



## CHANGES IN THE PROPORTION OF FISH SPECIES CAUGHT BY ARTISANAL FISHERS IN THE CROATIAN SECTION OF THE SAVA RIVER

Tomislav Treer

University of Zagreb Faculty of Agriculture, Department of Fisheries, Apiculture, Wildlife Management and Special Zoology, Svetošimunska 25, 10000 Zagreb, Croatia

\*Corresponding Author: treer@agr.hr

### ARTICLE INFO

Received: 27 November 2025

Accepted: 19 January 2026

#### Keywords:

Freshwater

Commercial fishermen

*Abramis brama*

*Rutilus rutilus*

Autochthonous fish species

Fish species share

### ABSTRACT

The number of artisanal fishers, and consequently their catch, in the Sava River has declined significantly over the past two decades. The average weight of some species has also changed significantly. Therefore, the aim of this paper is to investigate possible changes in the biomass proportion in the catch of the most important taxa during this period. Most of the investigated species showed considerable variation in catch from year to year, but without a clear trend ( $P > 0.05$ ). The largest fluctuations, with a coefficient of variation (CV) over 90%, were found in *Acipenser ruthenus*, *Cyprinus carpio*, *Leuciscus aspius* and allochthonous species. *Esox lucius*, *Leuciscus idus*, *Silurus glanis* and *Sander lucioperca* had CVs between 41% and 73%. The smallest variations in the proportion of catch were recorded for *Abramis brama* and other autochthonous species (the most abundant being *Rutilus rutilus*), with CVs of 37.77% and 33.43%, respectively. These two taxa also showed significant opposite trends ( $R^2 = 0.34$ ;  $P < 0.01$ ) and had a combined average biomass proportion of 67.03%.

### How to Cite

Treer, T. (2026): Changes in the proportion of fish species caught by artisanal fishers in the Croatian section of the Sava River. Croatian Journal of Fisheries, 84, 57-60. DOI: 10.2478/cjf-2026-0005.

## INTRODUCTION

Long-term investigations of freshwater fish communities often detect changes in the proportion of certain species. Research by Kaczkowski and Frankiewicz (2017) at Sulejow Reservoir in Poland, conducted from 1993 to 2015, showed that dominance fluctuated among four species within the fish community. Negative and positive correlations were observed between the biomass of some of these species. Interspecific competition within the cyprinid community of Hungarian Lake Balaton was reported by Biro et al. (1991). Lammens (1982) reported similar results in Lake Tjeukemeer in the Netherlands. In all these cases, as well as many others, competition for food was highlighted as particularly important. Analysis of Croatian artisanal logbooks from the River Sava over the past two decades showed a decline in total artisanal catches and catches by species (Treer, 2023, 2024a). The average weight of some species also changed significantly (Treer, 2024b). Therefore, the aim of this paper is to investigate possible changes in the biomass proportion in the catch of the most important taxa during this period.

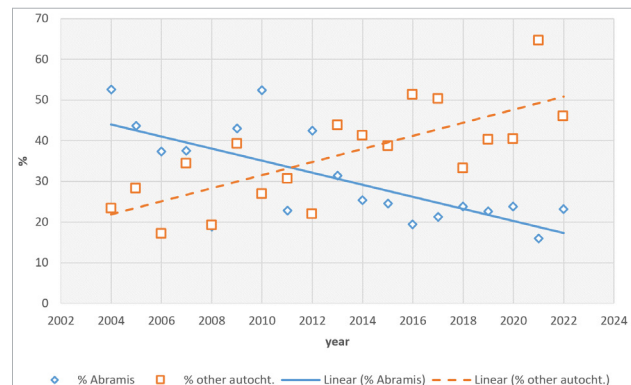
## MATERIALS AND METHODS

To help monitor freshwater fish stocks, fishers in Croatia are obliged to report their catches. Although the reliability of self-reporting of commercial catches has been questioned in some cases (Lyach and Remr, 2019; Schubert et al., 2022), logbooks can be useful in determining catch trends (Roos and Longo, 2021). The official data were obtained from the competent Directorate of Fisheries of the Ministry of Agriculture, Forestry and Fisheries, based on the annual reports of artisanal fisheries (MP, 2004; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017; 2018; 2019; 2020; 2021; 2022). The data were analysed for the eight most important species: common carp *Cyprinus carpio*, wels catfish *Silurus glanis*, pike-perch *Sander lucioperca*, northern pike *Esox lucius*, freshwater bream *Abramis brama*, sterlet sturgeon *Acipenser ruthenus*, ide *Leuciscus idus* and asp *Leuciscus aspius*, as well as for other autochthonous and allochthonous species.

For all data, the mean proportion of taxa in biomass catch (%) with 95% confidence limits (95% CL), coefficient of variation (CV %), and probability values for the correlation between years and proportions (p) were determined. The correlation between the two taxa with statistically significant opposite trends (*A. brama* and other autochthonous species) was also calculated. Statistical analysis was performed using IBM SPSS Statistics ver. 19.

## RESULTS AND DISCUSSION

Most of the investigated species showed considerable variations in catch from year to year, but without a clear trend ( $P > 0.05$ ). The largest fluctuations, with CV over 90%, were found for *A. ruthenus*, *C. carpio*, *L. aspius* and allochthonous species. CV between 41% and 73% was found for *E. lucius*, *L. idus*, *S. glanis* and *S. lucioperca*. The smallest variations in the proportion of catch were recorded for *A. brama* and other autochthonous species, with CV of 37.77% and 33.43%, respectively (Table 1). These two taxa also exhibited significant opposite trends ( $R^2 = 0.34$ ;  $P < 0.01$ ) (Fig. 1).



**Fig 1.** Proportion (%) of *Abramis brama* (rombs) and other autochthonous species (squares) in total fish catch (kg) by artisanal fishermen in the Croatian section of the River Sava from 2004 to 2022. These opposite trends are statistically significant ( $R^2 = 0.34$ ;  $P < 0.01$ )

The group “other autochthonous species” consists primarily of cactus roach *Rutilus virgo*, barbel *Barbus barbus*, common nase *Chondrostoma nasus* and chub *Squalius cephalus* (Matulić et al., 2024). Generally, the largest variations are most often observed in taxa with a small proportion, as the catch of only a few specimens can have a considerable influence.

The significant negative correlation between *A. brama* and other autochthonous species may result from competition, mostly with *R. virgo*, the most common species in this group. A highly negative correlation between the biomass of common bream and roach *Rutilus rutilus* was found by Kaczkowski and Frankiewicz (2017) in Sulejow Reservoir in Poland. In the reservoir, the dominance in biomass shifted between common bream and pike-perch during one period, then changed to roach and white bream *Blicca bjoerkna* in another. Similar competition between *A. brama* and *R. rutilus*, two of the most widespread and abundant fish species in Europe, was reported by Nunn et al. (2020).

**Table 1.** Proportion of taxa (mean %) with 95% confidence limits (95% CL), coefficient of variation (CV %) and probability values of correlation between years and proportions (*P*) in the Croatian section of the River Sava from 2004 to 2022

Taxon	Mean %	95% CL	CV%	<i>P</i>
<i>Cyprinus carpio</i>	3.76	2.02 – 5.50	92.27	<i>P</i> > 0.05
<i>Silurus glanis</i>	6.43	4.67 – 8.20	56.92	<i>P</i> > 0.05
<i>Sander lucioperca</i>	3.50	2.80 – 4.19	41.14	<i>P</i> > 0.05
<i>Esox lucius</i>	4.22	2.77 – 5.68	71.56	<i>P</i> > 0.05
<i>Abramis brama</i>	30.66	25.08 – 36.24	37.77	<i>P</i> < 0.01
<i>Acipenser ruthenus</i>	0.36	0.12 – 0.61	141.67	<i>P</i> > 0.05
<i>Leuciscus idus</i>	4.27	2.96 – 5.57	63.47	<i>P</i> > 0.05
<i>Leuciscus aspius</i>	3.36	1.87 – 4.86	92.26	<i>P</i> > 0.05
Other autochthonous species	36.37	30.51 – 42.24	33.43	<i>P</i> < 0.01
Allochthonous species	7.38	1.34 – 13.41	169.65	<i>P</i> > 0.05

The main reason for such competition is food, as mentioned by several authors (e.g. Lammens, 1982; Matena, 1998; Vasek et al., 2003). In conclusion, over the past two decades in the artisanal catch in the River Sava, significant changes in biomass proportions have not been registered among taxa with a small share, but a significant negative correlation has occurred between the two most abundant taxa (*A. brama* and other autochthonous species), with a combined average biomass proportion of 67.03%.

## PROMJENE UDJELA RIBLIH VRSTA U ULOVU GOSPODARSKIH RIBARA U HRVATSKOM DIJELU RIJEKE SAVE

### SAŽETAK

Broj gospodarskih ribara, a posljedično i njihov ulov u rijeci Savi kontinuirano padaju kroz dva desetljeća. Prosječna masa pojedinih vrsta se također značajno promijenila. Stoga je cilj ovoga rada istražiti moguće promjene u udjelu biomase najvažnijih taksona u ulovu. Većina vrsta pokazala je velike varijacije u ulovu iz godine u godinu, bez jasnog trenda (*P* > 0,05). Najveće oscilacije, s CV većim od 90% utvrđene su kod *Acipenser ruthenus*, *Cyprinus carpio*, *Leuciscus aspius* i alohtonih vrsta. CV između 41% and 73% su imali *Esox lucius*, *Leuciscus idus*, *Silurus glanis* i *Sander lucioperca*. Najmanje varijacije udjela u ulovu su utvrđene za *Abramis brama* (37,77%) i ostale autohtone vrste (najzastupljenija *Rutilus virgo*), (33,43%). Ova dva taksona su imali značajne suprotne trendove ( $R^2 = 0,34$ ; *P* < 0,01), a zajednički su u biomasi ulova zastupljeni s udjelom od 67,03 %.

**Ključne riječi:** slatke vode, komercijalni ribari, *Abramis brama*, *Rutilus pigus*, autohtone vrste riba, udio ribljih vrsta

### CONFLICT OF INTEREST

The author have declared no conflict of interest.

### DATA AVAILABILITY STATEMENT

The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

### REFERENCES

- Biro P.; Sadek S., Paulovits G. (1991): The food of bream (*Abramis-brama* L.) in 2 basins of Lake Balaton of different trophic status. *Hydrobiologia*, 209 (1), 51-58
- Kaczkowski Z.; Frankiewicz P. (2017): Long-term changes in fish community structure revealed by gillnet monitoring in a shallow, lowland reservoir. *Acta Ichthyologica et Piscatoria*, 47 (3), 279-288.
- Lammens E. (1982): Growth, condition and gonad development of bream (*Abramis-brama* L.) in relation to its feeding conditions in Tjeukemeer. *Hydrobiologia*, 95 (1), 311-320.
- Lyach R., Remr J. (2019): Changes in recreational catfish *Silurus glanis* harvest rates between years 1986–2017 in Central Europe. *Journal of Applied Ichthyology*, 35 (5), 1094-1104.

- Matena J. (1998): Diet spectra and competition between juvenile fish in the pelagic zone of a deep stratified reservoir during the first year of life. *International Review of Hydrobiology*, 83, 577-583.
- Matulić, D., Tomljanović, T., Piria, M., Gavrilović, A., Špelić, I., Radočaj, T., Rezić, A., Treer, T. (2024): Završno izvješće o provođenju programa praćenja stanja ribljeg fonda u slatkovodnom ribarstvu u 2024. godini, Grupa B) Ribolovno područje Sava (24/2024NV-2). Sveučilište u Zagrebu Agronomski fakultet, Zagreb, 154 p.
- MP (2004): Ulov g.r. Sava-Dunav 2004. (In Croatian. Catch of artisanal fishermen Sava-Danube 2004. Croatian Ministry of Agriculture)
- MP (2005): Ulov g.r. Sava-Dunav 2005. (In Croatian. Catch of artisanal fishermen Sava-Danube 2005. Croatian Ministry of Agriculture)
- MP (2006): Ulov g.r. Sava-Dunav 2006. (In Croatian. Catch of artisanal fishermen Sava-Danube 2006. Croatian Ministry of Agriculture)
- MP (2007): Ulov g.r. Sava-Dunav 2007. (In Croatian. Catch of artisanal fishermen Sava-Danube 2007. Croatian Ministry of Agriculture)
- MP (2008): Ulov g.r. Sava-Dunav 2008. (In Croatian. Catch of artisanal fishermen Sava-Danube 2008. Croatian Ministry of Agriculture)
- MP (2009): Ulov g.r. Sava-Dunav 2009. (In Croatian. Catch of artisanal fishermen Sava-Danube 2009. Croatian Ministry of Agriculture)
- MP (2010): Popis mjesečnog ulova GR za 2010. (In Croatian. List of monthly catch of artisanal fishermen in 2010. Croatian Ministry of Agriculture)
- MP (2011): Popis mjesečnog ulova GR za 2011. (In Croatian. List of monthly catch of artisanal fishermen in 2011. Croatian Ministry of Agriculture)
- MP (2012): Popis mjesečnog ulova GR za 2012. (In Croatian. List of monthly catch of artisanal fishermen in 2012. Croatian Ministry of Agriculture)
- MP (2013): Popis mjesečnog ulova GR za 2013. (In Croatian. List of monthly catch of artisanal fishermen in 2013. Croatian Ministry of Agriculture)
- MP (2014): Popis mjesečnog ulova GR za 2014. (In Croatian. List of monthly catch of artisanal fishermen in 2014. Croatian Ministry of Agriculture)
- MP (2015): Popis mjesečnog ulova GR za 2015. (In Croatian. List of monthly catch of artisanal fishermen in 2015. Croatian Ministry of Agriculture)
- MP (2016): Popis mjesečnog ulova GR za 2016. (In Croatian. List of monthly catch of artisanal fishermen in 2016. Croatian Ministry of Agriculture)
- MP (2017): Popis mjesečnog ulova GR za 2017. (In Croatian. List of monthly catch of artisanal fishermen in 2017. Croatian Ministry of Agriculture)
- MP (2018): Popis mjesečnog ulova GR za 2018. (In Croatian. List of monthly catch of artisanal fishermen in 2018. Croatian Ministry of Agriculture)
- MP (2019): Popis mjesečnog ulova GR za 2019. (In Croatian. List of monthly catch of artisanal fishermen in 2019. Croatian Ministry of Agriculture)
- MP (2020): Popis mjesečnog ulova GR za 2020. (In Croatian. List of monthly catch of artisanal fishermen in 2020. Croatian Ministry of Agriculture)
- MP (2021): Popis mjesečnog ulova GR za 2021. (In Croatian. List of monthly catch of artisanal fishermen in 2020. Croatian Ministry of Agriculture)
- MP (2022): Popis mjesečnog ulova GR za 2022. (In Croatian. List of monthly catch of artisanal fishermen in 2020. Croatian Ministry of Agriculture, Forestry and Fisheries)
- Nunn A. D., Vickers L. H., Mazik K., Bolland J. D., Peirson G., Axford S. N., Henshaw A., Cowx I. G. (2020): Dynamic competition and resource partitioning during the early life of two widespread, abundant and ecologically similar fishes. *Hydrobiologia*, 847 (10), 2211-2224.
- Roos N. C. and Longo G. O. (2021): Critical information for fisheries monitoring may be available in social media. *Aquatic Conservation*, 31, 2420-2428.
- Schubert, A., Nyingi, W., Tuda, P., Aura, C. M., Obiero, K., Manyala, J., Cowx, I. G., Vianna, G. M., Ansell, M., Meeuwig, J. J., Zeller, D. (2022): Reconstructing Kenya's total freshwater fisheries catches: 1950-2017. *Marine and Freshwater Research*, 73, 57-70.
- Treer T. (2023): Decline of artisanal fisheries in the Croatian section of the Sava River. *Croatian Journal of Fisheries*, 81, 45-48. DOI: 10.2478/cjf-2023-0005.
- Treer, T. (2024a): 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.
- Treer, T. (2024b): Trends in the average weight of fish caught by artisanal fishers in the Croatian section of the Sava River. *Croatian Journal of Fisheries*, 82, 159-162. DOI: 10.2478/cjf-2024-0020
- Vasek M., Kubecka J., Sed'a, J. (2003): Cyprinid predation on zooplankton along the longitudinal profile of a canyon-shaped reservoir. *Archiv für Hydrobiologie*. 156 (4), 535-550.