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COMPARATIVE INVESTIGATION BETWEEN PHYTOPLANKTON AND THE INTESTINAL CONTENTS OF CARP

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Abstract. Algological and ichthyological examinations were performed during the period from September 1990 to May 1993 in the Old Begej (Stari Begej) nature reserve.
Main aim of this paper is to recognize the phytoplankton in the water and in the intestinal content of carp.
Age of the examined carp individuals was between 2^+ and 6^+. Average body length waried betwen 144.30 and 3887.55 mm, and body weight between 1203.50 and 1691.56 g. All available food promoted good growth of carp.
232 species, varieties and forms of algae were recorded in the samples from Old Begej, and Chlorophyta was a dominant group of algae. In the intestinal content of carps 160 taxa of algae were recorded but dominant groups were Bacillariophyta and Chlorophyta.
On the basis of saprobity index after Pantle and Buck and quantity of carp, the water of Old Begej can be ranked as β-mesosaprobic one.

Keywords: bioindicators, carp, intestinal content, phytoplankton, saprobity.

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Introduction

During a manyfold examination of flora, vegetation and fauna of the Regional Park Old Begej (Stari Begej), performed by Institute for Nature Protection of Serbia, Department in Novi Sad, ichthyological and algological examinations played an important role. The Old Begej nature reserve is situated in low stream of the rivers Begej and Tisza. It is populated by 24 fish species (Budakov, 1989).

In the former examinations, attention was paid to the fish species of special protection demand and listed in the Red Book od Serbia, such as pike and pike-perch (Budakov, 1992) and weatherfish which is a natural rarity in the waters of Serbia (Budakov, 1993). Characteristics of growth of roach, significantly frequent in this biotop, were examined (Budakov, 1989a), as well.

Recently, our examinations have been directed towards carp, examined by a lot of local and foreign authors. Although carp is traditionally the most important fish of our waters, it is on the list of Red Book of Serbia, because its survival is endangered.

Complex examinations of growth rate and feeding of carp pointed out that the phytoplankton participated in the diet of carp only in the first years of its life (Janković, 1983).

Main aim of this paper was to recognize the phytoplankton community in the water of Old Begej, presence of algae in the intestinal content of carp, as well as presence of algae in the intestinal content of carp individuals of different age.

Material and methods

Examinations of carp were performed on the basis of samples caught during the period from September 1990 to May 1993 in the Old Begej (Stari Begej) nature reserve. Altogether 73 individuals were analysed. Age, longitudinal growth, growth of weight and growth rate were

calculated according to Ćugunova (1959).

Samples were taken from different intestinal regions of each individuals for the analysis of intestinal content, and relative abundance (percentage participation) of different phytoplankton species were measured.

Samples were taken simultaneously with carp catching for qualitative and quantitative analysis of the phytoplankton community and of saprobiological characteristics of the water of Old Begej. Standard limnological methods were used (Hribar, 1978). Saprobity index was calculated after Pantle and Buck (1955) on the basis of phytoplankton indicator species.

Results

232 species, varieties and forms of Cyanobacteria (19), Pyrrophyta (10), Xantophyta (3), Chrysophyta (4), Bacillariophyta (46), Euglenophyta (38) and Chlorophyta (112) were recorded in the samples from Old Begej. Overal density of the phytoplankton community was changeable, and varied from 18.5x103 ind/cm^3 to 53.3x103 ind/cm^3.

Relative abundance of different algal groups in the water of Old Begej is given in Fig. 1. Chlorophyta was the most abundant algal group throughout the whole examination period. Their relative abundance varied from 49.3 to 56.6 %. Relative abundance of Euglenophyta varied from 15.0 to 21.0 %, and that of Bacillariophyta varied from 9.3 to 18.8 %. Cyanobacteria and Pyrrophyta were less important members of the phytoplankton community, being present with 4.9 to 9.3 and 3.3 to 10.0 %, respectively. The representatives of Xantophyta and Chrysophyta were present constantly, but their relative abundance was low.

Table 1. Relative abundance of different groups of algae in the intestinal content of different age groups of carp.

	3+	4+	5+	6+
Cyanobacteria	5.9	5.0		
Pyrrophyta	4.4	1.2	2.9	4.9
Xantophyta	0.7	1.2	2.9	
Bacillariophyta	40.5	35.1	40.6	47.1
Euglenophyta	11.0	12.4	8.6	11.7
Chlorophyta	37.5	45.1	45.0	36.3

The phytopankton in carp feeding was examined in the total sample of carp. 68 of 73 individuals had intestinal content. 160 species, varieties and forms of Cyanobacteria (11), Pyrrophyta (6), Xantophyta (1), Chrysophyta (4),

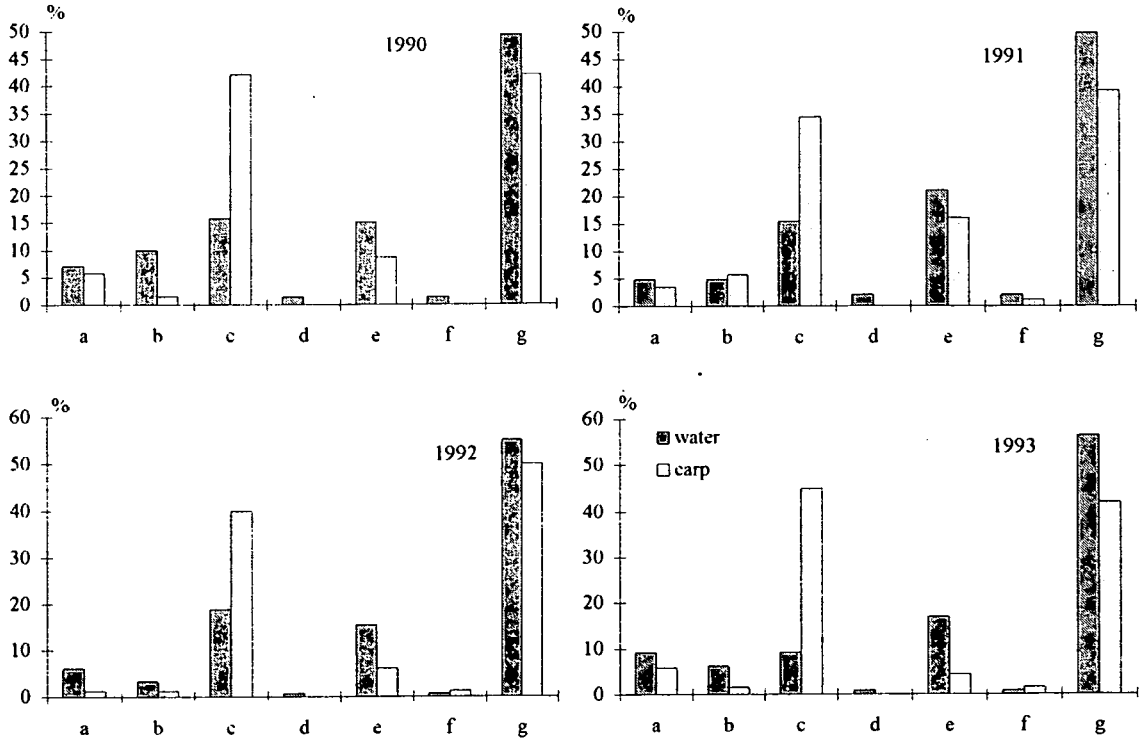

Fig. 1. Relative abundance of the phytoplankton in the water and in the intestinal content of carp

Bacillariophyta (63), Euglenophyta (18) and Chlorophyta (61) were recorded in the intestinal content. Fig. 1. shows relative abundance of different groups of algae, and Table 1. presents the distribution of relative abundance of algal groups among age groups.

Regarding relative abundance, Bacillariophyta and Chlorophyta represented dominant algal groups. Relative abundance of Cholorphyta varied from 34.5 to 44.9 %, while that of Chlorophyta ranged from 39.1 to 50.0 %.

Algae from Euglenophyta and Cyanobacteria groups are less important in carp feeding. Their relative abundance in the intestinal content of carp varied from 4.3 to 16.0 %, and from 1.3 to 5.8 %, respectively. Representatives of Xantophhyta were recorded sporadically, while those of Chrysophyta were not recorded in the intestinal content of carp.

Data related to the growth rate of carp are contribution to the knowledge of its ecology as well as a base for proposal of measures which would resulted in higher growth rate. In the examined sample, individuals of carp belonged to the age classes from 2^+ to 6^+ but individuals of ages from 3^+ to 5^+ were the dominant. Mean values of body length (without anal fin) ranged from 345.5 to 415.0 mm. According to calculated values the longitudinal growth (Fig. 2.) after the second year (114.3 mm) was duplicated, showing intensive increase in the first years of life. From the age 3^+ to the age 6^+, the longitudinal growth slightly increased (305.24 to 387.55 mm) but the weakest longitudinal growth occurred in the age groups 4^+ and 5^+.

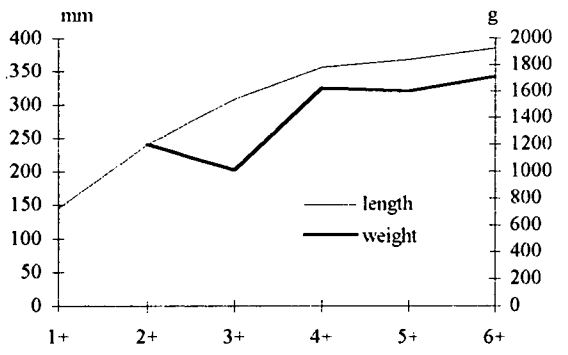

Fig. 2. Longitudinal and weight growth of *Cyprinus carpio* L. in Old Begej.

Annual longitudinal growth was wery intesive in the first year of life, then slightly decreased up to the age 5^+ (7.55 mm) but prominent increase (21.75 mm) was noticed then.

Body weight of examined carps ranged from 1203.30 to 1691.56 g. The growth of weight slightly increased regarding the age. Drastic decrease of weight growth happened after the age 2^+ (-195.95.g) but after the age 3^+ the weight growth increased (604.75 g) and had approximately similar values up to the age 6^+.

On the basis of physico-chemical parameters as well as on the basis of limnological examinations, which included the phytoplankton community and carp, saprobity of the Old Begej waters was determined. Indicator species of algae of the highest polluted waters, α-mesosaprob, β-mesosaprob and oligosaprob degree were recorded, but indicators of β-mesosaprob degree were dominant. Saprobnity index after Pantle and Buck (1955) varied from 2.1 to 2.4 pointing out to β-mesosaprob waters.

Discussion

Growth rate of the fish depends on several factors. First of all it depends on the food. Growth rate varies depending on conditions in the water biotop and differs from year to year. In eutrophic water biotops, it is generally higher because of sufficient available food. But, higher and higher pollution of the waters has negative influence on the growth rate of fish so the growth rate is not adequate to trophic level.

In the Old Begej waters, 232 species, varieties and forms of algae were recorded during the period of examinations which differs from the former ones (Brankovic, 1993), when 274 taxa of algae were recorded. Saprobity index was generally identical while density of the phytoplankton community was significantly higher compared to the former examinations. Higher density of the phytoplankton community pointed out to more intensive eutrophic processes in the water biotop.

The differences between these and former examinations could be explained by variation of climatic and other conditions in this biotop, by human influence, as well as by different number of samples and time of sampling.

Regarding some rivers in this region, the differences in qualitative composition of the phytoplankton community were noticed.

Examinations of the river Ponjavica (Obušković, 1991) showed that Euglenophyta and Chlorophyta were dominant groups of algae and were followed by Bacillariophyta and Cyanobacteria. Other groups of algae were represented with significantly lower number of taxa.

Obušković (1982) found that in the river Bosut

the representatives of Bacillariophyta were dominant and were followed by the representatives of Chlorophyta, Cyanobacteria and Euglenophyta. Other groups of algae were presented with significantly lower number of taxa.

It can be pointed out, that qualitative composition of the phytoplankton community of this aquatic biotop was almost similar to that in the Lake Ludaš (Seleši, 1981; Branković and Budakov, 1993) which is a protected area, as well. Namely, in the Lake Ludaš Chlorophyta were also a dominant group of algae, with the highest number of taxa. Bacillariophyta ranked the second place and were followed by Euglenophyta, Cyanobacteria and Pyrrophyta. Xanthophyta and Chrysophyta were present with only one taxa, respectively.

There were very significant differences between total number of taxa and number of taxa of different groups of algae in the water of Old Begej and in the intestinal content of carp. Relative abundance of Bacillariophyta was always higher in the intestinal contents while those of Chlorophyta and Euglenophyta were higher in the water (Fig. 1).

Some species, e.g. Chrysophyta were recorded sporadically in the waters but they were not found in the intestinal content of carp.

Relative abundance of Cyanobacteria, Pyrrophyta and Xantophyta were similar in the water and in the intestinal content.

There were significant differences between relative abundance of Chlorophyta, Euglenophyta and Bacillariophyta in the waters and in the intestinal content. The differences can be explained with characteristics of carp feeding and of different groups of algae. Because most of the species from the division Bacillariophyta are epiphytes, carp took in higher number of these algae with the detritus. These algae have characteristic silicate shells that made possible their determination for longer period. From the division Chlorophyta, the most abundant species were in the intestinal content of carp from the genus *Scenedesmus* what can be explained with their abundance in the water with their cell wall characteristics: the cell wall of these species contains sporopollenin which is enzyme-resistant.

Recently, examinations of growth rate and feeding of fish were very actual in the protected areas, e.g. Lake Palič and Lake Ludaš, the Old Begej and the Obedska bara swamp (Pujin and Budakov, 1979; Budakov, 1980, 1989, 1992; Maletin and Budakov, 1983; Budakov and Lecic, 1992).

From Old Begej, attention was paid to the growth rate and feeding of pike and pike-perch which species are listed in the Red Data Book of Serbia (Budakov, 1992) as well as to some allochtonous species (Maletin, 1988).

Literature data on feeding of Cyprinidae species are rather limited from this region. Complex examinations of growth rate and feeding of carp were carried out on the samples from the River Danube (Ristić, 1971), from the Lake Skadar (Drecun and Ristić, 1972) and on carp from several fishponds in Vojvodina (Pujin, 1967).

Carp inhabits slow-running and still waters and in certain period of year can be found on flooded areas. Carp is benthophagous (Drecun and Ristić, 1972) but Nikitina (1981) classified it as polyphagous species.

In the first years of its life, carp eats the phytoplankton, zooplankton and benthos but in older ages it usually consumes larger organisms of benthos such as larvae of Chironomida, Oligochaeta and others as well as ripe fruits. Older carps turn to predation and catch young individuals of other fish species.

Results of our examinations pointed out that algae are important in wide range of carp feeding. At all ages of carp, up to age class 6^{+}, different groups of algae were recorded dissimilar from literature data. Kostomarov (1961) stated that carp was selective in feeding, it showed an age dependent selection though there vere several species in the natural food source. We can not accept this statement on selectivity, because we recorded approximately the same proportions of different algal groups in all investigated age classes.

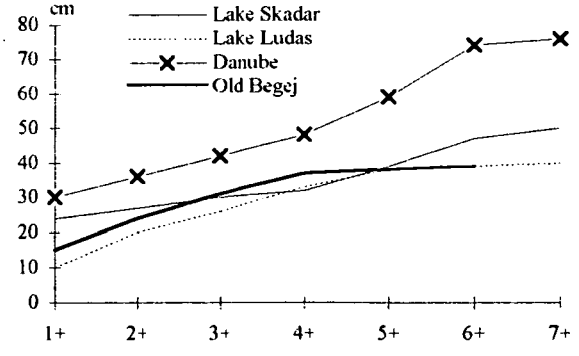

Fig. 3. Longitudinal growth of *Cyprinus carpio* L. in some aquatic habitats.

The growth rate of carp is good under optimal circumstances. The order of studied aquatic habitats on the basis of growth rate of carp is the following: Lake Ludaš < Stari Begej < River Danube < Lake Skadar. It was higher in Old Begej only compared

to Lake Ludaš (Pujin and Budakov, 1979). Lake Ludaš was characterized by intesive development of phytoplankton and by large variation in oxygene regime. A similar phenomenon was noticed in fishponds when, in the period of high temperature and intensive growth of phytoplankton, oxygen content of the water varied causing weaker growth of carp even though the food supply was not limiting (Pujin, 1967).

Oxygen content in Old Begej was very low in the first year of our examination. From May to October 1991 its values ranged from 6.46 to 11.22 mg/dm^3.

High density of phytoplankton community, favourable temperature regim and improvment of oxygen regime did not cause higher growth rate because of probable competition for food with other fish species.

In the protected area of Old Begej there are a lot of allochtonous species beside autochtonous ones, e.g. *Carassius auratus gibelio, Hypophthalmichthys molitrix* and *Aristichthys nobilis*. These allochthonous species adapted easily to the feeding conditions in the extended area, and because they are aggressive compete out autochthonous species (*Carassius carassius, Tinca tinca, Abramis brama, Rutilus rutilus, Cyprinus carpio*).

Aim of this study is the implementation of protection of autochthonous and all endangered species. These investigations are also important for protection of ichthyogenetic fund in our waters.

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