# Small Particles, Big Issue
# Sediment matters

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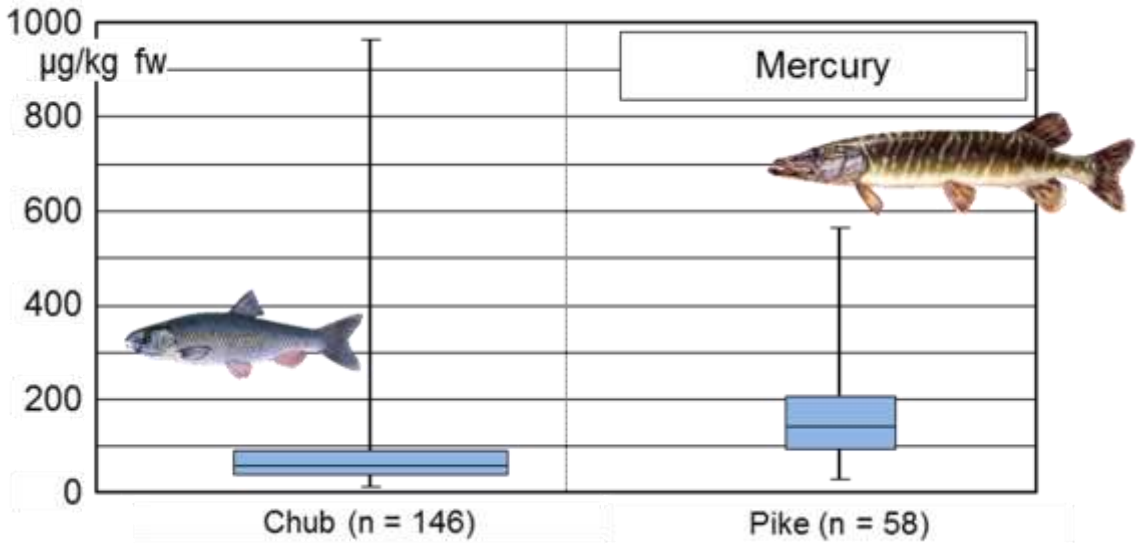
# The SedNet Puzzle


**Sediment quality – fine sediments**

# Mercury in Fish
# (Overview for Germany; Data: UPB*, 2015 - 2017)

## Mercury in Fish (µg/kg) **




**EQS = 20 µg/kg****

* German Environmental Specimen Bank, Figure: BUE, Hamburg

** fresh weight

# Toxicants in Aquatic systems

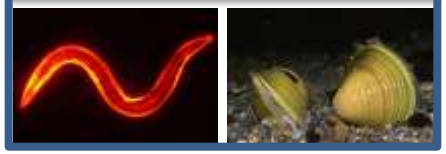
DNA, Protein, Organ

Mode of Action

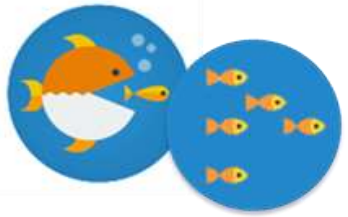
Toxicant

Organism

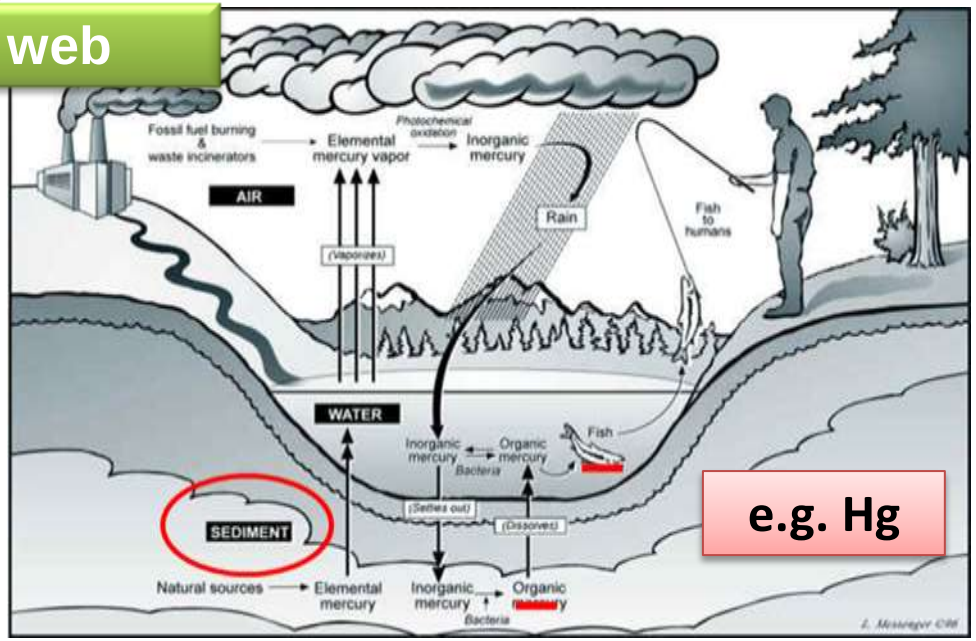
Survival /Growth



Aquatic system



Food web




e.g. Hg

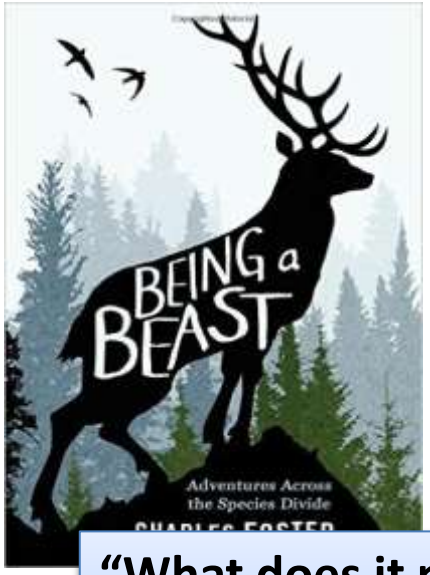
Population

Reproduction

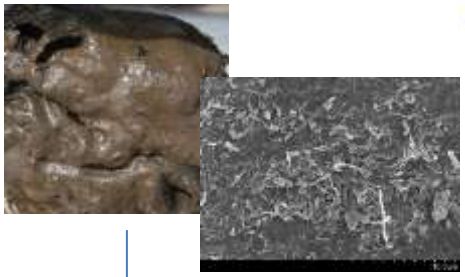
Community

Structure / function

# Being a beast




"What does it mean to live like a badger, a fox, an otter, a red deer or a common swift?"



NemaSPEAR

# NemaSPEAR: A nematode-based biotic index to indicate chemical stress in fine sediments

1. **Nema**tode **SPE**cies **A**t **R**isk – nematode species were classified into two groups:

**NemaSPEAR = „sensitive species“**

**- missing in sediments with higher contamination -**

**NemaSPE$_{not}$AR = „tolerant species”**

**- occur in all sediments irrespective of contamination -**

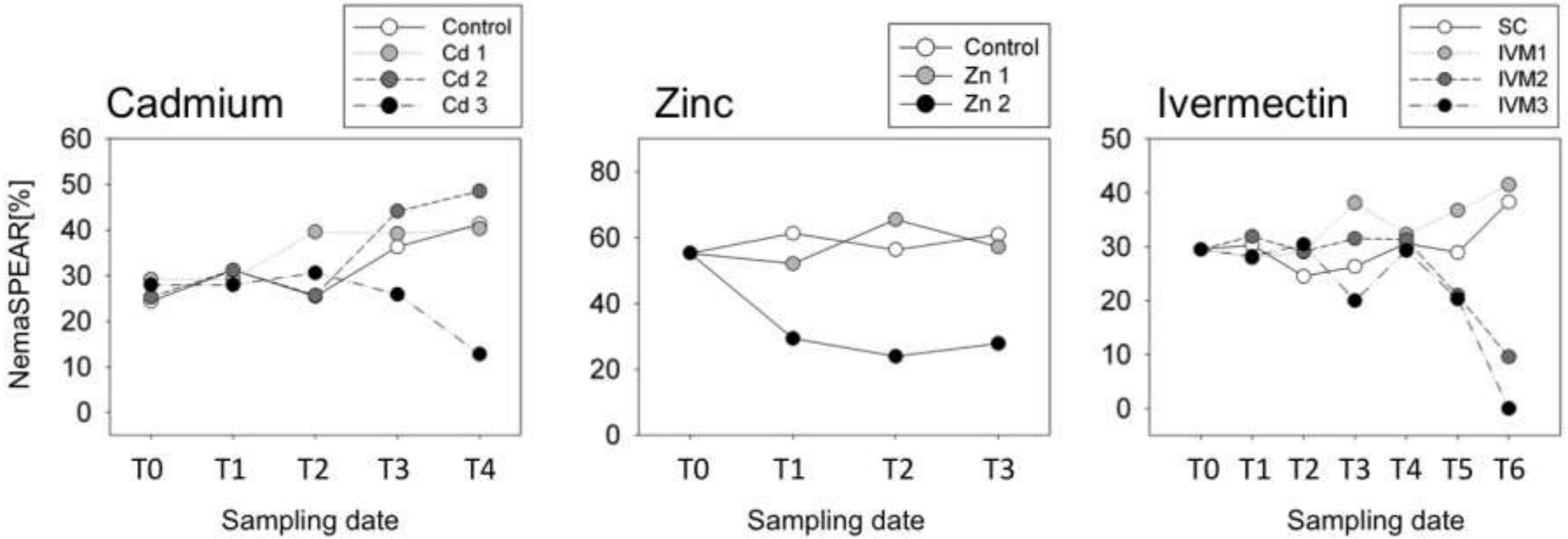
2. **Calculation of the index for sediment quality assessment:**

$$\text{NemaSPEAR}[\%] = 100 \times \frac{\Sigma \log [\text{NemaSPEAR}]_{relAb}}{\Sigma \log [\text{All Species}]_{relAb}}$$

⟶ **The index decreases if the proportion of pollution-sensitive species declines in a community**


- *Höss et al. (2011):* ***Environ. Int.****, 37, 940–949.*
- *Höss et al. (2017):* ***Ecol. Indic.****, 73, 52–60.*

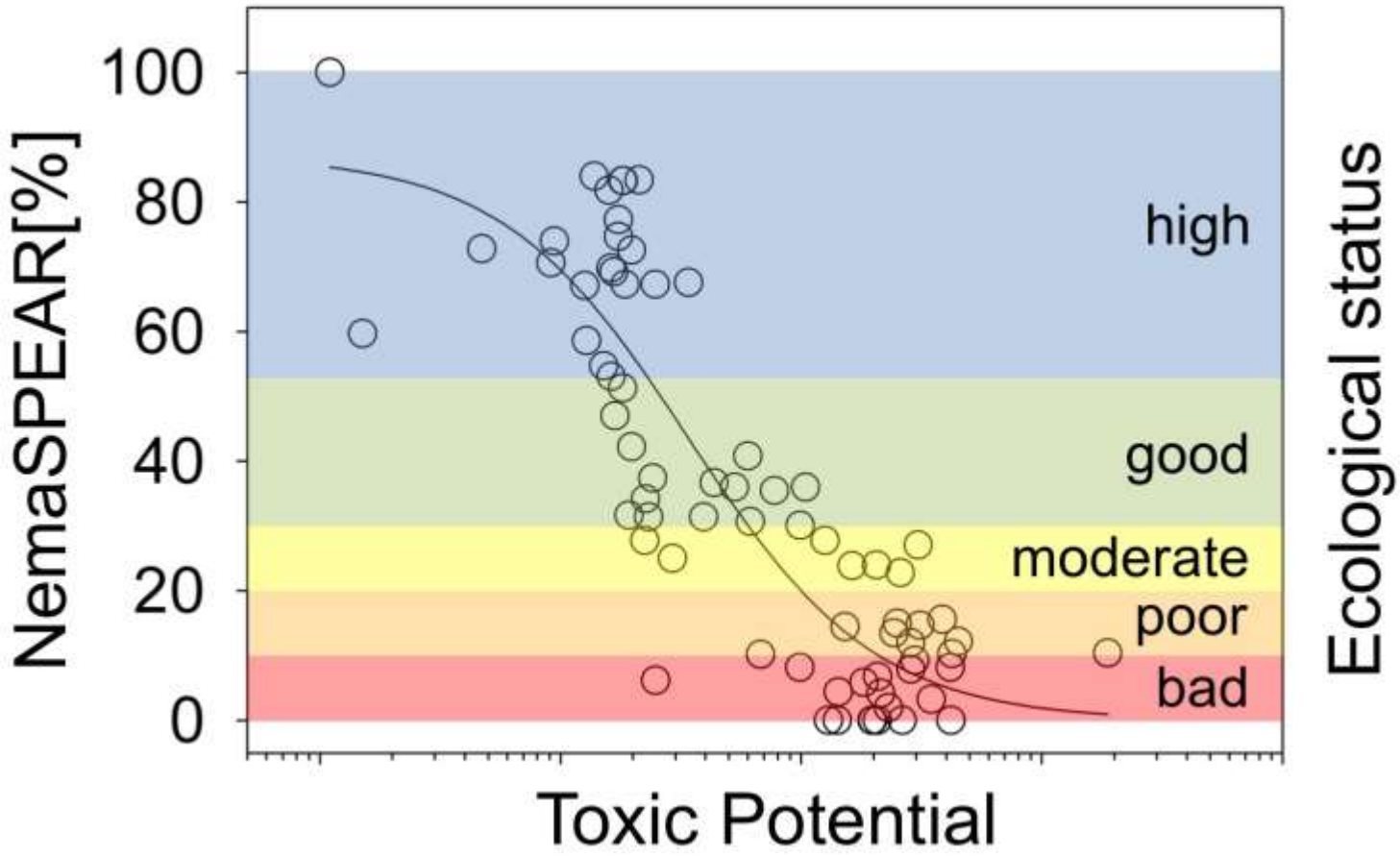
# Decrease of the NemaSPEAR[%]-index is induced by chemical treatment as shown in microcosm experiments




Based on experimental data from:

- *Brinke et al. (2011):* ***Environ. Toxicol. Chem.****, 30, 427-438* ***(Cadmium)****.*
- *Haegerbaeumer et al. (2016):* ***Environ. Toxicol. Chem.****, 35, 2987-2997* ***(Zinc)****.*
- *Brinke et al. (2010):* ***Aquat. Toxicol.****, 99, 126-137* ***(Ivermectin)****.*

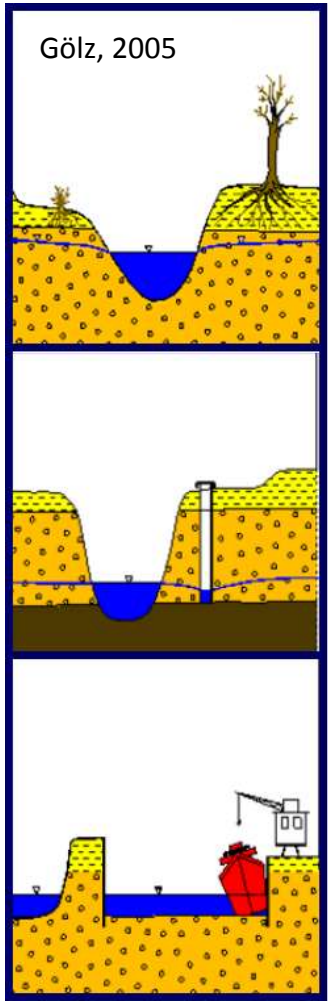
# The NemaSPEAR[%]-index relates dose-dependently to the toxic potential of field samples

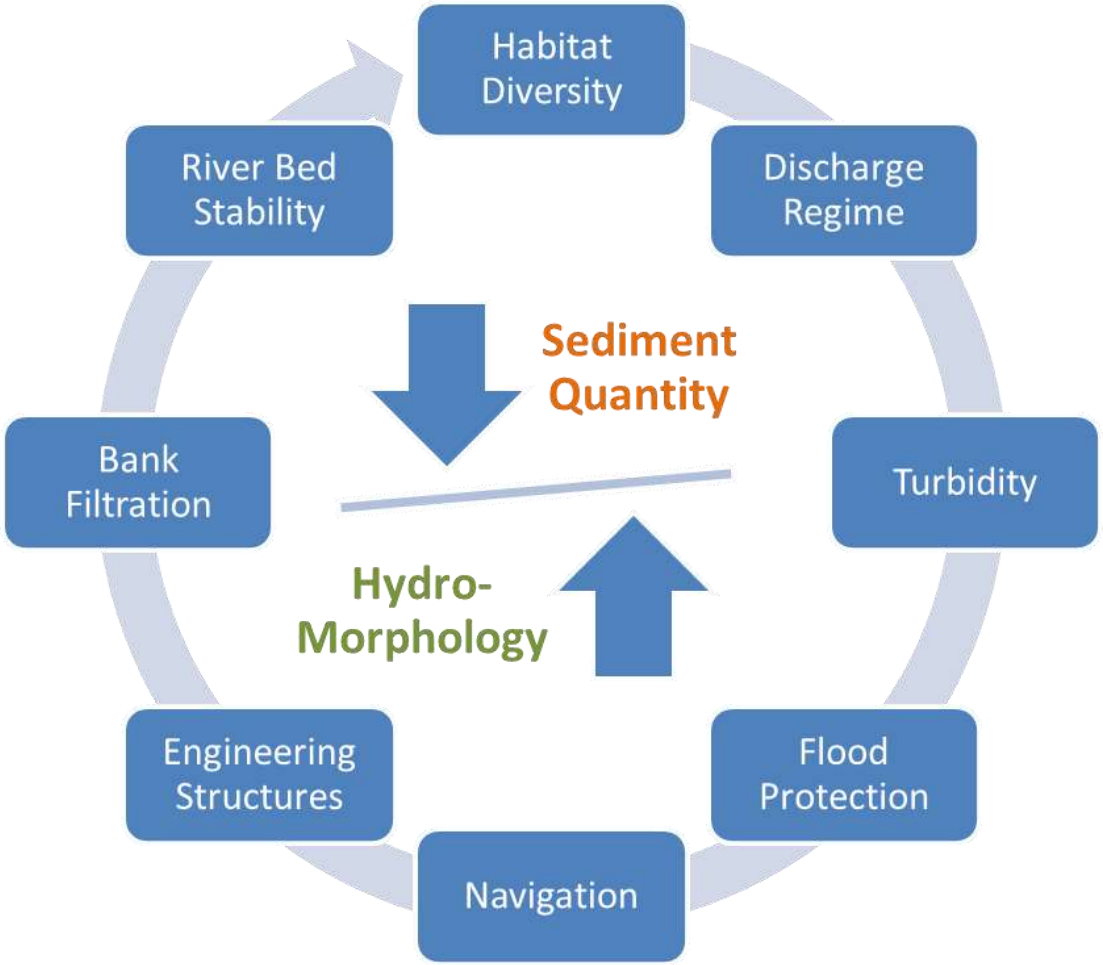



*Höss et al. (2017):* ***Ecol. Indic.****, 73, 52–60.*

*Toxic Potential: mean PEC-Q based on SQGs from de Deckere et al. (2011):* ***J. Soils Sediments****, 11, 504-517*

# Quality, Quantity, Hydromorphology: Sediment matters!



# Sediment matters: Conclusions and Decisions as part of the WFD process in the Elbe River

## 1st Management Plan

- Deficient hydromorphological conditions and contamination as significant management issues
- Unbalanced sediment conditions and contaminated sediments among main reasons

## ICPER/FGG Elbe (2009):

Sediment management concept in preparation of the 2nd management cycle (2016-2021)


**IKSE / MKOL, Magdeburg, 2014 (DE/CZ):** The Sediment Management Concept of the ICPER - Recommendations for a good sediment management practice in the Elbe

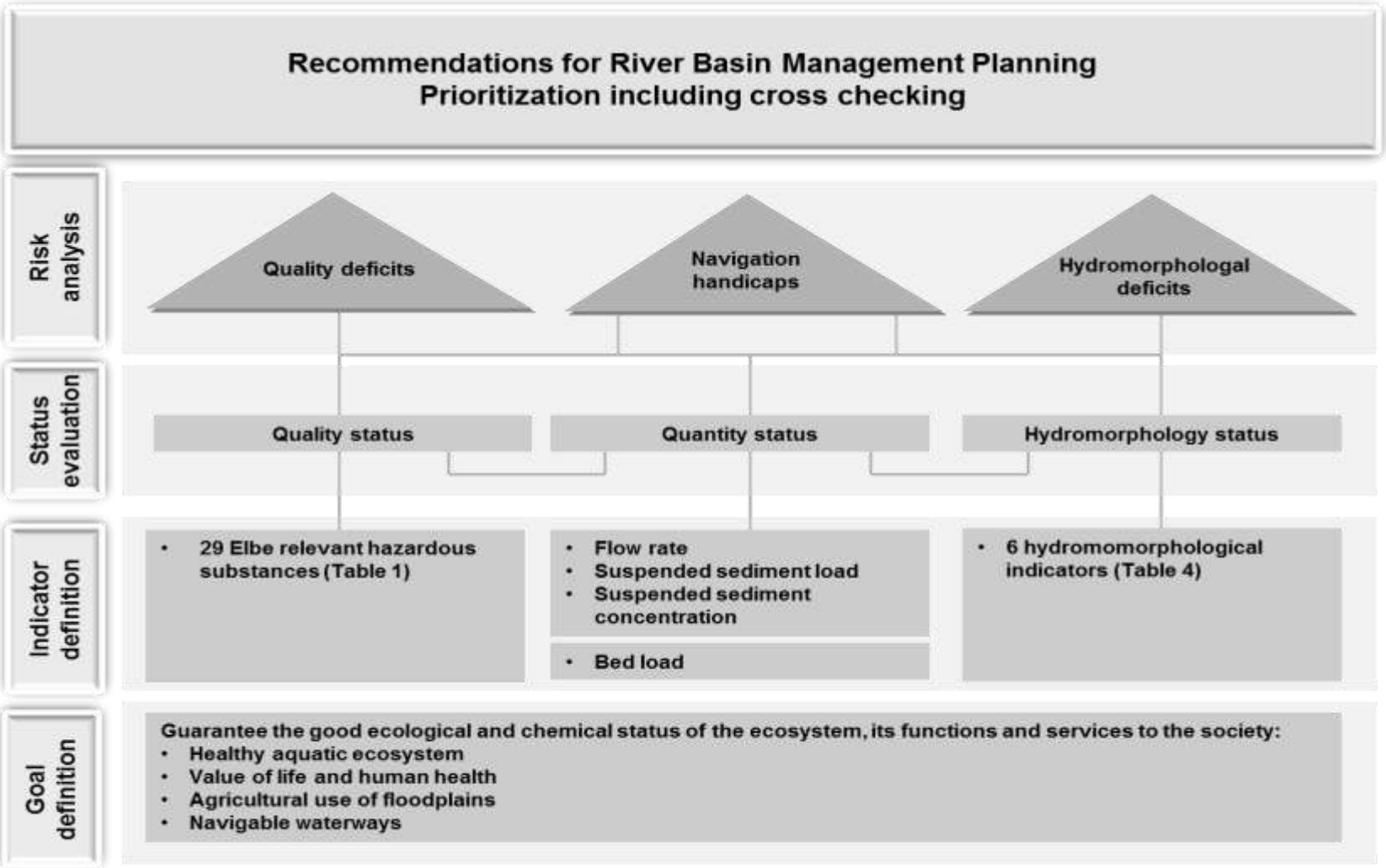
http://www.ikse-mkol.org/fileadmin/media/user_upload/D/06_Publikationen/01_Wasserrahmenrichtlinie/2014_IKSE-Abschlussbericht%20Sediment.pdf
http://www.ikse-mkol.org/fileadmin/media/user_upload/E/06_Publikationen/01_Wasserrahmenrichtlinie/2015_ICPER-Infomation-Sheet_Sediment.pdf

*Heininger et al. in Heininger & Cullmann (Eds.) "Sediment matters", Springer, 2015*


# ICPER and FGG Elbe
# Sediment Management Concept (2014)
# Related to the whole River Basin Elbe

- Considers the spatial interdependencies of the catchment (upstream – downstream, main river - tributaries, river – sea, river – floodplain)
- Considers sediment issues in terms of quantity, quality, and hydromorphology; their interaction
- Integrates environmental and use-oriented aspects [at the example of navigation]
- Is risk-based, i.e. conclusions rely on the analyses of risks for management goals from insufficient sediment status
- Considers sediment management within the institutional framework set by the WFD.

# Sediment Management Elbe – Conceptual Framework



# Recommendations for River Basin Management
# The Final Step

**Recommendation for actions are**

- Given individually from the three perspectives – quality, hydromorphology, navigation
- Prioritization is made according both to specific quantity, quality or hydromorphology criteria and to general criteria.

**Risk analysis in the case of sediment quality refers to**

- Point sources (P)
- Legacy, abandoned sites along the river / within the flooded area (L)
- Old contaminated sediments (S)
- Other sources / focus on urban areas (U).

Risk - Range – Prioritization:

- Hazard (toxic concentration)
- Amount
- Mobility (availability to the system)

# Recommendations for Action

**e.g. Hg**

| Sources S | Range |
|---|---|
| Side structures, downstream km 300 (German km) | 1 |
| Groyne fields, downstream km 350 (German km) | 1 |

| Sources S | Range |
|---|---|
| Side structures, Neratovice | 3 |
| Side structures, Pardubice | 3 |

| P | L | S | U |
|---|---|---|---|
| O | O | O | O |

| P | L | S | U |
|---|---|---|---|
| O | O | X | O |

| P | L | S | U |
|---|---|---|---|
| O | O | X | O |

DE - Tidal — DE-Inland — Saale — Mulde — Triebisch — CZ – Upper Elbe

| P | L | S | U |
|---|---|---|---|
| O | X | X | O |

| P | L | S | U |
|---|---|---|---|
| O | O | O | O |

| P | L | S | U |
|---|---|---|---|
| O | O | O | O |

| Source L | Range |
|---|---|
| Old sites, Weisse Elster | 1 |

| Sources S | Range |
|---|---|
| Side structures, lower Saale | 2 |
| 4 major barrages, lower Saale | 2 |

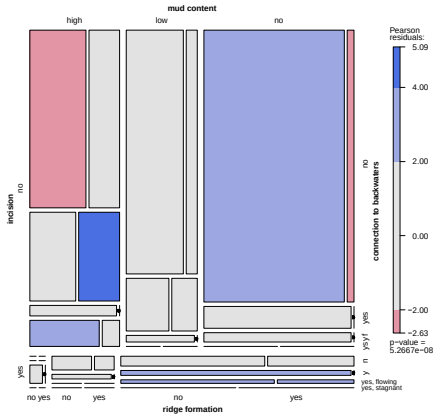
P – Point source
L – Legacy / abandoned site
S – Sediment
U – Urban Area

**Is this more than fantasy?!**

# Groyne Fields as an Element of Fine Sediment Management [1,2]

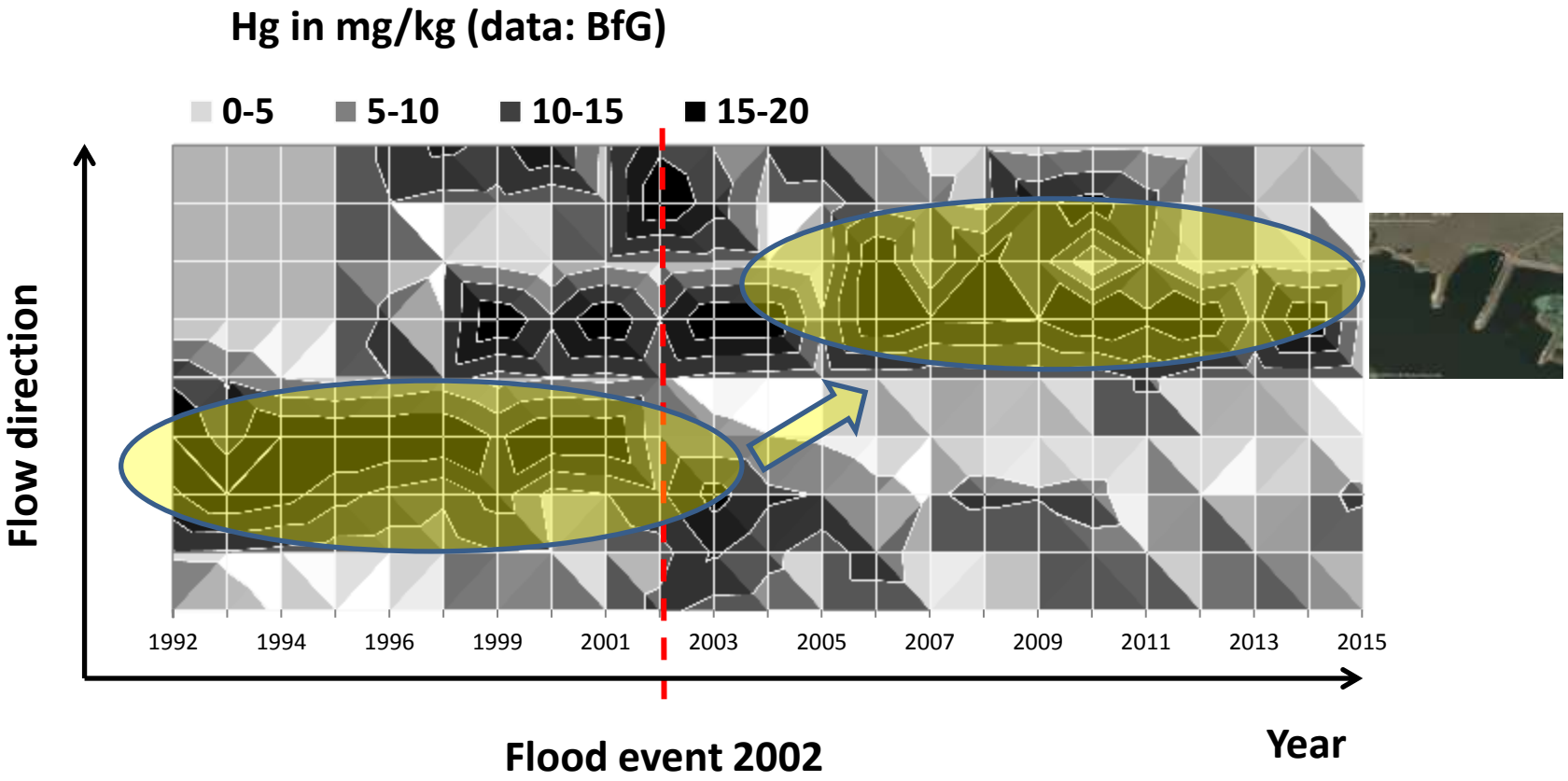
Totally ~ 6.600 groyne fields (German inland stretch)

- Multinomial logistic regression model using metric/geometric and category variables
- 872 fields (~ 14%) susceptible to fine sediment deposition
- Verified by on-site investigation of 270 fields (2010/11)
- Estimated fine sediment volume ~ 1 Mio $m^3$ (2014)
- Nearly 90% of the relevant groyne fields are located downstream km 350
- Reasonable Management Units (e.g. groups of 10 groyne fields) may be defined.

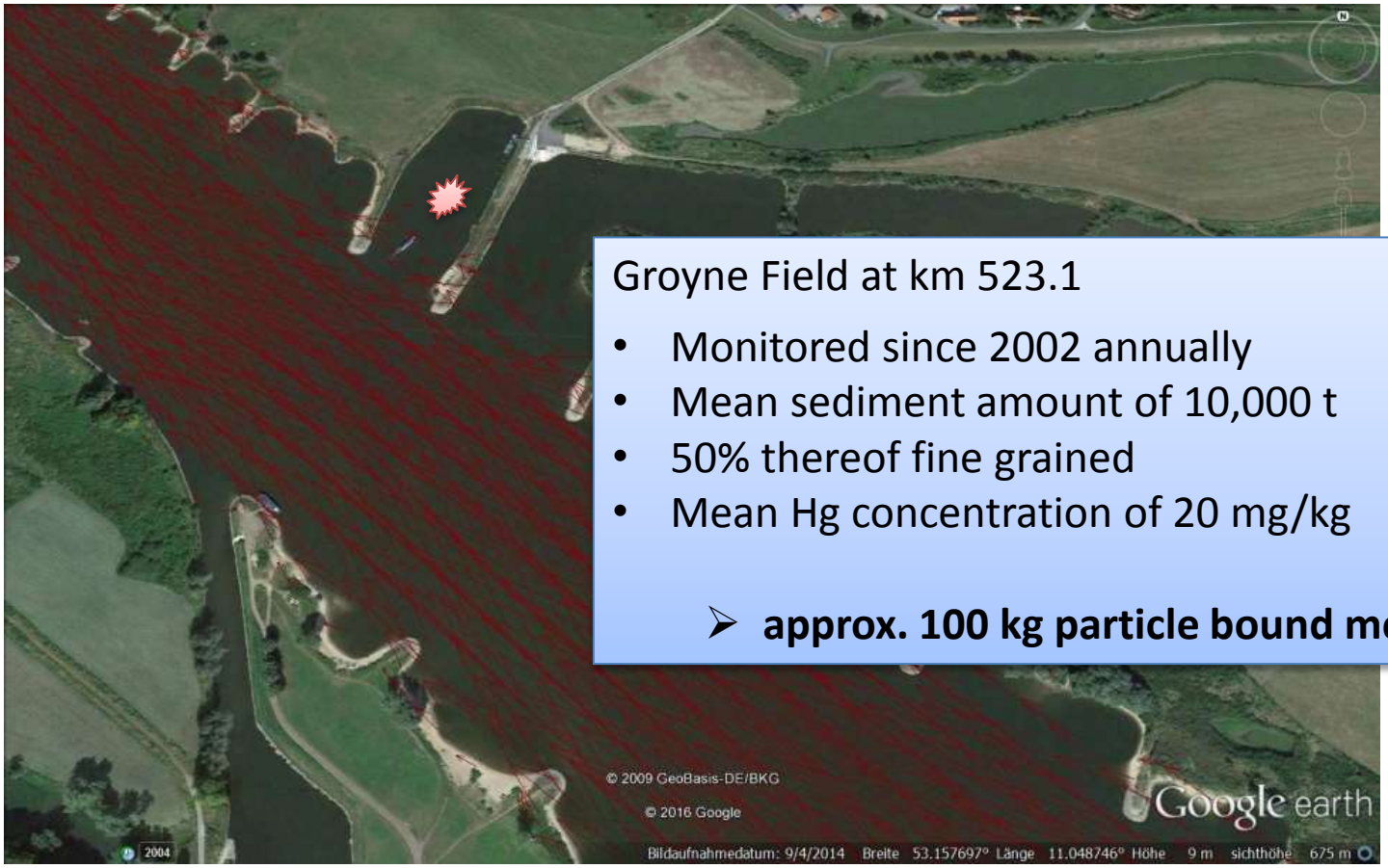



[1] Hillebrand, Claus et al. in: BfG-Mitteilungen Nr. 30 (2014)
[2] http://doi.bafg.de/BfG/2014/G_Buhnenfeldkataster.pdf

# “Sediments on the move”
# - and mercury comes along -



# “Sediments on the move”
# - but mercury can be stopped -




Groyne Field at km 523.1

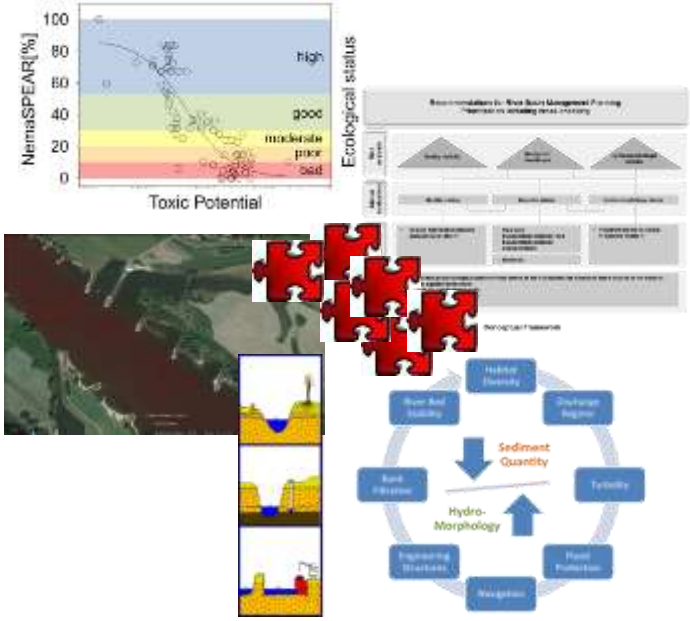
- Monitored since 2002 annually
- Mean sediment amount of 10,000 t
- 50% thereof fine grained
- Mean Hg concentration of 20 mg/kg

➢ **approx. 100 kg particle bound mercury**

**Load Hg (t/y)**
**Inland – Tidal Elbe**
**Data: IKSE**

| 1986 | 1989 | 1995-1999 | 2000-2004 | 2005-2009 | 2010-2012 |
|---|---|---|---|---|---|
| 22 | 12 | 1.8 | 1.4 | 1.3 | 0.6 |


# Summary:
# The Puzzle may be assembled




# Summary: Progress in the implementation is reported in years 2, 4 and 6 of the 2nd management cycle


## Progress in Sediment Management Implementation (ICPER, Feb 2017)

## Three kinds of measures are to be reported

**Practical status improvement: 46**

- Quality: 29
- HyMo: 14
- 8 in prep. 6
- 10 in prog. 4
- 3 finished 4
- Navigation: 3 (1 – 2)

**Improved Monitoring: 6**

- Loads / balance: 3
- Extremes: 3
- Other: 3

**Improved Knowledge: 28**

- Data basis: 11
- System understanding: 9
- Impact of measures: 6
- Relation to other regulation areas: 2

# Summary:
# Thank you SedNet!

## Identity of SedNet

In our network, we bring together sediment professionals from science, administration, management, NGOs, consultancy and industry.

**Many thanks**

**…. to Evelyn Claus, Marvin Brinke, Sebastian Höss and Ilka Carls**

**…. to all my other colleagues in and outside of BfG**

**…. to you!**