

Modifying rivers: ecological responses to hydromorphological degradation and restoration

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Outline

- objectives
- pressures on hydromorphology
- habitat bottleneck approach
- biotic response to hydromorphology
- outlook

Objectives

Ecological status of European Rivers in 1st RBMPs

- **56%** of river water bodies (**64%** of their total length) fail GES/GEP
- Hymo pressures & altered habitats impact **48.2%** & **42.7%** of WBs

EEA 2012, EC 2012 SWD(2012) 379 final; ETC/ICM Tech. Rep. 1&2/2012

Objectives

WP1: Review and meta-analyses of existing knowledge

- effect of pressures on hymo processes & variables
- interactions between hymo processes & variables and biota

Pressures on Hydromorphology

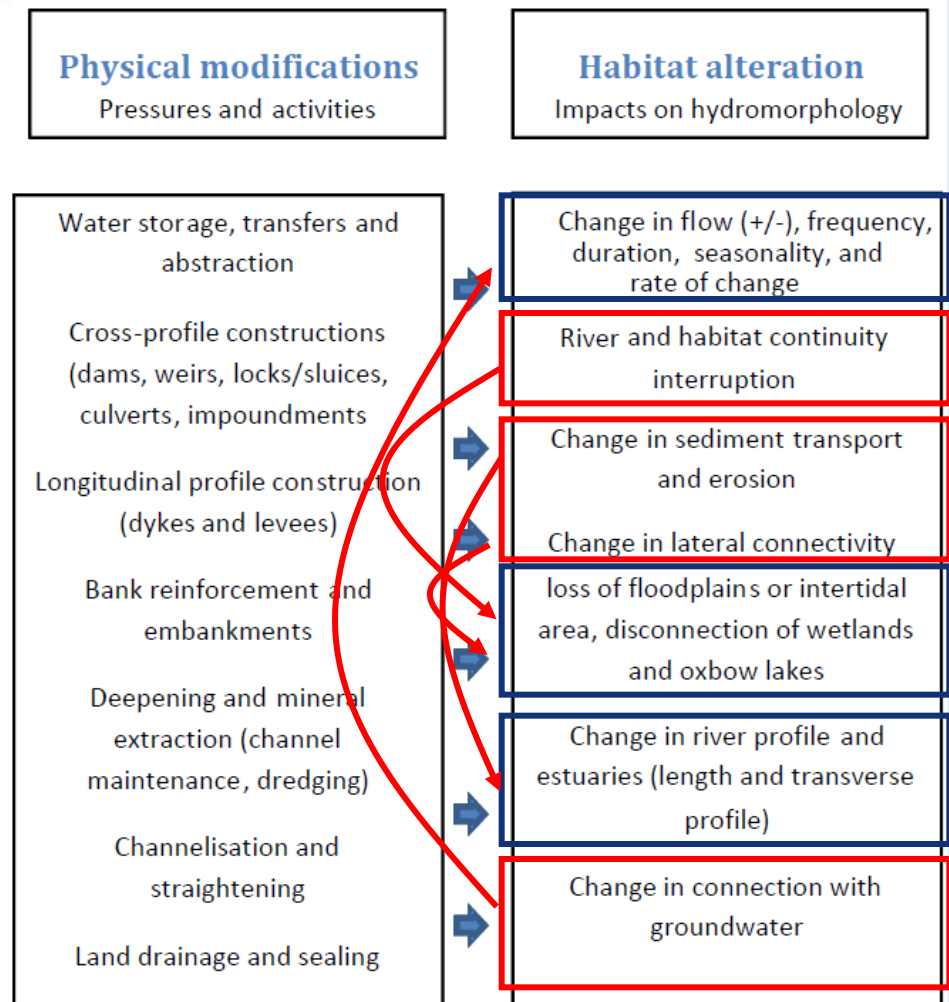
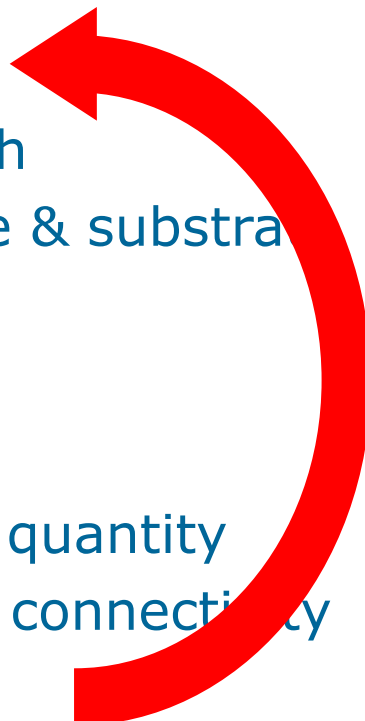
Conceptual overview

Hymo quality elements (WFD, Annex V)

Variables

- width & depth
- bed structure & substrate
- riparian zone
- continuity
- water flow & quantity
- groundwater connectivity

Processes



Pressures on Hydromorphology

Analyzing effects of pressures on hymo processes & variables

Main objectives

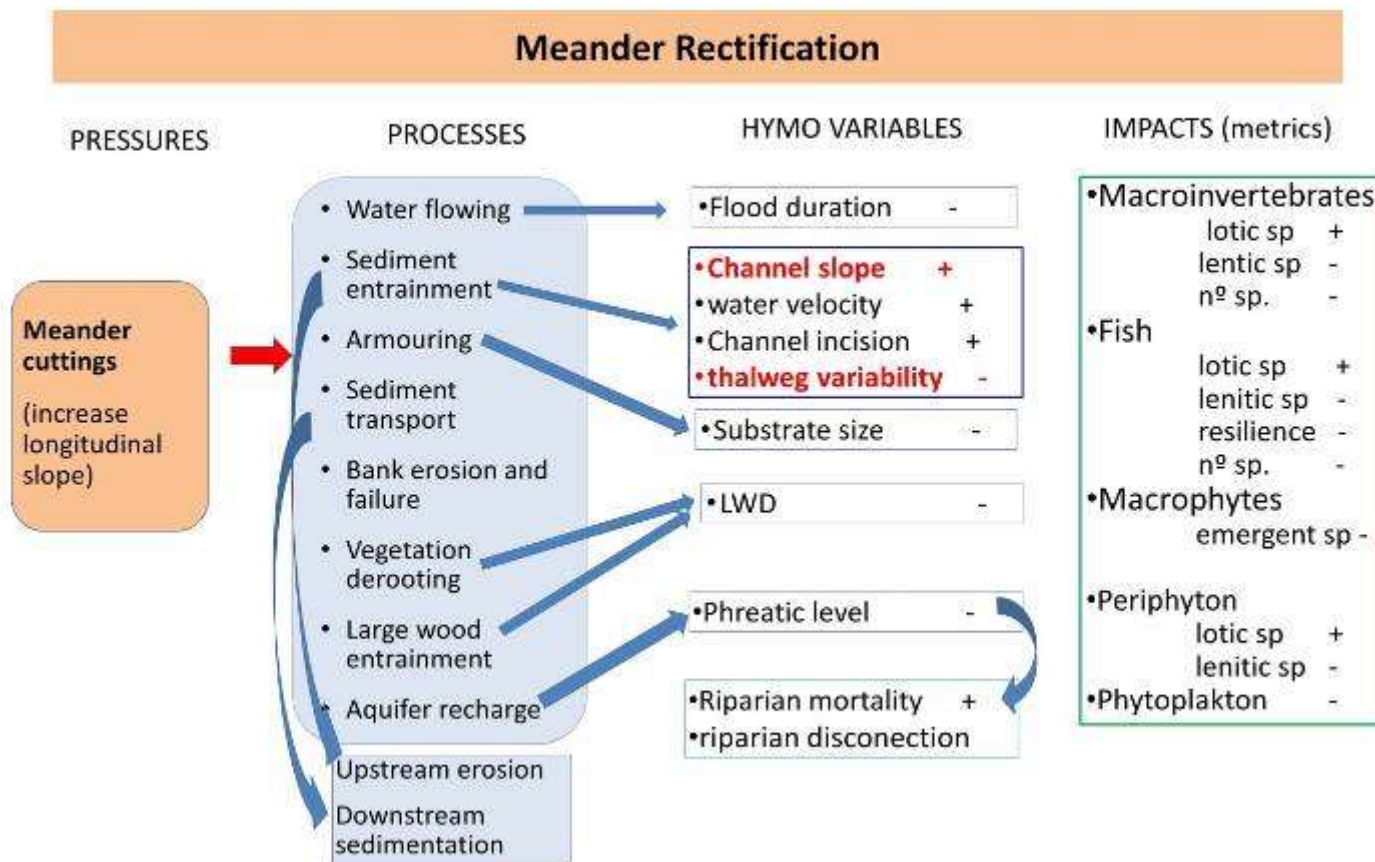
- identify key processes to be addressed by measures
- identify key variables indicating success

➡ 14 major hymo processes considered

➡ 50 most important variables out of ~ 130

Pressures on Hydromorphology

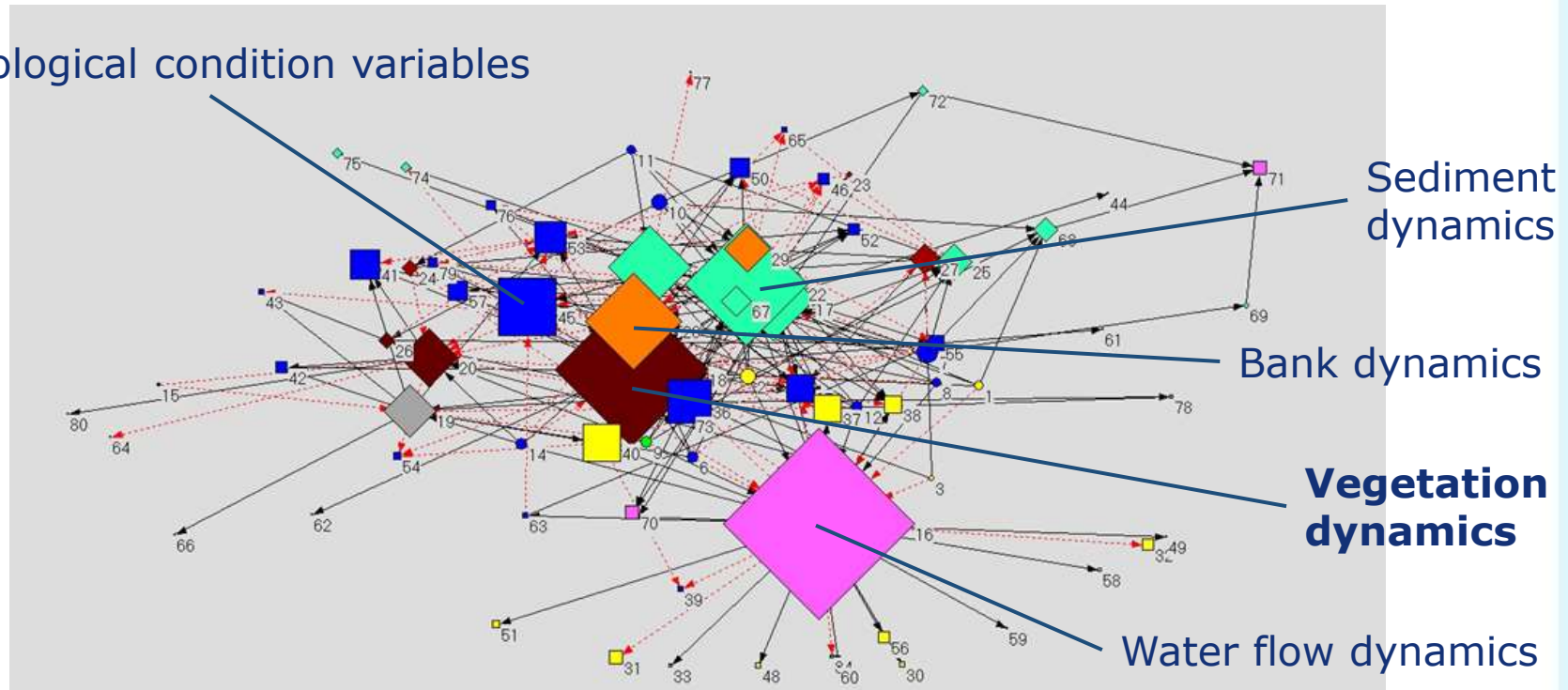
Conceptual frameworks for 14 major pressures



Pressures on Hydromorphology

Identification of most relevant hymo processes using fuzzy logic cognitive maps (FLCM)

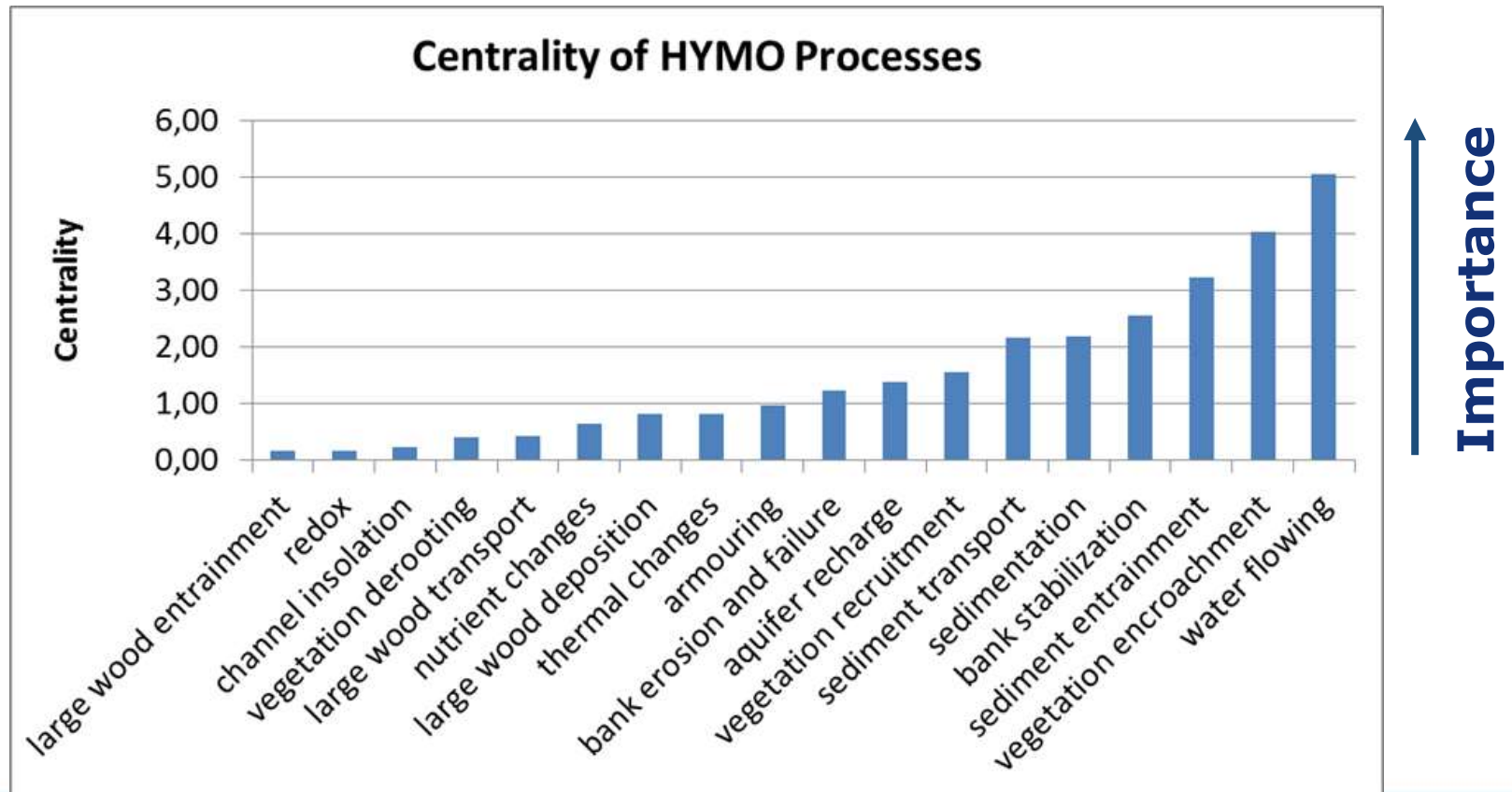
Morphological condition variables



centrality = contribution to the total system

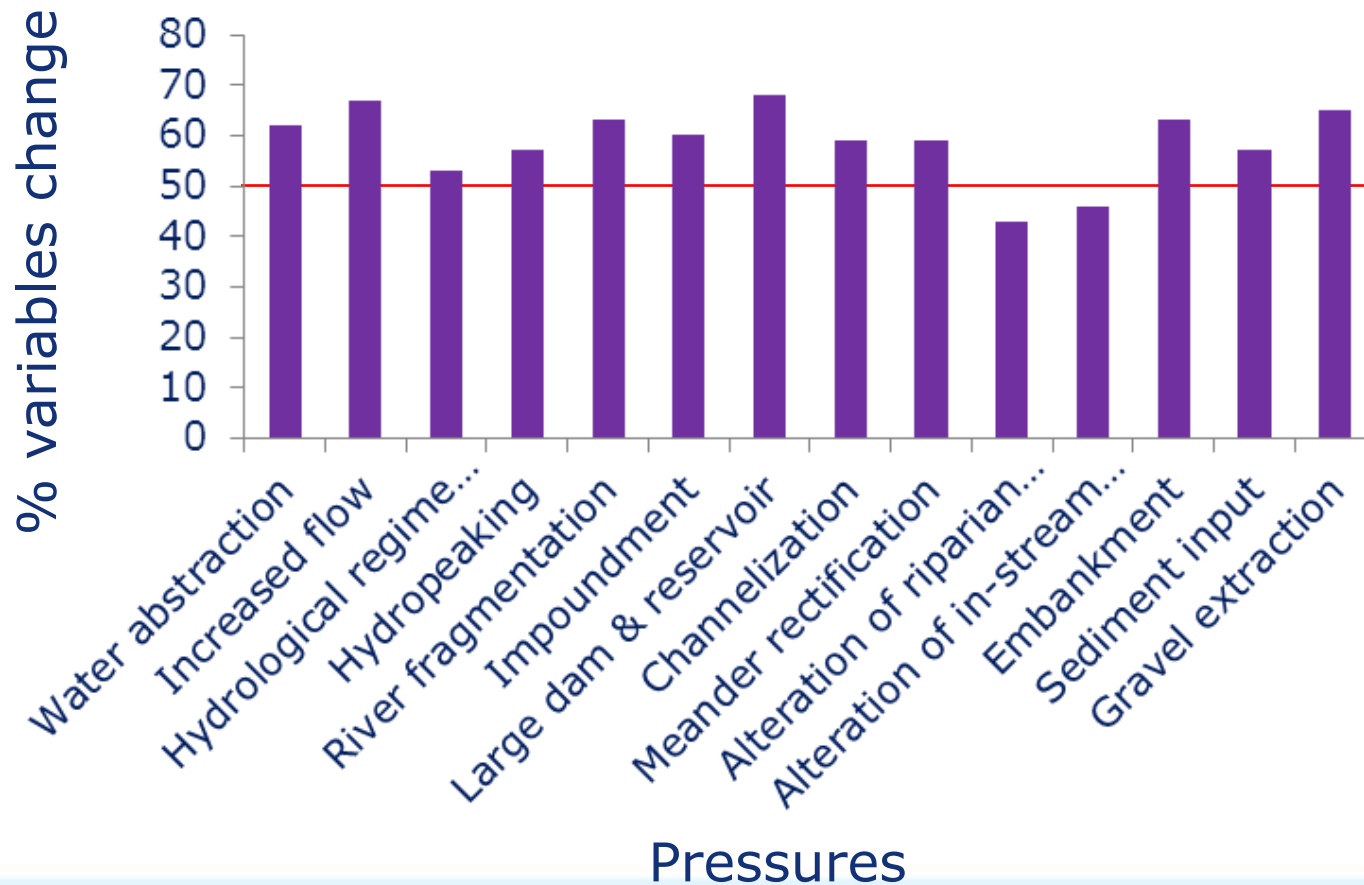
Pressures on Hydromorphology

Identification of most relevant hymo processes using fuzzy logic cognitive maps (FLCM)

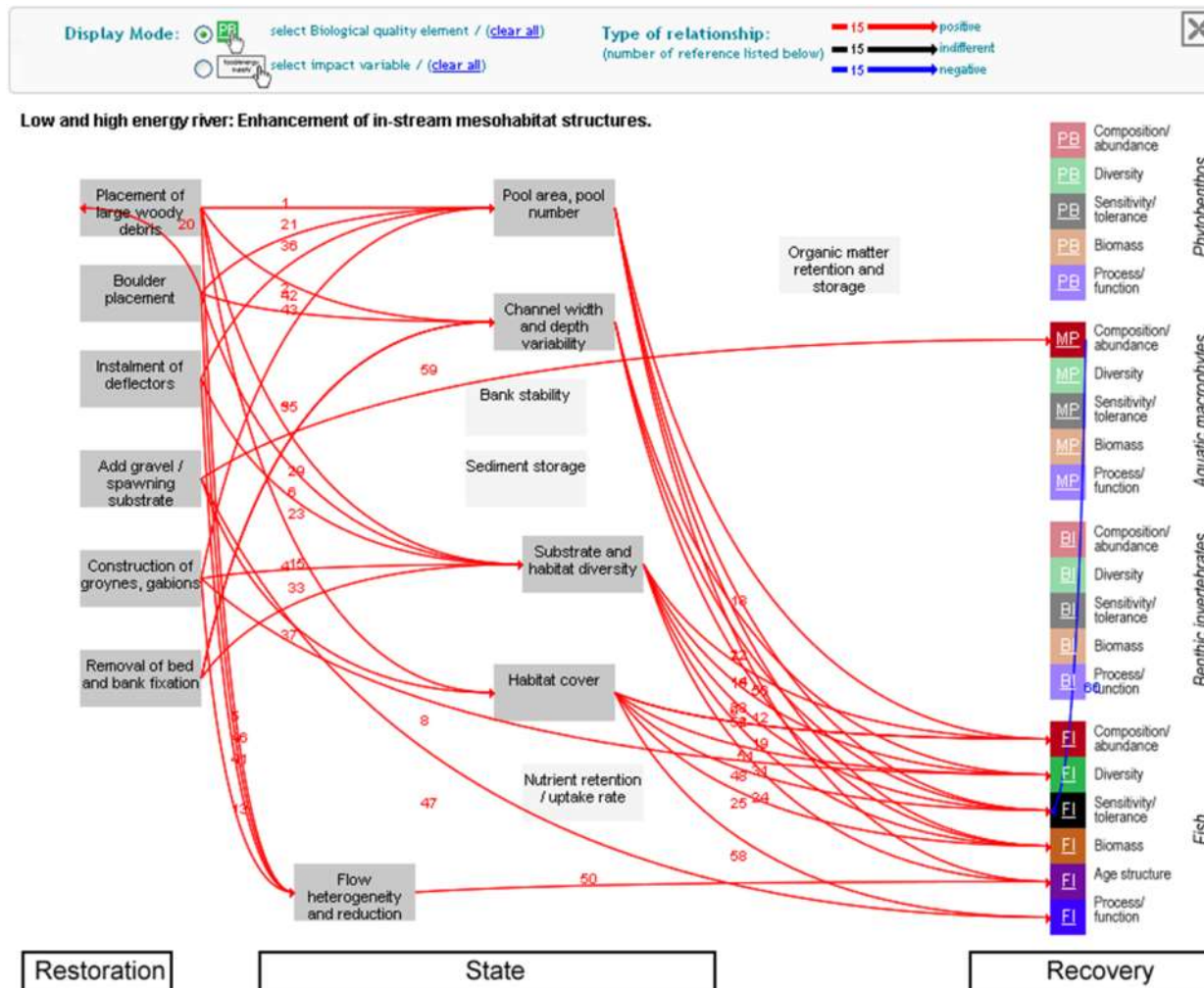


Pressures on Hydromorphology

Effects of single pressure removals



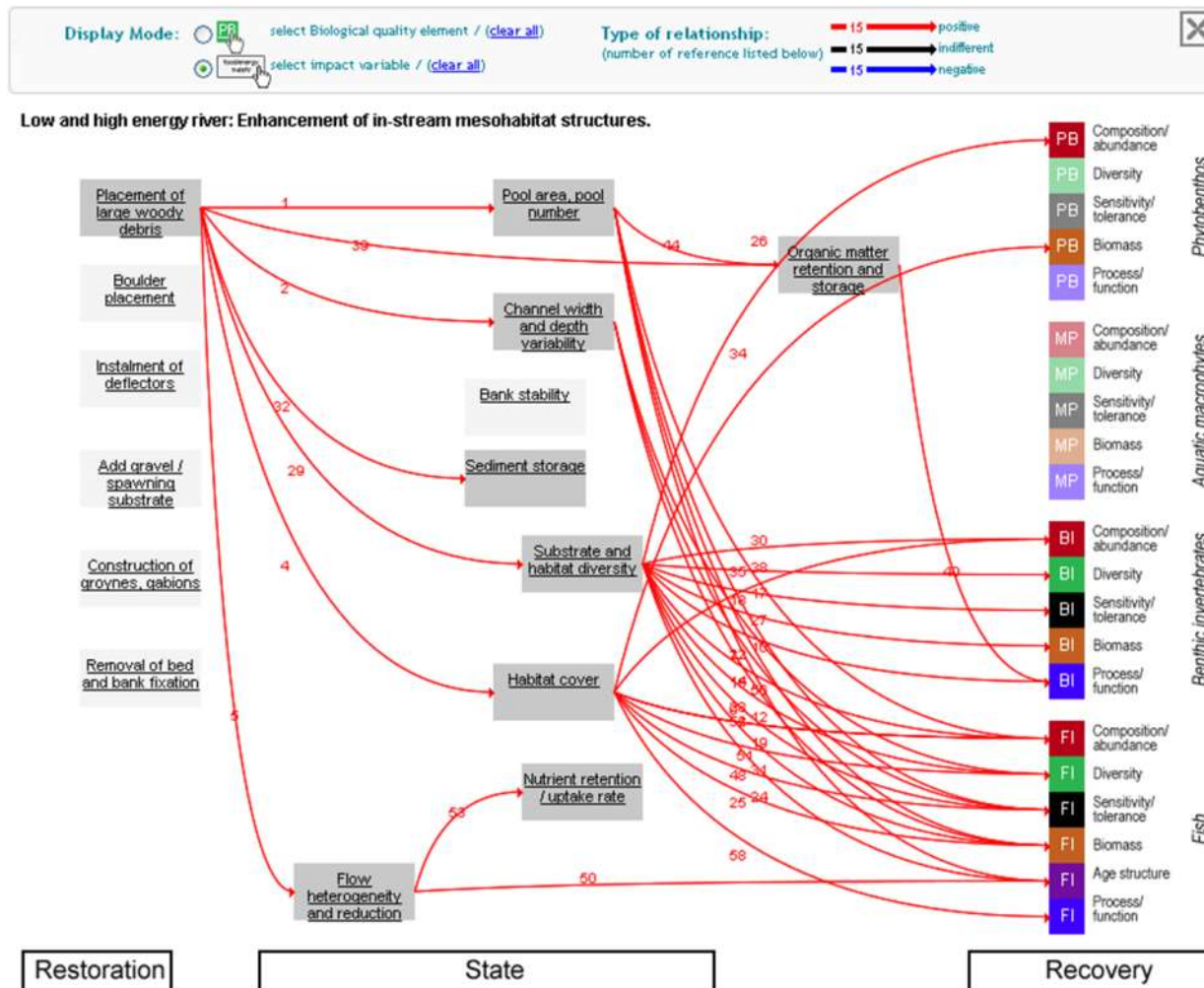
Biotic response to hymo change



Improving
fish

Biotic response to hymo change

Adding
large wood



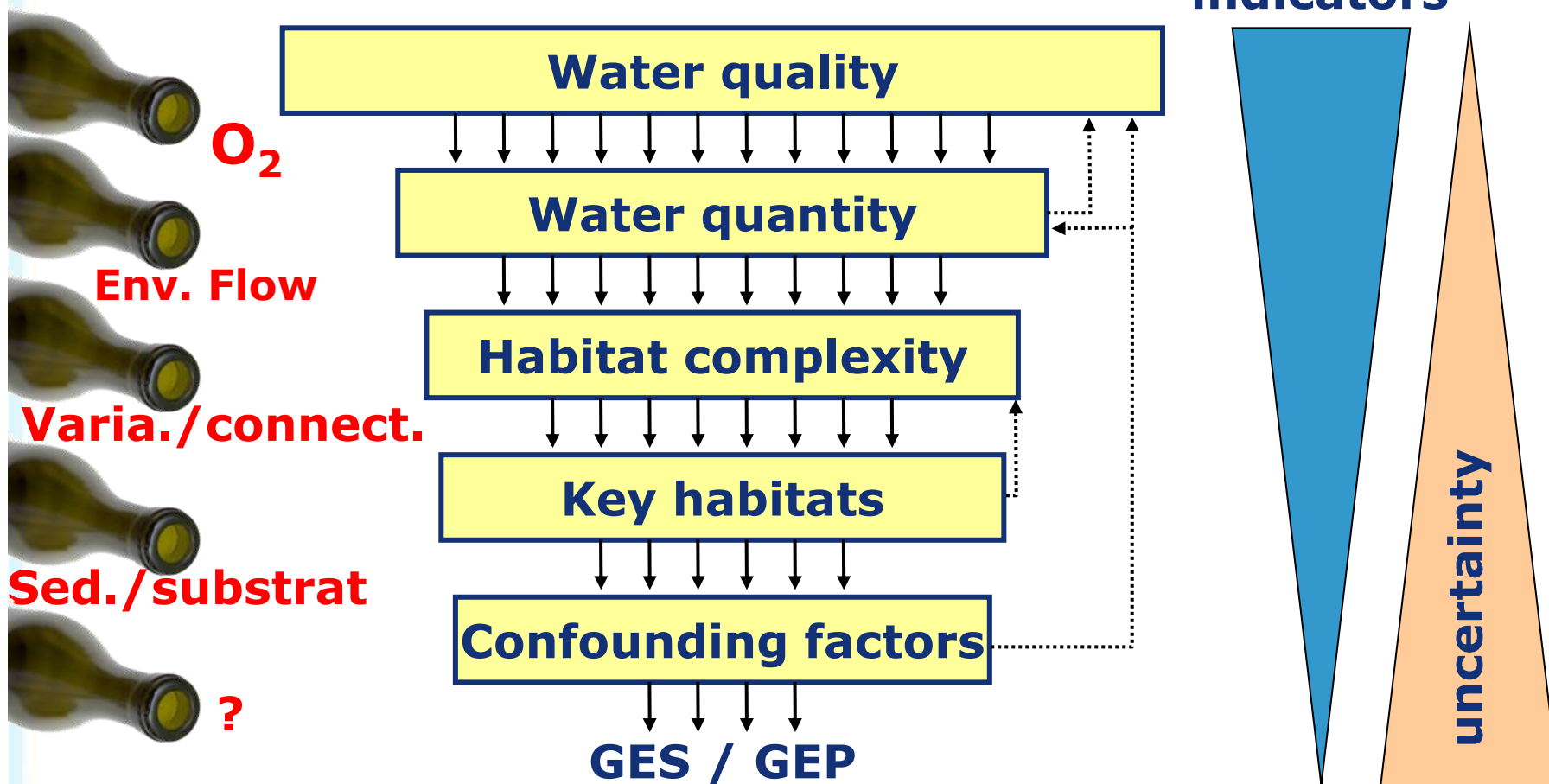
Habitat bottleneck approach



“good” old times

Habitat bottleneck approach

Bottlenecks as faunal filters



Biotic response to hymo change

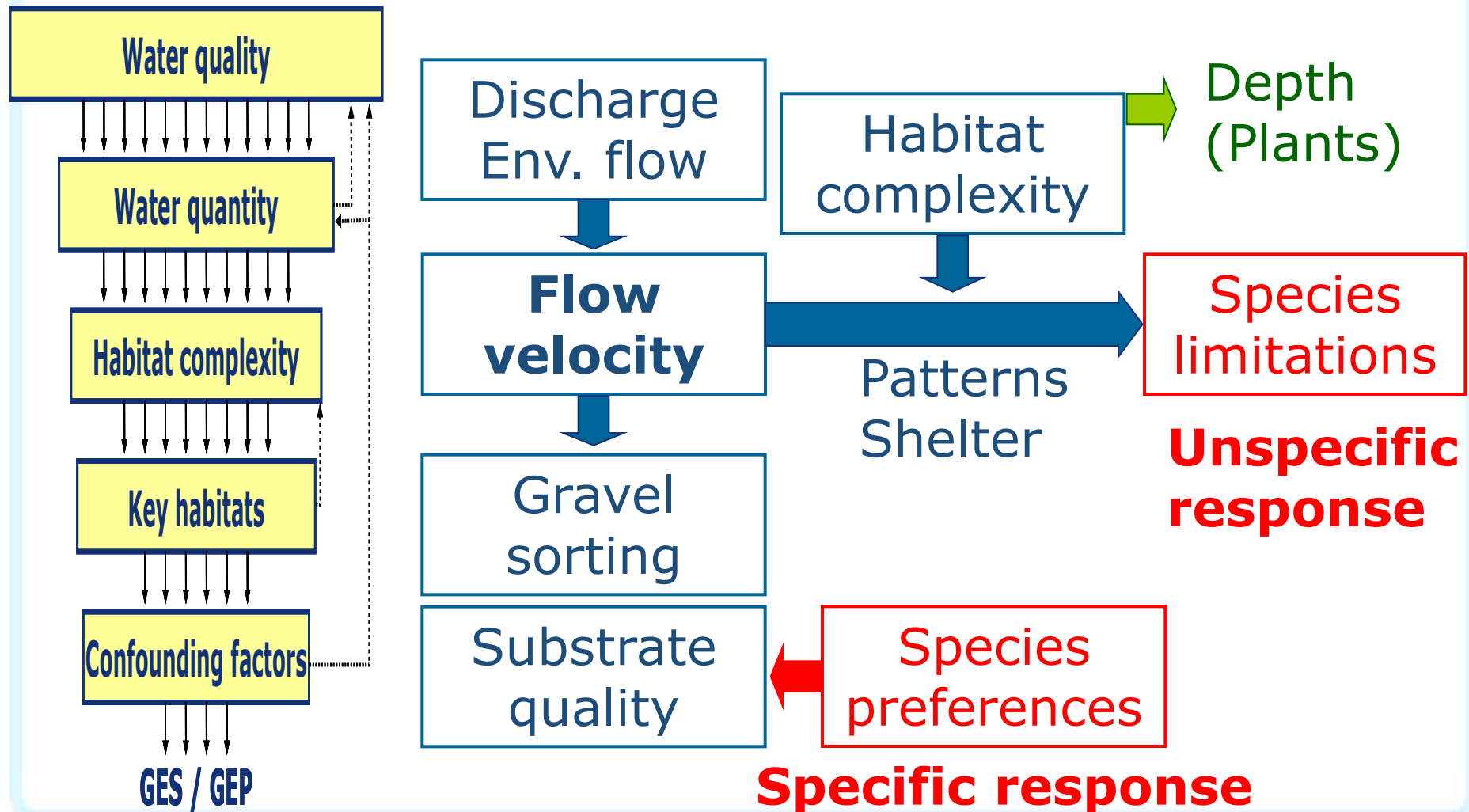
Analyzing interactions of hydromorphology and biota

Main objectives

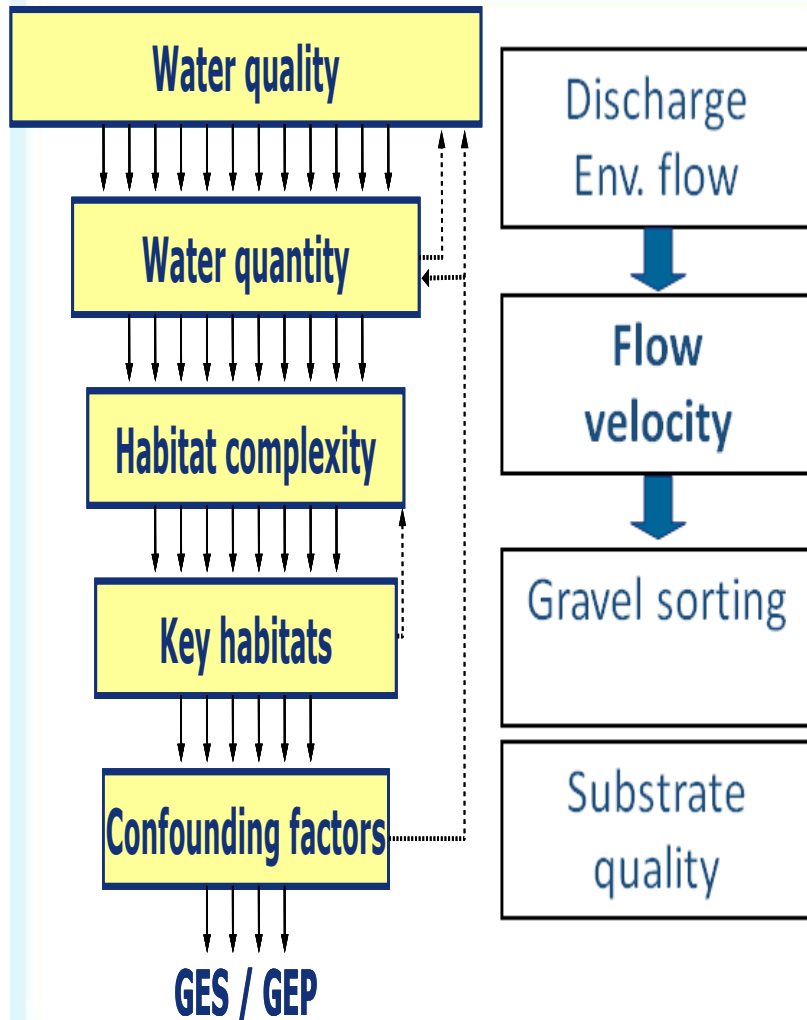
- identify essential habitat bottlenecks
- identify principal cause effect chains
- deriving potential indicators / restoration targets

➡ Review of aquatic plants, benthic invertebrates & freshwater fishes

Biotic response to hydo change



Biotic response to hydo change



~550 European lampreys
and fish species



218 ecol. classified (EFI+)



91 lithophilic

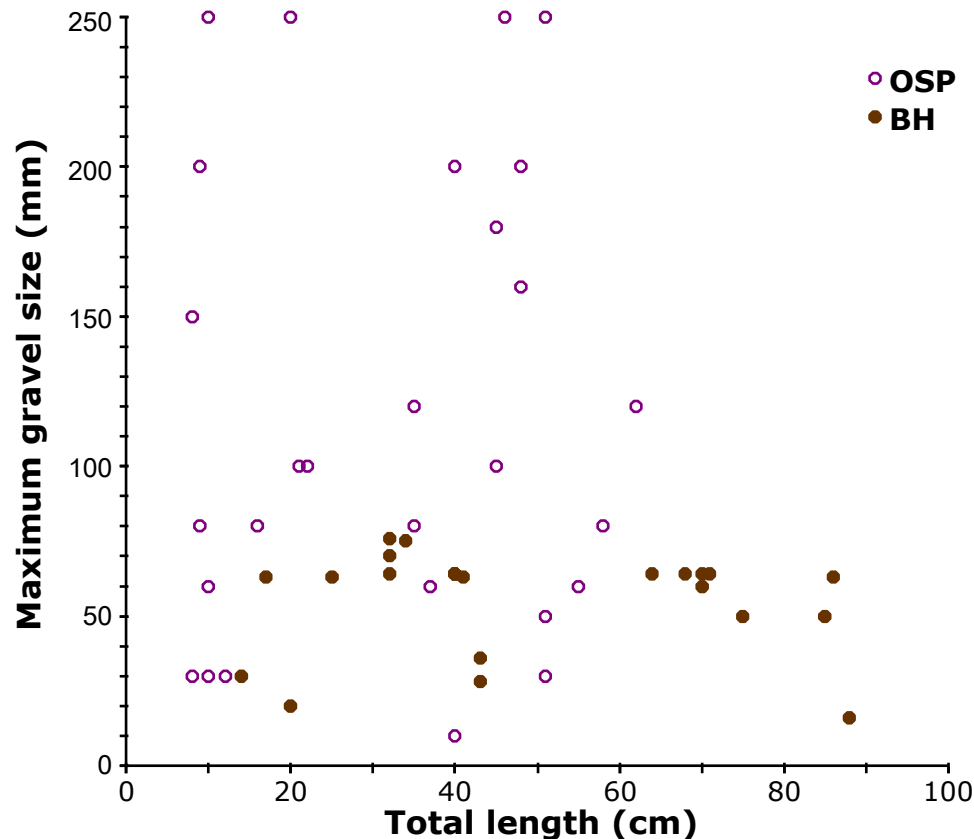


**26 with spawning
gravel size data**

Biotic response to hydo change

Size of spawning gravel

61 studies of 26 European lampreys and freshwater fishes



Biotic response to hydo change

Indi-
cators



~500 aquatic
plants



94 studied
(lit. refs)



77 classified



39 rheotolerant
13 gravel pref.

~23,000
invertebrates



1118 oper.
taxa list



201 indicators



72 substrate
preferences
60 gravel size
info

~550 fish species



218 classified



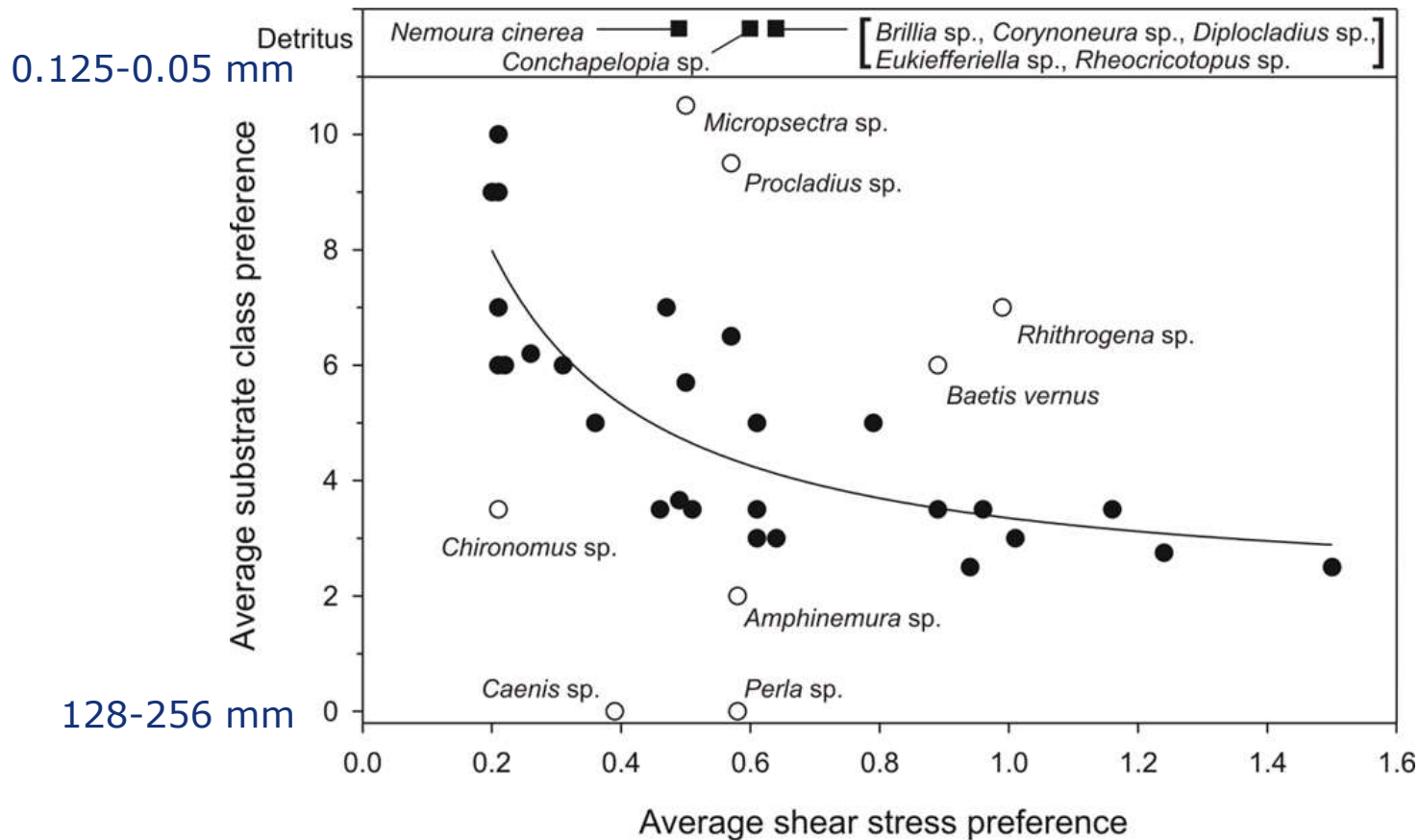
91 lithophilic



26 with reported,
gravel prefs

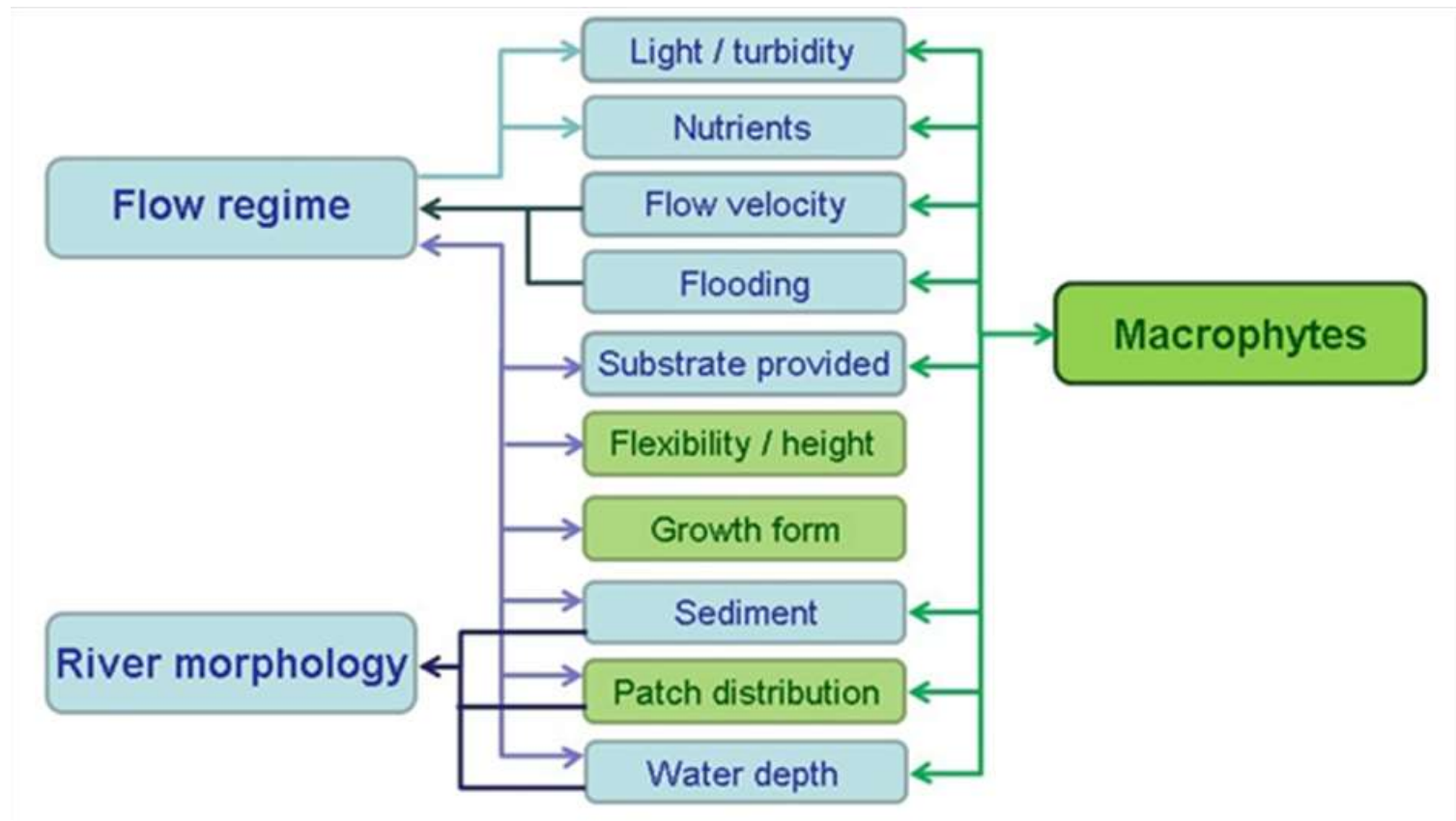
Biotic response to hymo change

Substrate preferences of benthic invertebrates

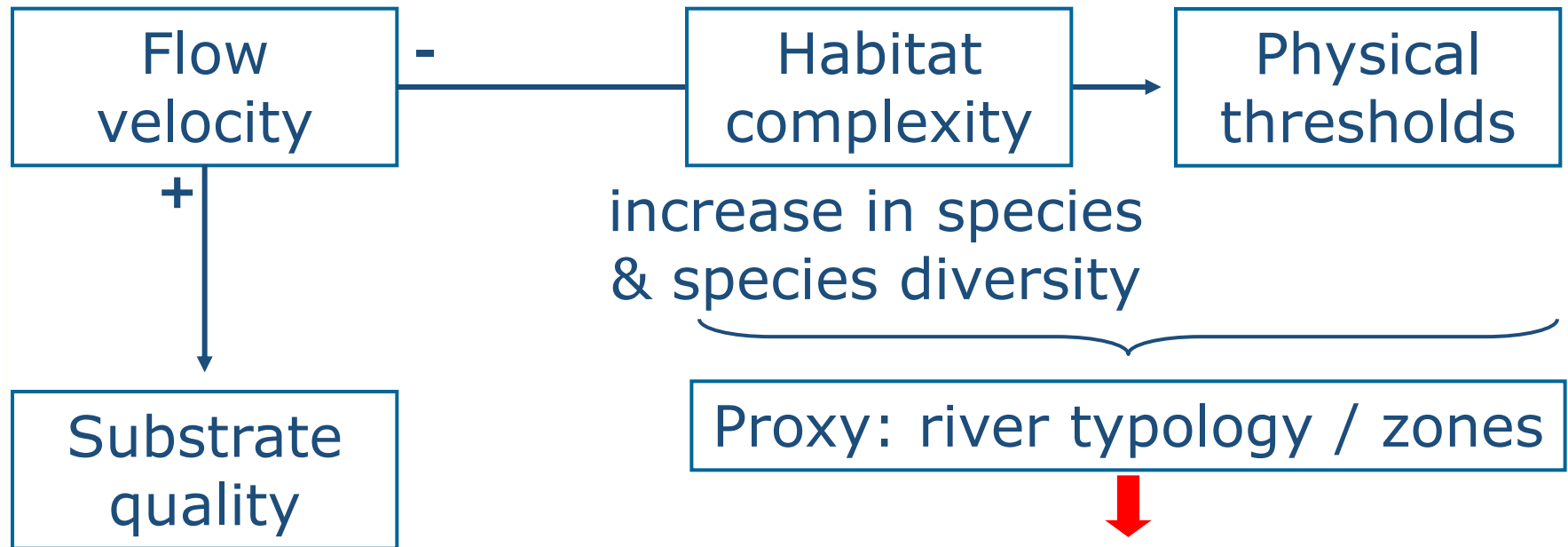


Biotic response to hymo change

Conceptual overview hymo, environmental factors and aquatic vegetation in rivers



Biotic response to hydo change



Indicator species set
+ def. gravel size req.
13 plants, 60 inverts,
26 fishes

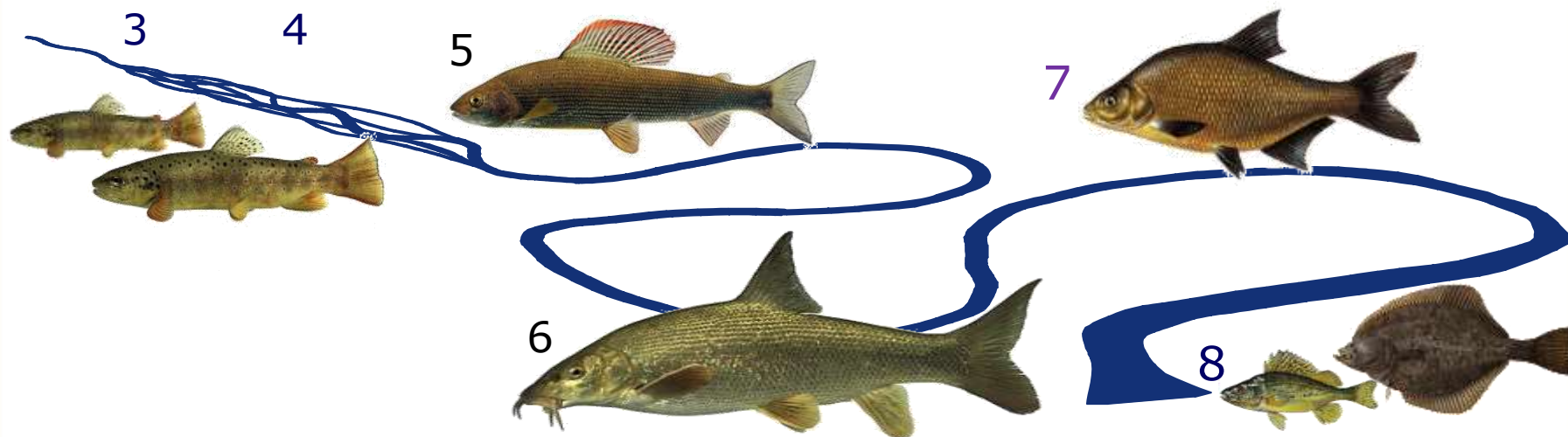
**Zonation qualifier for indi-
cator taxa**

River region indices, e.g. FRI
163 lampreys & fishes classified

Improvements

Fish Region Index – FRI

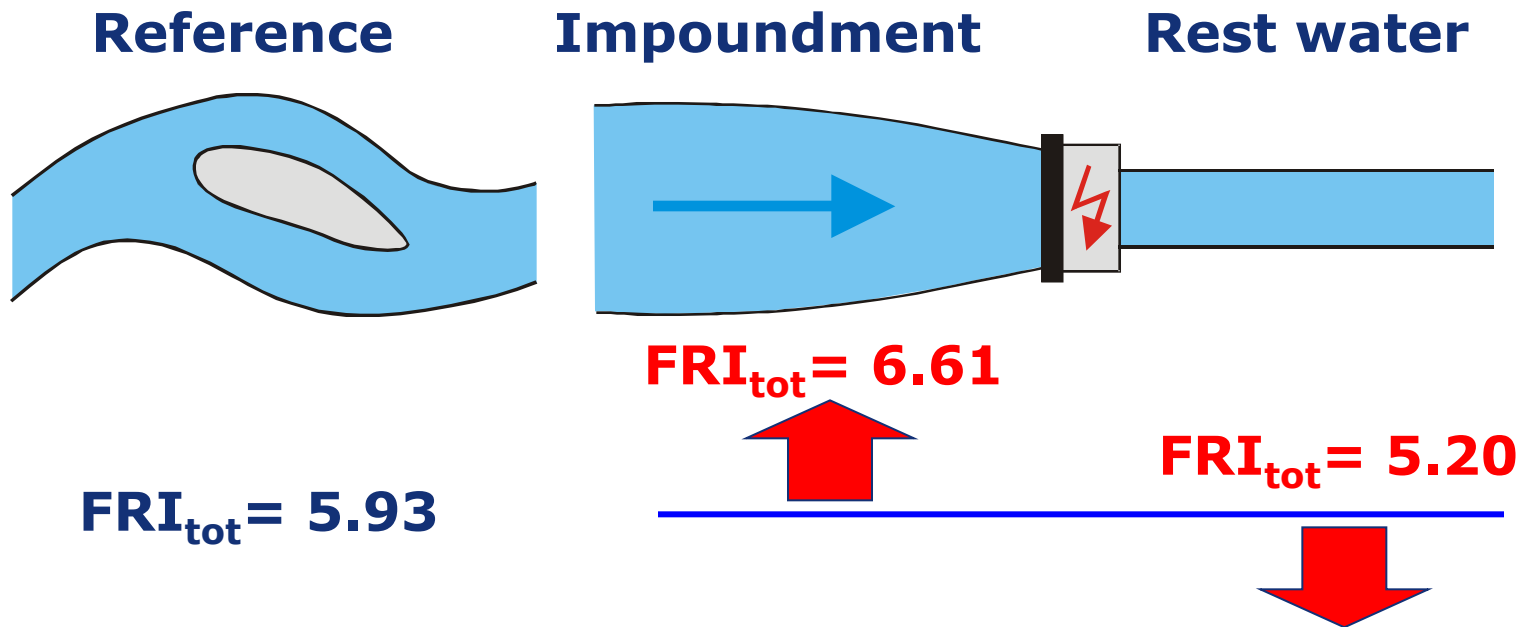
longitudinal distribution of fish in rivers – river zonation



Species	ER	MR	HR	EP	MP	HP	FRI	S ² FRI
	3	4	5	6	7	8		
<i>Alosa fallax</i>					3	9	7.75	0.20
<i>Barbus barbus</i>			2	7	3		6.08	0.45
<i>Chondrostoma nasus</i>			3	8	1		5.83	0.33
<i>Leuciscus leuciscus</i>		1	4	4	3		5.75	0.93
<i>Salmo trutta</i>	5	5	2				3.75	0.57

Outlook

Fish Region Index – sample FRI



Outlook

Fish Region Index – sample FRI

Barbel	99
Common bream	
Bleak	11
Brown trout	
Chub	73
Dace	58
Grayling	77
Gudgeon	6
Perch	50
Spiralin	27
Stone loach	
Roach	79
Sun bleak	2
⋮	

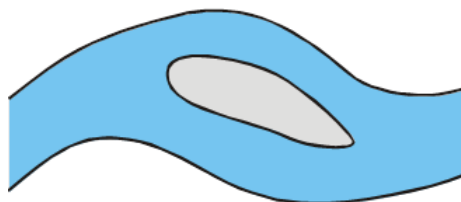
Reference

Barbel	
Common bream	21
Bleak	61
Brown trout	
Chub	3
Dace	1
Grayling	-
Gudgeon	42
Perch	-
Spiralin	1
Stone loach	1
Roach	93
Sun bleak	23
⋮	

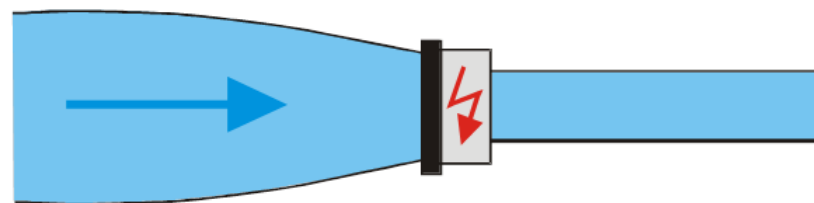
Impoundment

Barbel	11
Common bream	
Bleak	2
Brown trout	20
Chub	10
Dace	13
Grayling	91
Gudgeon	9
Perch	6
Spiralin	2
Stone loach	22
Roach	1
Sun bleak	
⋮	

Residual water



$FRI_{total} = 5.93$



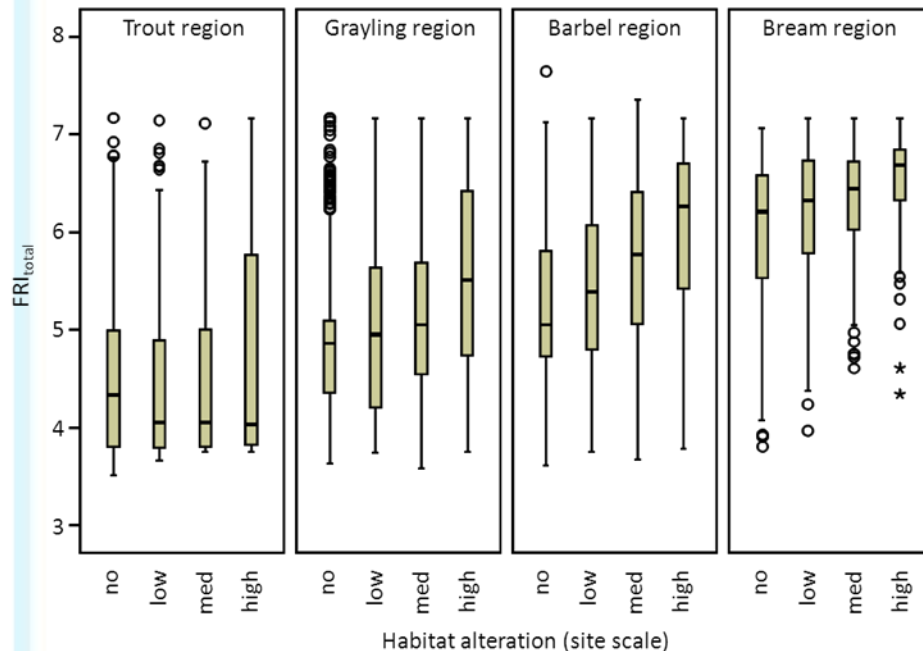
$FRI_{total} = 6.61$

$FRI_{total} = 5.20$

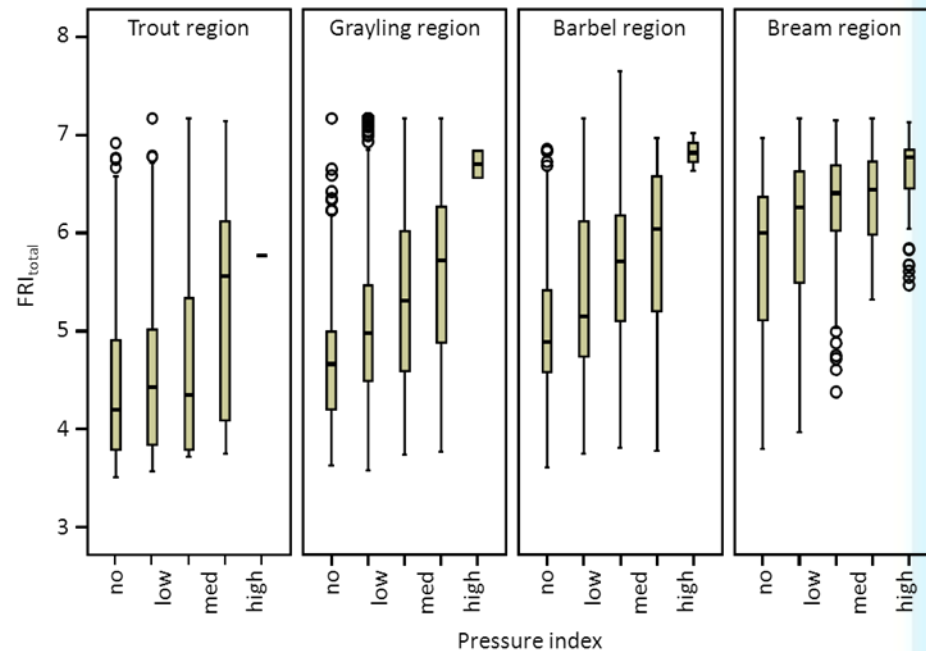
mod. Dußling et al. (2004)

Outlook

FRI response to selected hymo pressures



Habitat alteration



Pressure index

Outlook

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)

Outlook

Ongoing project work

- fine tuning of indicator sets
- improved species characterization in response to hymo processes based on work in WPs 2-4
- filling gaps identified in the reviews
- gather new data sets