REFORM

REstoring rivers FOR effective catchment Management

SEVENTH FRAMEWORK PROGRAMME

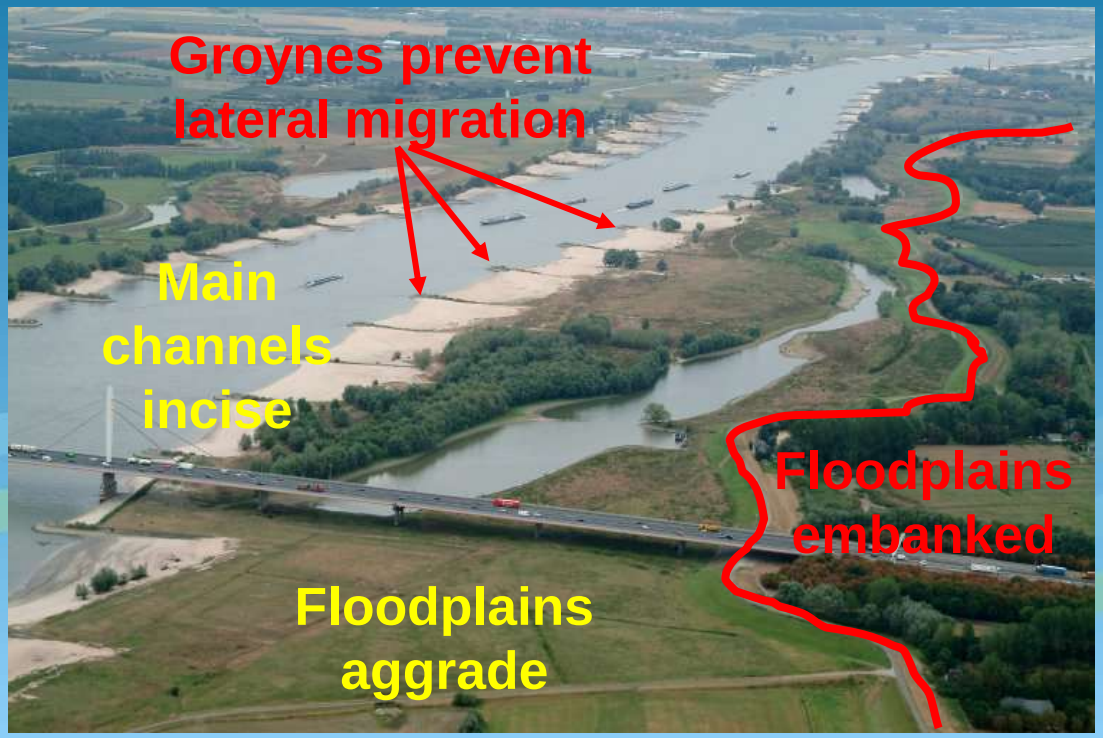
European River Restoration Conference

Featuring the IRF Riverprize

Celebrating Successes and Addressing Challenges

5th edition | 11-13 September 2013 | Vienna

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



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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

Protection of Europe's aquatic ecosystems and their services

- Balancing protection and sustainable use
- Water & Nature protection
  - Not enough coordination between WFD and Natura 2000
- Protection of small water bodies
  - Ongoing destruction
  - Political recognition of their importance to maintain healthy & diverse aquatic environments
- Restoring & preserving aquatic ecosystems
  - Multiple benefits for WFD and BHDs
  - Examples: making room for the rivers, river restoration and floodplain rehabilitation
  - Benefit through Strategy on Green Infrastructure (EC, 2010)

Source: EEA report 8/2012 European waters – assessment of status and pressures

EC Blueprint to safeguard Europe's water resources

- Land use & ecological status
  - Dams, regulation, draining land, embankments, over-abstraction of water
  - Buffer strips, green infrastructure, protecting headwaters, natural water retention measures (NWRM), ecological flows, river continuity
  - Policy integration (WFD, CAP), cross compliance
  - CIS Guidance on NWRMs – 2014
  - CIS Guidance on ecological flows – 2014
  - NWRM – Green CAP pillar 1, Structural and Cohesion Funds
- Floods & Droughts
  - Tune Flood Risk MPs with River Basin MPs – 2015
  - NWRMs – restoring floodplains & wetlands
- Crosscutting
  - Improving knowledge base
  - Science Policy Interface – prototype hydro-economic model (JRC)
    - Cost/benefits of reference scenarios and Programme of Measures

Hydromorphological pressures in large rivers in the Netherlands

Hydromorphological modification	Total # of water bodies	5	4	3	2	1
Embankments	23	21	0	0	2	0
Shore protection	23	10	11	0	2	0
Loss of active floodplain	21	6	15	0	0	0
Normalisation	18	17	1	0	0	0
Channelisation	13	11	2	0	0	0
Groynes	15	12	0	0	0	3
Sluices and weirs	12	7	1	2	2	0
Impoundments	11	8	2	0	0	1

5 No significant effect on ecology
4 No essential constraint to achieve good ecological status
3 Intention to restore, rehabilitate or mitigate
2 Possible to restore, rehabilitate or mitigate
1 Irreversible modification

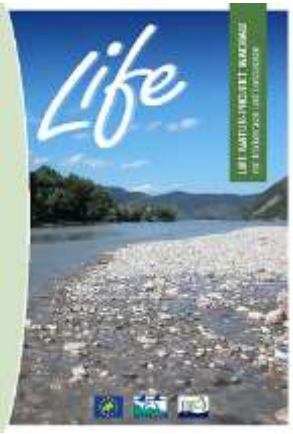
All large rivers are designated as heavily modified and can only to a limited part be rehabilitated

Reviewing existing information

Examples of EU funded River River restoration projects

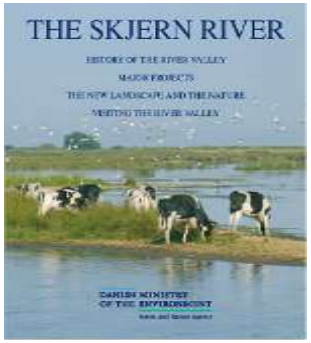
http://wwwlife-donau-ybbsat/

Count of ProjectName	Programme		
Global objective	INTERREG	LIFE	Grand Total
Flood management	20	1	21
Integrated River Basin Management	26	1	27
River & floodplain restoration	17	114	131
Water quality improvement	4	1	5
Species conservation and management	14	55	69
Grand Total	81	172	253

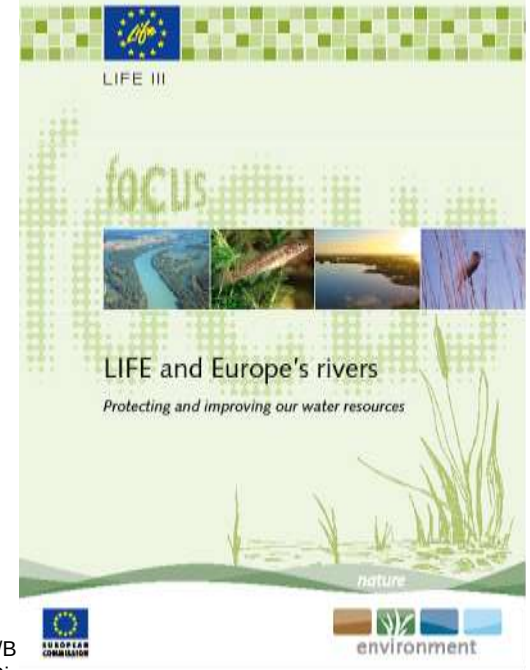


http://wwwlife-wachauat/

http://webarchivenationalarchivesgovuk/20110303155229/http://wwwstreamlifeorguk/



http://wwwnaturstyrelsendk/Naturoplevelser/Beskrivelser/Vestjylland/SkjernEnge/Skjern_River_Wetlandshtm



www.wwf.se/flodparlmussla

http://wwwhammde/lifelippeauehtml

REstoring rivers FOR effective catchment Management

November 2011 – October 2015

Tom Buijse, the Netherlands
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Angela Gurnell, UK
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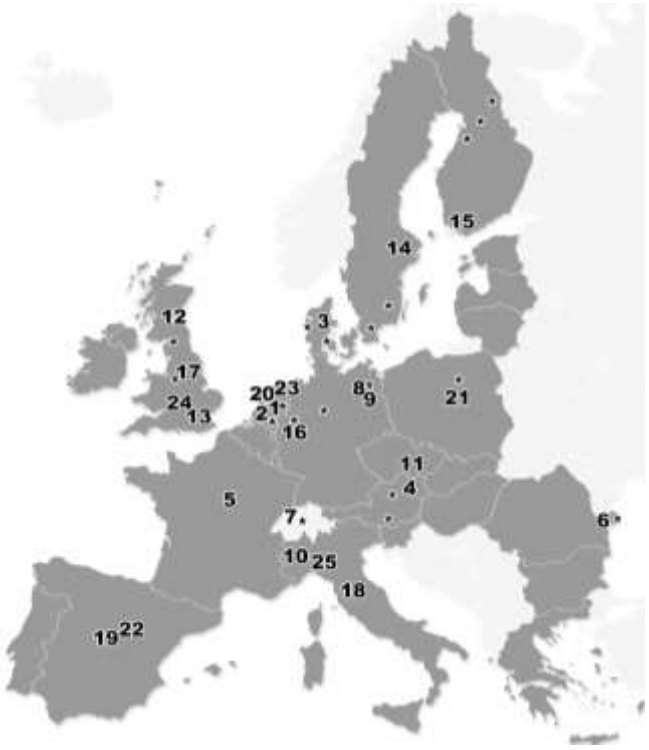
Erik Mosselman, the Netherlands
Susanne Muhar, Austria
Matthew O'Hare, UK
Tomasz Okruszko, Poland
Massimo Rinaldi, Italy
Jan Vermaat, the Netherlands
Christian Wolter, Germany

Partners



25 partners from 14 European countries

No.	Participant organisation name	Short name	Country
1	Stichting Deltares (Coordinator)	Deltares	Netherlands
2	Stichting Dienst Landbouwkundig Onderzoek B.V. – Alterra	Alterra	Netherlands
3	Aarhus University – National Environmental Research Institute	AU-NERI	Denmark
4	Universitaet fuer Bodenkultur Wien	BOKU	Austria
5	French Research Institute for agricultural and environmental engineering	Cemagref	France
6	Danube Delta National Institute for Research & Development	DDNI	Romania
7	Swiss Federal Institute of Aquatic Science and Technology	Eawag	Switzerland
8	Ecologic Institut gGmbH	Ecologic	Germany
9	Leibniz-Institute of Freshwater Ecology and Inland Fisheries	IGB	Germany
10	European Commission Joint Research Centre	JRC	Italy
11	Masaryk University	MU	Czech Republic
12	Natural Environment Research Council – Centre for Ecology & Hydrology	NERC-CEH	UK
13	Queen Mary, University of London	QMUL	UK
14	Swedish University of Agricultural Sciences	SLU	Sweden
15	Finnish Environment Institute	SYKE	Finland
16	University of Duisburg-Essen	UDE	Germany
17	University of Hull	UHULL	UK
18	Università di Firenze	UNIFI	Italy
19	Universidad Politécnica de Madrid	UPM	Spain
20	VU University Amsterdam, Institute of Environmental Studies	VU-IVM	Netherlands
21	Warsaw University of Life Sciences	WULS	Poland
22	Centro de Estudios y Experimentacion de Obras Publicas	CEDEX	Spain
23	Dutch Government Service for Land and Water Management	DLG	Netherlands
24	Environment Agency of England and Wales	EA	UK
25	Istituto Superiore per la Protezione e la Ricerca Ambientale	ISPRA	Italy

Objectives of REFORM

APPLICATION

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

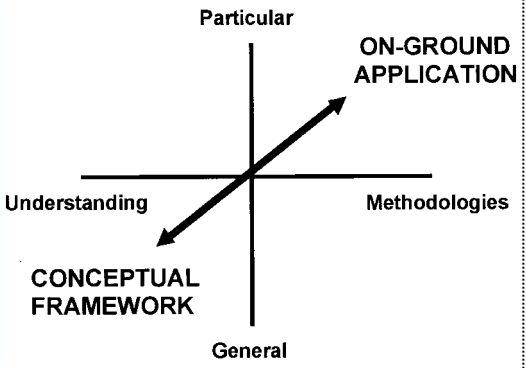
RESEARCH

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

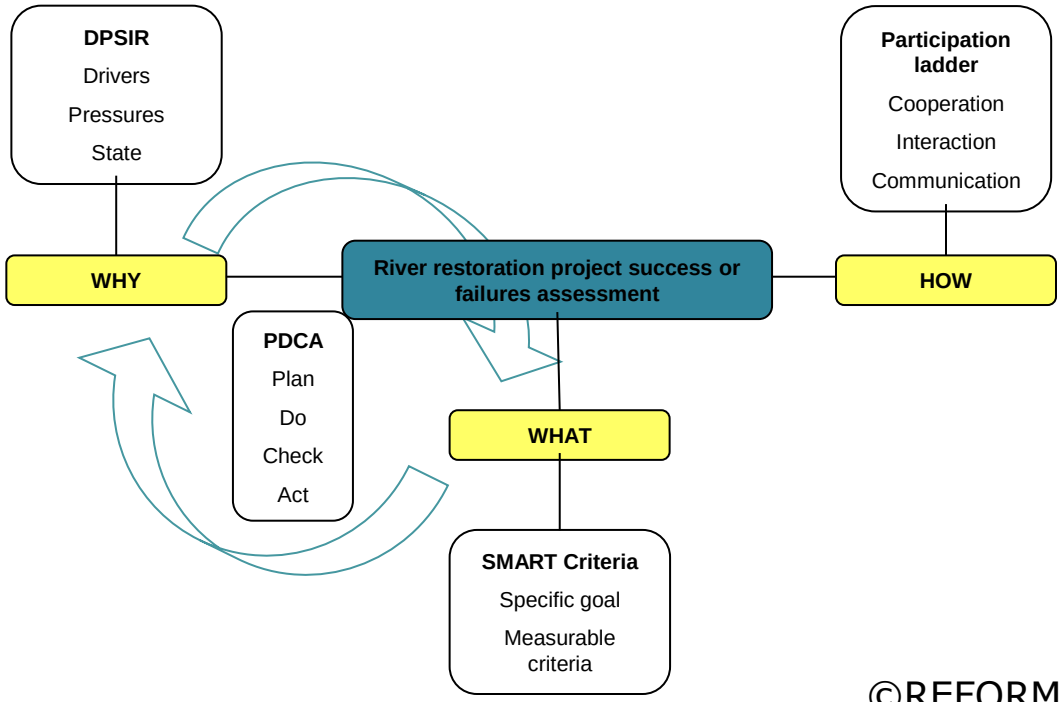
Linking general understanding to application



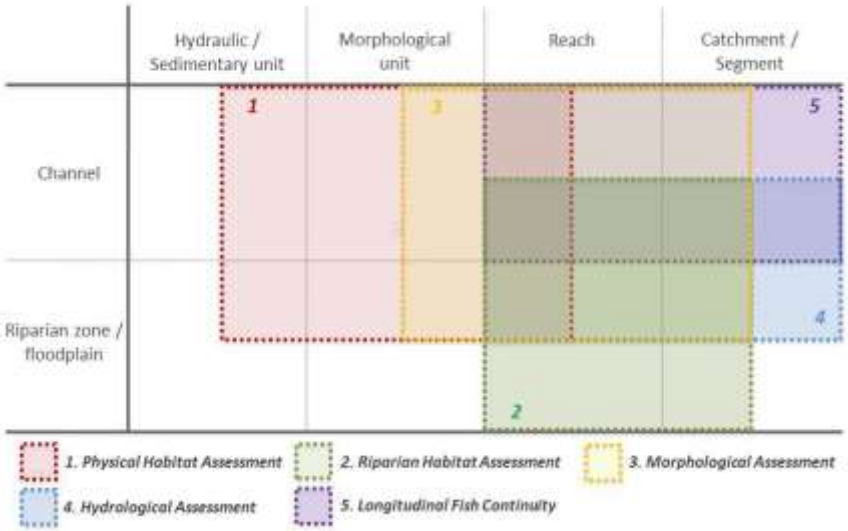
Source: Hobbs & Harris 2001
Restoration Ecology 9: 239–246

Open-source web-based KMS

Hierarchical process-based HYMO framework



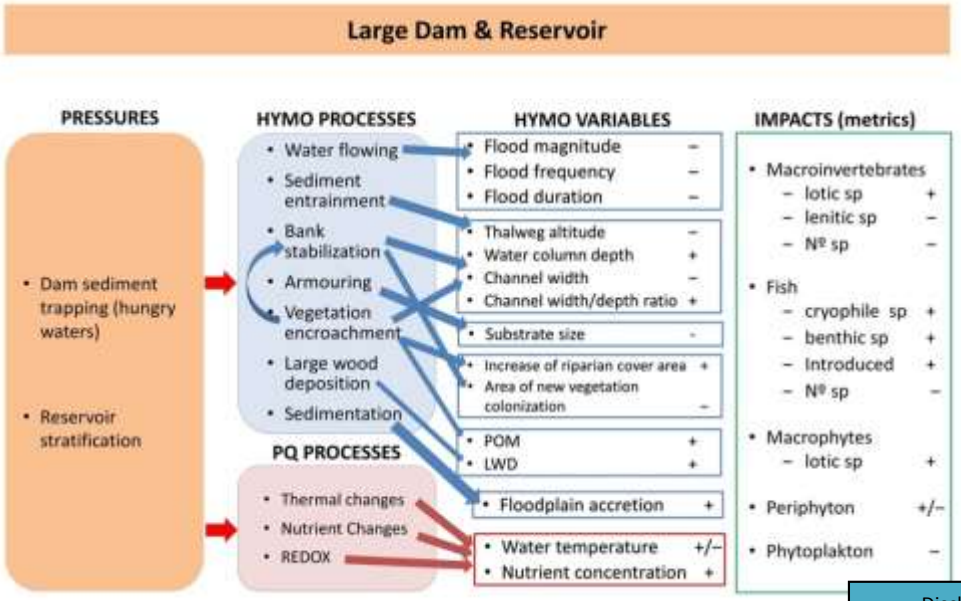
Review of eco-hydromorphological methods



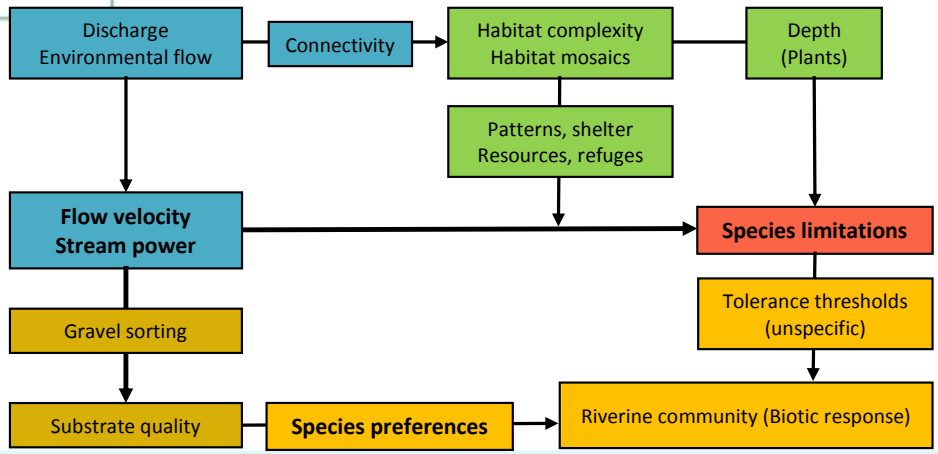
		Categories of methods					TOT
		1. Physical habitat	2. Riparian habitat	3. Morphological assessment	4. Hydrological assessment	5. Fish continuity	
Countries	**Europe**	**40**	**5**	**13**	**4**	**13**	**75**
	Austria	6				1	**7**
	Belgium	2				2	**4**
	Czech Republic	1		1			**2**
	Denmark	5					**5**
	England & Wales	4		4		2	**10**
	France	3		2		2	**7**
	Germany	5				1	**6**
	Ireland	1		1			**2**
	Italy	2	1	1	1	1	**6**
	Netherlands	2				1	**3**
	Poland	3		1			**4**
	Portugal	1					**1**
	Scotland			2	1	1	**4**
	Slovakia	1					**1**
	Slovenia	1					**1**
	Spain	2	4	3	2	2	**13**
	Sweden	2					**2**
	US	**24**	**5**	**8**	**4**	**5**	**46**
	Australia	**4**	**2**	**1**			**7**
	Switzerland	**1**					**1**
	Others*	**4**	**2**	**2**	**2**	**2**	**12**

*South Africa, Canada/Quebec, China, New Zealand, Ukraine

Conceptual HyMo Pressure – Process - Impact – Biota frameworks



Conceptual
pressure – process – impact
framework



Conceptual flow chart to link
HyMo with biota

Classifying pressures in line with European Water Framework Directive terminology

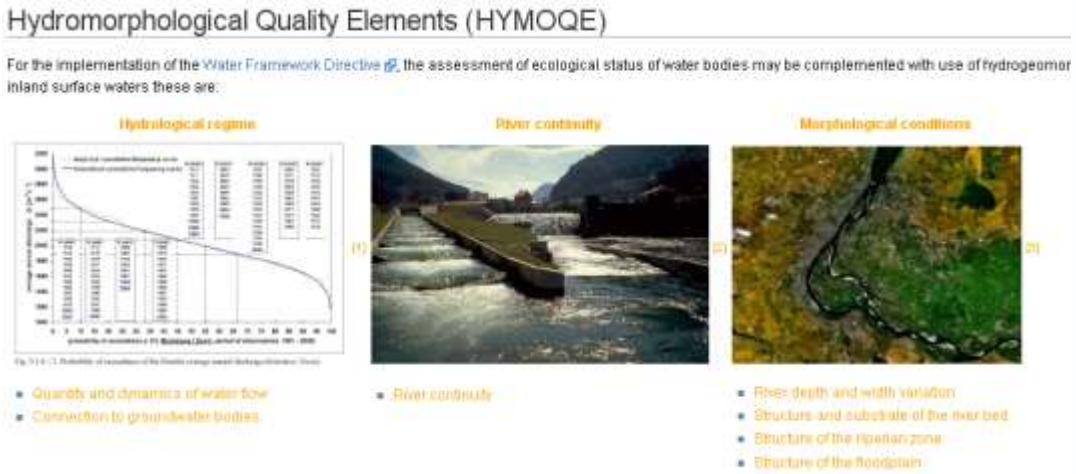
1 **WATER ABSTRACTIONS**
- Surface water abstraction
- Groundwater abstraction

2 **FLOW REGULATIONS**
- Discharge diversions and returns
- Interbasin flow transfers
- Hydrological regime modification: can be timing or quantity
- Hydropeaking
- Reservoir flushing
- Sediment discharge from dredging

3 **RIVER FRAGMENTATION**
- Artificial barriers upstream from the site
- Artificial barriers downstream from the site
- Colinear connected reservoir

4 **MORPHOLOGICAL ALTERATIONS**
- Impoundment
- Channelisation / Cross section alteration
- Alteration of riparian vegetation
- Alteration of instream habitat
- Embankments, levees or dikes
- Sedimentation
- Sand and gravel extraction
- Loss of vertical connectivity

5 **OTHER PRESSURES**



Standardised sampling of restored reaches across mid-sized rivers in Western, Central and Northern Europe

Mid-sized lowlands rivers		Mid-sized mountain rivers	
Where?	Who?	Where?	Who?
Em / Mörrum	SLU	Ruhr / Lahn	UDE
Skjern / Stora	NERI	Thur / Töss	EAWAG/UDE
Regge / Dommel / Dinkel	Alterra	Drau / Enns	BOKU
Spree / Lippe	IGB	Becva / Morava	MU
Narew / Warta	WULS	Kuivajoki/Vääräjoki	SYKE







Classification of restoration measures

1 **WATER FLOW QUANTITY IMPROVEMENT**
- Reduce surface water abstraction without return
- Reduce surface water abstraction with return (eg cooling water)
- Improve water retention (catchment, basin, capillaries)
- Reduce groundwater extraction
- Improve/Create Water storage
- Increase minimum flows
- Water diversion and transfer
- Recycle used water
- Reduce water consumption

2 **SEDIMENT FLOW QUANTITY IMPROVEMENT**
- Add/feed sediment
- Reduce undesired sediment input
- Prevent sediment accumulation in reservoirs
- Reduce erosion
- Improve continuity of sediment transport
- Manage dams for sediment flow
- Trap sediments

3 **FLOW DYNAMICS (BOTH WATER AND SEDIMENT) IMPROVEMENT**
- Ensure minimum flows
- Establish environmental flows / naturalise flow regimes
- Modify hydropeaking
- Increase flood frequency and duration in riparian zones or floodplains
- Reduce anthropogenic flow peaks (eg drainage, urban run-off)
- Favour morphogenic flows
- Shorten the length of impounded reaches
- link flood reduction with ecological restoration ('ecoflood')
- manage aquatic vegetation

4 **LONGITUDINAL CONNECTIVITY/CONTINUITY IMPROVEMENT**
- Remove barrier (eg weir, dam)
- Install fish pass/bypass/side channel for upstream migration
- Facilitate downstream migration
- Modify culverts, syphons, piped streams (eg daylighting)
- Manage sluice and weir operation for fish migration
- Fish-friendly turbines and pumping stations

5 **RIVER BED DEPTH AND WIDTH VARIATION IMPROVEMENT**
- Remeander water courses
- Widen water courses
- Shallow (ie opposite to deepen) water courses
- Allow/increase lateral channel migration or river mobility
- Narrow water courses
- Create low flow channels in over-sized channels

6 **IN-CHANNEL STRUCTURE AND SUBSTRATE IMPROVEMENT**
- Initiate natural channel dynamics to promote natural regeneration
- Remove sediments (eg eutrophic, polluted, fine)
- Modify aquatic vegetation ('weed') maintenance
- Introduce large wood
- Add sediments (gravel, sand)
- Recreate gravel bar and riffles
- Remove or modify in-channel hydraulic structures (eg groynes, deflectors)
- Reduce impact of dredging

7 **RIPARIAN ZONES IMPROVEMENT**
- Adjust land use (eg buffer strips) to develop riparian vegetation
- Revegetate riparian zones
- Remove bank fixation
- Remove non-native substratum
- Adjust land use (eg buffer strips) to reduce nutrient, sediment input or shore erosion
- Develop riparian forest

8 **FLOODPLAINS/OFF-CHANNEL/LATERAL CONNECTIVITY HABITATS IMPROVEMENT**
- Lower river banks or floodplains to enlarge inundation and flooding
- Set back embankments, levees or dykes
- Reconnect backwaters (oxbows, side channels) and wetlands
- Remove hard engineering structures that impede laterel connectivity
- Restore wetlands
- Retain floodwater (eg through local sluice management)
- Improve backwaters (eg morphology, vegetation)
- Construct semi-natural/artificial wetlands or aquatic habitats
- Isolation of water bodies

9 **OTHER MEASURES**

Substantial effort was needed to create short list with a level of detail which gives a notion of the type and aim of the measure

Benchmarking and targets for restoration

"There is a need to benchmark when restoration is successful"

"There is a need to set measurable targets for restoration"

"This is however often not done …."

REFORM develops a benchmarking and target setting protocol

- Abiotic and biotic indicators for restoration
- "SMART" – specific, measurable, attainable, relevant, time-bound
  - Specify the expectation
  - Set relevant target
  - Identify indicators to evaluate change
  - Baseline and reference condition
  - Mechanism to achieve expectation
  - Adjustment for external constraints
  - Means of evaluation
  - Time course

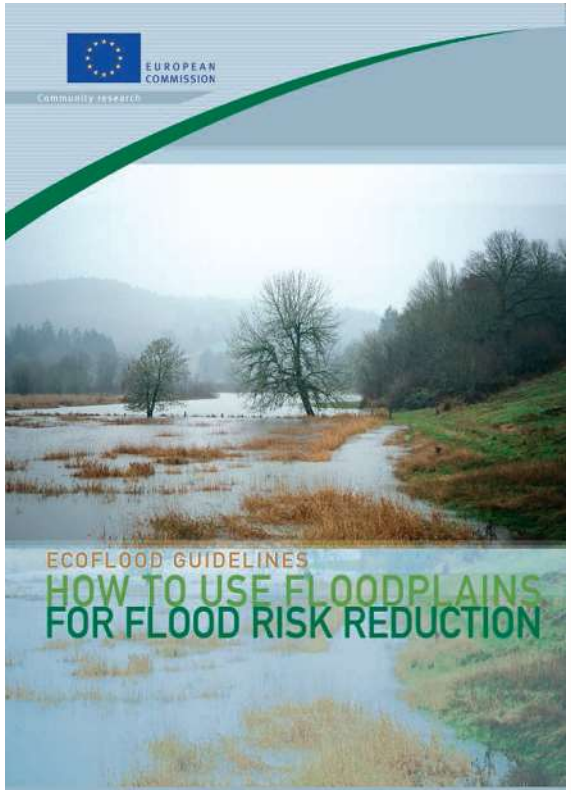
Adapted from Anderson et al 2005

Synergy between ecological restoration and ….

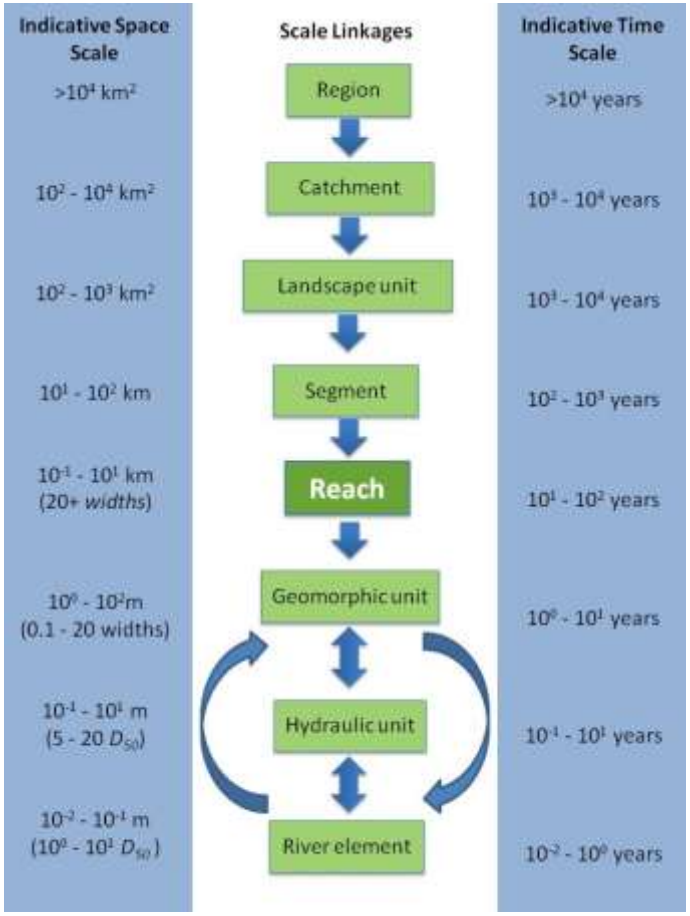
- Flood protection (Room for Rivers, Ecoflood)
- Navigation (parallel dams; wave action)
- Agriculture (land use of riparian zones; sediment dynamics, nutrients)
- Hydropower (Environmental flows; hydropeaking)

To …

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

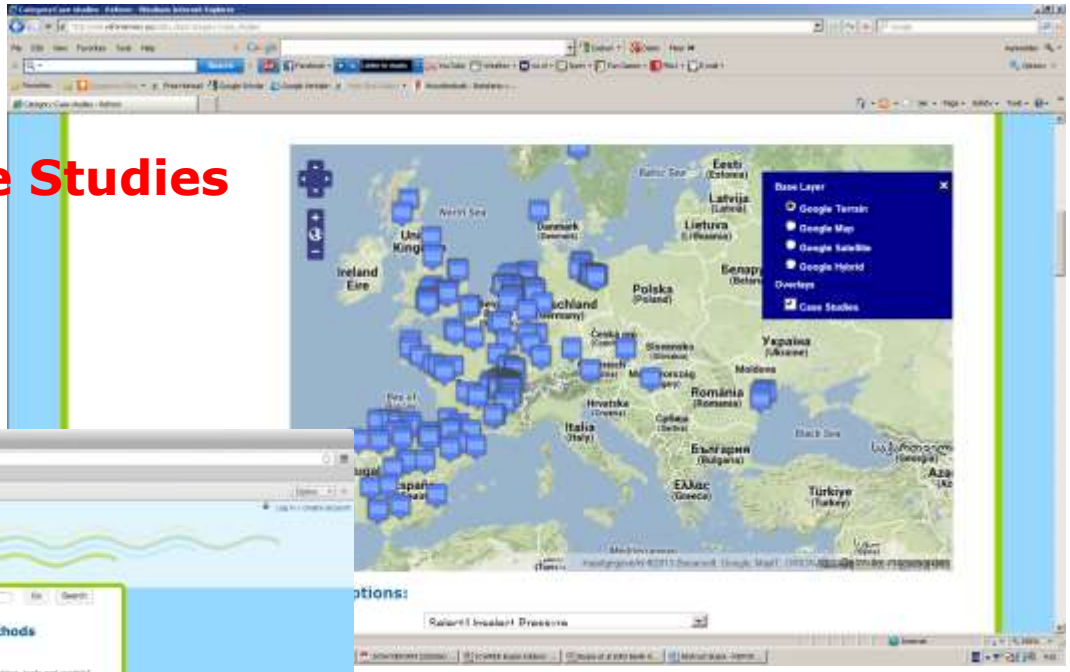


Hierarchical process-based HYMO framework that is ecologically relevant



REFORM GEO-WIKI – TOOLS

Case Studies



- River Characterisation
- Pressures
- Measures
- Tools
- Case studies
- Biological Quality
- HYMO Quality
- Ecosystem Services
- EU Directives
- Database

HTTP://WIKI.REFORMRIVERS.EU

Interaction with end-users

Communication & Dissemination Strategy

End-user groups: policy makers, practitioners, scientists

Standard

- Website, Newsletters (2/yr), Policy Briefs (3)

Advanced

- WIKI linking theory to practice and experience
- Interactive preparation of end-user workshop
- Interaction with ECOSTAT

Events

- interactive stakeholder workshop (Feb 2013)
- local workshops in case study catchments (tbd)
- summer school (2015)
- final conference (2015)

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

- 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

Cooperation with …

WISER

Restoring Europe's Rivers

European Centre for River Restoration
ECRR

Evdokia Achilleos, Gary Brierley, Johan Kling, Margaret Palmer, Hervé Piégay, Peter Pollard, Ursula Schmedtje, Bas van der Wal

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

RESTORE (LIFE+ Information & Communication)

European Centre for River Restoration (ECRR)

WFD Implementation: ECOSTAT common implementation strategy (CIS)

Advisory Board of REFORM

#	Description	Planning	Status	Where to find?	Will content be in WIKI?
D7.1	Communication and Dissemination Strategy	Jan-12	√	Website (results > deliverables)	No
D4.1	Field protocols and associated database	Apr-12	√	Submitted	To be decided
D7.2	project website: structure and functionality	Apr-12	√	www.reformrivers.eu	N.A.
D7.6	Project leaflet	Apr-12	√	Website in EN, ES, FR, GE and IT	No
D7.6	Project newsletters (8)	Every 6 months	√	Website: #1 and #2	No
D1.1	Review on eco-hydromorphological methods	Oct-12	√	Website (results > deliverables)	**Yes**
D7.2	REFORM GEOWIKI	Nov-12	√	http://wiki.reformrivers.eu	N.A.
D2.1	Multi-scale framework and indicators of hydromorphological processes and forms	Jan-13	Test version		**Yes**
D1.2	Review on effects of pressures on hydromorphological variables and ecologically relevant processes	Oct-13	Final draft		**Yes**
D1.3	Review on ecological responses to hydromorphological degradation and restoration	Oct-13	Final draft		**Yes**
D7.7	Policy brief (3)	Every 16 month #1: Feb-13	√		No
D7.3	Proceedings of the End-user workshop	Mar-13	√		No
D5.1	Review of methodologies for benchmarking and setting end-points for restoration projects	Oct-13	1st draft		**Yes**
D6.1	Synthesis of interim results for practical application to support the compilation of the 2nd RBMPs	Oct-13	1st draft		**Yes**
D1.4	Inventory of the cost of river degradation and the socio-economic aspects and costs and benefits	Oct-13	1st draft		**Yes**
D2.3	Framework to analyse ecosystem services provided by European river systems	Oct-13	1st draft		**Yes**
D3.1	Impacts of hydromorphological degradation and disturbed sediment dynamics on ecological status	Nov-13	In prep		**Yes**

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