

Bioassessment of wet-weather flow impacts on fine sediments in urban waters: coupling two different approaches

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I. Introduction

1. State of the art

- Wet-weather discharges are intermittent sources of pollution, best investigated by sediment quality
- Sediment chemistry results alone are important but insufficient
- Bioavailability of contaminants and their additive effects are critical in the impact on biodiversity
- Benthic organisms inhabiting sediment/water interface and integrating all exposure pathways are good indicators of general ecosystem health



Two different approaches of sediment quality assessment

NWRI

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The sediment triad approach
(Chapman, 1992)

- Sediment chemistry
- Sediment toxicity
(biotesting)
- Benthic community structure

An indices-based methodology on
Oligochaete communities as
bioindicators

- IOBS (Lafont, AFNOR 2002)
 - IOBL (Lafont, AFNOR 2005)
 - IOPP
- (+ Sediment chemistry)

2. Why Oligochaetes?

- Aquatic strict taxa / integrate all exposure pathways at all time
- Widespread over various aquatic systems but low vagile behavior
- Very low geographic variability distribution for most species
- Highly diverse group : Wide range of species sensitivity to pollutant

Oligochaete index method (IOBS, IOBL)

Advantages

- Standard methodology (allows comparisons/sites)
- Easy applicable and reliable
- No geographic variability Ex: France, Belgium, Guinea, Algeria.... Canada?
- Species identification (High ecological significance/ highest sensitivity)
- Cost / Benefit

Inconvenience

- Optimistic for sandy sediments (beaches) or thick layer of macrophytes and algae covering sediments
- Pessimistic for low habitability systems (e.g. mountain streams)
- High identification level (training / experience needed)

3. Main problematic

The sediment triad approach

- Lacks of biological responses / chemistry in some cases
e.g. stormwater management facilities (Rochfort, 2000)
- Requires a reference site for each case study.

Oligochaete Index-based methodology

- Needs to be tested in various hydrosystems: shallow ponds, stormwater management facilities
- Needs to be tested in a more global approach including ecotoxicological test (triad approach) to validate previous hypothesis for application in stormwater facilities



Complementary

4. Objectives

4.1 Applied Research

- Definition of the ecological status of the stormwater pond system
- Definition of the quality objectives
Dual function of the facility: Self purification & Biodiversity preservation
- Identification of effects / detrimental substances
Application and interpretation of the triad with Oligochaete indices
- Remediation / monitoring
Planning of measures to cut down most detrimental substances
Monitoring the best indicator(s) to reduce the cost / efficiency ratio

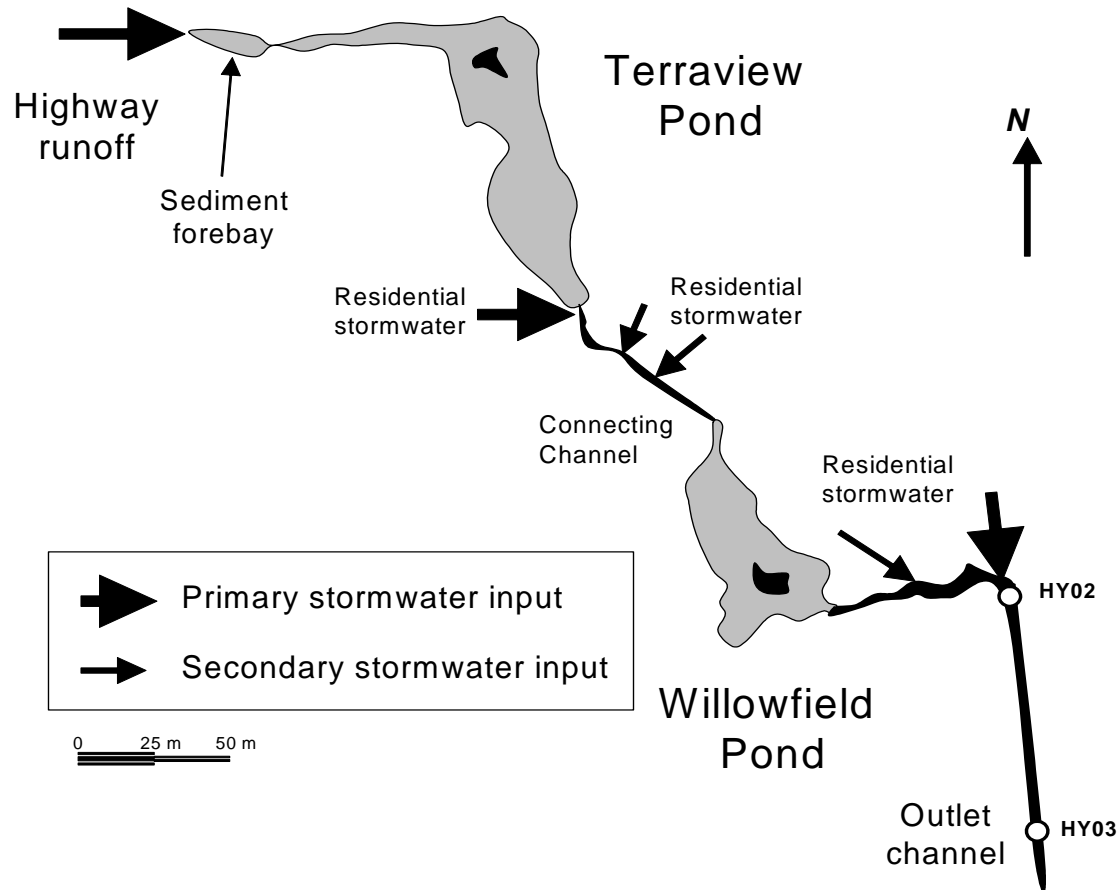
4.2 Research & Development

- Test hypothesis of previous research (IOBS, IOBL, IOPP)
- Validation or improvement of IOPP
- Integration of IOPP to the triad

4.3 Fundamental research

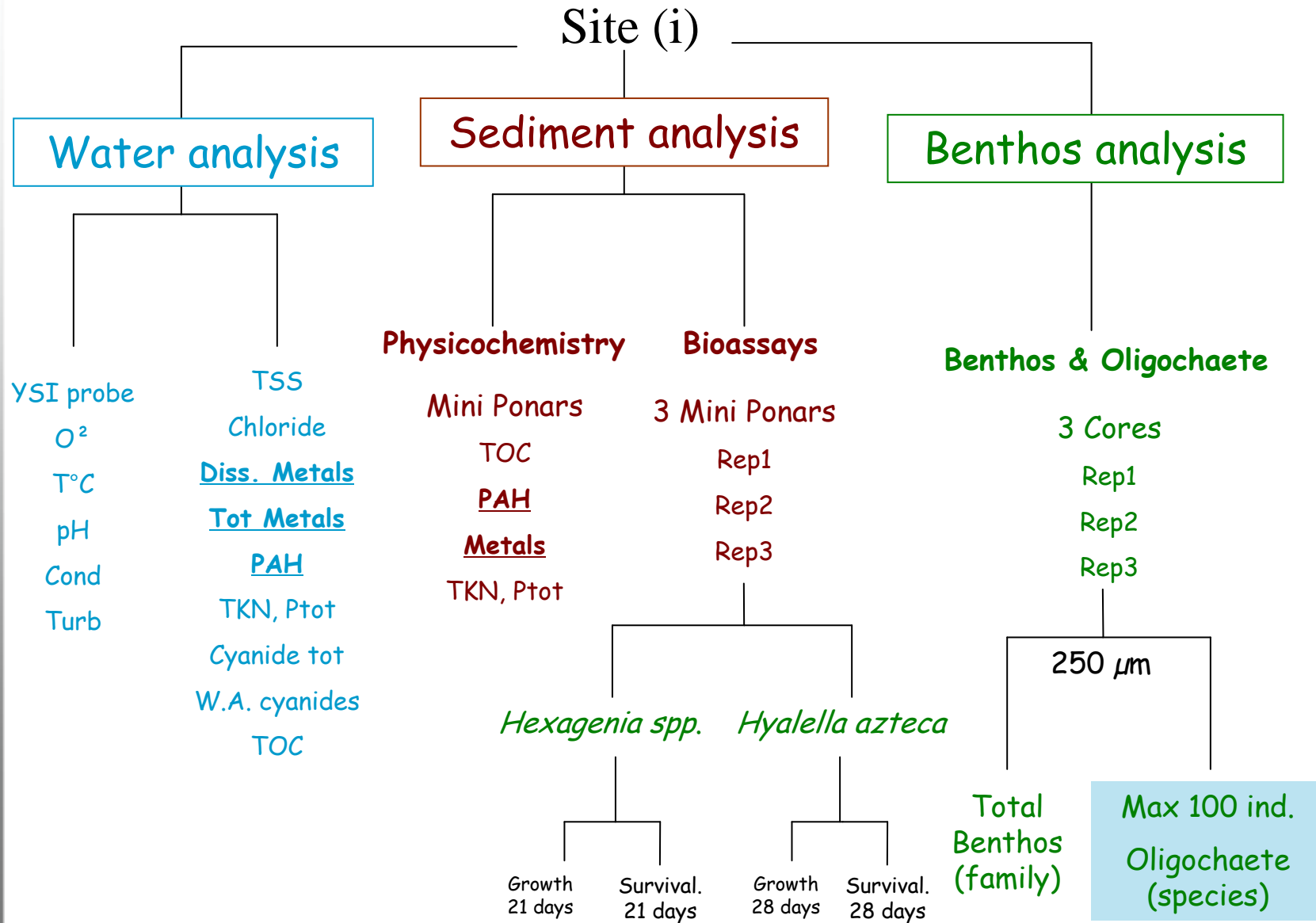
- Gaining knowledge on oligochaete species ecology / sensitivity
- Gaining knowledge on the complex toxicity mechanisms of pollutants

A case study: the Terraview Willowfield stormwater system

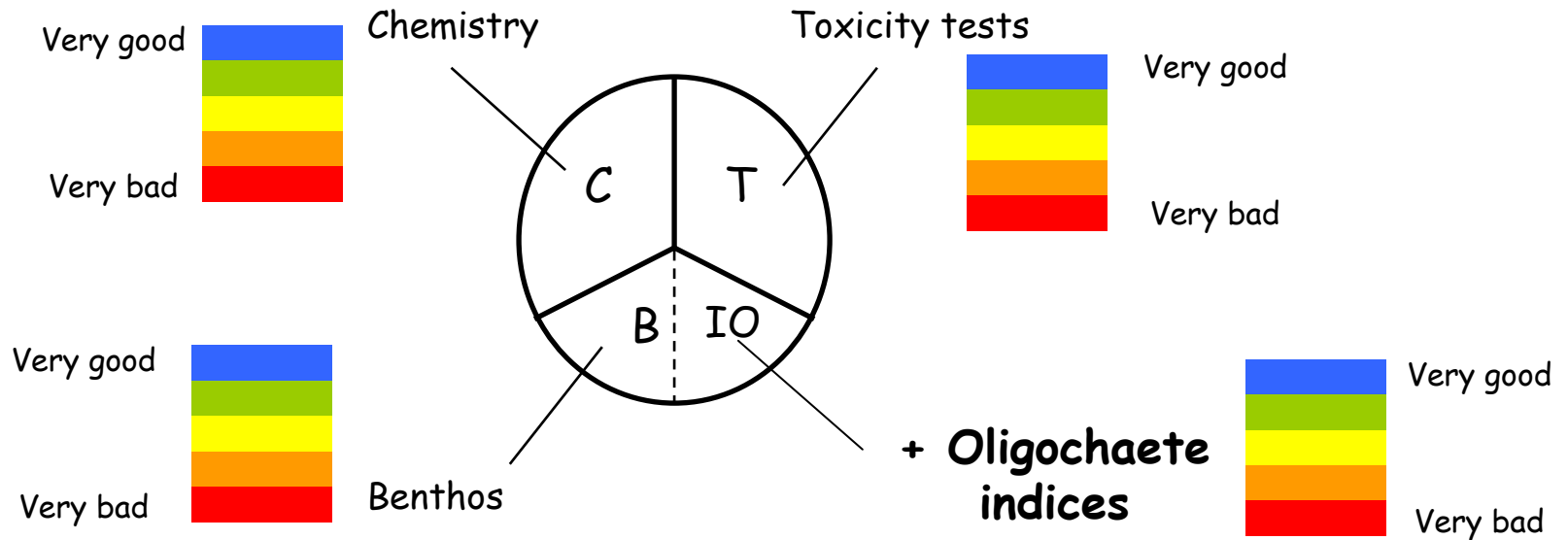


II. Material & Method

1. Sampling protocol



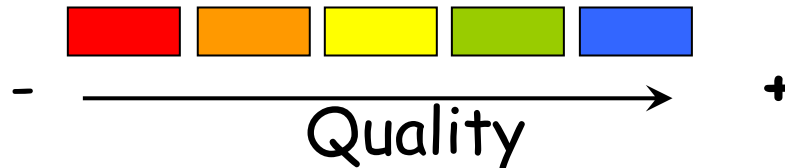
2. Application of the triad and integration of the Oligochaete index component



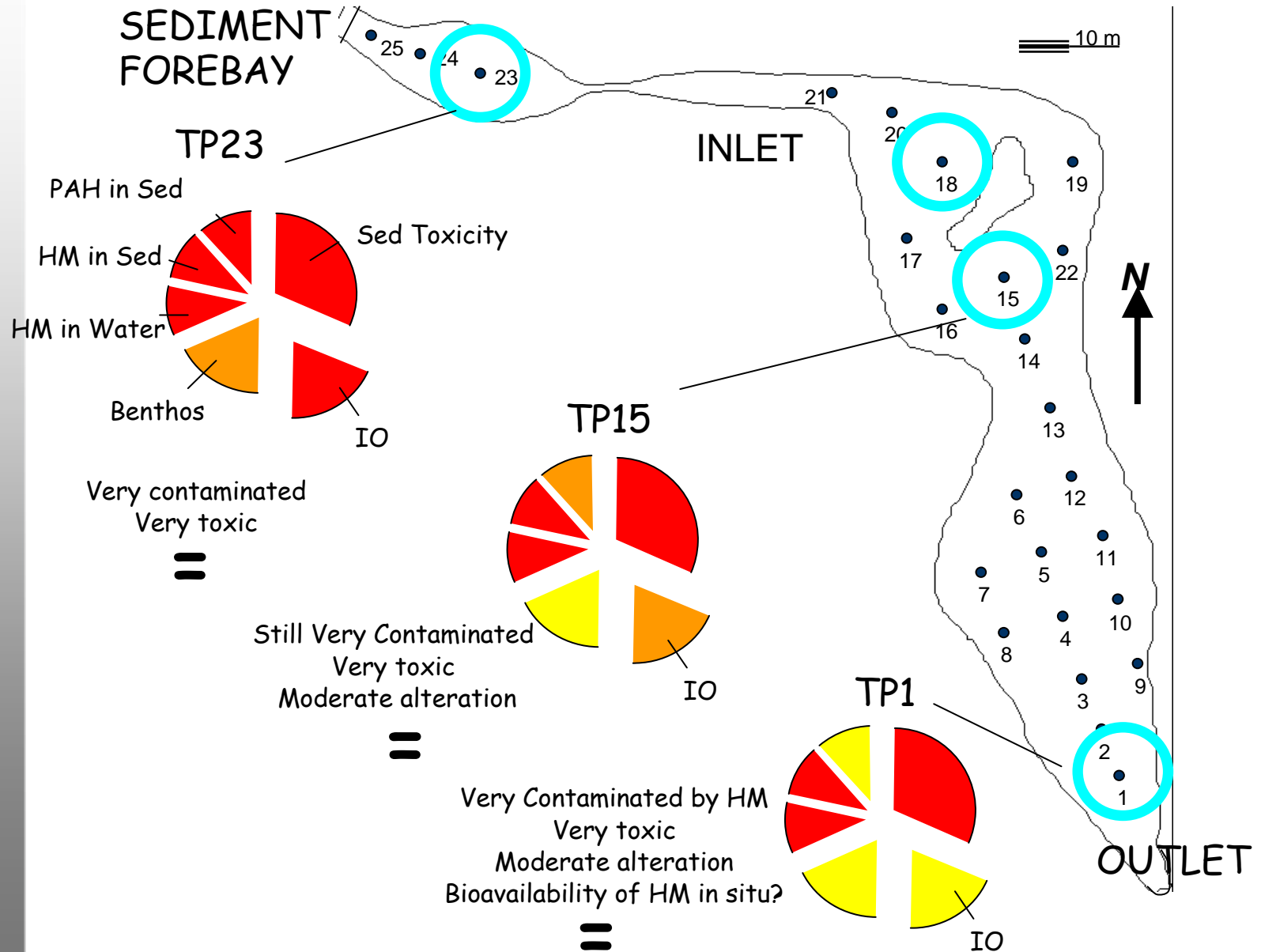
Interpretation of the global quality is based on each component separately AND in relation to the others



Use of ranking to summarize and integrate the information

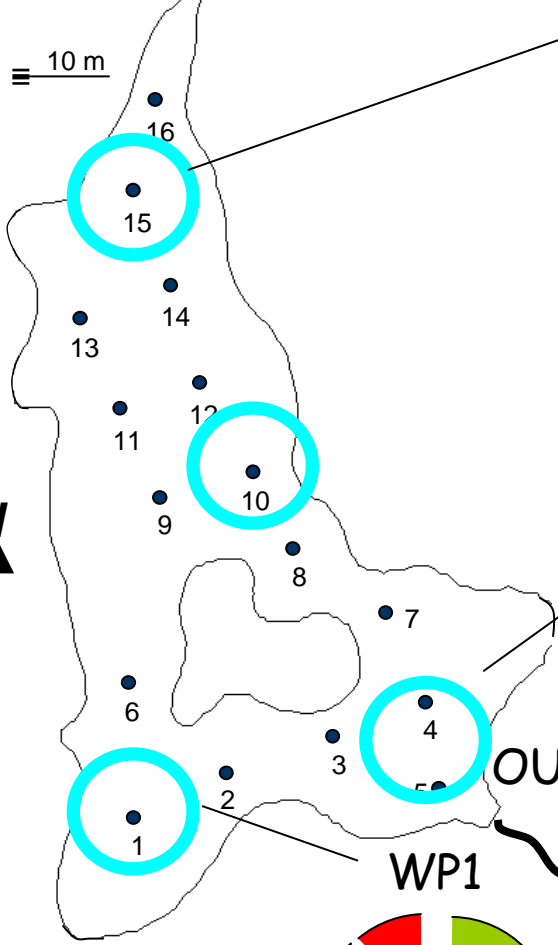


III. Results



INLET

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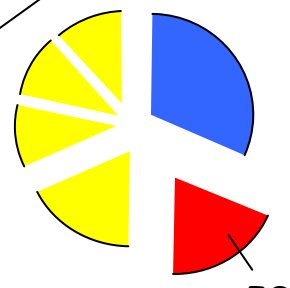


WP15



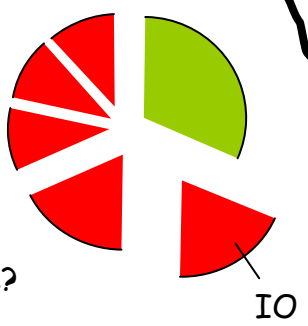
Very contaminated
Very toxic
=

WP4



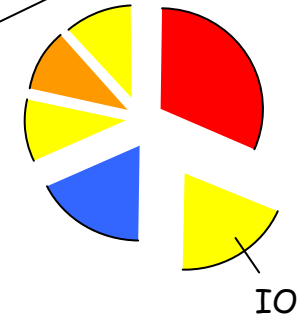
Moderate contamination
Moderate alteration
Not toxic
≠

WP1



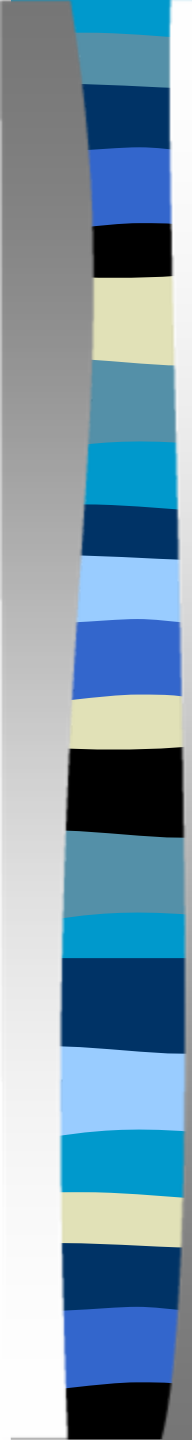
Very contaminated
Strong alteration
Bioassays realistic?
Test organisms appropriate?
=

HY01

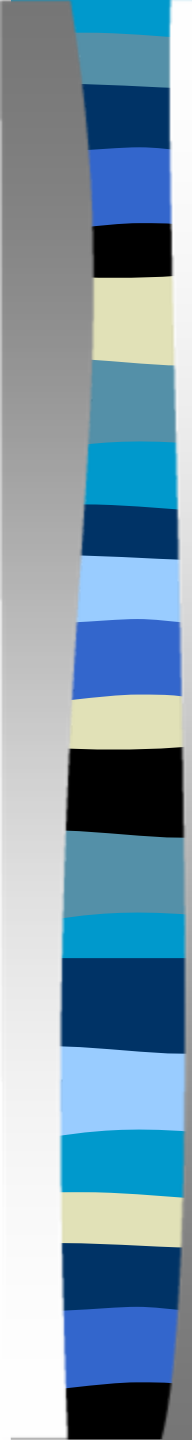


Moderate to strong contamination
Very toxic
No alteration in situ: reference
=

OUTLET



IV. Conclusion

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- ✓ Oligochaete index (IO) gives a similar assessment of the global quality than the triad *per se* in most cases.
 - ✓ Oligochaete methodology is complementary to the triad as it provides with additional information to confirm ex: TP1, WP1 or not ex: WP4 some trends in the benthos
 - ✓ HY01 best potential reference for benthos but still considered moderately contaminated by IO
 - ✓ IO allows to give numerical values to quantify quality objectives. SPP measurable from Bad to moderate but improvement needed towards good quality for BPP
 - ✓ PAH in sediment & Heavy metal contamination in water are likely to be responsible of biological impairment while metals in sediment appear less bioavailable.
 - ✓ Toxicity tests poorly match with the benthos & Oligochaete responses.
 - Controlled conditions realistic? Ex: DO, ammonia potential effect
 - Tests organisms adequate to the system?
 - ✓ Short term perspectives for applied research include an analysis of the seasonal variations to confirm the trends & to focus on special cases ex: WP4

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