COMBINATION OF INTENSIVE (RAS) AND EXTENSIVE (POND) AQUACULTURE FOR JUVENILE PRODUCTION IN PIKEPERCH (*SANDER LUCIOPERCA*)

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KOMBINOVANJE INTENZIVNE (RAS) I EKSTEZIVNE (RIBNJAK) AKVAKULTURE ZA PROIZVODNJU MLAĐI SMUĐA (*SANDER LUCIOPERCA*)

Apstrakt

Ovaj prilog daje kratak osvrt na naše rezultate u oblasti gajenja mlađi smuđa. Opisuju se sve faze gajenja, do dostizanja krajnje telesne težine ribe od 75g: 1) gajenje larvi i mlađi u ribnjaku, 2) izlov mlađi iz ribnjaka, 3) privikavanje mlađi na recirkulacioni sistem (RAS), 4) gajenje mlađi u RAS-u u trajanju od 90 dana, 5) nasađivanje mlađi iz RAS-a u ribnjake, 6) gajenje mlađi u jezerima u toku zime i proleća, 7) izlov mlađi iz ribnjaka i privikavanje na uslove RAS-a i 8) gajenje u RAS-u. Svaka faza gajenja je ocenjena istim parametrima proizvodnje: krajnjim TL (mm) i težina W (g), specifičnom stopom rasta (SGR_W in $\%.d^{-1}$), stopom preživljavanja (S u %), stopom kanibalizma (C u %) i koeficijentom konverzije hrane (FCR) ukoliko se primenjuje veštačka hrana.

Iniciajalno gajenje u ribnjaku je dalo veoma dobre i obećavajuće rezultate kada je reč o specifičnoj stopi rasta (SGR_W= 20.3 $\%.d^{-1}$) i preživljavanja (27.4%). Veoma velika efikasnost kao što je visoka stopa preživljavanja (78.5%) se pokazala kod mlađi koja je posle ribnjaka privikavana na RAS. Kombinacija gajenja u ribnjaku i RAS sistemu obezbeđuje mlađ za stabilno i efikasno gajenje u RAS sistemu. Njega karakteriše visoka stopa preživljavanja (S = 88.7 – 97.5 %) i visoka stopa rasta (SGR = 1.8 - 4.2 $\%.d^{-1}$). Iako je naredna grupa mlađi gajena u uslovima ribnjaka u toku zimske sezone imala nižu stopu preživljavanja (65%), ovaj sistem može da omogući regulisanje proizvodnje mlađi u vremenu.

Rezultati ove studije su pokazali da kombinacija gajenja mlađi smuđa u ribnjacima i RAS sistemima može da proizvede visoko kvalitetnu mlađ sa mogućnošcu da se proizvodnja vremenski reguliše.

Ključne reči: Sander lucioperca, akvakultura, efikasnost, ribnjak, RAS.
Key words: Sander lucioperca, aquaculture, efficiency, pond, RAS

INTRODUCTION

The pikeperch with delicate flesh and attractiveness as a game fish is among the most valuable freshwater fish in Europe and highly sought by the European market. The major supply of marketable pikeperch is provided by natural fisheries. Unfortunately, pikeperch catches are drastically decreasing in Europe due to overfishing and the decline of wild stock. Current pikeperch market is undersupplied in most European countries leading to the double or triple price of marketable fish. Increasing interest and expansion of aquaculture activity in pikeperch can be recorded from 1990's. Therefore, extensive and intensive pikeperch aquaculture has been developed during the past 20 years in Europe. However, the most of pikeperch farms has still a lot of technology problems with optimization of broodstock husbandry, reproduction and production of high-quality larvae and juveniles. The aim of our study was to establish and evaluate the complete system of juvenile pikeperch production mainly for intensive aquaculture with diversification of production in the time.

MATERIAL AND METHODS

This abstract summarizes our results related to pikeperch juvenile culture included following phases up to final fish body 75g: 1) larval and juvenile pond culture, 2) harvesting of juveniles from ponds, 3) weaning of juveniles in RAS, 4) 90 days juvenile culture under RAS, 5) stocking of juveniles from RAS to pond conditions, 6) pond juvenile culture during winter and spring, 7) harvesting and weaning of juveniles from pond into RAS conditions and 8) ongrowing culture under RAS. Each phase culture was evaluated by same production parameters: final TL (mm) and weight W (g), specific growth rate (SGR_W in $\%.d^{-1}$), survival rate (S in %), cannibalism rate (C in %) and food conversation rate (FCR) if artificial food was applied.

1) Larval and juvenile pond culture was performed in 8 ponds (with area 0.2 – 1.54 ha and initial density 200 000 – 400 000 larvae.ha^{-1}). The feeding and growth of fish and food supply were studied in all used ponds at one week interval. According actual fish size and food supply, the harvesting term was established in each pond during last inspection, when food supply was decreasing. Average duration of this culture phase was 35 days when harvesting of ponds was done 7-5 days after last inspection.

2) All fish were gently caught by nets in the outlet channel during **the harvesting of juveniles from each pond.**

3) Weaning of juveniles in RAS was done according to the study Policar et al. (2013) when pikeperch were weaned with frozen chironomid larvae (*Chironomus plumosus*), its combination with artificial food (INICIO Plus 0.8 – 1.1mm) and then exclusively with artificial food. All survival fish were weaned after 12-days adaptation.

4) In total, 100 800 weaned fish were stocked with initial stocking density 8 fish.L^{-1} into 18 rearing tanks (volume 700 L) for **90days juvenile culture under RAS**. Fish were fed with INICIO food (1.1, 1.5, 2 mm with feeding rate 10, 7.5, 5%) and kept un-

der optimal temperature (22 – 24 °C) and oxygen saturation (100 %). Fish grading was applied each 10 days for the elimination of cannibalism rate.

5) **Stocking of juveniles from RAS to pond conditions** was performed for time diversification of pikeperch production in the time. In total, 3 000 pikeperch were stocked into three ponds with identical area 0.15 ha (1 000 fish per each pond). Forge fish (*Pseudorasbora parva*, TL= 36.6±9.4 mm and W= 0.5±0.1 g) was stocked in all ponds with initial density 200 000 fish per each pond such as prey fish for pikeperch.

6) **Pond juvenile culture** took place **during winter and spring** from Sept.15, 2011 till April 20, 2012 (208 days) under natural conditions (average temperature= 5.6 ± 4.2 °C and oxygen saturation= 87 ± 25 %).

7) **Harvesting and weaning of juveniles from pond into RAS conditions** was performed after successful pond culture during winter and spring. All surviving juveniles were harvested by nets, counted and disinfected with formaldehyde (dose: 15 ml.100 L^{-1} and exposure time: 20 min.). In total, 1800 juveniles were stocked into three tanks (700 L) within RAS under identical initial fish density 0.86 fish.L^{-1}. Fish were exclusively fed with artificial food (INICO 2 mm with feeding rate 2%).

8) **Ongrowing culture under RAS** was done in two ways such as: continued ongrowing culture immediately after 90days juvenile culture under RAS (45 days) and ongrowing culture after pond culture (42 days). Both these rearing were performed up to 75g fish, when fish were produced in two different time – the first at the end of October 2011 and the second at the beginning of July 2012. These cultures were performed under closed same optimal controlled conditions for pikeperch.

RESULTS

Production parameters from all tested culture phases are presented in the following Table. Initial pond culture showed very good and promising results related to growth (SGR_W = 20.3%.d^{-1}) and survival (27.4%) rates. Very good efficiency such as high survival rate (78.5%) was found during of the weaning of pond-cultured juveniles under RAS. The combination of pond and RAS culture produces juveniles for stable and effective RAS culture characterized by high survival (S = 88.7 – 97.5 %) and growth rate (SGR = 1.8 - 4.2 %.d^{-1}). Next juvenile culture under pond conditions during cold season caused lower fish survival rate (65%), however this system can divide juvenile production in the time.

Culture phase	Initial TL (mm)	Initial W (g)	Final TL (mm)	Final W (g)	SGR_W (%.d^{-1})	C (%)	S (%)	FCR
Larval and juvenile pond culture (35 days)	5.2 ±0.44	0.00085 ± 0.00005	44.3 ± 0.3	0.55 ± 0.05	20.3 ± 2.4	1.0 ± 0.5	27.4 ± 10.5	——
Weaning of pond juveniles (12 days)	44.3 ± 2.1	0.55 ± 0.1	46.5 ± 2.5	0.60 ± 0.1	0.73 ± 0.2	5.0 ± 2.0	78.5 ± 8.5	1.6 ± 0.3
Juvenile culture under RAS (90 days)	46.5 ± 2.5	0.60 ± 0.1	141.4 ± 10.0	24.6 ± 5.6	4.2 ± 1.1	10.5 ± 2.5	88.7 ± 5.3	1.7 ± 0.3
Continued on growing phase under RAS (45 days)	141.4 ± 10.0	24.6 ± 5.6	220.5 ± 22.3	78.6 ± 25.2	2.6 ± 0.4	2.0 ± 0.5	95.5 ± 1.2	1.8 ± 0.3
Pond juvenile culture during winter and spring (181 days)	141.4 ± 10.0	24.6 ± 5.6	178.7 ± 15.89	46.1 ± 14.2	0.3 ± 0.05	——	65.0 ± 5.0	——
On growing culture under RAS after pond culture (28 days)	178.7 ± 15.9	46.1 ± 14.2	213.2 ± 19.9	76.2 ± 24.3	1.8 ± 0.6	1.8 ± 0.5	97.5 ± 1.0	2.0 ± 0.5

CONCLUSIONS

Results of our study showed that the combination of pond and RAS culture of pikeperch can provide high-quality juvenile production with possibility to divide production in the time.

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