The restoration programme for the Common Meuse aims to restore the fluvial dynamics of the river-floodplain system over a 50 km river stretch. Experiences from pilot projects, modelling of the future developments, target setting for habitats and species in this dynamic environment and research on ecological genetics of species within the river system illustrate the context of river habitat and species restoration. Special emphasis lies on the restoration of river dynamics and how this relates to habitat and species population dynamics, and how to solve the restrictions and constraints of conservation legislation. Further focus is on how to incorporate the restoration of river dynamics of river-floodplain systems in the targets for conservation status of Natura 2000 and ecological potential of the Water Framework Directive.

Biodiversity of the floodplain meadows at river basin scale showed a relationship with the surrounding ecoregions and the river dynamics (Van Looy ea 2006). The Common Meuse reach showed the highest diversity, yet we also detected strong effects of habitat fragmentation and species isolation in its floodplain. For floodplain forest patches in the area, a strong fragmentation is present due to river regulation and agricultural intensification. A particularly strong impact of the disruption of flood influence is present in species composition and diversity. The forests that were disconnected from flooding lost riverine species and do not gain true forest species as quickly (Van Looy ea. 2003). The river influence is responsible for a high diversity of species at intermediate flood intensities and a set of specialised species in dynamic stand conditions.

In floodplain grasslands a remarkable pattern was present of highest species richness in the smallest patches, and more rare river corridor species were present in the smallest, most species rich patches. There’s a group of relic grasslands in the area where rare species are present under strong threats of isolation and deterioration of habitat.

A restoration concept was worked out, making a win-win situation for safety, ecology and economy, as it combines gravel mining and flood protection. As the river bed is deeply incised, bank and floodplain lowering is needed to restore the river contact. This can be done by superficial gravel mining and results in a higher flood safety.

Whether the prospected developments of the restoration programme can be successful, depends on hydromorphological conditions (Pedroli ea 2002). These needed better study from reference conditions. Riparian forests show a close link to the hydromorphological conditions. This was illustrated for the width-depth ratio and the riparian forest extent for reference reaches and shows
a distance to target for the restoration (Van Looy ea 2008). To evaluate restoration potentials and outcome, an evaluation method was developed based on a modelling approach. This ecological model predicts potential habitat configuration through time based on fluvial dynamics. Within these shifting dynamics of habitat conditions, sustainable conditions for habitats and species are derived from the analysis of the present conditions of isolation (Van Looy ea 2005).

Restoration experiences are present in some pilot projects, the river bed showed a recovery in the conditions of sedimentation and erosion with even a remarkable restoration of the incision trend. For the river bed at the pilot project location, a strong recovery of bed elevation and natural substrate and habitats in the river bed was observed. Habitats and species responded quickly, with characteristic target species for the Natura 2000 site of water plants and dragonflies. With the bed elevation, the natural flood regime of the floodplain can be restored as well.

For plant species recovery, genetical analysis of the populations of three river corridor species showed strong relationship with the hydromorphic processes. An annual species of the riparian zone, Erysimum cheiranthoides (Honnay ea in press), a pioneer species with mixed annual and perennial populations, Sisymbrium chrysanthum (Jacquemyn ea 2006), and a perennial floodplain species, Origanum vulgare (Van Looy ea in press), showed a genetic differentiation related to fluvial dynamics and connectivity. The natural pattern of fluvial dynamics with its spatially and temporally differentiated flood regime of extreme and intermediate floods is necessary for colonisation and conserving genetic diversity, both for floodplain as for riparian pioneer species.

References
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Van Looy, K., Honnay, O., Pedroli, B. & Muller, S. 2006 Order and disorder in the river continuum. Continuity and connectivity contri-
Biodiversity of the River Meuse floodplain
in the context of the Common Meuse restoration programme

Kris Van Looy
Research Institute for Nature and Forest, Brussels, Belgium

Restoration of river habitats and species

1. Common Meuse floodplain biodiversity
2. River restoration and reference conditions
   • Hydromorphological alterations
   • Habitat fragmentation & species isolation
   • Restoration concept
   • Reference conditions
   • Restoration experiences
3. Indicators floodplain biodiversity
   • River corridor plants in isolation
   • Flood dispersal determines genetic structure
   • Modelling approach
   • Indicator favourable conservation status
Introduction

The River Meuse

River type:
- rain-fed river
- Source altitude 409 m
- Length 900 km
- catchment area: 34,500 km²
- 6 reaches
- Common Meuse reach km 450-500
- Natura2000 B: floodplain meadows/forests, NL: river bed

Floodplain diversity river reaches

Meuse reaches:
I: Lorraine
II: Ardennen
III: Common Meuse
IV: Peelhorst Meuse
V: Sand Meuse
VI: Tidal Meuse

Ecoregions:
1: Fluviatiel
2: Kempen
3: Brabant
4: Kalkstreek
5: Ardennen, Vogezen, Eifel

Van Looy et al. 2006 Journal of Biogeography
Hydromorphological character river Meuse

- Free-flowing meandering river
- Rain-fed river (10-3000 m³/s)
- Channelized bed, gravel mining
- Deeply incised river bed
- Disrupted floodplains (winter dikes)

Hydromorphological alterations: bed incision

Gradual lowering, still going on

Strong incision by gravel mining
Habitat fragmentation

Flood frequency
~ species composition
&
Species diversity

Restoration concept

Kris Van Looy & Alexander Van Braeckel
www.inbo.be
Hydromorphological, historical and actual reference

Pilot projects showed a restoration of hydromorphology, habitats and species.

Restoration experiences
Hydromorphological aspects in the restoration of river habitats and species

River bed recovers
• in elevation
• in habitat
• in species
  • Waterplants
    Potamogeton nodosus,
    ranunculus fluitans
  • Dragonflies
    gomphus flavipes

Common Meuse river bed
Habitat type 3260 species
Bed level 1998 - 2005

Legend
3260
Soort
  • Gomfau
  • Potmrd
  • Ranfl
bodd03398
Value
46.7 - 200
200 - 100
100 - 50
50 - 20
20 - 10
10 - 0
0 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100 - 200
200 - 400

Pilot project

Habitat restoration

November 2003

July 2004
Species recolonisation in pilot projects

Species diversity ~ patch area
Rare river corridor plants in isolated relics
Genetics of species recovery

- Annual species (Erisymum cheiranthoides) metapopulation dynamics
- Mixed annual-perennial pioneer species (Sisymbrium chrysanthum) shifting cloud with satellite populations
- Perennial floodplain species (Origanum vulgare) patchy population

P. Breyne (Inbo), O. Honnay, H. Jacquemyn (Univ. Leuven)

Floodplain conditions in modelling

Strong gradient
- Alcalinity
- Salt concentration
- Flood influence
  - pH ~ distance, contact river
  - EC ~ flood frequency, texture
- Vegetation
  - Composition/type
  - Spatial and temporal shift
- Modelling
  - Different types
  - Patches in space and time
Modelling approach

- Dry river grasslands: 4 types
- Overbank gravel deposition: Alysso-sedion albi
- Overbank sand deposition: Sedo-thymetum pulegioides
- Gravel deposition floodplain: Thero-airion

Evaluation

<table>
<thead>
<tr>
<th>Fauna</th>
<th>Bird</th>
<th>Habitat type</th>
<th>Target species</th>
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</table>
Thank you

and welcome
Welcome to the future