Studies on the ecological significance of bank filtration areas with special emphasis on groundwater fauna and hydrological patterns in Buk-Myeon and Dasan-Myeon of Nakdong River, Korea

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Introduction

Groundwater is one of the most important resources and also one of the biggest living spaces on earth, populated by a species rich fauna, the so-called stygofauna. These long-living stygobite animals are highly adapted to their biotope. They are blind, colourless and their body-length is stretched. They have also a reduced metabolism and low rates of reproduction (GIBERT 2001). As a result of their high adaptation and their long life span stygofauna are considered to be well suited for biomonitoring (Hahn & Friedrich 1999, Hahn 2002). It is well known that slow sand filter and bank filtration areas are colonized by communities that are similar to those of the groundwater (Husmann 1968; Rumm 1999). Numerous studies show the importance of hydro-logical influences on groundwater fauna (Moss-lacher et al. 1996; Hahn 2003), but there are no comparative ecological studies about the effects of bank filtration facilities on stygofauna yet.

In this study we want to answer the question, if interstitial meiofauna and stygofauna can evaluate bank filtration facilities. Another question is if bank filtration leads to changes in the spatio-temporal distribution of the interstitial meiofauna and stygofauna. The examination gives first evidence about groundwater-surface water interactions and hydraulic effects of bank-filtration-pumps on stygofauna. Furthermore the influences of flood on bank-filtration facilities and on the quality of drinking water will be discovered. The stygofauna will be registered by using stratified traps which are inserted in bores at Buk-Myeon and Dasan-Myeon area of Nakdong-River. During one year those traps will be sampled twice a month. According to the method as mentioned above biological indication using stygofauna could be a new tool for water quality-management and sustainable groundwater usage.

Aims and Issues

Main goal of this examination is the ecological evaluation of groundwater-surface water interactions in particular the interactions in bank filtration facility areas. Furthermore the evaluation of inexpensive stygofauna traps systems will be carried out. First comparative ecological cognitions about the effects of bank filtration and hydrological influences in case of flood will be made.

Special questions

This study makes a contribution to clarify elementary questions of groundwater ecology: Do the stygofauna reflect the water chemistry, the microbiology and the colonization of the surrounding groundwater? Can bank filtration lead to changes in the spatio-temporal distribution of the interstitial meiofauna and stygofauna? Which differences exist on the spatio-temporal distribution of the interstitial meiofauna and stygofauna between bank filtration areas and natural locations? Do interstitial meiofauna and stygofauna act as bioindicators for the evaluation of bank filtration facilities?

Economic efficiency

The examination of the fauna gives first evidence about:
1.) Groundwater-surface water interactions
2.) Hydraulic effects of bank-filtration-pumps on stygofauna
3.) Hydrological influences of flood on the interstitial meiofauna and stygofauna
4.) Flood influences on bank-filtration facilities and on the quality of drinking water

The results of these investigations could be a basis to develop a biological indicator system. Biological indication using stygofauna could be a new inexpensive tool for water quality-management and sustainable groundwater use. Contrary to methods we use up to now (water chemistry for example) biological indication covers groundwater conditions of a long period of time. With a small number of stygofauna-samples you are able to determine groundwater conditions. To draw a conclusion biological indication is a faster and cheaper method in comparison to other methods like physico-chemical analysis.

Study

The Study is in progress at the sampling site at Buk-Myeon and Dasan-Myeon by using stratified traps in a borehole with a depth of 12m. Fauna, water and bacteria are sampled twice in a month by pumping the contents of the traps and surrounding groundwater. The collection of data will derive from the period of July 2003 to June 2004.

Method

Five transect bores are bored near Buk-Myeon and three bores at the reference location near Dasan-Myeon. The boreholes are drilled to a depth of 12m and have a diameter of 30 cm. Therefore special pipes are used. They are made up of plastic and there are two different types of pipes. One sort is a closed pipe and the other variation is a so-called filter slot pipe. These slots are 1.5 mm breadth wise. Each borehole is packed with 10 cm of gravel (Æ = 2-3 mm).

Sampling is carried out by using the special type of Stygofauna traps. One trap system consists of three stratified traps. Those traps are fixed on a central thread pole (Æ = 6 mm) in several depths within the reach of the filter slots (width = 1, 5 mm) in the casing of every bore (Æ = 100 mm). A hose leads from each individual trap to the surface to permit discrete sampling of all parameters from each trap in the series.

Each trap consists of an inert plastic chamber (Æ = 94 mm, height = 150 mm) with 8 rows of 5 holes (Æ = 15 mm) in its upper part. To avoid hydro-chemical gradients within the chambers that could guide fauna out of the trap, a ring of 8 holes (Æ = 15 mm) which is covered with plankton netting (74 µm) is located at the bottom of every chamber. At every sampling occasion, a manual camping air pump is connected to a modified dessicator. A hose that leads to the device for collecting bacterial samples can be connected to the hoses of the traps by an adapter and is fixed on a plastic tube (outer Æ = 12 mm, length = 300 mm).

This plastic tube leads into the dessicator and ends around 10 mm above its bottom so that the water can flow into the measuring jug without bubbles. This suction pump operates well down to a groundwater level of around 7.50 m below the surface. Maximum flow rate is approximately 4 l/min. To draw a comparison between trap content and surrounding groundwater of all traps of Buk-Myeon and Dasan-Myeon will be initially sampled for physic chemistry and Stygofauna. The water including the fauna is removed in three fractions, [hose volume, trap volume and two litres of the surrounding groundwater], and compared with one another(MATZKE & HAHN 2002, HAHN 2003).

Buk-Myeon Sampling site

The sampling site is a young terrace at the right bank of the Nakdong-River. The study area of Buk-Myeon enfolded a bank zone of 500 m length and 200 m broad. This part of the right Nakdong bank can be easily destroyed by erosion because of the undercut slope position. Especially in the case of a high discharge like in flood seasons this bank area is highly endangered by destroying.

The terrace is utilized by agriculture very intensively. At this place the average of the groundwater level is about 5 m to 6 m. In case of flood the bank can be overflowed completely. A transect of seven bank-filtration pumps is located at the exterior part of the bank. Because of the agricultural land use it was impossible to drill a transect of three boreholes behind the series of pumps. However, the boreholes could only be drilled closed to the field path. Because of a broken filter pipe, wrong drilling and erosion of the Nakdong bank only four bores of six planed can utilized now.
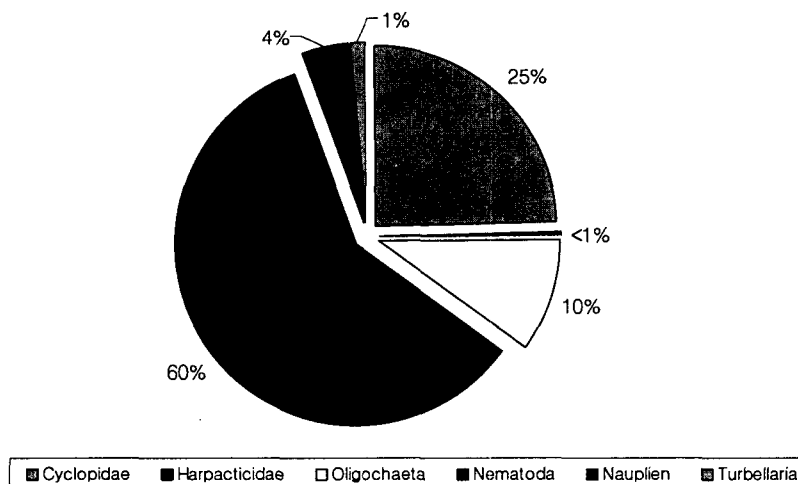
| ▨ Cyclopidae | ■ Harpacticidae | ☐ Oligochaeta | ■ Nematoda | ■ Nauplien | ▨ Turbellaria |

Figure 1. Fauna Buk-Myeon

Dasan-Myeon Sampling site

The study area Dasan-Myeon is at the right bank of the Nakdong-River. The sampling area is subdivided into two sections by a barrage. The area below this barrage enfolded a bank zone of 200 m length and 500 m broad. At here two bores have been drilled each to a total depth of 12 m. The part behind the barrage has a length of 200 m and a broad of 600 m. Close to the bordering mountain one borehole has been drilled to a total depth of 12 m. The three gauges are applied to a transect of 300 m length.Both areas are utilized very intensively by agriculture. At this place the average of the groundwater level is about 5 m to 6 m. In case of flood the bank area below the barrage can be overflowed completely. Because of the agricultural land use the three boreholes could only be drilled closed to the field path like at Buk-Myeon
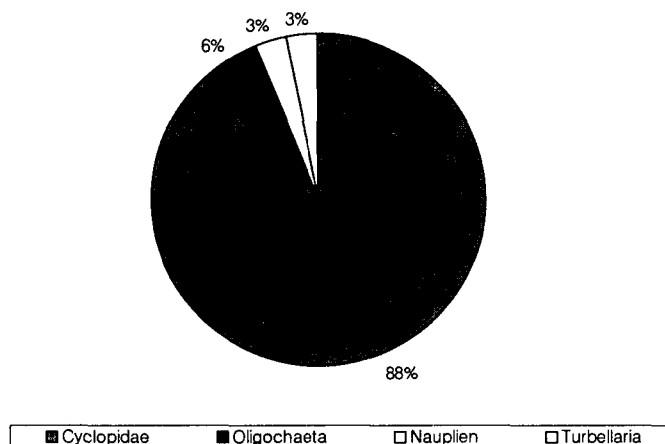

| ▨ Cyclopidae | ■ Oligochaeta | ☐ Nauplien | ☐ Turbellaria |

Figure 2. Fauna Dasan-Myeon

Acknowledgement

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