PhD research in REFORM - The effect of stream restoration on metabolism, leaf breakdown rate and macroinvertebrate species composition

About "PhD research in REFORM"

In the newsletter items dedicated to PhD research in REFORM, PhD students introduce the topic and the initial results of their research.

Introduction

It is well known that stream restoration affects the streams both physically and chemically (Violin et*al.*, 2011). On the other hand, little is known about how stream restoration affects functional parameters such as stream metabolism, organic matter breakdown rates or nutrient uptake rates by different stream organisms. Therefore, in order to comprehensively assess the effect of stream restoration, further research is needed that compares these functional parameters in restored versus impacted and natural streams.

Objectives

This PhD research had two main objectives. First, comparing functional parameters (metabolism and organic matter breakdown rates) and macroinvertebrate species composition in three different stream types: channelized, natural and restored streams.
Second, determining the dispersal potential of macroinvertebrates and macrophytes at 10 restored reaches to explore the possible impacts of restoration on the spatial distribution of biodiversity.

Approach

For the analysis of functional parameters, stream metabolism was measured at one location in nine streams (three for each stream type mentioned above). This was done by measuring diurnal changes in dissolved oxygen. Furthermore, organic matter decomposition as leaf breakdown was measured in six channelized, six natural and four restored streams by using two types of bags containing beech leaves; one with small mesh size for bacterial breakdown and one with bigger mesh size for both bacterial and macroinvertebrate breakdown (Fig. 1).

Macroinvertebrate samples were collected to compare species composition and the number of shredders in the reach in the 16 streams, and to examine if there was a link between the breakdown rate and the species composition. Macroinvertebrates were collected in the main stream channel and in the margin in order to identify different potential compositions in the two habitat types.

Dispersal potential (thereby meaning the potential of present species dispersing from nearby reaches) of macroinvertebrates and macrophytes on the restored reaches was studied by comparing species composition on the reach with species composition upstream and in neighbour catchments.

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Figure 1: The two types of leaf bags used for measuring leaf breakdown rate (photo: Anette B. Alnoee)

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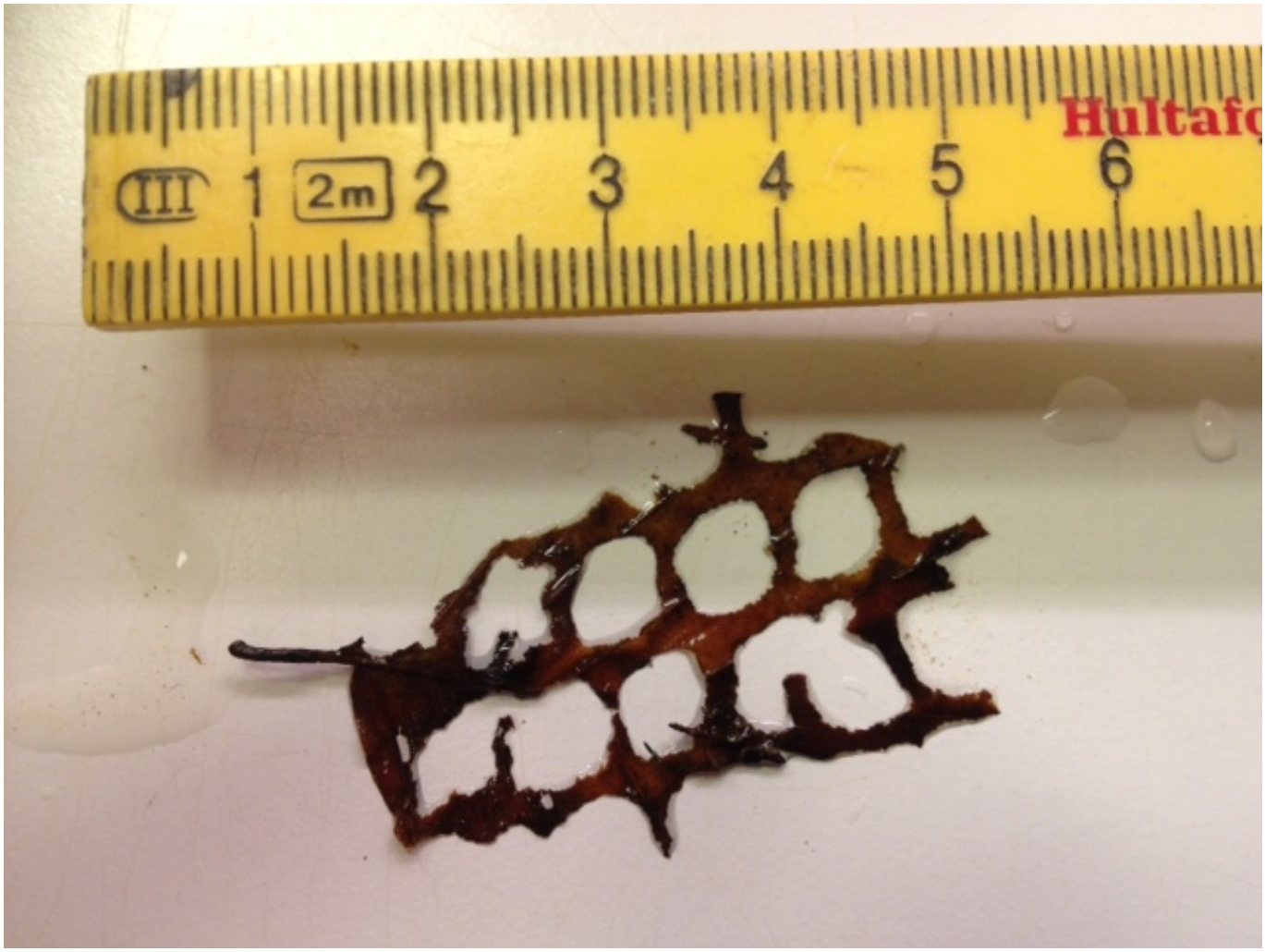

Figure 2: Holes occurring in a leaf from the bag with bigger mesh size (photo: Anette B. Alnoee)

Preliminary Results

Preliminary results show that there were no differences in metabolism between channelized, natural and restored reaches. Furthermore, there was no difference in breakdown rates between the various reaches. This was found for both types of leaf packages (big or small mesh size). Other factors were controlling the metabolism, such as the cover of all plants and number of submerged and emergent plants. Parameters affecting leaf breakdown rate were nutrient concentrations, substrate type and catchment size.

On the other hand, macroinvertebrate species had the tendency to differ in composition between the channelized, natural and restored reaches for samples collected in both the main channel and in the margin (Fig. 3, o vs Δ and □) , but there was no overlap of macroinvertebrate species between the main stream channel and the margin habitat was found (Fig. 3, blue vs. red dots).

Preliminary results on the dispersal potential of the macrophytes and macroinvertebrates are not available yet.

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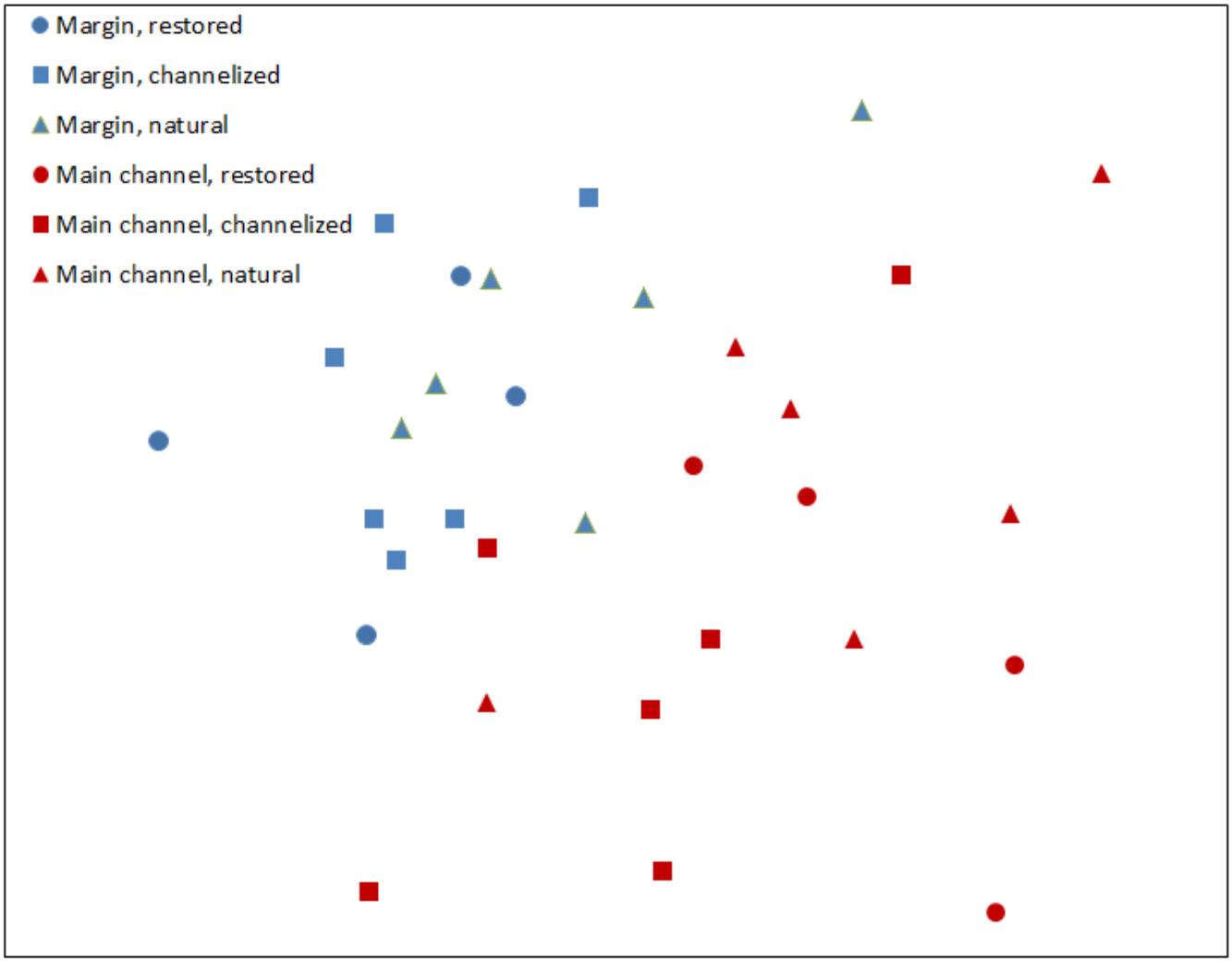

Figure 3: Non-metric Multi-Dimensional Scaling (NMS) showing macroinvertebrate data for channelized, natural and restored streams in the margin and main channel habitats of the streams. NMS is a measure for how identical or different the macroinvertebrate composition in two streams or sampling places are, so two plots close to each other are more identical than two plots far away from each other.

References

Violin C.R, Cada P., Sudduth E.B., Hassett B.A., Penrose D.L. and Bernhardt E.S. (2011) Effects of urbanization and urban stream restoration on the physical and biological structure of stream ecosystems. *Ecological Applications*, 21, 1932-1949.

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