

# Screening and Monitoring of Contaminants in the Aquatic Environment

## Finnish & Nordic examples

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# Screening of priority substances in Finland

- ❑ Identify EU/WaterFD prioritized and nationally selected organic pollutants in aquatic environments near sources of discharge
- ❑ Provide information to source identification – but not single pollution sources (impact monitoring, compliance checking => enterprises)
- ❑ To develop best practices, analytical methods and cooperation between laboratories
- ❑ To identify WFD substances which should enter the national monitoring networks
- ❑ Provide information for the classification of water bodies



# Screening and monitoring fragmented in Finland

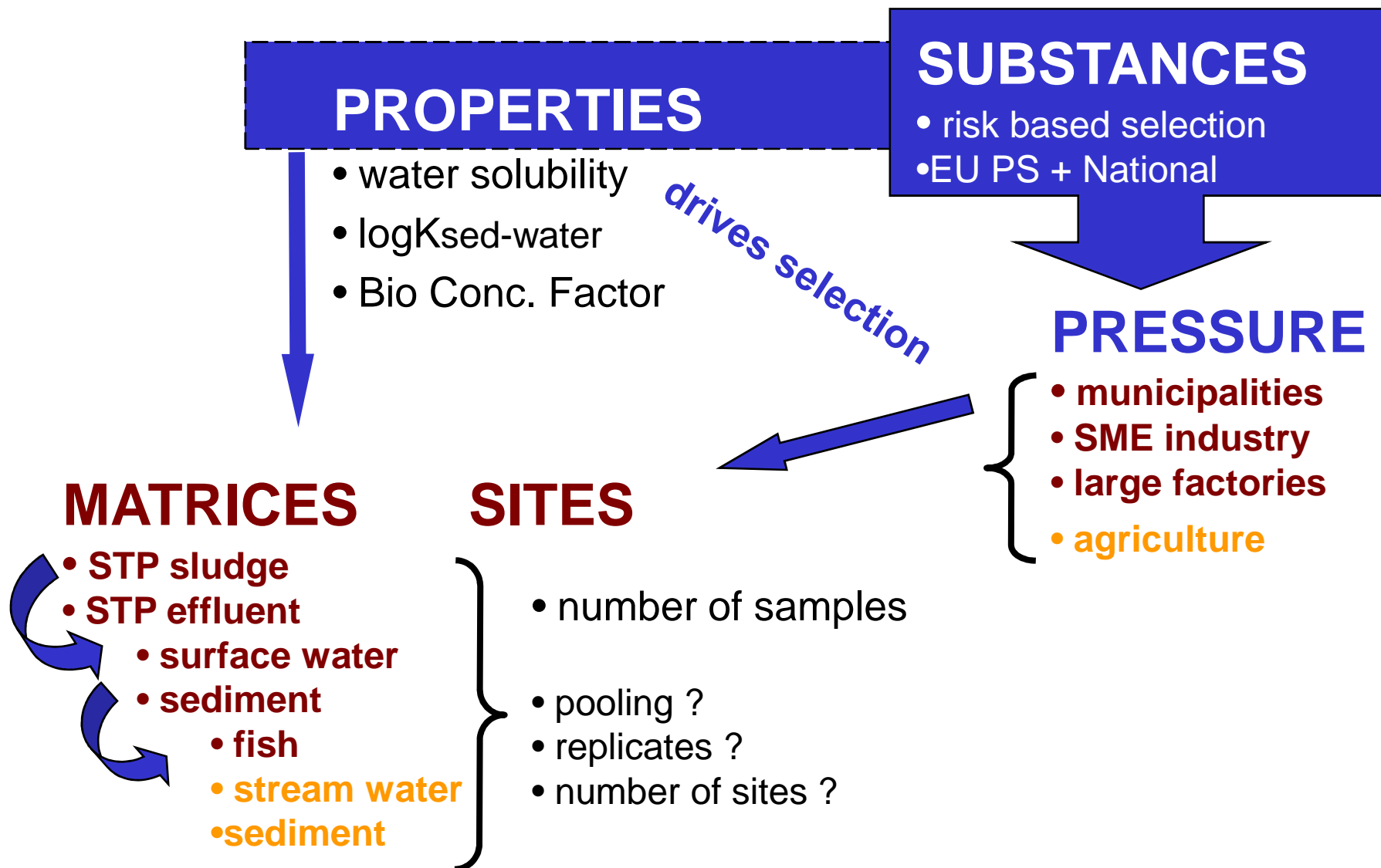
- Finnish Food Safety Authority
- The National Institute for Health and Welfare
- Finnish Environment Institute (SYKE)
- Game and Fisheries Research Institute
- Geological Survey of Finland

=> Advisory board on monitoring of hazardous substances

- Since 2005
- Forum for exchange of ideas, information
- Promotes harmonisation







4.5.2009

- Guidance on surface water chemical monitoring nro 19 (available on <http://circa.europa.eu/Public>)
- Guidance on chemical monitoring of sediment and biota



# Risk based prioritisation

## EXP. ASSESSMENT

- Subst. usage & pattern
- emissions
- persistence
- accumulation
- mobility

## EFFECTS ASSESSMENT

Toxicity to biota:

- "traditional effects"
- endocrine effects
- Other adverse effects (?)

PEC

PNEC~EQS

RELATIVE RISK



## First screening of WFD priority substance in 2003 - 2005

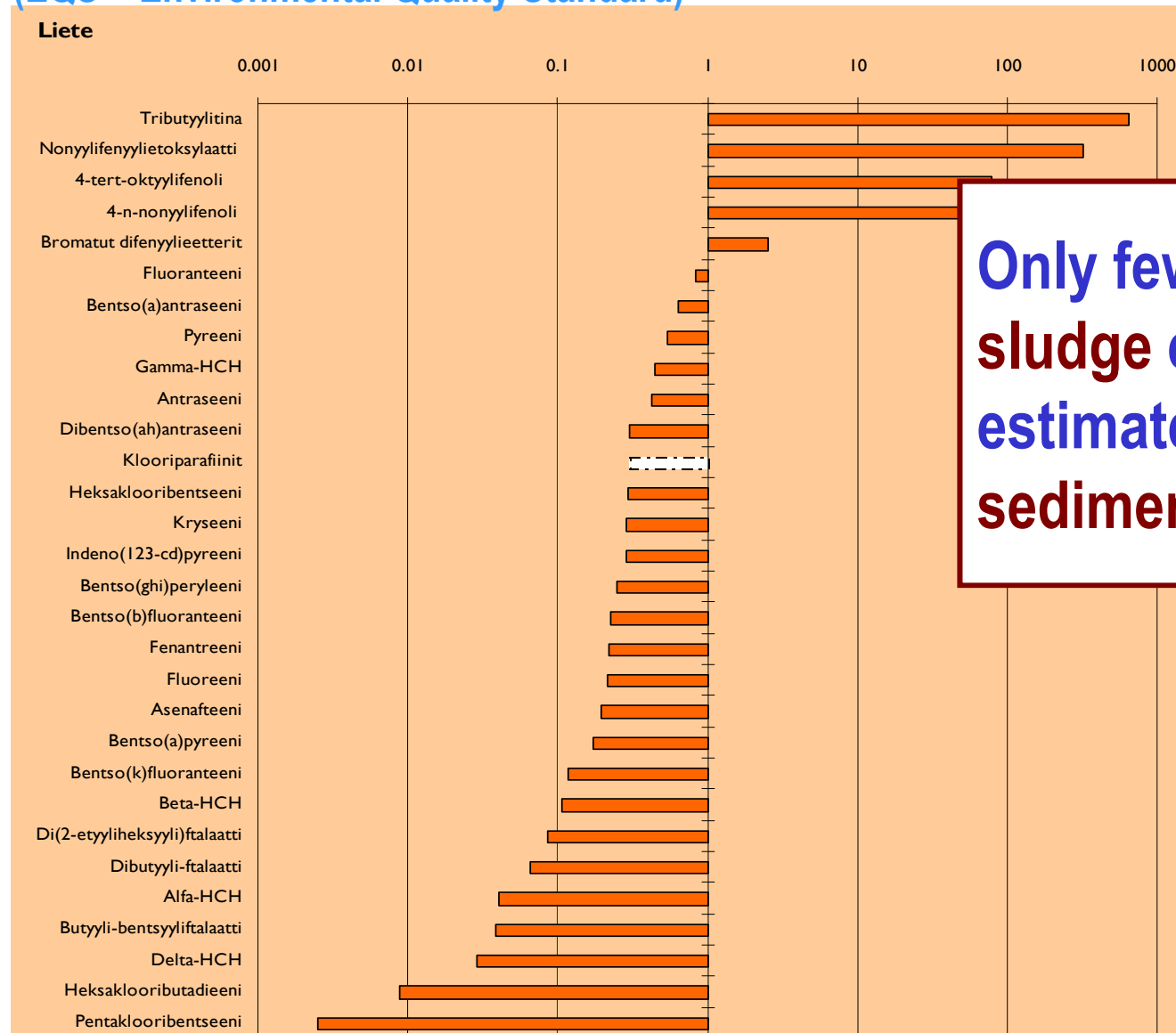
- 10 urban waste water treatment plants and their receiving waters were investigated for industrial/consumer chemicals
- Sludge, waste water, surface water, sediment and fish



# First screening results from 2003 - 2005

## Sludge - Maximum observed / EQS<sub>sediment</sub>

(EQS = Environmental Quality Standard)



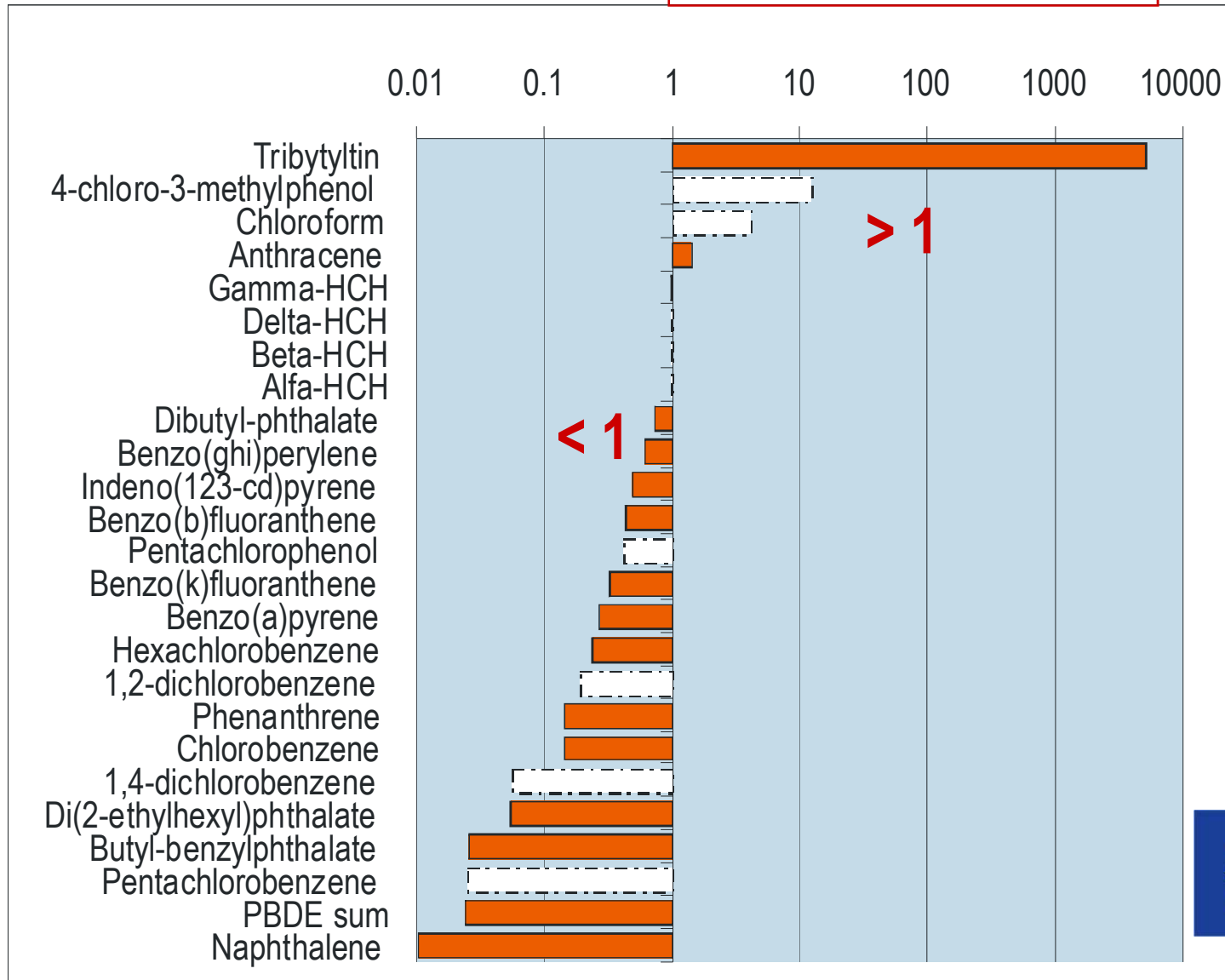
**Only few substances in  
sludge exceed the  
estimated EQS in  
sediment**

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# Mainly TBT exceed the estimated EQS-values in sediment

Max observed / EQS<sub>sediment</sub>



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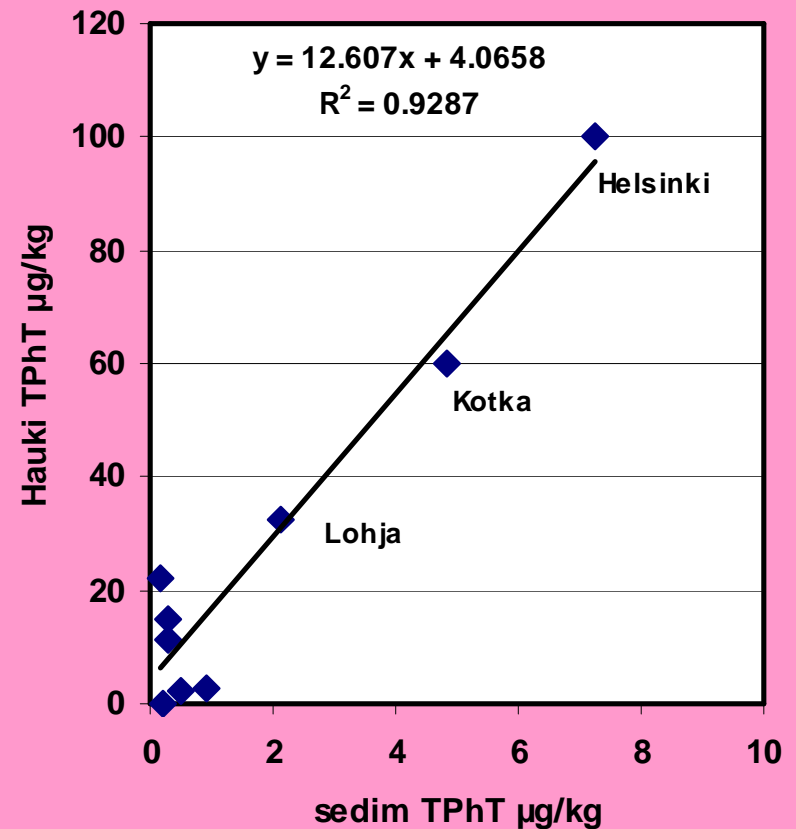
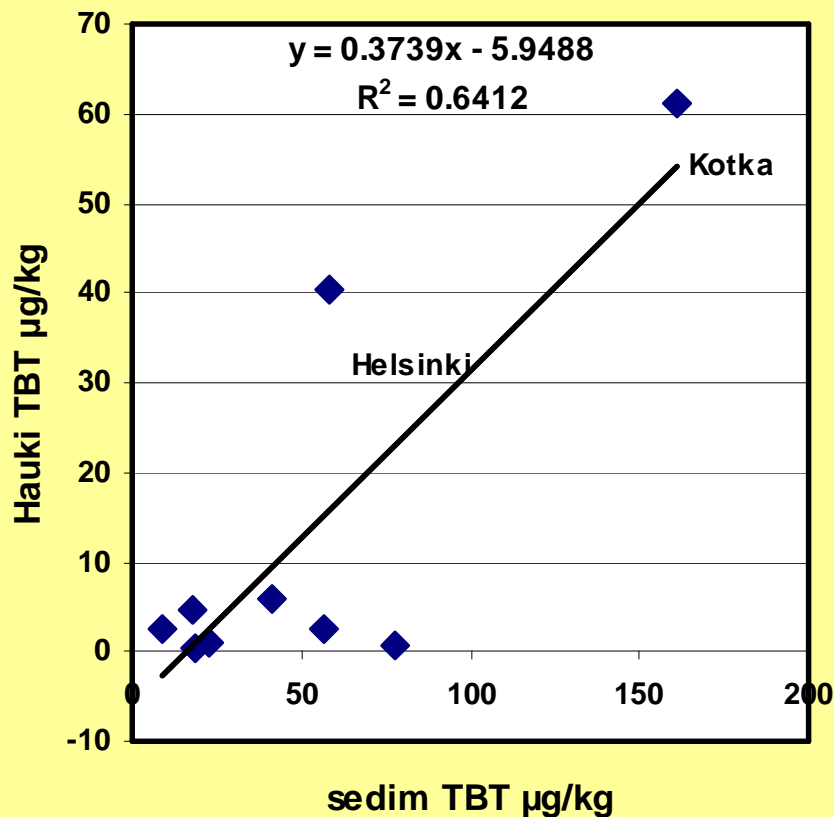




# TBT bioaccumulates, but TPhT bioaccumulates much stronger

If sediment clearly TBT contaminated, fish *might* be contaminated

If sediment **slightly TPhT** contaminated, fish **are contaminated**



# SYKE TBT and TPhT in FISH 2003, 2005 (mostly pike)

BACKGROUND AREAS

LAKES, RIVERS

WFD calc. Quality standard (EQS) 15 µg / kg

North -> South

COASTAL

sBT

sPT

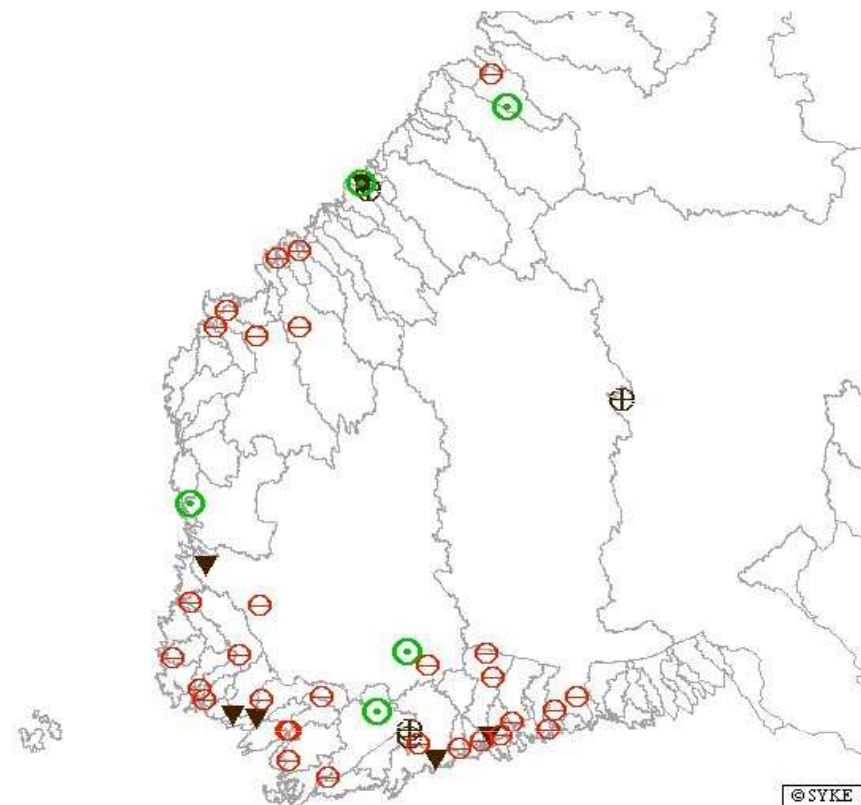
µg/kg

Pahtajärvi, Pallas (rautu)  
Valkea-Kotinen (ahven)  
Lappeenranta Haapajärvi H  
Pielinen Hn  
Säkylä Pyhäj Hk  
Porvoonjoki, Orimattila H  
Kymijoki Tammijärvi Hn  
Kymijoki Tammijärvi Hk  
Kymijoki Huruksela Hn  
Kymijoki Huruksela Hk  
Päijänne Tehins Hn  
Kokemäenj H  
Päijänne Tehins Hk  
Pirkkalan Pyhäjärvi H  
Lohjanjärvi H  
Kemin edusta H  
Hailuoto H  
Oulu, Toppila H  
Pori, Pihlavanlahti H  
Utö ulkosaari (silakka)  
Utö ulkosaari (ahven)  
Utö sisäsaari (ahven)  
Airisto Hn  
Tvärminne Hk  
Helsinki, Vanhank.lahti H  
Kotka, Ruotsinsalmi H  
Virolahti Hk  
Virolahti Hn



0 20 40 60 80 100 120 140

# VESKA 2: Pesticides Regional screening 2005



- 120 water samples;  
over 100 pesticides analysed  
– 46 found



## 35 agricultural rivers

### ○ Statistical sample, 2 sampling occasions

- selection based on watershed number
- sediment sample from most sites
- field percentage over 25

### ○ 5 reference areas, field percentage < 10

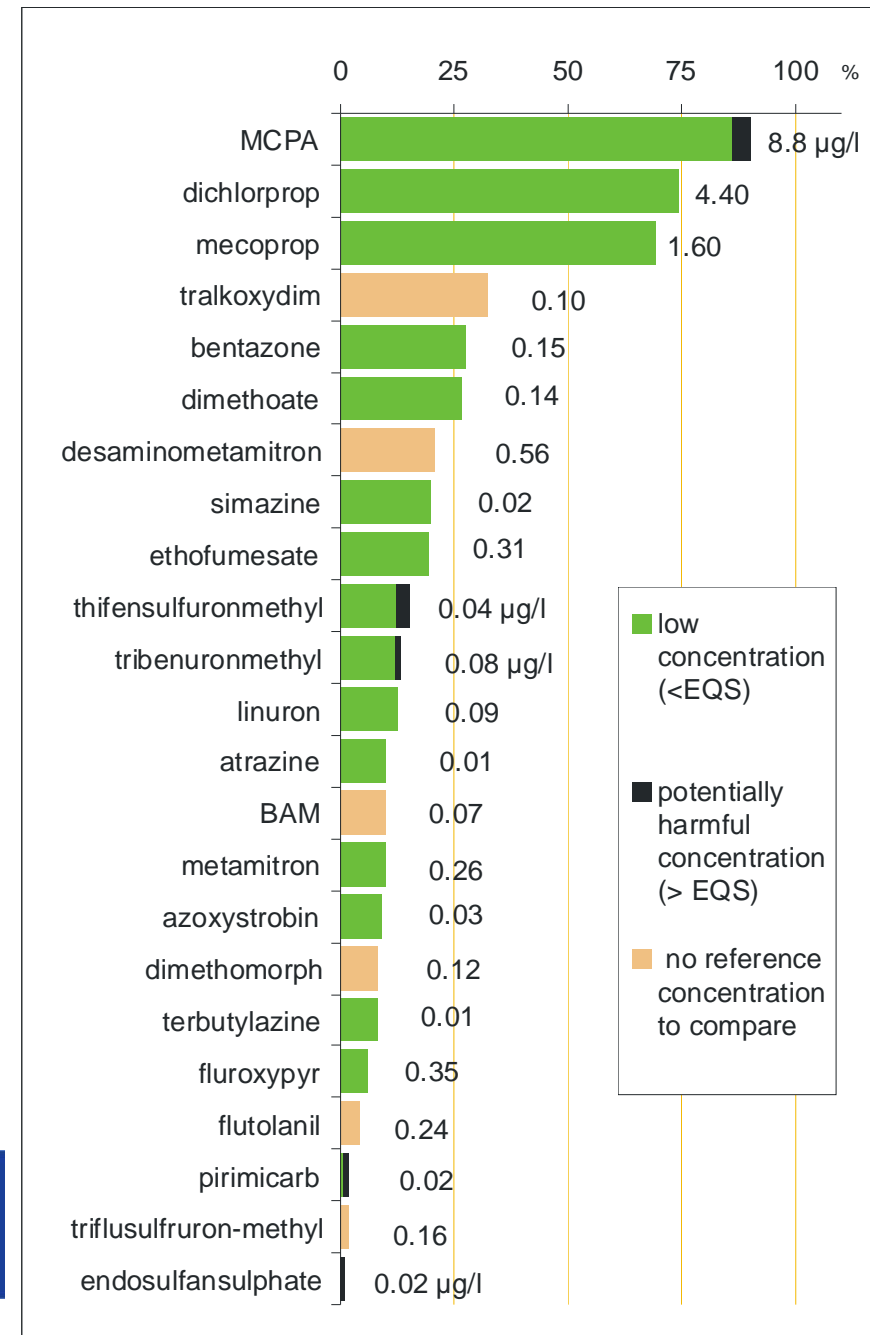
### ▼ 6 major rivers, monthly sampling



# Many substances found, but not much



## Percentage of samples with detected amount





# Identified risks for surface waters in Finland (organic compounds)

analytes	COMPOUND GROUP	STP effluent	Surface water	Sludge	Sediment	Pike	PROBLEMS			
6	Organotins	15		6	14	28	found constantly, observations > EQS (solid)			
120	Pesticides (mostly phenoxyherbicides)		160		35		detected in rivermouths, monitoring to be targeted			
7-9	PBDE			10	5	30	water analysis difficult, diffuse sources			
8-14	PAHs		40	20	14	10	water analysis difficult, diffuse sources			
3	NP, NPE, OP	20	70	20			difficult to analyse, diffuse sources			
3	Phthalates	10	40	6	14	10	easily contaminated, diffuse sources			
n.10	VOC: chlor & aromatic	40	70		14	10	have to be analysed rapidly			
7	HCB, HCHt, HCBd	40	30	20	14	monit	persistent, banned, still found			
2	SCCP	10		5			difficult to quatify, few analyses			
2	Chlorophenols	20	30	10	14					
1	TCMTB	13			3					
2	Bronopol &resorcinol	24	2	9	2	1				
	Detected, Risk		30	sample number						
	Unsure			not analysed						
	Detected, no risk			not analysed, wfd requirement, but DL > EQS						
	Not detected									





# Contaminant monitoring 2009 = >

(not surface/ground waters)

- 4+3 coastal areas (HELCOM + three estuaries)
- 3 large lakes
- ▲ 2 large rivers
- 2 background sites (perch, common shrew + deposition)
- Low frequency sites (3 up to 10 yr interval)

## MATRICE

**herring, perch, brown trout**  
sediment (lakes)

● sedimentation (2 rivermouth, 1 lake)

★ mussel incubation (Anodonta)

**Hg fish/sedim/water screening**

• common shrew

• deposition (rainwater/snow)

## frequency

yearly

>10 yr

1-3 month (summer)

1 month (Aug)

**10 yr ( 80 lakes?)**

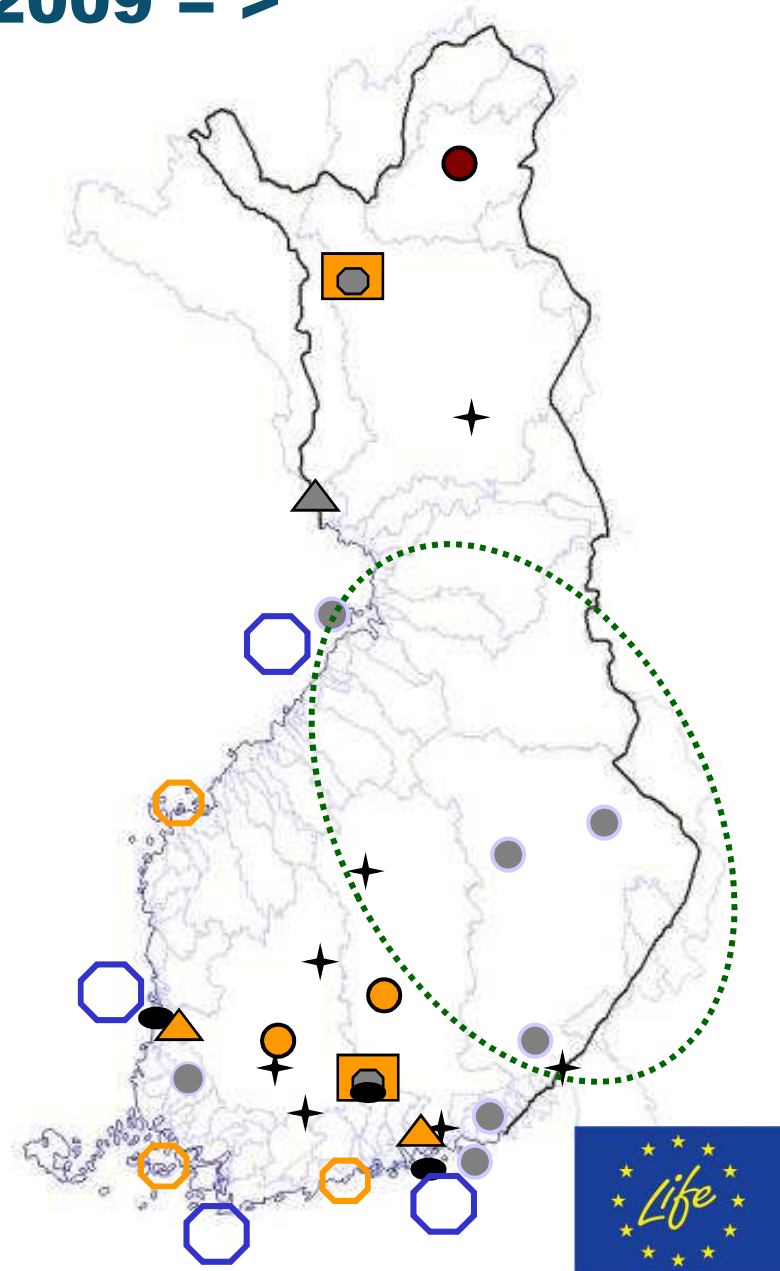
2 yr.

ca.1 m (summer/ winter)

## SUBSTANCES

- Hg, other trace metals
- PCB, PCDD/F, DDT, HCB, HCH, chlord.
- PBDE, OTC, + PFC (in 2009/10)

- only sediments: PAH, phthalates
- ( Nat Publ Health Inst: provisionally, PBB, PCN, PFC, PCC )



# River Basin District Surveillance Monitoring for WFD reporting

Water phase  
monthly sampling  
May-07 – April-08  
Biweekly in summer 2008

R Ähtävä  
R Kyrö  
R Kokemäki  
R Aura  
R Paimio  
R Mustio  
R Lepsämä + R Vantaa  
R Porvoo



**Pesticides:**  
>100 substances /  
sample  
- rivers 12 samples / yr  
  
Sites in three year rotation  
+ 3 intensive rivers every year  
  
=> max 9 rivers per year

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# Pesticides in ground water in Finland and Sweden



PESTICIDE	Finland 2002–2005			Sweden 1985–2001 <sup>2)</sup>		
		<0,1 µg/l	>0,1 µg/l		<0,1 µg/l	>0,1 µg/l
	n	%		n	%	
<b>BAM (H)</b>	168	8	3	1287	36	23
<b>Atrazin</b>	295	13	4	1489	17	7
<b>- DEA (H)</b>	295	8	2	1238	16	6
<b>- DIA (H)</b>	295	2	0	1053	<1	<1
<b>- DEDIA (H)</b>	295	1	2	*		
Terbutylazine	295	4	0	1377	2	1
Simazine	295	4	0	1345	<1	<1
Hexazinone	295	2	1	*		
<b>Bentazone</b>	295	1	0	1344	15	10
Mecoprop	295	1	0	1331	2	1
Bromasil	295	1	1	*		

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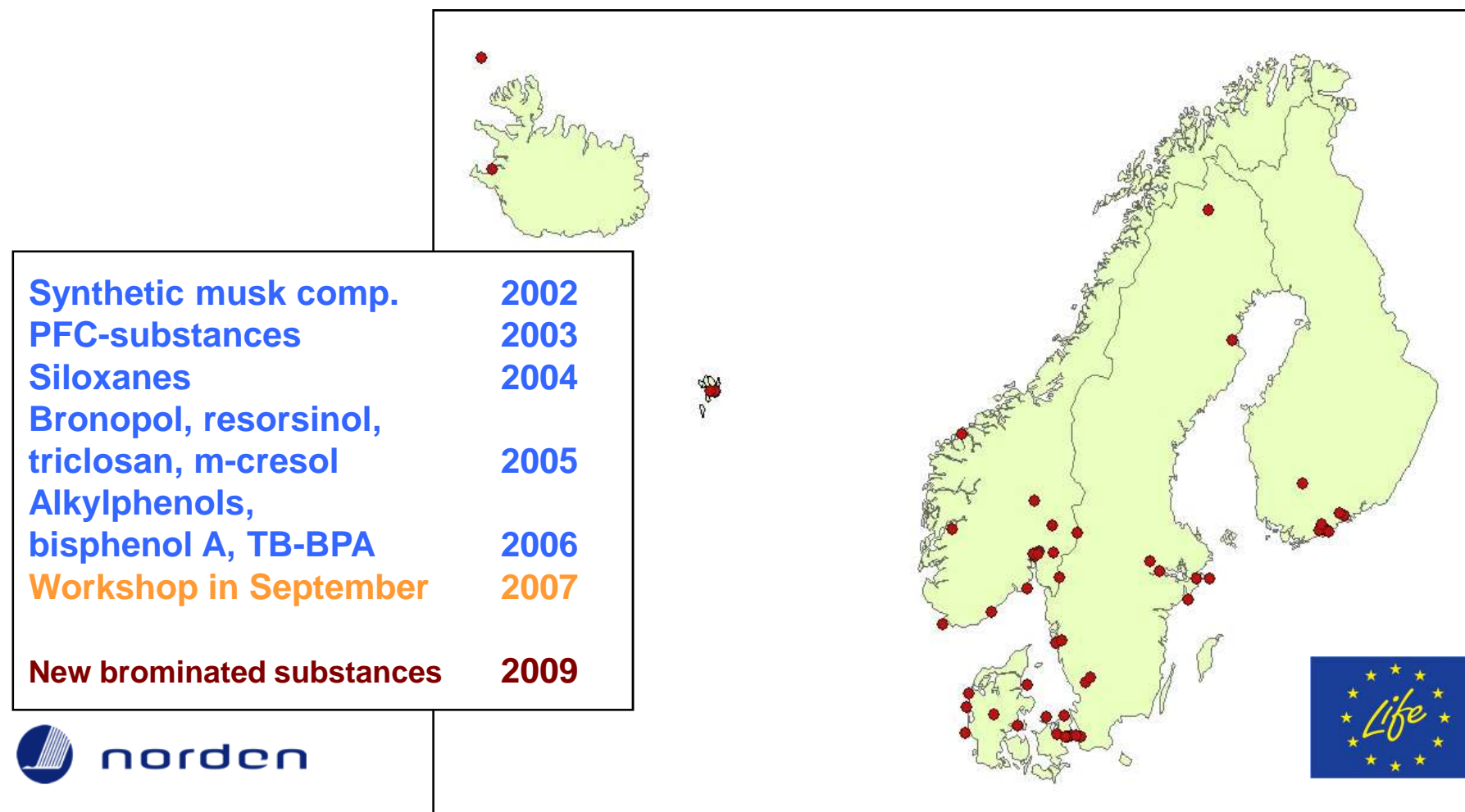
1) Rapala & Gustafsson, 2005. Pohjavedestä todetut torjunta-ainepitoisuudet vesilaitosten ongelmana. Ympäristö ja terveys-lehti 5/2005

2) Törnquist, M, Kreuger, J. ja Ulén, B. 2002 Förekomst av bekämpningsmedel i svenska vateen 1985-2001. Sammanställning av en databas. Ekohydrologi 65, Uppsala, 2002.

# Nordic Screening of Chemicals in the Environment

## 2002 =>

Reports, ppt-presentations, links:=> <http://www.nordicscreening.org>

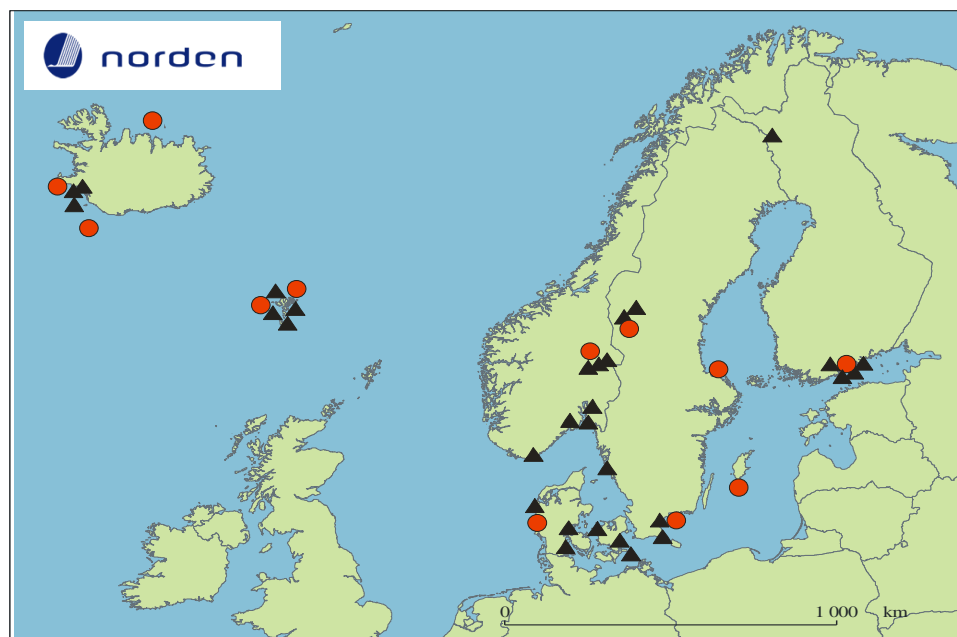


# NORDIC Screening 2003

Perfluorinated substances  
PFOS/PFOA

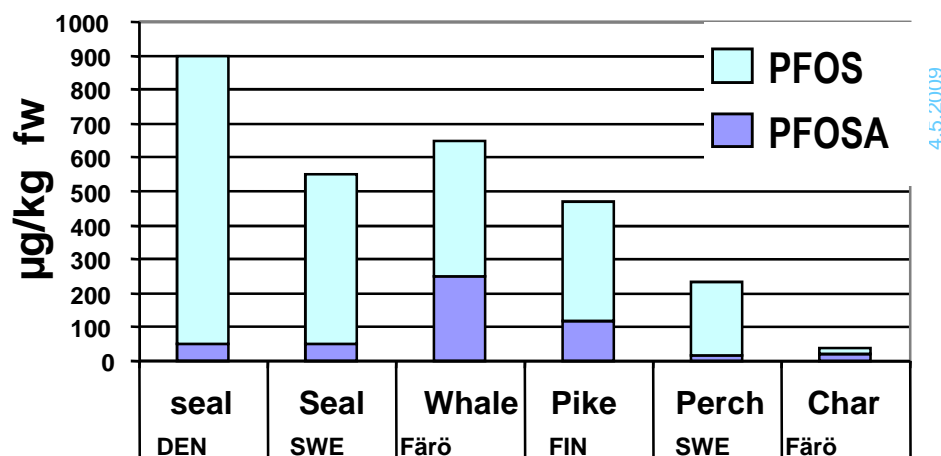
Harmonized sampling and  
analysis OK but:

- small data per matrix
- distribution random
- pressures unknown....



▲ = water-, sediment- and sludge

③ = biota



Kallenborn et al. 2004



norden



# Survey of new brominated flame retardants in Nordic countries *(planned 2009)*

<i>Compound name</i>
Tetrabromobisphenol A bis (2,3-dibromopropyl ether)
Tetrabromobisphenol A diallyl ether
Hexabromobenzene
Pentabromotoluene
Pentabromoethylbenzene
2,4,6-tribromophenyl allyl ether
2,3-dibromopropyl- 2,4,6- tribromophenyl ether
2,4,6- tribromophenol
Decabromodiphenylethane
1,2-Bis (2,4,6-tribromophenoxy) ethane
Ethylene bis tetrabromophthalimide
Tetrabromophthalic anhydride
Bis (2-ethylhexyl) tetrabromophthalate
2-ethylhexyl- 2,3,4,5-tetrabromobenzoate

## SAMPLES FROM:

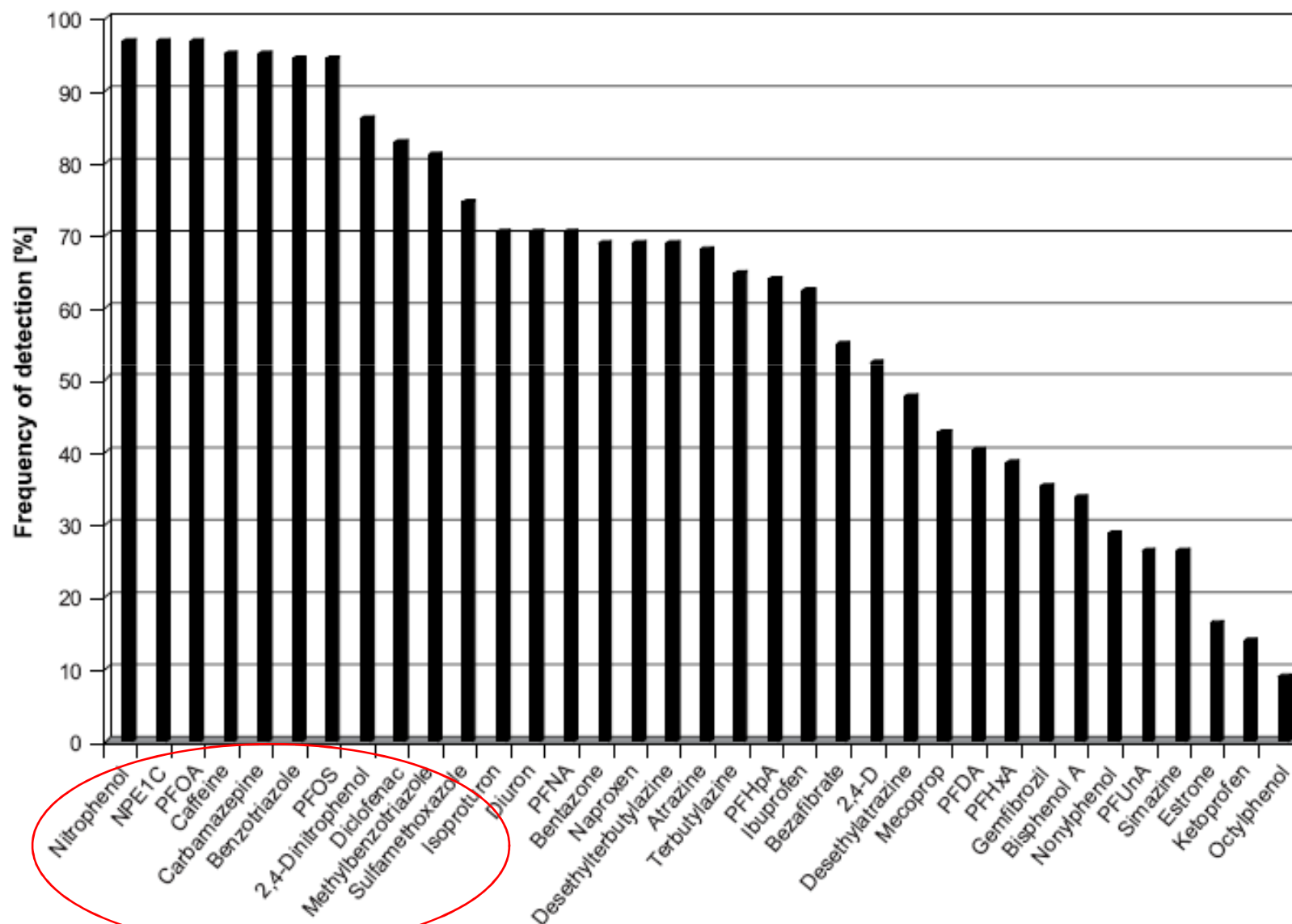
- Sludge and runoff water from landfills
- Sediments
- Biota (i.e. fish, blue mussel)
- House, work place and domestic dust
- Remote areas (air, biota)

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S Y K E

## EU-wide survey of POPs in >100 European rivers (27 countries) (Loos et al. 2008) (co-ordination by JRC)



# Screening by the Association of Waste Water Treatment Plants

- Implementation of E-PRTR reporting obligations
- 10-20 plants sampled twice for E-PRTR substances in 2007

= > "high" concentrations (around 5 – 50 µg/l) of NP/NPE, fenols, DEHP in in-coming wastewater. Concentration mainly below EQS-values in out-going wastewater.

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Vesi ja viemärlaitosyhdistyksen monistesarja Nro 24, Helsinki 2008.

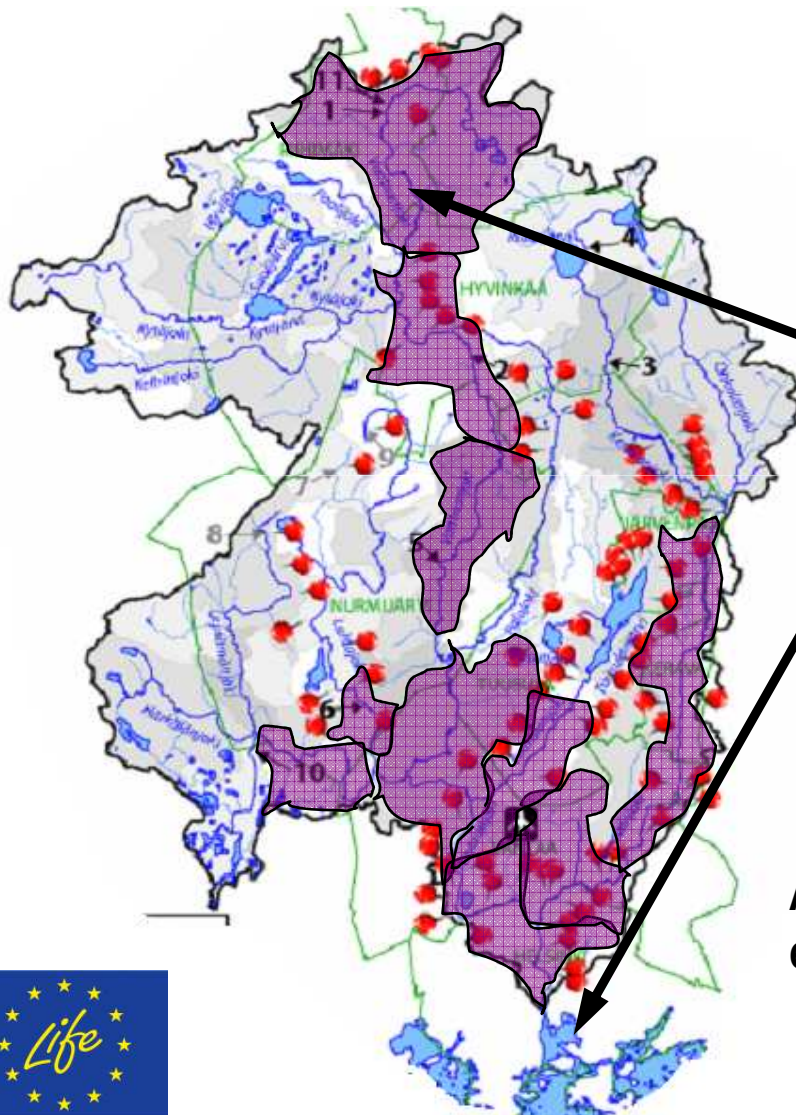


□ Modelling can save costs

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# The question for modeling



If we measure here...

... what may the concentrations be here?

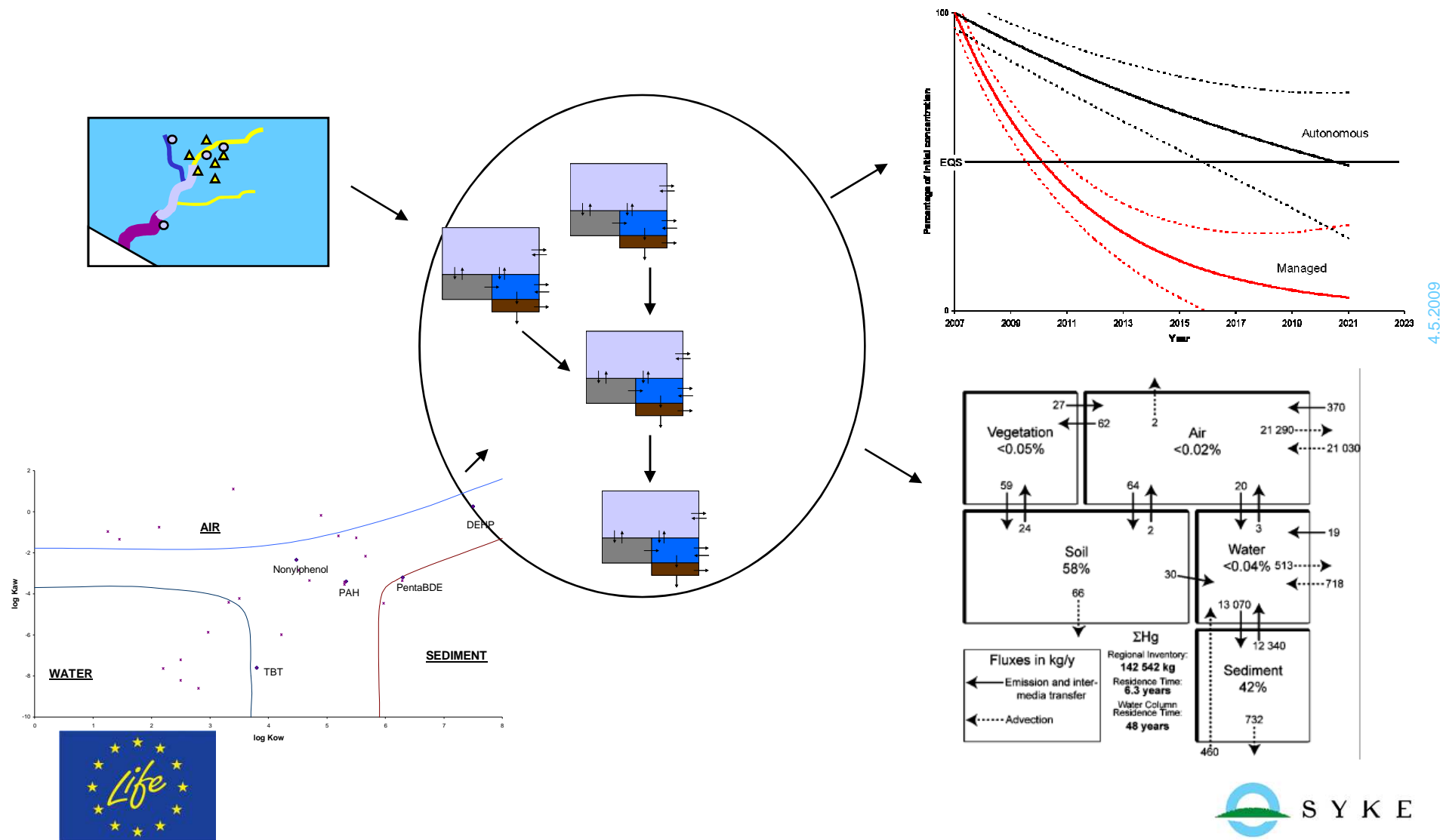
(Mainly a dilution problem)

## A hydrological model available for each subcatchment

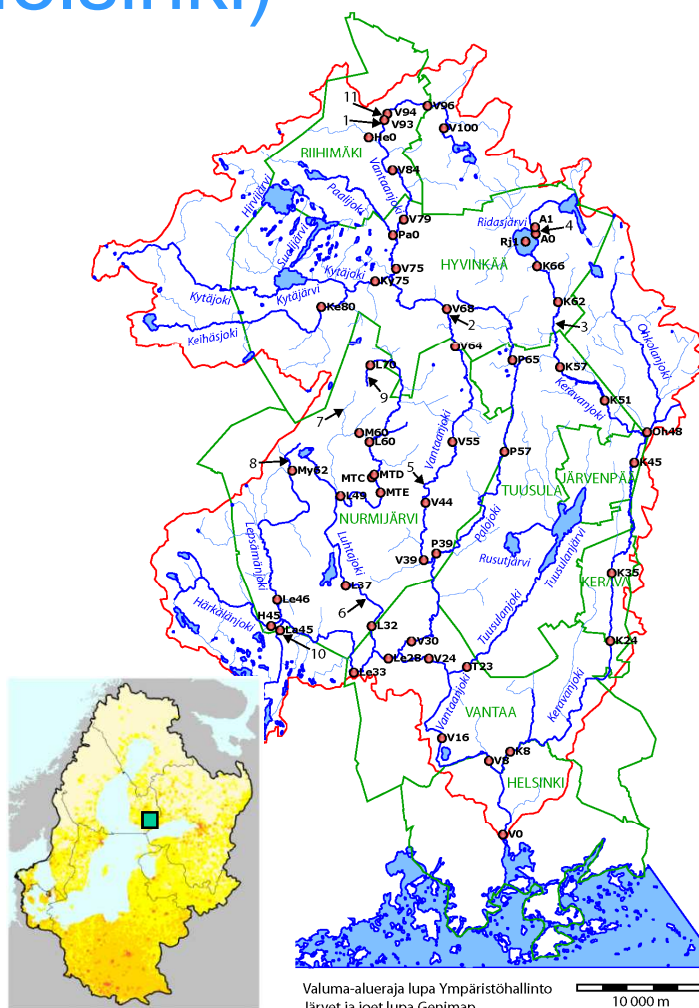


# Modeling scheme in River Vantaa

Sources – hydrology – compartments - partitioning – PEC/EQS



# River Vantaa (Helsinki)



## Substances

- PAH
- PBDE
- Nonylphenol
- DEHP
- TBT (TPhT)



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Catchment area 1 686 km<sup>2</sup>

Population of 1 milj. inhabitants

Agriculture (24 % cultivated)

Industry (dairy, food, metal, paint, detergent)

Drinking water source (emergency) to

Helsinki Metropolitan area

Irrigation source

Recreation object

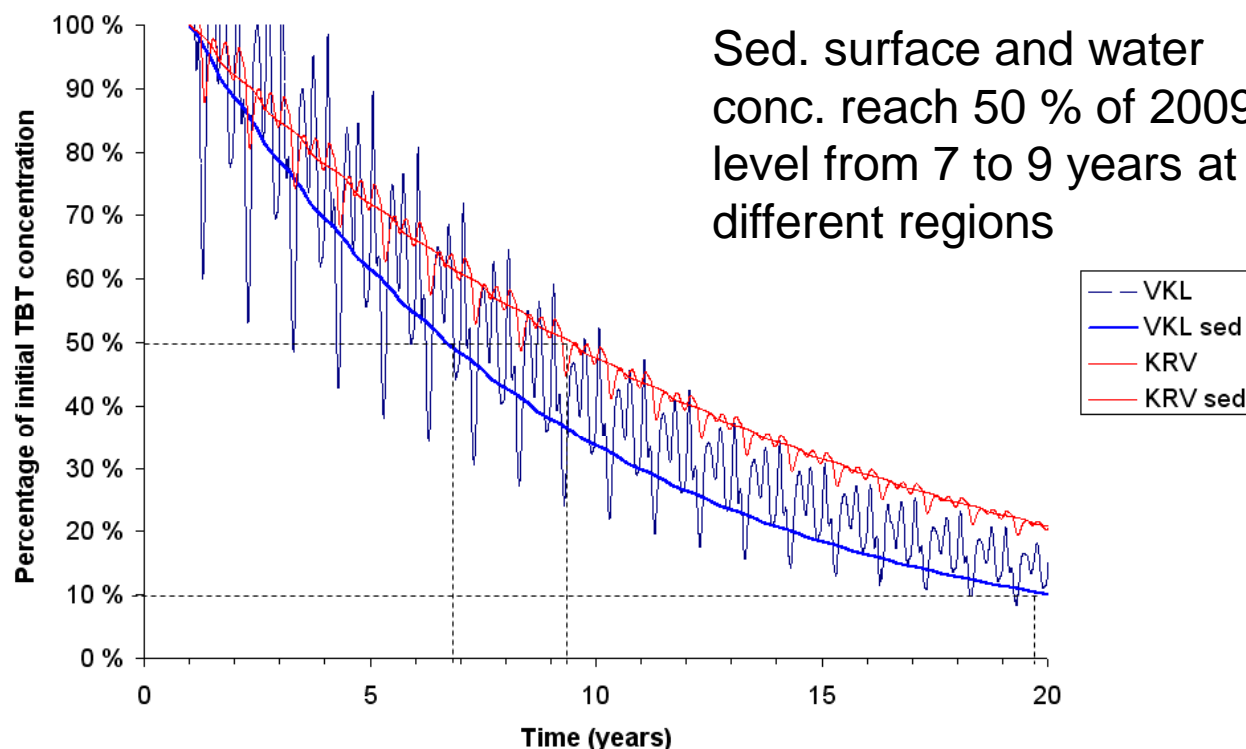
Cultural scenery and objects



# TBT: Baseline scenario

100 % = Dec. 2009

Sed. surface and water conc. reach 50 % of 2009 level from 7 to 9 years at different regions



## Uncertainties:

- Model predicts present TBT conc. 8 ng/l (40 times EQS)
- Measured TBT <1 to 12 ng/l
- Major uncertainty TBT degradation rates (oxic, anoxic)



# Emerging substances monitoring in future

- ❑ Better identification of sources
- ❑ Monitoring and screening activities should be internationally harmonized and optimized – cooperation!
- ❑ Importance of concentration in sediments & soils and biota must be understood better
  - ❑ => realistic Environmental Quality Standards
- ❑ Chemical monitoring & bioavailability combined to biological (effects) monitoring
  - ❑ Combined effects of several compounds likely
- ❑ QA/QC in the whole information chain
  - ❑ Planning, manuals, sampling, storage, pretreatment,
  - ❑ Analyses / validation, PT schemes
  - ❑ Data storage, reporting...
- ❑ Link to risk management and risk research
  - ❑ no “monitoring for monitoring” => think: why, what, where, how....







Thank You !

