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XXIV International Conference
Ecological Truth

Editors

Radoje V. Pantovic

Zoran S. Marković

EcoIst '16

12 – 15 June 2016

**Hotel "BREZA" Vrnjacka Banja,
SERBIA**

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ASSESSMENT OF BIOPOLLUTION IN THE SERBIAN PART OF THE DANUBE RIVER

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ABSTRACT

Introduction of alien species in aquatic ecosystems may or may not produce negative ecological and/or socio-economic impacts. In a case where impacts of introduced alien species are measurable, the biological pollution of the ecosystem should be evaluated. Assessment of biopollution of the Serbian reach of the Danube River was based on samples collected during August and September 2013. In total, 20 alien macroinvertebrate species were registered. For four species strong biopollution level was estimated: *Chelicorophium curvispinum*, *Corbicula fluminea*, *Dikerogammarus villosus* and *Dreissena polymorpha*. As these species were already proven to be highly invasive in other European waterways it indicates that applied biopollution level could be a valuable method for estimation of invasiveness of alien species.

Key words: Allochthonous macroinvertebrates, Danube River, BPL index, Serbia.

INTRODUCTION

Danube River is the second largest river in Europe with a 2857 km long watercourse. The Serbian stretch of the Danube is about 20.6% of its total length which is 588 km [1], from Bezdan to the mouth of the Timok River. Along this stretch a numerous tributaries are present. Among them the Tisa with catchment area of 157200 km² and the Sava with catchment area of 96400 km² are two the most significant tributaries not only in Serbia, but regarding entire Danube basin [1].

The examined sector of the Danube is highly affected by hydromorphological alterations, the most notable by damming. A construction of two dams and hydropower plants (Iron Gate I and II) at rkm 943 and rkm 862.8 led to a permanent modification of natural conditions [2] which had pronounced effect on native communities and ecosystem as well.

As a part of a South Invasion Corridor, the Danube River basin is one of the most interesting area for monitoring of alien species [3], but allochthonous species of the Danube and other aquatic ecosystems in Serbia were studied in more details only in a few publications [4, 5, 6, 7, 8, 9]. On the other hand, risk assessment methodology for biological invasions was thoroughly studied for the entire watercourse of the Danube [10] with special emphasis on the territory of Serbia.

MATERIAL AND METHODS

Macroinvertebrate samples were collected in August and September 2013 during the International expedition Joint Danube Survey 3 supported by International Commission for the Protection of the Danube River (ICPDR). In total, 16 localities of the main course of the Danube in Serbia were examined: upstream from the Drava confluence, Bogojevo, Bačka Palanka, Novi Sad (upstream and downstream), Stari Slankamen, upstream from the Sava confluence, Pančevo (upstream and downstream), Velika Morava confluence (upstream and downstream), Banatska Palanka, Golubac, Tekija, Vrbica and locality upstream from the Timok confluence. Benthic samples were taken by benthological hand net (mesh size 500 µm and 1000 µm).

In order to estimate the biopollution of the Danube in Serbia Biopollution level (BPL) was used [11]. Assessment of the biopollution level is one of the most comprehensive methods regarding the effects of introduced alien species, because it combines alien species abundance and distribution in relation to their impacts on community, habitat and ecosystem functioning. According to this method five levels of biopollution could be estimated: 0 – No, 1 – Weak, 2 – Moderate, 3 – Strong and 4 – Massive (Figure 1).

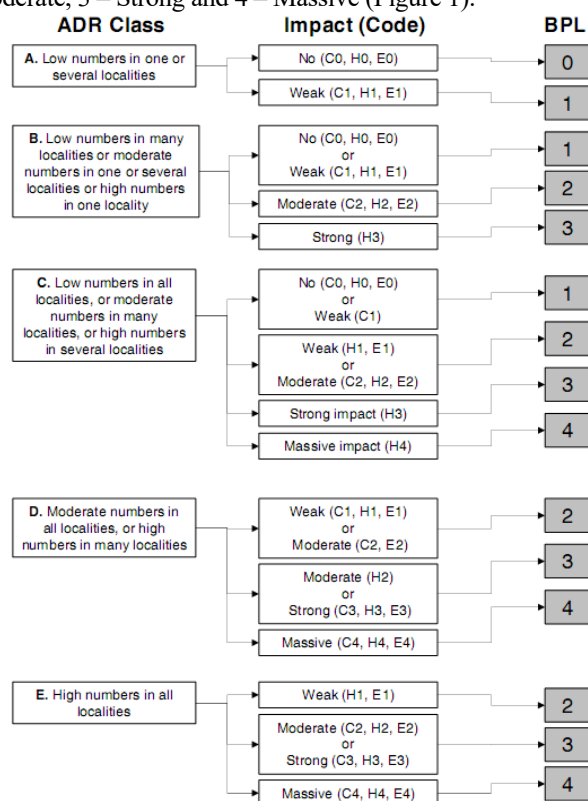


Figure 1. Scheme for assessment of Biopollution level (BPL). ADR was used for abundance and distribution range, C for community, H for habitats and E for ecosystem – according to [11].

RESULTS AND DISCUSSION

During the expedition 20 allochthonous macroinvertebrate species were found in the examined sector of the Danube. Based on the level of biopollution, for 16 alien species negative impact was confirmed, while for four species BPL was not evaluated. Of all species high D class was only estimated for two species – *Corophium curvispinum* and *Dikerogammarus villosus*, due to moderate numbers of individuals in many or all localities. Strong impact on community, habitat and/or ecosystem was assessed for species: *Corbicula fluminea*, *Dikerogammarus villosus*, *Dreissena polymorpha*, *Dreissena bugensis*, *Orconectes limosus*, *Pectinatella magnifica* and *Sinanodonta woodiana*. In accordance with abovementioned, strong biopollution level (BPL= 3) have had four species: *C. curvispinum*, *C. fluminea*, *D. villosus* and *D. polymorpha*. Massive biopollution level (BPL= 4) was assessed for none species.

Negative impacts on one or all components of the ecosystems of those four species contribute to their assessed strong biopollution level. For example, numerous experimental studies had proven predations of *D. villosus* on native amphipod species [12], which in combination with its high fertility and fecundity rate could cause severe impacts on macroinvertebrate and moreover fish communities in freshwater ecosystems [13]. Another allochthonous amphipod species *C. curvispinum* is one of the most widespread species in Europe [14]. Its high growing rate, an early maturation with few generations yearly and high fecundity rate, are stated as the most important features contributing to its rapid colonisation of European waterways [15]. An invasion potential of *D. polymorpha* has been increased by presence of free-living larval stage with high dispersion potential [16], wide ecological tolerance (for example, temperature and dissolved oxygen concentration) as well as ability to survive short period outside water [17]. Beside mainly negative impact, positive effects between *D. polymorpha* and two other allochthonous amphipod species *C. curvispinum* and *E. ishnus* are well documented, as well as their positive effects on native fauna [18, 19].

Registered species were already proven to be highly invasive in aquatic ecosystems all around Europe, indicating that biopollution level could be a valuable method for estimation the level of biological invasions of certain region. Risk assessment methodology on national level, should include this parameter as well, for more accurate estimation of impacts of allochthonous species.

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REFERENCES

1. Babić Mladenović, M., Kolarov, V. (2010). Natural characteristics of the Danube River in Serbia. In: Danube in Serbia – Joint Danube Survey 2 (eds. Paunović, M., Simonović, P., Simić, S., Simić, V.). Directorate for Water Management, Belgrade, pp. 59-78.

2. Petkovic, S., Babic-Mladenovic, M., Damnjanovic, M. (2004). Technical, Hydrological And Environmental Aspects of Iron Gate I and II, Report on International IAD Workshop „Hydrology and Limnology – another boundary in the Danube River Basin“, Vienna, Austria, pp. 42-44.
3. Panov, V.E., Alexandrov, B., Arbaciauskas, K., Binimelis, R., Copp, G.H., Grabowski, M., Lucy, F., Leuven, R.S.E.W., Nehring, S., Paunovic, M., Semenchenko, V., Son, M.O. (2009). Assessing the Risks of Aquatic Species Invasions via European Inland Waterways: From Concepts to Environmental Indicators. *Integrated Environmental Assessment and Management* 5(1): 110-126.
4. Paunovic, M., Borkovic, S.S., Pavlovic, S.Z., Saicic, Z.S., Cakic, P.D. (2008). Results of the 2006 Sava Survey – aquatic macroinvertebrates. *Archives of Biological Sciences* 60(2): 265-271.
5. Tomović, J., Csanyi, B., Stefanović, K., Atanacković, A., Tubić, B., Cakić, P., Paunović, M. (2010). Alien Mollusca in Serbian waters. BALWOIS Conference, Ohrid, Macedonia.
6. Zorić, K., Vranković, J., Cakić, P., Tomović, J., Vasiljević, B., Simić, V., Paunović, M. (2010b). Introduced species of aquatic macroinvertebrates. In: *Danube in Serbia – Joint Danube Survey 2* (eds. Paunović, M., Simonović, P., Simić, V., Simić, S.). Directorate for Water Management, Belgrade, pp. 267-280.
7. Zorić, K., Jakovčev-Todorović, D., Đikanović, V., Vasiljević, B., Tomović, J., Atanacković, A., Simić, V., Paunović, M. (2011). Distribution of the Ponto-Caspian polychaeta *Hypnina invalida* (Grube, 1860) in inland waters of Serbia. *Aquatic Invasions* 6(1): 33-38.
8. Zoric, K., Markovic, V., Vasiljevic, B., Tomovic, J., Atanackovic, A., Ilic, M., Kracun, M., Paunovic, M. (2013). Alien macroinvertebrate species of the Velika Morava River. „EcoIst '13“, Conference Proceedings, Bor, Serbia, pp. 43-47.
9. Zoric, K., Vasiljevic, B., Tomovic, J., Atanackovic, A., Tubic, B., Popović, N., Raković, M., Novaković, B., Paunovic, M. (2015). Allochthonous macroinvertebrate species of the Serbian stretch of the Tisa River. „EcoIst '15“, Conference Proceedings, Kopaonik, pp. 621-624.
10. Zorić, K. (2015). Invasiveness of allochthonous macroinvertebrate and fish species of the Danube River. Doctoral dissertation. University of Belgrade, Faculty of Biology, p. 141. [in Serbian]
11. Olenin, S., Minchin, D., Daunys, D. (2007). Assessment of biopollution in aquatic ecosystems. *Marine Pollution Bulletin* 55: 379-394.
12. Dick, J.T.A., Platvoet, D. (2000). Invading predatory crustacean *Dikerogammarus villosus* eliminates both native and exotic species. *Proceedings of Royal Society of London, Series B* 267: 977-983.
13. Devin, S., Piscart, C., Beisel, J.N., Moreteau, J.C. (2003). Ecological traits of the amphipod invader *Dikerogammarus villosus* on a mesohabitat scale. *Archiv für Hydrobiologie* 158(1): 43-56.
14. Van der Velde, G., Rajagopal, S., Kelleher, B., Muskó, I.B., Bij de Vaate, A. (2000). Ecological impact of crustacean invaders: general considerations and examples from the River Rhine. U: *The biodiversity crisis and Crustacea*:

- Proceedings of the 4th International Crustacean Congress (ur. Von Vaupel Klein, J.C., Schram, F.R.). Amsterdam, Brill, Leiden, Crustacean Issues, pp. 3-33.
15. Den Hartog, C., Van den Brink, F.W.B., Van der Velde, G. (1992). Why was the invasion of the river Rhine by *Corophium curvispinum* and *Corbicula* species so successful? *Journal of Natural History* 26: 1121-1129.
 16. Stoeckel, J.A., Schneider, D.W., Soeken, L.A., Blodgett, K.D., Sparks, R.E. (1997). Larval dynamics of a riverine metapopulation: implications for zebra mussel recruitment, dispersal, and control in a large river system. *Journal of North American Benthological Society* 16: 586-601.
 17. Zaiko, A., Lehtiniemi, M., Narščius, A., Olenin, S. (2011). Assessment of bioinvasion impacts on a regional scale: a comparative approach. *Biological Invasions* 13: 1739-1765.
 18. Jażdżewski, K., Konopacka, A. (2002). Invasive Ponto-Caspian species in waters of the Vistula and Oder basin and the southern Balic Sea. U: *Invasive Aquatic Species of Europe* (ur. Leppäkoski, E., Gollasch, S. Olenin, S.), Kluwer Academic Publishers, Dordrecht, Boston, London, 384-398.
 19. Köhn, J., Waterstraat, A. (1990). The amphipod fauna of Lake Kummerow (Mecklenburg, German Democratic Republic) with reference to *Echinogammarus ischnus* Stebbing, 1899. *Crustaceana* 58: 74-82.