

Preparation of samples and operation of the German environmental specimen bank (ESB) archive

**Bernd Göckener, Heinz Rüdell,
Karlheinz Weinfurtner**

**Fraunhofer Institute for Molecular Biology
and Applied Ecology (IME)
Schmallenberg / Germany**

Jan Koschorreck
**German Environment Agency
(Umweltbundesamt - UBA)
Dessau-Rosslau / Germany**



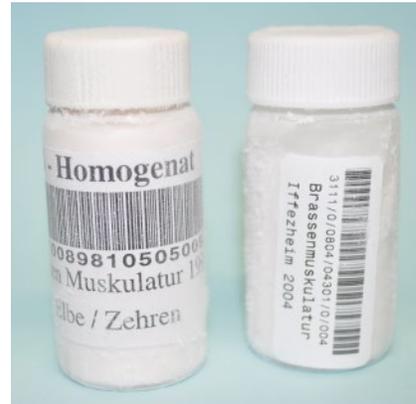
CONCEPT

- For the German ESB, representative environmental specimens are collected in representative ecosystems at fixed intervals and stored
- Long-term storage is performed under conditions which exclude any change of chemical composition or properties over several decades:
temperature $< -150^{\circ}\text{C}$, exclusion of oxygen by evaporating nitrogen



CONCEPT

- Sample treatment protocols for the German ESB were developed in 1970s
- The idea: treating the samples in a way that is compatible with many different analyses/uses of samples, even those that were not considered at the time of sampling
- Guidelines for the operation of the German ESB are laid down in a concept document



Current concept version of 2014:

<https://www.umweltprobenbank.de/en/documents/11426>

UMWELTPROBENBANK DES BUNDES

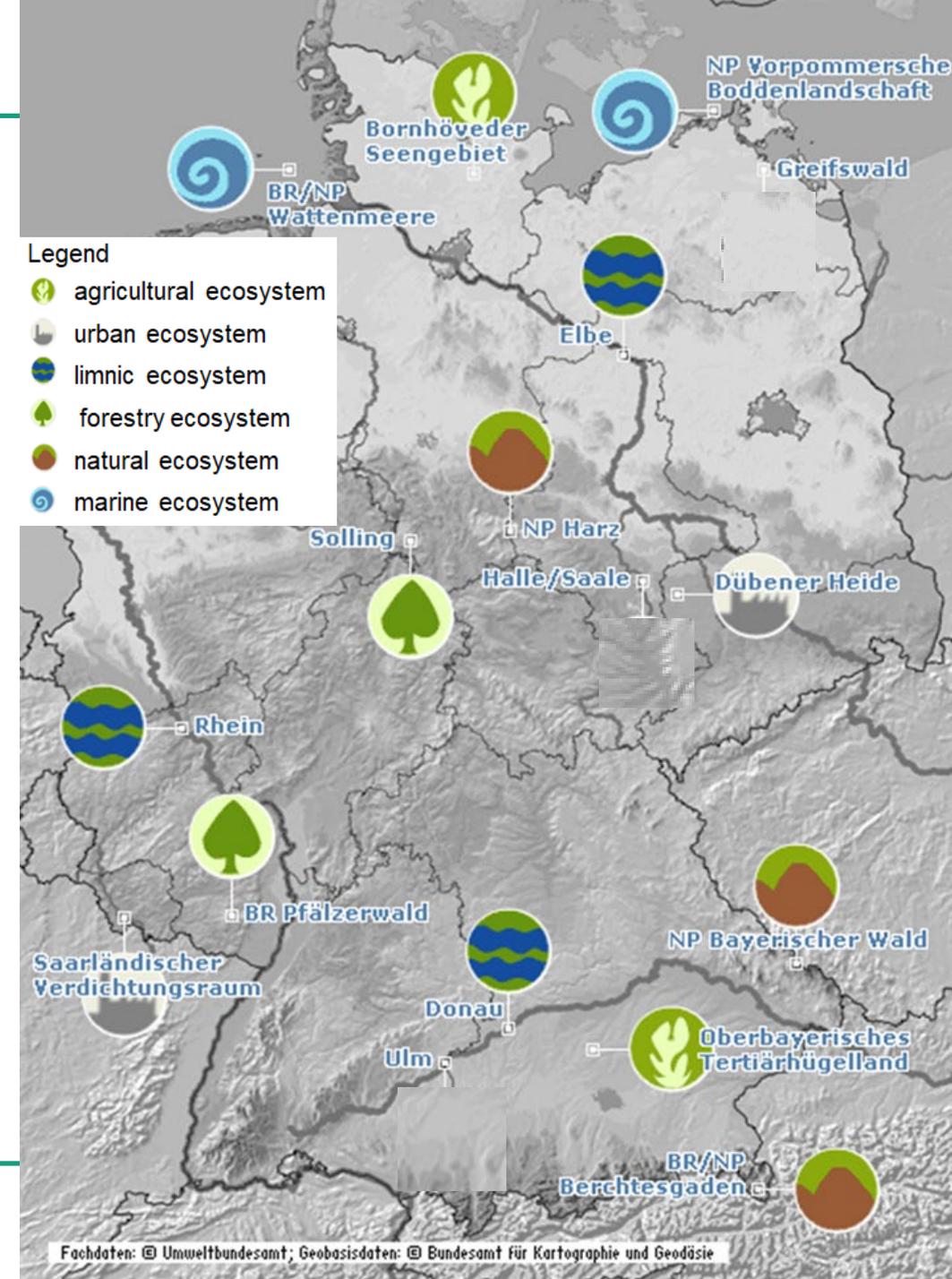
- *Konzeption* -

(Stand: Dezember 2014)

Umweltbundesamt Berlin

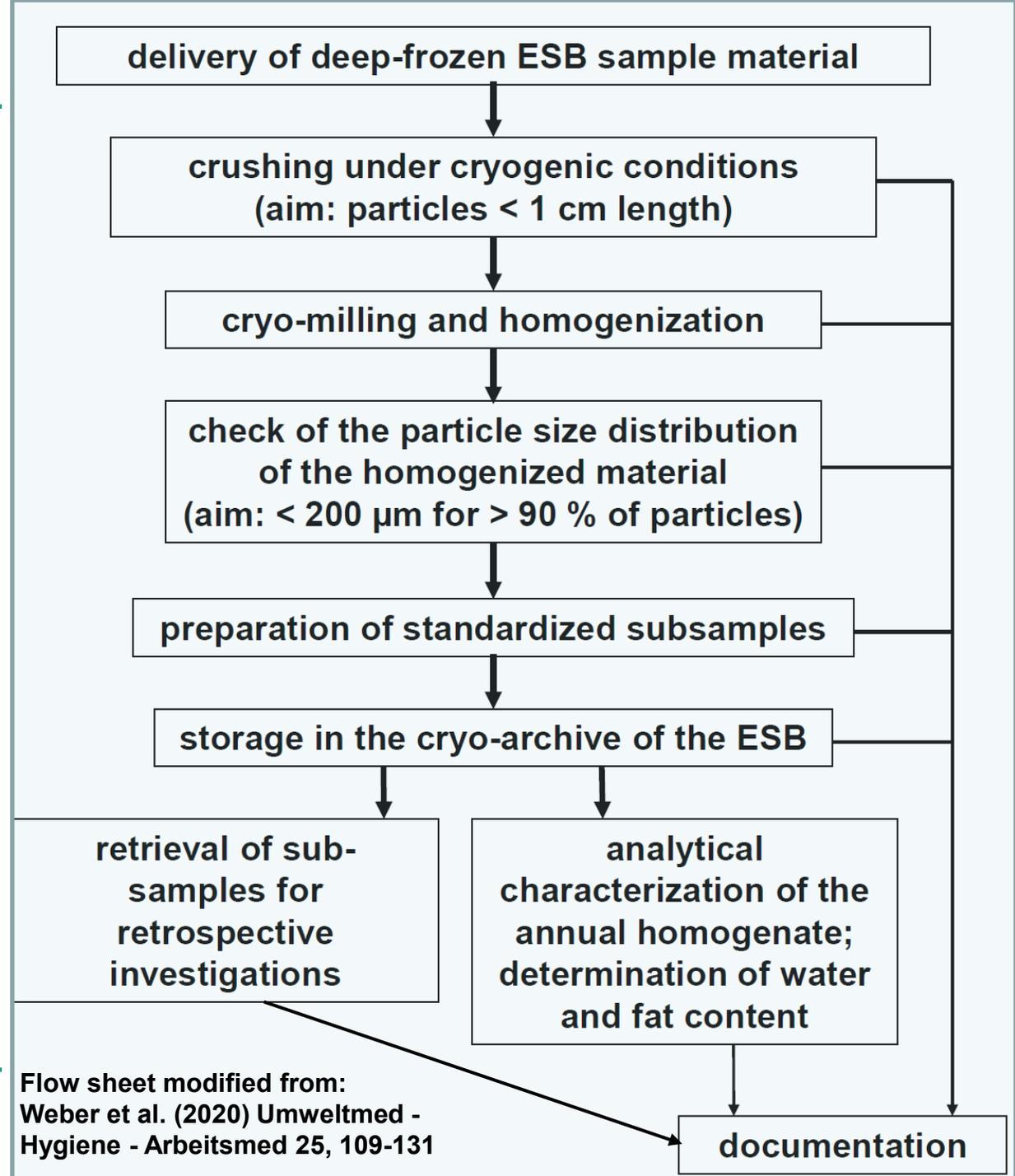
ESB SAMPLING RESPONSIBILITY

- Trier University, Biogeography
biota sampling: fish (fillet, liver), mussels, bird eggs, beech/poplar leaves, spruce/pine shoots, roe deer liver, earthworms
- Federal Institute of Hydrology (BfG), Koblenz
sampling of suspended particulate matter (SPM) in rivers
- Fraunhofer Institute for Molecular Biology and Applied Ecology (Fraunhofer IME)
soil sampling



PROCESSING

flow sheet: biota sample treatment



Flow sheet modified from:
Weber et al. (2020) Umweltmed -
Hygiene - Arbeitsmed 25, 109-131

PROCESSING OF BIOTA SAMPLES

Milling and homogenization

oscillating cryo mill

Palla VM-KT

(MBE Coal & Minerals Technology GmbH, Cologne; formerly KHD)

Materials:

titanium / stainless steel /

Teflon bellows



About **1 - 2 kg** of pooled raw sample:
after **several milling runs** and homogenization
up to 200 subsamples of about **5 - 10 g** each
are prepared

PROCESSING OF BIOTA SAMPLES

Milling and homogenization

Smaller amounts: milled in a Pulverisette 5 (Fritsch)
planetary ball mill with beakers made of zirconium oxide

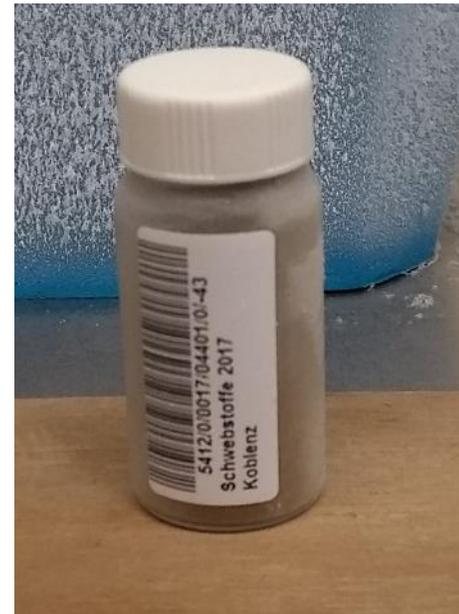
- Routinely, each beaker is filled with **up to 150 g of sample** and an appropriate number of **balls**
- **Several successive milling runs** with intermittent cooling



PROCESSING OF SPM (Suspended Particulate Matter)

Freeze-drying and homogenization

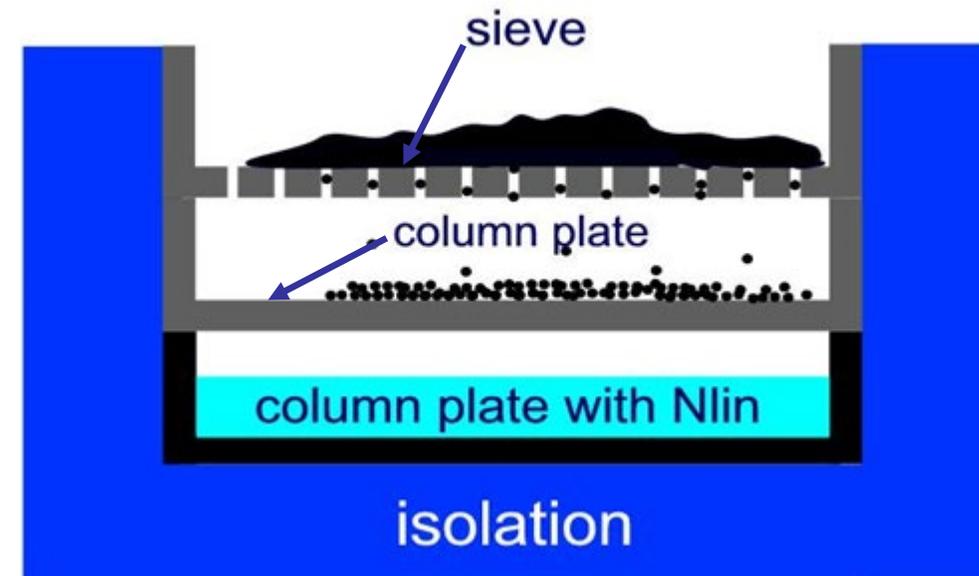
- SPM samples are collected monthly from river sites, passed through a 2 mm sieve and are frozen as thin blocks immediately after sampling
- Monthly samples are freeze-dried, aggregates are cautiously destroyed and the material is homogenized
- A part of the monthly samples is stored as subsamples, from the remainder an annual SPM sample from each site is prepared with a mixer
- Finally, about 100 subsamples of the annual SPM sample are prepared and stored



PROCESSING OF SOIL

Sieving and homogenization

- Sampling of the **humic layer** with a cutting frame
- The **mineral soil layers** are gained with a **split-tube-sampler**; several cores are taken from a sampling site for a representative sample
- **Sieving of the soil on site** to gain a fraction < 2 mm (mineral soil) or < 5 mm (soil humic layer) and immediate freezing (liquid nitrogen)
- **Homogenization of the sample** and destroying of aggregates in the lab (cryogenic conditions)
- **Preparation of 100 subsamples** of about 20 - 50 g each for each soil layer



ARCHIVING

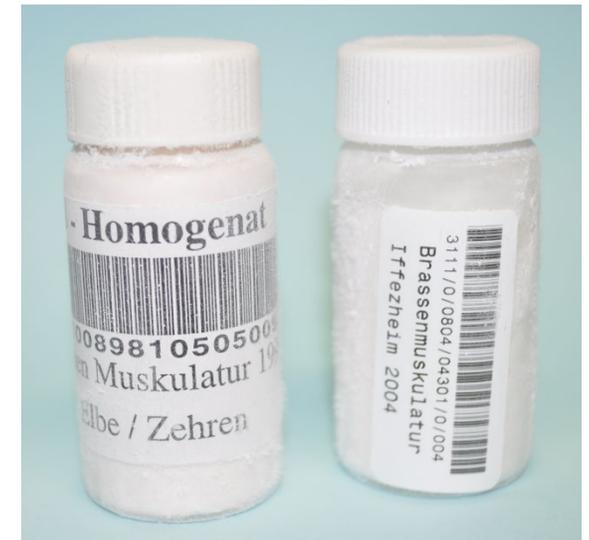
Storage conditions

- **Archive for Environmental Specimens at Fraunhofer IME Schmallenberg on behalf of the German Environment Agency**
- **Well-trained and experienced 24/7 on-call team**
- **About 70 cryogenic storage vessels with a total of > 85 m³ storage volume**
- **Storage temperature below -150°C; samples are stored in the inert gas atmosphere from evaporating nitrogen**
- **Since 1985 about 2650 annual samples (specimens) with approx. 390,000 subsamples were prepared**
- **Fast access to sub-samples due to storage in canisters and an inventory data bank program**



SUMMARY AND CONCLUSIONS

- The German Environmental Specimen Bank is **designed as a tool for the retrospective monitoring of pollutants in environmental samples**
- **Concentration trends can be identified by analyses of appropriate biota, soil and SPM samples representing different trophic levels of the covered ecosystems**
- Standardized sampling and sample treatment allows the detection of **small temporal changes or slight regional differences of concentrations**
- ESB monitoring data can be used as basis for the **justification of political measures (for example, banning of chemicals of emerging concern)**
- Retrospective monitoring allows the **assessment of the results of political measures taken in the past (a decreasing trend after restriction of uses)**



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University of Trier

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More information and data retrieval at:

www.umweltprobenbank.de/en