22e Entretiens du Centre Jacques Cartier - Lyon, France
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La connectivité latérale, un facteur de contrôle des processus écosystémiques et de la biodiversité des corridors fluviaux

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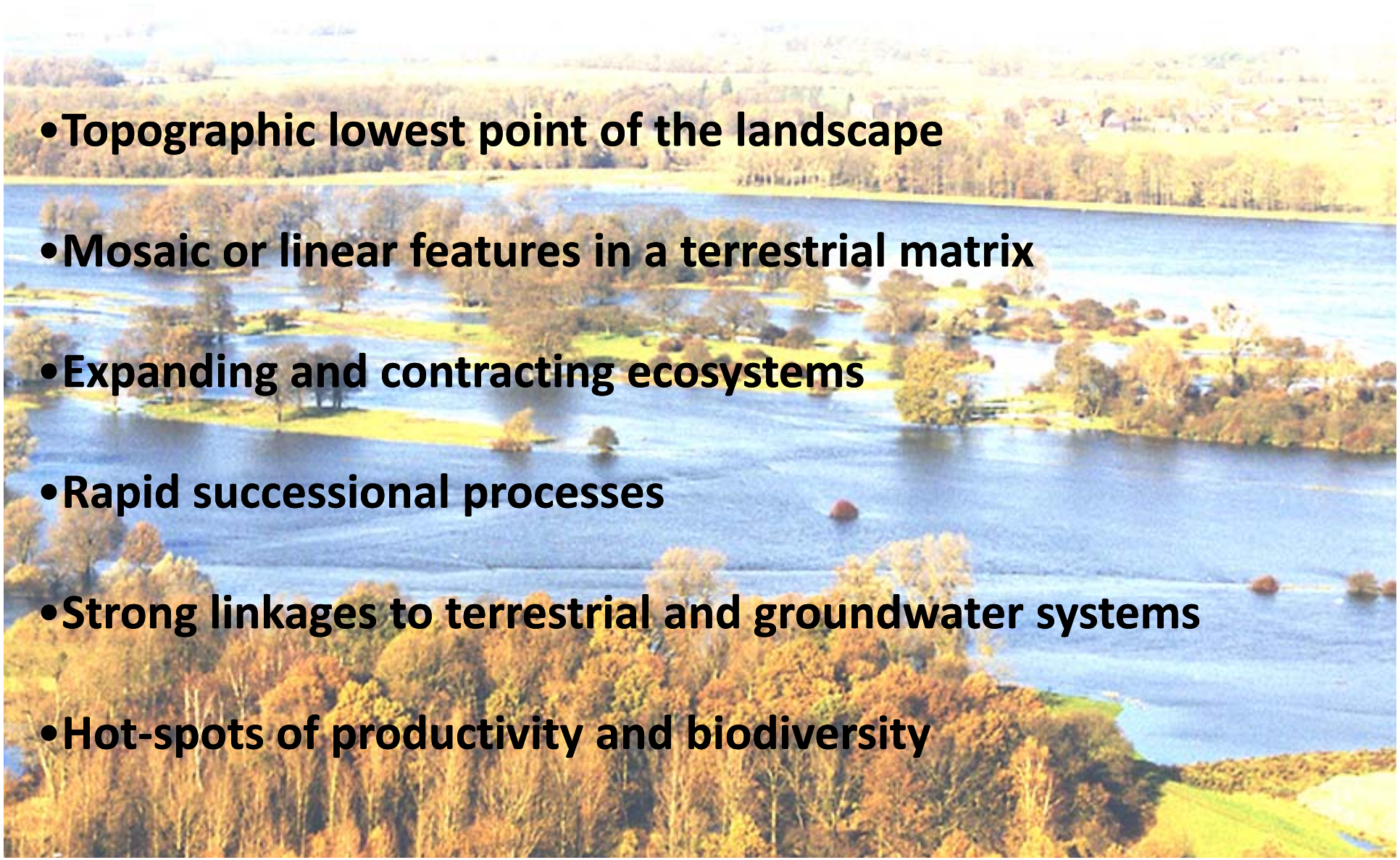
(Elbe River during flooding. Photo: Schwartz)

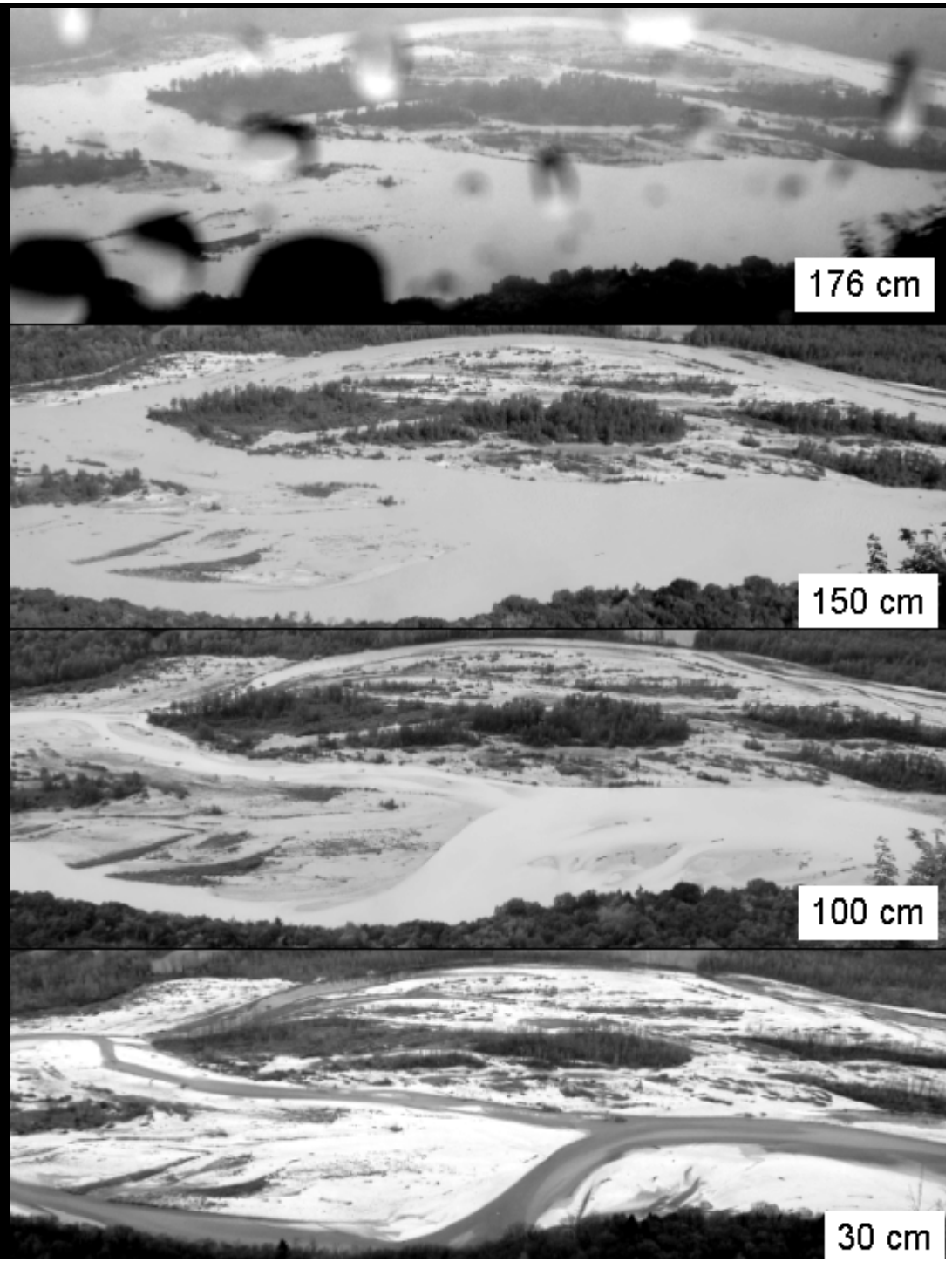
Unique Ecosystems



- Topographic lowest point of the landscape
- Mosaic or linear features in a terrestrial matrix
- Expanding and contracting ecosystems
- Rapid successional processes
- Strong linkages to terrestrial and groundwater systems
- Hot-spots of productivity and biodiversity

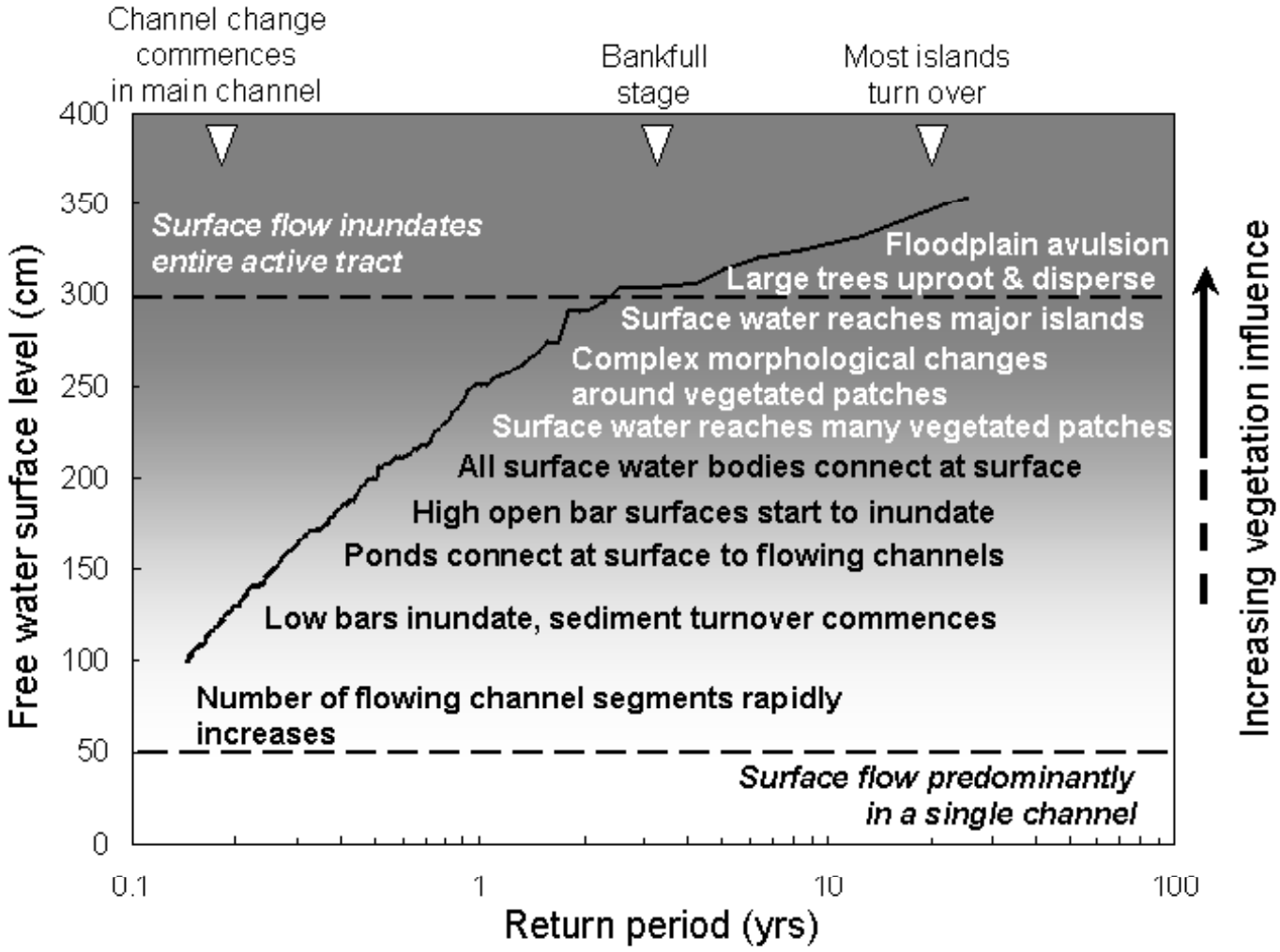
Pulsed ecosystems:

Spatio-temporal dynamics of linked aquatic-terrestrial landscapes



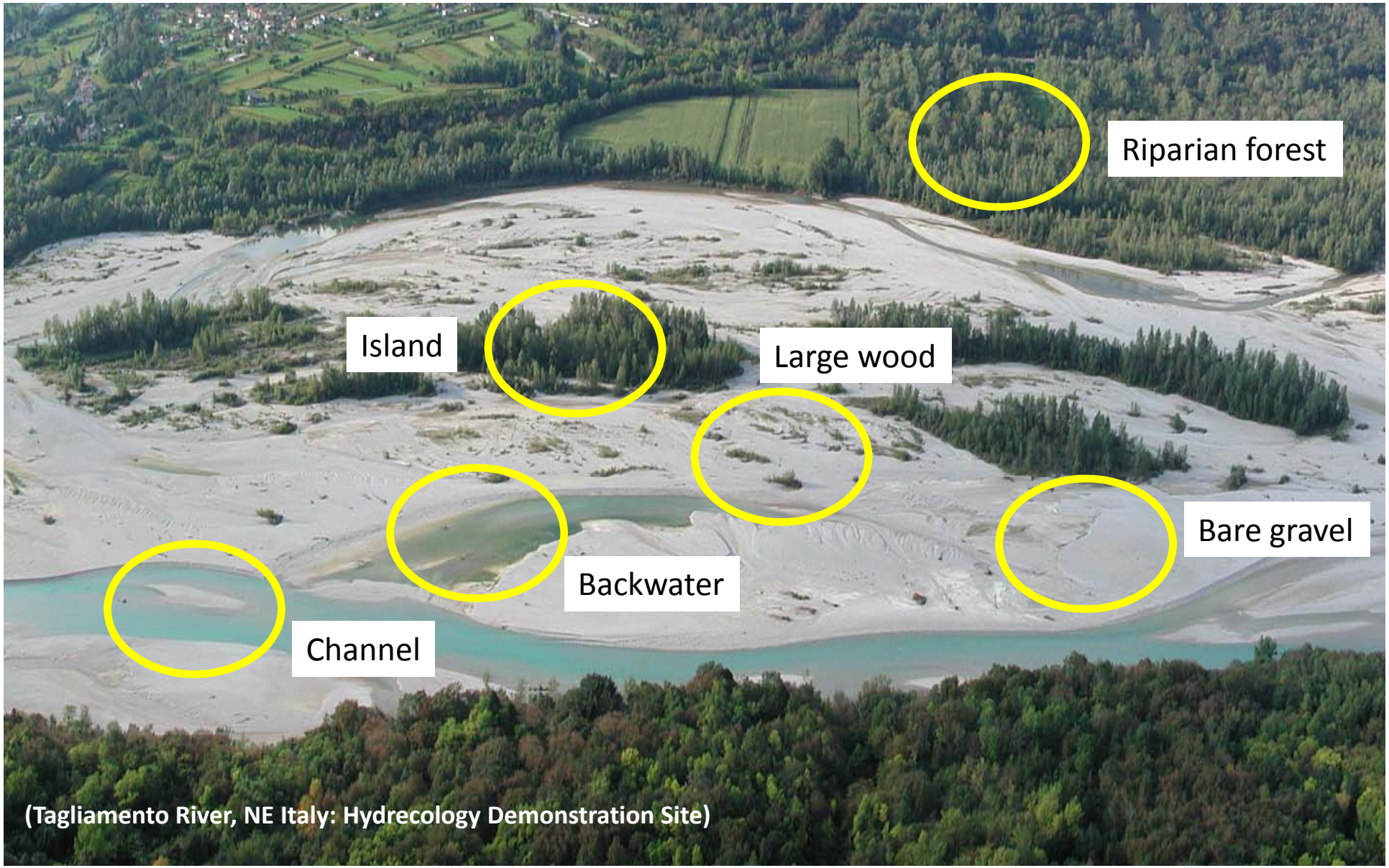
(Photos: Bertoldi *et al*. RRA. 2009)

Hydrogeomorphic tresholds in riverine floodplains



(Bertoldi *et al*. 2009. RRA)

Floodplains as habitat mosaics




Structure meets
function

Habitat-specific sediment respiration rates (Tagliamento)

Habitat Type	**Respiration** ($g\ C\ m^{-2}\ yr^{-1}$)
Pond	162
Channel	212
Gravel	142
Large Wood	503
Vegatated Island	1138
Riparian Forest	994
Floodplain* (t C yr^{-1})	**863**

*** Total Area: 1.83 km^2**

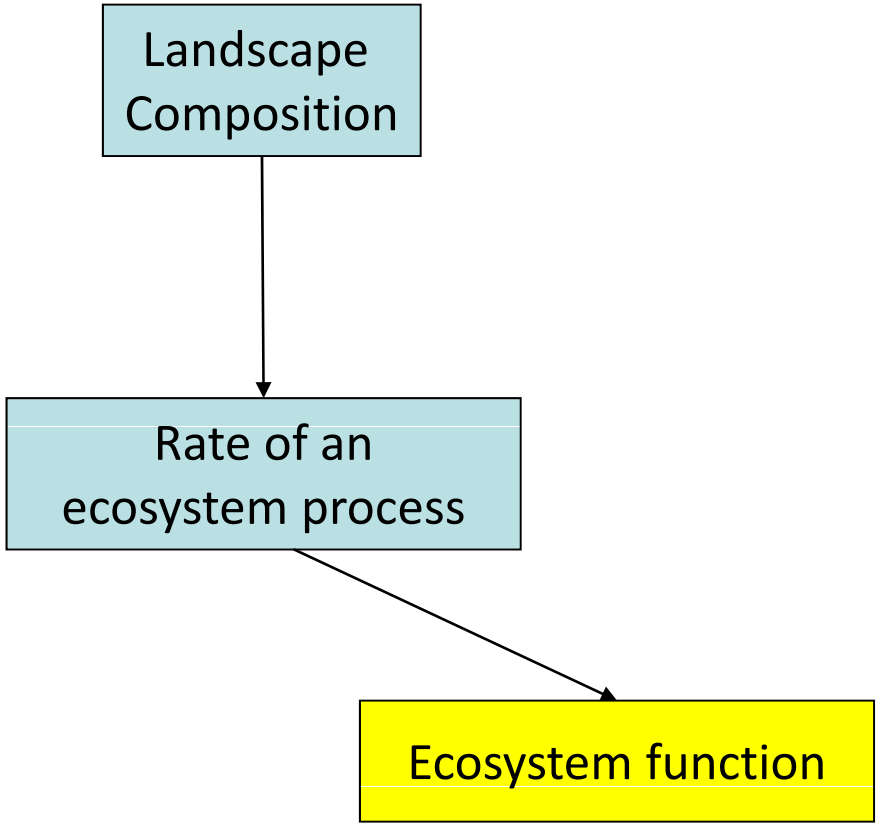
Sensitivity of sediment respiration to environmental change

Habitat Type	**Respiration** ($g\ C\ m^{-2}\ yr^{-1}$)	**+2°C**
Pond	162	**+06%**
Channel	212	**+08%**
Gravel	142	**+14%**
Large Wood	503	**+20%**
Vegatated Island	1138	**+14%**
Riparian Forest	994	**+31%**
Floodplain* ($t\ C\ yr^{-1}$)	**863**	**+20%**

*** Total Area: 1.83 km^2**

(Doering *et al*. Ecosystems. in revision)

Impact of habitat composition on ecosystem function



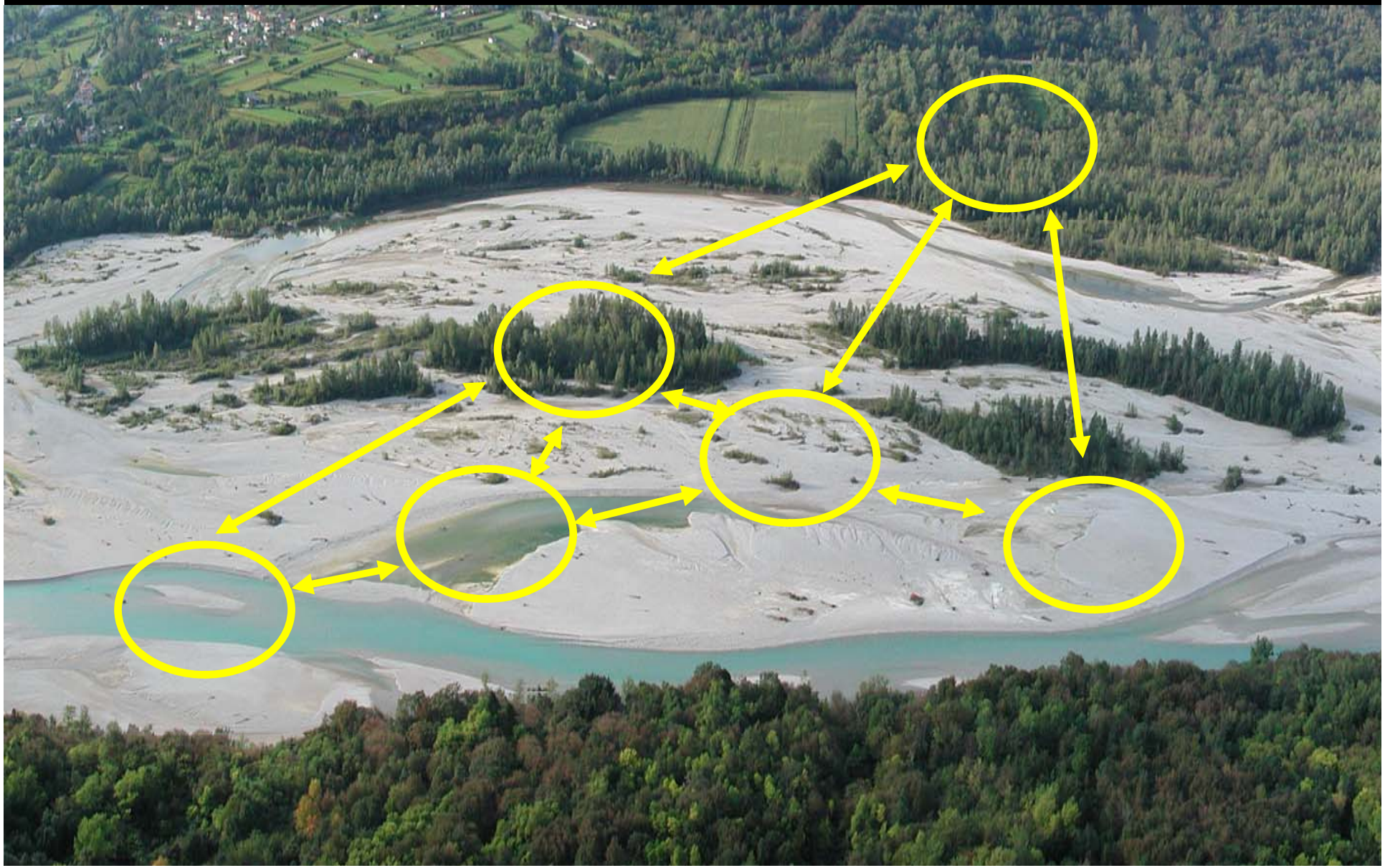
Functional performance of individual habitat types

Habitat	FPOM* ($g\ kg^{-1}$)	Respiration ($g\ C\ m^{-2}\ yr^{-1}$)	CPOM* ($g\ m^{-2}$)	Decomp. (k-value)	DOC Leach. ($mg\ l^{-1}$, 25°C)
Rip. forest	40.9	982	425	-0.0019	4.5
Island	23.3	1205	285	-0.0023	4.1
Large wood	19.3	624	60	-0.0019	2.1
Gravel	6.5	168	6	-0.0020	0.9
Pond	6.6	160	17	-0.0053	0.8
Channel	6.3	292	12	-0.0230	0.3

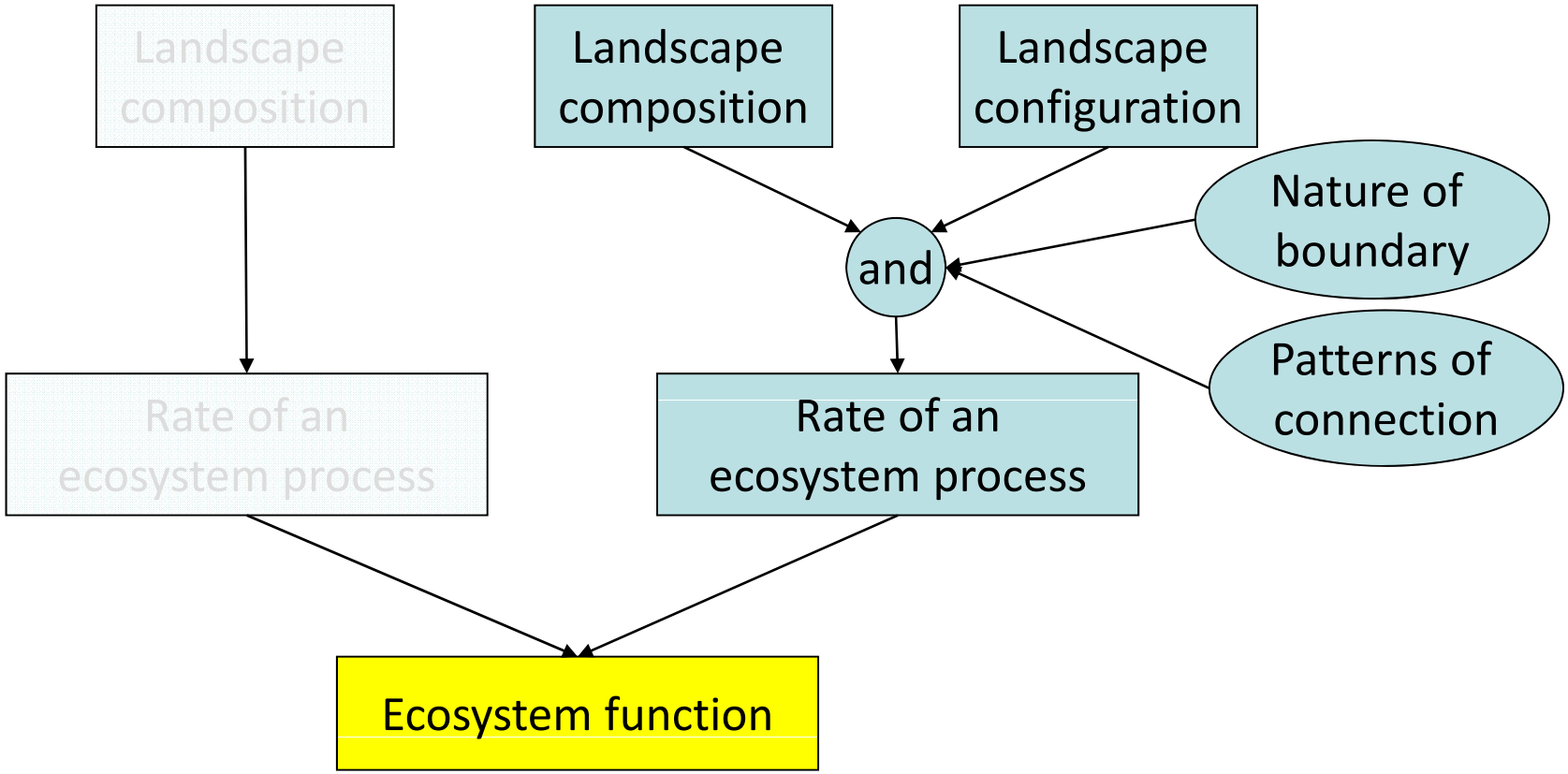
* CPOM > 1mm > FPOM

(Tockner *et al*. 2010)

Floodplains as interacting habitat mosaics



Impact of habitat composition, configuration, and connectivity on ecosystem function



(adapted from Lovett *et al*. 2005)

Hypotheses

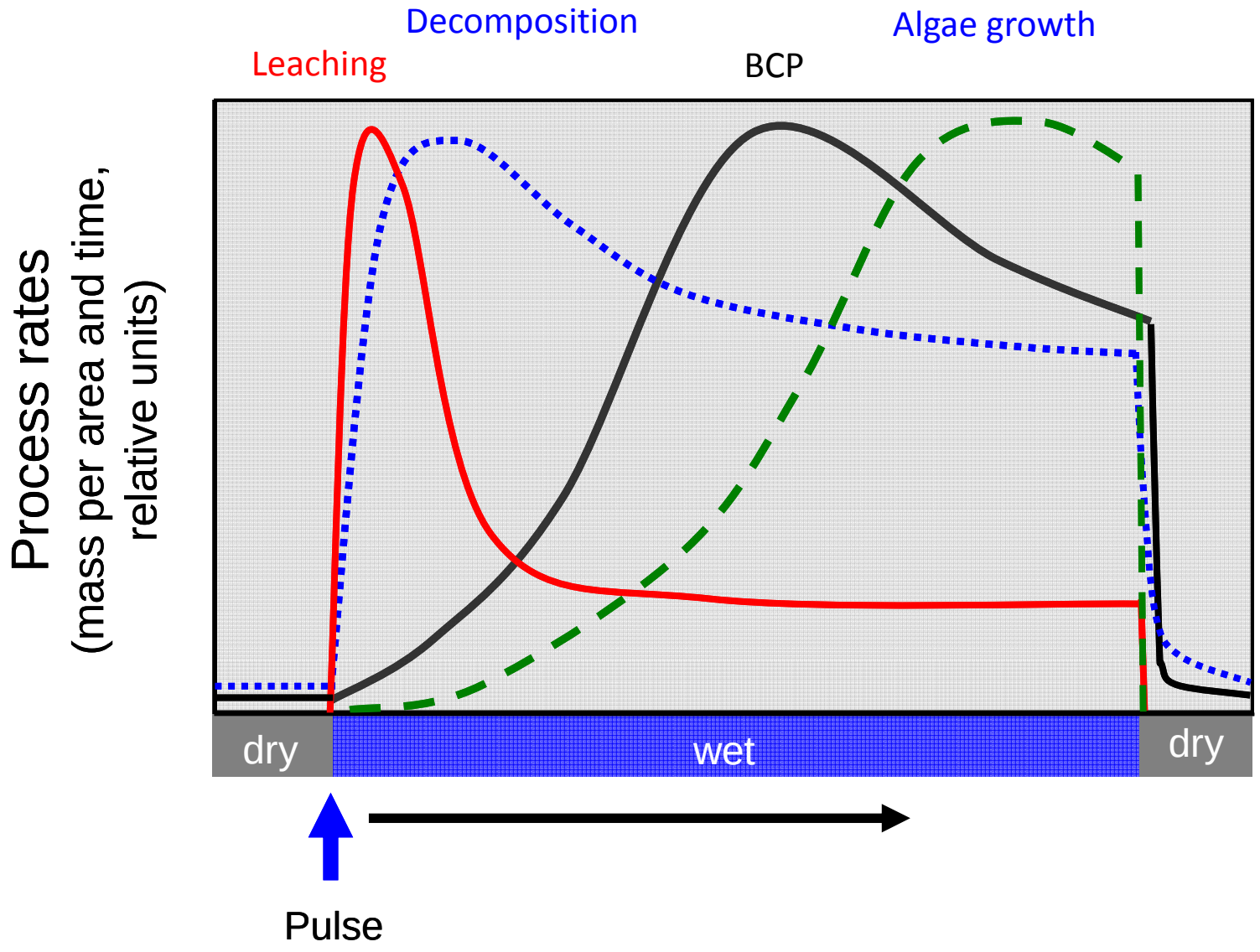
Some habitat types, even if small in absolute area, contribute disproportionately to predicting whole ecosystem transformative capacity

Juxtaposition of particular cover habitats alters at least magnitude and maybe even the direction of change in solute concentration

The importance of fine-scale spatial structure will vary across response variables

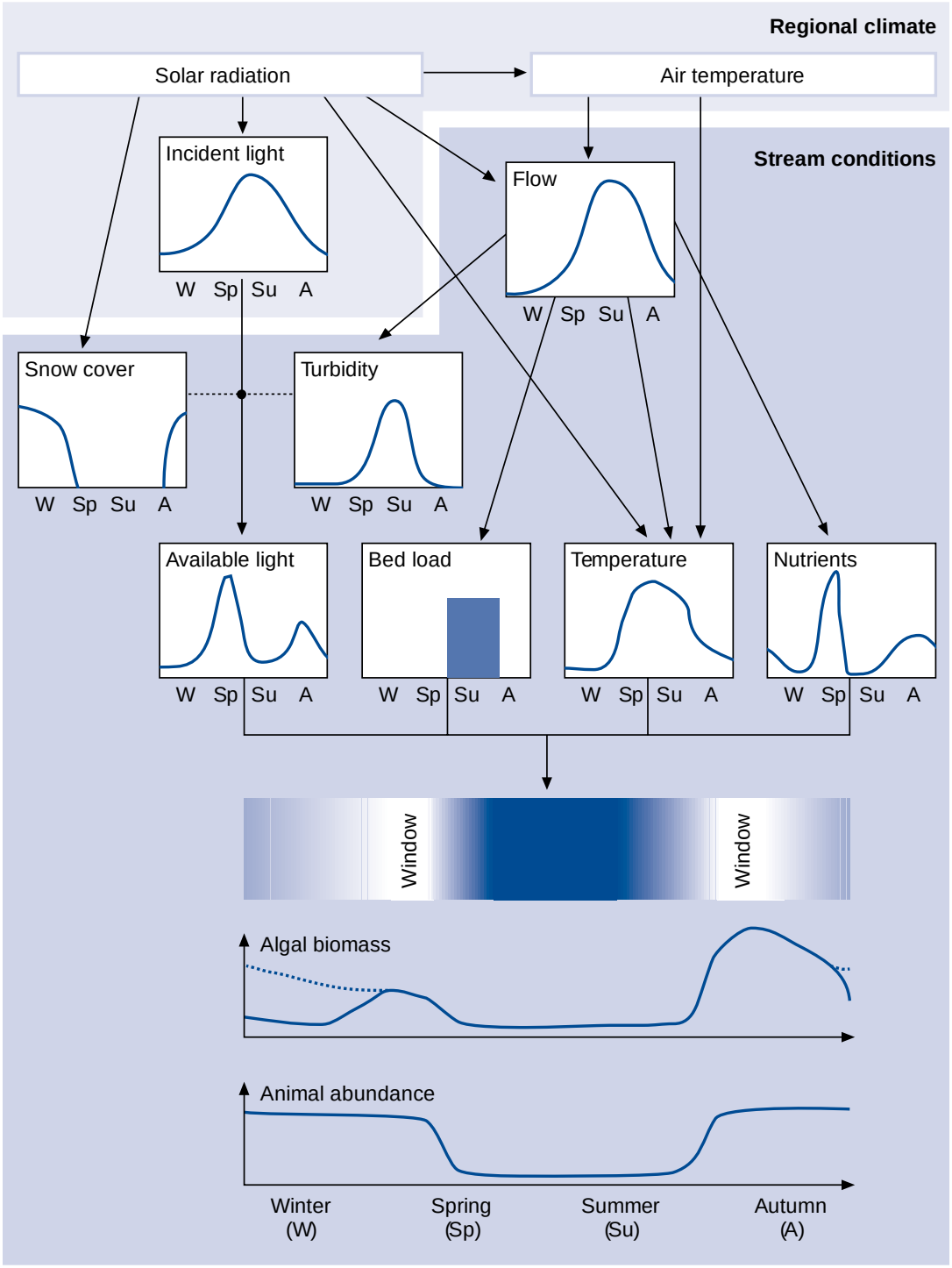

(Tagliamento River, NE Italy:
Hydroecology Demonstration Site)

Response of ecosystem processes to resource pulses (Tockner *et al.* 2010)



Interacting pulses in dynamic floodplains create:

Windows of ecological opportunity

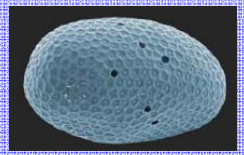


(Uehlinger, Tockner & Malard 2003; Tockner *et al*. 2010)

Linked ecosystems: Concave and convex islands

(*sensu* Karaus, Alder & Tockner. 2005. Wetlands)

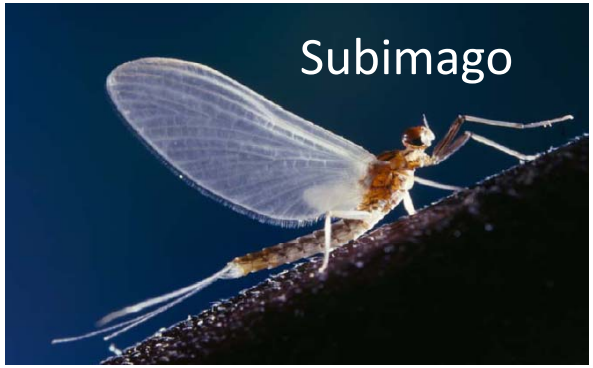
Larvae

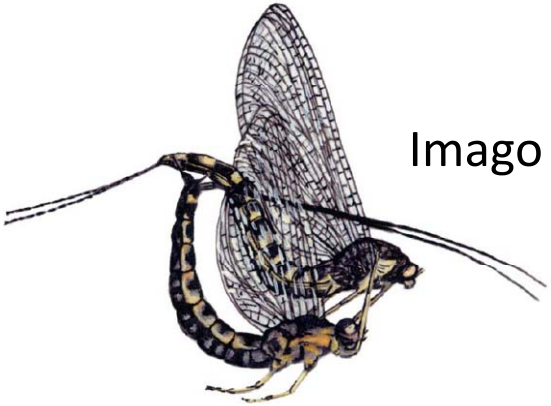


Egg

Water

Few days



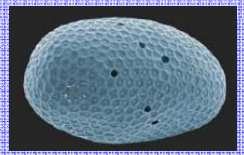


Imago

Land/Air

Several months

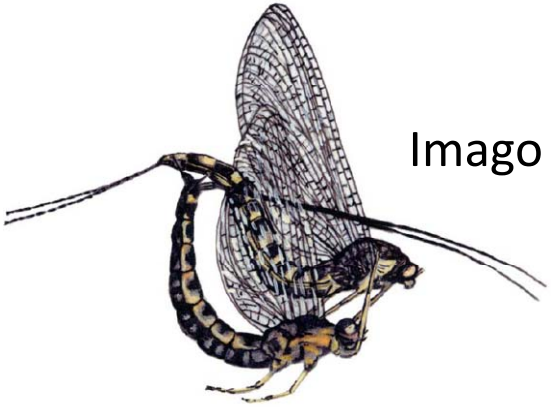
Larvae



Egg

Water

Emergence
Dispersal
Mating
Oviposition

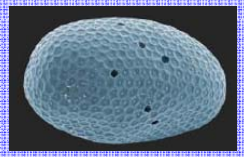


Imago

Land/Air

Growth

Larvae



Egg

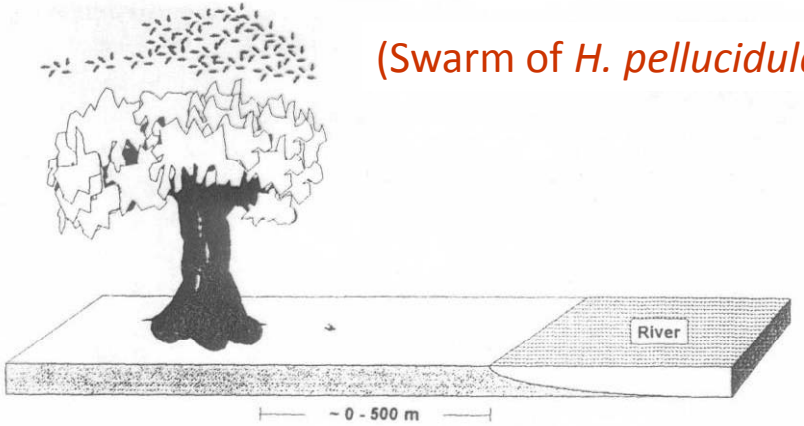
Water

Tisza River: *Palingenia longicauda*

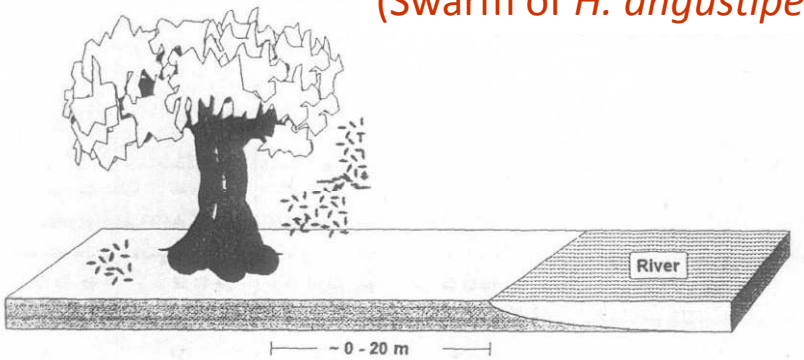
(Photo: C. Elpers)

Comparision of the swarming behaviour of three *Hydropsyche* species

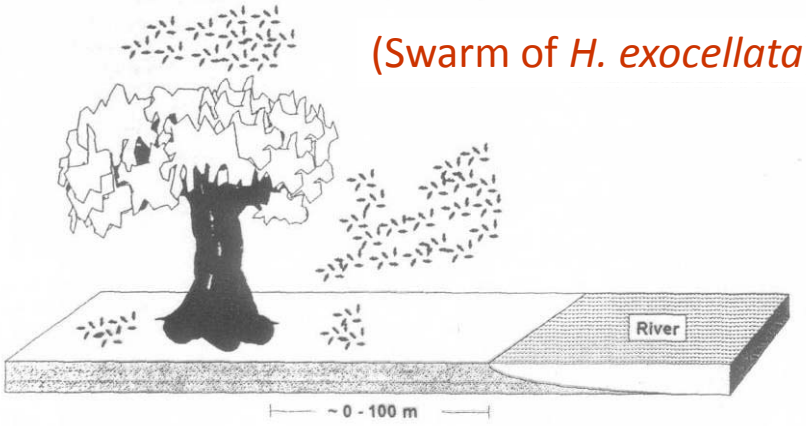
(Swarm of *H. pellucidula*)



(Swarm of *H. angustipennis*)

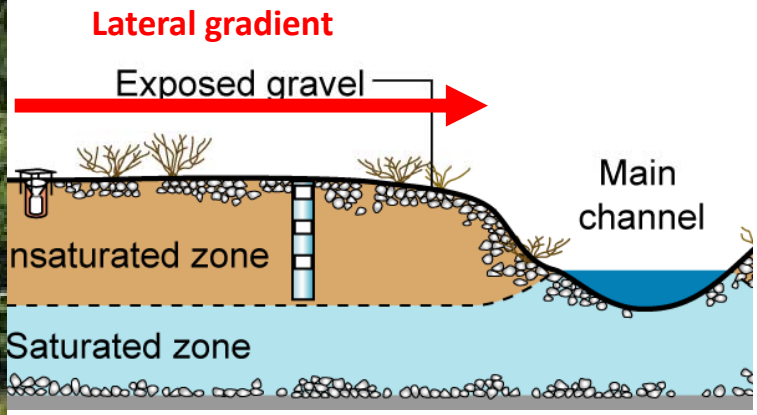


(Swarm of *H. exocellata*)



(Engels *et al.* 1996)

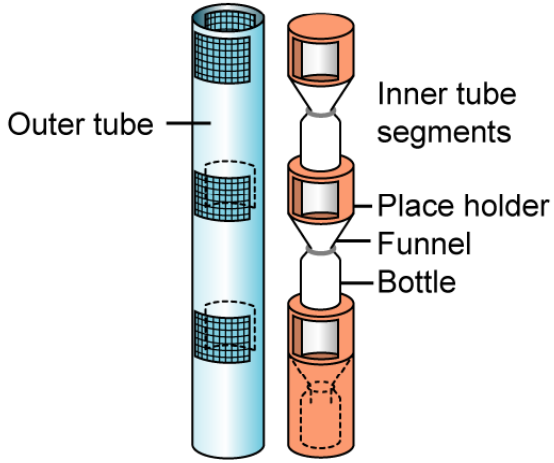
Floodplains: Multiple interactive layers



e

Sedimentscape

unnel
ottle
uter tube



(after Langhans & Tockner. In prep.)

Conceptual model of the airscape along a river corridor

Primary air flow:

down valley (cold)

up valley (warm)

uniderectional primary flows can be formed by diurnal meteorological cycles

Secondary flow:

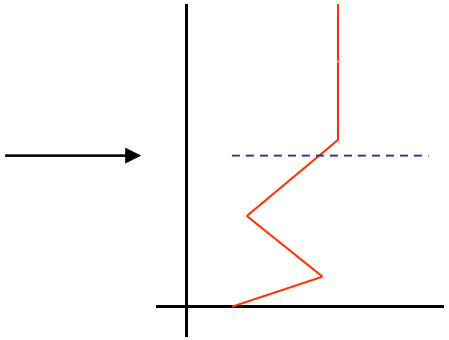
up slope (warm)

down slope (cold)

secondary flows can develop because of

Micro-structure of air flow:

effects of complex roughness distri-bution (water, se-diments, vegetation)



complex internal boundary layers, wakes, and mixing layers

Summary - Challenges

Challege I: To effectively link hydrogeomorphic and ecological processes, and the relevant feedback processes

Challenge II: Interaction of various pulses (e.g. flow, sediment, thermal, resource etc. pulses), and transfer of pulses across aquatic-terrestrial boundaries?

Challenge III: Hierarchical organization of biodiversity (genes, species, habitats, processes)

Challenge IV: Integration of the airscape, and its exploitation by organisms with complex life cycle?

Large Rivers are among the most threatened ecosystems globally

A European „super-catchment“ – facilitating the establishment of novel communities

Thank You for Your Attention

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