

# Analysis of methylmercury in roe deer liver, limnetic and marine mussels



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## Research Programme

The German Environmental Specimen Bank (ESB), located at the Fraunhofer IME, is an important tool for the long-term monitoring of pollutants in representative ecosystems. Within this program zebra mussels (*Dreissena polymorpha*), common mussels (*Mytilus edulis*) and roe deer liver are sampled at different locations in Germany, archived and analysed to environmental relevant substances. With data thus obtained, mutations of the mercury concentration and resultant changes of the environmental can be observed. The German ESB is coordinated by the German Federal Environmental Agency and financed by the German Ministry for the Environment, Nature Conservation and Reactor Safety (more information is provided at <http://www.umweltprobenbank.de>). The sampling is performed by University of Trier.

## Fate and behaviour of methylmercury in the environment

In contrast to the less toxic inorganic mercury, methylmercury (MeHg) is a neurotoxin which may cause severe chronic effects. Methylmercury is formed mainly by biological methylation of mercury in which the particular hazards of MeHg are based on its lipophilic property which enables absorption by organisms and bioaccumulation. Within the food web a biomagnification is observed. Therefore a long-term monitoring of indicator organisms especially in aquatic and terrestrial system is necessary. Contaminations with methylmercury compounds are known from Japan (fishes, Minamata Bay, 1953-1963) and Iraq (seeds preservatives on methylmercury basis, 1956 and 1971/72).

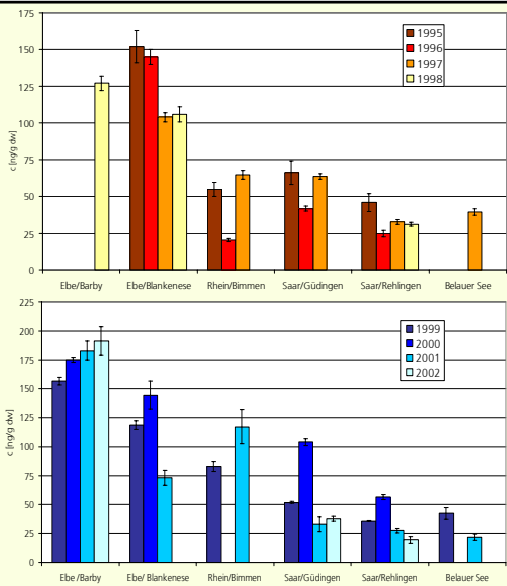


Figure: Progression of the MeHg loads of zebra mussels From different sampling sites between 1995 – 1998 and 1999 – 2002 (dw – dry weight)

## Selected Results

Table 1: Mean values of MeHg-, Hg-loads ± standard deviation in common mussels, dry weight basis

Sampling Area	1999		2000		2001		2002	
	MeHg [ng/g]	Hg [ng/g]	MeHg [ng/g]	Hg [ng/g]	MeHg [ng/g]	Hg [ng/g]	MeHg [ng/g]	Hg [ng/g]
Eckwarderhörne (North Sea)	62.9 ± 4.7	297 ± 22	59.0 ± 1.4	279 ± 12	64.4 ± 1.6	302 ± 3	55.9 ± 8.6	287 ± 4
Königshafen (North Sea)	79.5 ± 3.3	212 ± 11	105 ± 12	325 ± 8	90.5 ± 6.3	278 ± 3	78.9 ± 15	294 ± 1
Darßer Ort (Baltic Sea)	27.4 ± 2.8	89.8 ± 5.1	38.7 ± 7.1	105 ± 6	23.4 ± 2.0	71.6 ± 1.1	18.8 ± 1.5	60.6 ± 1

Table 2: Mean values of MeHg-, Hg-loads ± standard deviation in roe deer liver; dry weight basis

Sampling Area	1999		2000	
	MeHg [ng/g]	Hg [ng/g]	MeHg [ng/g]	Hg [ng/g]
NP Berchtesgaden	-	-	0.92 ± 0.5	8,89 ± 1.1
Solling	2.60 ± 0.3	24.6 ± 1.8	-	-
Saarkohlewald	-	-	5.55 ± 0.7	25,4 ± 1.0
NP Bayerischer Wald	-	-	1.88 ± 0.6	31.8 ± 1.1

## Conclusions:

- The CH<sub>3</sub>Hg<sup>+</sup>-content in relation to total mercury is different for the sample species. In Darßer Ort and Königshafen the average CH<sub>3</sub>Hg<sup>+</sup>/Hg ratio in common mussels is 33%, in Eckwarderhörne 21% and in roe deer liver 10% in Solling and Berchtesgaden, 22% in Saarkohlewald and about 6% in Bayerischer Wald.
- The MeHg-concentrations in zebra and common mussels are in the range between 20 and 190 ng/g. The MeHg-concentrations of the Baltic sea mussels are only approximately one third of those from the North Sea mussels. For the zebra mussels especially in the Elbe high loads were detected. In roe deer liver, the MeHg-concentrations are vary from 0.92 to 5.55 ng/g.

## Materials and Instrumentation

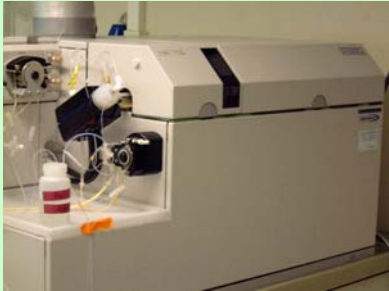
**Materials:** The mussels and the roe deer liver are stored at temperature below –150°C immediately after sampling. The conches are removed, the soft body and the liver are grinded at temperature below –130°C. For the MeHg-Analysis the homogenised sub-samples are used. By this measure an operationally defined CH<sub>3</sub>Hg<sup>+</sup>-fraction is determined which is reported on a dry weight basis.

**ICP-MS:** Agilent ICP-MS 7500i

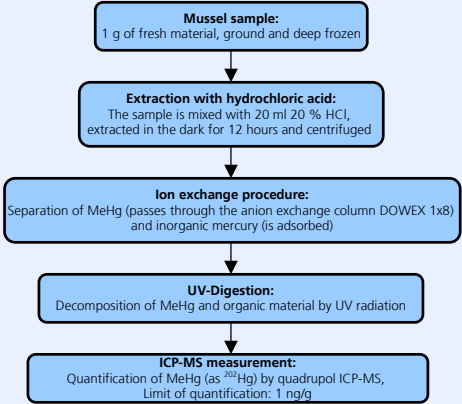
RF-power: 1300W  
RF-matching: 1.7 V  
Plasma gas: Ar, 1.21 L/min  
Auxiliary gas: Ar, 0.9 L/min

### Calibration

The method of standard addition was applied for the calibration of the analytical procedure by using the mussel and roe deer liver sample to be analysed.

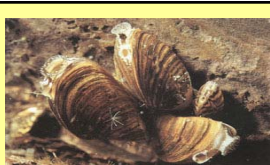


## Sample preparation



Common Mussel (*Mytilus edulis*)

The common mussel is one of the biggest producer of biomass in coastal waters. The common mussel has been used for many years in national and international monitoring programmes (the worldwide "Mussel Watch") as a load indicator for hazardous substances in coastal waters. The reasons for this is its significant function in the coastal water system, its ability to absorb and accumulate many hazardous substances rapidly, its sedentary behaviour, adequate availability, extensive geographical presence and not least widespread use as a source of human food. The entire soft body is used as a specimen. Sampling takes place every two month in the tideland and two times in the year (June/November) in the Baltic Sea.



Zebra Mussel (*Dreissena polymorpha*)

The zebra mussel is a sedentary inhabitant of slow-flowing and stagnant waters, where it filters herbal and animal micro-organisms. As a consequence, it is exposed to hazardous substances, whether in solution or particulate suspension and, therefore, useful in active biomonitoring and in toxicity- and impact tests. To ensure quantitative availability, easy access and improved reproducibility, an exposure system has been developed using uncontaminated breeding sites which can be colonized by larvae until adulthood. The entire soft body is used as a specimen. Sampling takes place every year between September and late November, preferably after final spawning.



Roe Deer (*Capreolus capreolus*)

The roe deer is the most frequently free-living larger herbivore (Consumer 1st order) in Europe and a well-researched bioindicator. It is suitable as a specimen type for the Environmental Specimen Bank because of its pronounced flexibility as well as in near-natural, forestal and agrarian used ecological system. The target organ is the liver. Sampling takes place from mid-May to mid-June (10-15 yearlings) and from September to the end of December (10-15 fawns).