UNIVERSITY OF PÉCS

Biological and Sportbiological Doctoral School

Microhabitat preference and biotic interactions among freshwater gammarids (Curstacea, Amphipoda)

PhD Thesis

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INTRODUCTION

The order of amphipods (Amphipoda), like most of the macroscopic crustaceans is belonging to the Malacostraca class. Despite most of the amphipods are can be found in marine environments, they inhabit a broad spectrum of freshwater habitats as well. Epibenthic groups are much more diverse and are usually bounded to the littoral vegetation in lakes and rivers or, to the sediment of small streams and springs (Väinölä et al., 2008). To reveal their ecological role as accurately as possible is urgent, because of their enormous number of individuals and biomass, they clearly stand out from the rest of the aquatic macroinvertebrates. As amphipods are occupying central position in freshwater food webs, they have a significant ecological role in the communities of flowing water systems. However, we have only limited information about their behavior and ecological needs.

Niche segregation depends on multiple influencing factors, including available resources, habitat variability and structure, and consequently the temporal and spatial patterns of species (abundances and densities of competitors and mutualists) (Chesson, 2000; Chase & Leibold, 2003). Accordingly, the habitat choice of freshwater gammarids can be influenced by a complex sequence of interacting biotic and abiotic factors (Dahl & Greenberg, 1996). The factors that may affect the distribution and number of *Gammarus* species can be grouped as follows: (1) environmental variables that determine the habitat choice of species regardless of other species (Savage, 1996), (2) differences in life cycle characteristics and fecundity (Pöckl, 1993)

(3) biotic interactions such as predation and competition (Dick et al., 1994; Dick, 1996; MacNeil et al., 1999).

(1) According to the environmental parameters, we can observe the zonation of species along the longitudinal sections of watercourses (Janetzky, 1994). *Gammarus fossarum* is already present in the krenal zone, but more abundant in the rhithron zone. Whereas *G. roeselii* inhabits the rhitron and the potamon zone, but most abundant in the transition zone between these two (Horvai et al., 2009). In other words, the overlapping of the two species is usually observed in the rhithron zone.

(2) *Gammarus roeselii* is able to permanently coexist with *G. fossarum* at many habitats. According to the literature, one of the most probable reasons is that interspecific difference can be found in the reproduction time of the two species and thus the maximum abundance of the species is separate, and some spatial separation can also be assumed (Pöckl & Humpesch, 1990; Kontschán, 2002, 2003). It has been proven that there are interspecific differences in: the time and length of reproductive gap, reproductive success, number, size and survival of the eggs, the time requires for the development of new the generation, the growth rate, the time lag between moults, seasonal fecundity and the energy allocated for reproduction (Pöckl & Humpesch, 1990; Pöckl & Timischl, 1990; Pöckl, 1992, 1993). Based on these findings, the faster life cycle and longer period of reproductive inactivity of *G. roeselii* connected with the slower development and shorter inactive state of *G. fossarum* provides that the reproductive and activity levels of the two species are balanced,

which can be an important factor in the stable coexistence of these two species.

To sum up, as long as there is a remarkable amount of information available about the large-scale distribution along the longitudinal sections of streams and rivers, as well as the differences in temperature-dependent activity and fecundity are also known. Our knowledge on the spatial habitat separation due to possible interspecific competition is deficient (3).

AIMS

According to the introduction, it is clearly seen that we have a limited knowledge on the co-existence pattern of native freshwater gammarid species i.e. the spatial separation in microhabitat level and the influence of environmental variables, biotic and abiotic factors on this phenomenon. In light of these, my aims are the followings:

1. Provide new data for the gammarid fauna of the Mecsek Mountains.

2. Explore the differences in abundance and distribution of species along the sections of the Völgységi-stream.

3. Study the difference in the abundance among microhabitats depending on the sympatric or allopatric distribution of the species.

4. Explore whether the riffle-pool system (mesohabitat) influences the choice of microhabitat of the species

5. Examine how anthropogenic disturbances affect the gammarid fauna of springs of Mecsek Mountains and their influence on the microhabitat level quantitative distribution.

MATERIAL AND METHODS

Sampling sites and procedure

Our work was carried out at 31 streams from Mecsek Mountains and Baranya Hilly Region, altogether 49 sampling sites were selected. From 33 sites only faunistical samples were taken, meanwhile from 10 streams in Mecsek Mountains, and from 6 locations along the longitudinal section of Völgységi-stream quantitative sampling was carried out based on the internationally accepted AQEM sampling protocol applied in the Water Framework Directive (AQEM Consortium, 2002).

Environmental variables

During the quantitative samples were carried out in Mecsek Mountains, variables on inorganic water chemistry, vegetation structure of the surroundings of each site and parameters of streambed morphology were recorded on the field each time, and additional water chemical parameters were determined based on the water samples introduced to laboratory. In this way, 48 local, abiotic environmental variables were recorded at each sampling site for each seasons related to streambed morphology (19), physicochemical attribute (15) and riparian vegetation (14). Water samples for physicochemical analyses were taken prior to the biological sampling. We calculated indices of

naturalness of riparian and streambed vegetation and vegetation of the nearest slopes based on the Landscape Ecological Vegetation Database and Map of Hungary (Molnár et al. 2007, Molnár & Horváth 2008).

NEW SCIENTIFIC RESULTS

1. In our study we contributed to the gammarid fauna of the Mecsek Mountains at 49 sampling points to gain a comprehensive knowledge on the distribution of the species. We proved that the dominant species is the *Gammarus fossarum*, *G. roeselii* appeared at only a few sites.

2. We proved that the quantitative distribution of the species at the level of the stream sections was greatly influenced by the diversity of the microhabitats (habitat complexity). So, the previously known zonation of the species along the longitudinal section of the Völgységi-stream aligns with the coverage and proportion of the microhabitats. The dominance of *G. fossarum* at upstream sections continuously transitioned into the dominance of *G. roeselii* through an intermediate section, where both species coexisted.

3. We proved the different quantitative distribution of the species among the microhabitats even the case of single occurrence and in case of coexistence. While *G. roeselii* had a definitive microhabitat preference, *G. fossarum* showed a uniform distribution in case of single occurrences. This distribution significantly changes in case of coexistence as a result of interspecific competition.

4. Both species occur in meso- and microhabitat combination resembling their usually occupied habitat along the stream continuum. *Gammarus fossarum*, which usually occupies higher altitudinal distribution ranges, chose the lithal in riffles. *Gammarus roeselii*, which usually inhabits the lower parts of a stream, preferred the biotic microhabitats located in deeper waters in pools in the middle section of Völgységi-stream.

5. We observed that in case of stronger anthropogenic impacts (e.g. highly degraded riparian vegetation) *G. roeselii* appeared at disturbed headwater sites with similar coexistence pattern which was found under natural circumstances in the middle section of the streams. We conclude that the degradation of near-pristine headwater sites could enable *G. roeselii* to further expand its area of occurrence and to occupy sections which basically, without disturbance, are not suitable for them.

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