Impacts of chronic and pulse pesticide exposures on periphyton communities

Agnes Bouchez, Ahmed Tlili, Annette A. Berard, Bernard Montuelle

7th Symposium for European Freshwater Sciences

Impacts of chronic and pulse pesticide exposures on periphyton communities

Agnès BOUCHEZ, Ahmed TLILI, Annette BERARD, Bernard MONTUELLE

ALIMENTATION
AGRICULTURE
ENVIRONNEMENT

River biofilms

Eukaryotic

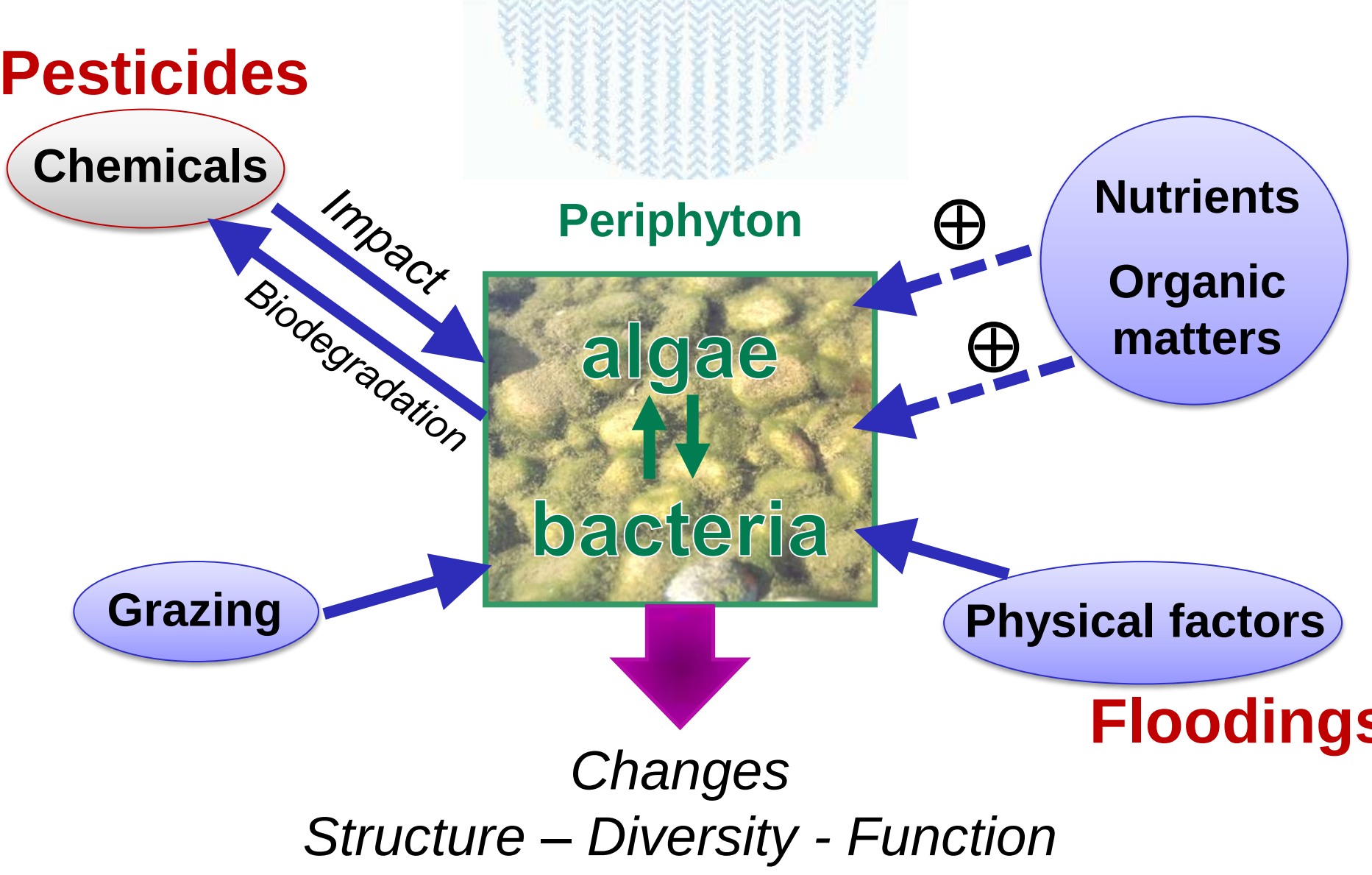
Prokaryotic

Periphyton

Phototrophic

Heterotrophic

- basic aquatic biocenosis
- key roles in aquatic ecosystems
- good bio-indicators of ecological quality


Pesticides
Chemicals
Impact
Biodegradation
Periphyton
algae
bacteria
Nutrients
Organic matters
Grazing
Physical factors
Floodings
Changes
Structure – Diversity - Function

TOX
Acute exposure
(flooding → pulses)

Pulse frequency
Pulse intensity

TOX
Chronic exposure

- **Structural changes**
- **Functional changes (PICT Pollution Induced Community Tolerance)**

Intensity and frequency of the exposition to pesticides may modify their impact on the microbial communities.

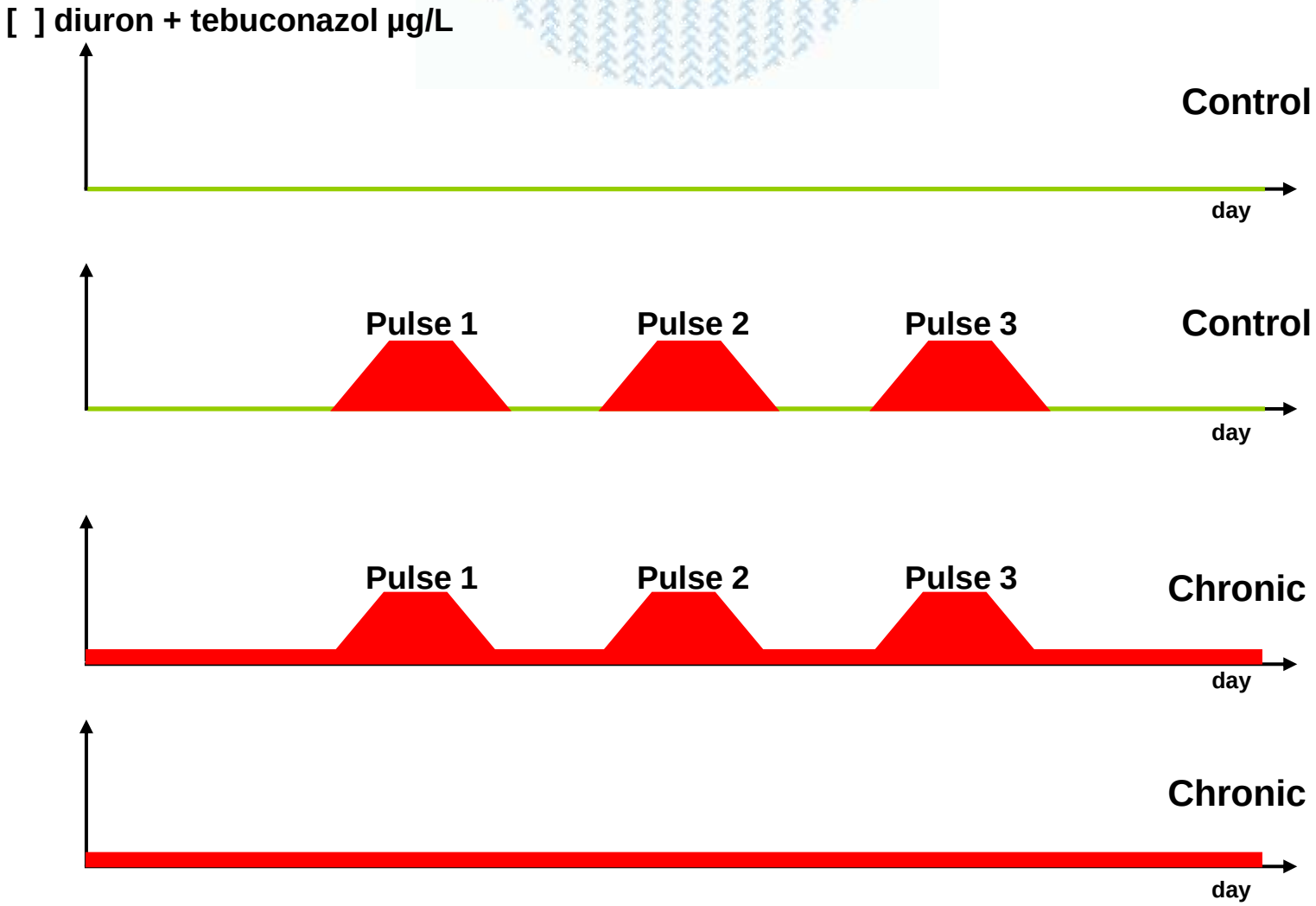
4 artificial streams
INRA Thonon – France
(provided by LSE)

Herbicide: diuron
Fungicide : tebuconazol

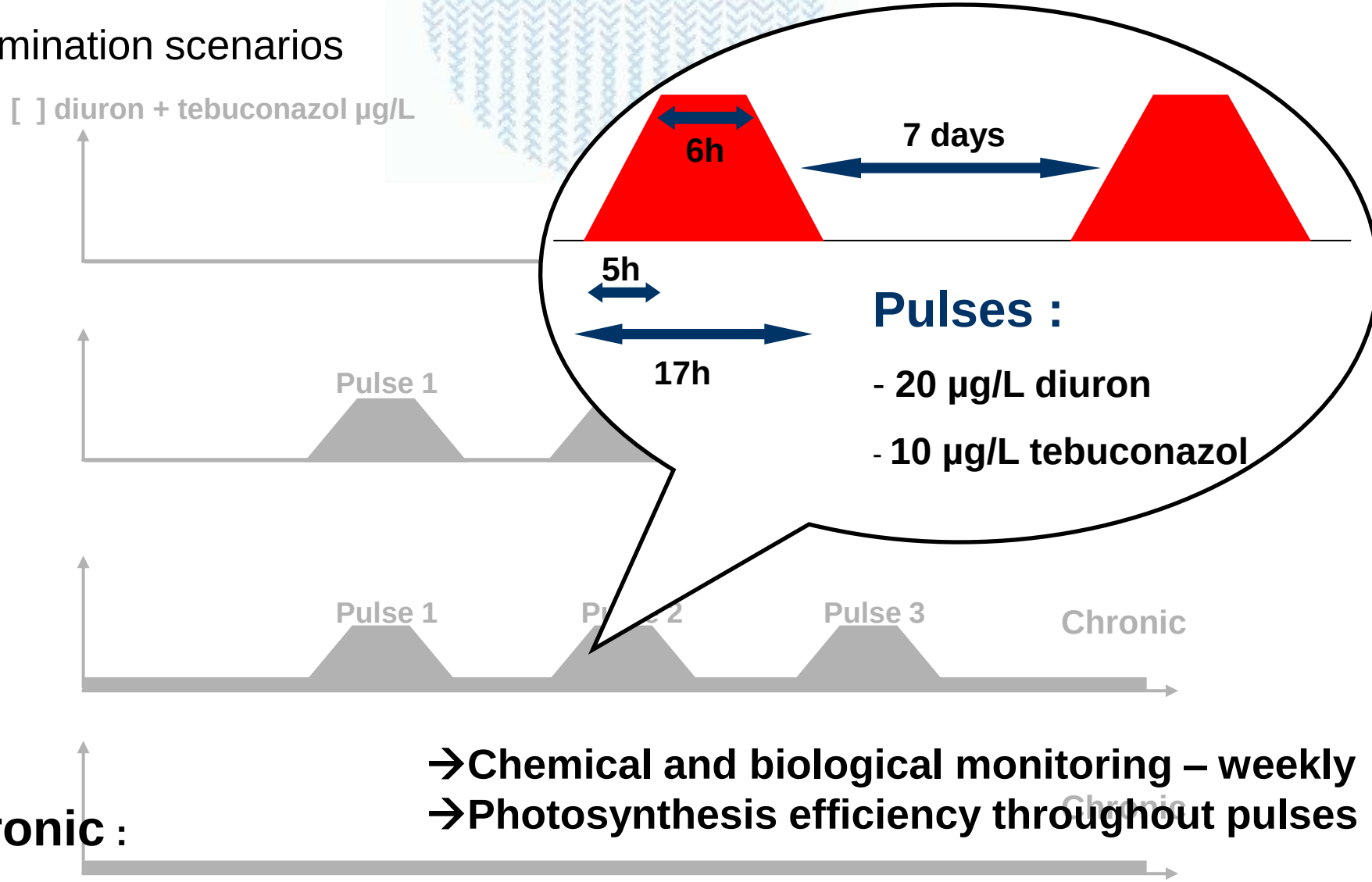
Fixed periphyton (glass plates)

Impacts on <u>algae</u>: structural - functional

Contamination scenarios



Contamination scenarios

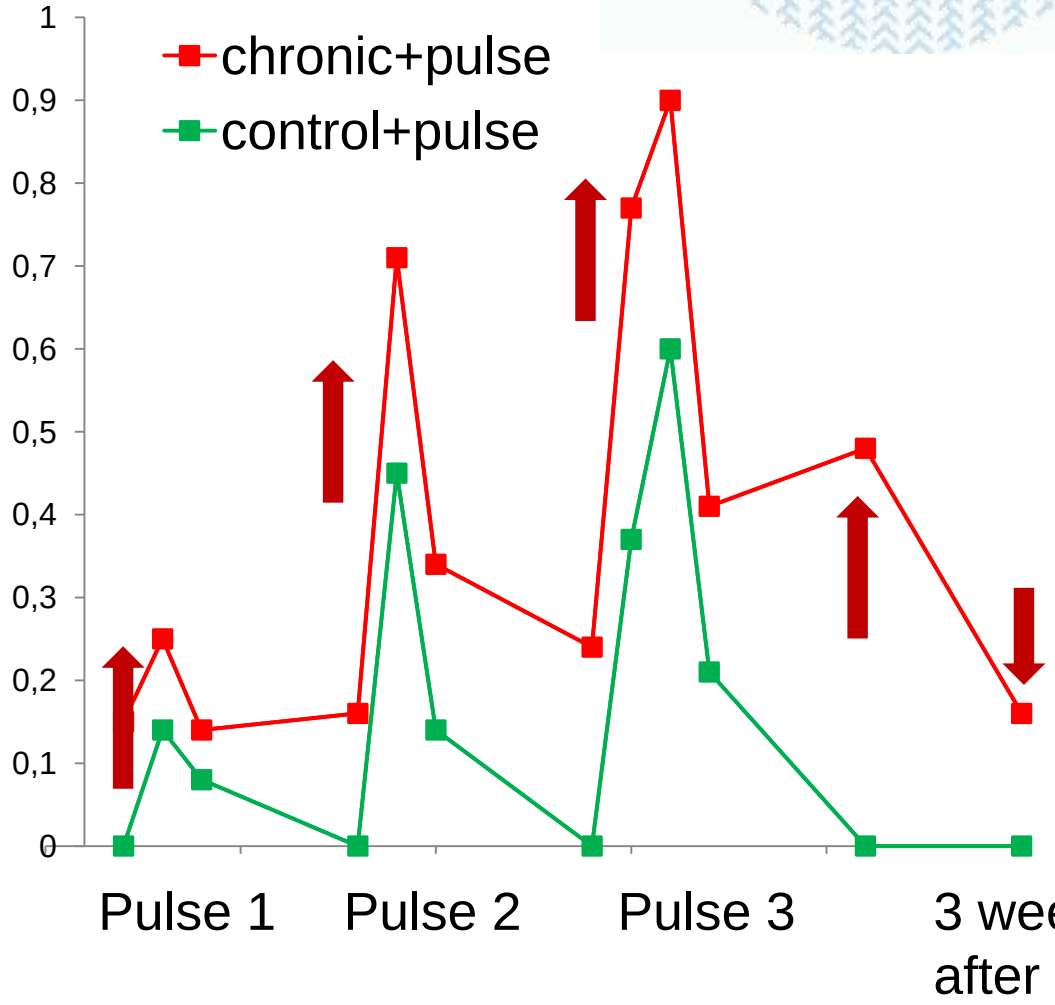


→Chemical and biological monitoring – weekly
→Photosynthesis efficiency throughout pulses

Chronic :

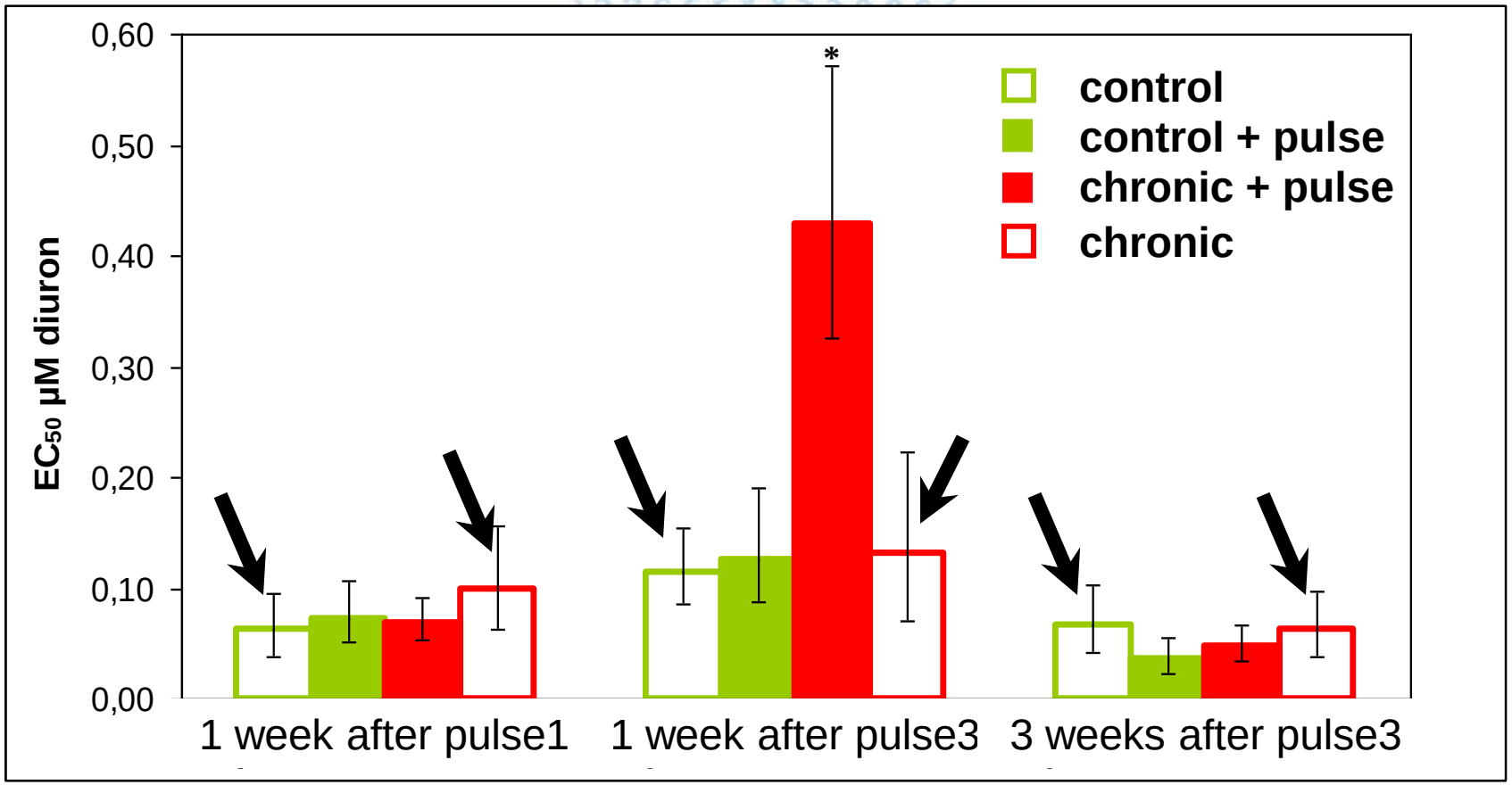
1 µg/L diuron + 0.5 µg/L tebuconazol

Diuron concentrations in periphyton



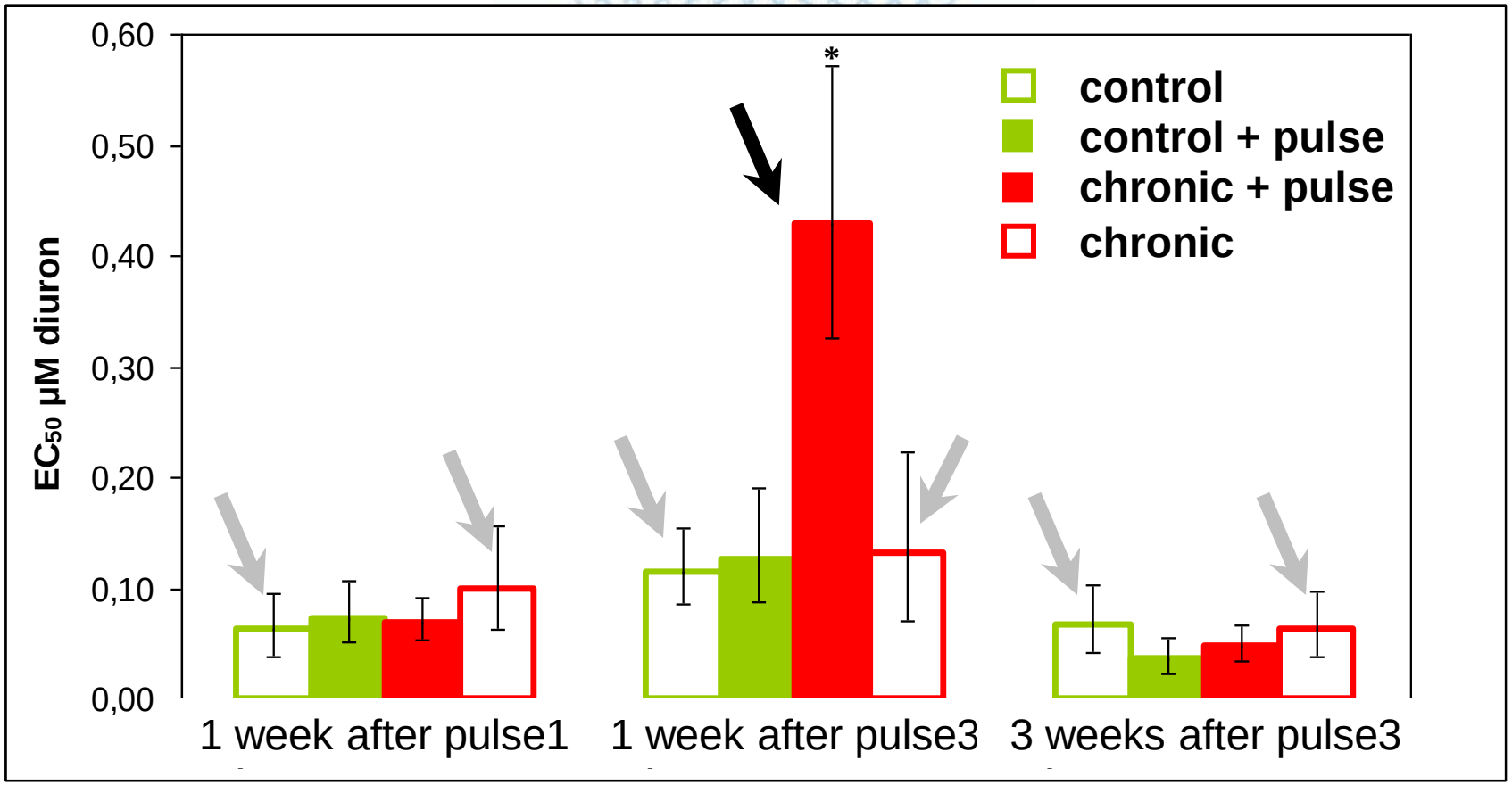
- accumulation of diuron in periphyton undergoing pulses (increasingly)
- persistent 1 week after the last pulse when chronic contamination
- back to chronic level 3 weeks after the last pulse

Diuron tolerance (biotests / photosynthesis)



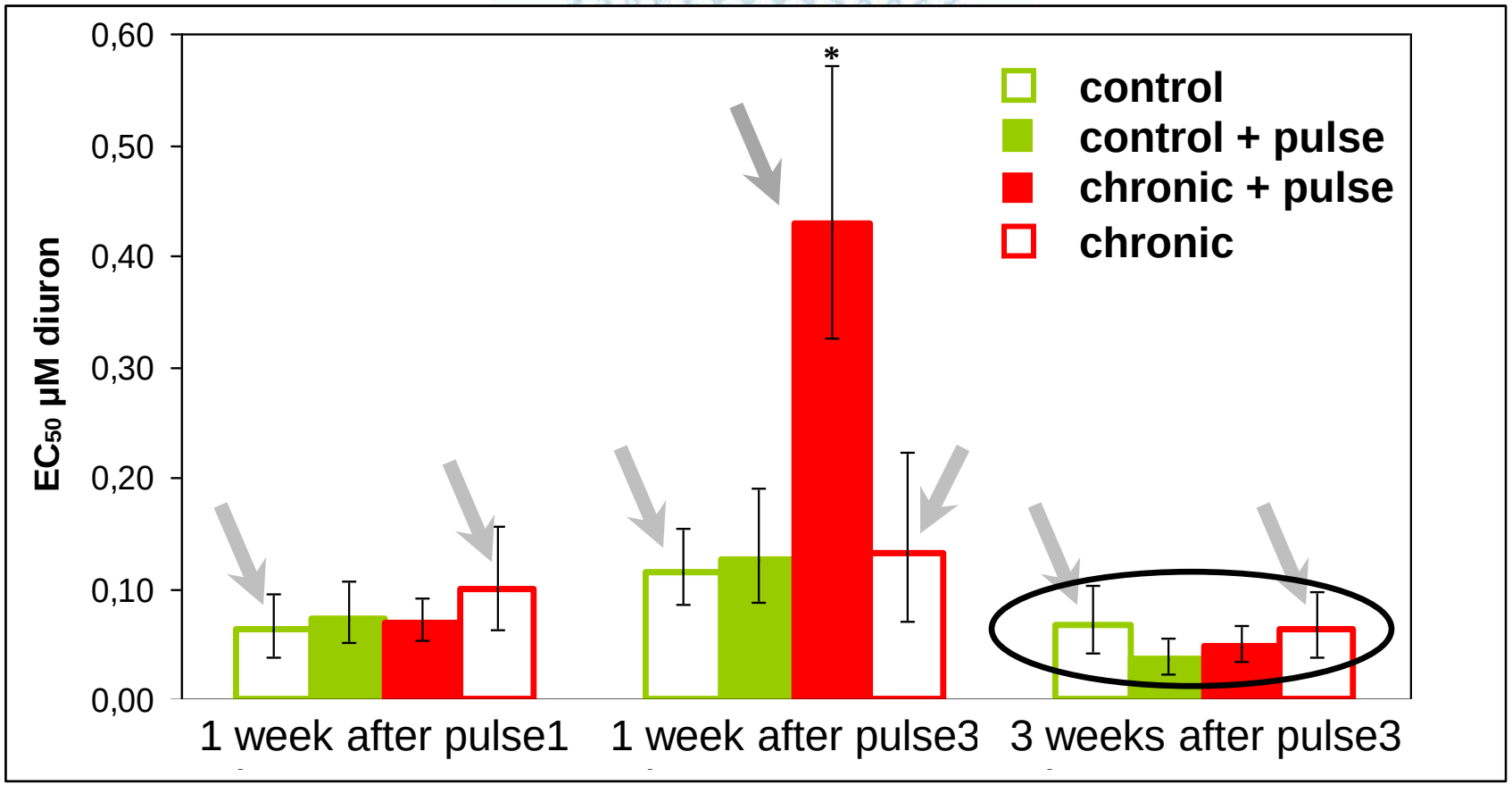
- the chronic exposure does not induce tolerance acquisition

Diuron tolerance (photosynthesis)



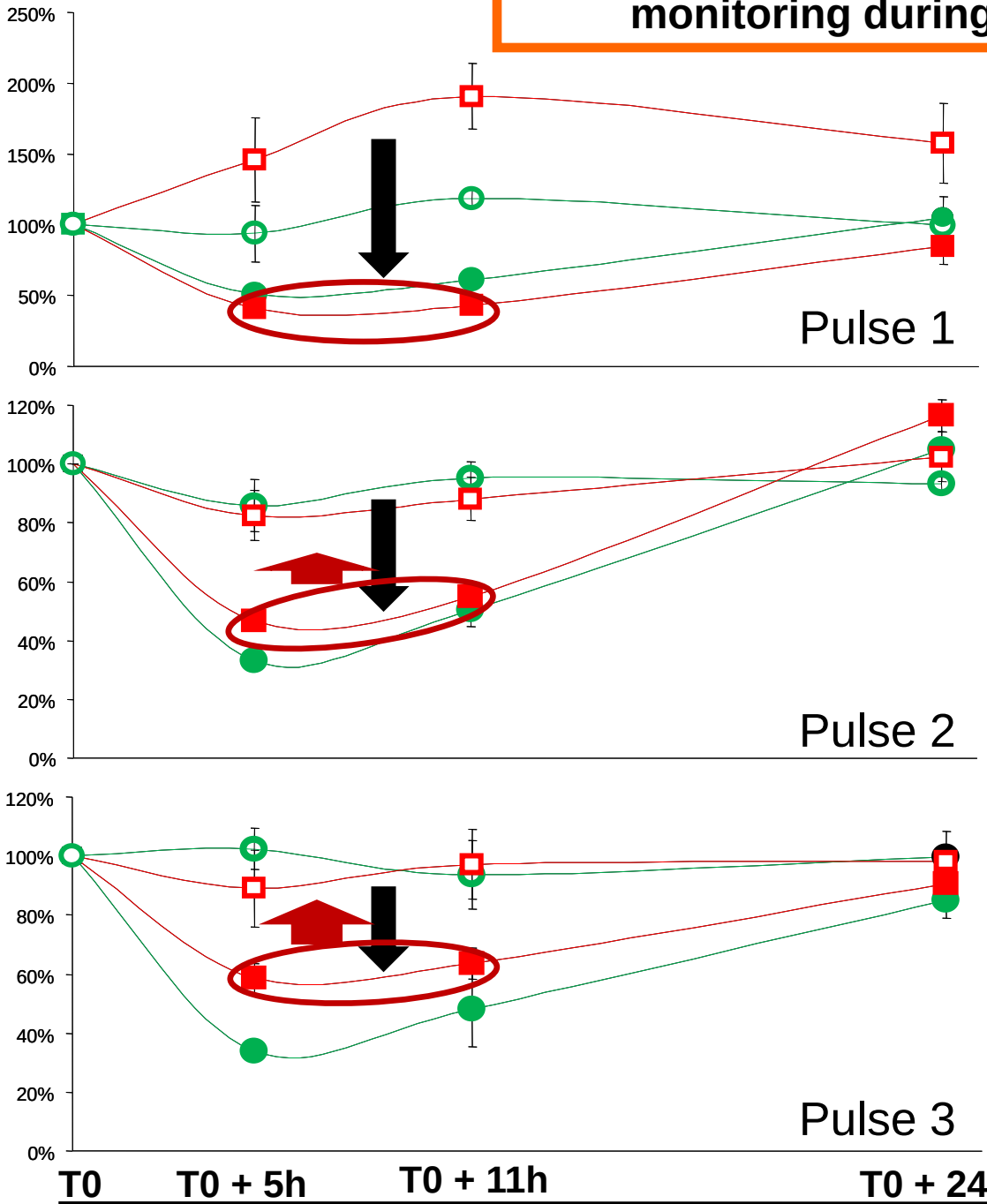
- the chronic exposure does not induce tolerance acquisition
- cumulative effect of chronic + acute exposure on tolerance acquisition

Diuron tolerance (photosynthesis)



- the chronic exposure does not induce tolerance acquisition
- cumulative effect of chronic + acute exposure on tolerance acquisition
- after 3 weeks disappearance of acquired tolerance

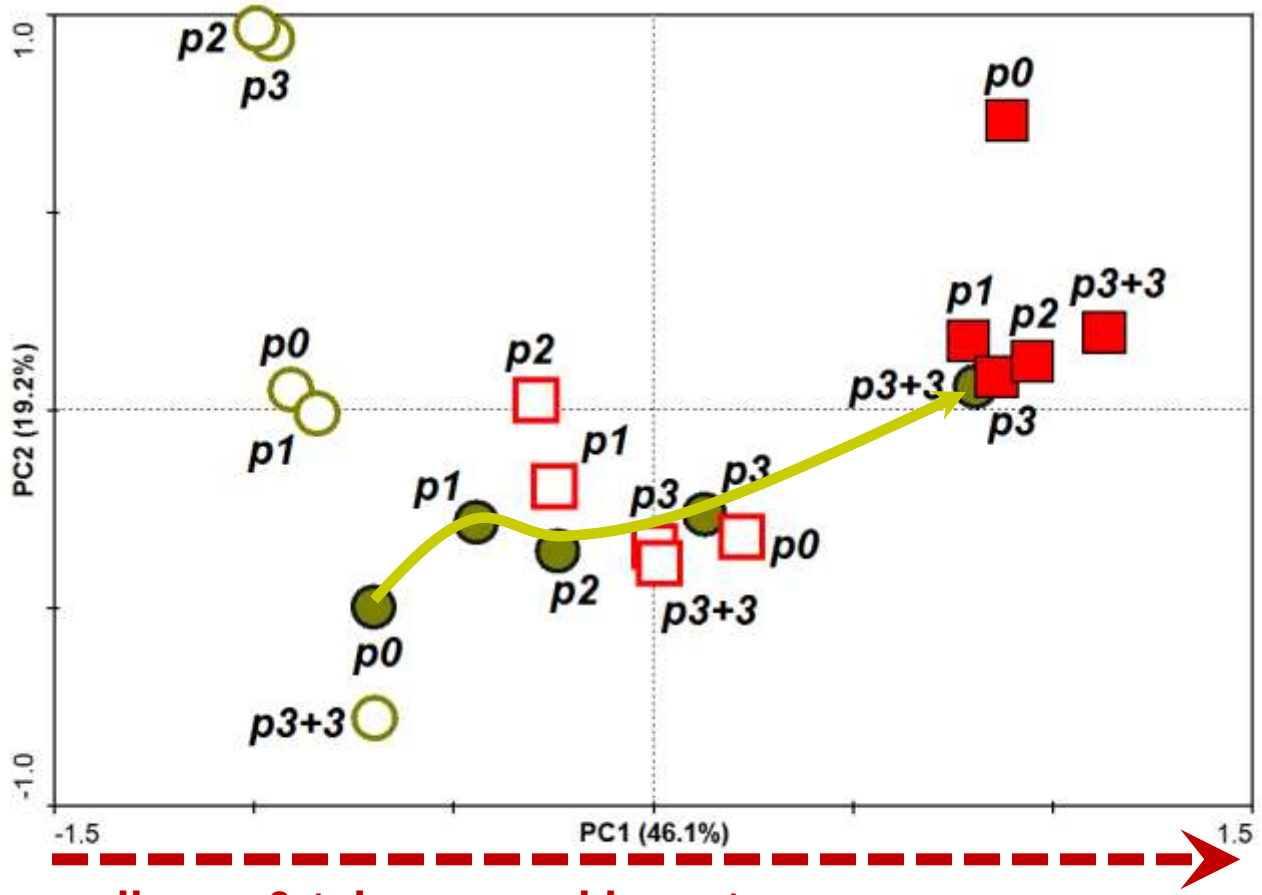
Photosynthetic efficiency monitoring during pulses



- Pulse effect : inhibition
- After successive pulses, chronically-exposed periphyton becomes less sensitive to pulses

control
control + pulse
chronic + pulse
chronic

eukaryotic diversity (DGGE 18S)

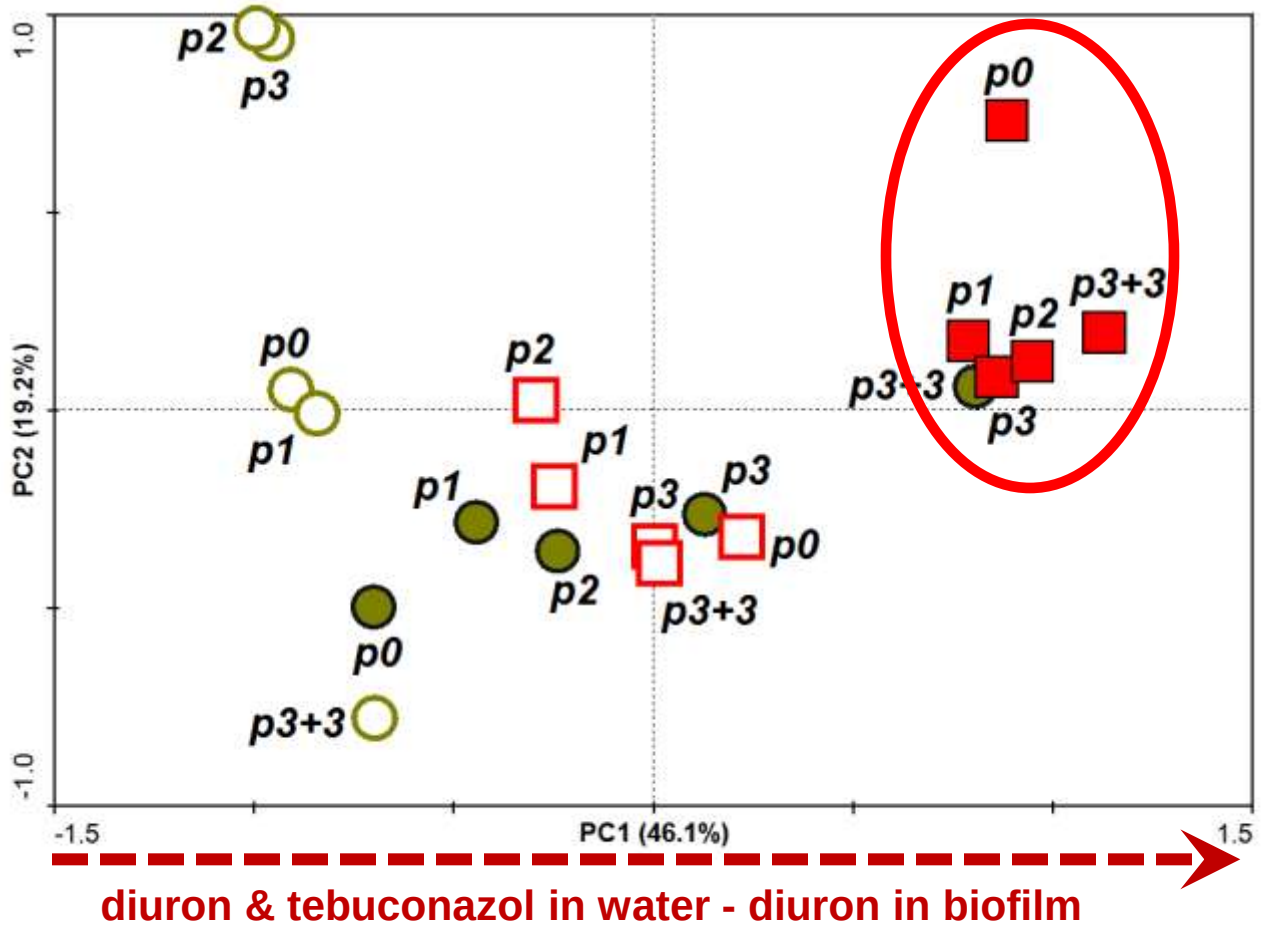


diuron & tebuconazol in water
diuron in biofilm

control
control + pulse
chronic + pulse
chronic

- structuring effect of pulses on the diversity of the eukaryotic community

eukaryotic diversity (DGGE 18S)



- control
- control + pulse
- chronic + pulse
- chronic

- structuring effect of pulses on the diversity of the eukaryotic community
- no effect of pulses on eukaryotic diversity of biofilms submitted to the chronic exposure

(1) **Acquired tolerance** to xenobiotics is strongly **modulated by the exposure history** of the biofilm microbial communities.

(2) **Cumulative effects** of (i) **chronic** and **acute** exposures and (ii) **successive acute** exposures.

(3) **Structural changes** of microbial communities **not necessarily induce functional changes** in these communities and vice versa.

(4) **Functional restoration** within a few weeks, **remaining structural effect** on the algae community.

and then ?

- Combine pesticides exposure with hydraulic aspects of flooding
- *In situ* impacts

acknowledgments

ONEMA French national agency
for water and aquatic ecosystems

PADYMA national program

P. Perney, B. Le Berre, P. Chifflet in the INRA lab

C. Guillemain, C. Margoum in the Cemagref lab