Für Mensch und Umwelt

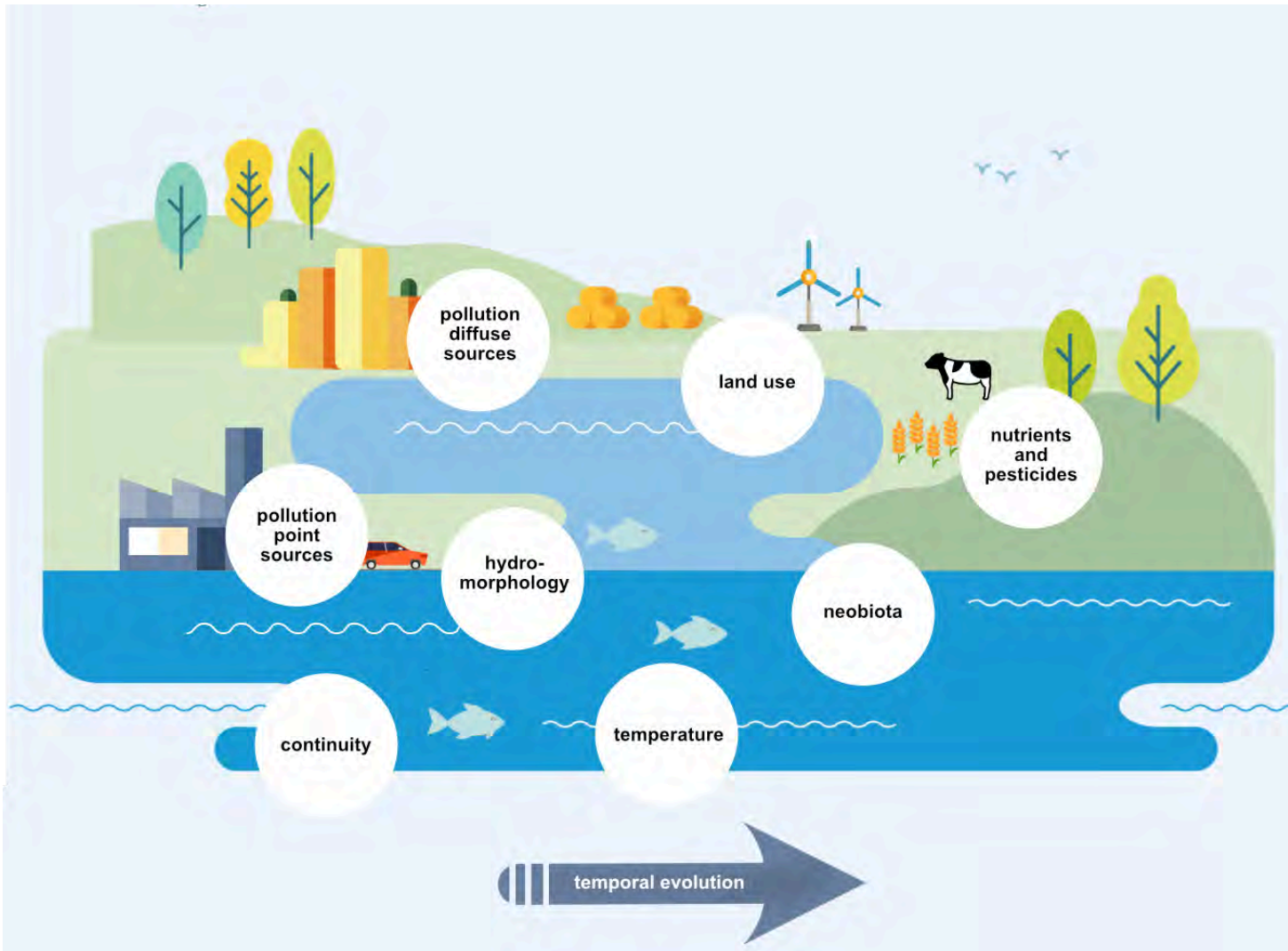**Umwelt Bundesamt**

Investigating chemical mixtures and biodiversity in a multi-stressor environment with the environmental specimen bank

Jan Koschorreck, Umweltbundesamt

Understanding stressors

Environmental data are becoming more important for

- assessing ecosystem health,

- derive meaningful indicators and measures,

- checking effectiveness of environmental/chemical management,

- projecting trends into the future.

New incentives for environmental monitoring

Remote sensing

Molecular methods

Non-Target Screening

Artificial intelligence

# Federal Environmental Specimen Bank: How is our environment changing?

- Long-term monitoring of ecosystems,

- Identification of emerging environmental stressors,

- Review effectiveness of environmental and chemical management,

- Providing historical samples for new analytical techniques,

- Storage of samples for as yet unknown questions that may arise in the future.

Quellen: Kfa Jülich, Fraunhofer IME, Universiät Trier, Eurofins Gfa Lab Service, Universität Duisburg Essen
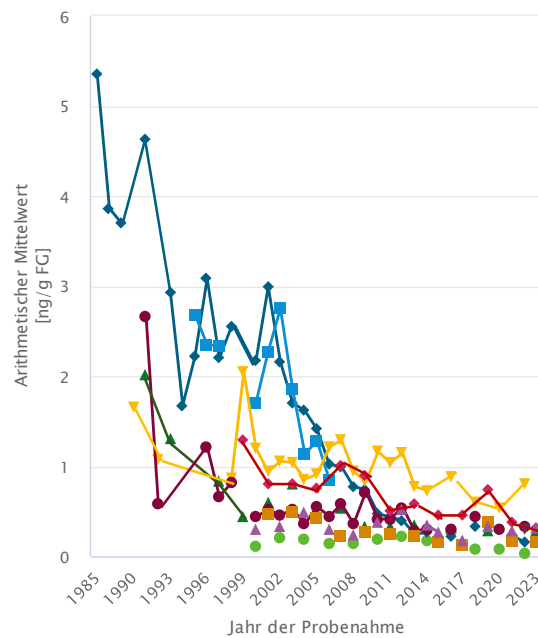
Understanding current exposure in its historical context

Weichkörper (Miesmuschel): Benzo[a]pyren
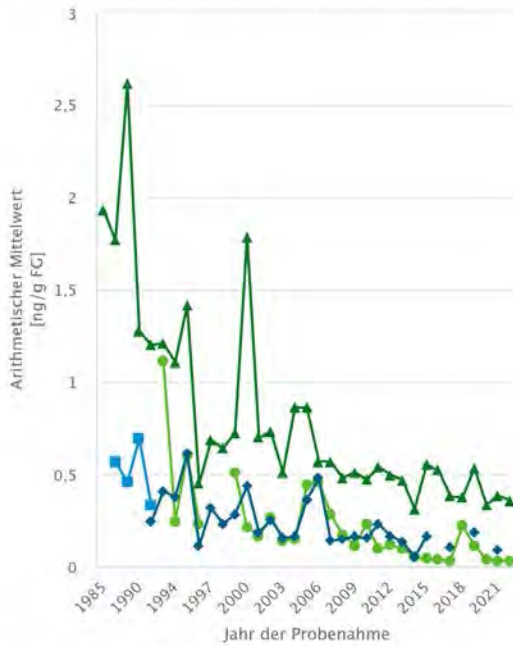
Darßer Ort (Halbinsel Fischland/Darß/Zingst)
Königshafen (Sylt-Römö-Watt)
südlich Lister Hafen (Sylt-Römö-Watt)
Eckwarderhörne (Jadebusen incl. Mellum)

Quelle: Umweltbundesamt – UPB, 6.3.2024
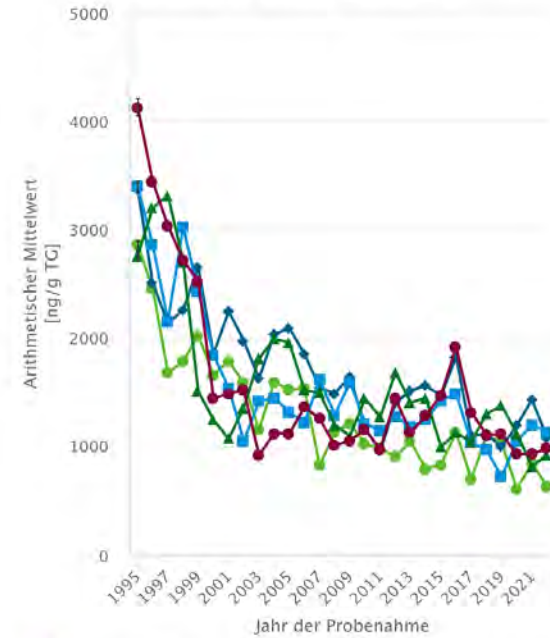
einjährige Triebe (Fichte): Benzo[a]pyren

Gries oberhalb Schloss (WEG Wimbachtal)
Warndt 1, Fuchsborn (Warndt)
Oberes Steinbachtal (Saarkohlewald)
Fichtenbestand Westufer (WEG Belauer See)
1/3

Quelle: Umweltbundesamt – UPB, 6.3.2024

Muskulatur (Brassen): Quecksilber

Prossen (km 13) (Grenze Deutschland/Tschechische Repu
Zehren (km 96) (Raum Zehren)
Barby (km 296) (Unterhalb Saalemündung)
Cumlosen (km 470) (Raum Schnackenburg)
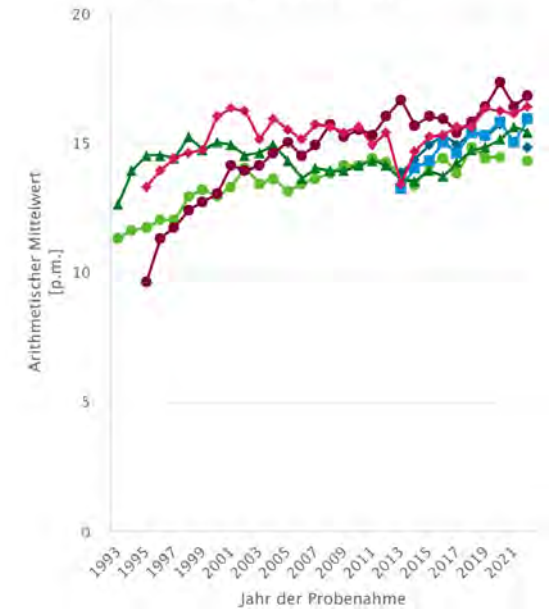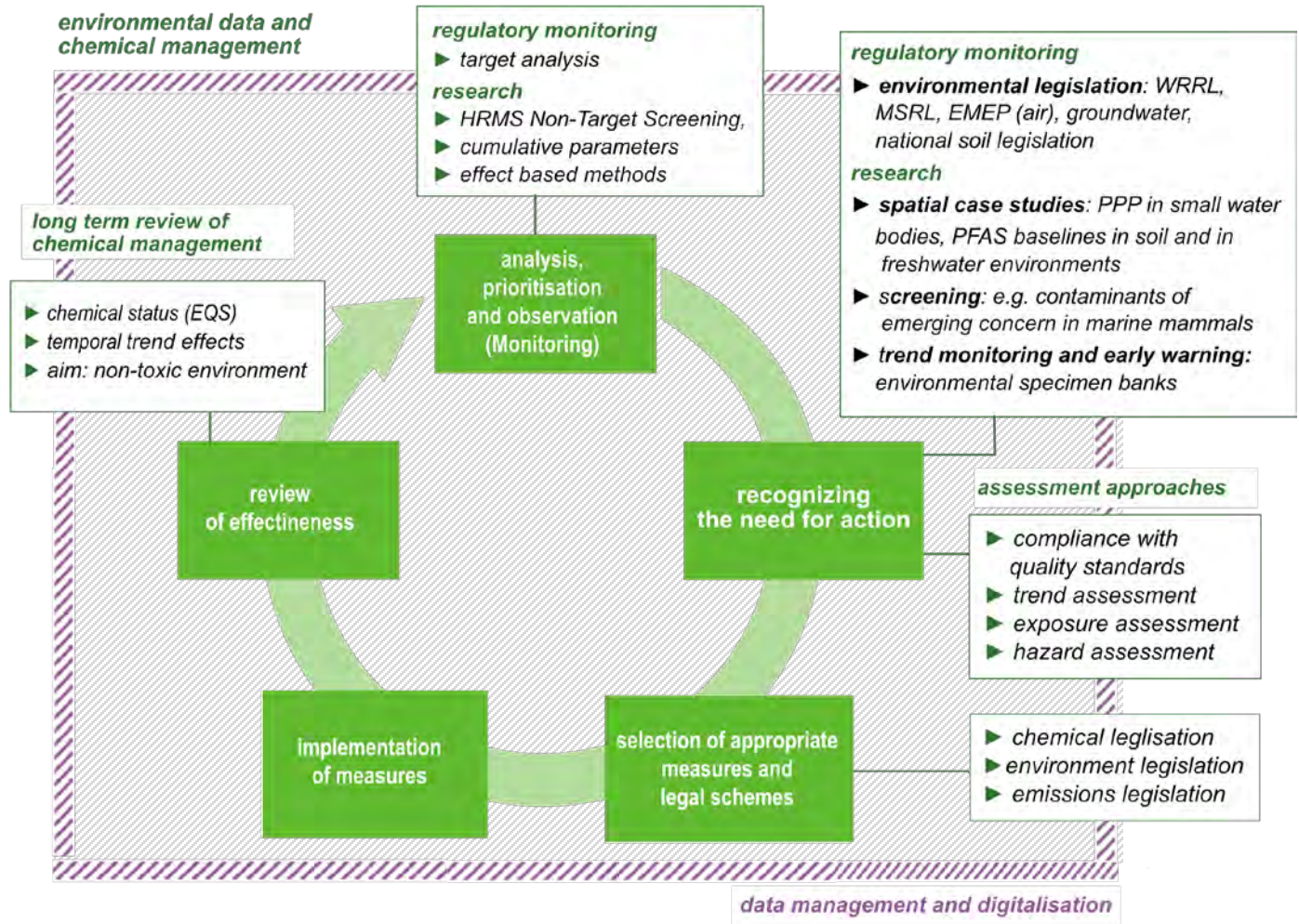1/2

Quelle: Umweltbundesamt – UPB, 7.1.2024

Muskulatur (Brassen): d15N

Prossen (km 13) (Grenze Deutschland/Tschechische Repul
Zehren (km 96) (Raum Zehren)
Barby (km 296) (Unterhalb Saalemündung)
Cumlosen (km 470) (Raum Schnackenburg)
1/2

Quelle: Umweltbundesamt – UPB, 6.3.2024
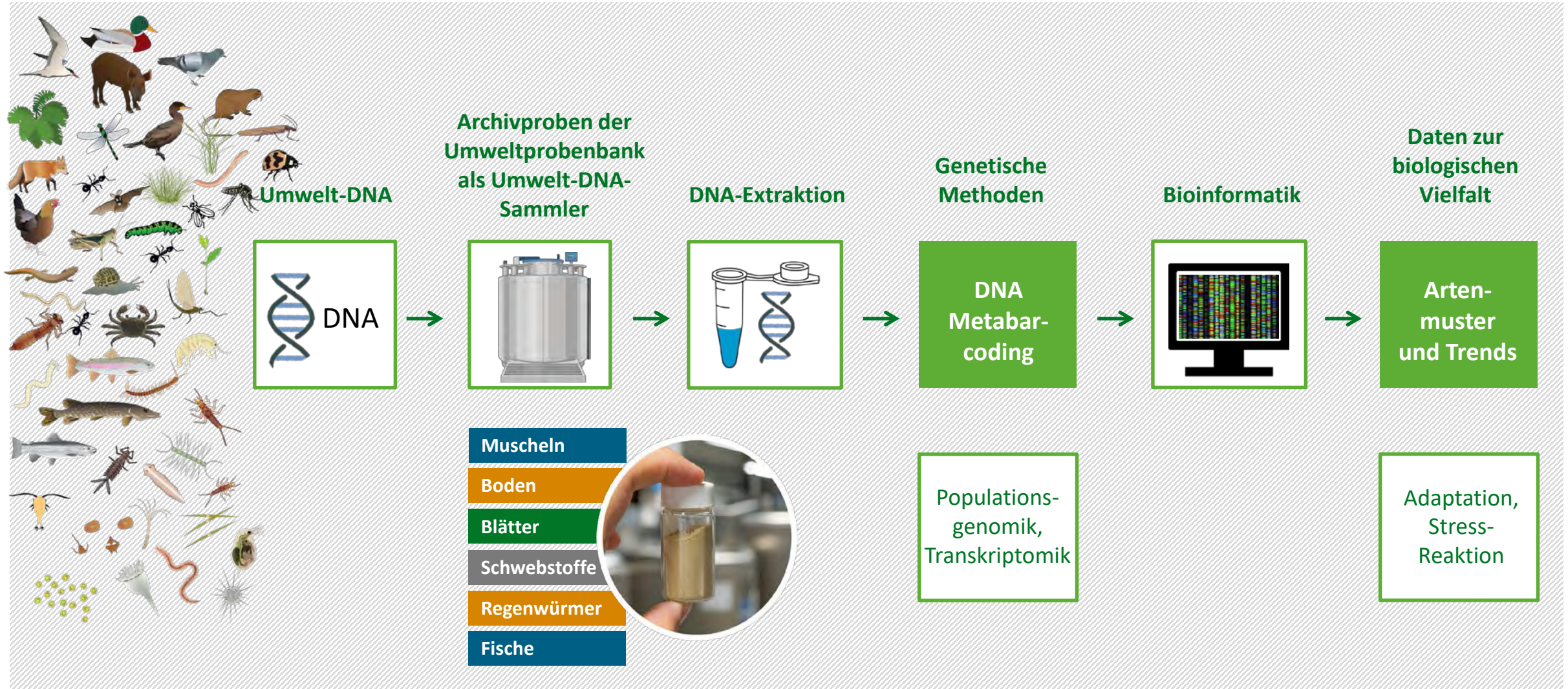
ESB support of chemical regulation and policy

environmental data and chemical management

regulatory monitoring
▶ target analysis

research
▶ HRMS Non-Target Screening,
▶ cumulative parameters
▶ effect based methods

long term review of chemical management
▶ chemical status (EQS)
▶ temporal trend effects
▶ aim: non-toxic environment

regulatory monitoring
▶ **environmental legislation**: WRRL, MSRL, EMEP (air), groundwater, national soil legislation

research
▶ **spatial case studies**: PPP in small water bodies, PFAS baselines in soil and in freshwater environments
▶ **screening**: e.g. contaminants of emerging concern in marine mammals
▶ **trend monitoring and early warning**: environmental specimen banks

analysis, prioritisation and observation (Monitoring)

review of effectiveness

recognizing the need for action

assessment approaches
▶ compliance with quality standards
▶ trend assessment
▶ exposure assessment
▶ hazard assessment

implementation of measures

selection of appropriate measures and legal schemes

▶ chemical leglislation
▶ environment legislation
▶ emissions legislation

data management and digitalisation

Fliedner et al, 2022. Environmental Specimen Banks an the European Green Deal

Quelle: Umweltbundesamt

– elements, incl. metals
– chlorinated, brominated and fluorinated legacy POPs
– CECs, incl. PPCPs, PPP, biocides, industrial chemicals
– dN15, dC13
– HRMS LC MS/MS Non Target Screeening , GC based methods in devolpement

Genetische Untersuchungen zur Beobachtung der biologischen Vielfalt

Umwelt-DNA

Archivproben der Umweltprobenbank als Umwelt-DNA-Sammler

DNA-Extraktion

Genetische Methoden

Bioinformatik

Daten zur biologischen Vielfalt

DNA

DNA Metabar-coding

Arten-muster und Trends

Muscheln
Boden
Blätter
Schwebstoffe
Regenwürmer
Fische

Populations-genomik, Transkriptomik

Adaptation, Stress-Reaktion

Molecular analysis of sample species and associated species communities

How does the microbiome of earthworms change?

In topsoil, species numbers (bacteria, fungi and metazoans) and their regional characteristics generally remain unchanged.

Methodological expertise, protocols and QA measures for the entire workflow.

How can we use transcriptomics to assess the effects of environmental stressors?

Warmer winters lead to dominant populations of invasive barnacles and their dispersal in the North Sea.

How does the eelpout genome evolve in response to changing environmental conditions?

In leaves, generally no change of species numbers of bacteria and arthropods. However, a constant exchange of species leads to a loss of the regional characteristics of the species communities.

Comparatively strong species exchange in tree fungi, especially those species that are typical for climate effects in forests.

Reference materials for molecular analysis in biological and non-biological samples.

Totals of native, invasive and red-listed fish species remain constant. Species exchange, especially for invasive fish.

No change in species numbers of bacteria and metazoans in bladderwrack.
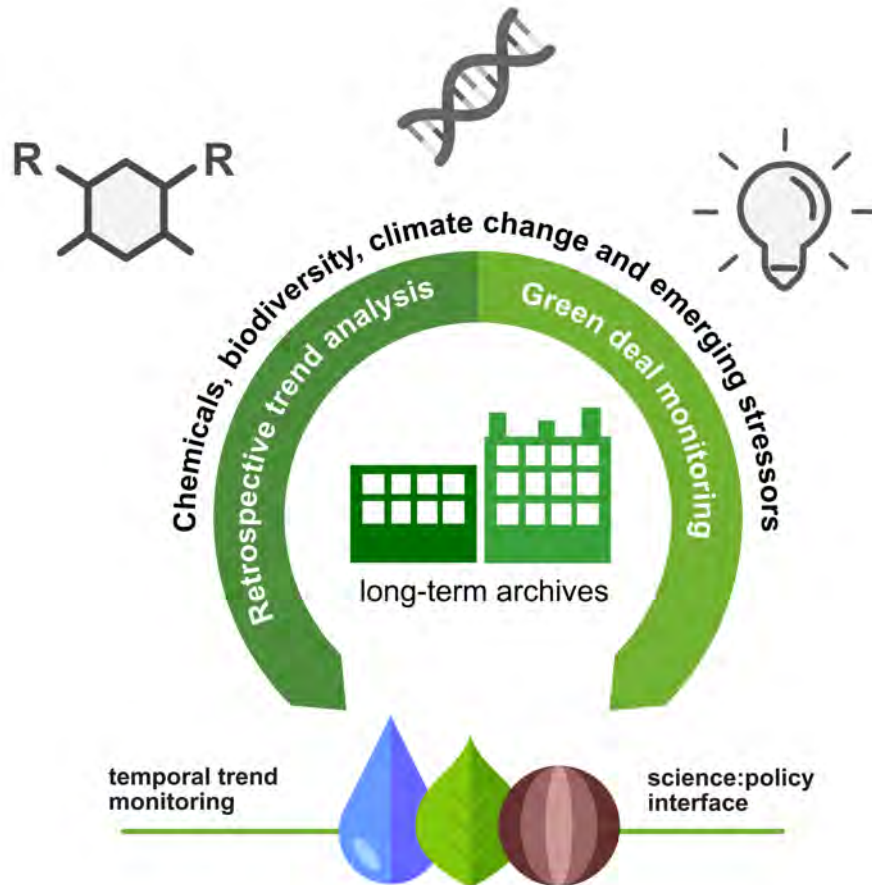
Quelle: Umweltbundesamt

ESB support of molecular biodiversity monitoring
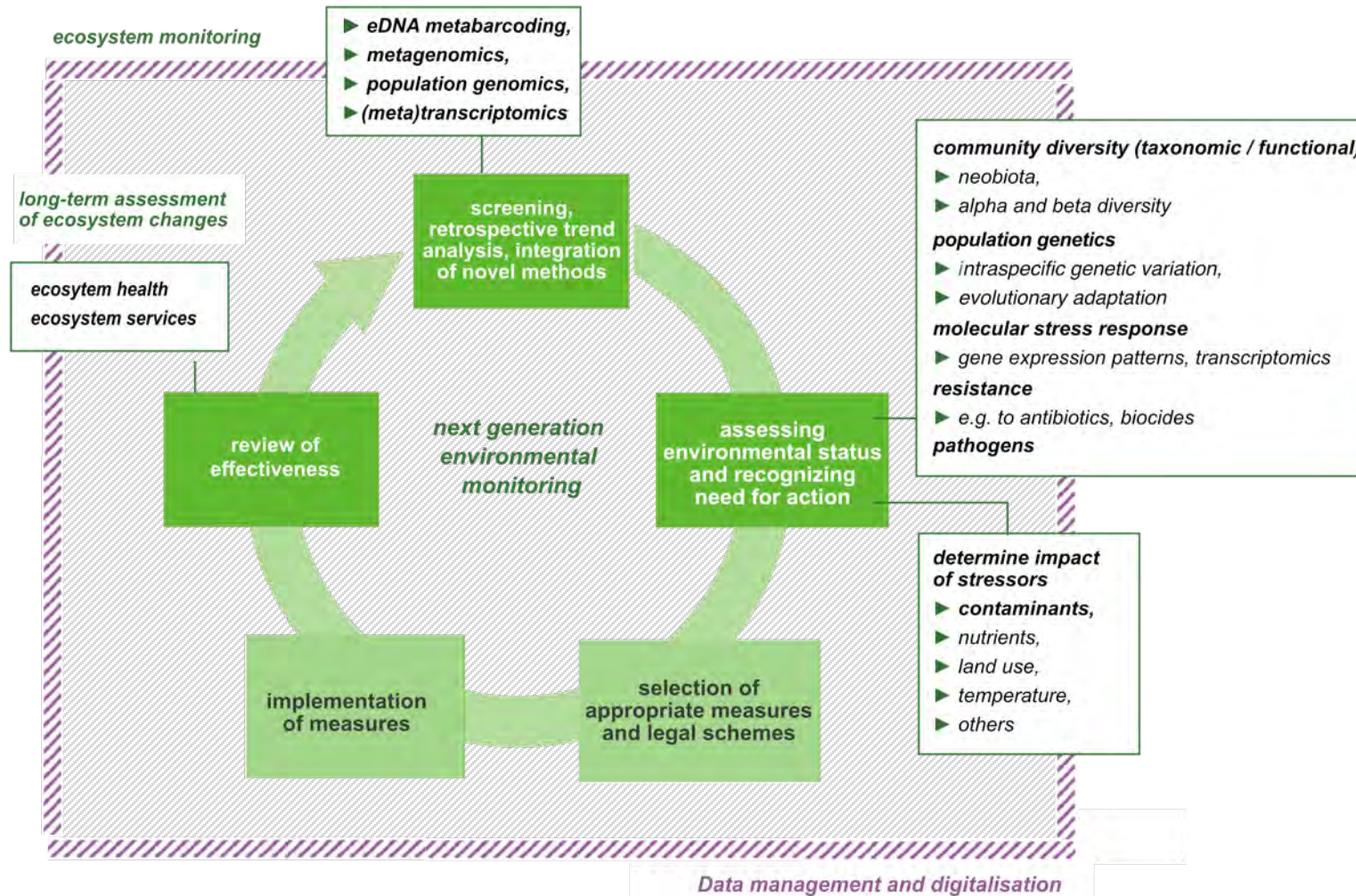
- Identify stressors and assess effects,
- derive indicators for temporal changes,
- place current changes in a historical context,
- provide forecasts for future developments.

Quelle: Umweltbundesamt

# TAKING ENVIRONMENTAL SPECIMEN BANKING INTO THE FUTURE

- The full potential of archived ESB samples unfolds as environmental analysis improves exponentially,

- retrospective trend analysis allows to better understand the past and predict future changes,

- identical subsamples allow integration of data from different disciplines of environmental analysis,

- links to new assessment concepts, e.g. planetary health and One Health,

- it is critical to establish new ESBs around the world. UBA project for Antarctica,

- please get in touch if you would like to propose project ideas for German ESB data and samples.

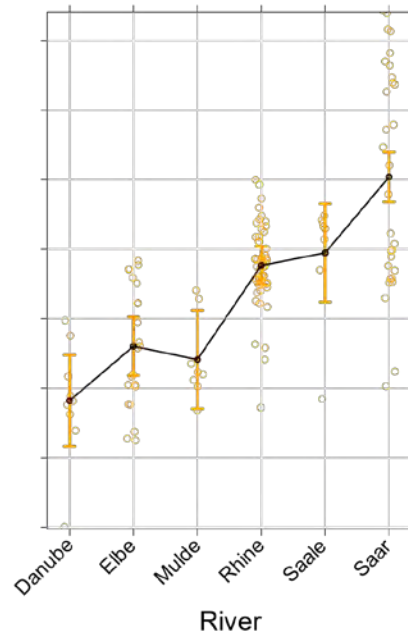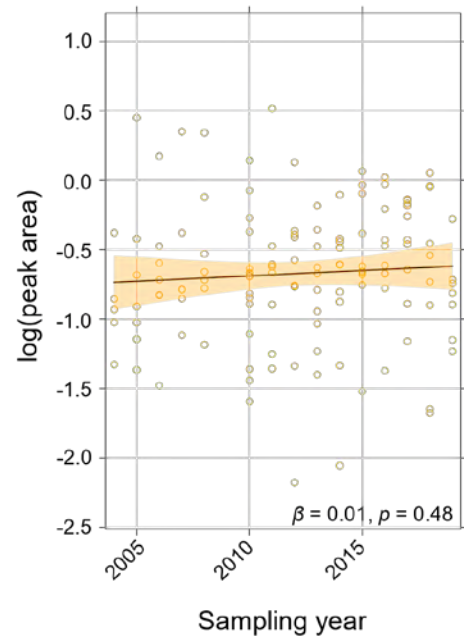Fliedner et al, 2022. Environmental Specimen Banks an the European Green Deal

Vielen Dank!

Does 6-PPD quinone from tire abrasion change fish diversity?
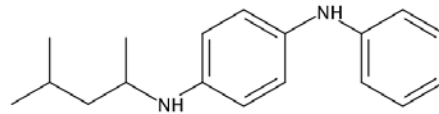
Hazard classification & labelling

HRMS NTS measurement intensity 6-PPD Chinon

$\beta = 0.01$, $p = 0.48$

fish species diversity
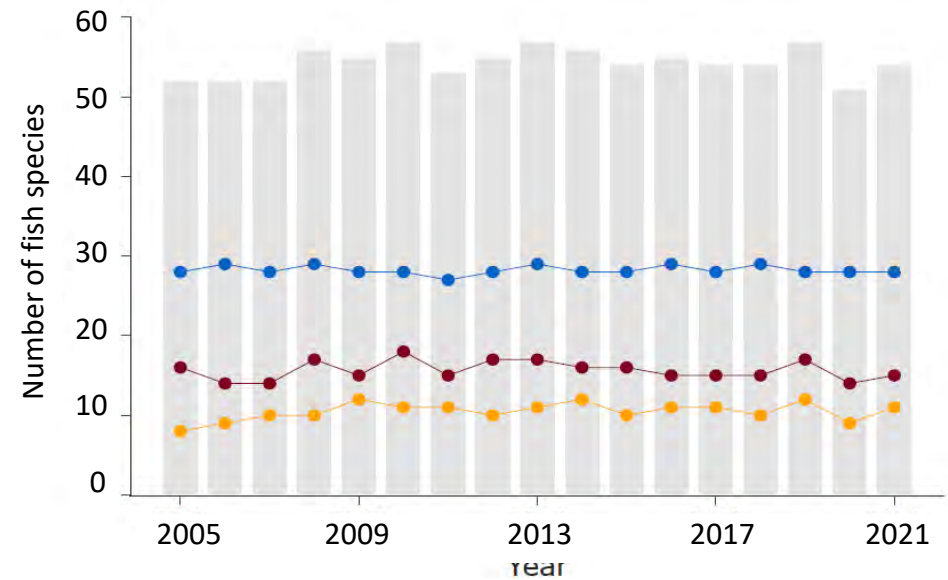
- all species
- common species
- invasive species
- red-list species