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CHLORINATED HYDROCARBONS IN THE ENVIRONMENT – MONITORING AND EFFECT MONITORING

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Introduction

According to the "European Inventory of Existing Commercial Substances" EINECS (after GDCh/BUA) [1], more than 100.000 different chemical substances are produced worldwide. 1000 to 2000 new chemicals are entering the market every year in addition to those already in circulation. For most of them we lack sufficient information about their effects on man, animals and plants and about their further reaction and fate in the environment (2). New technologies always produce unintended and unpredicted waste and impact. According to the single integrated EU waste list (CD 2000/532/EC, COM 2000) 347 final, COM (2001)216 final), the majority of waste from organic chemical processes (code 07) and significant part of waste from inorganic chemical processes (code 06) is considered as a hazardous waste. A large number of European Community legislation in force and in preparation is focused on various chemical waste and waste chemicals. It can be found in the EUR-Lex register 15.10.30.30. "Waste Management and clean technology", internet site: http://www.europa.eu.int/eur-lex/en/lif/reg/en register 15103030.html.

Usually the introduction of chemicals into the environment represents an irreversible step. A considerable number of chemicals reaching the environment do not degrade or only very slowly. They accumulate in the environment and, having distributed, become ubiquitous of certain pollutants e.g. PCBs, herbicides, chlorinated insecticides. Persistent biologically active chemicals, even at concentrations below our ability to analyze or detect, can pose serious pervasive and possible irreversible threats to human health and the integrity of the biosphere (3).

Numerous industrial countries have passed laws to assess the hazards of chemicals for man and the environment. EU legislation on chemicals is collected in the register EUR-Lex 15.10.20.50 "Chemicals, industrial risk and biotechnology" in the internet site

h:http://www.europa.eu.int/eur-lex/en/lif/reg/en register 15102050.html.

Among others, it comprise the Council Directive 76/769/EEC (1976) relating to the restrictions on the marketing and use of certain dangerous substances and preparations, with numerous amendments, the last one of 1999 (OJ L 207.06.08.1999 p.18), as well as three lists of priority substances established by commission Regulations (EC) No 1179/94 (1994), No. 2268/95 (1995) and No 143/97 (1997) as foreseen under Council Regulation (EEC) No 793/93 (1993). The principles for assessment of risks to man and environment of different chemicals were laid down in Commission Directive 93/67/EEC (1993), Regulations (EC) No 1488/94 (1994), as well as in Commission recommendations 1999/721/EC (1999) and C (2001) 439 of March 2001.

Living organisms and their associations, are enormously heterogeneous, complex and open systems characterized by poorly defined boundaries. Under the best circumstances, we can evaluate most quantitative features of biological systems only for certain properties and only by using certain samples or subsets of the class. Results are always statistical in nature and extrapolation from the sample to the class is necessary. Many environmental factors that cannot be reproduced or represented in the laboratory or by models can modify the environmental behaviour and effects of chemicals. The error in forecasts based upon trend extrapolations, without knowing the relationships of environmental variables may become enormously enlarged with time. Recognizing the actual form of a trend among reasonable alternatives is difficult and often subjective. Thus, the level of uncertainty of most forecasts and assessment of chemical impacts upon man and the environmental is often quite high. Even today, we repeatedly confront serious and unexpected consequences of our technologies, products and wastes. Politicians can only develop effective damage protection and risk contaminant strategies, if they have reliable scientific information available.

So, these problems are resulting in a lack of knowledge regarding damages in environ-

29

ment, human health risks, incorrect assessments and predictions. Persistent organic pollutants (POP'S) are still under discussion, especially halogenated organic pollutants (4).

Effective damage protection and risk contaminant strategies can only be developed by policy makers if they have reliable basic informations on chemical disposal.

So, after ca. 30 years discussion on POP's in the environment in 1998 valid definition was made as follows (UN ECE):

POP's are
·   chemicals with potential for long range atmospheric transport
·   chemicals with relatively high environmental persistency (eigher half-live
·   in water>2 month or half-live in soils or sediments>6month)
·   chemicals which can be bioaccumulated (log Kow>5 or fish/water bioconcentration factor >5000)

Three years ago UNEP started a global survey on POP's in the environment following the so-called "Stockholm convention" on the protection of human health and the environment from POP's

·   by getting rid of existing POP's
·   by avoiding further production and use of POP's
·   by minimising emissions of POP's which can't be eliminated

The idea that organisms can provide an indication of the quality of their environment is widespread and at least as old as agriculture (5). It is not possible to establish any clear definition for the term "bioindicatior" considering the large number of literature published in the last decades. The following definitions are suggested congruenting to many European authors (6):

·   Bioindication is the use of an organism (a part of an organism or a society of organisms) to obtain information on the quality (of a part) of its environment. Organisms which are able to give information on the quality (of a part) of its environment are bioindicators.
·   Biomonitoring is the continuous observation of an area with the help of bioindicators, which in the case may also be called biomonitors. With the aid of or-

ganisms trends in time and space concerning the distribution and ecological effects of environmental chemicals can be observed by a semi-quantitative evaluation of the results.

Biological samples from the environment are mainly used and analysed as representatives for larger entities or similar or related environmental compartments. This requires the selection of standardized (bio)indicatior systems, which react with known specifity and sensitivity to environmental chemicals and have the capability of spatial and/or temporal integration. Such indicator systems can be efficiently and reproducibly analysed and evaluated vicariously for the total entity of sensitive targets in the environment to be observed, which are often extremely variable with respect to the space, time and physiology. Bioindicator systems in such cases, where potential integral effects of complex or unknown immission types have to be detected and quantified. Such effects may occur on different levels from specific organs of single organism up to whole ecosystems. Bioindicators are also preferred in such cases, where they offer advantages due to their high sensitivity towards a broad spectrum of substances or because of their ability to accumulate a substance over an extended period of time or to integrate its influence in an area of known and relevant size. This is namely the case, if the sensitiveness of available analytical methods for dangerous substances it too low to find them in other environmental compartments like air, water and soils.

The most important property for using organisms as bioindicators is the bioavailibility of a chemical.

In case of an earthworm (e.g. *Lumbricus terrestris*) the bioavailibility is dependent from:
—   properties of the chemical
-   Kow
-   dissociation constant
-   affinity to charged surfaces

—   properties of the soil
-   organic matter content
-   pH
-   clay content

—   properties of the organism
-   uptake kinetics
-   physiological condition

In case of an earthworm it is relatively easy to determine the age and the physiological con-
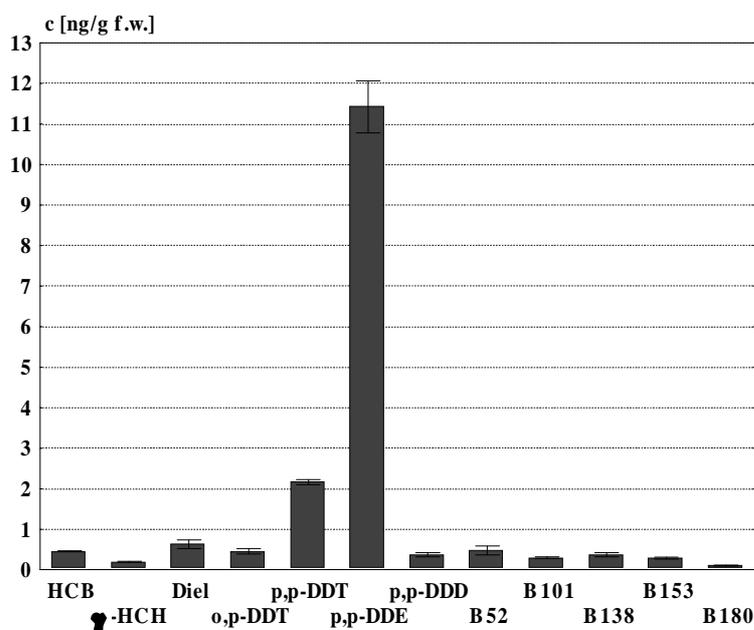
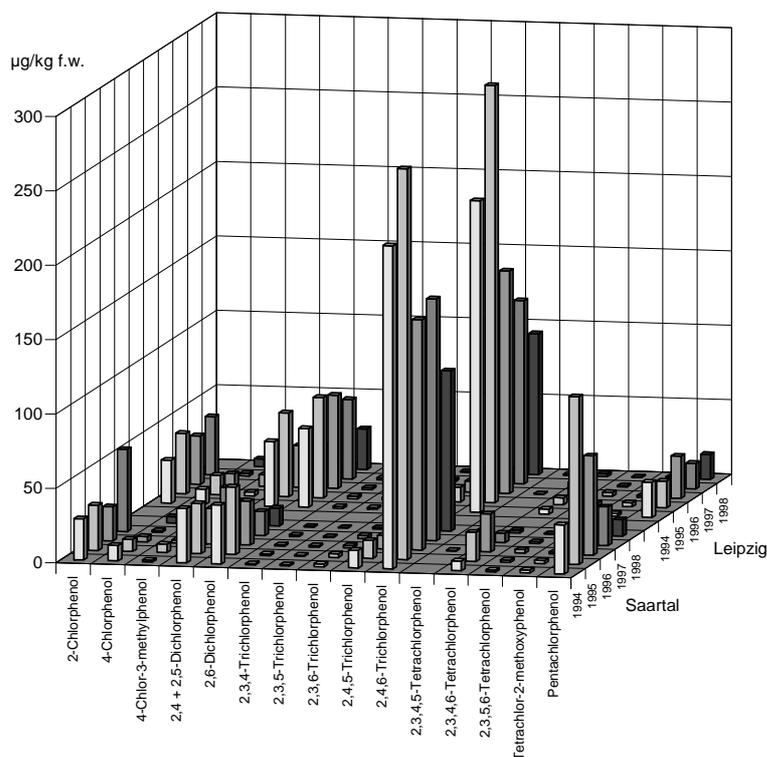Fig. 1: Sum of chlorinated hydrocarbons in *Lumbricus terrestris* sampled in the area of Leipzig

Fig. 2: Amount of different chlorinated phenols in
Lumbricus terrestris
Using earthworms as bioindicator it is possible to show that the soil contamination with chlorinated phenols is quite the same in the area of Leipzig (former GDR) and Saarbrьcken near the French border.

dition. Furthermore it is easy to sample an sufficient amount of the specimen. Earthworms like *Lumbricus terrestris* or *Aporrectodea longa* are good bioindicators for chlorinated hydrocarbons as can be shown in fig. 1.

It is obvious that 2,4,6-chlorophenol show the highest concentration in earthworms in both areas. Chlorphenols are used as an intermediate in the chemical industry but also as disinfectants, biocides, preservatives and pesticides.

In addition to the concentrations of toxic substances and their metabolites biological specimen can also be analysed for essential components and a broad spectrum of possible biochemical, physiological, morphological and/or genetical effects. Organisms and biological communities normally do not react to single components or substances in their environment. They show the effects of the totality of all the acting substances and environmental factors. Decisive for the use of biological specimen is their ecotoxicological relevance, that means the relevance or indicative function of the found effects for other living organisms and communities including men.

Idea of Environmental Specimen Banking

With respect to effects of pollutants, their quantities and distribution under natural conditions the acquisition of reliable information requires a systematic program of environmental monitoring in which concentrations of hazardous chemical substances are measured in suitable environmental specimen of various trophic stages and food chains. But actual monitoring of the environment can only be as good as our present knowledge and as analytical possibilities allow. From among the multitude of substances found in the environment only those can be monitored, which have already been recognized to be hazardous substances and thus, the quality of regulatory decisions suffers from the act that no results are available on pollutant burdens of former times or that the data which are available are ambiguous (7).

Before this background at the beginning of the 70s the idea of using biological samples as reference material to furnish proof of environmental pollution was put forward by Frederick Coulston of the Albany Medical College (Albany/NY), and Friedhelm Korte of Institute of Ecological Chemistry, GSF-Forschungszentrum, Munich-Neuherberg.

In an environmental specimen bank (ESB) carefully selected, relevant environmental samples are stored systematically at temperatures below - 150°C immediately after collection. In this way no, or as small as possible, chemical changes occur over a long period of time. Baseline levels of contaminants in the environment can be established by taking samples at the present time for future demand in ecological-chemical research. Long-term storage of samples with indicator functions represents an necessary complement to the actual monitoring of the environment and a safety net in the assessment of chemical risk.

A systemically established archive of frequently collected representative environmental specimen samples fullfill the following important functions [3,7-9]:

· They may be used for the determination of the environmental concentrations of those substances, which, at the time of storage, were not recognized to be hazardous or which at present cannot be analysed with adequate accuracy (retrospective monitoring)
· They may serve as reference samples for the documentation of the improvement of analytical efficiency and for the verification of previously obtained monitoring results.
· Early detection of environmental increases in hazardous chemicals thought to be under control is possible. Also, the effectiveness of restrictions, regulations, or management practices that have been applied to the community, the environmental or to the manufacture, distribution, disposal, or use of toxic chemicals can be assessed.
· Depending upon the analysis and evaluation of stored materials ESB can save considerable time and money when unexpected impacts are observed.
· Sources of chemical may be identified. Often, by the time a chemical is recognized as a health or environmental problem it is sufficiently wide-spread to defy

identification of the principal sources of pathways.
· ESB can offset the lack of reliable data on pollutant burdens of earlier times because inconsistencies or ambiguities among available data usually limit assessments and regulatory decisions.

In Germany the Federal Minister for Research and Technology supported a comprehensive pre- and pilot phase of ESB between 1976 and 1984. During this period the technical feasibility regarding the sampling of different species, handling and shipping of samples, deep freezing, homogenisation, ultra trace analysis, packing materials, logistics, storage temperature and documentation was confirmed [10]. The results were so encouraging that in 1985 the German government decided to set up a permanent ESB under the responsibility of the Federal Ministry for the Environment, Nature Conservation and Reactor Safety (BMU), coordinated by the Federal Environmental Agency (Umweltbundesamt). Two specimen banks are subsumed under the general heading of the German ESB:

· The Specimen Bank for Environmental Specimens at the Institute of Applied Physical Chemistry of the Research Center Jьlich (KFA) and since 2000 at the Fraunhofer Institute of Environmental Chemistry and Ecotoxicology/Schmallenberg
· The Specimen Bank for Human Organ Specimens at the Institute of Pharmacology and Toxicology of the University of Mьnster.

The work was distributed among these and some other institutions depending on their special scientific capabilities:
· Institute of Biogeography/University of the Saarland
· Institute of Ecological Chemistry of the Natl. Research Center of Environment and Health/Munich-Neuherberg
· Biochemical Institute for Environmental Carcinogens/GroЯhansdorf
· ERGO/Hamburg

In Germany environmental specimen banking has been successfully established as a permanent environmental surveillance tool.

The banking activities are focused on the preparation, characterisation and storage of representative samples from different ecosys-

32

tems in Germany. Based on reliable and well-documented analytical procedures the obtained monitoring results offers the opportunity for long-term control of environmental pollution by spatial differences and time-dependent trends.

In the meantime an international cooperation of ESB's in the Federal Republic of Germany, USA, Canada, Japan, Finland, Sweden, Norway and Denmark has been established [11,12].

Sampling areas and specimen types

Sampling areas have been chosen as to form a national network of Ecological Assessment Parks coordinating Environmental Specimen Banking with long-term ecological research and environmental monitoring [13-15]. An overall concept has been developed by a committee of experts under the auspices of the BMU, taking into consideration different types of ecosystems with corresponding representative sampling areas according to the following criteria:

· stability of utilization,
· assured long-term-use,
· sufficient minimal size,
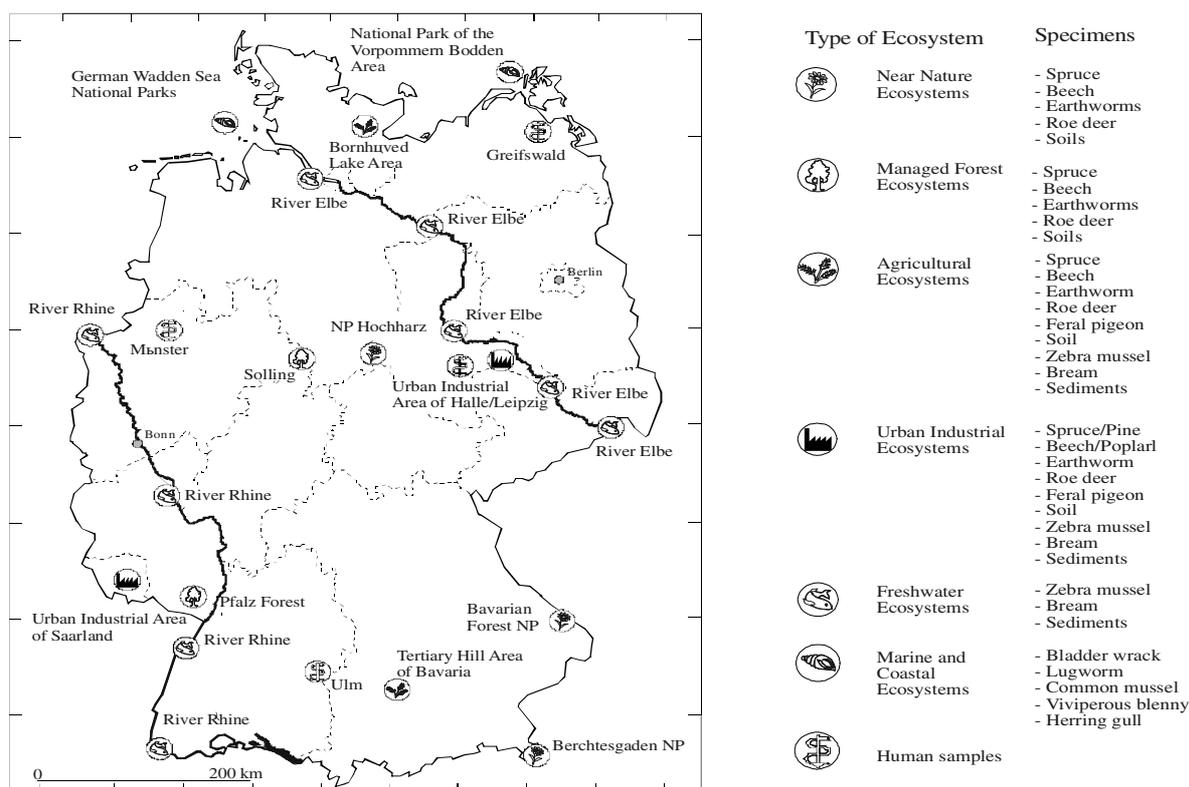· availability of suitable samples

Fig. 3. Sampling areas and specimens types (after Klein et. al) [13]

· practicability e.g. accessibility, public ownership (National Park), no conflict
· with the protection of biotopes and species, high level of information, nearby
· suitable institutions for research

The list of a present fourteen areas (see Fig. 3) comprises the major ecosystems and habitat types that occur within the Federal Republic of Germany including

· limnic and marine ecosystems,
· urban industrial ecosystems,
· forest and agricultural ecosystems and
· semi-natural ecosystems.

Continuous sampling is now performed in the following areas:

— The national parks of mud flats in Schleswig-Holstein and Lower Saxony (North Sea) and the Baltic Sea as marine ecosystems.
— River Elbe and River Rhine as limnic ecosystems.
— Saarland and the Halle/Leipzig/ Bitterfeld area as urban-industrialized regions.

The selection and assignment of representative specimen of the terrestrial, limnic and marine ecosystems for the ESB was undertaken by a committee of experts in consideration of the above mentioned indicator func-

tions so that a broad spectrum of different types of matrices (all trophic level) and media (air, sediment, soil) with environmentally relevant concentrations of xenobiotics is available (see Fig 3) [13,15].

Furthermore, the following requirements must be fulfilled for using a matrix as bioindicator:

· The chemicals must be accumulated comparable to levels occurring in the environment.
· Contamination trends in the environment must correspond to those in the matrix.
· The matrix should have a widespread distribution and must be available in time and place to a sufficient extent
· The organism should be sedentary and easy to identify.
· The species should accumulate the pollutants without being killed or rendered incapable of reproduction.

Standardized sampling guidelines in the sense of standard operating procedures (SOP) are the basis for the comparability, reliability, and repeatability of the banked samples.

They contain detailed instructions for the

· selection of sampling sites and specimens;
· sampling;
· providing cover for repeatability of sampling;
· area and sample characterization;
· sample treatment and long-term storage;
· documentation of sampling and storage conditions;
· chemical analysis;
· data processing and evaluation and
· quality assurance.

Nevertheless, sampling of biological and other environmental specimens is always influenced by factors which may modify the exposure as well as the accumulation behaviour of the specimen types in relation to xenobiotics, e.g. by climatic factors, weather conditions and changes in the population sampled or in the structure of the whole ecosystem [16].

Ecological and biometrical sample characterization provides basic information about changes in the quality of the sampled material and its comparability with previous and following samples from the same area or the same specimen type sampled in other areas. On the other hand biological sample characterisation can also given information about ecological and ecotoxicological effects to the population sampled.

In environmental specimen banking samples of different specimen types and ecosystems are frequently sampled, characterized, processed and stored with considerable effort in order to maintain the precautions necessary for deferred analysis on initially unknown substances or parameters. Quality assurance is therefore an absolute demand and an innovative challenge in ESB. Errors made during the sampling in the field, transportation and sample pre-treatment can seldom be recognized and never corrected afterwards during the following analytical measurements. Thus, the quality assurance system for ESB includes the whole process from planning, sampling, ecological and biometrical characterisation, packing, transportation, storage, homogenisation and sub sampling up to the analytical procedures and the evaluation of the results [17,18,20].

An average 2,5 kg of material per specimen per sampling site was collected producing nearly 250 standardized sub samples of approximately 10 g.

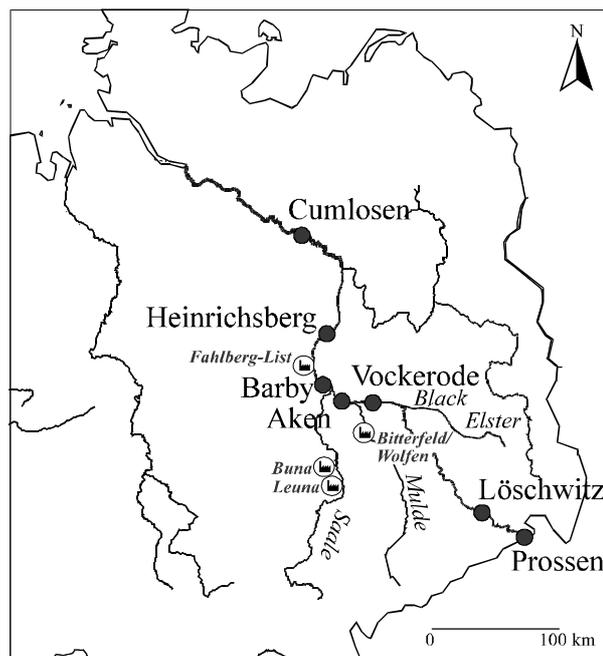## Chlorinated hydrocarbons as pollutants in ESB samples

Fig. 4: Location of the sampling stations of breams (*Abramis brama*) from the River Elbe and sites of chemical plants

For the determination of chlorinated hydrocarbons GC/ECD or HRGC/HRMS were used. More details about the applied method are given in (26-29).

Numerous chlorinated insecticides and industrial chlorinated hydrocarbons (e.g. polychlorinated biphenyls (PCBs) or polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F) are extremely resistant to degradation in the environment. Residues of these xenobiotics have been identified throughout the world although most of them have been banned since the 70s. Because of their toxicological properties and accumulation effects, long-term studies on their residues levels are essential to understand the environmental contamination in the past and to predict future trends.

The former German Democratic (GDR) was one of the major producers of elemental chlorine in East Europe. Due to economical reasons the production and application of low volatile CHC played a more important role in the chemical pest control in agriculture and forestry of East Germany than in the Western countries [35]. Under the pressure of worldwide application restrictions the production has ceased since the early 70s (DDT) or late 80s (lindane, toxaphene) respectively. Thus, the different economic and technical development of the two German states led to partly different patterns of environmental pollution. Reliable data of the pollution situation, especially of the industrialized areas, in the former GDR were not available on account of the strict political restriction regime. In order to detect the efficiency of legislative regulations for the environmental redevelopment, which were initiated directly after the reunification, and for the assessment of the environmental pollution a special sampling campaign was performed in representative areas of the former GDR in 1990/91 [36]. These samples can be regarded as a basis for monitoring the development of spatial and temporal trends in Eastern Germany (27,28).

Breams (Abramis brama) are freshwater fish with a small migration radius. They are an ideal organism for monitoring freshwater and sediment contamination because their feeding habits are characterized by permanent direct
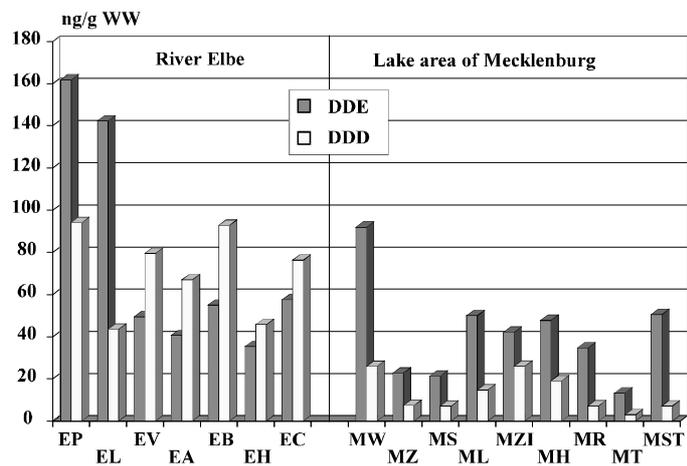
Abbreviations of the sampling sites

River Elbe		Lake area of Mecklenburg	
EP	Prossen	MW	Wanzkaer See
EL	Löschwitz	MZ	Zwirn-See
EV	Vockerode	MS	Schweingarten-See
EA	Aken	ML	Lutowsee
EB	Barby	MZI	Zierker See
EH	Heinrichsberg	MH	Haussee
EC	Cumosen	MR	Rödliner See
		MT	Großer See von Teterow
		MST	Stechlin-See

Fig. 5: Comparison of the DDE and DDD mean concentrations in bream muscle homogenates (*Abramis brama*) from the River Elbe and the lakes of Mecklenburg in 1990/91 (WW: wet weight)
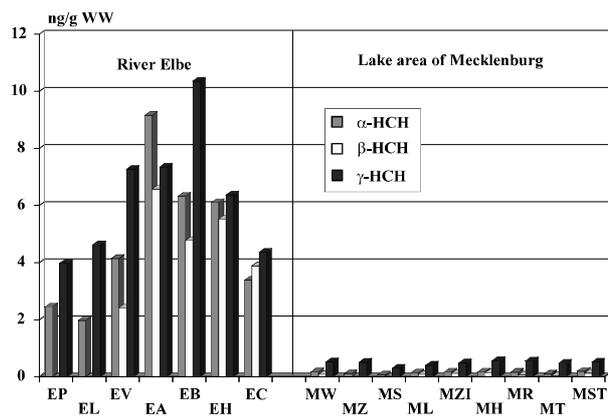

Fig. 6: Comparison of the HCH mean concentrations in bream muscle homogenates (*Abramis brama*) from the River Elbe and the lakes of Mecklenburg in 1990/91 (WW: wet weight) (Abbr.: cf. Fig. 7)
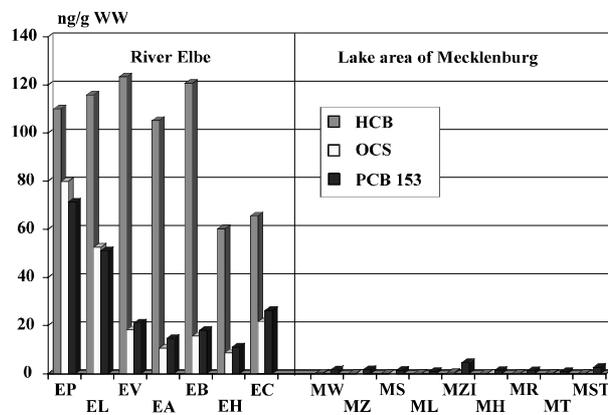

Fig. 7: Comparison of the mean concentrations of selected CHC in bream muscle homogenates (*Abramis brama*) from the River Elbe and the lakes of Mecklenburg in 1990/91 (WW: wet weight) (Abbr.: cf. Fig. 7)

contact with the sediments

On aime of the sampling campaign was the

35

characterization of the CHC burden along the German part of the River Elbe and to monitor the expected recovery of the river. Rot the past 20 years the River Elbe has been one of the most polluted rivers in Europe (37). Due to political changes in the Eastern part of Europe and especially in East Germany, various industries, who discharged their waste water into the river Elbe, were either closed or reduced their production activities. In order to characterize local variations of the CHC burden seven stations were selected with regard to various types and magnitudes of industrial pollution as shown in Fig. 4 (30).

In addition, bream samples were collected in 9 lakes of Mecklenburg which were mainly influenced by agriculture, livestock fattening and forest industry. Figures 8-10 present a comparison of the main contaminants in bream muscle homogenates from the River Elbe and the lake area of Mecklenburg.

As shown in Figures 5- 7 fish caught at the upper Elbe (Prossen and Loschwitz) exhibited

the highest concentrations of DDE, OCS and PCB. This observation is probably a result of the considerable pollution of the River Elbe from industrialized areas (e.g. Pardubice, Neratovice, Usti) of the former CSFR [30].

A significant decrease of these contaminants was found between stations Luschwitz and Vockerode. Between Vockerode and Heinrichsberg the levels remained nearly constant. The analytical data obtained for HCB concentrations in breams indicate a declining trend downstream of Barby. The high HCB contamination is considered to be an effect of the discharges from chemical plants in the former CSFR as well as of the influxes from the River Mulde (upstream from Aken) and River Saale (upstream from Barby). The increase of the HCH content in fish from these stations is also linked to the influence of both tributaries of the River Elbe (Figure 7).

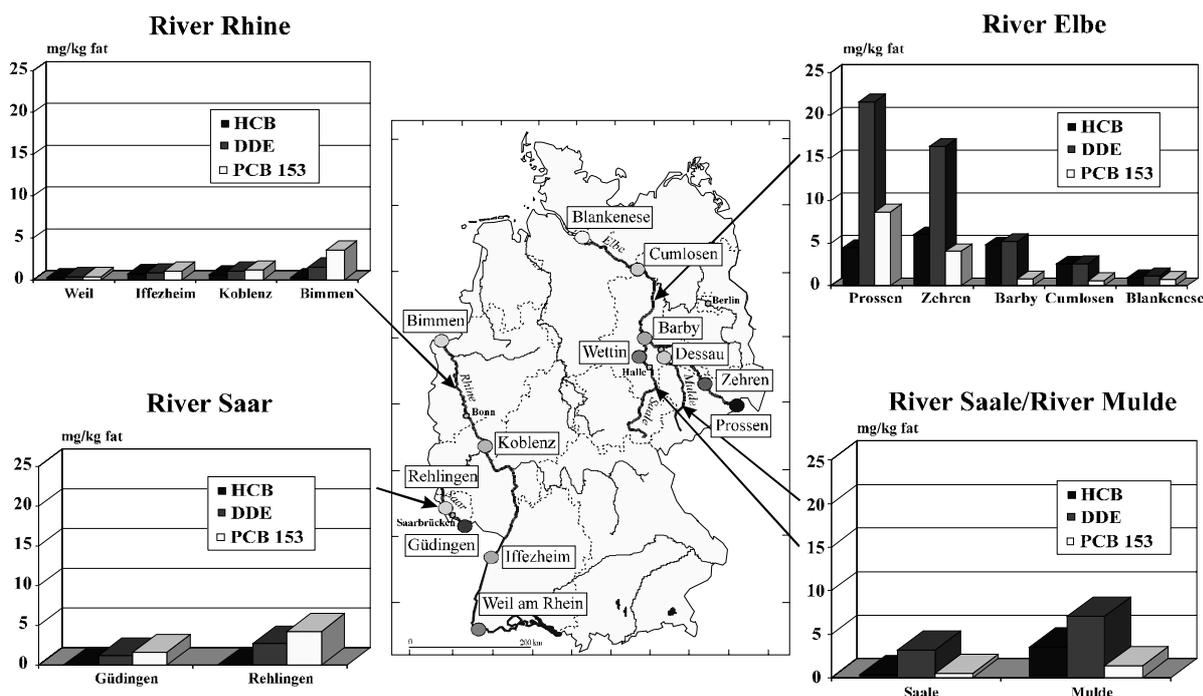The major polluters of the River Mulde

Fig. 8: Comparison of the mean concentrations of selected CHC in bream liver homogenates (*Abramis brama*) from different German rivers in 1995

were the chemical plants in the Bitterfeld/Wolfen area, although the production of chlorinated pesticides has stopped several years ago [35]. The CHC burden in the River Saale originated from Buna, Leuna and the pulp mill industry. Lindane and DDT containing wood preserving agents (e.g.Hylotox IP/Hylotox 59) were produced in Leuna. The high contamination levels of HCH in bream at the station Heinrichsberg might be explained by the influence of discharg-

es from the pesticides plant Fahlberg-List, located in Magdeburg. The results are consistent with waste water analysis of the plant and river sediment in 1990, which showed that both matrices were extremely contaminated by HCH [37]. Although the production of lindane has ceased since 1981, the pesticides were highly accumulated in the river sediments.

Another interesting aspect can be seen

the dominant DDT metabolite in fish from the River Elbe [38]. It is a degradation product of 4,4'-DDT by anaerobic conversion as well as a byproduct of the DDT synthesis. In sediment of the River Elbe and the River Mulde DDD levels were generally higher than those of DDE [39]. Interestingly, the recorded DDE values from the upstream stations (Prossen and Lцschwitz) were twice as high as those of DDD. From Vockerode to Cumlosen DDD/DDE, ratios ranged between 1.3 - 1.7. This results seems to imply that the DDD burden of sediments is well reflected by breams.

With the exception of the DDT metabolites the CHC burden in breams from Mecklenburg was considerably lower in comparison with fish from the River Elbe as could be expected due to the absence of chemical industries. The DDE lev-els were comparable to those found in fish from the River Elbe on account of the intensive agriculture in this region. Slightly higher PCB concentrations were found in breams from the Lake Stechlin-See and the Lake Zierker See. The Lake Stechlin-See is situated in a nature reserve which is influenced by the local recreation traffic from Berlin as well as by a former nuclear power station "Rheinsberg". The elevated PCB levels in the Lake Zieker See could be attributed to the long-term influx of untreated waste water from the city Neustrelitz.

Figures 8 and 9 illustrate results on the major CHC contaminates in bream livers from 5 different German rivers, obtained within the ESB routine program in 1995 [42]. Since 1994 bream samples have been periodically taken in the River Saar and since 1995 also in the River Mulde, River Saale and River Rhine (Fig. 8).

Samples were also obtained from stations along the River Elbe (Prossen, Zehren, Barby, Cumlosen, Blankenese), four station along the River Rhine (Weil am Rhein, Iffezheim, Koblenz and Bimmen), one station situated upstream of the River Saar (Gьdingen) and Rehlingen located downstream under the industrialized area of Saarbrьcken. The samples from the River Mulde were collected near Dessau and fish of the River Saale between Halle and Wettin.

It is apparent that the stations on the upper Elbe still exhibited the highest concentrations of HCB, DDE and PCB. High values for HCB and DDE were also found in samples from the River Mulde. This observation is mainly a result of the former industrial emissions of the chlorine industry and a leaching dumpsite at Bitterfeld. Wilken reported, that there had been further pesticide emitters in the area upstream of the River Mulde in Saxony, especially with respect to DDT. In West Germany the HCB and DDE concentrations were much lower in comparison with the levels in East Germany. Breams caught near the Rhine station Iffezheim contained HCB at higher levels because of a former chemical plant located
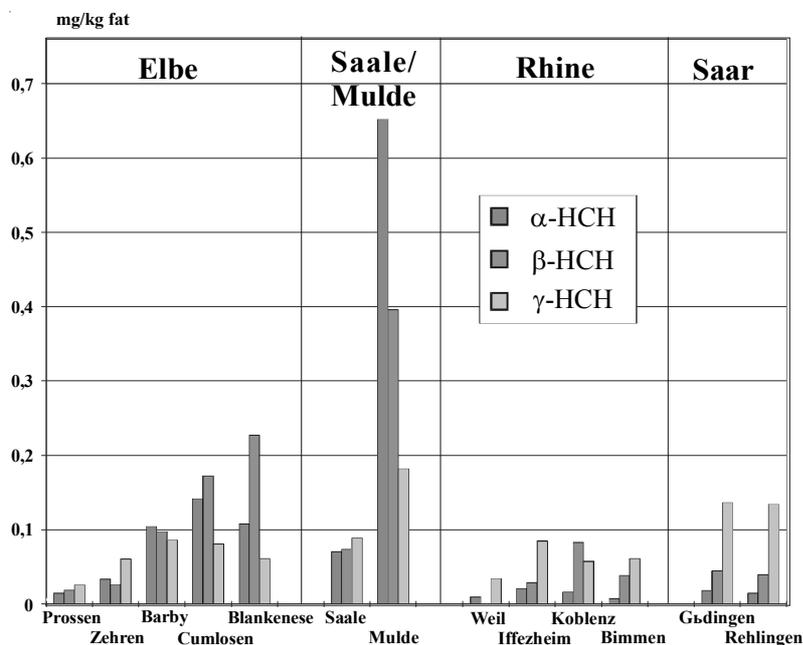

Fig. 9: Comparison of the mean HCH concentrations in bream liver homogenates (*Abramis brama*) from different German rivers in 1995
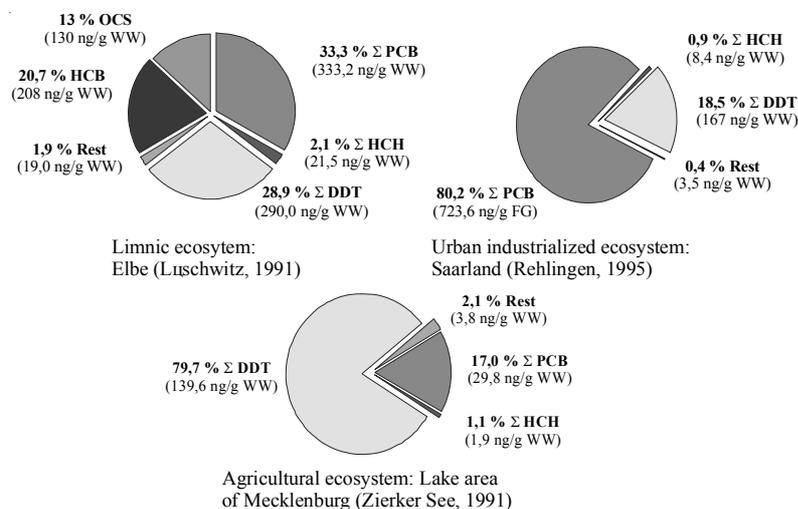

Fig. 10: Comparison of the proportion of different CHC pollutant classes in bream livers (*Abramis brama*) from East and West Germany

because of a former chemical plant located upstream, which produced pentachlorophenol [42]. The highest DDT amount in fish from West Germany were found in the River Saar at Rehlingen, in contrast to its small HCB levels.

Elevated levels of PCB were detected in breams from the lower Rhine at Bimmen and from the lower Saar at Rehlingen. The increasing concentrations along the River Rhine are partly a result of the influx of the River Mosel (upstream of Koblenz), containing high amounts of PCB [43]. The river Saar is strongly influenced by emissions from the mining industry situated in the Saar region.

The data shown in Figure 9 clearly indicate the HCH pollution of the River Mulde. Wilken et. al. [36] reported that sediments and soils from River system Mulde are still highly contaminated by pesticides and PCDD/F although the industrial emission has stopped. These sediment-bound pollutants can be remobilised and may lead to a secondary contamination of the River Elbe by pollutant transport. Therefore, it remains to be seen how long the recovery of the River Elbe will take.

Generally HCH patterns of breams from East Germany differ from those found in fish from West-Germany. The g-isomer predominates in the Western samples, whereas higher levels of the a and b-isomers are detected in the fish from the Eastern part of Germany.

The comparison of the CHC patterns in bream livers exhibits significant distinctions between the different ecosystems (Fig. 10). DDT metabolites and PCB contributed to one third each to the total CHC burden of bream livers from the limnic ecosystem of the River Elbe. PCB were the major organochlorine contaminants (70%) in breams of a typical industrialized area (Saarland) in West Gemany in contrast to agricultural areas of East Germany, where DDT metabolites were the dominant pollutants (80%).

This surprising result that DDT metabolites show high amounts in environmental samples of Eastern Germany can also be demonstrated in pigeon eggs.

The collected specimens have been successfully utilized for the characterization of the environmental pollution by CHC n the former GDR.

The dominant position of the DDT group in nearly all Eastern samples clearly reflects the central role of DDT in the pest control of the former GDR. For this pollutants class significant spatial differences between East and West Germany were detected in terrestrial, atmospheric and limnic environments. The HCH concentrations in animal samples were considerably lower. With the expedition of local hot spots of pollution the lindane contamination of both German parts was in the same range, whereas the concentration of a- and b-HCH isomers, byproducts of the lindane production, appeared to be higher in samples from East Germany, especially in the vicinity of former pesticide plants. Relatively low PCB levels were observed in specimens from the East compared to West Germany due to low usage of PCB in the former GDR.

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Summary

Thousands of chemicals are traded on the market, but only in a few cases is full information available on their distribution and their effects on man and the environment. In addition to real time monitoring of chemicals, it is, thus, necessary to establish an environmental specimen bank (ESB) for the retrospective monitoring of chemicals in the future. The base of ESB are representative bioindicators of systematically collected biological and environmental samples. As a result of extremely low storage temperature (T = < - 150°C) it is guaranteed that the samples are not subject to chemical changes during the long-term storage.

Furthermore we need in addition an effect monitoring, using in vitro testing like for example P 450 1A1 enzyme expression.

ХЛОРСОДЕРЖАЩИЕ УГЛЕВОДОРОДЫ В ОКРУЖАЮЩЕЙ СРЕДЕ – МОНИТОРИНГ И ЕГО ЭФФЕКТИВНОСТЬ

А.А.Ф. Кеттруп

В настоящее время на рынке присутствует огромное количество химических веществ, но только в некоторых случаях доступна полная информация об их распространенности и воздействиях, оказываемых ими на человека. В дополнение к мониторингу химических веществ, проводимому в реальном времени, необходимо создать банк образцов химических веществ, присутствующих в окружающей среде для проведения в будущем ретроспективного мониторинга. Основой такого банка данных могут стать репрезентативные биоиндикаторы систематически собираемых биологических образцов и образцов, присутствующих в окружающей среде. Поскольку температура хранения образцов в банке крайне низкая (Т< - 150°С) существует гарантия того, что образцы не будут подвергаться химическим изменениям во время длительного хранения. Но помимо прочего, нам необходим эффективный мониторинг, где бы использовались in vitro тест – системы, например, для определения экспрессии энзима 450 1A1.