SUSTAINABLE MEASURES FOR IMPROVEMENT OF RHEOPHILIC FISH PRODUCTION – PRELIMINARY RESULTS WITH CHUB (*SQUALIUS CEPHALUS*) POND CULTURE

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ODRŽIVE MERE ZA UNAPREĐENJE GAJENJA REOFILNIH VRSTA RIBA – PRELIMINARNI REZULTATI GAJENJA KLENA (*SQUALIUS CEPHALUS*)

Apstrakt

U jednom delu životnog ciklusa, posebno tokom ranih stadijuma razvoja većina reofilnih riba nastanjuje visoko produktivna obalska i lentična staništa reka. Ovakva staništa su često degradirana usled regulacije rečnih obala i toka reka kao i izgradnje brana. Nekada jedna od najrasprostranjenijih slatkovodnih ciprinida Evrope, klen (Squalius cephalus L.), tokom poslednje decenije pokazuje znake opadanja brojnosti u nekim rekama. Iako nema neku posebnu ekonomsku vrednost, ova riba je cenjena u sportskom ribolovu, ali pre svega ona je autohtona vrsta Evrope koja ukazuje na ekološki status reka, pa se njeno prisustvo u vodenim ekosistemima ne sme zanemariti. Osim mera za očuvanja prirodnih staništa, brojnost populacije riba se održava i poribljavanjem.

Produkcija mlađi je relativno zahtevna faza u gajenju ove vrste riba, posebno u segmentu obezbeđivanja dovoljno kvalitetne hrane. U cilju smanjivanja cene ove faze gajenja od velikog značaja može biti primena održivih mera koje bi poboljšale iskoristljivost prirodnih resursa.

Shodno tome, cilj ovog rada je bio da se istraži efikasnost održivih mera u gajenju mlađih uzrasnih kategorija klena (1+) radi poribljavanja prirodnih staništa.

Istraživanje je obavljeno tokom 7 meseci, od aprila do oktobra 2014. godine u 8 identičnih eksperimentalnih ribnjačkih bazena Fakulteta za ribarstvo i zaštitu voda (Univerzitet Južna Bohemija), u okviru AQUAECXEL FP7 projekta, „Transnational Access - TNA". Jezera veličine 0,08 ha su nasađena sa po 1250 jedinki jednogodišnje mlađi klena. Primenjena su dva tretmana, žute zamke za insekte i sveža biljna biomasa, u triplikatima i dve kontrole. Tokom trajanja eksperimenta, ni u jednom od jezera ribe nisu hranjene dodatnom hranom.

Osnovni parametri vode su mereni jednom mesečno. Standardna dužina i masa tela riba je merena na početku i na kraju eksperimenta. Od parametara rasta riba, određivani su prirast, specifična stopa rasta (SGR) i kondicioni faktor (CF).

Rezultati su pokazali da nije bilo stastističkih razlika u parametrima kvaliteta vode između tretmana i da su izmerene vrednosti bili u opsegu, koji je karakterističan za prirodna staništa juvenila klena. Na kraju eksperimenta (u oktobru) prosečna masa i dužina tela riba iz različitih tretmana su se značajno razlikovale ($p<0.001$), sa najvećim vrednostima u tretmanu sa žutim zamkama, osrednjim razlikama u tretmanu sa biljnom masom i najnižim u kontroli (35.78 ± 4.29 g, 29.74 ± 5.12 g, 26.40 ± 3.63 g i 130.7 ± 4.2 mm, 123.5 ± 5.8 mm, 116.8 ± 4.9 mm). Vrednosti prirasta riba su se takođe statistički veoma značajno razlikovale između tretmana ($p<0.001$), pri čemu je bolji prirast ostvaren u tretmanu sa žutim zamkama u odnosu na biljnu biomasu i kontrolu. Kod specifičnog prirasta riba nisu nađene značajne razlike između tretmana, ali su njihove vrednosti bile značajno veće od kontrole ($p<0.001$). Međutim, kondicioni faktor (FC) je pokazao statistički značajne više vrednosti u tretmanu sa žutim zamkama i kontroli u odnosu na tretman sa biljnom masom ($p<0.005$).

S obzirom na dobre rezultate u prirastu riba, ova jednostavna, ekonomski isplativa, a ekološki održiva mera za poboljšanje iskoristljivosti prirodnih resursa se može primeniti u gajenju drugih reofilnih vrsta riba. Osim u konzervacione svrhe, ova mera bi mogla naći primenu i u ekstenzivnom i poluintenzivnom sistemu gajenja riba, posebno onih vrsta koje žive u sličnim ambijentalnim uslovima i imaju sličnu ishranu, kao što je šaran i druge omnivorne vrste riba ili pak predatorske ribe koje konzumiraju insekte tokom mlađih životnih stadijuma.

Ključne reči: reofilne vrste riba, Squalius cephalus, klen, poluintenzivan sistem, održive mere
Keywords: reophilic fish, Squalius cephalus, chub, semiintensive system, sustainable measures

INTRODUCTION

Currently, populations of some rheophilic fish species in Europe are under threat due to continuous pollution, loss of habitats, overfishing and other anthropogenic influences (e.g. deterioration of physical habitat). In certain parts of their life cycle, especially during embryonic and early life stages (larvae and juveniles), most rheophilic fish inhabit highly productive inshore or slow-flow river zones called "nursing areas". These habitats are particularly affected by river channelizations, flow regulations and dam constructions. The chub, *Squalius cephalus* (L.) used to be one of the most common fish species in European freshwaters, but now local populations in some rivers are becoming decimated (Kupren et al., 2008). Although without special economic value, this fish is appreciated in recreational fisheries, but most important, it is an indigenous European fish indicating the river health, thus it should not be overlooked.

Production of fish fry in ponds is a quite demanding phase in fish farming, especially in providing fish with good quality feed. In order to decrease the cost of this phase, implementation of sustainable supplemental measures that will improve the usability of natural resources can be a valuable option.

Adults and larvae of aquatic and terrestrial insects are a significant part of the diet for most rheophilic fish species. Due to their high protein content, insects are seriously considered as an economically feasible and sustainable substitution of, or addition to expensive

commercial feeds, particularly for fish fry rearing. Studies from natural habitats of chub show that these fish highly rely on inputs from terrestrial ecosystems. Insects that appear on the water surface mostly emerge from the water body or its riparian habitats and to a smaller degree directly from the air ("aerial plankton") (Sanzone et a., 2003). Due to immediate contact with the shorelines, small water bodies are likely to provide higher insect biomass for fish feeding compared to large ones. Additional improvement of natural resources utilization in fish culture can be done by introducing insect traps and plant biomass on the water surface. Hence, the aim of this study was to investigate their efficiency as sustainable supplemental measures in rearing young chub (1+) for restocking natural waters.

MATERIAL AND METHODS

The study was carried out during 7 months, from April to October 2014 in 8 uniform experimental fish ponds of the Faculty of Fisheries and Protection of Waters (University of South Bohemia) as a part of the AQUAEXCEL project - „Transnational Access - TNA". The 0.08 ha ponds were stocked with 1250 individuals (mean total biomass 3294 ± 120.44 g) of one-year-old chub fingerlings per pond. Two experimental treatments (installation of yellow insect traps and regular fresh plant biomass application) and the control were tested in triplicates, and duplicate, respectively. The yellow insect traps installation consisted of 8 yellow plates (0.7 x 0.7 m) evenly distributed and submerged (1 - 2 cm) under water surface, nearby (~3 m) the shore-line. The treatment with plant biomass (a mixture of fresh grass and meadow plants) application consisted in its distribution at a rate of 150 $kgha^{-1}$ to ponds weekly providing a suitable substratum for colonization by phytophilous water invertebrates. No treatments were applied in the control ponds. During the experiment, fish in any of the ponds were not provided with supplementary feed. The essential environmental parameters (oxygen concentration, oxygen saturation, temperature, pH, turbidity, conductivity and transparency) were measured monthly. Standard length and weight of body fish were measured at the beginning and end of the experiment. Weight increment (ΔW), specific growth rate (SGR) and condition factor (CF) were calculated using the following equations: $\Delta W = Wt - Wo$; specific growth rate, $SGR = (100 \times (\ln Wt - \ln Wo) \times days^{-1})$; $CF = (W * L^{-3}) \times 100$, where W, Wo and Wt is the current, initial and final body weight (g), respectively and L is the standard body length (cm).

Results of environmental variables, standard length, weight and growth parameters of fish in the different treatments were tested using analysis of variances (one-way ANOVA) with treatment as the main factor. Differences between treatments were tested using Tukey's post hoc test. The analyses were performed using PAST 3.06. (Hammer et al., 2001).

RESULTS AND DISCUSSION

There was no difference in the environmental parameters among treatments, and the values were mostly within the range of conditions as in natural habitats of juvenile chub. At the end of the study period (October) the average weight and standard length of chub from experimental treatments were significantly different ($p<0.001$), being the highest in fish from insect trap treatment, intermediate in treatment with plant biomass and the lowest in control (35.78 ± 4.29 g, 29.74 ± 5.12 g, 26.40 ± 3.63 g respectively and 130.7 ± 4.2 mm, 123.5 ± 5.8 mm, 116.8 ± 4.9 mm respectively). Accordingly, body increment differed among the

treatments being significantly higher in the treatment with insect traps compared to the one with plant biomass and control ($p<0.001$). No significant differences were found for specific growth rates between the treatments but their values were significantly higher than in the control ($p<0.001$). However, the condition factors of fish from the control were significantly higher than those from treatment with plant biomass ($p<0.001$), while no difference was found between control and treatment with insect traps.

Insect traps have been widely used as a standard tool in faunistic and agricultural surveys for collecting insects. Especially the yellow water traps have been preferred for these purposes because they attract high diversity and amounts of insects. Their application as a food support in fish ponds is scarce in literature. Erhard et al. (1993) measured the insect biomass and its application in fish farming. However, this measure is quite well known to aquaculturists particularly in low-intensity (hobby) salmonid culture.

CONCLUSIONS

Contributing considerably to fish growth performances, these simple, economically feasible and ecologically sustainable measures for the improvement of utilization of natural resources can be applied to the culture of different coarse and reophilic fish species. In addition to conservation issues, this supplemental measure can be also applied in extensive and semi-intensive production of fish species having similar habitat and feeding requirements, as common carp and other omnivorous or even predatory species which are able to ingest insects during earlier life stages.

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