Assessing a new method based on soil morphology to evaluate floodplain restoration success

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Introduction

Floodplains have been deeply modified since the middle of the 19th century. However, in the last 20 years, restoration projects appeared aiming to re-establish the structure and ecological functions of floodplains. But a general consensus on standardized guidelines for evaluation is still in progress. As soils play crucial roles in ecosystems, we propose soil as an indicator of success of river restoration aiming at increasing floodplain biodiversity. Soil is considered as a potential habitat for riparian species.

Illustrations: Thur River (TG/ZH), BHAteam, Chr. Herrmann

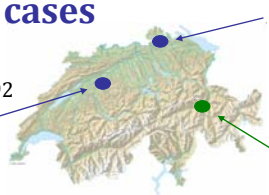
General aims

We propose a new methodology based on soil morphology parameters to evaluate the efficiency of river widening.

Thur River (BE)

Application cases

Emme River (BE):
- restored in 1991/92 and 1998/99
- un-restored site



Thur River (TG):
- restored in 2002
- un-restored site

(study site of the projet CCES-RECORD)

Rhine River (GR):
- near-natural system

The proposed methodology

Principles:

- We compare restored sites to pre-restoration site and/or near-natural system- which are assumed to represent the worst and best case states of floodplain.
- The methodology takes into account different soil morphology descriptors related to:
  - **soil profiles** (number of horizons, total depth, hydromorphic features,…)
  - **horizons** (thickness and depth of appearance, texture,…)
  - **topsoil horizons** (type of structure, thickness, root abundance,…)

- Three criteria and their related indicators are used to evaluate restoration success:

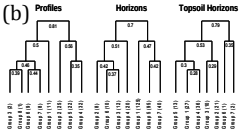
Diversity increases (Shannon index richness)	**Typicality increases** (frequency of alluvial characteristics; i.e. frequency of bare soil typical of pioneer species)	**Dynamism increases** (erosion/ sedimentation rates in response to fluvial dynamics)

Different steps:

1) Selection of sites, restored site to prerestoration site and/or near-natural system
2) Elaboration of soil sampling design according to the heterogeneity of the floodplain
3) Field description using pedological variables that characterize soil profiles, topsoils and horizons (a)
4) Clustering analyses to identify soil groups within floodplain(s) (b)
5) Calculation and comparison of criteria among different states of floodplain(s) (c)
6) Assessment of the project: do all pedological criteria show that restored site has moved towards the near-natural conditions? (d)
7) Validation of the pedological evaluation by comparison with other evaluations (biological methods) (d)

(a)

(b)



(c)

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

Shannon diversity indice (Shannon and Weaver 1949)

(d)

Emme River (BE)

Preliminary results

- Thur river evaluation : a partial success : the pedological evaluation confirms other evaluations based on several methods.
- Compared to the near-natural system, restored sites do not achieve to specific characteristics of alluvial environments.

Advantages and limits of the methodology

- ✓ User-friendly method, low time and money consuming; based on a single survey done 5 years after river widening.
- ✓ Objective evaluation based on statistical calculation, reproducible with various number of observations.
- ✓ Well adapted to upper and middle course of the river where fluvial dynamics is mainly due to erosion/sedimentation processes instead of water table fluctuations.
- ✓ Complementary to others evaluation methods (biological surveys, landscape surveys, geomorphological indexes, …).

Perspectives

- ✓ Application to different restored sites (Thur River, Emme River, Kander River).
- ✓ Statement of other evaluation criteria such as humus layer (i.e. soil structure formation, soil organic matter quality including water extractable organic carbon).

MHV Programme