

# JDS4 monitoring of invasive alien species in the Bulgarian sector of the Danube River using standard and citizen science technologies

Teodora Trichkova<sup>1</sup>, Milcho Todorov<sup>1</sup>, Marian Kenderov<sup>2</sup>, Ivan Botev<sup>1</sup>, Zdravko Hubenov<sup>3</sup>

<sup>1</sup> Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria; E-mail: trichkova@gmail.com

<sup>2</sup> Biological Faculty, Sofia University 'St. Kliment Ohridski', Sofia, Bulgaria

<sup>3</sup> National Museum of Natural History, Bulgarian Academy of Sciences, Sofia, Bulgaria



## INTRODUCTION

The introduction and spread of invasive alien species (IAS) in the Danube River Basin (DRB) have increased recently (Tittizer et al. 2000, Puky et al. 2005, 2008, Hubenov, Trichkova 2007, Arbačiauskas et al. 2008, Panov et al. 2009, Puky 2009, Polačik et al. 2009, Lenhardt et al. 2011, Hubenov et al. 2013, Paunović et al. 2015, Trichkova et al. 2017a, Paunović, Csányi 2018). During the Joint Danube Survey 3 (JDS3) (2013), a total of 25 neophytes (four aquatic), 34 alien aquatic macroinvertebrates (out of 460 benthic invertebrate taxa) and 12 alien fish species (out of 67 fish taxa) were recorded. The level of biocontamination was estimated as moderate to high, with higher levels for the Upper and Middle Danube River sectors (Paunović et al. 2015).

The International Commission for the Protection of the Danube River (ICPDR) acknowledges that IAS have become a major concern for the DRB and considers their importance for the implementation of the EU Water Framework Directive 2000/60/EC (ICPDR 2015). An individual IAS programme has been designed and implemented at country levels in the frame of the Joint Danube Survey 4 (JDS4) in 2019 (Paunović 2018a,b). Furthermore, ICPDR in collaboration with the EASIN developed an extended list with IAS of regional concern for the DRB and updated the smartphone application 'Invasive Alien Species Europe' of the EC Joint Research Centre. The list includes 64 species, of which 29 fish and 44 aquatic invertebrates.

The main aim of this study was to assess the status (based on qualitative and quantitative parameters) of aquatic IAS in the shoreline zone of the Bulgarian sector of the Danube River, Danube tributaries and adjacent standing water bodies for the purposes of the JDS4. The implementation of this task includes the following objectives:

- Monitoring of IAS of benthic invertebrate species with focus on molluscs and crayfish of concern to EU, DRB and Bulgaria
- Monitoring of IAS of fish of concern to EU, DRB and Bulgaria
- Recording of target species with the smartphone application 'Invasive Alien Species Europe'
- Data analysis and assessment of biocontamination level of water bodies studied.

## MATERIALS AND METHODS

The sampling was conducted in July – October 2019, during five expeditions in the Danube River, in adjacent standing water bodies (canals, lakes, marshes), lower reaches of the Danube tributaries, as well as in lower and middle reaches of the Yantra River and its main tributaries (82 sites). The samples were collected by standard hydrobiological methods: beach seine and dip net for fish, dredging from a boat and from the shore for molluscs, and LiNi traps for crayfish.

Where possible the IAS were recorded with the 'Invasive Alien Species Europe' app.

The level of biocontamination of sampling sites was assessed based on the abundance contamination index (ACI) and ordinal richness contamination index (RCI), and accordingly, the site-specific biocontamination index (SBCI) and integrated biocantamination index (IBCI), after Arbačiauskas et al. (2008), Panov et al. (2009), and JDS4 recommendations (Paunović 2018a,b, Paunović, Csányi 2018).

## RESULTS

Fourteen IAS (7 invertebrates and 7 fish) were recorded out of 60 taxa of benthic invertebrates and 45 fish species. Of them, four IAS were of EU concern and 14 of DRB concern (Table 1). A total of 56 specimens were recorded with the app.

The crayfish were represented by *Faxonius limosus*, which was more frequent and abundant in the tributaries compared to the Danube River. The highest number of IAS molluscs was found in the Danube River (at over 2 m depth) and middle and lower reaches of the tributaries. Most frequent and abundant were the mussels *Corbicula fluminea*, *Dreissena bugensis* and *Sinanodonta woodiana*. The highest percentage of IAS fish was found in the adjacent standing water bodies (canals, lakes, marshes). Most frequently found and abundant there were *Carassius gibelio*, *Perccottus glenii* and *Lepomis gibbosus*. *Carassius gibelio* was frequent also in the Danube River and the tributaries. The abundance of IAS fish in the Danube River was comparatively low.

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Table 1.

List of invasive alien species of benthic invertebrates and fish recorded in the Bulgarian sector of the Danube River and adjacent water bodies during JDS4.

No	Taxon	IAS of EU concern	IAS of DRB concern	Priority species for Bulgaria	IAS app records
	Bryozoa				
	Pectinatellidae				
1	<i>Pectinatella magnifica</i>		X	X	2
	Turbellaria				
	Dugesidae				
2	<i>Girardia tigrina</i>		X		
	Decapoda				
	Cambaridae				
3	<i>Faxonius limosus</i>	X	X	X	6
	Gastropoda				
	Physidae				
4	<i>Physella acuta</i>		X	X	
	Bivalvia				
	Unionidae				
5	<i>Sinanodonta woodiana</i>		X	X	13
	Dreissenidae				
6	<i>Dreissena bugensis</i>		X	X	2
	Cyrenidae				
7	<i>Corbicula fluminea</i>		X	X	17
	Actinopterygii				
	Cyprinidae				
8	<i>Carassius gibelio</i>		X	X	2
9	<i>Ctenopharyngodon idella</i>		X	X	1
10	<i>Hypophthalmichthys molitrix</i>		X	X	1
11	<i>Pseudorasbora parva</i>	X	X	X	6
	Ictaluridae				
12	<i>Ameiurus melas</i>		X	X	1
	Centrarchidae				
13	<i>Lepomis gibbosus</i>	X	X	X	2
	Odontobutidae				
14	<i>Perccottus glenii</i>	X	X	X	3

The integrated biocontamination by type of water bodies during our study ranged from moderate, indicating 'moderate' ecological status, in the shoreline zone of the Danube River, from moderate to high in the canals and lakes adjacent to the Danube River, to severe ('bad' ecological status) in the Danube tributaries, and severe in the studied reservoirs (Table 2).

Table 2. Biocantamination and ecological status of studied sites in Bulgaria during JDS4.

Sites	SBCI Decapoda	SBCI Mollusca (up to 2 m)	SBCI Mollusca (2–4.5 m)	SBCI Mollusca 10 m2	SBCI Fish Beach seine 100 m	SBCI Fish Dip net 100 m	SBCI Fish Gill nets	IBCI	Ecological status
Danube River (39 sites)	1	2	4		1		2	1/2	Moderate
Danube tributaries (28 sites)	4			4		2		4	Bad
Lakes and canals (9 sites)				1		4		2/3	
Reservoirs (7 sites)				4		4		4	

