

How to reach the goals of the Water Framework Directive? The role of time and riparian land use

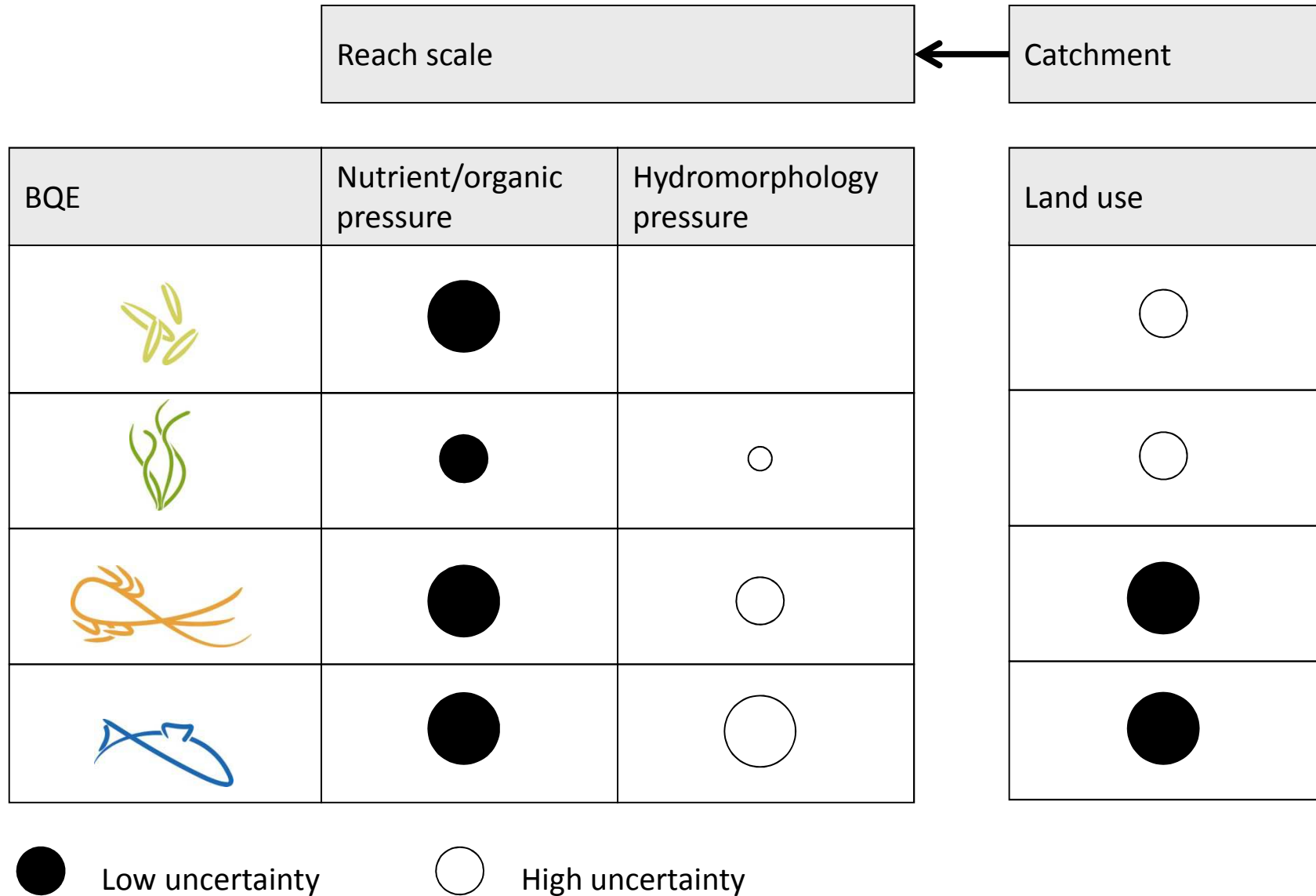
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The WFD is based on several assumptions

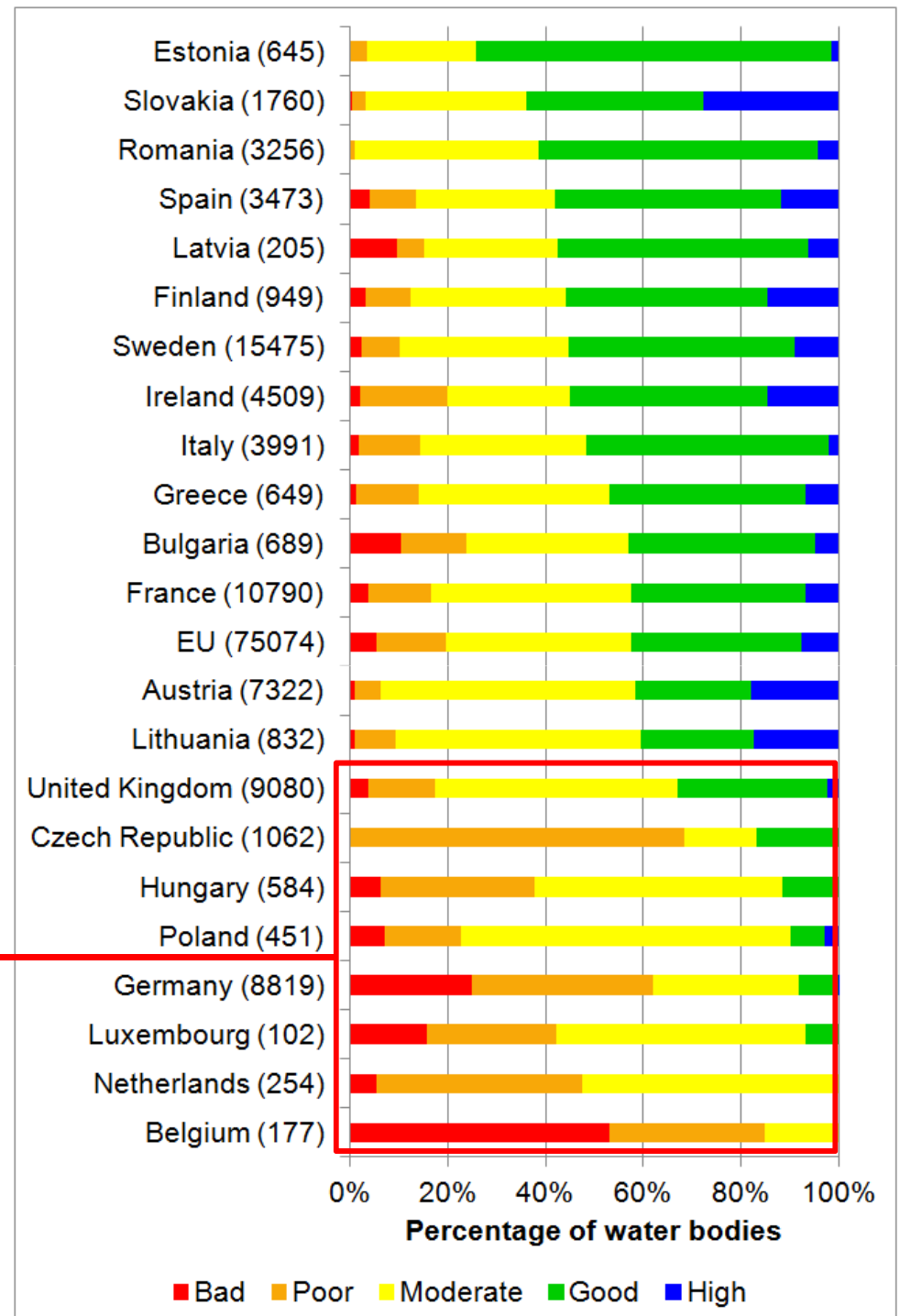
- Aquatic organism groups reflect intensity of various (known and unknown) stressors
- Aquatic organism groups respond similarly strong to degradation and to restoration
- Restoration requires the catchment scale

Response of organisms to stress in rivers



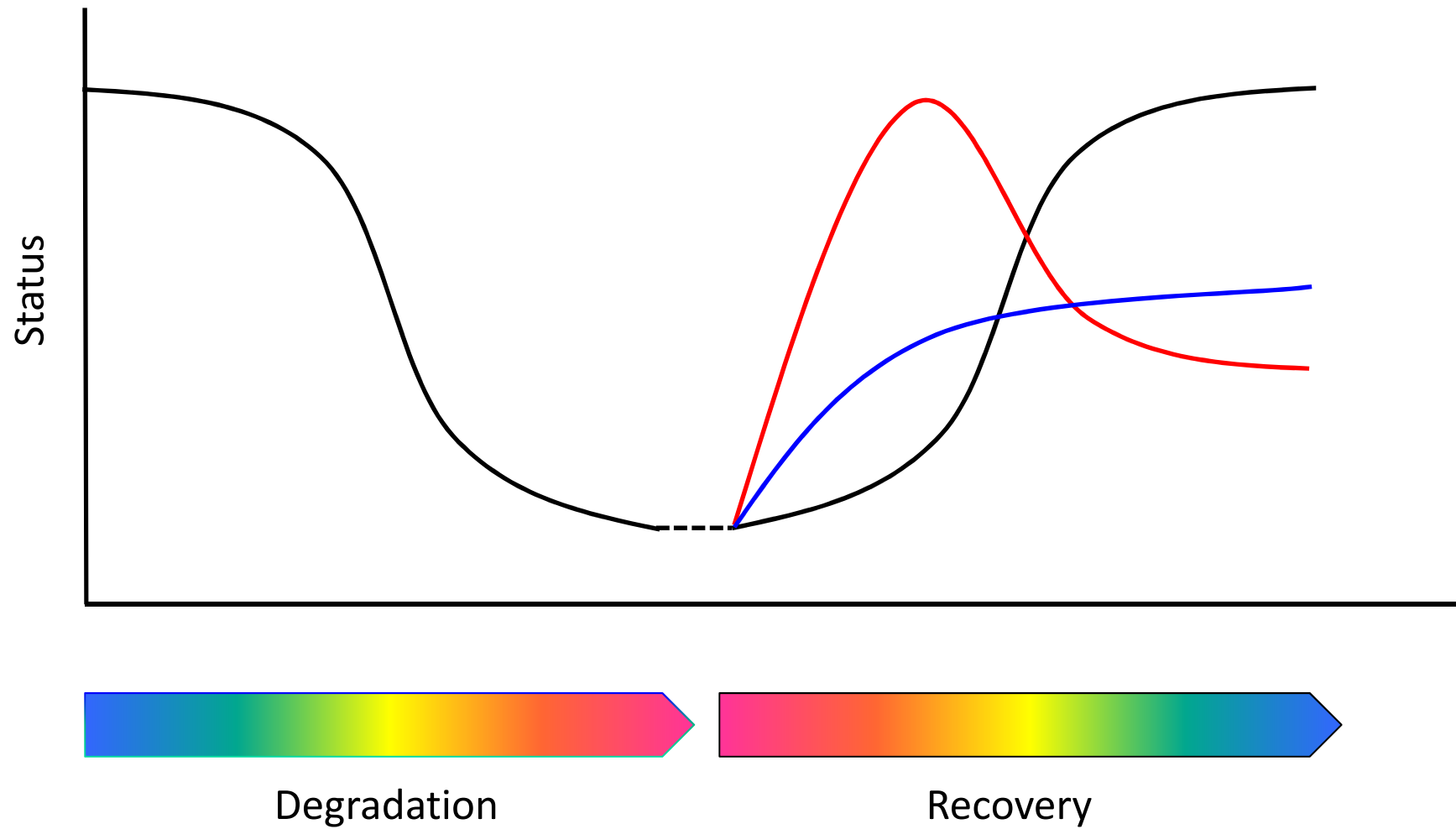
Ecological status of European rivers

Outcome of the precautionary principle ("one out-all out")



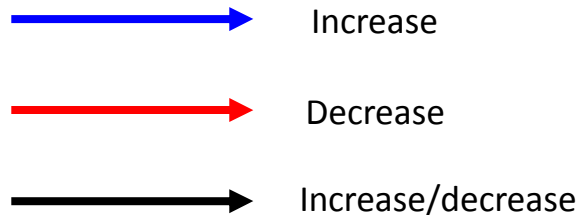
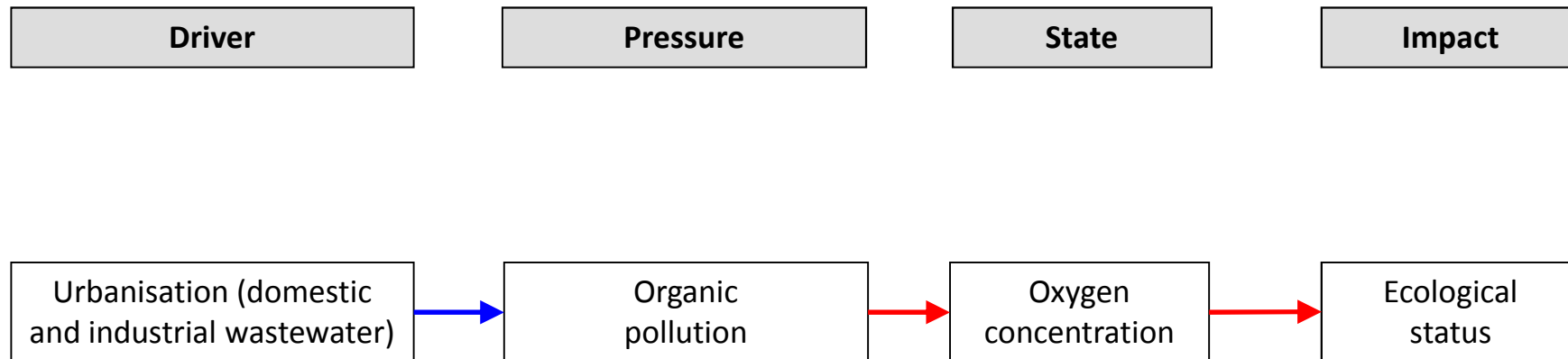
Source: EEA Report No 8/2012

Degradation and recovery

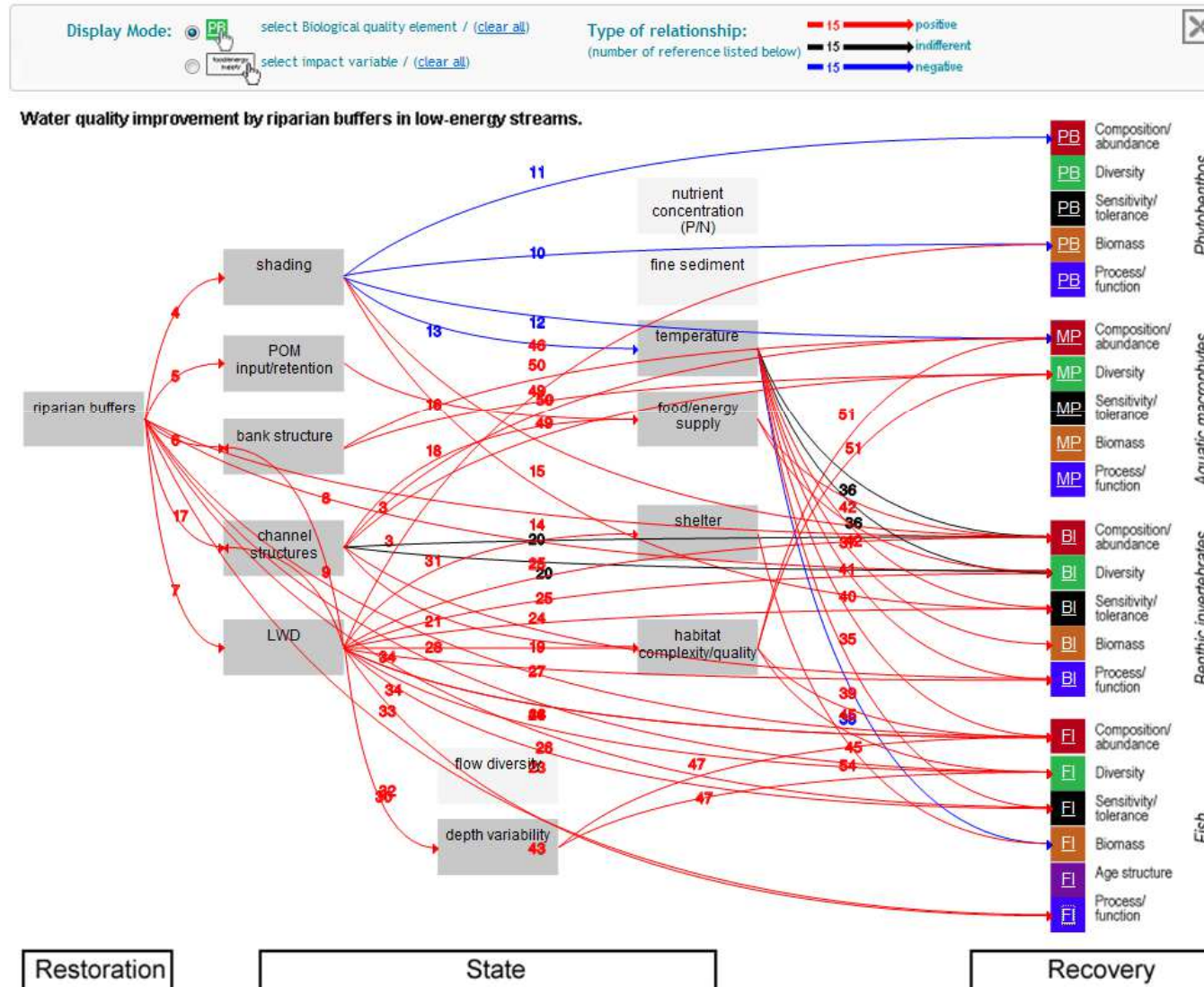


Restoration concepts in simple cases:

Reducing organic load and ecological status



Restoration concepts in complex cases: Hydromorphological restoration



Conclusions on restoration needs

- Effects of stress on rivers and lakes well documented
- Huge – often discouraging – needs for restoration
- Less is known on restoration effects, particularly in complex multi-stress situations

Lahn: degraded



Lahn: restored



Gartroper Mühlenbach: degraded



Gartroper Mühlenbach: restored



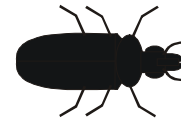
Monitoring of hydromorphological restoration



← comparison →



hydromorphology



ground beetles



fish



floodplain
vegetation



benthic invertebrates

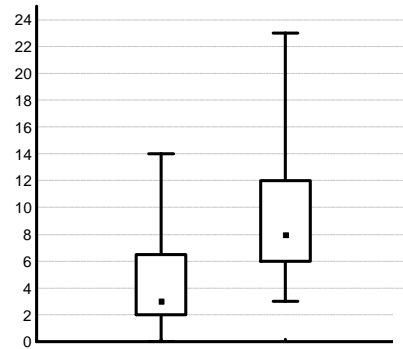


aquatic macrophytes

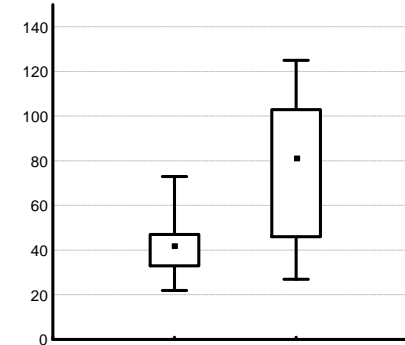
Restored vs. non-restored reaches



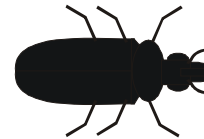
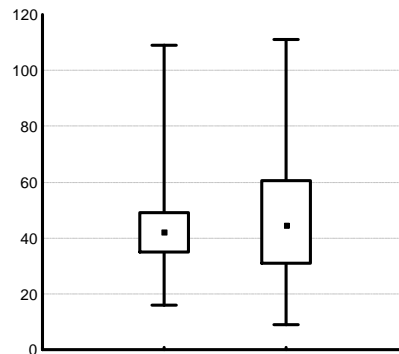
$p < 0.01$



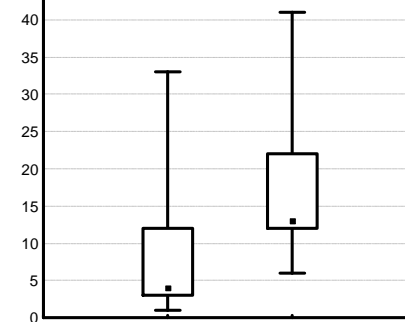
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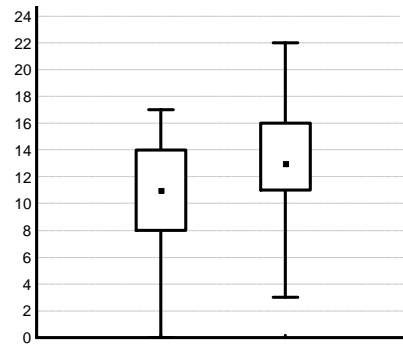
n.s.













$p < 0.01$



$p < 0.01$



Ranking of stressors affecting ecological status

	Area	River size	Variable 1	Variable 2	Variable 3
	Mountain	Small	catchment / riparian land use	catchment / riparian land use	site scale, hydromorphology
	Mountain	Medium	catchment / riparian land use	site scale, physico-chemistry	catchment / riparian land use
	Mountain	All	catchment / riparian land use	catchment / riparian land use	site scale, physico-chemistry
	Lowland	Small	catchment / riparian land use	catchment / riparian land use	site scale, physico-chemistry
	Lowland	Medium	site scale, physico-chemistry	catchment / riparian land use	catchment / riparian land use
	Lowland	All	catchment / riparian land use	catchment / riparian land use	site scale, physico-chemistry
	Mountain	Small	catchment / riparian land use	catchment / riparian land use	site scale, physico-chemistry
	Lowland	Medium	catchment / riparian land use	catchment / riparian land use	site scale, physico-chemistry
	Mountain	Small	catchment / riparian land use	site scale, physico-chemistry	site scale, physico-chemistry
	Lowland	Medium	catchment / riparian land use	site scale, physico-chemistry	site scale, physico-chemistry

Monitoring data of about 6,000 sampling sites in Germany. Multiple regression and BRTs.



teal: site scale, physico-chemistry
 yellow: site scale, hydromorphology
 light green: catchment / riparian land use

The scientists perspective

- Local restoration measures have often been successful (for restoring habitats, fish fauna, floodplains)
 - Biotic recovery takes time
 - Biota are primarily ruled by parameters acting at the reach or catchment levels
- Catchment-scale measures are required

What we hear from water managers

- Great need to improve ecological status
- Only local measure feasible, but they have – apparently – limited effects on status
- Even these limited effects are not documented in the maps of ecological quality
- Catchment-scale measures are purely an illusion

Questions

- What can be done at the catchment level to supplement local measures?

Water temperature and riparian vegetation



Logger



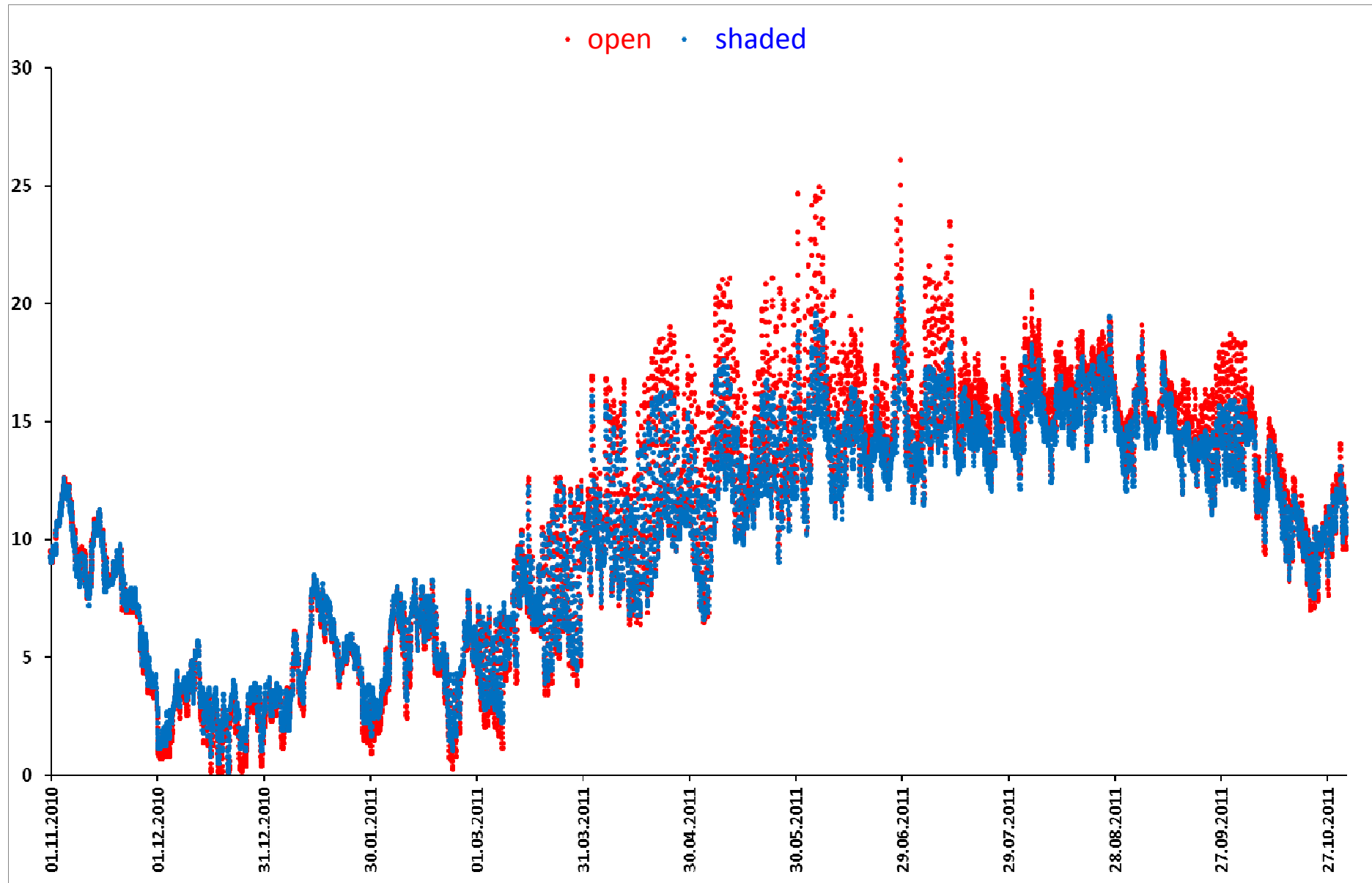
Logger



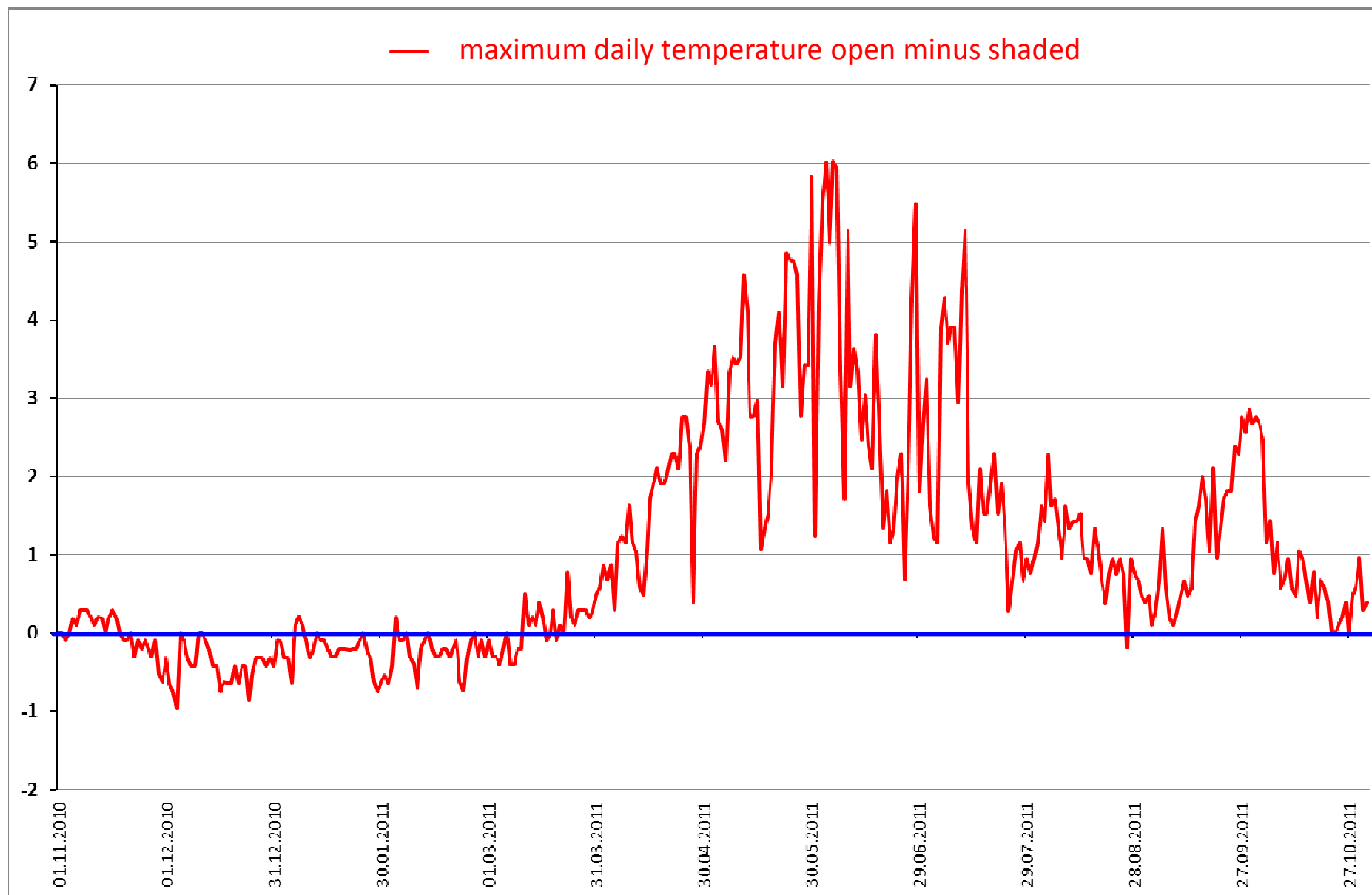
Direction of flow

2000 m

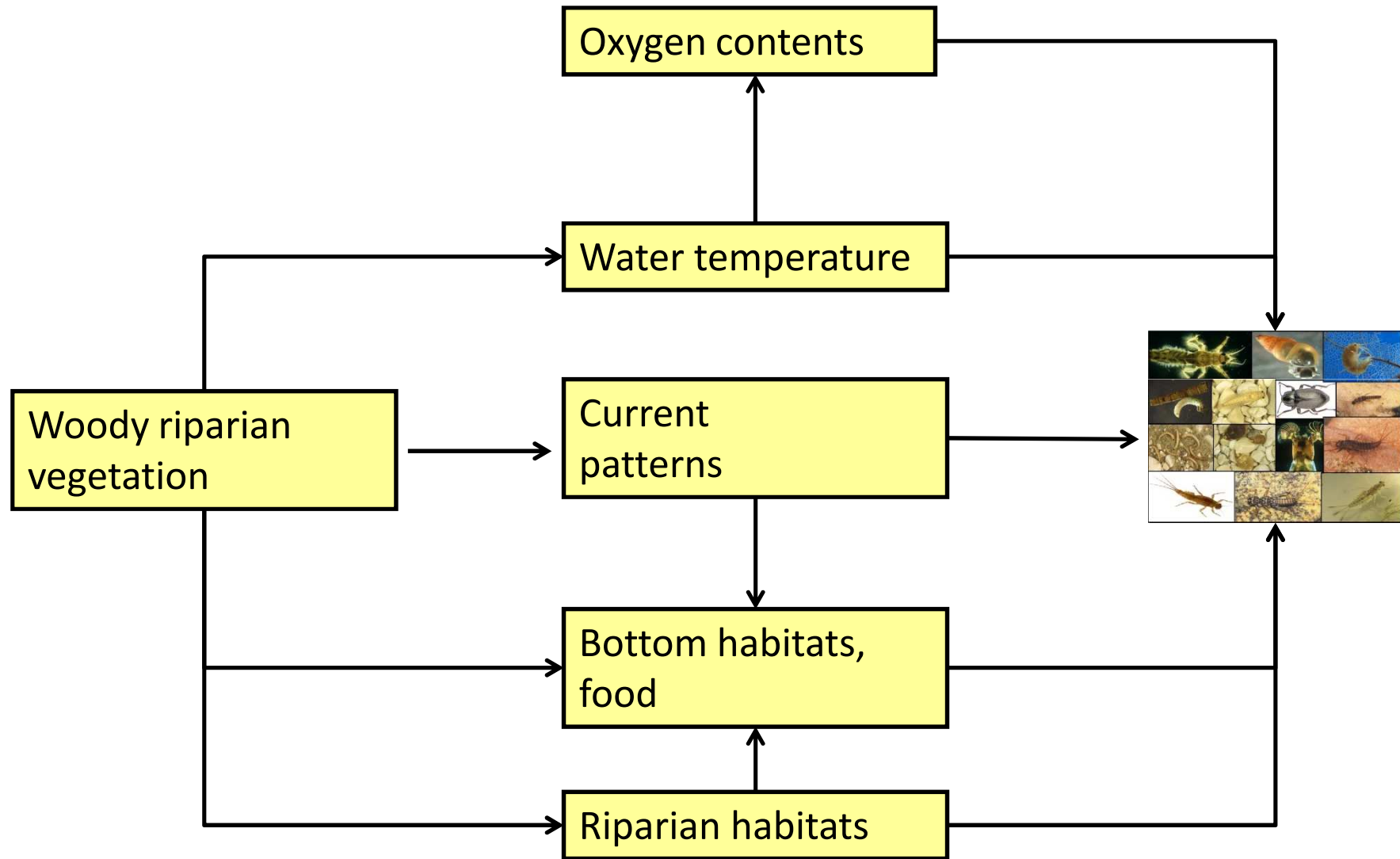
Hourly measurements



Difference in maximum daily temperature



Effects of riparian vegetation



Vision

- Extensive local measures (re-braiding, remeandering...) where feasible – to build hotspots in ecological quality
- (Probably more important: Protect and extend the still existing hotspots)
- Supplement the local extensive measures by simple inexpensive measures at the catchment scale: riparian buffers with various widths
- We need to realize:
 - It will take time (much longer than 2027)
 - It means to struggle with agriculture

Agro-environmental measures in reality

- Receiving subsidies but doing nothing
 - Placing roads along the streams as pesticides are not allowed any longer
- Agro-environmental measures are confounded by cobra effects
- The term cobra effect stems from an anecdote set at the time of British rule of colonial India. The British government was concerned about the number of venomous cobra snakes in Delhi. The government therefore offered a reward for every dead cobra. Initially this was a successful strategy as large numbers of snakes were killed for the reward. Eventually, however, enterprising persons began to breed cobras for the income. When the government became aware of this, the reward program was scrapped, causing the cobra breeders to set the now-worthless snakes free. As a result, the wild cobra population further increased. The apparent solution for the problem made the situation even worse (quoted from wikipedia).