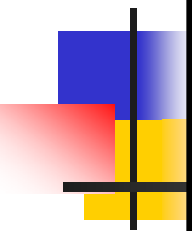




CIS Workshop

National Classification Systems for the Assessment of the Ecological Status of Surface Waters

Paris, 11-12 June 2007



How to derive a WFD compliant and ecologically relevant classification system for rivers?

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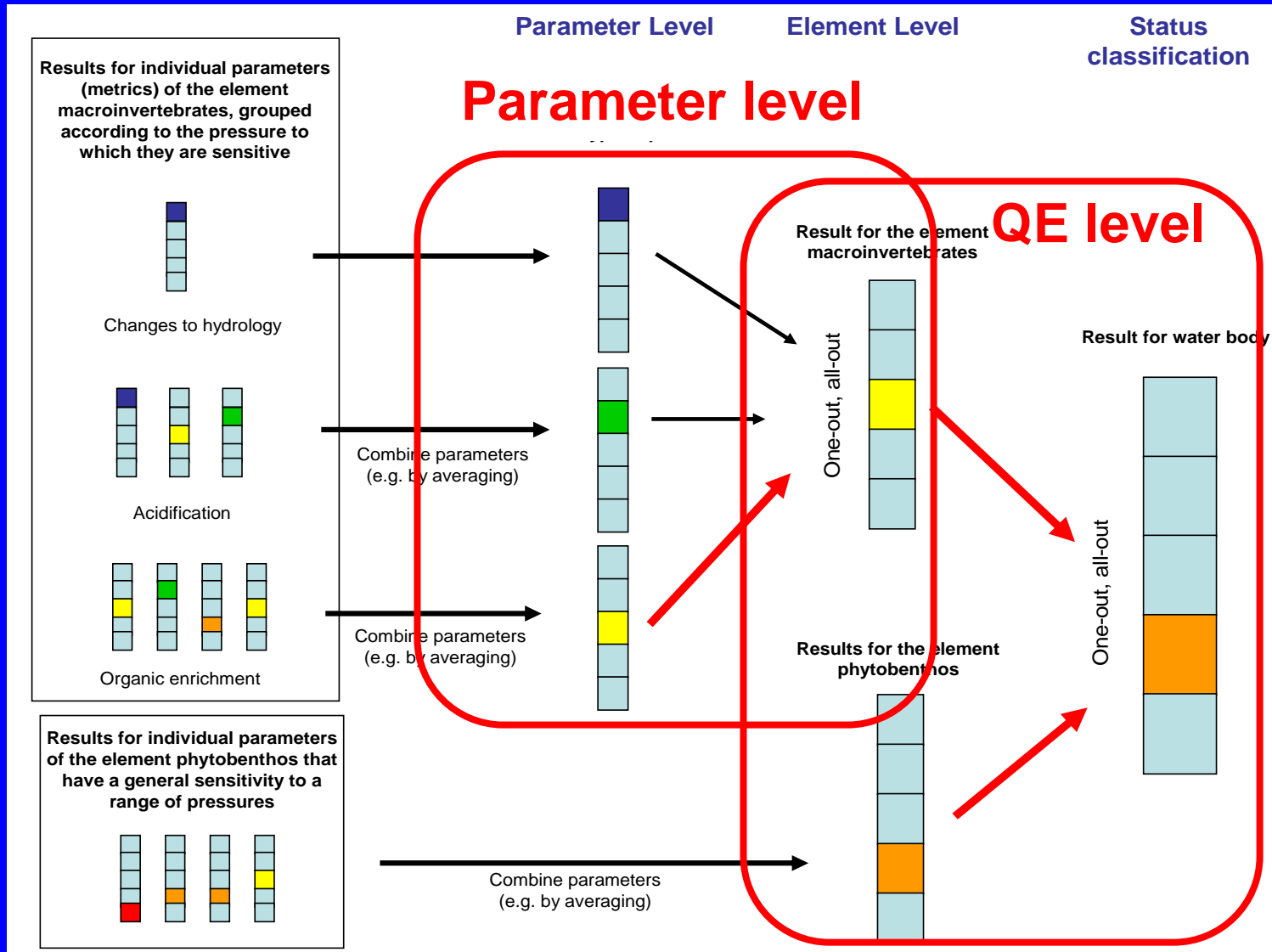




Some questions about ...

- the One Out - All Out principle
 - How **Uncertainty** can affect the OO-AO classification of a site ? - (*L. Sandin*).
 - Are other **alternatives** ecologically relevant and WFD compliant ?
- The Chemical quality elements
 - How to **harmonise** the Physico-chemical and Biological classifications ?

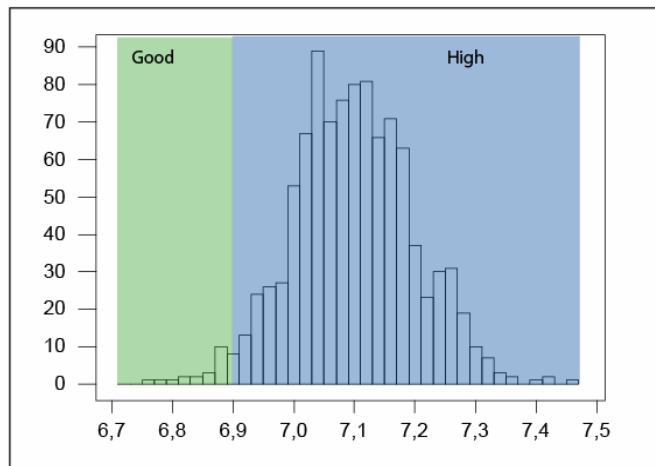
1 - ONE Out - ALL Out and natural variation



Uncertainty in classification

- Variation due to
 - **Natural variability**
 - Sampling and laboratory processing
- Variation in index values can be measured in terms of Standard deviation (SD)
 - For ASPT SD of 0,25 (Clarke et al. 2002, Freshwater Biology)
- Test of Variation using 0,1 0,25 and 0,5 SD units
 - **How will the assessment be affected?**

SD = 0.1



Effect of Variation on classification at the site level

With SD = 0.5:

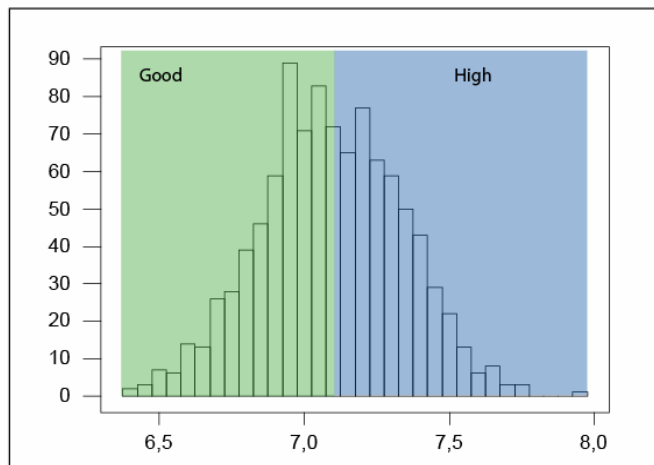
High = 63.3 %

Good = 34.7 %

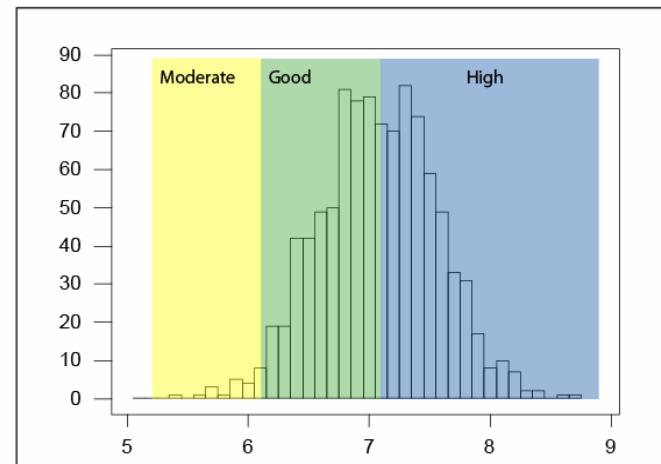
Moderate 2.0 %

Mean ASPT = 7.1 - High status





SD = 0.25



SD = 0.5



An example in the real world: Sweden

Stream				
Sandån	high	high	good	high
Hamrångeån	mod	good	good	high
Broströmmen	mod	mod	mod	mod

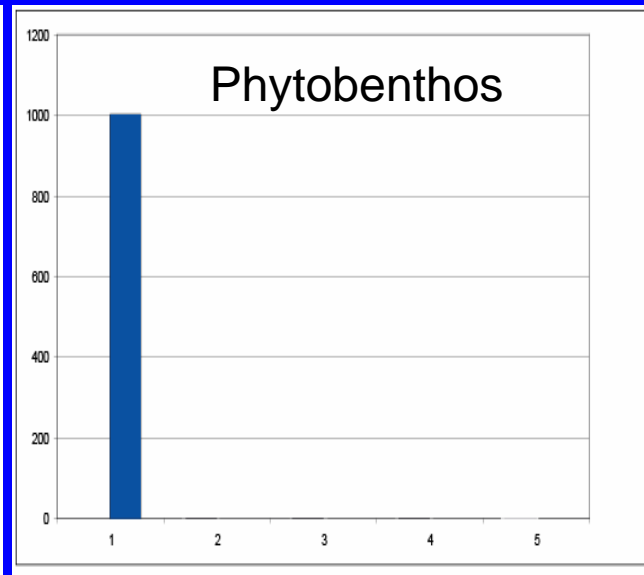
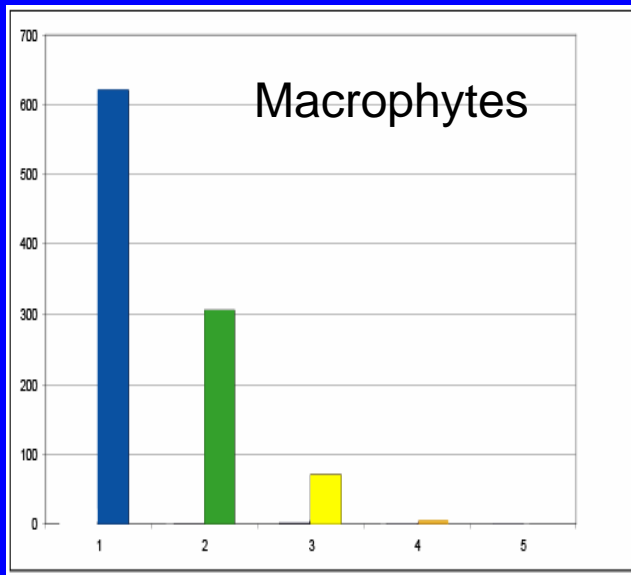
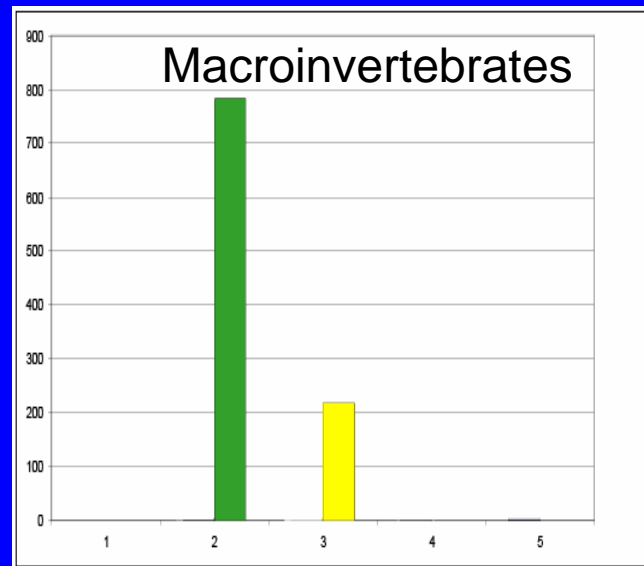
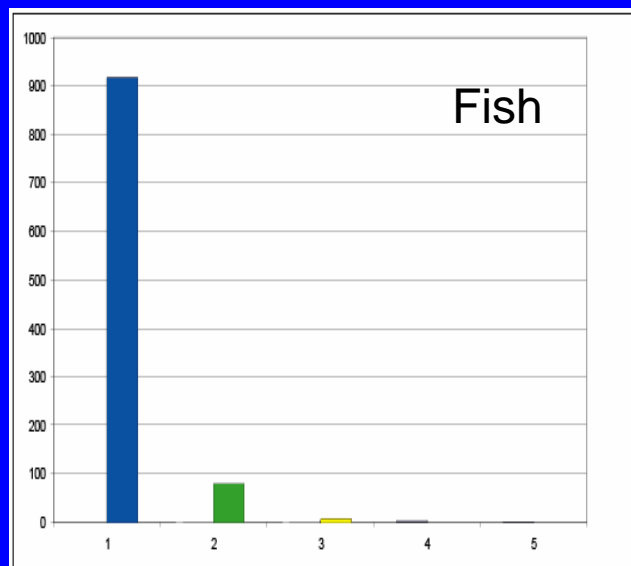
Variation in SD

- Calculated based on 6 streams pre-classified as references
- Macroinvertebrate indices:
 - ASPT SD 0.28 range 6.4 – 7.1
 - DSFI SD 0 range 7
 - Shannon-Wiener SD 0.52 range 3.12 – 4.10
 - Acid index SD 3.0 range 5 – 14
- MTR
 - SD 17 range 38 – 85
- Phytobenthos
 - IPS SD 1.61 range 15.2 – 19.7
 - IDG SD 2.08 range 13.6 – 19.6
- Fish
 - No of species SD 1.86 range 4 - 9
 - Weight SD 605 range 279 - 1756
 - No of individuals SD 93 range 22 - 267
 - Proportion of salmonids SD 0.18 range 0 – 0.44
 - Proportion of non-native species SD 0 range 0
 - Acid sensitive species score SD 0.82 range 1 - 3
 - *Not reproduction of salmonids*

Classification – with variation

Sandån

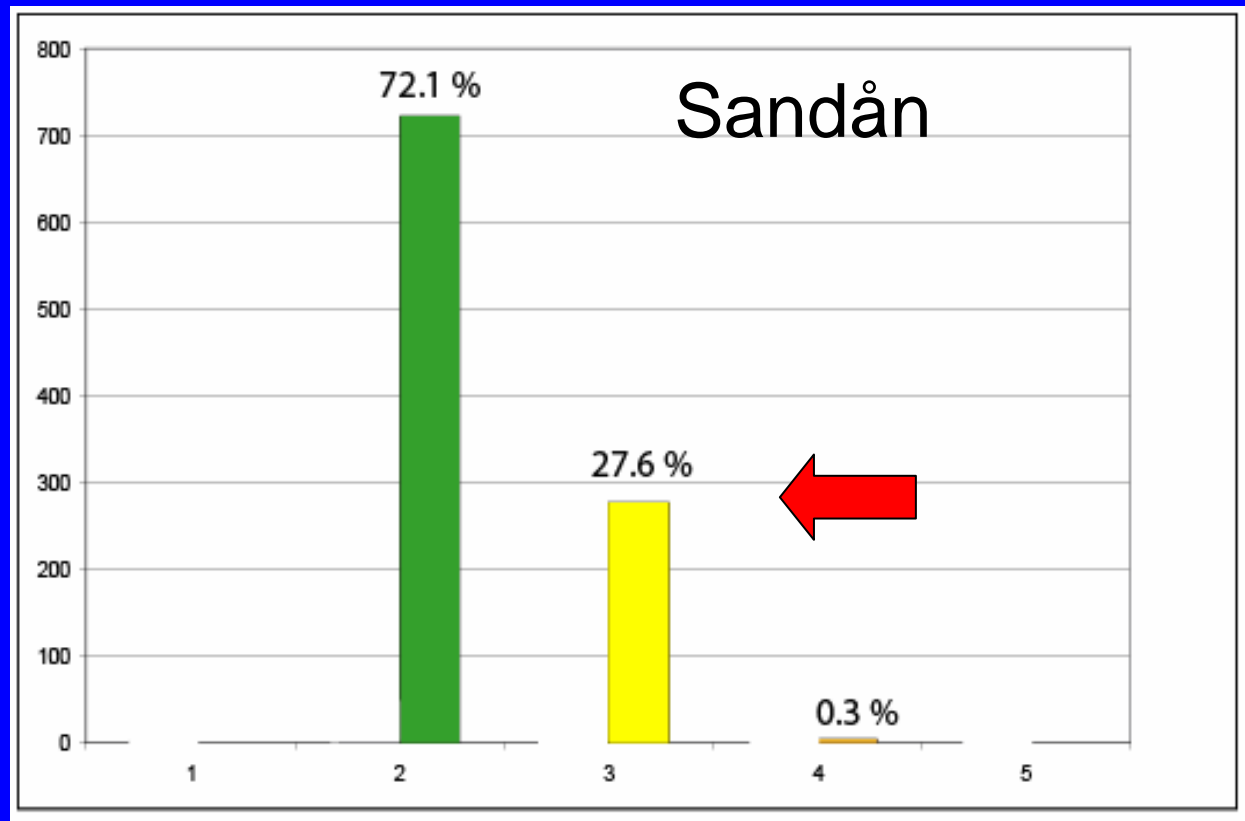
Probability of
classification
for each QE



ONE Out - ALL Out at the QE level

Probability of
classification
of the site

Using the
median of
parameters
for each QE

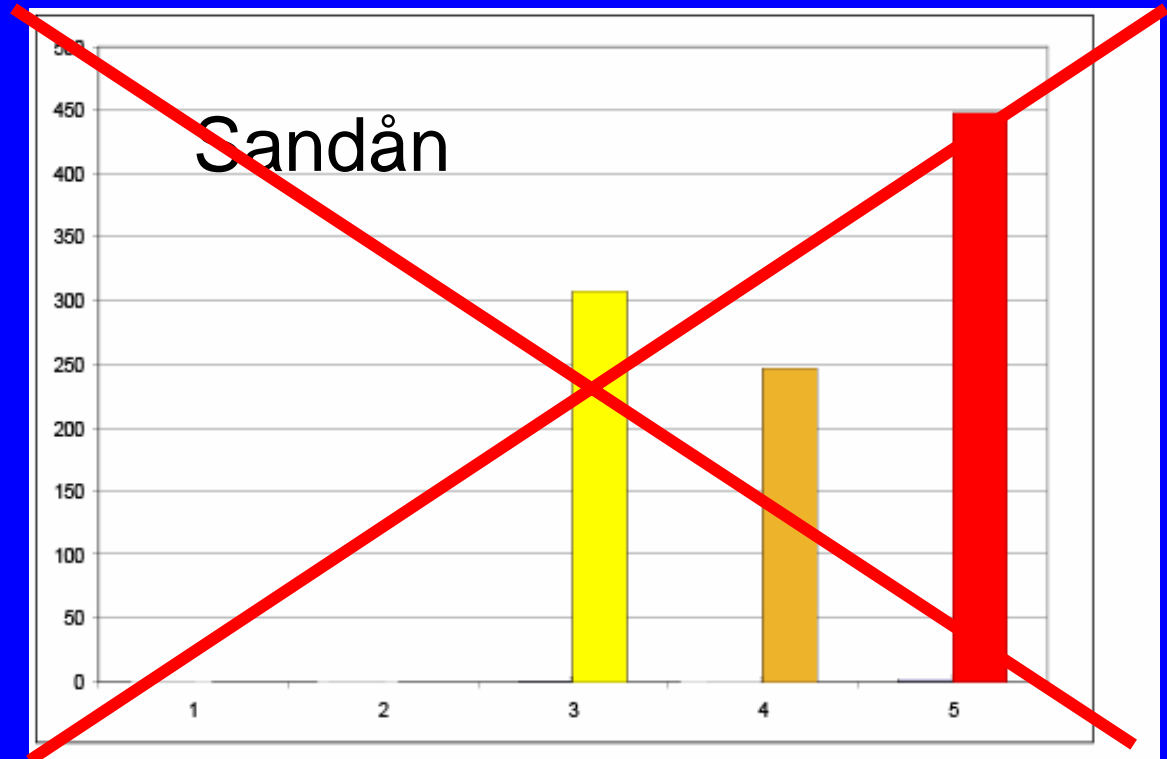


- The stream never classified as having a "High" status
- 28 % of the times the stream failed to be at least "Good"
- Need to take into account water chemistry and hydromorphology for "High" and "Good"

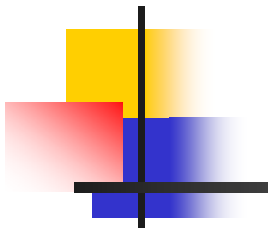
ONE Out - ALL Out at the parameter level

Probability of
classification
of the site

Using the
lowest value
of the
parameters
for each QE



- The stream never classified better than "Moderate"
- 44.7 % of the times the stream classified as "Bad"

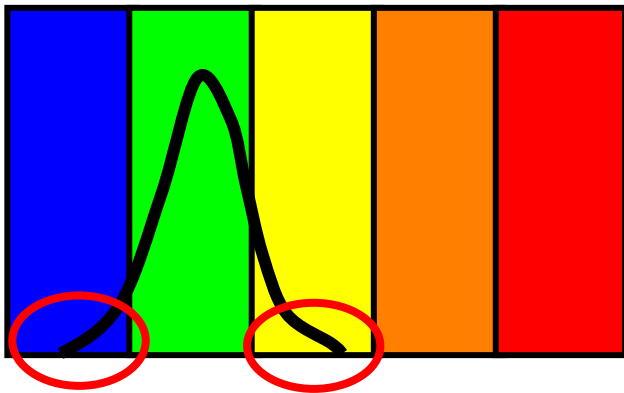


Discussion (1) :

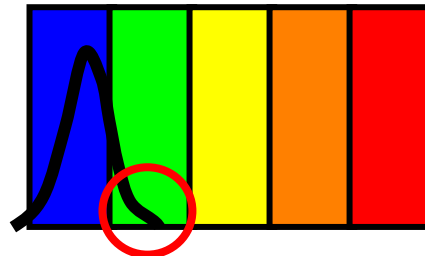
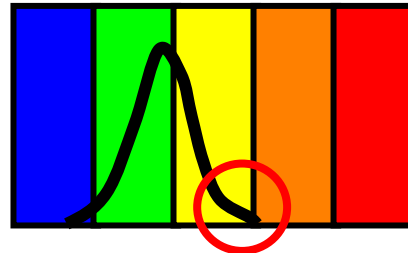
OO - AO and biological variability

- The Ecological status is a **conceptual object** - and the result of the classification process
- No index value are "True" :
 - there is no "standard" or "benchmark" to calibrate the ecological status
- Biological communities are intrinsically variable
 - A large part of the index variation is **natural**
- **The OO-AO rule introduce a bias** in the Ecological Status classification:
 - **Only the negative variations are taken into account**

Summing the negative variations



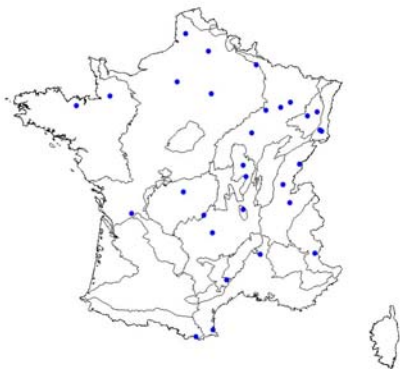
One QE:
Equal probability of
positive and negative
Variation to be taken into
account



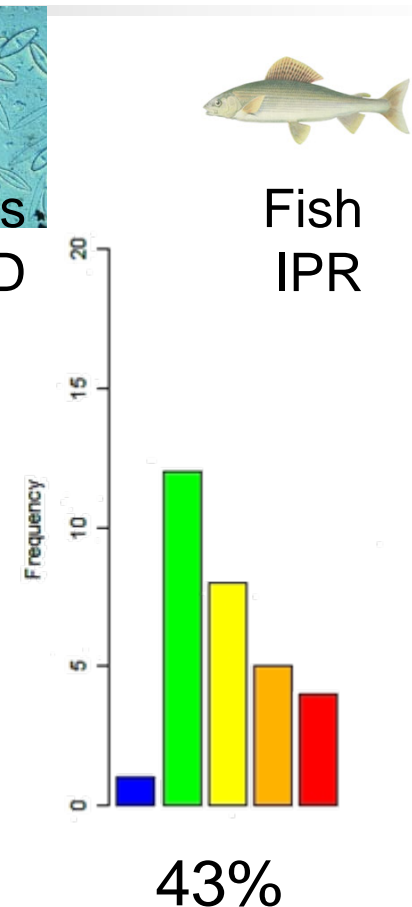
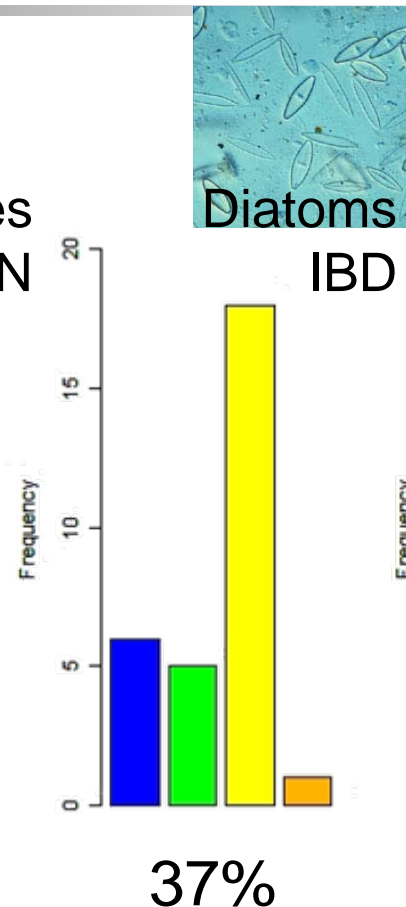
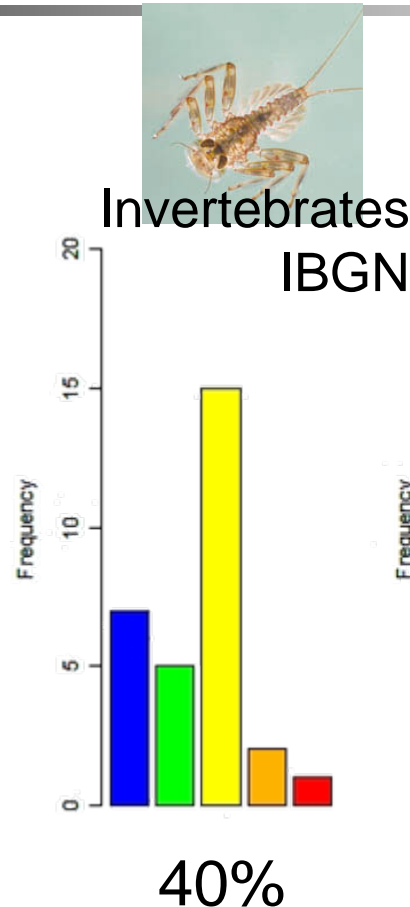
ONE Out - ALL Out
Only the **negative**
variation can
influence the final
classification

2 - Biological classification: testing OO-AO and alternatives

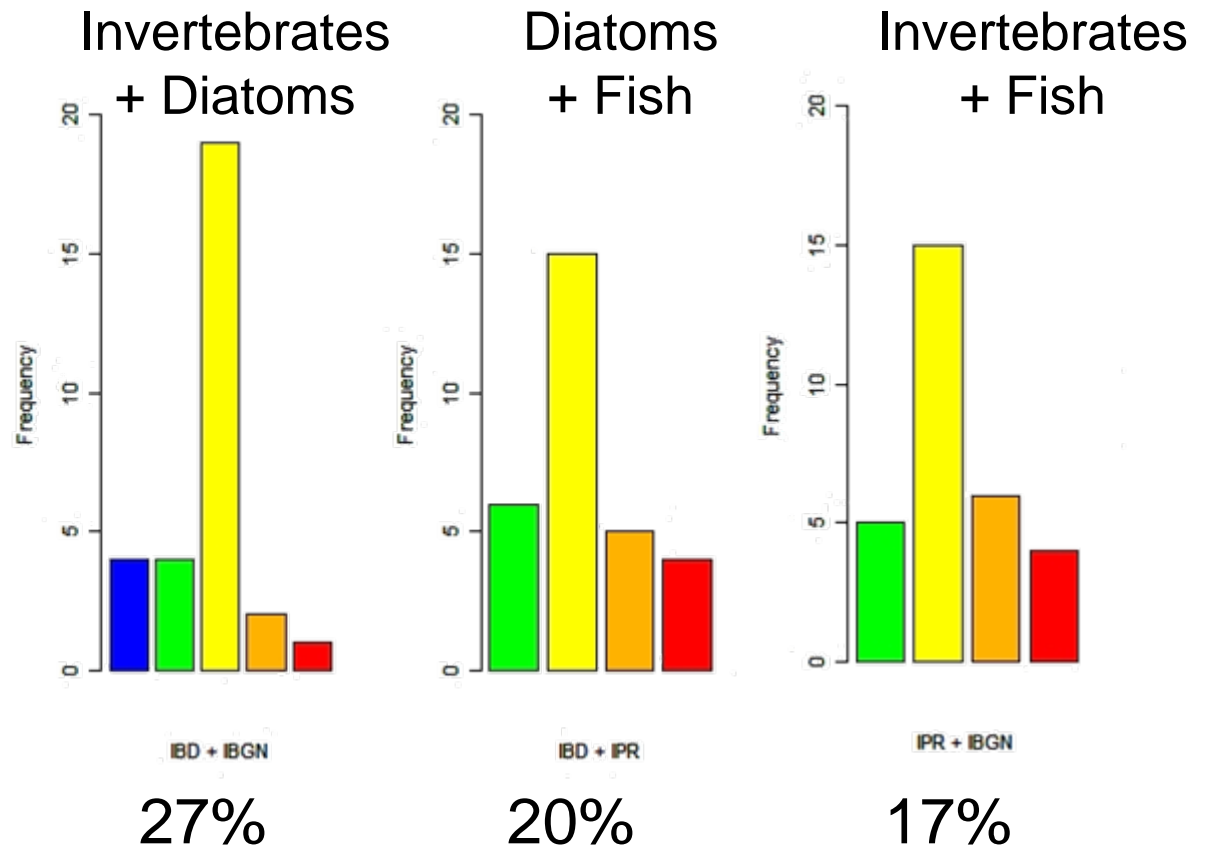
Test dataset:
30 sites
3 QE



% of "H + G"



ONE Out - ALL Out with two Biological QE



% of "H + G"

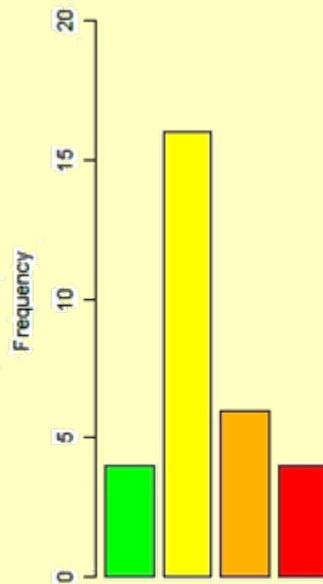
27%

20%

17%

ONE Out - ALL Out with Three Biological QE

**Invertebrates
+ Diatoms
+ Fish**



ONE OUT, ALL OUT

% of "H + G"

13%

**Invert.
40%**

**Diatoms
37%**

**Fish
43%**

**Invert.
+ Diatoms
27%**

**Diatoms
+ Fish
20%**

**Invert
+ Fish
17%**

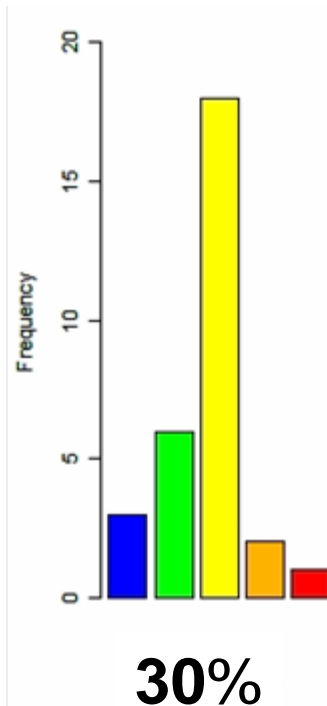
Then you add :
- *Macrophytes*
- *Physico-chemistry*

Alternative Classification (1): Averaging EQRs

Invertebrates
+ Diatoms
+ Fish

Mean EQR

% of "H + G"

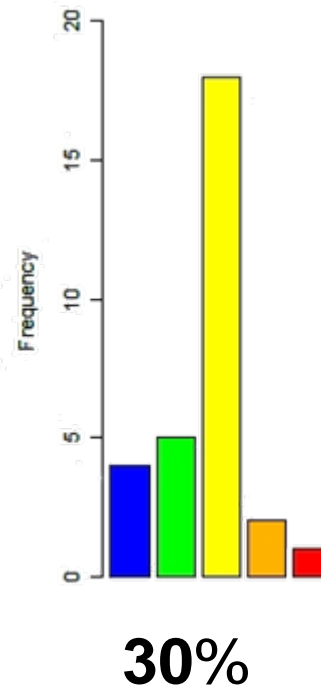


Weighted
Average EQR
I:2 - D:1 - F:1

Invertebrates

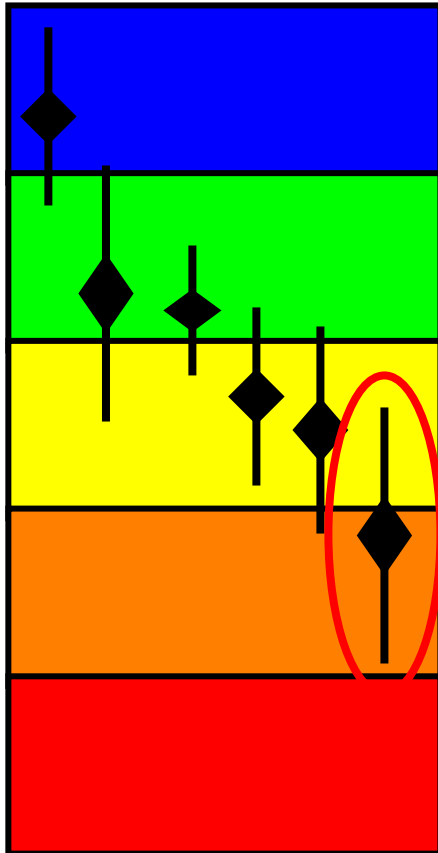
- 40 years experience
- More robust index
- All pressures

Weights can be adjusted by types
- e.g. Fish in large rivers



More ecologically relevant - No classification Bias

Taking into account the uncertainty



If the range of uncertainty for a QE equals one class width ($\pm 8 - 10 \%$), **the probability of misclassification is high with the OO-AO at the G/M level**

Application of the OO-AO at a lower level (moderate / poor):

- will reduce the Bias of misclassification
- could maintain the "philosophy" of the WFD concept

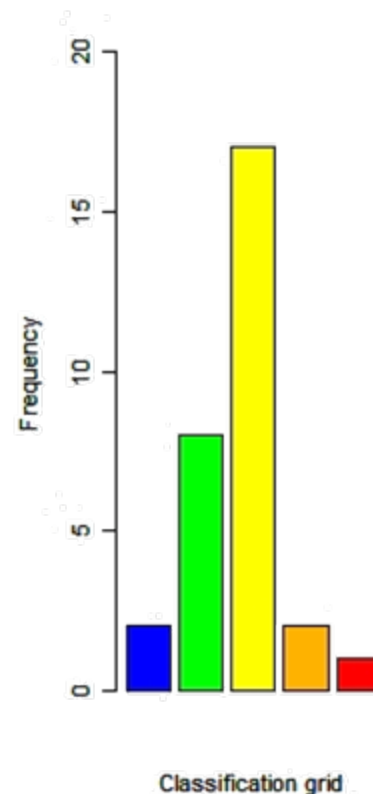
The classification of a site should never be based on a single sample ...

Alternative (2): Classification Grid

2/3 rule : at least two QE in a given class to classify the site in this class
- Index variability can be taken into account

	Invert	Diatoms	Fish	score decision
H	1	1	1	H<7
G	3	3	3	G<20
M	10	10	10	M<40
P	20	15	15	P<60
B	30	20	20	B>=60

**Needs harmonisation of
classification grids**



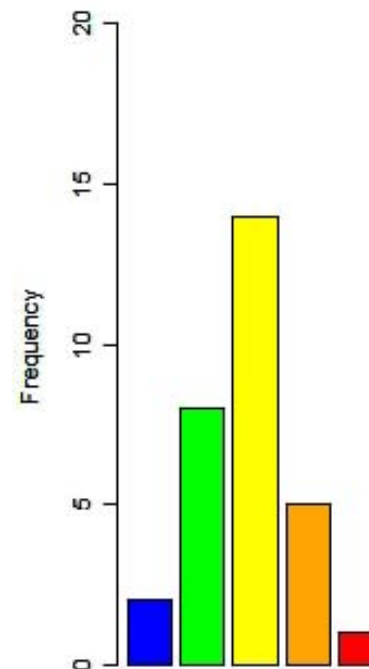
"H + G" = 33%

Alternative (2): "Safe" ONE Out - ALL Out

2/3 rule: at least two QE in a given class
OO-AO: at the "Poor status" level

	Invert	Diatoms	Fish	score decision
H	1	1	1	H<7
G	3	3	3	G<20
M	10	10	10	M<40
P	20	20	20	P<60
B	30	20	20	B>=60

More "expert" classification
Ecologically relevant
WFD Compliant ?



Classification grid 2

"H + G" = 33%



Discussion (2): ONE Out - ALL Out and Biological quality elements

- *Is the OO-AO principle really adapted to biological classification? Is it "Evaluation" or "Precaution" ?*
 - The "**one pressure / one response**" relationship is **theoretical!**
- The G/M boundaries were set with a relatively high level of exigency, i.e. higher than:
 - the Normative definition basic requirements
 - the thresholds of important ecosystem degradation
- **Averaging EQRs** could give an objective picture of the ecological status
- **Classification Grids** as decision support could help using the OO-AO principle - at a lower level- in a "**safer**" and **transparent** way

3 - Physico-chemical and Biological classifications

- A "bad" (i.e. < "good") Physico-Chemical status should correspond to a "bad" Biological status
 - If not, the PC Classification is too stringent - the expected impact does not appear -
- But a too low level exigency for PC will have counter-productive effects :
 - Not protective for biology
 - Not understandable
- **Examples for French rivers:**
 - Existing national PC Classification system : **SEQ Eau** (V.2)
 - Ecological status : **EQR-IBGN** (Invertebrate index)

Is there a need for harmonisation ?

General PC elements: regional approach - Organics

Organic Pollution:
O₂ BOD₅ COD NH₄ NKJ...

Lowlands

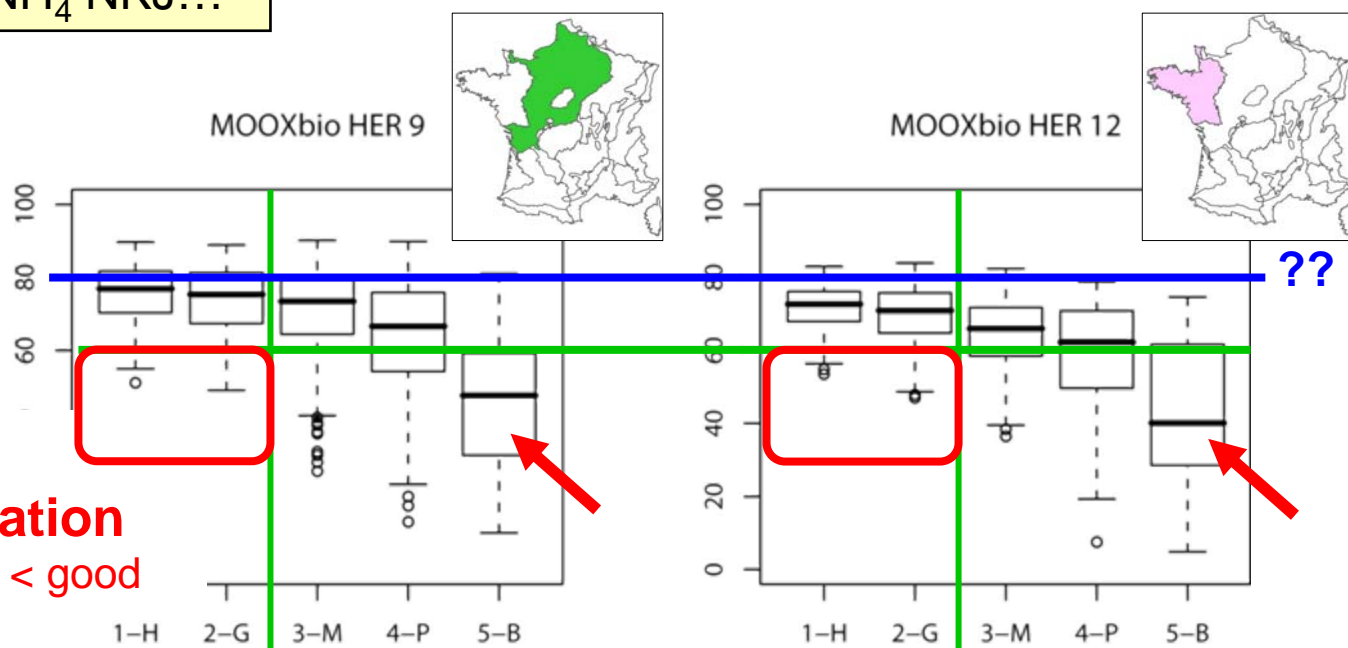
**SEQ Eau
Score**

H/G limit

G/M limit

**Low risk of
misclassification**

Bio ≥ good & PC < good



Invertebrate Classification : EQR -IBGN

General PC elements: regional approach - Phosphorus

Phosphorus:
 PO_4 , P_{tot}

Lowlands

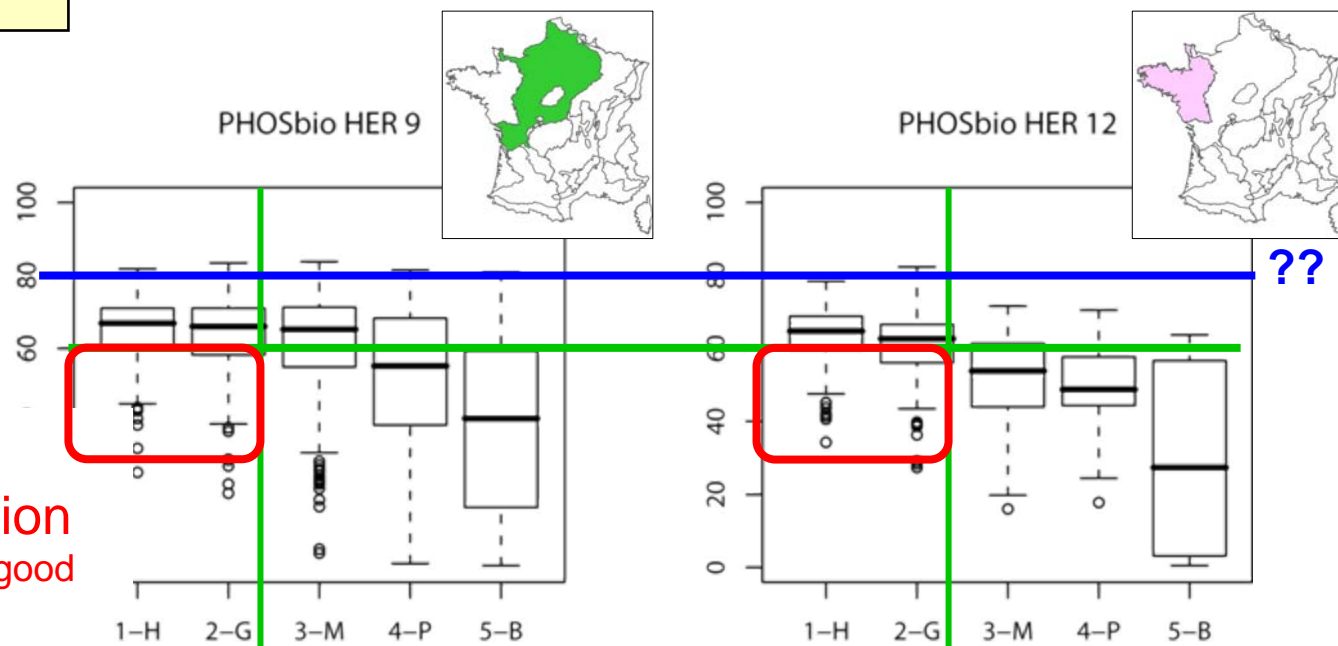
**SEQ Eau
Score**

H/G limit

G/M limit

**High risk of
misclassification**

Bio \geq good & PC < good



Invertebrate Classification : EQR -IBGN

General PC elements: regional approach - Organics

Organic Pollution:
O₂ BOD₅ COD NH₄ NKJ...

Middle Mountains

Alps

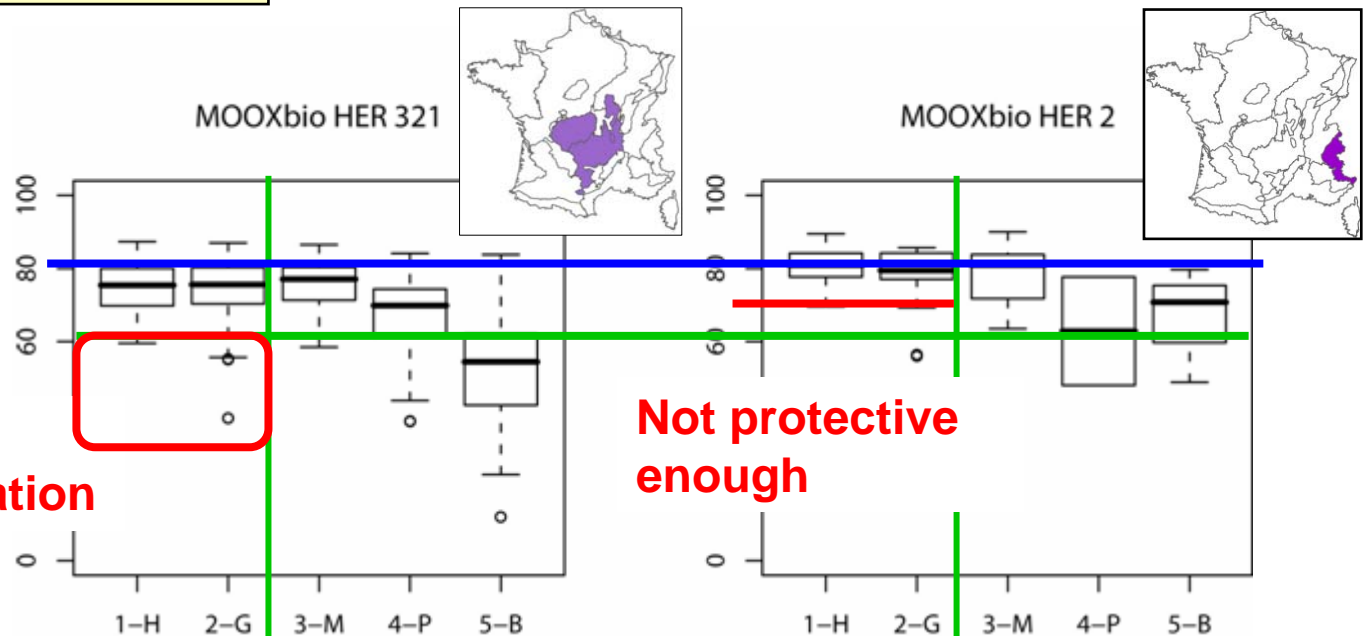
**SEQ Eau
Score**

H/G limit

G/M limit

**Low risk of
misclassification**

**Not protective
enough**



Invertebrate Classification : EQR -IBGN

General PC elements: regional approach - Phosphorus

Phosphorus:
 PO_4 , P_{tot}

Middle Mountains

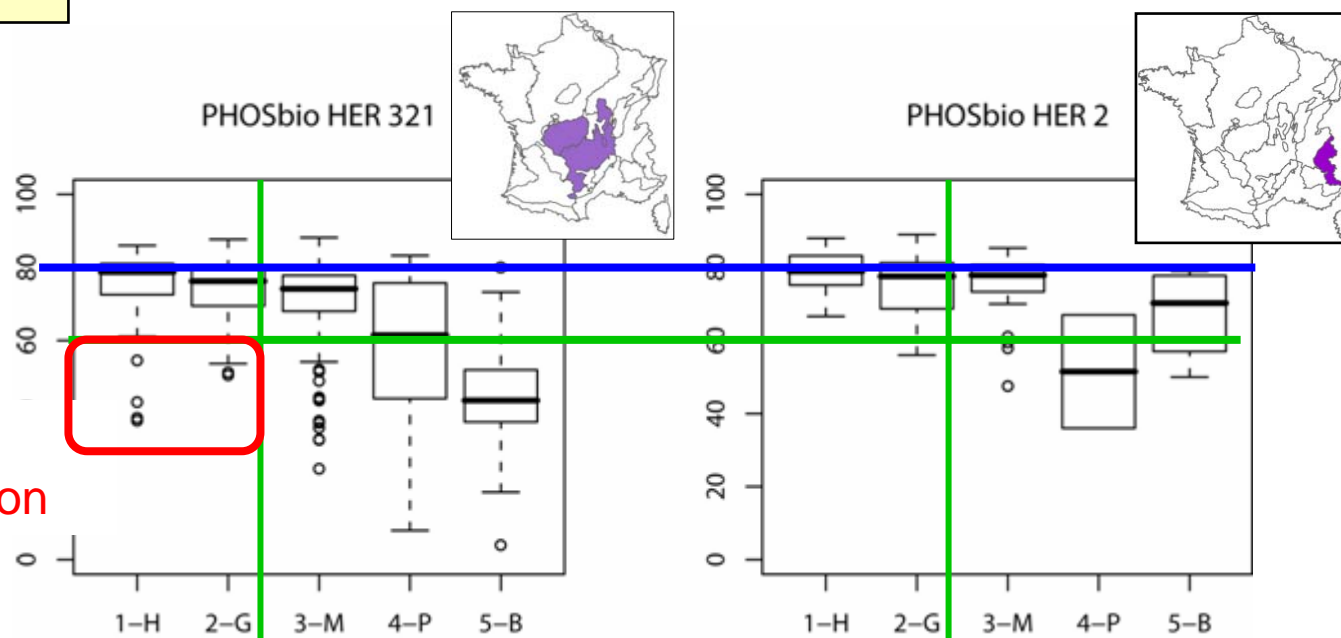
Alps

**SEQ Eau
Score**

H/G limit

G/M limit

**Low risk of
misclassification**

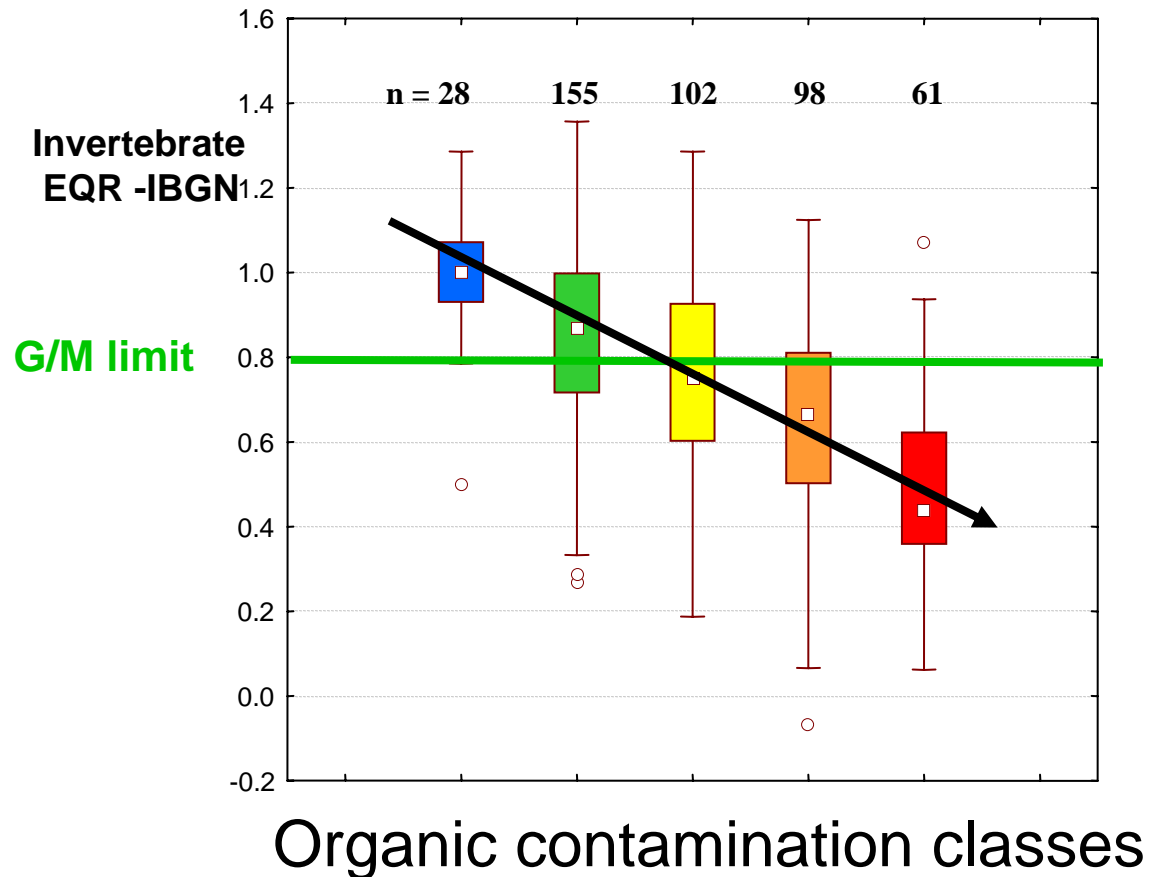


Invertebrate Classification : EQR -IBGN

Toxics contamination and ecological status

Test dataset : 444 sites
- Organic Pollution
- Toxic contamination
Water + sediment

Expected relationship
between Invertebrate
response and
Organic pollution



Toxic contamination and ecological status

Test dataset : 444 sites
- Organic Pollution
- Toxic contamination
Water + sediment

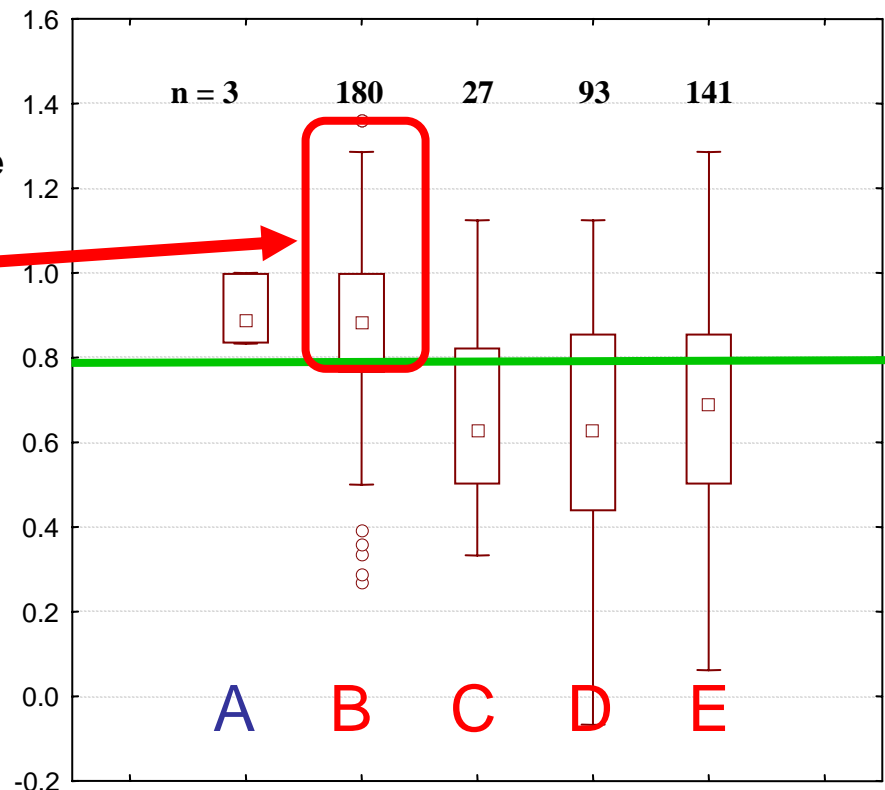
High probability of misclassification with toxic contamination alone

Sites grouped according to their dominant pollution

A - no pollution
B - only Toxics
C - Toxic > organic
D - Organic > toxic
E - Organic = toxic

Invertebrate
EQR -IBGN

G/M limit





Discussion (3): Physico-Chemical and Biological quality elements

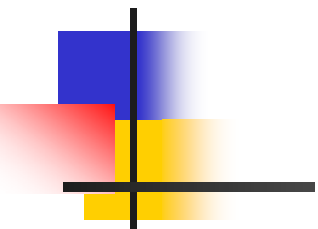
- **Strong need for harmonization** of Biological and Physico-chemical classifications.
- **French SEQ Eau: good starting point for the G/M limit**, but needs adjustments (up and down)
 - For some river types (regional scale),
 - For some PC parameters
- But the **High/Good** limit must be totally **revised**
- **Toxic contamination alone** : high probability of **discordance** with biological classification



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Merci
Thank you
Danke
Takk
Hvala
Multumesc
Köszönöm
Grazie
Gracias
Obrigado

...

