Sveučilište u Zagrebu
Agronomski fakultet

University of Zagreb
Faculty of Agriculture

DEPARTMENT OF FISHERIES, APICULTURE, WILDLIFE MANAGEMENT AND SPEC. ZOOLOGY



STRESSORS THAT ALTER FISH COMMUNITIES IN LARGE RIVERS

Prof. Marina Piria
E-mail: mpiria@agr.hr

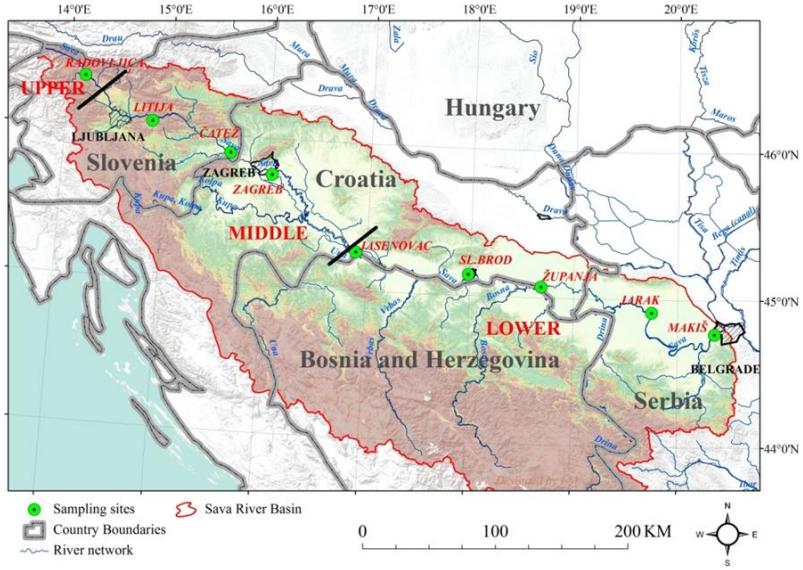
Introduction

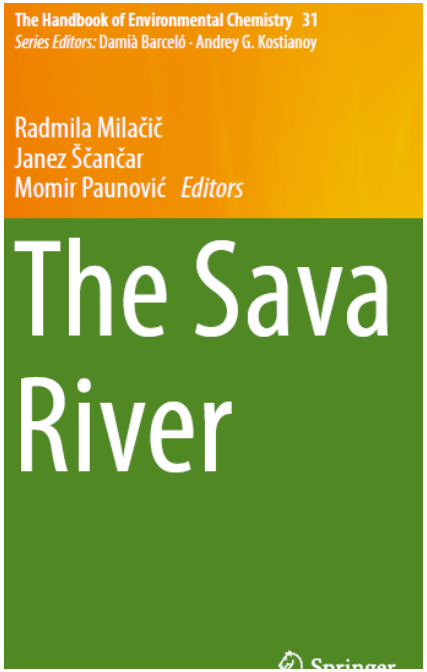
- Human activities expose inland water ecosystems to a wide range of stressors that threaten the biodiversity of ecosystems and ecosystem processes
- Physical, environmental and physiological disturbances induce stress in many aquatic species
- results of disturbances can lead to
  - decrease in food intake and fecundity
  - reduced biodiversity
  - increase in disease prevalence
  - changes in communities pattern
  - appropriate habitat for introduction of alien species,
  - increased numbers of small, opportunistic native/non-native species with a short life-span
  - Increased water temperature (e.g. NPP warm water discharge)

THE SAVA RIVER– CASE STUDY

- 17 century - records about fishes in the River Sava drainage area
- 19- mid 20 century - data collected were obtained from lists of commercial and sport fisherman's catches
- 1978 – first detailed fish community analyses of the middle and upper Sava
- resulted in a list of 54 fish species from 10 families, including 3 introduced fish species

- From 2003 regular fish monitoring (only in Croatian part of the Sava)



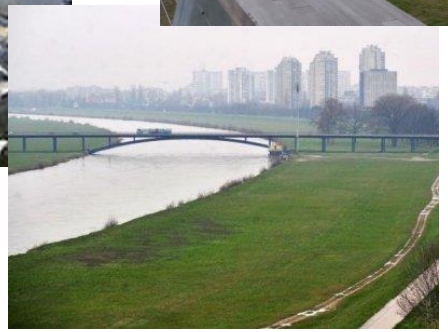


Ichthyofauna of the River Sava System

Predrag Simonović, Metka Povž, Marina Piria, Tomislav Treer, Avdul Adrović, Rifat Škrijelj, Vera Nikolić, and Vladica Simić

- 2015 - fish and lamprey fauna of the River Sava catchment consists of 74 species, 15 of which being considered alien

Stress – pollution, habitat loss, flow alteration



- At the beginning of the 20th century, the Sava River was clean and rich in ichthyofauna, but after 1920, carbon dust was emitted from the heavy and mining industries that started up
- 1945 and 1975 - massive fish kills were observed due to heavy pollution
- beginning of 1990s - heavy and mining industries were abandoned in Slovenia
- In the last 100 years, many interventions in the riverbed of the Sava for flood protection were carried out, causing habitat loss for fish spawning – particularly at middle and upper Sava.
- Kopački rit and Lonjsko polje – protected - spawning regions

Stress - pollution

No spirlin have been registered in the barbel zone of the Sava River, Croatia in the late seventies of the last century.

Since then, due to improved water quality the presence of spirlin gradually increased in number (23.3%) and in biomass (4.7%).

Folia Zool. – 55(1): 97–106 (2006)

Diet and growth of spirlin, *Alburnoides bipunctatus* in the barbel zone of the Sava River

Tomislav TREER, Marina PIRIA, Ivica ANIČIĆ, Roman SAFNER and Tea TOMLJANOVIĆ

Faculty of Agriculture, University of Zagreb, Department of Fisheries, Beekeeping and Special Zoology, Svetošimunska 25, 10000 Zagreb, Croatia; e-mail: treer@agr.hr

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Stress – pollution

Potentially toxic elements in muscle tissue of different fish species from the Sava River and risk assessment for consumers

Tea Zuliani [a,b,*], Janja Vidmar [a], Ana Drinčić [a,b], Janez Ščančar [a,b], Milena Horvat [a,b], Marijan Nečemer [c], Marina Piria [d], Predrag Simonović [e,f], Momir Paunović [f], Radmila Milačič [a,b]

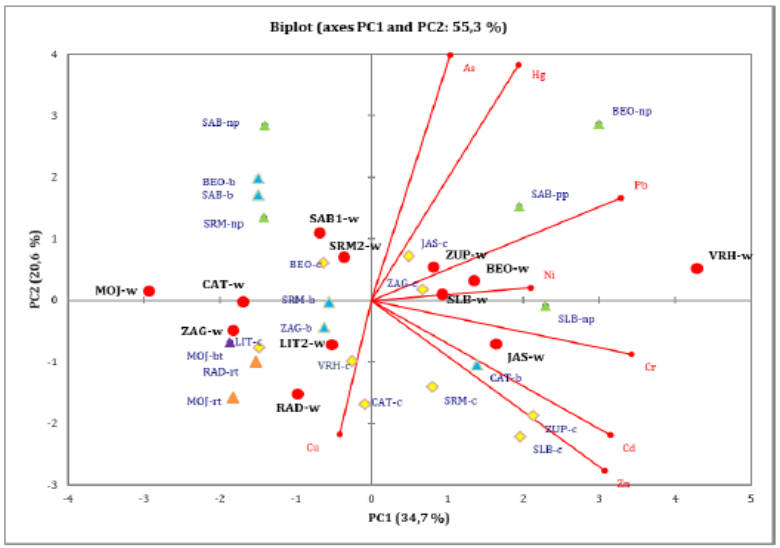
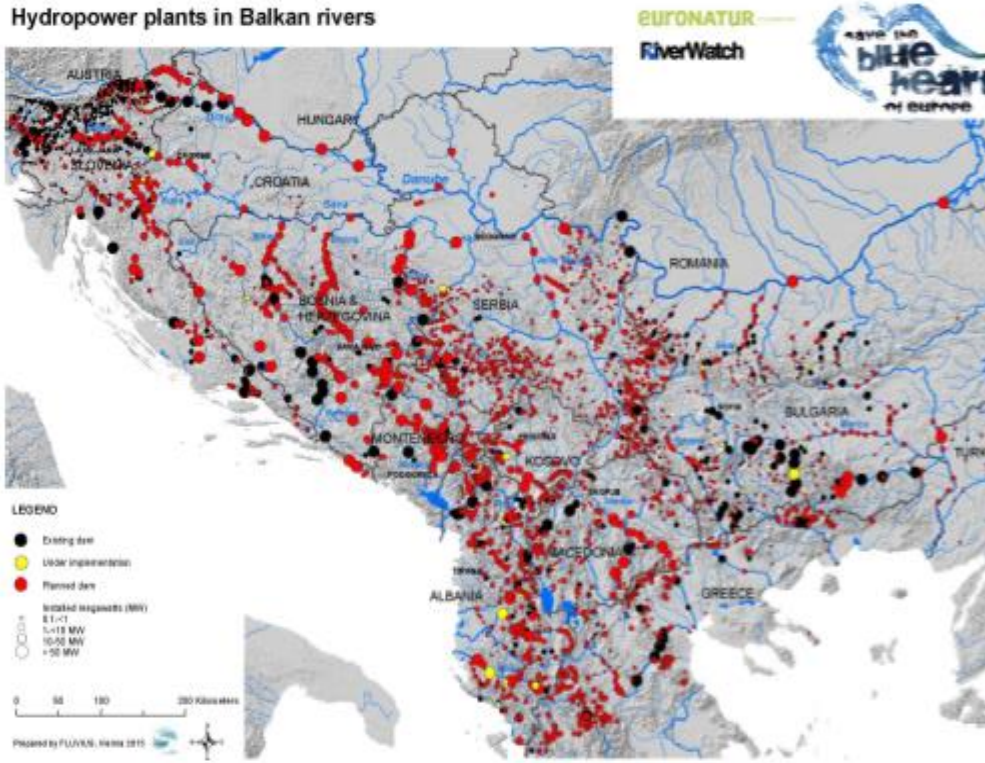


Fig 3 a: PCA biplot displaying Zn, Cd, Cu, Cr, Pb, Ni, As, Hg distribution between water sites (Mojstrana (MOJ-w), Radovljica (RAD-w), Litija (LIT2-w), Vrhovo (VRH-w), Čatež (CAT-w), Zagreb (ZAG-w), Jasenovac (JAS-w), Slavonski Brod (SLB1-w), Županja (ZUP-w), Sremska Mitrovica (SRM1-w), Šabac (SAB-w) and Belgrade (BEO-w) and fish species; rainbow trout (rt, N=2), brown trout (bt, N=1), chub (c, N=9), barbel (b, N=5), northern pike (np, N=2) and pikeperch (pp, N=1) sampled in 2015.

- **Methylmercury (MeHg) is an environmental pollutant known to cause neurobehavioral defects**
- **northern pike and pikeperch**

Stress - Damming

- The construction of the HPP began in Slovenia in early 1950 - substantial changes in ichthyofaunal and other biocenose structures
- 1980s, - Krško NPP near the border between Croatia and Slovenia - broke upstream fish migration
- Recent hydropower projects - Krško and Brežice HPPs - started operations in 2014 and 2017, respectively.
- Although a significant part of the River Sava and its tributaries is under Natura 2000 protection, the construction of new dams is planned
- Today, the subalpine upper River Sava in Slovenia crosses several breakthrough stretches and small basins, and is partially impounded by hydropower dams
- due to the discharge of water from the hydropower plant, there are frequent changes in the water level - disturbance in fish spawning



Stress – Damming, river connectivity

Study Series within the Campaign:

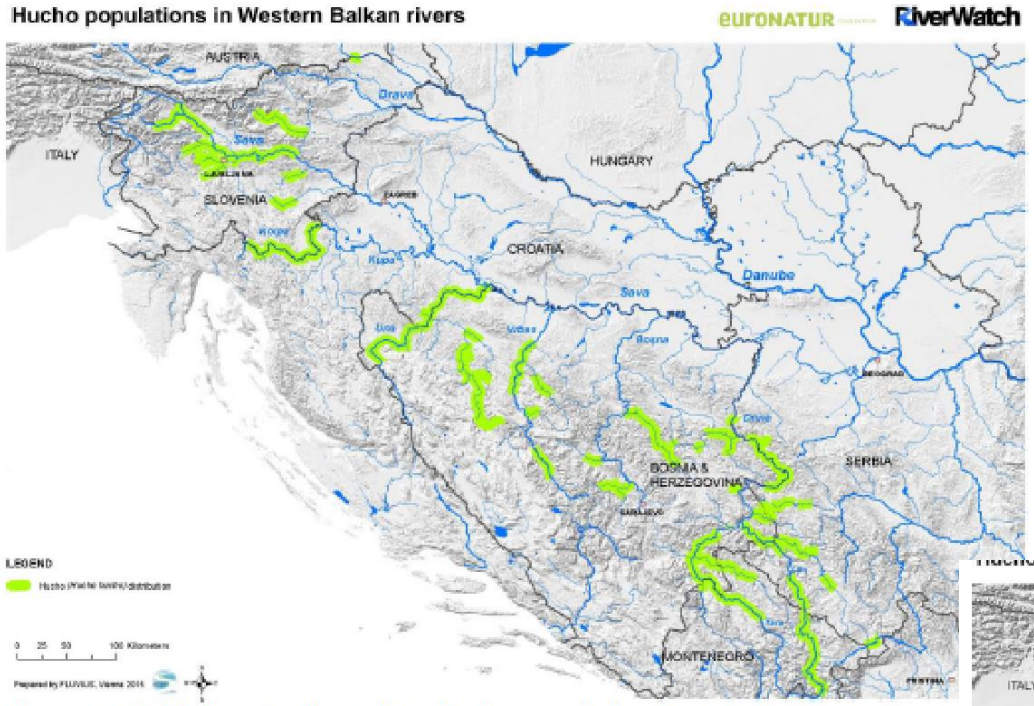


Figure 1. Distribution of self-sustaining Huchen populations in the Balkan region.

The Huchen *Hucho hucho* in the Balkan region

Distribution and future impacts by hydropower development

Prepared by

J. Freyhof, S. Weiss, A. Adrović, M. Ćaleta, A. Duplić, B. Hrašovec, B. Kalamujić, Z. Marčić, D. Milošević, M. Mrakovčić, D. Mrdak, M. Piria, P. Simonović, S. Šljuka, T. Tomljanović & D. Zabric

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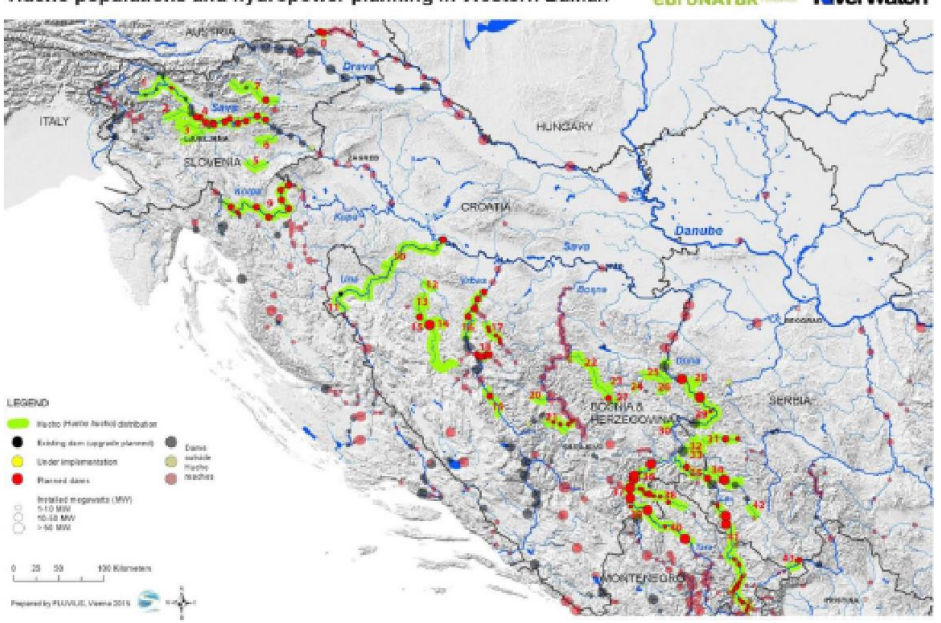

Figure 2. Distribution of self-sustaining Huchen populations and existing as well as potential future hydropower plants in the Balkan region. Numbers correspond to Table 1.

Stress – Damming, habitat degradation

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Science of the Total Environment

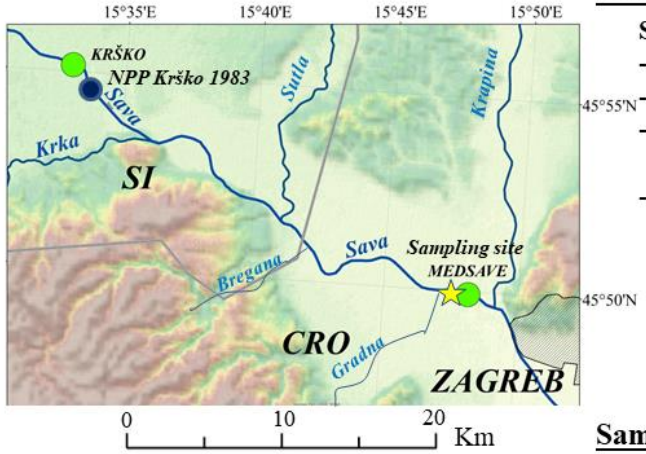
journal homepage: www.elsevier.com/locate/scitotenv

Threatened *Telestes souffia* seems is missing from the Medsave site

Long-term analysis of fish assemblage structure in the middle section of the Sava River – The impact of pollution, flood protection and dam construction

Marina Piria [a,*], Predrag Simonović [b,c], Davor Zanella [d], Marko Ćaleta [e], Nikica Šprem [a], Momir Paunović [c], Tea Tomljanović [a], Ana Gavrilović [a], Marija Pecina [f], Ivan Špelić [a], Daniel Matulić [a], Andrea Rezić [a], Ivica Aničić [a], Roman Safner [a], Tomislav Treer [a]

SP1 1978- 1980
SP2 1991- 1994



Sampling period (SP1 and SP2)

Stress

- Mining industry
- Nuclear power plant (NPP)
- Hydromorphological degradation: Slightly modified
- Heated effluents

Fish communities
- eurytopic
- limnophylic
- 26 species (4 alien)

SP3 2001- 2006
SP4 2011- 2017

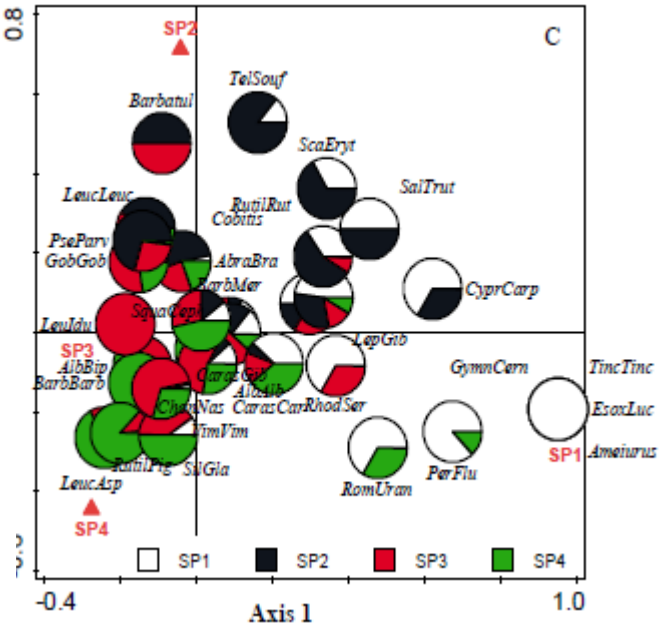
Sampling period (SP3 and SP4)

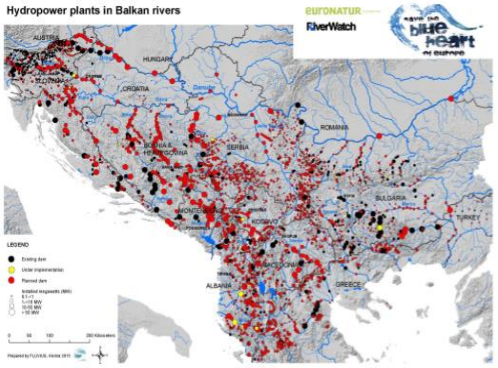
Stress

- Hydromorphological degradation: moderately modified
- NPP and Hydropower plant (HPP)
- Heated effluents
- Hydropeaking
- Flow modifications
- Habitat degradation

- Existing dam
- Under implementation
- Planned dam

Fish communities
- rheophilic
- 22 species (3 alien)





Stress – alien species, natives in non-native habitat

Science of the Total Environment 574 (2017) 264–271

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Characterization of sections of the Sava River based on fish community structure

Predrag Simonović [a] Marina Piria [b,*] Tea Zuliani [c] Marija Ilić [d] Nikola Marinković [d]
Margareta Kračt

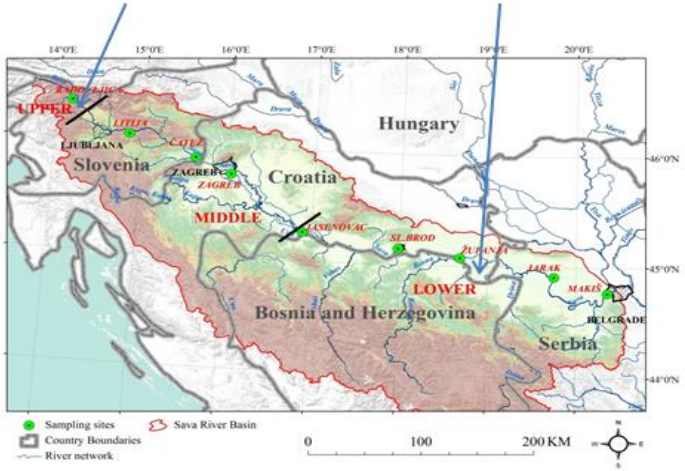
River flood

Short term stress

Natives out of their common zones and habitats

Mirror carp in trout fish community

Tench in a barbel zone

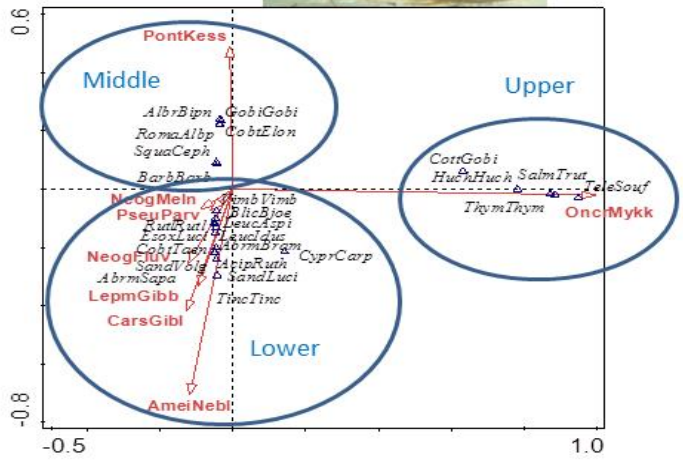


Regular water level

Long term stress

Aliens out of their common zones increasing in number

Ponticola kessleri new record



Number of alien fish increases downstream

Stress – new non-natives

2004: bighead goby – S. Šamac (370 rkm) (Mustafić, 2005)

Journal of Applied Ichthyology
J. Appl. Ichthyol. 27 (2011), 1383–1384
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Received: February 11, 2011
Accepted: March 14, 2011
doi: 10.1111/j.1439-0426.2011.01800.x

Short communication

First record of monkey goby, *Neogobius fluviatilis* (Pallas, 1814) in the barbel zone of the Sava River, Croatia

By M. Piria, T. Treer, T. Tomljanović, N. Šprem, D. Matulić, I. Aničić and R. Safner

Department of Fisheries, Beekeeping and Special Zoology, Faculty of Agriculture, University of Zagreb, Zagreb, Croatia

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Aquatic Invasions (2011) Volume 6, Supplement 1: S153–S157
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Open Access
Aquatic Invasions Records

First record of round goby, *Neogobius melanostomus* (Pallas, 1814) in the Sava River, Croatia

Marina Piria[1], Nikica Šprem[1]*, Ivan Jakovlić[2], Tea Tomljanović[1], Daniel Matulić[1], Tomislav Treer[1], Ivica Aničić[1] and Roman Safner[1]

NF = *N. fluviatilis*; PK = *P. kessleri*; NM = *N. melanostomus*

Journal of Applied Ichthyology
J. Appl. Ichthyol. 31 (2015), 888–894
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Accepted: January 15, 2015
doi: 10.1111/jai.12803

Distribution, abundance and condition of invasive Ponto-Caspian gobies *Ponticola kessleri* (Günther, 1861), *Neogobius fluviatilis* (Pallas, 1814), and *Neogobius melanostomus* (Pallas, 1814) in the Sava River basin, Croatia

By I. Jakovlić[1,2], M. Piria[2], N. Šprem[2], T. Tomljanović[2], D. Matulić[2] and T. Treer[2]

Stress – new non-natives

Science of the Total Environment 540 (2016) 386–395

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Dietary habits of invasive Ponto-Caspian gobies in the Croatian part of the Danube River basin and their potential impact on benthic fish communities

Marina Piria [a,*], Goran Jakšić [b], Ivan Jakovlić [c], Tomislav Treer [a]

- Monkey goby - Trichoptera, Chironomidae, Bivalvia and Odonata are highly important prey items
- Bighead goby - small fish and *Dikerogammarus* sp.
- Round goby - Gastropoda and various insect larvae (Trichoptera and Chironomidae)
- feeding overlap between monkey and round goby
- Round and bighead goby - possibility of influence on native Balkan golden loach *Sabanejewia balcanica*, zingel *Zingel streber*, Balkan loach *Cobitis elongata* and crucian carp *Carassius carassius* is indicated
- Monkey goby could be impacting common carp *Cyprinus carpio*, burbot *Lota lota* and Balkan loach *C. elongata* populations

Stress – alien fish introductions

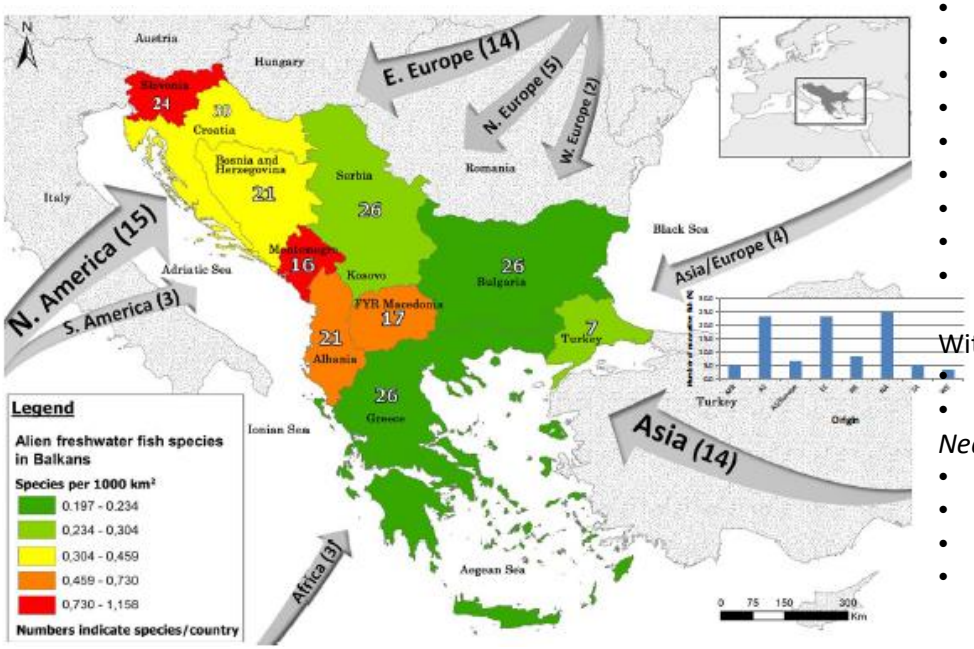
Received: 9 January 2017 | Accepted: 20 July 2017
DOI: 10.1111/faf.12242

ORIGINAL ARTICLE

WILEY FISH and FISHERIES

Alien freshwater fish species in the Balkans—Vectors and pathways of introduction

Marina Piria[1] | Predrag Simonović[2,3] | Eleni Kalogianni[4] | Leonidas Vardakas[4] | Nicholas Koutsikos[4,5] | Davor Zanella[6] | Milica Ristovska[7] | Apostolos Apostolou[8] | Avdul Adrović[9] | Danilo Mrdak[10] | Ali Serhan Tarkan[11] | Dragana Milošević[10] | Linda N Zanella[6] | Rigers Bakiu[12] | F Güler Ekmekçi[13] | Metka Povž[14] | Kastriot Korro[15] | Vera Nikolić[2] | Rifat Škrijelj[16] | Vasil Kostov[17] | Andrej Gregori[14] | Michael K Joy[18]



ALIEN FISH introductions – Croatia - Sava basin (13-15 self-sustaining)

- three P-C gobies
- North american catfish - *Ameiurus melas, A. nebulosus*
- Siberian sturgeon -*Acipenser baerii*
- Goldfish *Carassius auratus*
- Gibel carp *Carassius gibelio*
- Grass carp *Ctenopharyngodon idella*
- Pumpkinseed *Lepomis gibbosus*
- Topmouth gudgeon *Pseudorasbora parva*
- Rainbow trout *Oncorhynchus mykiss*
- Brown trout *Salmo trutta (AT)*
- Silver carp *Hypophthalmichthys molitrix*
- Bighead carp *Hypophthalmichthys nobilis*

Without established populations

- Chinese sleeper *Perccottus glenii - ESTABLISHED 2020*
- Nile tilapia *Oreochromis niloticus*

Nearby recently found:

- *Hybrid african catfish*
- North African catfish *Clarias gariepinus*
- Striped/white bass hybrid Morone chrysops × Morone saxatilis
- Pirapitinga *Piaractus brachypomus*

Previously mentioned stressors could open space for new alien fish invasions

Stress- Commercial and recreational fishing

- Fish stocking by anglers
- Not known changes caused by fishing

Croatian Journal of Fisheries, 2017, 75, 89-94
T. Treer and I. Kubatov: Recreational and artisanal fisheries in rivers

DOI: 10.1515/cjf-2017-0012

CODEN RIBAEG ISSN 1330-061X (print),
1848-0586 (online)

DE GRUYTER
OPEN

THE CO-EXISTENCE OF RECREATIONAL AND ARTISANAL FISHERIES IN THE CENTRAL PARTS OF THE DANUBE AND SAVA RIVERS

Tomislav Treer[1]*, István Kubatov[2]

from 2004 to 2011

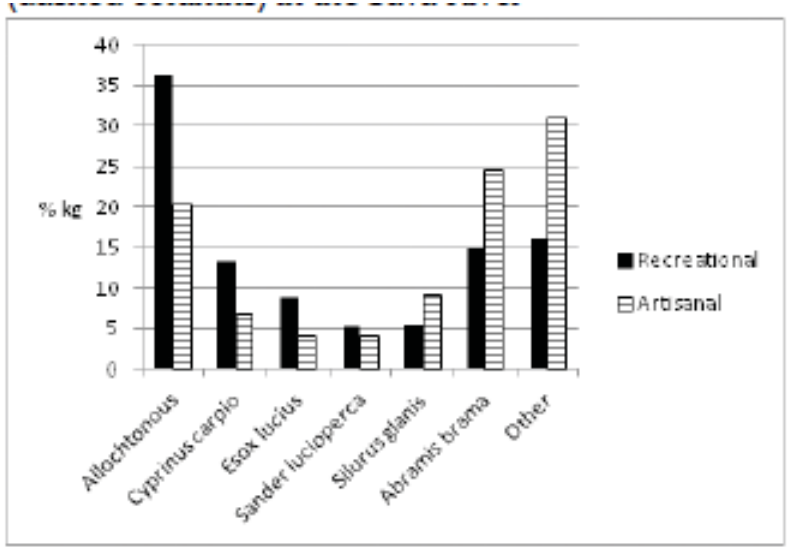
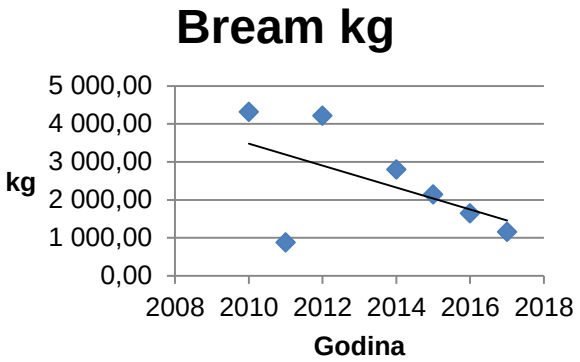
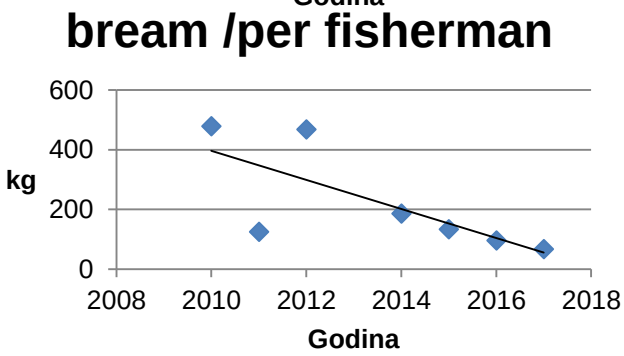
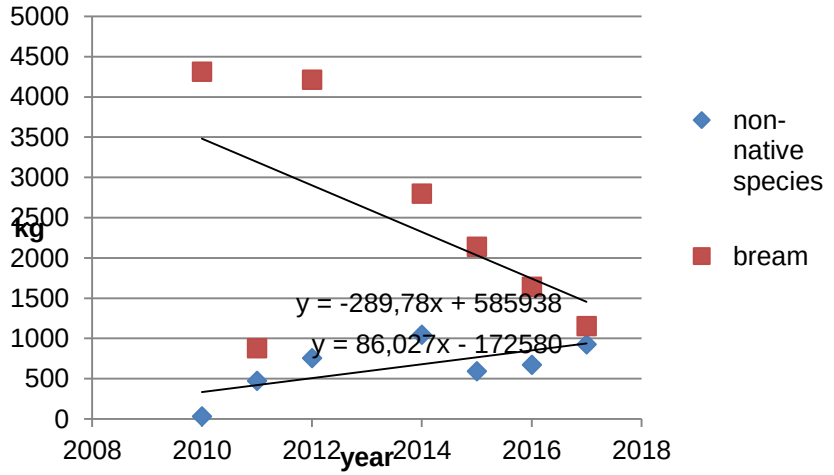


Fig 4. Average annual share of species in total catch (% kg) by recreational (full columns) and artisanal fishermen (dashed columns) in the Croatian section of the Danube







- Total catch (kg) bream and non-native species (Sava river)

Global Ecology and Conservation 27 (2021) e01520

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: http://www.elsevier.com/locate/gecco

Original Research Article

Identifying threats from introduced and translocated non-native freshwater fishes in Croatia and Slovenia under current and future climatic conditions

Tena Radočaj [a], Ivan Špelić [a], Lorenzo Vilizzi [b, *], Meta Povž [c], Marina Piria [a]

Stress: global warming

- 76 non-native freshwater fish species of which 48 extant (both introduced and translocated) and 28 horizon were screened for their risk of invasiveness under current and future climatic conditions.
- the highest-scoring species for Croatia
  - Brown bullhead *Ameiurus nebulosus*,
  - round goby *Neogobius melanostomus*,
  - topmouth gudgeon *Pseudorasbora parva*
  - Wels catfish *Silurus glanis*
- the highest-scoring species for Slovenia
  - *A. nebulosus*, snakehead *Channa argus* and *P. parva*
- the BRA+CCA risk scores increased for ≈50% of the species,
  - western mosquitofish *Gambusia affinis*, channel catfish *Ictalurus punctatus* and black carp *Mylopharyngodon piceus* achieving the highest score increment for Croatia,
  - and round goby *Neogobius melanostomus* and Chinese (Amur) sleeper *Perccottus glenii* for Slovenia.

Summary

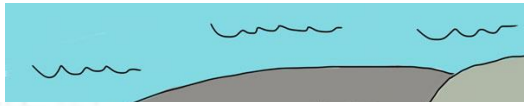
- Fish and lamprey fauna of the River Sava catchment consists of 74 species, 15 of which being considered alien
- Improved water quality of the Sava after 1990
- the number of stressors on native ichthyofauna progressively increases downstream (alien species, toxic elements, flow alteration, commercial fishery)

Short term stress

- human-induced stressors on the ecosystem (e.g., carp in trout fish community & tench in the main river course)
- Non-native (exotic) fish introduction

Long term stress

- Toxic elements contamination - daily consumption of fish, especially those from the lower stretch of the River Sava is posing a serious health threat to the local people
- Non-native speces – e.g Ponto Caspian Gobies still spreading upstream and has possible impact on 5 native (protected) and 1 commercially important fish species
- previous and future human-induced interventions (HPPs, embankment) - changes in fish species composition and a decline in diversity
  - habitat loss, flow alteration
- Stocking by recreational fishers
- Recreational and commercial fishery
- 50% non-native species may increase their invasiveness due global warming



Thank you for your attention