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Ecological Truth

PROCEEDINGS

Edited by
Radoje V. PANTOVIC
and
Zoran S. MARKOVIC

EcoIst '13

Hotel "Jezero", Bor Lake, Bor, SERBIA
4 -7 June 2013

UNIVERSITY OF BELGRADE
TECHNICAL FACULTY BOR

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FRESHWATER SNAILS IN THE BELGRADE REGION

Vanja Markovic*, J. Tomovic, M. Kracun, M. Ilic, K. Zoric, B. Vasiljevic, A. Atanackovic, B. Tubic, M. Paunovic

University of Belgrade, Institute for Biological Research "Sinisa Stankovic", Belgrade, SERBIA

*1marva21@gmail.com

ABSTRACT

The aim of this paper is to present preliminary results of investigation of the Belgrade freshwater snails. The sampling was conducted at 31 sites, in the Summer of 2012. Snails were found at 18 localities. During the investigation relatively high diversity consisting of 13 gastropod taxa, belonging to 8 families, was found. The majority of them were adapted to moderate organic pollution and phytal and pelal microhabitats. The dominant species were eurivalent *Physella acuta* and *Valvata piscinalis*, both adapted to high organic load. Performed Correspondence analysis reveals five macrohabitat types. However, as limited set of data was used, further investigations are needed.

Key words: Freshwater gastropods,, fauna composition, macrohabitat types, Corespondence Analysis, Belgrade.

INTRODUCTION

The Belgrade region is the largest and the most populated urban area in Serbia, and one of the biggest in Southeastern Europe. About 1.7 million residents [1] live on 3223 km² of metropolitan area (ca 530 inhabitants per km²). In other words on 3.6% of Serbia's territory is accommodated about 25% of the country's population.

The city is located at the confluence of two large European rivers, the Danube and the Sava. Many smaller streams, the left and the right tributaries of the Sava and the Danube make the very unevenly developed hydrographic network. The terrain south of the large rivers is hilly, while north of them stretches the flat Pannonian Plain.

Densely populated area features a wide range of anthropogenic impacts. The most important are hydromorphological pressures (regulation and chanellization, bank reinforcement and embankments, sediment/sand extraction), organic and nutrient pollution (communal and urban wastewaters, agricultural drainages) and industrial and toxic pollution (industrial wastewaters, medical waste). All waterflows are under intensive hydromorphological pressures, besides channels on the north are under heavy organic\nutrients pollution (agricultural land drainage), while the south Belgrade flows

are under intensive communal, industrial and toxic pollution. Finally, the Sava and the Danube are the main overall colectors.

In addition to running waters, artificially created lakes are present. Among them the famous Ada Ciganlija is the biggest. Besides, there are acumulations near Avala Mountain (the Pariguz, the Bela Reka and the Duboki Potok). The acumulations are threatened by communal waste, especially Pariguz (Resnik suburban area)

The Institute of Public Health Belgrade controls quality of Belgrade surface waters. The estimation of the water quality based on benthic macroinvertebrate communities is part of monitoring. However, besides large rivers Danube and Sava, there are no published data regarding whether benthos macroinvertebrates, or snails in particular.

Snails are integral component of benthos community, characteristic for large lowland rivers in the region [2; 3, 4; 5]. Besides, as low mobile whole aquatic organisms, they are good indicators of water and habitat quality.

MATERIAL AND METHODS

In June and September 2012, as part of regular monitoring of surface water quality in Belgrade region, conducted by the Institute of Public Health Belgrade, a 38 benthic macroinvertebrate samples was taken. Semi-quantitative sampling was done by combining hand net (25x25 cm, 500 μm mesh size) and Van Veen dredge/grab (270 cm^2). Where it was possible (hand net sampling) a multi-habitat sampling procedure [6] has been applied. Samples from acumulations consist from one profundal part (by using dredge/grab) and one littoral part (by using hand net), while the rest of samples was taken mostly by hand-net. The samples were preserved by using 4% formaldehyde solution and further processed in the laboratory. The Gastropoda were found to be present in 18 samples,and were identified to the species level.

Composition of the gastropod fauna is provided in table 1. The supposed classification of monitoring sites into five groups/types according to overall (geomorphological, hydromorphological characteristics and dominant anthropogenic pollution) characteristics is given, and tested by multivariate ordination of data matrix. Correspondence Analysis (CA, [7]) was performed on 18-by-13 samples-by-taxa data matrix. To ensure consistency of data flora standardization was used [8]. Obtained ordination biplot, consisting of points representing samples and squares representing taxa, showed their multidimensional corelations. The callculation was done by the FLORA software (ver 6.0.: [8])

Table 1 - Composition of gastropod fauna of the Belgrade region

	Dun. Bat	Sa. Mak	Kol. Ob	Kol. Cel	Zel	Top	Bar	Belj	Ralj	Gal	Sib	Viz	Bela Rek	Parig	Dub. Pot	Ada1	Ada2	Ada3
	type 1		type 2		type 3					type 4			type 5					
Bythinia tentaculata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Esperiana acicularis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	2	2
Esperiana esperi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Gyraulus laevis	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0	0
Gyraulus sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Holandriana holandrii	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Litoglyphus naticoides	4	0	0	20	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa fontinalis	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6	0	0	0
Physella (Physa) acuta	0	2	76	0	2	9	118	0	11	0	3	0	0	0	0	0	0	0
Radix auricularia	0	0	0	0	2	0	1	0	8	0	1	0	0	0	21	0	0	0
Theodoxus fluviatilis	15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata piscinalis	0	0	0	0	1	0	1	5	425	52	0	0	0	0	0	14	0	0
Valvata sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0

LEGEND:

Dun. Bat	Dunav, Batajnica
Sa. Mak	Sava, Makiš
Kol. Ob	Kolubara, Obrenovac
Kol. Cel	Kolubara, Ćelije
Zel	Železnička reka
Top	Topčiderski potok
Bar	Barajevska reka
Belj	Beljanica
Ralj	Ralja
Gal	Galovica
Sib	Sibnica
Viz	Vizelj
BelaRek	Bela reka
Parig	Pariguz
Dub.Pot	Duboki potok
Ada1	children's pool
Ada2	Well 12-1
Ada3	Well 14-1

RESULTS AND DISCUSSION

During investigation relatively rich community with 13 gastropod taxa belongig to eight families was found. Such high overall diversity, considering detorated habitats and intensive anthropogenic impacts, could be related to different types of macrohabitats and microhabitats.

Considering percentage participation *V. piscinalis* with 56% (87% at the Beljanica locality) and *P. acuta* with 25% (98% at the Topciderska River) were found to be dominant members of gastropod community.

With regard to frequency of occurrence *P. acuta* (F=0.39) and *V. piscinalis* (F=0.33) were also the most important species. On the other hand, many species were present in one sample/sampling sites (rare species), namely, *Bythinia tentaculata* (Vizelj), *Gyraulus laevis* (Beljanica), *Gyraulus* sp. (Galovica), *Holandriana holandrii* (Kolubara Celije), *Valvata* sp, *Esperiana esperi* and *Esperiana acicularis* (Ada samples). However, knowing that abundant occurrence and high frequency of occurrence are confirmed for some of these species, for example: *E. acicularis* and *E. esperi* in Danube and Sava Rivers [9, 10], future investigations should reveal more about this inconsistency.

The majority of identified taxa was adapted to moderate and/or considerable organic load (beta and alpha mesosaprobs) according to AQEM database [11]. Among them *P.acuta* as alpha-mesosaprob tolerates high organic pollution (poly-saprobic conditions). It should be mentioned that some taxa, the most notably *V.piscinalis*, *E. acicularis* and *E. esperi*, due to either a lack of data or wide ecological tolerance, could not be assessed. Therefore it is important to continue data collection.

Regarding microhabitats preferences, phytophylous and pelophylous taxa were dominant. Among them *G. laevis* and *P. fontinalis* are phytophylous, while *V.piscinalis* is pelophylous *par excellence*. [11]

Performed Corespondence analysis reveals (figure 2) separation of five main groups of samples/sites. The first group consists of Danube (Dan_Bat) and Kolubara (Kol_Cel) samples, with characteristic taxa *L. naticoides*, *Theodoxus fluviatilis* and *H. holandrii*. The second group is composed from Ada samples (Ada_1, Ada_2 and Ada_3) defined by taxa *Valvata* sp., *E. acicularis* and *E. esperi*. The third group are the Beljanica (Bel), the Barajevska River (Bar) and the Ralja (Ral), with taxa *V. piscinalis* and *G. laevis*. The fourth group, located in centre of biplot, consists of acumulations near Avala (Dub_Pot, Par and Bel_rek) and Vizelj (Viz) samples, along with species *B. tentaculata, Radix auricularia and P. fontinalis*. Finally, the fifth group consists of Sava (Sav_Mak), Kolubara (Kol_Obr), Topčiderska (Top) and Železnička (Zel) rivers samples. Species *P. acuta* determines this group. Samples Galovica (Gal) with *Gyraulus* sp. and Sibnica (Sib) are intermediary located. Hence, CA modifies supposed tipology of sampling sites, revealing faunistical/ecological differences. Thus, the first group consists of the upstream samples (near the edge of the Belgrade Region) which are least contaminated, where oligo to beta mesosaprob taxa (*T.fluviatilis* and *H.holandrii*) were found. The Ada is separated as the second type, due to presence of *Esperiana* species, which are found in potamon type of rivers [3, 9, 10]. *Gyraulus laevis* and especially *V.piscinalis* are species with wide environmental tolerance, rapid growth and high fecundity,so well adapted to variable conditions of small often polluted and occasionally dry streams, as those from the third group. The fourth group is influenced with communal and agricultural waste, with limno- to rheophylous species adapted to organic pollution (*B. tentaculata* and *R. auricularia).* Species *P. acuta* tolerant to high organic load, and with wide ecological preferences determines the final group consisting of the Sava river and lower parts of its tributaries, which are under intensive hydromorphological pressures. Remaining sites (Gal and Sib), considering their characteristics, gravitate toward the fourth group. However it should be emphasized that for more accurate analyze, to determine and to test differences in faunal composition, detailed investigation is needed.

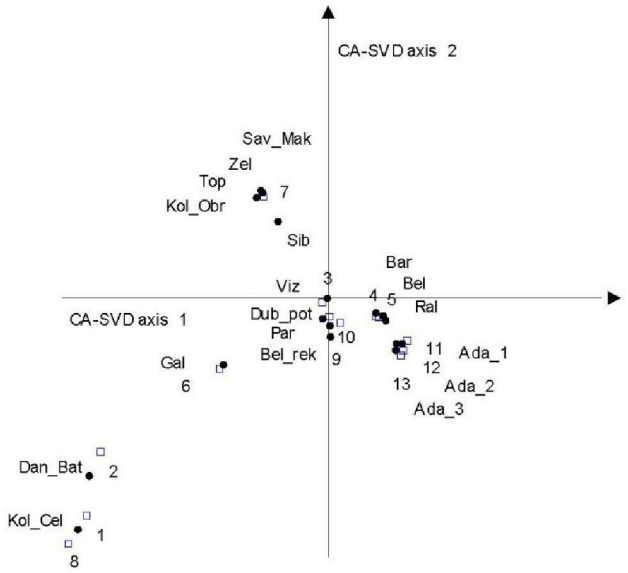

Figure 1. CA biplot performed on matrix of 18 samples x 13 taxa. The species names are numbered as follows: 1 - *Litoglyphus naticoides*, 2 - *Theodoxus fluviatilis*, 3 - *Bythinia tentaculata*, 4 - *Valvata piscinalis*, 5 - *Gyraulus laevis*, 6 - *Gyraulus* sp., 7 - *Physella acuta*, 8 - *Holandriana holandrii*, 9 - *Radix auricularia*, 10 - *Physa fontinalis*, 11 - *Esperiana esperi*, 12 - *Esperiana acicularis* and 13 - *Valvata* sp

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REFERENCES

1. 2011 Census of Population, Households and Dwellings in The Republic of Serbia: Ethnicity - Data by municipalities and cities". Statistical Office of Republic Of Serbia, Belgrade. 2012. p. 20. ISBN 978-86-6161-023-3. Retrieved 2012-11-30.
2. Csányi, B., & Paunovic, M. (2006). The aquatic macroinvertebrate community of the River Danube between Klostenburg (1942 rkm) and Calafat—Vidin (795 rkm). Acta Biol. Debr. Oecol. Hung, 14, 91-106.

3. Paunovic, M. M., Jakovcev-Todorovic, D. G., Simic, V. M., Stojanovic, B. D., & Cakic, P. D. (2007). Macroinvertebrates along the Serbian section of the Danube River (stream km 1429–925). Biologia, 62(2), 214-221.
4. Paunović, M. M., Borković, S. S., Pavlović, S. Z., Saičić, Z. S., & Cakić, P. D. (2008). Results of the 2006 Sava survey: Aquatic macroinvertebrates. Archives of Biological Sciences, 60(2), 265-271
5. Sommerwerk, N., Baumgartner, C., Bloesch, J.,Hein, T., Ostojić, A., Paunović, M., Schneider-Jakoby, M., Siber, R. and K. Tockner (2009).The Danube River Basin, Part 3, pp. 59-113. In: Rivers of Europe (Eds. Tockner, K., Uehlinger, U. and Robinson, C.T.). Academic Press, San Diego.
6. Hering, D., Verdonschot, P.F.M. , Moog, O., Sandin, L.(eds) (2004). Overview and application of the AQEM assessment system.Hydrobiologia 516: 1–20.
7. Pielou, E. C. (1984). The interpretation of ecological data: a primer on classification and ordination. Wiley-Interscience
8. Karadzic, B., Saso-Jovanovic, V., Jovanovic, Z., & Popovic, R. (1998). "Flora" A Database and Software for Floristic and Vegetation Analyzes. In *Progress in Botanical Research* (pp. 69-72). Springer Netherlands.
9. Paunović, M., Tomović, J., Kovačević, S., Zorić, K., Žganec, K., Simić, V., ... & Lucić, A. Macroinvertebrates of the Natural Substrate of the Sava River–Preliminary Results. electronic form only:: NE
10. Marković, V., Atanacković, A., Tubić, B., Vasiljević, B., Kračun, M., Tomović, J., ... & Paunović, M. Indicative status assessment of the Danube River (Iron Gate sector 849-1,077 rkm) based on the aquatic macroinvertebrates.
11. AQEM Consortium. (2002). Manual for the application of the AQEM system. A comprehensive method to assess European streams using benthic macroinvertebrates, developed for the purpose of the Water Framework Directive. Version, 1, 202.