WFD BQEs AND THE ABILITY TO DETECT HYMO STRESS

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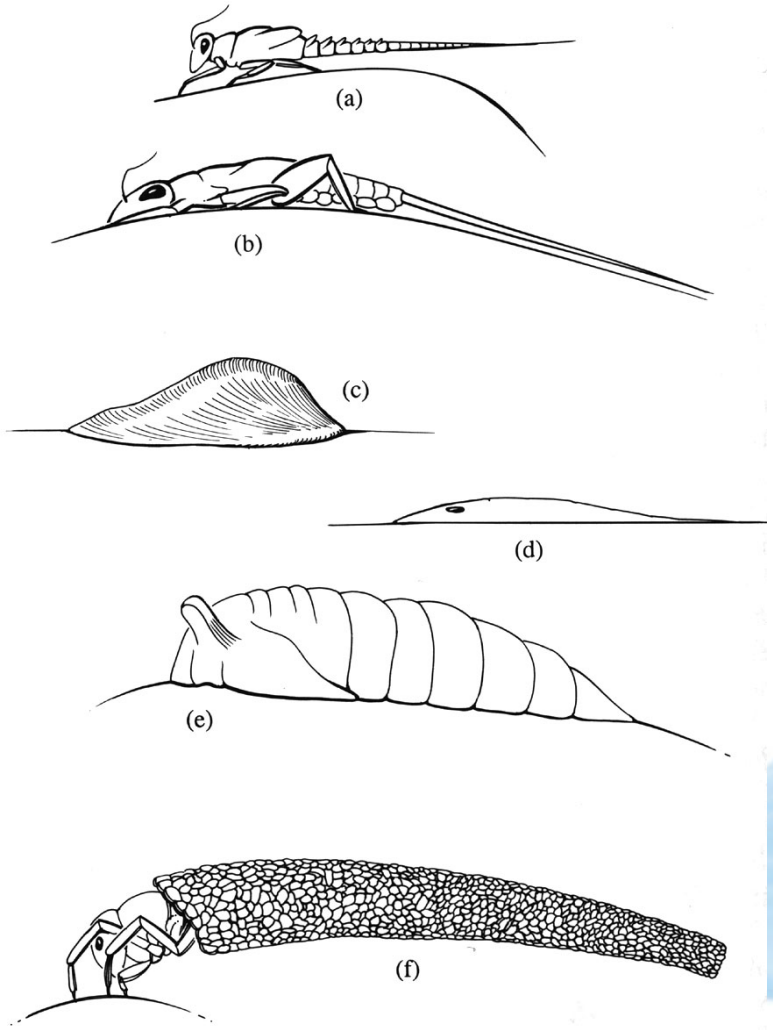
Outline

- Drivers of community composition in rivers
- Sensitivity of biomonitoring metrics towards HYMO change
- Interaction between HYMO and other stressors
- The influence of confounding variables in assessing effects of HYMO degradation
- Ways to assess HYMO degradation

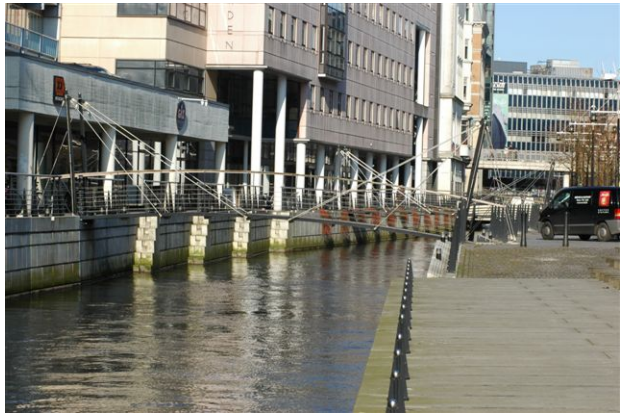
Highly dynamic



Alarming loss of biodiversity

- Freshwater habitats cover less than 1 % of Earth surface area, but contain about 10 % of all known species
- At the same time, freshwater biodiversity has declined more than in other any other ecosystems in the world

HYdroMOrphological stress

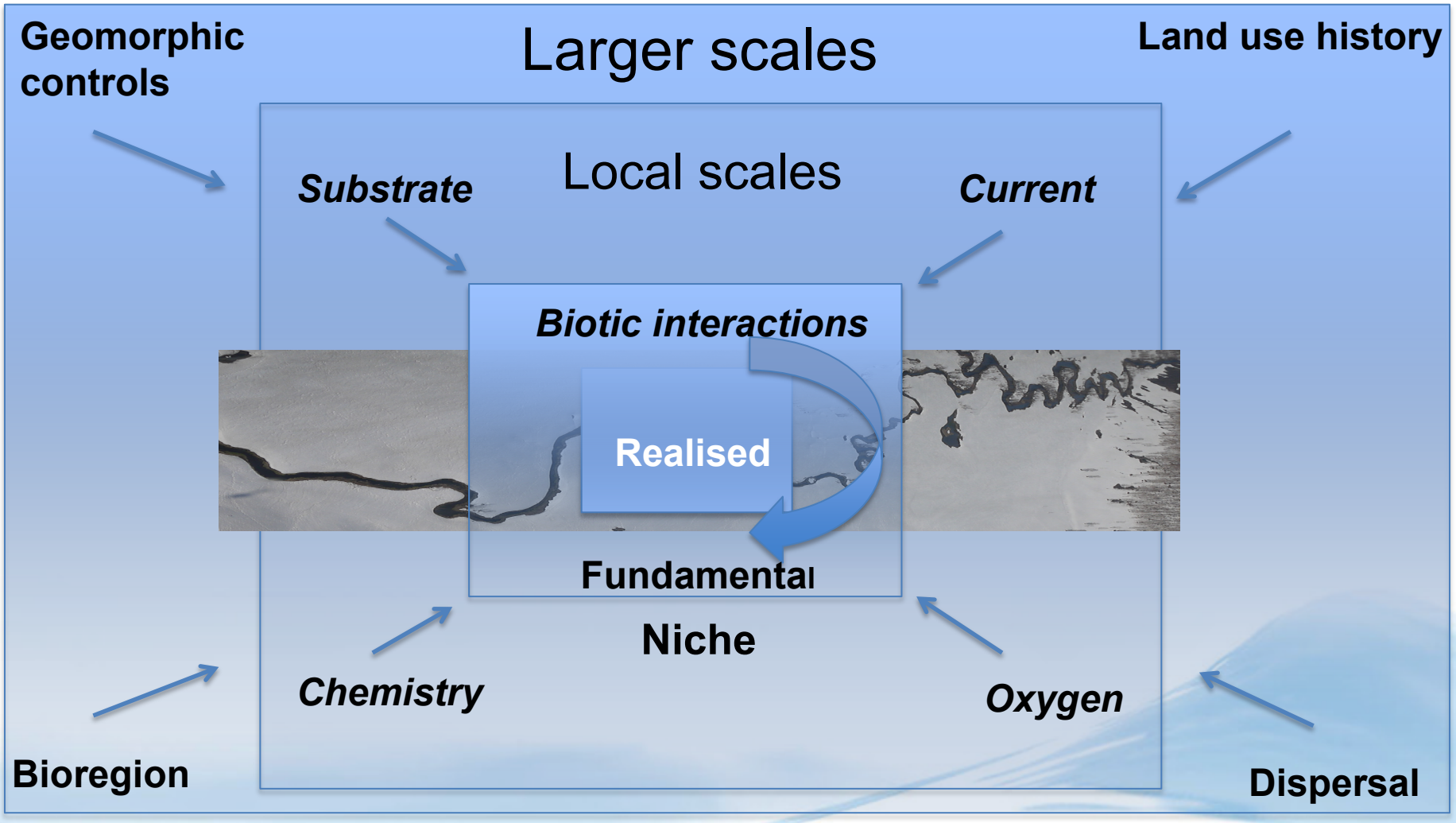


- Quantitatively the main problem in most river basins and much HYMO degradation is historical
- Flood protection, hydropower, navigation, urban sprawl are among contemporary challenges

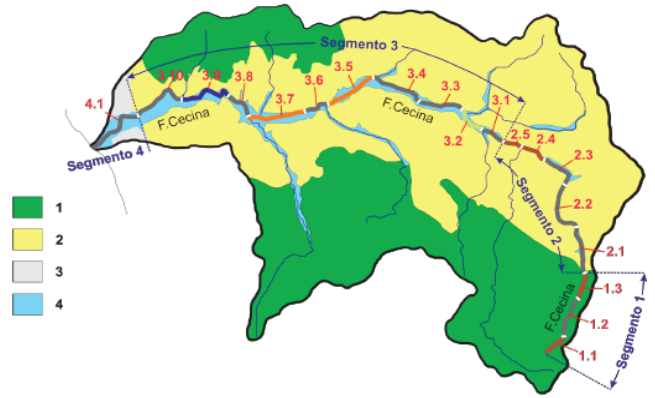
We are struggling to assess the impact HYMO degradation as the focus on local *environmental* filters ignores:

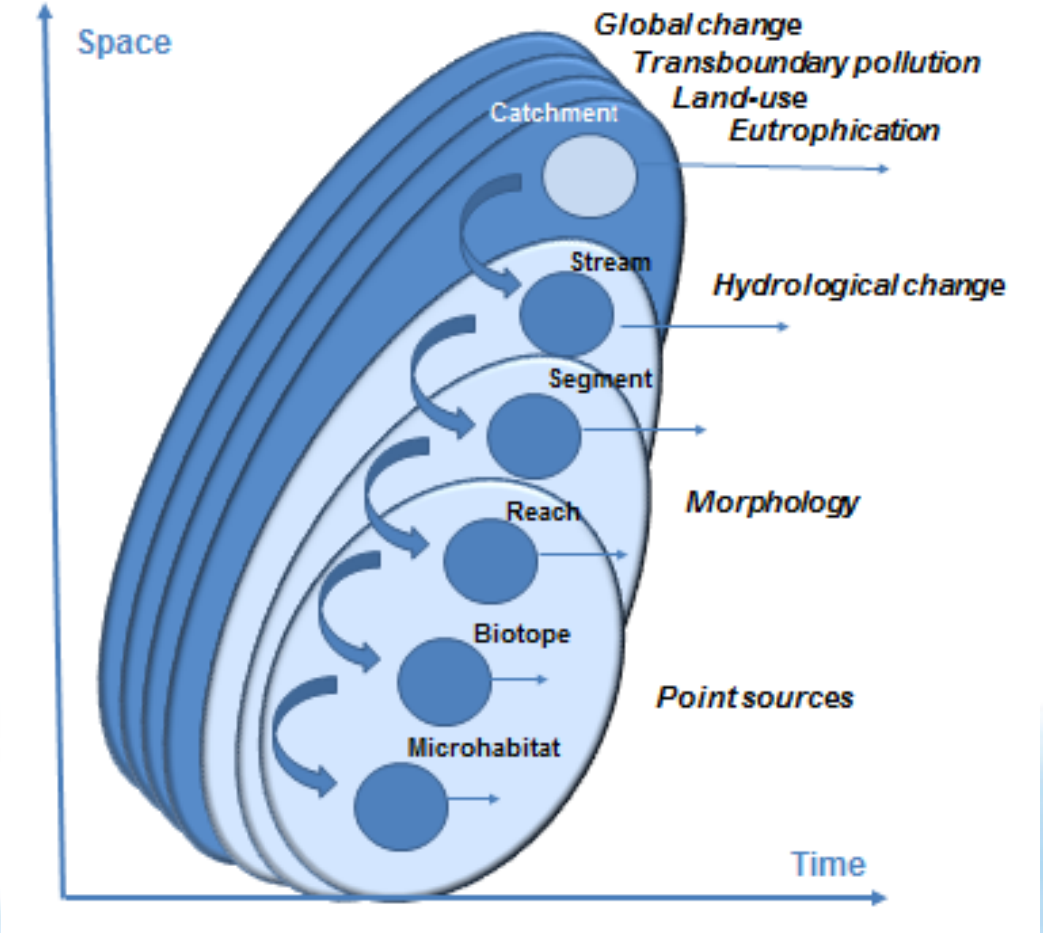
- Biotic interactions
- Dispersal (meta-community theory)
- Larger scales controls (temporal and spatial) on local conditions
- Interaction of multiple stressors across scales

What drives community composition?

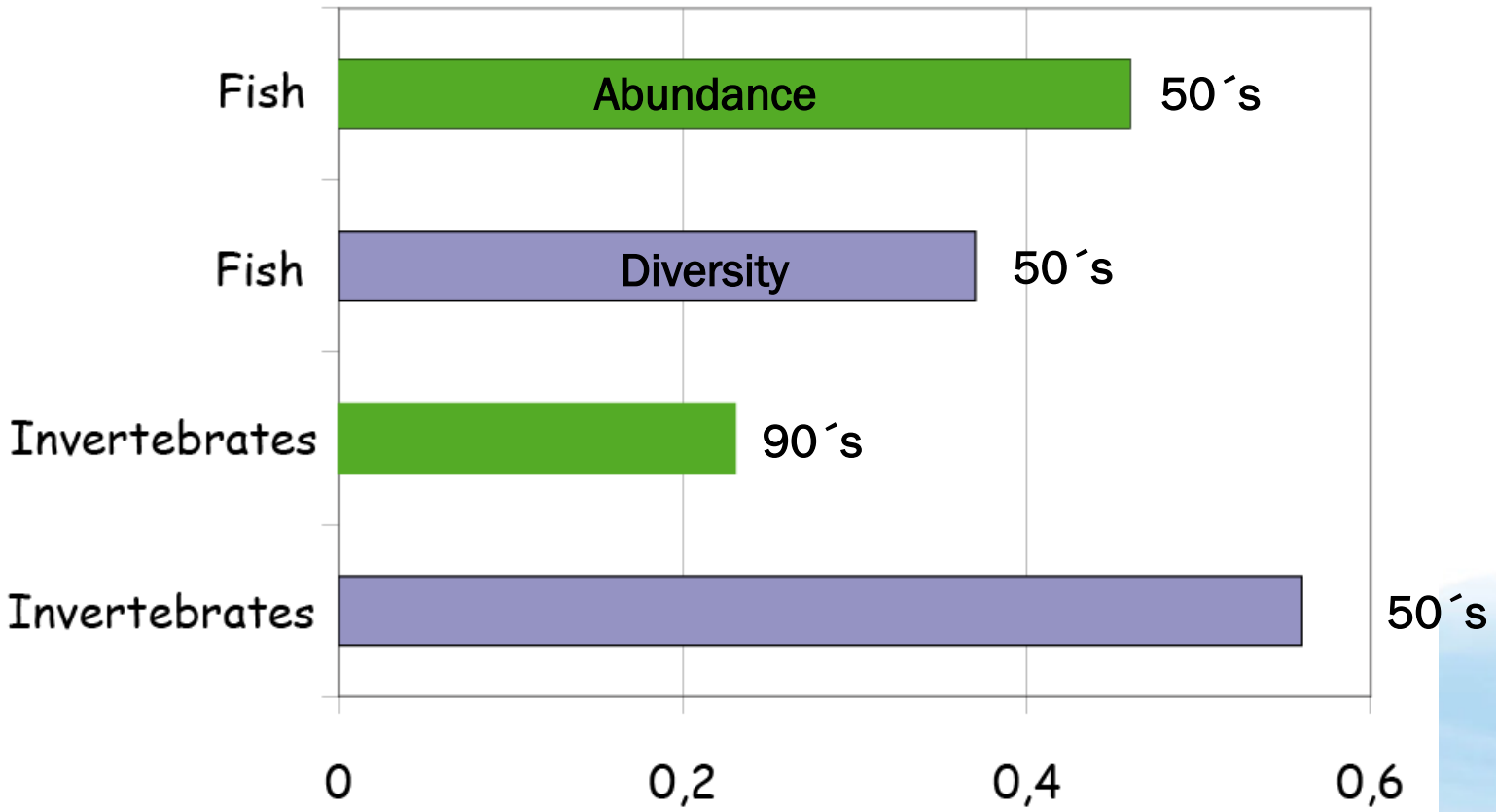


Importance of scale





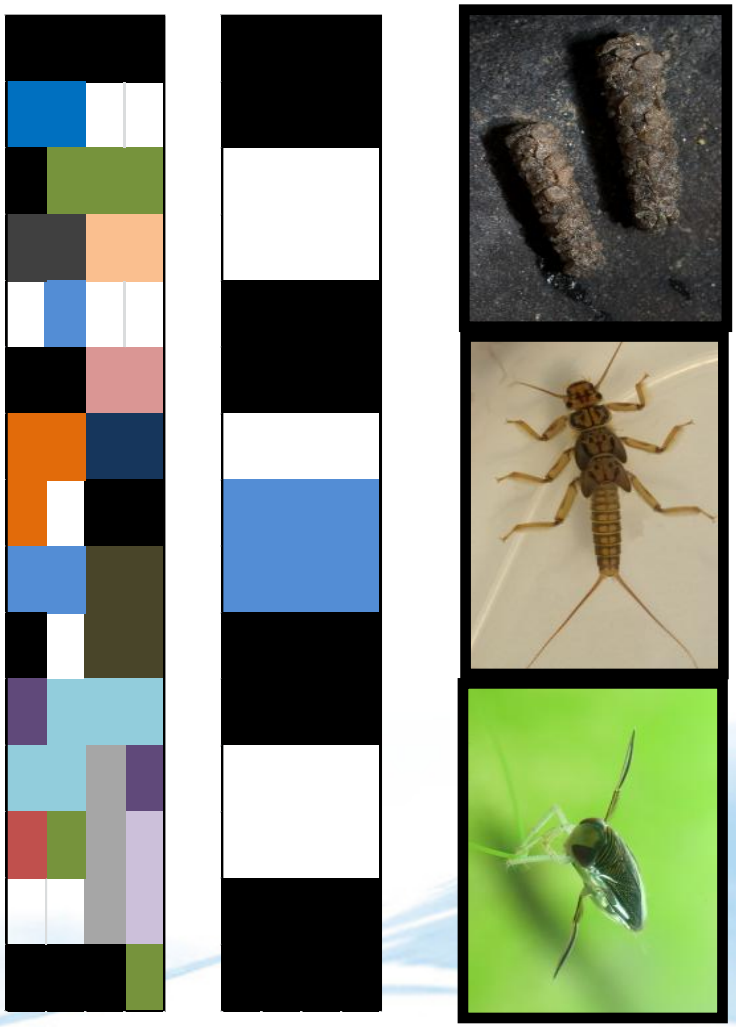
Acknowledge Ghosts of the past - the temporal dimension



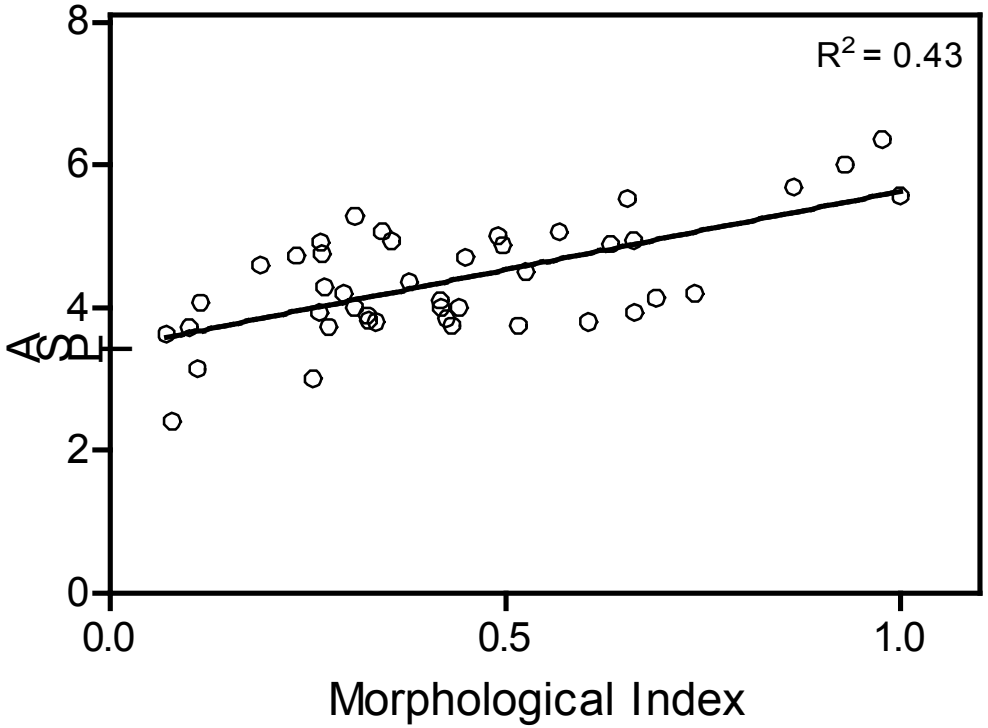
Harding et al. *Proc Natl* Acad Sci 95, 1998

HYMO-Biota linkages

A large body of research supports that in-stream biota are influenced by local HYMO conditions – these are, however, often small scale studies with high sampling intensity



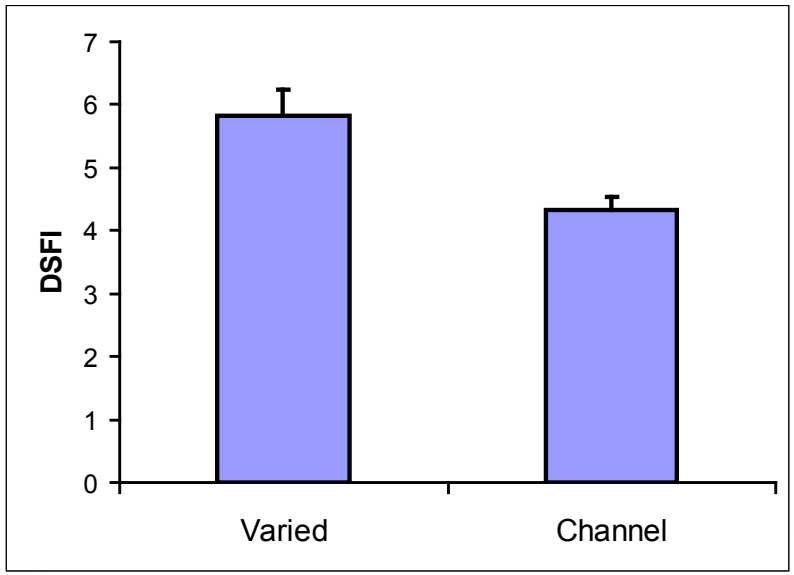
A standard metric

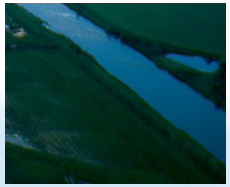


Morphological index ranging from uniform (0) to very complex (1)

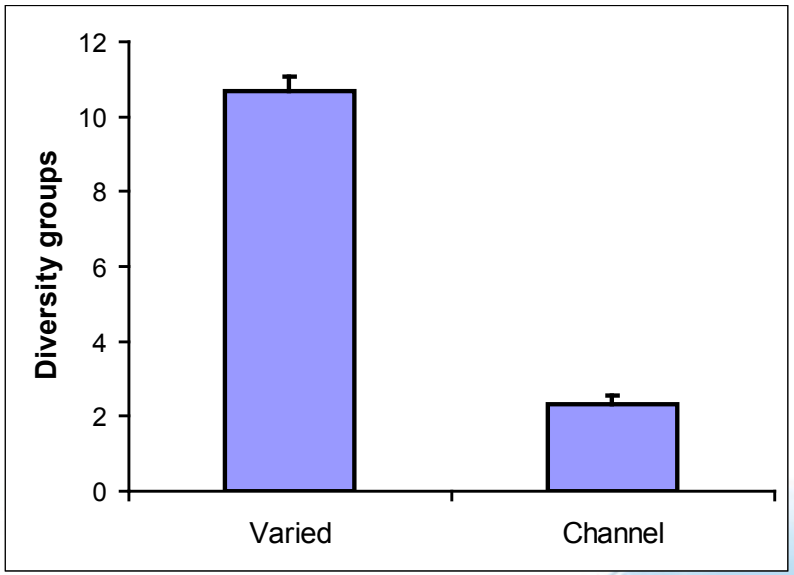
Paired comparison – BACI type design

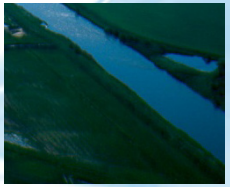
IC Danish DSFI metric
(organic pollution)





Component part of DSFI
Without indicator weighing





Olsen & Friberg, 1997

Metrics sensitive to hydrological alterations

	MESH	LIFE			
Normal flow	0.61	0.52			
Low flow	-0.58	-0.47			

high positives = good/low negatives = bad (+1 to – 1)

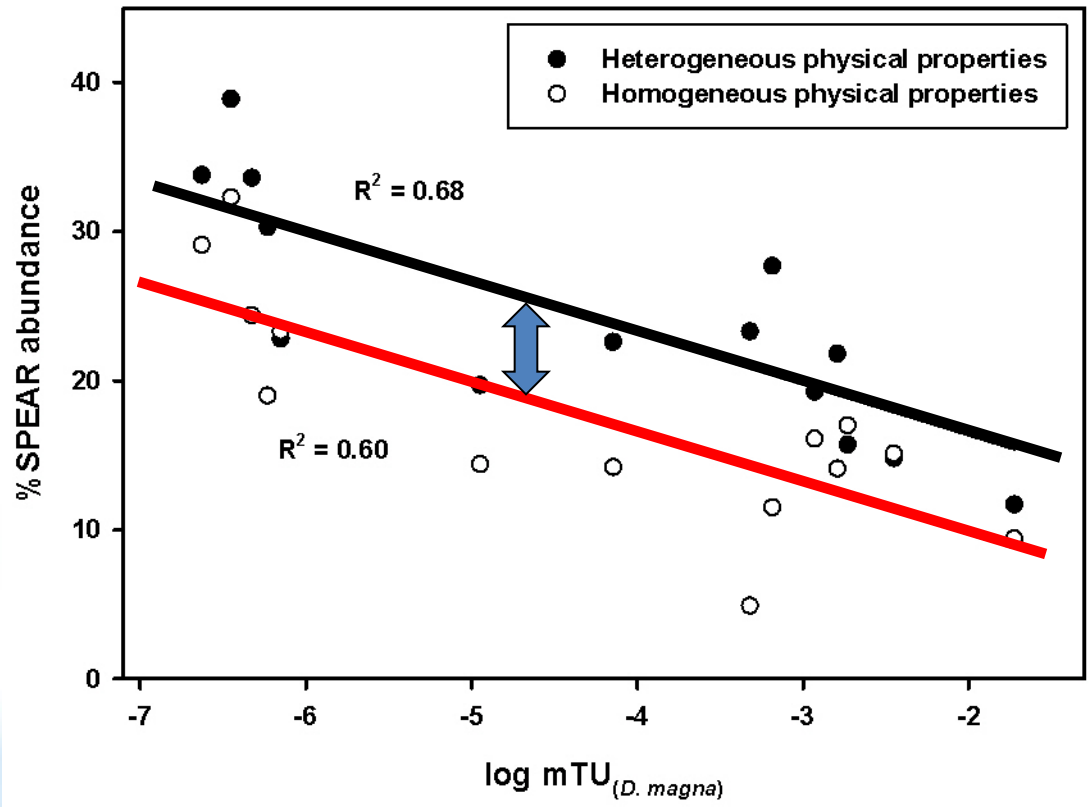
Metrics sensitive to hydrological alterations vs. other stressor specific metrics

	MESH	LIFE	ASPT (organic)	EPT (general)	SPEAR (pesticides)
Q90	0.61	0.52	0.59	0.44	0.6
Q10	-0.58	-0.47	-0.52	-0.43	-0.55

high positives = good/low negatives = bad (+1 to – 1)

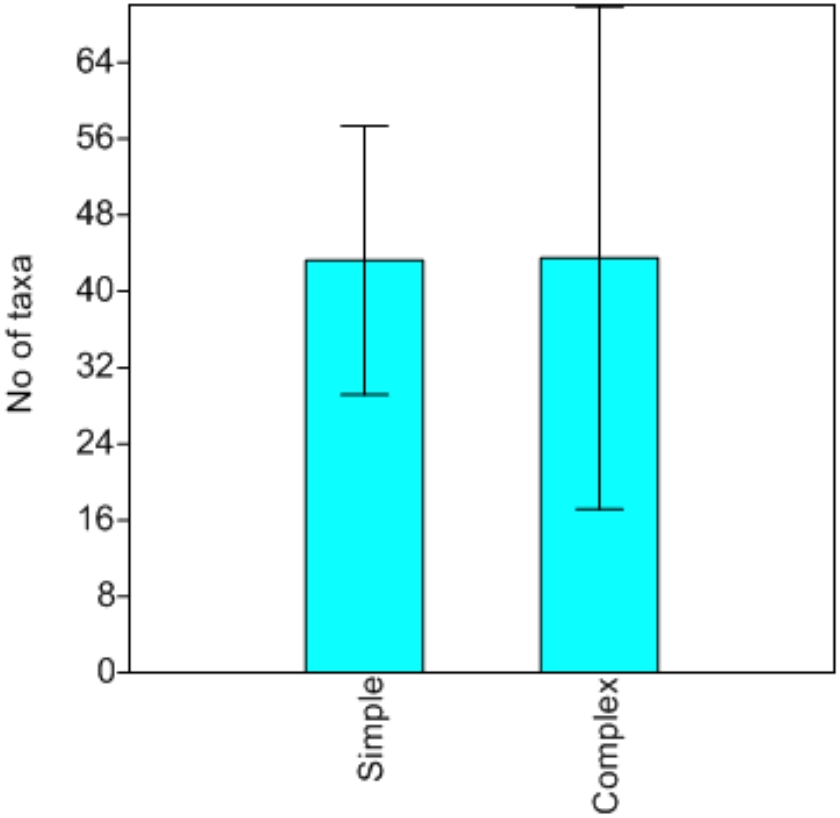

Multiple stressor scenarios –
the rule, not the exception

Good habitat conditions lower the effects of pesticides or?

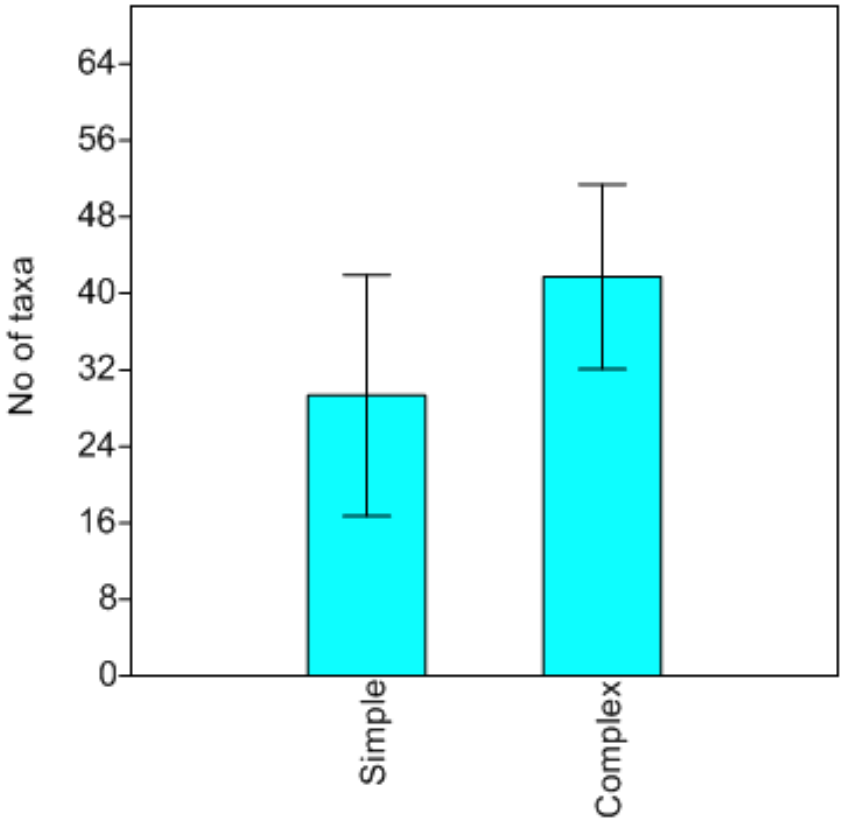


Rasmussen et al. 2012, *Environ. Poll.* **164**, 142-149

Good HYMO conditions can mitigate other effects of other stressors



Low Total P



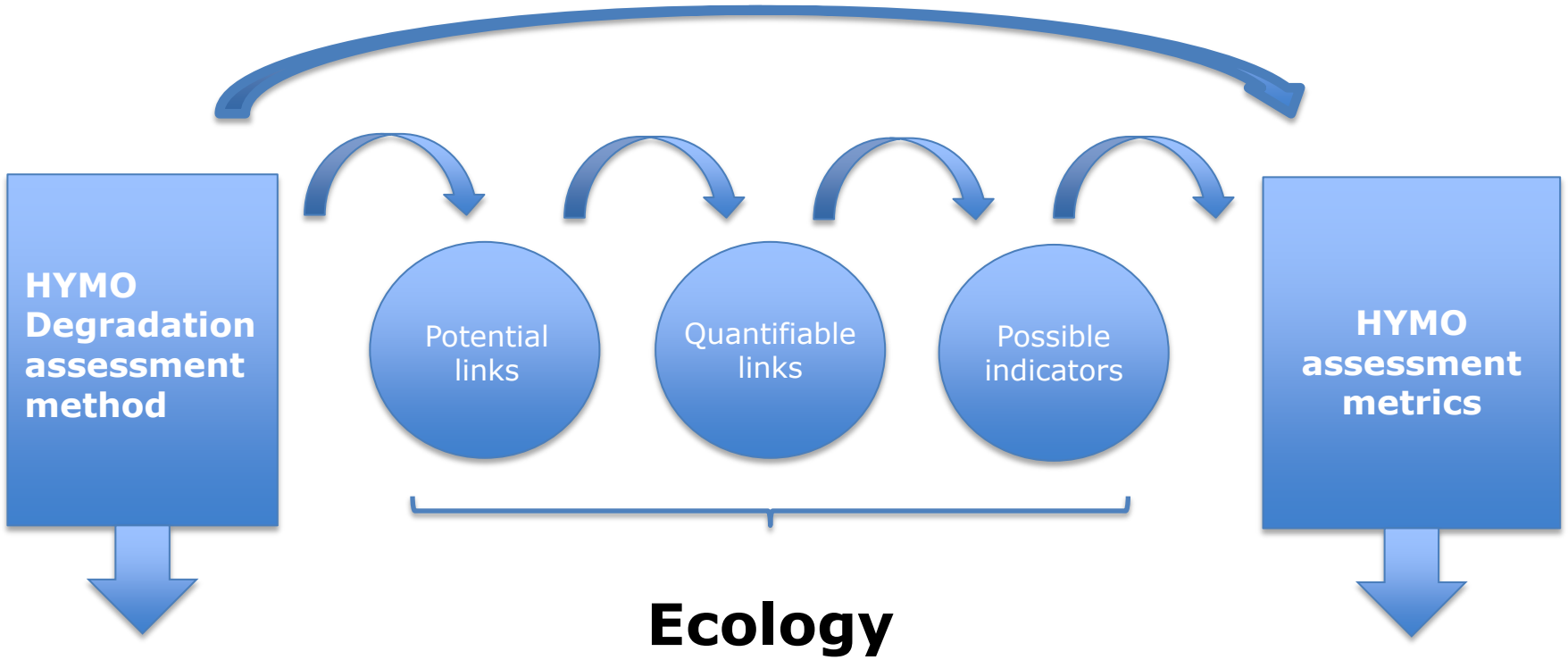
HighTotal P

In HYMO simple and complex stream channels
(Sandin unpublished, STAR project)

Data analyses

- Several large WFD-compliant data sets were analysed across Europe
- Species data, species traits and a range of metrics were analysed against:
  - Measures of HYMO stress
  - Water chemistry
  - Land use

Analytical approach



- Process oriented
- Spatial and temporal scales
- Riparian vegetation

- Sensitive
- Stressor specific
- Low uncertainty
- Scale dependent

Potential links – HYMO stress

- *Loss of hyporheric zone (macroinverts, fish)*
- *Low oxygen levels*
- *(macroinvertebrates)*
- *Scouring at high flows*
- *(perifyton)*
- *Changes in biotic interactions (realised habitat)*

BQEs

- Algae:
  - Will (with some uncertainty) be able to quantify the impact of nutrients
  - **New methodology:** More groups than diatoms need to be considered/larger spatial coverage of assessment
  - Might be used partly as indicators of hydraulic/fine sediment stress (coverage, morphs, traits)

BQEs

- Macroinvertebrates:
  - General degradation indicators; organic pollution
  - Diagnostic tools needs to be used with care – **they cannot indicate HYMO stress with a necessary degree of certainty**
  - Combine information on multiple sites to increase scale
  - **New sample methodology:** Sample areas indicating high HYMO quality - might only be done in top tier/"pristine" sites as features will be lost at more degraded sites

BQEs

- Macrophytes can be used if an appropriate typology is developed and traits/morphs are meaningful (mechanisms/functioning)

- Depending on stream type macrophyte community composition can add information on e.g. eutrophication

BQEs

- Fish (age groups, composition) are likely to be good indicators of HYMO stress but they have a number of limitations e.g. presence/absence have many reasons other than environmental conditions

- In general less sensitive to other types of stress compared with the rest of the BQEs

Quantifiable links

BQE	Sampling method (often CEN standards)	HYMO diagnostics?
Algae (diatoms)	Single stones/macrophytes	No
Macroinvertebrates	1-3 m^2 stratified by «habitat» types along 20 to 50 m «reaches»	Yes e.g. LIFE, DFI, Mesh **but none intercalibrated**
Macrophytes	Reach scale assessments (50-100 m); coverage and species/taxa composition	No
Fish	Reaches (100 m or more)	Partly – the guilds approach relates to overall HYMO conditions

Why it also was difficult to detect HYMO degradation using WFD compliant monitoring data

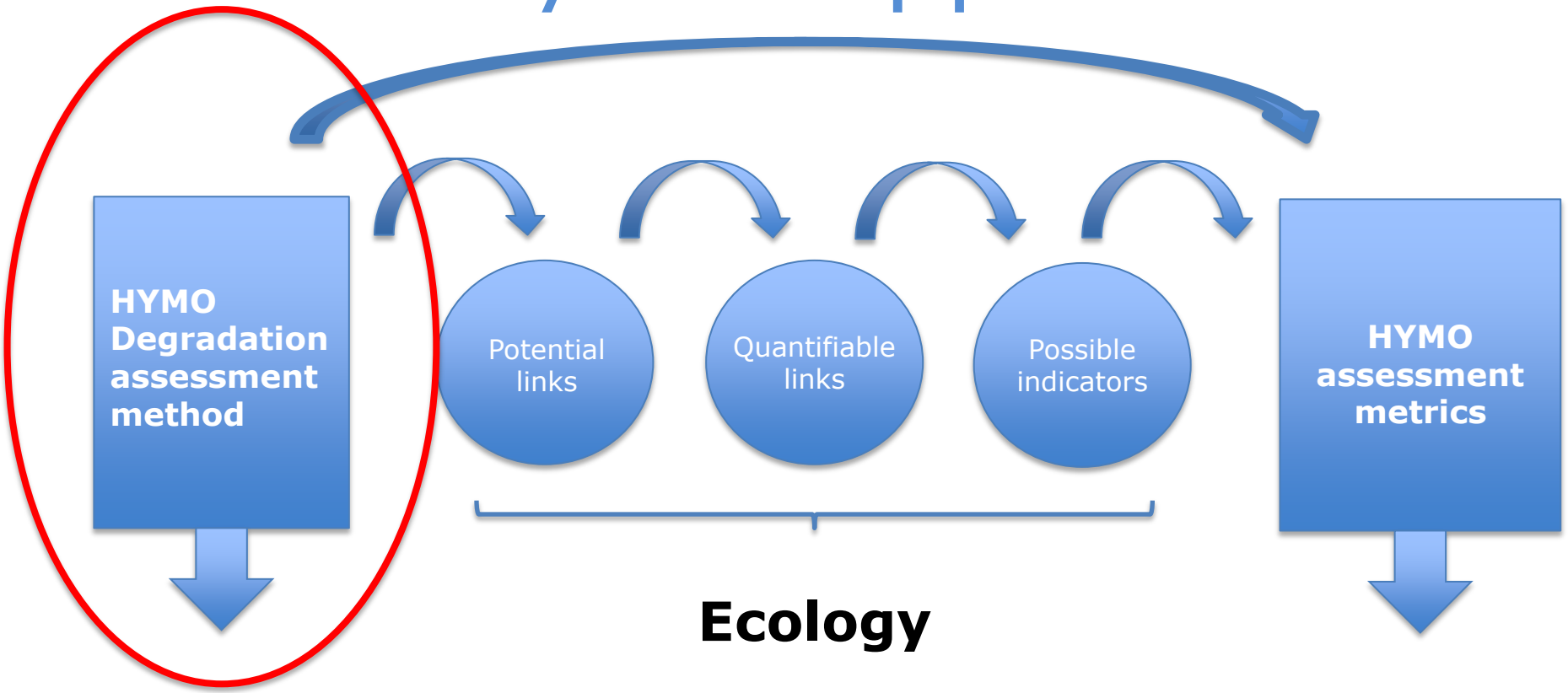
Hydromorphology

- Measured on a different spatial scale than the biota
- Static rather than dynamic measurements; often very limited number of consistent HYMO variables available across data sets

Hydrology

- Few hydrological stations compared with biological monitoring stations and often not at the same place

Analytical approach



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Possible indicators

- Use of species traits: habitat template theory
- Riparian organisms (ground beetles, amphibians)
- Ecosystem functioning
- Alternative sampling strategies

Recommendations

- Use the HYMO method to assess impact along the entire gradient
- Focus on improving processes when ever possible
- BQEs can primarily inform on the impact of other stressors which are relevant in multiple stress scenarios
- Fish is the most sensitive BQE with regard to HYMO; macrophytes in lowland rivers
- Alternative/new methods (not standardised; not IC'ed) can be used in investigative monitoring

Thank you!