The importance of hydromorphodynamics and its ecological effects on water body status in rivers

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Hydromorphological pressures in European surface waters

- 127 000 surface water bodies
  - 82% rivers
- HYMO pressures affecting ..
  - 40% river and transitional waters
- Causes
  - Hydropower
  - Navigation
  - Agriculture
  - Flood protection
  - Urban development

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

Much investments in river restoration. How do we share the expertise?

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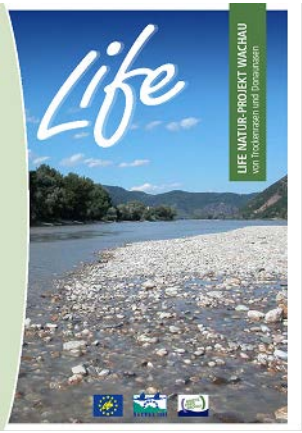
Examples of EU funded River River restoration projects

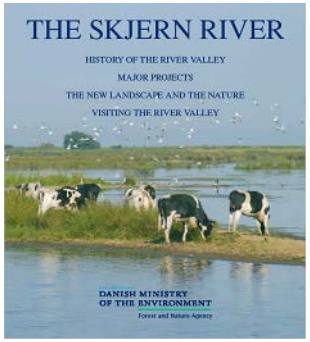
http://wwwlife-donau-ybbsat/

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

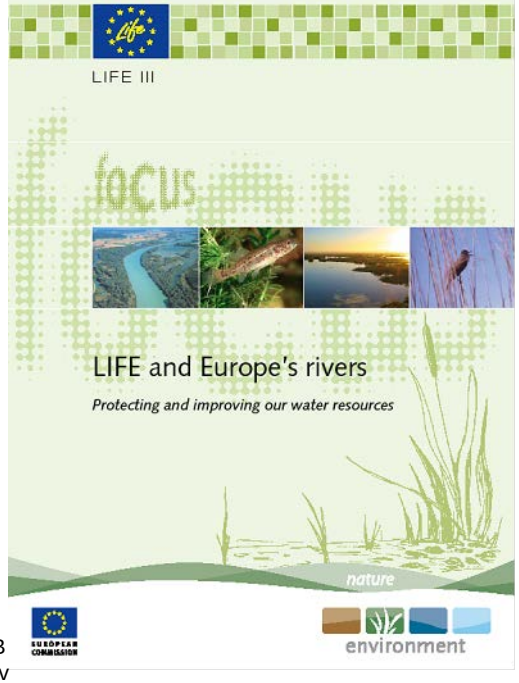


http://wwwlife-wachauat/

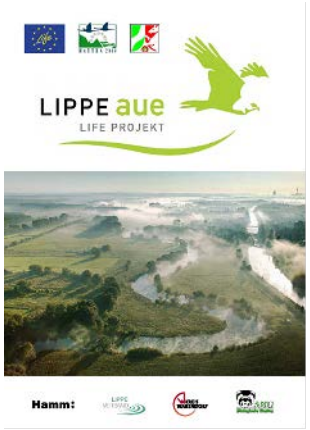
http://webarchivenationalarchivesgovuk/20110303155229/http://wwwstreamlifeorguk/



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



www.wwf.se/flodparlmussla

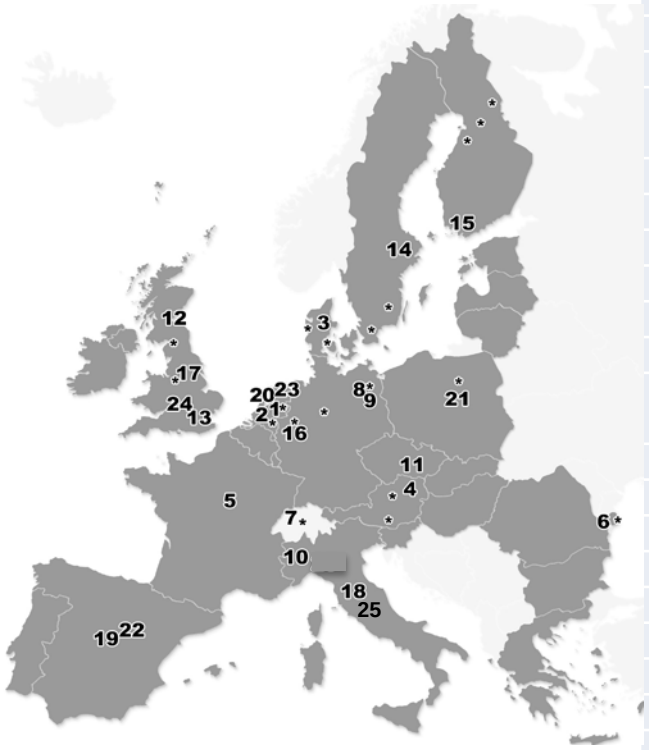


http://wwwhammde/lifelippeauehtml

REFORM - REstoring rivers FOR effective catchment Management

Klare Konzepte. Saubere Umwelt.

Partners



26 partners from 15 European countries

2011 - 2015

No	Name	Short name	Country
1	Stichting Deltares	Deltares	Netherlands
2	Stichting Dienst Landbouwkundig Onderzoek	Alterra	Netherlands
3	Aarhus University	AU-NERI	Denmark
4	Universitaet fuer Bodenkultur Wien	BOKU	Austria
5	Institut National de Recherche en Sciences et des Technologies pour l'Environnement et l'Agriculture	IRSTEA	France
6	Institutul National de Cercetare-Dezvoltare Delta Dunarii	DDNI	Romania
7	Swiss Federal Institute of Aquatic Science and Technology	EAWAG	Switzerland
8	Ecologic Institut Gemeinnützige Gmbh	Ecologic	Germany
9	Forschungsverbund Berlin E.V.	FVB.IGB	Germany
10	Joint Research Centre- European Commission	JRC	Belgium
11	Masaryk University	MU	Czech Republic
12	Natural Environment Research Council - Centre for Ecology and Hydrology	NERC	United Kingdom
13	Queen Mary University of London	QMUL	United Kingdom
14	Swedish University of Agricultural Sciences	SLU	Sweden
15	Finnish Environment Institute	SYKE	Finland
16	Universitaet Duisburg-Essen	UDE	Germany
17	University of Hull	UHULL	United Kingdom
18	Universita Degli Studi Di Firenze	UNIFI	Italy
19	Universidad Politecnica de Madrid	UPM	Spain
21	Warsaw University of Life Sciences	WULS	Poland
22	Centro de Estudios y Experimentacion de Obras Publicas	CEDEX	Spain
23	Dienst Landelijk Gebied	DLG	Netherlands
24	Environment Agency	EA	United Kingdom
25	Istituto Superiore per la Protezione e la Ricerca Ambientale	ISPRA	Italy
26	Norsk Institutt for Vannforskning	NIVA	Norway
27	Stichting VU-VUmc	VU-Vumc	Netherlands

Objectives of REFORM

APPLICATION

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

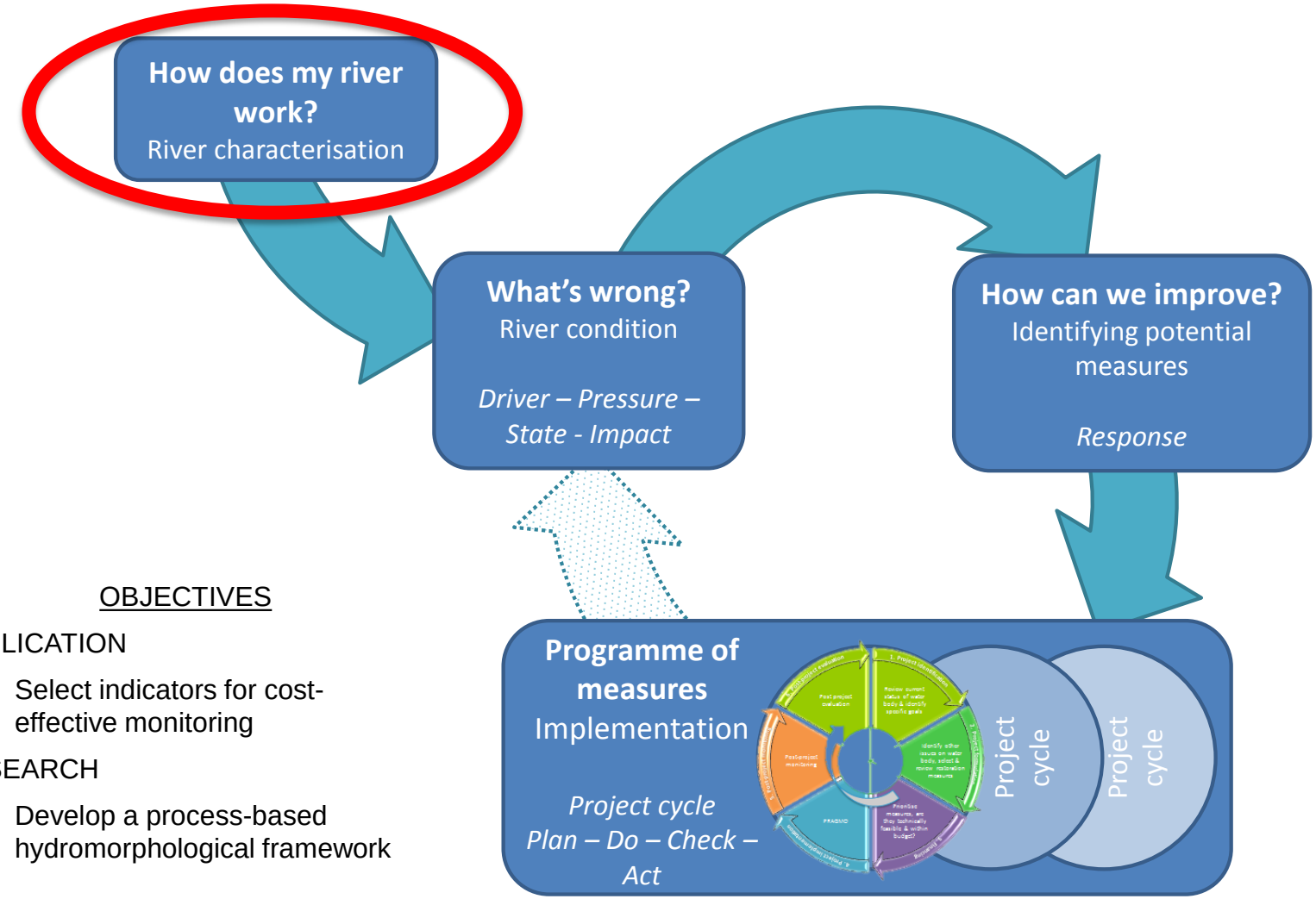
RESEARCH

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

DISSEMINATION

8. Enlarge appreciation for the benefits of restoration

Connecting REFORM's output to River Basin Management Planning



OBJECTIVES

APPLICATION

- Select indicators for cost-effective monitoring

RESEARCH

- Develop a process-based hydromorphological framework

Water Framework Directive

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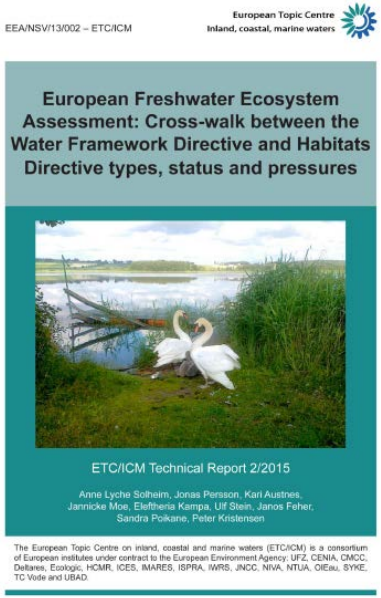
Overview of broad European river types

Broad river type name	Broad river type code	Altitude (masl)	Catchment area (km²)	Geology	number of national types	number of WBs	% of WBs
Very large rivers (all Europe)	1	any	>10 000	any (usually mixed)	54	827	1,0 %
Lowland, Siliceous, Medium-Large	2	≤200	100 - 10 000	Siliceous	24	1139	1,4 %
Lowland, Siliceous, Very small-Small	3	≤200	≤100	Siliceous	30	7302	8,9 %
Lowland, Calcareous or Mixed, Medium-Large	4	≤200	100 - 10 000	Calcareous/Mixed	67	2872	3,5 %
Lowland, Calcareous or Mixed, Very small-Small	5	≤200	≤100	Calcareous/Mixed	47	14137	17,1 %
Lowland, Organic and Siliceous	6	≤200	<10 000	Organic and Siliceous	18	6193	7,5 %
Lowland, Organic and Calcareous/Mixed	7	≤200	<10 000	Organic and Calcareous/Mixed	9	336	0,4 %
Mid altitude, Siliceous, Medium-Large	8	200 - 800	100 - 10 000	Siliceous	41	3051	3,7 %
Mid altitude, Siliceous, Very small-Small	9	200 - 800	≤100	Siliceous	37	8627	10,5 %
Mid altitude, Calcareous or Mixed, Medium-Large	10	200 - 800	100 - 10 000	Calcareous/Mixed	61	1797	2,2 %
Mid altitude, Calcareous or Mixed, Very small-Small	11	200 - 800	≤100	Calcareous/Mixed	48	7663	9,3 %
Mid-altitude, Organic and siliceous	12	200 - 800	<10 000	Organic and Siliceous	8	3290	4,0 %
Mid-altitude, Organic and Calcareous/Mixed	13	200 - 800	<10 000	Organic and Calcareous/Mixed	6	154	0,2 %
Highland (all Europe), Siliceous, incl. Organic (humic)	14	>800	<10 000	Siliceous	16	1525	1,8 %
Highland (all Europe), Calcareous/Mixed	15	>800	<10 000	Calcareous/Mixed	17	2227	2,7 %
Glacial rivers (all Europe)	16	> 200	<10 000	any	16	3251	3,9 %
Mediterranean, Lowland, Medium-Large, perennial	17	≤200	100 - 10 000	any	16	941	1,1 %
Mediterranean, Mid altitude, Medium-Large, perennial	18	200 - 800	100 - 10 000	any	13	615	0,7 %
Mediterranean, Very small-Small, perennial	19	< 800	≤100	any	21	1942	2,4 %
Mediterranean, Temporary/Intermittent streams	20	any	<1 000	any	26	3549	4,3 %
				Total	575	71438	86,6 %



ETC/ICM, 2015. European Freshwater Ecosystem Assessment: Cross-walk between the Water Framework Directive and Habitats Directive types, status and pressures, ETC/ICM Technical Report 2/2015, Magdeburg: European Topic Centre on inland, coastal and marine waters, 95 pp. plus Annexes.

Take the catchment perspective

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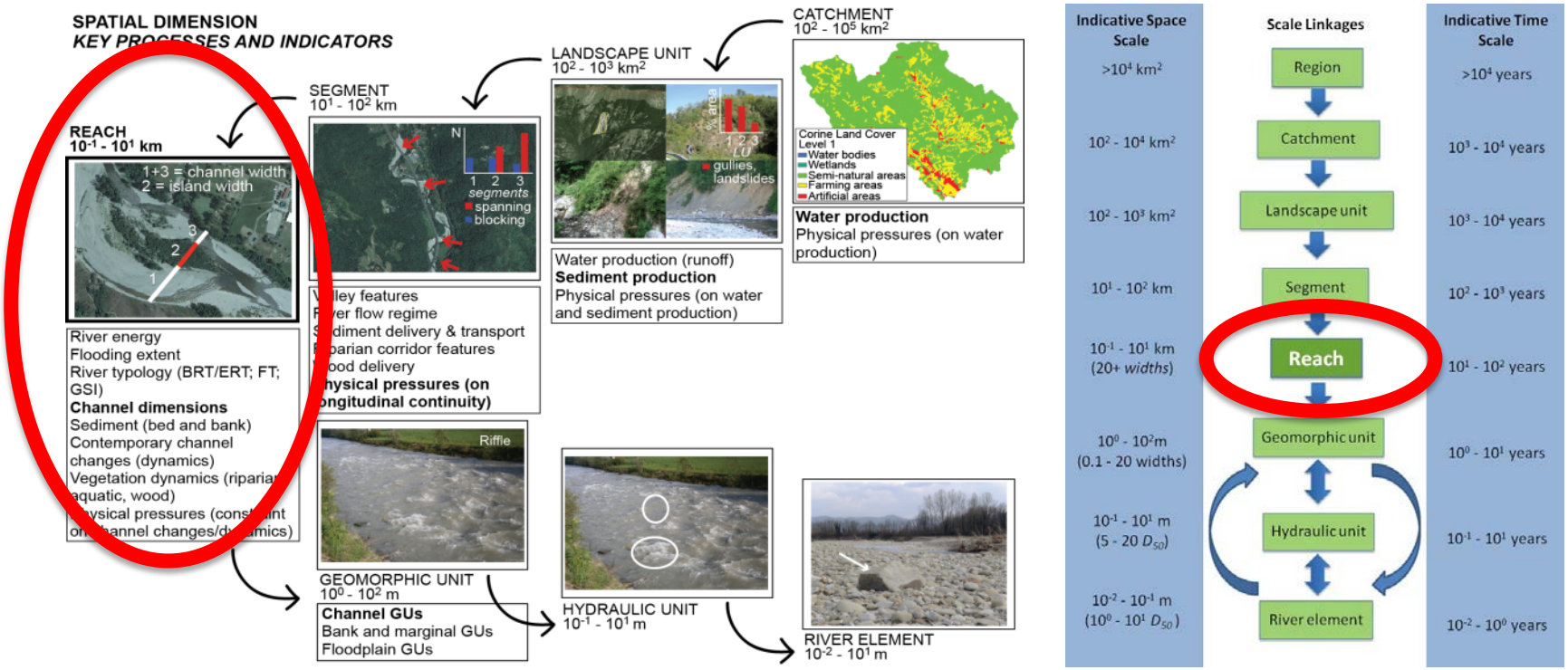
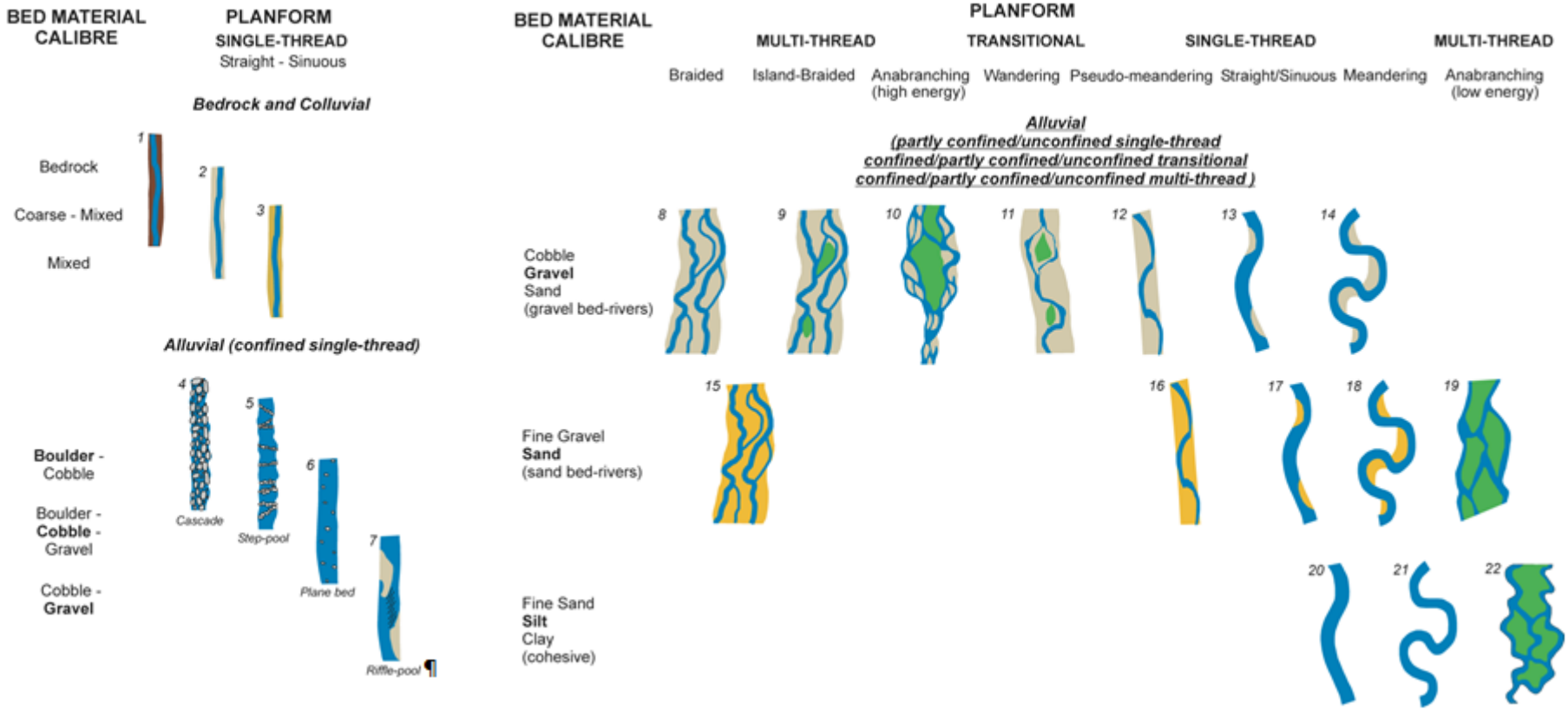
Awareness to relevant spatial and temporal aspects beyond river restoration project boundaries and project life span



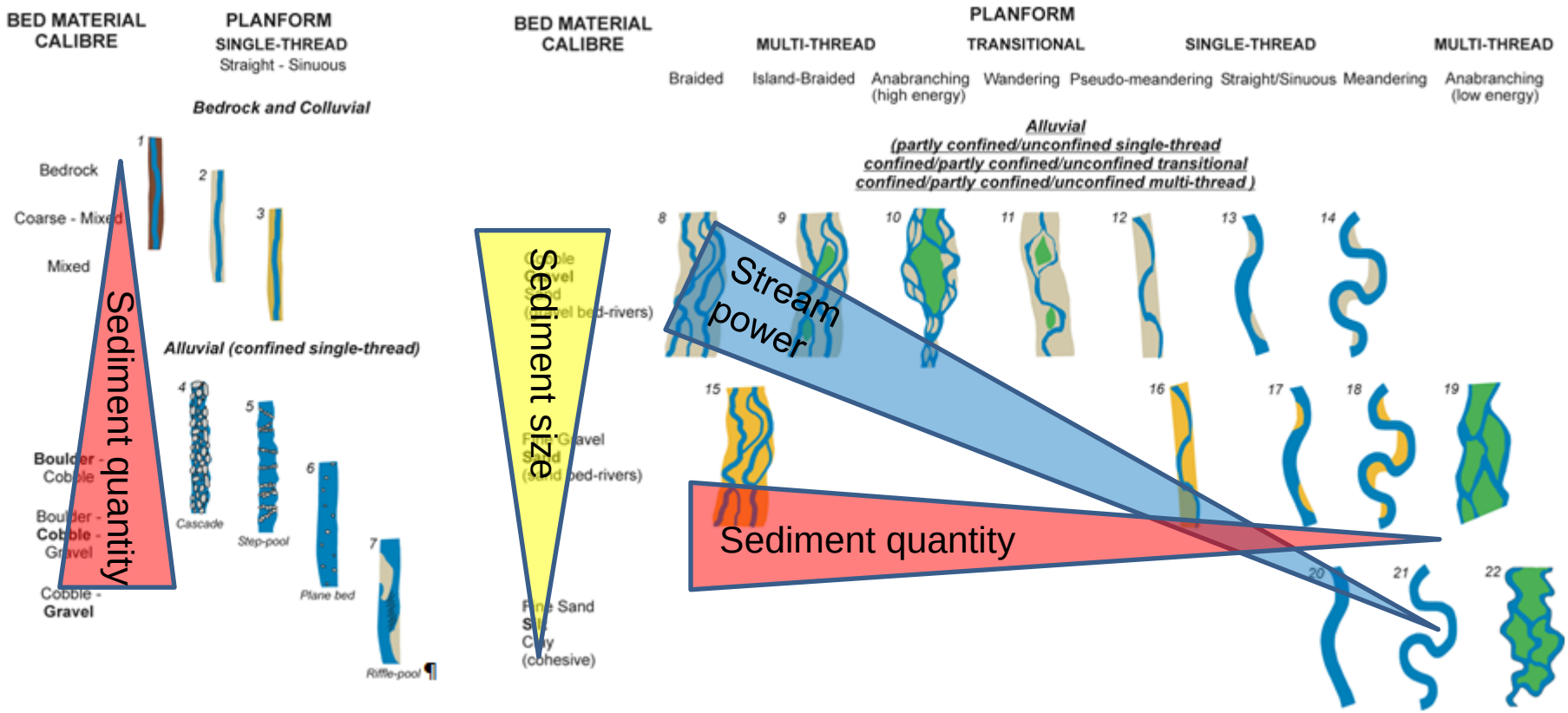
Grabowski, R.C., N. Surian and A.M. Gurnell (2014) Characterizing geomorphological change to support sustainable river restoration and management. WIREs Water. doi/10.1002/wat2.1037

Gurnell, A. et al (2014)Multi-scale framework and indicators of hydromorphological processes and forms. REFORM deliverable 2.1

Hydromorphological processes and vegetation affecting river reaches



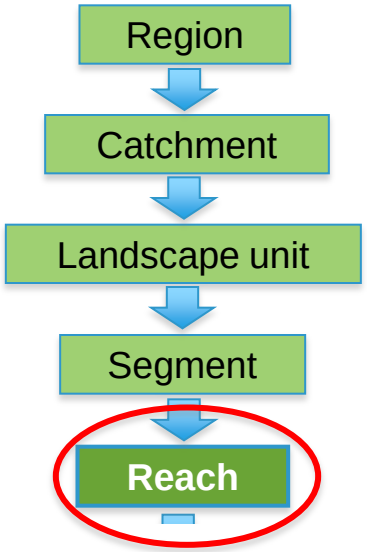
Hydromorphological processes and vegetation affecting river reaches



\+ .... interaction with vegetation

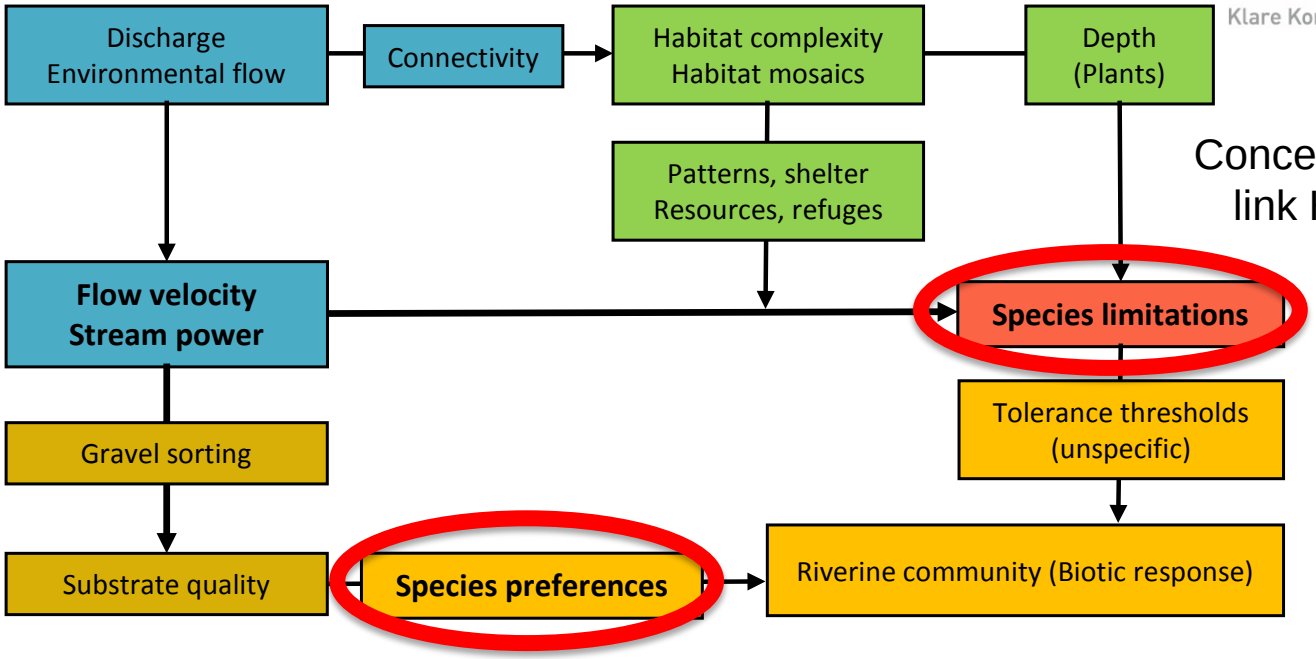
REFORM Framework: Delineation

- '**Reach**' key spatial scale
  - i.e. portion with sufficiently uniform boundary conditions so that the river maintains a near consistent set of process-form interactions



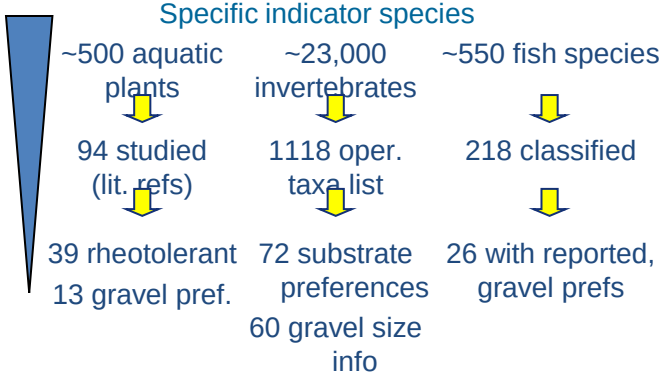
- **WFD water bodies** can be further sub-divided into 'reaches' using additional geomorphological criteria (morphological types)

Hydromorphology – biota interactions

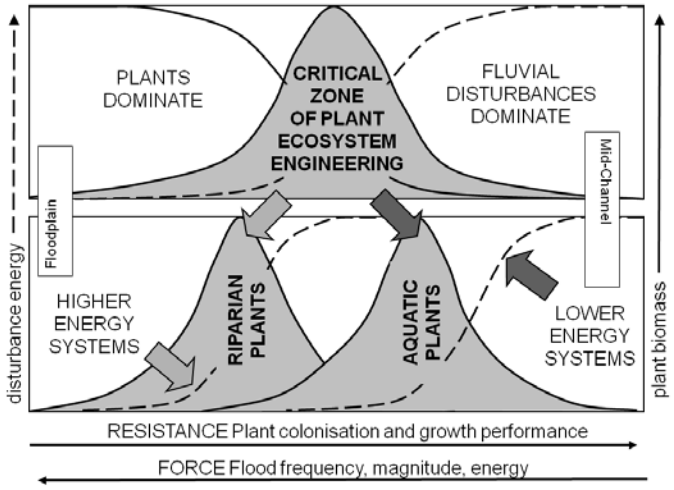


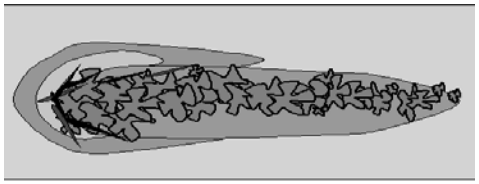
Conceptual flow chart to link HyMo with biota

- **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



Vegetation as ecosystem engineer for river restoration is too often insufficiently taken into account



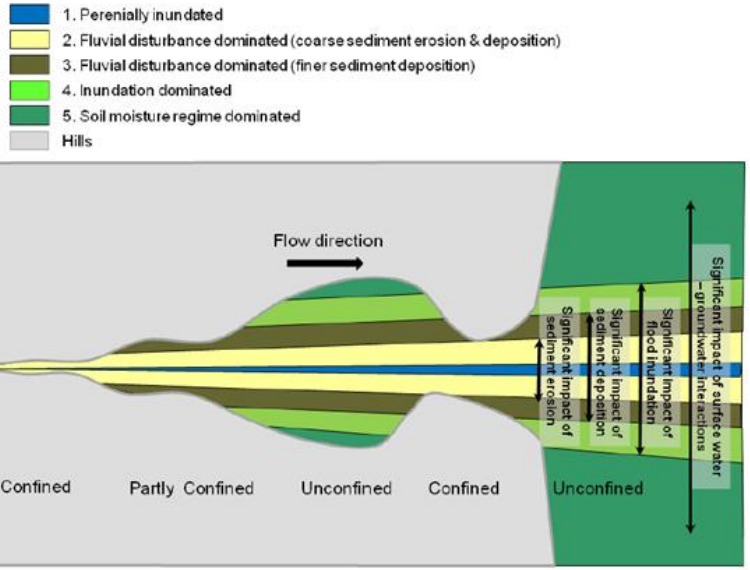


-> Nature-based solutions

Gurnell, A. et al. D2.2 (2014) Influence of natural hydromorphological dynamics on biota and ecosystem functioning. REFORM deliverable 2.2 part 1

Gurnell, A.M. (2014) Plants as river system engineers. Earth Surface Processes and Landforms 39: 4–25

Existing EU Directives provide a too limited legislative framework for riparian zones and floodplains



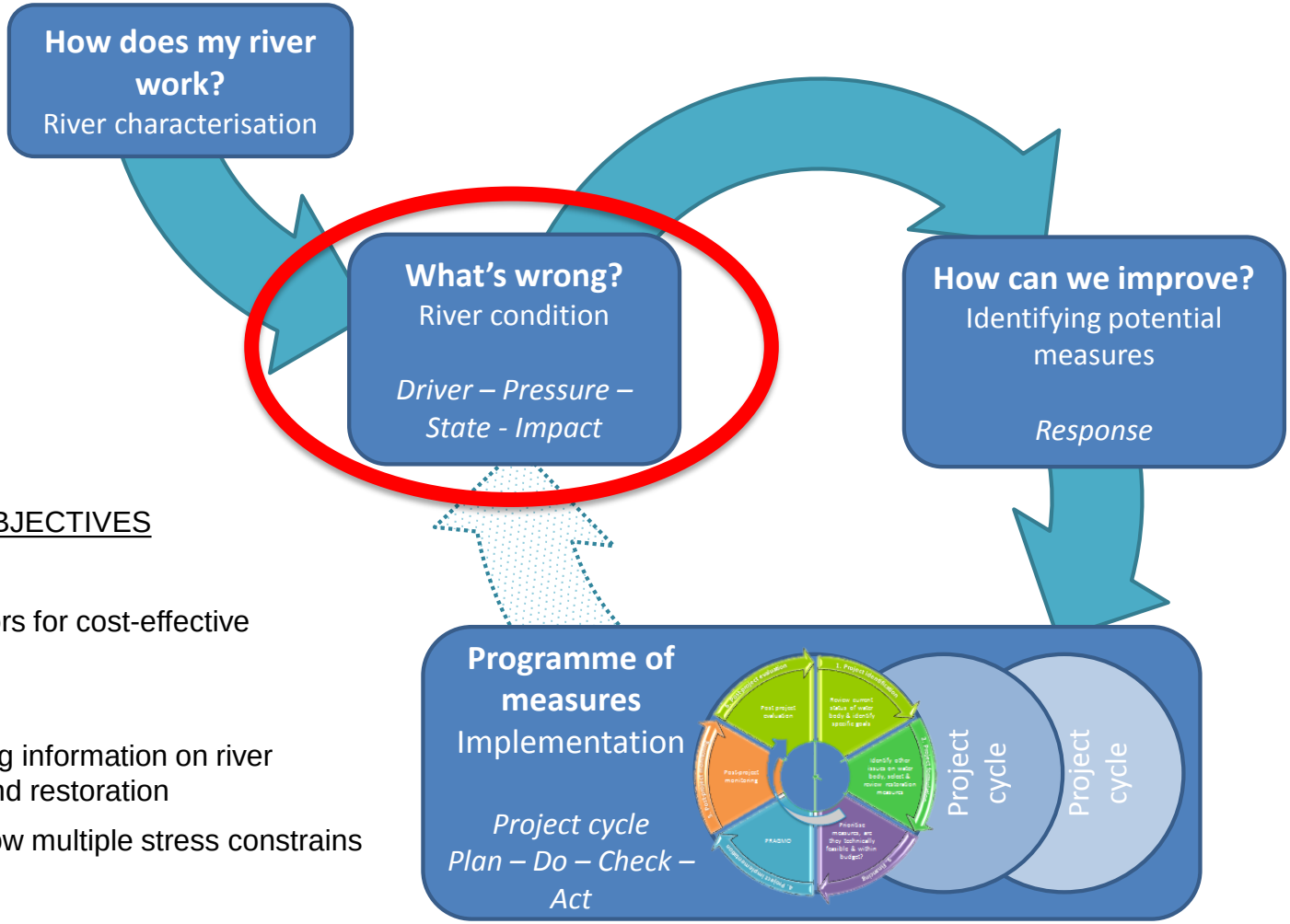
- Hydromorphological impacts can take years to fully manifest themselves
- Riparian and floodplain ecosystems are not subject to extensive monitoring
- Plant diversity alone cannot be considered a valid and exhaustive indicator to assess the health of a river system and its functioning
- A generic framework is recommended for assessing the impact on floodplain and riparian ecosystems

Baattrup-Pedersen, A., M. O'Hare et al. (2015) Guidance on how to identify impacts of hydromorphological degradation on riparian ecosystems. REFORM deliverable 3.4

Baattrup-Pedersen, A., Göthe, E., Riis, T., & O'Hare, M. T. (2016). Functional trait composition of aquatic plants can serve to disentangle multiple interacting stressors in lowland streams. Science of The Total Environment, 543, 230-238. http://dx.doi.org/10.1016/j.scitotenv.2015.11.027

Connecting REFORM's output to RBMPs

Status monitoring and assessment



OBJECTIVES

APPLICATION

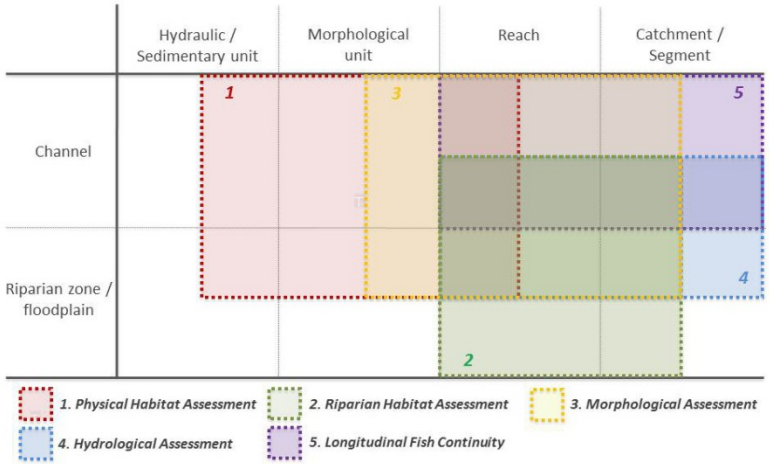
- Select indicators for cost-effective monitoring

RESEARCH

- Review existing information on river degradation and restoration
- Understand how multiple stress constrains restoration

Consider physical processes

most applied hydromorphological methods do this insufficiently



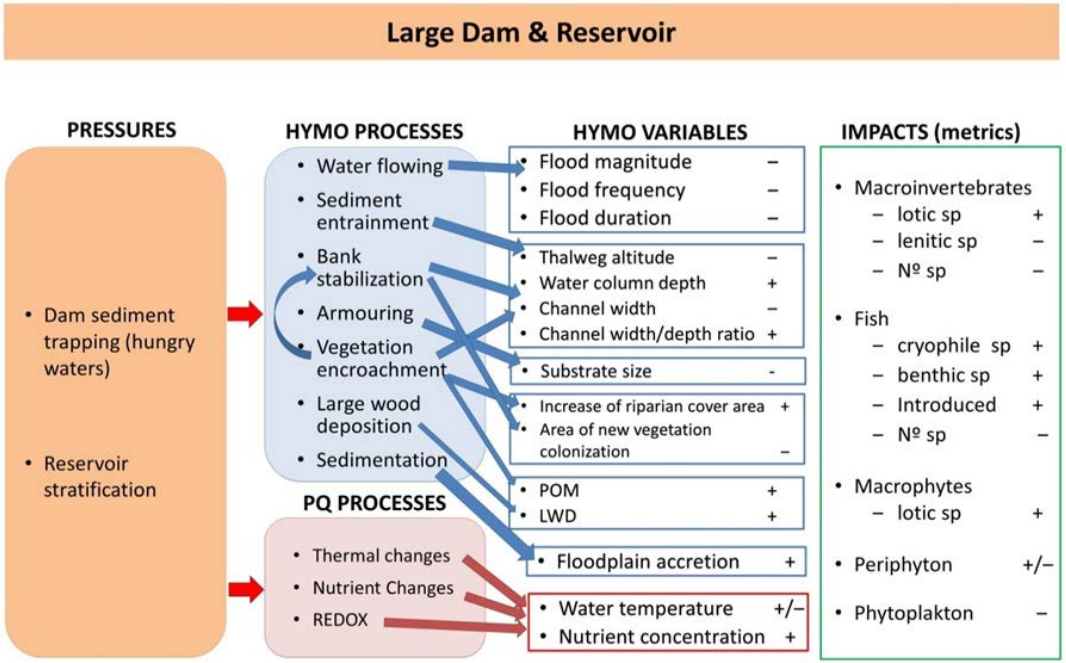
		Categories of methods					TOT
		1. Physical habitat	2. Riparian habitat	3. Morphological assessment	4. Hydrological assessment	5. Fish continuity	
Countries	**Europe**	**40**	**5**	**13**	**4**	**13**	**75**
	Austria	6				1	**7**
	Belgium	2				2	**4**
	Czech Republic	1		1			**2**
	Denmark	5					**5**
	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

Rinaldi, M., B. Belletti et al. (2013) Review on eco-hydromorphological methods. REFORM deliverable 1.1

Belletti, B., Rinaldi, M., Buijse, A.D., Gurnell, A.M., Mosselman, E (2015) A review of assessment methods for river hydromorphology. Environmental Earth Sciences 73:2079–2100

Conceptual DIAGNOSIS
pressure – process – impact framework



- 18 most significant HyMo pressures reviewed that impact aquatic biota
  - Hydrological regime pressures, including water abstraction and flow regulation
  - River fragmentation pressures
  - Morphological alteration pressures
- Diagnosis helps to identify appropriate restoration measures

Garcia de Jalon, D. et al. (2013) Review on effects of pressures on hydromorphological variables and ecologically relevant processes. REFORM deliverable 1.2

Wolter, C. et al. (2013) Review on ecological responses to hydromorphological degradation and restoration. REFORM deliverable 1.3

Fish and macrophytes best BQEs to detect HyMo degradation

- Fish most sensitive biological quality element (BQE) for HYMO.
- Macrophytes can be used for assessing HYMO degradation in low-land rivers, if a trait-based metric is developed.
- Need to develop **NEW** biota sampling methods that are more sensitive to HYMO impacts.
  - Current sampling methods are not appropriate to capture HYMO impacts and they underestimate the influence of HYMO on biota.
- Alternative/new methods using biota (not standardised; not intercalibrated) can be used in investigative monitoring already now to assess HYMO impacts.

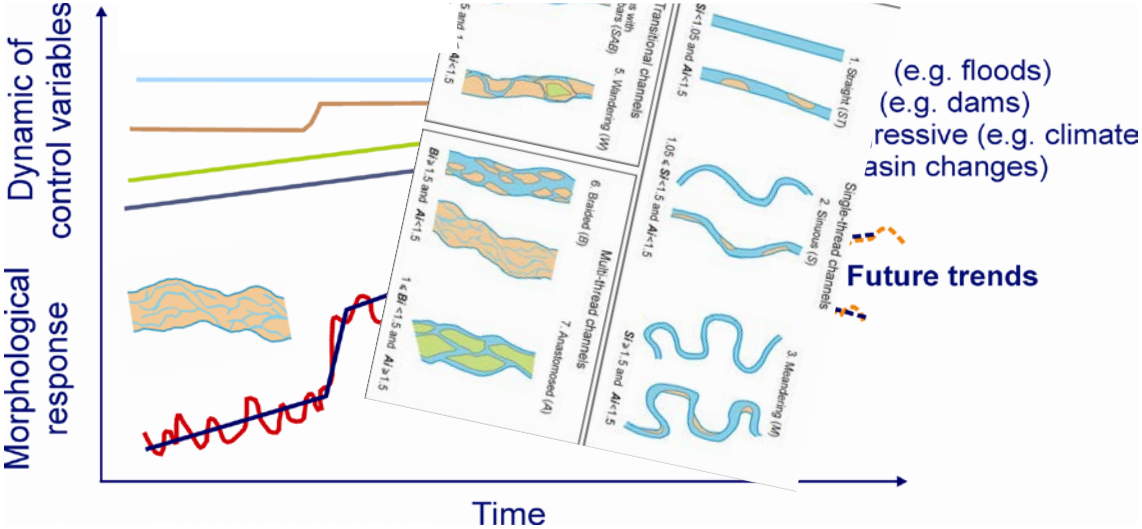
Friberg, N. (2014) Impacts and indicators of change in lotic ecosystems. WIREs Water 2014 doi/10.1002/wat2.1040

Friberg, N., M. O'Hare & A.M. Poulsen [eds.] (2013) Impacts of hydromorphological degradation and disturbed sediment dynamics on ecological status. REFORM deliverable 3.1

O'Hare, M. et al. (2015) Understanding biological responses to degraded hydromorphology sediment dynamics and multiple stress. REFORM deliverable 3.2

Verdonschot, P. et al. (2015) Evaluation of candidate indicators for case studies including uncertainty. REFORM deliverable 3.3

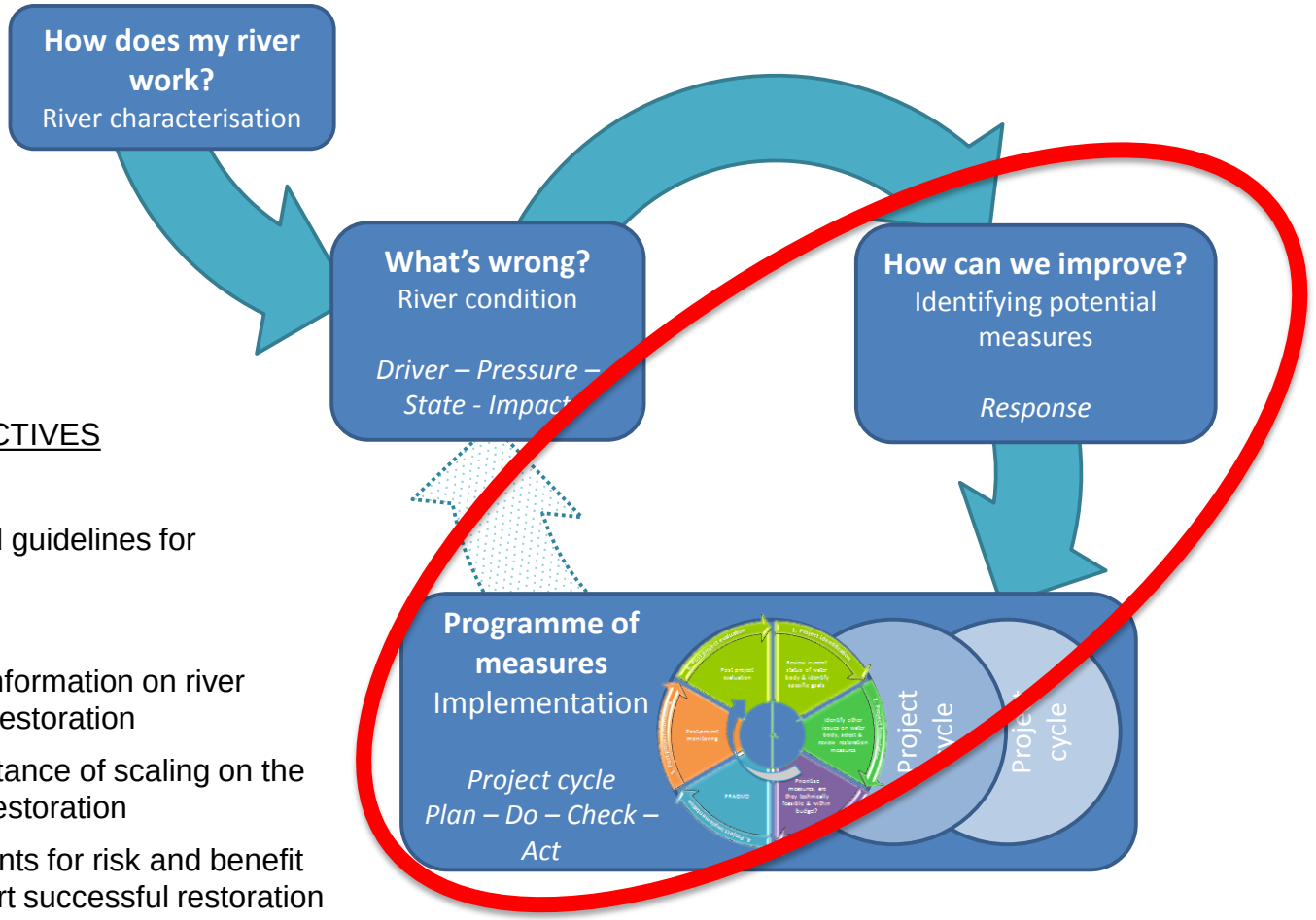
HYMO assessment along the entire gradient from high to bad ecological status



- Hydromorphological impacts can take years to fully manifest themselves.
  - HYMO assessment early warning
- At present BQEs cannot differentiate between different degrees of HYMO degradation with sufficient precision
- HYMO assessment essential to diagnose impact of HYMO pressures and to identify appropriate restoration measures
- The proposed REFORM HYMO assessment method is specifically tailored to this purpose.

Connecting REFORM's output to RBMPs

Programme of Measures & Individual Restoration Projects



OBJECTIVES

APPLICATION

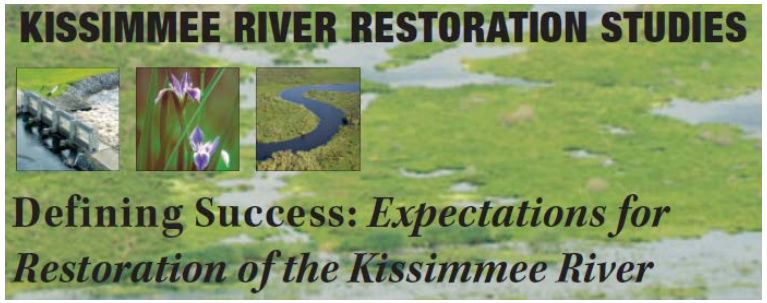
- Improve tools and guidelines for restoration

RESEARCH

- Review existing information on river degradation and restoration
- Assess the importance of scaling on the effectiveness of restoration
- Develop instruments for risk and benefit analysis to support successful restoration

Good planning and management

Restoration projects should have well-defined success criteria



Kissimmee River restoration expectations

9 describe abiotic responses for hydrology, geomorphology, and water quality.

5 describe changes in plant communities in the river channel and floodplain

6 describe invertebrate and amphibian and reptile communities.

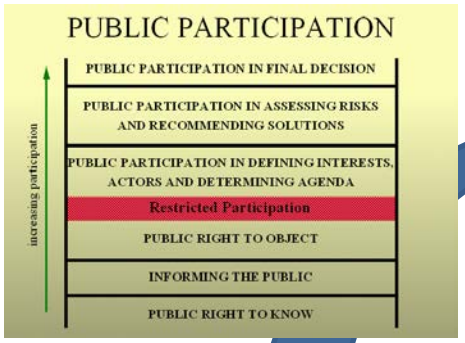
5 describe anticipated changes in fish and bird communities.

Angelopoulos N.V., Cowx I.G., Buijse A.D. Integrated planning framework for successful river restoration projects: upscaling lessons learnt from European case studies. Environmental Science and Policy 76: 12–22. https://doi.org/10.1016/j.envsci.2017.06.005

Friberg, N., N.V. Angelopoulos, A.D. Buijse, I.G. Cowx, J. Kail, T.F. Moe, H. Moir, M.T. O'Hare, P.F.M. Verdonschot, C. Wolter (2016) Effective River Restoration in the 21st Century: From Trial and Error to Novel Evidence-Based Approaches Advances in Ecological Research 55: 535-611. http://dx.doi.org/10.1016/bs.aecr.2016.08.010

Good planning and management

Application of existing management tools can substantially enhance the efficiency and effectiveness of restoration



Plan

Diagnosis
Driver
Pressure
State
Impact
Response

Do

Restoration measures
Specific
Measurable
Achievable
Realistic
Time-bound

Check

Monitoring (BACI)
Before – **A**fter
Control - **I**mpact

Act

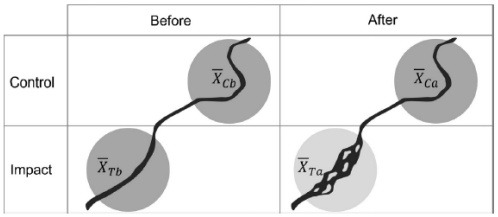
Participation ladder

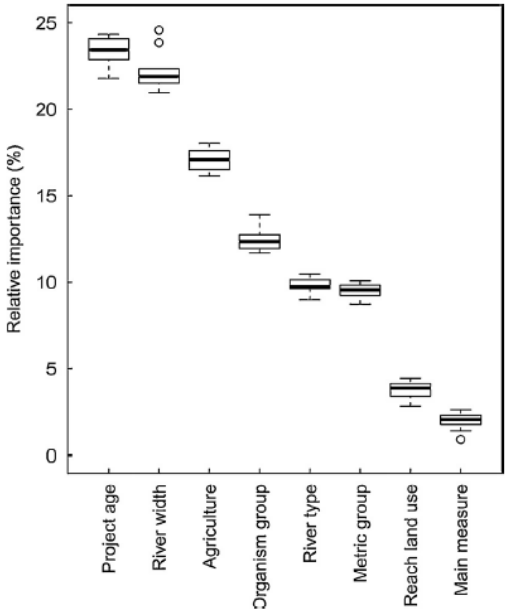
River Restoration does benefit Biological Quality Elements

- Compilation of peer-reviewed literature and unpublished databases
- Significant effects
  - instream measures on fish, benthic invertebrates
  - river widening on macrophytes
- Restoration resulted in a higher number of individuals but few new species
  - Recolonization potential?
- Most strongly affected by agricultural, river width and project age.
  - Project age indicates that restoration benefits may vanish over time
  - Need for long-term monitoring to understand trajectories of change following restoration and improve sustainability

Data sources, number of publications, projects, and response ratios.

	Peer-reviewed literature	Unpublished studies
Publications	69	–
Projects	91	64
Response ratios	239	299
Unique response ratios (per project, organism group, metric group)	132	265





Kail, J. & N. Angelopoulos et al. (2014) Evaluation of hydromorphological restoration from existing data. REFORM deliverable 4.2

Kail, J. et al. (2015) The effect of river restoration on fish, macroinvertebrates and aquatic macrophytes: a meta-analysis. Ecological Indicators 58 (2015) 311–321.

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

Klare Konzepte. Saubere Umwelt.

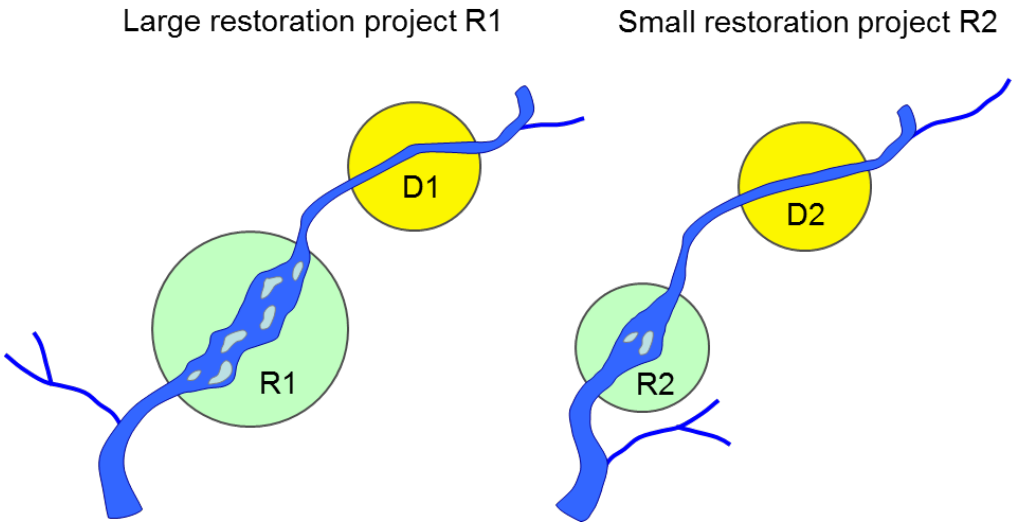
Mid-sized lowlands rivers

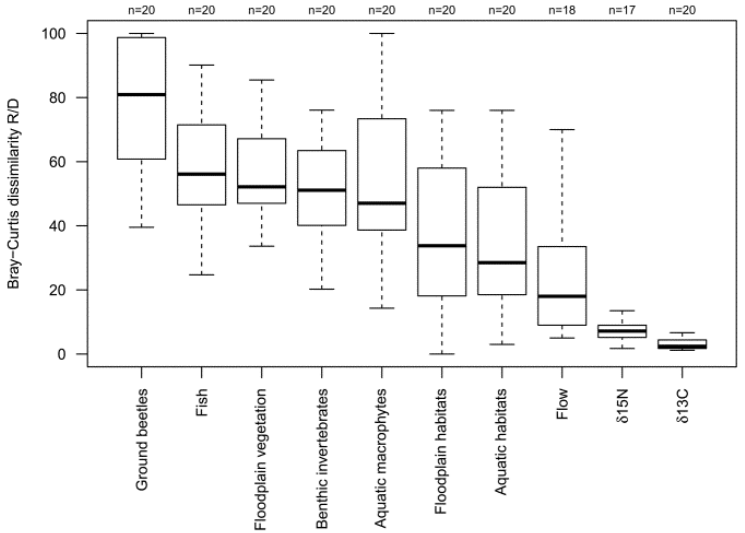
Mid-sized mountain rivers

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

Restoration matters!

Comparing common restoration practices e.g. widening cross sections, remeandering and expanding aquatic-terrestial transition zones in medium-sized rivers





River restoration benefits not only aquatic biota.
Terrestrial and semi-aquatic species (e.g. floodplain vegetation, ground beetles) benefited more

Smaller projects did perform surprisingly similar as larger ones

Hering. D. et al (2015) Contrasting the roles of section length and instream habitat enhancement for river restoration success: a field study of 20 European restoration projects. J. Applied Ecology – published online 23 September 2015.

Kail, J., A. Lorenz & D. Hering [eds.] (2014) Hydromorphological and ecological survey of the restoration case studies. REFORM deliverable 4.3

Cost data are too scarce hampering cost-benefit analysis

Measure	Germany	Spain	UK	Netherlands
Flow Quantity (1)	1%	0%	0%	0%
Sediment Flow Quantity (2)	4%	**29%**	5%	**23%**
Flow Dynamics (3)	1%	0%	0%	0%
Longitudinal Connectivity (4)	**21%**	**32%**	7%	**55%**
Depth and Width Variation (5)	13%	0%	**53%**	9%
In-channel Structure and Substrate (6)	**27%**	7%	**19%**	9%
Riparian Zone (7)	4%	11%	7%	5%
Floodplains/Lateral Connectivity (8)	**29%**	**21%**	9%	0%
Total of Measures	453	228	45/55	30

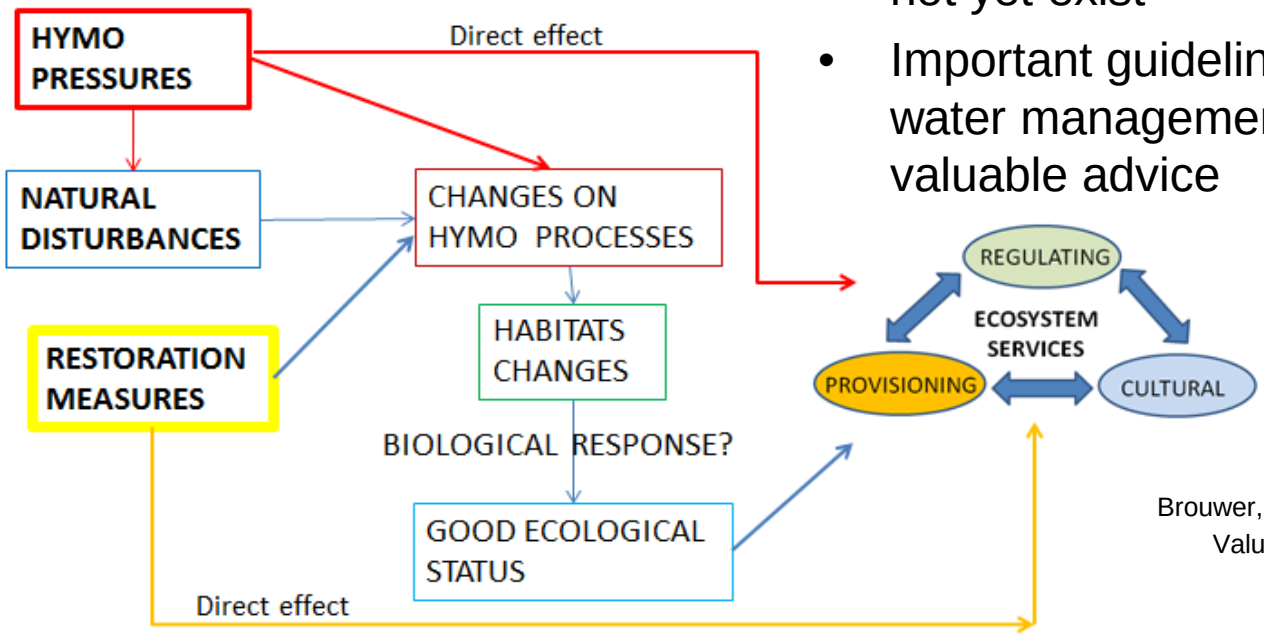
Conclusions & Recommendations

- Incorporating cost information into decision making is a 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

Ayres, A., H. Gerdes, M. Lago et al. (2014) Inventory of the cost of river degradation and the socio-economic aspects and costs and benefits. REFORM deliverable 1.4

Cost-Benefit Analysis aids in prioritizing restoration measures and plans

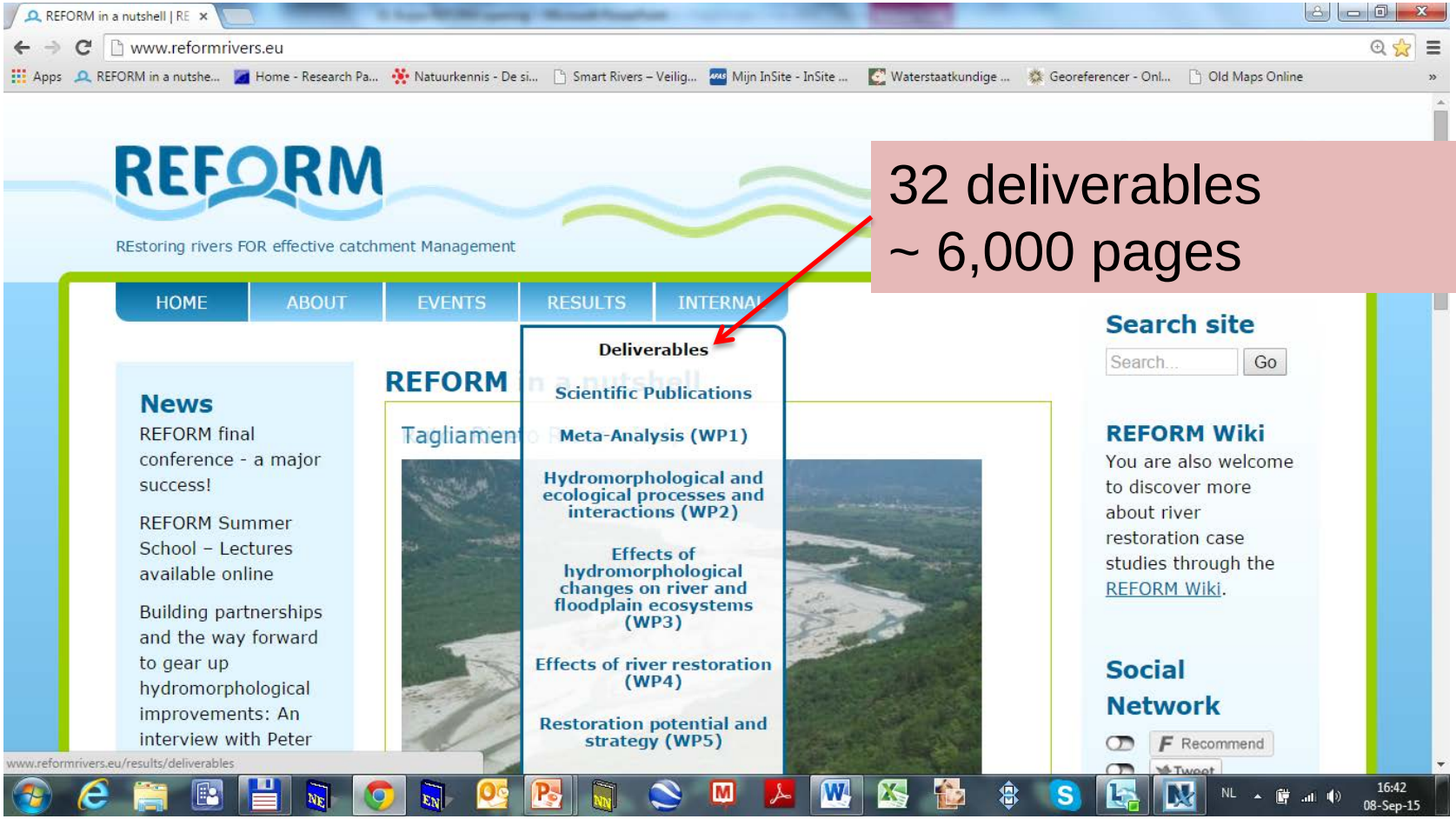
- In Europe, prioritization of restoration measures in the context of the WFD based on CEA/CBA is still very limited
- Manuals and guidelines for the economic analysis of river restoration projects do not yet exist
- Important guidelines on the economics of water management in general offer valuable advice



Brouwer, R., H. Gerdes, P. Reichert et al. (2015) Valuing the ecosystem services provided by European river corridors – an analytical framework. REFORM deliverable 5.2

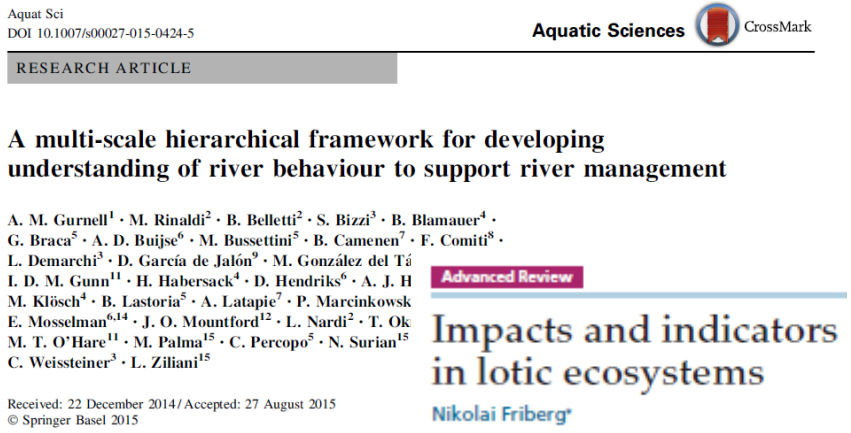

?
How do we restore this river successfully?

website: WWW.REFORMRIVERS.EU



> 100 Scientific publications

DWA
Klare Konzepte. Saubere Umwelt.


Aquat Sci
DOI 10.1007/s00027-015-0424-5

Aquatic Sciences CrossMark

RESEARCH ARTICLE

A multi-scale hierarchical framework for developing understanding of river behaviour to support river management

A. M. Gurnell[1] · M. Rinaldi[2] · B. Belletti[2] · S. Bizzi[3] · B. Blamauer[4] · G. Braca[5] · A. D. Buijse[6] · M. Bussettini[5] · B. Camenen[7] · F. Comiti[8] · L. Demarchi[3] · D. García de Jalón[9] · M. González del Tá I. D. M. Gunn[11] · H. Habersack[4] · D. Hendriks[6] · A. J. H M. Klösch[4] · B. Lastoria[5] · A. Latapie[7] · P. Marcinkowsk E. Mosselman[6,14] · J. O. Mountford[12] · L. Nardi[2] · T. Ok M. T. O'Hare[11] · M. Palma[15] · C. Percopo[5] · N. Surian[15] C. Weissteiner[3] · L. Ziliani[15]

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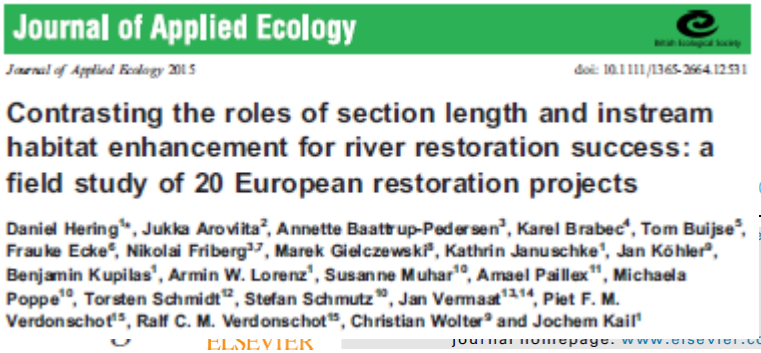
Advanced Review

Impacts and indicators in lotic ecosystems

Nikolai Friberg*


Journal of Applied Ecology

Journal of Applied Ecology 2015 doi: 10.1111/1365-2664.12531

Contrasting the roles of section length and instream habitat enhancement for river restoration success: a field study of 20 European restoration projects

Daniel Hering[1]*, Jukka Aroviita[2], Annette Baattrup-Pedersen[3], Karel Brabec[4], Tom Buijse[5], Frauke Ecke[6], Nikolai Friberg[3,7], Marek Gielczewski[8], Kathrin Januschke[1], Jan Köhler[9], Benjamin Kupilas[1], Armin W. Lorenz[1], Susanne Muhar[10], Amael Paillex[11], Michaela Poppe[10], Torsten Schmidt[12], Stefan Schmutz[10], Jan Vermaat[13,14], Piet F. M. Verdonschot[15], Ralf C. M. Verdonschot[15], Christian Wolter[9] and Jochem Kail[1]

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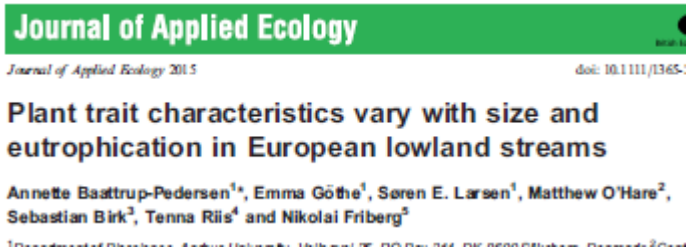
Journal of Applied Ecology

Journal of Applied Ecology 2015 doi: 10.1111/1365-

Plant trait characteristics vary with size and eutrophication in European lowland streams

Annette Baattrup-Pedersen[1]*, Emma Göthe[1], Søren E. Larsen[1], Matthew O'Hare[2], Sebastian Birk[3], Tenna Riis[4] and Nikolai Friberg[5]

The conceptual foundation of environmental decision support

Peter Reichert*, Simone D. Langhans [1], Judit Lienert, Nele Schuwirth

Eawag, Swiss Federal Institute of Aquatic Science and Technology, 8600 Dübendorf, Switzerland


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Earth Surf. Process. Landforms (2015)
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Distinct patterns of interaction between vegetation and morphodynamics

Mijke van Oorschot,[1,2]* Maarten Kleinhans,[1] Gertjan Geerling[2] and Hans Middelkoop[1]
[1] Faculty of Geosciences, Universiteit Utrecht, 3508 TC Utrecht, The Netherlands
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Environ Earth Sci (2015) 73:2079–2100
DOI 10.1007/s12665-014-3558-1

ORIGINAL ARTICLE

Review

The effect of river restoration on fish, macroinvertebrates and aquatic macrophytes: A meta-analysis

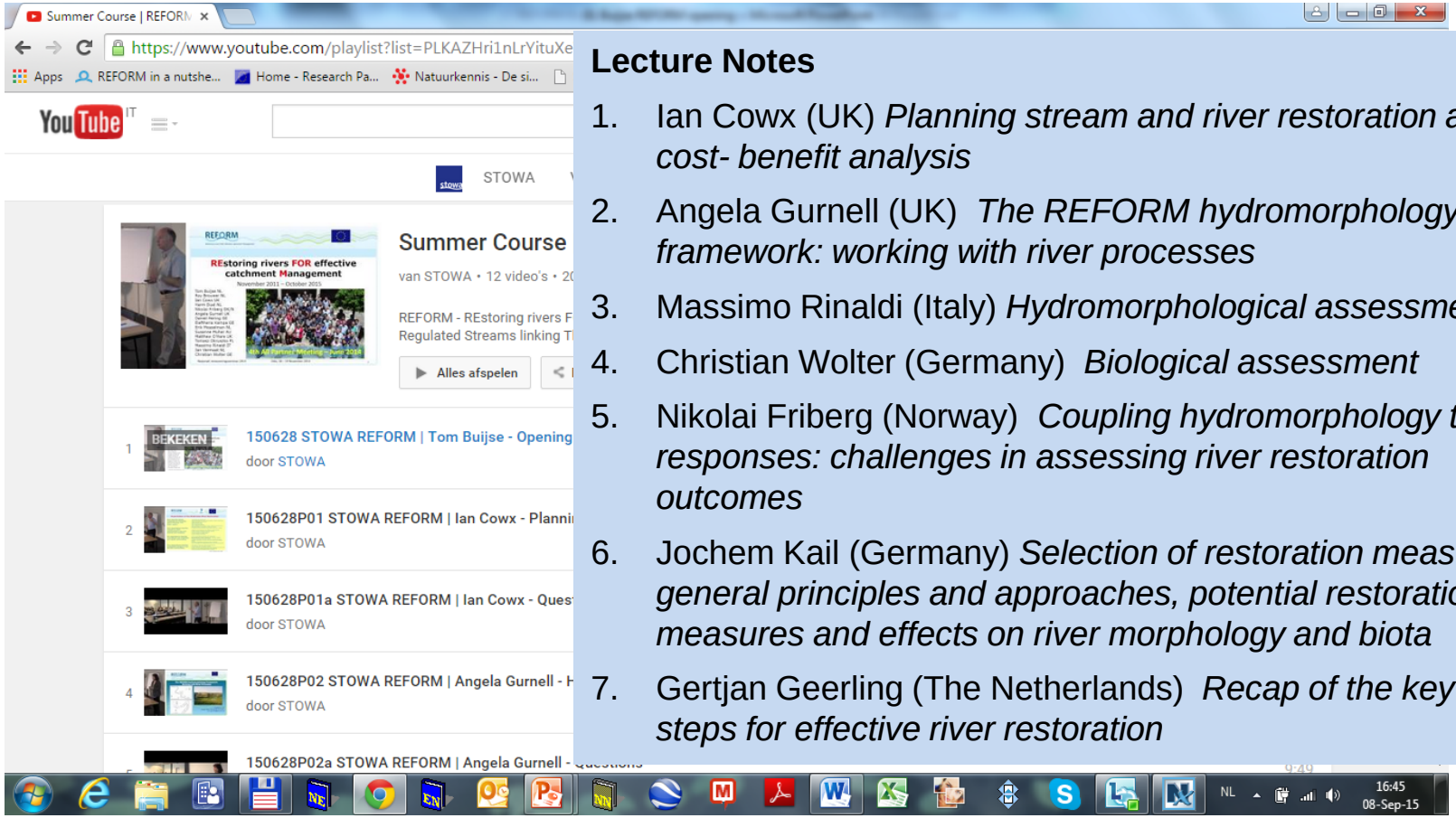
Jochem Kail[a,*], Karel Brabec[b], Michaela Poppe[c], Kathrin Januschke[a]

A review of assessment methods for river hydromorphology

B. Belletti · M. Rinaldi · A. D. Buijse · A. M. Gurnell · E. Mosselman

http://www.reformrivers.eu/results/scientific-publications

Summer school
“Restoring Regulated Streams linking Theory and Practice”

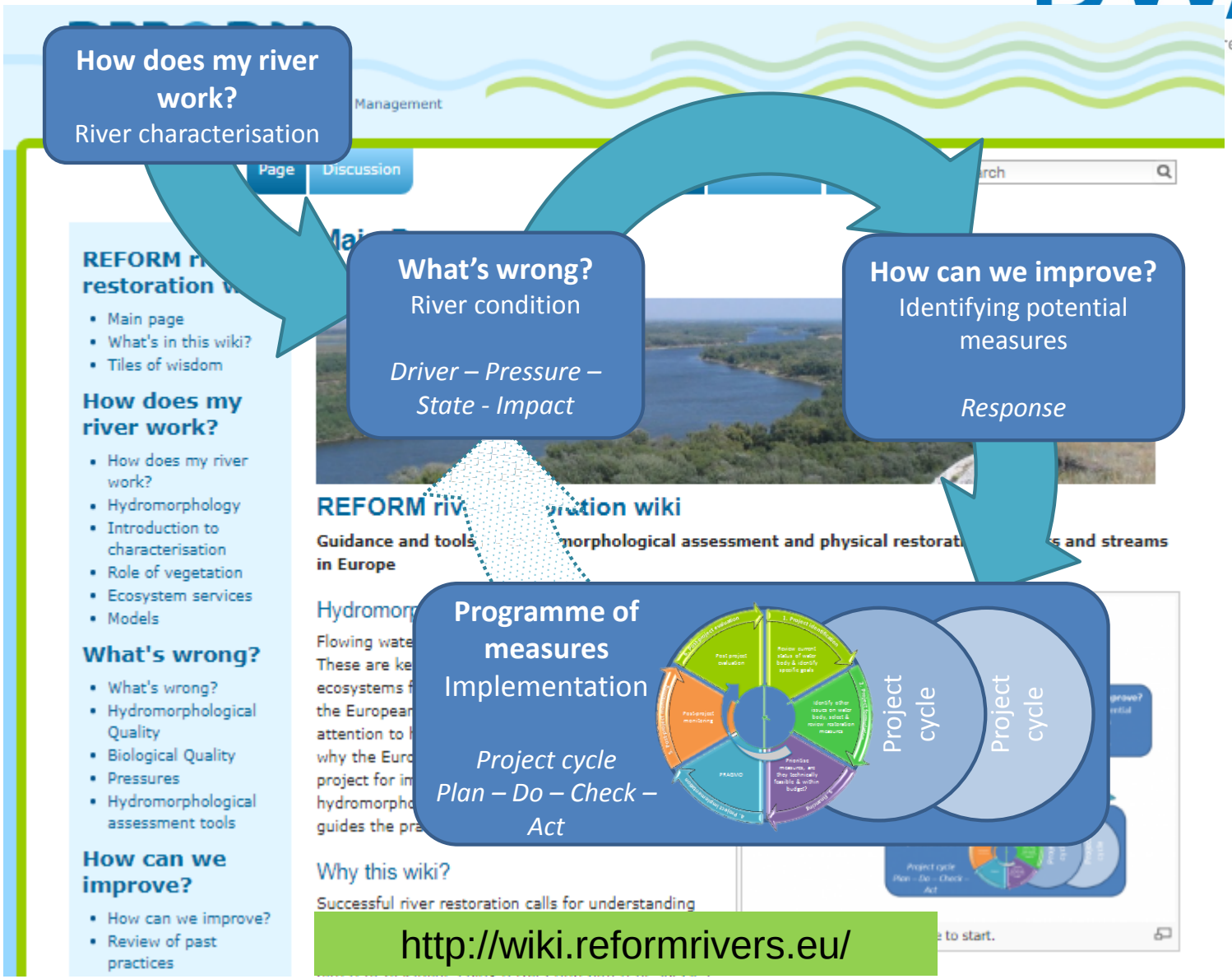


Lecture Notes

1. Ian Cowx (UK) *Planning stream and river restoration and cost- benefit analysis*
2. Angela Gurnell (UK) *The REFORM hydromorphology framework: working with river processes*
3. Massimo Rinaldi (Italy) *Hydromorphological assessment*
4. Christian Wolter (Germany) *Biological assessment*
5. Nikolai Friberg (Norway) *Coupling hydromorphology to biotic responses: challenges in assessing river restoration outcomes*
6. Jochem Kail (Germany) *Selection of restoration measures: general principles and approaches, potential restoration measures and effects on river morphology and biota*
7. Gertjan Geerling (The Netherlands) *Recap of the key reform steps for effective river restoration*

http://www.reformrivers.eu/events/summer-school

Guidance and tools – REFORM WIKI



Take home messages - 1 -

Assess HYMO along the entire gradient, from high to bad ecological status

+ The REFORM method is extremely useful for analyzing and interpreting critical problems and causes of alteration.

! Restoration need to consider temporal and spatial aspects beyond project boundaries and project life span

Riparian zones and floodplains are crucial to river morphodynamics and ecology

- Too little legislative framework and monitoring

+ Vegetation can play a cost-effective and significant role as ecosystem engineers for river restoration -> Nature-based solutions

Need to develop NEW biota sampling methods that are more sensitive to HYMO impacts

- Current sampling methods are not appropriate

Take home messages - 2 -

Restoration requires well-defined success criteria

+ Planning benefits from adopting a more synergistic approach and applying existing planning and management tools

Cost-benefit analysis can help prioritizing restoration measures

- Cost data are too scarce

Restoration pays!

+ It increases ecosystem services and benefits other biota

+ Success even in small projects

- Benefits may vanish over time **!** Need for monitoring and maintenance

Thank you for your attention

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Please visit
www.reformrivers.eu

COLLABORATIVE PROJECT
LARGE SCALE INTEGRATING PROJECT

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