



Restoring Europe's Rivers

The RESTORE project is made possible with the contribution of the LIFE+ financial instrument of the European Community



and works in partnership with



Ecology and River Restoration

“Ecology is the study of the relationships between plants and animals and the environment in which they live.” Owen, 1980

Martin Janes

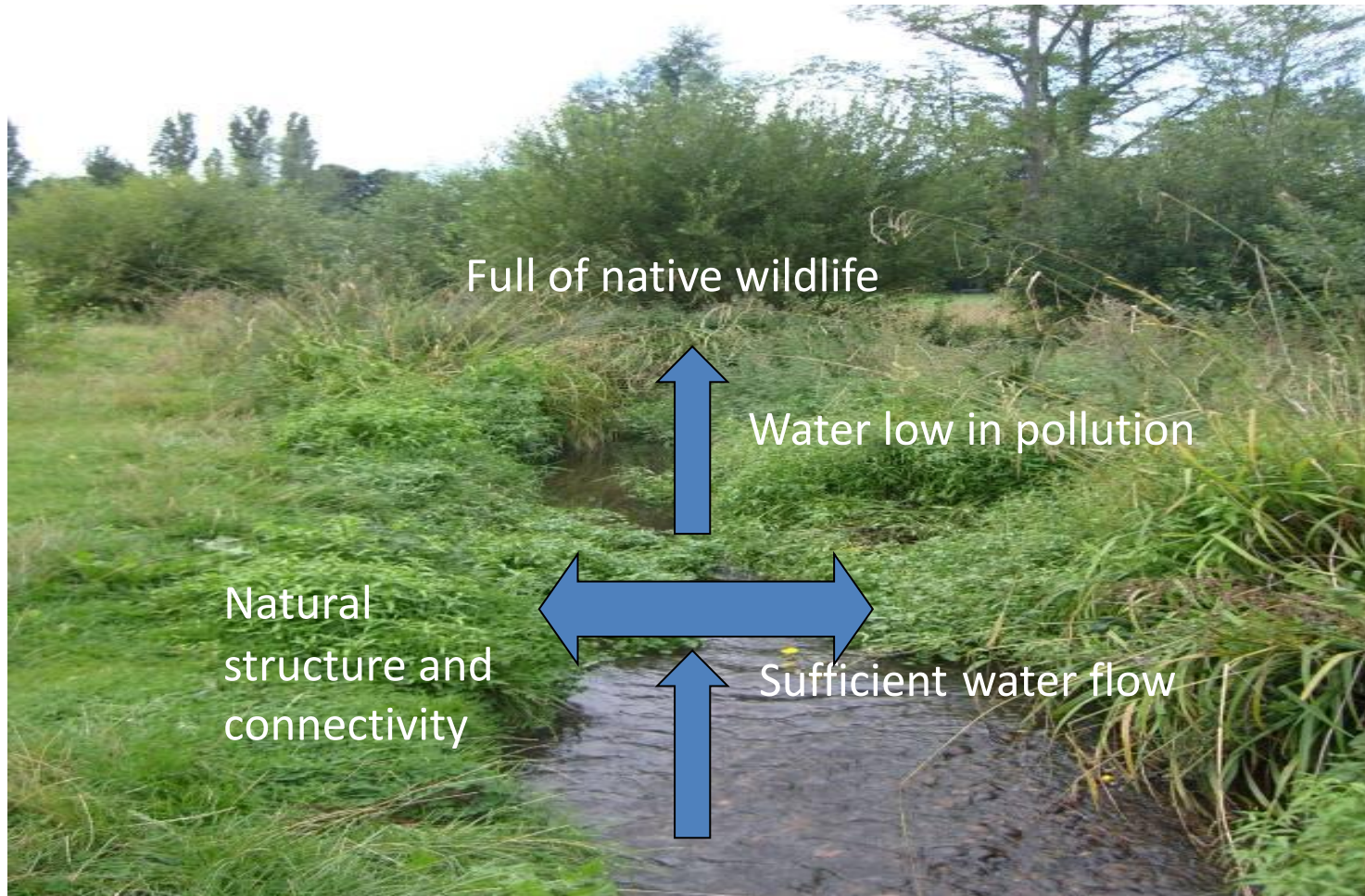
Managing Director
The River Restoration Centre (UK)
RESTORE West Region Lead

Content

- Processes affecting aquatic ecology
- Understanding habitats & interactions
- How to use your knowledge of habitats in River Restoration



What do we want to achieve?



From RRC's Monitoring Guidance document

Processes influencing ecology



Longitudinal processes:

- Hydrology
- Fluvial geomorphology



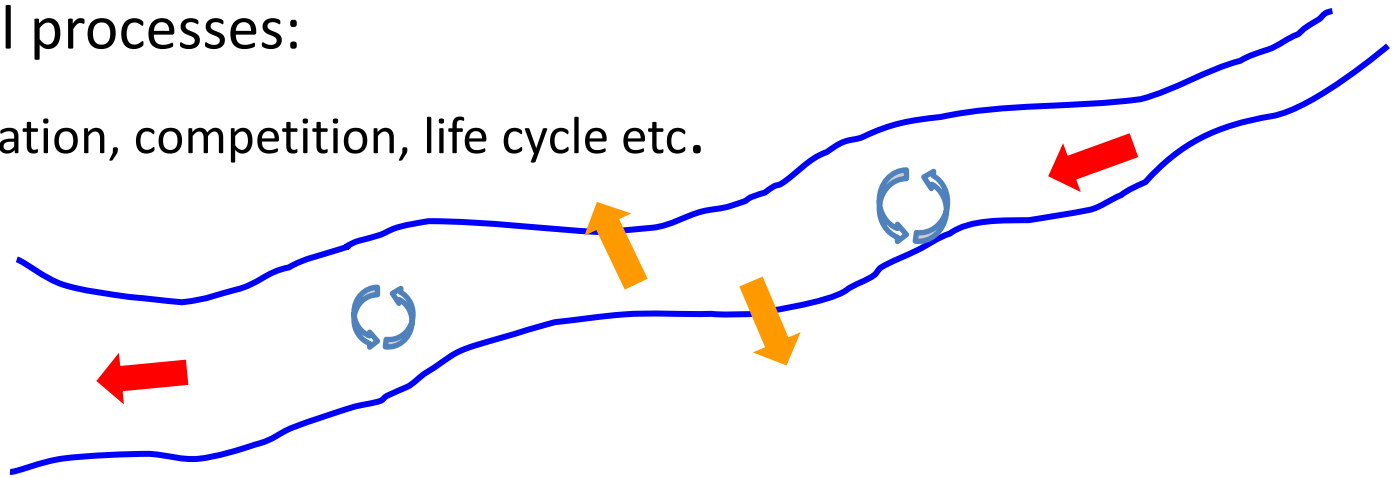
Lateral processes:

- Interactions with riparian zones & floodplains

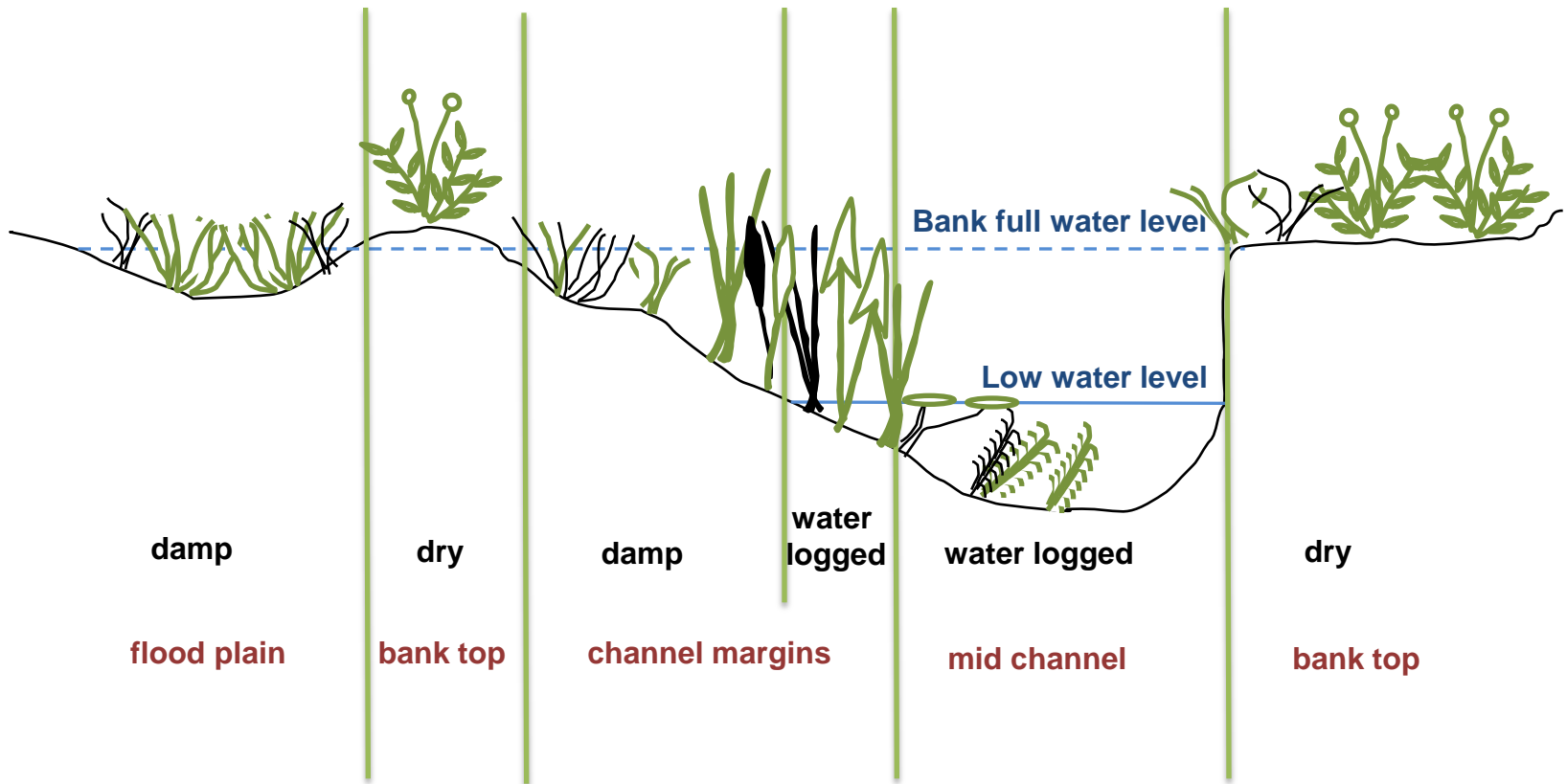


Internal processes:

- Predation, competition, life cycle etc.

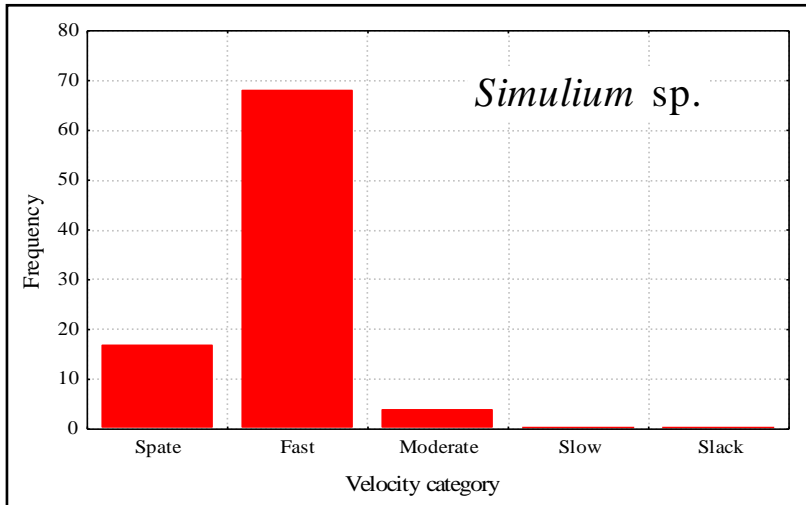


Influence of hydrology on plants

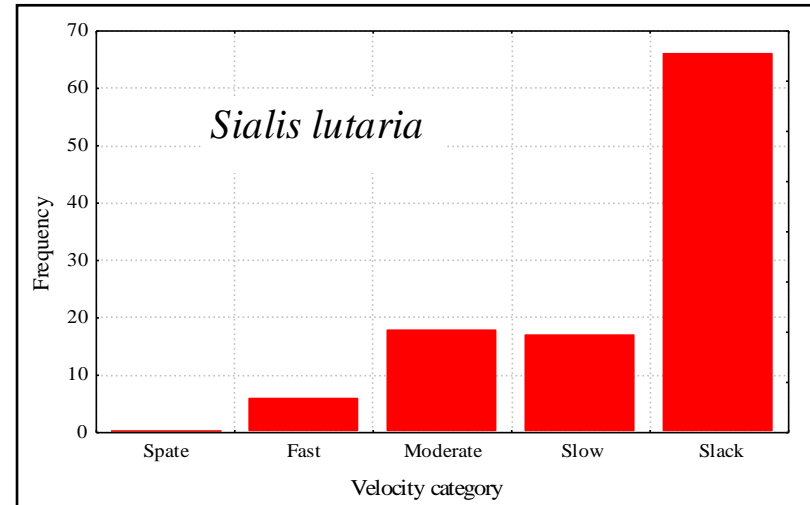


Influence of hydrology on invertebrates

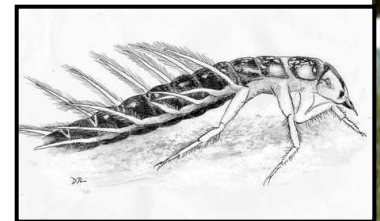
Some taxa have flow preferences, relating to feeding preferences & physical adaptations



Black fly larvae, filter feeder. Preferred velocities - a balance between those that bring food particles and being dislodged.



Alder fly larvae, burrowing predator. Preferred velocities – a balance where prey can be found and being dislodged.



Influence of hydrology on fish

Culvert Guidance criteria illustrating maximum velocities permitted through a culvert barrel to enable upstream migration of adult salmonids (adapted from NMFS, 2001).

Culvert length (m)	Velocity (m/s) – adult salmonids
< 18	1.8
18-30	1.5
30-61	1.2
61-91	0.9
> 91	0.6

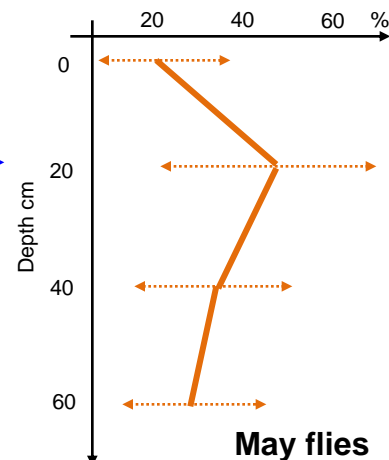
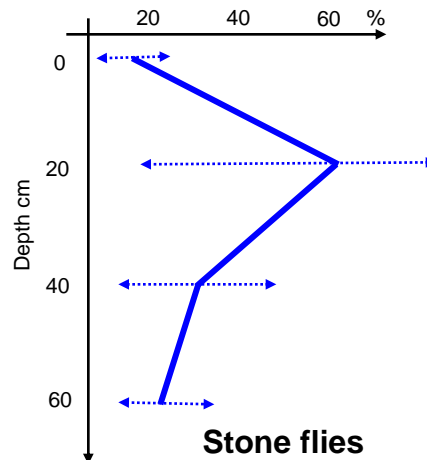
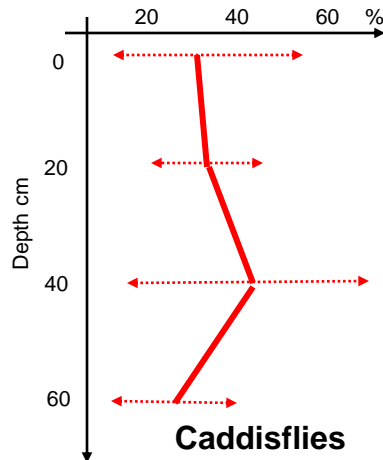


Influence of morphology on plants

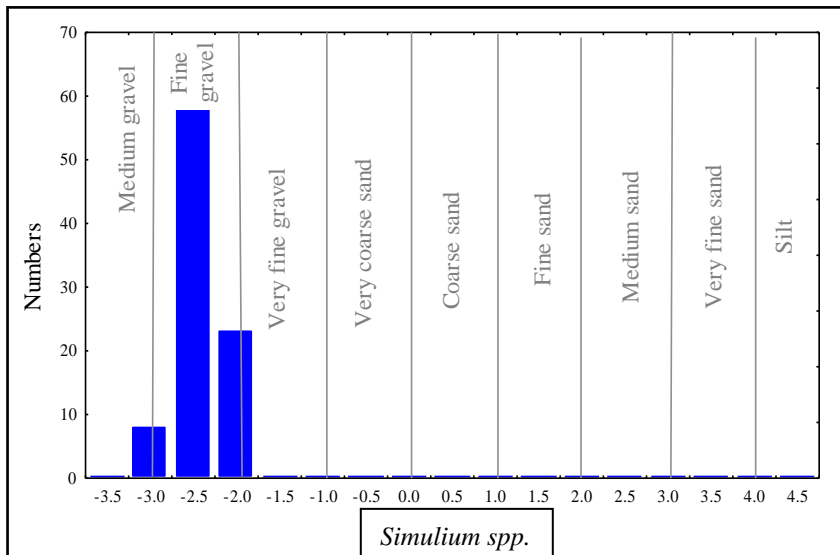


Influence of morphology on invertebrates

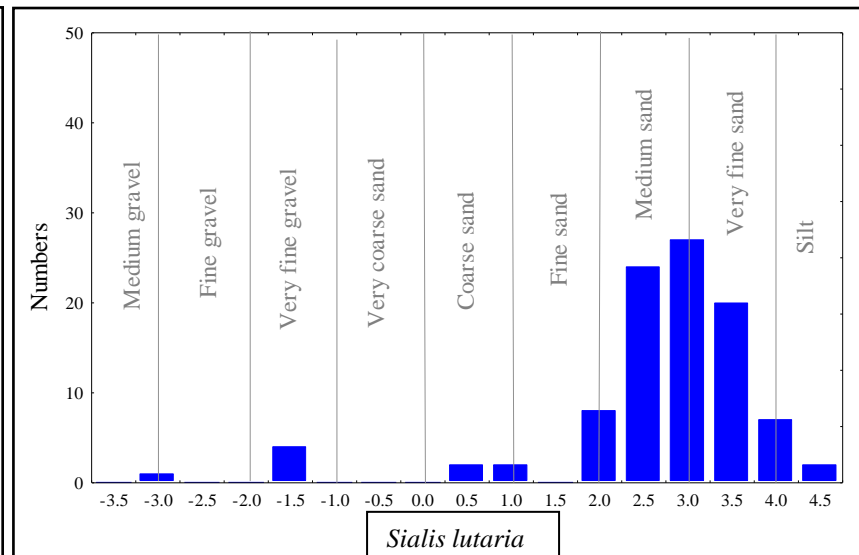
- Impacts on substrate size
- Impacts on substrate patchiness
- Impacts on substrate movement
- Impacts on substrate depth



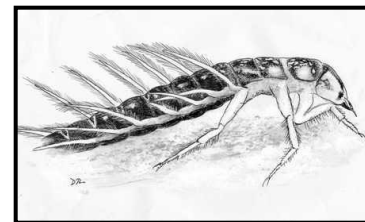
Influence of substrate on invertebrates



Black fly larvae,
filter feeders.
Found in larger
substrate sizes
providing stable
substrate.



Alder fly larvae,
burrowing
predator. Found
in finer, softer
sediment.



Influence of morphology on fish



Lateral processes

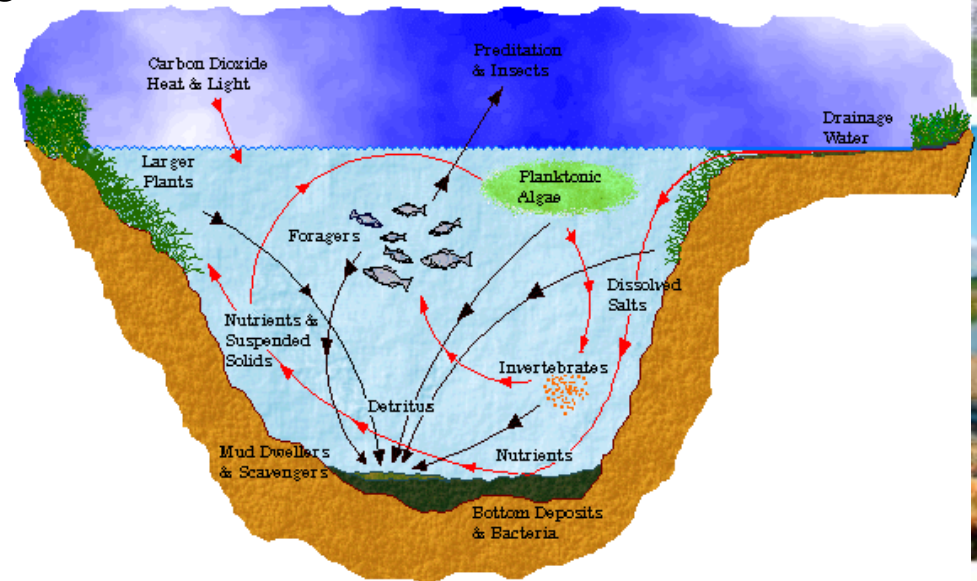
Connections with riparian zones & floodplains

- Refugia in margins
- Nutrient Input from
 - catchment
 - organic matter – leaves, etc.
 - terrestrial invertebrates
- Shade
 - temperature regulation
 - In-channel growth
 - Breeding strategies

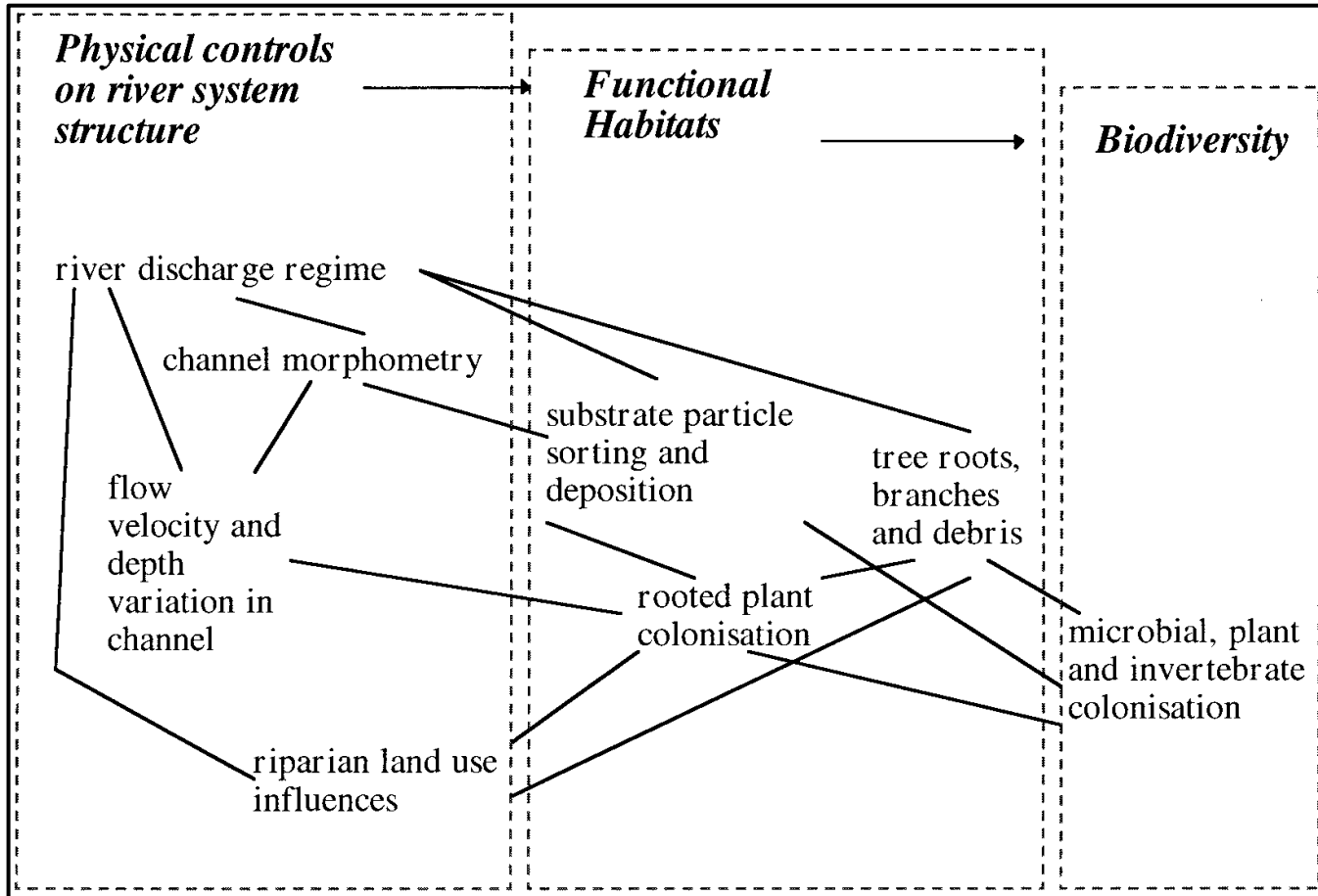


In-river processes

- Physio-chemical processes
 - Nurient cycling
 - Carbon cycling
- Biological interactions
 - Competition
 - Herbivory
 - Predation
 - Life cycles



Functional habitats



Source: Harper and Everard, 1998

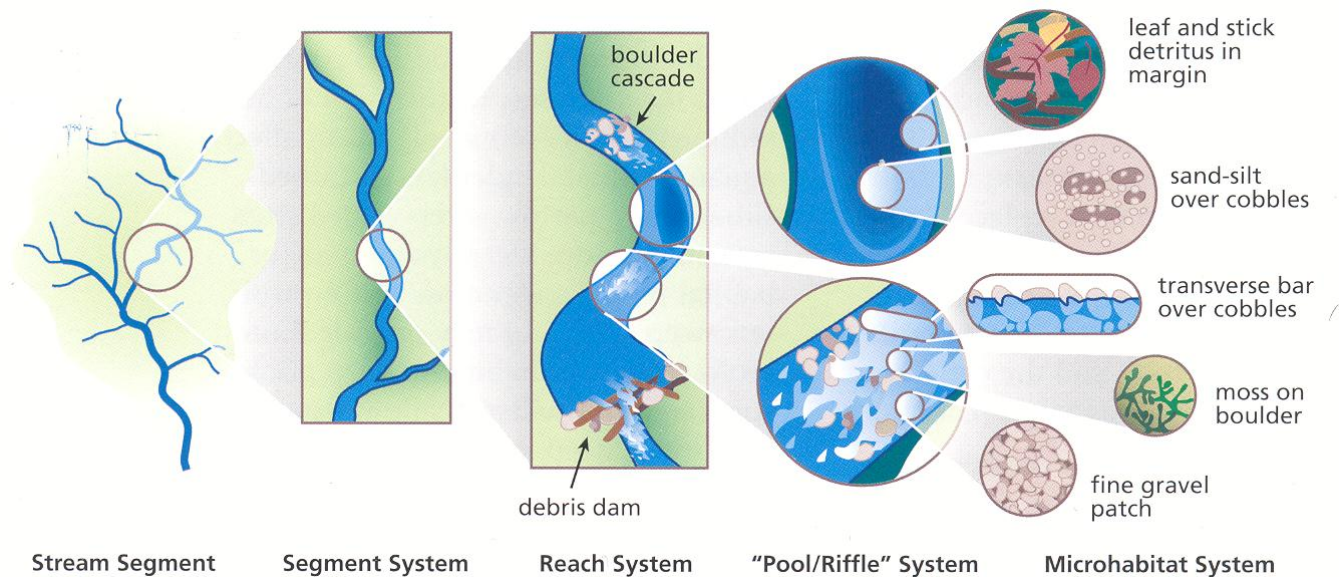


Understanding habitats

- What is a habitat?

“The physical and biological environment on which a given species depends for its survival; the place or type of site where an organism or population naturally occurs.” (www.ecoagriculture.org)

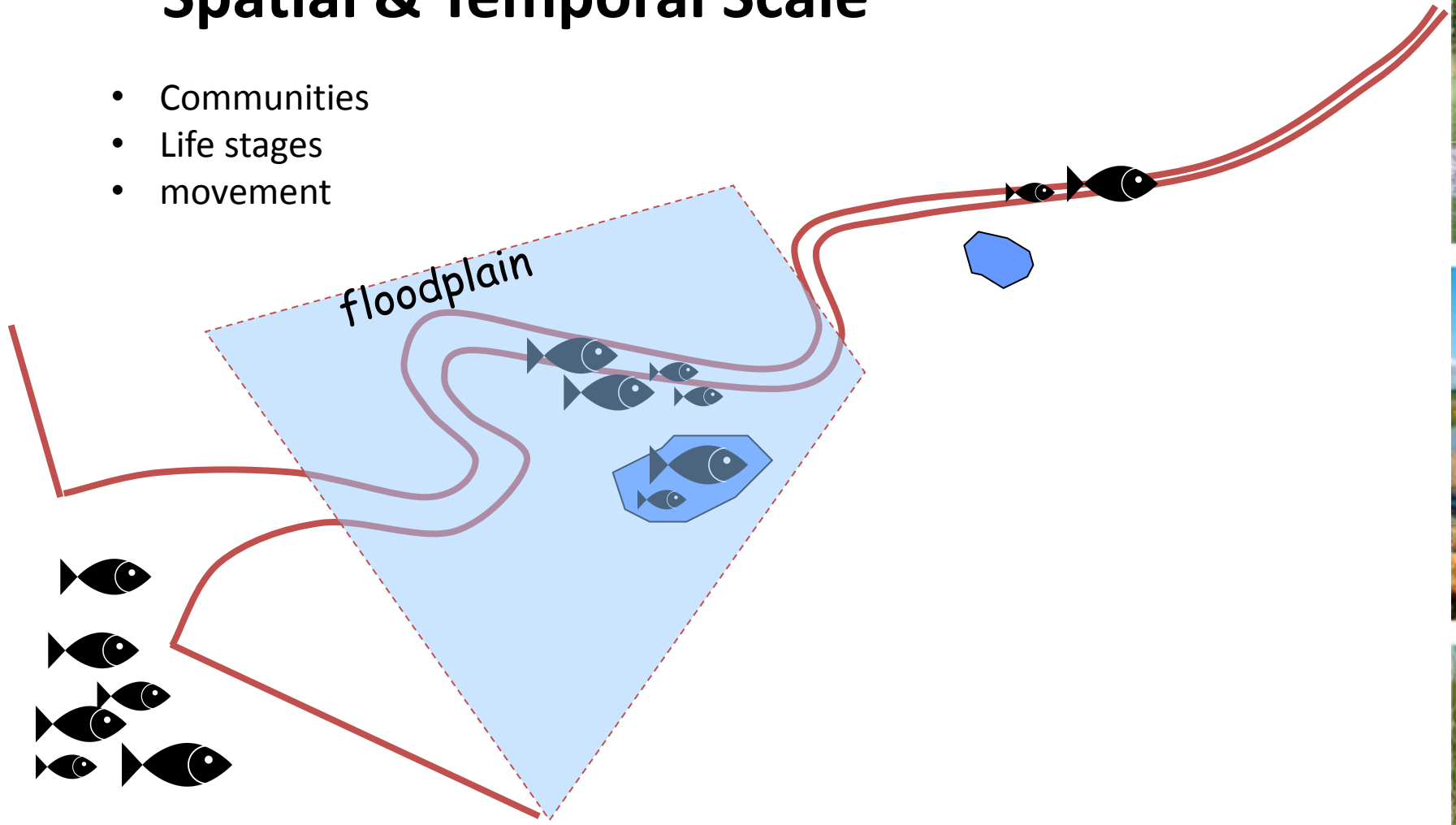
- What scale should you look at?



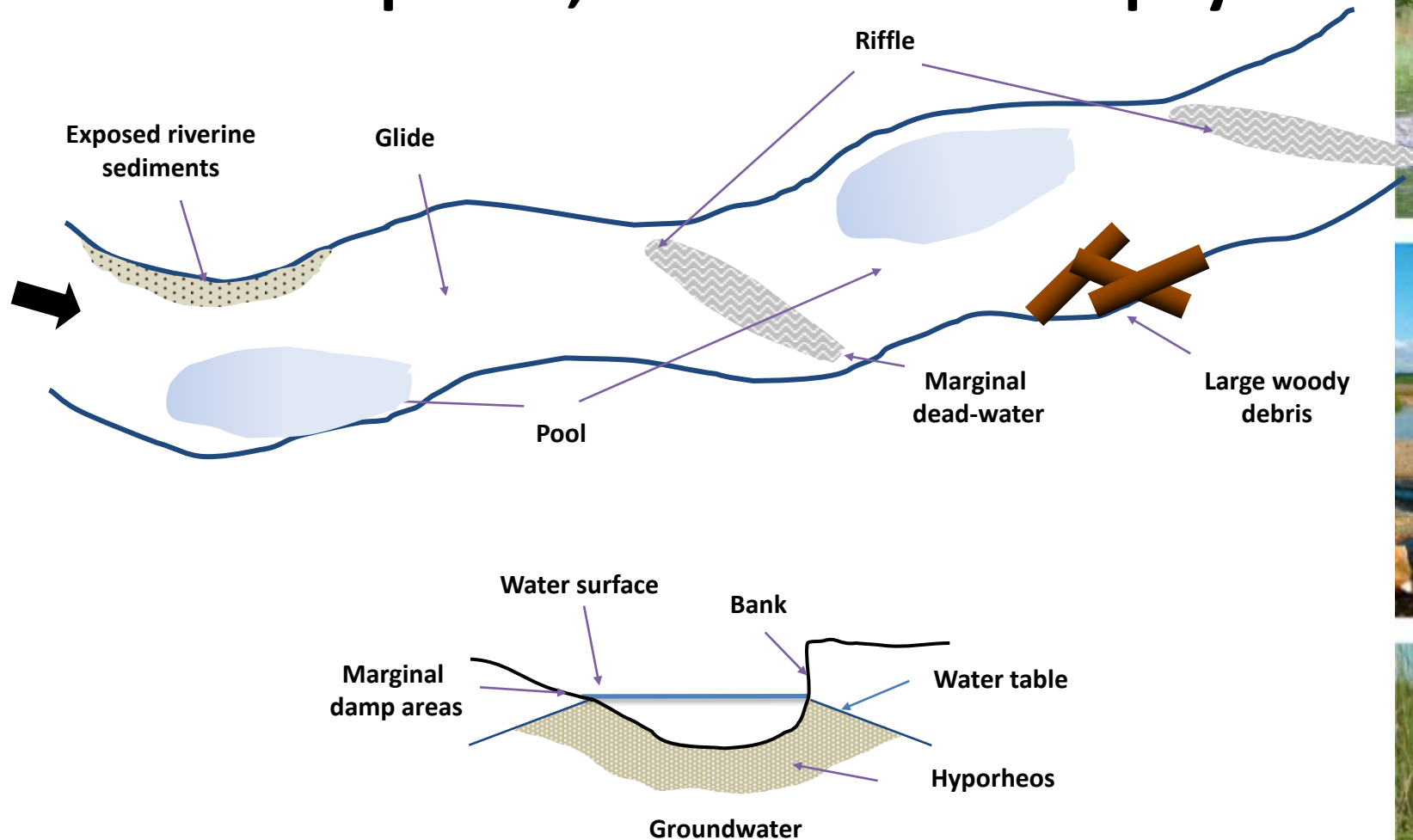
Frissell et al. (1986)

Spatial & Temporal Scale

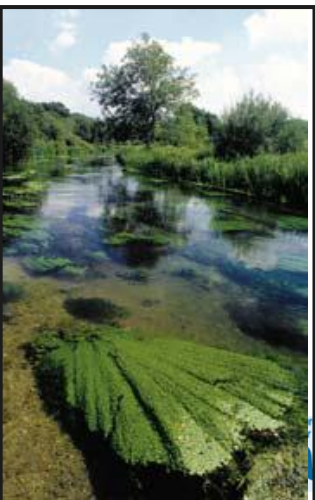
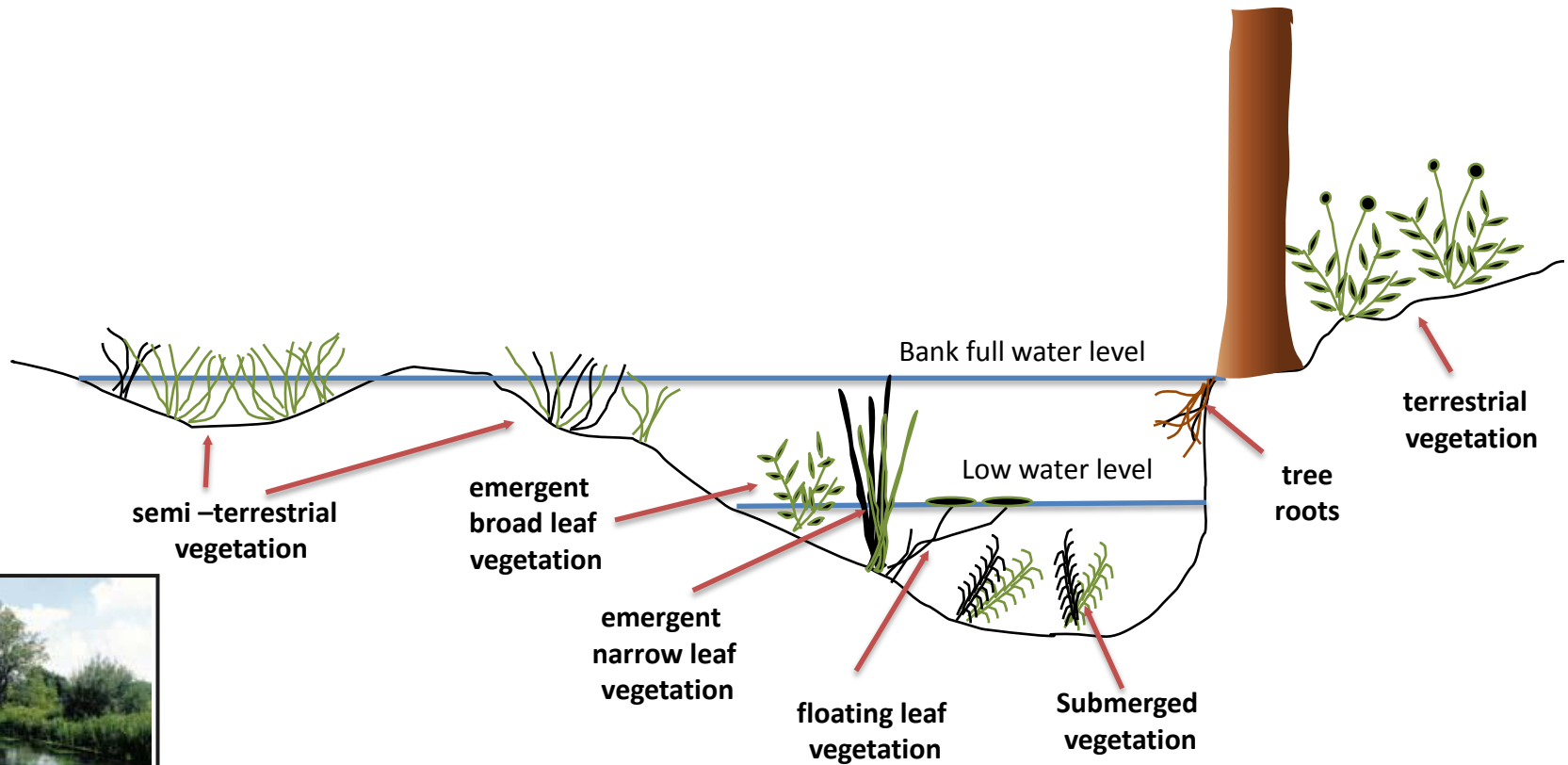
- Communities
- Life stages
- movement



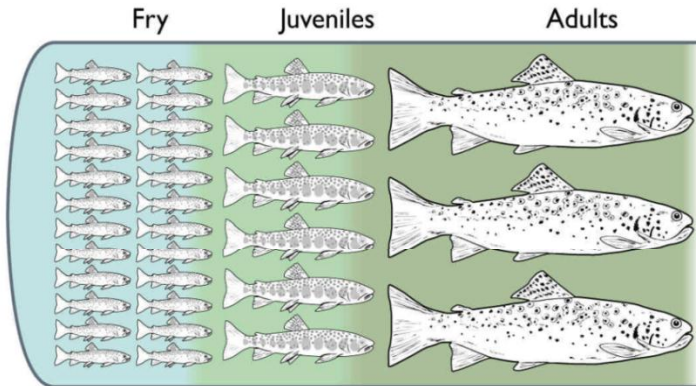
Habitats for plants, inverts and fish - physical



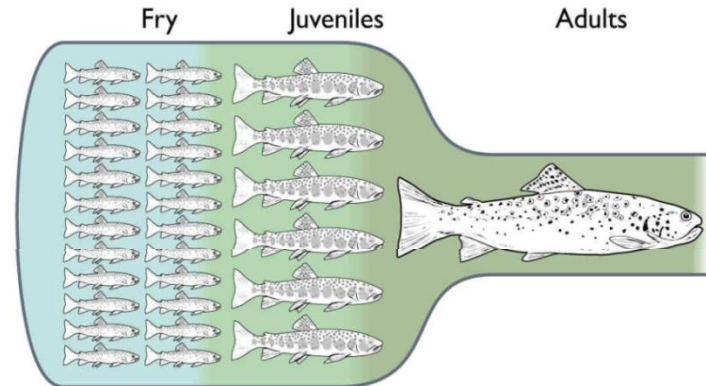
Habitats for Invertebrates & fish - Vegetation



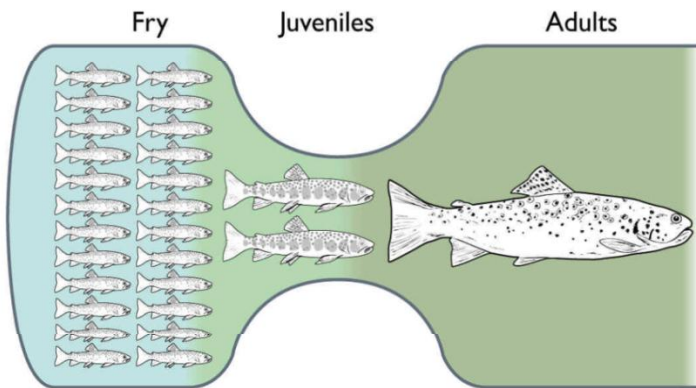
Habitat – limiting factors



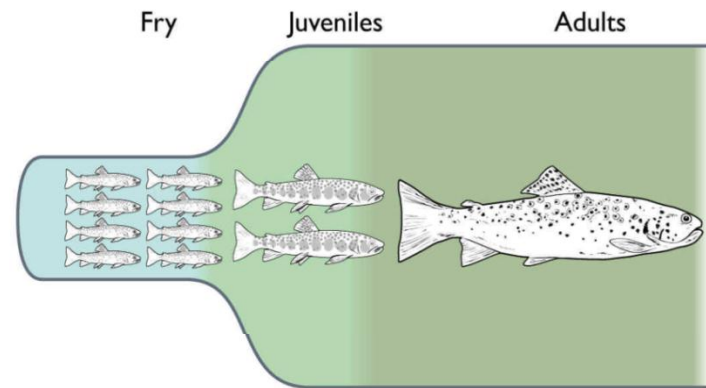
a). No limiting factor



b). Adult habitat acting as limiting factor



c). Juvenile habitat as limiting factor



d). Spawning habitat as limiting factor

Fisheries limiting factors as bottlenecks.



Short Exercise - Assessing habitats

Which invertebrates live in each habitat?

Sand

?

Silt

?

Emergent vegetation

?

Gravel

?

Stones

?

Sand



Silt



Emergent vegetation



Gravel



Stones



Using knowledge of ecological processes and habitat understanding in river restoration

Linking it all together!

WFD Ecological status

(Annex V: 1.2 Normative definitions of ecological status classifications. Table 1.2 General Definitions)

- **Good ecological status:**

The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.

- **Moderate ecological status:**

The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.



Annex V 1.1.1. RIVERS

Annex V 1.1.2. LAKES

Biological elements

- Composition and abundance of aquatic flora¹¹
- Composition and abundance of benthic invertebrate fauna
- Composition, abundance and age structure of fish fauna

- Composition, abundance and age structure of phytoplankton
- Composition and abundance of benthic invertebrate fauna
- Composition and abundance of fish fauna

Hydromorphological elements supporting the biological elements

- Quantity and dynamics of water flow
- Connection to ground water bodies
- River continuity
- River depth and width variation
- Structure and substrate of the river bed
- Structure of the riparian zone

- Quantity and dynamics of water flow
- Residence time
- Connection to the ground water bodies
- Lake depth variation
- Quantity, structure and substrate of the lake bed
- Structure of the lake shore

Chemical and physicochemical elements supporting the biological elements

- Thermal conditions
- Oxygenation conditions

- Transparency
- Thermal conditions

How to use habitat awareness in RR

- Concentrate on restoring processes
 - Substrate size is important to the distribution of invertebrates & fish
 - How stable will the substrate be?
 - Will the inundation pattern be correct for the desired plants?
- Habitats should be appropriate
 - use reference sites
 - Increase ecological resistance and resilience to changes



R. Neb, Isle of Man

- Salmon & Sea Trout river, upland phase only!
- Deteriorating weir needed work
- Obstacle to passage
- Original re-build design rejected for rock ramp
- Landowner obligation for fish passage
- Resulted in
 - a significant cost saving (70%),
 - free passage for Salmon, Sea and Brown Trout,
 - incorporated a low flow channel,
 - habitat used by juvenile fish (1000+ salmon).







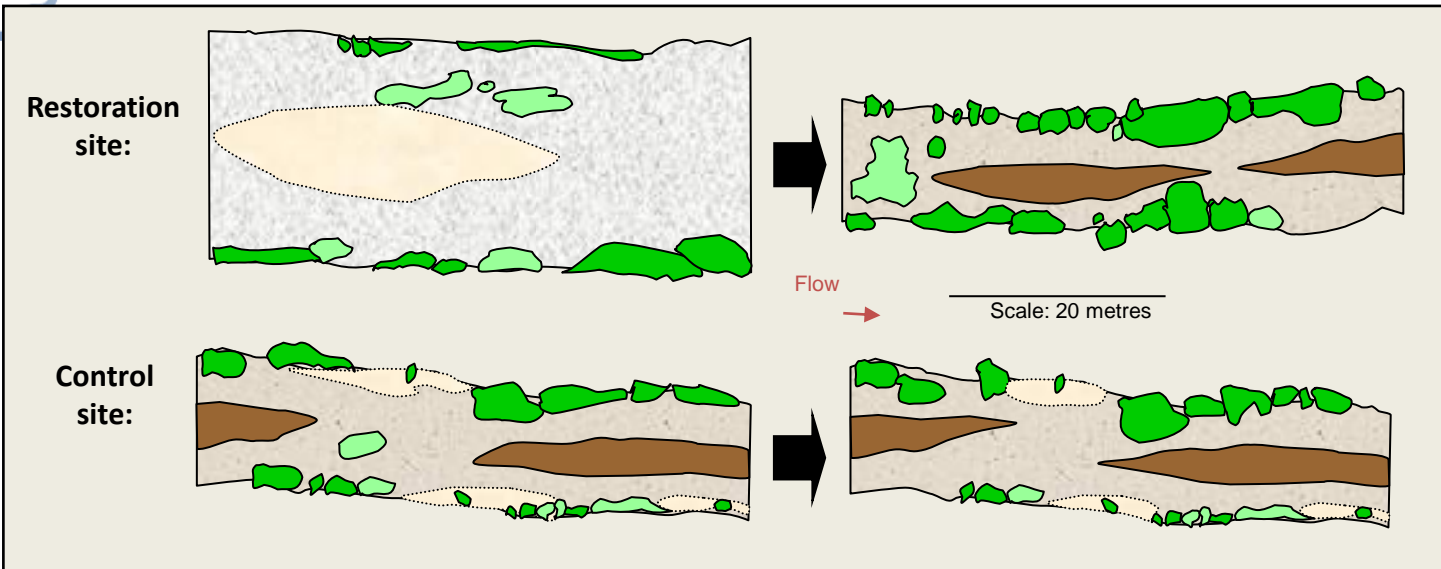




How to use habitat awareness in RR

- Concentrate on restoring processes
 - Substrate size is important to the distribution of invertebrates & fish
 - How stable will the substrate be?
 - Will the inundation pattern be correct for the desired plants?
- Habitats should be appropriate
 - use reference sites
 - Increase ecological resistance and resilience to changes
- Assess biota in relation to the habitat changes
- Important to monitor changes in relation to the reference/control site





Functional Habitat	Restored section		Control section	
	Before	After	Before	After
Emergent Vegetation				
Submerged Vegetation				
Fast Gravel				
Slow Gravel				
Sand				
Silt				

Functional Habitat:

Emergent vegetation

Submerged vegetation

Fast gravel

Slow gravel

Sand

Silt





Display Mode: ☒ PB select Biological quality element / (clear all)

☐ food/energy supply select impact variable / (clear all)

Type of relationship:

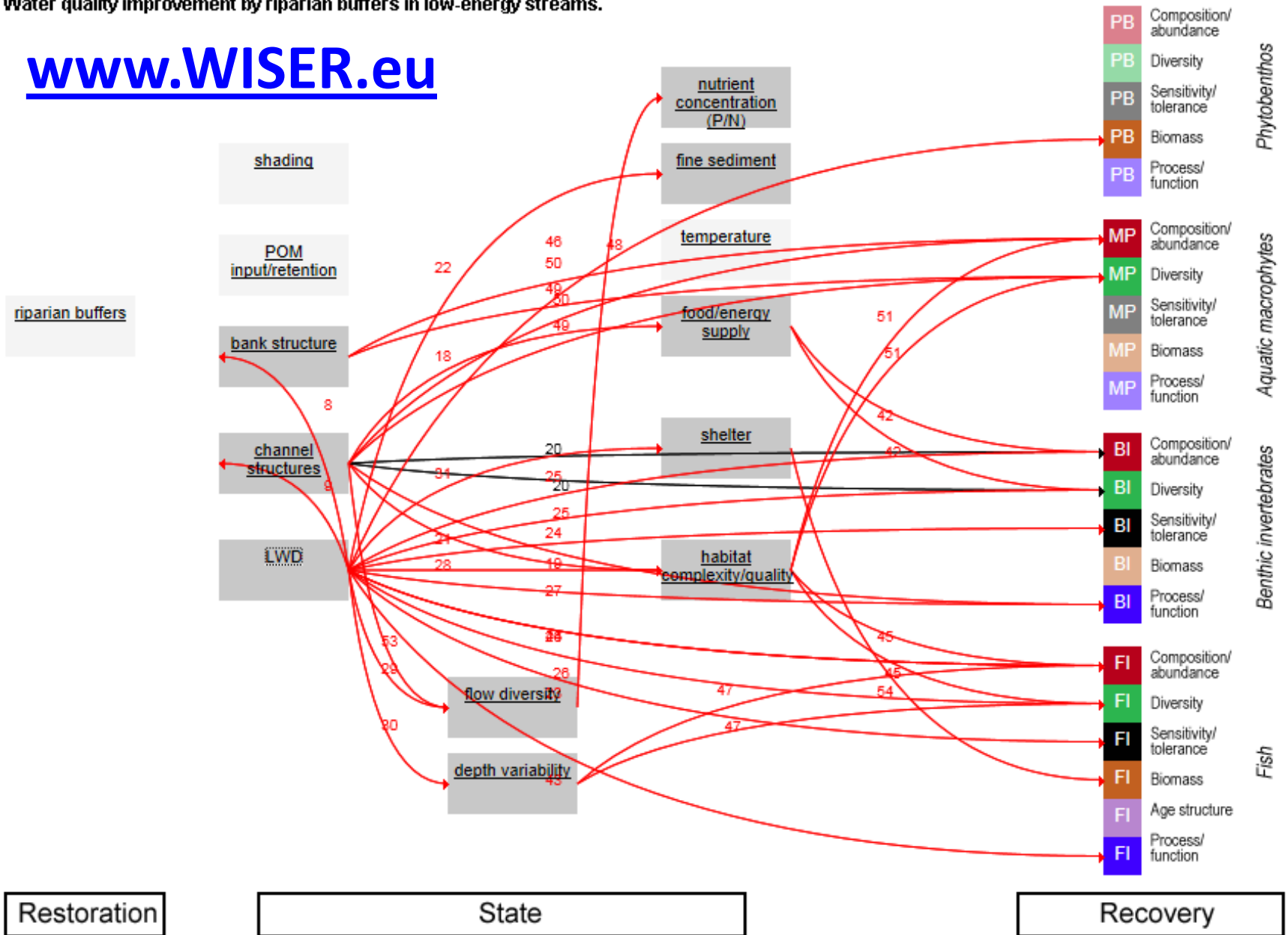
(number of reference listed below)

15 positive
15 indifferent
15 negative



Water quality improvement by riparian buffers in low-energy streams.

www.WISER.eu



Processes and functioning

“.....If natural hydrology and morphology are recreated, with careful consideration given to the hydraulic aspects, then there is every possibility that natural ecological recovery will follow....”

Brookes, A. and Shields, F.D. (1996)

Resulting in diverse riverine habitat...













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But other factors can affect ecological recovery

- Poorly specified aims & objectives
- Water quality
 - inhibit biota richness & diversity
- Processes of colonisation
 - source, ability, succession
- Alien species ???
- Wider issues
 - Habitat fragmentation
 - Climate change
 - Evidence availability
 - Quantifying changes





Discuss.....

