

Results of selective removal of the black bullhead (*Ameiurus melas*) in two different lentic systems

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INTRODUCTION

In the sake of better understanding of the mechanisms that drive interactions between invasive species and ecosystems, selective removal has been conducted in two different lentic systems. **Ponjavica Nature Park** has watercourse of the plains with very slow flow and the coastal remains of wetlands. **Lake Markovačko** was built for the needs of the irrigation system of the nearby agricultural land. Both systems suffer dominance of the black bullhead, characterized as "globally high risk" species.

MATERIALS AND METHODS

The research at Ponjavica lasted from June 2018 to October 2019, and from August 2020 to September 2021 at Lake Markovačko. The field research had three phases that did not differ in sampling methodology and duration.

I phase - zero-point state of the fish population (multimesh nets 30 m, height 2 m, mesh sizes from 8 to 100 mm and electrofishing)

II phase - selective removal of black bullhead (fyke nets were placed in three rows at each location 5 nets in each row, 24 h, 3 days)

III phase - post-removal state of the fish population (multimesh nets 30 m, height 2 m, mesh sizes from 8 to 100 mm and electrofishing)

Native fish species caught during the research were returned to the water, while non-native fish species were removed from the ecosystem.



Ponjavica Nature Park



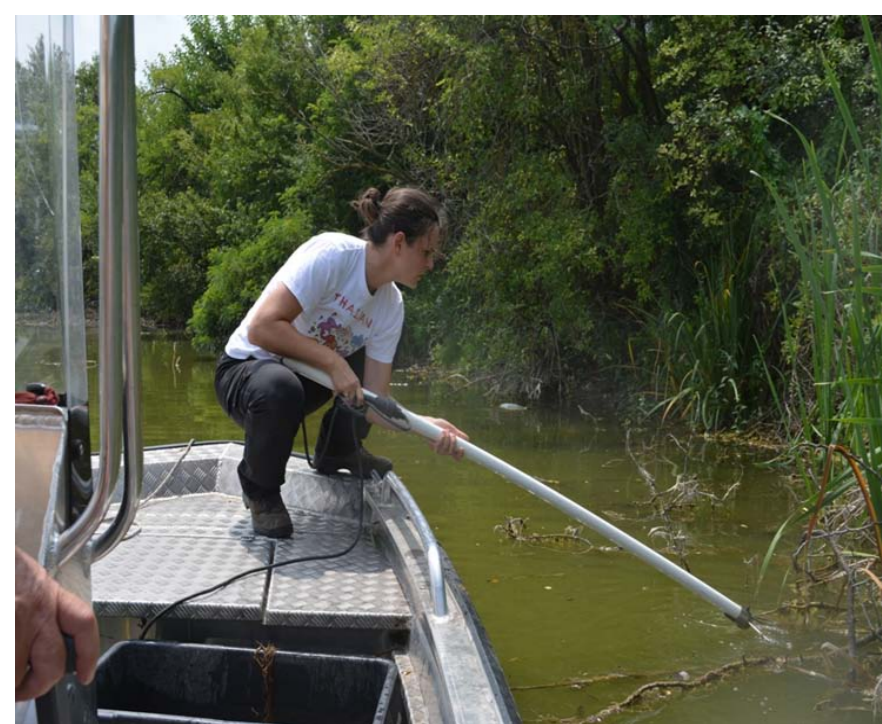
Markovačko lake

RESULTS AND DISCUSSION

Selective removal in **Ponjavica** lasted from Aug. – Oct. 2018, Apr. – Sept. 2019, with 20,145 individuals removed, showed decreased abundance of bleak (*Alburnus alburnus*) 2.3 times, roach (*Rutilus rutilus*) and European perch (*Perca fluviatilis*) remained almost unchanged. A significant increase in abundance was recorded in rudd (*Scardinius erythrophthalmus*) (5.3 times). The abundances of topmouth gudgeon (*Pseudorasbora parva*), pumpkinseed (*Lepomis gibbosus*), and Prussian carp (*Carassius gibelio*) increased 25.5, 4.9, and 4.2 times, respectively.

The mass removal on **Lake Markovačko** lasted from Aug. – Oct. 2020, Apr. – Sept. 2021, and 15,921 specimens were removed. Post removal state from Markovačko lake resulted in two species in the sample for the first time: European perch and chub (*Squalius cephalus*). The abundance of bleak increased 3 times, abundance of Prussian carp reduced 8 and black bullhead 16 times. The abundance of roach decreased 11, rudd 10, pike-perch (*Sander lucioperca*) 4 and freshwater bream (*Abramis brama*) 2 times. The abundances of pumpkinseed increased 10, Monkey goby (*Neogobius fluviatilis*) 3 and topmouth gudgeon 2.5 times.

The results showed that the fyke nets can be most effectively and selectively applied to control the abundance of black bullhead because of simplicity and non-harmfulness to other species. It is not possible to completely remove this species from the ecosystem, but reduce the negative impact by suppression (removal programs) and containment of existing state.



Acknowledgements: This work was supported by the Rufford Foundation through two project "Black bullhead (*Ameiurus melas*) in Ponjavica Nature Park: biological characteristics, effects on native ichthyofauna, mass removal and experimental rearing" (Application ID: 24690 – 1) and "Mass removal of the black bullhead (*Ameiurus melas*) – Possibilities for self-sustaining commercial farming in Serbia" (Application ID: 31053 – 2).

Effects of selective removal of the black bullhead (*Ameiurus melas*) on other non-native fish populations in the Ponjavica Nature Park (Serbia)

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STARTING FACTS

Black bullhead (*Ameiurus melas*) is one of the most abundant and successful invasive species of fish inhabiting the inland waters of Europe, including Serbia. In previous research that dealt with this species and its population characteristics, it is noted that selective removal could be a potential solution to the problems that this species causes in the waters where it has been introduced. However, so far no field research has been conducted to confirm or disprove this claim. Selective removal of this species have been carried out in Serbia so far, but without scientifically based data on the effects on native and non-native fish populations.



Figure 1. A picture of the locality with marked rows of fyke nets

MATERIALS AND METHODS

The Ponjavica River (N44°42'52"; E20°47'44"; altitude 71 m) is a small slow-running lowland river situated in the southern part of Vojvodina (Serbia), in the Ponjavica Nature Park. The research lasted from June to October 2018 and from April to October 2019, at three sampling sites: Location 1 near Banatski Brestovac, Location 2 in the middle of the stream and Location 3 near Omoljica. The field research had three phases that differed in sampling methodology and duration. The first phase took place during June and July 2018, when the zero-point state of the fish population in the river was assessed. The second phase of the research included the selective removal of black bullhead that lasted from August to October 2018 and from April to September 2019. The third phase was realized in October 2019, when the post-removal state of the fish population after the selective removal was assessed. In the first phase, multimesh nets (length 30 m, height 2 m, mesh sizes from 8 to 100 mm) and electrofishing were used. Selective removal of black bullhead was carried out using a cylindrical fyke nets with two conical-shaped funnel openings (length 85 cm, diameter 50 cm, 8 mm mesh). Fyke nets were placed in three rows at each location – one on the left bank, one on the right bank and one in the middle of the stream. Each row had five nets (Figure 1). On each sampling date, the fyke nets were set for 24 h and then checked daily for 4 consecutive days in 2018 and 3 consecutive days in 2019. The sampling methodology in the third phase was the same as in the first phase, using the same fishing gear and effort to determine the newly established state of the fish assemblage at these three localities after the mass removal of the black bullhead. Native fish species caught during the research were returned to the water unharmed, while non-native fish species were removed from the ecosystem.

RESULTS AND DISCUSSION

20,145 black bullheads from the Ponjavica Nature Park were removed. The most significant changes between the zero-point state and the post-removal state have been recorded among the populations of non-native fish species: the abundances of topmouth gudgeon (*Pseudorasbora parva*), pumpkinseed (*Lepomis gibbosus*), and Prussian carp (*Carassius gibelio*) increased 25.5, 4.9, and 4.2 times, respectively. Previous research has shown that smaller black bullhead individuals enter into competitive relationships with the topmouth gudgeon, while larger individuals use the topmouth gudgeon as prey. By removing black bullhead individuals from the ecosystem, a part of the ecological niche used by both species was freed. Also, the predatory pressure on topmouth gudgeon decreased by removing larger black bullhead individuals. All these factors led to an increase in the abundance of topmouth gudgeon. Black bullhead and pumpkinseed have overlapping diets and are therefore considered competitors for food. Moreover, research on the black bullhead's feeding ecology showed that this species feeds on the pumpkinseed. When a greater number of black bullhead individuals were removed from the ecosystem, it led to an increase in the abundance of pumpkinseed. The abundance of Prussian carp also increased after the removal of the black bullhead. The Prussian carp and the black bullhead are quite similar in terms of diet habits, habitat preferences, and reproductive characteristics. Since these two species are in direct competition, the decline in the black bullhead population contributed to an increase in the Prussian carp population. These results point to the fact that management programs must include multiple species and methods, and one of them is the removal of all undesirable, invasive non-native species. Further research should also focus on possible diet shifts in allochthonous fishes after removing the black bullhead.



Acknowledgements: The authors would like to acknowledge the Nature Protection Guards of the Ponjavica Nature Park for their cooperation in facilitating the sample collection. Funding was provided by the Rufford Foundation through the project "Black bullhead (*Ameiurus melas*) in Ponjavica Nature Park: biological characteristics, effects on native ichthyofauna, mass removal and experimental rearing" (Application ID: 24690 – 1).