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THE NUTRITION OF A PIKEPERCH, *Stizostedion lucioperca* Linnaeus, 1758 in THE RIVER NERETVA

S. Trožić–Borovac, R. Škrijelj

Summary

The analysis of content of a pikeperch gastro–intestine system was done on the basis of examination of contents of gastro–intestine systems of 27 specimens captured in the accumulations of the river Neretva system. The fish capture was done using the nets set by the members of *Ichthyology and Fishing Center at the Faculty of Science Sarajevo*, in the period between 17. 07 — 24. 09. 2002. The dissection and fixation of gastro–intestine systems using the 4 % formaldehyde were done on the terrain. The examination of their contents was done in the laboratory of the *Faculty of Science Sarajevo*. The appearance of a pikeperch in the river Neretva system is result of an accident introduction in the lake Rama (Škrijelj, 1995; Škrijelj and Mašović, 2001). The analysis results of the contents of a pikeperch gastro–intestine system have indicated very various way of its nutrition caused by capacity of a water ecosystem and a specimen size. Its tendency to the nutrition with the other fish species is expressive in the lakes with the bigger competition with the other fish species and its tendency to cannibalism is expressive in the hydro–accumulations (Salakovac and Mostar). The cannibalism has characterized a pikeperch specimens larger than 30 cm. The specimens in the lake Grabovica (4), shorter than 30 cm, ate the specimens of the zoobenthos settlement. The algae are registered in stomach of one specimen. The survival of important autochthonous species of salmonoids and cyprinids has been endangered because of the established expressive greed of a pikeperch (the larger size specimens). This fact has caused larger negative ecological changes in the central water current of the river Neretva system. These conditions require the measures of control of a pikeperch population density and introduction in general. Comparison of the nutrition of this fish species with the others in the river Neretva accumulations (Kačanski et al., 1976; Trožić–Borovac, 2002a), it could be concluded that a pikeperch has no competitor. The other fish species have fed on the invertebrates and plants of benthos, accept a rare lake trout *Salmo trutta m. lacustris* Linnaeus,

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1758 specimens which have shown tendency to the greedy way of the nutrition.

This paper is the contribution to the knowledge of a pikeperch nutrition in the river Neretva accumulations that is, beside the reproduction, the important character of population growth control of this greedy animal, and in the aim of the survival of the autochthonous ichthyopopulations in the river Neretva system.

Key words: pikeperch nutrition, river Neretva, hydro–accumulations

INTRODUCTION

A pikeperch is a fish species belongs to the family Percidae and it is an autochthonous species in Europe. It's interesting for the sport fishing because of its high–quality meat. During the 19th century the intensive introduction of this species in the European lakes has begun: 1882. in the area of Galicia (East Europe), and in the German waters, at first in Bodensee in the river Rhine system (Löffler, 1998). The intensive period of a pikeperch introduction in Europe was 1966–1979 when almost all water systems of Germany, Denmark, Holland, Sweden, Italy, France and Great Britain were included. The survival of the important autochthonous fish species has been dangered by a pikeperch introduction. Trough the organisations like FAO, it has been pointed to the damage that uncontrolled introduction has caused in water ecosystems (FAO, 1984).

A pikeperch appears in waters with the minimum oxygen concetration of 3.5 mg/l. From the water quality aspect, it settles the eutrophic waters with lower degree of purity, together with cyprinids. This fish species settles the littoral zone in mesotrophic lakes and rivers. From the ecological aspect, it has a great adaptable power to environmental conditions. It is important to mention the fact a pikeperch, even if it appears in pure waters, the larger biomass will reach in eutrophic waters. In Europe, a several times it has been pointed to the uncontrolled processes of the fish introduction and problems they have caused (Rasmussen and Geertz–Hansen, 1998).

In the past, the pikeperch spread in Bosnia and Herzegovina was limited on the waters of the Black sea system (Vuković, 1977). In the end of the eighties of the 20th century this species was registered in the lake Rama, and later, in the lakes: Jablanica, Grabovica and Salakovac (Škrijelj and Mašović, 2001). During the latest investigations, the domination of this fish species in the hydroaccumulation Jablanica was established. Beside it, a pikeperch population has a large density in the hydroaccumulation Salakovac, less in the hydroaccumulation Grabovica, and the least population density in the hydroaccumulation Mostar (Sofradžija et al., 2002). The augmentation of a pikeperch population density has been caused by its greedy way of the

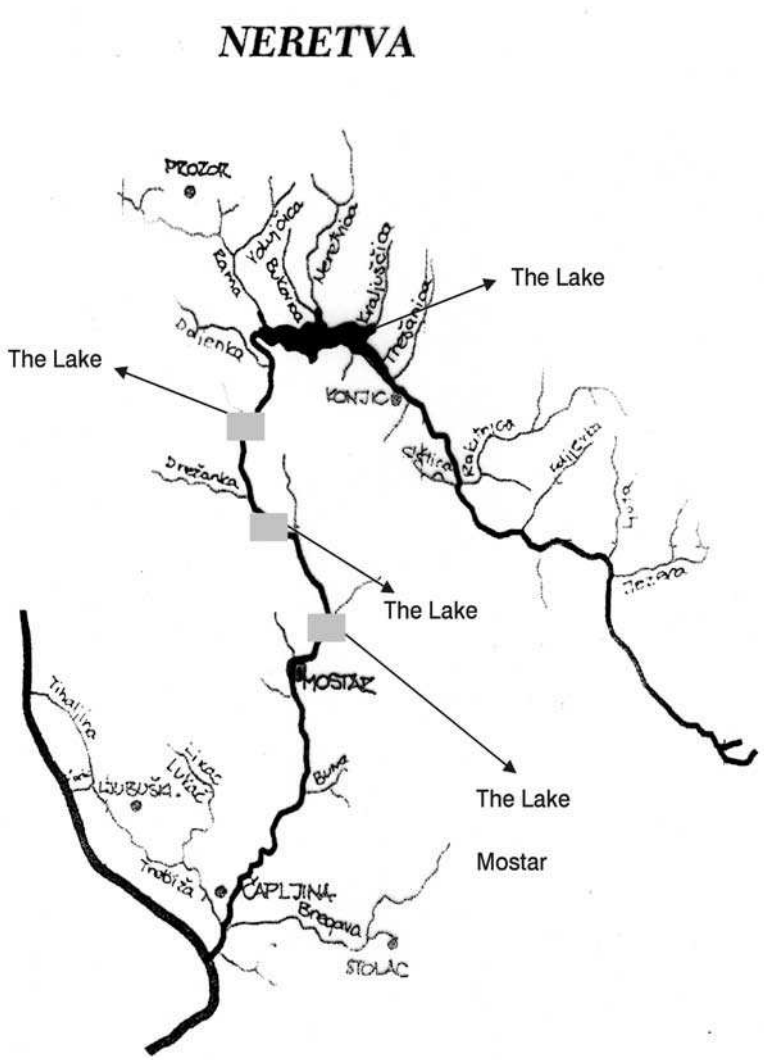


Figure 1. Place of the river Neretva where the capture of a pikeperch was made in 17. 07–23. 09. 2002.
Slika 1. Lokaliteti izlova smuđa na slijevu rijeke Neretve, 17. 7. — 24. 9. 2002.

nutrition, and also, by its expressive abilities of adaptation and ressistance (Smith et al., 1998). This fish is direct threat to the survival of important autochthonous, especially endemic, salmonides and cyprinids that habit in the river Neretva system. Because of it, all data about nutrition of this species contribute to the better and more complete knowledge of its autecology. In the world, there are a large number of papers dedicated to its growing and knowledge of its reproduction, especially from the aquacultural aspect.

Until today, the data about a pikeperch nutrition didn't exist on the territory of the former Yugoslavia. In the literature, it is possible to find the data about the nutrition of cyprinids and salmonides in Europe (McCormack, 1962; Elliot, 1967; Šenk and Aganović, 1968; Tuša, 1968; Kačanski and Kosorić, 1970; Popovska–Stanković and Georgiev, 1973; Kačanski and Ratković, 1988; Ellis and Goving, 1957; Trožić–Borovac, 2002).

The aim of this paper is to point out, especially natural nutrition of this fish (in closed artificial ecosystems), economically important, but very dangerous competitor from the aspect of ecological balance and preservation. The knowledge about the nutrition of this fish species can contribute to the limited and controlled growth of its populations in the river Neretva system.

MATERIAL AND METHODS

The fish capture was done in period between 17. 07–24. 09. 2002. on the 17 places in the river Neretva (Fig. 1) system by eletric aggregate type *Honda* EZ 2.200 kV, portable aggregate ELT 61 300/500 V and nets with different mesh sizes. The capture and net setting were done by members of *Ichthyology and Fishing Center at the Faculty of Science Sarajevo*. The separation of gastro–intestine systems and their fixation in 4 % formaldehyde were done on the terrain. The dissection and examination of contents of gastro–intestine systems were done in *Laboratory for the Ecology and Biosystematics of Animals of the Faculty of Science Sarajevo*. The determination was done using the binocular magnifying glass type *Laica* and microscope type *Jeneval*.

The results are presented by places in the tables consisting the data about the number of registered specimens (in total or in parts), their percentage in total number of the registered organisms and the percentage of fish which use these organisms in their nutrition. Beside that, the relation between the determined organisms used in the fish nutrition is presented by graphs by each individual place of the river Neretva system. The contents of a pikeperch gastro–intestine systems in the lakes Jablanica, Salakovac, Grabovica and Mostar are presented by photographs.

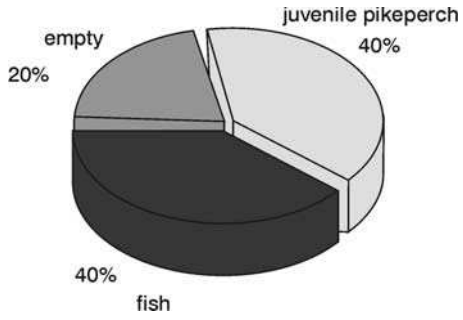
RESULTS AND DISCUSSION

The total number of the analysed pikeperch specimens was 27. The analysis of the pikeperch nutrition was done on the basis of the sample consisting 10 specimens in the lake Jablanica, 4 specimens in the lake Grabovica, 11 specimens in the lake Salakovac and 2 specimens in the lake Mostar.

From the 10 analyzed specimens in the lake Jablanica (Table 1), 40 % ate their own juvenile fish (Graph. 1). Just 20 % of the analysed fish of this

Table 1. The data about the nutrition of a pikeperch, Stizostedion lucioperca *Linnaeus, 1758 (ten specimens) from the Lake Jablanica, 13.–18. 09. 2002.*
Tablica 1. Podaci o prehrani jedinki smuđa Stizostedion lucioperca *Linnaeus, 1758 (deset jedinki) iz jezera Jablanica, 13.–18. 9. 2002.*

Place — the Lake Jablanica Lokalitet — Jezero Jablanica Composition of the stomach Sastav želuca	No. of the colle. spec. Broj jedinki	% of the total numb. of the organ. % udjela u organizmu	% of the tot. numb. of the fish which use theese organ. in their nutrit. % jedinki smuđa koji se njima prehranjuje
Juvenile pikeperch Mlade jedinke smuđa	15	65,21	40
Fish Ribe	8	43,78	40
Empty Prazan želudac			20



Graph. 1. The percentage of the organisms in the nutrition of a pikeperch in the Lake Jablanica, 13–18. 09. 2002.
Graf. 1. Udio (%) organizama u prehrani jedinki smuđa u jezeru Jablanica, 13.–18. 9. 2002.

species had empty gastro–intestine system. All specimens had the high degree of fat with well developed fat tissue of digestive system.

The analyzed specimens ate exclusively fish (80 % of them), although the zoobenthos settlement was well developed (Fig. 2 and 3). Ten analysed specimens had length from 27.5 to 43.5 cm and average weight 600 g.

Comparising the results of a pikeperch nutrition in the lake Jablanica we have noticed that the analysis of 4 specimens of this fish in the lake Grabovica has been indicated the domination of the water insects larvae in their nutrition (Table 2). The preimaginal stages and imagos of the two–winged insects prevail in their nutrition, and the larvae of the mayflies — Ephemeroptera are presented with the considerable lower percentage.

The two–winged insects from the family Chironomidae have the largest percentage in the pikeperch nutrition in the investigated hydroaccumulations

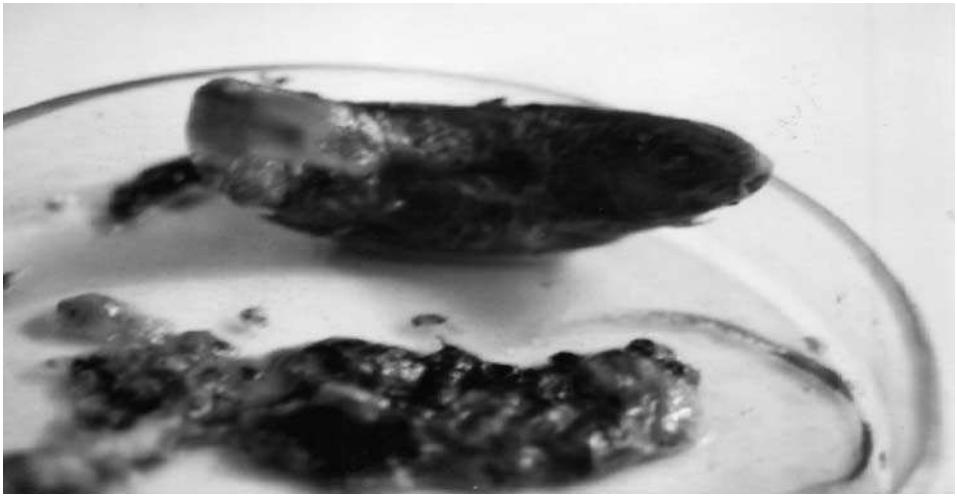


Figure 2. The stomach content of on pikeperch specimens in the lake Jablanica
Slika 2. Sastav želuca jedinki smuđa iz jezera Jablanica

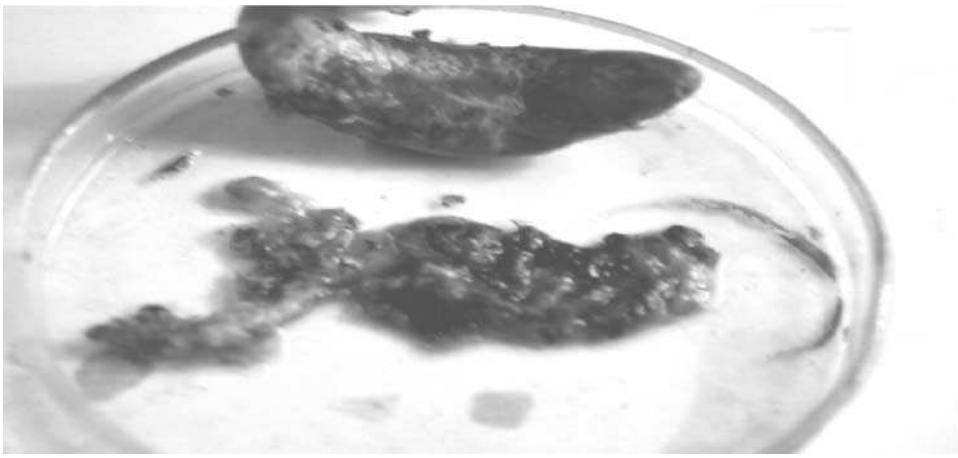


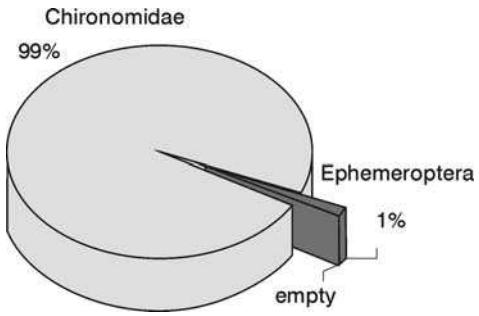
Figure 3. The stomach content of the pikeperch specimens: bleak, juvenile pike–perch and water insects in the lake Jablanica
Slika 3. Sastav želuca jedinki smuđa: mlade jedinke smuđa i vodeni kukci, iz jezera Jablanica

— 99 % (Graph. 2). It is significant to mention that a pikeperch wasn't a greedy animal in this hydroaccumulation. The algae are also registered in the gastro–intestine systems of two specimens. The total length of the analysed fish was between 22.7 and 25 cm and the average weight was 297 g.

Among the 11 analyzed pikeperch specimens captured in the lake Salakovac, 45.45 % ate their own juvenile fish and even 45.45 % (Graph. 3) ate a bleak *Alburnus alburnus allborela* (de Filippi, 1844).

Table 2. The data about the nutrition of a pikeperch, Stizostedion lucioperca *Linnaeus, 1758 (forty specimens) from the Lake Grabovica, 17–19. 07. 2002.*
Tablica 2. Podaci o prehrani jedinki smuđa Stizostedion lucioperca *Linnaeus, 1758 (četiri jedinke) iz jezera Grabovica, 17.–19. 7. 2002.*

Place — the Lakes Grabovica Lokalitet — jezero Grabovica Composition of the stomach Sastav želuca	No. of the colle. spec. Broj jedinki	% of the total numb. of the organ. % udijela u organizmu	% of the tot. numb. of the fish which use theese organ. in their nutrit. % jedinki smuđa koji se njima prehranjuje
Algae			50
INSECTA			
Diptera			
Chironomidae			
— larvae	20	7,32	25
— pupe	150	54,94	50
— imago	100	36,63	50
Ephemeroptera	3	1,09	25
Empty / Prazan			25



Graph. 2. The percentage of the organisms in the nutrition of a pikeperch from the Lake Grabovica, 17–19. 07. 2002. godine
Graf. 2. Udio (%) organizama u prehrani smuđa u jezeru Grabovica, 17. –19. 7. 2002.

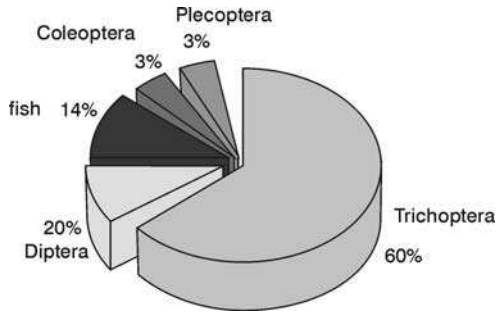
From the rest of the organisms, the percentage of the water insects is significant, especially caddisflies — Trichoptera (60.74 %), and the two–winged insects and stoneflies — Plecoptera are also presented (Table 3).

The fish registered in the stomach of the pikeperch in the lake Salakovac are presented at the Figure 3.

The water insects domination and the significant fish percentage in the nutrition of this fish could be noticed from the percentage relation of the

Table 3. The data about the nutrition of a pikeperch, Stizostedion lucioperca *Linnaeus, 1758 (11 specimens) in the lake Salakovac, 21–22. 09. 2002.*
Tablica 3. Podaci o prehrani jedinki smuđa Stizostedion lucioperca *Linnaeus, 1758 (11 jedinki) iz jezera Salakovac, 21.–22. 9. 2002.*

Place — the Lakes Salakovac Lokalitet — jezero Salakovac Composition of the stomach Sastav želuca	No. of the colle. spec. Broj jedinki	% of the total numb. of the organ. % udijela organizma	% of the tot. numb. of the fish which use theese organ. in their nutrit. % jedinki smuđa koji se njima prehranjuje
INSECTA			
Diptera			
— imago	22	20,56	18,18
Trichoptera	65	60,74	27,27
Coleoptera			
— imago	3	2,8	9,09
Plecoptera	2	1,86	9,09
Alburnus alburnus	4	3,73	45,45
Juvenile pikeperch Mlade jedinke smuđa	11	10,28	45,45



Graph. 3. The percentage of the organisms in the nutrition of a pikeperch in the lake Salakovac, 21–22. 09. 2002.
Graf. 3. Udio (%) organizama u prehrani smuđa iz jezera Salakovac, 21.–22. 9. 2002.

organisms used in the pikeperch nutrition in the accumulation Salakovac (Fig. 4). The total length of the analyzed fish was between 32–54 cm and the average weight was 700 g.

Two pikeperch specimens among 14 specimens captured in the accumulation Mostar ate exclusively their own juvenile fish (Table 4 and Fig. 5). The total length of the pikeperch analyzed specimens was 34 and 35.4 cm and the weight was 311–351 g.

In general, 27 pikeperch specimens captured in the hydroaccumulations of the river Neretva system used exclusively animals in their nutrition (the

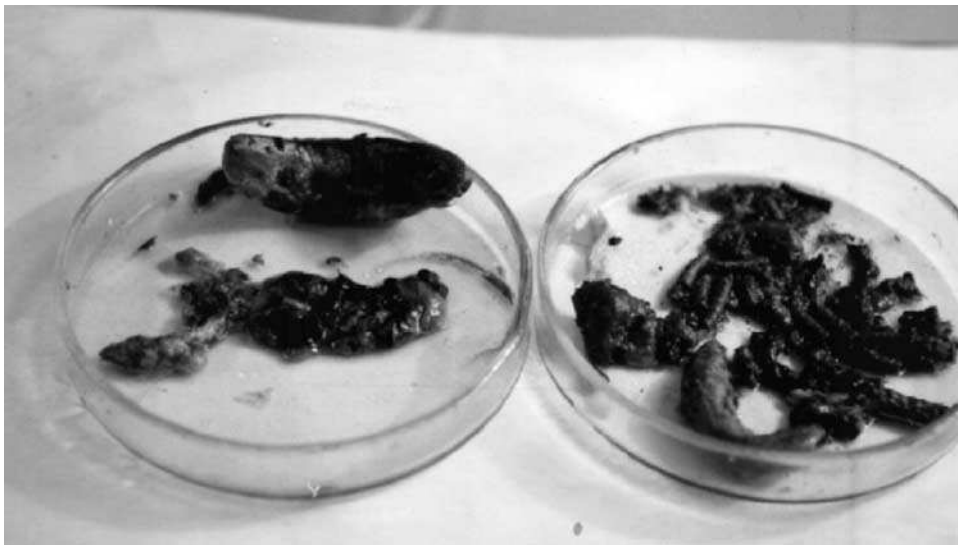


Figure 4. The stomach content of the pikeperch specimens captured in the lake Sakovac bleak, juvenile pikeperch and the caddisflies
Slika 4. Sastav želuca jedinki smuđa iz jezera Salakovac: uklija, mlade jedinke smuđa i vodeni moljci

Figure 5. Pikeperch with bleak in ihe mouth, the lake Salakovac, september, 2002
Slika 5. Smuđ s uklijom u ustima iz jezera Salkovac, rujan 2002.

Table 4. The data about the nutrition of a pikeperch, Stizostedion lucioperca *Linnaeus, 1758 (two specimens) in the lake Mostar, 22–23. 09. 2002.*
Tablica 4. Podaci o prehrani jedinki smuđa Stizostedion lucioperca *Linnaeus, 1758 (dvije jedinke) iz jezera Mostar, 22.–23. 9. 2002.*

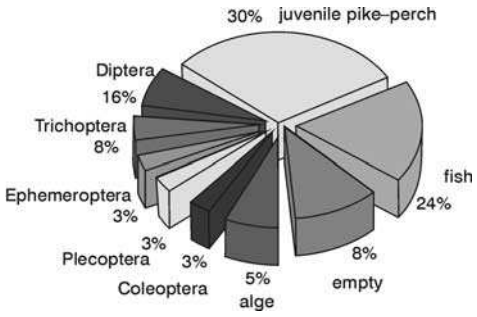
Place — the Lakes Mostar Lokalitet — jezero Mostar Composition of the stomach Sastav želuca	No. of the colle. spec. Broj jedinki	% of the total numb. of the organ. % udijela u organizmu	% of the tot. numb. of the fish which use theese organ. in their nutrit. % jedinki smuđa koji se njima prehranjuje
Juvenile pikeperch Mlade jedinke smuđa	14		100

Figure 6. The stomach content of the two pikeperch specimens in the lake Mostar: a juvenile pike–perch
Slika 6. Sastav želuca dviju jedinki smuđa iz jezera Mostar, mlade jedinke smuđa

avertebrates and the fish). According to the analysis results of these pikeperch specimens (Graph. 4), the imagos and preimaginal stages of two–winged insects — *Diptera* have the largest percentage in the nutrition (70 %).

Analysing the results of a pikeperch nutrition in the accumulations Jablanica, Grabovica, Salakovac and Mostar, the expressive greed, the characteristic of this fish species, has been noticed.

Comparising the nutrition of this fish species with the other cyprinids habiting in the mentioned accumulations (Trožić–Borovac, 2002a), it



Graph. 4. The percentage of the organisms in the nutrition of a pikeperch in the lakes of the river Neretva, 17–19. 07., 13. 09.–24. 09. 2002.
Graf. 4. Udio (%) organizama u prehrani jedinki smuđa u jezerima rijeke Neretve, 17.–19. 7. te 13.–24. 9. 2002.

could be accented that a pikeperch has no competitor in these closed ecosystems. *Leuciscus svallize* (Heckel and Kner, 1858) has indicated no tendency to the nutrition with the other fish species. Among the salmonides, just one lake trout specimen ate the other fish.

The second significant fact is a pikeperch has shown the tendency to use a bleak in its nutrition. A bleak is autochthonous in the river Neretva system, it lives in the crowd and its small size and expressive slow movement contribute to a pikeperch easier hunting. This is a tipical negative example of the introduction that has caused the slow disappearance of autochthonous ichthyofund and the smaller, less movable species have been the first victims. The ecological conditions in the lakes of the central water current of the river Neretva system with its chemical and physical characteristics completely are the optimal conditions for the survival of a pikeperch specimens which will be the dominated fish species in foreseeable future. Its competitors are the large lake trout specimens which, in the competition with a pikeperch, can bring to the reduction of its population. The fact that it was very short time from the appearance of the first specimen in the Neretva lakes to the augmentation of the populations points to the caution and invention of the measures for the growth restriction of this dangerous greedy animal.

CONCLUSIONS

On the basis of the results of analysis of digestive tract from 26 specimens of pikeperch from the river Neretva in the period from July 7 to September 24, 2002, it could be concluded that:

- The results of the analysis of digestive tract of pikeperch indicate various nutrition habits caused by the capacity of water ecosystem;

- Tendency for feeding with other fish is pronouced in lakes where exist higher competition with other fish species;
- In artificial reservoirs (lake Salakovac) there is pronounced tendency for canibalism;
- Due to the determined high predacy in this fish species, the survival of certain autochtonous both salmonid and cyprinid fish species is questionable, which without ay doubt causes higher negative ecological changes in the middle course of the river Neretva;
- This situation stress the need for activities in control of population density of pikeperch and control of introduction in general.

Sažetak

PREHRANA SMUĐA *Stizostedion lucioperca* Linnaeus, 1758 U RIJECI NERETVI

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Analize sadržaja probavnoga trakta smuđa provedene su na osnovi pregleda 27 jedinki iz akumulacija slijeva Neretve. Izlov ribe obavili su postavljanjem mreža članovi *Centra za ihtiologiju Prirodoslovno–matematskog fakulteta Sveučilišta u Sarajevu* od 17. srpnja do 24. rujna 2002. Disekcija i fiksacija probavnoga trakta u 4 %–tnom formaldehidu izvršena je na terenu, a pregled sadržaja probavnoga trakta u Laboratoriju *Prirodoslovno–matematskog fakulteta Sveučilišta u Sarajevu*. Pojava smuđa u slijevu Neretve rezultat je slučajnog unosa u Ramsko jezero u (Škrijelj, 1995; Škrijelj i Mašović, 2001). Rezultati analize sadržaja probavnoga trakta smuđa upućuju na veoma raznovrstan način prehrane uvjetovan kapacitetom vodnog ekosustava i veličinom jedinki. Sklonost prehrani drugim ribama izražena je u jezerima gdje je veća kompeticija s drugim vrstama riba, a u akumalacijskim jezerima (Salakovac, Mostar) izražena je sklonost kanibalizmu. Kanibalizam je karakterističan za jedinke smuđa koje su dulje od 30 cm. Sve jedinke iz jezera Grabovica (4) čija je dužina manja od 30 cm hranile su se zoobentosom, a u želucu jedne jedinke registrirane su i alge. Zbog utvrđene velike grabljivosti (kod većih jedinki) ove ribe dovodi se u pitanje opstanak važnih autohtonih vrsta riba (*Salmonidae* i *Cyprinidae*), što nedvojbeno uzrokuje veće ekološke promjene u srednjem toku slijeva Neretve u negativnome smislu. Ovakvo stanje nameće obvezu poduzimanja mjera u kontroli gustoće populacije smuđa

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i introdukcije uopće. Uspoređujući prehranu spomenute vrste ribe s drugim vrstama riba u neretvanskim akumulacijama (Kaćanski i sur., 1976; Trožić–Borovac, 2002a), možemo zaključiti da nema nikakva konkurenta, jer se sve se ribe hrane avertebratima i bentosnim biljkama, a samo su rijetki primjerci jezerske pastrve *Salmo trutta m. lacustris* Linnaeus, 1758 skloni grabljivom načinu prehrane. Rad pridonosi upoznavanju prehrane smuđa u neretvanskim akumulacijama, koja, uz reprodukciju, označuje bitan karakter u pronalaženju načina kontrole rasta populacije ove grabljivice i na taj način omogućivanje opstanka autohtonih ihtipopulacija u slijevu Neretve.

Ključne riječi: prehrana smuđa, rijeka Neretva, vodne akumulacije

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