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# Challenges for efficient river rehabilitation

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## Outline

- objectives
- pressures on hydromorphology
- conceptual approach
- biotic response to hydromorphology
- recommendations for improvements

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## Objectives

Review and meta-analyses of existing knowledge

- effect of pressures on hymo processes & variables
- interactions between hymo processes & variables and biota
- to derive conclusions for effective river restoration and its evaluation

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## What has been lost?

**Flow dynamics**



**Habitat complexity**







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## What has been lost?



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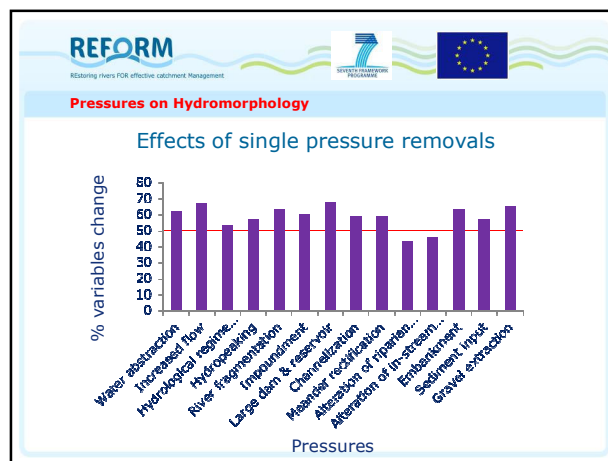
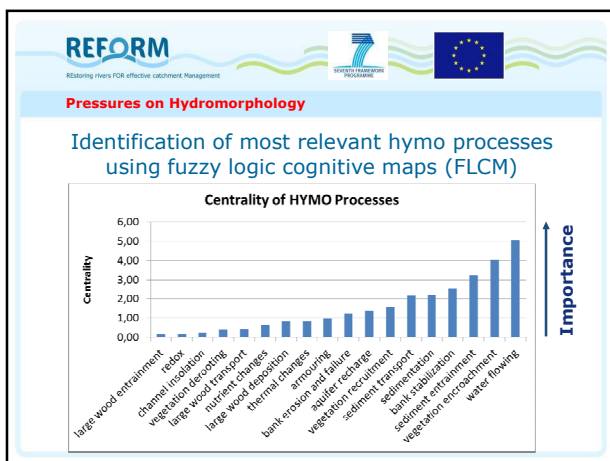
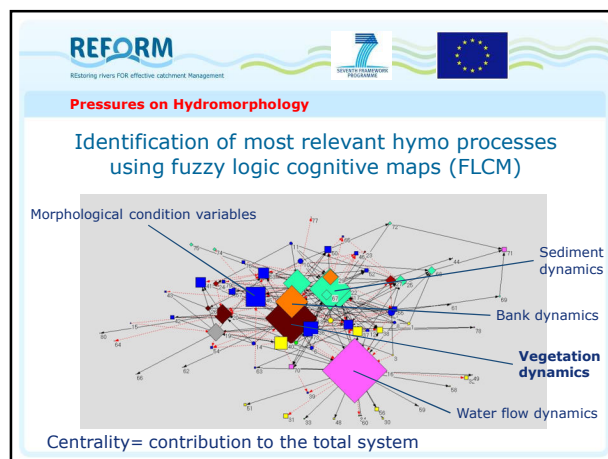
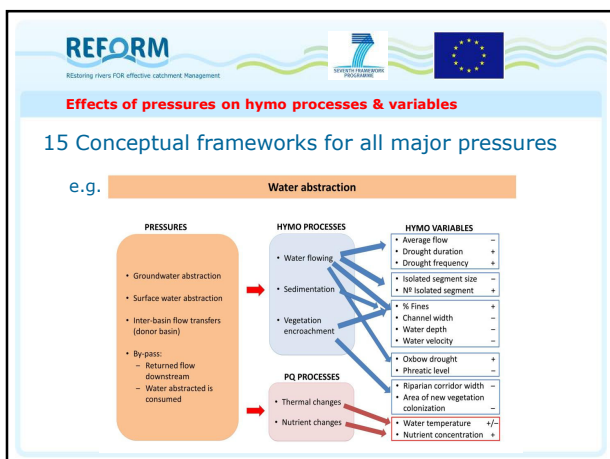


## Effects of pressures on hymo processes & variables

What are the key hydromorphological processes?  
- to be addressed

What are the key hydromorphological variables?  
- indicating success

- ➔ 14 major hydromorphological processes identified & conceptualized
- ➔ 50 most important variables out of ~ 130 considered



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**Hydromorphology – biota interactions**

How do biota respond to hydromorphological degradation / rehabilitation?

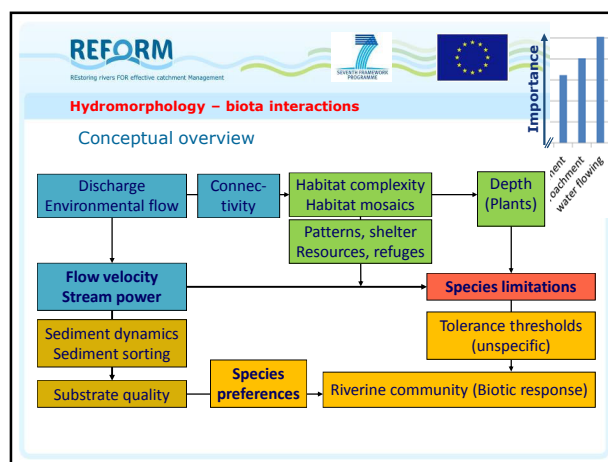
What are principal cause effect chains?

What are essential habitat bottlenecks / variables?

- to monitor / mitigate

What are potential restoration targets / indicators

- Review of aquatic plants, benthic invertebrates & freshwater fishes



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**Hydromorphology – biota interactions**

Specific indicator species

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

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**Hydromorphology – biota interactions**

There are gravel-dependent lowland river species ...

*Aspius aspius*

Observed egg densities  
Mean 25,463 m<sup>-2</sup>  
(2,300-72,063 m<sup>-2</sup>)

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**Hydromorphology – biota interactions**

Unspecific response to complex structures

Flow velocity → Habitat complexity → Physical thresholds

Functional process zones

Longitudinal distribution of emerging fry from a spawning area

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**Hydromorphology – biota interactions**

Unspecific response to complex structures

Flow velocity → Habitat complexity → Physical thresholds

Functional process zones

Community metrics for river regions – Fish Region Index (FRI)

163 lampreys & fish species classified

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**Outlook**

Fish Region Index – sample FRI

Barbel	99	Barbel	21	Barbel	11
Common bream	11	Bleak	81	Common bream	2
Bleak	73	Brown trout	1	Bleak	20
Brown trout	89	Chub	3	Brown trout	10
Chub	77	Dace	1	Dace	13
Dace	8	Grayling	-	Grayling	94
Grayling	50	Gudgeon	42	Gudgeon	9
Gudgeon	27	Perch	-	Perch	6
Perch	88	Spirlin	1	Spirlin	2
Spirlin	78	Stone loach	1	Stone loach	22
Stone loach	2	Bream	93	Stone loach	1
Bream	2	Sun bleak	23	Bream	1
Sun bleak				Sun bleak	

Reference: Barbelregion (FRI<sub>total</sub> = 5.98)

Impoundment: Breamregion (FRI<sub>total</sub> = 6.61)

Residual water: Graylingregion (FRI<sub>total</sub> = 5.20)

mod. Dußling et al. (2004)

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**Outlook**

FRI response to hydromorphological pressures

Habitat alteration

Pressure index

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**Achievements**

REFORM Achievements for WFD implementation

- characterization of most relevant hydro processes & variables (environmental flow, velocity, substrate, connectivity)
- provision of thresholds for limiting factors (physical threshold values)
- identification of physical targets and target species for restoration planning
- indicator improvement (region based indicators)

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**Challenges**

Existing uses are perpetuating and socially accepted  
Hydromorphological changes are often irreversible

➡ Limitations for river rehabilitation



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**Challenges**

Hydromorphological improvements often contradict flood-protection

➡ Limitations for river rehabilitation



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**Solutions / Suggestions**

Substituting essential habitats, e.g. spawning sites

Groyne heads



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**Solutions / Suggestions**

Substituting essential habitats, e.g. spawning sites

Weir removal / fish migration facilities



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**Solutions / Suggestions**

Substituting habitat complexity

Wooden groyne River Elbe stream-km 441

Fotos: K.-H. Jährling





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**Solutions / Suggestions**

Substituting habitat complexity

Island formation River Oder at Reitwein



The image shows an aerial view of a river with several islands and sandbars. A close-up inset shows a sandbar with a small stream flowing through it.

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**Outlook**

**Experiences needed!!!**

- compilation of alternative bank protections / habitat improvements (PIANC InCom WG 128)
- performance evaluation

Ongoing REFORM project work

- fine tuning of indicator sets
- improved species characterization in response to hydromorphological processes & variables

