REFORM
REstoring rivers FOR effective catchment Management

Policy brief

Issue No. 2 September 2014

Challenges for effective river restoration: New insights and tools from REFORM

www.reformrivers.eu

About REFORM

REFORM (REstoring rivers FOR effective catchment Management) brings together 26 partners (renowned research institutes and applied partners) from 15 European countries with the objective of developing guidance and tools to make river restoration and mitigation measures more cost-effective. In this context, it specifically seeks to support the River Basin Management Plans (RBMPs) for implementation of the Water Framework Directive (WFD). The project consortium is supported by an Advisory Board of 8 independent persons representing international and national stakeholders, including river basin managers, representatives of the economic sectors relevant to river restoration and lead scientists in river ecosystem restoration.

Contribution to policy

The results and new information made available as an outcome of REFORM can improve the basis for implementing the following key EU policies:

- Water Framework Directive - 2000/60/EC
- Floods Directive - 2007/60/EC
- Birds and Habitats Directives - 2009/147/EC & 92/43/EEC
- Water Blueprint - COM (2012) 673 final
- Green Infrastructure - COM(2013) 249 final

Key REFORM outputs in support of policy (June 2013 - June 2014)

The REFORM project has generated substantial mid-term outputs in time to support the drafting of the 2nd River Basin Management Plans (RBMPs) for the Water Framework Directive. This policy brief concentrates on the following mid-term deliverables.

- *D1.2 "Review on pressure effects on hydromorphological variables and ecologically relevant processes"* is a bibliographic review of the key hydromorphological (HYMO) processes that need to be addressed and the key HYMO variables indicating success in river restoration.

- *D1.3 "Review on ecological responses to hydromorphological degradation and restoration"* focuses specifically on the linkages between HYMO variables that influence ecological status and functioning and on the tolerance thresholds of species. Emphasis was put on the mandatory biological quality elements of the WFD: macrophytes, macroinvertebrates and fish.

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REFORM Policy Brief no. 2

- *D1.4 "Inventory of river restoration measures: effects, costs and benefits"* reviewed case studies and literature on costs and benefits of river restoration in Europe.
- D3.1 *"Impacts on hydromorphological degradation and disturbed sediment dynamics on ecological status"* evaluated existing metrics for their strength to distinguish the impact of hydromorphological pressure on the mandatory biological quality elements from other stressors.
- D5.1 *"Measuring success of river restoration actions using end-points and benchmarking"* developed a protocol for restoration project planning that incorporates benchmarking and setting specific and measurable targets for restoration and mitigation measures.
- D6.1 "*Synthesis of interim results for practical application to support the compilation of the 2nd RBMPs*" synthesised the interim results of the project and presented a strategy for making the information available to practitioners in an accessible way.

Key achievements (June 2013 – June 2014)

- Characterisation of the most important HYMO processes & variables (environmental flow, velocity, substrate, connectivity) in the HYMO pressure/impact system
- Identification of physical targets and target species for restoration planning
- New proposed indicators for assessing HYMO integrity (e.g. Fish Region Index)
- Collection and collation of data on costs and benefits of restoration measures
- Demonstration of potential to derive biota-based metrics to indicate HYMO impacts
- Protocol for restoration project planning
- Population of a WIKI with key project results that provides accessible information on restoration project design and outcomes.

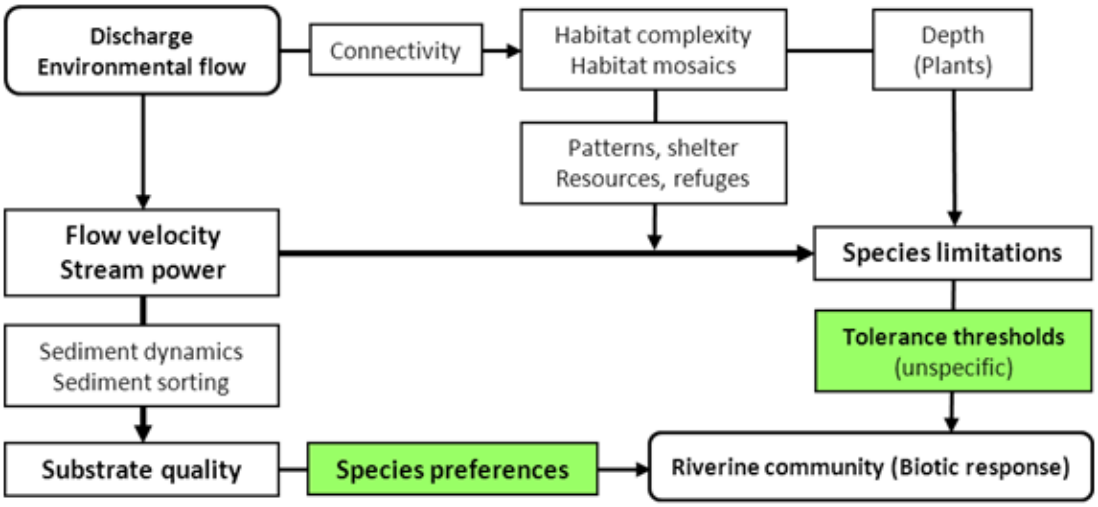
Which central HYMO processes need to be addressed?

How does biota respond to HYMO degradation and restoration?

Key conclusions and recommendations

- The **dynamics of flowing water** emerged as the most important HYMO process in the HYMO pressure/impact system. This underlines the necessity to reinstate a more natural flow regime to improve the HYMO status of rivers and related biological communities. The next most important processes were related to **vegetation encroachment** (in line with the importance of riparian vegetation in shaping riverine landscapes) and to **sediments** underlining the key role of bedload transport and sediment dynamics in forming fluvial habitats.
- **Coarse gravels** maintained by stream power and flow velocity emerged as key indicators for HYMO integrity with relevance to aquatic organisms. Species preferring or depending on coarse substrates provide specific indicators for HYMO degradation, rehabilitation and integrity. A second, rather unspecific, response of biota to hydromorphology emerged from the **limitation of species by stream power**, i.e. by

physical forces of flows. Indirectly related to that is a **positive response of species to habitat diversity and habitat complexity** providing shelter from high flow velocities, and resources. In addition, river zones encompass a characteristic set of HYMO processes and patterns; thus, species preferences for specific zones are of indicative value for assessing HYMO integrity and have been developed accordingly for European fish species. Highly promising results have been obtained using the **Fish Region Index**, whose applicability and sensitivity will be further tested and improved. Ongoing work comprises the improvement of the newly proposed indices and indicators.



- **Significant knowledge gaps** have been identified **on the ecological classification and habitat requirements of riverine species,** which need to be addressed in further field surveys**.** These should potentially yield further sensitive indicator species for HYMO changes, and consequently potential target species for river rehabilitation design and evaluation.

New insights on biota-based metrics of HYMO impacts

- Research within REFORM showed that **there is potential to develop metrics from monitoring data on fish and macrophytes to indicate HYMO impacts**.

Biological Quality Element (BQE)	Ability to indicate HYMO impacts
Macrophytes	Plants have particularly **strong potential as useful metrics**, especially given their intimate role in geomorphological processes. Nevertheless, significant further development is required. As macrophyte assemblages change with physical river type, trait responses may be specific to individual river types.
Fish	The sensitivity of fish to HYMO pressures was also detected. Logistic regression analyses revealed 69% of the analysed European freshwater species display a **significant** (>90% c.l.) **response to HYMO pressures**. Responses could be both positive and negative depending on the species.

- **None of the relationships between hydromorphological degradation and macroinvertebrate metrics were very strong**. The reasons for the lack of sensitivity can most likely be attributed to a number of explanatory variables not being measured as part of routine monitoring programmes or in the currently used hydromorphological assessment schemes. Both metric development and sampling scales need to be scrutinised to improve sensitivity, if possible.

- Land-use data on a spatial scale beyond the reach scale (corridor and catchment) showed significant relationships to a number of macroinvertebrate metrics. These findings imply that **land-use data could be a more robust way of assessing impacts than reach specific data** and could be more relevant in the decision-making process on land-use and HYMO degradation in a catchment management perspective.

- **Combinations of biological quality elements** (BQEs) and a range of diagnostic tools are likely to be able to disentangle important stressors with a reasonable degree of certainty. In addition, frequently overlooked topics such as **sediment quality and groundwater issues** ought to supplement or be included **in HYMO assessments** due to their potential for explaining variance in biological datasets.

What are the costs and benefits of restoration measures?

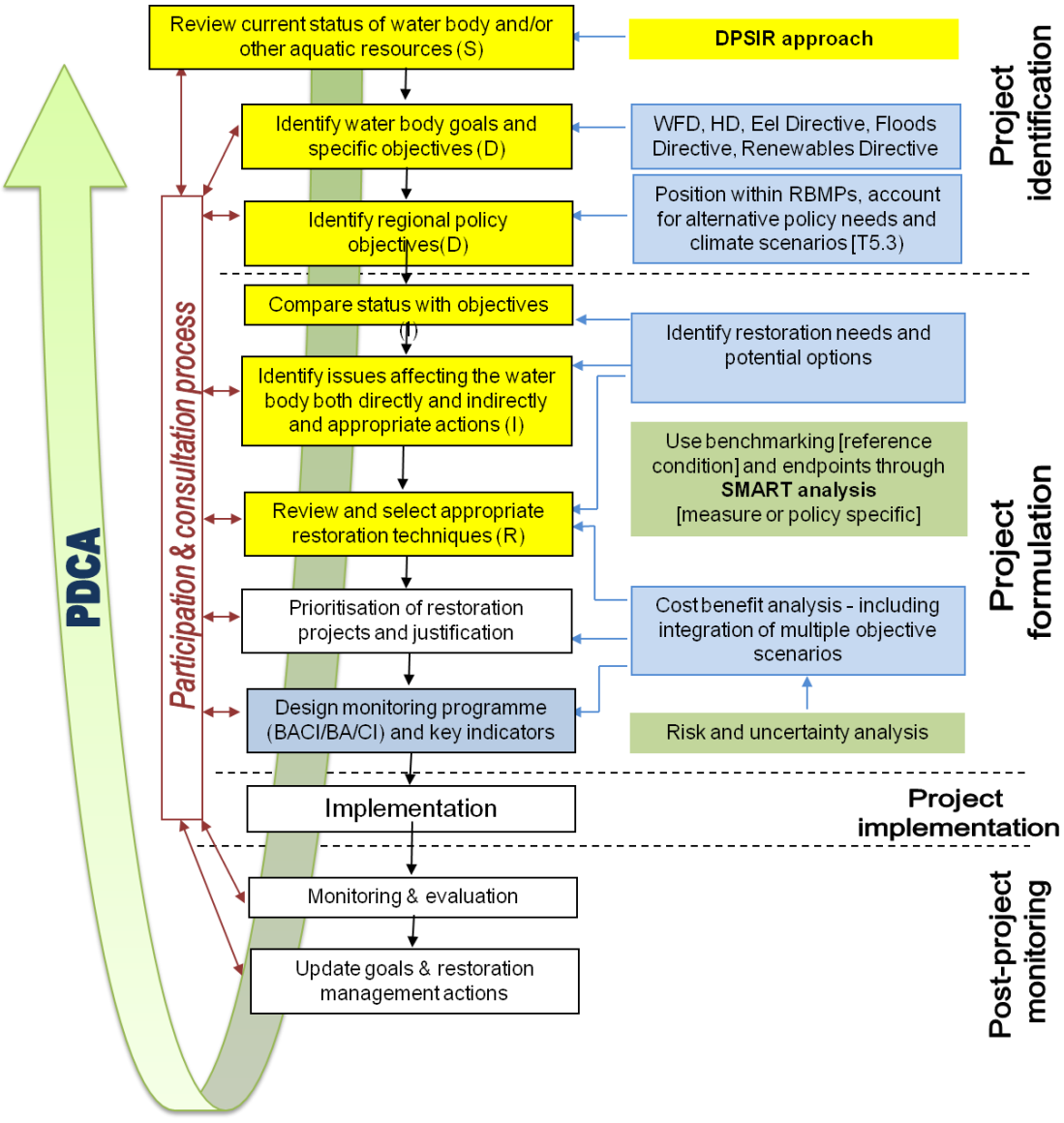
- An inventory of river restoration measures showed that the **cost data** for most measures are quite variable across different European Member States (Netherlands, Spain, Germany and UK) and usually not available in a form appropriate for further assessments (e.g. CBA, CEA). Thus, investing efforts in standards and protocols to gather and incorporate cost information in a more systematic way will increase the efficiency of decision-making regarding river restoration practices. The proposed inventory can help inform a decision-making framework for river basin managers by providing best practice examples of the most applied measures. This also applies as to how cost data could be gathered and analysed, in addition to providing representative values for the costs of some restoration measures, when aggregation was possible.

- The **economic benefits of hydromorphological river restoration** were proxied through the environmental benefits and services provided by restored river ecosystems and/or riparian zones. As a rule, a restoration project was treated as a bundle of ecosystem services, which made it very difficult to determine total economic values for these services individually or as a whole. Examples of the most commonly considered services (benefits) include, among others, increased freshwater biodiversity, provision of drinking water, improved water and air quality and flood protection.

How can restoration project planning follow a more systematic approach?

- Despite the rapid increase in river restoration projects, little is known about the effectiveness of these efforts and many practitioners do not follow a systematic approach for planning restoration projects. REFORM has developed **a protocol for restoration project planning**

that incorporates benchmarking and setting specific and measurable targets for restoration and mitigation measures. The approach uses project management techniques to solve problems and produce a strategy for the execution of appropriate projects to meet specific environmental and social objectives. Using this strategy, it is important to recognise that **each restoration scheme proposal should be treated on an individual basis**, as no two situations are alike. The decision support tool allows proposals to be evaluated at different levels and stages and will effectively curtail a proposal at an early stage should it be impractical or unviable.



Making scientific results available for the 2nd RBMPs

A synthesis of the interim scientific results of REFORM was prepared and made available for practical application to support the current river basin management cycle. The synthesis also presents a strategy for making the information available to practitioners and policy-makers in an accessible way, based on the set-up and population of a WIKI (http://wiki.reformrivers.eu). The content of project deliverables will

Further information on the REFORM project:

Starting/Ending date:

November 1, 2011 – October 31, 2015

Coordinator

Tom Buijse, Deltares

Type of R&D:

Collaborative project (large-scale integrating project)

Programme:

7th Framework Programme

Theme: Environment (including climate change)

Topic: ENV.2011.2.1.2-1 Hydromorphology and ecological objectives of WFD

Grant Agreement 282656

Web-Links:
www.reformrivers.eu
wiki.reformrivers.eu

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be continuously uploaded in the REFORM WIKI in factsheets with linkages to background information and case studies. The WIKI also acts as a tool to quickly gather reviews from restoration practice, therefore, providing valuable support to current restoration work and the implementation of relevant policies.

More information can be obtained from:
http://reformrivers.eu/

Upcoming REFORM International Conference

International Conference on River and Stream Restoration

"Novel Approaches to Assess and Rehabilitate Modified Rivers"

30 JUNE – 2 JULY 2015

Wageningen, The Netherlands

More info on http://www.reformrivers.eu/events/final-conference

REFORM partners

- Stichting Deltares, NL
- Alterra, NL
- Aarhus University, Department of Bioscience, DK
- University of Natural Resources and Life Sciences, Vienna (BOKU), AT
- National Research Institute of Science & Technology for Environment and Agriculture (IRSTEA), FR
- Danube Delta National Institute for Research & Development, RO
- Swiss Federal Institute of Aquatic Science & Technology, CH
- Ecologic Institute, DE
- Leibniz-Institute of Freshwater Ecology & Inland Fisheries, DE
- European Commission Joint Research Centre, IT
- Massaryk University, CZ
- Natural Environment Research Council Centre for Ecology & Hydrology, UK
- Queen Mary, University of London, UK
- Swedish University of Agricultural Sciences, SE
- Finnish Environment Institute, FI
- University of Duisburg-Essen, DE
- The University of Hull, International Fisheries Institute, UK
- Università di Firenze, IT
- Universidad Politécnica de Madrid, ES
- Institute for Environmental Studies, VU University Amsterdam, NL
- Warsaw University of Life Sciences, PL
- Centro de Estudios y Experimentación de Obras Públicas (CEDEX), ES
- DLG, Government Service for Land and Water Management, NL
- Environment Agency, UK
- Istituto Superiore per la Protezione e la Ricerca Ambientale, IT
- Norwegian Institute for Water Research, NO