




Restoration concepts for large rivers – experiences from the Danube

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Scope

1. Danube – a major W-E corridor in Europe
2. major river engineering works, ecological consequences
3. restoration scenarios: scope, approaches, constraints
4. developing guidelines

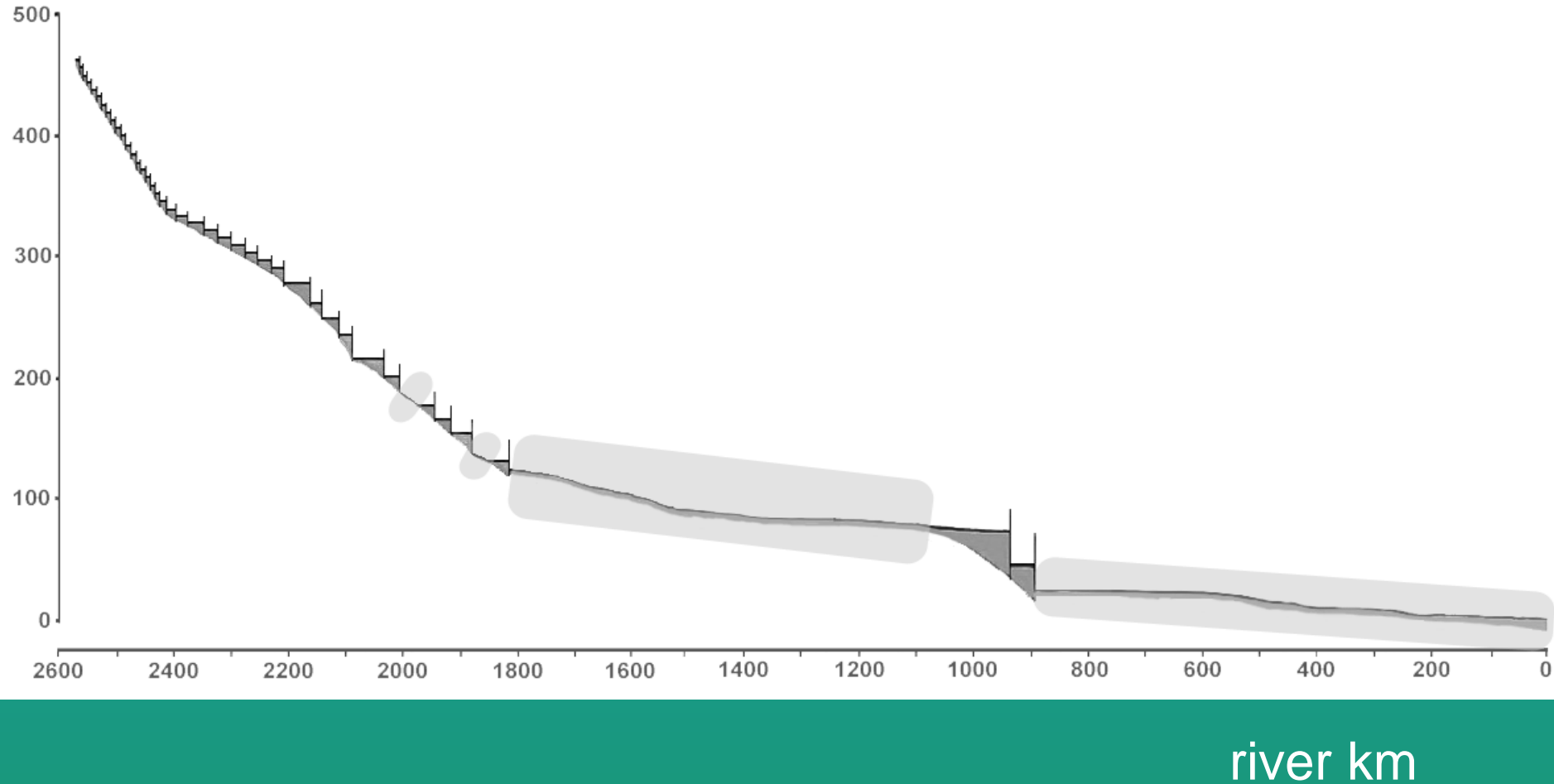


length:	2.900 km
catchment area:	805.000 km ²
mean discharge at mouth:	6.500 m ³ / sec.

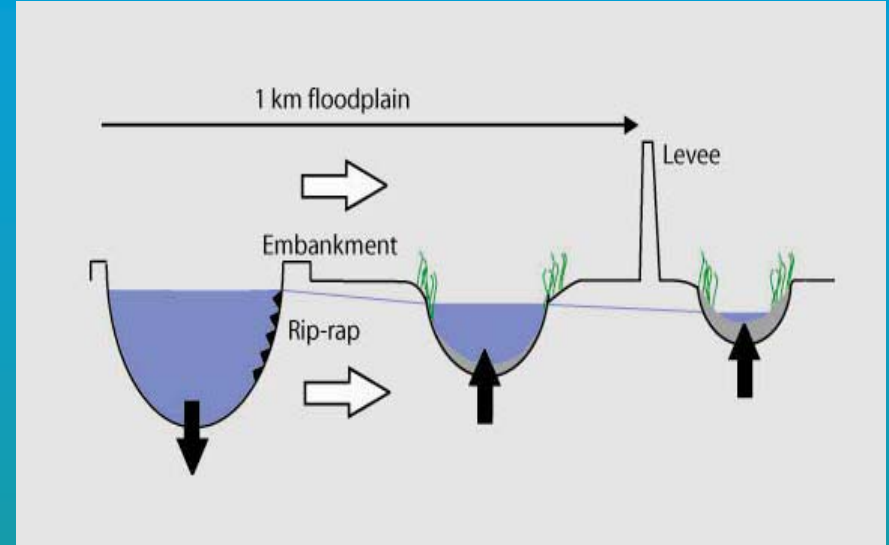
DANUBE

Danube – a major W-E corridor in Europe

River engineering - chain of dams, regulation



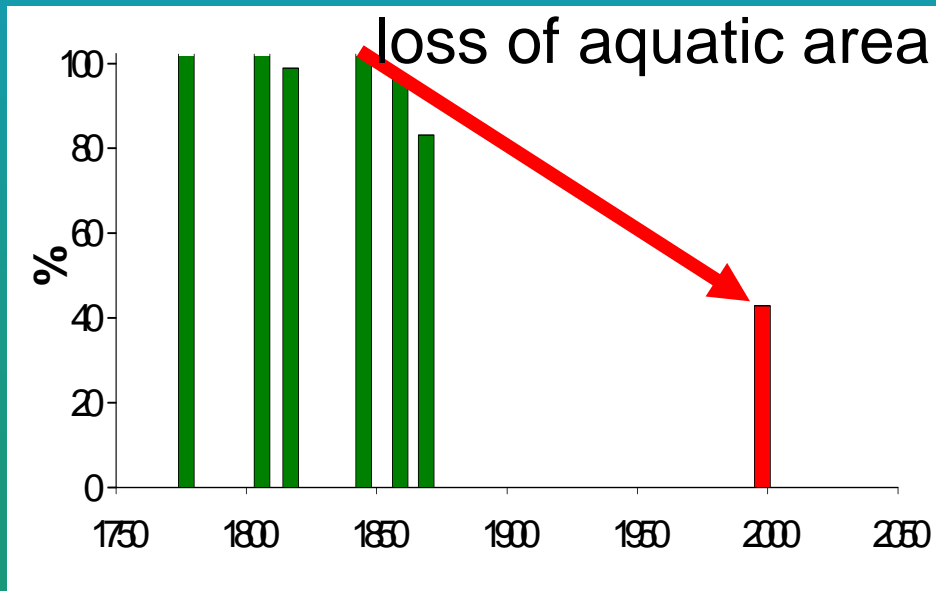
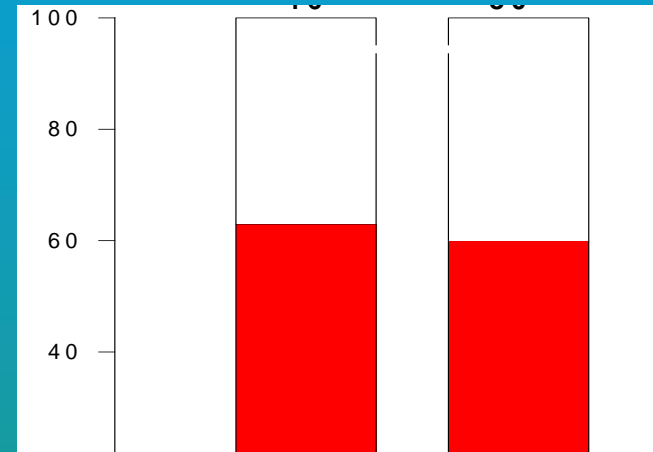
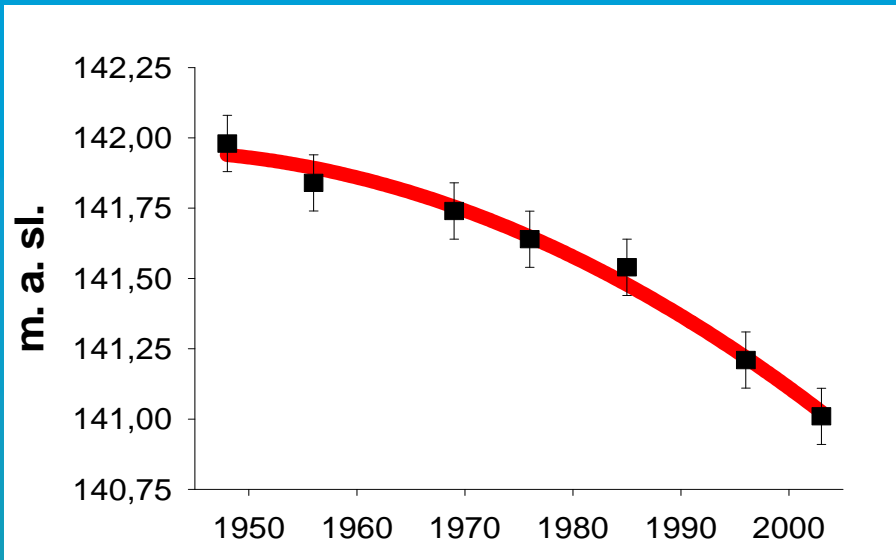
Effects of regulation



Immediate effects:

- loss of
- riverine inshore zones
- hydrol. connectivity
- geomorphic processes

Long-term consequences of river regulation



Restoration scenarios

1. Vienna–Bratislava

2. Lobau

3. Bratislava–Budapest



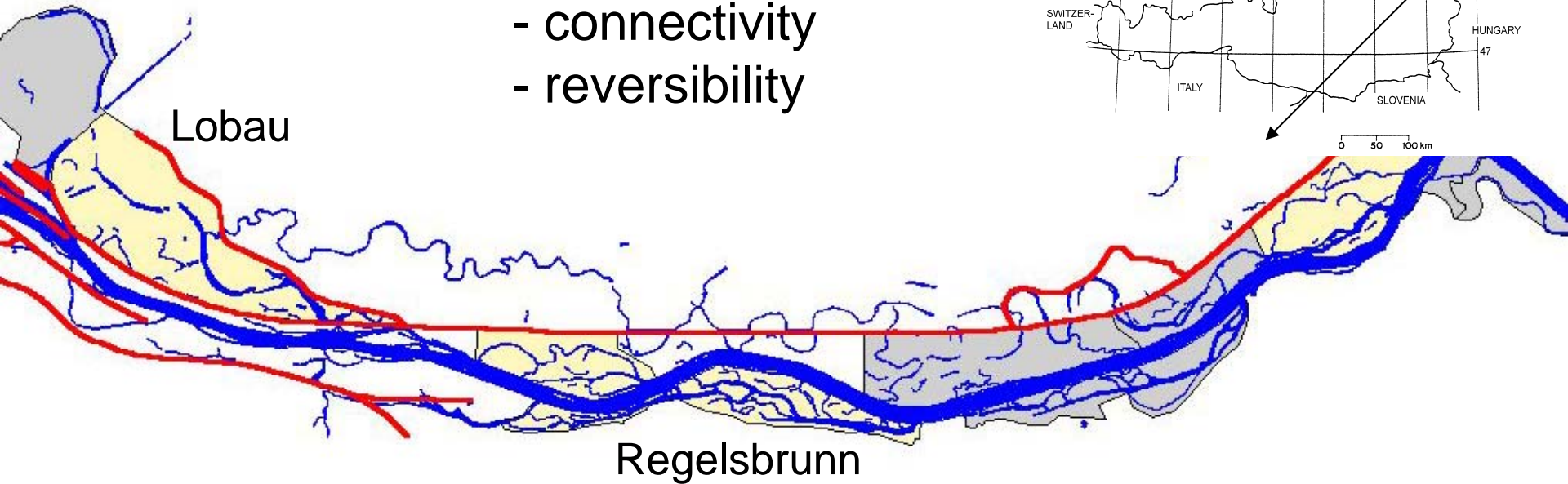
- environmental state
- restoration scope and reversibility
- stakeholder interest
- constraints

Scenario 1: Vienna to Bratislava



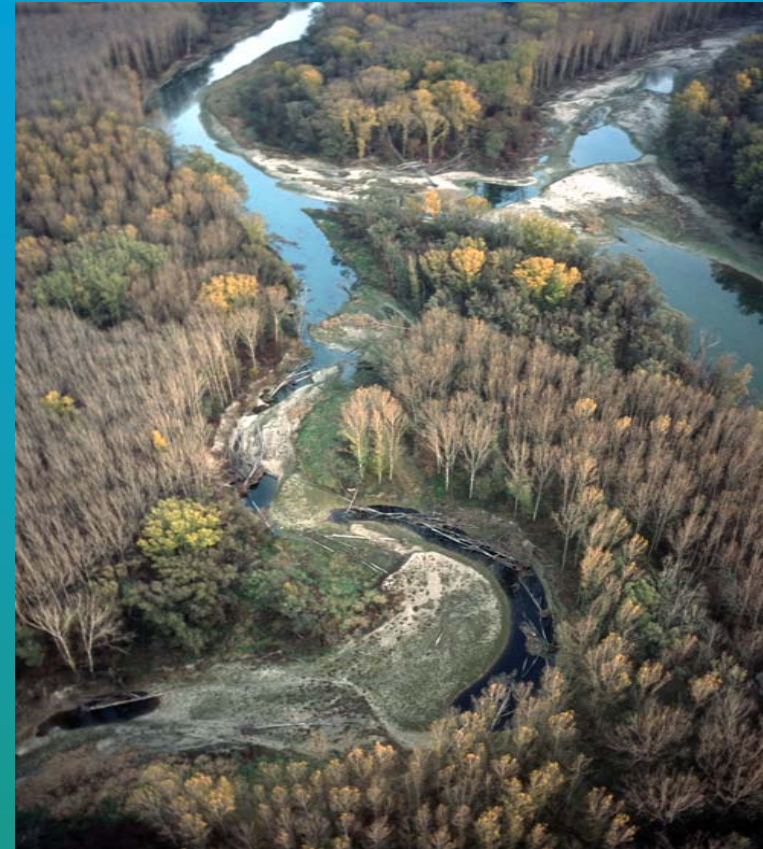
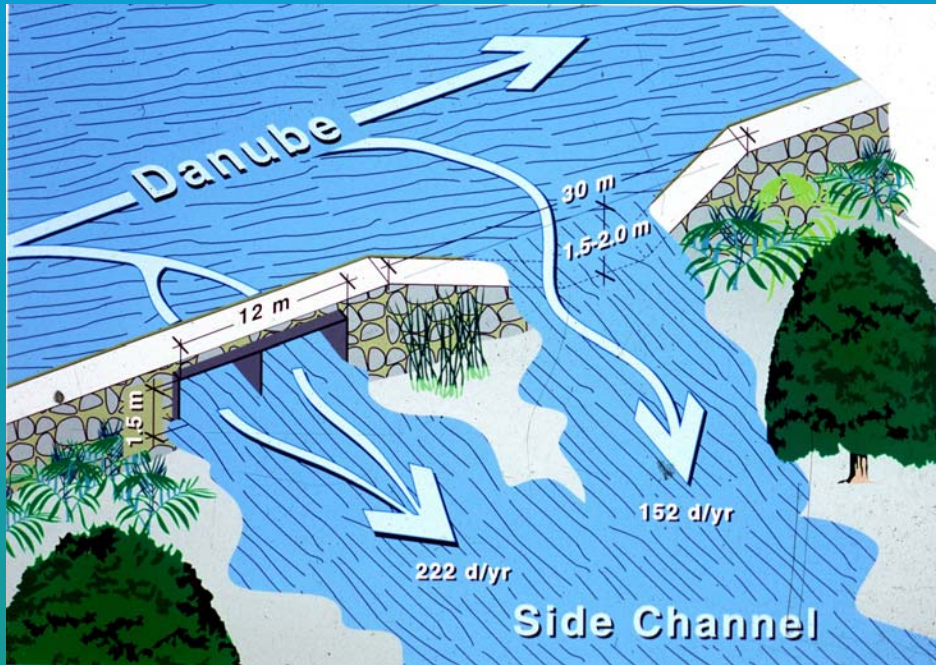
floodplain scenarios:

- ecological state
- connectivity
- reversibility



“Integrated River Engineering Programme”

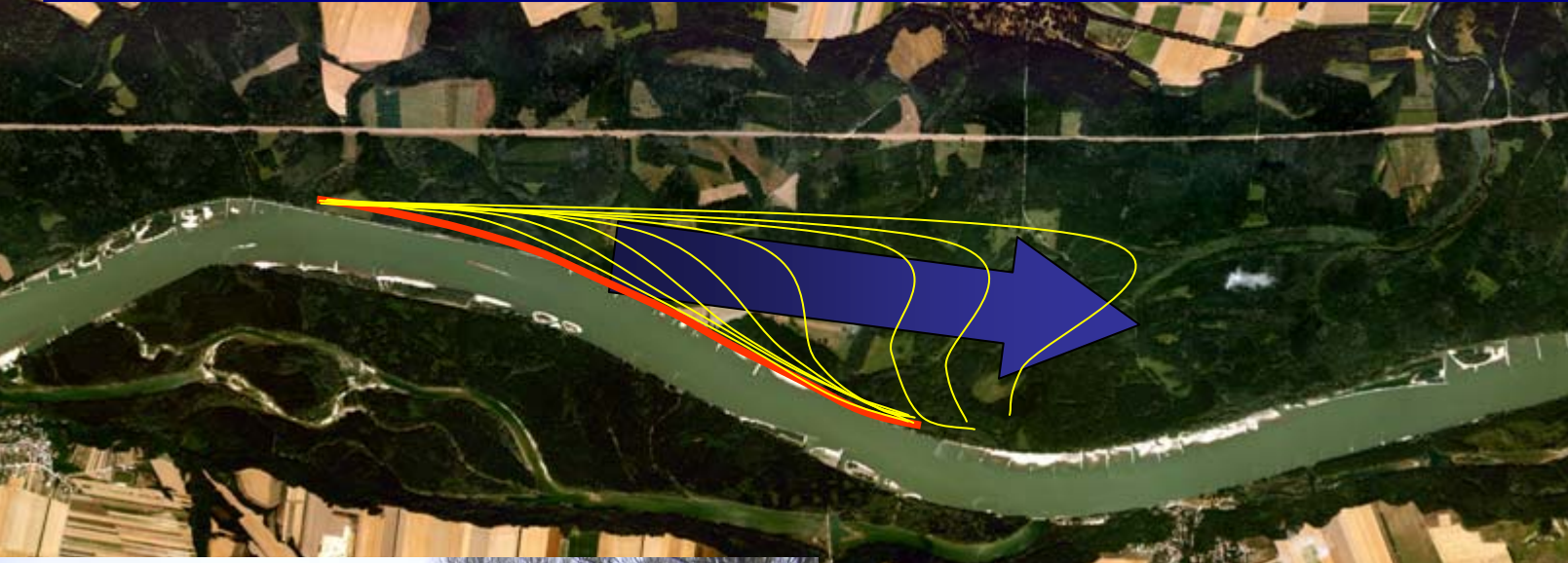
Restoration goal: sidearm reconnection



A first large scale pilot programme (Schiemer et al. 1999)

1. Lowering of riverside embankments
2. Increasing flow capacities between floodplain lakes

Restoration goal: rehabilitation of inshore zones

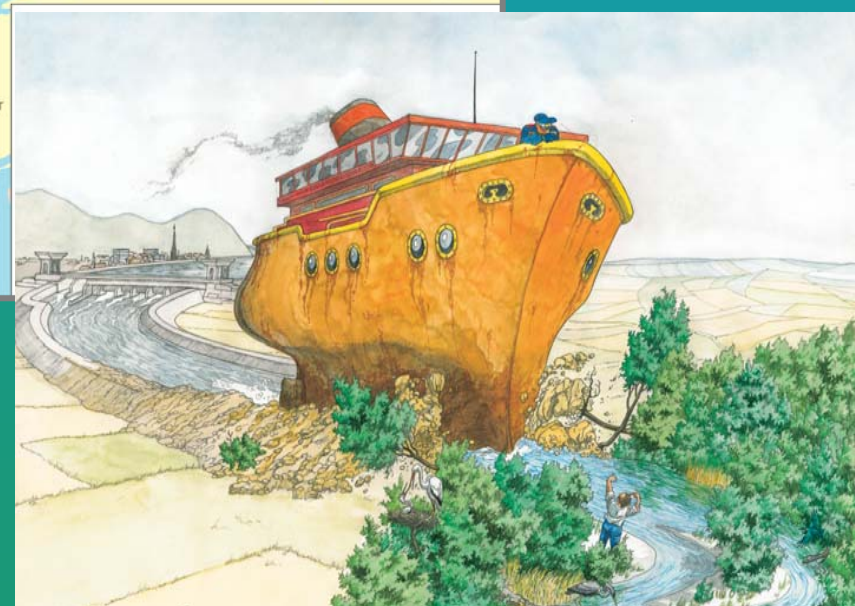


Inshore Retention Concept
Schiemer et al. 2001

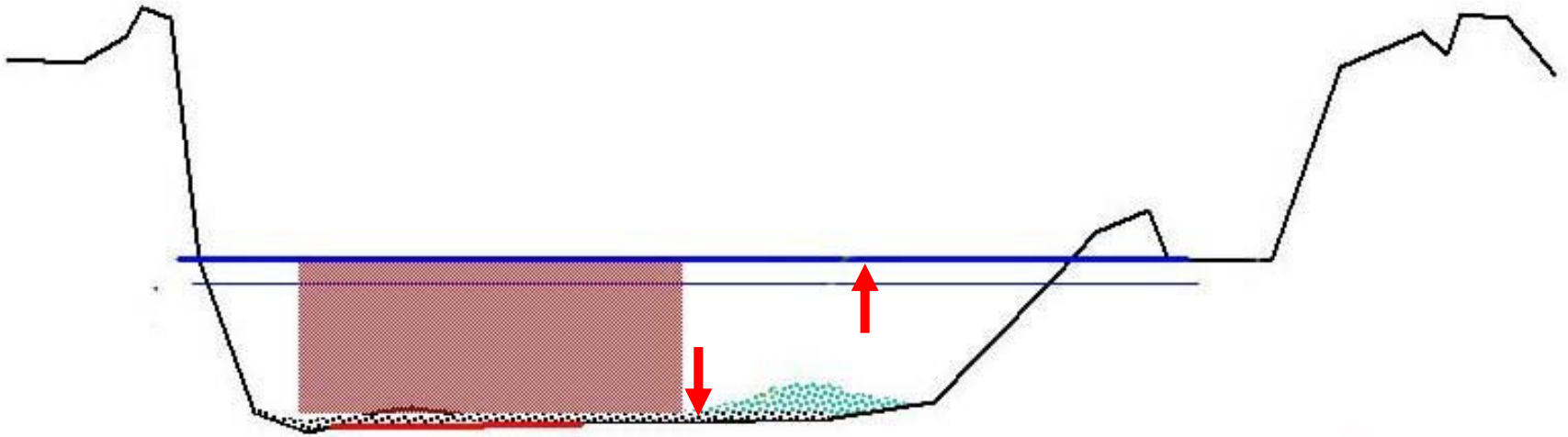
Navigation:



Pan European Transport Corridor



Requested navigation corridor: 120m x 3.2m



MLWL-regulation achieved by:

- gravel excavation
- groynes

Approach to resolve controversy

- Scientific board (ecologists, hydrologists, navigation experts, socio-economists)
- Planning team (civil engineers plus ecology consultants)
- Stakeholders
- Public participation

3 years process

joint planning principles

12 scenarios

ecological benchmarking

Achieved compromise

1. reduced waterway transect:

100x2.7m instead of 120x3.2 m

2. added restoration measures:

a) “granulometric bed improvement” (N,E)

b) river bank restoration (E)

c) side arm reconnection (E)

EIA, Implementation 2008 - 2020

Bratislava-Budapest



“Strategic environmental impact assessment”
Directive 2001/42/EC

A general “standard operating procedure” (SOP) for Large River Restoration

1. Legal framework

- “Water Framework directive” 2000/60/EC
- “Habitats Directive” (92/43/EC)

2. Guidelines for a scientific approach

3. Integrated planning approach

Guidelines for a scientific approach to large river rest.

1. reference standards, hierarch. framework of application
2. ecological targets, reversibility and sustainability
3. formulation of prognostic eco-hydrological parameter
4. interdisciplinary monitoring programmes

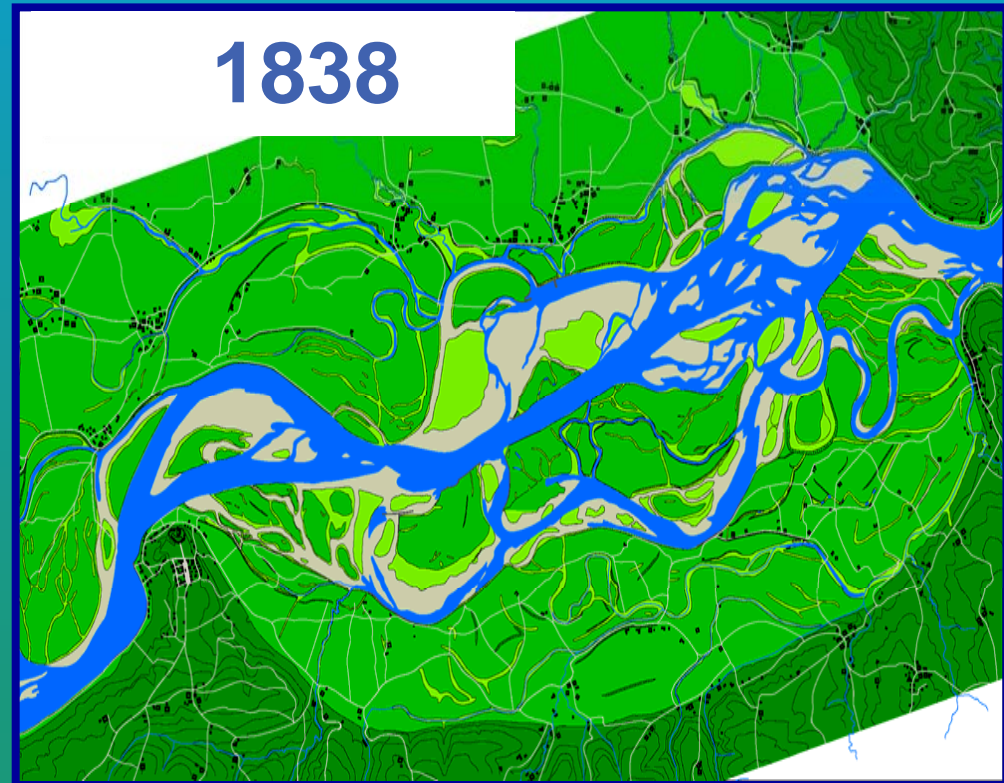
Restoration

„ re-establishment of predisturbance aquatic functions and related physical, chemical and biological characteristics“



Reference standard

Original landscape pattern as the dynamic equilibrium of fluvial processes; defined by geomorphology, hydrology and bed load transport



Hierarchical framework to be followed in the application of reference standards

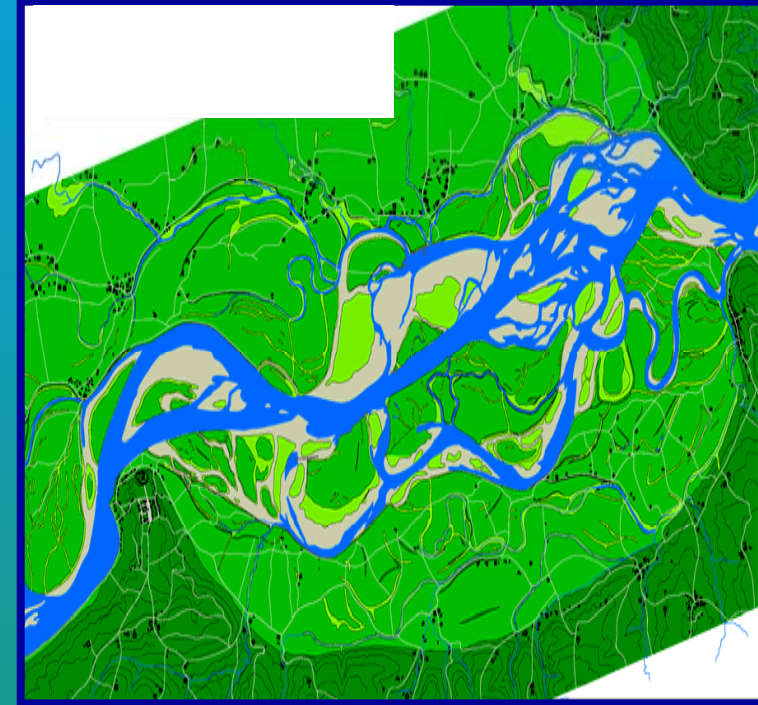
key processes
(hydrology & geomorphic
dynamic)



landscape composition
dynamic equilibrium in
habitat composition &
connectivity



Characteristic
ecological processes
and biotic diversity



Development and promotion of restoration

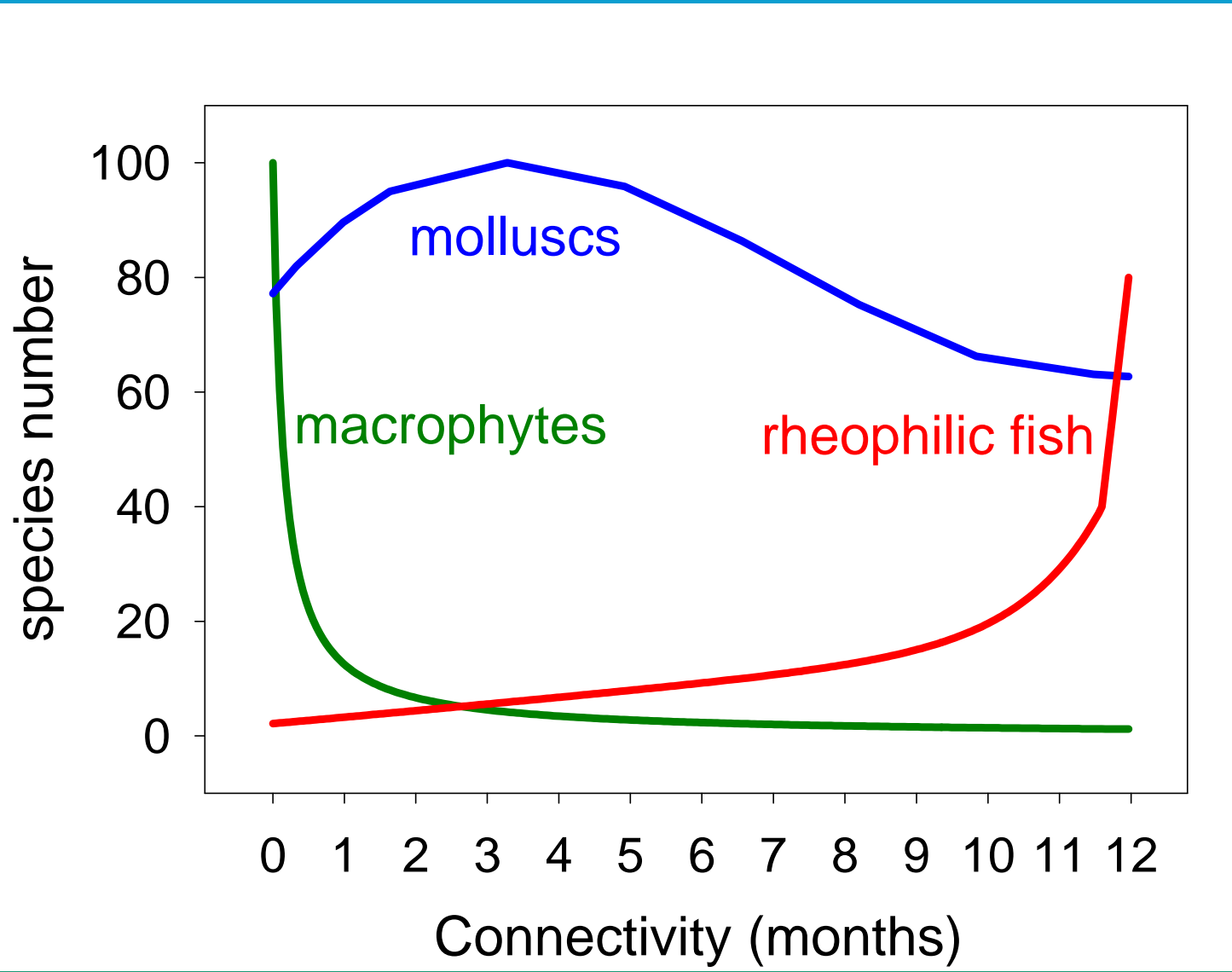
- Scope and necessity for restoration high (acc. WFD)
- legal framework not sufficient to promote programs with exclusively environmental orientation
- strong stakeholder interests for: flood control, water abstraction, navigation, (hydropower)
- From a conservationist point of view it is necessary to build alliances and develop win-win situations

Integrative Planning Approach

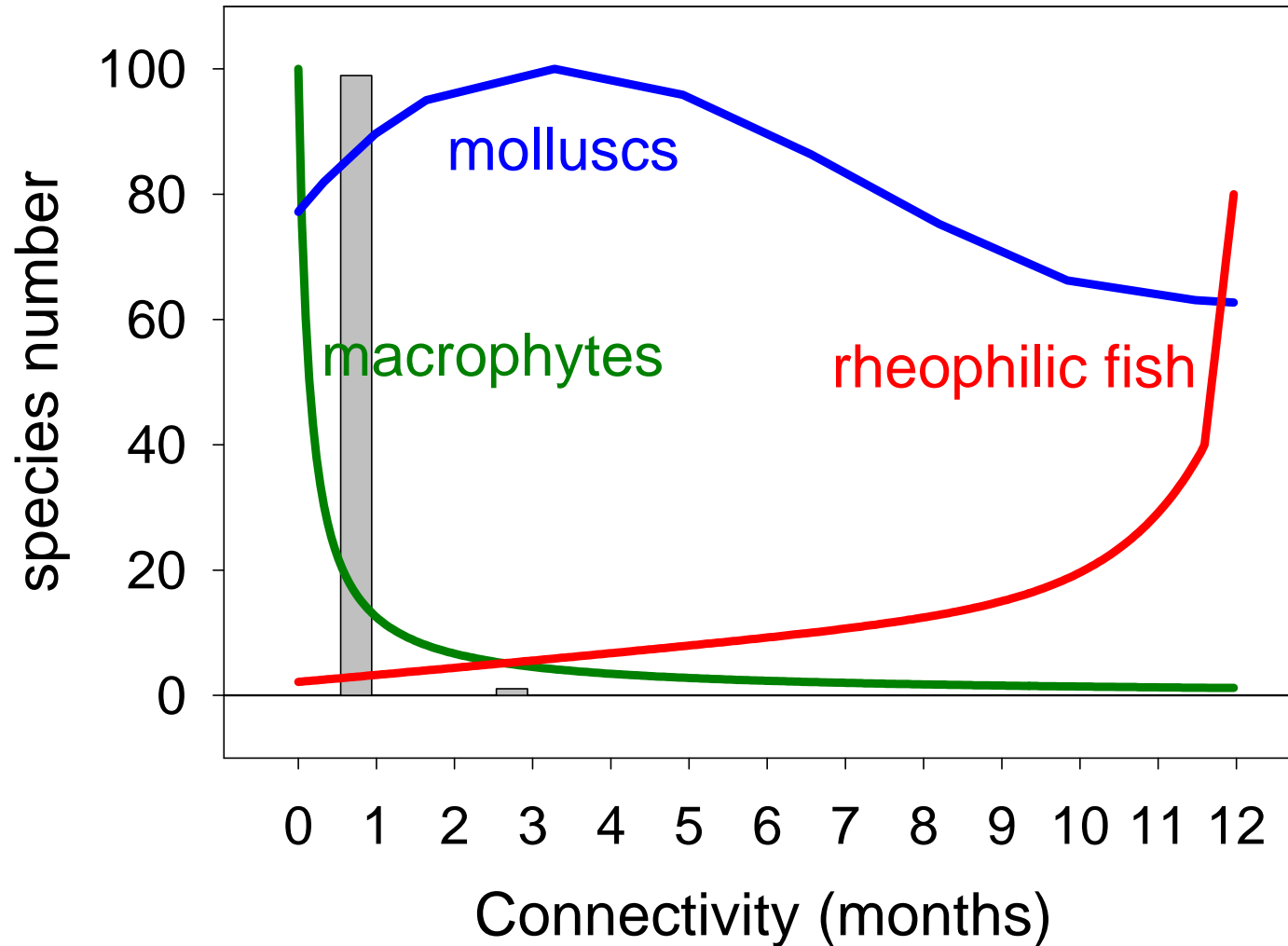
- interdisc. teams (experts, planners)
- define planning objectives & priorities
- transparent planning process
- stepwise, adaptive implementation

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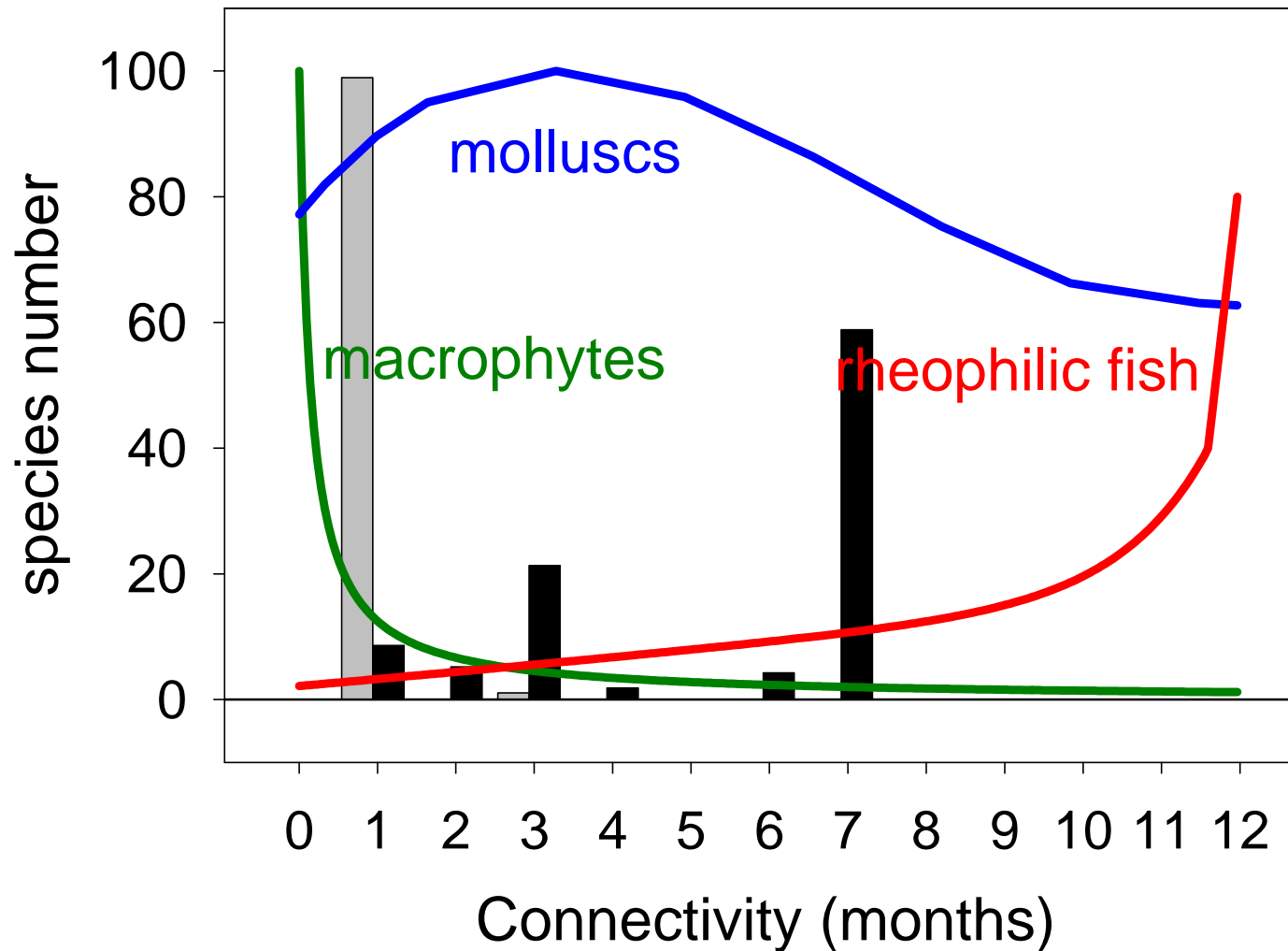
The functional response between connectivity and biodiversity



„Regelsbrunn“ before restoration



„Regelsbrunn“ after restoration



Scenario: Lobau

Restoration goals:

- maintaining wetlands by water enhancement
- upstream connection with the river

Stakeholders:

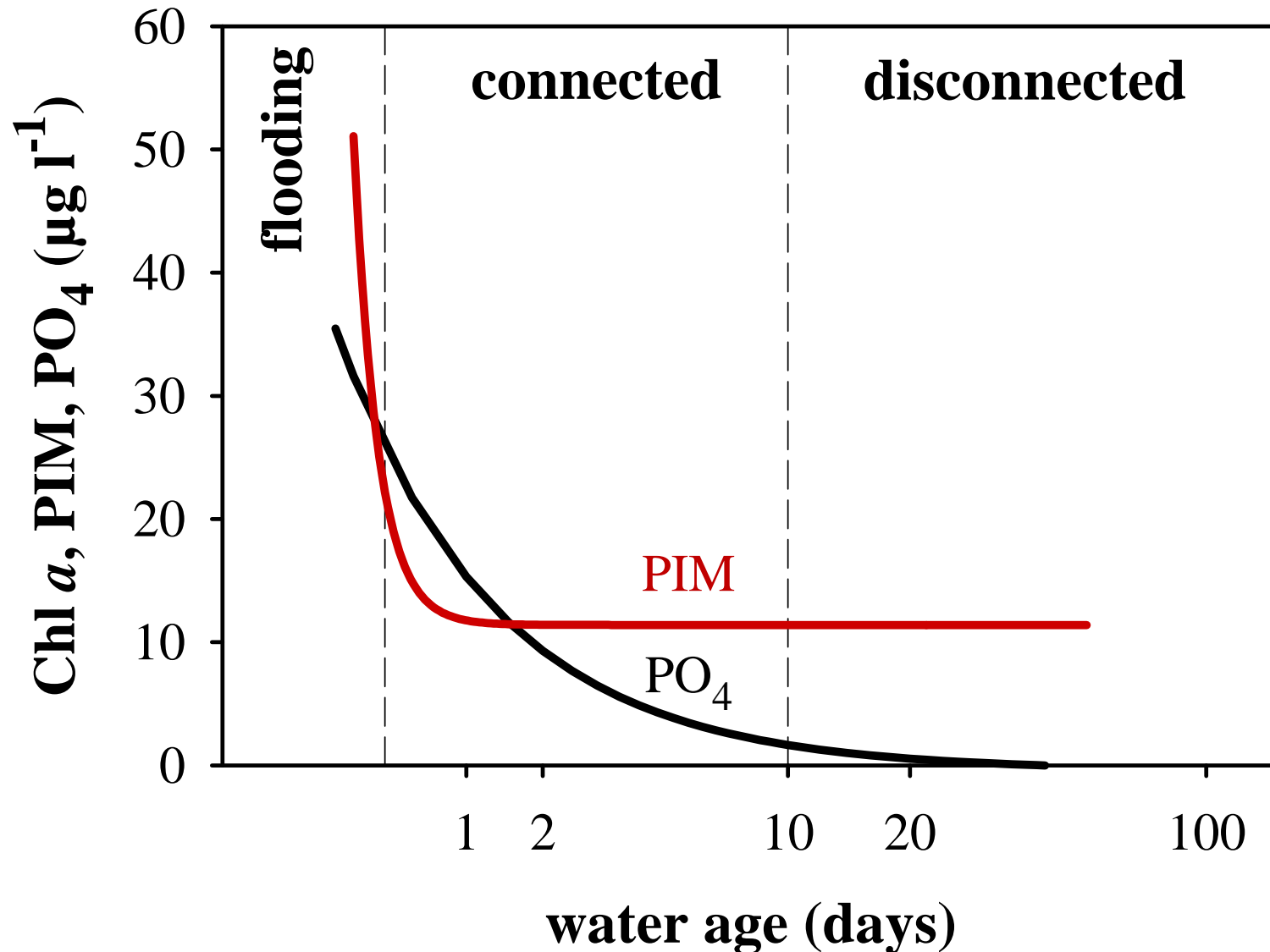
- flood control
- drinking water supply

Resolution:

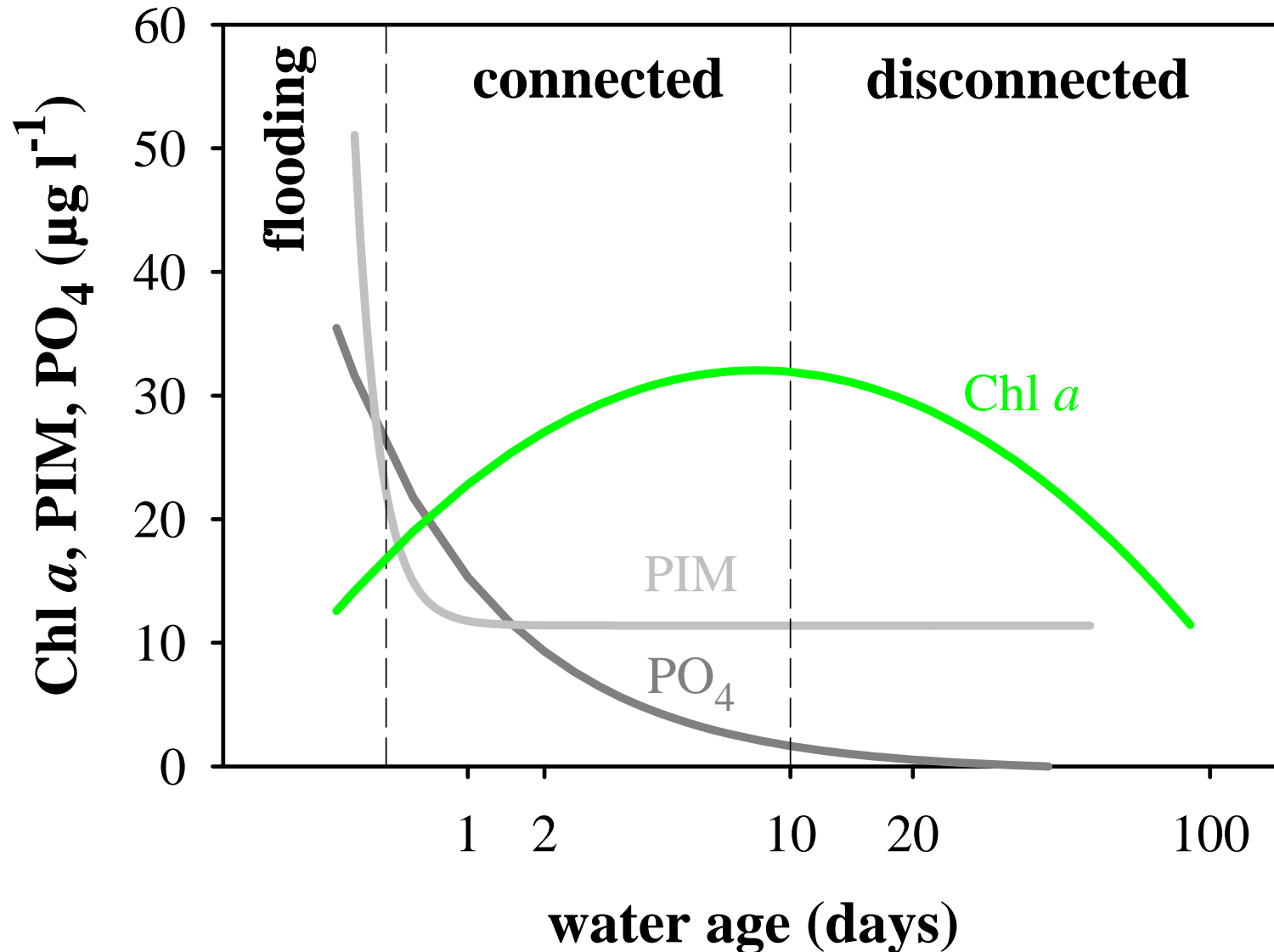
- interdisciplinary planning process

Implementation: 2012 ?

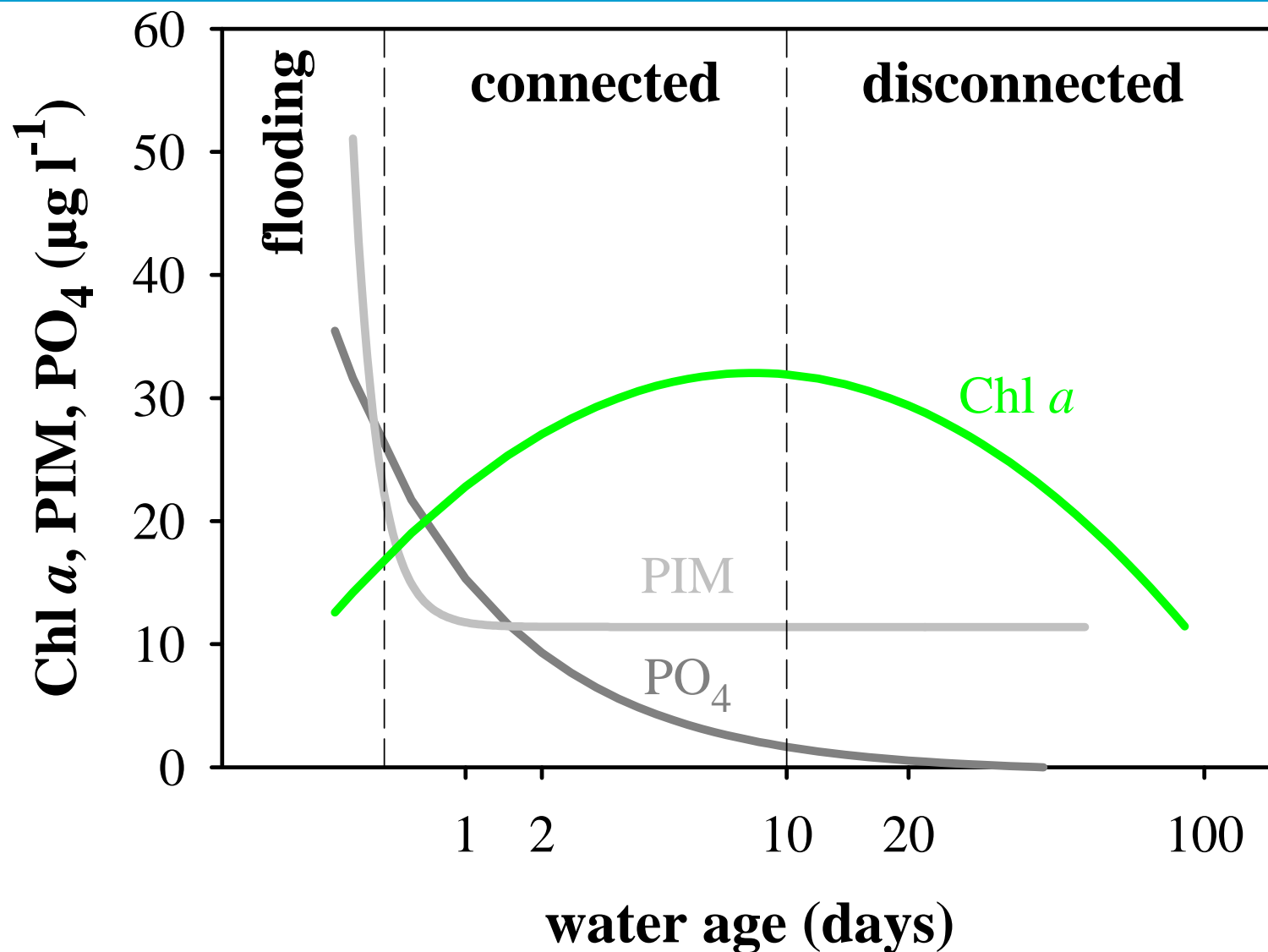
Functional response of limnological parameters to „water-age“

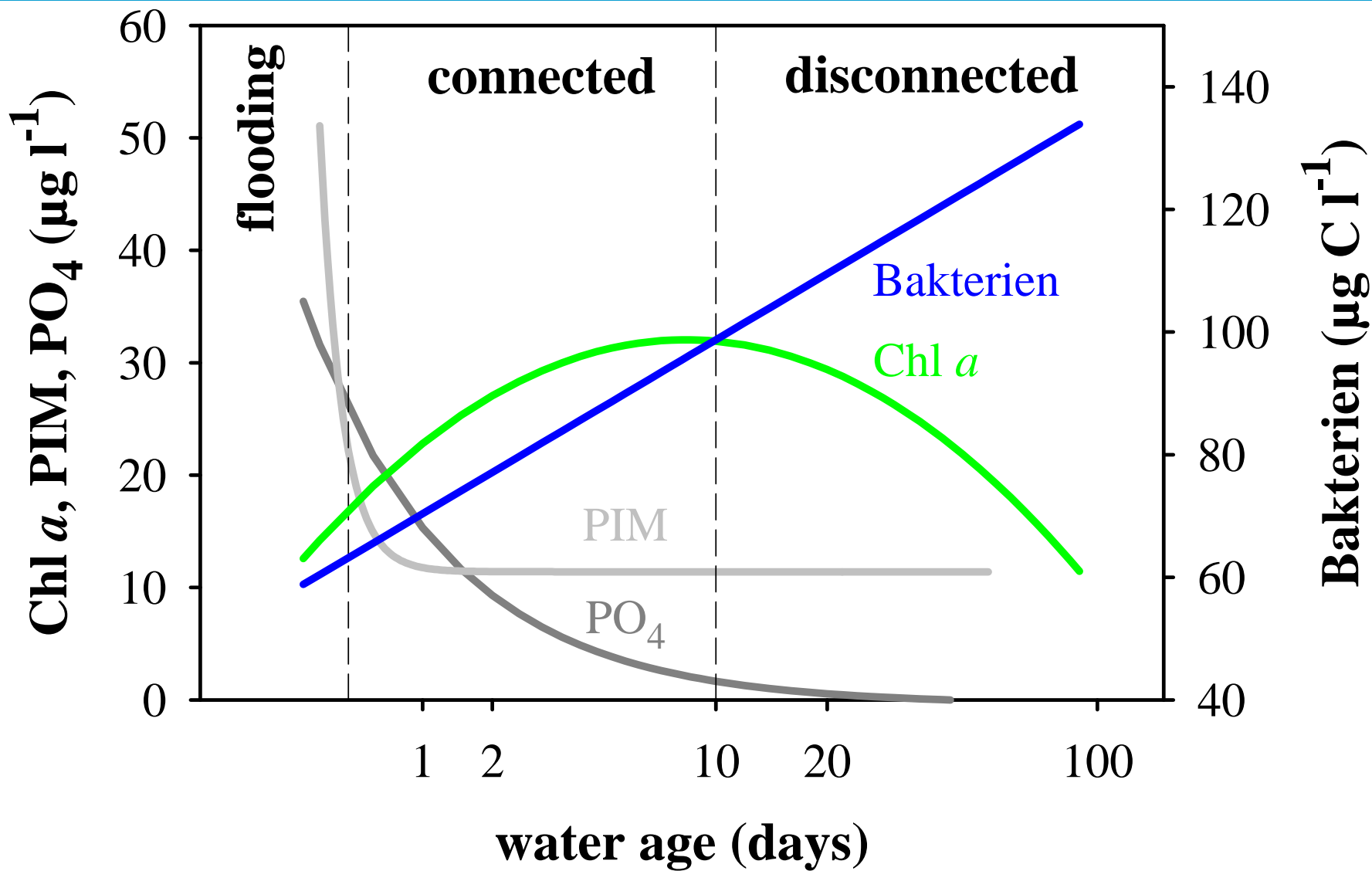


Functional response of limnological parameters to „water-age“



Functional response of limnological parameters to „water-age“





Scenario: Bratislava - Budapest

Ecological requirements:

- water diversion

Stakeholder:

- national politics
- hydropower: Slovakia yes, Hungary no
- navigation

Resolution:

“strategic environmental impact assessment“

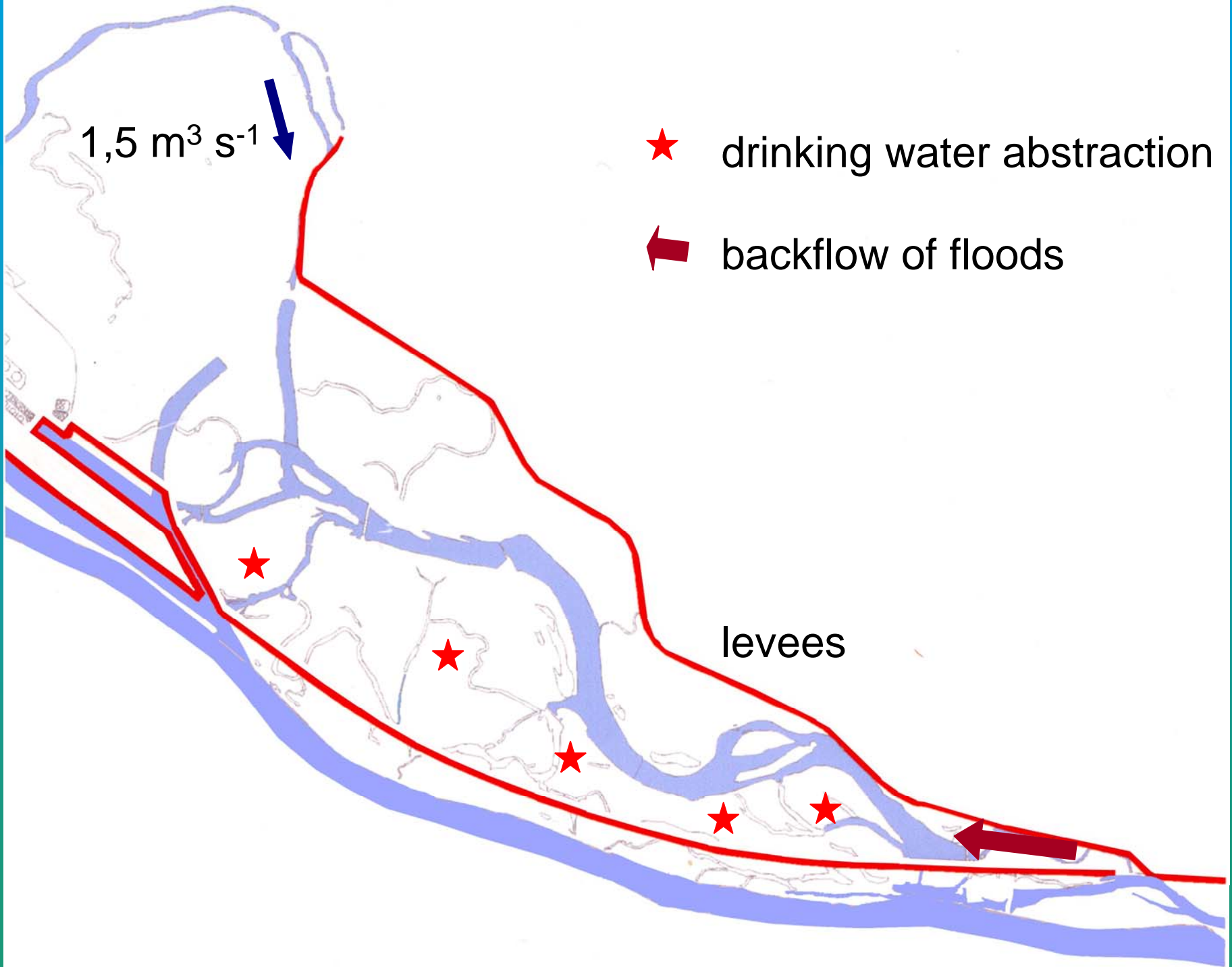
Directive 2001/42/EC

Comparison of scenarios

	Vien-Brat	Lobau	Brat-Bud
deviation from reference	low	high	high
ecol. targets	rest. fluv. processes	water enhancement	water enhancement
stakeholders	navigation	flood control	hydropower navigation

Scenario 2: urban floodplain Lobau



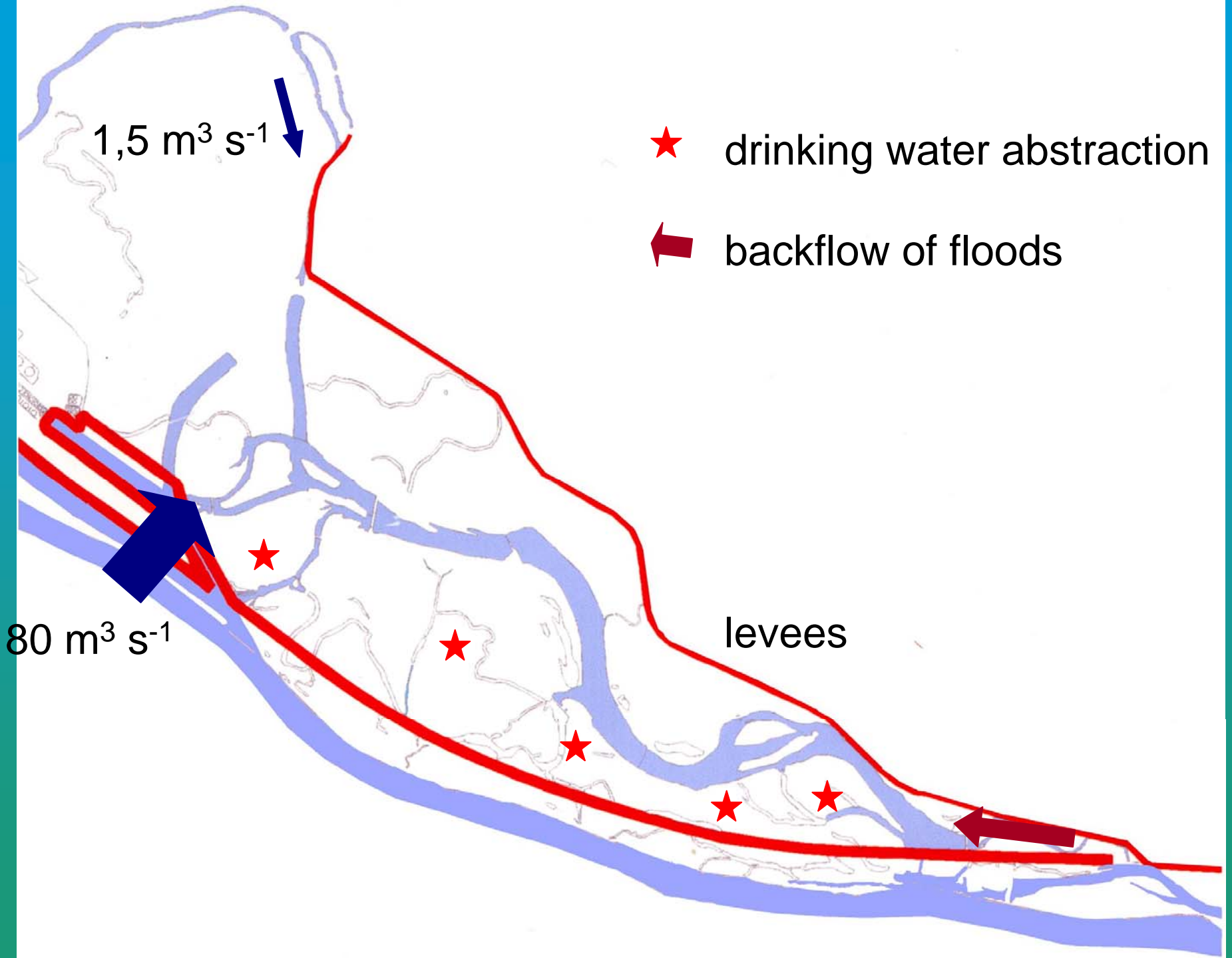


$1,5 \text{ m}^3 \text{ s}^{-1}$

★ drinking water abstraction

← backflow of floods

levees



Integrative Planning Approach

1. Restoration planning steps based on „Scientific guidelines“
 - assess deficiencies
 - assess irreversible changes
 - define constraints by other water uses
 - delineate ecol. targets
 - assess feasibility of restoration measures
 - predict long-term dynamic endpoints

Integrative Planning Approach

2. Recommended approach

- interdisc. teams (experts, planners, managers)
- transparent planning process
- define planning objectives, priority ranking
- stepwise, adaptive implementation
- interdisciplinary monitoring programmes