UNDP/GEF
Danube Regional Project

Integration of the Nutrient Reduction Function in Riverine Wetland management

Final Workshop
18.04. – 20.04. 2007

TU VIENNA · IWAG · BOKU · WasserCluster Lunz GmbH · University Cluster For Freshwater Research · Geological Institute of Hungary (MAFI)

Monitoring and Assessment
of Nutrient Removal Capacity of Riverine Wetlands

General aims of DRP

- Evaluation of the role of riverine wetlands for nutrient removal
- Assessing the potential of wetlands to reduce the load to the Black Sea

Specific aims of phase 1 in 4.3

To evaluate the most effective monitoring strategies and programmes as a basis for a guideline

- To prepare pilot activities for Phase 2

Specific aims of the 2nd phase

Phase 2

- Highlight the role of wetlands in nutrient cycling
- Recognition of wetlands by management
- Experience from case studies
- Guideline for future wetland restoration projects and integrated wetland management

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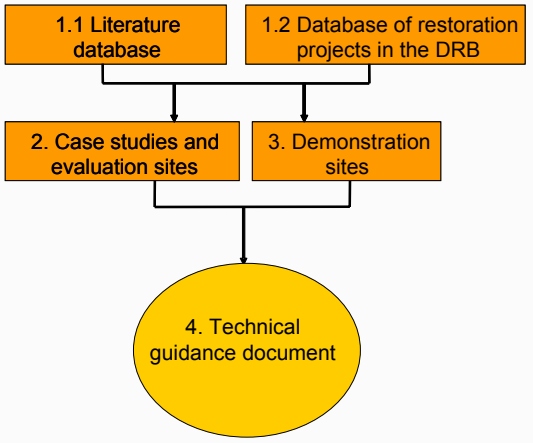
Output of phase 2

- Update knowledge
- Selection of case studies and questionnaire
- Cooperation with demonstration sites
- [Technical] guideline for target audience



[Technical] Guidance Document

- **Target audience for TGD**
  wetland and river basin managers

- **Aim**
  to inform about the potential role of wetlands in sub-river catchments
  to create a guideline for best practise in wetland management (emphasizing restoration / conservation) in the light of nutrient retention in the DRB

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1. Wetland Policy and International Framework

Basis: - EU-Water Framework Directive (WFD)
- Horizontal Guidance on Wetlands
- Danube Pollution Reduction Program (DPRP)
- Joint Action Program (JAP)
- Issue papers (nutrient pollution, hydromorph. alteration)

▪ To minimize water pollution -> initiating of wetland restoration and creation projects

▪ Wetlands are known for their functions and benefits -> lack of knowledge about their long-term efficiency

▪ Wetlands are included in the WFD only if they are in close context to surface water bodies, parts of surface water bodies or a target of the objectives for groundwater bodies

- acknowledge pressures on wetlands and highlight their potential important role in RBM

▪ recommendation to integrate wetlands in the Program of Measures (PoM)

- linked with ground or surface water aims

- cost effective and socially to achieve the environmental objectives of the WFD

2. Current knowledge on nutrient dynamics in riverine wetlands

Basis: Literature database (135 reports and scientific papers)

In general the balance of four basic processes determines whether / when / what parts of a riverine wetland acts as a source or a sink for nutrients:

- Transport (high or low discharge)
- Storage (*sedimentation*, precipitation, adsorption to and filtration through sediments, algal uptake, uptake by terrestrial plants and heterotrophic growth)
- Removal (only denitrification and harvest of biomass)
- Release (erosion of sediment/soil, re-suspension processes)

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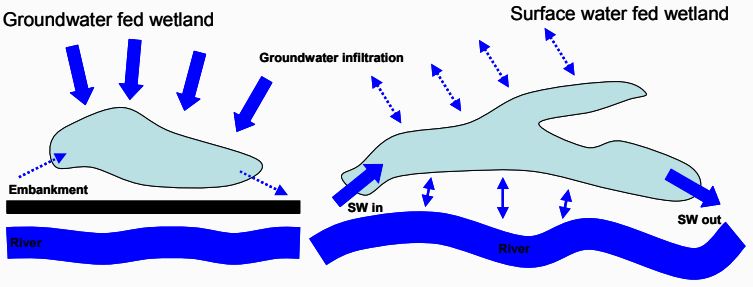
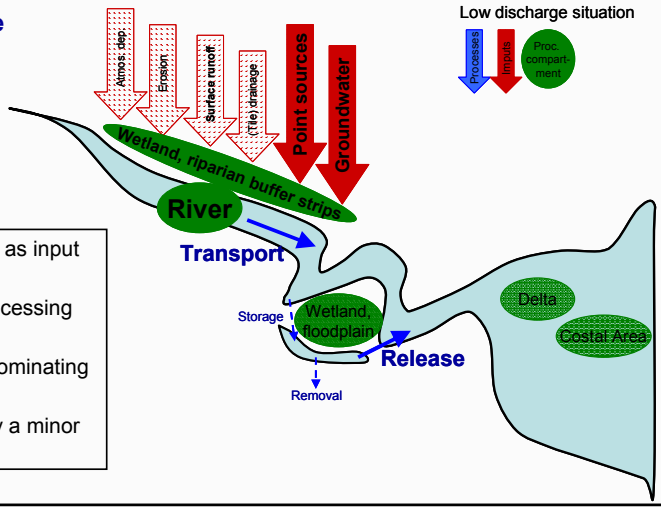
2. Current knowledge on Nutrient dynamics in riverine wetlands



dissolved nutrients	Input	part. & diss. nutrients
dependent on GW & land use	Hydrology	dependent on connectivity
low production	Productivity	high production
releases P and N	Sink/source	retention of P, sediment & OM, N
autochton	Siltation	allochton
no erosion	Erosion	erosion
phytoplankton dominated	Susp. Solids	decreasing OM with increasing connectivity

2. Current knowledge on nutrient dynamics in riverine wetlands

Low discharge



- point sources large role as input sources
- the river is the main processing compartment
- transport and release dominating processes
- floodplain wetlands play a minor role in nutrient uptake

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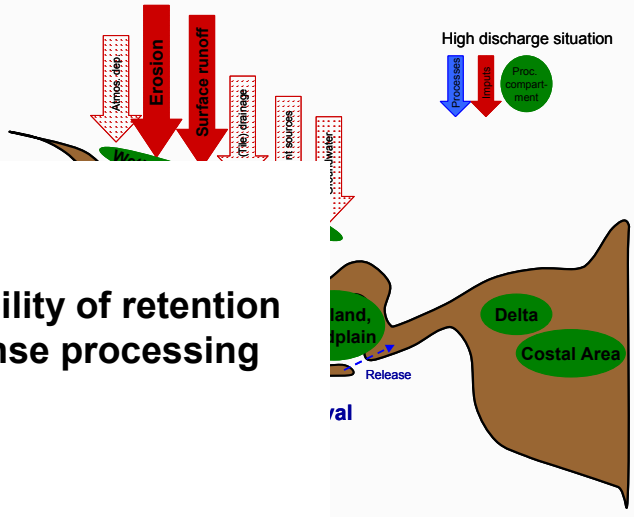
2. Current knowledge on nutrient dynamics in riverine wetlands

High discharge



Spatial variability of retention areas – intense processing

3. Nutrient dynamics in the Danube River Basin

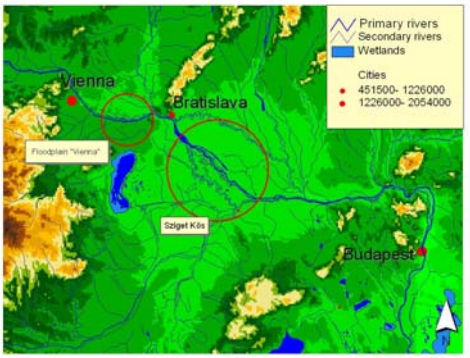
Case study between Vienna (Austria) and Medve (Hungary)

Basis:

Transport behaviour of the Danube

Floodplains – retention mechanisms

Analysis of contrasting years and floodplain types



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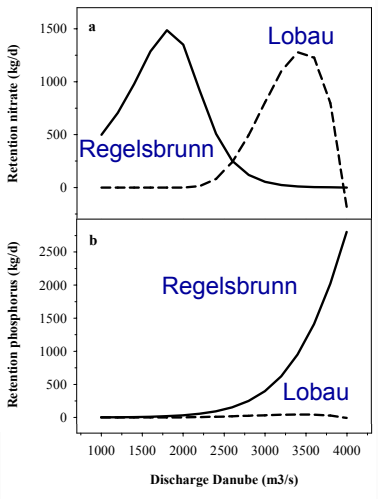
3. Nutrient dynamics in the Danube River Basin



Regelsbrunn (restored)

The highest nitrate retention is found at low discharges (below mean water).

Retention capacity for sediment and for total phosphorus (TP) rises with discharge.

Lobau (decoupled)

Nitrate retention peak at higher discharge (elevated mean water flow)

No extensive retention capacity, neither for suspended solids nor for TP

4. Inventory of nutrient retention of riverine wetlands within the DRB

Basis: - project database

- developed questionnaire (to 44 wetland restoration projects or wetland areas within the DRB and 17 were received again)

Aims:

- to show the restoration efforts in the different sub river basins
- the relevance of the nutrient reduction topic in these projects
- to get an overview of existing data in wetlands dealing with nutrient fluxes

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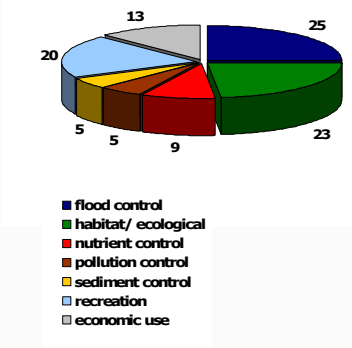
4. Inventory of nutrient removal capacities of riverine wetlands within the DRB

Recognized wetland functions:



- Wetland restoration activity takes place, but not all wetland functions and the catchment context are taken into account
- Motivation, design and monitoring could be optimized
- Lack of integrated groundwater monitoring
- Provision of basic information in the respectively national language.

5. Examples for nutrient retention measures in wetlands (demo sites)

Nutrient reduction and ecological revitalization on the wetlands of the Danube-Drava National Park (Hungary, Gemenc and Bèda-Karapancsa)

primary objective: *nutrient retention and removal*

Wetland restoration and pollution reduction project (Bulgaria, Marshes on Belene Island and Kalimok/Brushlen Marshes)

primary objectives: *nutrient retention and removal; biodiversity*

Monitoring and assessment of nutrient removal capacities of riverine wetlands (Ukraine, Katlabuh Lake)

primary objectives: *reducing salinity, general improvement of water quality*

Monitoring and assessment of nutrient removal capacity of riverine wetlands (Moldova, Yalpugh and Cahul wetland areas)

primary objectives: *improve surface water quality and groundwater quality in the catchment*

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6. Recommendations

- This guideline focuses on the nutrient reduction function of wetlands.
- An important step to enhance this function is the integration in wetland and also river basin management and consider the linkages between all ecosystem functions provided by wetlands.
- A special challenge thereby is the transboundary aspect, and therefore a unified guideline in the DRB is required.
- The recommendations provide a stepwise approach to integrate the nutrient retention function, depending on the local knowledge

Phase I

Estimating the nutrient retention potential

1 Connectivity?
2 Quantify discharge?
3 Morphology of the stretch?
4 Nutrient sources?
5 Data availability?

Phase II

Minimum requirements for nutrient retention calculations

Black box approach:

Input-output measurements considering discharge, water retention time and water quality data.

→ **Detailed load calculations**

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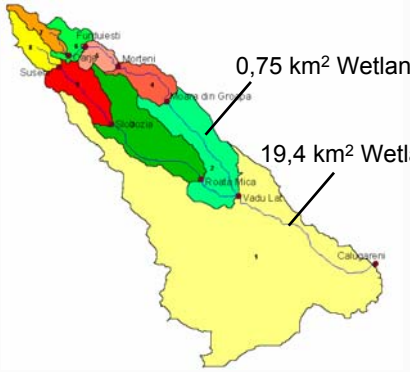
Phase III

MONERIS applications

- On statistical and GIS based data MONERIS quantifies nutrient sources and pathways
- MONERIS results give an overview concerning the nutrient situation in catchments and subcatchments
- MONERIS is not related to nutrient retention in wetlands but results and database provides **helpful prerequisite to implement measures on smaller scales (e.g. construction of WWTP or use of riverine wetlands to reduce nutrient loads)**

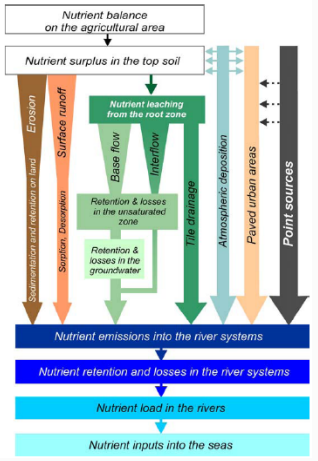
MONERIS applications

- Neajlov subcatchments (3720 km²)



- Data can be aggregated to smaller subcatchments
- Precondition are inlet and outlet measure-ments (red points)

Nutrient pathways considered in MONERIS (TP, TN, DIN)



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Phase IV

Specific Monitoring

From results of phase III a more specific monitoring can be implemented, considering the specific situation of the wetland. Thus, beneath surface water monitoring other subjects like groundwater, soils, sediments, inundation water, plants can be included into the programme.

Specific recommendations in phase 1 report

7. Future prospects

• Development of an integrated river basin management (integration of all services and wetland functions)

• Implementations of further policies and measures, to support the reduction of nutrient emissions and link to other issues like flood protection

• Mix of measures (e.g. construction of Waste Water Treatment Plants, reconstruction and restoration of riverine wetland sites)

• **All suggestions regarding nutrient removal need to be seen as an additional benefit for conservation and restoration activities of natural wetlands without leading to any further degradation of nature conservation values as these are already appreciated to be of major importance, especially in natural wetlands.**

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Main messages

• **Natural wetlands are key landscape elements for diverse functions**

• **Wetland management support the nutrient reduction and is linked to other issues like flood protection**

• **Demo sites point to continuation**

• **Integrated management approach (what are the next steps to be implemented?)**

• **Combined efforts in the light of the WFD**

3. Nutrient dynamics in the Danube River Basin

Results from the case study imply:

- Annual nutrient load transported into the riverine wetland is very variable
  depends highly on the hydrological exchange condition
  geomorphic settings of in- and outflow areas.
- Restoring connections shall allow uncontrolled water exchange related to the riverine discharge:
  during floods: TP retention and sedimentation.
  during low river discharge: nitrate removal.
- Ecological functioning depends on many factors:
  - hydrologic exchange (surface and groundwater),
  - water age in the respective water bodies,
  - contribution of shallow areas,
  - sediment conditions (boundary to the subterranean ecosystem),
  - shoreline length (measure of the boundary between aquatic and terrestrial landscape elements) – a measure of heterogeneity
  - inundation area - size matters.

2. Current knowledge on nutrient dynamics in riverine wetlands

Following characteristics determine the process conditions in the wetland:

- timing of floods and low waters,
- the characteristics of the connection to the main channel
  - surface water dominated
  - groundwater dominated

  exchange processes
- proportion of surface and subsurface flow

River alteration may strongly alter this natural interaction between the catchment, the river and accompanying wetland elements.

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MONERIS applications

- Nutrient retention

- High nutrient emissions and resulting high concentrations in the surface water (e.g. at Suseni and Moara din Gropa) are tightly related to point sources
- High retention rates found downstream Moara din Gropa obviously stem from a adjacent complex of wetlands (Izyoro)