Risk Assessment in Aquatic Systems

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Overview

Risk
- Assessment
- Communication
- Managemnet

Exposure Toxicity Ratio ETR
Szenarios: sediment / soil / water

Quality Standards: EQS
Quality Norms: QN, UQN, EQN

Ecological Risk Assessment

Roadway - Implementation WFD

The good ecological status

The good chemical status

Effect related Bioassays are in use for the “good chemical status”: Quality Norms (QN – [µg/L])

REACH and surface water protection

Ecological Risk Assessment

Risk Assessment

Risk Definition:

Proparibility and Quantification of Disruptions by Hazards

Process of Risk Assessment:

1. Identification of Risk
2. Effects Assessment
3. Exposure Assessment
4. Risk Characterisation

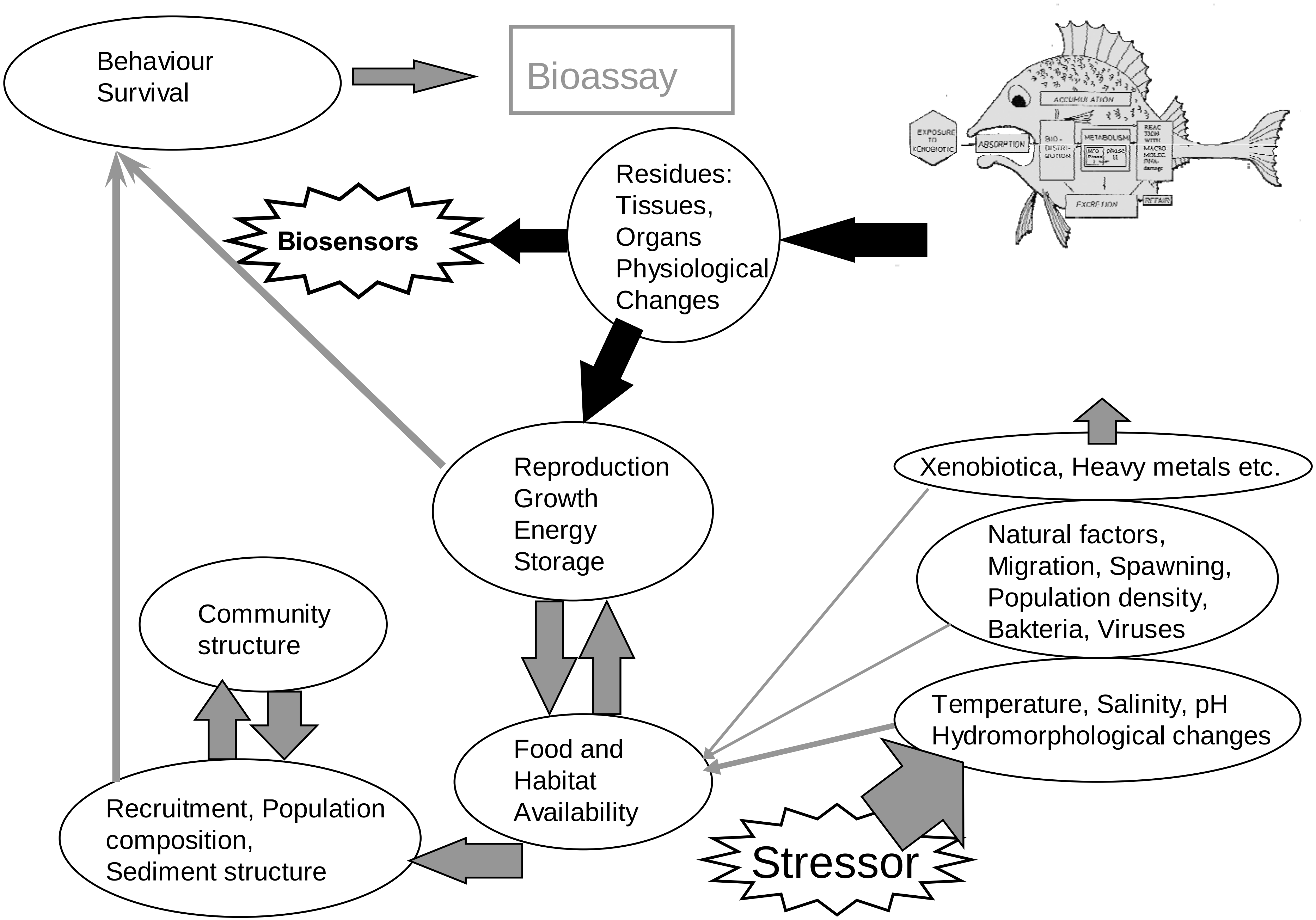
Concept of the Risk Assessment

Exposure
(Exposure Assessment)

- ➔ Compounds Sale
- ➔ Formulation and active ingredient
- ➔ Comp. structural properties/effecs
- ➔ Exposure matrices and routing
- ➔ Biotransformation
- ➔ Metabolites
- ➔ Excretion
- ➔ Kinetics and Excretion
- ➔ Biological degradation (Persistence)
- ➔ Bioavailability

Effects
(Effects Assessment)

- ➔ Accumulation
- ➔ acute and/or chronic Toxicity
- ➔ Enzyme induction
- ➔ Enzyme inhibition
- ➔ Antibiotica Resistence
- ➔ Reproductions Toxikology


Behaviour
Survival
Bioassay
Biosensors
Residues:
Tissues,
Organs
Physiological
Changes
Reproduction
Growth
Energy
Storage
Xenobiotica, Heavy metals etc.
Natural factors,
Migration, Spawning,
Population density,
Bakteria, Viruses
Temperature, Salinity, pH
Hydromorphological changes
Community
structure
Food and
Habitat
Availability
Recruitment, Population
composition,
Sediment structure
Stressor

Effects Assessment - Environment and Human Health
Environmental Signalling

1 Reaction → **2 Adaptation** → **3 Death**

1 Reaction

Biosensors
Endpoints

- ➔Enzyme-Induction
- ➔Enzym-Inhibition
- ➔Biotransformation
- ➔Oxiradicals
- ➔Gentoxicity
- ➔Endocrine Effects
- ➔Immuntoxicity
- ➔Proteinbinding (Metals)

2 Adaptation

real time - Bioassays
Large scale Bio-Monitoring
Chronic Effects

Adaptive Enzymes
- ➔Inhibition of Functions
- ➔Disruption of Structures
- ➔Reconstitution

Change of Behaviour
- ➔Populationsselection
- ➔Change in Reproductionstrategy

3 Death

Lost of important Biochemical Functions

Environmental Risk Assessment

exposure assessment

biotransformation; metabolites; exposure pathway; excretion; retention period; biodegradability; market penetration (sales); properties of substance.

$PEC_{\text{surface water}}$ or EIC_{aquatic}

effect assessment

accumulation; acute und chronic effects;
adverseor indirect effects; (e.g. enzyme induction, Antibiotica resistence, Reduction in Fertilisation

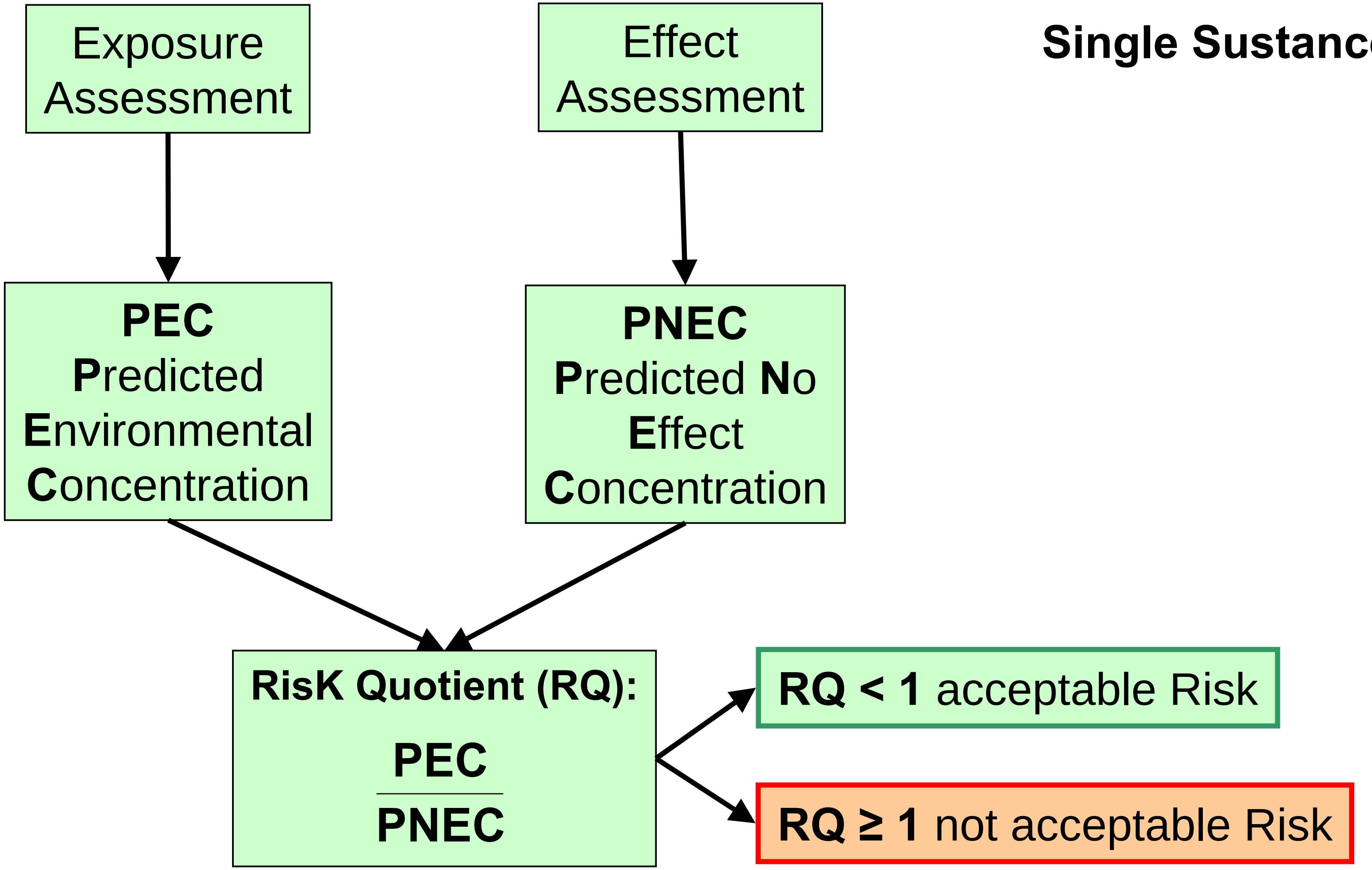
PNEC and PEC/PNEC

ERA

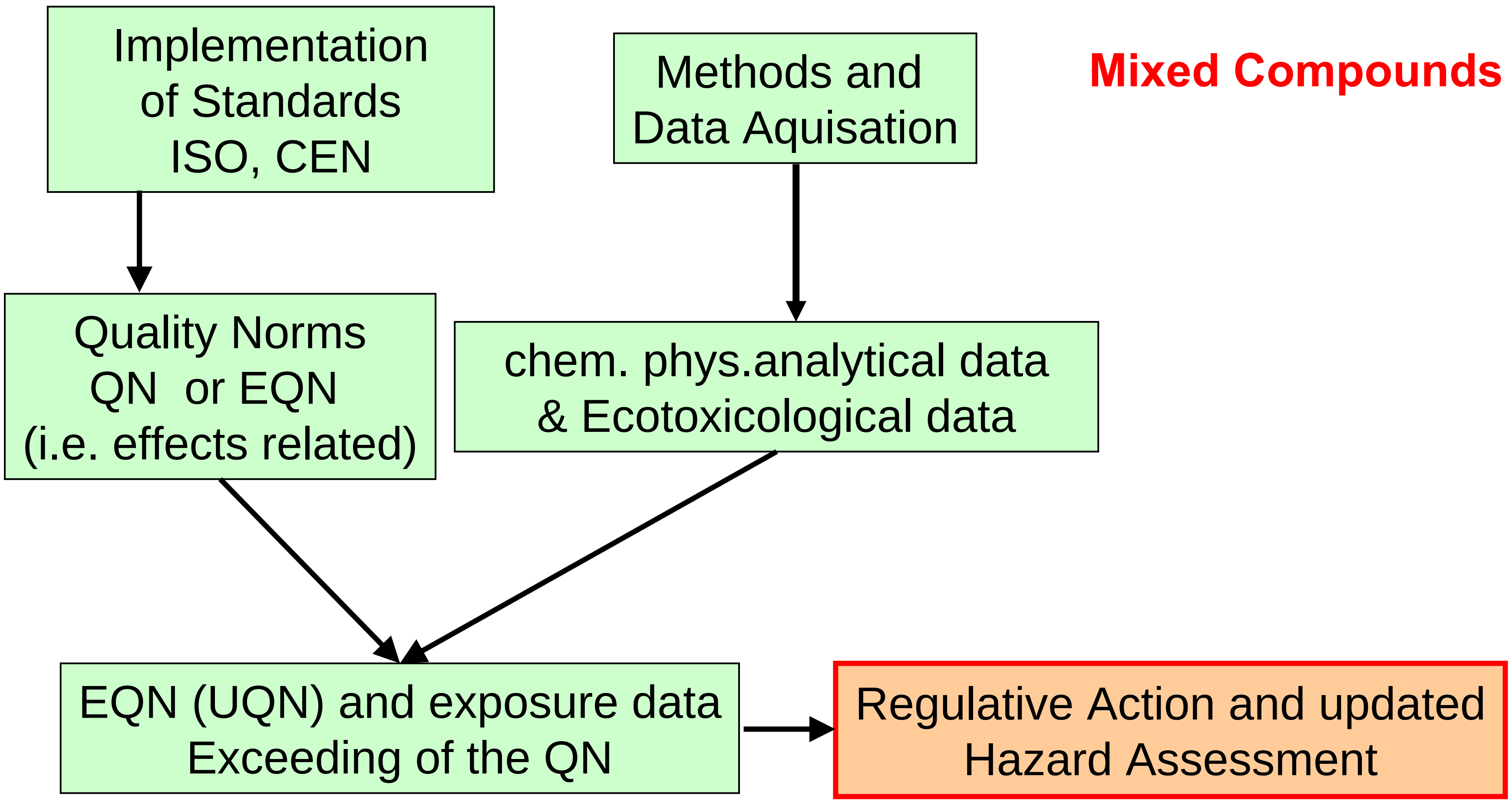
Water Sediment
Biota

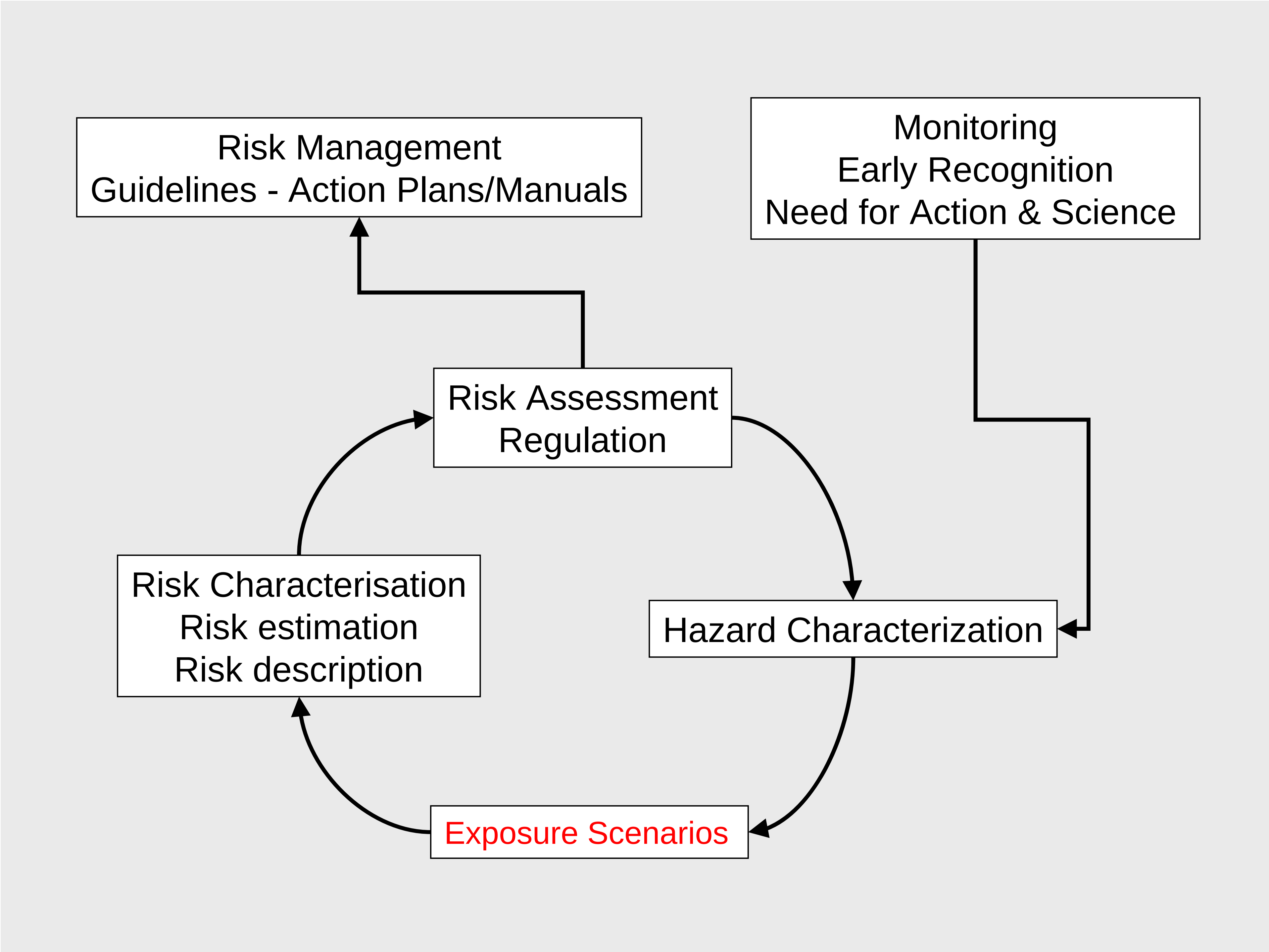
Concept of the Risk Assessment

Single Sustances

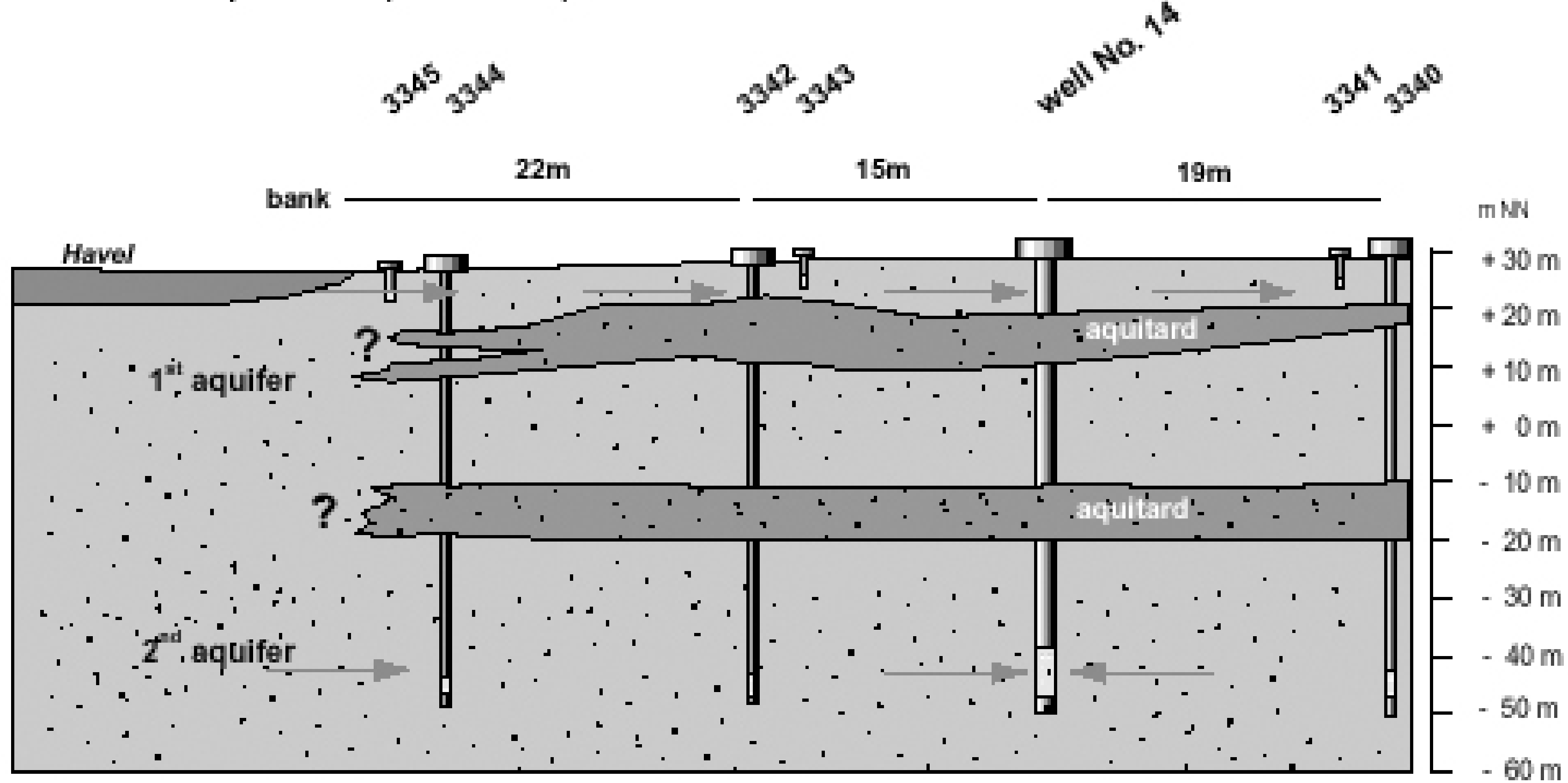


Concept of Hazard Assessment




Risk Management
Guidelines - Action Plans/Manuals
Monitoring
Early Recognition
Need for Action & Science
Risk Assessment
Regulation
Risk Characterisation
Risk estimation
Risk description
Hazard Characterization
Exposure Scenarios

Transect Lieper Bucht (Havel River)



Einzelstoff	Konzentration in ng/l
2,4-D	ND- 20
Bentazone	ND - 50
Mecoprop	ND - 130
o,p´-DDA	ND - 25
p,p´-DDA	ND - 90
NPS*	15 -1180
TCEP**	20 - 270
TCIPP***	65 - 1160
Bezafibrate	ND - 420
Compound X	ND - 830
Carbamazepine	25 - 1075
Clofibric Acid	2 - 450
Caffeine	80 - 970
Diclofenac	ND - 1030

Einzelstoff	Konzentration in ng/l
Fenofibric Acid	up to 700
Gemfibrozil	ND - 85
Ibuprofen	ND - 75
Indomethacine	ND - 85
Ketoprofen	ND - 65
Mefenamic Acid	ND - 20
Naproxen	ND - 95
Oxazepam	ND - 85
Pentoxifylline	ND - 30
Primidone	ND - 635
Propiphenazone	ND - 1970
Tolfenamic Acid	ND - 20

* N-(Phenylsulfonyl)-Sarcosine

** Tris-(ChloroEthyl)-Phosphate

*** Tris-(ChloroIsoPropyl)-Phosphate

Ethinylestradiol: 1.0 ng/l

17ß-Estradiol 0.5 ng/l

Estron 0.9 ng/l

Nonylphenol 110 ng/l

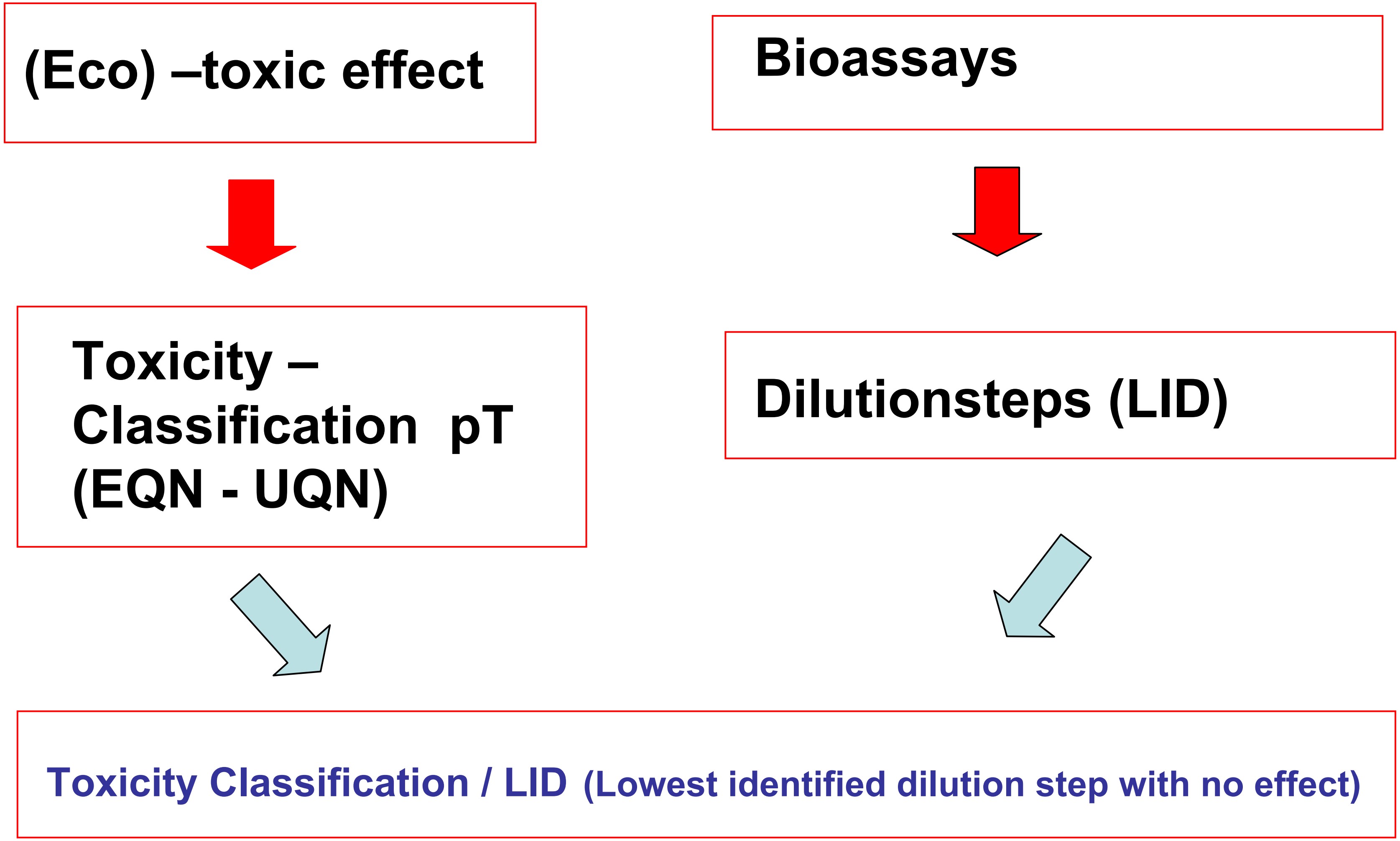
Diallylphtalat 225 ng/l

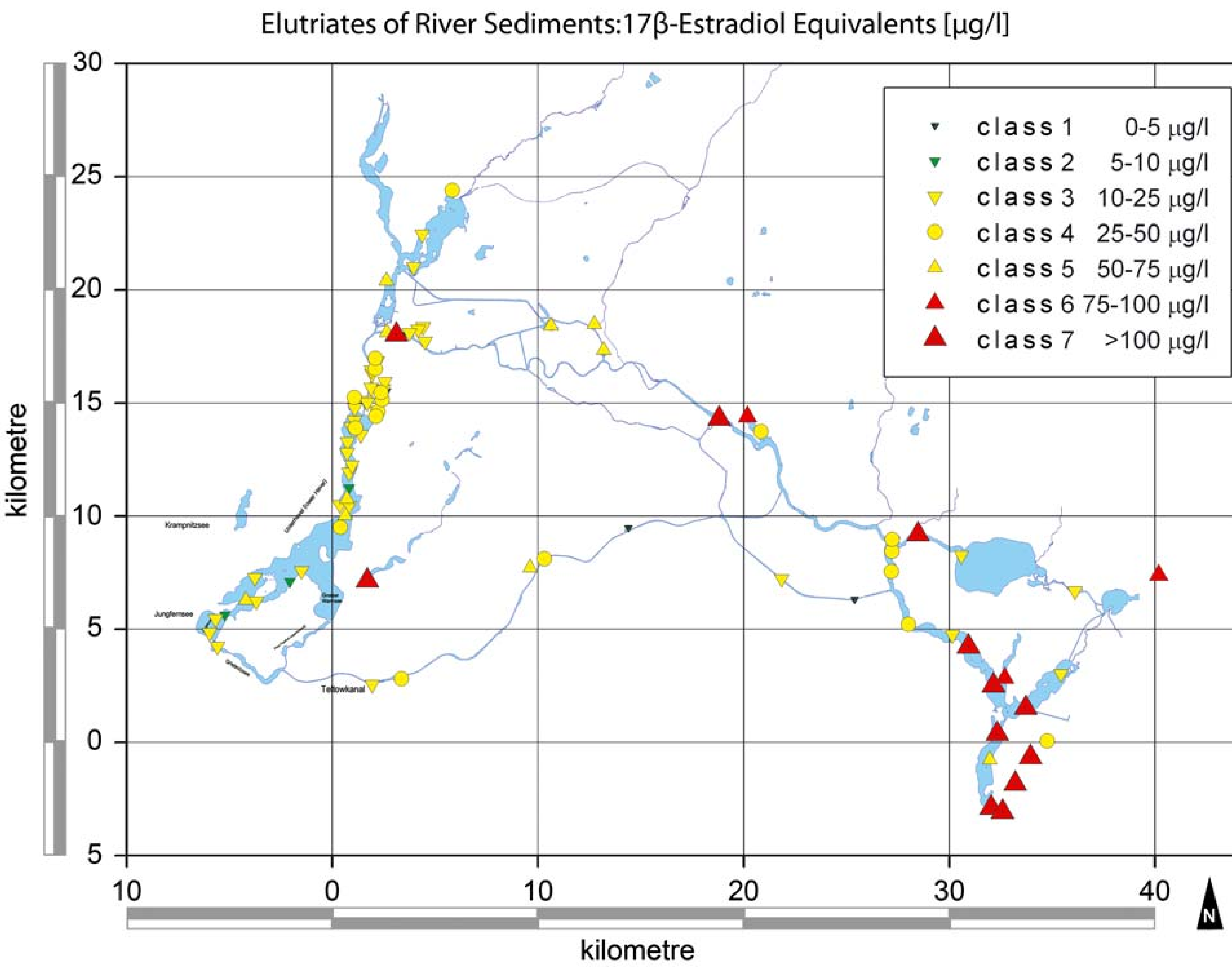
Bisphenol A 31 ng/l

Composited samples in Sedimentlayers 0-5 cm

	4° C	27° C	pH 4	pH 10
Einwaage (g)	2,01	2,04	2,21	2,15
PAK in µg/g TS				
Naphthalen	4,4	1,4	2,4	1,5
Acenaphthylen	1,5	0,9	1,2	1,5
Acenaphthen	4,4	1,8	3,8	3,2
Fluoren	9,3	5,6	10,6	9,5
Phenanthren	21,1	18,1	29,2	25,0
Anthracen	10,0	8,5	12,2	11,2
Fluoranthen	35,4	38,9	52,0	41,1
Pyren	31,4	32,5	44,7	37,1
Benz(a)anthracen	21,3	24,9	31,2	28,0
Chrysen/Triphenylen	21,1	23,5	30,0	27,3
Benzo(b,j)fluoranthen	21,3	23,8	29,1	27,5
Benzo(k)fluoranthen	14,1	15,7	18,9	18,2
Benzo(e)pyren	22,5	24,4	31,0	28,3
Benzo(a)pyren	21,3	24,3	27,9	27,6
Perylen	11,0	11,3	13,8	13,8
Dibenzo(a,h)anthracen	7,7	7,3	9,5	10,7
Indeno(1,2,3-cd)pyren	15,8	17,2	18,7	21,5
Benzo(g,h,i)perylen	16,3	17,1	18,6	22,2
Σ PAK (12)	**236,9**	**251,9**	**322,0**	**297,4**
Σ PAK	**290,0**	**297,4**	**384,7**	**355,2**

Risk Assessment - Sediments

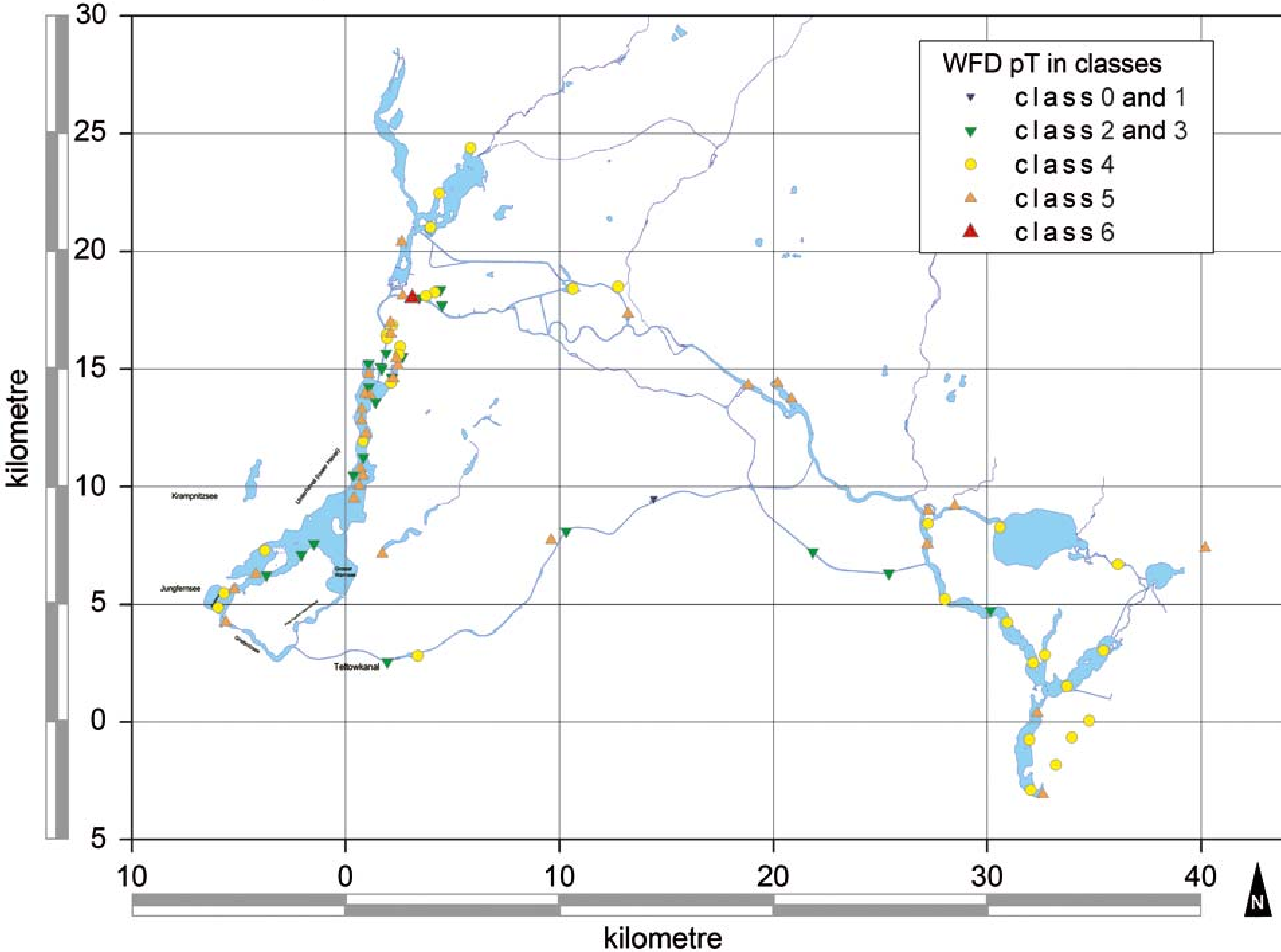




Elutriates of River Sediments:17β-Estradiol Equivalents [µg/l]
class 1 0-5 µg/l
class 2 5-10 µg/l
class 3 10-25 µg/l
class 4 25-50 µg/l
class 5 50-75 µg/l
class 6 75-100 µg/l
class 7 >100 µg/l
Krampnitzsee
Jungfernsee
Teltowkanal
kilometre
kilometre
30
25
20
15
10
5
0
5
10
0
10
20
30
40
N

Highest dilution level without effect	Dilution factor	pT-value	Toxicity classes		Management categories	
			7-level system	Designation	3-level assessment	Colour coding
Original sample	2^{0}	0	0	toxicity non-detectable	uncritically polluted	0
1:2	2^{-1}	1	I	very slightly toxic		I
1:4	2^{-2}	2	II	slightly toxic		II
1:8	2^{-3}	3	III	moderately toxic	critically polluted	III
1:16	2^{-4}	4	IV	distinctly toxic		IV
1:32	2^{-5}	5	V	highly toxic	hazardous	V
$\leq$ (1:64)	$\leq 2^{-6}$	≥ 6	VI	extremely toxic		VI

WFD: pT-values and Classification of River Sediments (Elutriates)



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ECOTOXICOLOGICAL CLASSIFICATION OF THE BERLIN RIVER SYSTEM USING BIOASSAYS IN RESPECT TO THE EUROPEAN WATER FRAMEWORK DIRECTIVE

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Abstract. Bioassays as well as biochemical responses (biomarkers) in ecosystems due to environmental stress provide us with signals (environmentally signalling) of potential damage in the environment. If these responses are perceived in this early stage in ecosystems, the eventual damage can be prevented. Once ecosystem damage has occurred, the remedial action processes for recovery could be expensive and pose certain logistical problems. Ideally, "early warning signals" in ecosystems using sensing systems of biochemical responses (biomarkers) would not only tell us the initial levels of damage, but these signals will also provide us with answers by the development of control strategies and precautionary measures in respect to the European Water Framework Directive (WFD). Clear technical guidelines or technical specifications on monitoring are necessary to establish and characterise reference conditions for use in an ecological status classification system for surface water bodies. For the Ecotoxicological Risk Assessment (ERA) of endocrine effects we used an approach of the exposure – dose – response concept. Based on the "Ecotoxicological Classification System of Sediments" that uses pT-values to classify effects in different river systems, we transferred the biomonitoring data to the five-level ecological system of the WFD. To understand the complexity of the structure of populations and processes behind the health of populations, communities and ecosystems an ERA should establish links between natural factors, chemicals, and biological responses so as to assess causality. So, our ecological monitoring assessment has incorporated exposure & effects data.

Keywords: bioassay, effect assessment, ecotoxicological classification in sediment, endocrine effects, exposure of drugs

1. Introduction

For risk assessment and risk assessment tools new recommendations are described in the Technical Guidance Document of EU – Edition 2 (TGD, 2003), in the new EU Chemicals Legislation REACH (REACH, 2004) and in the status report for toxicological methods of the European Centre for the Validation of Alternative Methods (ECVAM, 2003). In the EU Water Framework Directive (WFD, 2000) a general requirement for ecological protection, and a general minimum chemical standard, was introduced to cover all surface waters. For the description of "good ecological status" and "good chemical status" effects monitoring tools are needed for the description of the ecological status of river basin systems. In some case

Exposure
Toxicity
Ratio = ETR

Exposure-Toxicity-Ratio: *ETR*

The **risk potential** will be expressed as a ratio of the **exposure** (Predicted Environmental Concentration: *PEC*) and the **toxicity of the active substance** (*LC50*).

acute risk potential

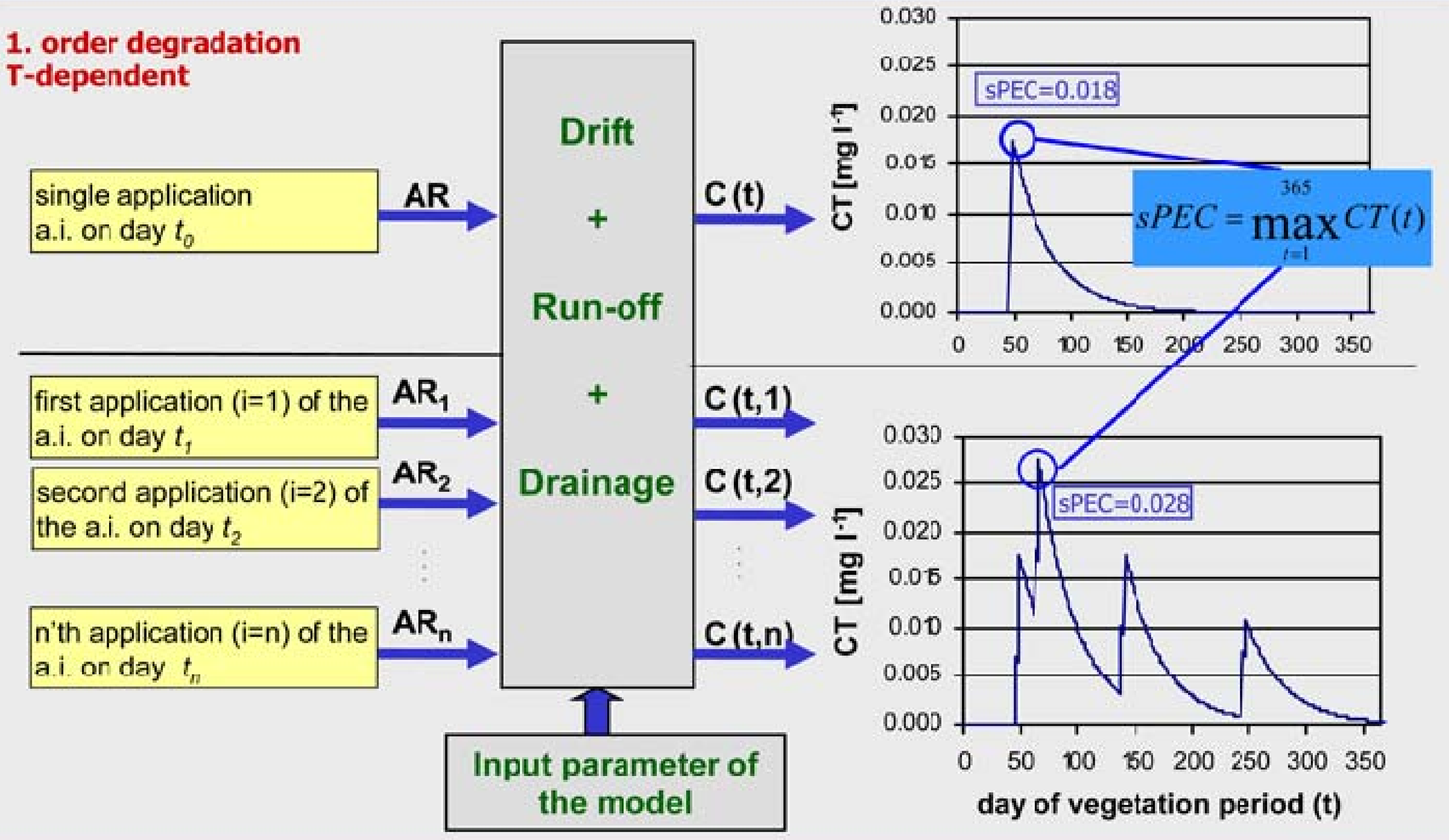
$$ETR_{acute} = \frac{sPEC}{LC50_{species}}$$

chronic risk potential

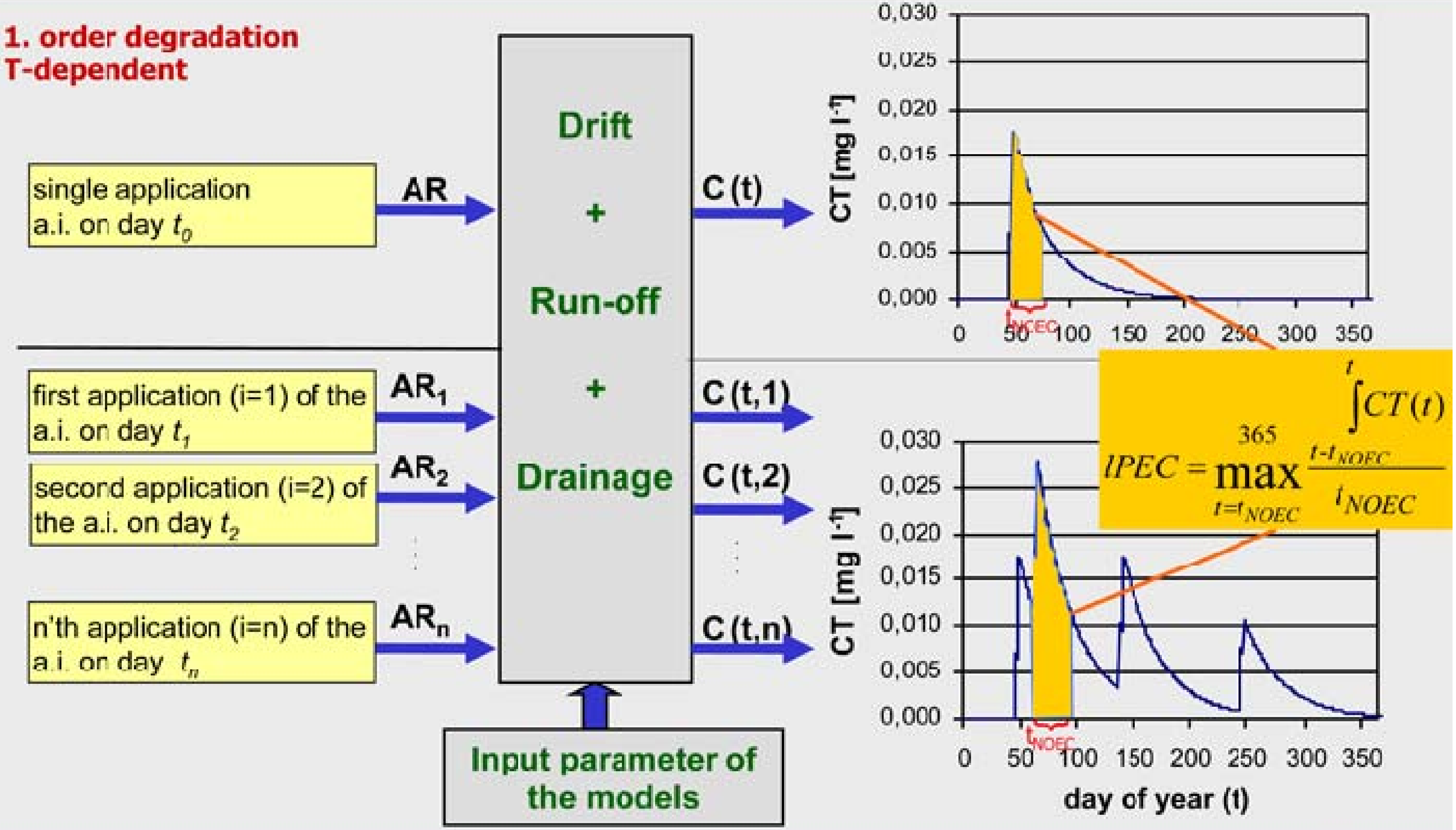
$$ETR_{chronic} = \frac{lPEC}{NOEC_{species}}$$

$ETR_{species}$	Exposure-Toxicity-Ratio
sPEC	short-term exposure in the surface water
lPEC	long-term exposure in the surface water
$LC50_{species}$	Lethal concentration
$NOEC_{species}$	No effect concentration

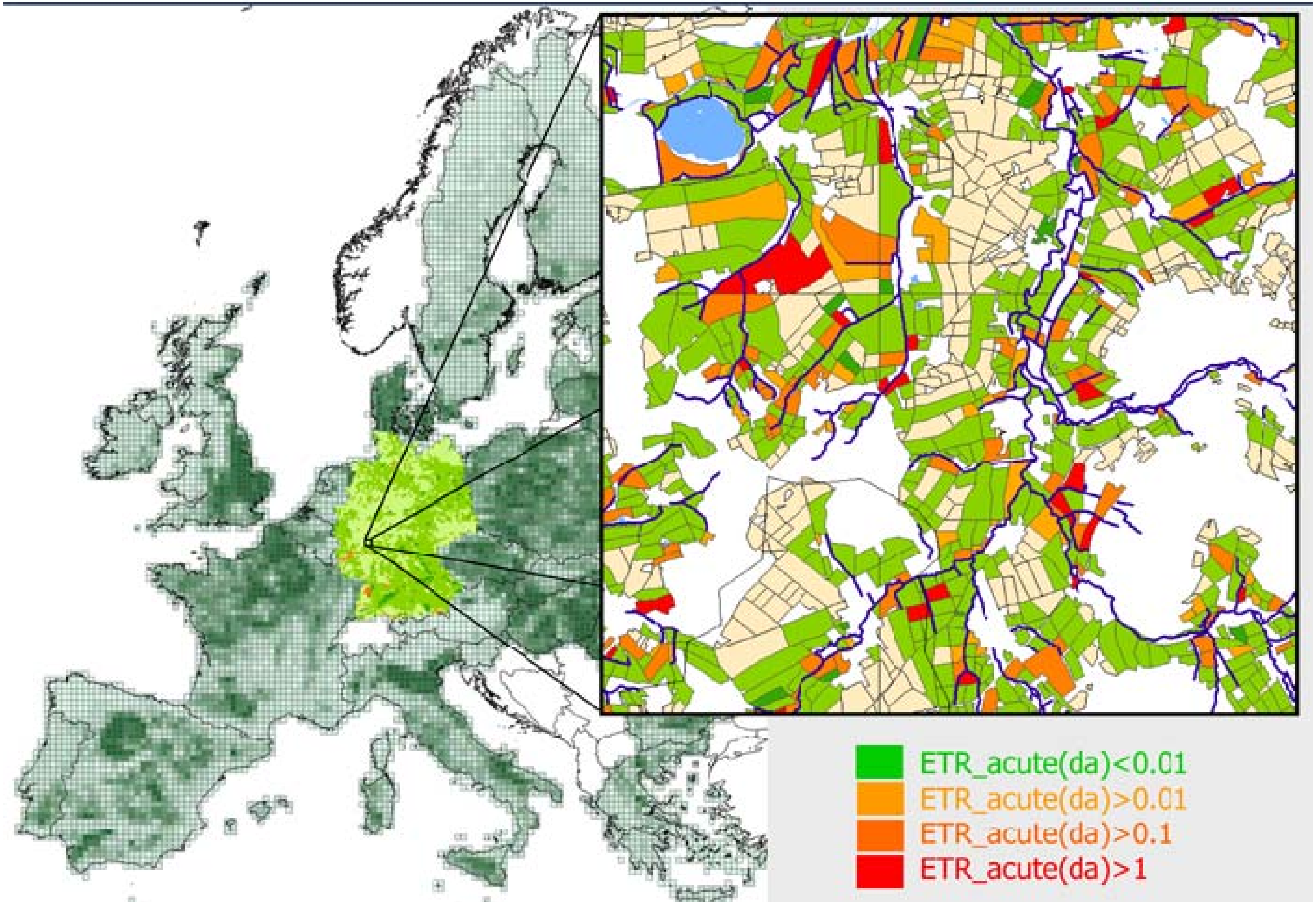
Calculation of *sPEC*: acute risk



Calculation of *IPEC*: chronic risk



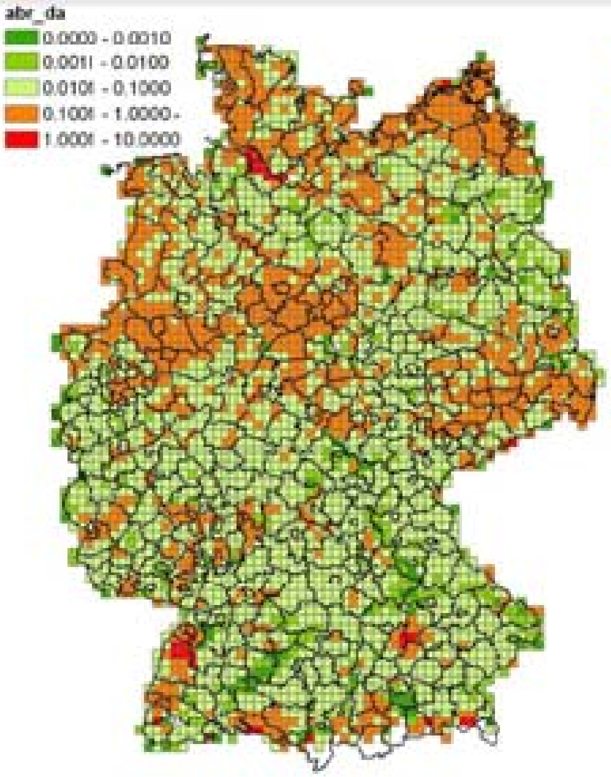
Risk assessment on field level



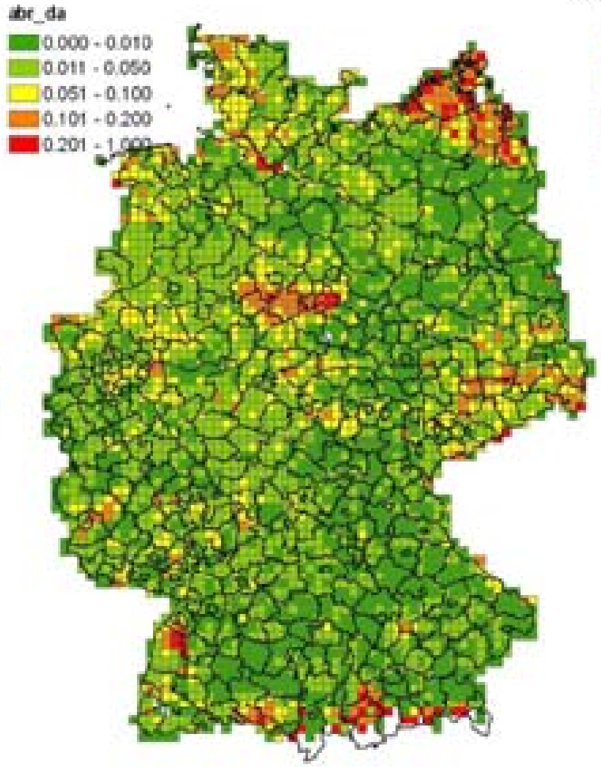
Spatial aggregation of acute risk ($ETR_{acute(daphnia)}$)

Risk potentials $ETR_{acute(daphnia)}$ were calculated without considering buffer zone distances.

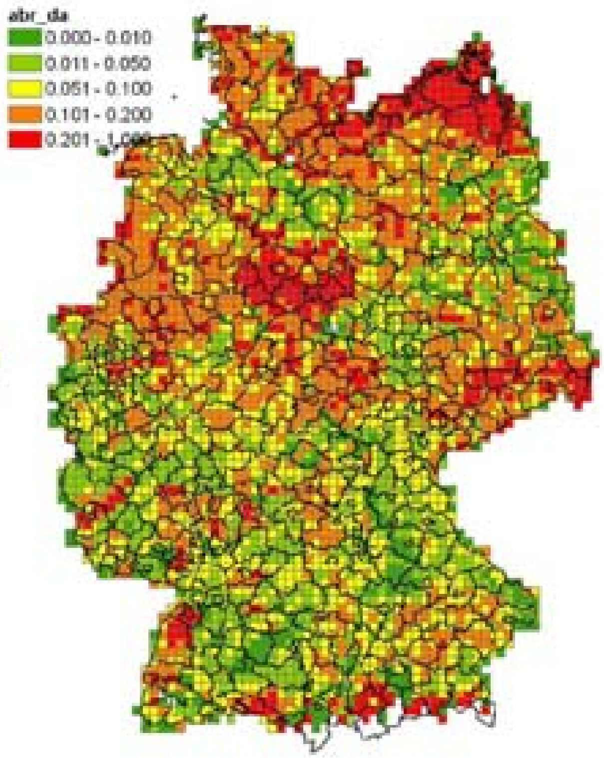
weighted mean (by area)



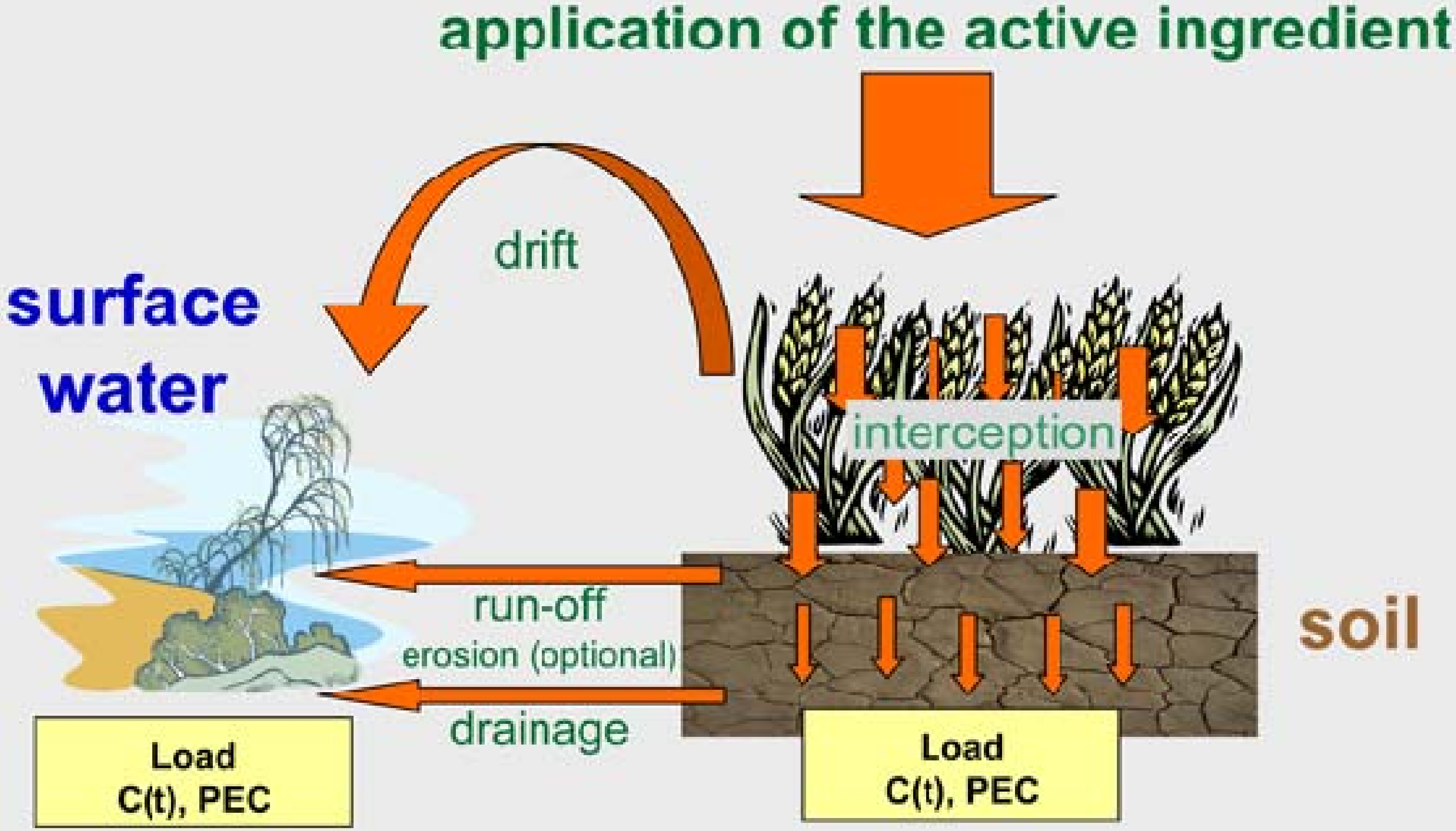
fraction of arable land with ETR_{acute}>1



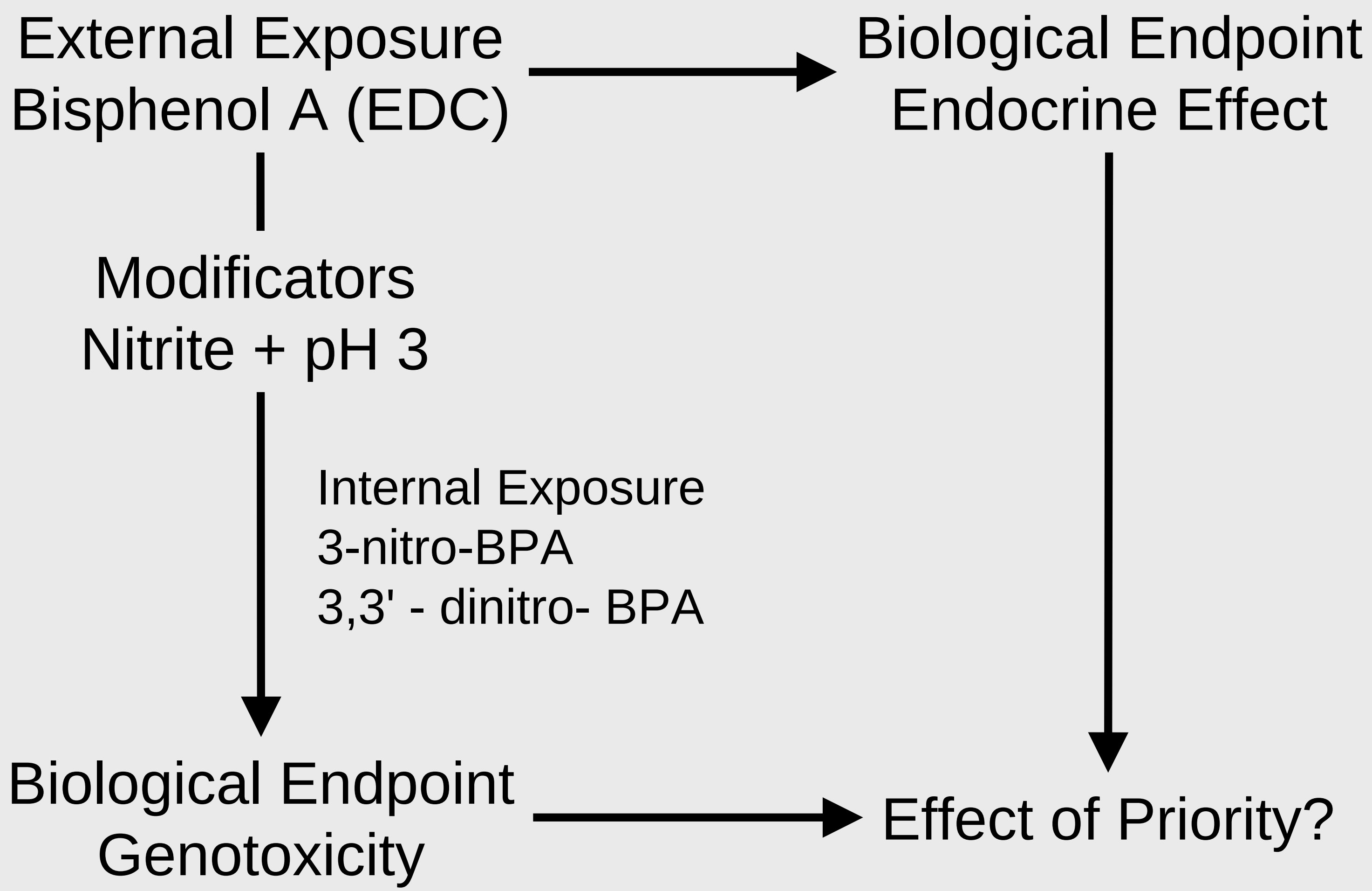
fraction of arable land with ETR_{acute}>0.1

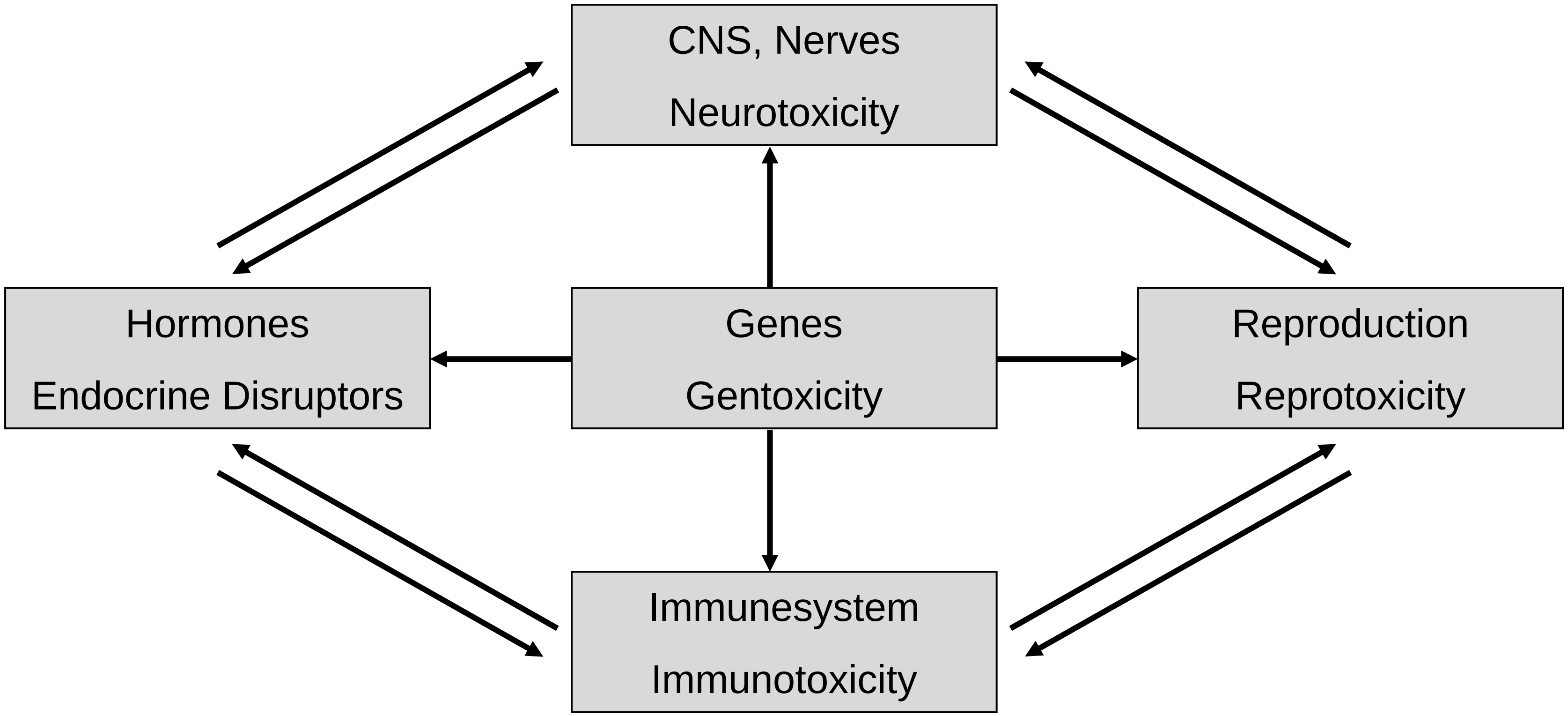


Modeled pathways



Realistic Exposure Szenarios and Modificators (mixed effects)




CNS, Nerves
Neurotoxicity
Hormones
Endocrine Disruptors
Genes
Gentoxicity
Reproduction
Reprotoxicity
Immunesystem
Immunotoxicity

Quality Norms: QN, UQN, EQN

Single Substance Approach

Tools = Bioassays

Approach used to derive Quality Norms (UQN/EQN) for aquatic communities (Recognized test methods include methods developed by DIN, ISO, CEN, OECD)

General principle: lowest test result for the most sensitive species is to be used as the starting point for the derivation of quality norms (QN).

Compensationfactors
(uncertainty - extrapolation test results to the real environment)

F1 = 0.1	NOEC data are available for each trophic stages
F2 = 0.01	NOEC data are available for at least two of the trophic stages in addition, a wide range of aquatic toxicity data is available

F2 = 0.1	- additional risk: - the substance is persistent in the aquatic environment (BCF > 100) - the substance is capable of transforming into dagerous substances synergism and/or additive effects

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Quality Norm (QN): Fishery

$$QO\ [\mu g/L] = \frac{WF\ [mg/kg]}{BCF\ [l/kg]}$$

Quality Norm (QN): supply of drinking water

$QO = 0.5 \cdot TG$ (TG = Limit value for drinking water)

(For the xenobiotic substances listed in Annex 2 of the Drinking Water Ordinance, the reduction factor F may not exeed

Tools WFD Environmental Quality Norm (EQN)

Standardisation and Normalisation DIN, CEN, ISO 2006:

Effect related parameters already in the regulations:
Bacteria-, Algae-, Crustaceans-, Fish- Assays, Genotoxicity
Replacements: Fish Egg Assay, DIN 38415 T6 / ISO NWI

Genotoxicity (procaryontic assays):
umu-Assay, DIN 38415 T3 - ISO 13829 (Gov.Lab.)
AMES-Assay, DIN 38415 T4 - ISO/CD 16240 (Industry)
In addition:
Eucaryontic assays (except COMET assays):
Micronulei-Assay, ISO/CD 21427

New effect related parameters for regulations:

(1) Immunotoxicity, DIN UA 5.7
(2) Endocrine effects, DIN UA 7.3 / ISO TC147/SC5 NW

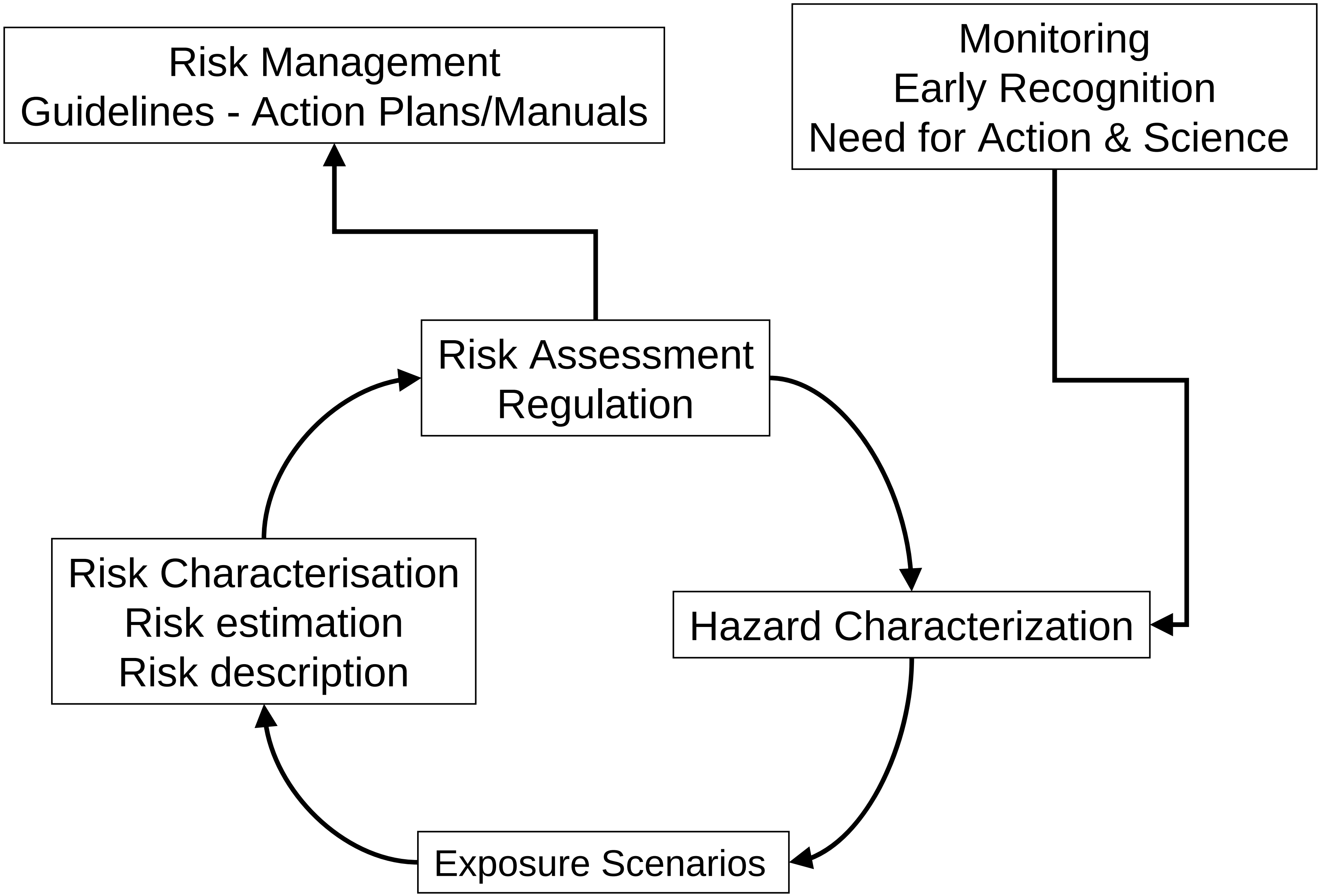
Quality Norm (QN) for PCBs of the Lower Havel

EG-Nr.	Stoff	**QN**	Mittel 1999	Mittel 2000	Mittel 2001
99e	Fluoranthen	0,025 µg/l	<QZ	0,028	0,027
101a	PCB 101	20 µg/kg	n.g.	45,27	32,76
101b	PCB 118	20 µg/kg	n.g.	n.g.	27,30
101c	PCB 138	20 µg/kg	n.g.	55,96	39,82
101d	PCB 153	20 µg/kg	n.g.	52,52	31,80
101e	PCB 180	20 µg/kg	n.g.	34,04	22,93
101f	PCB 28	20 µg/kg	n.g.	91,76	32,76
101g	PCB 52	20 µg/kg	n.g.	40,50	30,35

Compound	76/464/EWG **a) List I** b) List II	QN	Rili 76/464	**QN** **Water**	**QN** **Suspended Solids**
HHCB	**BW, BE, BY, TH**			**7,0 µg/l**	
Ioxynil	List II		0,1 µg/l	**0,1 µg/l**	
Kobalt	List II		80 mg/kg	**0,9 µg/l**	**50 mg/kg**
Molybdän	List II		5 mg/kg	**7,0 µg/l**	**8,9 mg/kg**
Monolinuron	**List I – 99S**	0,1 µg/l		**0,01 µg/l**	
Propanil	**List I – 99S**	0,1 µg/l		**0,9 µg/l**	
Propazin	List II		0,1 µg/l	**0,25 µg/l**	

Compound	QN in µg/l [g/kg
Acenaphthen	0,32[0,08]
	0,32
	[0,08]
Anilin	0,81
Benz(a)anthracen	0,002
	0,002
Bezafibrat	
Butylbenzylphthalat	5,2
Carbamazepin	0,5
Chlorbenzilat	0,6
Chrysen	0.9
Clofibrinsäure	5
Cyanazin	0,12
Desethylterbutylazin	
Desisopropylatrazin	
Desmetryn	0,03
Dibutylphthalat	10
Dibutylzinn	0,21

Diclofenac	0,1
EDTA-Na	2200
Ethofumesat	24
Fluor	
Fluoren	2,1[0,9]
	2,1
	[0,9]
Fluroxypyr	152
Iopamidol	
Kresoxim-methyl	0,3
Lenacil	1
Metalaxyl	120
Methyl-tert.-butylether (MTBE)	2600
Methylisothiocyanat	0,05
Metobromuron	2
Metoxuron	0,09
Metribuzin	0,18
NTA / NTA-Natriumsalz	930
2-Methoxyanilin (o-Anisidin)	5,5
Pencycuron	1,3[1,3]
Pendimethalin	0,27
Penanthren	0.5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Exposure Scenarios

Which substances are we talking about ?

- 76/464/EEC
  - Dangerous substances
  - "List I"
    - The 18 substances regulated under "so called daughter Directives"
    - "PBT"
  - "List II"
    - **All other** substances belonging to the categories included in Annex I (List I and List II)
    - Deleterious effect on the aquatic environment
    - Metals
    - Identified by the Member States

- Water Framework Directive (2000/60/EC)
  - Priority substances:
    - "presenting a significant risk to or via the aquatic environment"
    - *included in annex X WFD*
  - Hazardous substances (or priority hazardous substances) :
    - PBT or other equivalent concern
    - *Part of the priority substances in annex X WFD*
  - Other pollutants :
    - "any substance liable to cause pollution"
    - Identified by river basin
    - *categories included in annex VIII*

List of 33 Priority Substances (Decision 2455/2001/EC or Annex X WFD)

Priority substances

- Alachlor
- Benzene
- Chlofenvinphos
- 1,2-Dichloroethane
- Dichloromethane
- Flouranthene
- Nickel and its compounds
- Trichloromethane (Chloroform)

PHS under review

< >

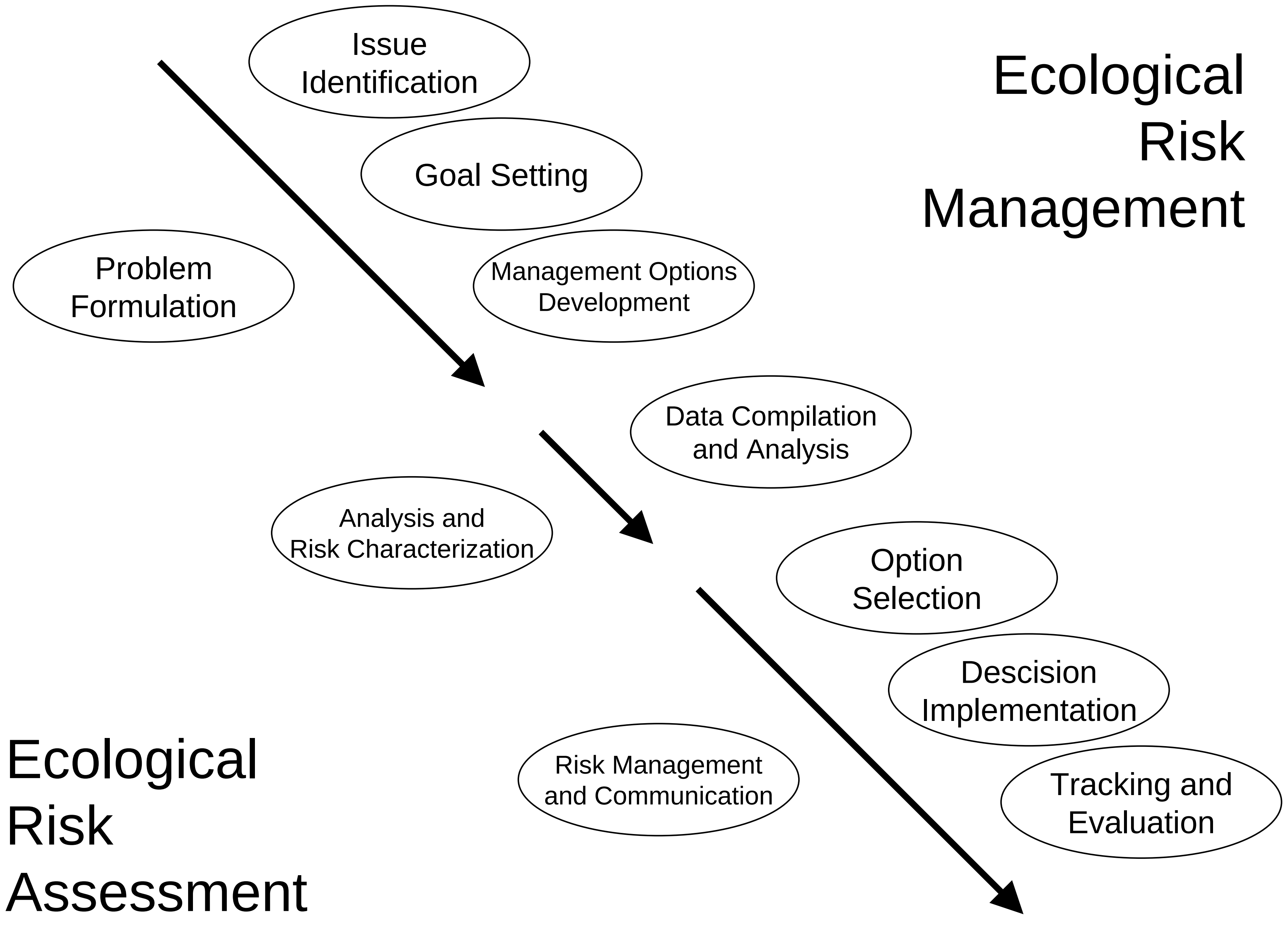
- Anthracen
- Atrazine
- Chlorpyrifos
- DEHP
- Diuron
- Endosulfan
- Isoproturon
- Lead
- Naphtalene
- Octylphenols
- Pentachlorophenols
- Simazine
- Trichlorobenzenes
- Trifluralin

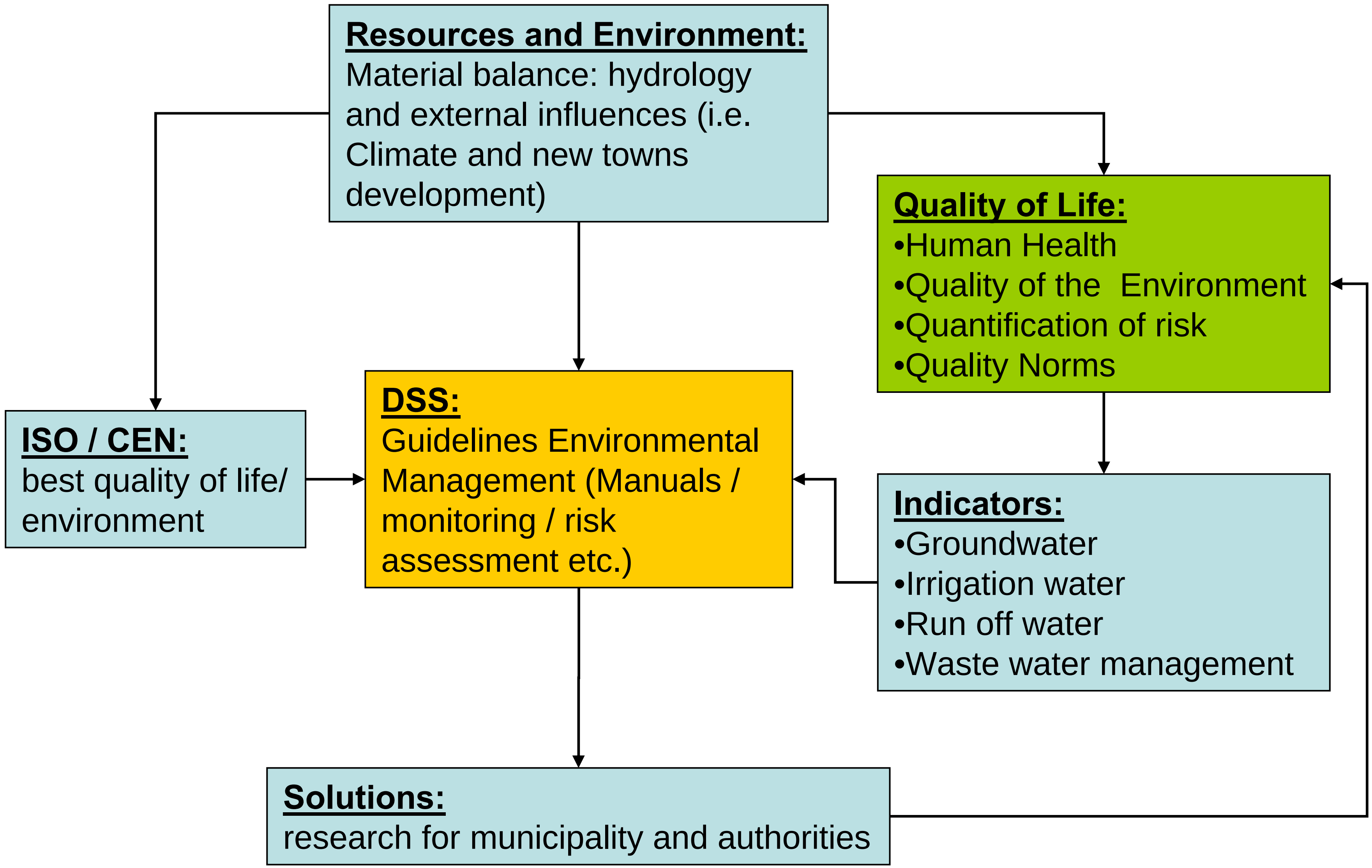
Priority hazardous substances

- Cadmium
- C10-13-chloroalkanes
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclohexane
- Mercury
- Nonylphenols
- PAH
- Pentachlorobenzene
- PBDE
- Tributyltin compounds

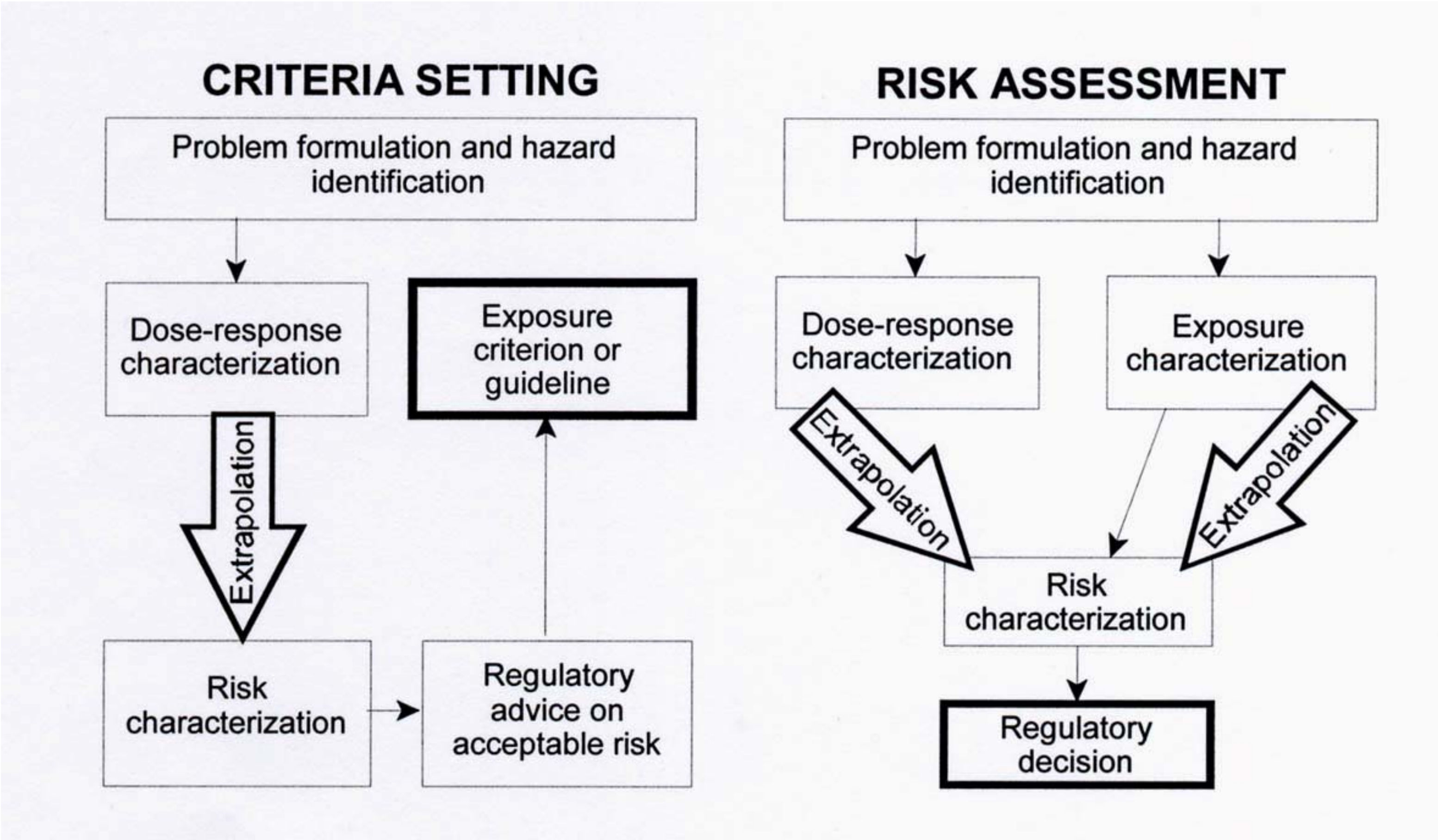
"Daughter Directives"

- 82/176/EEC : Mercury (by chlor-alkali electrolysis industry)
- 83/513/EEC : Cadmium
- 84/156/EEC : Mercury (by other sectors)
- 84/491/EEC : Hexachlorocyclohexane
- 86/280/EEC : Dangerous Substances Discharges :
  - Carbon tetrachloride
  - DDT
  - Pentachlorophenol
  - Aldrin, Dieldrin, Endrin and Isodrin (as amended by 88/347/EEC)
  - Hexachlorobenzene
  - Hexachlorobutadiene
  - Chloroform (as amended by 90/415/EEC)
  - 1,2-dichloroethane (EDC)
  - Trichloroethylene (TRI)
  - Perchloroethylene (PER)
  - Trichlorobenzenes and 1,2,4-TCB


Issue
Identification
Ecological
Risk
Management
Goal Setting
Problem
Formulation
Management Options
Development
Data Compilation
and Analysis
Analysis and
Risk Characterization
Option
Selection
Descision
Implementation
Ecological
Risk
Assessment
Risk Management
and Communication
Tracking and
Evaluation

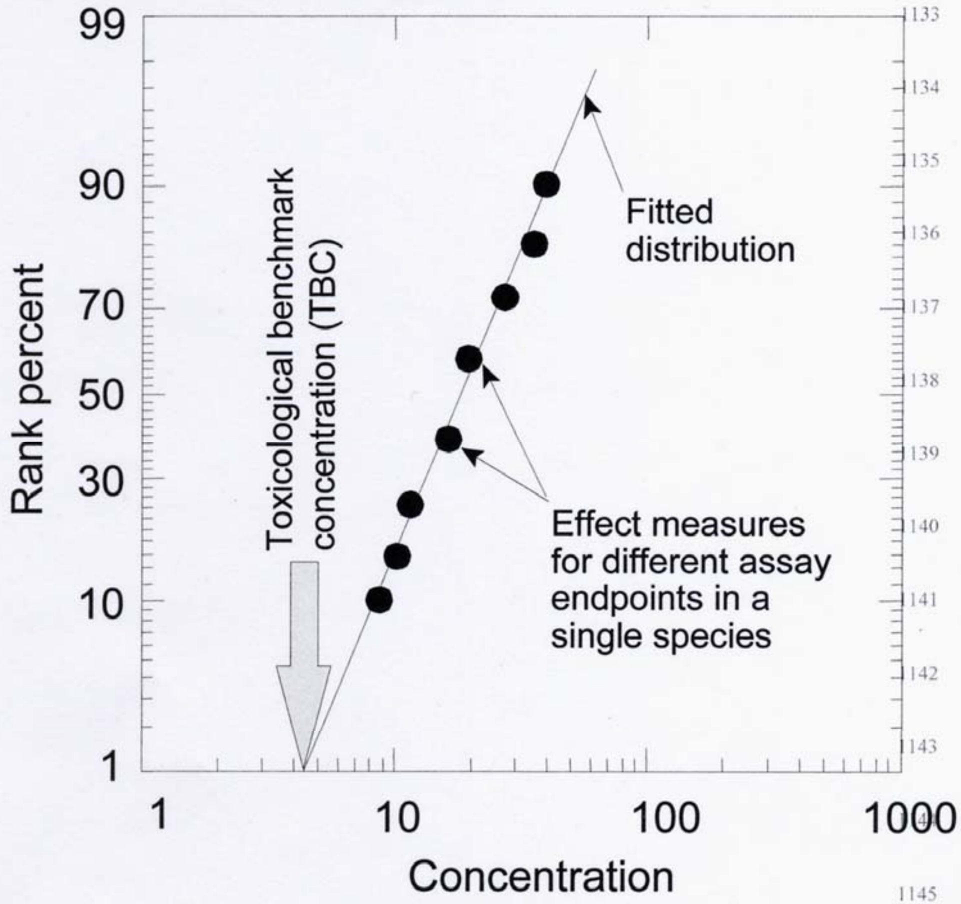

Resources and Environment:
Material balance: hydrology and external influences (i.e. Climate and new towns development)
Quality of Life:
•Human Health
•Quality of the Environment
•Quantification of risk
•Quality Norms
ISO / CEN:
best quality of life/ environment
DSS:
Guidelines Environmental Management (Manuals / monitoring / risk assessment etc.)
Indicators:
•Groundwater
•Irrigation water
•Run off water
•Waste water management
Solutions:
research for municipality and authorities

Setting criteria and assessing risk from existing exposures



Distribution of endpoints for a species to extrapolate a TBC

Extrapolation Practice for Ecological Effect Characterization of Chemicals



Toxicological benchmark concentration (TBC)

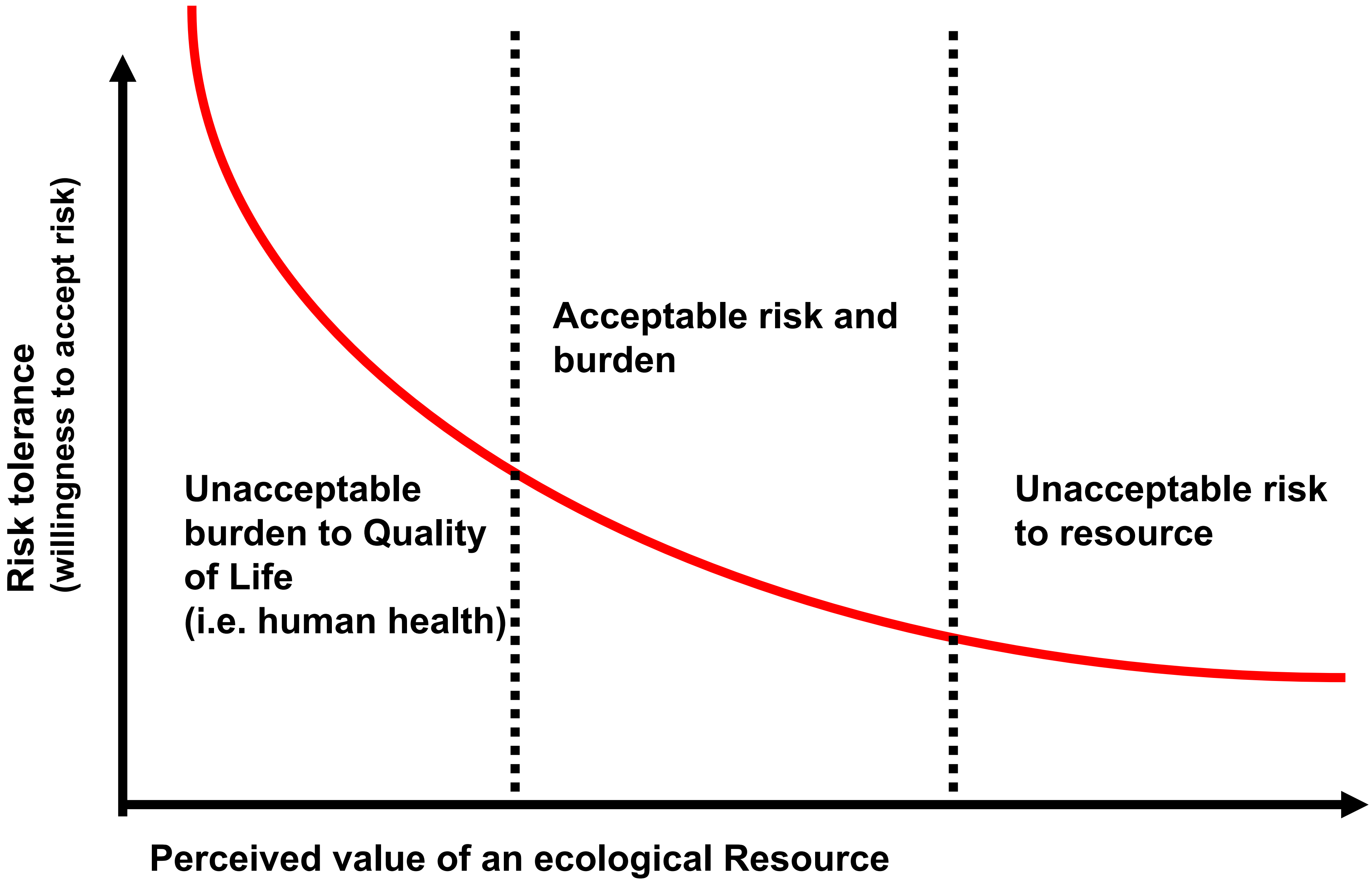
Benchmarking may be defined as "a continuous process to look for the best operating practices in order to achieve the most superior (environmental) performance".

Other definitions have been given in the literature, but this is the one closest to the workfield of Environmental Investigations.

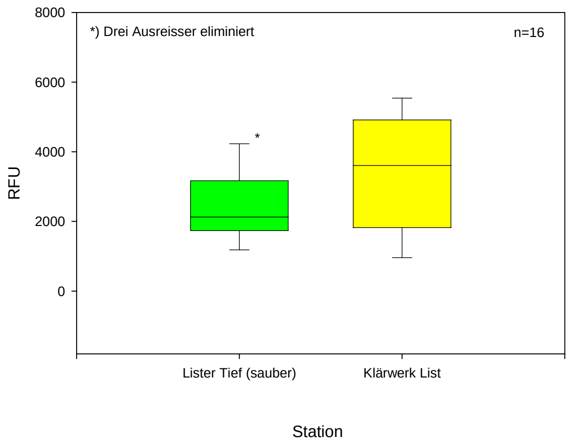
There are three main items in this definition:

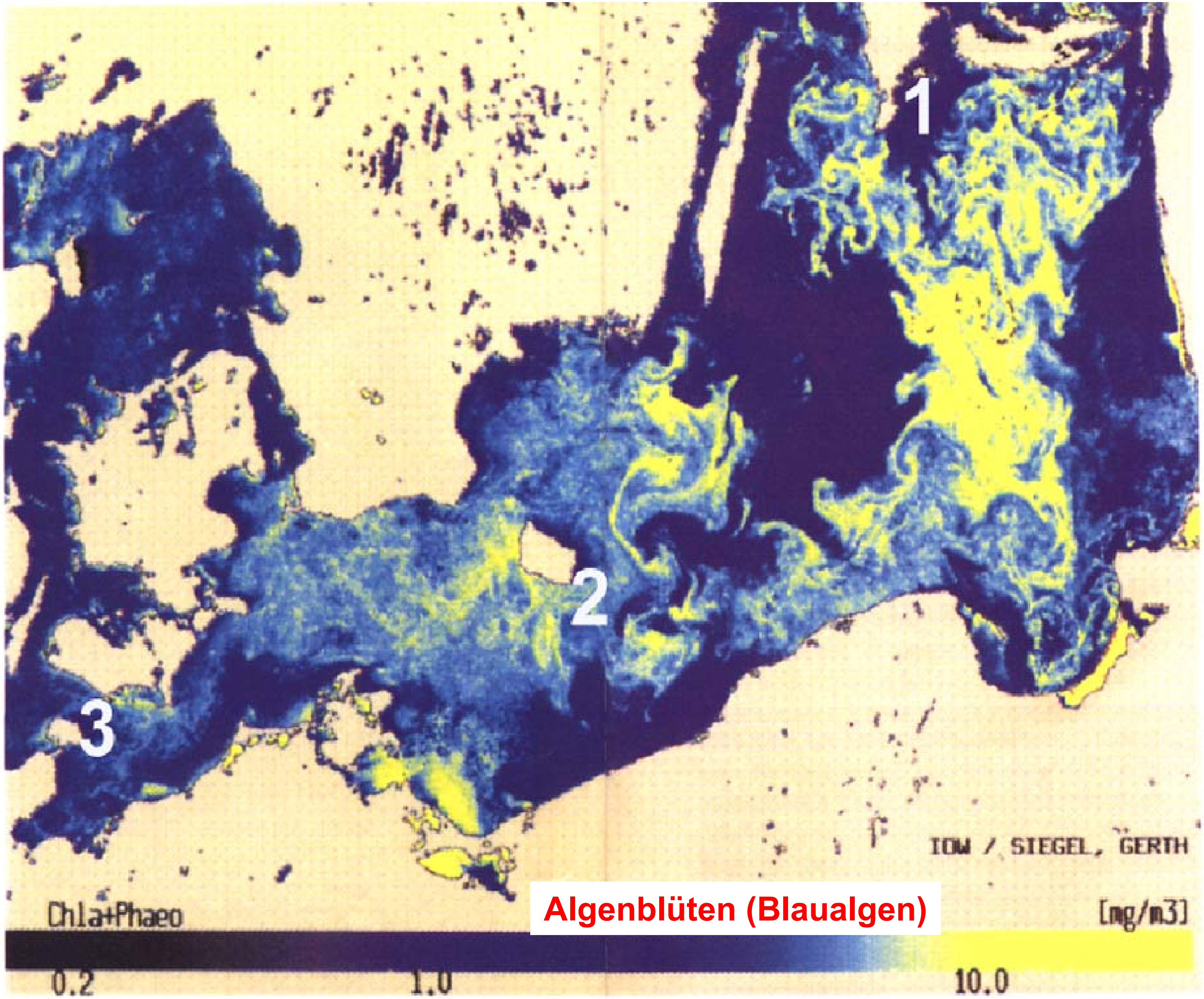
1. Environmental performance
2. The best operating practices
3. a continuous process

- toxicity load as such;
- toxicity load per tons of production capacity;
- toxicity load per tons of product really produced


Risk tolerance
(willingness to accept risk)
Acceptable risk and
burden
Unacceptable
burden to Quality
of Life
(i.e. human health)
Unacceptable risk
to resource
Perceived value of an ecological Resource

Phagozytosis activity of exposed *M. edulis*
Island of Sylt, May 2005




1
2
3
IOW / SIEGEL, GERTH
Chla+Phaeo
Algenblüten (Blaualgen)
[mg/m3]
0.2
1.0
10.0

Overview of Key Phytoplankton Toxins and Their Recent Occurrence in the North and Baltic Seas

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ABSTRACT: The frequency and intensity of harmful algal blooms (HABs) appear to be on the rise globally. There is also evidence of the geographic spreading of toxic strains of these algae. Consequently, methods had to be established and new ones are still needed for the evaluation of possible hazards caused by increased algal toxin production in the marine food chain. Different clinical effects of algae-related poisoning have attracted scientific attention; paralytic shellfish poisoning, diarrhetic shellfish poisoning, and amnesic shellfish poisoning are among the most common. Additionally, cyanobacteria (blue-green algae) in brackish waters often produce neurotoxic and hepatotoxic substances. Bioassays with mice or rats are common methods to determine algal and cyanobacterial toxins. However, biological tests are not really satisfactory because of their low sensitivity. In addition, there is growing public opposition to animal testing. Therefore, there has been increasing effort to determine algal toxins by chemical methods. Plankton samples from different European marine and brackish waters were taken during research cruises and analyzed on board directly. The ship routes covered marine areas in the northwest Atlantic, Orkney Islands, east coast of Scotland, and the North and Baltic seas. The first results on the occurrence and frequency of harmful algal species were obtained in 1997 and 1998. During the 2000 cruise an HPLC/MS coupling was established on board, and algal toxins were measured directly after extraction of the plankton samples. In contrast to earlier cruises, the sampling areas were changed in 2000 to focusing on coastal zones. The occurrence of toxic algae in these areas was compared to toxin formation during HABs in the open sea. It was found that the toxicity of the algal blooms depended on the prevailing local conditions. This observation was also confirmed by monitoring cyanobacterial blooms in the Baltic Sea. Optimal weather conditions, for example, during the summers of 1997 and 2003, favored blooms of cyanobacteria in all regions of the Baltic. The dominant species regarding the HABs in the Baltic was *Nodularia spumigena*. However, in addition to high concentrations of *Nodularia spumigena* in coastal zones, other blue-green algae are involved in bloom formation, with changes in plankton communities influencing both toxin profiles and toxicity. © 2005 Wiley Periodicals, Inc. Environ Toxicol 20: 1–17, 2005.

Keywords: algal toxins; paralytic shellfish poisoning (PSP) toxins; domoic acid; diarrhetic shellfish poisoning (DSP) toxins; spirolides; nodularin; LC/MS analysis

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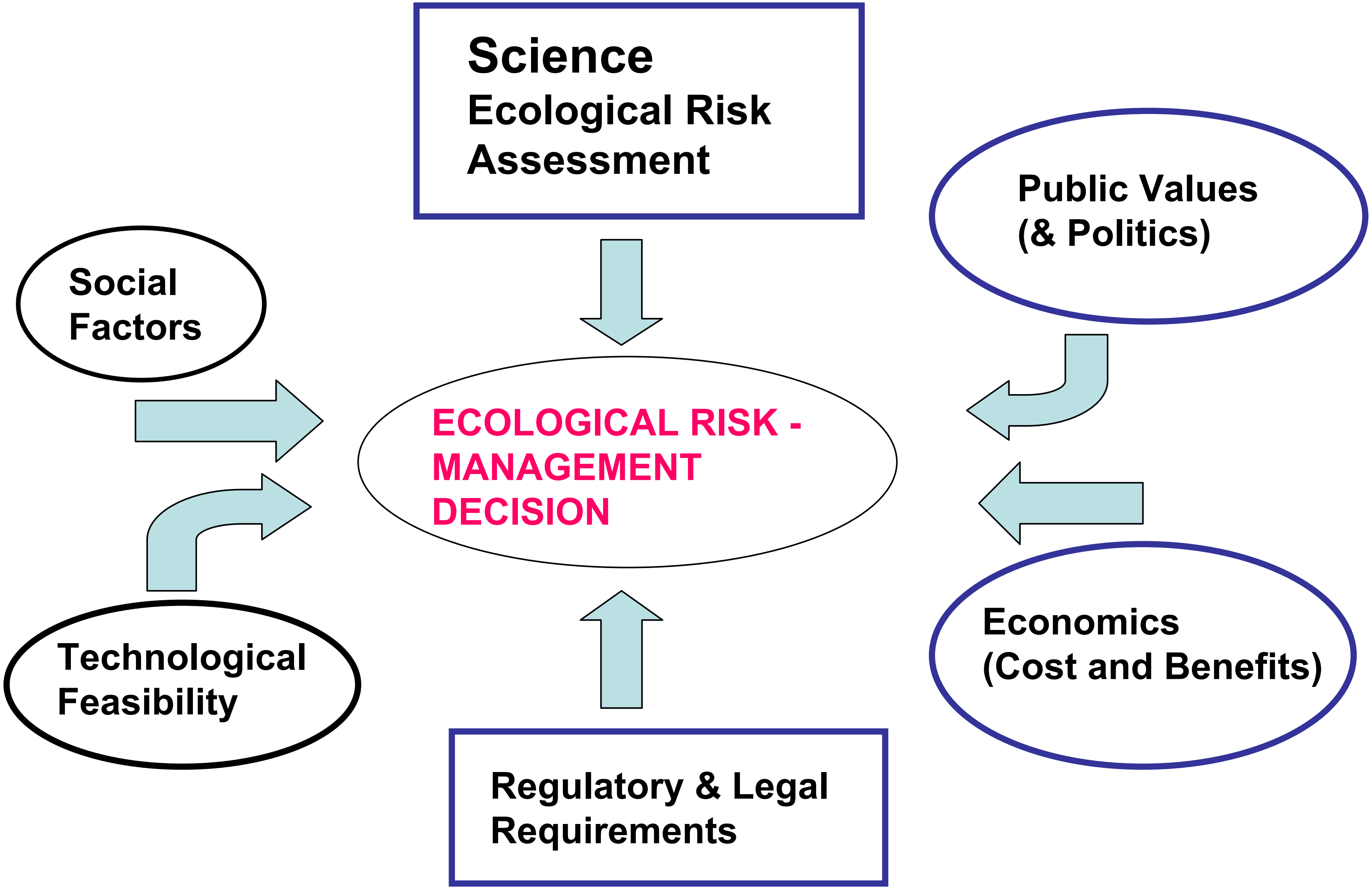
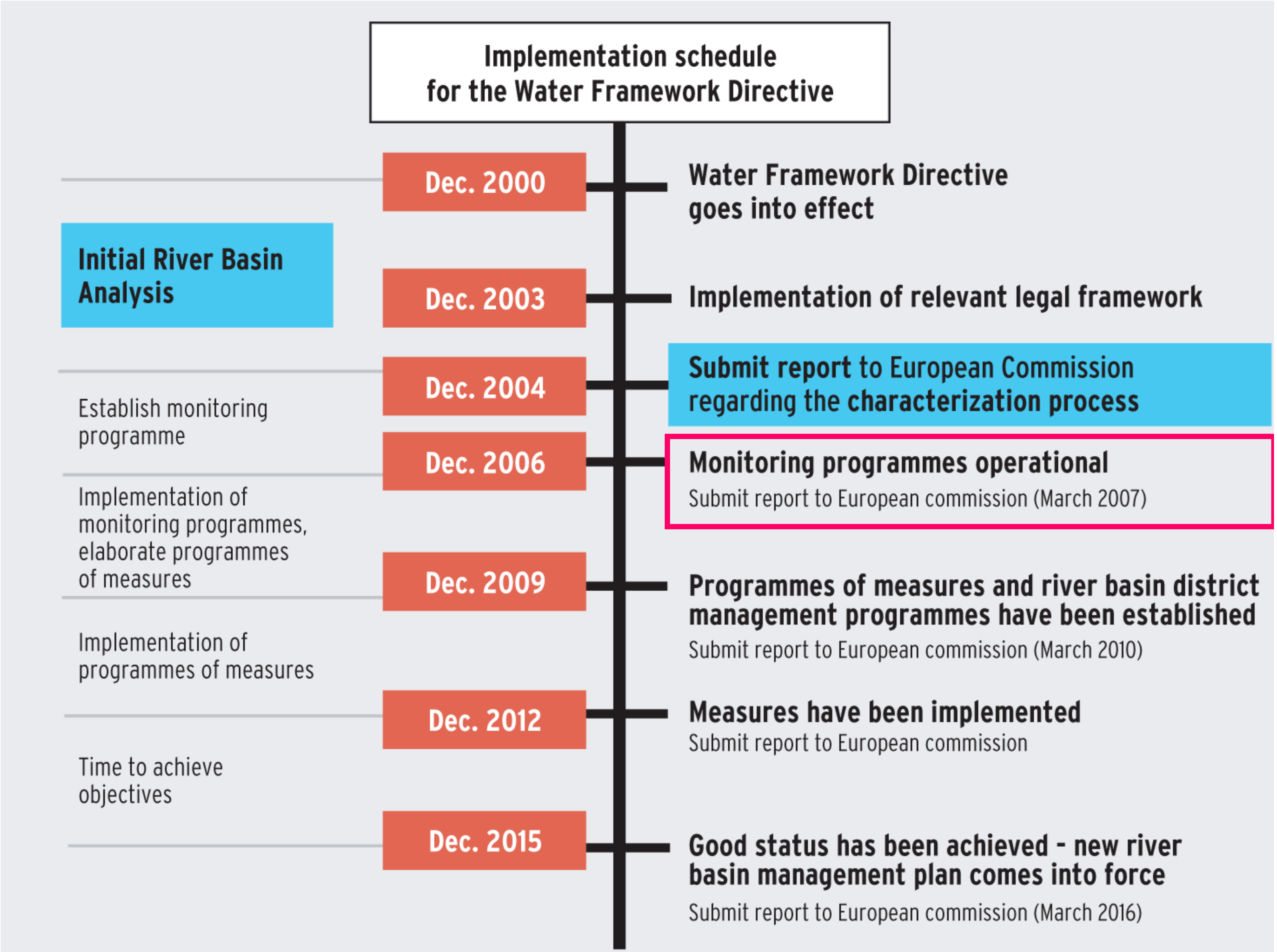
HARMFUL ALGAL BLOOMS

Natural "contaminants" may accumulate via food chains. A typical example is the ingestion and accumulation of algal toxins in filter feeders such as mollusks. Because mollusks

Inputs to the ecological risk management decisions





Implementation schedule
for the Water Framework Directive
Dec. 2000
Water Framework Directive
goes into effect
Initial River Basin
Analysis
Dec. 2003
Implementation of relevant legal framework
Dec. 2004
Submit report to European Commission
regarding the characterization process
Establish monitoring
programme
Dec. 2006
Monitoring programmes operational
Submit report to European commission (March 2007)
Implementation of
monitoring programmes,
elaborate programmes
of measures
Dec. 2009
Programmes of measures and river basin district
management programmes have been established
Submit report to European commission (March 2010)
Implementation of
programmes of measures
Dec. 2012
Measures have been implemented
Submit report to European commission
Time to achieve
objectives
Dec. 2015
Good status has been achieved - new river
basin management plan comes into force
Submit report to European commission (March 2016)

The WFD describes:

- **Surveillance monitoring**

The assessment and description of long-term ecological trends and an overall description of the waters to determine whether a good status has been or will be achieved.

- **Operational monitoring**

The assessment of the status of the water mass of which it has become evident that it may not meet the environmental objectives and/or to assess the changes in the status of this water mass resulting from the programme of measures.

- **Investigative monitoring**

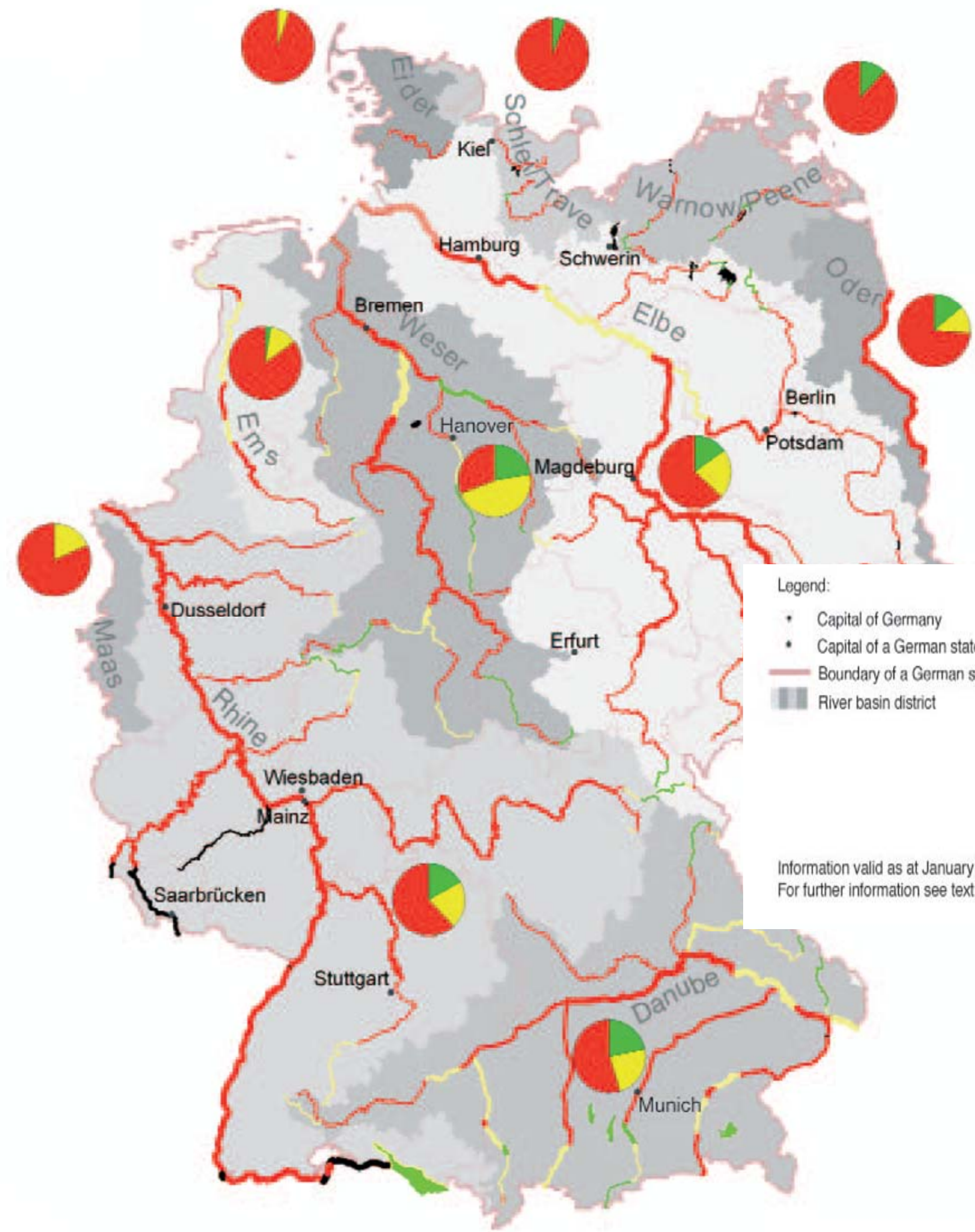
The identification of the cause of the failure to achieve a good status.

The characterization process and the three questions:

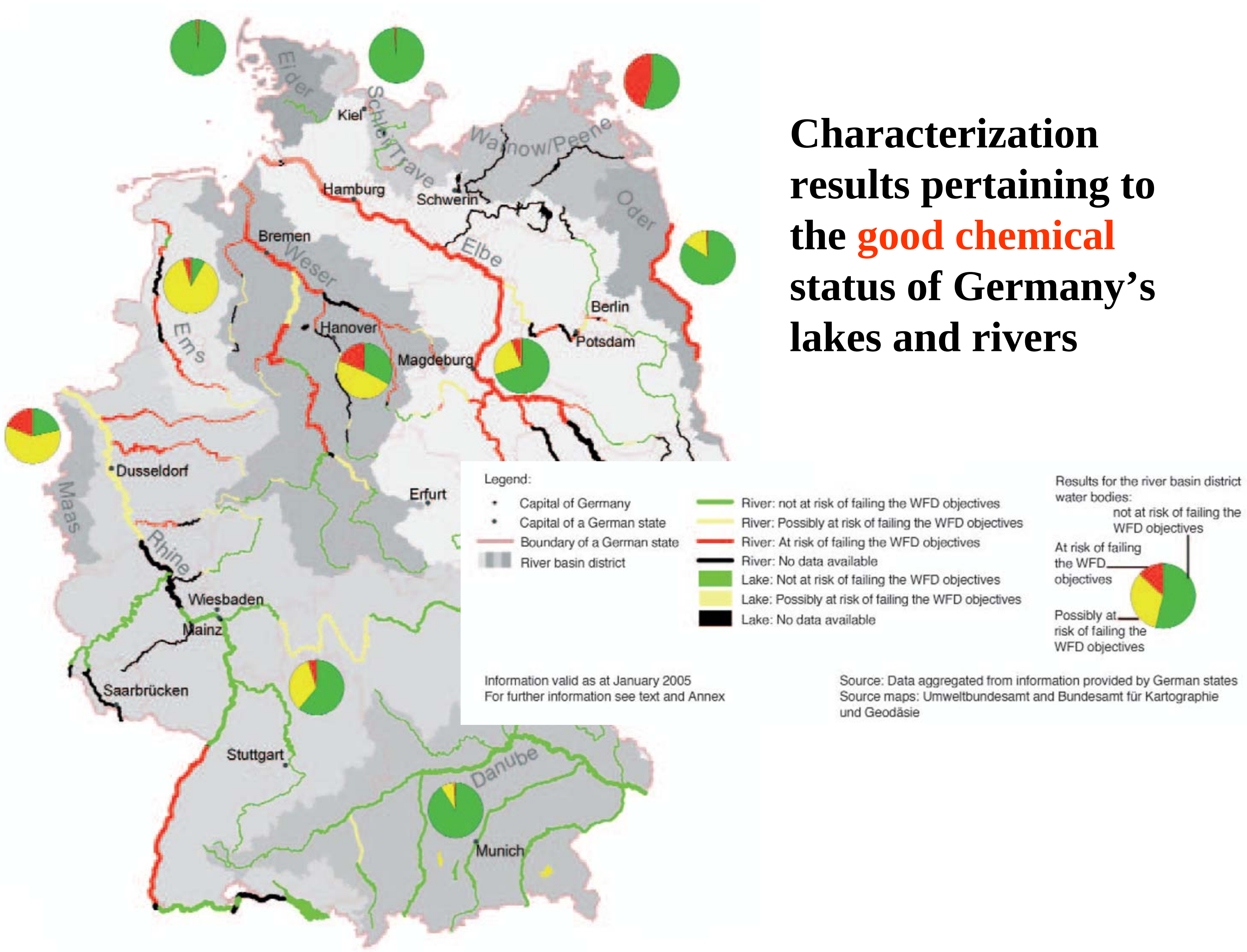
1. Which water bodies might fail the environmental WFD objectives
2. Which chemical and non-chemical pressures are to blame for the failure to meet these objectives?
3. Which mechanisms and effects should therefore be the focus of operative monitoring

The results of these investigations will form the basis for the elaboration of the monitoring programmes

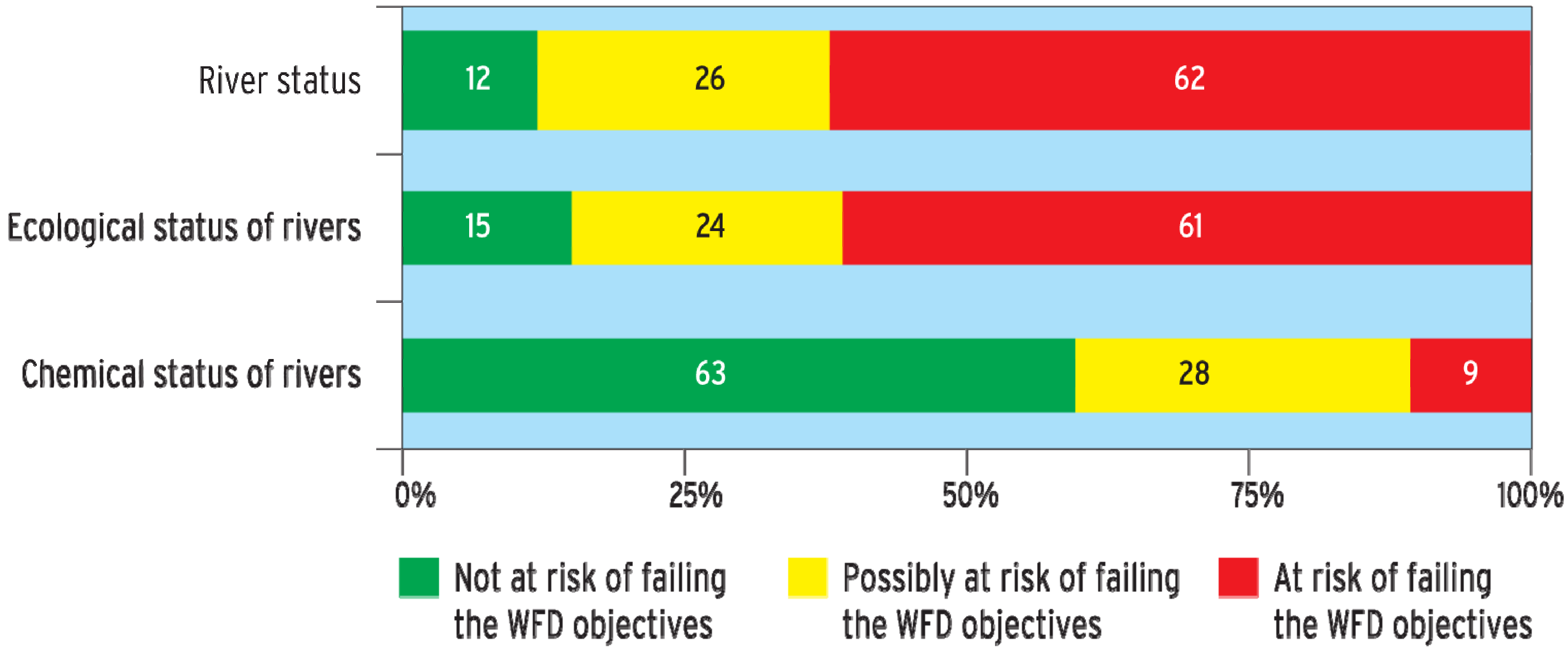
Characterization results pertaining to the good ecological status of Germany's lakes and rivers



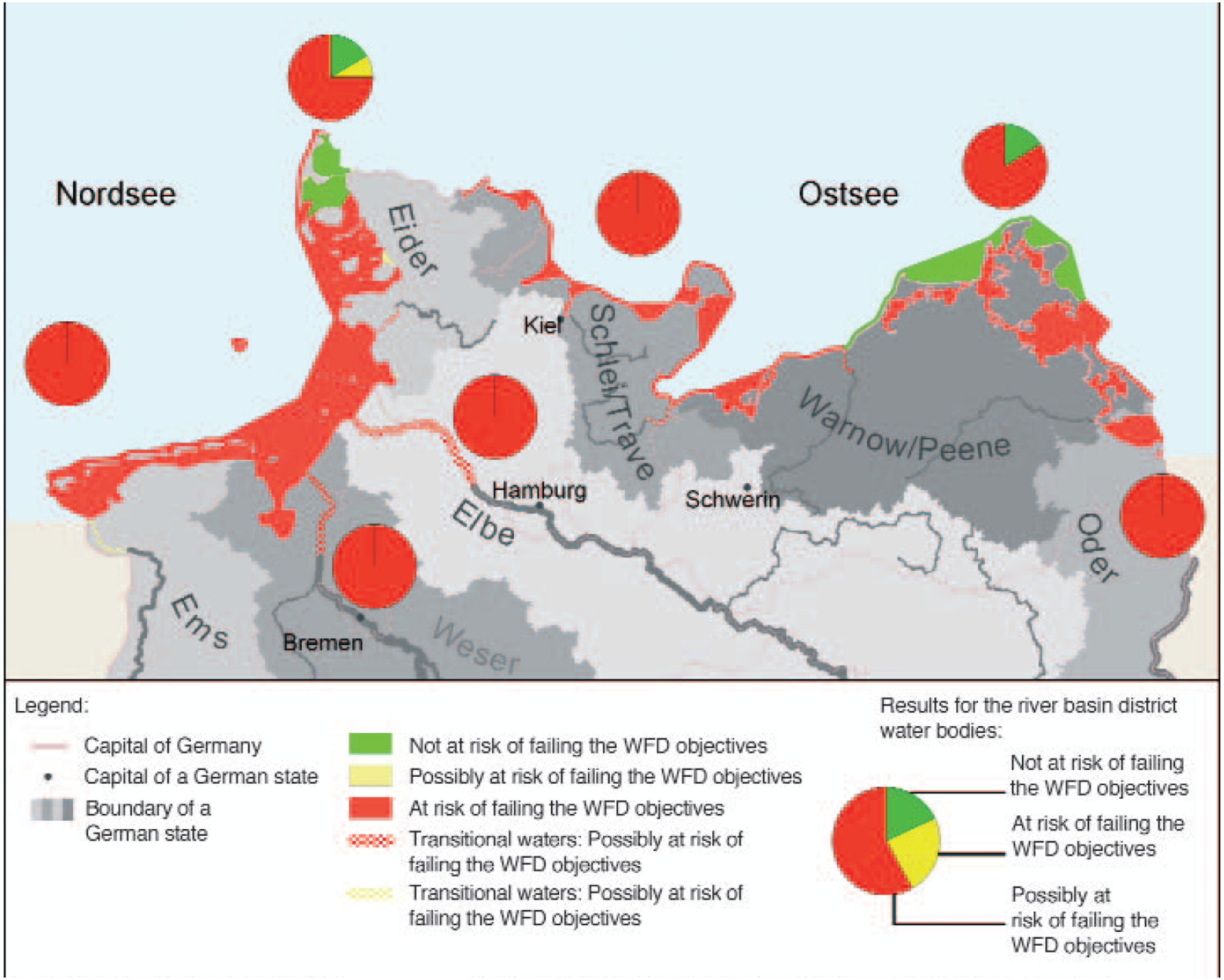
Characterization results pertaining to the good chemical status of Germany's lakes and rivers



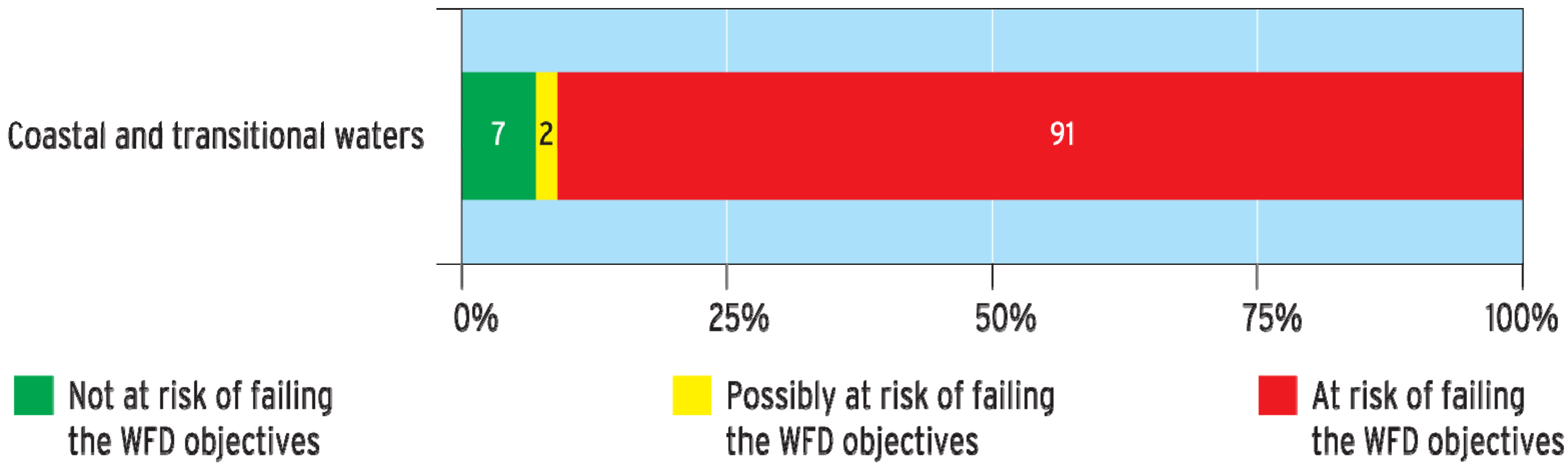
Characterization results for rivers



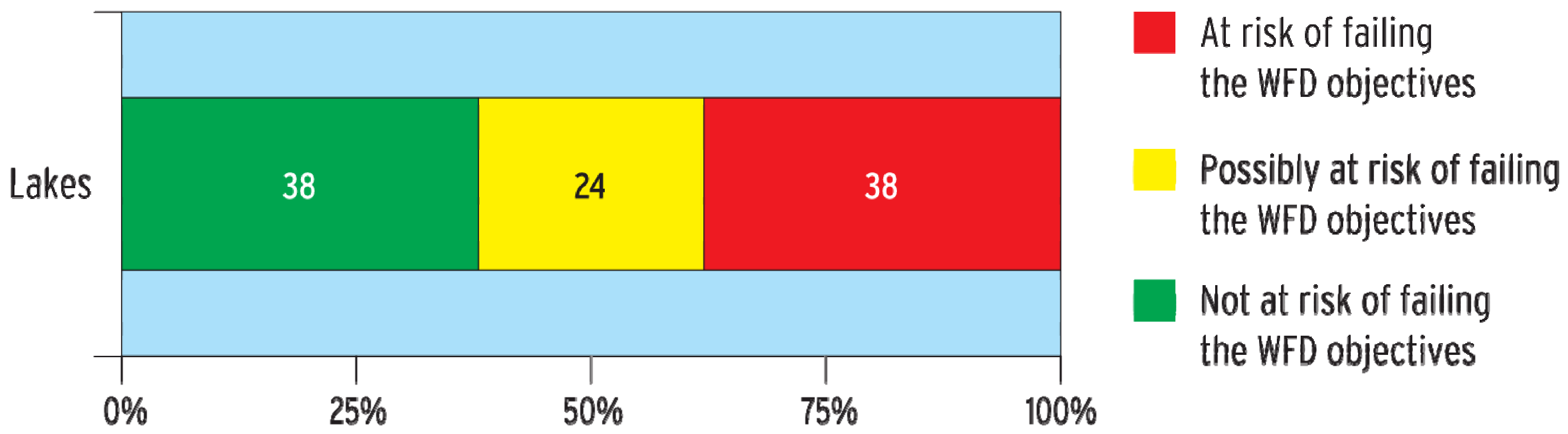
Characterization results pertaining to the good status of Germany's transitional and coastal waters



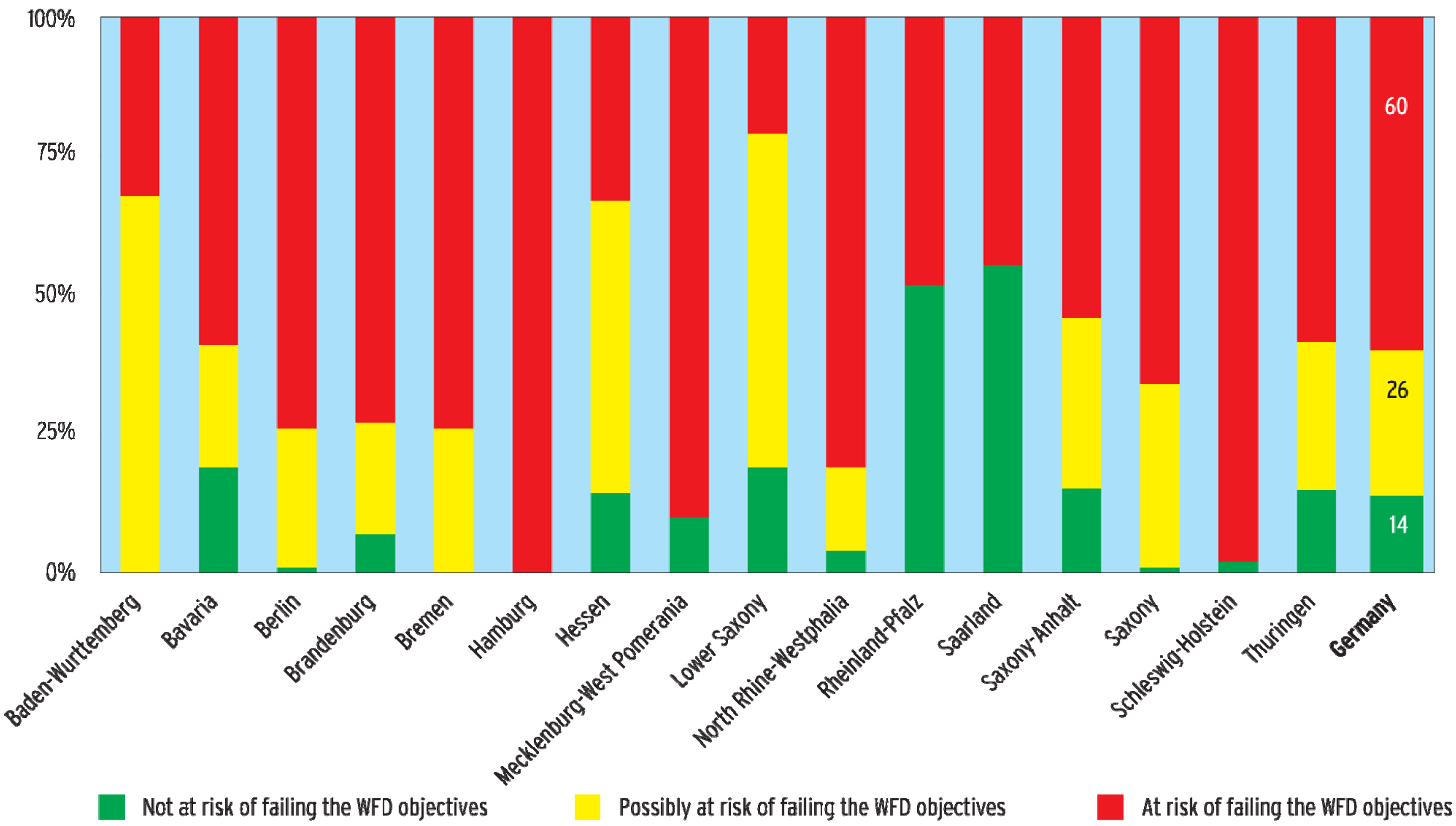
Characterization results for coastal and transitional waters



Assessment results for lakes



Initial characterization of Germany's surface water bodies



Environmental Quality Standards (EQS) for Priority Substances in Suface Water (AA: Annual Average; MAC: Maximum Allowable Concentration)

Unit: [µg/l].

(1)	(2)	(3)	(4)	(5)	(6)	(7)
N°	**Name of substance**	**CAS number**	**AA-EQS** **Inland surface waters**	**AA-EQS** **Other surface waters**	**MAC- EQS** **Inland surface waters**	**MAC-EQS** **Other surface waters**
(1)	Alachlor	15972-60-8	0.3	0.3	0.7	0.7
(2)	Anthracene	120-12-7	0.1	0.01	0.4	0.4
(3)	Atrazine	1912-24-9	0.6	0.6	2.0	2.0
(4)	Benzene	71-43-2	10	8	50	50
(5)	Pentabromodiphenylether	32534-81-9	0.0005	0.0002	1.4	1.4

Environmental Quality Standards (EQS) for Priority Substances in Surface Water (AA: Annual Average; MAC: Maximum Allowable Concentration)

Unit: [μg/l].

(1)	(2)	(3)	(4)	(5)	(6)	(7)
N°	**Name of substance**	**CAS number**	**AA-EQS** **Inland surface waters**	**AA-EQS** **Other surface waters**	**MAC- EQS** **Inland surface waters**	**MAC-EQS** **Other surface waters**
(1)	DDT total	50-29-3	0,025	0,025	*not applicable*	*not applicable*
	para-para-DDT	*CHECK*	0,01	0,01	*not applicable*	*not applicable*
(2)	Aldrin	309-00-2	S=0,010	S=0,005	*not applicable*	*not applicable*
(3)	Dieldrin	60-57-1				
(4)	Endrin	72-20-8				
(5)	Isodrin	465-73-6				
(6)	Carbontetrachloride	56-23-5	12	12	*not applicable*	*not applicable*
(7)	Tetrachloroethylene	127-18-4	10	10	*not applicable*	*not applicable*
(8)	Trichloroethylene	79-01-6	10	10	*not applicable*	*not applicable*

Änderungen AA-EQS für Fließgewässer

Nr.	Stoff	AA-EQS Juli 05	AA-EQS Dez. 05	AA-EQS Mai 06	ZV A
16	HCB	0,0004	0,0002	0,01	0,01
17	Hexachlorbutadien	0,003	0,003	0,1	0,5
20	Blei	2,1	2,1	7,2	3,4 1)
23	Nickel	1,7	3,8	20	4,4 1)
25	Octylphenol	0,06	0,06	0,1	
27	Pentachlorphenol	0,2	0,4	0,4	bereits Dez.05 geändert
28	Summe Benzo(g,h,i)perylen Indeno(1,2,3-cd)pyren	0,02	0,002 2)	0,002 2)	bereits Dez.05 geändert
32	Trichlormethan	12	2,5	2,5	bereits Dez.05 geändert

Änderungen MAC-EQS für Fließgewässer

Nr.	Stoff	MAC-EQS Juli 05	MAC-EQS Dez. 05	MAC-EQS Mai 06	
16	HCB	0,05	0,002	0,05	
17	Hexachlorbutadien	0,6	0,04	0,6	
19	Isoproturon	1,3	1	1	bereits Dez.05 geändert
28	Benzo-a-pyren	0,05	0,1	0,1	bereits Dez.05 geändert
30	TBT	0,002	0,0015	0,0015	bereits Dez.05 geändert

green = AAEQS yellow <10%; orange=10-25%; red >25%

Summary

The good ecological status is mainly supported by the hydromorphological elements (no Bioassays!)

Comprehensive strategy is given for a Ecological risk assessment (ERA) that based on two major elements: characterization of effects and characterization of exposure.

Effect related appproaches (bioassays, biomarkers, biosensors (?) - environmental signalling (on line real time bioassays) - are only relevant in the context to the “Quality Norms (QN)” developed after the WFD in correspondence to the “good chemical status”

It was demonstrated how to develop a strategy of classification of sediments and how to include effect related data of river sediments into the WFD concept.

Measurement data from monitoring programmes provide the basis for water quality evaluations (QN) for the purpose of achieving the environmental objectives of the Water Framework Directives (WFD) .

Further tools (Swift Programm):

Contribution of the REACH Concept for Natural Water Conservation?!

REACH=Registration, Evaluation, Authorisation of Chemicals **(Registration, Bewertung, Zulassung und Beschränkung von chemischen Stoffen)**

QSAR=Qualitative Structure Activity Relationship

If there is a river “at risk”?

Monitoring in support of ERA should be adequate for the characterization of exposure and effects thus enabling the sustainable development for aquatic life and human health protection.

Acknowledgement

European Commission, DG Research I.-3

SedNet, European Sediment Research Network

CITY FISH: Modelling the Ecological Quality of Urban Rivers: Ecotoxicological Factors Limiting Restoration of Fish Populations

SANDRINE – www.sandrine-wwc.de

BEEP, BIOMAR I+II

Thank You!

Department of Ecotoxicology - Institute for Ecological Research and Technology

www.tu-berlin.de/~oekotox
www.ecosystemhealth.net

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