



DECLINE OF ARTISANAL FISH CATCH BY SPECIES IN THE CROATIAN SECTION OF THE SAVA RIVER

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ARTICLE INFO

Received: 16 November 2023

Accepted: 18 January 2024

Keywords:

Freshwater
Professional fishermen
Common carp
Wels catfish
Pike
Ppike perch
Bream

ABSTRACT

The aim of this study is to analyse the development of artisanal fish catch by species in the Croatian section of the Sava River. For *Abramis brama* and *Silurus glanis*, a significant decline in catches (in kg) was observed throughout the study period (2004-2021). Since 2013, this has also been the case for *Cyprinus carpio*, *Esox lucius*, *Sander lucioperca*, other autochthonous species and allochthonous species, while catches of *Leuciscus idus* have declined significantly since 2014. The catches of three species (*Acipenser ruthenus*, *Leuciscus aspius* and *Tinca tinca*) fluctuated without a trend, which can be attributed to the low quantities. This decline in catches of the most sought-after species in the Sava was greater than that of the other less sought-after autochthonous species (mainly other cyprinids), whose share of the total catch increased significantly.

How to Cite

Treer, T. (2024): Decline of artisanal fish catch by species in the Croatian section of the Sava River. Croatian Journal of Fisheries, 82, 43-47. DOI: 10.2478/cjf-2024-0005.

INTRODUCTION

Commercial freshwater fisheries continue to be a very important source of food and income on a global scale (Lynch, 2020; Embke et al., 2022). However, it has been declining in most countries of the developed world for many years (Cowx, 2015). In addition to reduced interest, many other human activities also have a negative impact, such as competition of recreational fishermen (e.g. Roos et al., 2021; Bergström et al., 2022), overfishing (e.g. Schork, 2012), threats from invasive species (e.g. Jellyman et al., 2016), poor management (e.g. Khan, 2016), environmental degradation (e.g. Nilsson et al., 2019; Hernandez-Barrero, 2022), the cutting off of spawning grounds (e.g. Psuty, 2023) and the climate (Olsson, 2019). The Sava is the longest Croatian river with the largest catchment area and is part of the Danube catchment area (Hrvatske vode, 2017). Its lower part flows along the border with Bosnia and Herzegovina, where both fishing activities are allowed in both countries – artisanal fishing and recreational fishing (angling). Previous studies have shown that total commercial catches have declined sharply in the Croatian section (Treer, 2023). In addition, the last part of the river in Croatia (Vukovar-Sirimiun County) is characterised by the trend of declining catches of common carp *Cyprinus carpio*, northern pike *Esox lucius*, pike perch *Sander lucioperca* and wels catfish *Silurus glanis* (Treer, 2022). In addition to a possible decline in artisanal interest, higher fishing pressure from anglers from the Croatian side and both groups of fishermen from the riverbank in Bosnia and Herzegovina, as well as the negative influence of the polluted waters of the large Bosnian Bosna River which flows through urban and industrial cities before entering the lower part of the Sava, are cited as reasons (Tousova et al., 2019). The aim of this article is therefore to analyse the trends of artisanal catches by the main fish species.

MATERIALS AND METHODS

The monitoring of freshwater fish stocks is essential for the management of artisanal fisheries (Amarasinghe and Da Silva, 1999; Roos et al., 2021). Therefore, the official data were obtained from the competent Directorate of Fisheries of the Ministry of Agriculture based on the annual reports on artisanal fisheries (MP, 2004; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021). Logbook data, despite potential limitations, are important to support the sustainable management of freshwater fisheries and can be useful in determining the trend of catches (e.g. Lych and Remr, 2019; Schubert et al., 2022). For all data, the correlation between the annual catch by species and the respective year was determined. The statistical analysis was calculated using IBM SPSS Statistics ver.19.

RESULTS AND DISCUSSION

The register of artisanal fish catches was compiled for nine species and two species groups (other autochthonous and allochthonous fish). The part of the Sava River in Croatia where commercial fishing is allowed belongs to the bream area. Therefore, the freshwater bream *Abramis brama* is the most frequently caught species. Catches peaked in 2010 (4312 kg) and declined to 338 kg in 2021 (Fig. 1).

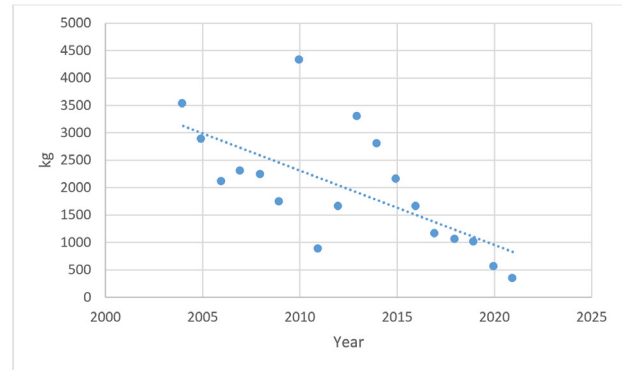


Fig 1. Total catch (kg) of freshwater bream by artisanal fishermen in the Croatian section of the River Sava from 2004 to 2021 ($R^2 = 0.443$; $P < 0.01$)

Furthermore, catches decreased significantly ($P < 0.01$) throughout the period studied, from 2004 to 2021. Tierney et al. (1999) found that the ichthyocoenosis in Irish waters with thriving freshwater bream populations is in significantly better condition and vice versa. This statement is consistent with the results of the present study. The next species whose catch declined significantly ($P < 0.01$) throughout the study period is wels catfish (Fig. 2).

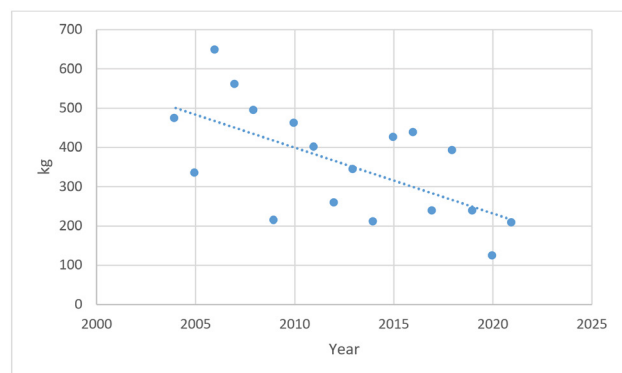


Fig 2. Total catch (kg) of wels catfish by artisanal fishermen in the Croatian section of the River Sava from 2004 to 2021 ($R^2 = 0.400$; $P < 0.01$)

It peaked a long time ago in 2006 (646.95 kg) and reached its lowest point in 2020 (121.80 kg). Since 2013, a similarly significant negative trend has been observed for common carp ($P < 0.05$), northern pike ($P < 0.05$) and pike perch ($P < 0.01$), whose annual catch fell below 100 kg (Fig. 3), as well as for other autochthonous ($P < 0.01$) and allochthonous species ($P < 0.01$) (Fig. 4).

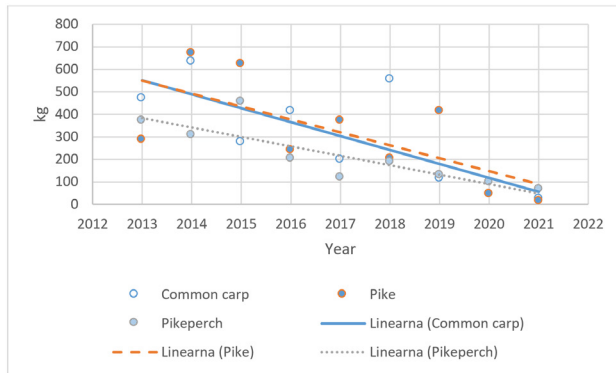


Fig 3. Total catch (kg) of common carp ($R^2 = 0.575$; $P < 0.05$), northern pike ($R^2 = 0.472$; $P < 0.05$) and pike perch ($R^2 = 0.736$; $P < 0.01$) by artisanal fishermen in the Croatian section of the River Sava from 2013 to 2021

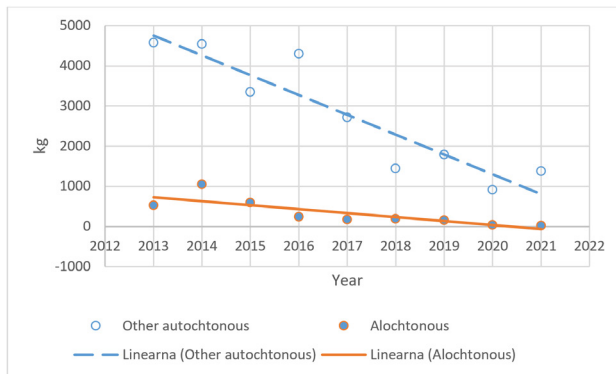


Fig 4. Total catch (kg) of other autochthonous ($R^2 = 0.853$; $P < 0.01$) and allochthonous ($R^2 = 0.672$; $P < 0.01$) fishes by artisanal fishermen in the Croatian section of the River Sava from 2013 to 2021

Only one year later, since 2014, the same has been the case for the catches of ide *Leuciscus idus* ($R^2 = 0.563$; $P < 0.05$). In the same period, the catches of the other three species mentioned in the register, starlet *Acipenser ruthenus*, asp *Leuciscus aspius* and tench *Tinca tinca*, fluctuated without trend, which can be attributed to high CV at the low quantities (Treer, 2022).

These negative trends in absolute catch numbers (kg) are followed by a significant decline in CPUE ($P < 0.01$) among artisanal fishers (Treer, 2023). The decline in catches of sought-after fish species can also be observed elsewhere and has been thoroughly investigated in the Baltic Sea, where declines have been recorded particularly for pike (Nilsson et al., 2019; Bergström et al., 2022; Psuty et al.,

2023), pike perch and roach *Rutilus rutilus* (Mustamaki et al., 2014; Andrasunas et al., 2022). However, there has been a general and sharp decline in predatory fish populations worldwide (Olsson, 2019). This decline in catches of the most sought-after species in the Sava was greater than that of the other less sought-after autochthonous species (mainly other cyprinids), whose share of the total catch increased significantly (Fig. 5). This is a known effect that also occurred elsewhere (e.g. Gray et al., 2017; Mustamaki and Mattila, 2015; Capitani et al., 2021; Nakiyende et al., 2023).

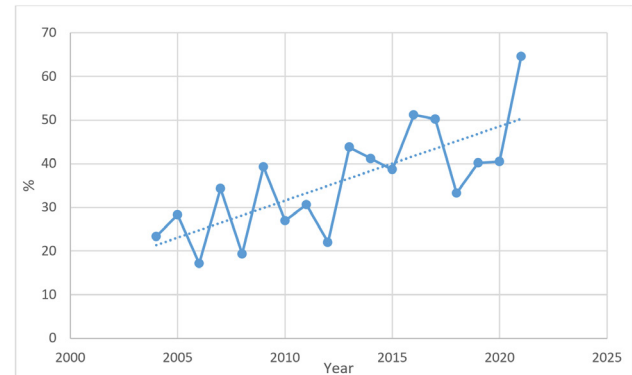


Fig 5. Proportion (%) of other autochthonous species in total fish catch (kg) by artisanal fishermen in the Croatian section of the River Sava from 2004 to 2021 ($R^2 = 0.545$; $P < 0.01$)

Well-organized monitoring and management can reverse these trends and improve artisanal fisheries, as has been done in some reservoirs in Sri Lanka (Amarasinghe and De Silva, 1999), along with good cooperation from neighbouring countries (Treer, 2003; Antunes, 2016; Pietrock, 2019).

SMANJENJE ULOVA POJEDINIH VRSTA RIBA GOSPODARSKIH RIBARA U HRVATSKOM DIJELU RIJEKE SAVE

SAŽETAK

Cilj ovoga rada je analizirati trendove ulova pojedinih vrsta riba u gospodarskom ribolovu na hrvatskom dijelu rijeke Save kroz 18 godina istraživanja (2004-2021). Značajni pad ulova (kg) kroz cijelo istraživano razdoblje utvrđen je za deveriku i soma. Od 2013. isto je utvrđeno i za šarana, štuku, smuđa, ostale autohtone vrste i alohtone vrste, dok ulov jeza značajno opada od 2014. Ulov preostale tri vrste riba o kojima se vodi evidencija (kečiga, bolen i linjak) varirao je bez pokazivanja trenda, kao rezultat malih količina. Pad ulova poželjnih vrsta riba je veći nego ostalih autohtonih (uglavnom ostali ciprinidi), čiji se udio, unatoč apsolutnom padu, u ukupnom ulovu značajno povećao.

Ključne riječi: slatke vode, profesionalni ribolovci, šaran, som, štuka, smuđ, deverika.

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