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István Juhász
West-Transdanubian Water Directorate
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István Juhász
West-Transdanubian Water Directorate, Department of Water Conservation and River Basin Management, 9700 Szombathely, Vörösmarty u. 2., Hungary
(E-mail: juhasz.istvan@nyuduvizig.hu, Phone: +36 70 399 13 19)

Abstract:
According to the EU Water Framework Directive (WFD) the most important element in the assessment of an ecological status is the biological status, which is determined by the status of five groups of organisms (including benthic invertebrates). Macroinvertebrates indicate many environmental factors well; therefore, they are very useful in detecting changes in the status of an environment. The main aim in this research was to investigate the territorial distribution of the main metrics indicated by the macroinvertebrate data, because this can show the local differences and anomalies, which can indicate the impact of human pressures. The quantitative and representative macroinvertebrate data stem from the WFD's biological monitoring from 2007 to 2015. The macroinvertebrate data was processed using the ASTERICS 4.0.4 program. The program calculated some important metrics (i.e., microhabitat distributions, longitudinal zonation, functional feeding guilds, etc.). The metrics were plotted using the coordinates of the monitoring points of the ArcGIS 10.4 program.
Keywords: aquatic macroinvertebrates, territorial distribution, autoecological information, functional feeding guilds, microhabitat preference, current preference, sabrobic valence

Introductions

The aquatic macroinvertebrates are a very diverse group of organisms, which can be found in every type of water body. Macroinvertebrates have a broad taxonomic spectrum, different strategies of life histories (aquatic, amphibious), varied habitat preferences, a broad range of lifestyles, different lengths of generation time, diverse specialities of phenology, and variegated roles in the feeding web; furthermore, some of them are protected or increasingly protected species (Müller, 2010). Therefore, they are excellent indicators and extremely useful in indicating the changes in an aquatic ecosystem. Based on the knowledge of autoecological information on aquatic macroinvertebrates, the following methods can be used to indicate the ecological features of the habitat (AQEM Consortium, 2002):

- Functional feeding guilds (FFG)
- Microhabitat preference (MhP) $FFG_{Gra}=\frac{\sum_{i=1}^{n} gra^i h^i}{\sum_{i=1}^{n} h^i}\times\frac{100}{10}$; $MhP_{Arg}=\frac{\sum_{i=1}^{n} arg^i h^i}{\sum_{i=1}^{n} h^i}\times\frac{100}{10}$; $CuP_{LB}=\frac{\sum_{i=1}^{n} h^i_{LB}}{\sum_{i=1}^{n} h^i}$
- Current preference (CuP)
- Longitudinal zonation (Z)
- Locomotion types (LoM) $Z_{Euc}=\frac{\sum_{i=1}^{n} euc^i h^i}{\sum_{i=1}^{n} h^i}\times\frac{100}{10}$; $LoM_{ss}=\frac{\sum_{i=1}^{n} ss^i h^i}{\sum_{i=1}^{n} h^i}\times\frac{100}{10}$; $SV_x=\frac{\sum_{i=1}^{n} s_x{}^i h^i}{\sum_{i=1}^{n} h^i}\times\frac{100}{10}$
- Saprobic valence (SV)

Using these ecological features, calculated with these metrics, it is possible to compare the habitats in two or more sampling points (Juhász, 2016). These distribution of ecological features can be plotted on the map, so thus we can see the natural distribution of the ecological features in the area. If anomalies are discovered in these natural distributions, we can conclude that only human effects could have distorted the natural distributions of each ecological feature at the sampling points.

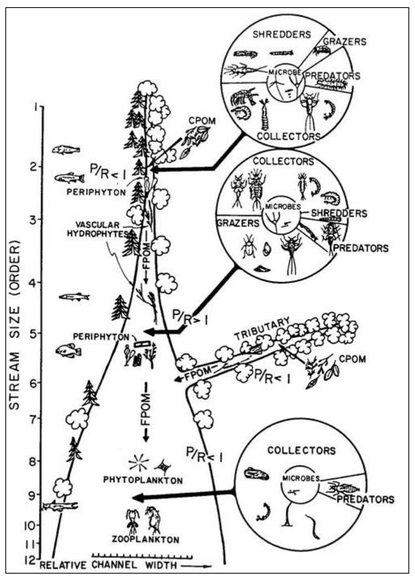
Material and methods

The quantitative and representative macroinvertebrate data stem from the WFD's biological monitoring from 2007 to 2015 on the operation area of West-Transdanubian Water Directorate. The macroinvertebrate data was processed using the ASTERICS 4.0.4 program. The program calculated some important metrics (i.e., microhabitat preference, longitudinal zonation, functional feeding guilds, current preference, saprobic valence, etc.). Just the scored taxa was used to prepare the distribution of 100%. The average of the ecological features calculated from all samples was used for each sampling point. The metrics were plotted using the coordinates of the monitoring points of the ArcGIS 10.4 program.

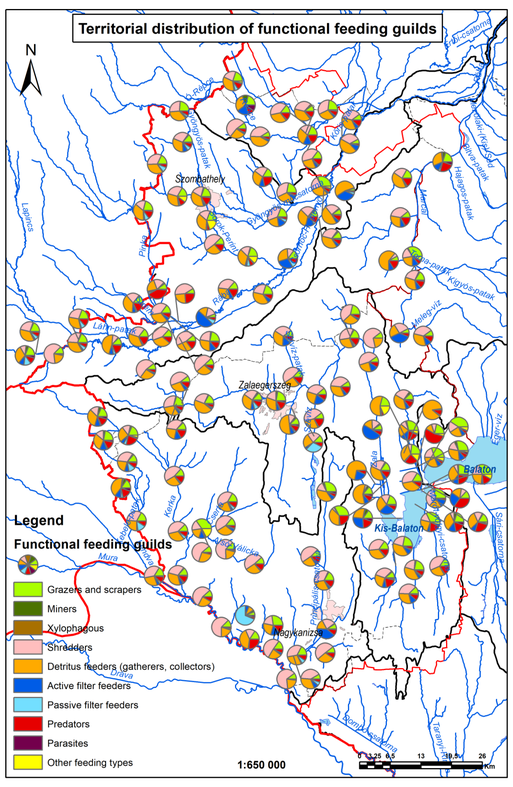
Results

Functional feeding guilds:

The relationship between the functional feeding guilds and the stream orders was revealed in the River Continuum Concept (Vannote et al., 1980). Based on this concept, the below figure shows that each feeding guild isn't change each other sharply but overlapping each other and they can be found along the streams with continuously variable rate. Based on the below figure, predators and detritus feeders can be found in every stream section, while the shredders are present mostly in the upstream and the grazers mainly



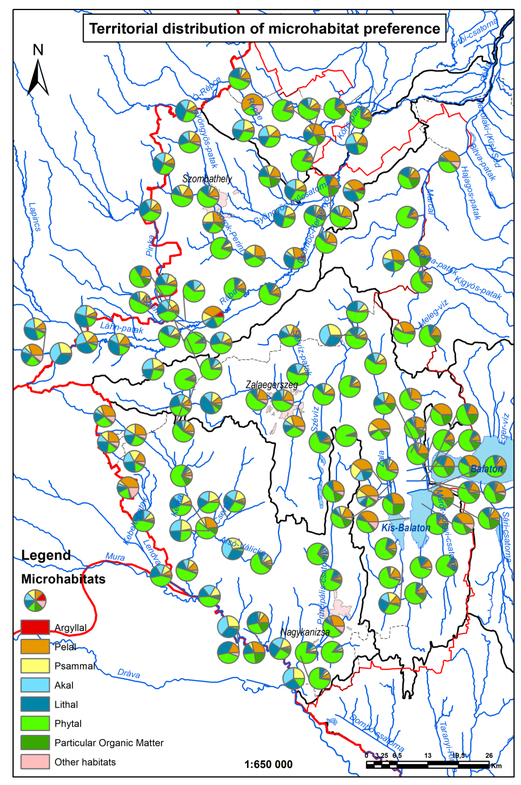
A proposed relationship between stream size and the progressive shift in structural and functional attributes of lotic communities.
(Vannote et al., 1980)

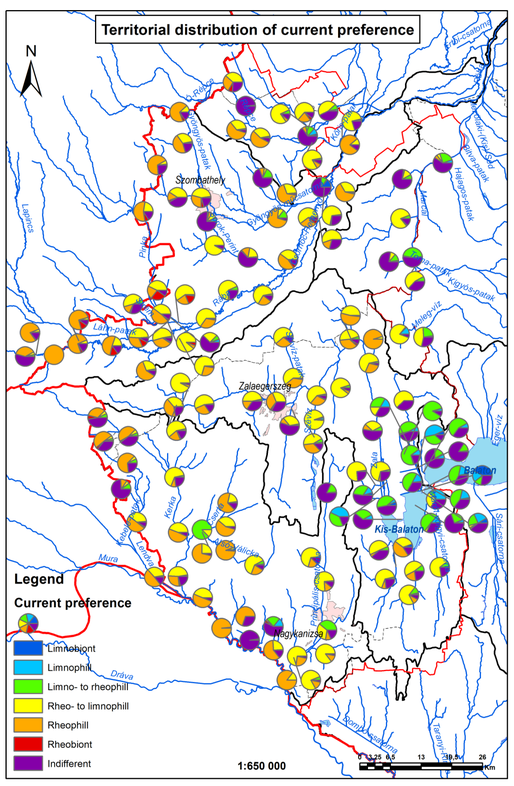


the middle section on the stream. Almost all of the examined stream sections have low order numbers, where the detritus feeder and the shredder taxa are dominant. But we can also found predator and grazer taxa and they prevail near the Kis-Balaton. The rate of active filter feeders increases in the larger river (Rába) and in the small streams with large organic matter which is caused usually by the fishing reservoirs.

Microhabitat preference:

The microhabitat preference primarily shows the distribution of the typical habitats of the sampling point, therefore it's very difficult to conclude specific deductions which are characteristics of a larger territorial unit. For example sludge fraction may indicate emission of cleaned wastewater else sedimentation caused by the downstream section or artificial changes in the flow conditions. It can be said that coarser mineral substrates occur exclusively in the upstream sections. Plant microhabitats are dominant where the flow speed is low and the river bed is shadow free. The presence of particular organic matter as substrate can be observed in the channels around the Kis-Balaton and downstream of the emission points of cleaned wastewater.



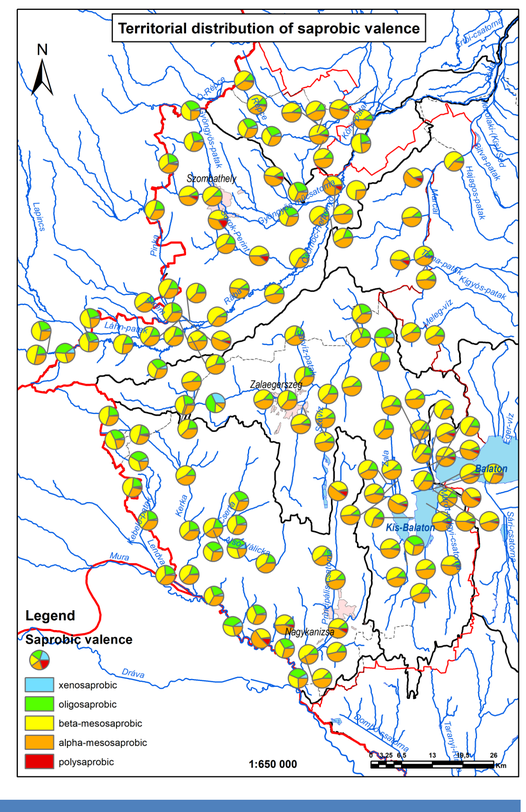


Current preference:

The current preference depends primarily on the river bed slope so the territorial differences can be discovered perfectly. In the upper section of streams the rheobiont and rheophill taxa are dominant, at the downstream the rheo- to limnophill taxa become dominant. The limno- to rheophill current preference appears in the lowland streams with extremely small river bed slope, while the limnophill and the limnobiont taxa are present in the area of Kis-Balaton and the nearby channels. The taxa with no flow preference show the greatest variation, primarily they are present in the area of Kis-Balaton and the surrounding channels but they are also indicators of the overgrown river beds due to the organic pollution.

Saprobic valence:

In case of sabrobic valence, the oligosabropbic and the mesosaprobic valences occur every sampling point. The alpha-mesosaprobic valence is dominant on the downstream section in the streams, in plain area and in the area of Kis-Balaton. While the oligosaprobic valence appears in higher ratio only in the hilly upstream sections of the streams. The xeno-saprobic valence appears solely on small water-courses where the impact of human activities are minimal (e.g. Keresztúri-patak, Törösznеki-patak, etc.). Contrarily, the polysaprobic valence perfectly shows the streams which are significantly affected by emissions of cleaned wastewater (e.g. Birkitói-árok, Sorok-Perint, Cinca, Principális-csatorna, etc.).



Conclusion

The normal territorial distributions of ecological features can be well observed on the maps. The anomalies in the maps show the effects of human activities. The emission of cleaned wastewater is indicated by the increased polysaprobic valence, sludge and particular organic matter microhabitats. The active filter feeder feeding guild can be indicated the reservoir in the upstream section on small streams.

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