



TEMPORAL AND SPATIAL TREND OF ORGANIC MICROPOLLUTANTS IN SEA WATER IN THE NORTH SEA AND THE BALTIC SEA

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There is some uncertainty about the temporal trend in contamination of the sea water with organic micropollutants. This is due to several factors:

- few laboratories have reported results;
- low levels make analysis difficult and prone to errors;
- lack of standardized methods makes comparison between laboratories difficult if not impossible;
- intercalibration exercises have given inadequate results.

Our laboratory has been monitoring organic micropollutants over a period of time long enough to enable us to give a trend analysis for some compounds. As our participation in calibration exercises was successful and as the method has not greatly changed, results can be readily compared.

The number of organic micropollutants traceable in offshore waters is limited. From 50 chlorine containing contaminants positively identified at the freshwater edge of the Elbe, only five can be identified in offshore waters (HCB, α -, β -, γ -HCH, PCP) (1). The others are either hydrolyzed in water or degraded microbially in the sediment.

From existing data from a national monitoring programme, time series were compiled in the North Sea (German Bight) and in the Baltic Proper (Arkona Basin). The coverage with hydrographic data was incomplete, therefore normalization for salinity was not possible. Statistical methods have not been used because the number of data is too small.

The following method was applied (2) without significant changes:

- sampling with an all-glass and stainless-steel sampler;
- hexane extraction of unfiltered water;
- clean-up of the extract with sulphuric acid;
- gas chromatography on capillary column with ECD.

At concentrations well above the quantification limit, the relative standard deviation of the method is below 10 %. Table 1 summarizes compound-specific limits of quantification obtained by the method described. Baseline concentrations found in the NE-Atlantic are also given.

Table 1:

	quantification limit	baseline concentration NE-Atlantic (1)
	- ng/l -	
α -HCH	0.02	0.7 - 1.2
γ -HCH	0.02	0.15 - 0.25
HCB	0.03	≤ 0.03

German Bight

A station (El 9.1) near the "ELBE" lightvessel has been sampled at least once a year since 1980 for organic micropollutants in water. The station was chosen as a compromise between high concentrations with high variability in a tidal estuary and the decreasing variability and concentrations in the marine environment. The salinity there varies mostly between 30 and 32.5 and seldom drops below 28 PSU. The station is located at 54°00' N and 008°05' E in JMP area 13.

The contamination pattern of the North Sea (Fig. 1) is similar in both survey years though the levels were different. Owing to the high freshwater input in general, continental coastal water is more contaminated than the western and central parts of the North Sea. The additional input of the Baltic Sea can be seen in the Skagerrak and the joint plume of contamination leaves the area with the residual current causing the isopleths to run parallel to the Norwegian west coast. The rapid exchange with Atlantic water keeps the concentrations low in the northern North Sea.

For the German Bight, the river Elbe is the dominant source of input. Input data have been calculated from concentrations and run-off volumes upstream of the freshwater edge.

Table 2:

	Input from the Elbe in tons per year (3)									
	1981	82	83	84	85	86	87	88	89	90
α -HCH	0.8	0.5	0.4	0.1	0.3	0.1	0.2	0.1	0,13	0,12
γ -HCH	0.8	0.5	0.7	0.6	0.7	0.5	0.8	0.5	0,44	0,21
HCB	1.2	0.5	0.3	0.1	0.2	0.1	0.05	0.08	0,11	0,08

The input data are average means of 8 - 12 data sets for each year. They show a decreasing trend for α -HCH and HCB; no trend for Lindane can be seen (excluding the year 1990).

Trend at El 9.1 (Fig. 2)

The variability at station El 9.1 is high for three independent reasons:

- the variable input of contaminants from Elbe and Weser,
- the variable position of the plume of contamination relative to the station,
- the variable flushing conditions of the sea.

Irrespective of this complicated situation, some conclusions can be made.

- 1) Owing to the ban on the use of technical HCH as an insecticide (with 60 % α -HCH as main ingredient), the concentrations of α -HCH have dropped to near baseline concentrations.

(The 2/81 and 3/81 data are not felt to be representative of the regular flushing conditions in the German Bight.)

- 2) No trend can be seen for the Lindane data. This observation coincides with input data given in Table 2. Results of the spatial surveys in 1981 and 1986 (Fig. 1) indicate a considerable increase in Lindane from the observed NW-shift of the 1.0 ng/l isopleth. In view of unchanged input from the Elbe, this shift has to be explained by greater flushing of the North Sea in 1981 compared with 1986. Unfortunately, this statement cannot be confirmed by hydrographic data, but the baseline concentration of 0,2 ng/l observed SE of the Shetlands in 1981 was found NW of these islands in 1986 as well. This link excludes a major error in the investigation.

- 3) HCB concentrations were quite high in the early 1980s. Owing to improved emission controls introduced in the meantime, they have come close to the quantification limit at the "ELBE" lightvessel. The decrease is reflected in the near shore displacement of the 0,05 ng/l isopleth (Fig. 3).

Western Baltic Proper

The limited water exchange in the Baltic Proper results in a lower variability of the data compared with the German Bight and also causes higher levels of contaminants in larger areas compared with the North Sea or even the German Bight; this is evident for α - and γ -HCH.

Station BMP K4 (formerly BY2) at 55°00' N, 14°05' E has been sampled every second year since 1975. It serves as a link between the more homogeneous Baltic Proper and the transitional area of the Belt Sea with also higher variability.

Trend at BMP K4 (Fig. 4)

- 1) Since 1975, α -HCH has decreased by about 50 % and is falling further. This decrease is confirmed throughout the entire Baltic Sea (Fig. 5). The decrease is due to the ban on the use of technical HCH as an insecticide.
- 2) For Lindane, a clear trend cannot be seen from the time series at station BMP K4. However, a comparison of the spatial distribution between 1983 and 1988 (Fig. 6) gives an impression of how the compound is slowly "rinsed out" of the Baltic Sea along with the southward displacement of the 2.0 and 3.0 ng/l isopleths (4), (5).
- 3) HCB concentrations were close to or below the quantification limit at the BMP K4 station, accordingly a trend cannot be established.

Conclusion

Complex interrelations seldom give an easy answer.

Acronyms

BMP :	Baltic Monitoring Programme
ECD :	Electron Capture Detector
HCB :	Hexachlorobenzene
HCH :	Hexachlorocyclohexane
JMP :	Joint Monitoring Programme
PCP :	Pentachlorophenol
PSU :	Practical Salinity Unit

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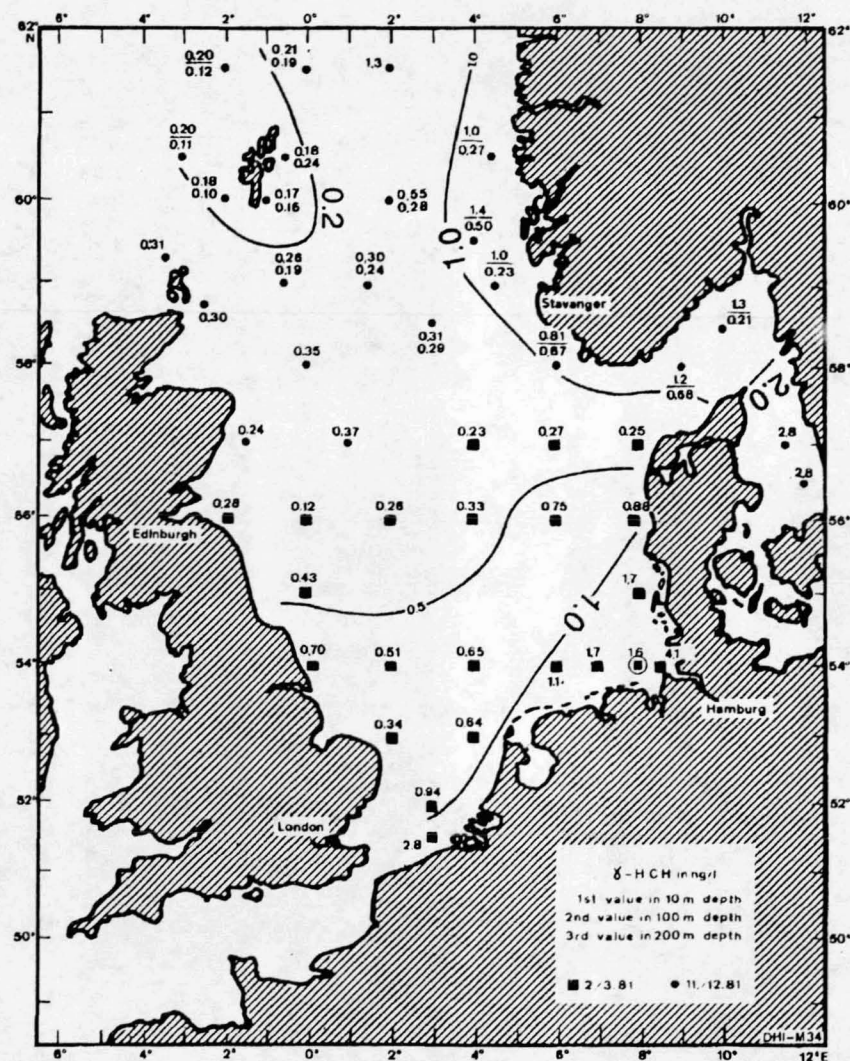
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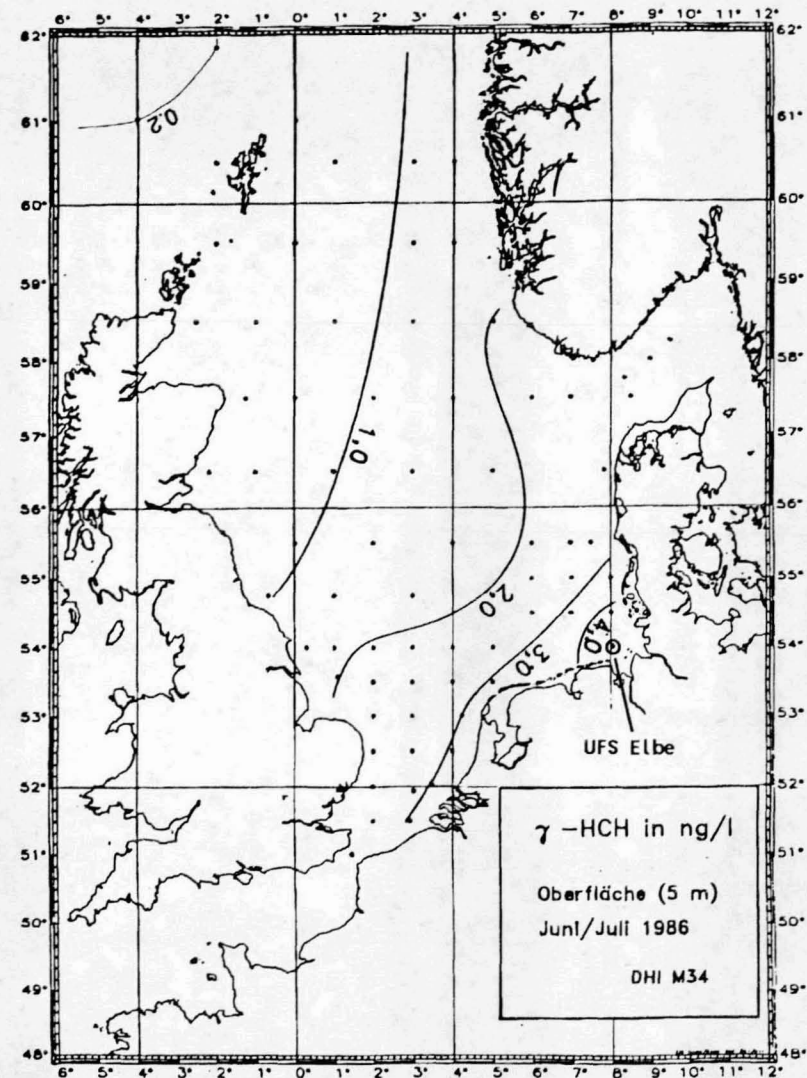
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Bundesamt



1981



1986

Fig. 1: Surface water concentration of Lindane

Station EI 9.1
54°00'N 008°05'E

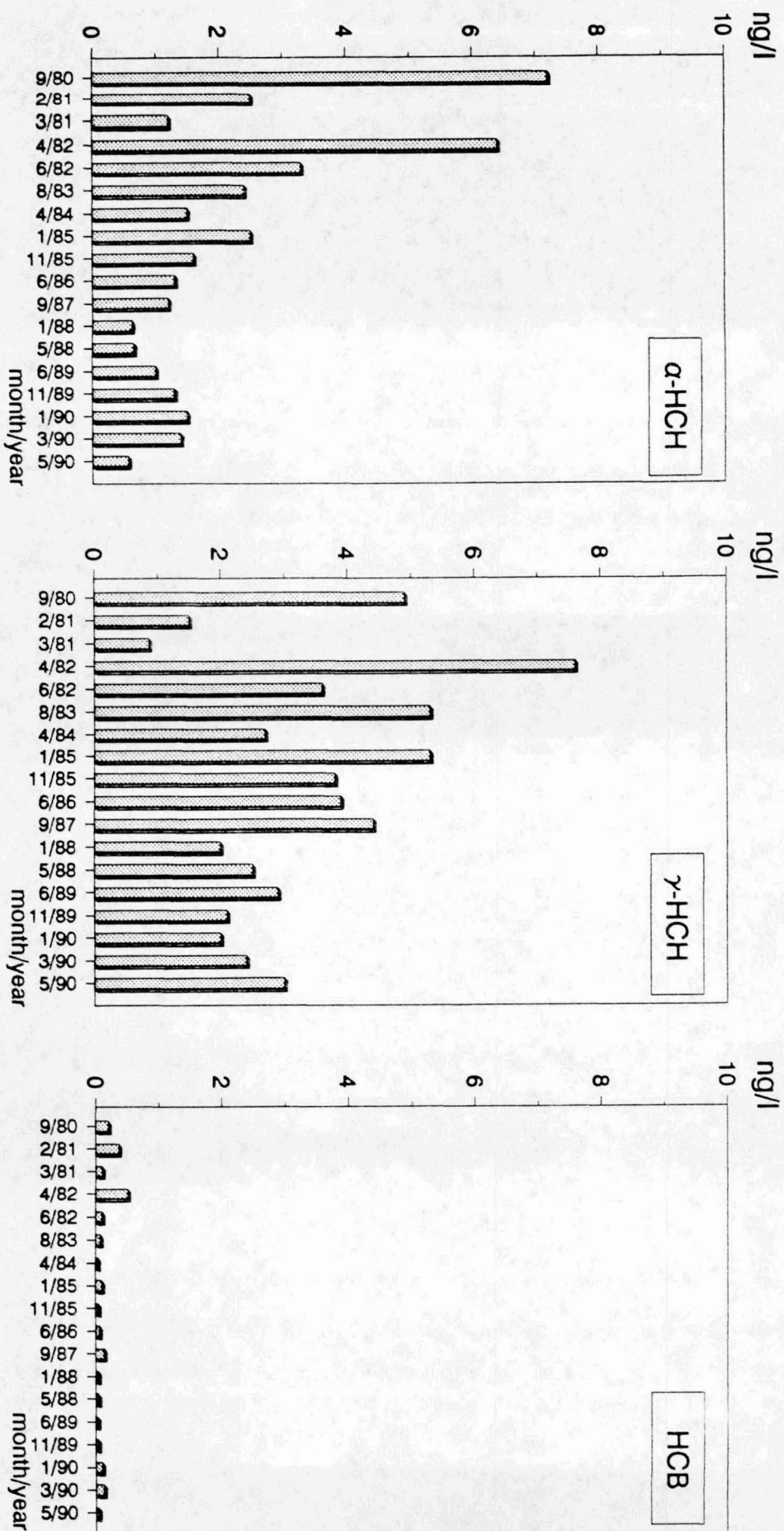
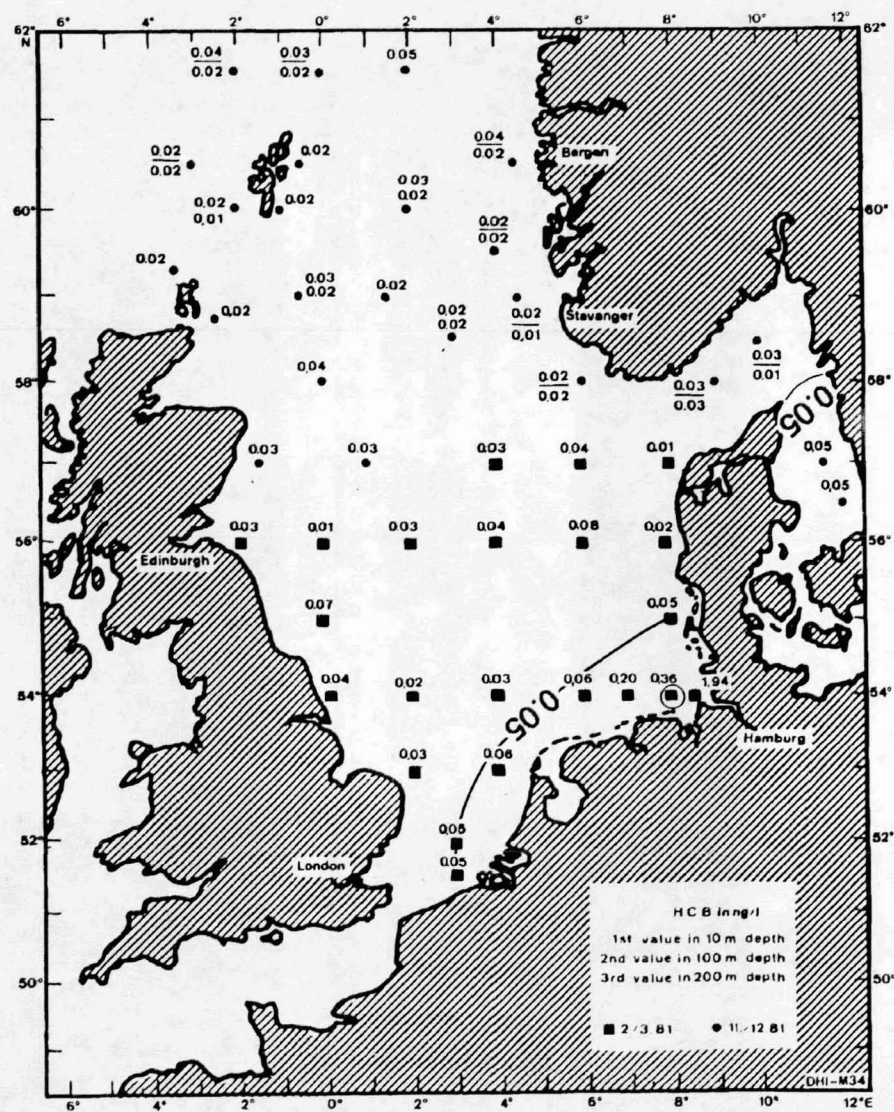
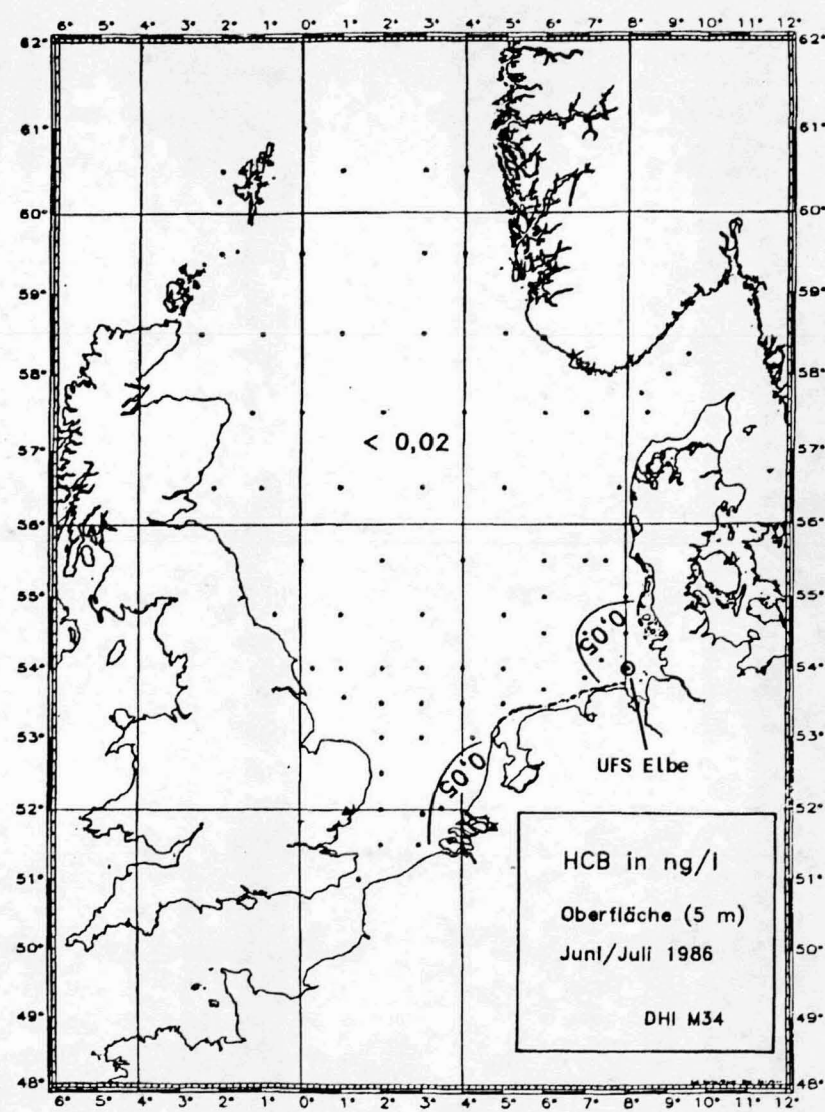


Fig. 2



1981



1986

Fig. 3: Surface water concentration of HCB

Arkona Basin BMP K4

55°00'N 14°05'E

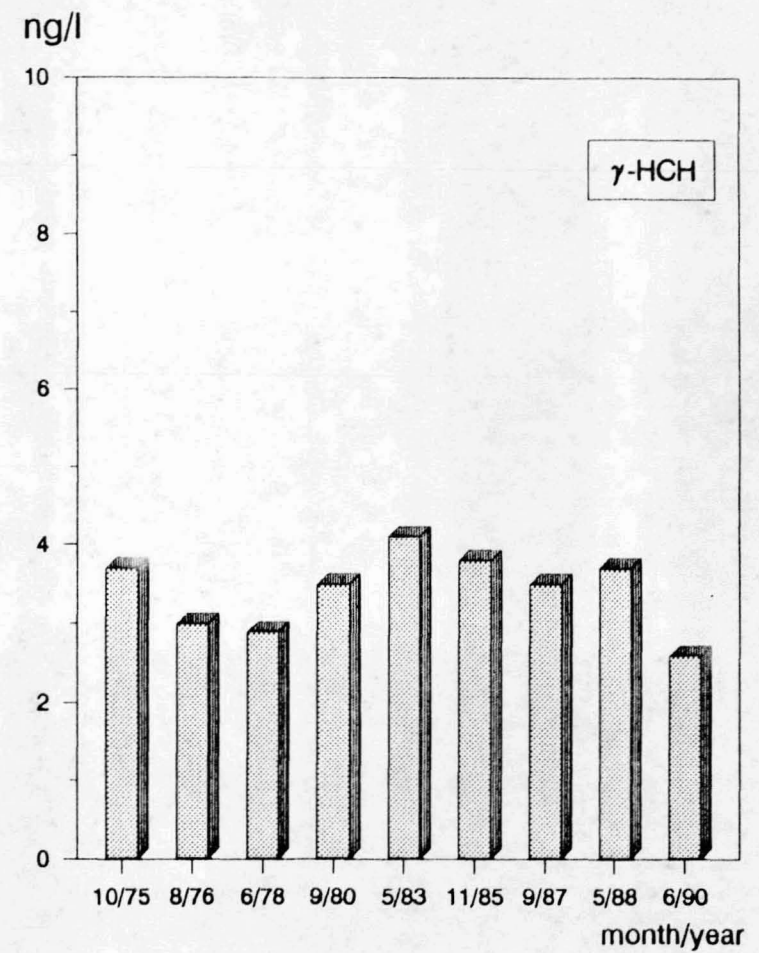
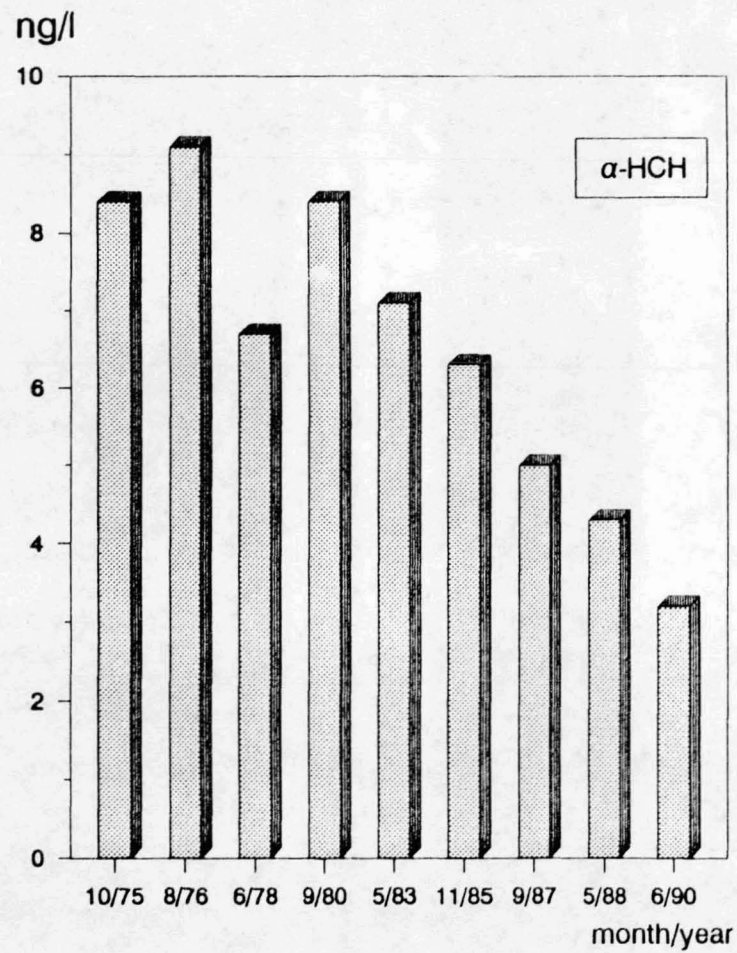
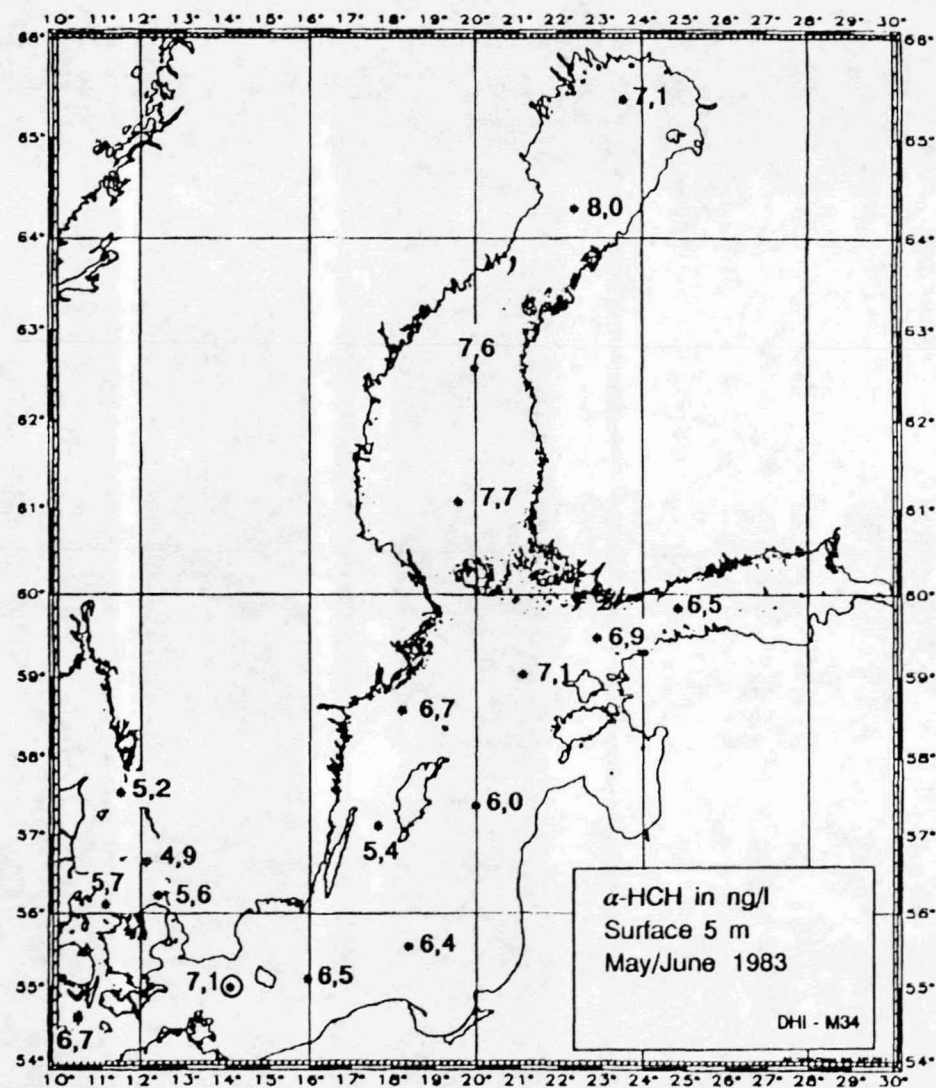
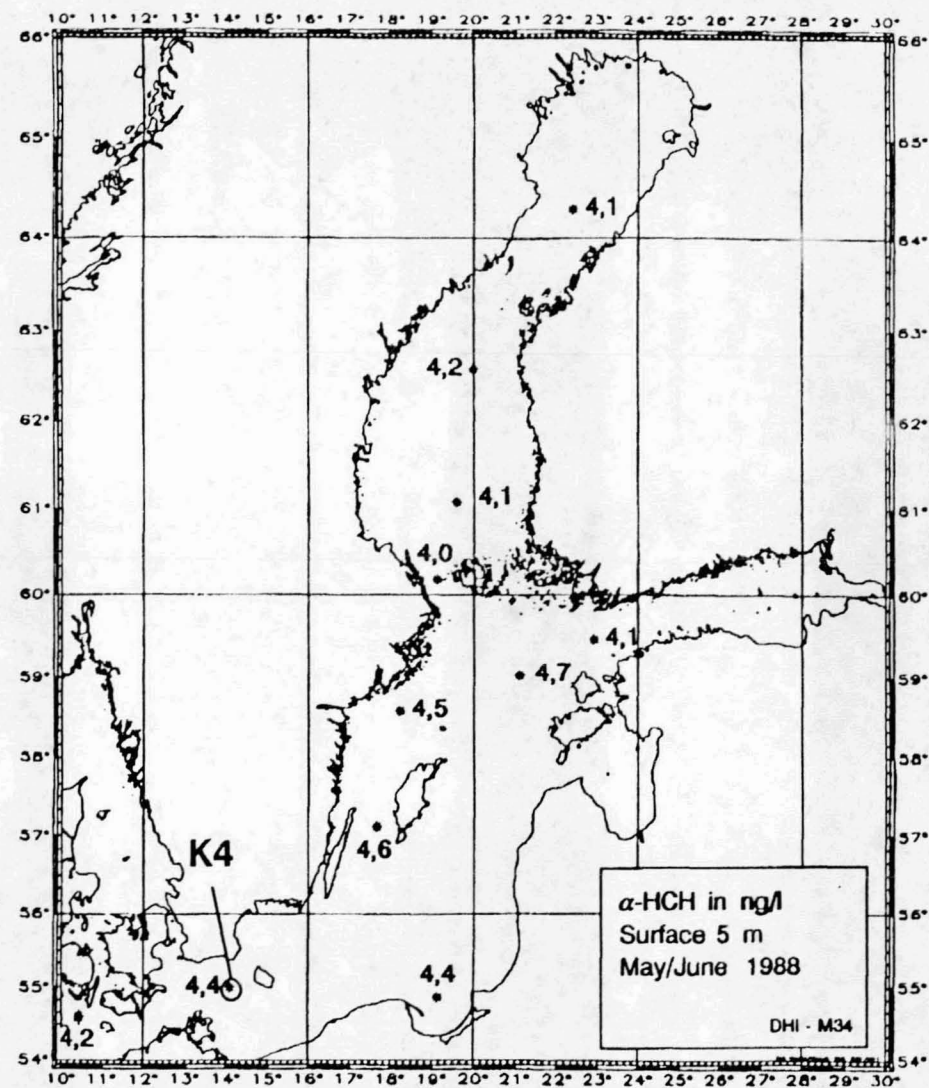


Fig. 4



1983



1988

Fig. 5 Surface water concentration of α -HCH

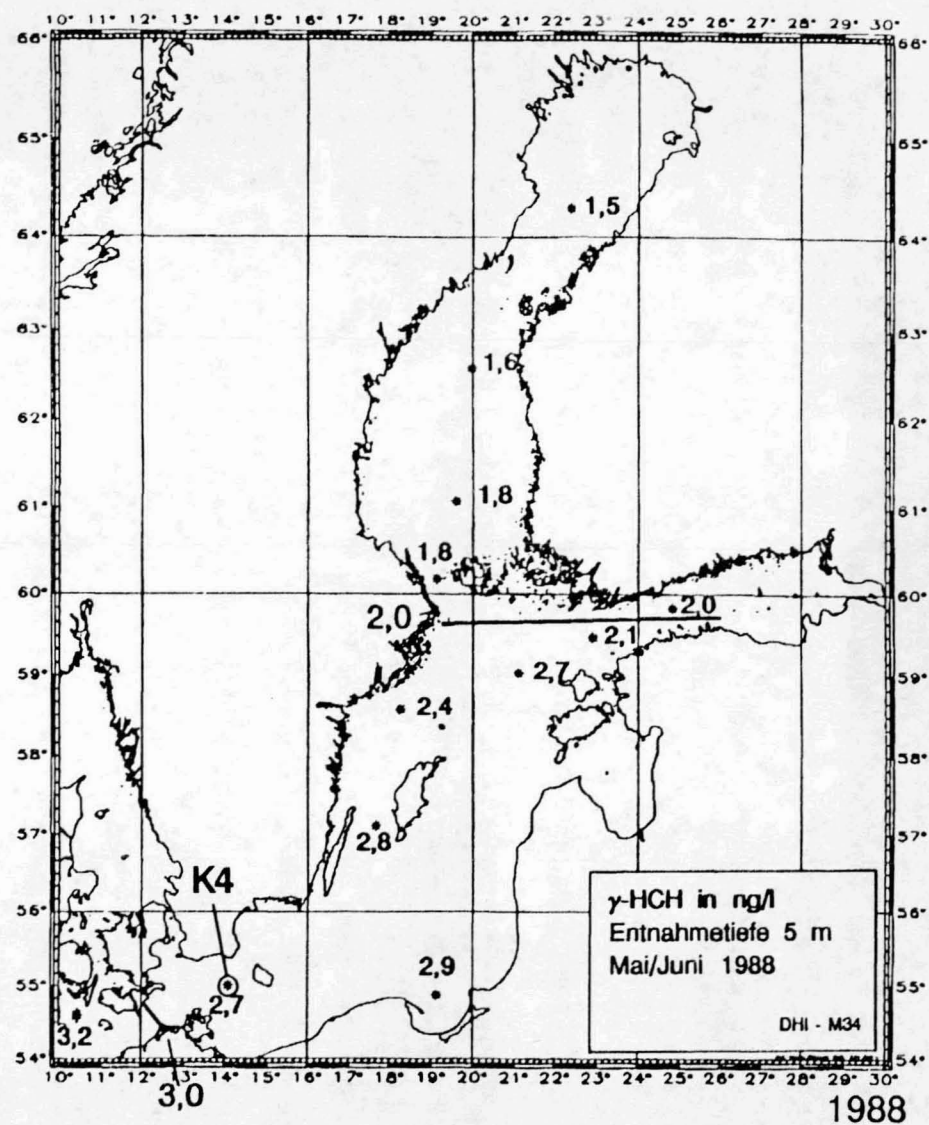
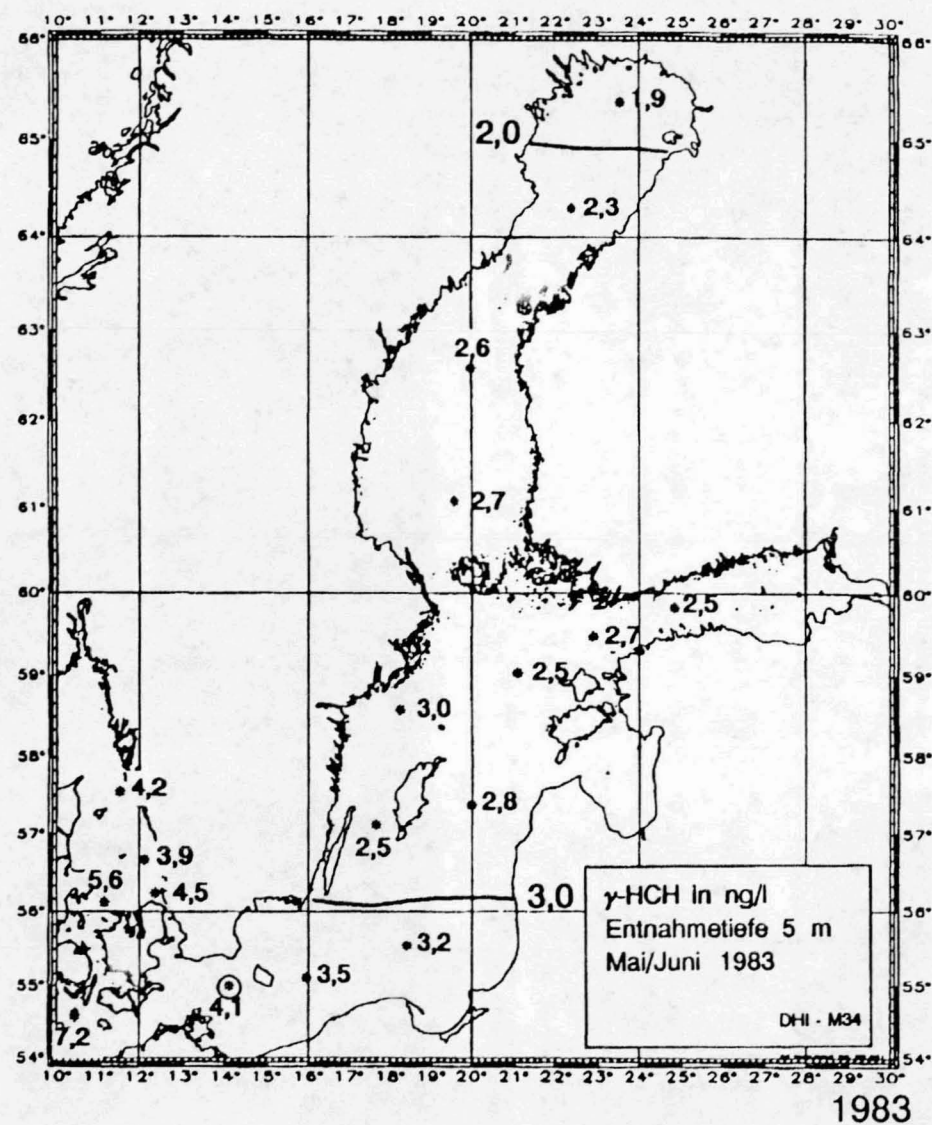


Fig. 6 Surface water concentration of Lindane (γ -HCH)