

Validation of the zebra mussel as a relevant tool for active biomonitoring approach (BIOESSAI & BIOMOSE Programs)

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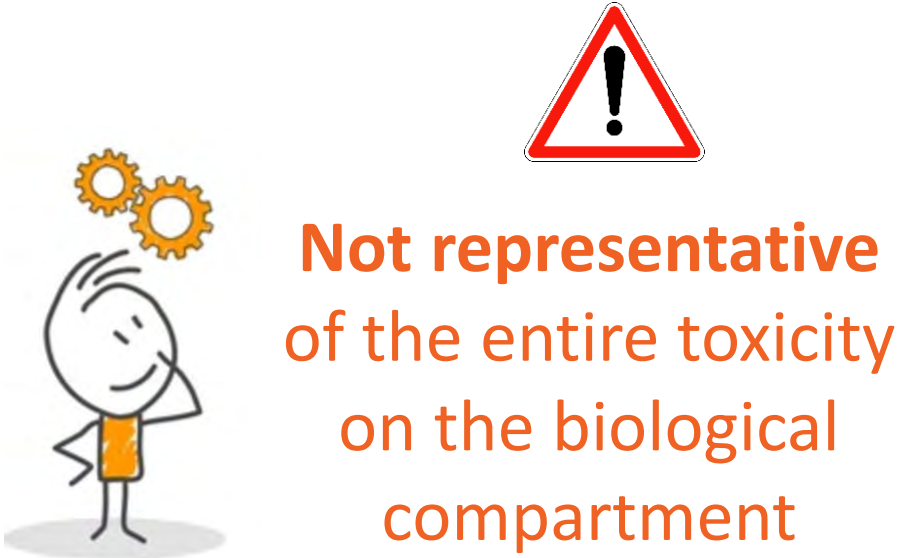


REGULATORY CONTEXT

Chemical contamination of water bodies

European legislation : Water Framework Directive (WFD)

Chemical analysis (NQE) (Water, sediment and biota)



Ecological analysis (populations, communities)



New Tools are needed to meet the WFD regulations on bioaccumulation and to extend ecotoxicological impact diagnosis

Main objective : Validate the use of the zebra mussel (*Dreissena polymorpha*) in active biomonitoring strategies based on the methodology developed within the framework of BIOESSAI and BIOMOSE programs

PROPOSED TOOL

Biomonitoring

Methods for detecting pollutants in the biological compartments of environments and evaluating their effects on organisms (Forbes and Forbes, 1997)

Active biomonitoring : Caging organisms from a reference site

- ✓ Possibility to assess a site where the sentinel species is difficult to access
- ✓ Calibration of individuals used (sex, age, size)
- ✓ Controlled exposure conditions (location, time)

(Catteau et al. 2022)



Zebra mussel (*Dreissena polymorpha*)

- Freshwater mussel
- Adult : from 2cm to 3cm
- Sessile filter feeder
- Bioaccumulate pollutants in tissues
- Ecotoxicological sentinel species

METHODOLOGY

4 campaigns between 2021 and 2023 at different seasons



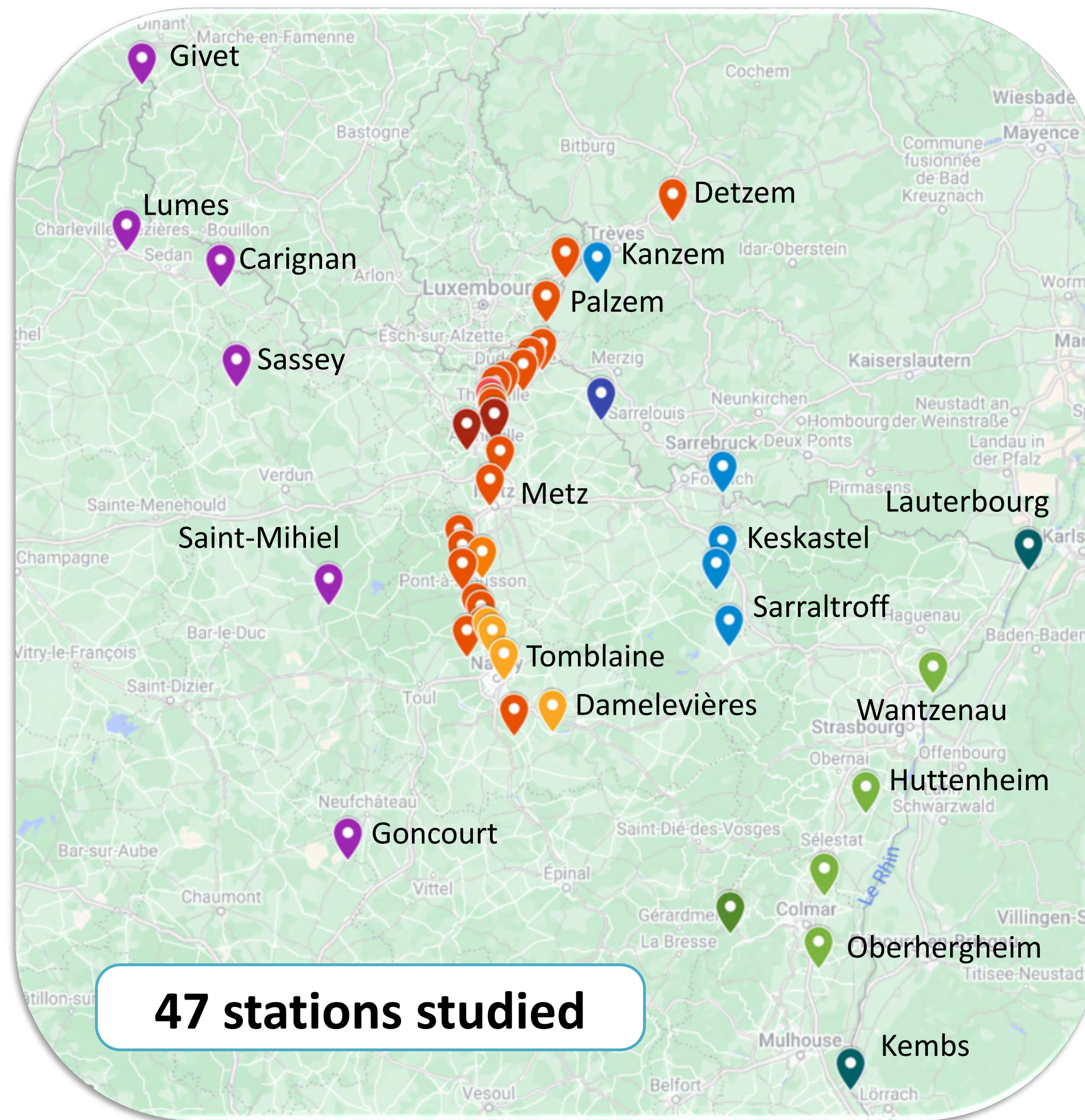
Mussels from Lac du Der maintained several weeks in the laboratory

3 weeks of caging

Laboratory analyses



- Moselle River (and tributaries)
- Meuse River
- Sarre River (and tributaries)
- Rhin River (and tributaries)

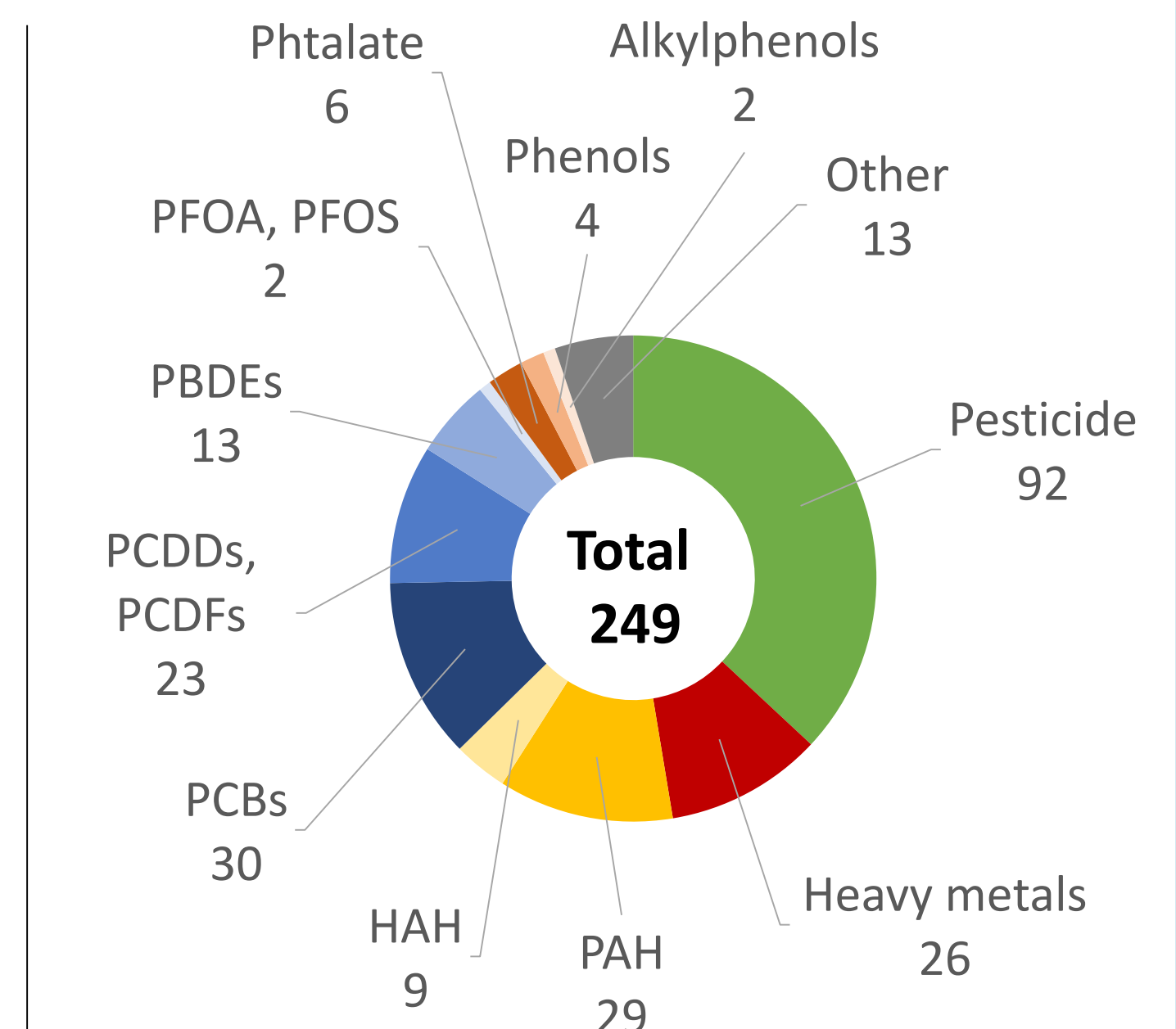


47 stations studied

CHEMICALS BIOACCUMULATION

249 chemicals assessed in the mussel tissues

- PFOA, PFOS:** Per- and polyfluoroalkyl substances, Perfluorooctanesulfonic acid
- PBDEs:** Polybrominated diphenyl ethers
- PCDDs, PCDFs:** Polychlorinated dibenzodioxins, Polychlorinated dibenzofurans
- PCBs:** Polychlorinated biphenyls
- HAH:** Halogenated aromatic hydrocarbons
- PAH:** polycyclic aromatic hydrocarbon



BIOMARKER RESPONSES

Biomarker : A biochemical, cellular, physiological, or behavioral variation that can be measured in a tissue, or entire organism, highlighting the exposure or effects of a stressor (Depledge, 1994)

GENOTOXICITY

DNA damages

IMMUNOTOXICITY

Haemocytes necrosis
Phagocytosis capacity
Phagocytosis avidity
Phenoloxydase

CELLULAR DEATH

Caspase 3

Energy ACQUISITION

Amylase
Lipase
ALAT

Energy USING

METABOLIC DETOXICATION

Energy reserves
ETS
CEA

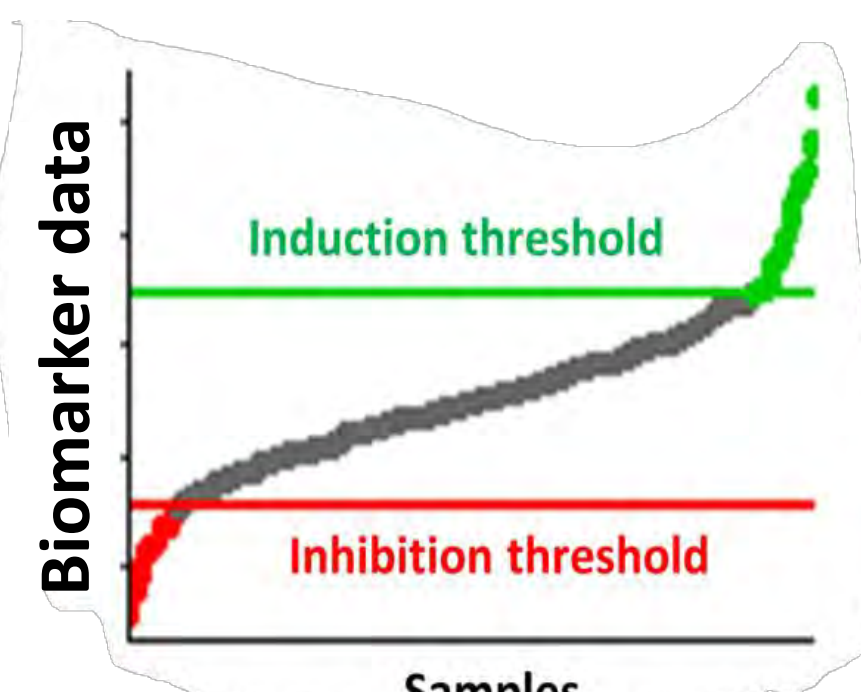
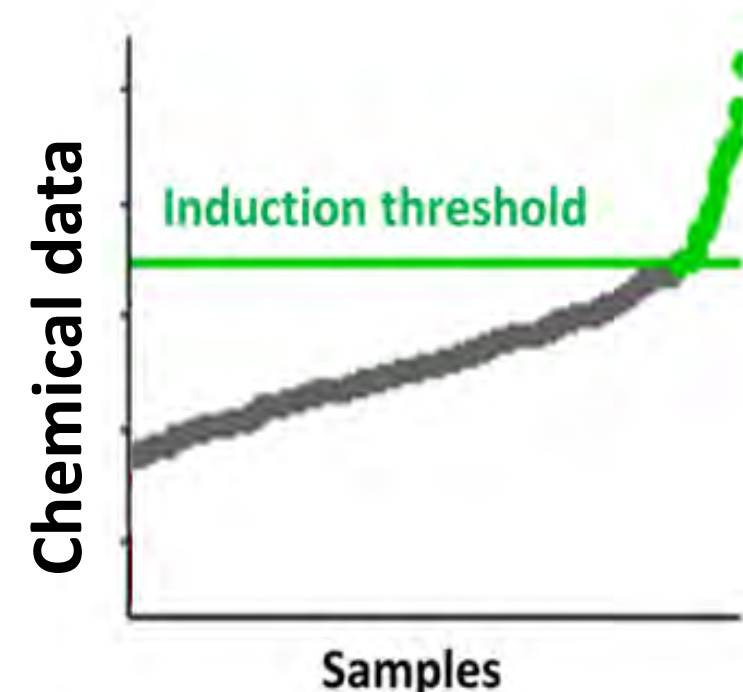
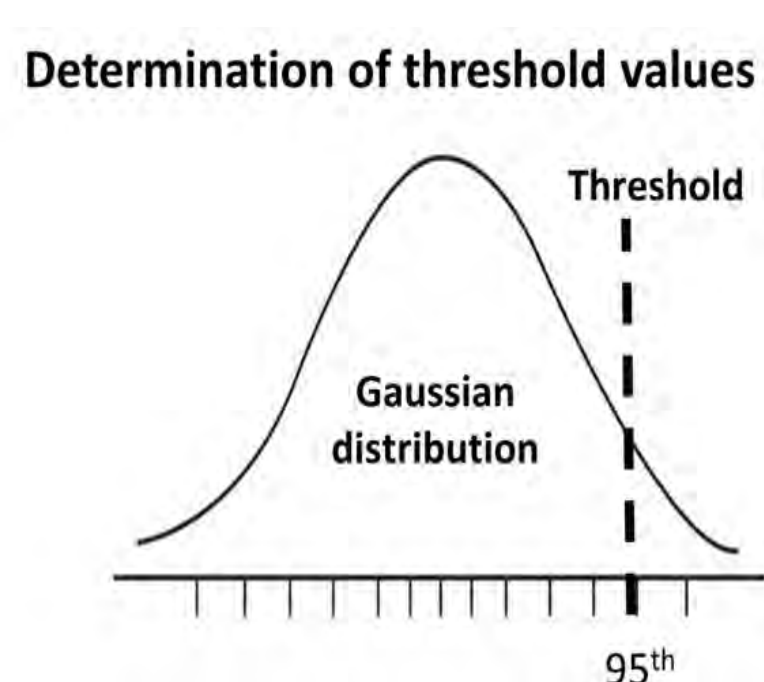
OXYDATIVE STRESS

CE GST

SOD GPx TAC LOOH

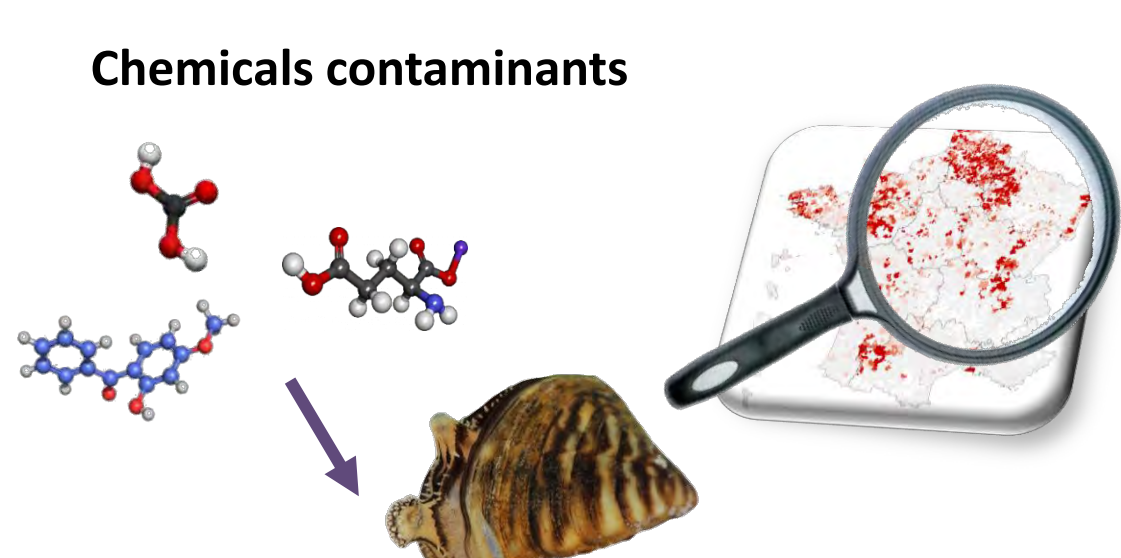
DEFINITION OF THRESHOLD VALUES

Following the method described in Leprêtre et al. 2022



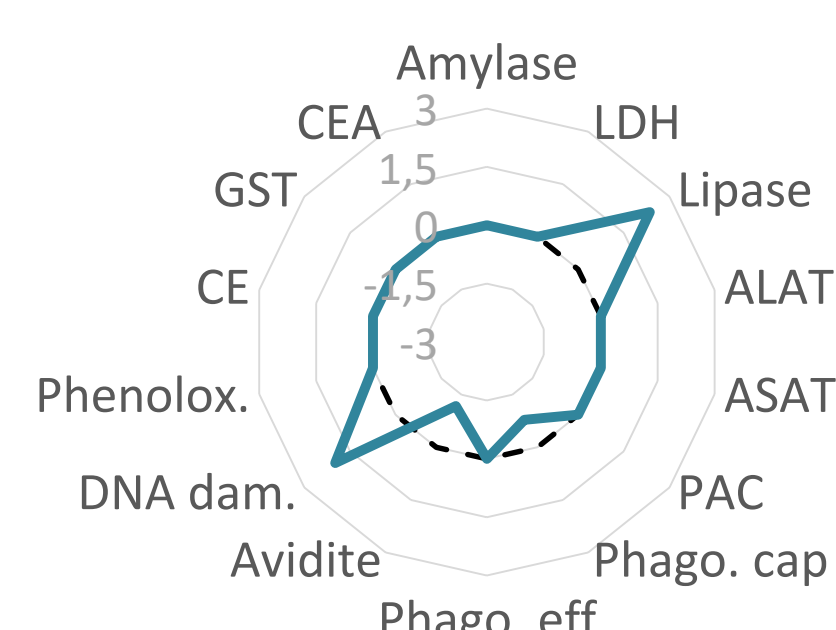
PERSPECTIVES

Measurement of chemicals bioaccumulation in mussels tissues



Cartography of chemicals bioaccumulation and toxicity

Calculation of an Integrated Biomarker Index - Threshold (IBR-T) for each station



IBR-T = 1,53

(Catteau and Le Guernic et al. In press.)

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