

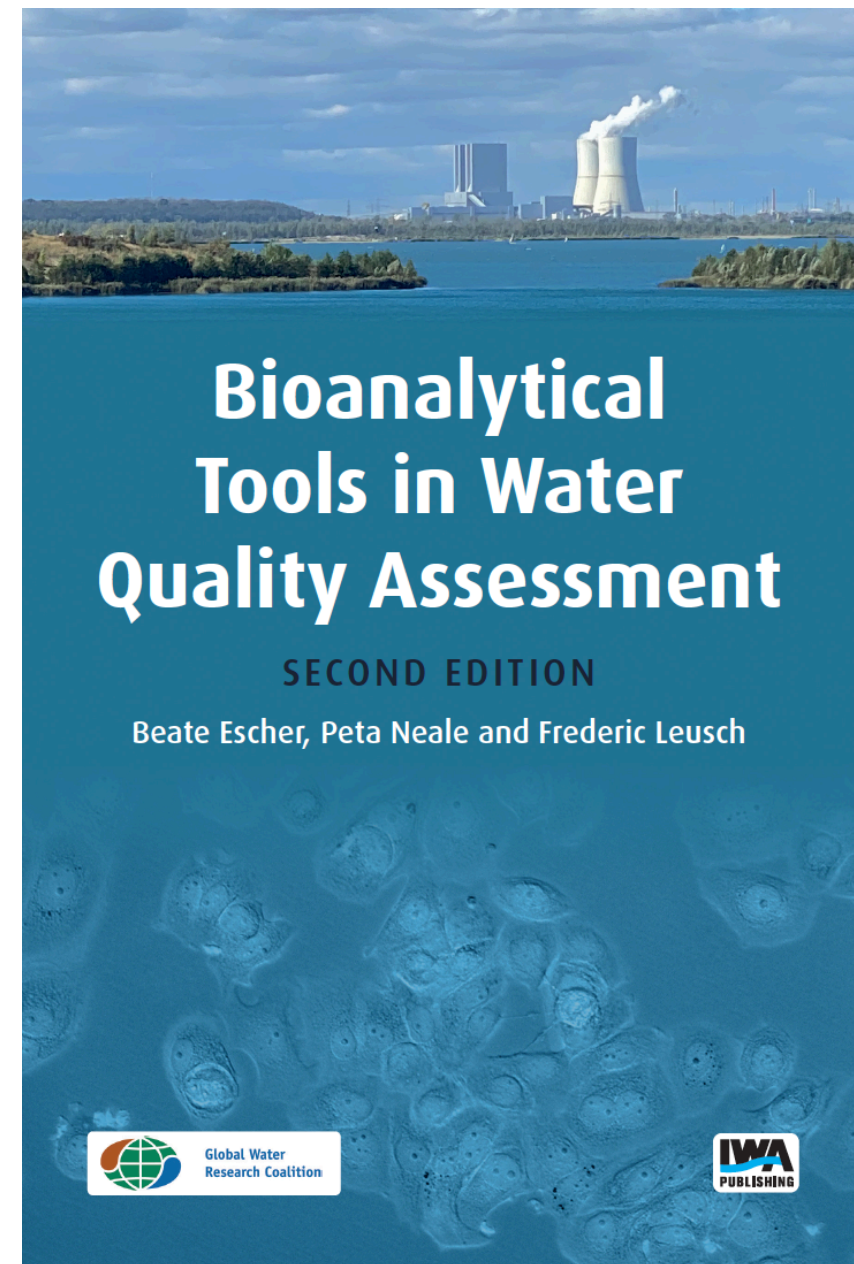
Chapter 3

Water quality assessment & whole effluent toxicity testing

This presentation accompanies Chapter 3 of
“Bioanalytical Tools in Water Quality Assessment”
<https://www.iwapublishing.com/books/9781789061970/bioanalytical-tools-water-quality-assessment-2nd-edition>

Exercises can be found at www.ufz.de/bioanalytical-tools

Questions? please send an e-mail to bioanalytical-tools@ufz.de



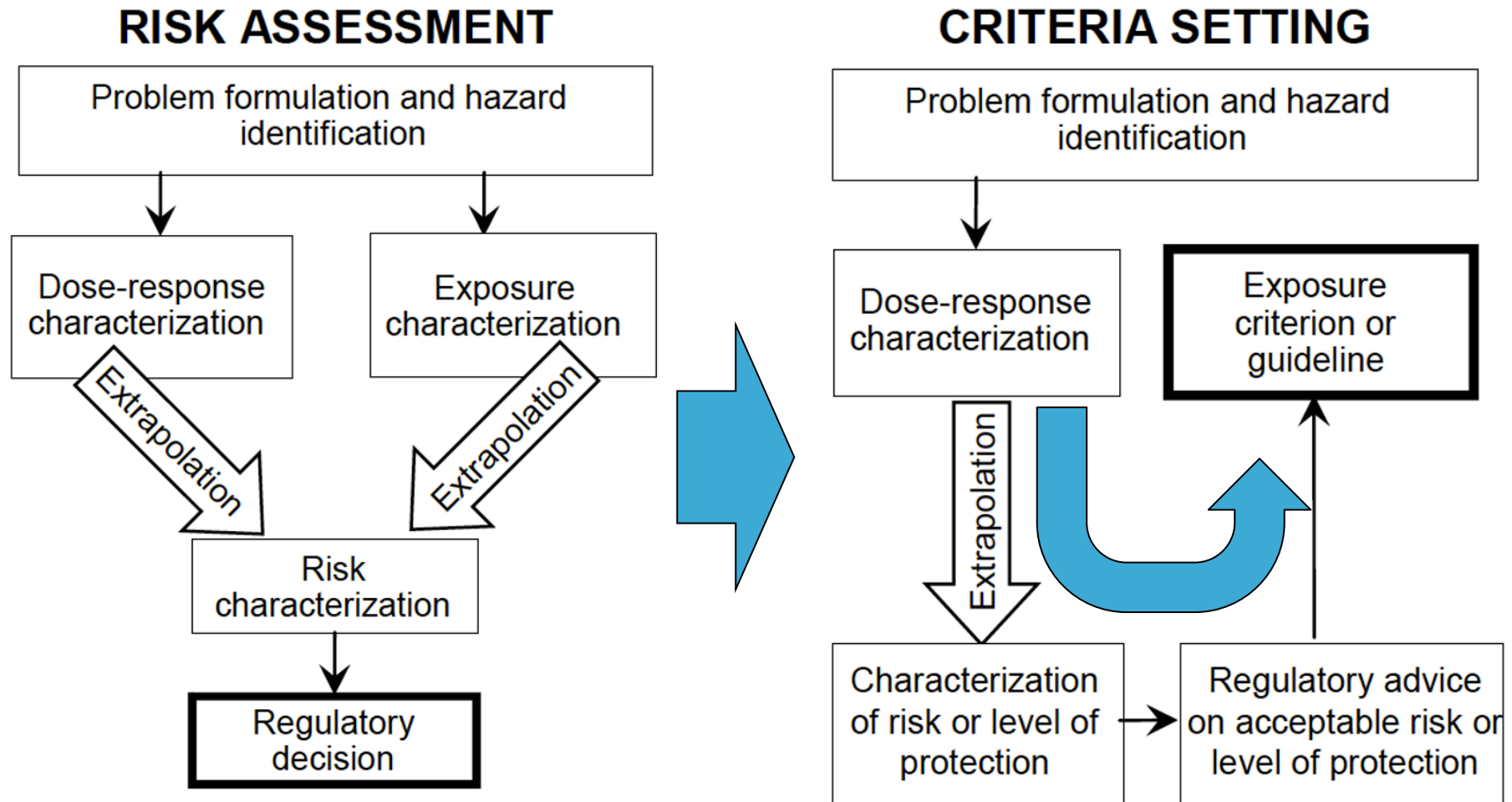
Learning goals

- You are familiar with conventional water quality testing
- You can differentiate between water quality criteria, guidelines, and standard

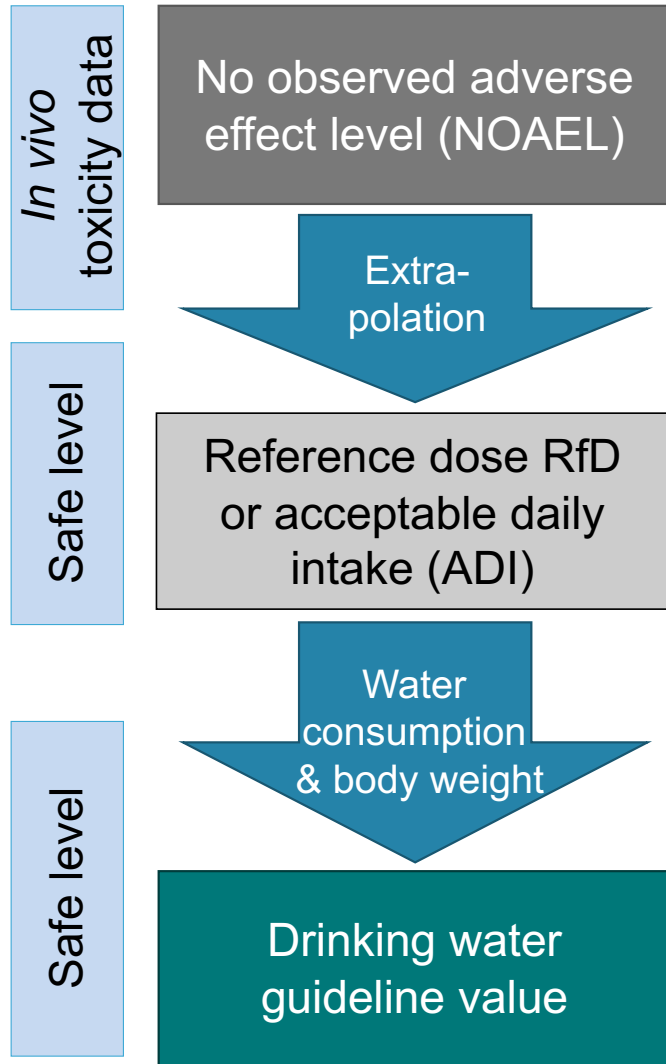
Some definitions

- Water quality criteria
 - based on data, scientific judgement, environmental effects
 - provide guidance for regulators when they are setting the standards, but they are not laid down in any legislation
- Water quality guidelines
 - recommendations on safe levels but they are not legally enforceable
 - provide targets but exceeding them does not necessarily result in clean up or enforcement actions
- Water quality standards
 - upper exposure limits that are included in legislation
 - derived from scientifically based water quality criteria both by applying safety factors and by political decision
 - If exceeded action must be taken

Setting of water quality criteria uses the same approaches as risk assessment



Protection goal: Human health
Water type: Drinking water



Protection goal: Ecosystem health
Water type: Surface water



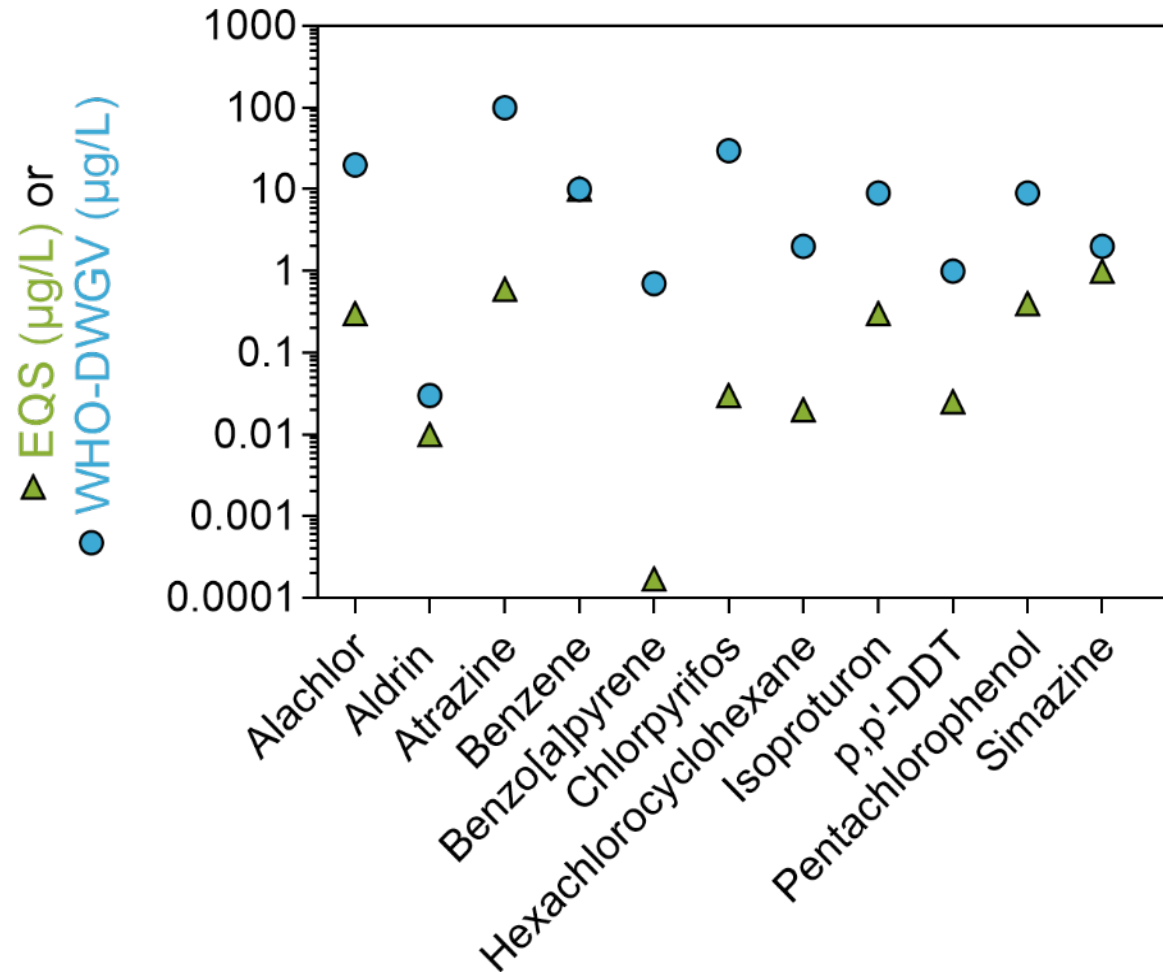
Similarity in the approaches for drinking water and surface water despite the difference in protection goals

EU Water Framework Directive

Two types of Environmental Quality Standards (EQS)

- ◆ **AA-EQS:** Annual average EQS, long-term standard, not to be exceeded by yearly average concentrations, based on chronic toxicity data
- ◆ **MAC-EQS:** Maximum acceptable concentration EQS, short-term standard, never to be exceeded, based on acute toxicity data
- **Separate Saltwater/freshwater EQS** if FW or SW databases indicated significant differences in species sensitivities or if differences in behaviour of toxicant due to different matrices can be expected (e.g., for metals)

Comparison drinking water vs. surface water



Comparison of common chemicals with both the EU's Water Framework Directive and Swiss EQS and WHO Drinking Water Guideline values (DWGV)

Whole effluent toxicity testing (WET)

- Situation- and site-specific assessment
- WET testing evaluates the adverse effects or toxicity to a population of aquatic organisms determined experimentally in the laboratory with surrogate organisms believed to be representative of those in the environment exposed to the effluent discharge
- Acute toxicity of effluents is generally measured using the original sample and a minimum of five dilution concentrations

Bioassays applied for WET

Simplified aquatic food chain

Common test species

Primary producers
(*photosynthetic organisms*)



Green algae



Biomagnification

Herbivores
(*invertebrates*)



Water flea



Biomagnification

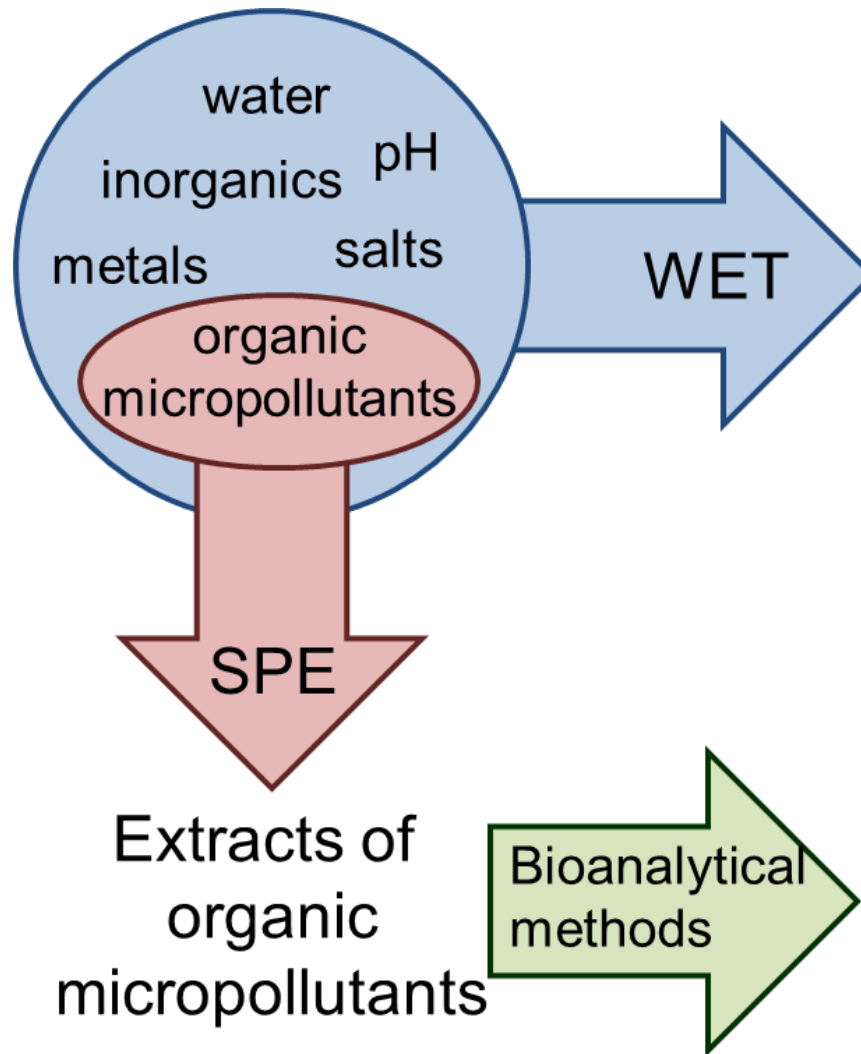
Higher herbivores,
carnivores (*vertebrates*)



Fish, also FET

Bioanalytical tools in whole effluent toxicity testing

- *in vitro* assay typically run after extraction and enrichment not as WET
- minimum sample preparation required for *in vitro* assays (filtration, pH-adjustment etc)
- Most popular for WET: fish embryo toxicity test with *Danio rerio* (zebrafish)



Whole-effluent toxicity

- *in vivo* assays
- limited *in vitro* assays
- biomarkers

Battery of *in vitro* assays

- specific MoA ↔ apical endpoint
- high-throughput

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