# "SMART RIVERS 2013"



Technical-biological river bank protection – a contribution to the ecological improvement of the banks of Federal waterways in Germany – First experiences from a field test along the River Rhine

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### All large rivers have been severely modified by bank fixation





...same situation in the test stretch along the River Rhine before modification with technical-biological bank protection measures, as also shown in Petra Fleischer's previous presentation...











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# Introduction – Legal framework



EC Water Framework Directive (EC

German Water Act (WHG)

> Federal Natu Conservation Act (BNatSchG)

...demand:

- conservation, enhancement, support of sensitive habitats in and along watercourses
- preservation of ecological functions
- improvement of the physical structure

Scope of activities of the Federal Waterways and Shipping Administration (WSV) has widened Management of Federal waterways under navigational aspects

> Integration of environmental requirements

Improvement of the riparian structural diversity/quality

Increase in species diversity

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- New concepts for bank protection which combine navigational issues with improvements of habitats and species diversity
- Different approaches were developed by the Federal Waterways Engineering and Research Institute (BAW) and the Federal Institute of Hydrology (BfG)
- tested along different waterways to gain practical experiences under technical as well as ecological aspects
  - structural improvement of rip-rap
  - technical-biological river bank protection
  - Alternative technical-biological bank protection applied on inland waterways
    - test stretch along the River Rhine



## measures installed from September to December 2011





# Test-StretchModificationsMonitoringFirst ResultsConclusion





TF No. 7 precultivated plant mats Ecological objective: development of sitetypical river bank vegetation



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## measures installed from September to December 2011







# Ecological improvement of rip-rap:

- breakwater-like stone wall with shallow water zone protected against hydraulic impacts
- inert wood trunks with roots
- willow-branch cuttings
- brush/hedge layers
- living fascines

Use of native site-typical species as: purple and white willow, hardwood floodplain shrubs cted Ecological objective: refuge for fish and macrozoobenthos Ecological objective: development of soft- and











Ecological improvement of rip-rap:

- inert fascines below
  Mean Water Level (MW)
- rip-rap with gravel fill, groups of individual stones

Ecological objectives: increase of structural diversity, promotion of natural succession





## measures installed from September to December 2011







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Removal of rip-rap to promote structural diversity by erosion effects





- Pre- and Post-Monitoring until 2016
  - bank stability (...see BAW-paper 111)
  - ecological potential/effectiveness (vegetation and animals)
  - maintenance requirements
  - costs
- Methods (vegetation and fish community)
  - Vegetation: mapping of the different bank slope zones (plant species inventory, full area coverage, number and dominance of individual species, vitality of introduced plants, parameters of physical structure..)
  - Fish: electrofishing along the bank (fishes were identified, sized and returned to river + additional parameters: distance to bank, water depth, dominant substrate material...)
  - for both: premonitoring to examine the ecological status, identification of reference stretches







# Vegetation:

Initial state and difficult conditions soon after completion (several flood

events, frost, persitent low-water levels + hydraulic impacts..)



 Fixing elements proved their importance (especially when the protection layers are lightweight and may become afloat)



Inserted plants have generally resisted the diverse stresses and have grown well so far. Single failures and losses in vitality were predominantly compensated  $\rightarrow$  inserted plant species tolerate the prevailing dynamic conditions.



Site-typical riverbank vegetation of reeds, moisture-loving tall perennial herbs, grass and herb species, soft- and hardwood floodplain has established.



Natural succession has set in on all test fields.



Plants inserted into rip-rap developed into habitat components (woody plants, single or in groups, grass and herb growth)





In bank zones protected by a stone wall, first potamogeton species settled and first reed stands began to evolve.

The vitality of pre-cultivated plants at the time of installation proved to have great influence on successful rooting and growth. Plots, where the pre-cultivated plants were less vital and the systems were lightweight suffered some losses → repairs were needed in the test fields with plant mats (TF No. 5 and 7)







- The first results of monitoring (1 year after completion) showed that:
  - Vegetation-based bank protection systems with native site-typical species have predominantly developed well – even under conditions of hydraulic stress and after repeated flooding. Some losses suffered in pre-cultivated, lightweighted plant mats.
  - Natural succession is advancing.
  - The installed bank-protection systems have already developed into different habitat components.
  - Structures that were built-in without having bank-protecting functions initiated secondary positive effects → woody debris along rip-rap favour native fish species over non-native species

....<u>but:</u> a final assessment of the ecological effectiveness of technical-biological bank protection measures will take several years of detailed monitoring





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All results were published on the website (http://ufersicherung.baw.de)

