What can environmental monitoring tell us about human exposure to dioxins?

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What are ”dioxins”?

- Chemically, ”dioxins” are polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) (together: PCDD/Fs)
- Formed unintentionally only. Can thus not be banned, just restricted
- The total number of PCDD/Fs is 210 but only 17 of these have the specific toxicological profile that characterises the most toxic congener: TCDD

What are ”dioxins”

- In addition, there are 12 dioxin-like PCBs (DL-PCBs) that also have been shown to act via the same toxicological mechanism as TCDD
- Toxic equivalence factors (TEFs) are used to calculate toxic equivalence concentrations (TEQs) of dioxins and DL-PCBs.
- Current internationally accepted TEF scheme: *van den Berg et al.*, 2006 (WHO 2005)
- NB: A number of different TEF schemes have been applied since the 1980s (I-TEF, WHO-TEF, etc.)

Some implications of persistency

- Slow break down but also slow reactions with biological systems. Thus, toxic effects will be chronic rather than acute
- Ample time to be transported and redistributed in the environment
- Long time until positive changes from actions can be observed in the environment

Toxicology of dioxins

- Important effects for human risk assessment of dioxins are developmental, cancer and immunological effects

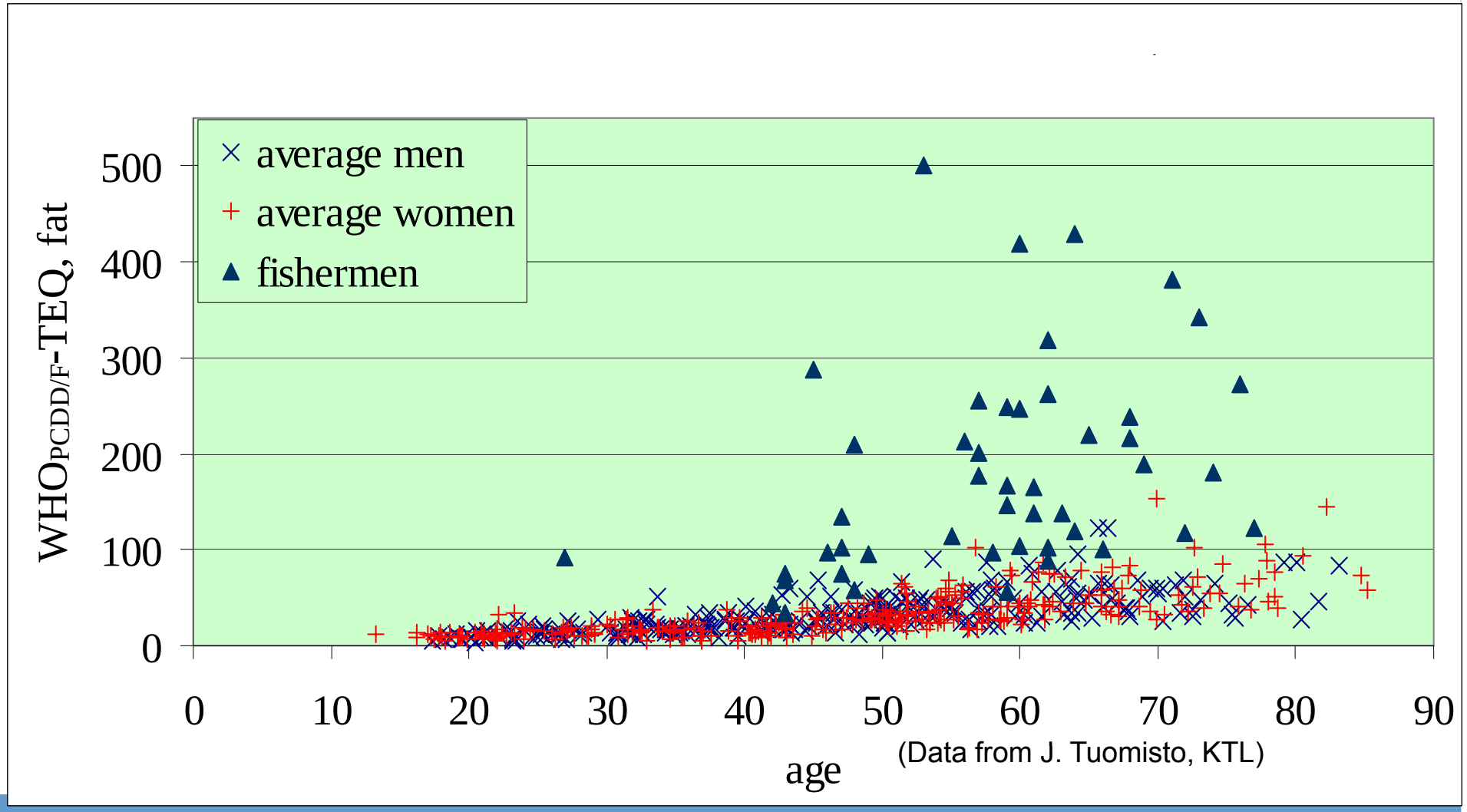
Tolerable daily intake, TDI

- TDI of dioxins and DL-PCBs for humans should represent long-term intake with no risk of negative effects of human health.
- The TDI generally applied within the EU is currently 2 pg TEQ/kg b.w.

Estimated daily intake of dioxins, pg TEQ/kg b.w.

Country	Age	Mean intake
The Netherlands	40	1.1
The Netherlands	10	1.5
The Netherlands	2	2.8
Italy	13-94	2.28
Italy	7-12	3.37
Italy	0-6	5.34
P R China	18-45	0.15-0.96
Japan	17-72	0.79-1.06
USA	>80	1.9
USA	0-1	42
Egypt	-	6.04-6.68

Finnish fishermen and general population in the late 1990s



Environmental monitoring of contaminants

- **Purpose:** checking the state of the environment and to study trends
  - how well environmental objectives are met
  - detect new environmental issues
- Often carried out as multidisciplinary programmes of recurring, ***systematic studies*** that reveal the state of the environment.

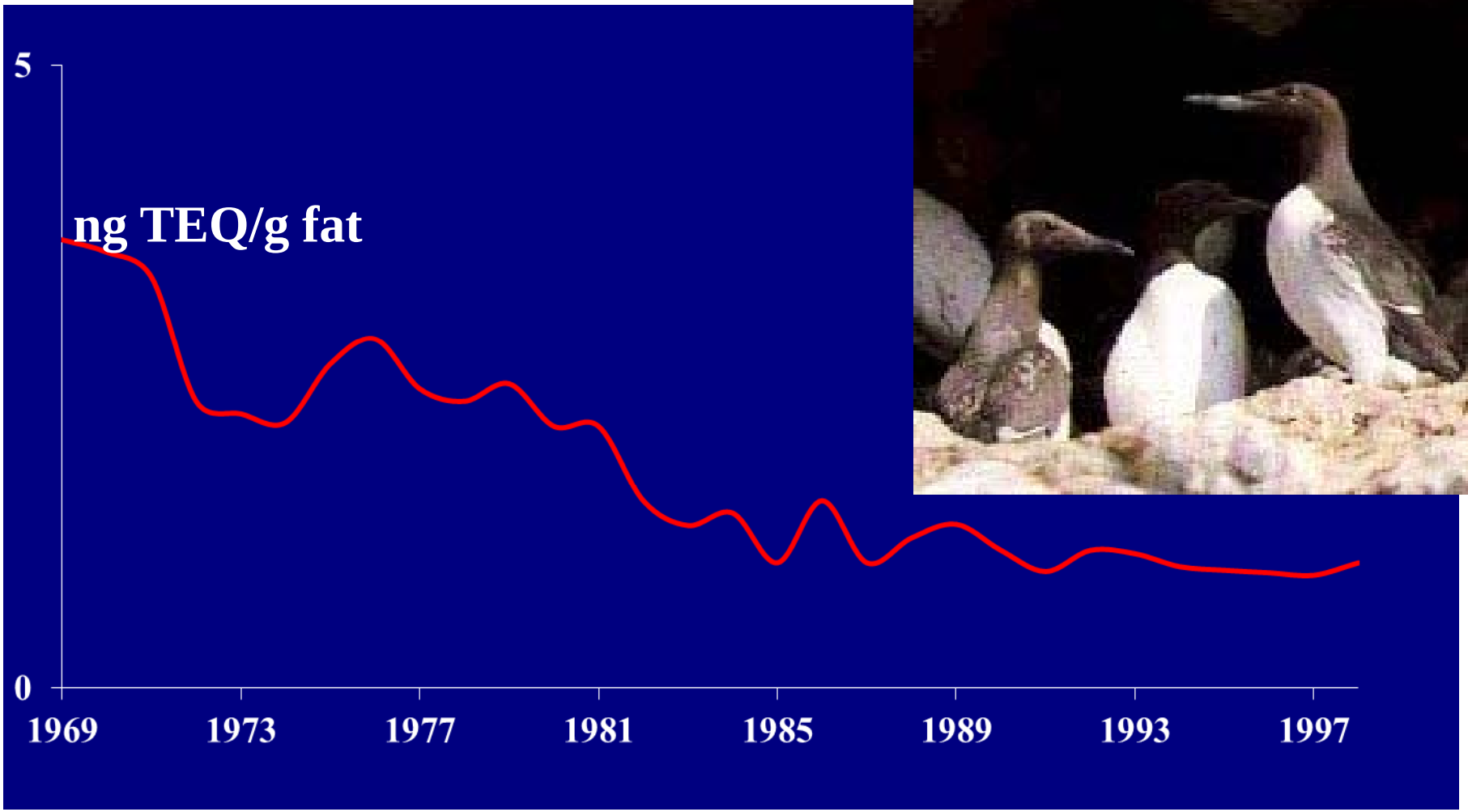
Recurring environmental monitoring of contaminants in biota

- ***Systematic approach in order to reduce biological variation***
  - Standardised with respect to sampling method, time, site, species, sex, age, developmental stage, organ etc.
  - Collect contextual information on a number of physical, chemical and biological variables
  - Analysis of several contaminants and other compounds
  - Analysis of other variables that can add to the characterisation of the samples.

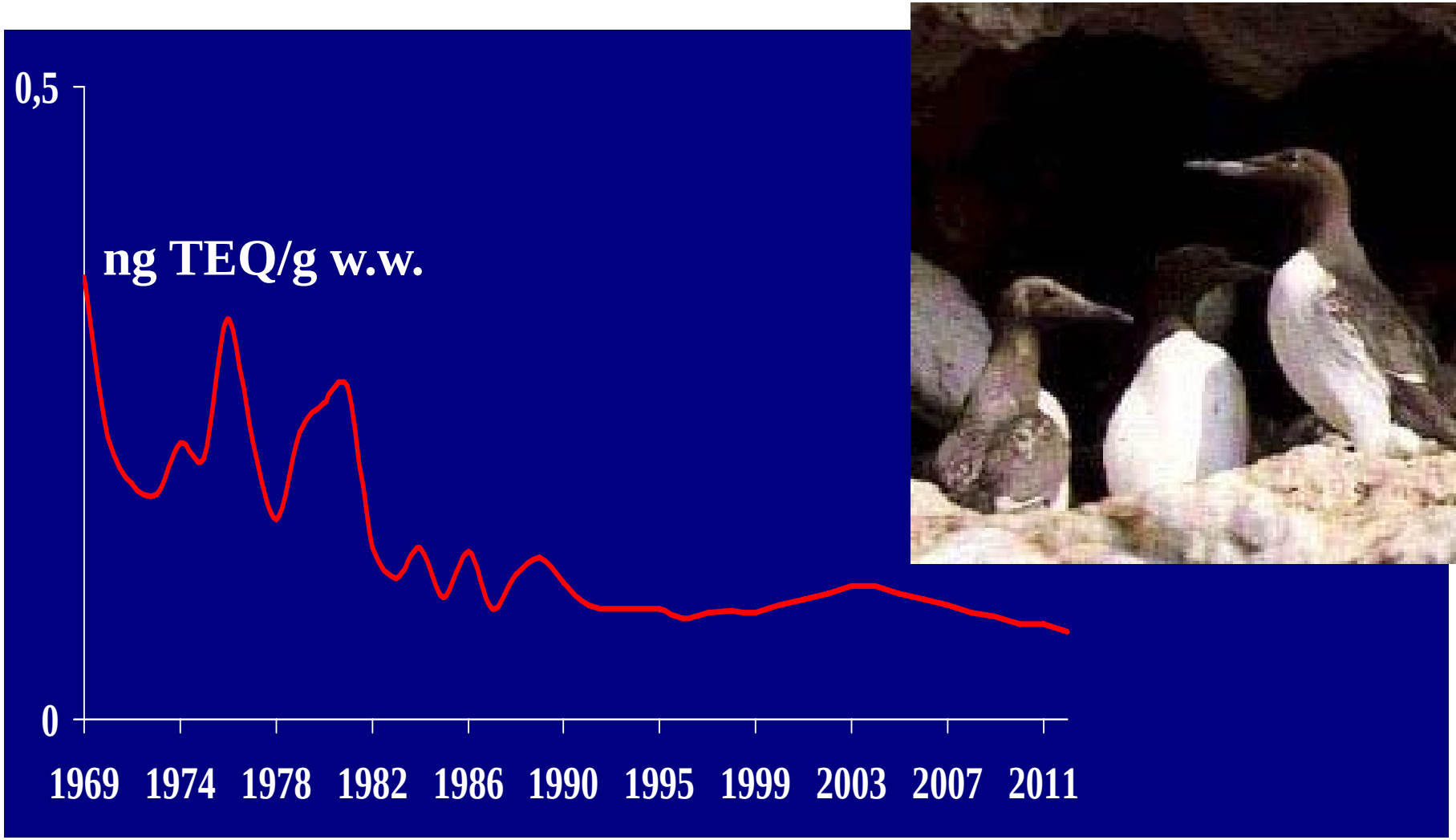
Environmental monitoring of contaminants

- Recurrent monitoring in background areas
  - Detection of temporal trends
- In grids and or transects including possible sources.
  - Identification and quantification of affected areas
- Emission control
  - Control the effect of emission reducing actions taken at point sources
- Screening
- Bio-banking

Dioxins in Baltic Proper Guillemots

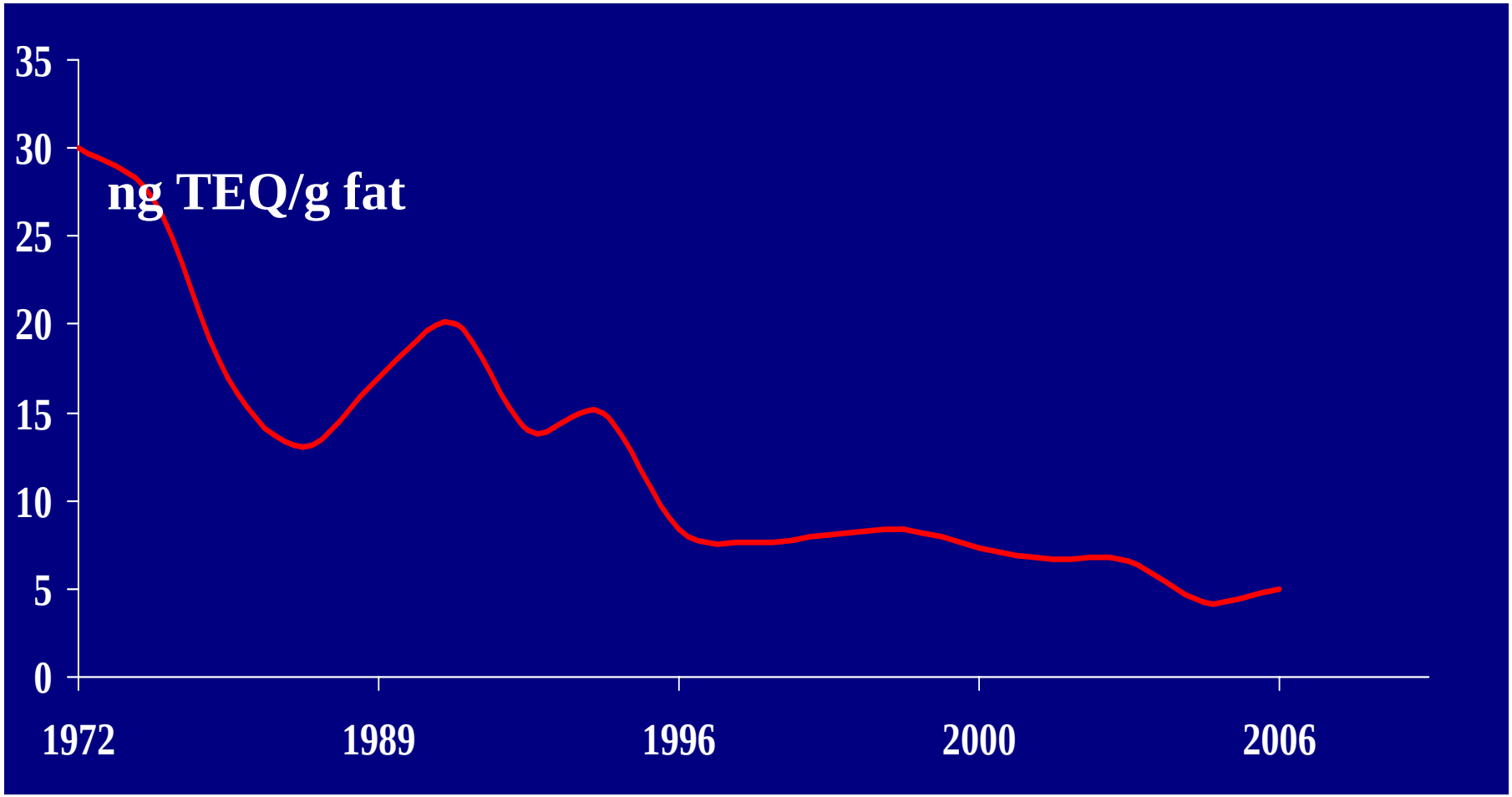


Dioxins in Baltic Proper Guillemots

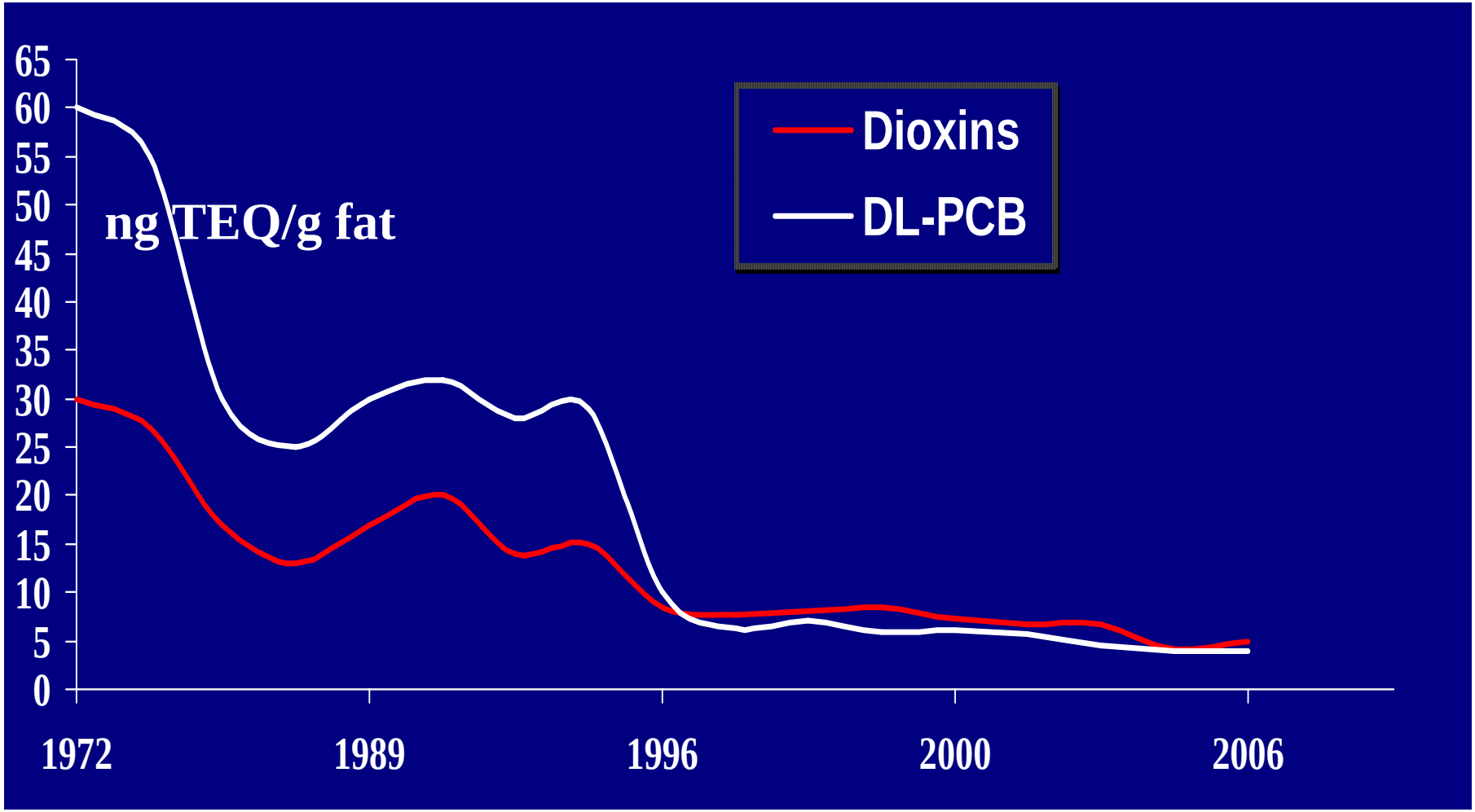


Dioxins and DL-PCBs in Baltic Proper Guillemots

Dioxins in human milk



Dioxins and DL-PCBs in human milk

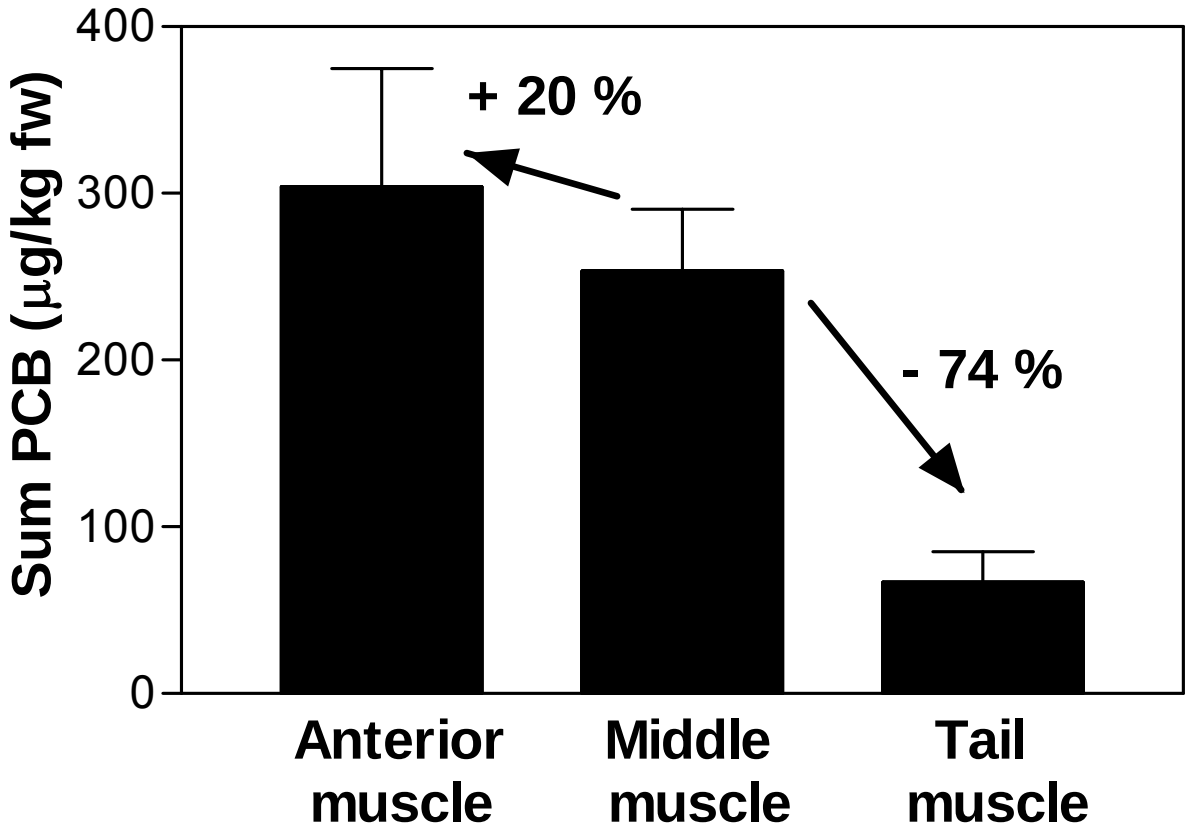


My fishmonger

Information given: species (also scientific name), catchment area, eco-labelling …

Representativity and relevance of analytical results for the exposure assessment

Where to take samples?



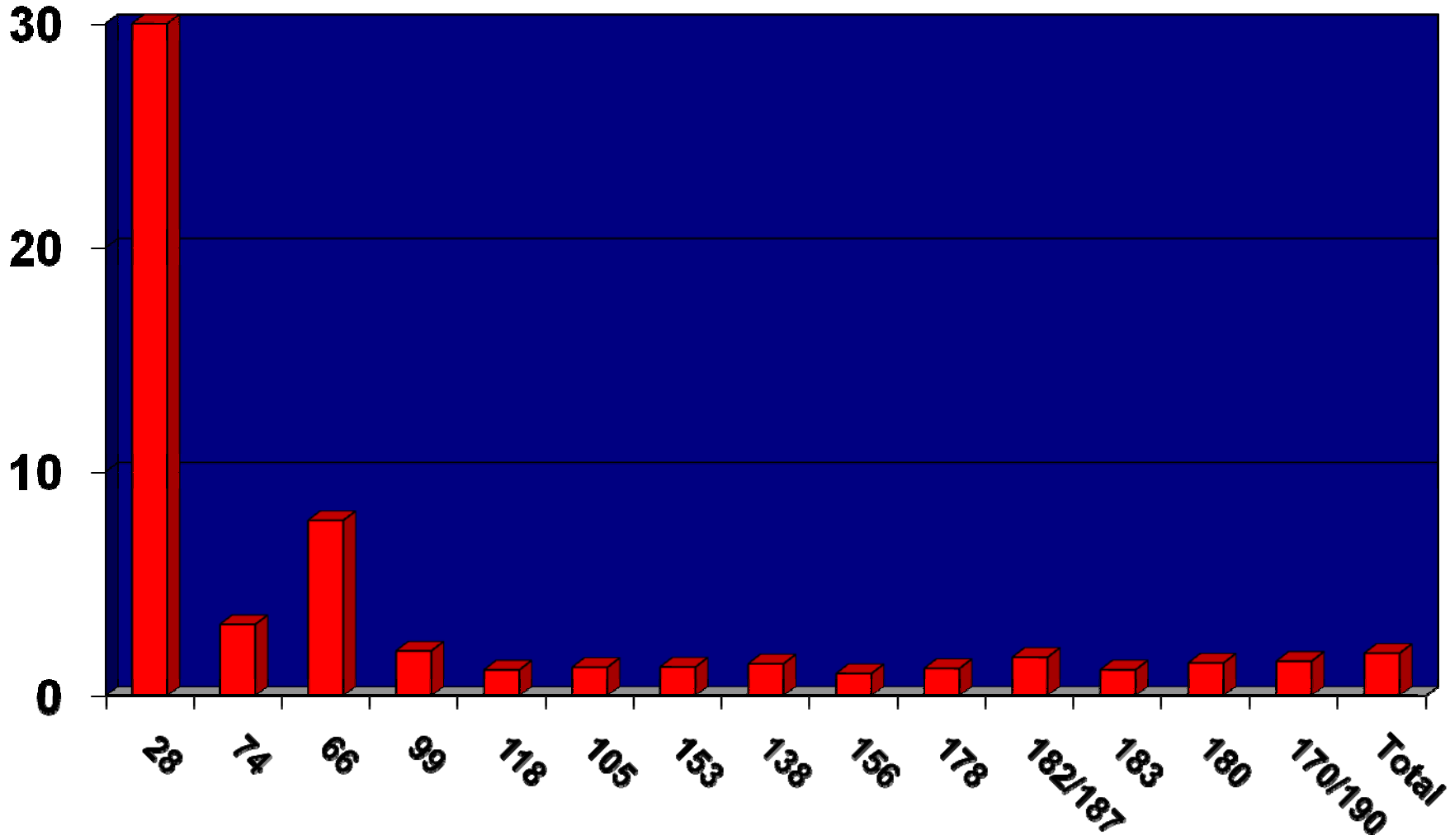
Spatial trends

- Often found in gradient studies and expressed as coast-open sea- and north-south gradients
- Gradient from possible sources
  - Active point sources
  - Contaminated sediments

Pattern analysis

- An elevated quotient of DDE/DDT reveals recent emission of DDT
- Different patterns of dioxins indicate different sources
- Differences between biological and non-biological samples

Ratio individual PCB congeners between residents in flats in buildings with and without PCB



Important information from environmental monitoring

- Temporal trends
- Pattern analysis
  - Sources
    - Exposure routes
  - Metabolism
    - Quotients
    - Recent emission?

Important information from environmental monitoring, cont.

- Spatial trends, facilitated by standardisation
  - Sources
- Co-variation of compounds
  - Temporal
  - Common sources?
- Relative contribution to total exposure from different exposure routes

Conclusions

- Information on temporal and spatial trends of contaminants in biota could improve the general assessment of contaminants in food
- Borders could be overcome as we have a win-win situation
- To accomplish this we need to further harmonise food- and environmental monitoring