PRELIMINARY RESULTS ON SUCCESSFUL STOCKING OF PIKEPERCH (*SANDER LUCIOPERCA* L.) IN THE ZLATAR RESEVOIR

BRANISLAV MIĆKOVIĆ[1], MIROSLAV NIKČEVIĆ[1], ALEKSANDAR HEGEDIŠ[1], MIRJANA LENHARDT[2], MILICA PUCAR[1], STEFAN SKORIĆ[1]
[1]*Institute for multidisciplinary research, Kneza Višeslava 1, Belgrade*
[2]*Institute for biological research "Siniša Stanković", Bulevar Despota Stefana 142, Belgrade*

PRELIMINANARNI REZULTATI O USPEŠNOM NASAĐIVANJU SMUĐA (*SANDER LUCIOPERCA*) U AKUMULACIJU ZLATAR

Abstrakt

Zlatarsko jezero je nastalo izgradnjom hidroelektrane „Kokin Brod" koja je počela sa radom 1962. godine. Brana izgrađena na reci Uvac dugačka je 1264 m i visoka je 83 m. Jezero se nalazi na nadmorskoj visini od 880 m. Prosečan godišnji doticaj Uvca je 12.45 m^3/s, a površina sliva jezera je 1057 km^2. U basenu jezera akumulirano je 250 miliona m^3 vode. Voda jezera je visokog kvaliteta i kreće se u granicama druge klase (Stanković, 2005). Riblje naselje koje se danas sreće u akumulaciji je nastalo na bazi ribljih vrsta koje su ishodno naseljavale tok Uvca i na bazi vrsta koje su unete različitim višekratnim poribljavanjima (Mićković i Hegediš, 2007). U cilju regulisanja brojnosti i gustine prenamnožene populacije ukljeve (*Alburnus alburnus*) u jezero je 2005. godine introdukovan smuđ (*Sander lucioperca*).

Na bazi uporednog pregleda sastava ribljeg naselja u akumulaciji „Zlatar" u periodu od 2003. do 2010. godine konstatovano je da je introdukcija smuđa donela značajne promene u strukturi zajednice riba: jasna dominacija domaćih (klen, plotica, skobalj, rečna mrena) i unetih (šaran, babuška) ciprinidnih riba po abundanciji (72,7% i 86,9% u 2003. odnosno 2007.) i masenom udelu (51,4%, odnosno 82%) je značajno smanjena u 2010. godini (abundancija 40,3%, maseni udeo 58,3%), zastupljenost salmonidnih riba (jezerske zlatovčice) kontinuirano opada (abundancija 27, 3%, 10,9%, 0,6%, maseni udeo 48,6%, 17,9%, 1,8%, u 2003, 2007 i 2010, respektivno).

Karakteristike dužinsko-težinskog odnosa i rasta smuđa u Zlatarskom jezeru su takve da se u uzrastu 3+ dostiže lovna veličina od 40 cm sa masom tela od oko 450 g, dok se uzrast 4+ karakteriše prosečnom dužinom oko 50 cm i masom oko 1 kg, što se može

oceniti kao sasvim zadovoljavajućim odlikama rasta. Koeficijent alometrije od 3,081 ukazuje na proporcionalan prirast mase u odnosu na dužinu tela.

Inspekcijom digestivnog trakta utvrđeno je da 95,3 % ishrane smuđa u jezeru čini ukljeva: od ukupno 21 primerka riba u ishrani bilo je 20 ukljeva i jedan primerak jezerske zlatovčice.

Prema Richa *et al.*, (2009) ihtiocenoza akumulacije „Zlatar" se, sa aspekta stabilnosti zajednice riba, do unošenja smuđa nalazila u visoko stabilnoj „cyprinid-phase", odnosno „riverine species phase" u skladu sa Kubečka (1993). Introdukcija i aklimatizacija smuđa je tu stabilnost pomerila ka tranzitnoj „percid-cyprinid-phase" (Kubečka, 1993). Dalja istraživanja pokazaće da li se zajednica riba kreće ka visoko dinamičnoj i nestabilnoj „perch-phase" ili se vraća stabilnoj „cyprinid-phase" (Richa *et al.*, 2009). Od toka pomenutog procesa zavise mere ribarstvenog gazdovanja koje će se primeniti u akumulaciji „Zlatar".

***Ključne reč**: introdukcija, akumulacija, „Zlatar"*

INTRODUCTION

Zlatar reservoir was created by constructing a hydro power plant "Kokin Brod" that began working in 1962. The dam that was built on the Uvac River is 1264 m long and 83 m high. The reservoir is situated at an altitude of 880m. The average annual flow of Uvac is 12.45 m^3/s, and the area of the lake basin is 1057 km^2. The lake basin has accumulated 250 million m^3 of water. The area of the Zlatar reservoir is 7.25 km^2, and the maximum depth is up to 75m. During the year, the amplitude of water level can reach 45m (Stanković, 2005). Fish community, which is now present in the reservoir, was created based on fish species that initially inhabited Uvac river and species which were several times introduced by restocking (Mićković and Hegediš, 2007). Nikčević *et al.* (2003) and Mićković and Hegediš (2007) reported that the reservoir is inhabited by a numerous population of bleak (*Alburnus alburnus*). Pikeperch (*Sander lucioperca*) was introduced into the reservoir in 2005, in order to regulate the population density of this species. This article presents the preliminary results of the pikeperch's successful acclimatisation into the Zlatar reservoir.

MATERIAL AND METHODS

Samples of the fish fauna were collected in October 2010. For sampling the following fishing nets were used:

- benthic gillnets 20 m x 2 m, mesh size 20 mm; 60 m x 3 m, mesh size 30 mm; 30 m x 1.5 m, mesh size 50 and 60 mm;
- benthic trammel nets 30 m x 1.5 m, mesh size 40 and 60 mm.

Nets were set in the evening and lifted the next morning. Length-weight relationship, growth and diet of the pikeperch were analyzed based on the length frequency distribution and stomach content analysis in 62 caught specimens. The data about the fish community structure from years 2003. and 2007. were obtained from Nikčević *et al.* (2003) and Mićković and Hegediš (2007).

RESULTS

Comparative review of the fish community composition in the Zlatar reservoir for the 2003.-2010. period (Table 1.), showed that the introduction of pikeperch has induced significant changes to the fish community structure. Clear domination of cyprinids in abundance (72.7% and 86.9% in 2003 and 2007. respectively) and mass proportion (51.4% and 82% in 2003 and 2007. respectively) has significantly decreased in 2010. (abundance 40.3%, mass proportion 58.3%). Participation of salmonid species has been continuously declining (abundance 27.3%, 10.9%, 0.6%, and mass proportion 48.6%, 17.9%, 1.8%, in 2003., 2007. and 2010., respectively). However, data from 2010 should be taken with caution, because the nets were placed in the shallow zones (< 10 m) of the reservoir, while most of the Arctic char population is usually found at depths exceeding 20 m.

Characteristics of the length-weight relationship and growth of the pikeperch in the Zlatar reservoir are shown in Figure 1. At the age 3^+ specimens reach minimum landing size of 40 cm, while the age 4^+ is characterized by average length of about 50 cm and 1 kg mass, which can be described as quite satisfactory growth characteristics. Alometry coefficient of 3.081 indicates a proportional increase in the mass relative to body length.

Table 1. Review of the composition of the fish community between 2003 and 2010.

Fish species	2003.		2007.		2010.	
	% number	% biomass	% number	% biomass	% number	% biomass
Arctic char *Salvelinus alpinus*	27,3	48,6	10.9	17.9	0.6	1.8
Danubian roach *Rutilus pigus*	4,5	2,6	17.4	6.6	20.5	17.6
Chub *Squalius cephalus*	45,5	37,7	8.7	28.2	8.7	12.1
Nase *Chondrostoma nasus*	-	-	23.9	16.9	8.1	18.5
Barbel *Barbus barbus*	18,2	9,4	28.2	1.8	1.2	4.8
Carp *Ciprinus carpio*	4,5	1,7	2.2	26.1	1.9	1.7
Prussian carp *Carassius gibelio*	-	-	6.5	2.4	0.6	1.6
Bleak *Alburnus alburnus**	*	*	*	*	19.3	2
Pumpkinseed *Lepomis gibosus*	-	-	2.2	0.1	0.6	0.1
Pikeperch *Sander lucioperca*	-	-	-	-	38.5	39.8
* - in all of the three given years, a very high representation of the bleak population has been acknowledged in the reservoir, which is expressed in tens of kilogrames per hectare						

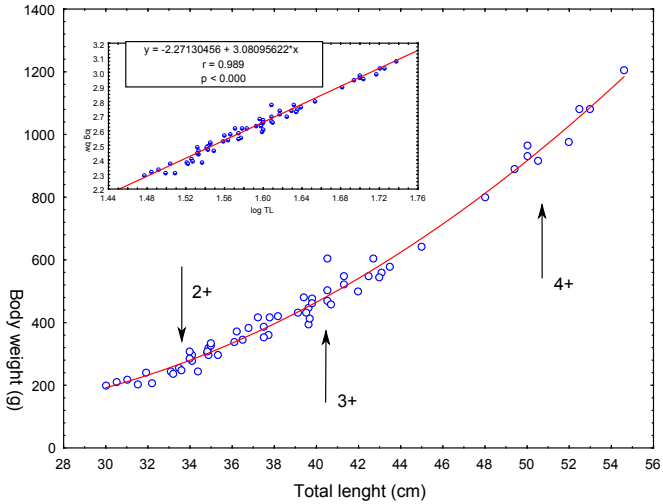

Figure 1. The length-weight relationship and growth of the pikeperch in the Zlatar reservoir

Analysis of stomach content showed that 95.3% of the pikeperch diet consisted of bleak, the remaining being Arctic char.

DISCUSSION

Lake biomanipulation theory (Shapiro and Wright, 1984) assumes that the introduction and subsequent population increase of piscivorous fish species in the reservoir will induce abundance planktivorous fish species. Although there are some doubts about the effects of biomanipulation (De Melo *et al.,* 1992), this restoration technique was applied in a number of cases in European stagnant waters (Jacobsen *et al.,* 2004; Gulati and Van Donk, 1989; Salonen *et al.,* 1996). Drenner and Hambright (1999), based on experiences from 39 lakes worldwide, defined 5 types of biomanipulative techniques and determined their efficiencies: piscivore stocking (28.6%), piscivore stocking + partial fish removal (60%), partial fish removal (90%), elimination of fish (40%), and elimination of fish followed by restocking (66.7%).

In the time scale, the observed changes in the fish community of the Zlatar reservoir followed similar pattern which was reported for considerable number of highland reservoirs in Serbia: 1) the dominance of autochthonous cyprinids indigenous in the river course accompanied with significant presence of autochthonous salmonids; 2) introduction of autochthonous cyprinids and allochthonous salmonids as well as unintentional introduction of autochthonous and allochthonous species. After that, a rapid population growth of some unintentionally introduced species occurs (bleak in the Zlatar reservoir) accompanied by declining participation of autochthonous salmonids. With aim to regulate overcrowded bleak population in the Zlatar reservoir, the "piscivore stocking" type of biomanipulation techniques was applied. The stocking of pikeperch was conducted in 2005 (930 kg, age 1^+, average weight 250 g) and the first positive results were noted in 2008. In 2010 the presence of stable and reproductively successful population was recorded. Diet analysis showed that pikeperch feed almost exclusively on bleak thus

indicating that growth of pikeperch population was directly related to the state of bleak population, while there were no significant effects on the rest of the species.

The fish community in the Zlatar reservoir before the introduction of pikeperch was in a highly stable cyprinid phase (Richa *et al.,* 2009), i.e. "riverine species phase" in accordance to Kubečka (1993). Introduction and acclimatization of pikeperch has pushed this stability towards a transit "percid-cyprinid-phase" (Kubečka, 1993). Additional studies are needed in order to monitor further development of fish community. According to Richa *et al.,* (2009), two processes may occur, developing of fish community towards a highly dynamic and unstable "perch-phase", or its returning to the stable "cyprinid-phase". Fishery management measures that should be applied will depend on the aforementioned processes.

ACKNOWLEDGMENT

Supported by the Ministry of Education and Science, project number TR37009.

REFERENCES

DeMelo, R., France, R. and Donald J. McQueen, D. J. (1992). Biomanipulation: Hit or Myth? Limnology and Oceanography, Vol. 37, No. 1, 192-207.

Drenner, R. W. and Hambright, K. D. (1999). Review: Biomanipulation of fish assemblages as a lake restoration technique. Arch. Hydrobiol. 146. 2. 129-165.

Gulati, R. D. and Van Donk, E. (1989). Biomanipulation in the Netherlands: applications in fresh-water ecosystems and estuarine waters – an introduction. Hydrobiol. Bull. 23. 1-4.

Jacobsen, L. Berg, S. and Skov, C. (2004). Management of lake fish populations and lake fisheries in Denmark: history and current status. Fisheries Management and Ecology. 11, 219–224.

Kubečka, J. (1993). Succession of fish communities in reservoirs of Central and Eastern Europe. In: M. Straškraba, J.G. Tundisi & A. Duncan (eds.) Comparative Reservoir Limnology and Water Quality Management. Amsterdam: Kluwer Academic Publishers Group, pp. 153–168.

Mićković, B. i Hegediš, A. (2007). Srednjoročni program unapređenja ribarstva na području Specijalnog rezervata prirode „Uvac" za period 2007. – 2011. godina. Institut za multidisciplinarna istraživanja i SRP „Uvac", Nova Varoš, Beograd. 57 str.

Nikčević, M., Mićković, B. i Hegediš, A. (2003). Srednjoročni program unapređenja ribarstva na području „Lim" za period 2003. – 2007. godina. Centar za multidisciplinarne studije Univerziteta u Beogradu i OOSR „Mladica", Priboj, Beograd. 64 str.

Riha, M., Kubečka, J., Vašek M., Seda, J., Mrkvička, T., Prchalova, M., Matena, J., Hladik, M., Čech, M., Draštik, V., Frouzova, J., Hohausova, E., Jarolim, O., Juza, T., Kratochvil, M., Peterka, J. and Tušer, M. (2009). Long-term development of fish populations in the Rımov Reservoir. Fisheries Management and Ecology, 16, 121–129.

Shapiro, J. and Wright, D. I. (1984). Lake restoration by biomanipulations. Round Lake, Minnesota-the first two years. Freshwater Biol. 14: 37 l-383.

Salonen, S., Helminen, H. and Sarvala, J. (1996). Feasibility of controlling coarse fish populations trough pikeperch (*Stizostedion lucioperca*) stocking in Lake Koylionjarvi, SW Finland. Ann. Zool. Fennici. 33, 451-457.

Stanković, S. (2005). Jezera Srbije. Zavod za udžbenike i nastavna sredstva, Beograd. 244 pp.