Hydromorphology of rivers and floodplains – What is at stake and how will REFORM contribute?

- Groynes prevent lateral migration
- Main channels incise
- Floodplains aggrade
- Floodplains embanked

REFORM
Iberian Stakeholder Workshop
Sevilla
2 June 2014

Tom Buijse
Deltares
Utrecht, the Netherlands
E: tom.buijse@deltares.nl
Hydromorphological pressures in European surface waters

- 127 000 surface water bodies
  - 82% rivers
  - 15% lakes
  - 3% coastal and transitional waters

- HYMO pressures affecting ..
  - 40% river and transitional waters
  - 30% lakes

- Causes
  - Hydropower
  - Navigation
  - Agriculture
  - Flood protection
  - Urban development

Source: EEA report 8/2012 European waters – assessment of status and pressures
### European Commission supports River Restoration and Management

Examples of EU funded River River restoration projects

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<th>Programme</th>
<th>INTERREG</th>
<th>LIFE</th>
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- [http://wwwlife-donau-ybbsat/](http://wwwlife-donau-ybbsat/)
- [http://wwwnaturstyrelsendk/Naturopagascar/Beskriver/](http://wwwnaturstyrelsendk/Naturopagascar/Beskriver/)
- [http://wwwstreamlifeorguk/](http://wwwstreamlifeorguk/)
- [http://wwwwwfse/flodparlmussla](http://wwwwwfse/flodparlmussla)
- [http://wwwlife-wachauat/](http://wwwlife-wachauat/)

REstoring rivers FOR effective catchment Management

November 2011 – October 2015

Tom Buijse NL
Ian Cowx UK
Harm Duel NL
Nikolai Friberg DK/N
Angela Gurnell UK
Daniel Hering GE
Eleftheria Kampa GE
Erik Mosselman NL
Susanne Muhar AU
Matthew O’Hare UK
Tomasz Okruszko PL
Massimo Rinaldi IT
Jan Vermaat NL
Christian Wolter GE

3rd All Partners Meeting – Oct 2013
## Partners

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
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26 partners from 15 European countries
Objectives of REFORM

APPLICATION
1. Select indicators for cost-effective monitoring
2. Improve tools and guidelines for restoration

RESEARCH
1. Review existing information on river degradation and restoration
2. Develop a process-based hydromorphological framework
3. Understand how multiple stress constrains restoration
4. Assess the importance of scaling on the effectiveness of restoration
5. Develop instruments for risk and benefit analysis to support successful restoration

DISSEMINATION
1. Enlarge appreciation for the benefits of restoration
REFORM Stakeholder Workshop (Brussels, February 2013)

BREAKOUT SESSIONS
- Lowland rivers
- Highland/midland rivers
- Mediterranean rivers
- Unraveling the impact of hydromorphological pressures in multiple-pressure settings
- Designing programmes of measures
- Heavily modified water bodies

IMPORTANT TOPICS
- Cause-effect between HyMo and biota
- Ecological indicators of HyMo impacts
- Sediment assessment methods & sediment continuity issues
- Disentangling effects of HyMo pressures
- Use HyMo to define GEP of heavily modified water bodies
- Guidance on environmental flows
- Robust ways to confidently demonstrate success of RR
- Cost-effective methods for RR monitoring
- Process-led RR & account for cumulative impacts within a catchment scale approach
- Decision support tools to emphasise benefits of RR
- General framework for ecosystem services

Confronting prioritised requests from participants with foreseen output of REFORM

D7.3 Proceedings of the End-user workshop
Cooperation with ...

make use of earlier research projects (e.g. REBECCA, WISER, FORECASTER)

RESTORE (LIFE+ Information & Communication)

European Centre for River Restoration (ECRR)

WFD Implementation: common implementation strategy (CIS)

Advisory Board of REFORM

Evdokia Achilleos, Gary Brierley, Johan Kling, Margaret Palmer, Hervé Piégay, Peter Pollard, Ursula Schmedtje, Bas van der Wal
What is yet available?

- D1.1 Review on eco-hydromorphological methods
- D1.2 Review on effects of pressures on hydromorphological variables and ecologically relevant processes
- D1.3 Review on ecological responses to hydromorphological degradation and restoration
- D1.4 Inventory of the cost of river degradation and the socio-economic aspects and costs and benefits
- D2.3 Framework to analyse ecosystem services provided by European river systems
- D3.1 Impacts of hydromorphological degradation and disturbed sediment dynamics on ecological status
- D4.1 Field protocols and associated database
- D5.1 Review of methodologies for benchmarking and setting end-points for restoration projects
- D6.1 Synthesis of interim results for practical application to support the compilation of the 2nd RBMPs
- D7.1 Communication and Dissemination Strategy
- D7.3 Proceedings of the End-user workshop
Where can you find our results?

www.reformrivers.eu -> results
Case Studies of river restoration projects

Tools (assessment, indicators, models, guidelines, monitoring)

European environmental directives and policies

Hydromorphology

Biota

Ecosystem goods and services

Pressures

Know-How

Knowledge

Evaluation

.... with links to background info

http://wiki.reformrivers.eu
D1.1 Review of eco-hydromorphological methods

- Most applied is physical habitat assessment
- Main gap is insufficient consideration of physical processes
- Little information available on specific response of individual methods to hydromorphological pressures
- Recommendation: a framework for integrated HyMo analysis

### Categories of methods

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*South Africa, Canada/Quebec, China, New Zealand, Ukraine
D1.2  Review on effects of pressures on hydromorphological variables and ecologically relevant processes

Conceptual DIAGNOSIS pressure – process – impact framework

- 18 most significant HyMo pressures that impact aquatic biota
- Help to identify appropriate restoration measures
D1.3 Hydromorphology – biota interactions

- Specific indicator species
  - ~500 aquatic plants
  - 94 studied (lit. refs)
  - 39 rheotolerant
  - 13 gravel pref.
  - ~23,000 invertebrates
  - 1118 oper. taxa list
  - 72 substrate preferences
  - 60 gravel size info
  - ~550 fish species
  - 218 classified
  - 26 with reported, gravel prefs

- ~23,000 invertebrates
- 1118 oper. taxa list
- 72 substrate preferences
- 60 gravel size info
- ~550 fish species
- 218 classified
- 26 with reported, gravel prefs

Conceptual flow chart to link HyMo with biota

- Discharge
  - Environmental flow
  - Connectivity
  - Flow velocity
    - Stream power
    - Gravel sorting
    - Substrate quality
  - Species preferences
- Depth (Plants)
  - Habitat complexity
    - Habitat mosaics
  - Patterns, shelter
    - Resources, refuges
  - Species limitations
    - Tolerance thresholds (unspecific)
  - Riverine community (Biotic response)

Recommendation
river region approach using biotic indicators

• High flow velocities and coarse gravel key indicators for HyMo integrity relevant to aquatic organisms.
• Species depending on coarse substrates specific indicators for HYMO degradation, rehabilitation, and integrity
• Review on the substrate and flow velocity preferences: quantifiable data are rather limited

Recommendation
river region approach using biotic indicators
D1.4 Inventory of river restoration measures: effects, costs and benefits

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Conclusions & recommendations

• Incorporating cost information into decision making prerequisite to increase river restoration efficiency -> more effort needed

• Difficult to determine ecosystem benefits and services from restoration projects both individually and as a whole
D2.3 Valuing the ecosystem services provided by European river corridors – an analytical framework

Generic Design Economic Survey

Model 1: Which site would you visit?

- Applied to REFORM case studies catchments
- Combining Corine land cover typology with MEA Ecosystem services
D3.1 Impacts on hydromorphological degradation and disturbed sediment dynamics on ecological status

Conclusions & recommendations

- For fish and macrophytes metrics indicating HYMO impacts could be developed from monitoring data.
- Many existing macroinvertebrate metrics lack specificity and can provide false positive responses to HYMO pressure.
- Potential to derive metrics sensitive to fine sediment loads.
- HYMO pressures should be considered in the protection of specific habitats in particular under changing climate.
- Land-use data on a spatial scale beyond the reach scale (corridor and catchment) relates to site-specific macroinvertebrate metrics and could be a more robust way of assessing impacts.

<table>
<thead>
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D5.1 Measuring success of river restoration actions using end-points and benchmarking

- Many practitioners do not follow a systematic approach for planning restoration projects.
- Many restoration efforts fail or fall short of their objectives.
- Objectives often have not been explicitly formulated.

• Project management techniques to solve problems and produce a strategy for the execution of appropriate projects to meet specific environmental and social objectives.

Hydromorphology measures in RBMPs (source: EEA 2012)
What is there to come?

• D2.1 Multi-scale framework and indicators of hydromorphological processes and forms (October 2014)
• D2.2 Influence of natural hydromorphological dynamics on biota and ecosystem services (July 2014)
• D3.2 Understanding biological responses to degraded hydromorphology sediment dynamics and multiple stress (October 2014)
• D3.3 Evaluation of candidate indicators for case studies including uncertainty (April 2015)
• D3.4 Guidance on how to identify impacts of hydromorphological degradation on riparian ecosystems (April 2015)
• D4.2 Evaluation of hydromorphological restoration from existing data (April 2014)
• D4.5 Fact sheets for restoration projects (October 2014)
• D5.2 Cost effective restoration measures that promote wider ecosystem and societal benefits (January 2015)
• D5.3 Effects of climate and land use changes on river ecosystems and restoration practices (October 2014)
• D5.4 Risks and uncertainty of different restoration strategies and options analysis (April 2015)
• D6.2 Methods, models, tools to assess the hydromorphology of rivers (July 2015)
• D6.3 Guidelines and decision support for cost-effective river-floodplain restoration and its benefits (October 2015)
Hierarchical process-based HYMO framework that is ecologically relevant
Synergy between ecological restoration and ....

- Flood protection (Room for Rivers, Ecoflood)
- Navigation (parallel dams; wave action)
- Agriculture (land use of riparian zones; sediment dynamics, nutrients)
- Hydropower (Environmental flows; hydroppeaking)

To ...

- Expand the potential for restoration
- Support the intercalibration of Good Ecological Potential of heavily modified and artificial water bodies (ECOSTAT)
Thank you for your attention

-Stay informed –
Register to our newsletter on the website

Our project website is our display window
www.reformrivers.eu

COLLABORATIVE PROJECT
LARGE SCALE INTEGRATING PROJECT

ENV.2011.2.1.2-1
HYDROMORPHOLOGY AND ECOLOGICAL OBJECTIVES OF WFD

GRANT NO. 282656

Acknowledgements
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