 and 1971) considers German carp a polophagous species, although he reports an extraordinary high rate of detritus in its diet. In some investigations of the nutrition of this subspecies presence of detritus is not accentuated (PUJIN and MALETIN, 1987; MALETIN ET AL., 1990 etc.). Regardless of this failure, it is obvious that German carp is an euriphagous- polyphagous species in the diet of which etritus has an important place throughout the entire year. KL'IUCHAREVA ET AL. (1964) point out that detritus in lakes of South Sakhalin has an important role in nutrition of German carp as it consists of a number of bacteria (5 billion bacteria were found in 1 mg). It is well known that some other species in some seasons have much more significant portion of detritus in their diet (ANTIPOVA, 1980; COWX, 1989 an others), but such a high rate is rare. Differences in nutrition of the Amur and European species (including also detritus) represented one of the main reasons for introducing the Amur complex into the European and West Siberian waters (VASNECOV, 1951a and 1951b). The similarity of nutrition of German carp from Skadar lake and from other localities is also in the fact that they consume the organisms from the lake's bottom. Those are various representatives of the group *Copepoda* and *Cladocera* which are connected to the lake's bottom or which are situated immediately above it and the typical representatives which live in mud (detritus) like *Chironomidae.* Significant component in the nutrition belongs to various species of *Mollusca* and various types of algae, as reported by KL'IUCHAREVA ET AL. (1964) and TUGARINA and EL'COVA (1974). Feeding with benthic organisms situated in its surfacial part are caused by the structure of mouth apparatus (ZHUKOV,1965). This may be the reason for low presence of *Oligochaeta* in their diet, although at some sites, in some periods of the year they may predomina-

te over the *Chironomidae* (KARAMAN and NEDIC, 1981). NIKOL'SKII (1956); KL'IUCHAREVA ET AL. (1964), ZHUKOV (1965) and TUGARINA and EL'COVA (1974) also report *Oligochaeta* in diet, but they point out *Chironomidae;* however, PUJIN and MALETIN (1987) and MALETIN ET AL. (1990) record also this group of organisms as a significant component of German carp nutrition component in waters of Vojvodina.

Specificity, and by that the difference, in nutrition of Skadar's German carp is that there exists a clear selectivity in certain moment and habitat of only one group of organisms (in addition to detritus). Detailed investigations have shown that in the intestinal contents two or three components may be rarely found in equal ratio; most frequently one group of organisms is predominating (for instance *Mollusca, Chironomidae* or *Copepoda + Cladocera*). According to GILIAROV (1987) there are many factors which influence the choice of victim (feed) of some species in certain habitat. More significant presence of only one group of organisms in intestinal tract may be caused by the habitat what was established also with Cyprinus carpio from this lake (STEIN ET AL. 1975; JANKOVIC, 1983). On basis of former investigations of zoo plankton and zoo benthos (NEDELJKOVIC, 1959; PETKOVIC, SM. and PETKOVIC, ST., 1968; JANKOVIC, 1974; STEIN ET AL. 1975; KARAMAN & BEETON, 1981; PETKOVIC, 1981 and others) it was established that there are great differences among the localities, respectively micro habitats. Feeding of a certain number of specimens (of the same age) with mainly *Mollusca* or *Chironomidae* on a relatively small space has been caused exactly by the differences in micro habitat. STEIN ET AL. (1975) established the selectivity of Skadar's carp and they think that it may be the result of grouping the prey on a certain spot. This may be the main reason that on the mouth of the Moraca a few German carps had mainly *Mollusca* in their diet at the same time, while the other group had *Chironomidae.*

The choice of prey, selectivity, may be caused by various factors. DRENNER ET AL. (1978), VINYARD (1980) and others established that the organisms easier to catch (less mobile) are better presented in the diet, while SCHMIDT & O'BRIEN (1982) report greater presence of large zoo plankton. KITTLE & O'BRIEN (1978) proved that the selection of prey depends of the colour, while JENSSEN (1981) reports that it depends of the angle under which the prey is caught etc. By this investigation it was revealed that German carp in Skadar Lake feeds almost exclusively

on the species of genus *Alona,* and in most cases on big specimens. *Copepoda* are exceptionally rarely presented in greater numbers (*Eucyclops sp.* in autumn period), although their presence in certain period of the year on some localities is significantly higher than the presence of *Cladocera* (PETKOVIC, 1981). The difference between these two species in mobility is big and only the *Copepoda* of benthos are not good swimmers, but they also are only sporadically presented in nutrition. In majority of cases the diet consists of some coarse/big specimens of *Alona,* and only in winter time one can find tinnier forms with somewhat increased numerosity of species *Chidorus.* Nutrition with coarse forms (except of the winter season) may indicate that there is enough feed therefore German carp may choose. The selection is better pointed with large specimens (GILIAROV, 1987), while the juvenile specimens use the size proportionate to their mouth opening (MIHEV, 1984). Only the adult German carp specimens were studied. The nutrition with large specimens of Alona sp., is obviously the result of selectivity, although it may be caused by the structure of branchiospines (SHPET ET AL. 1961). Nutrition with specimens of genus *Alona* may indicate its greater presence closer to the lake bottom, higher numerosity or perhaps even some other factor, like specifc colours which attract predator. *Alona* sp. as related to *Bosmina sp.* and *Daphnia sp.* have pointed ornaments on their body which perhaps attract predator, German carp in this instance. Comparative analysis of obtained results with scarce literature data indicate nevertheless that the nutrition of German carp in Skadar Lake is very versatile.

Competition

Bearing in mind the way and character of nutrition the question of competition of this subspecies with other species in Skadar Lake has to be posed, especially as regards the autochthonous ones. Nutrition of native fish has been sufficiently studied only for a small number of species, while the nutrition of introduced fish has not been studied at all.

NEDELJKOVIC, (1959) and IVANOVIC (1968) studied the diet of bleak (*Alburnus alburnus alborella*) and they found that it feeds on typically zoo planktonic organisms. Among these organisms significant share belongs to *Diaphansoma sp.* or *Eudiaptomus sp.* which are typical of planktonic hydrobionts, which were not recorded in digestive tract of

German carp. Share of *Chironmidae* and other forms in bleak diet is insignificant; thus it may be stated that the bleak and German carp are in very little or no competition.

Feeding of *Chondrostoma nasus* was also studied (PETKOVIC, ET AL. 1970). It was established that *Chondrostoma nasus* in Skadar lake feeds mainly on various algae species. The share of other organisms in diet, like *Cladocera + Copepoda,* insects and worms is insignificant. Since German carp in specifc periods of the year may have signifcant presence of algae in its diet, this subspecies has got some competition with *Chondrostoma nasus.*

Leuciscus cephalus in Skadar Lake feeds on various species of benthic organisms, but the fish are the main diet (JANKOVIC and TRIVUNAC, 1978; STANKOVIC-TRIVUNAC, 1981). Its nutrition indicaties a clear seasonal dynamics throughout the year. More signifcant share of animal component in all seasons in addition to fish are the insects (terrestial forms, larvae of *Trichoptera, Hemiptera and Ephemeroptera*), crabs, shellfish and snails. Significant place belongs to algae, to some extent macrophytes and detritus. VUKOVIC ET AL. (1972) report the share of plant component of up to 42 %. Feeding on larvae of insects is particularly pointed in Spring period, while algae (*Chlorophyceae, Cyanophiceae* and *Diatomeae*) are best represented in summer, when the snails and shellfish is also significant. In autumn period *Leuciscus* cephalus takes plant particles and detritus (25 %) with equal share of insects and *Mollusca.* Comparing the diet spectrum of *Leuciscus cephalus* with the diet of German carp one can observe significant differences. In the nutrition of German carp there is no fish, no adult forms of terrestrial insects. German carp very rarely feeds on larvae of insects, except of *Chironomidae,* which, as related to *Leuciscus cephalus* have an important role. Similarity of diet of these two species is primarily their feeding on algae, and than feeding on *Mollusca,* so that the competition is more signifcantly expressed only as regards these organisms.

Diet of *Scardinius erythrophthalmus scardafa* in Skadar Lake is mainly composed of plants (KNEZEVIC, 1984); the fragments of macrophytes (60-90 %) and fllamentous algae (to 20 in summer period). Share of detritus rated from 8 to 35 %, animal components occurring sporadically. The competition of German carp and this subspecies is in feeding with filamentous algae (during the summer) and detritus (during the

winter).

According to VUKOVIC ET AL. (1972) and KNEZEVIC (1976), *Rutilus rubilio* (probably *R. prespensis*) mainly feeds on plant diet, with significantly lower share of detritus. Since there are no more precise data about the plant component, but that these are the fllamentous algae (KNEZEVIC, 1976) it may only be stated that there is a certain competition in period of luxuriant developement of these forms. Bearing in mind the presence of filamentous algae in nutrition of *Chondrostoma nasus* and *Scardinius sp.*, it may be concluded that he competition of *Rutilus sp.* with German carp is somewhere in between the two above mentioned species, when talking about the algae mentioned.

For *Pachychilon pictum,* besides data on ratio of plant and animal component (VUKOVIC ET AL.1972) there are no closer data on nutrition in Skadar Lake. According to mentioned authors with this species also plant component is more important than the animal one. Bearing in mind such data and data on nutition of German carp the level of competition may only be preassumed.

Among all native species in Skadar lake the best known is the nutrition of carp (*Cyprinus carpio*) (STEIN ET AL. 1975; JANKOVIC and TRIVUNAC, 1978, JANKOVIC, 1983). On basis of these investigations it may be concluded that the diet of carp is very versatile. Seasonal dynamics is clearly pointed, and it was established that the nutrition depends of the site (JANKOVIC, 1983), what was also recorded for the German carp. Competition in nutrition of native carp and German carp is clearly visible and very high. It is the least pointed during the winter when the German carp mainly feeds on detritus. Observed by the groups on which these two species feed the competition is best pointed in their nutrition with *Mollusca* and *Chironomidae* during the entire year. Similar relation of this component in nutrition of carp and German carp was reported by TUGARINA and EL'COVA (1974) in the Baykal basin. Significant competition is in nutrition with algae, than *Copepoda + Cladocera,* less in detritus consumption. Different from German carp a significant place in nutrition of carp belongs to other groups of insects, than *Asellidae* and *Gammaridae,* while significant portion belongs to the seeds of various plant species. Among the forms mentioned German carp uses only the seeds in very low rates, while *Gammarus sp.* and larvae of insects used to be found individually. TUGARINA and EL'COVA

(1974) believe that in the Baykal basin there is no stronger competition between these two species and it is more signifcantly pointed in autumn period. At that time these two species feed mainly on *Chironomidae* and *Mollusca,* but since the numerosity of German carp is low, the competition looses its significance. Opposite to this, in Skadar Lake both carp and German carp have a high numerosity so that every competition has a great importance. The competition in nutrition with *Copepoda* and *Cladocera* is the most pointed in autumn period, when all these forms at the same time are the most numerous (PETKOVIC, 1981). However, German carp is quantitatively signifcantly more oriented towards the nutrition with these organisms. This fact was one of the main reasons for joint culturing of German carp and carp (SHPET ET AL. 1961). The most pointed competition not only for the little crabs, but also for other plankton organisms, between these two species, is by all means in the first stages of postembryonal development. At that time these, as well as the fngerling of other species, use almost identic diet for their nutrition. According to SHPET ET AL. (1961) German carp and carp differ significantly for their structure and number of branchispines what causes the large individuals to feed on significantly different quantity of these *Microcrustacea.* Due to its structure the carp, according to them, may succesfully feed on, for instance, *Bosmina sp.* only to the size of 100 grams, and German carp with the ones over 200 grams. All this indicaties that there is a certain competition in nutrition with *Copepoda* and *Cladocera,* but it is significantly pointed only in juvenile specimens. As the fngerling of both species spend their first vegetative season at the same site this competition has an extraordinary significance and it may influence the growth speed of juvenile carps. It is quite possible that lack or weaker growth of German carp, also, in the frst year of life, in period 1984- 1987 was the result of great numerosity of this species, that is great competition for diet among the juvenile specimens of German carp (paper in press). Since the native populations are less plastic in battle for space, diet and like, their displacing is inevitable, and sometimes it leads to disappearing. Although the decline of native population numerosity was recorded before the introduction of German carp (STEIN ET AL 1981) it is certain that this subspecies along with other introduced species has accelerated that process.

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