

Bioverfügbarkeit von Metallen

Environmental Research and Innovation Department – ERIN

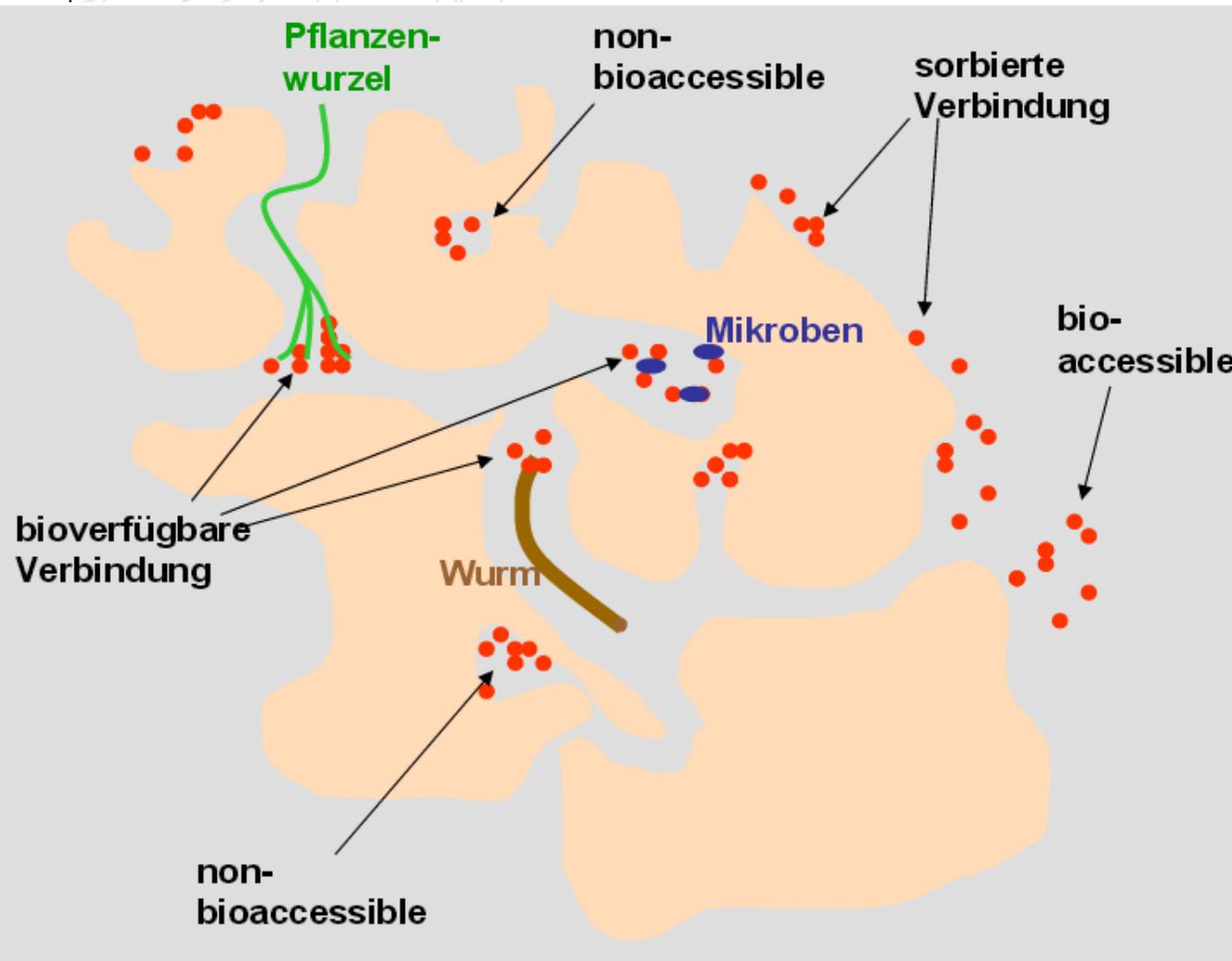
Life Cycle Sustainability and Risk Assessment Unit - LISRA

Arno C. Gutleb



LUXEMBOURG
INSTITUTE
OF SCIENCE
AND TECHNOLOGY





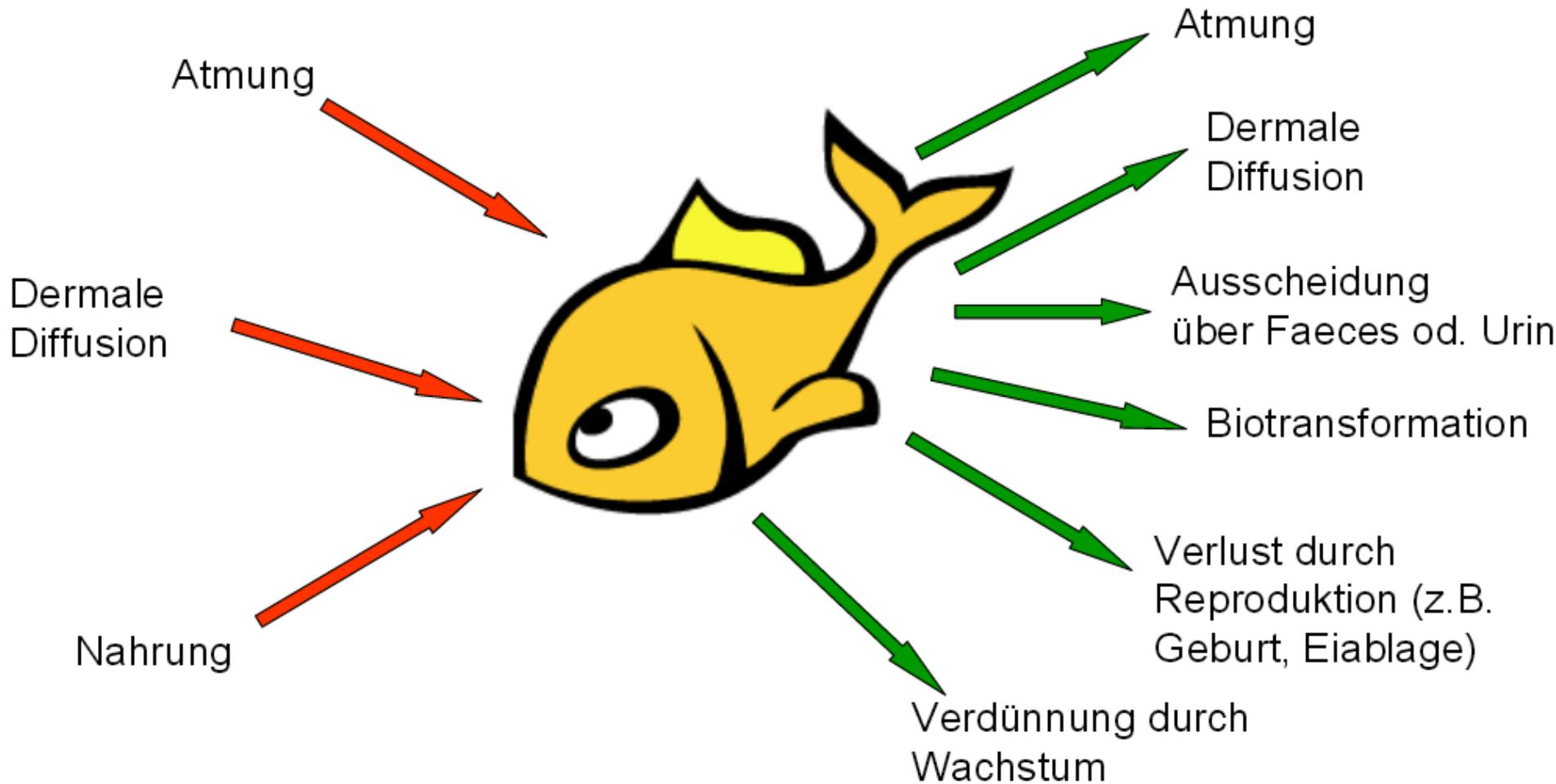
modifiziert nach: Semple et al. 2004 ES&T 38(12): 228A-231A

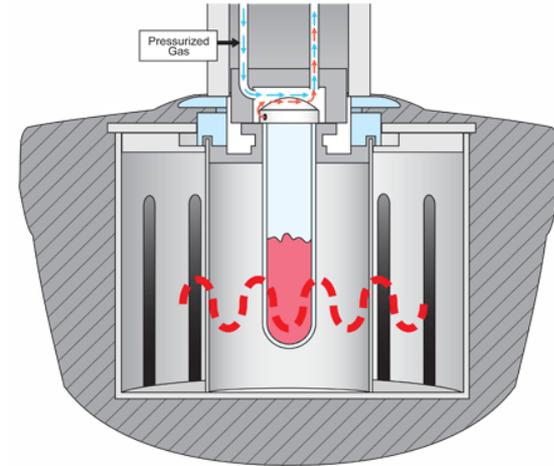
Definitionen

(nach Semple et al. 2004)

- bioverfügbar (bioavailable) = frei verfügbare Verbindung, die die Zellmembran eines Organismus durchqueren kann; zu einem bestimmten Zeitpunkt
- bio"zugänglich" (bioaccessible) = bioverfügbare Verbindung plus Verbindung, die bioverfügbar werden kann

Eliminierung von Schadstoffen





Bioverfügbarkeit



pH und Bioverfügbarkeit

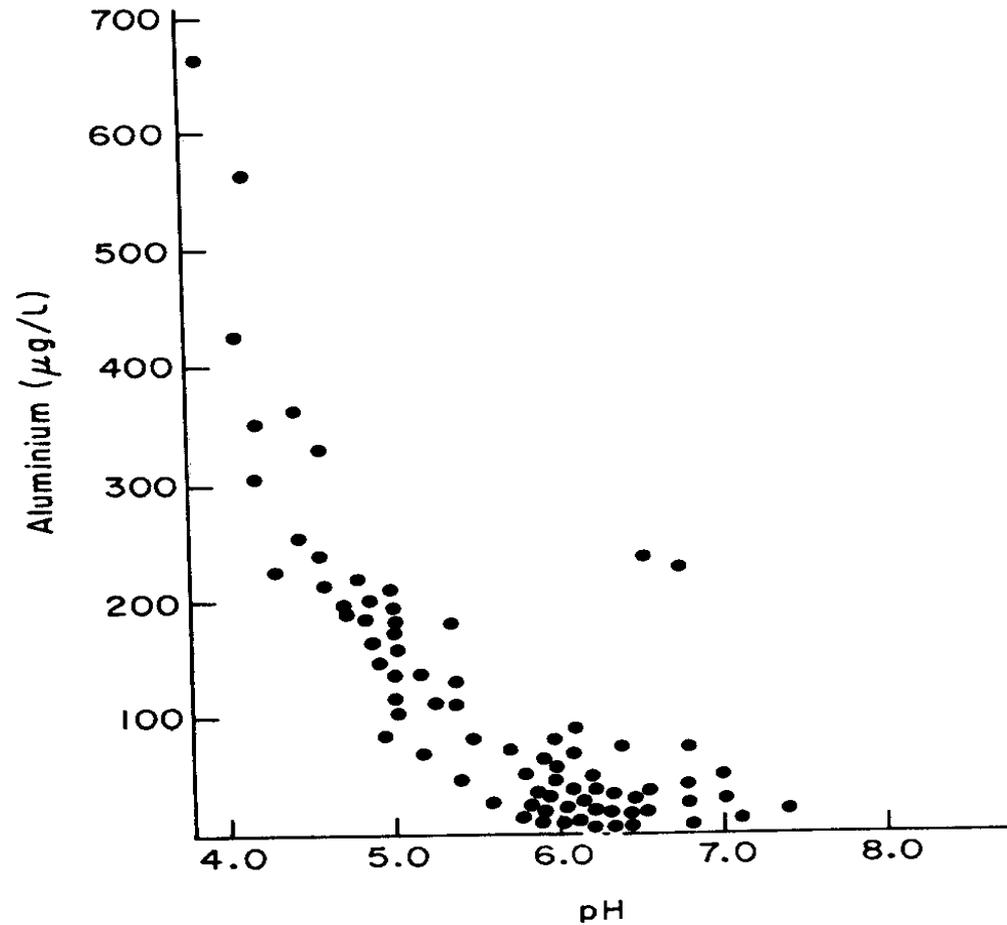


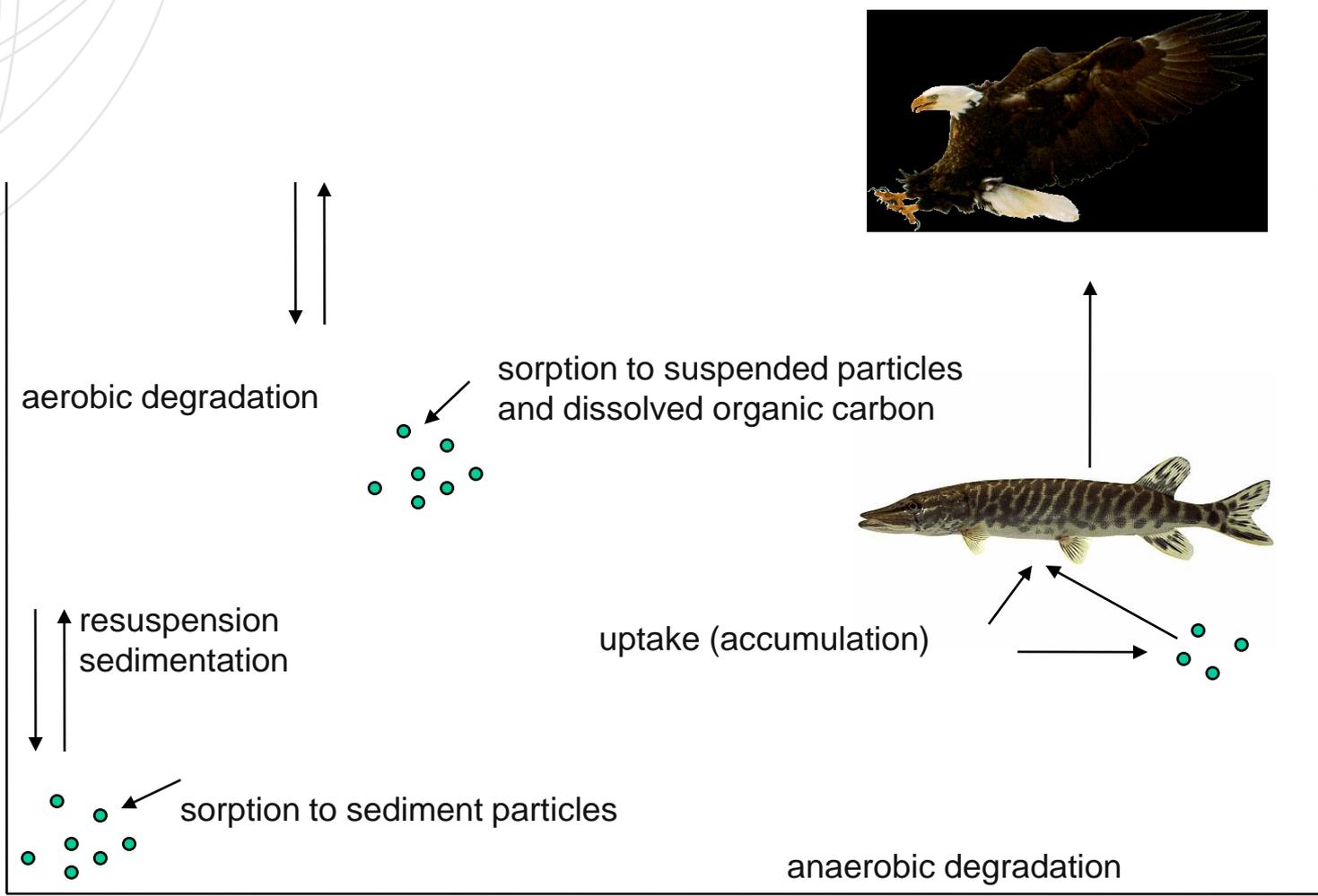
Fig. 1.5 The pH and concentration of total aluminium in the water of Swedish lakes during the summer and autumn of 1976. The two anomalous values are for lakes high in humic acids. (From Dickson, 1980.)

Verteilung

Luft

Wasser

Sediment



- **Assel:** keine Ausscheidung; Speicherung im Hepatopankreas
(erreichen praktisch nie toxische Konzentrationen)
- **Springschwänze:**
regular excretion via epithelia of intestine
(steady-state concentration will be reached)
- **Laufkäfer:**
no excretion; no storage
(constantly increasing concentration)



TABLE 1.1 *Anthropogenic enrichment factors (AEF) for total global annual emissions of cadmium, lead, zinc, manganese and mercury in the 1980s (all values 10^6 kg year⁻¹)**

Metal	Anthropogenic sources (A) (industry etc.)	Natural sources (volcanoes etc.)	Total (T)	AEF (A/T) × 100
Cadmium (Cd)	8	1	9	89%
Lead (Pb)	300	10	310	97%
Zinc (Zn)	130	50	180	72%
Manganese (Mn)	40	300	340	12%
Mercury (Hg)	100	50	150	66%

*From various sources.

Lead-based additives to petrol

Compound

Uptake

mercury vapour

++++

alkyl mercury

+++

Hg⁺⁺ compounds

++

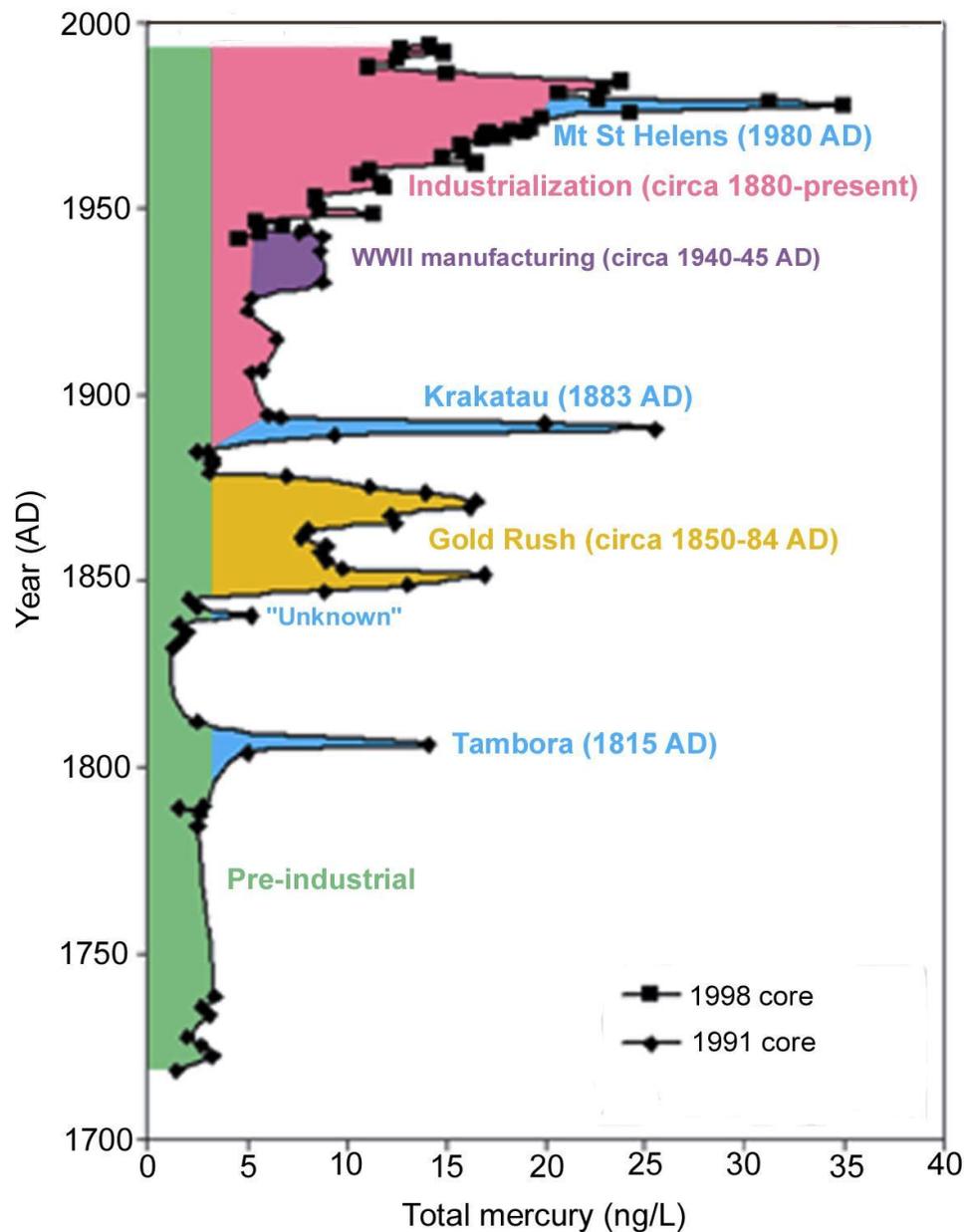
Hg⁺ compounds

+

Hg⁰ mercury liquid metal

-

Figure 2



A 270-year record

Major atmospheric releases

- Natural
 - Background (42%)
 - Volcanic (6%)
- Anthropogenic (52%)
 - Gold rush
 - WWII
 - Industrialization

Significantly

The last 100 years
anthropogenic: 70%

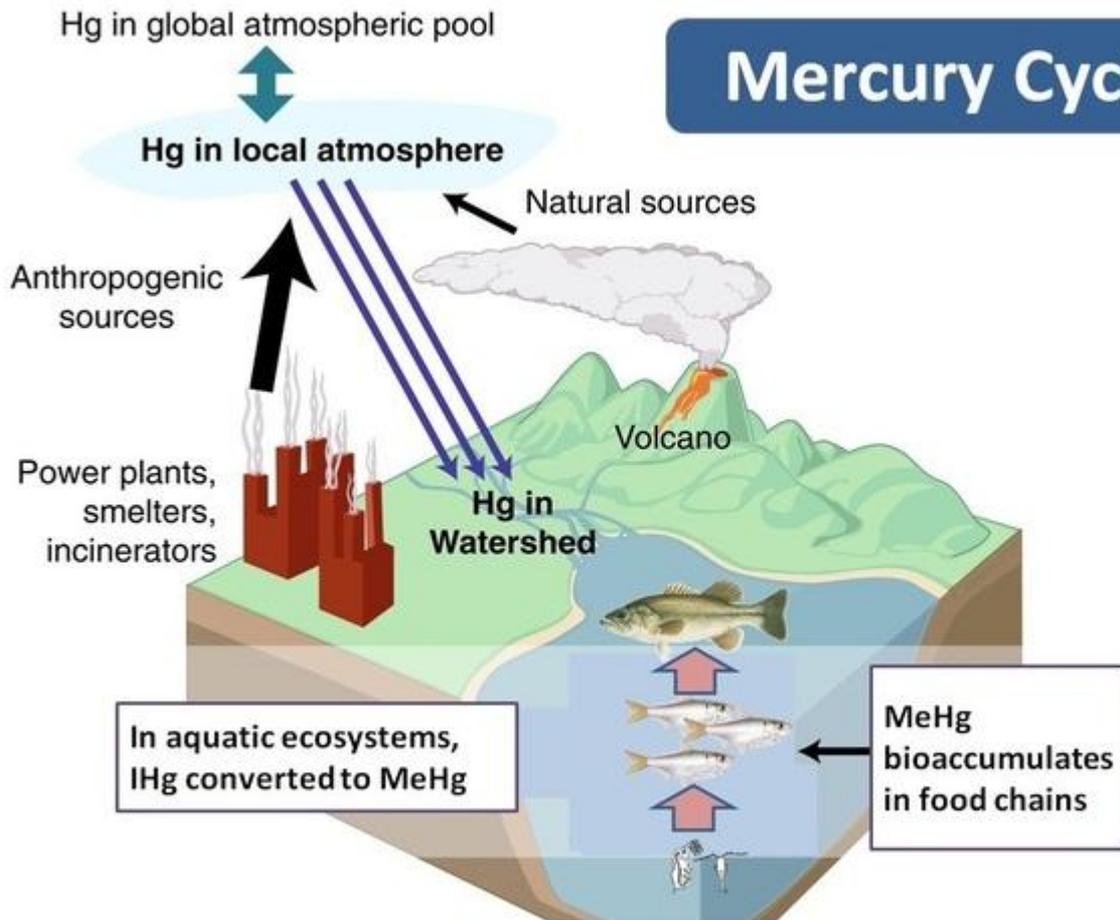
The last 10 years
an apparent decline

Arsenic in Bangladesh:

Up to 75 million at risk from arsenic contaminated water from wells dug during 1980s and early 1990s.

The problem was not noticed until victims began showing external symptoms of arsenic poisoning: calluses on the palms and soles of feet, leading to skin cancers.





Box 2. Long-term health effects of exposure to arsenic

Skin lesions
Skin cancer
Internal cancers
 Bladder
 Kidney
 Lung
Neurological effects
Hypertension and cardiovascular disease
Pulmonary disease
Peripheral vascular disease
Diabetes mellitus

Box 1. Magnitude Bangladesh

Population of Bangladesh
Total population in some wells are known to be contaminated:
Maximum concentration permitted in drinking water according to WHO recommendation
Maximum concentration in Bangladesh:

Number of tube-wells in Bangladesh
the British Geological Survey
– Proportion of wells with arsenic concentrations >100 µg/l
– Proportion of wells with arsenic concentrations >300 µg/l:

8.4%



Photo: WHO

Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. AH. Smith, EO. Lingas, & M Rahman
Bulletin of the World Health Organization, 2000, 78 (9)









