A Tiered Toolbox to Assess the Impact of Metal Emissions on Biodiversity Integrating Mixture Risk Calculations, Biomonitoring and Metabarcoding

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EU GREEN DEAL

Avoid impact of the combined effect of chemicals on biodiversity

ISSUE

Current European risk assessment methodology focus on single substance and does **not assess** the **risk** to **biodiversity directly**

WAY FORWARD

Metals Environment Exposure Data (MEED): **ECORELEVANCE TIERED TOOLBOX** to assess the additional impact of local metal emissions

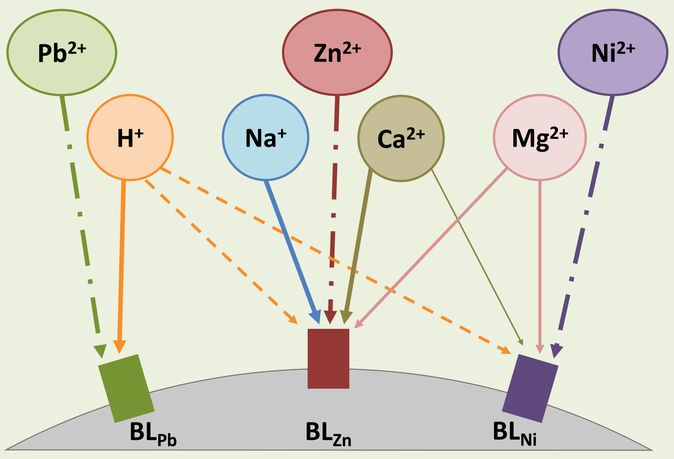
TIER I: BIOAVAILABILITY-BASED METAL MIXTURE INDICES

TIER II: BIODIVERSITY INDICES

TIER III: METABARCODING OF AQUATIC BIOFILMS

PILOT CASE: KLEINE NETE RIVER, BELGIUM

TIER I: BIOAVAILABILITY-BASED METAL MIXTURE INDICES



PREDICT MIXTURE RISK METALS

- Based on dissolved metal concentrations
- Bioavailability corrections: incorporate water chemistry (e.g. pH, [Ca^{2+}], DOC)
- Risk: based on available effect data
- Two indices selected

Metal Mixture Risk Assessment Framework[1]

WHAM-Ftox[2]

TIER 2: BIODIVERSITY INDICES

ASSESS SENSITIVITY TO METAL POLLUTION

Using biological monitoring data (periphyton, macroinvertebrates), determine whether local biodiversity is affected
Three different types of biodiversity analysis selected:

Traditional biodiversity indices
e.g. species richness, EPT richness (Ephemeroptera, Plecoptera, Tricoptera)

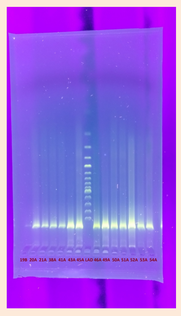
Trait-based indices
Typically for macroinvertebrates
e.g. predator-prey ratio, feeding type ratio

Multivariate analysis
Analyse patterns in species composition
e.g. RDA, TITAN

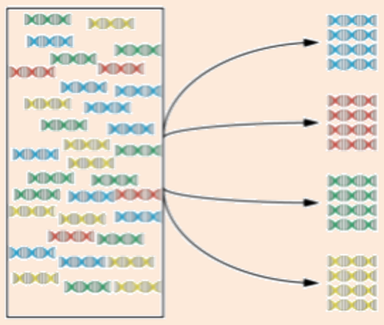
TIER 3: METABARCODING OF AQUATIC BIOFILMS

TAXONOMIC IDENTIFICATION OF EUKARYOTIC BIOFILM COMMUNITY BY HIGH-THROUGHPUT DNA ANALYSIS

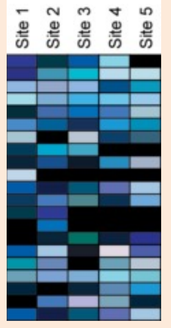
Sampling of aquatic biofilms in the field



DNA extraction and amplification



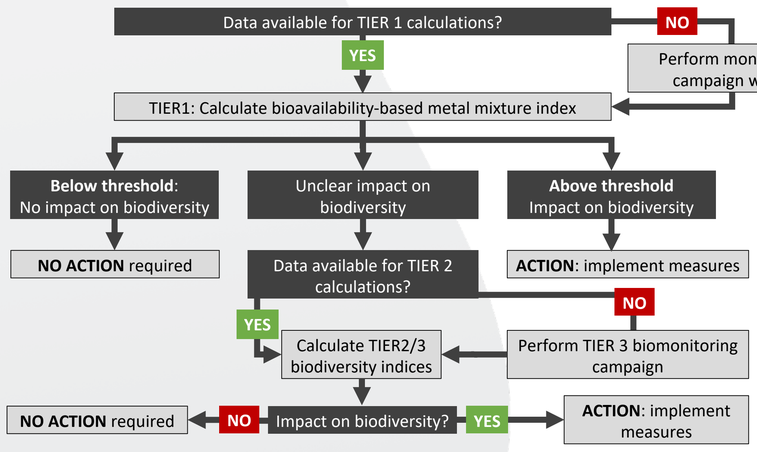
Sequencing and bioinformatics



Ecological analysis

NEXT STEPS

- ✓ Refine methodology of the toolbox: apply metal mixture calculations to more metals, develop trait-based indices, metabarcoding workflow, …
- ✓ Apply the toolbox to two more case studies: other metals, communities, environmental conditions, …
- ✓ Identify selection criteria for each tier: when are which methods applicable / preferred? When to switch to higher tier methods?
- ✓ Develop a tiered assessment strategy to apply the toolbox in a cost-efficient way



Hypothetical flowchart for cost-efficient application of ECORELEVANCE tiered toolbox

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References: [1]*Nys et al. (2018). ET&C 37: 623-642;* [2]*Tipping et al. (2021). Aquatic Toxicology 231: 105708.*

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