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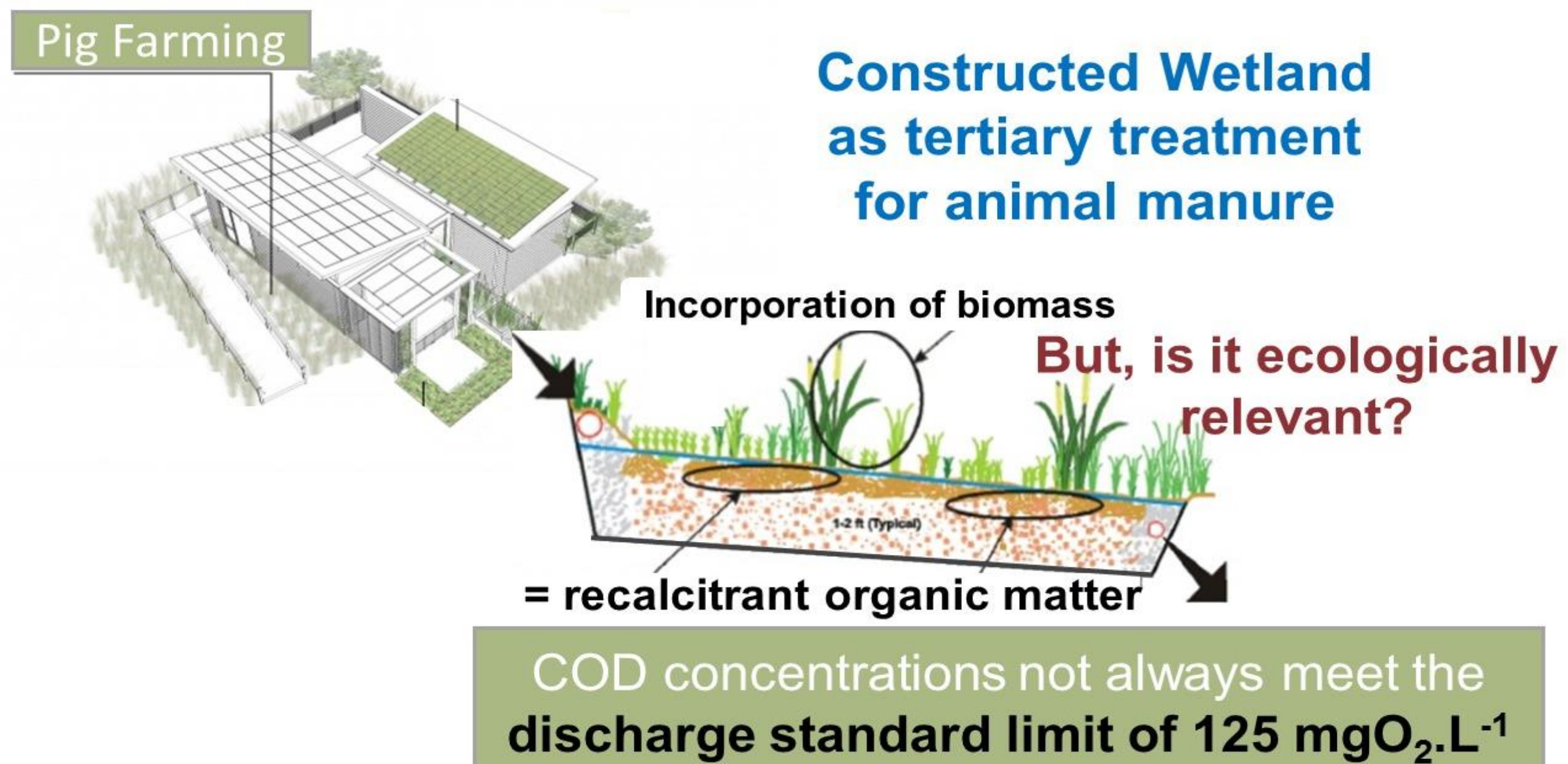
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Introduction



Objectives

- Evaluate the response of the water quality index, called Multimetric Macroinvertebrate Index Flanders (MMIF) and organic pollution sensitive taxa as a function of water quality parameters through statistical regression models.
- Investigate the limitations and practicality to define proper standard limits regarding the status of aquatic systems.

Methodology

- Site selection:** Fresh and brackish small polder watercourses and case study CWs located in Flanders -Belgium.
- Data exploration** of water quality of selected sites and presence of organic pollution sensitive taxa regarding environmental and discharge standard limits as a function of the MMIF classes (bad, poor, moderate, good, high).
- Statistical regression models development predictor variables:** pH, conductivity, COD, biological oxygen demand (BOD₅), dissolved oxygen (DO), total nitrogen (TN), nitrate (NO₃), ammonia (NH₄) and total phosphorous (TP) concentrations; **response variables:** MMIF and presence of organic pollution sensitive taxa.
- Selection of the optimal model configuration** through stepwise selection procedure.
- Estimation of marginal effects** *i.e.* $\left(\frac{\partial MMIF_{lt}}{\partial predictor\ variable}\right)$ of the predictor variables on the variance of the MMIF means and the probability of occurrence of organic pollution sensitive taxa. Study period 1989 - 2016.

Results

Data exploration

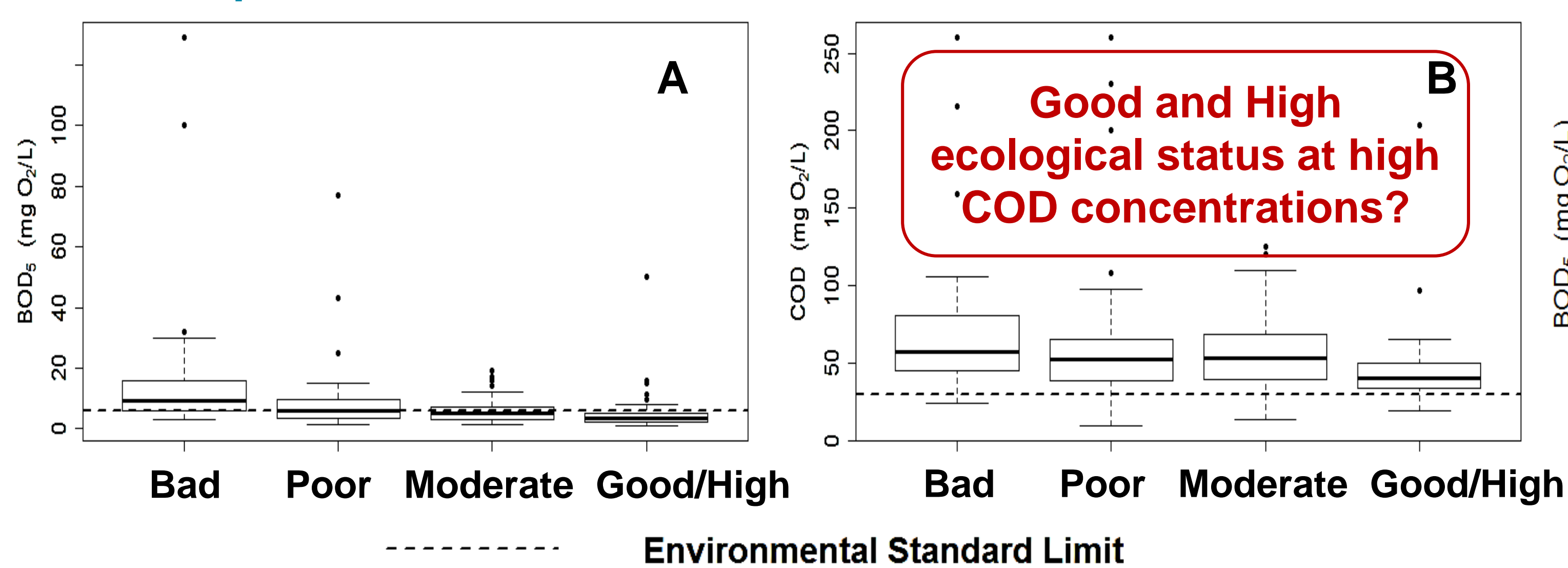


Figure 1: A. BOD₅, B. COD concentrations recorded in fresh and brackish polder watercourses compared to the environmental standard limits of 6 mgO₂.L⁻¹, 30 mgO₂.L⁻¹ respectively and ranking score MMIF classes.

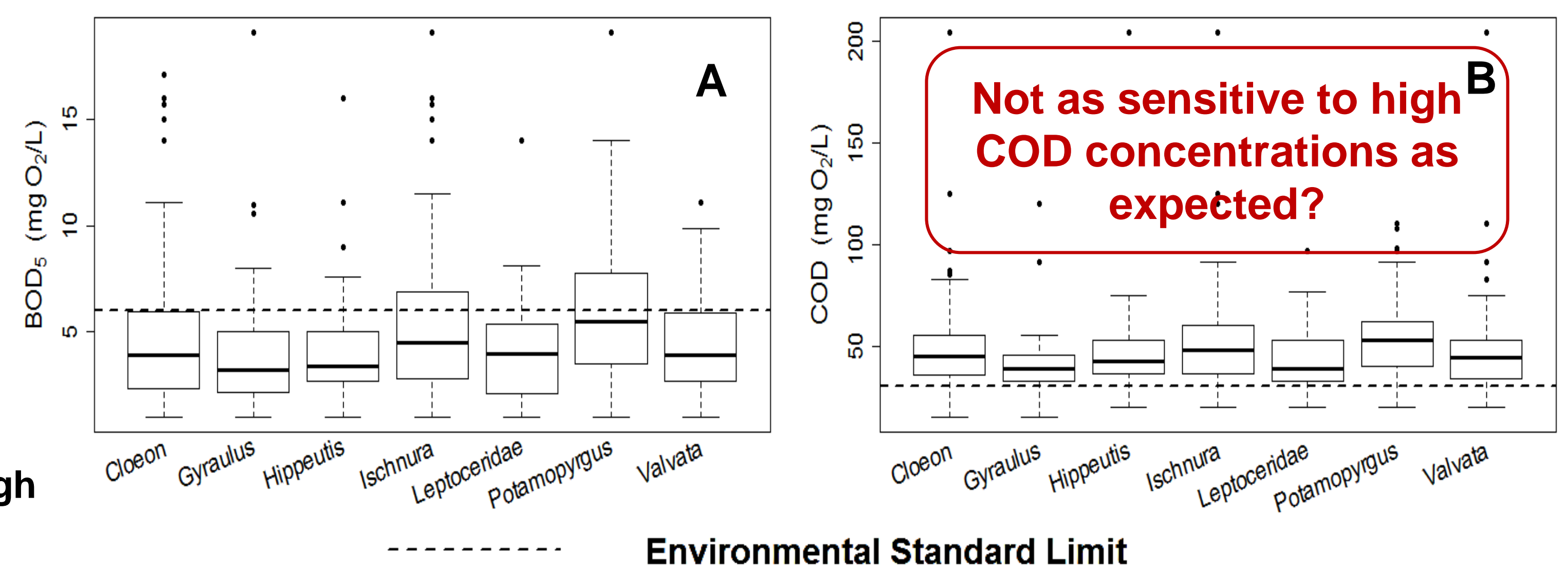


Figure 2: Example of sensitive taxa present in the polder watercourses in relation to the environmental standard limits for A. BOD₅, B. COD .

How we calculated the estimated marginal effects of BOD₅ and COD on the ecological quality (MMIF)?

$$a) \frac{\partial MMIF_{lt}}{\partial BOD_{5lt}} = \beta_{BOD_5} + \beta_{BOD_5*NO_3}[NO_{3it}] + \beta_{BOD_5*TSS}[TSS_{it}] + \beta_{BOD_5*DO}[DO_{it}] + \beta_{BOD_5*EC}[EC_{it}] + \beta_{BOD_5*NH_4}[NH_{4it}]$$

$$= -0.0311 - 0.0032*[NO_{3it}] - 0.0003*[TSS_{it}] + 0.0002*[DO_{it}] + 4.73 \times 10^{-6}[EC_{it}] + 0.0027*[NH_{4it}]$$

$$b) \frac{\partial MMIF_{lt}}{\partial COD_{lt}} = \beta_{COD} + \beta_{COD*DO}DO_{it} + \beta_{COD*TSS}TSS_{it}$$

$$= 0.0033 - 4 \times 10^{-5}[DO_{it}] + 0.0001*[TSS_{it}]$$

Table 1: Example of estimated marginal effects on the MMIF means given the mean concentrations of water quality parameters determined at the Yser river basin

Basin	Average concentrations used as input on equation a) and b)							Estimated marginal effect	
	BOD ₅ mg.L ⁻¹	COD mg.L ⁻¹	DO %	EC mS.cm ⁻¹	NH ₄ mg.L ⁻¹	pH Units	TSS mg.L ⁻¹	BOD ₅	COD
Yser River	5.6	52.3	66.4	1325	0.4	7.9	26.3	-0.021	0.0026

Conclusions

The studied **ecological water quality indicators are estimated to respond more to BOD₅ rather than COD concentrations**. Thus, to define proper standard limits, models with high explanatory and predictive power need to be developed based representative ecological information in combination with abiotic data. For this, the selected sampling locations should be periodically monitored and at the same frequencies.

The presence of recalcitrant COD (e.g. in form of humic substances in CWs) make this a non-sensitive parameter. Future research suggest the **development of a more sensitive legislation around BOD₅ or other (to be developed) parameters correlated with organic pollution** analysed in a reliable and high-throughput manner. So that the **implementation of CWs could be promoted** in Flanders and agricultural intense areas.