University of Sopron

Faculty of Forestry

Theses of doctoral (PhD) dissertation

Composition of macroinvertebrate communities in small streams depending on hydromorphological characteristics

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Introduction

Composition of the fauna and flora of a riverine ecosystem is continuously altered by natural disturbing factors. Life conditions of aquatic macroinvertebrates are affected equally by flood waves caused by heavy rainfalls, erosion of high banks or the period with shallow water following summer droughts. Due to changes not only their ecological niche is being modified or even decreased but also interactions between individuals undergo a transition.

Macroinvertebrates living in a stream have adapted to the dynamics and extremities of discharge as well as to the characteristics of water flow with their life strategy, morphology and behavioural patterns.

On the local scale flow conditions, composition of the riverbed material and surroundings of the stream equally affect not only abundance and diversity of macroinvertebrate species but also that of habitats that can be occupied by them.

Objectives

There are few biological or hydraulic samplings where every characteristic is considered with similar emphasis and elaboration.

Primary aim of present research is the elaboration of a complex sampling methodology that enables small-scale analysis of the relationship between aquatic macroinvertebrates and background variables.

The methodology enables to choose the scale of the survey according to the purpose. Thus another aim of the survey is the analysis of the suitability of pool-riffle sequences on the mesohabitat level, as well as the definition of different microhabitat types considering several variables.

With the help of the complex sampling methodology character species of individual meso- and microhabitat types in headwater streams can be determined. Furthermore, the survey of the species' habitat preference as well as the description of differences between habitat choice of species within different taxonomic units and age groups is enabled.

The methodology enables species-specific habitat preference analyzes, thus can be applied for nature conservation purposes, during the elaboration of species conservation plans. Is also

enables – having information about flow dynamics and the composition of the local macroinvertebrate community – planning and implementation of riverbed management according to the requirements of species.

Theses of the dissertation

1. I elaborated a complex sampling methodology enabling small-scale survey of the connection between aquatic macroinvertebrates and their environment [**1, 2, 6**].

Subunits of the elaborated methodology are 33x50 cm big sub-quadrates with an area of 0,165 m^2, for each of which there are available: one quantitative biological sample, one riverbed material sample and minimally 10 water velocity data as well as hydraulic parameters in similar numbers partly derived from that. Six sub-quadrates comprise one quadrate (size 1x1 m, area 1m^2), the number of which depends on the width of the stream at a given point. Results obtained during the sampling methodology can be scaled according to the set aims. The new methodology is cheap, with a time expenditure not larger than that of similarly habitat based samplings. Opposite to the small-scale technique elaborated by me most methodologies use one big mixed sample derived from relevant microhabitats to

describe a given stream. Furthermore, the materials collected this way can be paired with less hydrobiological and hydromorphological data than in the case of the quadrate method.

2. With the help of the complex sampling methodology I defined seven different microhabitat types within the mesohabitats.

Taking in account field observations, water depth, water velocity and hydraulic roughness of sub-quadrates I differentiated between following seven microhabitat types: 1: riffle margin (type 1), 2: riffle margin (type 2), 3: riffle center, 4: pool margin (type 1), 5: pool margin (type 2), 6: pool center (type 1), 7: pool center (type 2). Types of pool margin are differentiated by their locality within a curve (inner or outer bend of the curve), types of riffle margins by the composition of riverbed material a (fine grained or fine grained with stones) and types of pool center by their character (flushed or non-flushed). By applying above types we can get an even more precise picture of the habitat diversity and macroinvertebrate fauna of a stream, as well as micro-scale needs of species.

3. I proved that during surveys on the mesohabitat level the mesohabitat type called transition by me (in the literature "run") may not be overlooked [**3**].

During evaluations on the mesohabitat level I succeeded in proving the significance of differentiating the transitory mesohabitat type. During sampling this mesohabitat type is rarely applied due to its difficulty to be defined, however, based on my results the units classified as this type differ not only by the composition of macroinvertebrate communities in samples (species stock, FFG distribution) but also by the examined background variables. The transition type shows similar traits to the other two mesohabitat types based on both the characteristics of biotic and abiotic elements, however, in the majority of cases is characterized by an FFG distribution with special proportions and hydraulic values.

4. The sampling methodology elaborated by me enables a more accurate determination of the habitat preference of species [**4, 5**].

During the analyses differences in the habitat preference of several species, adult and juvenile individuals of a species as well as of genera within a given family were detected and

proven. With the help of the methodology observations and experiences in the field may be proven also statistically. The connections described in most cases are not new to science but prove the operability and justification of the methodology.

5. I compared and described macroinvertebrate species-groups in space (on the mesohabitat level and between different streams) and time (in the case of Rák-patak) **[3, 4, 6]**.

During spatial analyses, composition of macroinvertebrate communities in streams with similar characteristics differed from each other based on quantities, whereas based on species stock samples of two streams (Kőbányai-patak, Petőczi-árok) mingle with each other. Based on my results, species stock of sections in the category riffle show significant similarity in the case of above mentioned two streams. During temporary analyses samples of certain years differed more according to species stock than according to the abundance of aquatic macroinvertabrates. Based on the last fact it can be stated that the composition of the macroinvertebrate community of a natural small stream follows the transition of habitats, if no major regrouping caused by the separation of an oxbow or bigger flood wave occurs on the section of stream in question.

6. I defined hydraulic factors determining organization of macroinvertebrate species communities of the studied stream types.

Based on my results the composition of macroinvertebrate communities, in the case of the three surveyed natural forest streams is determined by background variables of the following three groups of characteristics: the first group includes parameters describing the extension of the habitat (width and depth of the stream), the second group includes the Froude number describing the connection between water depth and velocity, whereas the third group includes the Reynolds number describing the connection between the composition of the riverbed material and the water velocity.

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