

**GERMAN**

**ENVIRONMENTAL SPECIMEN BANK**

**- *Concept* -**

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## I. CONCEPT OF THE ENVIRONMENTAL SPECIMEN BANK (ESB)

### 1. The Environmental Specimen Bank in the context of environmental monitoring

The transfer of the **precautionary principle** (under the aspect of sustainability and overall national government requirements) into practical federal environmental policy requires a corresponding scientific infrastructure, a comprehensive data base to facilitate identification and assessment of the current environmental situation, and a long-term observation of the chemical, physical and biological processes taking place in the environment with respect to space and time.

The distribution and transportation of substances released into the environment primarily depends on their physical/chemical properties and their stability. All these substances and their conversion products are found in ecosystems, sometimes in higher concentrations.

An **ecosystemic characterization** and evaluation of representative habitats within Germany – encompassing both the current situation and future development – will provide an important basis to ensure the prompt

- Identification of emerging **aberrations** within ecosystems
- Assessment of findings about the **nature and scope** of any aberrations arising and the consequences thereof (damages)
- Collation of findings to enable the **prioritisation of political action** by the Federal Government, and
- Formulation of a **precautionary policy** by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, both for nature and environmental conservation, and for human health.

As an important part of **environmental monitoring** the Environmental Specimen Bank provides a means of solving these tasks by supplying ecological and toxicological evidence in the form of archiving (i.e. storing in a manner which precludes chemical changes) representative soil, suspended matter, plant, animal and human specimens and performing initial characterization thereof.

## 2. Principles of the Environmental Specimen Bank

The Environmental Specimen Bank is essential to a comprehensive, inter-disciplinary improvement of the Federal Government's legal standards in the field of nature and environmental conservation, particularly for the purposes of:

- Establishment of maximum limits
- Efficiency control of the Federal Government's environmental protection, nature conservation and remediation mechanisms
- Prioritisation (precautionary measures)

Moreover, the Environmental Specimen Bank provides orientation for other environmental monitoring programmes (reference system). In future, it will acquire growing significance within the context of bilateral, multilateral and supranational cooperation.

### Definition:

**For the German ESB, ecologically representative environmental and human specimens will be collected, analysed for environmentally relevant substances, and stored.**

**Long-term storage is performed under conditions which exclude any change in composition or chemical properties over a period of several decades.**

**This archive retains specimens for retrospective analytical characterization concerning unpredictable questions which may arise in future.**

Although specimens being representative for a given ecosystem, will be analysed for around 60 environmental substances prior to storage (monitoring), the genuine value of the Environmental Specimen Bank is the storage of samples (**archive**) to serve as records for the conservation of ecotoxicological and toxicological evidence.

This facilitates retrospective determination of the concentrations or derivatives of substances which were not yet known, or could not be analysed, or were not considered to be important, at the time of sampling.

In order to attain a high level of quality assurance, all stages from sampling itself, to the transportation of specimens, the preparation and analysis of specimens, through to long-term storage, are set out in mandatory standard operating procedures (SOPs) for all types of environmental and human specimens.

At the same time a first step has also been accomplished to achieve a synecological survey and assessment of the state of the environment for estimating the environmental risk imposed by pollutants. This will create an opportunity for balanced political action based on the status of representative ecosystems.

The environmental specimens are obtained from representative areas (ecosystems); representative ecosystems from the terrestrial, limnetic and marine environment have been selected as examples. With regard to its entire composition each ecosystem is depicted by the biological, physical and chemical characterization of specimens taken from this system: producer, consumer, and decomposer (Annex 3).

Chemical characterization (initial analysis prior to storage) of the specimens provides an excellent chance of identifying pollutants at an early stage (monitoring) which would otherwise remain undetected until damage had become apparent.

Following a successful development and trial phase, expansion of the ESB to full-scale operation (14 representative ecosystems and 4 human-specimen sampling locations) started on 1 January 1994 in accordance with the phase plan listed below, which reflects the funding available:

### **Environmental field**

- 1994 - Wadden Sea Biosphere Reserve/National Park (Schleswig-Holstein/Lower Saxony)
  - Bodden National Park of Western Pomerania
  - River Elbe
  - Saarland conurbation
  - Dueben Heath
- 1995 - River Rhine
- 1996 - Upper Harz National Park (since 2006, Harz National Park<sup>1</sup>)
- 1997 - Bornhoeved Lake District
- 1998 - Berchtesgaden Biosphere Reserve/National Park
  - Bavarian Forest Biosphere Reserve/National Park (since 2006, Bavarian Forest National Park<sup>2</sup>)
- 1999 - Solling
- 2000 - Upper Bavarian Tertiary Uplands
- 2001 - Palatinate Forest Biosphere Reserve
- 2003 - River Danube

### **Human field**

- 1994 - Muenster University
- 1995 - Halle/Saale University
- 1996 - Greifswald University
- 1997 - Ulm University

<sup>1</sup> 01.01.2006: The Upper Harz and Harz National Parks were combined into Harz National Park. Sampling areas remain unchanged.

<sup>2</sup> 01.01.2006: Biosphere Reserve status was revoked. Sampling areas remain unchanged.

## II. IMPLEMENTATION OF THE CONCEPT

The Environmental Specimen Bank is operated according to defined "Standard operating procedures for the sampling, transportation, storage and chemical characterization of environmental and human specimens".

If the accompanying research reveals that a new procedure produces "better" results or requires less effort (cost saving), the guidelines should be altered accordingly. Alterations have to be approved by the Federal Environment Agency.

### 1. Representative sampling areas

#### 1.1 Environmental specimens

Sampling areas were determined by a combination of the following criteria:

1. **Regional representativeness**, in the sense that on the basis of the ecologically interpretable findings available, every sampling area should be deemed comparable with its wider landscape in as many static and functional biotope and biocoenosis structures as possible, and
2. **National representativeness**, as a cross-section of the principal types of ecosystem and ecosystem complexes in Germany which, when combined, should provide optimum informative value with respect to the environmental status and development in Germany, thanks to their geographical distribution and the way in which they complement functional system structures.

The outcome of the selection procedure is a network of ecologically representative areas which reflects the environmental situation in Germany and its development in space and time.

Furthermore, the following criteria should be taken into account when selecting geographical areas:

- Long-term utilisation consistency and stability
- Secured long-term studies (measuring facilities)
- Sufficient minimum size
- Availability of suitable specimen types and
- Accessibility and status of ownership.

The sampling areas should be reviewed at regular intervals in order to ensure future representativeness.

Development of the sampling areas must be monitored in order to

- Obtain information on the current status of areas and specimen types for the geographical information system and, based on this, data interpretation (e.g. location of polluters, changes in land use, exchange of information and data with other research projects)
- Adjust sampling plans towards the current status of areas and specimen types
- Plan and coordinate work in the sampling sites.



## Sampling areas (environmental field) for the Environmental Specimen Bank

Sampling area (current area designations)	Ecosystem type
Wadden Sea BR/NP (Schleswig-Holstein/Lower Saxony)	Marine ecosystem
Bodden NP of Western Pomerania	Marine ecosystem
Elbe	Riverine ecosystem
Rhine	Riverine ecosystem
Danube	Riverine ecosystem
Bornhoeved Lake District	Agrarian ecosystem
Upper Bavarian Tertiary Uplands	Agrarian ecosystem
Solling	Forestry ecosystem
Palatinate Forest BR	Forestry ecosystem
Saarland conurbation	Ecosystem close to conurbation
Dueben Heath	Ecosystem close to conurbation
Harz NP	Nearly natural terrestrial ecosystem
Berchtesgaden BR/NP	Nearly natural terrestrial ecosystem
Bavarian Forest NP	Nearly natural terrestrial ecosystem

BR = UNESCO Biosphere Reserve (MAB programme)

NP = National Park

### 1.2 Human specimens

Human being is part of his environment and is therefore also subject to the effects of his own influences. Today, however, due to mobility, changing conditions in the living environment and at work, and the distribution of food and consumption, modern man largely stands outside of ecosystemic representation. Therefore, an investigation of human specimens ascertains those influences which directly affect humans.

## **2. Representative functional sub-areas and sampling sites**

### 2.1 Environmental specimens

To ensure reliable sampling within the selected sampling areas, representative sites for sampling within those territories must be delimited and must be permanently and reliably available. Sampling sites are determined on the basis of water catchment areas to ensure compatibility with other ecological monitoring programmes abroad. A number of random samples collected within the selected sampling areas provide important information about:

- Homogeneity with respect to environmental chemicals and nutrient supply
- Delimitation of sub-sections within the sampling area which are characterised by a comparatively high level of homogeneity of ecological and environmental chemical parameters
- Specification of the number of random samples and sampling frequency required for routine operation.

By means of contractual provisions with the owners of the sampling sites, measures are taken to ensure that

- Access and sampling are permanently guaranteed and
- No changes are made to the sites which could endanger future sampling.

The federal states must ensure that sampling sites are excluded from any plans and developments which could pose a threat to the intended purpose of sampling.

### 2.2 Human specimens

Significant differences are not expected in the results originating from subjects of different habitats, apart from the situation in the New Laender. Therefore, a definition of sampling sites is omitted for human specimens. Nevertheless, the analysis and storage of human specimens remains a principal component of the Environmental Specimen Bank, because the policy of reducing pollutants is qualitatively and quantitatively reflected in human specimens as well as environmental specimens.

## **3. Representative specimen types**

The selection of specimen types for the Environmental Specimen Bank begins with the requirement to representatively record substance discharges into the respective ecosystems or the human organism, together with key substance distribution and conversion processes taking place, using the information obtained from the specimens. The specified specimen types represent an optimised minimum set which should be sampled as fully as possible throughout all sampling sites in order to emulate the substance cycle.

### 3.1 Environmental specimens

For each sampling area, a set of specimen types is drawn up encompassing the environmental media and organisms from the various levels of the materials flow.

The specimen types from the various trophic levels should satisfy the following criteria equally well:

- Wide prevalence
- Wide ecological valency
- Sufficient availability
- Indicator function for ecosystem-typical processes
- Loyalty to a certain region or habitat
- Genetic identity
- High level of information
- Sufficient resistance to pollutants
- Sufficient exposure to pollutants
- Reliable and assured identification

Each set of specimen types is based on a two-phase structure:

1. Set of widespread species which are available in all sampling areas (as far as possible)
2. Ecological replacements for the species cited under 1. in areas where they do not occur; these "replacement species" must have corresponding indicator functions for the respective ecosystem as ecosystem-typical species.

This supports comparison between given contamination states of the individual sampling areas (spatial comparison) and a precise description of the total contamination of each sampling area over a temporal axis (identification of trends).

### 3.2 Human specimens

The selection of human specimens is derived from current toxicological knowledge, particularly analytical experiences gleaned during the "Environmental Specimen Bank" pilot project. The following criteria were used as a basis:

- An opportunity for complete anamnestic recording of all life data
- Exclusion/selection of subjects to answer special questions in anamnestically identifiable specific and/or increased levels of contamination due to exposure at the workplace
- Exclusion/selection of subjects to answer special questions in the case of existing chronic diseases, particularly metabolic diseases

Specification of the individual specimen types shall be binding.

## 4. Sampling

Sampling is regulated by prescribed sampling timetables and by standard operating procedures.

For all matrices, correspondingly detailed information has been recorded in the standard operating procedures.

### 4.1 Documentation

Sampling must be comprehensively recorded in the data sheets. The sample data sheets accompany the specimen from sampling, to transportation and (if necessary) interim storage, specimen preparation, analysis and evaluation, through to final storage.

### 4.2 Statistics

A sampling programme must be drawn up prior to sampling, containing statistical data on the spatial and temporal dimension, in order to facilitate the mathematical logging of both natural inhomogeneities arising during sampling, as well as any systematic errors occurring during sampling. These sampling programmes should be documented and given as binding in the standard operating procedures.

### 4.3 Sampling frequency

The sampling frequency and the mass of individual specimen will be adapted to the requirements and possibilities for each specimen type once the initial values have been statistically validated.

#### 4.3.1 Environmental specimens

Principally, sampling should take place annually, at the same time of year. It is possible to deviate from this principle if it is ascertained, either now or after the expiry of 5 years, that sampling is taking place in a particularly "sluggish" ecosystem, or that the external changes (input and discharge) are expected to be more or less constant. In such cases, sampling will be extended to a two-year cycle. Sampling of soil will take place every 4 years.

The sampling frequency (including the number of specimens and their mass) must be based on the ecological and analytical requirements so as to ensure that the results provided are statistically validated. The "Sampling plan of the Environmental Specimen Bank" is binding (see Annexes 1 and 2).

#### 4.3.2 Human specimens

Since 1997, specimens have been taken from living persons in order to ascertain normal body burden and their dependency on time. These specimens are analysed and stored in a change-free environment (real-time monitoring – RTM).

The selection of student RTM groups ensures nationwide representation of average (and not identifiably specific) contamination levels amongst the German population.

The student groups each comprise 100-150 participants (sex ratio approximately 1:1), approximately 90% of whom belong to the 20-29 age group.

## **5. Transportation of specimens**

The specimen collectors use suitable sampling vehicles which meet the requirements of the standard operating procedures in terms of sample volume and cooling during transportation.

During transportation, the specimens obtained must not undergo any chemical changes compared with the chemical status at the time of sampling.

The institutes involved, in collaboration with the Federal Environment Agency, have set out binding requirements for specimen transport in the standard operating procedures.

## **6. Specimen characterization**

Specimen analysis is preceded by specimen preparation. Specimen preparation is carried out in a manner which either precludes changes to the anticipated original value, or such that the scope and nature of any such changes can be estimated; the binding procedures are set out in the standard operating procedures.

The substances under investigation are representatives for substances or substance groups which either describe the basic physiological status or toxic or carcinogenic conditions. The specified substances represent substance groups thought to have health significance.

In accordance with scientific progress, other substances may be included in future studies if they are suspected of having or promoting eco-toxicological, human-toxicological or carcinogenic properties. The inclusion of new substances requires the written consent of the Federal Environment Agency.

The analysis of specimens shall take place in accordance with the procedures outlined in the standard operating procedures.

Overview of substances to be routinely examined for the Environmental Specimen Bank (analysis prior to storage)		
Human specimens	Matrix	Analysis of
	Whole blood Blood plasma 24-hour urine Scalp hair	1. Organic substances 1.1 Organochloric compounds  HCB PCB 138, PCB 153, PCB 180 Pentachlorophenol (PCP)  2. Inorganic substances  Arsenic.....As Lead.....Pb Cadmium ..... Cd Calcium..... Ca Copper ..... Cu Magnesium ..... Mg Mercury..... Hg Strontium ..... Sr Zinc.....Zn
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Environmental specimens	Common mussel Eelpout (muscle and liver) Herring gull egg Zebra mussel Bream (muscle and liver) Earthworm Roe deer (liver) Domestic pigeon egg Suspended matter Soil	1. Organic substances 1.1 Organochloric compounds  Aldrin Dieldrin $\alpha$ -HCH, $\beta$ -HCH, $\gamma$ -HCH HCB Heptachlorine (HC) Heptachlorepoxyde (HE, cis + trans) Octachlorostyrene (OCS) 2,4'-DDT, 4,4'-DDT, 4,4'-DDE, 4,4'-DDD PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180 Pentachlorobenzene
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	Common bladder wrack Common mussel Zebra mussel Spruce/pine shoots Lombardy poplar/beechn leaves Earthworm Suspended matter Soil	1.2 Polycyclic aromatic hydrocarbons  Anthanthrene Anthracene Benz[a]anthracene Benzo[a]pyrene Benzo[b,j,k]fluoranthene Benzo[b]naphto[2,1-d]thiophene Benzo[e]pyrene Benzo[ghi]fluoranthene Benzo[c]phenanthrene Benzo[ghi]perylene Chrysene+triphenylene Coronene Dibenz[a,h]anthracene Fluoranthene Indeno[1,2,3-cd]pyrene Phenanthrene Pyrene

Continued from page 2	<p>Common bladder wrack Spruce/pine shoots Lombardy poplar/beech leaves</p> <hr/> <p>Zebra mussel Common mussel Roe deer (liver)</p> <hr/> <p>Earthworm</p> <hr/> <p>Bream (musculature) Eelpout (musculature) Herring gull egg</p> <hr/> <p>Domestic pigeon egg</p> <hr/> <p>Suspended matter Soil</p>	<p>2. Inorganic substances</p> <p>Arsenic.....As Barium .....Ba Cadmium .....Cd Cobalt .....Co Chromium .....Cr Copper.....Cu Iron .....Fe Mercury.....Hg Magnesium .....Mg Manganese .....Mn Nickel.....Ni Lead.....Pb Sulphur .....S Selenium .....Se Thallium .....Tl Zinc.....Zn</p> <hr/> <p>Arsenic.....As Cadmium .....Cd Cobalt .....Co Copper.....Cu Mercury.....Hg Methyl mercury ..... Me-Hg Nickel.....Ni Lead.....Pb Selenium.....Se</p> <hr/> <p>Calcium.....Ca Cadmium .....Cd Cobalt .....Co Mercury.....Hg Potassium .....K Magnesium .....Mg Phosphorous.....P Sulphur .....S</p> <hr/> <p>Arsenic.....As Copper.....Cu Mercury.....Hg Lead.....Pb Selenium.....Se Thallium .....Tl</p> <hr/> <p>Copper.....Cu Mercury.....Hg Lead.....Pb Selenium.....Se</p> <hr/> <p>Arsenic.....As<sup>1</sup> Cadmium.....Cd<sup>2</sup> Cobalt .....Co<sup>2</sup> Chromium.....Cr<sup>2</sup> Copper.....Cu<sup>2</sup> Iron.....Fe<sup>2</sup> Mercury.....Hg Nickel.....Ni<sup>2</sup> Phosphorus.....P<sup>1</sup> Lead.....Pb Selenium.....Se<sup>1</sup> Thallium.....Tl<sup>1</sup> Zinc.....Zn<sup>2</sup></p>
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<sup>1</sup> only in suspended matter

<sup>2</sup> in NH<sub>4</sub>NO<sub>3</sub> and aqua regia extract as prescribed by the Federal Soil Protection and Contaminated Sites Ordinance

## 7. Quality assurance

Quality control in the laboratory comprises internal and external controls. Around 30% of a laboratory's work should be devoted to quality assurance.

### 7.1 Intra-laboratory quality assurance

The institutes involved are obliged to carry out internal quality assurance measures at regular intervals.

Internal controls shall comprise the following:

- Control of the reproducibility of a measurement station's results (functional control) by means of repeated measurements at periodic intervals on the same samples under identical measurement conditions. This facilitates the identification of random errors (precision control).
- The correctness of a method (accuracy control) is controlled by means of repeated measurements on standard samples
- Regular control of the "zero effect" of a measurement arrangement. If necessary, these controls should be carried out with blank samples under the same conditions as when creating a measurement preparation; where applicable, it may be necessary to carry out the entire chemical separation process.

### 7.2 Inter-laboratory quality assurance

Round robins involving several laboratories and comparison measurements between two laboratories can yield hints to possible biased errors in a given laboratory. Round robins and comparison measurements are mandatory for the institutes involved.

### 7.3 Documentation

The institutes involved are obliged to document regular performance of internal and external quality controls and to submit proof of this annually to the Federal Environment Agency.

The documentation must disclose the results and experimental conditions, and must cite the names of all participants.

### 7.4 Statistics

The data obtained when measuring substance concentrations in the individual environmental fields should be documented and summarised on the basis of standardised aspects. This will provide a series of measurements which were measured at different sampling stations at different times and by several different laboratories. In the case of single measurement results, the fluctuation range should be characterised by the statistical uncertainty of the measurement technique.



## 8. Storage

Following technical preparation in the laboratory, the specimens are divided into approximately 200 sub-specimens, analysed and then placed in deep-freeze storage facilities which largely excludes the possibility of retrospective chemical changes to the specimen characteristics. This technique is outlined in separate standard operating procedures.

### 8.1 Storage facilities

Storage capacity approximately equivalent to the volume of the annual programme should always be kept on hand in case it becomes necessary, in exceptional situations, to store specimens from special programmes.

The technical details of storage, the storage facility itself and the removal of specimens from storage is documented in a separate standard operating procedure.

Sufficient cooling capacity (reserve) should be provided.

### 8.2 Parallel storage facilities

Stored specimens are a very valuable resource. Despite the fact that extensive back-up reserves should be provided, it is impossible to exclude the possibility that a storage facility's stock could be at risk from unauthorised interference or possible accidents. For this reason, the environmental specimen's storage facility and the human specimens storage facility will each keep 15% of a given year's samples at a different location.

## 9. Documentation

The entire procedure, from extraction of a specimen to evaluation and assessment of the results, should be documented in detail. Only in this way is it possible to ensure consistency of the parameters on which the result was based during subsequent retrospective investigations. At the same time, this documentation forms the basis for required reports by the Environmental Specimen Bank.

### 9.1 Reports

The institutes involved will submit a summarising annual report on the previous year's results by **15 April**, based on a format to be prescribed by the Federal Environment Agency.

The Federal Environment Agency will summarise these reports and submit them by **5 June** each year, in the form of an annual report on the Environmental Specimen Bank with an evaluation to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Moreover, the Federal Environment Agency, in collaboration with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the institutes involved, shall publish the results of the two preceding years in the form of a biennial report. The Federal Environment Agency shall ensure that the biennial report is published by **1 October** of every even year.

The Federal Environment Agency shall report any significant findings immediately to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

## 9.2 Representation

The reports should reflect all the individual results; time-dependency diagrams should also be used. Wherever possible, the accounts should include and explain the ecological processes and all significant factors, and should be intelligible to the general public as far as possible.

The Federal Environment Agency shall specify binding formats for electronic data processing of the reports and the accounts contained therein.

## 9.3 Assessment

The reports should be formulated in such a way as to provide the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety with information about any emerging aberrations of the ecosystems and any risks to human health, and to provide the general public with an overview of the environment's status on the basis of representative examples.

The assessment should elucidate the situation from both an autecological and a synecological viewpoint. The institutes involved shall participate in the assessment.

## 9.4 References to other Federal Government surveys

Where deemed scientifically expedient, the Federal Environment Agency shall include references to other Federal Government surveys (such as the Federal Environment Agency measurement network), particularly for a co-ordinated assessment of the data obtained in one year. Moreover, and in particular, results from the Federal Government's ecosystem research (the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry of Education and Research) shall also be taken into account. For this purpose, however, only data taken from comparable locations and/or which may be useful for explaining related findings will be taken into account.

## **10. Regulations for use**

The samples obtained, the analysis data gleaned and the evaluations of individual specimens shall be the property of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and, generally speaking, shall be solely available to the Ministry itself for the purposes of retrospective analysis. However, individual specimens may be given to third parties, provided this does not conflict with the Federal Government's interests, and as long as these are specimens which can be removed and the enquiring institute is considered to be an analytically qualified laboratory.

### 10.1 Retrieval and use of specimens

Apart from the purposes of retrospective studies, stored specimens may also be used for round robins and comparative measurements, provided they involve the institutes of the Environmental Specimen Bank.

### 10.2 Use of data

The data obtained from the measurement programmes of the Environmental Specimen Bank shall be used for an ecosystemic representation of the environmental situation, as reference values for the federal states authorities, and for the purposes of international data exchange.

### 10.3 Release of data

According to the Environmental Information Act (implementation of Council Directive 90/313/EEC of 7 June 1990 on the freedom of access to information on the environment), as a general principle, the data shall be available to anyone having a justified interest. The Federal Environment Agency shall be responsible for the release of data and shall also provide information about the data's synecological context.

### 10.4 Fees for external users

Fees for the supply of information should reflect the material costs (copies etc.). Fees for the release of sub-specimens from the store must be based on the amount of effort involved. The "Rules for the provision of specimens and data from the ESB and for the processing of inquiries to the ESB" shall form the basis of this.

### 10.5 Data protection

The provisions of the Federal Data Protection Act of 20 December 1990 and the "Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data" (European Council, 28 January 1981) shall be met.

## 11. Accompanying research

The rapidly-changing situation in both the biotic and the abiotic environment on the one hand, and progress in scientific methods and equipment on the other, necessitate accompanying research. This will ensure that, despite changing conditions, the correct specimens for the Environmental Specimen Bank can still be recorded, documented and evaluated to optimum effect.

### 11.1 Review of sampling sites

All sampling sites should be reviewed with respect to their suitability at suitable intervals. The results shall be forwarded to the Federal Environment Agency together with an evaluation which should also – if necessary – contain details of a suitable alternative. Upon application, the Federal Environment Agency shall issue a written decision on the use of new sampling sites.

### 11.2 Special programmes for the conservation of evidence in case of extraordinary, non-routine situations

Whilst the routine programme addresses possible chronic changes in the environmental situation, special programmes may be implemented in order to conserve ecological evidence in extraordinary situations, such as floods. .

The adoption of a special programme is subject to the written consent or written request of the Federal Environment Agency following prior consultation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

### 11.3 Fingerprint analysis

Based on the current concept, which envisages specimen characterization of the compound categories outlined, the environmental policy objectives of the Environmental Specimen Bank can only be realised by expanding the range and number of such compounds. One particularly crucial factor is that this allows substances to be included in the studies which may have an – as yet unknown – significance. The technical, i.e. instrumental opportunities for a multi-component analysis of this kind (fingerprint analysis) are available in principle, but need to be adapted to the specific scientific requirements of the Environmental Specimen Bank.

The introduction of "screening analyses" must also be considered from the same aspect. Screening analyses are intended to facilitate simple yes/no decisions regarding the presence or absence of entire groups of pollutants.

### 11.4 Methodological development

The analytical techniques for routinely identified substances must be continuously adapted in line with the latest state of the art in order to optimise precision, accuracy, sample throughput and – if necessary – powers of detection and blank readings.

### 11.5 Review of specimen types

The informative value of the specimen types collected must be reviewed in the light of the aims of the Environmental Specimen Bank. To this end, separate investigations are necessary so as to eliminate certain specimen types, where appropriate, and introduce new ones felt to be more suitable.

### 11.6 Durability studies

Although, in principle, cryo-storage is expected to ensure long-term stability, investigations into the stability of certain chemical substances and also on the general behaviour of materials at low temperatures are needed.

### 11.7 Reference materials

The high requirements (long-term precision) placed on the data from the Environmental Specimen Bank materials may lead to some new analytical concepts. Apart from the instrumental component, this also produces innovations vis-à-vis reference materials, which must be extremely homogeneous, largely matrix-identical, and hence left in their "natural state" for the purposes of quality control and the development of new methods.

### 11.8 Retrospective investigations

Retrospective analyses have to be performed on stored samples to answer current scientific questions.

## 12. Information system for the Environmental Specimen Bank

A cross-media, integrated evaluation of the state of the environment requires the integration of all data and information from routine operation of the Environmental Specimen Bank. For this purpose, a centralised and computerised information system was established for uniform data collection, storage, maintenance and processing, taking into account the necessary data security aspects.

The task of this information system is to make all surveys arising during routine operation of the Environmental Specimen Bank available in the form of an overall system for current access, to provide comprehensive documentation, and to make them available for retrospective studies.

The information system is set up in such a way that it is possible to

- Record and process quality-tested data and information from every relevant phase, from sampling, specimen transportation and analysis, to storage and delivery of the specimens, according to the responsibilities of the institutes involved, and to make such data and information available for the purposes of evaluation
- Include explanatory texts (e.g. standard operating procedures, details of sampling plans, territory descriptions) into the information system
- Link factual data with geographical allocation
- Set up interfaces to a geographical information system and hence portray, evaluate and transmit surveys in their ecosystemic context
- Exchange data and network with other systems managing status data
- To prepare and transmit required reports in a timely manner.

Networking of the institutions involved, and the permanent operation of the common information system are basic prerequisites for continuous updating of the data and their evaluation in an ecosystem context.

The results of the Environmental Specimen Bank must be made freely accessible to a broad range of users via the Internet.

## Annex 1: Principles of the ESB sampling plan for environmental specimens

- (1) The specified sampling dates should be viewed as the norm, from which deviations may arise depending on the weather conditions. The regional-specific climatic situation must also be taken into account.
- (2) The sampling quantities should be seen as targets which cannot always be met for a number of reasons (climate, weather, population fluctuations etc.). Particularly in cases of population decline, the storage of smaller quantities and protection of the remaining population for future sampling may be of equal importance.
- (3) With sampling generally taking place once a year, the respective sampling sites must be carefully chosen to ensure that they are of a sufficient size to avoid endangering the local population as a result of sampling.
- (4) **One-year-old shoots from coniferous trees** are collected each year (depending on the weather conditions and sampling area) in the first sampling period from March to the end of May (before the start of sprouting).
- (5) Sampling of leaves of **deciduous trees** takes place once a year in late summer before the leaves start to colour, generally from August to mid-September.
- (6) Sexually mature **earthworms** are collected in the autumn (October to December).
- (7) Sampling of **roe deers** takes place once a year. Livers are taken from yearlings in spring (May to late June).
- (8) **Eggs from domestic pigeons** are only collected during the main laying period (March to August).
- (9) **Soil** sampling takes place every four years during September/October.
- (10) **Zebra mussels** are collected from September to the end of November (depending on the waterbody in question), where possible after the last spawning. At locations where there is neither natural colonisation of existing substrates nor colonisation of the exposure plates additionally mounted by the ESB, the plate stacks are placed in Lake Constance for prior colonisation.
- (11) **Bream** are sampled in late summer (August and September) once the spawning period is over.
- (12) For **suspended matter**, a homogeneous annual sample is prepared from 12 individual monthly samples.
- (13) **Common bladder wrack** is collected at two-month (Wadden Sea Biosphere Reserve/National Park, from February) and half-yearly (Bodden National Park of Western Pomerania, in June and November) intervals. These intervals have been found to be favourable, due to the seasonal variation in pollutants in the thallus. At the end of the year, the individual samples are combined into an annual sample.
- (14) For the reason cited in point (13), **common mussels** are collected at two-month (Wadden Sea Biosphere Reserve/National Park, from February) and half-yearly (Bodden National Park of Western Pomerania, in June and November) intervals. At the end of the year, the individual samples are combined into an annual sample.
- (15) **Eelpouts** are collected once a year in early summer (May to June), before the mating period, in the Wadden Sea and in the Baltic Sea.
- (16) Sampling of **herring gull eggs** takes place once a year during the main breeding period in April/May.

## Annex 2: Annual programme for the collection of environmental specimens

Sampling area	FSA	SS	Specimen type	Hom.	02	03	04	05	06	07	08	09	10
Wadden Sea BR/NP (Schleswig- Holstein)	1	1	Common bladder wrack	1	X	X	X	X	X	X	X	X	X
	1	1	Common mussel	1	X	X	X	X	X	X	X	X	X
	1	1	Eelpout <sup>3)</sup>	2	X	X	X	X	X	X	X	X	X
	1	1	Herring gull	1	X	X	X	X	X	X	X	X	X
Wadden Sea BR/NP (Lower Saxony)	1	1	Common bladder wrack	1	X	X	X	X	X	X	X	X	X
	1	1	Common mussel	1	X	X	X	X	X	X	X	X	X
	1	1	Eelpout <sup>3)</sup>	2	X	X	X	X	X	X	X	X	X
	1	1	Herring gull	1	X	X	X	X	X	X	X	X	X
Bodden NP of Western Pomerania	1	1	Common bladder wrack	1	X	X	X	X	X	X	X	X	X
	1	1	Common mussel	1	X	X	X	X	X	X	X	X	X
	1	1	Eelpout <sup>3)</sup>	2	X	X	X	X	X	X	X	X	X
	1	1	Herring gull	1	X	X	X	X	X	X	X	X	X
Elbe	3	3	Zebra mussel	3	X	X	X	X	X	X	X	X	X
	5	5	Bream <sup>3)</sup>	10	X	X	X	X	X	X	X	X	X
Rhine	4	4	Zebra mussel	4	X	X	X	X	X	X	X	X	X
	4	4	Bream <sup>3)</sup>	8	X	X	X	X	X	X	X	X	X
			Suspended matter	4				X	X	X	X	X	X
Danube	3	3	Zebra mussel	3		X	X	X	X	X	X	X	X
	3	3	Bream <sup>3)</sup>	6		X	X	X	X	X	X	X	X
			Suspended matter <sup>5)</sup>										
Bornhoeved Lake District <sup>1)</sup>	1	1	Spruce	1		X		X		X		X	
	1		Beech	1		X		X		X		X	
			Roe deer <sup>2)</sup>	2/1		X		X		X		X	
	1		Domestic pigeon	1		X		X		X		X	
	1	1	Earthworm	1		X		X		X		X	
	1	1	Zebra mussel	1		X		X		X		X	
	1	1	Bream <sup>3)</sup>	2		X		X		X		X	
1	1	Soil	2	X					X			X	
Upper Bavarian Tertiary Uplands <sup>1)</sup>	1	1	Spruce	1	X		X		X		X		X
	1	1	Beech	1	X		X		X		X		X
			Roe deer <sup>2)</sup>	2/1	X		X		X		X		X
	1	1	Earthworm	1	X		X		X		X		X
	1	1	Soil	2	X		X		X		X		X
Solling <sup>1)</sup>	1	1	Spruce	1		X		X		X		X	
	1	1	Beech	1		X		X		X		X	
			Roe deer <sup>2)</sup>	2/1		X		X		X		X	
	1	1	Earthworm	1		X		X		X		X	
	1	1	Soil	2	X		X		X		X		X

Palatinate Forest BR <sup>1)</sup>	1	1	Spruce	1		X		X		X		X	
	1	1	Beech	1		X		X		X		X	
			Roe deer <sup>2)</sup>	2/1		X		X		X		X	
	1	1	Earthworm	1		X		X	X	X		X	
	1	1	Soil	2	X				X	X			X

Sampling area	FSA	SS	Specimen type	Hom.	02	03	04	05	06	07	08	09	10
Saarland conurbation <sup>4)</sup>	2/1	2/1	Spruce	2/1	X	X	X	X	X	X	X	X	X
	1	5	Lombardy poplar	1	X	X	X	X	X	X	X	X	X
	2/1		Roe deer <sup>2)</sup>	4/1	X	X	X	X	X	X	X	X	X
	1	3	Domestic pigeon	1	X	X	X	X	X	X	X	X	X
	1	5	Earthworm	1	X	X	X	X	X	X	X	X	X
	1	2	Zebra mussel	2	X	X	X	X	X	X	X	X	X
	1	2	Bream <sup>3)</sup>	4	X	X	X	X	X	X	X	X	X
	2	2	Suspended matter	2				X	X	X	X	X	X
	2	2	Soil	4	X				X				X
Dueben Heath	1	5	Pine	1	X	X	X	X	X	X	X	X	X
	1	6	Lombardy poplar	2	X	X	X	X	X	X	X	X	X
	1		Roe deer <sup>2)</sup>	2/1	X	X	X	X	X	X	X	X	X
	1	2	Domestic pigeon	2	X	X	X	X	X	X	X	X	X
	1	4	Earthworm	2	X	X	X	X	X	X	X	X	X
		2	Bream <sup>3)</sup>	4	X	X	X	X	X	X	X	X	X
	2	2	Suspended matter	2				X	X	X	X	X	X
	2	2	Soil	4	X				X				X
Harz NP	1	1	Spruce	1	X	X	X	X	X	X	X	X	X
	1	1	Beech	1	X	X	X	X	X	X	X	X	X
			Roe deer <sup>2)</sup>	2/1	X	X	X	X	X	X	X	X	X
	2	2	Soil	4	X				X				X
Berchtesgaden BR/NP <sup>1)</sup>	1	1	Spruce	1		X		X		X		X	
	1	1	Beech	1		X		X		X		X	
			Roe deer <sup>2)</sup>	2/1		X		X		X		X	
	1	1	Soil	2	X				X				X
Bavarian Forest NP	1	1	Spruce	1		X	X	X	X	X	X	X	X
	1	1	Beech	1		X	X	X	X	X	X	X	X
			Roe deer <sup>4)</sup>	2/1		X	X	X	X	X	X	X	X
	1	1	Soil	2	X				X				X

### Key

<sup>1)</sup> Sampling at 2-year intervals

<sup>2)</sup> From 2007, 1 homogenate per functional sub-area (FSA)/sampling site (SS) from yearlings; fawns have been deleted

<sup>3)</sup> For eelpout and bream, homogenates are prepared from the musculature and liver

<sup>4)</sup> From 2007, deletion of one sampling site (Saarkohlewald)

<sup>5)</sup> under preparation



**Annex 3 – Specimen types and their ecosystems**

Ecosystem	Primary producer	Consumer		Decomposer	Medium
		Filter feeder	Omnivore		
Marine ecosystems	Common bladder wrack (thallus)	Common mussel (soft body part)	Eelpout (muscle, liver) Herring gull (egg)		
Riverine ecosystems		Zebra mussel (soft body part)	Bream (muscle, liver)		Suspended matter (1-year cumulative sample)
		Herbivore	Granivore	Saprovore	
Forest ecosystems	Spruce (1-year-old shoots) Beech (leaves)	Roe deer (liver)		Earthworm (after defaecation)	Soil (mineral soil and humic layer)
Nearly natural terrestrial ecosystems	Spruce (1-year-old shoots) Beech (leaves)	Roe deer (liver)			Soil (mineral soil and humic layer)
Agrarian ecosystems	Spruce (1-year-old shoots) Beech (leaves)	Zebra mussel (soft body part) Roe deer (liver)	Bream (muscle, liver) Domestic pigeon (egg)	Earthworm (after defaecation)	Soil (mineral soil and humic layer)
Ecosystems close to conurbation	Spruce/pine (1-year-old shoots) Poplar (leaves)	Zebra mussel (soft body part) Roe deer (liver)	Bream (muscle, liver) Domestic pigeon (egg)	Earthworm (after defaecation)	Suspended matter (1-year cumulative sample) Soil (mineral soil and humic layer)

## **Annex 4 - Rules for the provision of specimens and data from the German ESB and for the processing of inquiries to the German ESB**

### **1. Provision of sub-specimens**

The provision of sub-specimens from the German ESB is subject to the following conditions:

- 1.1 Provision may only take place in justified cases; particular conditions to be observed include, for example:
  - the envisaged investigations must serve special purposes of environment, nature and health protection,
  - the specimens may not serve to replace standard reference materials (SRMs),
  - they may not serve as test material in the development of analytical procedures,
  - nor as starting material for the manufacture of biochemical products on a commercial scale.
- 1.2. The provision as well as the passing on of sub-specimens requires the written consent of the Federal Environment Agency.
- 1.3. The provision of excess material takes place on the basis of a public announcement. If the demand exceeds the stock of excess material, it shall be up to the Federal Environment Agency to decide on priorities.
- 1.4. Special reasons must be given for the provision of sub-specimens in amounts lower than the minimum quantity of 60 sub-specimens per year, and doing so requires the consent of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.
- 1.5. An exclusion of liability for the sub-specimens provided shall be agreed.
- 1.6. Provisions must be made to ensure the protection of data in accordance with the Federal Data Protection Act of 20 December 1990 or the Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data (Council of Europe, 28 January 1991); in particular, no personal data relating to sub-specimens provided must be disclosed unauthorised.
- 1.7. The provision of sub-specimens is carried out on behalf of the Federal Environment Agency by the contracting institution where the sub-specimens to be provided are stored.
- 1.8. Sub-specimens are delivered at the basic price of:
  - 335 € per sub-specimen (environmental specimens)
  - 160 € per sub-specimen (human specimens).

The prices are quoted ex repository. In addition, the distribution costs associated with the provision of the sub-specimen(s) (e.g. personnel costs, other expenditures, cost of organising a cooling chain where necessary) have to be taken into account.
- 1.9. The proceeds from the sale of sub-specimens shall be allocated to chapter 1602, item 119 99.
- 1.10. In particular cases – especially such expecting considerable results – specimen delivery is free-of-charge; reservedly the agreement of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.
- 1.11. The data and findings obtained in the analysis of the sub-specimen(s) shall be made available to the database of the Federal Government's Environmental Specimen Bank and, in so doing, detailed information shall be given on the methods used.

## **2. Provision of data**

- 2.1 Access to data from the German ESB is subject to the provisions of the Environmental Information Act (UIG).
- 2.2 The Federal Environment Agency will furnish data to be provided with information on the ecological context.
- 2.3 Applicants shall be charged, in accordance with the fee schedule of the Environmental Information Act, for the administrative cost (personnel cost, other expenditures) associated with provision of the data.