FACULTY OF AGRICULTURE
UNIVERSITY OF BELGRADE
SERBIA

POLJOPRIVREDNI FAKULTET
UNIVERZITET U BEOGRADU
SRBIJA

INTERNATIONAL AQUATIC
VETERINARY BIOSECURITY
CONSORTIUM,
LUDWIG-MAXIMILIANS-UNIVERSITY
MUNICH, GERMANY

MEĐUNARODNI VETERINARSKI
KONZORCIJUM ZA BIOSIGURNOST
AKVATIČNIH ORGANIZAMA
LUDVIG-MAKSIMILIJAN UNIVERZITET
MINHEN, NEMAČKA

VIII INTERNATIONAL
CONFERENCE

VIII MEĐUNARODNA
KONFERENCIJA

WATER & FISH

CONFERENCE
PROCEEDINGS
June 13 - 15, 2018

ZBORNIK
RADOVA
13. - 15. Jun 2018.

UNIVERSITY OF BELGRADE, FACULTY OF AGRICULTURE - SERBIA
AND INTERNATIONAL AQUATIC VETERINARY BIOSECURITY CONSORTIUM, LUDWIG-MAXIMILIANS-UNIVERSITY MUNICH, GERMANY

SUPPORTED BY
EUROPEAN AQUACULTURE SOCIETY, EAS
AND
PAN-HELLENIC SOCIETY OF TECHNOLOGISTS ICHTHYOLOGISTS, (PASTI)

8th INTERNATIONAL CONFERENCE "WATER & FISH"

CONFERENCE PROCEEDINGS

Faculty of Agriculture, Belgrade-Zemun, Serbia
June, 13 – 15. 2018.

PUBLISHER
University of Belgrade - Faculty of Agriculture

FOR THE PUBLISHER:
Prof. Dr. Milica Petrović

COMPUTER DESIGN
GRAPHIC, Novi Sad

TECHNICAL PREPARATION OF A COVER
Dr. Božidar Rašković

TECHNICAL TEXT PREPARATION
Dr. Ivana Živić

PRINTED BY
GRAPHIC, Novi Sad

NUMBER OF COPIES PRINTED
400 COPIES

ORGANIZATION OF THE CONFERENCE SUPPORTED BY:
Ministry of Education, Science and Technological Development Republic of Serbia

GENERAL DONOR
DTD RIBARSTVO, Bački Jarak

UNIVERZITET U BEOGRADU, POLJOPRIVREDNI FAKULTET - SRBIJA
I MEĐUNARODNI VETERINARSKI KONZORCIJUM ZA
BIOSIGURNOST AKVATIČNIH ORGANIZAMA,
LUDVIG-MAKSIMILIJAN UNIVERZITETA U MINHENU, NEMAČKA

UZ PODRŠKU
EVROPSKOG DRUŠTVA ZA AKVAKULTURU - EAS
I
PAN-HELENSKOG DRUŠTVA TEHNOLOGA IHTIOLOGA - PASTI

VIII MEĐUNARODNA KONFERENCIJA ”VODA I RIBA”

ZBORNIK PREDAVANJA

Poljoprivredni fakultet, Beograd– Zemun, Srbija
13. – 15. jun, 2018. godine

IZDAVAČ
Univerzitet u Beogradu, Poljoprivredni fakultet

ZA IZDAVAČA:
Prof. dr Milica Petrović

GLAVNI I ODGOVORNI UREDNICI
Prof. dr Vesna Poleksić, Doc. dr Božidar Rašković i Prof. dr Zoran Marković

RAČUNARSKA OBRADA
GRAPHIC, Novi Sad

TEHNIČKO UREĐENJE KORICA
Dr Božidar Rašković

TEHNIČKA PRIPREMA TEKSTA
Dr Ivana Živić

ŠTAMPA
GRAPHIC, Novi Sad

TIRAŽ
400 primeraka

ODRŽAVANJE SKUPA POMOGLO:
Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije

GENERALNI DONATOR
DTD RIBARSTVO, Bački Jarak

CONTENTS:

SADRŽAJ:

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

639.2/.3(082)

INTERNATIONAL Conference "Water & Fish" (8 ; 2018 ; Beograd)
Conference Proceedings / 8th International Conference "Water & Fish", Faculty of Agriculture, Belgrade-Zemun, Serbia, June, 13-15. 2018. ; [editors in chief Vesna Poleksić, Božidar Rašković and Zoran Marković]. - Belgrade : University, Faculty of Agriculture, 2018 (Novi Sad : Graphic). - XII, 544 str. : ilustr. ; 23 cm

Tekst na engl. i srp. jeziku. - Na spor. nasl. str.: Zbornik predavanja. - Tiraž 400. - Bibliografija uz svaki rad. - Apstrakti ; Abstracts.

ISBN 978-86-7834-308-7

a) Рибарство - Зборници
COBISS.SR-ID 264387852

ISBN 978-86-7834-308-7

FYKE NETS SELECTIVITY FOR BLACK BULLHEAD (*AMEIURUS MELAS*) IN SAVA LAKE

MILICA JAĆIMOVIĆ[1], JASMINA KRPO-ĆETKOVIĆ[2], MARIJA SMEDEREVAC-LALIĆ[1], MIRJANA LENHARDT[3], DUŠAN NIKOLIĆ[1], ALEKSANDAR HEGEDIŠ[1,2]
[1]Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1, 11030 Belgrade, Serbia
[2]Faculty of Biology, University of Belgrade, Studentski trg 16, 11000 Belgrade, Serbia
[3]Institute for Biological Research «Siniša Stanković», University of Belgrade, Bulevar despota Stefana 142, 11060 Belgrade, Serbia

SELEKTIVNOST VRŠA U IZLOVU CRNOG AMERIČKOG PATULJASTOG SOMA (*AMEIURUS MELAS*) U SAVSKOM JEZERU

Apstrakt

Istraživanje populacione dinamike crnog američkog patuljastog soma *Ameiurus melas* (Rafinesque, 1820) u Savskom jezeru realizovano je u periodu od avgusta 2009. do decembra 2012. godine. U cilju pronalaženja načina za smanjenje i kontrolu brojnosti populacija ove invazivne alohtone vrste (pre svega u stajaćim vodama), važno je ispitati i selektivnost ribolovnog alata (vrša). Selektivnost vrša procenjena je na osnovu odnosa ulovljenih jedinki crnog američkog patuljastog soma i drugih vrsta riba, za svaki mesec pojedinačno. Ukupno je uhvaćeno 13866 jedinki, od čega su jedinke crnog američkog patuljastog soma činile 94.2%, grgeča (*Perca fluviatilis*) 3.2% i sunčice (*Lepomis gibbosus*) 2.1%. Ulov štuke (*Esox lucius*), deverike (*Abramis brama*), babuške (*Carassius gibelio*), šarana (*Cyprinus carpio*), bodorke (*Rutilus rutilus*)), smuđa (*Sander lucioperca*) i glavoča (Gobiidae) bio je na nivou statističke greške (< 1%). Rezultati istraživanja pokazuju da se vrše mogu primenjivati u kontroli brojnosti populacija crnog američkog patuljastog soma, jer osim što su selektivne, efikasne i lake za rukovanje, imaju minimalan negativni uticaj na druge vrste riba.

Ključne reči: *crni američki patuljasti som, selektivnost ribolovnog alata, vrše, kontrola populacija*
Keywords: *black bullhead, fish gear selectivity, fyke nets, population control*

INTRODUCTION

The impacts of non-native invasive species are immense and usually irreversible, and their adverse effects to native species and ecosystems can be compared to those caused by

the loss and degradation of habitats (IUCN, 2000). Introduction of non-native species can have a serious negative impact on the environment, diversity of native species, economic resources, and human health (Clavero & García-Berthou, 2005; Shirley & Kark, 2006). A large number of non-native fish species were introduced into freshwater ecosystems on a global scale (Leprieur et al., 2008), and at least 134 exotic/translocated fish species are introduced in Europe (Holčík, 1991). The black bullhead *Ameiurus melas* (Rafinesque, 1820), native to North America, is one of the most abundant and successful non-native fish species in European freshwater ecosystems (Cucherousset et al., 2006b). It poses a major problem for fisheries management throughout Europe, which has led to many attempts to apply selective fishing of this species (Cucherousset et al., 2006b; Louette & Declerck, 2006). The first record of the black bullhead in Serbia was in 2005 (Cvijanović et al., 2005), and according to Lenhardt et al. (2011), it is one of the dominant non-native species in Serbian waters.

The aim of this research was to investigate the efficiency of fyke nets as a sampling tool for population assessment, as well as their selectivity for population control and mass removal of this species, considering that there are only a few studies published on the efficiency of black bullhead trapping and mass removal (Cucherousset et al. 2006a; Louette & Declerck, 2006).

MATERIALS AND METHODS

Sava Lake is a reservoir formed in 1967 by damming a right-hand branch of the Sava River in Belgrade (Serbia), near the Ada Ciganlija river island, as a facility for water supply, water sports, and recreation. It is a mesotrophic to eutrophic lake in the process of succession on the site of a former river ecosystem (Janković & Janković, 1987). The lake has the status of a special fishing waterbody ("catch-and-release fishing").

Based on the total biomass, among 20 fish species currently present in the lake, the most notable are the common carp *Cyprinus carpio* (21.2%), pikeperch *Sander lucioperca* (13.5%), common bream *Abramis brama* (8.4%), Eurasian perch *Perca fluviatilis* (6.0%), and European catfish *Silurus glanis* (4.3%). The non-native species with the highest biomass are the silver carp *Hypophthalmichthys molitrix*, bighead carp *Hypophthalmichthys nobilis*, black bullhead (5.7% each), and Prussian carp *Carassius gibelio* (5.0%) (Hegediš et al., 2008).

Black bullhead samples were collected monthly from August 2009 to December 2012 using double fyke nets (length 85 cm, diameter 50 cm, 8 mm mesh-size). Nets were positioned in three rows, with five nets placed in each row, at 3 m, 10 m, 18 m, 25 m, and 35 m distance from the shore, at depths of 1.5 m, 4 m, 5.5 m, 7.5 m, and 8 m, respectively. The distance between the rows was 15 m. Nets were left in water for 3 nights each month and checked daily.

The selectivity of fyke nets was estimated based on the ratio of the captured individuals of black bullhead and of other fish species in the total catch for each month: northern pike (*Esox lucius*), common bream, Prussian carp, common carp, roach (*Rutilus rutilus*), Eurasian perch, pikeperch, pumpkinseed (*Lepomis gibbosus*), and gobies (Gobiidae).

RESULTS

The results in 2009 and 2010 were similar, and the percentage of black bullhead individuals in the total catches was 94.6% ± 5.0 and 99.9% ± 0.17 (mean ± SD), respectively. Different results were observed in 2011. May was the month in which the percentage of

black bullhead individuals was the lowest (17.3%), and it was the month when a mass mortality of the bullhead occurred in the lake. At that time, the Eurasian perch comprised the largest percentage in the catch (55.6%), followed by pumpkinseed (23.5%), common bream (2.5%), and Prussian carp (1.2%). The next month with the lowest number of black bullhead individuals in the total catch was November 2011 (64.6%), followed by pumpkinseed (24.8%) and Eurasian perch (10.6%). In July 2011, the percentage of black bullhead individuals in the total catch was 67.7%, followed by Eurasian perch (22.9%), gobies (7.3%), and pumpkinseed and common bream (1% each). The catch in other months of 2011 was uniform, and the average percentage of black bullhead individuals was 88.1% ± 7.3, and of all other fish species it was 5.6% ± 5.6. Not a single northern pike or common carp were caught during 2011.

March and June 2012 are characterized by a lower percentage of black bullhead in the total catch (11.5% and 36.9%, respectively). In March, individuals of Eurasian perch were dominant (87.8%), and in June, the percentage of pumpkinseed and Eurasian perch individuals were 34.7% and 27.6% respectively. During all other months of 2012, black bullhead was dominant in the total catch and its average percentage was 96.9% ± 2.9, while of all other fish species it was 0.8% ± 1.1. No common carp or roach were caught in 2012.

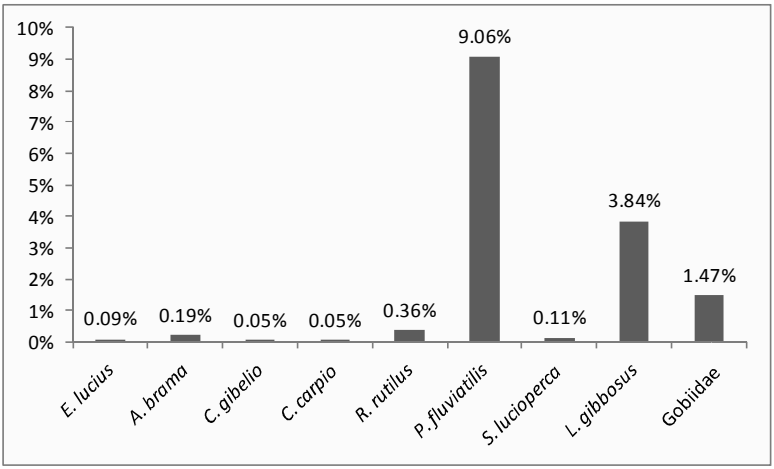

Figure 1. The average percentage of other fish species (black bullhead excluded) in the catch from August 2009 to December 2012.

The average percentage of black bullhead individuals caught during the entire sampling period was of 84.8%, and for other species it was 15.2%. The average percentage of other species was the highest for the Eurasian perch (9.1% ± 18.9), followed by pumpkinseed (3.8% ± 8.5), and gobies (1.5% ± 3.6) (Figure 1). High values of standard deviation (SD) indicate large differences between months. The average percentage in the total catch of the northern pike, common bream, Prussian carp, common carp, roach, and pikeperch were low and uniform, less than 1%, and SD values ranged from 0.2 to 1.5.

DISCUSSION

The results from Sava Lake suggest that fyke nets represent a highly selective fishing tool for black bullhead. During the four-year research, it was observed that in stable conditions (2009,

2010, the first half of 2011, and the second half of 2012), the percentage of black bullhead in the total catch ranged from 79.1% to 100%. Only from May 2011 (when the mass mortality event occurred) until the first half of 2012 (when the population stabilized), the catch of the black bullhead was variable. The percentage of other non-native invasive species that are considered undesirable, such as pumpkinseed and gobies, were higher than for native species, except for the Eurasian perch. The catch of the commercially most important fish (northern pike, common carp, and pikeperch) was at the level of statistical error. It is important that the caught individuals of these species stay alive, so that they can be returned unharmed into the water.

Other studies have also confirmed the efficiency and selectivity of fyke nets for black bullhead. In 28 lakes of South Dakota these nets proved to be very effective, especially in the catch of smaller black bullhead individuals (Hanchin et al., 2002), and this was confirmed by Pedicillo et al. (2008) for Corbara Lake (Italy). Hanchin et al. (2002) also observed that, for black bullhead population monitoring in waterbodies where black bullhead abundance is high, fyke nets provide a better estimate of the relative abundance, expressed as the mean catch-per-unit effort of stock-length ($\geq$ 15 cm total length) bullheads, than gill-nets, probably due to faster saturation of gill-nets. Krueger et al. (1998) showed that fyke nets represent a particularly effective tool for sampling of benthic fishes, such as black bullhead, in lakes and reservoirs. A study in the De Maten Nature Reserve (Belgium), which consists of a series of interconnected small and shallow ponds, suggests that double fyke nets, when combined with the mark-recapture technique, are a very useful tool for the efficient and reliable assessment of brown bullhead populations; the recapture efficiency of fyke nets for brown bullhead was 66% and for pumpkinseed, Prussian carp, rudd (*Scardinius erythrophthalmus*), and tench (*Tinca tinca*) it ranged between 23% and 47% (Louette & Declerck, 2006). The results of the same study also suggest that double fyke nets may potentially be a cost-effective tool for the mass removal of non-native brown bullhead (*Ameiurus nebulosus*) populations from small to medium-sized shallow water bodies. It proved that double fyke nets do not damage other fish species, they are easy to use, and therefore they could help managers to reduce the number of reproductive individuals within one year. If the selective removal continues during following years, young-of-the-year individuals could be prevented from reaching sexual maturity. This could consequently lead to a reduction of abundance or even to eradication of these species from the ecosystem (Louette & Declerck, 2006). Considering the great similarity of these two species, the results of this research can be fully compared with the results from Sava Lake.

The results of fyke nets selectivity assessment for black bullhead in Sava Lake suggest that the mass removal would be most effective if conducted during the summer and autumn period (when the population density is at its peak), in the zone of the macrophyte vegetation. Juvenile individuals should be removed along with adult (reproductive) individuals. This model, with some modifications, could be applied to most lake ecosystems in Serbia. However, long-term monitoring of these ecosystems would be necessary, in order to keep track of the recruitment and possible rapid renewal of the black bullhead population. In addition to these management measures, it would be desirable to occasionally restock these ecosystems with native fish species as well as to evaluate possible habitat alterations.

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Education, Science, and Technological Development of the Republic of Serbia, Project No. TR37009 and Project No. OI173045.

REFERENCES

Clavero, M., García-Berthou, E. (2005): Invasive species are a leading cause of animal extinctions. Trends in Ecology and Evolution, 20: 110.

Cucherousset, J., Paillisson, J.M., Carpenter, A. (2006a): Is mass removal an efficient measure to regulate the North American catfish *Ameiurus melas* outside of its native range? Journal of Freshwater Ecology, 21(4): 699–704.

Cucherousset, J., Paillisson, J.M., Carpenter, A., Eybert, M.C., Olden, J.D. (2006b): Habitat use of an artificial wetland by the invasive catfish *Ameiurus melas*. Ecology of Freshwater Fish, 15: 589–596.

Cvijanović, G., Lenhardt, M., Hegediš A. (2005): The first record of black bullhead *Ameiurus melas* (Pisces, Ictaluridae) in Serbian waters. Archives of Biological Sciences, 57(4): 21–22.

Hanchin, P.A., Willis, D.W., St. Sauver, T.R. (2002): Comparison of concurrent trap-net and gill-net samples for black bullheads. Journal of Freshwater Ecology, 17(2): 233–237.

Hegediš, A., Nikčević, M., Mićković, B. (2008): Srednjoročni program unapređenja ribarstva na delu ribarskog područja «Srbija-Zapad» za period 2008-2012. godina. [Mid-term program for the improvement of fisheries in the fishing area «Serbia-West» for the period 2008-2012]. Institute for Multidisciplinary Research, University of Belgrade, Belgrade, Serbia, 6 pp. (In Serbian)

Holčík, J. (1991): Fish introductions in Europe with particular reference to its Central and Eastern part. *Canadian* Journal of *Fisheries* and *Aquatic* Sciences, 48: 13–23.

IUCN (2000): Guidelines for the prevention of biodiversity loss caused by alien invasive species. IUCN – Species Survival Commission, Gland, Switzerland, 15 pp.

Krueger, K.L., Hubert, W.A., Price, R.M. (1998): Tandem-set fyke nets for sampling benthic fishes in lakes. North American Journal of Fish Management, 18: 154–160.

Janković, M.M., Janković, M. (1987): Prilog poznavanju i rešavanju problema eutrofizacije i zarašćivanja Savskog jezera (Ada Ciganlija) kod Beograda. [Contribution to the knowledge and solution of problems of eutrophication and overgrowth of Lake Sava (Ada Ciganlija) in Belgrade]. Glasnik instituta za botaniku i botaničke bašte Univerziteta u Beogradu, 16, 1–41. (In Serbian)

Lenhardt, M., Marković, G., Hegediš, A., Maletin, S., Ćirković, M., Marković Z. (2011): Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries, 21: 407–421.

Leprieur, F., Beauchard, O., Blanchet, S., Oberdorff, T., Brosse S. (2008): Fish invasions in the world's river systems: when natural processes are blurred by human activities. PLOS Biology, 6(2): e28.

Louette, G., Declerck, S. (2006): Assessment and control of non-indigenous brown bullhead *Ameiurus nebulosus* population using fyke-nets in shallow ponds. Journal of Fish Biology, 68: 522–531.

Pedicillo, G., Bicchi, A., Angeli, V., Carosi, A., Viali, P., Lorenzoni, M. (2008): Growth of black bullhead *Ameiurus melas* (Rafinesque, 1820) in Corbara Reservoir (Umbria, Italy). Knowledge and Management of Aquatic Ecosystems, 389: 05.

Shirley, S.M., Kark, S. (2006): Amassing efforts against alien invasive species in Europe. PLoS Biology, 4(8): e279.