

Environmental risk assessment in European Community –

background for environmental risk
assessment; differences between risk
assessment and hazard assessment

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Environmental Risk Assessment

- **Definition**

- Capacity for determination of the relationship between a predicted exposure and adverse effects

- **Background**

- European policy
 - sustainable development of industrial activities
 - no harm to the environment
 - policy in European maritime areas to avoid harmful environmental impacts in a proactive way
- Necessary to develop tools for a proactive approach need for 'early warning'
 - based on sound scientific methods and knowledge
 - In lack of scientific basis the precautionary principle will be applied
 - example: Off-shore oil exploitation in the Norwegian Arctic



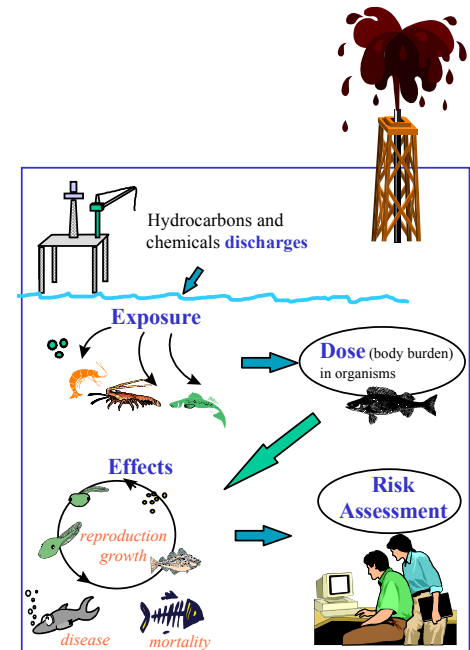
Environmental Risk Assessment ERA

- ERA implies...

- Predictions (what will happen)

- ~ Forecasts (prediction of future situations)

- ~ Prognosis (forecast esp. related to health)



Environmental Hazard Assessment

- **Definition**

- adverse effects indicating that a substance has an inherent capacity to cause cellular or organism damage



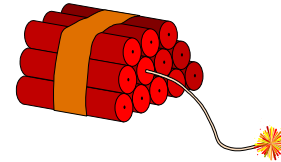
Environmental predictive assessments different approaches

Not very acute differences...

Hazard

Emphasis on...

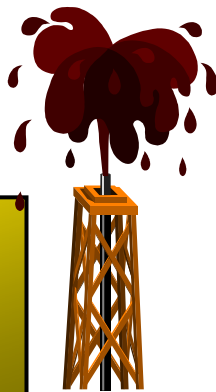
Environmental properties
of discharged chemical product



Risk

Emphasis on...

Fates and effects of discharge
in a particular environmental
compartment



Environmental Risk Assessment

(EUs TGD, OSPAR)

- Capacity for determination of the relationship between a predicted exposure and adverse effects, in the following major steps:
- **Assessment of Effects**; comprising
 - **Hazard identification**
 - definition of adverse effects that a substance has an inherent capacity to cause
 - **Dose (concentration) – response (effect) assessment**
 - estimation of the relationship between the dose (or level of exposure to a substance), and the incidence and severity of effect, where appropriate
- **Exposure assessment**
 - determinations of concentration/doses to which environmental compartments are or may be exposed
- **Risk characterisation**
 - estimation of the incidence and severity of the adverse effects likely to occur in an environmental compartment due to actual or predicted exposure to a substance.
 - may include 'risk estimation', i.e., the quantification of that likelihood



Environmental Risk Assessment

(alternative meaning of the term)

- Capacity for determination of the relationship between a measured exposure (or dose) and adverse effects
 - Commonly used in the U.S. and also in the European scientific community
 - Different meanings cause confusion and should as far as possible be avoided !



Environmental Impact Assessment

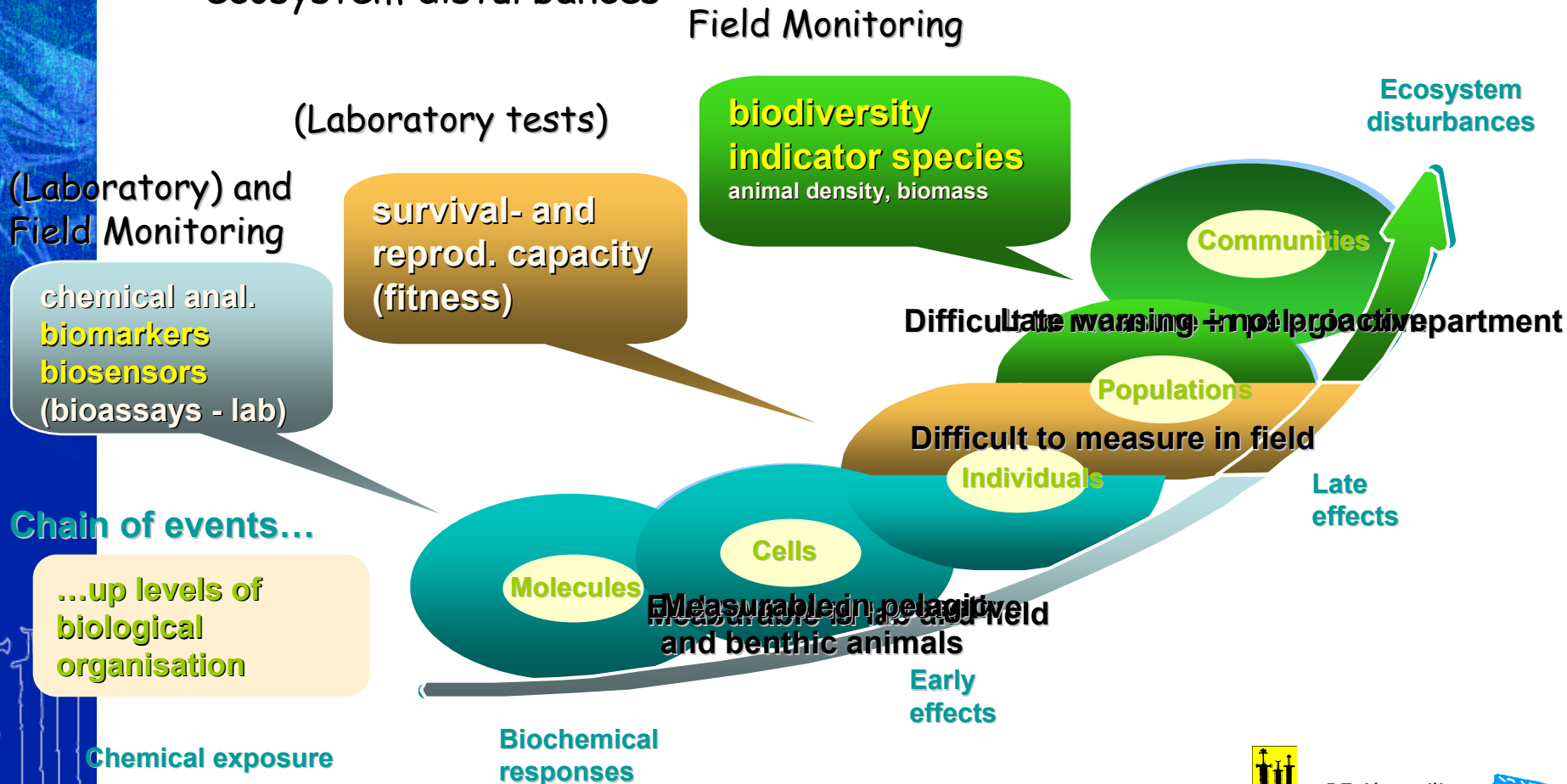
- **EIA** - A term used somewhat ambiguously (?)
 - Assessment of environmental impact
 - based on
 - prognostic information ('desk estimate'), possibly augmented with
 - diagnostic data ('field measurement')
 - » = Environmental (or Biological) Effect Monitoring called: **EEM**, BEM or 'Biomonitoring'



Environmental Effect Monitoring (EEM)

Overview - which measurement tools for which purpose ?

- exposure -
- biological uptake and transformation - harmful effects -
- ecosystem disturbances



Summary of Assessments

- Hazard Assessment
 - Laboratory based
 - Bio-assays (TIE), Toxicity tests (fitness)
- Risk Assessment
 - 'Desk assessment' based on
 - Exposure predictions and Laboratory tests (toxicity; fitness)
- Impact Assessment
 - 'Desk' assessment based on
 - site specific information
 - Field assessment based on
 - Environmental Effect Monitoring (EEM or 'Biomonitoring')



Key elements in present ERA developed in Europe

- PEC:PNEC
- SSD



PEC:PNEC

- Explanations
 - PEC = Predicted Environmental Concentration
 - PNEC = Predicted No Effect Concentration
 - If $PEC > PNEC$, then there is an environmental risk
- Strengths
 - Screening, prioritizing hazards
- Limitations
 - The environmental risk is not graded
 - Bioavailability and Depuration are poorly represented
 - No quantification of likelihood of effects
 - No characterization of the extent of effects
 - Only an indicator of risk
- Alternatives
 - Dose related (BB:CBB)
 - Body Burden/ Critical Body Burden
 - Future (?):
 - Exposure / Biological Response Related (PEC:'TBR')
 - PEC : 'Threshold Biomarker Response' (?)

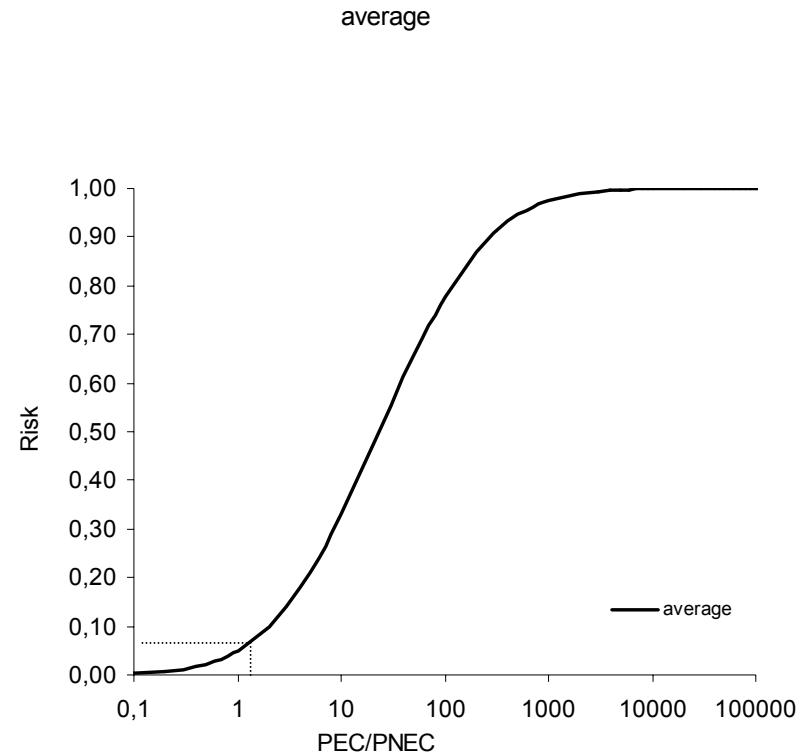


SSB

- Species Sensitivity Distributions

- Concept used to represent the environmental sensitivity in ERA

- Why & How ?



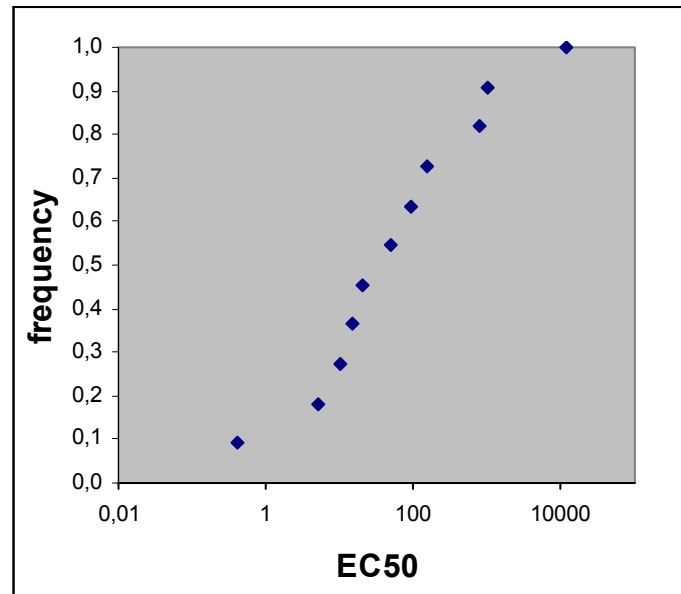
SSB – Why...

- To estimate the sensitivity of "all" species from a limited set of toxicity data
 - Used instead of "the most sensitive species"
- To estimate a concentration that would protect a certain percentage of species from any kind of adverse effects
 - usually 95%, but it is arbitrary!
 - Predicted No Effect Concentration (PNEC)



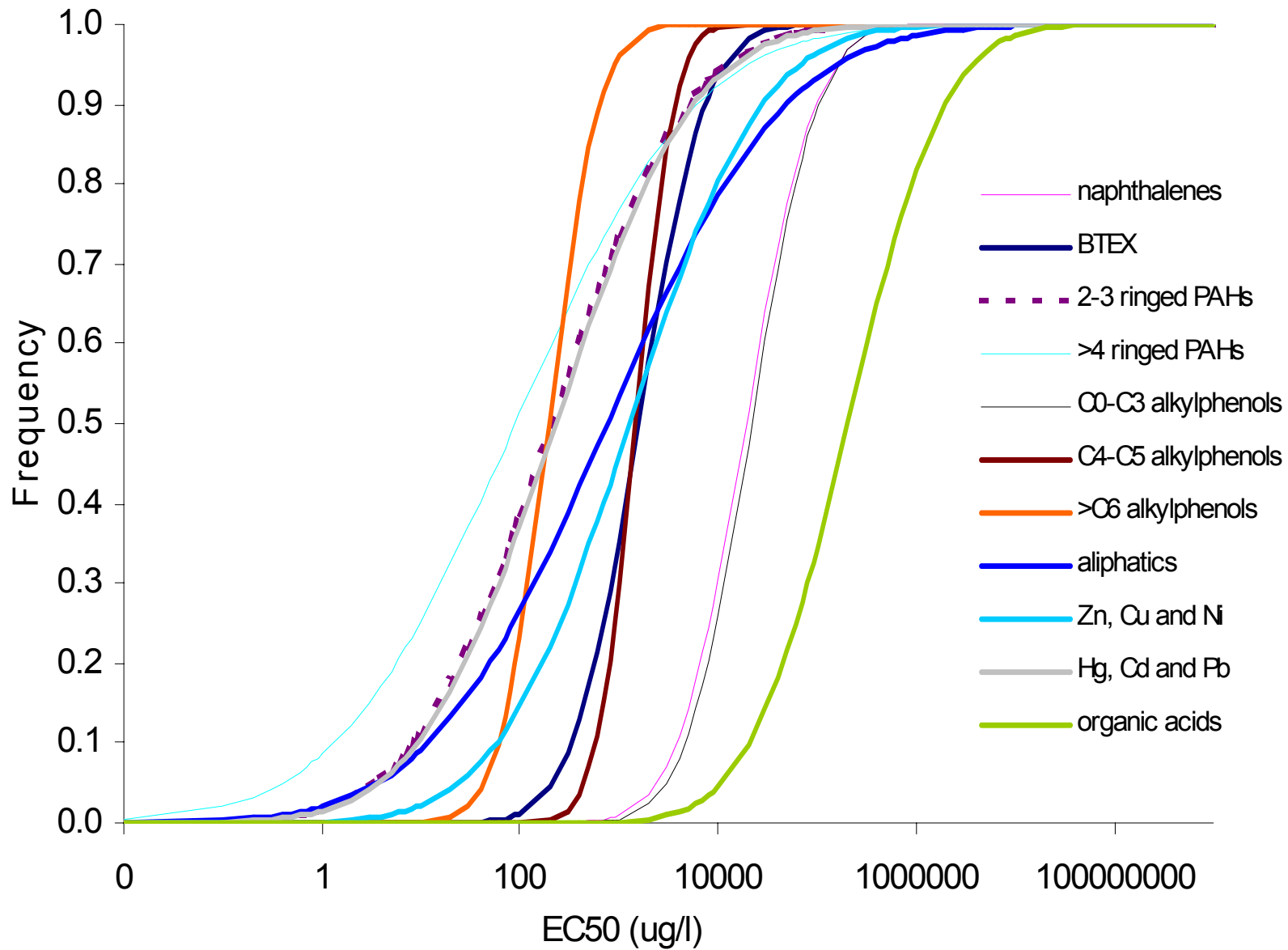
How...

- Toxicity data are needed for various species
 - Could be NOECs, or EC50s, or ...
 - Preferably from different taxonomic groups



Species	EC50	Frequency
1 crustacean A	0,4	0,09
2 mollusc A	5	0,18
3 crustacean B	10	0,27
4 fish A	15	0,36
5 mollusc B	20	0,45
6 mollusc C	50	0,55
7 alga B	90	0,64
8 fish B	150	0,73
9 echinoderm	800	0,82
10 alga A	1000	0,91
11 annelid	12000	1,00

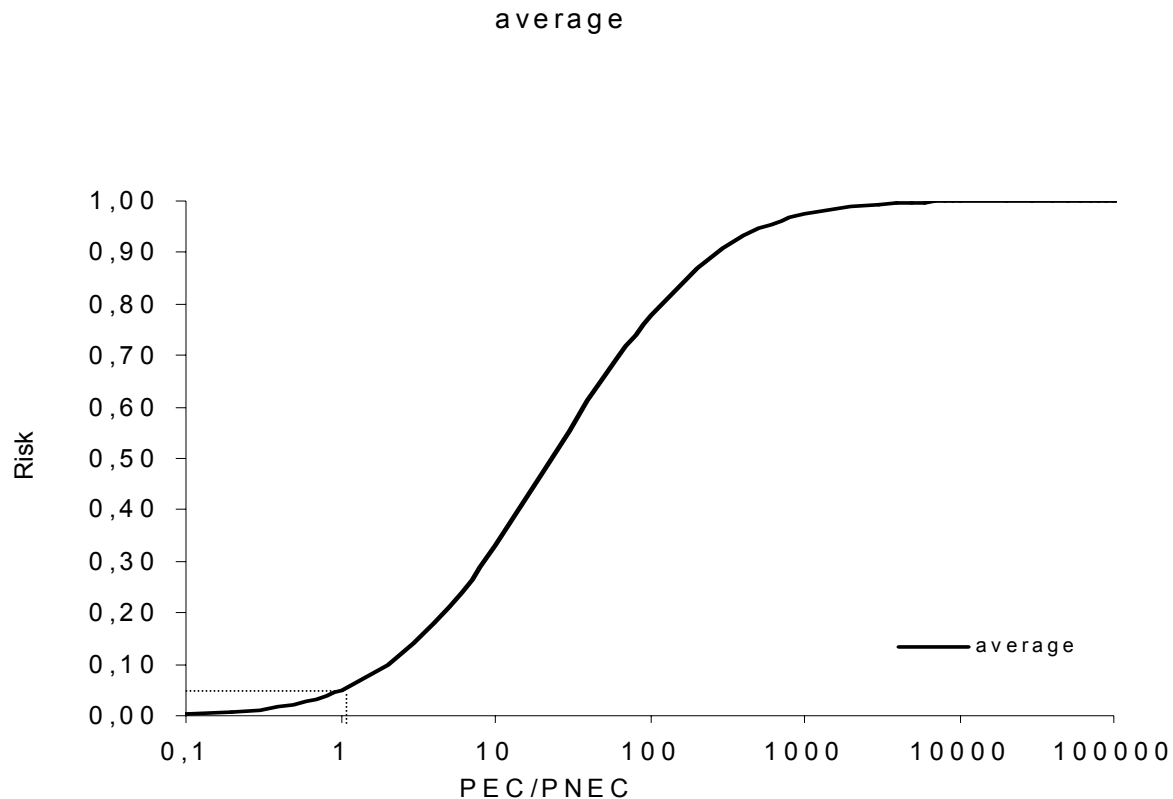
How...



How...

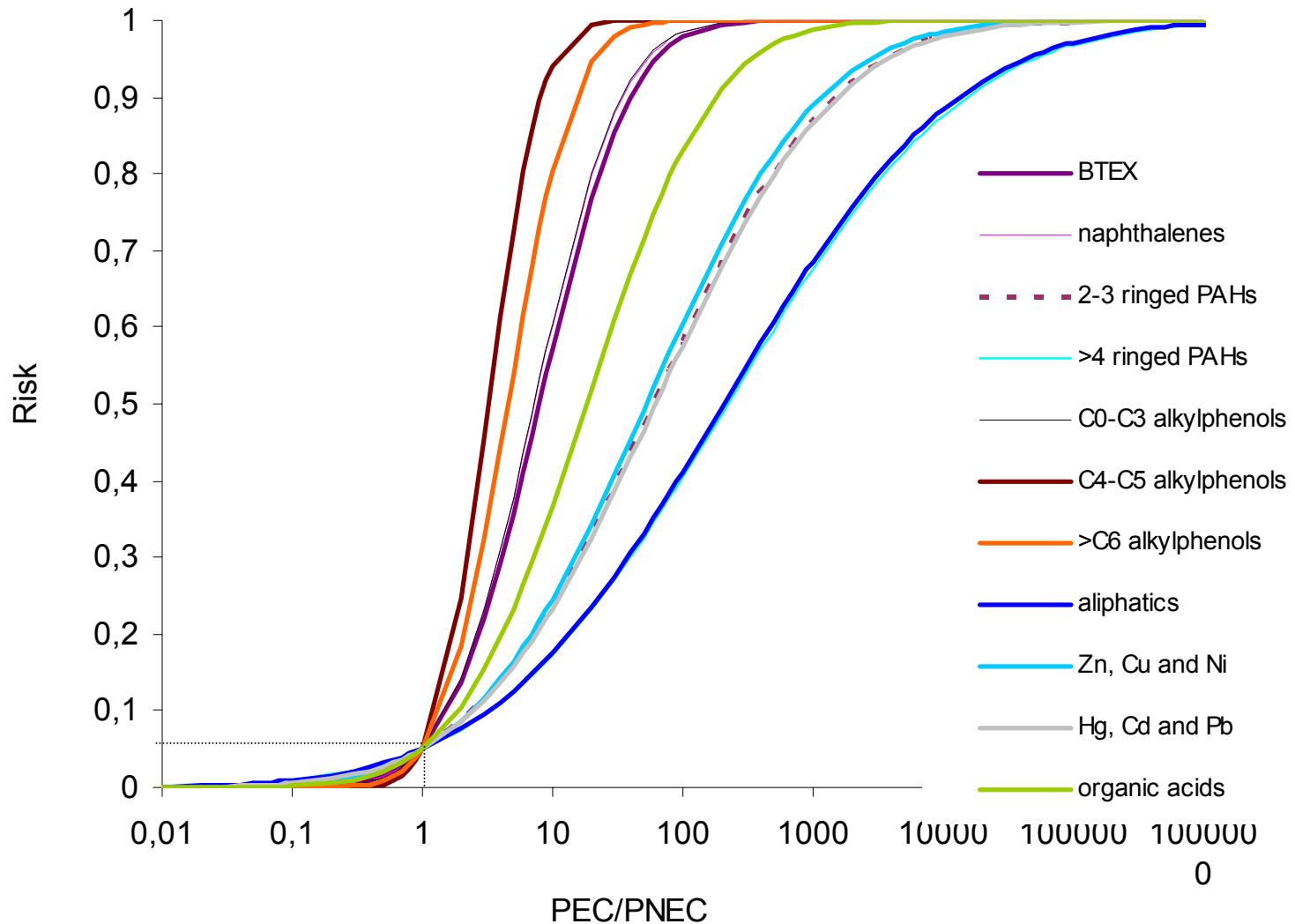
Average curve $PEC:PNEC=1$; risk = 5%

The variation of sensitivity is fitted assuming a log-normal distribution



How...

Average curve $PEC:PNEC=1$; risk = 5%



Environmental Risk Assessment Tools

- ERA - High complexity
 - Need for calculation tools
 - standardized and powerful
 - Several developed for oil industry
 - Computer simulation models / spreadsheet calculation / expert systems
 - Most important related to oil industry in Europe are:
 - CHARM, EUSES, OSCAR, DREAM, PROTEUS, EIF, ParTrack, ERMS, MEMW...
 - ... next presentation →

