

COOPERATIVE RESEARCH REPORT

No. 63

STUDIES OF THE POLLUTION OF THE BALTIC SEA

by

the ICES/SCOR Working Group on the
Study of Pollution of the Baltic

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PREFACE

This document consists of two separate reports dealing with different aspects of identification and quantification of pollutants in the Baltic Sea and its living resources. The reports are presented separately and no attempt has been made to cross-interpret the results of the studies with one another.

The first report, on the Replies to the Questionnaire to Determine Sources of Input to the Baltic Sea, provides a follow-up to the earlier ICES Report on Pollution of the Baltic Sea (Coop.Res.Rep., Ser.A, No.15 (1970)), which presented estimates of the amounts of pollutants discharged into the Baltic primarily from sewage and industrial wastes. This follow-up report presents data, accurate to the end of 1972, provided by all Baltic Sea States in response to a questionnaire circulated by the ICES/SCOR Working Group on the Study of Pollution in the Baltic. Data from each country are presented as to the amount of sewage and industrial waste flowing into the Baltic, both directly from land and also through rivers. Additional information is provided regarding certain specific pollutants, nutrients, and oxygen demand in these inputs to the Baltic.

The second report, on the Baseline Study of the Level of Contaminating Substances in Living Resources of the Baltic 1974/75, and on the Inter-calibration Exercise connected with it, contains the results of a co-ordinated survey of the levels of selected metals and organochlorine compounds in certain species of fish and shellfish in the Baltic Sea. Included in the report are the results of the intercalibration exercises for the determination of concentrations in fish tissue of trace metals and of the organochlorine compounds DDT, its metabolites, and PCBs. This study was conducted under the auspices of the ICES/SCOR Working Group on the Study of Pollution in the Baltic, and was executed by various laboratories in the Baltic Sea States.

The ICES/SCOR Working Group is very grateful to Dr H J Brosin and his collaborators for their work on the study of inputs to the Baltic, and to Professor K Grasshoff and his collaborators on the Baseline Study for their work.

G Kullenberg

Chairman

ICES/SCOR Working Group on the Study
of Pollution of the Baltic and
its Effects on Living Resources

I. REPORT ON THE REPLIES TO THE QUESTIONNAIRE TO DETERMINE SOURCES OF
INPUT TO THE BALTIC SEA

INTRODUCTION

The ICES Report on Pollution of the Baltic Sea (Coop.Res.Rep., Ser.A, No.15 (1970)), included information on the input of pollutants into the Baltic, mainly in relation to the size of the contributing population, and estimates of inputs of domestic sewage and some industrial wastes. At the first meeting of the ICES/SCOR Working Group on the Study of Pollution of the Baltic, held in Lund (Sweden) in May 1972, it was agreed to circulate a questionnaire about the sources of input in general into the Baltic Sea. The aim was to obtain more detailed information than that contained in the previous report.

The Working Group is of the opinion that a comprehensive survey of the input of pollutants into the Baltic Sea is a necessary prerequisite to the determination of measures to protect the Baltic Sea, as well as for pollution research, both fundamental and applied. Correct input data are needed for assessment of the present situation in the Baltic and for evaluation of the developing trends.

Such data are also necessary for a determination of the fluxes of dissolved and suspended matter and of the material balances. The development and verification of realistic models of the Baltic ecosystem also require reliable input data and a total material budget. Assessments of various components affecting eutrophication and oxygen balance are important for the development of a numerical model for the evaluation of the risks connected with nutrient inputs.

A correlation should also be attempted between the input data, especially of environmental contaminants such as Hg, DDT, etc., and the levels found in Baltic sea water and in the organisms living there.

With these objectives in view a questionnaire (Appendix 1) was distributed to all Baltic countries in July 1972. Each country was requested to divide its coastline into a number of zones and, for each zone, to provide data on the flow of sewage and industrial wastes. Details on the quantities of several pollutants, on dumping activities, and information about programs to monitor atmospheric inputs were also asked for.

All countries had replied by April 1974 and a Sub-Group was established by the Working Group at its meeting in Charlottenlund in May 1974 with the task of compiling the data and drafting a report. The Group consisted of:

Dr H J Brosin (Convenor)
Dr A Voipio
Mr A Haverinen
Dr W Slaczka

The Sub-Group worked by correspondence.

The replies from the Baltic countries vary as to the amount of information supplied (Table 2). The data submitted are, with a few exceptions, considered to be accurate to the end of 1972. The replies have been summarised in Appendix 2 and Tables 1 and 3-7.

The original data from the replies have been used as a basis for this report. However, both data and methods vary considerably. Much wanted information, especially on inputs other than nutrients and certain

industrial wastes, is not yet available, and the Working Group does not consider it appropriate to undertake extrapolations for the whole Baltic area based on incomplete data from one or a few countries. No such extrapolations have, therefore, been made in the present report.

Figures and information from the previous ICES report were included in some cases, if there was no other information and if they conformed with the other submitted information.

Special attention has been paid to the estimation of input via rivers. It must be taken into consideration that the input of pollutants via rivers is particularly important in the Baltic, with its extended coast line of about 20 000 km, a drainage area for all rivers of about 1.6 million km² and the large influence of river discharges on the water balance of the Baltic. River discharges amount to about 480 km³/year, or 2.2% of the total volume of the Baltic. On the other hand, only a part of the input of pollutants from drainage areas reaches the open sea due to the process of self-purification. It is difficult or impossible to estimate how much of the river load actually reaches the open Baltic Sea and how much is retained in the coastal zone by sedimentation and other processes. The submitted data on inputs via rivers are, therefore, of importance mainly for a more or less extended nearshore zone, the width of which is dependent on the actual hydrological situations (for instance, this area is 25-35 km wide in the German Democratic Republic, 5-40 km wide in Finland, and 20-100 km wide in Sweden).

INPUT RESULTS

Inputs of Pollutants in Domestic Sewage

The replies regarding domestic sewage are summarised in Tables 3-5. Not all replies contained information on the total dry weather flow, and in some cases figures were given for domestic sewage only. Due to differences in water consumption, the conversion factor per person used to calculate domestic sewage varied to a considerable extent (from less than 0.1 m³/day per person to 0.3 or in some cases up to 0.5 m³ per day). The proportion of industrial effluents permitted into town sewage systems also varied considerably. It was mentioned in some replies (for instance, from Denmark and GDR) that most industrial wastes were discharged and treated together with domestic sewage.

The ratio of domestic sewage to industrial wastes varied for the different parts of the Baltic. About 50% or more of the waste water input along the western and southern borders of the Baltic area results from domestic sewage. The proportion is smaller for the eastern part of the Baltic proper, the Gulf of Finland and the Bothnian Sea and Bothnian Bay. More than 80% of waste water input from the Finnish coast comes from industrial sources (mostly from the paper and pulp industries). There is no information for the Swedish coast on this subject, but from the submitted figures on loads, one may assume the main input to be industrial waste, especially for the Bothnian Sea and Bothnian Bay.

The total number of people contributing to the direct and indirect input of domestic sewage is about 17.5 million. An additional temporary population of tourists during the summer time is included in some reports. About two thirds of the population contribute directly to the open sea and about one third via estuaries and rivers. Centres of high population are situated in the Øresund region, in the Belt Sea, in some regions of the Baltic proper and around the Gulf of Finland. The estimated total number for the contributing population is smaller than in the previous ICES report by about 10%.

The total inflow of domestic sewage may be estimated to be about 2.3 million m³/day as direct input and 1.2 million m³/day as indirect

input, if one allows for input from Poland and U.S.S.R. calculated on the basis of water consumption figures alone. The main inputs are located in the Øresund region, around the Gulf of Finland and in the Stockholm area.

Comparatively large amounts of sewage are discharged into the Baltic without treatment. The submitted figures for this proportion vary between 5-10% and 60%. Altogether about 40% of the direct and 20% of the indirect input are discharged without treatment. About 20% of the direct and 30% of the indirect discharges receive settlement treatment only; about one third of all discharges receive settlement and biological treatment. Only 3% of the direct and approximately 15% of the indirect discharges get additional treatment (mainly in Finland and Sweden).

The oxygen demand resulting from the sewage entering the Baltic Sea was calculated by each country and given as an approximate figure for BOD. Information on COD was not included. Because of variations in the conversion factors, COD values have not been calculated in this report. Not all countries have given figures for oxygen demand per person per year. The submitted values vary between 20 and 25 kg BOD per person per year, and some corrections for sewage treatment (and also some additions) were mentioned in the replies. It has not been possible to distinguish between BOD from domestic and industrial wastes for all countries. All figures, taken together, give a total input of BOD of about 1 100 000 tons/year. Based on the applied figures for BOD input from industrial waste water for Finland, Sweden and U.S.S.R., and an additional estimate of about 75 000 tons/year for the other countries, the industrial contribution would be approximately 750 000 tons/year. These figures are in good agreement with previous (ICES, 1970) estimates (industrial BOD about 800 000 tons/year and BOD from domestic sewage 390 000 tons/year). The main input of BOD takes place in the Gulf of Finland and in the Bothnian Sea and Bothnian Bay.

Estimates of the amounts of transported nitrogen and phosphorus were carried out on the basis of values given in the replies. Conversion factors were given, however, in only a few cases.

Information on nitrogen input in sewage was included in only a few replies. The total input has been calculated using the conversion factor for Denmark (4.4 kg nitrogen/year per person). This approach appears to be correct, because a comparison between the replies from Finland and Sweden and calculations made on this basis leads to differences of only 10-15%. The total nitrogen input in sewage so calculated amounts to about 77 000 tons/year. The contribution from industrial waste has not been included, nor has the effect of sewage treatment been considered.

A figure of approximately 27 000 tons/year has been estimated as the total amount of phosphorus in sewage discharged into the Baltic. In the replies from Finland and Sweden, industrial phosphorus inputs are given as 20-25% of the values for sewage. Application of this relationship gives a figure of approximately 33 700 tons/year for the total phosphorus input, or about 30% more than in the previous ICES report. The greater part of this nutrient load is discharged into the Gulf of Finland and the Øresund.

The replies from Finland and Sweden also contain information on the input of lignin (total quantity about 505 000 tons/year), mainly in the northern Baltic, the Bothnian Sea and the Bothnian Bay.

Data on the content of pesticides and PCBs in domestic and mixed sewages are totally lacking.

Data are also lacking on the input of metals. No country could provide figures for metal contents in sewage effluents on a country-wide basis. Only in the reply from Denmark were some figures given for metal inputs

in one sewage system from the Copenhagen area, serving about 450 000 people and including industries. These values amounted to 150 tons Zn/year, 23 tons Cu/year and 7.4 tons Cr/year. Some figures for heavy metal discharges in municipal sewage treatment plants in Sweden have also been given by Engwall (1972). He estimated a yearly input of about 100 tons of zinc, 30 tons of copper and manganese, 10 tons of lead, 3 tons of nickel and 1 ton of cobalt, cadmium and mercury. But he warned that these figures should be used with great care. The Working Group has further been informed that input of arsenic in Sweden (Area 2) amounted to about 1 600 tons (as As_2O_3) in 1974, in the form of industrial waste.

It is not possible to make even first order estimates of the total input of metals on the basis of this poor information. Indirect conclusions based on metal consumption are also impossible, because both data and conversion factors are lacking.

Inputs of Pollutants in Industrial Wastes

Information on the major industries contributing to the input of wastes is contained in all replies (Table 6), but information on the main industrial waste products is insufficient. Two replies indicate that there is a large amount of waste from paper and pulp industries which is discharged into the northern parts of the Baltic Sea and into the Bothnian Sea and Bothnian Bay.

The replies referring to the input of industrial wastes are summarised in Table 7. Only Finland was able to provide detailed information, as the result of a questionnaire by the National Board of Waters in 1972. Poland has given information on two discharge sources of industrial effluents in the province of Gdańsk. The figures in the Swedish reply do not summarise the total amount of industrial waste discharged into the Baltic, because direct measurements of the transported toxic substances have been made for only a limited number of industries.

Cooling water discharges, when not mixed with other effluents, from conventional and nuclear power stations and from other industries have not been included here due to lack of information.

Information on BOD and nutrients in industrial effluents is missing. (Figures on industrial waste discharged together with domestic sewage were included in the previous section.) There is only very insufficient information on input of metals and other possible pollutants, such as phenols and oils, and the few figures available show significant regional differences. In the Finnish reply, for instance, total industrial inputs of 0.2 tons Hg/year are mentioned, while the Swedish figure amounted to 6.3 tons Hg/year. There are indications that the discharge of mercury in these countries is being reduced. A few figures on industrial inputs of chlorinated hydrocarbons and organic substances from the production of synthetics are included in the Swedish reply (Table 7).

On the basis of this information it is not possible to estimate the total flow of industrial effluents into the Baltic Sea. Comprehensive data on the quantities of industrial wastes as well as on the transported toxic substances are missing almost completely. It does not appear justified to make extrapolations on the basis of data from one country alone, because of the specific character of the industries in the different regions.

Inputs by Marine Dumping

According to the replies, deliberate dumping activities of industrial waste, sewage sludge and other waste did not play a significant role in the Baltic area in the period 1967-72.

Accidental fishing-up of dumped ammunitions from World War II has sometimes created problems for the fisheries (for instance in the Little Belt and near Bornholm).

With the exception of the dumping of dredged materials from operations in harbours and waterways, there are at present no existing or planned dumping activities, and no past dumping activities were reported in the replies from Denmark, German Democratic Republic, Poland and U.S.S.R.

A dumping of about 140 tons/day of digested sewage sludge southeast of the Breitgrund, reported originally in the reply from the Federal Republic of Germany, has been discontinued since January 1974.

Occasional dumpings of minor amounts of ammunition have been made in the Bothnian Bay ($64^{\circ}10'N$, $22^{\circ}27'E$), but are now discontinued. In the late 1960s, one illegal dumping of about 6 tons of waste (including 5-6% cyanides) from a metal industry occurred in Finnish territorial waters.

A survey carried out by the Swedish Chemical Industries showed that dumping has occurred to a limited extent in non-territorial waters, but mostly outside the Baltic Sea. The reply refers to the dumping of 30 kg mercury (in contaminated rinse water, packages and refuse), 200 kg fosgen (in steel barrels), 500 kg azidophenyle acetic acid and 4 500 kg nickel (in used catalysts) in the Landsort Deep between 1965 and 1968.

Inputs by Atmospheric Fallout

At present only very little information exists on atmospheric fallout and precipitation over the sea and on the input of pollutants via the atmosphere, but there are some investigations currently undertaken on different parameters and in the framework of different organisations.

Denmark contributes to the work of OECD and the IHD on measurement of pH and SO_2 in air and atmospheric precipitation.

Investigations on the content of floating dust, ozone and SO_2 in the atmosphere are carried out by the Meteorological Service of the German Democratic Republic at the nearshore station Arkona.

About 150 air and 75 rain water samples are collected monthly from five sampling stations under the leadership of the Finnish Meteorological Institute and are combined with an OECD monitoring programme. The content of sulphates in the air samples is analysed, and conductivity, pH, sodium, chlorides, organic carbon and total nitrogen are determined from the water samples. A monitoring of the quality of rain water at about 50 locations (distributed over the entire territory of Finland) was started in 1971 by the National Board of Waters. The following parameters are determined monthly: conductivity, pH, strong acids, organic carbon, SO_4-S , Cl, Na, K, Ca, Mg, total P, total N, NO_3-N and NH_4-N .

The following figures are given as an example of the results obtained so far by Polish investigations: the total atmospheric fallout of solids in the province of Szczecin (western part of the Polish coastline) amounts to 52-483 tons/km²/year; mean values of 120-170 tons/km²/year are found in towns in the province of Koszalin. Measurements of air-borne fallout take place in Kolobrzeg and Koszalin. Current investigations on mercury content in air and precipitation, including samples taken at sea near the shore, showed as preliminary results 0.18-2.14 $\mu g Hg/m^3$ for air and 0.12-1.50 $\mu g Hg/l$ for rainwater.

The Swedish programme for monitoring atmospheric fallout includes the following two main projects:

Investigations of soot and particle-borne sulphur at some inland stations and along the southern and western coasts;

Participation in the European Atmospheric Chemistry Network (parameters measured in precipitation: Cl, NO₃, Na, K, Mg, Ca, alkalinity, pH, conductivity; in air, the same parameters are measured, including also NH₃ and soot). In cooperation with the Meteorological Institute of Stockholm University, average monthly levels of PCB and ΣDDT in air-borne fallout are determined from some 20 stations within Sweden.

In U.S.S.R., atmospheric fallout is studied on a routine basis by the State Hydrometeorological Service of the U.S.S.R. Scientific research on atmospheric fallout is carried out mainly by the Academies of Sciences of the Estonian SSR and the Lithuanian SSR.

It can be seen from these programmes that only in a few cases are substances included which are likely to cause marine pollution in the Baltic. Apparently no publication summarising the data is yet available.

Inputs by Other Sources

In some replies, other sources of pollution were also mentioned. Ship-generated waste, such as garbage, oil, sewage and accidental release of bulk chemicals can contribute to pollution, especially in regions with dense traffic by ferries or shipping lanes (for instance, in the Belt Sea). An investigation on pollution by ships in the western Baltic (Ocean und Technik, 1972) showed an input of about 2 000 tons of garbage and 100 000 m³ of sewage for the period July-September 1971, corresponding to a population of about 40 000. Oil spills in harbour areas, coastal waters, and the open sea area are mentioned as additional sources of pollution. The transport of crude oil and oil products in the Baltic Sea amounted to approximately 35 million tons in 1966 (Heeckt, 1968). The transported quantity has since increased considerably and it may be justified to assume at least double that amount in the early 1970s.

Averages in the range of 0.5 to 5 per mille of the amount of transported oil are reported to reach the sea. Considering the strict regulations in the Baltic, it may be permitted to use the lower figure, which leads to a yearly input of oil of about 35 000 tons. (To this figure should be added the input of oil from industrial sources, for instance, about 350 tons/year from Finland and at least 5 100 tons/year from Sweden.)

CONCLUSIONS

The present report, when compared with the corresponding part of the 1970 report, shows that in some cases more information has now become available. There are more details on inputs of sewage and mixed effluents of sewage and industrial waste. Other data have also been improved. However, figures on input quantities of oxygen-demanding substances and nutrients are still limited, and there is very little information on the input of metals. Information on the content of pesticides, PCBs and other contaminating substances in sewage and other effluents is almost totally lacking. There is little information on the input of industrial wastes outside of those in municipal sewage treatment systems. The quantities of pollutants from the atmosphere are unknown.

The reasons for this incomplete picture are, first, the lack of national investigation programmes; second, the possibility that not all available information has been reported due to lack of national coordination; and third, that some national activities on evaluation of input data have been started only recently and data series of a preliminary character may not have been reported.

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- OCEAN und TECHNIK, 1972. Verschmutzung durch Schiffe in der Ostsee. Ocean und Technik, No.34.

Table 1. Key to area codes.

| Country | Code | Area | Remarks |
|-----------------------------|-------|--|---|
| Denmark | De 1 | Northern Belt Sea | Subdivision according to ICES Coop.Res.Rep., Ser.A, No.15, Fig.1 |
| | De 2 | Central and Southern Belt Sea | |
| | De 3 | Øresund | |
| | De 4 | Bornholm | |
| Federal Republic of Germany | | Whole coast line | |
| Finland | | Whole coast line | |
| German Democratic Republic | | Whole coast line | |
| Poland | Po 1 | Western part of Polish coast with the rivers Odra, Swina, Dzwina and Rega | |
| | Po 2 | Central part of Polish coast with the rivers Parseta, Wieprza, Słupia and Lupawa | |
| | Po 3 | Eastern part of Polish coast with rivers Leba and Wisła | |
| Sweden | Sw 1 | Bothnian Bay | The Swedish coast has been divided into 10 sections in agreement with the main hydrographical features of adjacent sea and land areas. The sections have also been adjusted to agree with administrative units. |
| | Sw 2 | Bothnian Bay | |
| | Sw 3 | Bothnian Sea | |
| | Sw 4 | Bothnian Sea | |
| | Sw 5 | Bothnian Sea and Baltic proper | |
| | Sw 6 | Baltic proper | |
| | Sw 7 | Baltic proper | |
| | Sw 8 | Baltic proper | |
| | Sw 9 | Gotland | |
| | Sw 10 | Øresund and Baltic proper | |
| U.S.S.R. | | Whole coast line | |

Table 2. Summary of replies to the questionnaire on inputs to the Baltic Sea.

| | Section A Domestic and industrial sewage | Section B Details on industrial wastes | Section C Dumping and mining activities | Section D Atmospheric fallout | Section E Other pollution sources |
|-----------------------------------|---|---|--|---|--|
| Denmark | Information subdivided into 4 areas | Some additional information | No registered or planned dumping activities of industrial wastes or <u>sewage sludge</u> | Information on partici- pation in international programmes | No other source |
| Federal Republic of Germany | Information for whole coastline | Some additional information | Details provided for one regular former dumping of sewage sludge. No existing or planned dumping <u>activities</u> | No information available | Ship-borne wastes |
| Finland | Information for whole coastline | Some additional information | Details provided for one past illegal dumping of wastes. No existing or <u>planned dumping activities</u> | Information on partici- pation in national and international programmes | No information |
| German Democratic Republic | Information for whole coastline | Some additional information | No past dumping of indu- strial wastes or sewage sludge. No existing or planned dumping activities | Information on national programmes | No other source |
| Poland | Information subdivided into 3 areas | Some additional information | No dumping and mining activities | Some information on air- borne fallout | Oil pollution in harbours |
| Sweden | Information subdivided into 10 areas | Some additional information | Details provided for past dumping activities. No existing or planned dumping activities | Information on national and international pro- grammes | Oil spills in coastal waters and in the open sea |
| U.S.S.R. | Information for whole coastline | Some additional information | No activities | Information on national programmes | No information |

Table 3. Data on contributing population and waste water flow.
(For further remarks on Table 3, see p.12).

N.I. = no information

| Country and area | Dry weather flow (10 ³ m ³ /day) | | | Population (10 ³ inhabitants) | | | Proportion (%) | | | | | |
|------------------|---|--------------------|---------------------|---|-------------------|---------------------|-----------------|----------|-------|------------------|----------|-------|
| | | | | | | | Domestic sewage | | | Industrial waste | | |
| | direct | indirect | total | direct | indirect | total | direct | indirect | total | direct | indirect | total |
| Denmark | | | | | | | | | | | | |
| De 1 | 70 | 190 | 260 | 164 | 444 | 608 | 43 | 47 | 46 | 57 | 53 | 54 |
| De 2 | 110 | 150 | 260 | 261 | 370 | 631 | 45 | 47 | 46 | 55 | 53 | 54 |
| De 3 | 540 | 30 | 570 | 1 436 | 130 | 1 566 | 54 | 67 | 54 | 46 | 33 | 46 |
| De 4 | 8 | 1 | 9 | 28 | 4 | 32 | 62 | 100 | 67 | 38 | 0 | 33 |
| Total | 728 | 371 | 1 099 | 1 889 | 948 | 2 837 | 52 | 49 | 51 | 48 | 51 | 49 |
| F.R.G. | N.I. ¹⁾ | N.I. ¹⁾ | N.I. ¹⁾ | 610 ²⁾ | 355 | 965 | | | | | | |
| G.D.R. | N.I. ³⁾ | N.I. ³⁾ | N.I. ³⁾ | 150 | 830 | 980 ⁴⁾ | | | | | | |
| Poland | | | | | | | | | | | | |
| Po 1 | 0 | 12 | 12 | | | 122 | 0 | 72 | 72 | 0 | 28 | 28 |
| Po 2 | 17 | 48 | 65 | | | 450 | 69 | 63 | 66 | 31 | 37 | 34 |
| Po 3 | N.I. | N.I. | N.I. | | | 900 | | | | | | |
| Total | | | | | | 1 472 | | | | | | |
| U.S.S.R. | 1 500 ⁵⁾ | N.I. | N.I. | 5 620 ⁶⁾ | 782 ⁶⁾ | 6 402 ⁶⁾ | 40 | N.I. | N.I. | 60 | N.I. | N.I. |
| Finland | 2 280 ⁷⁾ | 123 ⁷⁾ | 2 403 ⁷⁾ | 1 326 | 44 | 1 370 | 17 | 11 | 16 | 83 | 89 | 84 |
| Sweden | | | | | | | | | | | | |
| Sw 1 | | | | 2 | 182 | 184 | | | | | | |
| Sw 2 | | | | 4 | 139 | 143 | | | | | | |
| Sw 3 | | | | 47 | 75 | 122 | | | | | | |
| Sw 4 | | | | 19 | 211 | 230 | | | | | | |
| Sw 5 | N.I. ⁸⁾ | N.I. ⁸⁾ | N.I. ⁸⁾ | 1 018 | 405 | 1 423 | | | | | | |
| Sw 6 | | | | 52 | 344 | 396 | | | | | | |
| Sw 7 | | | | 57 | 99 | 156 | | | | | | |
| Sw 8 | | | | 50 | 153 | 203 | | | | | | |
| Sw 9 | | | | 25 | 2 | 27 | | | | | | |
| Sw 10 | | | | 407 | 176 | 583 | | | | | | |
| Total | | | | 1 681 | 1 786 | 3 467 | | | | | | |
| BALTIC TOTAL | | | | | | 17 493 | | | | | | |

Remarks to Table 3

- 1) F.R.G.: Flow of domestic sewage ($10^3 \text{ m}^3/\text{day}$)
 direct input: 92
 Input via rivers + Schlei + inner
 Flensburg Fjord: 53
- 2) including 50 000 tourists (averaged over the year)
- 3) G.D.R.: Flow of domestic sewage ($10^3 \text{ m}^3/\text{day}$)
 direct input: 18
 Input via rivers + Bodden: 100
- 4) including 85 000 tourists (averaged over the year)
- 5) U.S.S.R.: with the exception of Leningrad
- 6) Figures from ICES (1970). The figure for indirectly contributing population in reply to the questionnaire was calculated for the whole U.S.S.R. drainage area to the Baltic Sea and seems to be considerably too high.
- 7) Finland: Waste water from food stuffs industry and also some minor industries were excluded as well as all cooling waters.
- 8) Sweden: Because total dry weather flow was estimated on the basis of 300 l/person per day plus 75 l covering some service industries, but without other industries, only the flow of domestic sewage ($10^3 \text{ m}^3/\text{day}$) was calculated on the basis of submitted figures, as follows:

Calculated flow of domestic sewage ($10^3 \text{ m}^3/\text{day}$) for Sweden

| Area | Direct input | Input via rivers |
|-------|--------------|------------------|
| Sw 1 | 0.6 | 54 |
| Sw 2 | 1 | 42 |
| SW 3 | 14 | 22 |
| Sw 4 | 6 | 63 |
| Sw 5 | 306 | 122 |
| Sw 6 | 16 | 103 |
| Sw 7 | 17 | 30 |
| Sw 8 | 15 | 46 |
| Sw 9 | 7 | 0.5 |
| Sw 10 | 122 | 53 |
| Total | 504.6 | 535.5 |

Table 4. Data on treatment of wastes (% total direct or indirect). N.I. = no information.

| Country and Area | Discharged direct | Untreated ¹⁾ indirect | Settlement | | Settlement and Biological treatment | | Additional or other treatment | |
|------------------|-------------------|----------------------------------|------------|----------|-------------------------------------|----------|-------------------------------|----------|
| | | | direct | indirect | direct | indirect | direct | indirect |
| Denmark: De 1 | 10 | 1 | 80 | 31 | 10 | 68 | | |
| De 2 | 61 | 8 | 34 | 63 | 5 | 29 | | |
| De 3 | 63 | 3 | 16 | 10 | 21 | 87 | | |
| De 4 | 95 | 14 | 5 | 29 | 0 | 57 | | |
| Weighted average | 58 | 4 | 25 | 42 | 17 | 54 | | |
| F.R.G. | ~ 5 | | ~ 40 | | ~ 55 | | | |
| G.D.R. | 20 ²⁾ | 50 | 80 | 40 | | 10 | 40 | |
| Poland: Po 1 | 0 | 28 | 0 | 72 | | | | |
| Po 2 | 0 | 19 | 100 | 72 | | 6 | | 3 |
| Po 3 | N.I. | N.I. | N.I. | N.I. | N.I. | N.I. | | |
| U.S.S.R. | ~ 60 | ~ 60 | ~ 30 | ~ 30 | ~ 10 | ~ 10 | | |
| Finland | 32 | 47 | 5 | 1 | 51 | 42 | 12 | 10 |
| Sweden: Sw 1 | 0 | 13 | 48 | 43 | 52 | 30 | 0 | 13 |
| Sw 2 | 0 | 80 | 34 | 9 | 66 | 5 | 0 | 6 |
| Sw 3 | 18 | 45 | 9 | 28 | 73 | 11 | 0 | 16 |
| Sw 4 | 0 | 2 | 69 | 33 | 31 | 48 | 0 | 17 |
| Sw 5 | 2 | 0 | 1 | 1 | 89 | 18 | 7 | 81 |
| Sw 6 | 0 | 0 | 37 | 10 | 4 | 84 | 59 | 6 |
| Sw 7 | 4 | 3 | 44 | 14 | 13 | 39 | 39 | 44 |
| Sw 8 | 40 | 6 | 4 | 8 | 56 | 70 | 0 | 15 |
| Sw 9 | 0 | 0 | 92 | 0 | 2 | 100 | 5 | 0 |
| Sw 10 | 29 | 0 | 0 | 1 | 71 | 94 | 0 | 5 |
| Weighted average | 10 | 10 | 6 | 14 | 76 | 47 | 7 | 28 |

1) "Untreated" means that there is no arranged common sewage treatment; in most Baltic countries, however, houses without connection to a central sewage treatment plant must have appropriate sedimentation tanks before discharge.

2) G.D.R.: mainly waste waters from Sassnitz (Island Rügen). Mechanical and biological treatment under construction to be completed at the end of 1975.

Table 5. Data on inputs of substances¹⁾ in tons/year.
(For notes to Table 5, see page 15)

N.I. = no information.

| Country and Area | BOD ²⁾ | | | Total N | | | Total P | | | Lignin | |
|------------------------|-------------------|----------|----------|---------|----------|----------|---------|----------|----------|---------|----------|
| | direct | indirect | Industry | direct | indirect | Industry | direct | indirect | Industry | direct | indirect |
| Denmark | | | | | | | | | | | |
| De 1 ³⁾ | 30 000 | 13 000 | | N.I. | N.I. | | 800 | 1 300 | | | |
| De 2 ³⁾ | | | | | | | | | | | |
| De 3 ⁴⁾ | 45 000 | 800 | | 6 400 | 600 | | 2 000 | 200 | | | |
| De 4 ³⁾ | 1 500 | 500 | | N.I. | N.I. | | 60 | 20 | | | |
| Total | 76 500 | 14 300 | | | | | 2 860 | 1 520 | | | |
| F.R.G. ⁵⁾ | 9 000 | 0 | | N.I. | N.I. | | 400 | 1 100 | | | |
| G.D.R. ⁶⁾ | 3 450 | 18 000 | | N.I. | N.I. | | 190 | 1 040 | | | |
| Poland ⁷⁾ | | | | | | | | | | | |
| Po 1 | 0 | 25 000 | | 0 | 46 700 | | 0 | 3 100 | | | |
| Po 2 | 35 820 | 5 400 | | N.I. | 2 600 | | N.I. | 300 | | | |
| Po 3 | N.I. | N.I. | | N.I. | 48 350 | | N.I. | 4 570 | | | |
| U.S.S.R. ⁸⁾ | 140 000 | 19 600 | 107 000 | N.I. | N.I. | N.I. | 5 600 | 790 | N.I. | | |
| Finland ⁹⁾ | 16 500 | 640 | 144 000 | 5 500 | 175 | 1 383 | 950 | 45 | 213 | 116 000 | 2 800 |
| Sweden ¹⁰⁾ | | | | | | | | | | | |
| Sw 1 | 26 | 2 763 | 21 800 | 7 | 731 | 222 | 2 | 211 | 44 | 17 300 | |
| Sw 2 | 39 | 3 605 | 39 700 | 14 | 635 | 387 | 4 | 190 | 77 | 23 200 | |
| Sw 3 | 537 | 1 546 | 147 000 | 179 | 323 | 1 281 | 55 | 90 | 256 | 168 600 | |
| Sw 4 | 305 | 2 310 | 113 600 | 76 | 806 | 985 | 23 | 225 | 199 | 133 900 | |
| Sw 5 | 6 598 | 1 935 | 9 000 | 3 660 | 1 442 | 533 | 1 068 | 159 | 107 | 3 000 | |
| Sw 6 | 545 | 2 565 | 17 200 | 200 | 1 252 | 161 | 35 | 370 | 32 | 7 400 | |
| Sw 7 | 735 | 831 | 11 300 | 223 | 366 | 157 | 50 | 85 | 32 | 15 300 | |
| Sw 8 | 787 | 1 276 | 21 500 | 201 | 564 | 264 | 62 | 153 | 53 | 17 400 | |
| Sw 9 | 484 | 12 | | 105 | 6 | 19 | 31 | 2 | 4 | | |
| Sw 10 | 5 176 | 1 057 | | 1 587 | 628 | | 489 | 186 | | | |
| Total | 15 232 | 17 900 | 381 100 | 6 252 | 6 753 | 4 009 | 1 819 | 1 671 | 804 | 386 100 | |

Notes to Table 5

- 1) Input data include both domestic sewage and industrial wastes in most of the replies. A distinction between the domestic and industrial sources was possible only for Finland, Sweden and U.S.S.R.

When figures from ICES (1970) were used, they were estimated on the basic assumption that sewage from one person per year is equivalent to 25 kg BOD₅ and 1 kg total phosphorus. In some cases, corrections were made for known sewage treatment or other circumstances.
- 2) BOD₅ and BOD₇ were not always distinguished.
- 3) Denmark: figures for Areas De 1, De 2 and De 4 from ICES (1970).
- 4) Equivalents for De 3 = 22 kg BOD₅, 1.4 kg total P and 4.4 kg total N.
- 5) F.R.G.: figures from ICES (1970).
- 6) G.D.R.: equivalents = 20 kg BOD₅ and 1 kg total P. Corrections for sewage treatment and additions for some industrial and agricultural wastes were carried out.
- 7) Poland: total flow.
- 8) U.S.S.R.: figures from ICES (1970).
- 9) Finland: BOD₇. Figures concerning lignin are only crude evaluations.
- 10) Sweden: BOD₇. In accordance with the calculations for other countries, the discharges into upland sections of rivers were not considered. The data for industrial inputs in the reply to the questionnaire (forest industry) were completed by figures from Engwall (1972).

Table 6. Information on main industries.

N.I. = no information.

| Country and Area | Main industry type | Main industrial wastes |
|-----------------------|---|---|
| Denmark ¹⁾ | | |
| De 1 | Oil refinery, metal plating | N.I. |
| De 2 | Oil refineries, paper and pulp, bulk chemicals, metal plating | N.I. |
| De 3 | Bulk chemicals, drug manufacture, metal plating | N.I. |
| De 4 | Metal plating | N.I. |
| F.R.G. | Food industries, paper mills, iron industry | Wastes from food industries and paper mills |
| G.D.R. ²⁾ | Food industries (sugar and fish processing factories), timber industry (fibre board plant), agriculture (stock farming, production of silage) | Organics, mainly of agricultural origin |
| Poland | | |
| Po 1 | Chemical and food industries, heavy industries (ship yard), mining, cellulose and paper industries | Phenols, phosphates, pesticides |
| Po 2 | Timber industry (hardboard) | N.I. |
| Po 3 | Phosphate and tanning industries | Sulphates, fluorides, phosphates and chromium |
| U.S.S.R. | Food industries (incl. fish processing industries), paper and pulp, oil shale industry, fertiliser industry | Wastes from food industries, paper and pulp factories |
| Finland | Paper and pulp industries ³⁾ , textile industries, bulk chemicals, iron works, metal refineries and plating, tanneries | Dissolved organic materials (from wood) caused by paper and pulp industries |
| Sweden ⁴⁾ | | |
| Sw 1 | Paper and pulp industries, iron works | Dissolved organic materials from paper and pulp industries |
| Sw 2 | Paper and pulp industries, metal refineries | " |
| Sw 3 | Paper and pulp industries, bulk chemicals | " |
| Sw 4 | Paper and pulp industries, petrochemical industries, iron works, bulk chemicals | " |
| Sw 5 | Iron works, metal refineries, metal plating, drug manufacturers, petrochemical industries, bulk chemicals | N.I. |
| Sw 6 | Iron works, bulk chemicals, textile industries | N.I. |
| Sw 7 | Metal refineries and metal plating, paper and pulp industries | N.I. |
| Sw 8 | Iron works, metal plating, paper and pulp industries | N.I. |
| Sw 9 | Metal plating | N.I. |
| Sw 10 | N.I. | N.I. |

Notes to Table 6

- 1) Denmark: metal plating is taking place in many small industries in almost all major towns. Most of the industries discharge to combined sewage systems.
- 2) G.D.R.: industrial waste is usually treated and discharged together with domestic sewage.
- 3) Finland: about 80% of the total flow consists of wastes from paper and pulp industries.
- 4) Sweden: information in the reply to the questionnaire was completed by details from Engwall (1972).

Table 7. Additional information on inputs of industrial wastes.

N.I. = no information.

| Country and Area | Main waste-producing industries and flow (m ³ /day) | Input (tons/year) ¹⁾ |
|---|---|--|
| Poland Po 3 | Phosphoric acid plant (Gdańsk) 4 800 Tanning factory (Rumia) N.I. | BOD 17.3, SO ₄ 1 410, PO ₄ 30, F 72 Cr 16.2 |
| Finland ²⁾ | Fertilisers Sea: 375 000 Rivers: 29 000 Petrochemical Sea: 860 000 Ti O ₂ Sea: 50 000 Chlorine-alkali Sea: 8 000 Rivers ⁴⁾ : 78 000 Tanneries Rivers: N.I. Iron and steel Sea: 360 000 Metal refineries Sea: 545 000 Rivers: 35 000 | P 81, N 870 P 12, N 11.1 Oil 105, phenol 3 FeSO ₄ 114 000, Hg 0.03 ³⁾ Hg 0.12 Hg 0.03 Cr 18 Ni 15, Zn 228, Cu 16.5 ⁵⁾ Ni 24, Cu 9 |
| Sweden ⁶⁾ Sw 1 Sw 2 Sw 3 Sw 4 Sw 5 Sw 6 Sw 7 TOTAL | Iron and steel Metal refineries Bulk chemicals Petrochemical Metal refineries Bulk chemicals Iron and steel Metal refineries Bulk chemicals Petrochemical Iron and steel Iron and steel Metal refineries | Fe 150, CN 21.6, oil 108 Hg 6.2, Cd 9.7, Cu 114, Pb 148, Zn 144, As 1 080, Bi 1.2, Se 4, Cl 89, F 86 Hg 0.04 FA 10, VC 50, PVC 50 F 173 Hg 0.05 Fe 4 946, Zn 0.2, Cr 0.2, H 10, H ₂ S 38.2, CN 12.6, Oil 1 692 Fe 310, Co 1, Mo 2, Wo 2, Ni 37, Cr 27, NO ₃ 742, SO ₄ 94, F 92, Oil 14.4 Ni 43.2, Ph 0.05, Aa 0.1, ClC 0.03 Cu 0.6, Pb 1.8, Ph 12.6, Oil 3 024 Fe 148, Ni 14, Cr 18.3, F 130, Oil 408 Ph 126, CN 10.8 Cd 0.02, Ni 0.2, SO ₄ 850 Hg 6.3, Cd 9.7, Cu 114.6, Pb 149.8, Zn 144.2, As 1 080, Bi 1.2, Se 4, Ni 94.4, Cr 45.5, Co 1, Mo 2, Wo 2, Fe 5 554, H 10, H ₂ S 38.2, CN 45.0, Ph 138.7, NO ₃ 742, SO ₄ 944, Cl 89, F 481, FA 10, VC 50, PVC 50, Aa 0.1, ClC 0.03, Oil 5 246 |

Notes to Table 7

- 1) Figures were given in kg/day, partly in tons/year. Conversion was carried out on the basis of 300 working days = 1 year.
- 2) Finland: typical wastes of some industries in 1972. Cooling waters are included in the total flow. Input via rivers at a distance of about 5-40 km from the coast.
- 3) In 1971. 4) Two plants 75-100 km from the coast. 5) Mainly from one single plant.
- 6) Sweden: the figures do not summarise the total amount of industrial wastes discharged into the Baltic. Direct measurements have been carried out only for a few industries. Ph: phenols, Cl: chloride, F: fluoride, FA: formaldehyde, H: heavy metals, VC: vinyl chloride, PVC: polyvinyl chloride, Aa: aliphatic alcohols, ClC: chlorinated hydrocarbons.

APPENDIX 1

QUESTIONNAIRE TO DETERMINE SOURCES OF INPUT TO THE BALTIC SEA

(Details required of outfalls and other sources of
wastes entering the Baltic Sea)

Section A Domestic sewage and industrial wastes

1. Boundaries of the whole drainage area (show also on map)
2. Total dry weather flow (m^3/day) of waste water without rainwater drainage:
 - a) direct input into the sea including fjords and estuaries up to about 5 or 10 km from the coastline.
 - b) input into the sea via rivers including lakes.
3. Total population contributing to:
 - a) direct input into the sea
 - b) input via rivers
4. Flow of domestic sewage (m^3/day)
 - a) direct input into the sea
 - b) input via rivers
5. Flow of industrial sewage (m^3/day)
 - a) direct input into the sea
 - b) input via rivers
6. Which percentage of flow:
 - is discharged untreated
 - a) direct input
 - b) input via rivers
 - receives settlement only
 - a) direct input
 - b) input via rivers
 - receives settlement and biological treatment
 - a) direct input
 - b) input via rivers
 - receives additional treatment
 - a) direct input
 - b) input via rivers
 - receives other treatment
 - a) direct input
 - b) input via rivers

7. Details of discharge according to:

- a) direct input into the sea
- b) input via rivers

| | |
|-----------------------------|-----------|
| BOD (tons/yr) | |
| COD (tons/yr) | |
| Total nitrogen | (tons/yr) |
| Total phosphorus | (") |
| Pesticides | (") |
| PCBs | (") |
| Chlorinated aliphatics | (") |
| Metals (say which) | (") |
| Lignin | (") |
| Other substances | (") |
| Heat (flow and temperature) | |

- 8. Which major industries contribute to the flow?
- 9. Which are the main industrial wastes present?

Section B Location of industries handling potentially toxic stable substances (give only major sources of pollution)

Produce map or other form of presentation showing areas on rivers, estuaries, or on coast where these industries are located. Where possible, give details of discharges, and quantities of substances discharged. Also give details, where known, of amounts of wastes entering the open sea from rivers or estuaries. Industries to be considered include:

- Ore mining
- Iron and steel
- Bulk chemicals (inc. fertilizers, chlorine alkali, etc.)
- Petrochemical
- Metal plating (incl. block-making)
- Metal refineries
- Paper and pulp
- Drug manufacture
- Tanneries
- Textile industries (e.g. where dieldrin is used for impregnation)
- Power stations

Section C Dumping and mining activities in the Baltic Sea.

(Include industrial waste, sewage sludge, colliery waste, major harbour dredgings, spoil, household refuse, etc.)

1. Past dumping and mining activities (during last 5 years until now):
 - a) routine dumping activities (whether authorised or not)
 - b) incidental dumping activities (whether authorised or not)

Give area of dump, with date, frequency, quantity, composition, origin, whether in containers or released into surface waters. Show location by reference to map.

2. Planned dumping and mining activities - Give details as for 1.

Section D Atmospheric fallout

Give details of national programmes to determine atmospheric fallout at sea or at coastal stations removed from immediate sources of air pollution.

Show areas of sampling, substances being measured, and give reference if publications are available, and also address of the leading national authority.

Section E

Can you suggest other pollution sources not covered in this questionnaire?

Notes

- 1) In Section A, include the Danish Belts and Øresund.
- 2) For Section A, divide coast into convenient geographical regions (large estuaries, lengths of open coast) and combine together discharge in each region. A suggested form of presentation is that given on pp. 40-41 of the ICES North Sea Report (Coop.Res. Rep., Ser.A, No.13 (1969)).
Include maps wherever possible.
- 3) Details of radioactive wastes or discharges not required.

APPENDIX 2

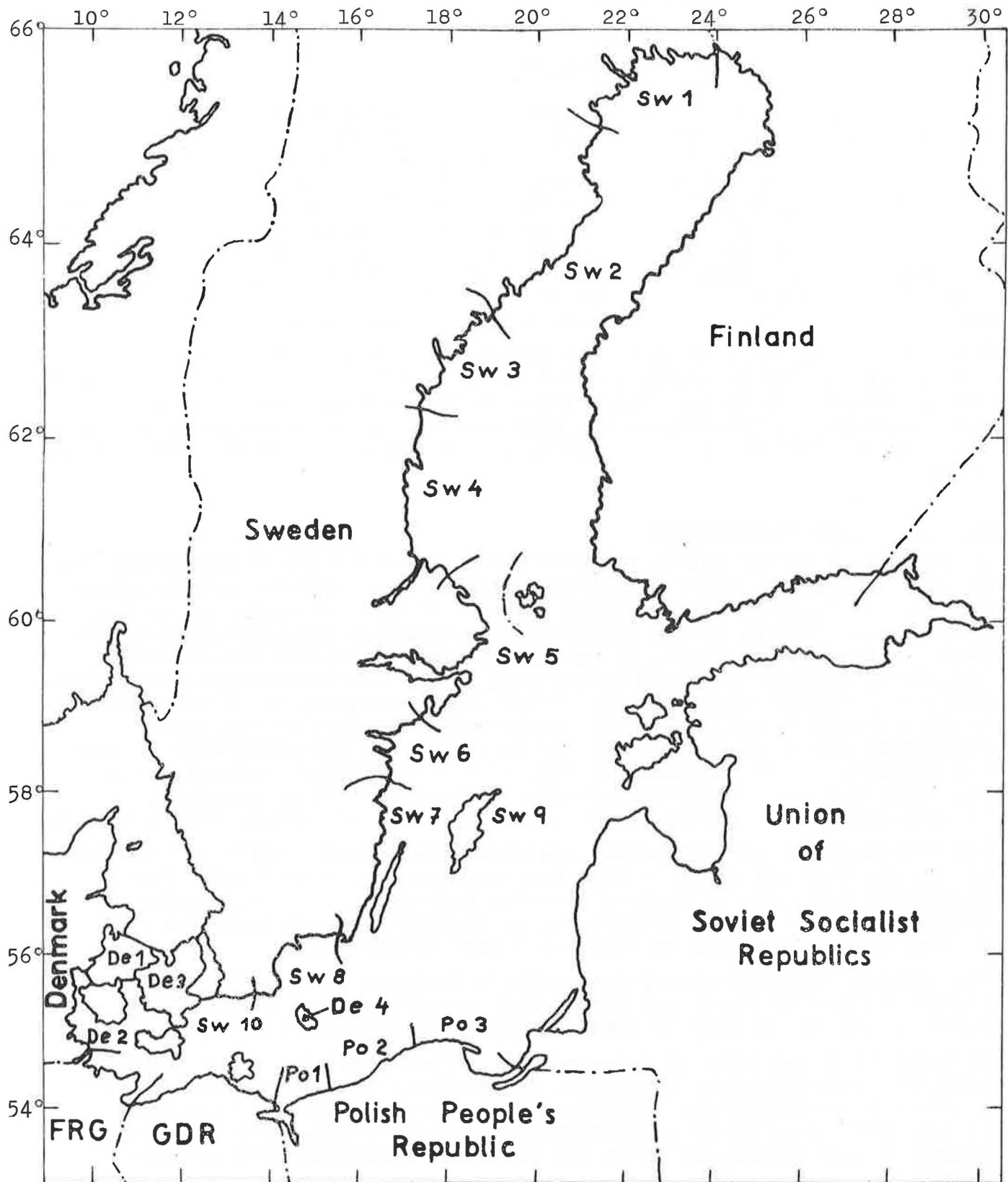


Figure 1. Area divisions. (for code, see Table 1, p.9).

II. REPORT ON THE BASELINE STUDY OF THE LEVEL OF CONTAMINATING SUBSTANCES
IN THE LIVING RESOURCES OF THE BALTIC 1974/75, AND THE INTERCALIBRATION
EXERCISES CONNECTED WITH IT

INTRODUCTION

The study reported here resulted from a decision taken by the ICES/SCOR Working Group on the Study of Pollution in the Baltic that there was a clear need for an investigation to determine the levels of toxic substances in the living resources and environment of the Baltic Sea. To this end, the Working Group established guidelines for a Baseline Study which was to present a picture of contaminating substances in Baltic fish and shellfish at a particular point in time and set up an Action Planning Group to develop a detailed plan for the study. This Baseline Study was also intended to parallel a similar study being conducted in the North Sea area, so that a comparison of the two areas might be possible.

Meeting in June 1973, the Action Planning Group developed the detailed work programme for the survey, which is set forth below. According to this plan, sampling was to have taken place in the last quarter of 1973. However, due to numerous difficulties, the sampling period had to be postponed by one year, so that the actual sampling period was 1 October 1974 to 30 April 1975.

Work Programme of the Study

As determined by the Action Planning Group set up by the ICES/SCOR Working Group, the Baseline Study should investigate the levels of certain metals and organic substances in selected species of fish and shellfish in the Baltic Sea. In view of the differences in capacity and capability of the participating laboratories, it was agreed that only a limited number of obligatory substances should be analysed by all participating laboratories. However, a supplementary list was determined containing those substances which it would be desirable that laboratories analyse, if they have facilities for doing so. In setting up this list, the Group kept in mind the desirability of including as many of the substances analysed during the North Sea Study (ICES Coop.Res.Rep., No.39 (1974)) as possible, because comparison between the two areas could be of considerable interest.

The metals chosen for obligatory analysis were mercury, lead, and cadmium. Second priority was given to zinc and copper and it was additionally considered desirable to analyse chromium and cobalt. It was considered necessary to distinguish between "total mercury" and organomercury compounds, with information on "total mercury" obligatory.

The organic compounds chosen for analysis included BHC, Dieldrin, DDT (total and derivatives), and PCBs. Each participating laboratory was asked to analyse as many of these compounds as they had facilities for.

With regard to analysis of hydrocarbons, it was hoped that they could be separated into aromatic, aliphatic, and olefinic compounds. Analysis of aromatic hydrocarbons was considered the most important, as this group is the best indicator of petro-hydrocarbonic pollution. The other two groups include substances which may have been generated from natural products.

Chlorinated aliphatic hydrocarbons were also included on the list of organic compounds to be analysed.

In the choice of which organisms to include in the Baseline Study, several factors were deemed important. First, the choice must be such that it forms an appropriate basis for later monitoring programmes. Second, it

was desirable that, to the extent possible, the same organisms as were used in the North Sea Study should be included in this study. Finally, it was considered important that the study encompass benthic organisms, bottom fish, and pelagic fish.

Some participants in the Group felt that the study should also encompass plankton organisms. However, in view of the difficulties with comparable sampling, the differences in composition of the samples, and the problems of age determination of larger planktonic animals, such as Mesidothea, it was agreed that inclusion of plankton organisms should not be made mandatory at this stage.

The list of obligatory organisms, which had to be sampled and analysed by all participating laboratories, consisted of:

cod, herring, flounder, and mussels.

The list of desirable organisms included:

sprat, plaice, Macoma baltica, Mesidothea entomon, and Crangon crangon.

Of these, plaice and Crangon are of interest for comparison with the North Sea Study. It was hoped that the laboratories in whose areas they occur would include them in their analyses.

With regard to mussels, a representative sample of a population should be analysed and the size distribution determined. For the fish, both 0-group and older specimens should be included. Fat content, sex, year class and size distribution must be determined. For herring, both fillets (obligatory) and whole fish (desirable) were to be analysed.

The Group recommended that the laboratories which have the appropriate facilities should determine the amount of petroleum hydrocarbons in mussels and that the laboratories concerned exchange reference standards among themselves.

The Group stressed that complete comparability of results from all participating laboratories is essential for the success of the Baseline Study. Comparability includes sampling procedures, sample preparation and storage, calibration of the methods used and intercalibration among the laboratories. A review of the methods used in the different laboratories revealed a wide variety of procedures, and the Group found that the best way to ensure complete comparability would be that one or, preferably, two experts visit the participating laboratories. This would result in a collection of methods, which would be made available to everyone, and in an exchange of views as to the best procedure to select for the present study.* In this connection it was, however, stressed that the aim is comparability and not standardisation. Recommendations as to sampling were as follows:

Cod and herring should preferably be sampled in October-December. Sampling of 0-group cod and herring is desirable, but not essential. For older herring, each sample must be of uniform age, and sex and size determined. For cod, one should aim at sampling the 3 and 4 year olds, and sex, age and size distribution must be reported. Flounder should also be sampled in the last quarter of the year, each sample to be of uniform age, and age, sex, and size distribution to be reported.

* These methods are contained in the document "Report on Applied Methods for the Analysis of Selected Potential Pollutants in Baltic Laboratories" (Ed. L Kremling and W Slaczka, 1974). Available in reprinted form from UNESCO.

Plaice (when collected), as for flounder.

Sprat (when collected), as for herring.

Mussels should also preferably be collected at the end of the year, or a little earlier. Size should be reported.

The Group recommended that, in addition to each country sampling in its own coastal waters, the sea areas should be divided as follows:

| | |
|------------------|--|
| <u>Finland:</u> | the Bay of Bothnia and the Åland Sea, some samples also from the Finnish Bay. |
| <u>Sweden:</u> | the Bothnian Sea and from Åland to Gotland/Öland; west of Gotland; in the Arkona Basin, and between Bornholm and Sweden. |
| <u>Denmark:</u> | the Danish Belts, the Sound and around Bornholm. |
| <u>F.R.G.:</u> | the Kiel Bight, west of Bornholm, and the Arkona Basin. |
| <u>G.D.R.:</u> | along its coasts. |
| <u>Poland:</u> | east of Bornholm, south of Gotland. |
| <u>U.S.S.R.:</u> | the eastern part of the Gotland Basin, the Bay of Riga and the Finnish Bay. |

It was stressed that while sampling must be made both in coastal areas and in the open Baltic, the sampling network in the coastal areas should be denser.

It was strongly recommended that the laboratories which will participate in the Baseline Study should join the international intercalibration organised under the auspices of the ICES Working Group on the Study of Pollution of the North Sea, where provisions had already been made for participation by Baltic laboratories.

As has already been indicated, sampling could not be accomplished in late 1973, as envisaged by the Action Planning Group. A revised sampling period was determined by the Coordinator of the Baseline Study and was circulated, along with materials on laboratory procedures, by ICES to participating laboratories in July 1974. Under this revised plan, sampling was to start in October 1974 and be completed by the end of April 1975. It was recommended that analysis of the samples be completed by July 1975, in order that a first evaluation of the level of potential pollutants in marine organisms from the Baltic could be made before the end of 1975.

Included in the materials on revised sampling instructions was a Manual for the sampling procedure and for the preparation of samples (see Appendix II). This Manual was prepared by the Swedish Institute for Water and Air Control Research based on many years of experience and was agreed upon by the Scandinavian laboratories. It was recommended that the procedures outlined in this Manual be used by all laboratories participating in the Baseline Study.

Finally, at the May 1974 meeting of the ICES/SCOR Working Group for the Study of Pollution in the Baltic, it was decided that all laboratories involved in the analysis of samples from the Baseline Study should also obligatorily analyse the spiked standards prepared by the British laboratories and used in the North Sea Baseline Study, in order to achieve the necessary intercalibration.

Intercalibration Standards

The intercalibration exercises were based on samples of fish flour (for metal analysis) and maize oil (for chlorinated hydrocarbon analysis). These samples were prepared by the United Kingdom laboratories and were used in the intercalibration exercises of the laboratories which took part in the corresponding study of the North Sea. In the first intercalibration exercise, a diluted solution of metal ions was circulated with the fish flour sample to provide an exact metal standard to be compared with the individual standards.

The fish flour used in this exercise was prepared from freshly caught inshore cod by the MAFF Humber Laboratory in Hull. The details of preparation of this flour are as follows:

- (i) Freshly caught cod from an inshore area was stored in ice after capture.
- (ii) The fish was filleted, but the fillets were not skinned.
- (iii) The fillets were steamed for about 30 minutes and then broken up into small pieces.
- (iv) The cooked fish was air dried in a tunnel for about 24 hrs.
- (v) The dried fish was minced and then repeatedly ground in a hammer mill.

The reference solution of metal ions was prepared from BDH stock standard solutions by dilution, using 1 N HCl as the diluent.

A maize oil standard containing known amounts of α , β and γ BHC, HCB, Dieldrin, p, p'-DDE, p, p'-DDD, p, p'-DDT and PCB (Arichlor 1254) was prepared by DAFS, Freshwater Fisheries Laboratory, Pitlochry, Scotland. This sample was circulated under the label Reference Sample No 3A and 3B. A tenfold initial dilution was recommended prior to analysis, with further dilution of Sample 3B as necessary. This sample was the same as that used in the North Sea Baseline Study.

As mentioned above, the metals for obligatory analysis were mercury, lead, and cadmium; second priority metals were zinc and copper. The organic compounds to be analysed were γ -BHC, Dieldrin, DDT (total and derivatives), and PCBs.

The organisms for obligatory analysis were cod, herring, flounder and mussels (Mytilus). Second priority organisms were sprat, plaice, Macoma baltica, Mesidothea entomon, and Crangon crangon.

Finland, the German Democratic Republic, the Federal Republic of Germany, Poland and Sweden were able to carry out the sampling in the period from October 1974 to April 1975. The sampling by the U.S.S.R. was delayed, but samples were taken in the summer of 1975. Unfortunately the initial samples taken by the German Democratic Republic were destroyed by a failure in the deep-freezing facilities; however, the sampling was repeated in autumn 1975. Denmark was unable to participate in the sampling, but agreed to make data available from recent national investigations.

RESULTS

All data must be interpreted with great care and in consideration of all the sampling details given in the tables. Higher concentrations found in some specimens do not necessarily indicate higher levels of environmental

pollutants, because the age of the fish, sex, maturity status, migration behaviour, etc. may have a great influence on the accumulation of the metal pollutants. This is also true for contamination with organic pollutants (ref. M J Hattula, Ph.D.Thesis, 1973, Univ. of Helsinki).

METALS

Intercalibration

For the first and second trace metal intercalibration exercises, laboratories participating in the Baltic Baseline Study were supplied with fish flour circulated by the Marine Laboratory, Aberdeen.

The same material was used in the second intercalibration exercise within the ICES Working Group for the Study of the Pollution of the North Sea, and in the first intercalibration exercise within the Working Group on Pollution Baseline and Monitoring Studies in the Oslo Commission and ICNAF Areas.

A future comparison of the North Sea and the Baltic Sea fish data was intended, and the common intercalibration exercise served to this end. In the first exercise, each laboratory received a reference solution in addition to the fish flour. The fish flour was intended for analysis by both a standard procedure and the analytical procedure adopted by the laboratory.

In the second exercise, participating laboratories received standard stock solutions for each element under study in addition to the fish flour. Calibrations had to be performed by utilising the laboratory's own methods on the submitted standards. A standard procedure was not obligatory for this exercise.

Neither of the two fish flours was spiked with any of the heavy metals under study. As the true values of the different elements were unknown, an evaluation of the analytical methods used was difficult. Regarding the accuracy of the data, the overall mean values served with the highest probability as "true" values.

No reported values have been omitted from the calculations. The lead data from one institute were initially wrong by one order of magnitude due to a calculation error. This has been amended. None of the reported data deviated significantly to such a degree that omission would be statistically correct.

A comprehensive appraisal of the intercalibration exercises on the basis of statistical evaluations was not performed as the number of participating countries was small and not all laboratories submitted the analytical data required.

Results

The results of the fish flour analyses, including the reference solution analyses of the first exercise, are presented in Tables 1 and 2. A summary of the overall means, standard deviations, and coefficients of variation of the means of all samples from all laboratories is given in Tables 3 and 4.

Zinc and copper

The results for zinc and copper from both intercalibration exercises are in good agreement among laboratories. Although different analytical

methods were used, the overall coefficient of variation ranged from 6.5% to 14% for zinc and from 1.6% to 11% for copper.

Mercury

The results of both intercalibration exercises indicate that there are no significant differences among the data reported by the individual laboratories.

The values from the Swedish laboratory for the first exercise were based only on the determination of (mono)methyl-mercury. Assuming that 80-90% of mercury in fish is present in this form (priv.comm. by Dr R Vaz, Wallenberg Lab., Sweden), the data from this laboratory are in good agreement with data from the other laboratories. This assumption may be valid for fish, especially for cod and the cod-based fish flour, but does not apply to molluscs.

The extremely low (mono)methyl-mercury values in the second exercise were regarded as inexplicable from the analytical point of view. It is possible that the treatment of the fish material during the preparation of fish flour led to a breakdown of the mercury-carbon binding.

Covalent mercury compounds have relatively high vapour pressures. In order to prevent losses of mercury during the digestion procedure, closed systems may be used. From this point of view, the prevalent method of the first intercalibration exercise is not recommended because the loss of mercury due to volatilization cannot be excluded (see Appendix I).

Cadmium

There are no significant differences among the mean values from the laboratories which have supplied results to the Baseline Study. Although the precision of cadmium analyses in both exercises is poor compared with the precision of analyses of copper and zinc, a significant improvement in the reliability of cadmium analysis is indicated by the fact that both exercises provided comparable overall coefficients of variation, even though the cadmium content was an order of magnitude lower in the second standard than in the first fish flour standard.

Lead

The individual precision of lead analyses and the overall coefficient of variation of the mean values were the poorest of all the metals analysed. It is the common feeling of the analysts who took part that the analytical confidence of lead determination is not on the same level as that of the other elements.

This must be taken into consideration when the analytical data are discussed later. The great discrepancies in the lead data cannot be traced back to any specific systematic error, but are most probably affected by several concurrent factors, e.g. contamination during the different analytical steps, and losses resulting from elevated ashing temperatures. Special problems arise during determination with the graphite tube, because atomization of lead is highly dependent upon matrix compounds and the acids employed as solvent for the sample.

Conclusions

In general, the results presented here show that all participating laboratories are capable of producing inter-comparable data.

An effort must be made to improve the confidence of lead analyses.

It should be noted that with X-ray fluorescence analysis, as used by the Battelle Institute, Federal Republic of Germany, the problems arising from volatility and chemical decomposition are essentially avoided. This is especially an advantage in the case of lead.

The Baseline Study

Tables 5 to 10 present the results of the metal analyses of fish and shellfish.

The principal types of fish analysed in the Baseline Study were cod, herring, and flounder. A lesser number of sprat and plaice were investigated. Only two countries analysed shellfish. The analytical data obtained are also shown in charts which give the contaminant concentrations in the organisms studied in relation to the location where they were caught, using the division of the Baltic into ICES fishing areas (see Figures 1-35).

Most of the central and eastern parts of the Baltic were not covered in this Baseline Study.

The fish sampled cover a range of several age groups. The data do not give a reliable indication of the existence of a relationship between higher metal concentrations and increased age of the fish. However, the amount of fish material in this study from the same sampling sites and belonging to different age groups is too small to draw statistically valid conclusions.

Available details of sampling, age, sex, number of species, etc. are listed in the respective tables. The graphical display is made according to the data given in the tables.

Zinc concentrations in fish

- Cod: Zinc concentrations in the muscle tissue of Cod range from 1.2 to 9.2 mg/kg wet weight, with a majority of the values in the more limited range from 4-5 mg/kg. The distribution pattern of the data shows no significant gradient in concentrations with respect to location of catch (zinc concentrations in cod from uncontaminated areas of the North Sea are of the same order).
- Herring: The corresponding values for Herring lie between 3.4 and 32 mg/kg. The highest values appear only at the two fishing areas in the Gulf of Bothnia at or off the Swedish coast, with values from near-coastal areas higher than those from the open sea.
- Sprat: Sprat was only caught in the Gulf of Finland, the Åland Sea, and the Gulf of Bothnia. The data are in good agreement with those obtained for herring. The concentrations range from 7-20 mg/kg muscle tissue.
- Flounder: The zinc concentrations in Flounder taken from different parts of the Baltic show a rather even distribution ranging from 3.5 to 11.3 mg/kg, with an average around 6 mg/kg. Higher than average values seem to appear only in the Bornholm area and at the entrances to the Baltic.
- Plaice: Zinc values in the muscle tissue of Plaice are only available from two localities. The data are in agreement with the values found in flounder (i.e., around 5 mg/kg).

In general, herring and sprat contain more zinc than the other species analysed.

Copper concentrations in fish

- Cod: Copper concentrations in the muscle tissue of Baltic Cod range from 0.08 mg/kg to 2.4 mg/kg. The central value is about 0.20 mg/kg. Slightly higher values are found in samples

taken from the eastern and middle parts of the Baltic, especially west of Bornholm. One exception is a single sample from the western part of the Bornholm Sea (0.08 mg/kg).

- Herring: The copper concentrations in Herring vary between 0.3 and 1.9 mg/kg. The higher values are found near the Swedish coast, in the Gulf of Bothnia, the Gulf of Finland and in the Bornholm area. The concentrations in the rest of the Baltic, including the western Baltic and the Kiel area, are around 0.4 mg/kg.
- Sprat: The copper concentrations in Sprat collected in the Gulf of Finland, the Åland Sea and the inner Gulf of Bothnia compare very closely with the copper concentrations in herring in the same area. The average value is 0.4 mg/kg, with higher values in the Gulf of Finland.
- Flounder: The copper concentrations in Flounder range from 0.10 to 0.89 mg/kg. The higher values are reported from the Bornholm area and the Øresund area. The lower values are found mainly in the Kiel area, Mecklenburg and the Finnish outer coast. The average value is about 0.3 mg/kg.
- Plaice: The copper concentrations in Plaice caught in two places north and south of Bornholm do not differ from those in flounder from the same area. Plaice caught in the Gulf of Finland, however, are reported to contain 1.2 mg/kg of copper.

Lead concentrations in fish

In view of the results from the intercalibration exercise, the reported data for lead should be considered with reservation. The level of confidence of the lead data is certainly lower than that for the other metals.

- Cod: The lead concentrations in Cod range from 0.03 to 1.3 mg/kg wet muscle tissue. On the average, the values are below 0.1 mg/kg with a few exceptions mostly from inshore samples.
- Herring and Sprat: The lead concentrations in Herring lie between 0.01 and 1.4 mg/kg. Most values are below 0.1 mg/kg, with a few exceptions from the inner archipelago and the eastern Baltic. Otherwise, the lead values are rather evenly distributed.
- The lead data from Sprat show concentrations mostly below 0.1 mg/kg.
- Flounder and Plaice: The reported lead values from Flounder range between 0.02 and 0.26 mg/kg. The average values are around 0.1 mg/kg. No obvious differences can be observed in data from the different parts of the Baltic. The two available lead values from Plaice are within the concentration range reported for flounder. One high value (1.1 mg/kg) was reported from the Gulf of Finland.

Cadmium concentrations in fish

- Cod: The cadmium concentrations in wet muscle tissue of Baltic Cod vary between 2 and 50 µg/kg. The values seem to indicate that inshore samples from the archipelago have a significantly higher cadmium content. This is also valid for samples in the Bornholm Sea. Values from less sheltered areas are, on average, below 5 ppb. No clear differences along the axis of the Baltic Sea can be observed.
- Herring: The cadmium values in Baltic Herring show the same pattern of distribution as in cod. The concentration range is between 2 and 72 µg/kg in wet muscle tissue. The near-shore data are

5 to 10 times higher than the data from the open sea areas. On average, the cadmium content of this species is higher than that of cod. The highest values are reported from the Swedish side of the Bothnian Sea, 72 ppb in 7 to 11 year old specimens.

Sprat: The tendency toward increased cadmium concentrations in fish from sheltered and near-shore waters is repeated in the analytical data for Sprat which were caught in the Bothnian Bay, the Åland Sea, and the Gulf of Finland. The concentrations range from 6 to 200 µg/kg in wet tissues.

Flounder: The cadmium concentrations in Flounder range from 2 to 40 ppb (µg/kg) in wet muscle tissues. The low values are found in the western Baltic and in the outer archipelago in the Gulf of Finland, whereas the higher values are found in samples from more sheltered areas. For this species, the areas covered are far from complete.

Plaice: Only four values were reported, 11, 14, 16, and 100 ppb. These are in fair agreement with the cadmium levels in flounder from the same areas.

Mercury concentrations in fish

Cod: The mercury concentrations in Cod muscle tissue vary between 0.02 and 0.88 mg/kg. The values are mainly below 0.1 mg/kg. The highest average regional value, 0.48 mg/kg (average of 15 fish; range 0.17 - 0.88 mg/kg) is found in Øresund. Slightly elevated values (0.1 - 0.2 mg/kg) are found in the Bothnian Sea, the Gulf of Finland, the Bothnian Sea at the Swedish coast, and in Gdańsk Bay.

Herring and Sprat: The mercury concentrations in Herring muscle tissue vary between 0.004 and 0.09 mg/kg, with two exceptions: one at the Swedish coast in the Bothnian Sea, where the mercury content in 7-11 year old herring is 0.14 mg/kg, and the other at the entrance of the Gulf of Finland near the Estonian coast, where the mercury level in herring was 0.3 mg/kg. Values above 0.05 mg/kg seem to be more common in the western Baltic; otherwise, there was an even distribution of the mercury levels in herring muscle in the Baltic Sea area. The mercury concentrations in Sprat muscle tissue is comparable to that in herring muscle tissue, and always below 0.09 mg/kg.

Flounder and Plaice: The mercury concentrations in Flounder muscle tissue vary between 0.45 (average of 23 fish from one sampling locality in Øresund) and 0.01 mg/kg. The mercury levels in flounder muscle tissue in the central and northern Baltic were mainly below 0.05 mg/kg. Higher than average mercury levels in flounder muscle tissue were found in the Bornholm Sea, in the Øresund and at the Swedish south coast. The mercury content in Plaice muscle tissue at the sampling localities in the Arkona Sea, the Bornholm Sea, and the Gulf of Finland was below 0.1 mg/kg.

Shellfish

Because of the scarcity of Mytilus edulis in the central Baltic and the Gulf of Finland, Macoma baltica has been sampled in addition to Mytilus edulis. Only two countries have analysed bi-valve molluscs. The metal concentrations in bi-valve molluscs may be influenced by the ingested amount of particles and the time of sampling (i.e., low or high tide). The mollusc data are given as an appendix. An appraisal seems to be impossible in view of the small numbers of sampling stations.

Other organisms

Mesidothea entomon was sampled and analysed only by Finland. The data are given as an appendix for additional information. These data are of value as a baseline for future investigations in the northern and eastern part of the Baltic.

CHLORINATED HYDROCARBONS

Intercalibration

Introduction

The laboratories which participated in the intercalibration exercise are listed in Appendix I. Two laboratories participated from Finland; Laboratory 1 performed the analyses of samples from coastal areas, and Laboratory 2 from deep sea areas. Two laboratories participated jointly from Sweden.

ICES Reference Sample No.3 was analysed. It consisted of two maize oil samples, 3A and 3B. Sample 3A was unspiked and the levels present were well below the limits of detection of the methods applied by the participating laboratories. Sample 3B was spiked with levels commonly found in environmental samples. The methodology used for the analyses of the intercalibration samples and the biological material is presented in Appendix I.

Full details of the analytical methods are described in the "Report of Applied Methods for the Analyses of Selected Potential Pollutants in the Baltic Laboratories",* which was compiled and discussed by the analysts prior to the Baseline Study.

Results

The results of the intercalibration of the maize oil standards are given in Table 11. Only the results for the analyses of Sample 3B are given. No corrections were made for the results obtained from the analyses of Sample 3A because it was assumed that the latter values were well below the limits of detection. Table 11 shows the values reported by each participating laboratory, together with the mean values, standard deviations, standard deviations as percentage of the mean, and the percentage deviation from the true mean. For comparison, values for the standard deviation as the percentage of the mean are also given from the intercalibration analyses for the 1972 North Sea Baseline Study.

Comments

From Table 11, it can be seen that only some of the laboratories estimated HCB, the BHC isomers, and Dieldrin. Therefore, the available data on these substances will only be presented for information; no attempts were made to determine the possible sources of error in the results. Thus comments here will be confined to the results of the analyses of DDT and its metabolites and PCB.

The majority of the results for the DDT and PCB compounds lie around $\pm 20\%$ from the true value. This is acceptable for the purposes for which the results will be applied, in view of the variations introduced by the

* See note on page 23.

sampling problems and extraction procedures associated with the biological material and the fact that it was the first attempt at intercalibration for many laboratories.

There are, nevertheless, some poorer results. For example, Laboratory 3 results show a poor recovery for p, p'-DDD and p, p'-DDT. The chromatograms for Sample 3B from this laboratory showed, however, good correspondence with similar chromatograms from other laboratories that had good recovery for the DDT compounds. A possible source of error could thus be the standards used. This laboratory pointed out that it had used new standards when analysing the biological material so that the latter results were more reliable.

The reported values for p, p'-DDE and p, p'-DDT from Laboratory 5 were not in good agreement with the true values. Although no chromatograms were available here for examination, it seems probable that on-column conversion of p, p'-DDT to p, p'-DDE could explain why the DDE value was too high and the DDT value too low. As the Σ DDT is in good agreement with the true value, this possibility cannot be excluded. It was pointed out by this laboratory that such an on-column conversion could be occasional and did not necessarily imply unreliability of the results of the analyses of the biological material.

Laboratory 5 participated both in the intercalibration exercise of the North Sea laboratories and that of the Baltic laboratories. The same Samples 3A and 3B (spiked maize oil) were used in both intercalibrations.

The following results were obtained by Laboratory 5 in the North Sea Study intercalibration:

| Substance | Concentration (in $\mu\text{g/kg}$) |
|---------------|--------------------------------------|
| HCB | 30 |
| α -BHC | 29 |
| β -BHC | - |
| γ -BHC | 41 |
| Dieldrin | 80 |
| pp-DDE | 100 |
| pp-DDD | 200 |
| pp-DDT | 175 |
| Σ DDT | 475 |
| PCB | 948 |

(from the report of A V Holden, May 1976, No.6)

From the above data, it can be seen that appropriate results were obtained during the North Sea intercalibration by Laboratory 5. This strongly supports the assumption that an occasional breakdown of DDT occurred on the new gas chromatographic column utilised during the Baltic intercalibration of this laboratory. Thus, because the analyses of the biological material from the Baltic were done with the same columns as were used for the North Sea intercalibration, it appears that the analyses of the biological material can be regarded as reliable.

The results of the PCB analyses showed good comparability in spite of the complicated nature of the PCB determination. However, Laboratory 6 results showed a relatively large deviation from the true value. As can be seen from Appendix I, this was the only laboratory that used Arochlor 1260 as the standard. It was also the only laboratory that used the product of the retention time and the peak height as a measure of the concentration.

As not all laboratories had included chromatograms from the intercalibration analyses in their reports, it was impossible to make a critical evaluation of the results. Conclusions could only be drawn from the reported values. Thus, no comments could be made on the analyses of the unspiked Sample 3A, which, having levels well below the detection limits, could otherwise have been a good indicator of interferences introduced by the methodology used.

Possible errors in the quantification step due to poor gas chromatographic conditions could not be traced. It should be pointed out that one laboratory reporting good recovery for PCB had performed the evaluations from chromatograms in which the gas chromatographic separation was poor and the peak heights were seldom higher than 20 mm. This indicates the dangers in drawing conclusions from reported values without consideration of the gas chromatograms used for the evaluation.

Conclusions

Some general conclusions can be drawn as a result of the intercalibration. First, if further intercalibration is to be carried out, it is suggested that chromatograms be requested from the participants in order to enable a critical evaluation of the results. Second, it is desirable that two spiked samples be distributed so that the reproducibility of the results can be determined. Third, it should also be emphasized that only a single analysis be performed as is normally the case for the biological material. Fourth, a realistic sample should be included so that the extraction and fat determination steps can be checked in the intercalibration.

The Baseline Study

Results

The results of the Baseline Study are compiled in Tables 12-20 and in Figures 36-57. The agreed ICES fishing areas in the Baltic are used for identification of the sampling site. All analysts determined DDT, DDD, DDE, and PCB. These results are summarised in Tables 12-20. Three laboratories also analysed for Lindane and Dieldrin and one analysed for HCB and γ -BHC.

In contrast to the recommendations given for sampling with respect to age groups, some countries reported data from fish of different age groups. Therefore, the data given in Tables 12-20 should be consulted when the distribution maps are considered. The age of the fish collected in the Danish programme is not reported.

It was desired that 0-group fish should also be sampled and analysed. This was followed only by Sweden.

Some analyses were made on homogenates consisting of 5-10 specimens; others were made on individual fish. These details should be carefully considered for an evaluation of the data.

The DDT figures are reported both individually, as DDE, DDD, and DDT, and as Σ DDT. To obtain the Σ DDT value, DDE and DDD are added, multiplied by the factor 1.11, and then added to the DDT value.

In all cases, the figures are reported on a wet weight basis in $\mu\text{g}/\text{kg}$ and on a fat weight basis in mg/kg . As the intercalibration exercise did not include an estimation of fat percentage, it is not known how reliable the fat weight results are. They are included in the tables for information only.

When comparing results, it is important to remember that for levels of DDT and PCB in biological material below 20 ppb ($\mu\text{g}/\text{kg}$), there is an increasing uncertainty as one approaches the limits of detection.

To evaluate the results, it is necessary to take into account the results of the intercalibration. An acceptable result in the intercalibration exercise for PCB will not necessarily imply exact PCB estimates of levels in biological materials. The reason is that the maize oil standard used was spiked with Arochlor 1254 standard PCB, which is rather easy to quantify correctly when the same standard is used for the quantification. In biological samples, however, the PCB pattern changes.

Repeating again that all results must be evaluated individually in accordance with the results of the intercalibration, the age class of the specimens, and the way the samples were handled, it may nonetheless be useful to report here the general indications of the ranges of the results. True ranges are not possible, because some of the data reported represent averages only, but an indication of the ranges of results for each organism can be given.

Σ DDT concentrations in fish

- Cod:** The range of values for Σ DDT runs from 1 to 230 $\mu\text{g}/\text{kg}$ wet weight muscle tissue. Most of the values fall between 15 and 55 $\mu\text{g}/\text{kg}$, but values from Finland and the German Democratic Republic were generally lower. The Σ DDT concentrations reported in fat range from 1.0 to 12 mg/kg fat weight. Two countries reported levels of Σ DDT in cod liver, showing a range from 220 to 27 000 $\mu\text{g}/\text{kg}$ wet weight.
- Flounder and Plaice:** Concentrations of Σ DDT in Flounder are reported from 11 to 370 $\mu\text{g}/\text{kg}$ wet weight muscle tissue. Most values lie between 25 and 90 $\mu\text{g}/\text{kg}$. On a fat weight basis, reported levels lie between 1.3 and 9.1 mg/kg for flounder. Not enough Plaice were sampled to report the results here.
- Herring:** A range of concentrations from 28 to 3 300 $\mu\text{g}/\text{kg}$ wet weight is reported for Σ DDT in Herring. Most values fall between 160 and 630 $\mu\text{g}/\text{kg}$, with results from Finland generally lower than this and those from Poland higher. In fat, Σ DDT results run from 0.6 to 37 mg/kg , with wide variations in the results from the different countries.
- Sprat:** Reported levels for Σ DDT in Sprat run from 60 to 2 200 $\mu\text{g}/\text{kg}$ wet weight muscle tissue. Values lie primarily between 220 and 680 $\mu\text{g}/\text{kg}$. On a fat weight basis, Σ DDT concentrations were reported between 0.7 and 11 mg/kg .

PCB concentrations in fish

- Cod:** Reported concentrations of PCBs in muscle tissue of Cod ranged from 5 to 220 $\mu\text{g}/\text{kg}$ wet weight. Most of these values were between 10 and 80 $\mu\text{g}/\text{kg}$, while data from Finland and the German Democratic Republic were often lower. PCB values in fat were given as 1.2 to 36 mg/kg fat weight. For cod liver, there was a wide range in the few reported values, which ran from 1 000 to 12 000 $\mu\text{g}/\text{kg}$ wet weight.

Flounder and Plaice: PCB concentrations in Flounder were given from less than 10 to 225 µg/kg wet weight, with most values falling between 40 and 100 µg/kg. In fat, concentrations of 2.8 to 19 mg/kg were found in flounder. Not enough data for Plaice were reported to give reliable figures for ranges.

Herring: In Herring, PCB concentrations were found from 17 to 2 100 µg/kg wet weight, but values primarily fell between 110 and 560 µg/kg. In fat, the range of concentrations was from 1.7 to 84 mg/kg fat weight, with most values between 2 and 16 mg/kg; the Federal Republic of Germany data were higher than this latter figure, however.

Sprat: Data on PCBs in Sprat fell in the range between 27 and 4 200 µg/kg wet weight muscle tissue. Values fell, however, principally between 230 and 590 µg/kg. PCB levels on a fat weight basis occurred in a small range, from 0.54 to 2.3 mg/kg.

Shellfish and other organisms

Only two countries sampled for and analysed Mytilus edulis, Macoma baltica, and Mesidothea entomon, so not enough data are available to present ranges properly.

COMMENTS AND CONCLUSIONS

Although originally intended to be a comprehensive baseline study, the results reported here amount to a less comprehensive survey. Numerous weaknesses can be pointed out, particularly with respect to the conformity to the sampling instructions.

The coverage of the Baltic Sea area with respect to the sampling of the biological material was only fair for cod and herring. For the other species, only some parts of the Baltic were sampled. This is particularly true for the coastal regions and for the Central Baltic. Crangon crangon was not sampled at all. Samples from large stretches of the coastal region of the German Democratic Republic, Poland and U.S.S.R. were not available.

Moreover, the sampling time (October 1974 until April 1975) was not always respected. This is especially true for the samples collected for heavy metal analysis in the Belt Sea region and Bornholm area from Denmark. (Denmark was only able to provide data from previous years but was not able to repeat sampling and analysis in 1974/75.)

Additionally, the sampling of specimens and selection of the age groups according to the requirements was only performed by some countries. Other countries provided data from lumped age groups or gave only the weight of the sample or the size of the fish. The sampling of 0-group specimens was only done sporadically. A differentiation according to sex and maturity status of the fish was not provided, nor was the size distribution of shellfish samples given. Moreover, in many instances the sampling position was only given approximately (according to fishermen's reports).

Shellfish were only sampled and analysed by two countries for Macoma baltica and by one country for Mytilus edulis. The coverage of the Baltic Sea area is, therefore, very limited in this respect.

In terms of the analyses, no determinations of petroleum hydrocarbons in biological material have been reported and, in some cases, only minimum and maximum concentrations of pollutants were given instead of

individual concentrations. Furthermore, no information was provided about the extent to which the instructions given for sample preparation were followed by the participating laboratories. Nor was information given about the performance of replicate analysis on one and the same sample, so as to allow an evaluation to be made of the reproducibility of the analytical method.

Nonetheless, the experience from this study shows that the Baltic laboratories are capable of analysing pollutants in fish and shellfish in an intercomparable way. In order to obtain a more comprehensive baseline survey, a better coordination of sampling is necessary and full cooperation between chemists and biologists is required. Intercalibrations would have to be repeated and certain analytical methods should preferably be improved prior to a renewed study.

Table 1. First Intercalibration Exercise (Baltic Baseline Study).

| Institute/Country | Concentrations in mg/kg | | | | | | | | | |
|---|-------------------------|------|--------|------|-------|-------|------|-------|------|------|
| | Zn | | Cu | | Pb | | Cd | | Hg | |
| | A | B | A | B | A | B | A | B | A | B |
| Fish flour: National Food Administration Sweden | 26.5 | 27.5 | 8.8 | 10.0 | 0.3 | 1.1 | 0.29 | 0.30 | 0.62 | a) |
| | | | | | | | | | 0.59 | |
| | | | | | | | | | 0.57 | |
| | | | | | | | | | 0.61 | |
| | | | | | | | | | 0.60 | |
| | 26.3 | 26.6 | 10.2 | 10.0 | 0.3 | 1.9 | 0.32 | 0.44 | 0.64 | |
| Institute Marine Research Finland | 22 | 25 | 9.8 | 9.4 | 1.3 | 2.3 | 0.48 | 0.43 | 0.40 | 0.78 |
| | 23 | 26 | 9.8 | 9.5 | 1.0 | 2.0 | 0.39 | 0.43 | 0.43 | 0.74 |
| | 22 | 26 | 9.7 | 9.5 | 1.4 | 1.6 | 0.39 | 0.39 | 0.40 | 0.78 |
| | 22 | 23 | 9.5 | | 1.3 | 2.3 | 0.38 | 0.38 | 0.42 | 0.72 |
| National Board of Waters Finland | | 22.6 | | 8.9 | | 3.8 | | 0.46 | | 0.54 |
| | | 22.6 | | 11.0 | | 3.1 | | 0.53 | | 0.48 |
| | | 24.0 | | 9.2 | | 4.1 | | 0.53 | | 0.54 |
| | | 24.4 | | 10.3 | | 3.8 | | 0.49 | | 0.52 |
| | | 24.2 | | 9.2 | | | | | | 0.51 |
| | | 25.1 | | 10.5 | | | | | | 0.55 |
| National Food Institute Denmark | 24.9 | 25.7 | 9.7 | 10.5 | 1.3 | 1.5 | 0.35 | 0.18 | | 0.60 |
| | | 26.0 | 10.0 | 9.1 | 1.5 | 1.3 | 0.38 | 0.24 | | 0.60 |
| | | | 10.0 | | 2.1 | | 0.58 | 0.21 | | |
| Battelle Institute Frankfurt F.R.G. | | 23.3 | | 14.9 | | 1.28 | | | | |
| | | 23.3 | | 21.0 | | 0.80 | | | | |
| | | 22.2 | | 13.7 | | 0.91 | | | | |
| | | 25.3 | | 14.0 | | 0.83 | | | | |
| | | 22.5 | | | | | | | | |
| Marine Chemistry Dept., Inst. of Thermoph. and Elec- trophys. of the Acad. of Sc. Estonian SSR | | 28 | | 12.4 | | 0.89+ | | 0.25+ | | 0.80 |
| | | 29 | | 12.5 | | 0.90+ | | 0.23+ | | 0.83 |
| | | | | | | | | | | |
| Mean* | | | | | | | | | | |
| Standard metal solution: | | | | | | | | | | |
| Statens Livsmedels- verk, Sweden | 0.49 | | 0.45 | | 0.25 | | 0.08 | | - | |
| Inst. Marine Res. Finland | 0.50 | | (0.10) | | 0.05 | | 0.10 | | 0.10 | |
| National Board of Waters, Finland | 0.69 | | 0.54 | | 0.48 | | 0.13 | | 0.11 | |
| National Food Inst., Denmark | 0.56 | | 0.50 | | 0.032 | | 0.11 | | 0.11 | |
| | 0.56 | | 0.49 | | 0.033 | | 0.11 | | 0.12 | |
| | | | | | | | 0.13 | | 0.12 | |
| | | | | | | | 0.13 | | 0.11 | |
| | | | | | | | | | 0.12 | |

A = standard method. B = own method. a) methyl mercury.

+ = without background correction.

| Mean values (standard deviations in parentheses) | | | | | | | | | |
|--|--------|--------|--------|--------|--------|--------|--------|--------------------|--------|
| Zn | | Cu | | Pb | | Cd | | Hg | |
| A | B | A | B | A | B | A | B | A | B |
| 26.4 | 27.5 | 9.5 | 10.0 | 0.33 | 1.5 | 0.30 | 0.36 | 0.60 ^{a)} | (0.02) |
| 22.3 | 25.0 | 9.70 | 9.47 | 1.25 | 2.05 | 0.41 | 0.41 | 0.42 | 0.76 |
| (0.50) | (1.4) | (0.14) | (0.06) | (0.17) | (0.33) | (0.05) | (0.03) | (0.02) | (0.03) |
| | 23.8 | | 9.85 | -- | 3.70 | | 0.50 | | 0.52 |
| | (1.01) | | (0.86) | | (0.42) | | (0.03) | | (0.03) |
| 24.9 | 25.85 | 9.90 | 9.8 | 1.63 | 1.40 | 0.44 | 0.21 | | 0.60 |
| | | (0.17) | (1.0) | (0.42) | | (0.13) | (0.03) | | |
| | 22.1 | | 15.8 | | 1.0 | | | | |
| | (2.9) | | (2.1) | | (0.4) | | | | |
| | 28.5 | | 12.5 | | | | | | 0.82 |
| Mean* | | | | | | | | | |
| 24.5 | 26.1 | 9.70 | 10.32 | 1.1 | 2.2 | 0.38 | 0.37 | 0.66 (without a) | (0.11) |
| (1.7) | (1.69) | (0.16) | (1.10) | (0.5) | (0.9) | (0.06) | (0.10) | | |
| 0.49 | | 0.45 | | 0.25 | | 0.08 | | - | |
| 0.50 | | (0.10) | | 0.05 | | 0.10 | | 0.10 | |
| 0.69 | | 0.54 | | 0.48 | | 0.13 | | 0.11 | |
| 0.56 | | 0.50 | | 0.033 | | 0.12 | | 0.12 | |
| 0.56 | | 0.50 | | 0.37 | | 0.11 | | 0.11 | |
| (0.08) | | (0.04) | | (0.16) | | (0.02) | | (0.010) | |
| 0.50 | | 0.40 | | 0.30 | | 0.10 | | 0.10 | |

Mean
true
values

* Values from the Battelle Institute not included in the overall mean.

Table 2. Second Intercalibration Exercise (Baltic Baseline Study).

| Institute/Country | Concentrations in mg/kg | | | | | | | | | | | |
|--|--|--|--|--|--|---|--|--|--|--|--|--|
| | Zn | | Cu | | Pb | | Cd | | Hg | | | |
| | C | D | C | D | C | D | C | D | a) | C ^{b)} | D | e) |
| National Food Administration, Sweden | 33.0 33.3 36.4 34.1 33.6 | 35.0 35.8 36.9 36.6 35.5 | 3.0 3.3 3.5 3.2 3.3 | 2.9 3.2 3.5 3.1 3.2 | | 0.39 0.82 0.39 0.34 0.41 0.37 | | 0.044 0.048 0.043 0.039 0.042 | 0.22 0.22 0.22 0.23 0.23 0.22 | 0.86 0.92 0.86 0.80 0.84 0.85 | 0.89 0.94 0.88 0.82 0.86 0.87 | 0.83 0.92 0.90 0.82 0.84 0.85 |
| Institute Marine Research, Finland | | 32.5 35.0 34.0 34.5 36.5 33.5 | | 2.5 2.7 2.8 2.8 2.6 | | 1.56 0.35 0.35 0.75 0.02 0.05 | | 0.05 0.04 0.03 0.03 0.02 0.05 | C | | D | |
| National Food Inst., Denmark | | 37.1 34.5 33.5 35.1 36.1 35.5 | 3.8 3.3 3.0 3.8 3.3 3.8 | 3.8 3.3 3.0 3.8 3.3 3.8 | 1.3 1.7 0.9 0.7 2.6 1.2 | 1.3 1.7 0.9 0.7 2.6 1.2 | | | | | | |
| BFA Fishery, F.R.G. | 41.2 39.7 38.7 38.8 39.1 37.9 | 41.2 39.7 38.7 38.8 39.1 37.9 | 4.0 3.6 3.9 3.8 3.9 3.7 | 4.0 3.6 3.9 3.8 3.9 3.7 | 0.46 0.57 0.53 0.53 0.48 0.61 | 0.46 0.57 0.53 0.53 0.48 0.61 | 0.032 0.033 0.035 0.032 0.036 0.037 | 0.027 0.029 0.027 0.030 0.036 0.037 | 0.79 0.80 0.85 0.80 0.83 0.80 | | | 0.79 0.80 0.85 0.80 0.83 0.80 |
| Hygiene Inst., Rostock, G.D.R. | 32 | | 2.9 | | 1.1 | | 0.050 | | | | | |
| Inst. f. Meereskunde, Rostock-Warnemünde, G.D.R. | 33.5 | | 3.0 | | 0.8 | | 0.06 | | | | | |
| Polish Inst. Meteorol. & Water Management, Gdynia Branch, Poland | | 25.3 26.2 26.2 | | 3.75 3.75 3.71 | 0.8 0.6 1.0 0.9 1.0 0.9 | 0.83 0.87 0.76 | | 0.046 0.045 0.045 | | | | 0.72 0.66 1.03 0.61 1.10 0.90 |
| Marine Chem. Dep. Inst. of Thermoph. & Electroph. of the Acad. of Sc. Estonian SSR | | 40 42 | | 4.0 4.2 | | 0.66 ⁺ 0.63 ⁺ 0.4 ⁺⁺ | | 0.12 ⁺ 0.13 ⁺ 0.05 ⁺⁺ | | | | 0.91 0.93 |

| Mean values (standard deviations in parentheses) | | | | | | | | | | | |
|--|---------------|----------------|-----------------|----------------|------------------|-------------------|------------------|------------------|-----------------|-----------------|-----------------|
| Zn | | Cu | | Pb | | Cd | | Hg | | | |
| C | D | C | D | C | D | C | D | a) | C ^{b)} | D | e) |
| 34.1 (1.4) | 36.0 (0.8) | 3.26 (0.18) | 3.18 (0.22) | | 0.45 (0.18) | | 0.043 (0.003) | 0.22 (±0.005) | 0.86 (±0.04) | 0.88 (±0.04) | 0.86 (±0.04) |
| | | | | | | | | C | | D | |
| 34.3 (1.4) | | 2.68 (0.13) | | 0.75 (0.57) | | 0.037 (0.012) | | | | 0.80 (0.028) | |
| 35.3 (1.3) | | 3.5 (0.4) | | 1.40 (0.7) | | | | | | | |
| 39.2 (1.1) | | 3.82 (0.15) | | 0.53 (0.06) | 0.034 (0.002) | 0.028 (0.002) | | | | 0.81 (0.02) | |
| 32 | | 2.9 | | 1.1 | | 0.050 | | | | | |
| 33.5 | | 3.0 | | 0.8 | | 0.06 | | | | | |
| 25.9 (0.4) | | 3.7 (0.02) | 0.86* (0.14) | 0.82 (0.04) | | 0.045 (0.0004) | | | | 0.83 (0.20) | |
| 41 | | 4.1 | | 0.4 | | 0.05 | | | | 0.92 | |
| 34.7 (3.1) | 35.3 (4.8) | 3.0 (0.15) | 3.5 (0.5) | 0.92 (0.13) | 0.72 (0.3) | 0.048 (0.010) | 0.04 (0.007) | | | 0.84 (±0.04) | |

a) methyl mercury; b) and e) = total mercury (\bar{b}) = AAS, e) = activation analysis/ Mean

C = common standard solution provided; D = own standard solution.

* values omitted; + = without background correction; ++ = with background correction.

Table 3. First Intercalibration Exercise (Baltic Baseline Study).

Means, standard deviations (s.d.) and coefficients of variation (c.v.) of the means of all samples from all institutes.*

| Metal | Fish flour | | |
|---------|------------------------------|----------------------|-----------------------|
| | Reference sol. | Standard method | Individual method |
| Mercury | 0.11 0.01 9% | 0.42 ^{b)} | 0.66 0.11 16% |
| Lead | 0.37 ^{a)} - - | 1.1 0.5 45% | 2.2 0.9 41% |
| Copper | 0.50 0.04 8% | 9.70 0.16 1.6% | 10.32 (1.1) 11% |
| Zinc | 0.56 0.08 14% | 24.5 1.7 6.9% | 26.1 1.69 6.5% |
| Cadmium | 0.11 0.02 18% | 0.38 0.06 16% | 0.37 0.10 27% |

a) only 2 results. b) only 1 result.

*) values from the Battelle Institute not included because Battelle did not participate in the analysis of the biological material, but only in the intercalibration. (Values, see Table 1, p.37).

Table 4. Second Intercalibration Exercise (Baltic Baseline Study)

Means, standard deviations (s.d.) and coefficients of variation (c.v.) of the means of all samples from all institutes.

| Metal | Fish flour | |
|---------|--------------------------|------------------------------|
| | Common standard solution | Individual standard solution |
| Mercury | 0.84 ^{a)} - | 0.84 0.04 4.7% |
| Lead | 0.92 0.13 14% | 0.72 0.3 42% |
| Copper | 3.0 0.15 5% | 3.5 0.3 14% |
| Zinc | 34.7 3.1 8.9% | 35.3 4.8 14% |
| Cadmium | 0.048 0.010 21% | 0.04 0.007 18% |

a) only 2 laboratories.

Table 5. Metal concentrations in COD (*Gadus morhua*).

| Sampling area | Date of collection | Age group | Number analysed | Concentration in mg/kg, wet weight | | | | | | | | | |
|----------------|--------------------|-----------|-----------------|------------------------------------|------|--------------|------|--------------|------|----------------|-------|----------------|-------|
| | | | | Zn | | Cu | | Hg | | Pb | | Cd | |
| | | | | min max | mean | min max | mean | min max | mean | min max | mean | min max | mean |
| <u>Denmark</u> | 1973 | | | | | | | | | | | | |
| 28 G8 42 | June | ~ 3 | 1 | | 4.4 | | 0.19 | | 0.07 | | <0.10 | | |
| 26 G9 39 | 15.08 | ~ 4 | 1 | | 5.2 | | 0.30 | | 0.21 | | <0.10 | | |
| 25 G5 39 | June | ~ 3 | 1 | | 5.9 | | 0.35 | | 0.04 | | <0.17 | | |
| 25 G5 39 | 08.04 | 4 | 1 | | 6.2 | | - | | 0.12 | | 0.15 | | |
| 25 G5 39 | 24.01 | - | 1 | | 5.3 | | 0.24 | | 0.04 | | <0.15 | | |
| 25 G5 38 | 22.02 | ~ 3 | 1 | | 4.1 | | - | | 0.06 | | <0.16 | | |
| 25 G5 38 | 19.11 | ~ 3 | 1 | | 3.5 | | 0.43 | | 0.08 | | <0.10 | | |
| 25 G5 38 | 28.11 | ~ 3 | 1 | | 3.5 | | 0.27 | | 0.05 | | 0.15 | | |
| 25 G5 38 | 28.10 | ~ 3 | 1 | | 5.4 | | 0.40 | | 0.03 | | <0.14 | | |
| 24 G4 38 | 20.09 | ~ 3 | 1 | | 5.9 | | 0.33 | | 0.08 | | <0.10 | | |
| Øresund | | | | | | | | | | | | | |
| 23 G2 46 | Jan. | - | 2* | 3.7 3.8 | 3.75 | - | - | 0.38 0.61 | 0.50 | 0.04 0.06 | 0.05 | | |
| " " " | 12.03 | - | 1 | | 4.2 | | 0.22 | | 0.88 | | 0.12 | | |
| " " " | 24.03 | 2 | 1 | | 5.1 | | - | | 0.40 | | 0.12 | | |
| " " " | 14.05 | 3-4 | 2* | 3.9 4.3 | 4.1 | 0.18 0.95 | 0.57 | 0.16 0.18 | 0.17 | 0.05 0.27 | 0.16 | | |
| " " " | 25.07 | 4-5 | 2* | 4.2 4.6 | 4.4 | 0.21 0.30 | 0.26 | 0.49 0.87 | 0.68 | 0.05 0.05 | 0.05 | | |
| " " " | 14.08 | 3 | 1 | | 4.6 | | 0.24 | | 0.25 | | <0.11 | | |
| " " " | 25.09 | 3-5 | 2* | 4.7 4.8 | 4.75 | 0.22 0.43 | 0.33 | 0.13 0.48 | 0.31 | <0.10 <0.14 | <0.12 | | |
| " " " | 22.11 | 5 | 1 | | 4.6 | | 0.19 | | 0.48 | | <0.13 | | |
| " " " | 29.11 | - | 1 | | 3.9 | | 0.19 | | 0.18 | | 0.09 | | |
| " " " | 12.12 | 3-4 | 2* | 4.9 5.6 | 5.3 | 0.20 0.24 | 0.22 | 0.75 0.78 | 0.77 | <0.10 <0.10 | <0.10 | | |
| <u>Finland</u> | 1974 | | | | | | | | | | | | |
| 32 H6 49 inner | Oct. | 2 | 2* | 3.0 3.2 | 3.1 | 0.10 0.13 | 0.12 | 0.15 0.16 | 0.16 | 0.2 0.3 | 0.25 | 0.010 0.015 | 0.013 |
| 32 H6 49 outer | Oct. | 2 | 1 | | 3.2 | | 0.16 | | 0.18 | | 0.016 | | 0.002 |
| 32 H3 48 inner | Oct. | 2 | 2* | 3.1 3.3 | 3.2 | 0.13 0.14 | 0.13 | 0.02 0.04 | 0.03 | 0.2 0.3 | 0.25 | 0.015 0.015 | 0.015 |
| 32 H3 48 outer | Oct. | 2 | 1 | | 3.2 | | 0.13 | | 0.03 | | 0.03 | | 0.002 |
| 29 H1 49 inner | Oct. | 2 | 2* | 3.8 3.8 | 3.8 | 0.14 0.15 | 0.15 | 0.02 0.03 | 0.03 | 0.1 0.1 | 0.10 | 0.015 0.025 | 0.020 |
| 29 H1 49 outer | Oct. | 2 | 1 | | 3.0 | | 0.11 | | 0.04 | | 0.05 | | 0.002 |
| 29 H0 49 inner | Oct. | 2 | 2* | 3.4 3.5 | 3.5 | 0.13 0.18 | 0.16 | 0.04 0.05 | 0.05 | 0.07 0.15 | 0.11 | 0.010 0.025 | 0.018 |
| 29 G9 49 outer | Oct. | 2 | 1 | | 3.4 | | 0.11 | | 0.03 | | 0.04 | | 0.002 |
| 30 H1 52 inner | Oct. | 2 | 2* | 3.8 3.9 | 3.9 | 0.16 0.17 | 0.17 | 0.05 0.16 | 0.11 | 0.2 0.3 | 0.25 | 0.015 0.020 | 0.018 |
| 31 H3 57 outer | Oct. | 2 | 1 | | 3.8 | | 0.16 | | 0.06 | | 0.05 | | 0.002 |

* each fish was analysed individually.

continued

Table 5 (ctd) COD (*Gadus morhua*).

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | | |
|------------------------------------|--------------------|------------|-----------------|-------------------------------------|------|---------------|------|---------------|------------------|---------------|------|----------------|-------|
| | | | | min Zn max | mean | min Cu max | mean | min Hg max | mean | min Pb max | mean | min Cd max | mean |
| <u>Federal Republic of Germany</u> | 1975 | | | | | | | | | | | | |
| 24 G2 38 | Feb. | 3-4 | 10* | 3.4 3.9 | 3.5 | 0.16 0.22 | 0.19 | 0.06 0.08 | 0.07 | 0.05 0.09 | 0.06 | 0.003 0.006 | 0.004 |
| 22 G0 37 | Feb. | 3-4 | 10* | 3.0 3.1 | 3.6 | 0.14 0.20 | 0.17 | 0.05 0.21 | 0.10 | 0.04 0.07 | 0.05 | 0.003 0.005 | 0.003 |
| 24 G4 37 | Feb. | 3-4 | 10* | 2.3 4.1 | 3.3 | 0.10 0.20 | 0.16 | 0.05 0.14 | 0.08 | 0.03 0.08 | 0.05 | 0.002 0.007 | 0.003 |
| <u>Sweden</u> | | | | | | | | | | | | | |
| 30 G8 50 | 28.10.74 | 2-8 | 10 (h) | | 4.1 | | 0.45 | | 0.12 (0.12) | | 0.13 | | 0.024 |
| 25 G5 40 | 09.10.74 | 2-5 | 9 (h) | | 1.2 | | 0.08 | | 0.064 (0.062) | | 0.07 | | 0.012 |
| 25 G4 39 | 16.03.75 | 2 | 10 (h) | | 3.4 | | 0.45 | | 0.020 (0.018) | | 0.07 | | 0.012 |
| 25 G6 39 | 22.01.75 | 3-4 | 10 (h) | | 3.2 | | 0.20 | | 0.061 (0.052) | | 0.06 | | 0.009 |
| 25 G5 38 | 29.01.75 | 3-5 | 10 (h) | | 3.4 | | 0.28 | | 0.060 (0.053) | | 0.08 | | 0.011 |
| 24 G3 39 | 07.10.74 | 3-4 | 10* | 2.8 5.1 | 4.2 | 0.10 0.67 | 0.46 | 0.039 0.11 | 0.075 | 0.04 0.08 | 0.06 | 0.006 0.009 | 0.008 |
| 24 G3 38 | 27.01.75 | 2-4 | 10 (h) | | 3.6 | | 0.31 | | 0.056 (0.047) | | 0.07 | | 0.014 |
| 25 G4 39 | 08.10.74 | 0-1 | 10 (h) | | 6.1 | | 0.88 | | 0.024 | | 0.05 | | 0.010 |
| 25 G6 39 | 22.01.75 | 0 | 10 (h) | | 4.9 | | 0.61 | | 0.018 (0.016) | | 0.08 | | 0.007 |
| 24 G3 39 | 07.10.74 | 0 | 10 (h) | | 9.2 | | 0.47 | | 0.024 | | 0.07 | | 0.012 |
| 24 G3 39 | 23.01.75 | 1 | 10 (h) | | 6.4 | | 1.13 | | 0.066 (0.062) | | 0.09 | | 0.016 |
| 24 G3 39 | 10.10.74 | 1-2 | 10 (h) | | 5.7 | | 0.75 | | 0.020 (0.022) | | 0.14 | | 0.018 |
| <u>U.S.S.R.</u> | 1975 | Size in cm | | | | | | | | | | | |
| 32 H7 48 | Apr. | 53 | 1 | | 6 | | 2.4 | | 0.18 | | 1.3 | | 0.05 |
| 32 H3 47 | " | 53 | 1 | | | | | | | | 0.12 | | 0.018 |

* each fish was analysed individually. (h) results are based on a homogenate of muscle tissue.

Mercury values in () are given as methyl mercury.

Table 6. Metal concentrations in FLOUNDER (*Pleuronectes flesus*).

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | | |
|------------------------------------|--------------------|-----------|-----------------|-------------------------------------|------|---------------|------|---------------|------------------|---------------|-------|----------------|-------|
| | | | | min Zn max | mean | min Cu max | mean | min Hg max | mean | min Pb max | mean | min Cd max | mean |
| <u>Denmark</u> | | | | | | | | | | | | | |
| 24 G4 38 | 27.09.73 | 4 | 2 (m) | | 8.8 | | 0.46 | | 0.04 | | <0.08 | | |
| 25 G5 38 | 28.11.73 | - | 4 (m) | | 6.1 | | 0.35 | | 0.06 | | <0.10 | | |
| 25 G5 38 | 19.12.73 | 4 | 2 (m) | | 6.0 | | 0.58 | | 0.074 | | <0.10 | | |
| 25 G6 38 | 28.08.73 | 3 | 3 (m) | | 10.0 | | 0.52 | | 0.10 | | 0.12 | | |
| 25 G5 39 | 25.01.73 | 4 | 1 | | 7.5 | | - | | 0.13 | | 0.24 | | |
| 25 G5 39 | 24.02.73 | 5 | 1 | | 6.0 | | - | | 0.091 | | 0.21 | | |
| 25 G5 39 | 29.03.73 | 3 | 1 | | 4.1 | | - | | 0.068 | | 0.09 | | |
| 25 G5 39 | 07.04.74 | 4 | 1 | | 4.8 | | 0.32 | | 0.077 | | 0.17 | | |
| 25 G5 39 | Jun/Jul 73 | 2 | 3 (m) | | 8.6 | | 0.61 | | 0.10 | | <0.10 | | |
| 25 G5 39 | Jun/Jul 73 | 3 | 3 (m) | | 8.8 | | 0.89 | | 0.04 | | <0.12 | | |
| 25 G5 39 | 15.10.73 | 4 | 2 (m) | | 6.5 | | 0.40 | | 0.15 | | 0.11 | | |
| <u>Øresund</u> | | | | | | | | | | | | | |
| 23 G2 40 | Jan/Feb 73 | - | 1 | | 6.2 | | 0.25 | | 1.50 | | 0.08 | | |
| " " " | " " " | 5 | 1 | | 8.2 | | - | | 0.43 | | <0.14 | | |
| " " " | 12.03.73 | 4 | 1 | | 8.2 | | - | | 0.20 | | 0.26 | | |
| " " " | 24.03.73 | 2 | 1 | | 6.7 | | 0.32 | | 0.29 | | 0.09 | | |
| " " " | 25.05.73 | 4 | 2 (m) | | 11.3 | | 0.44 | | 0.44 | | 0.10 | | |
| " " " | 16.07.73 | 3 | 2 (m) | | 7.0 | | 0.36 | | 0.18 | | <0.13 | | |
| " " " | 25.09.73 | 3 | 3 (m) | | 10.5 | | 0.47 | | 0.33 | | <0.08 | | |
| " " " | 27.09.73 | 2 | 2 (m) | | 6.5 | | 0.52 | | 0.30 | | 0.09 | | |
| " " " | 22.10.73 | 3 | 3 (m) | | 8.4 | | 0.51 | | 0.60 | | 0.12 | | |
| " " " | 24.11.73 | 3 | 3 (m) | | 6.7 | | 0.29 | | 0.32 | | <0.10 | | |
| " " " | 19.12.73 | - | 4 (m) | | 8.1 | | 0.49 | | 0.41 | | 0.35 | | |
| <u>Finland</u> | | | | | | | | | | | | | |
| 32 H6 49 outer | Oct. | 4 | 1 | | 4.5 | | 0.30 | | 0.07 | | 0.02 | | 0.008 |
| 32 H3 48 outer | Oct. | 4 | 1 | | 3.5 | | 0.20 | | 0.03 | | 0.08 | | 0.002 |
| 29 H2 49 inner | Oct. | 3 | 1 | 6.2 6.4 | 6.3 | 0.26 0.35 | 0.30 | 0.01 0.01 | 0.01 | 0.04 0.20 | 0.12 | 0.02 0.02 | 0.02 |
| 29 H1 49 outer | Oct. | 4 | 1 | | 3.5 | | 0.13 | | 0.01 | | 0.05 | | 0.002 |
| 29 G9 49 outer | Oct. | 3 | 1 | | 5.3 | | 0.13 | | 0.04 | | 0.05 | | 0.002 |
| 30 H1 52 inner | Oct. | 2-3 | 2* | 5.9 6.6 | 6.9 | 0.34 0.36 | 0.35 | 0.05 0.06 | 0.06 | 0.02 0.20 | 0.11 | 0.01 0.04 | 0.030 |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | |
| 24 G2 38 | Feb. | 3-4 | 10* | 3.3 4.9 | 4.1 | 0.13 0.18 | 0.15 | 0.04 0.15 | 0.09 | 0.03 0.05 | 0.04 | 0.002 0.006 | 0.003 |
| 22 G0 37 | Feb. | 3-4 | 10* | 3.4 5.1 | 4.2 | 0.12 0.18 | 0.15 | 0.04 0.07 | 0.05 | 0.04 0.09 | 0.07 | 0.003 0.008 | 0.004 |
| 24 G4 37 | Feb. | 3-4 | 10* | 3.6 4.4 | 4.0 | 0.10 0.20 | 0.16 | 0.04 0.13 | 0.07 | 0.04 0.09 | 0.05 | 0.003 0.012 | 0.007 |
| <u>Sweden</u> | | | | | | | | | | | | | |
| 25 G4 39 | 08.10.74 | 2-4 | 10 (h) | | 4.8 | | 0.46 | | 0.062 (0.053) | | 0.06 | | 0.021 |
| 25 G5 38 | 29.01.75 | 3-5 | 10 (h) | | 4.6 | | 0.49 | | 0.065 (0.058) | | 0.05 | | 0.015 |
| 24 G3 39 | 07.10.74 | 2-5 | 4 (h) | | 6.2 | | 0.55 | | 0.068 (0.060) | | 0.07 | | 0.024 |
| " " " | 23.01.75 | 2-4 | 10 (h) | | 4.8 | | 0.41 | | 0.24 (0.22) | | 0.07 | | 0.019 |

* each fish was analysed individually. (m) = mixed before analysis. (h) = results are based on homogenate of muscle tissue.

Mercury values in () are given as methyl mercury.

Table 7. Metal concentrations in PLAICE (*Pleuronectes platessa*).

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg. wet weight | | | | | | | | | |
|-----------------|--------------------|------------|-----------------|-------------------------------------|------|---------------|------|---------------|------------------|---------------|------|---------------|-------|
| | | | | min Zn max | mean | min Cu max | mean | min Hg max | mean | min Pb max | mean | min Cd max | mean |
| <u>Sweden</u> | 1975 | | | | | | | | | | | | |
| 25 G5 38 | 29.01 | 3 | 10 (h) | | 4.7 | | 0.56 | | 0.028 (0.029) | | 0.05 | | 0.11 |
| 24 G3 38 | 27.01 | 2-3 | 9 (h) | | 5.8 | | 0.45 | | 0.070 (0.062) | | 0.08 | | 0.014 |
| <u>U.S.S.R.</u> | 1975 | Size in cm | | | | | | | | | | | |
| 32 H3 48 | April | 25 | 1 | | 10 | | 1.2 | | 0.07 | | 1.1 | | 0.10 |
| 32 H3 47 | " | 25 | 1 | | - | | - | | - | | 0.18 | | 0.016 |

(h) results are based on a homogenate of muscle tissue.

Mercury values in () are given as methyl mercury.

Table 8. Metal concentrations in HERRING (*Clupea harengus*).

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | | |
|----------------|--------------------|-----------|-----------------|-------------------------------------|------|---------------|------|---------------|-------|---------------|-------|---------------|-------|
| | | | | min Zn max | mean | min Cu max | mean | min Hg max | mean | min Pb max | mean | min Cd max | mean |
| <u>Denmark</u> | | | | | | | | | | | | | |
| 24 G4 38 | 15.10.73 | 3 | 5 (m) | | 11 | | 1.0 | | 0.03 | | <0.10 | | |
| 25 G5 38 | 15.08.73 | 8+ | 6 (m) | | 10.7 | | 1.0 | | 0.05 | | 0.12 | | |
| 25 G5 38 | 30.11.73 | - | 5 (m) | | 9.4 | | 0.71 | | 0.03 | | <0.10 | | |
| 25 G5 38 | 30.12.73 | 3 | 5 (m) | | 14 | | 0.91 | | 0.03 | | 0.12 | | |
| 25 G5 39 | 25.01.73 | - | 1 | | 12 | | - | | 0.02 | | 0.16 | | |
| 25 G5 39 | 29.03.73 | - | 1 | | 13 | | - | | <0.04 | | 0.20 | | |
| " " " | June 73 | 3 | 6 (m) | | 14 | | 0.9 | | 0.07 | | <0.10 | | |
| " " " | June 73 | - | 1 | | 8.5 | | 0.7 | | <0.04 | | <0.10 | | |
| " " " | 24.09.73 | 8+ | 5 (m) | | 8.8 | | 1.4 | | 0.02 | | 0.06 | | |
| <u>Øresund</u> | | | | | | | | | | | | | |
| 23 G2 40 | 14.05.73 | - | 4 (m) | | 19 | | 1.1 | | 0.04 | | <0.10 | | |
| " " " | 29.11.73 | 5+ | 4 (m) | | 8.3 | | 0.8 | | 0.20 | | 0.11 | | |
| " " " | 22.04.74 | 8+ | 4 (m) | | 9.8 | | 1.1 | | 0.07 | | 0.20 | | |
| " " " | 15.05.74 | 3 | 5 (m) | | 12 | | 0.98 | | 0.09 | | 0.14 | | |
| " " " | 26.08.74 | 8+ | 5 (m) | | 6.4 | | 0.86 | | 0.02 | | <0.15 | | |
| " " " | 26.11.74 | 8+ | 5 (m) | | 7.3 | | 1.3 | | 0.02 | | 0.09 | | |
| " " " | 17.10.75 | 8+ | 5 (m) | | 6.5 | | 0.80 | | 0.07 | | <0.11 | | |
| <u>Finland</u> | | | | | | | | | | | | | |
| 32 H6 49 outer | Oct. 74 | 0-4 | 10 (h) | | 5.2 | | 0.44 | | 0.034 | | 0.036 | | 0.016 |
| 32 H3 48 inner | Oct. 74 | 2-3 | 12 (h) | | 7.8 | | 0.30 | | 0.004 | | 0.35 | | 0.04 |
| 32 H3 48 outer | Oct. 74 | 2-7 | 8 (h) | | 5.6 | | 0.42 | | 0.02 | | 0.06 | | 0.007 |
| 29 H2 49 inner | Oct. 74 | 1-8 | 8 (h) | | 8.2 | | 0.32 | | 0.03 | | 0.15 | | 0.025 |
| 29 H1 49 outer | Oct. 74 | 2-11 | 12 (h) | | 5.2 | | 0.31 | | 0.004 | | 0.05 | | 0.004 |
| 29 H0 49 inner | Oct. 74 | 0-2 | 10 (h) | | 8.2 | | 0.34 | | 0.006 | | 0.20 | | 0.06 |

m = mixed before analysis. (h) results are based on a homogenate of muscle tissue.

continued

Table 8 (ctd) Herring (*Clupea harengus*)

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | | |
|------------------------------------|--------------------|------------|-----------------|-------------------------------------|------|--------------|------|--------------|------------------|--------------|------|----------------|-------|
| | | | | Zn | | Cu | | Hg | | Pb | | Cd | |
| | | | | min max | mean | min max | mean | min max | mean | min max | mean | min max | mean |
| <u>Finland (ctd)</u> | | | | | | | | | | | | | |
| 29 G9 49 outer | Oct. 74 | 0-4 | 10 (h) | | 5.3 | | 0.38 | | 0.025 | | 0.01 | | 0.015 |
| 30 H1 52 inner | Oct. 74 | 2-7 | 12 (h) | | 7.7 | | 0.32 | | 0.03 | | 0.15 | | 0.025 |
| 31 H3 57 inner | Oct. 74 | 1-7 | 10 (h) | | 6.2 | | 0.54 | | 0.04 | | 0.12 | | 0.01 |
| 31 H3 57 outer | Oct. 74 | 1-4 | 10 (h) | | 5.0 | | 0.53 | | 0.02 | | 0.05 | | 0.03 |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | |
| 24 G2 38 | Feb. 75 | 2-3 | 10* | 3.5 7.3 | 4.9 | 0.34 0.63 | 0.50 | 0.04 0.16 | 0.08 | 0.03 0.11 | 0.06 | 0.002 0.006 | 0.003 |
| 22 G0 37 | Feb. 75 | 2-3 | 10* | 3.5 5.1 | 4.2 | 0.33 0.70 | 0.43 | 0.04 0.18 | 0.09 | 0.03 0.11 | 0.07 | 0.002 0.009 | 0.004 |
| 24 G4 37 | Feb. 75 | 2-3 | 10* | 3.4 6.0 | 4.8 | 0.31 0.66 | 0.49 | 0.05 0.15 | 0.08 | 0.04 0.10 | 0.06 | 0.003 0.008 | 0.004 |
| <u>Sweden</u> | | | | | | | | | | | | | |
| 30 G8 54 | 07.01.75 | 7-11 | 5 (h) | | 18.0 | | 1.04 | | 0.14 (0.13) | | 0.08 | | 0.072 |
| 30 G8 54 | 07.01.75 | 2-4 | 5 (h) | | 22.9 | | 0.98 | | 0.042 (0.043) | | 0.08 | | 0.042 |
| 30 G8 50 | 22.11.74 | 3-5 | 10 (h) | | 19.2 | | 1.60 | | 0.066 (0.064) | | 0.07 | | 0.034 |
| 25 G4 39 | 26.09.74 | 3-6 | 10 (h) | | 13.1 | | 0.82 | | 0.038 (0.035) | | 0.08 | | 0.042 |
| 28 G8 43 | 26.09.74 | 3-8 | 10 (h) | | 11.8 | | 0.74 | | 0.033 (0.031) | | 0.08 | | 0.028 |
| 24 G3 39 | 07.10.74 | 2-4 | 10 (h) | | 6.5 | | 0.83 | | 0.040 (0.038) | | 0.10 | | 0.020 |
| 25 G4 39 | 27.11.74 | 0-1 | 10 (h) | | 16.2 | | 1.44 | | 0.022 (0.025) | | 0.09 | | 0.024 |
| 24 G3 39 | 26.09.74 | 1 | 9 (h) | | 15.8 | | 0.99 | | 0.017 (0.015) | | 0.09 | | 0.065 |
| <u>U.S.S.R.</u> | | | | | | | | | | | | | |
| 32 H7 48 | 1975 April | Size in cm | 7 | | - | | - | | 0.07 | | - | | - |
| " " " | " | 9.3-10.2 | 5 | | - | | - | | 0.14 | | - | | - |
| " " " | " | 12.3-13.2 | 5 | | - | | - | | 0.10 | | - | | - |
| " " " | " | 16.1-18.8 | 5 | | - | | - | | - | | - | | - |
| " " " | " | 14.7-16.0 | 11 | | 27 | | 1.5 | | - | | 1.3 | | 0.06 |
| 32 H3 48 | " | 19.5-21.0 | 10 | | 32 | | 1.0 | | - | | 1.1 | | 0.05 |
| " " " | " | 15.0-16.8 | 6 | | - | | - | | 0.30 | | - | | - |
| 28 H3 44 | " | 18.0-21.1 | 10 | | 20 | | 1.9 | | - | | 1.4 | | 0.05 |
| " " " | " | 17.8-19.2 | 5 | | - | | - | | 0.07 | | - | | - |
| 28 H0 44 | " | 17.5-20.8 | 10 | | 24 | | 1.4 | | - | | 1.1 | | 0.05 |
| " " " | " | 17.0-18.0 | 5 | | - | | - | | 0.05 | | - | | - |
| " " " | " | 17.8-20.4 | 3 | | - | | - | | 0.03 | | - | | - |
| " " " | " | 15.2-17.7 | 5 | | - | | - | | 0.03 | | - | | - |
| " " " | " | 18.0-21.0 | 5 | | - | | - | | 0.05 | | - | | - |
| 26 H0 39 | " | 18.7-21.0 | 5 | | - | | - | | 0.04 | | - | | - |
| 29 H0 48 | " | 17.4-19.5 | 10 | | 20 | | 1.8 | | - | | 1.3 | | 0.05 |
| " " " | " | 20.0-23.6 | 5 | | - | | - | | 0.08 | | - | | - |

(h) results are based on a homogenate of muscle tissue.
*each fish was analysed individually.

Mercury values in () are given as methyl mercury.

continued

Table 8 (ctd) Herring (*Clupea harengus*).

| Sampling area | Date of collection | Size in cm | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | |
|----------------|--------------------|------------|-----------------|-------------------------------------|------|---------------|------|---------------|------|---------------|------|---------------|
| | | | | min Zn max | mean | min Cu max | mean | min Hg max | mean | min Pb max | mean | min Cd max |
| U.S.S.R. (ctd) | | | | | | | | | | | | |
| 32 H7 48 | April | 12.7-14.0 | 2 | - | | - | | - | | 0.15 | | 0.023 |
| 32 H3 47 | " | 18.6-20.1 | 10 | - | | - | | - | | 0.31 | | 0.027 |
| 28 H3 43 | " | 17.1-21.1 | 9 | - | | - | | - | | 0.21 | | 0.020 |
| 28 H0 43 | " | 18.1-20.1 | 8 | - | | - | | - | | 0.32 | | 0.020 |
| 29 H1 47 | " | 19.1-22.1 | 5 | - | | - | | - | | 0.32 | | 0.012 |

Table 9. Metal concentrations in SPRAT (*Sprattus sprattus*).

| Sampling area | Date of collection | Age group | Number analysed | Concentrations in mg/kg, wet weight | | | | | | | | | |
|-----------------|--------------------|------------|-----------------|-------------------------------------|------|-----|------|-----|-------|-----|-------|-----|-------|
| | | | | Zn | | Cu | | Hg | | Pb | | Cd | |
| | | | | min | mean | min | mean | min | mean | min | mean | min | mean |
| | | | | max | | max | | max | | max | | max | |
| <u>Finland</u> | 1974 | | | | | | | | | | | | |
| 32 H6 49 outer | Oct. | 2-11 | 10 (h) | | 7.7 | | 0.40 | | 0.09 | | 0.012 | | 0.027 |
| 32 H3 48 inner | Oct. | 2-6 | 12 (h) | | 12.0 | | 0.42 | | 0.02 | | 0.05 | | 0.015 |
| 32 H3 48 outer | Oct. | 2-11 | 10 (h) | | 7.0 | | 0.50 | | 0.018 | | 0.04 | | 0.005 |
| 29 H1 49 outer | Oct. | 1-7 | 13 (h) | | 14.5 | | 0.36 | | 0.03 | | 0.07 | | 0.023 |
| 29 H0 49 inner | Oct. | 1-6 | 10 (h) | | 9.9 | | 0.45 | | 0.03 | | 0.08 | | 0.01 |
| 29 G9 49 outer | Oct. | 2-14 | 10 (h) | | 11.0 | | 0.40 | | 0.06 | | 0.01 | | 0.02 |
| 31 H3 57 outer | Oct. | 7 | 2 (h) | | 9.0 | | 0.42 | | 0.05 | | 0.10 | | 0.015 |
| <u>U.S.S.R.</u> | 1975 | Size in cm | | | | | | | | | | | |
| 32 H7 48 | Apr. | 11.9-14.3 | 4 | | - | | - | | 0.20 | | - | | - |
| 32 H3 48 | " | 11.9-13.6 | 5 | | 20 | | 1.0 | | - | | 1.9 | | 0.20 |
| " " " | " | 12.3-14.4 | 5 | | - | | - | | 0.22 | | - | | - |
| 28 H0 44 | " | 12.0-14.2 | 3 | | - | | - | | 0.09 | | - | | - |
| " " " | " | 12.0-12.6 | 3 | | 17 | | 1.6 | | - | | 0.9 | | 0.10 |
| 32 H3 47 | " | 11.1-12.4 | 6 | | - | | - | | - | | 0.12 | | 0.022 |
| 28 H0 43 | " | 11.7-12.9 | 5 | | - | | - | | - | | 0.11 | | 0.021 |

(h) results are based on a homogenate of muscle tissue.

Table 10a. Metal concentrations in MUSSELS (*Mytilus edulis*).

| Sampling area | Date of collection | Size distrib. in cm min max mean | Number analysed | Concentration in mg/kg, wet weight | | | | |
|------------------------------------|--------------------|--|-----------------|------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | | | | min Zn max mean | min Cu max mean | min Hg max mean | min Pb max mean | min Cd max mean |
| <u>Federal Republic of Germany</u> | | | | | | | | |
| 24 G2 38 | Feb. 75 | 5.5 6.0 5.7 | 20 (h) | 20.0 | 1.0 | 0.07 | 0.16 | 0.14 |
| 22 G0 37 | Feb. 75 | 5.5 6.0 5.7 | 20 (h) | 15.9 | 1.2 | 0.09 | 0.21 | 0.19 |

(h) results are based on a homogenate of muscle tissue.

Table 10b. Metal concentrations in *Macoma baltica*.

| Sampling area | Date of collection | Depth in m | Number analysed | Concentration in mg/kg, wet weight | | | | |
|----------------|--------------------|------------|-----------------|------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | | | | min Zn max mean | min Cu max mean | min Hg max mean | min Pb max mean | min Cd max mean |
| <u>Finland</u> | 1974 | | | | | | | |
| 32 H5 48 | 05.09 | 40-41 | | 66 (440) | 14 (95) | 0.040 (0.27) | 0.77 (5.16) | 0.16 (1.04) |
| 32 H5 48 | 19.06 | 51 | | 65 (500) | 4.6 (35) | 0.013 (0.10) | 0.43 (3.33) | 0.13 (0.99) |
| 32 H3 48 | 20.08 | 50-55 | | 88 (625) | 10.5 (75) | 0.035 (0.25) | 0.78 (5.12) | 0.15 (1.05) |
| 29 G9 49 | 21.08 | 30-50 | | 100 (720) | 4.2 (30) | 0.042 (0.30) | 0.53 (3.81) | 0.24 (1.68) |
| 30 H1 51 | 23.08 | - | | 77 (515) | 6 (40) | 0.044 (0.29) | 0.82 (5.47) | 0.15 (0.98) |
| 31 H1 56 | 24.08 | 48 | | 110 (700) | 16 (100) | 0.125 (0.78) | 1.56 (9.75) | 0.56 (3.47) |
| 30 H1 55 | 31.08 | 38 | | 87 (545) | 8 (50) | 0.066 (0.41) | 1.39 (8.67) | 0.39 (2.46) |

Values in () on a dry weight basis.

Table 10c. Metal concentrations in *Mesidothea entomon*.

| Sampling area | Date of collection | Depth in m | Number analysed | Concentration in mg/kg, wet weight | | | | | | | | | |
|---------------|--------------------|------------|-----------------|------------------------------------|-----------------|------------|-----------------|------------|-----------------|------------|----------------|------------|----------------|
| | | | | Zn | | Cu | | Hg | | Pb | | Cd | |
| | | | | min max | mean | min max | mean | min max | mean | min max | mean | min max | mean |
| Finland | 1974 | | | | | | | | | | | | |
| 32 H5 48 | 05.09 | 40-41 | | | 14 (73) | | 24 (125) | | 0.006 (0.03) | | 0.20 (1.08) | | 0.17 (0.91) |
| 32 H5 48 | 19.06 | 51 | | | 25 (130) | | 23 (120) | | 0.006 (0.03) | | 0.23 (1.20) | | 0.17 (0.91) |
| 32 H3 48 | 04.09 | 50-55 | | | 21 (94) | | 27 (120) | | - | | 0.41 (1.88) | | 0.20 (0.89) |
| 29 G9 49 | 21.08 | 30-50 | | | 13 (59) | | 29 (130) | | - | | 0.44 (1.97) | | 0.20 (0.89) |
| 29 G9 49 | 03.09 | 131 | | | 15 (75) | | 48 (240) | | 0.004 (0.02) | | 0.18 (0.90) | | 0.58 (2.90) |
| 30 G9 51 | 28.08 | 123 | | | 25 (112) | | 50 (225) | | 0.01 (0.06) | | 0.56 (2.52) | | 0.67 (3.03) |
| 30 G9 51 | 24.07 | 90 | | | 22 (94) | | 28 (120) | | 0.009 (0.04) | | 0.68 (2.92) | | 0.26 (1.14) |
| 30 H1 52 | 01.09 | 65 | | | 18 (67) | | 49 (190) | | - | | 0.53 (2.02) | | 0.43 (1.65) |
| 30 H0 53 | 24.08 | 81 | | | 27.0 (112.0) | | 43.0 (180.0) | | 0.031 (0.13) | | 0.26 (1.09) | | 0.27 (1.14) |
| 30 H1 55 | 31.08 | 38 | | | - | | - | | 0.025 (0.10) | | - | | - |
| 31 H4 59 | 27.08 | - | | | 15.0 (68.0) | | 19.0 (85.0) | | - | | 0.15 (0.69) | | 1.00 (4.54) |
| 30 H2 55 | Sep. | | | | 28.0* | | 56.0* | | 0.13* | | 0.86* | | 0.57* |
| | | 9 | | | (118.0) | | (213.0) | | (0.62) | | (5.10) | | (2.50) |
| | | 8 | | | (120.0) | | (224.0) | | (0.45) | | (2.70) | | (2.40) |
| | | 7 | | | (120.0) | | (260.0) | | (0.31) | | (3.30) | | (2.50) |
| | | 6 | | | (109.0) | | (245.0) | | (0.74) | | (2.70) | | (2.30) |
| | | 4 | | | (104.0) | | (194.0) | | (0.53) | | (3.80) | | (1.90) |
| 31 H5 59 | Sep. | 19 | | | 16.0 (84.0) | | 15.0 (79.0) | | 0.12 (0.63) | | 1.50 (7.80) | | 0.27 (1.40) |
| 31 H3 57 | Sep. | 29 | | | 21.0 (73.0) | | 26.0 (89.0) | | 0.04 (0.15) | | 1.20 (4.20) | | 0.61 (2.20) |

Values in () on a dry weight basis.

* Average from 5 samples.

Table 11. Results of the analyses of maize oil intercalibration Sample 3B.

| Laboratory | Reported values in µg/kg | | | | | | | | | | Percentage deviation from true values | | | | | | | | | |
|--|--------------------------|-------|-------|-------|--------|----------|----------|----------|-------|-------|---------------------------------------|-------|-------|-------|--------|----------|----------|----------|-------|-------|
| | HCB | α BHC | Σ BHC | β BHC | Dieldr | p,p'-DDE | p,p'-DDD | p,p'-DDT | Σ DDT | Σ PCB | HCB | α BHC | Σ BHC | β BHC | Dieldr | p,p'-DDE | p,p'-DDD | p,p'-DDT | Σ DDT | Σ PCB |
| Lab.1 Finland | 78 | - | - | - | - | 120 | 190 | 230 | 540 | 1300 | +47 | - | - | - | - | +20 | -10 | +10 | +4 | +18 |
| Lab.2 Finland, series I | 26 | 51 | 56 | - | 80 | 80 | 170 | 210 | 460 | 970 | -51 | +9 | +12 | - | -20 | -20 | -19 | ±0 | -12 | -12 |
| Lab.2 Finland, series II | 46 | 54 | 48 | - | 84 | 86 | 170 | 200 | 480* | 1000 | - | - | - | - | - | -21 | -66 | -54 | -52 | -10 |
| Lab.3 Poland | - | - | - | - | - | 79 | 72 | 96 | 250 | 990 | - | - | - | - | - | -7 | -29 | -24 | -23 | -9 |
| Lab.4 GDR | - | - | - | - | - | 93 | 150 | 160 | 400 | 1000 | - | - | - | - | - | -7 | -29 | -24 | -23 | -9 |
| Lab.5 FRG ^{x)} | 30 | 35 | 48 | - | 100 | 200 | 180 | 83 | 460 | 950 | -43 | -26 | -4 | - | ±0 | +100 | -14 | -60 | -12 | -14 |
| Lab.6 Denmark ^{xx)} | 20 | 42 | 42 | - | 92 | 110 | 190 | 190 | 490 | 480 | -62 | -16 | -16 | - | -8 | +10 | -10 | -10 | -6 | -56 |
| Lab.7 Sweden | 56 | 40 | 46 | 45 | 53 | 99 | 200 | 200 | 500 | 1100 | +6 | -15 | -8 | -21 | -47 | -1 | -5 | -5 | -4 | ±10 |
| Lab.8 USSR | - | - | 65 | - | - | 103 | 307 | 140 | 550 | 930 | - | - | +30 | - | - | +3 | +47 | -33 | +6 | -16 |
| True values | 53 | 47 | 50 | 57 | 100 | 100 | 210 | 210 | 520 | 1100 | | | | | | | | | | |
| Mean | 42 | 42 | 51 | - | 81 | 110 | 182 | 163 | 490 | 970 | | | | | | | | | | |
| Standard deviation | 24 | 6.7 | 9.2 | - | 21 | 39 | 65 | 54 | 52 | 140 | | | | | | | | | | |
| Standard deviation as percentage of mean | 57 | 16 | 18 | - | 26 | 35 | 28 | 33 | 11 | 14 | | | | | | | | | | |
| Standard deviation as percentage of mean in the North Sea intercalibration | - | - | 11 | - | 6.9 | 21 | 17 | 10 | - | 11 | | | | | | | | | | |

x) refer to remarks on page 32.

xx) recovery of HCB by this method is normally approx. 50%. Arochlor 1260 used as standard.

* value omitted.

Table 12. Chlorinated hydrocarbon concentrations in COD (*Gadus morhua*).

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concen. in mg/kg fat weight | | Ratio | Concentration in µg/kg, wet weight | | | | |
|------------------------------------|------------------|-----------|--------------------------------|-------|------------------------------------|-----|-----|------|-----|-----------------------------|------|-------|------------------------------------|-----|-------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | DDT/PCB | HCB | α BHC | Lind. | Dieldrin |
| <u>Denmark</u> | | | | | | | | | | | | | | | | | |
| 25 G5 39 | Nov. 74 | - | 500 g | - | 15 | ND | 10 | 27 | 20 | - | - | 1.4 | - | - | - | <7 | |
| 25 G5 39 | Nov. 74 | - | " | - | 15 | ND | 14 | 31 | 20 | - | - | - | - | - | - | <7 | |
| 25 G5 38 | Dec. 74 | - | " | - | 18 | 7 | 16 | 44 | 30 | - | - | 1.5 | - | - | - | <7 | |
| 25 G2 40 | Oct. 74 | - | " | - | ND | ND | ND | ND | 20 | - | - | - | - | - | - | <7 | |
| " " " | Nov. 74 | - | " | - | ND | ND | ND | ND | 30 | - | - | - | - | - | - | <7 | |
| " " " | Nov. 74 | - | " | - | ND | ND | ND | ND | 30 | - | - | - | - | - | - | <7 | |
| " " " | Dec. 74 | - | " | - | ND | ND | ND | ND | 20 | - | - | - | - | - | - | <7 | |
| <u>Finland</u> | | | | | | | | | | | | | | | | | |
| 29 H0 49 | Oct. 74 | 2 | 2* | 0.49 | 5 | 3 | 6 | 15 | 59 | 3.8 | 12 | 0.30 | - | - | - | - | |
| 29 G9 49 | Oct. 74 | 2 | 1 | 0.32 | <5 | <5 | <5 | 7 | 8 | 2.2 | 2.5 | 0.88 | - | - | <5 | <5 | |
| 31 H3 57 | Oct. 74 | 2 | 1 | 0.38 | <5 | **T | T | <5 | 5 | 1.0 | 1.2 | 0.83 | - | - | <5 | T | |
| 30 H1 52 | Oct. 74 | 2 | 2* | 0.46 | 4 | 1 | 4 | 9 | 41 | 1.9 | 8.9 | 0.22 | - | - | - | - | |
| 32 H6 49 ^x | Oct. 74 | 2 | 2* | 0.52 | 10 | 3 | 5 | 19 | 52 | 3.4 | 10 | 0.34 | - | - | - | - | |
| 32 H6 49 | Oct. 74 | 2 | 1 | 0.32 | 9 | <5 | <5 | 13 | 20 | 4.1 | 6.2 | 0.65 | - | - | <5 | <5 | |
| 32 H3 48 ^x | Oct. 74 | 2 | 2* | 0.42 | 11 | 4 | 7 | 24 | 32 | 5.5 | 12 | 0.75 | - | - | - | - | |
| 32 H3 48 | Oct. 74 | 2 | 1 | 0.23 | <5 | <5 | T | 7 | 5 | 3.1 | 2.1 | 1.4 | - | - | <5 | T | |
| 29 H2 49 ^x | Oct. 74 | 2 | 2* | 0.47 | 5 | 1 | 3 | 10 | 49 | 2.1 | 10.6 | 0.20 | - | - | - | - | |
| 29 H1 49 | Oct. 74 | 1 | 1 | 0.30 | <5 | <5 | <5 | 6 | 5 | 1.9 | 1.7 | 1.2 | - | - | <5 | <5 | |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | | | | | |
| | 1975 | | | | | | | | | | | | | | | | |
| 24 G2 38 | Feb. | 3-4 | 10 (h) | 0.33 | 11 | 7 | 14 | 32 | 83 | 9.6 | 24 | 0.39 | - | - | 7 | 4 | |
| 22 G0 37 | Feb. | 3-4 | 10 (h) | 0.19 | 6 | 3 | 9 | 17 | 70 | 8.9 | 36 | 0.24 | - | - | 5 | 2 | |
| 22 G1 37 | Feb. | 3-4 | 10 (h) | 0.21 | 7 | 5 | 10 | 22 | 76 | 11 | 36 | 0.29 | - | - | 6 | 3 | |
| <u>Sweden</u> | | | | | | | | | | | | | | | | | |
| 25 G4 39 | Mar. 75 | 2 | 10 (h) | 0.71 | 10 | 3 | 10 | 24 | 55 | 3.5 | 7.8 | 0.44 | <1 | <1 | <1 | <1 | |
| 24 G3 39 | Oct. 74 | 3-4 | 10 (h) | 0.71 | 24 | 10 | 28 | 62 | 67 | 8.7 | 9.3 | 0.93 | <1 | <1 | <1 | <1 | |
| 24 G3 38 | Jan. 75 | 2-4 | 10 (h) | 0.68 | 14 | 7 | 17 | 38 | 43 | 5.6 | 6.4 | 0.88 | <1 | <1 | <1 | <1 | |
| 30 G8 50 | Oct. 74 | 2-5 | 10 (h) | 0.74 | 11 | 1 | 6 | 17 | 33 | 2.4 | 4.5 | 0.52 | <1 | <1 | <1 | <1 | |
| 25 G5 40 | Oct. 74 | 2-5 | 9 (h) | 0.64 | 21 | 8 | 22 | 52 | 56 | 8.1 | 8.8 | 0.93 | <1 | <1 | <1 | <1 | |
| 25 G6 39 | Jan. 75 | 3-4 | 10 (h) | 0.38 | 19 | 7 | 19 | 45 | 53 | 12 | 14 | 0.85 | <1 | <1 | <1 | <1 | |
| 25 G5 38 | Jan. 75 | 3-5 | 10 (h) | 0.66 | 15 | 6 | 16 | 38 | 47 | 5.8 | 7.2 | 0.81 | <1 | <1 | <1 | <1 | |
| 24 G3 39 | Oct. 74 | 0-1 | 10 (h) | 1.01 | 10 | 4 | 6 | 21 | 48 | 2.1 | 4.8 | 0.44 | <1 | 2 | <1 | <1 | |
| 24 G3 39 | Oct. 74 | 0 | 10 (h) | 0.97 | 20 | 5 | 10 | 28 | 74 | 2.9 | 7.6 | 0.38 | <1 | <1 | <1 | <1 | |
| 24 G3 39 | Jan. 75 | 1 | 10 (h) | 0.86 | 18 | 2 | 15 | 36 | 99 | 4.1 | 11.3 | 0.36 | <1 | <1 | <1 | <1 | |
| 25 G6 39 | Jan. 75 | 0 | 10 (h) | 1.0 | 19 | 8 | 20 | 54 | 61 | 5.4 | 6.1 | 0.89 | <1 | <1 | <1 | <1 | |
| 25 G4 39 | Oct. 75 | 0-1 | 10 (h) | 0.9 | 18 | 8 | 19 | 48 | 91 | 5.3 | 10 | 0.53 | <1 | <1 | <1 | <1 | |

* each fish was analysed individually.

** T = traces only.

ND = not detectable.

continued

^x inner archipelago. (h) = results are based on a homogenate of muscle tissue.

Table 12 (ctd) Cod (*Gadus morhua*)

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg fat weight | | Ratio $\frac{DDT}{PCB}$ | Concentration in µg/kg, wet weight | | | |
|-----------------------------------|-------------------|-----------------------|--------------------------------|-------|------------------------------------|----------------|----------------|------------------|-----------------|-------------------------------|------|----------------------------|------------------------------------|-------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | α BHC | Lind. | Dieldrin |
| <u>German Democratic Republic</u> | 1975 | | | | | | | | | | | | | | | |
| 24 G2 37 | 28.10 | 2 | 1 | - | 1.25 | 0.25 | 2.50 | 4.00 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 2 | 1 | - | 2.00 | 0.50 | 7.50 | 10.00 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 1 | 1 | - | 0.38 | 0.12 | 1.00 | 1.50 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 1 | 1 | - | 0.38 | 0.12 | 1.00 | 1.50 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 2 | 1 | - | 0.38 | 0.12 | 1.25 | 1.75 | 12.5 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 1 | 1 | - | 0.38 | 0.12 | 1.25 | 1.75 | 10.0 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 1 | 1 | - | 0.50 | 0.12 | 1.00 | 1.62 | 12.5 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 1 | 1 | - | 0.62 | 0.38 | 1.25 | 2.25 | 12.5 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 1 | 1 | - | 0.62 | 0.38 | 1.25 | 2.25 | 12.5 | - | - | - | - | - | - | - |
| 24 G2 37 | 18.11 | 2 | 1 | - | 0.25 | 0.12 | 0.75 | 1.12 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 18.11 | 1 | 1 | - | 0.38 | 0.12 | 1.00 | 1.50 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 18.11 | 1 | 1 | - | 0.25 | 0.12 | 0.88 | 1.25 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 18.11 | 1 | 1 | - | 0.25 | 0.12 | 0.63 | 1.00 | 6.25 | - | - | - | - | - | - | - |
| 24 G2 37 | 18.11 | 1 | 1 | - | 0.38 | 0.12 | 0.88 | 1.38 | 6.25 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 3 | 1 | - | 2.50 | 1.00 | 3.75 | 7.25 | 10.0 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 4 | 1 | - | 6.25 | 2.50 | 10.00 | 18.75 | 17.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 2 | 1 | - | 3.75 | 1.25 | 5.00 | 10.00 | 10.0 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 2 | 1 | - | 5.00 | 2.50 | 8.75 | 16.25 | 12.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 3 | 1 | - | 2.50 | 0.75 | 5.00 | 8.25 | 7.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 2 | 1 | - | 2.50 | 1.00 | 2.50 | 6.00 | 7.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 2 | 1 | - | 6.25 | 1.25 | 10.00 | 17.50 | 17.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 2 | 1 | - | 3.75 | 1.00 | 3.75 | 8.50 | 12.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 3 | 1 | - | 6.25 | 1.25 | 7.50 | 15.00 | 12.5 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 3 | 1 | - | 3.75 | 1.25 | 3.75 | 8.75 | 12.5 | - | - | - | - | - | - | - |
| <u>Poland</u> | Oct.74 -Mar.75 | min max average | 8* | 1.3 | 10 60 25 | 10 80 15 | 60 90 60 | 30 230 100 | 20 220 54 | 4.0 | 2.2 | 1.85 | | | | |
| <u>U.S.S.R.</u> | 1975 | Size in cm | | | | | | | | | | | | | | |
| 32 H7 48 | Apr. | 53 | 1 | 0.34 | 54 | 29 | 38 | 130 | 56 | 38.3 | 16.3 | 2.35 | - | - | 4 | - |
| 29 H1 47 | " | 29 | 1 | 0.45 | 16 | 9 | 2 | 30 | 125 | 6. | 27.8 | 0.22 | - | - | 1 | - |

* each fish was analysed individually.

Table 13. Chlorinated hydrocarbon concentrations in FLOUNDER (*Pleuronectes flesus*).

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat weight | | Ratio DDT/PCB | Concentration in µg/kg, wet weight | | | |
|---|-------------------|-----------------------|--------------------------------|-------|------------------------------------|-----|-----|------|-----|--------------------------------|------|---------------|------------------------------------|-------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | α BHC | Lind. | Dieldrin |
| <u>Denmark</u> | | | | | | | | | | | | | | | | |
| 25 G5 39 | Nov. 74 | - | 500 g | - | 13 | 11 | 16 | 42 | 30 | - | - | 1.3 | - | - | - | <7 |
| 25 G5 39 | Nov. 74 | - | " | - | 22 | 26 | 35 | 88 | 40 | - | - | 2.3 | - | - | - | <7 |
| 25 G5 38 | Dec. 74 | - | " | - | 33 | 55 | 48 | 145 | 60 | - | - | 2.5 | - | - | - | <7 |
| 23 G2 40 | Sep. 74 | - | " | - | <20 | <20 | <20 | 20 | 80 | | | | | | | <20 |
| 23 G2 39 | Oct. 74 | - | " | - | <20 | <20 | <20 | <20 | <10 | | | | | | | <20 |
| 23 G2 40 | Nov. 74 | - | " | - | <20 | <20 | <20 | <20 | 60 | | | | | | | <20 |
| 23 G2 40 | Dec. 74 | - | " | - | <20 | <20 | <20 | <20 | 50 | | | | | | | <20 |
| <u>Finland</u> | | | | | | | | | | | | | | | | |
| 32 H6 49 ^x | Oct. 74 | 5 | 2* | 2.27 | 24 | 20 | 20 | 69 | 140 | 3.0 | 6.2 | 0.49 | - | - | - | - |
| 29 H2 49 ^x | Oct. 74 | 3 | 2* | 0.63 | 7 | 2 | 3 | 13 | 81 | 2.1 | 13.0 | 0.16 | - | - | - | - |
| 29 H1 49 | Oct. 74 | 5 | 1 | 8.34 | 120 | 67 | 170 | 370 | 240 | 4.5 | 2.8 | 1.63 | - | - | 7 | ND |
| 29 G9 49 | Oct. 74 | 3 | 1 | 0.60 | <5 | <5 | 6 | 11 | 19 | 1.9 | 3.1 | 0.58 | - | - | <5 | <5 |
| 30 H1 52 | Oct. 74 | 2-3 | 2* | 1.75 | 20 | 1 | 5 | 28 | 71 | 1.6 | 4.1 | 0.39 | - | - | - | - |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | | | | |
| 24 G2 38 | Feb. 75 | 3-4 | 10 (h) | 0.68 | 13 | 10 | 23 | 46 | 94 | 6.8 | 14 | 0.49 | - | - | 8 | 3 |
| 22 G0 37 | Feb. 75 | 3-4 | 10 (h) | 0.65 | 7 | 9 | 5 | 20 | 130 | 3.1 | 19 | 0.25 | - | - | 8 | 3 |
| 22 G1 37 | Feb. 75 | 3-4 | 10 (h) | 0.59 | 21 | 33 | 36 | 90 | 170 | 9.1 | 7.1 | 0.53 | - | - | 15 | 3 |
| <u>Sweden</u> | | | | | | | | | | | | | | | | |
| 25 G5 38 | Jan. 75 | 3-5 | 10 (h) | 1.32 | 11 | 9 | 18 | 44 | 46 | 3.3 | 3.5 | 0.96 | 1 | 1 | 1 | 1 |
| 25 G4 39 | Oct. 74 | 2-4 | 10 (h) | 1.24 | 11 | 11 | 14 | 39 | 55 | 3.2 | 4.4 | 0.71 | 1 | 1 | 1 | 1 |
| 24 G3 39 | Oct. 74 | 2-5 | 4 (h) | 1.32 | 9 | 10 | 7 | 29 | 57 | 2.1 | 4.3 | 0.51 | 1 | 1 | 1 | 1 |
| 24 G3 39 | Jan. 75 | 2-4 | 10 (h) | 1.12 | 5 | 3 | 5 | 14 | 47 | 1.3 | 4.1 | 0.30 | 1 | 2 | 1 | 1 |
| <u>German Demo- cratic Republic</u> | | | | | | | | | | | | | | | | |
| | 1975 | | | | | | | | | | | | | | | |
| 24 G2 37 | 28.10 | 4 | 1 | | 5 | 3 | 12 | 20 | 75 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 4 | 1 | | 9 | 8 | 25 | 42 | 100 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 6 | 1 | | 8 | 5 | 20 | 33 | 100 | - | - | - | - | - | - | - |
| 24 G2 37 | 28.10 | 5 | 1 | | 30 | 38 | 50 | 118 | 225 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 5 | 1 | | 13 | 8 | 25 | 46 | 75 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 4 | 1 | | 4 | 3 | 10 | 17 | 25 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 4 | 1 | | 5 | 3 | 8 | 16 | 38 | - | - | - | - | - | - | - |
| 24 G2 37 | 5.11 | 7 | 1 | | 50 | 25 | 63 | 138 | 200 | - | - | - | - | - | - | - |
| <u>Poland</u> | | | | | | | | | | | | | | | | |
| 26 G8 38) | Oct.74- Mar.75 | min max average | 4* | 7.1 | 30 | 20 | 90 | - | - | - | - | - | - | - | - | - |
| 26 G8 37) | | | | | 40 | 30 | 150 | - | - | - | - | - | - | - | - | |
| 26 G9 37) | | | | | 39 | 26 | 110 | 175 | 210 | 2.5 | 2.9 | 0.83 | - | - | - | - |

x inner archipelago.

*each fish was analysed individually.

(h) results are based on a homogenate of muscle tissue.

Table 14. Chlorinated hydrocarbon concentrations in PLAICE (*Pleuronectes platessa*).

| Sampling area | Date of collect. | Age group or size | Number analysed | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg fat wt | | Ratio $\frac{\text{DDT}}{\text{PCB}}$ | Concentration in µg/kg, wet weight | | | |
|-----------------|------------------|-------------------|-----------------|-------|------------------------------------|-----|-----|------|-----|---------------------------|-----|--|------------------------------------|-------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | α BHC | Lind. | Dieldrin |
| <u>Sweden</u> | | | | | | | | | | | | | | | | |
| 25 G5 38 | Jan. 75 | 3 | 10 (h) | 1.14 | 10 | 8 | 10 | 31 | 32 | 2.6 | 2.8 | 0.97 | <1 | <1 | <1 | 2 |
| 24 G3 38 | Jan. 75 | 2-3 | 10 (h) | 1.00 | 10 | 13 | 7 | 33 | 39 | 3.3 | 3.9 | 0.85 | <1 | <1 | <1 | <1 |
| <u>U.S.S.R.</u> | 1975 | | | | | | | | | | | | | | | |
| 32 H3 47 | Apr. | 29 cm | 1 | 2.98 | 79 | 57 | 37 | 190 | 270 | 7.4 | 8.9 | 0.83 | - | - | 18 | - |

(h) results are based on a homogenate of muscle tissue.

Table 15. Chlorinated hydrocarbon concentrations in HERRING (*Clupea harengus*).

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt | | Ratio <div>DDT PCB</div> | Concentration in µg/kg, wet weight | | | |
|------------------------------------|------------------|-----------|--------------------------------|-------|------------------------------------|-----|-----|------|-----|----------------------------|------|------------------------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| <u>Denmark</u> | | | | | | | | | | | | | | | | |
| 24 G4 38 | Oct. 74 | - | 500 g | 7.5 | 130 | 120 | 180 | 450 | 150 | 6.0 | 2.0 | 3.0 | - | - | - | 20 |
| 24 G4 38 | Nov. 74 | - | " | 10.2 | 190 | 140 | 240 | 590 | 220 | 5.8 | 2.2 | 2.7 | - | - | - | 28 |
| 25 G5 39 | Dec. 74 | - | " | 6.8 | 210 | 140 | 250 | 630 | 220 | 9.3 | 3.2 | 2.9 | - | - | - | 23 |
| 23 G2 40 | Nov. 74 | - | " | 15.0 | 70 | 50 | 110 | 240 | 260 | 1.6 | 1.7 | 0.92 | - | - | - | 40 |
| <u>Finland</u> | | | | | | | | | | | | | | | | |
| 32 H6 49 ^x | Oct. 74 | 1-4 | 9 (h) | 2.67 | 41 | 20 | 16 | 77 | 210 | 2.9 | 7.9 | 0.37 | - | - | - | - |
| 32 H6 49 | Oct. 74 | 1-4 | 7 (h) | 3.50 | 55 | 43 | 47 | 160 | 190 | 4.5 | 5.3 | 0.84 | - | - | 3 | 3 |
| 32 H3 48 ^x | Oct. 74 | 2 | 8 (h) | 4.26 | 32 | 34 | 28 | 94 | 190 | 2.3 | 4.6 | 0.50 | - | - | - | - |
| 32 H3 48 | Oct. 74 | 2-8 | 10* | 3.95 | 56 | 53 | 36 | 170 | 140 | 4.3 | 3.9 | 1.2 | - | - | <5 | 5 |
| 29 H1 49 | Oct. 74 | 2-6 | 13 (h) | 6.31 | 82 | 100 | 140 | 320 | 520 | 5.2 | 8.3 | 0.62 | - | - | 7 | - |
| 29 H0 49 ^x | Oct. 74 | 0-3 | 10 (h) | 2.35 | 24 | 20 | 19 | 63 | 140 | 2.7 | 5.8 | 0.45 | - | - | - | - |
| 29 G9 49 | Oct. 74 | 1-5 | 10* | 2.39 | 58 | 18 | 22 | 74 | 170 | 3.9 | 10 | 0.44 | - | - | <5 | 5 |
| 31 G3 57 ^x | Oct. 74 | 1-7 | 10* | 4.07 | 40 | 4 | 43 | 95 | 120 | 2.3 | 3.1 | 0.79 | - | - | 5 | <1 |
| 31 H3 57 | Oct. 74 | 1-3 | 10* | 4.95 | 20 | **T | 3 | 28 | 95 | 0.6 | 1.9 | 0.30 | - | - | 4 | <5 |
| 30 H1 52 ^x | Oct. 74 | 2-5 | 8 (h) | 2.75 | 70 | 10 | 36 | 116 | 280 | 4.2 | 10.0 | 0.41 | - | - | - | - |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | | | | |
| 24 G2 38 | Feb. 75 | 2-3 | 10 (h) | 2.53 | 310 | 100 | 200 | 610 | 430 | 24 | 84 | 1.4 | - | - | 6 | 7 |
| 22 G0 37 | Feb. 75 | 2-3 | 10 (h) | 7.02 | 62 | 41 | 73 | 180 | 460 | 2.68 | 33 | 0.39 | - | - | 5 | 23 |
| 22 G1 37 | Feb. 75 | 2-3 | 10 (h) | 2.63 | 140 | 84 | 170 | 450 | 380 | 17 | 72 | 1.18 | - | - | 9 | 13 |
| <u>Sweden</u> | | | | | | | | | | | | | | | | |
| 30 G8 54 | Jan. 75 | 2-4 | 5 (h) | 3.93 | 43 | 7 | 36 | 86 | 180 | 2.2 | 4.7 | 0.48 | 6 | 8 | 2 | 9 |
| 30 G8 54 | Jan. 75 | 7-11 | 5 (h) | 5.40 | 460 | 20 | 140 | 620 | 850 | 12 | 16 | 0.73 | 17 | 14 | 3 | 15 |
| 30 G8 50 | Nov. 74 | 3-5 | 10 (h) | 4.98 | 85 | 27 | 59 | 180 | 270 | 3.6 | 5.4 | 0.67 | 13 | 26 | 5 | 7 |
| 28 G8 43 | Sep. 74 | 3-8 | 10 (h) | 6.38 | 210 | 120 | 150 | 410 | 450 | 7.6 | 7.0 | 0.91 | 16 | 16 | 7 | 37 |

continued

^x inner archipelago.

* each fish was analysed individually.

(h) results are based on a homogenate of muscle tissue.

**T traces only.

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt | | Ratio DDT PCB | Concentration in µg/kg, wet weight | | | | |
|--|--------------------------------|-----------------------|--------------------------------|-------|------------------------------------|---------------------|---------------------|-----------------------|---------------------|----------------------------|-------|-------------------------|------------------------------------|-------|-------|----------|---|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | α BHC | Lind. | Dieldrin | |
| Sweden (ctd) | | | | | | | | | | | | | | | | | |
| 25 G4 39 | Sep. 74 | 3-4 | 6 (h) | 2.69 | 250 | 100 | 220 | 570 | 560 | 21 | 21 | 1.0 | 10 | 6 | 2 | 6 | |
| 25 G4 39 | Sep. 74 | 5-6 | 4 (h) | 2.59 | 400 | 130 | 380 | 920 | 640 | 35 | 24 | 1.4 | 12 | 6 | 2 | 9 | |
| 25 G4 39 | Sep. 74 | 5-6 | 4 (h) | 3.66 | 630 | 230 | 500 | 1 400 | 940 | 37 | 26 | 1.4 | 14 | 8 | 3 | 11 | |
| 24 G3 39 | Oct. 74 | 2 | 5 (h) | 9.21 | 95 | 56 | 100 | 250 | 370 | 2.7 | 4 | 0.68 | 9 | 17 | 9 | 22 | |
| 24 G3 39 | Oct. 74 | 3-4 | 5 (h) | 10.9 | 160 | 92 | 160 | 420 | 550 | 3.7 | 5 | 0.76 | 18 | 22 | 10 | 20 | |
| 25 G3 39 | Nov. 74 | 0-1 | 10 (h) | 4.92 | 40 | 52 | 89 | 180 | 210 | 3.8 | 4.3 | 0.86 | 8 | 6 | 3 | 6 | |
| 25 G4 39 | Sep. 74 | 1 | 9 (h) | 2.94 | 100 | 66 | 150 | 310 | 400 | 12 | 16 | 0.78 | 8 | 12 | 6 | 6 | |
| Poland | | | | | | | | | | | | | | | | | |
| 26 G8 38 } 26 G8 39 } | Oct.74- Mar.75 | min max average | 10x1kg (h) | 6.6 | 60 700 520 | 490 1 500 140 | 200 1 700 350 | 800 3 300 1 010 | 350 2 100 412 | 14.8 | 6.2 | 2.45 | - | - | - | - | |
| U.S.S.R. | | | | | | | | | | | | | | | | | |
| 32 H7 48 " " " " " " " " " " " " " " " 32 H3 47 " " " " " " 28 H3 43 " " " 28 H0 43 26 H0 39 | 1975 | Size in cm | | | | | | | | | | | | | | | |
| | Apr. | 7.6-9.6 | 7 | 3.22 | 33 | 57 | 40 | 140 | 110 | 4.31 | 3.44 | 1.25 | - | - | 8 | - | |
| | " | 19.2-21.6 | 5 | 2.47 | 110 | 94 | 54 | 280 | 260 | 11.42 | 10.68 | 1.07 | - | - | 16 | - | |
| | " | 16.2-20.0 | 5 | 2.85 | 140 | 160 | 28 | 360 | 360 | 12.70 | 12.56 | 1.01 | - | - | 18 | - | |
| | " | 16.2-18.1 | 7 | 2.03 | 110 | 120 | 36 | 300 | 23 | 14.72 | 1.13 | 13.03 | - | - | 13 | - | |
| | " | 13.4-18.2 | 8 | 1.18 | 110 | 80 | 10 | 220 | 140 | 18.44 | 11.53 | 1.60 | - | - | 8 | - | |
| | " | 8.3-11.3 | 5 | 1.41 | 140 | 190 | 90 | 460 | 78 | 32.28 | 5.53 | 5.84 | - | - | 2 | - | |
| | " | 16.0-20.0 | 5 | 0.84 | 150 | 70 | 22 | 260 | 460 | 31.26 | 55.00 | 0.57 | - | - | 6 | - | |
| | " | 14.2-20.4 | 5 | 3.86 | 110 | 140 | 61 | 340 | 18 | 8.76 | 0.47 | 18.64 | - | - | 17 | - | |
| | " | 16.1-19.6 | 5 | 1.79 | 150 | 77 | 40 | 300 | 17 | 16.49 | 0.95 | 17.36 | - | - | 10 | - | |
| | " | 13.2-15.5 | 5 | 1.32 | 29 | 50 | 22 | 110 | 53 | 8.28 | 4.00 | 2.07 | - | - | 10 | - | |
| | " | 13.2-15.5 | 5 | 0.95 | 29 | 42 | 12 | 90 | 55 | 9.52 | 5.79 | 1.64 | - | - | 4 | - | |
| | " | 17.8-19.5 | 5 | 0.80 | 59 | 60 | 13 | 150 | 70 | 18.11 | 8.70 | 2.08 | - | - | 6 | - | |
| | " | - | 5 | 0.23 | 28 | 15 | 6 | 54 | 59 | 23.60 | 25.72 | 0.92 | - | - | 5 | - | |
| | German Demo- cratic Republ. | | | | | | | | | | | | | | | | |
| | 24 G2 37 | 1975 | Age group | | | | | | | | | | | | | | |
| | " " " | 28.10 | 5 | 1 | - | 100 | 60 | 100 | 260 | 800 | - | - | - | - | - | - | - |
| " " " | 28.10 | 5 | 1 | - | 70 | 30 | 70 | 170 | 600 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 7 | 1 | - | 200 | 50 | 150 | 400 | 800 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 5 | 1 | - | 50 | 20 | 50 | 120 | 600 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 5 | 1 | - | 120 | 80 | 120 | 320 | 800 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 7 | 1 | - | 200 | 120 | 250 | 570 | 1 000 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 3 | 1 | - | 70 | 50 | 120 | 240 | 600 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 7 | 1 | - | 150 | 100 | 200 | 450 | 800 | - | - | - | - | - | - | - | |
| " " " | 28.10 | 3 | 1 | - | 150 | 80 | 120 | 350 | 800 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 4 | 1 | - | 70 | 50 | 90 | 210 | 800 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 6 | 1 | - | 100 | 80 | 100 | 280 | 500 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 5 | 1 | - | 100 | 70 | 110 | 280 | 1 000 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 6 | 1 | - | 100 | 70 | 120 | 290 | 750 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 4 | 1 | - | 160 | 90 | 200 | 450 | 1 000 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 3 | 1 | - | 120 | 90 | 140 | 350 | 1 000 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 4 | 1 | - | 150 | 100 | 200 | 450 | 1 200 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 3 | 1 | - | 90 | 70 | 100 | 260 | 500 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 4 | 1 | - | 80 | 30 | 80 | 190 | 500 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 3 | 1 | - | 80 | 60 | 150 | 290 | 1 200 | - | - | - | - | - | - | - | |
| " " " | 5.11 | 3 | 1 | - | 150 | 70 | 250 | 470 | 800 | - | - | - | - | - | - | - | |

(h) results are based on a homogenate of muscle tissue

continued

Table 15 (ctd) Herring (*Clupea harengus*)

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat weight | | Ratio DDT/PCB | Concentration in µg/kg, wet weight | | | |
|---------------|------------------|-----------|--------------------------------|-------|------------------------------------|-----|-----|------|-------|--------------------------------|-----|---------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| G.D.R. (ctd) | 1975 | | | | | | | | | | | | | | | |
| 24 G2 37 | 5.11 | 4 | 1 | - | 200 | 120 | 250 | 570 | 1 500 | - | - | - | - | - | - | - |
| " " " | 5.11 | 3 | 1 | - | 150 | 70 | 180 | 400 | 800 | - | - | - | - | - | - | - |
| " " " | 5.11 | 4 | 1 | - | 150 | 50 | 100 | 300 | 800 | - | - | - | - | - | - | - |
| " " " | 5.11 | 7 | 1 | - | 400 | 150 | 400 | 950 | 3 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 3 | 1 | - | 200 | 50 | 100 | 350 | 800 | - | - | - | - | - | - | - |
| " " " | 5.11 | 4 | 1 | - | 150 | 70 | 150 | 370 | 800 | - | - | - | - | - | - | - |
| " " " | 5.11 | 6 | 1 | - | 400 | 200 | 300 | 900 | 2 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 4 | 1 | - | 150 | 70 | 150 | 370 | 800 | - | - | - | - | - | - | - |
| " " " | 5.11 | 3 | 1 | - | 70 | 70 | 100 | 240 | 500 | - | - | - | - | - | - | - |

Table 16. Chlorinated hydrocarbon concentrations in SPRAT (*Sprattus sprattus*).

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt. | | Ratio DDT/PCB | Concentration in µg/kg wet weight | | | |
|--------------------------------|------------------|-------------------------|--------------------------------|-------|------------------------------------|--------------------|------------------|--------------------|--------------------|-----------------------------|-----|---------------|-----------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| Finland | 1974 | | | | | | | | | | | | | | | |
| 32 H6 49 ^x | Oct. | 5-9 | 10 (h) | 5.99 | 86 | 36 | 75 | 200 | 370 | 3.2 | 6.2 | 0.54 | - | - | - | - |
| 32 H6 49 | Oct. | 2-7 | 10* | 9.40 | 75 | 71 | 130 | 290 | 190 | 3.6 | 2.2 | 1.5 | - | - | 8 | 2 |
| 32 H3 48 ^x | Oct. | 1-6 | 7 (h) | 8.46 | 64 | 57 | 100 | 220 | 290 | 2.7 | 3.5 | 0.76 | - | - | - | - |
| 32 H3 48 | Oct. | 2-8 | 10* | 11.2 | 180 | 130 | 400 | 750 | 370 | 8.2 | 3.9 | 2.0 | - | - | 7 | 10 |
| 29 H1 49 | Oct. | 1-5 | 4* | 13.0 | 42 | 33 | 78 | 150 | 150 | 1.7 | 1.4 | 1.0 | - | - | 7 | **T |
| 29 H0 49 ^x | Oct. | 2-5 | 10 (h) | 8.55 | 63 | 36 | 76 | 180 | 270 | 2.0 | 3.1 | 0.67 | - | - | - | - |
| 29 G9 49 | Oct. | 3-10 | 10* | 7.09 | 260 | 110 | 290 | 690 | 310 | 11 | 5.0 | 2.2 | - | - | 4 | 13 |
| Poland | | | | | | | | | | | | | | | | |
| 26 G8 38 | { .74 .75 | min. max. average | 9x1kg(h) | 15.3 | 10 650 200 | 30 1 000 190 | 20 550 290 | 60 2 200 680 | 60 2 400 420 | | | | | | | |
| U.S.S.R. | 1975 | Size in cm | | | | | | | | | | | | | | |
| 32 H7 48 | Apr. | 18.1-19 | 4 | 10.14 | 19 | 150 | 160 | 530 | 230 | 5.2 | 2.3 | 2.26 | - | - | 19 | - |
| 32 H3 47 | " | 12.3-14 | 5 | 3.30 | 12 | 66 | 71 | 270 | 27 | 8.3 | 0.8 | 10.38 | - | - | 12 | - |
| German Demo- cratic Republ. | 1975 | | | | | | | | | | | | | | | |
| 24 G2 37 | 13.11 | ND | 1 | - | 80 | 60 | 90 | 230 | 610 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 250 | 70 | 250 | 570 | 780 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 90 | 40 | 80 | 210 | 410 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 170 | 90 | 220 | 480 | 580 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 20 | 20 | 20 | 60 | 130 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 150 | 80 | 150 | 380 | 570 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 250 | 100 | 200 | 550 | 720 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 150 | 60 | 140 | 350 | 570 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 180 | 100 | 180 | 460 | 620 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 100 | 50 | 100 | 250 | 590 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 50 | 40 | 90 | 180 | 310 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 160 | 40 | 120 | 320 | 480 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 30 | 20 | 60 | 110 | 120 | - | - | - | - | - | - | - |
| " " " | 13.11 | ND | 1 | - | 130 | 90 | 170 | 390 | 530 | - | - | - | - | - | - | - |

(h) results are based on a homogenate of muscle tissue. x inner archipelago. ND = not determined.

Table 17. Chlorinated hydrocarbon concentrations in MUSSELS (*Mytilus edulis*).

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat weight | | Ratio $\frac{DDT}{PCB}$ | Concentration in µg/kg, wet weight | | | |
|------------------------------------|-----------------------|-----------|--------------------------------|-------|------------------------------------|-----|-----|------|-----|--------------------------------|-----|-------------------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| <u>Federal Republic of Germany</u> | | | | | | | | | | | | | | | | |
| 24 G3 38 | Feb. 75 | - | 40 (h) | 0.77 | 9 | 7 | 8 | 24 | 117 | 3.1 | 15 | 0.21 | - | - | 52 | 3 |
| 22 G1 37 | Feb. 75 | - | 60 (h) | 1.94 | 6 | 10 | 6 | 11 | 139 | 1.1 | 7.1 | 0.08 | - | - | 17 | 6 |
| <u>Poland</u> | | | | | | | | | | | | | | | | |
| 26 G8 37 | { Oct. 74 -Mar. 75 | min | 5x15g* | 7.0 | 6 | 12 | 21 | 46 | 32 | 1.0 | 0.6 | 1.67 | - | - | - | - |
| 26 G8 38 | | max | | | 8 | 85 | 52 | 132 | 60 | | | | | | | |
| 26 G9 37 | | average | | | 7 | 48 | 25 | 80 | 48 | | | | | | | |

(h) results are based on a homogenate of muscle tissue.

* individual analysis.

Table 18. Chlorinated hydrocarbon concentrations in *Macoma baltica*.

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt. | | Ratio $\frac{DDT}{PCB}$ | Concentration in µg/kg, wet weight | | | |
|----------------|-----------------------|-----------|--------------------------------|-------|------------------------------------|-----|-----|------|-----|-----------------------------|-----|-------------------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| <u>Finland</u> | 1974 | | | | | | | | | | | | | | | |
| 32 H4 48 | Sep. | - | - | 3.37 | 15 | 25 | T** | 46 | 61 | 1.4 | 1.8 | 0.75 | - | - | - | 6 |
| 32 H3 48 | Aug. | - | - | 3.92 | 7 | 12 | T | 24 | 41 | 0.6 | 1.0 | 0.59 | - | - | - | 3 |
| 29 G9 49 | Aug. | - | - | 1.67 | 12 | 11 | T | 28 | 40 | 1.7 | 2.4 | 0.70 | - | - | - | 3 |
| 30 H1 51 | Aug. | - | - | 2.59 | 11 | 24 | T | 41 | 38 | 1.6 | 1.5 | 1.1 | - | - | - | 11 |
| 31 H1 56 | Aug. | - | - | 3.07 | 8 | 20 | T | 34 | 40 | 1.1 | 1.3 | 0.85 | - | - | - | 11 |
| <u>Poland</u> | | | | | | | | | | | | | | | | |
| 26 G8 37 | { Oct. 74 -Mar. 75 | min | 4x15g* | 3.3 | 9 | 8 | 5 | 22 | 20 | 2.2 | 1.4 | | | | | |
| 26 G8 38 | | max | | | 21 | 76 | 38 | 112 | 98 | | | | | | | |
| 26 G9 37 | | average | | | 17 | 38 | 15 | 70 | 48 | | | | | | | |

* individual analysis.

T** = traces only.

Table 19. Chlorinated hydrocarbon concentrations in Mesidothea entomon.

| Sampling area | Date of collect. | Age group | Sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt. | | Ratio DDT/PCB | Concentration in µg/kg, wet weight | | | |
|----------------|------------------|-----------|-------------|-------|------------------------------------|-----|-----|------|-----|-----------------------------|-----|---------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| <u>Finland</u> | 1974 | | | | | | | | | | | | | | | |
| 32 H3 48 | Sep. | - | - | 0.71 | 3 | 28 | **T | 36 | 75 | 5.1 | 11 | 0.48 | - | - | - | T |
| 29 G9 49 | Sep. | - | - | 0.95 | 5 | 47 | T | 60 | 60 | 6.3 | 6.3 | 1.0 | - | - | - | 10 |
| 30 G9 51 | Aug. | - | - | 3.59 | 24 | 33 | T | 66 | 120 | 1.9 | 3.3 | 0.55 | - | - | - | 16 |
| 30 H0 54 | Aug. | - | - | 3.73 | 22 | 35 | T | 66 | 79 | 1.8 | 2.1 | 0.84 | - | - | - | 26 |
| 31 H1 56 | Aug. | - | - | 1.29 | 5 | 10 | T | 19 | 63 | 1.5 | 4.9 | 0.30 | - | - | - | 3 |
| 31 H4 59 | Aug. | - | - | 1.28 | 3 | T | T | 8 | 37 | 0.64 | 2.9 | 0.22 | - | - | - | T |
| <u>Poland</u> | | | | | | | | | | | | | | | | |
| 26 G8 37 | {Oct.74 | min | 5x15g* | | 35 | 32 | 45 | 130 | 80 | - | - | - | - | - | - | - |
| 26 G8 38 | {-Mar.75 | max | | | 68 | 320 | 92 | 480 | 130 | - | - | - | - | - | - | - |
| 26 G9 37 | | average | | 7.7 | 42 | 98 | 50 | 190 | 85 | 2.5 | 1.1 | 2.24 | - | - | - | - |

* individual analysis.

** T = traces only.

Table 20. Chlorinated hydrocarbon concentrations in COD LIVER.

| Sampling area | Date of collect. | Age group | Number analysed or sample size | % fat | Concentration in µg/kg, wet weight | | | | | Concentr. in mg/kg, fat wt. | | Ratio DDT/PCB | Concentration in µg/kg, wet weight | | | |
|-----------------------------|------------------|-----------|--------------------------------|-------|------------------------------------|-------|-------|--------|--------|-----------------------------|-----|---------------|------------------------------------|------|-------|----------|
| | | | | | DDE | DDD | DDT | ΣDDT | PCB | ΣDDT | PCB | | HCB | αBHC | Lind. | Dieldrin |
| <u>Denmark</u> | 1974 | | | | | | | | | | | | | | | |
| 23 G2 40 | Sep. | - | 500g | - | 960 | 660 | 2 000 | 3 700 | 8 500 | - | - | 0.44 | - | - | - | 150 |
| 23 G2 40 | Nov. | - | " | - | 540 | 230 | 680 | 1 500 | 3 200 | - | - | 0.47 | - | - | - | 77 |
| 25 G5 39 | Sep. | - | " | - | 1 400 | 3 100 | 5 400 | 10 330 | 9 200 | - | - | 1.1 | - | - | - | 370 |
| 25 G5 39 | Nov. | - | " | - | 12 000 | 4 200 | 9 700 | 27 000 | 11 000 | - | - | 2.5 | - | - | - | 420 |
| <u>German Demo-Republic</u> | 1975 | | | | | | | | | | | | | | | |
| 24 G2 37 | 28.10 | 2 | 1 | - | 400 | 140 | 400 | 940 | 4 000 | - | - | - | - | - | - | - |
| " " " | 28.10 | 2 | 1 | - | 140 | 100 | 300 | 540 | 2 000 | - | - | - | - | - | - | - |
| " " " | 28.10 | 1 | 1 | - | 180 | 100 | 400 | 680 | 3 000 | - | - | - | - | - | - | - |
| " " " | 28.10 | 1 | 1 | - | 160 | 100 | 400 | 660 | 2 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 2 | 1 | - | 200 | 100 | 300 | 600 | 2 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 1 | 1 | - | 150 | 70 | 270 | 490 | 2 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 1 | 1 | - | 140 | 100 | 300 | 540 | 2 000 | - | - | - | - | - | - | - |
| " " " | 5.11 | 1 | 1 | - | 270 | 180 | 450 | 900 | 2 700 | - | - | - | - | - | - | - |
| " " " | 5.11 | 1 | 1 | - | 300 | 200 | 500 | 1 000 | 3 000 | - | - | - | - | - | - | - |
| " " " | 18.11 | 2 | 1 | - | 300 | 140 | 400 | 840 | 4 000 | - | - | - | - | - | - | - |
| " " " | 18.11 | 1 | 1 | - | 160 | 60 | 200 | 420 | 2 000 | - | - | - | - | - | - | - |
| " " " | 18.11 | 1 | 1 | - | 140 | 100 | 200 | 440 | 2 000 | - | - | - | - | - | - | - |
| " " " | 18.11 | 1 | 1 | - | 80 | 40 | 100 | 220 | 1 400 | - | - | - | - | - | - | - |
| " " " | 18.11 | 1 | 1 | - | 160 | 100 | 200 | 460 | 2 000 | - | - | - | - | - | - | - |
| 24 G3 38 | 9.12 | 3 | 1 | - | 1 200 | 800 | 2 000 | 4 000 | 6 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 4 | 1 | - | 1 400 | 800 | 2 400 | 4 600 | 8 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 2 | 1 | - | 800 | 400 | 1 200 | 2 400 | 4 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 2 | 1 | - | 1 600 | 1 200 | 4 000 | 6 800 | 12 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 3 | 1 | - | 800 | 600 | 2 000 | 3 400 | 6 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 2 | 1 | - | 1 000 | 800 | 2 000 | 3 800 | 6 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 2 | 1 | - | 1 200 | 800 | 2 400 | 4 400 | 6 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 2 | 1 | - | 600 | 400 | 1 200 | 2 200 | 8 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 3 | 1 | - | 1 400 | 800 | 3 200 | 5 400 | 12 000 | - | - | - | - | - | - | - |
| " " " | 9.12 | 3 | 1 | - | 1 000 | 800 | 2 400 | 4 200 | 8 000 | - | - | - | - | - | - | - |

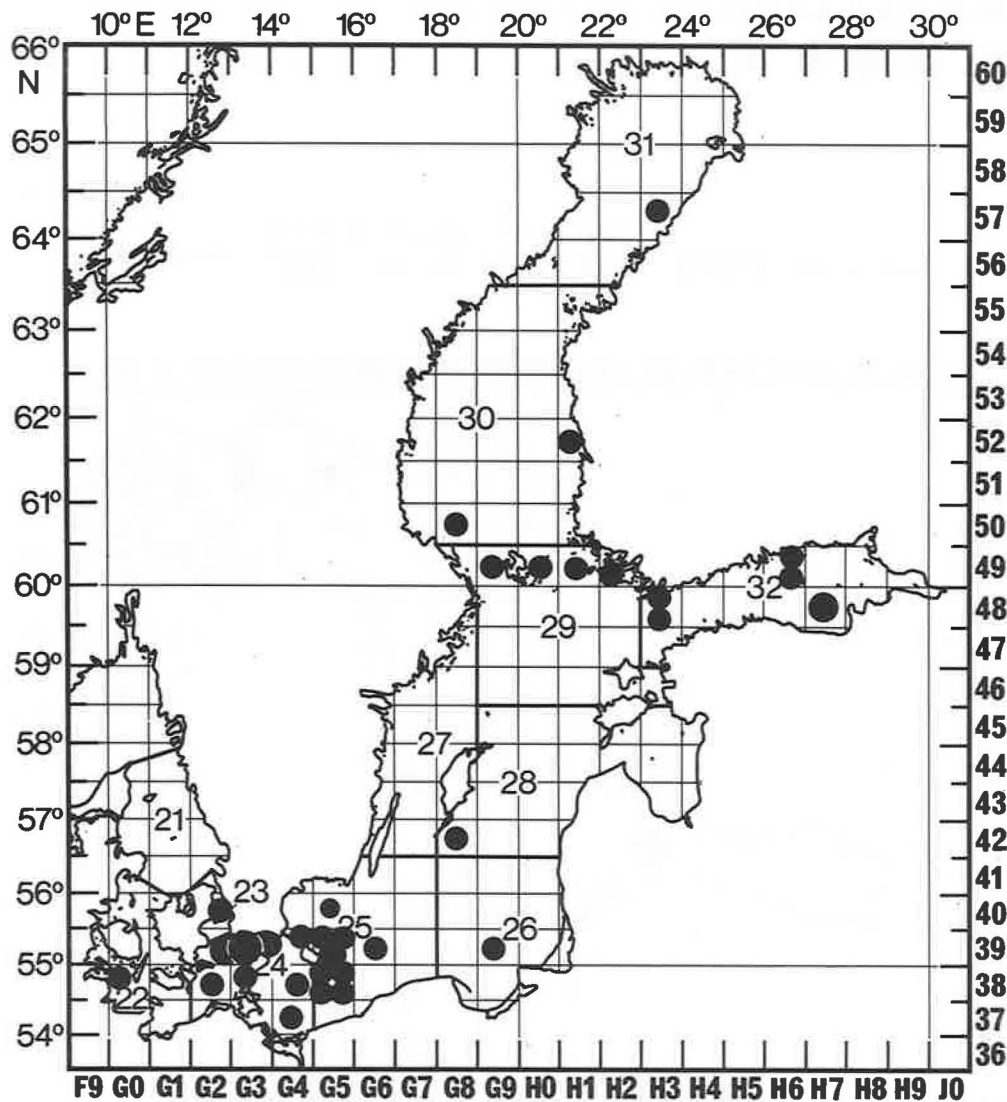


Figure 1. ZINC concentrations in COD relative to locations of catch.

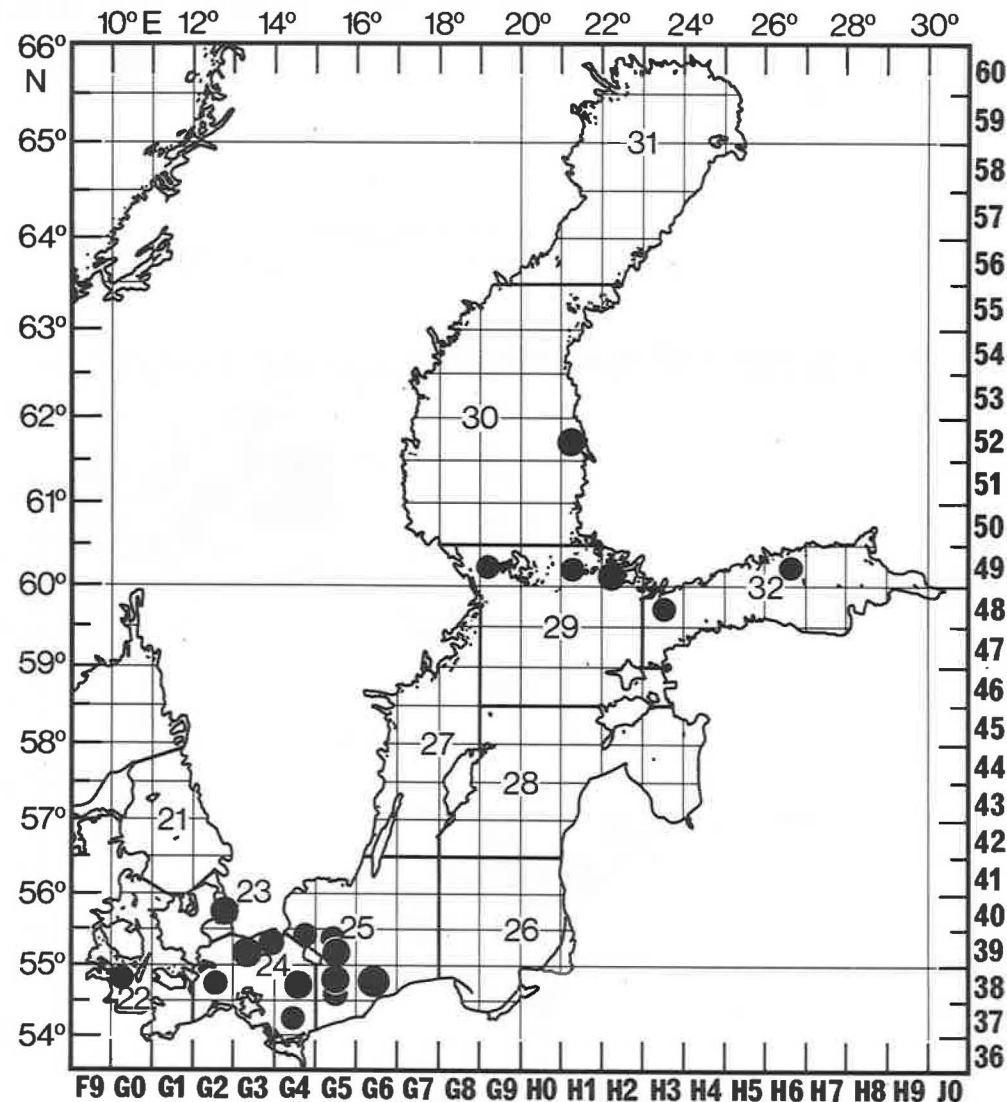


Figure 2. ZINC concentrations in FLOUNDER relative to locations of catch.



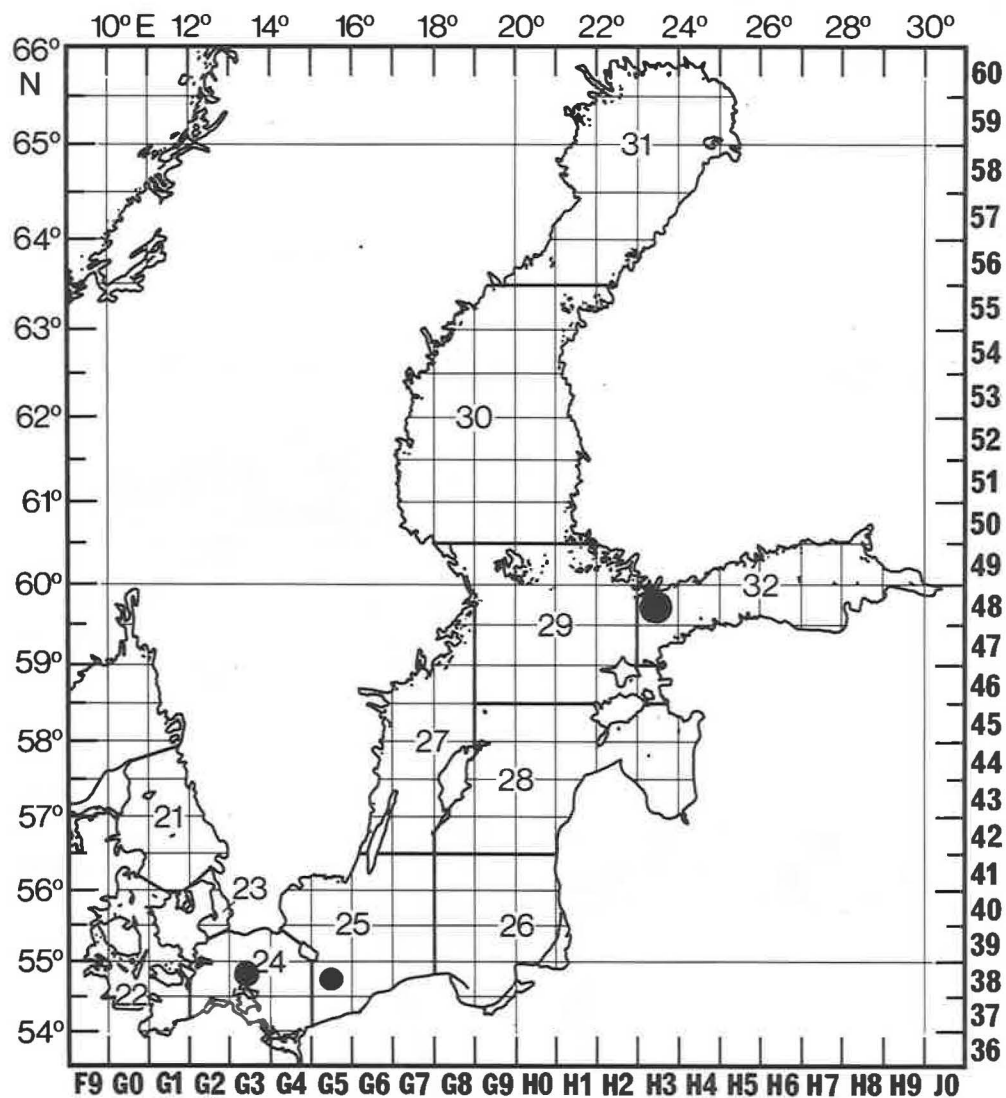


Figure 3. ZINC concentrations in PLAICE relative to locations of catch.

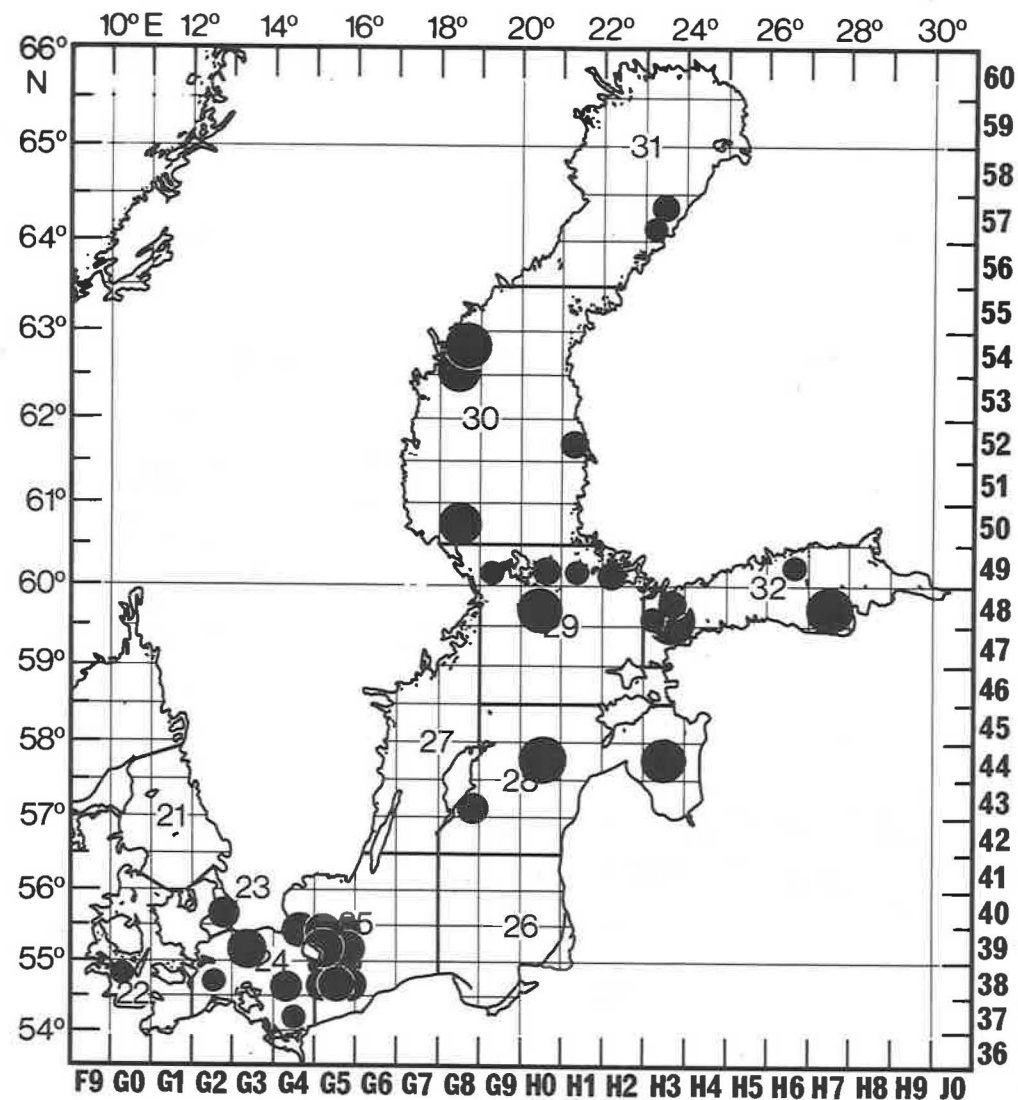


Figure 4. ZINC concentrations in HERRING relative to locations of catch.



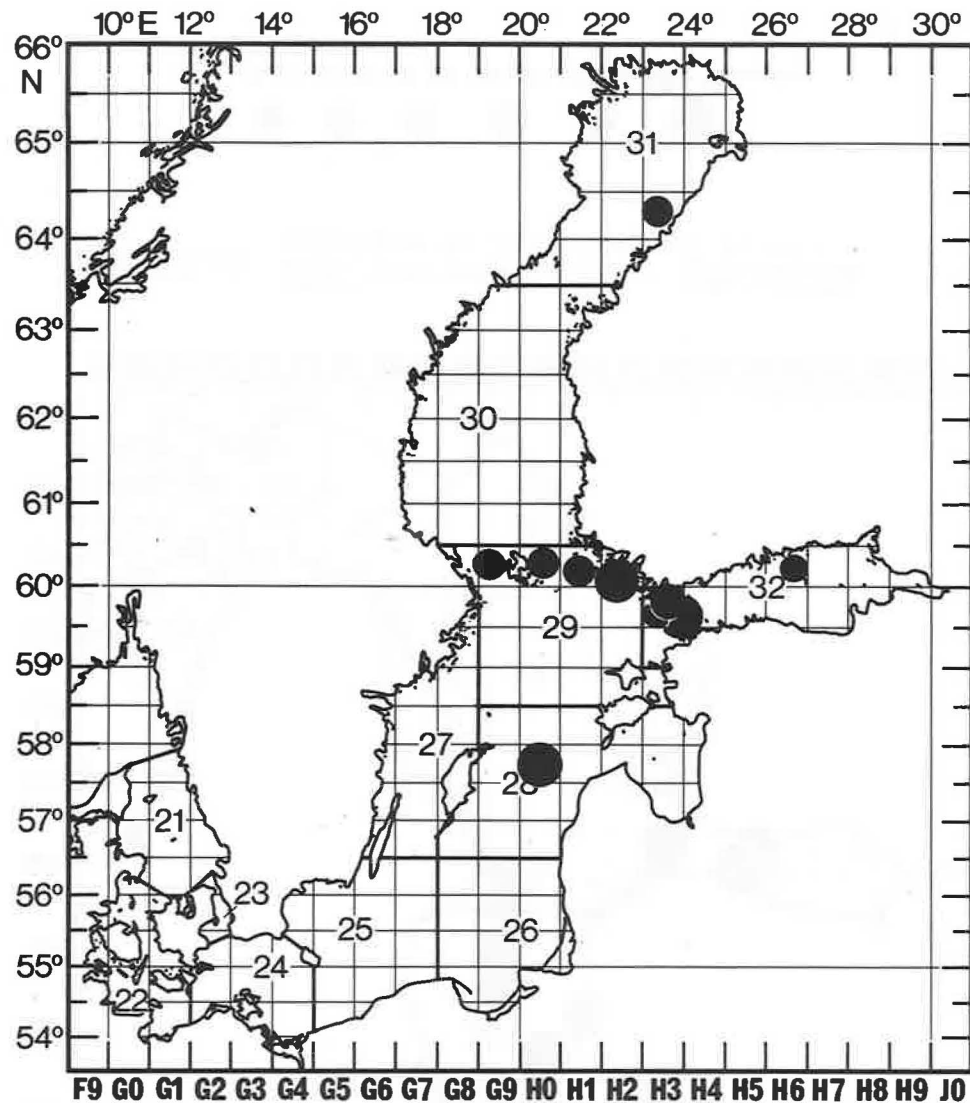


Figure 5. ZINC concentrations in SPRAT relative to locations of catch.

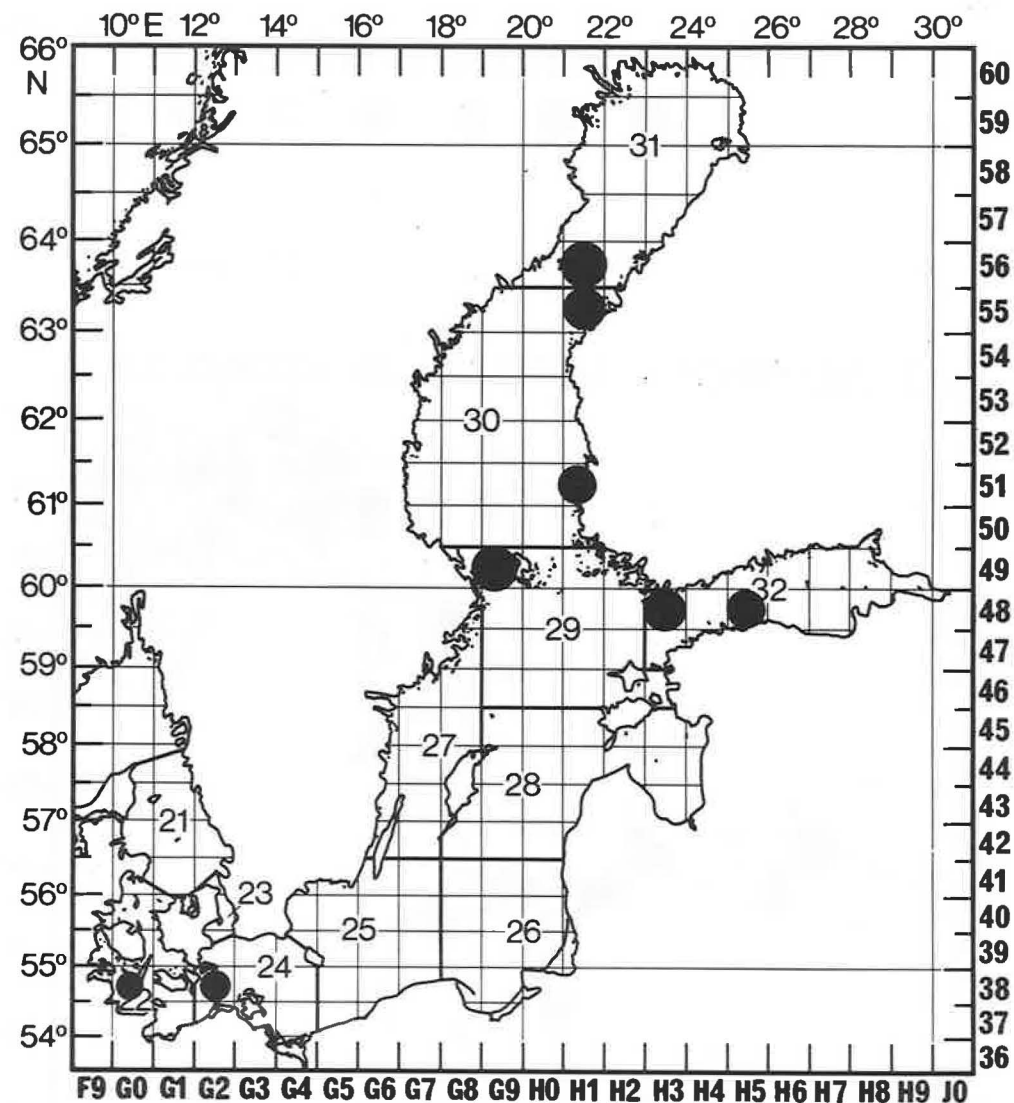


Figure 6. ZINC concentrations in MYTILUS and MACOMA relative to locations of catch.

0-3 3-6 6-9 9-12 12-15 15-18 18-21 21-24 mg/kg

wet weight muscle tissue

0-20 20-40 40-60 60-80 80-100 100-120 mg/kg

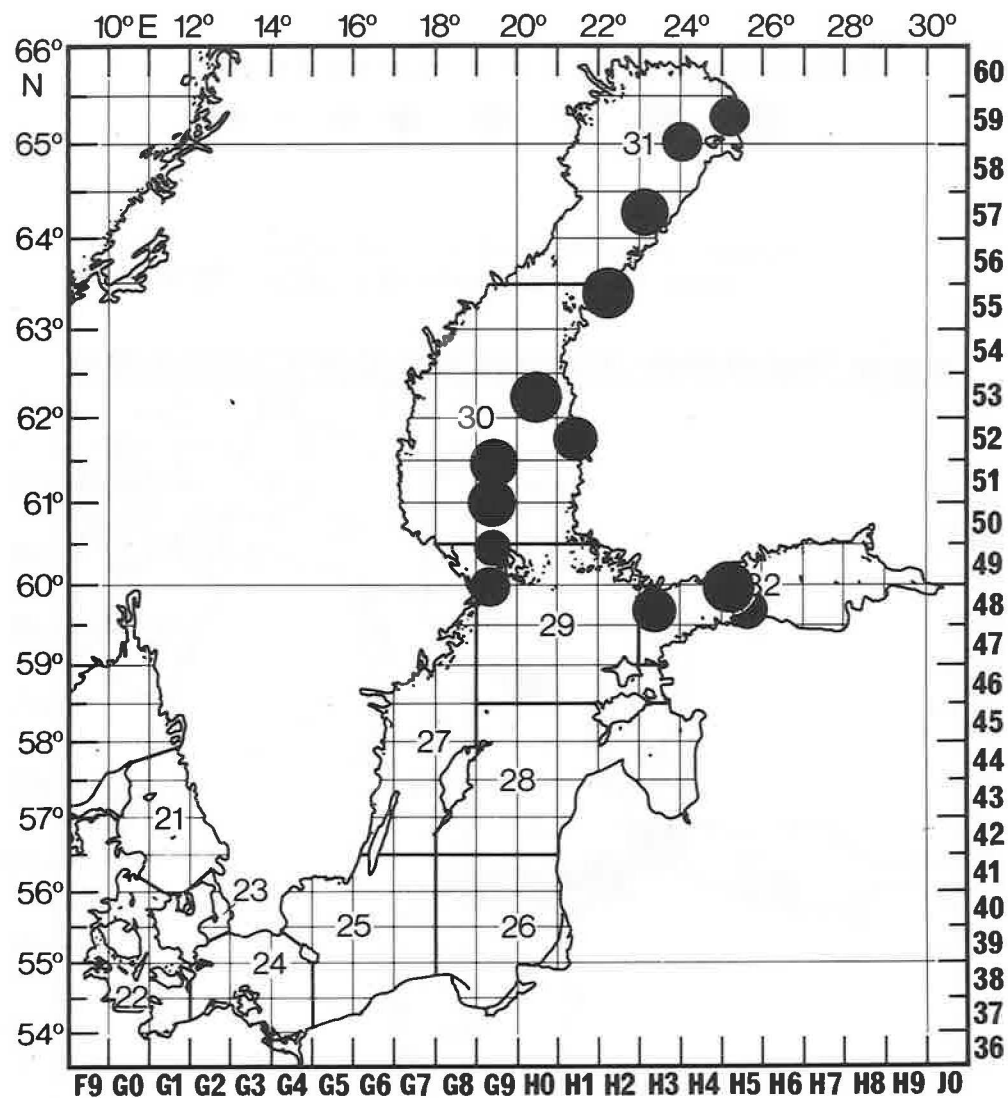


Figure 7. ZINC concentrations in *MESIDOTHEA* relative to locations of catch.

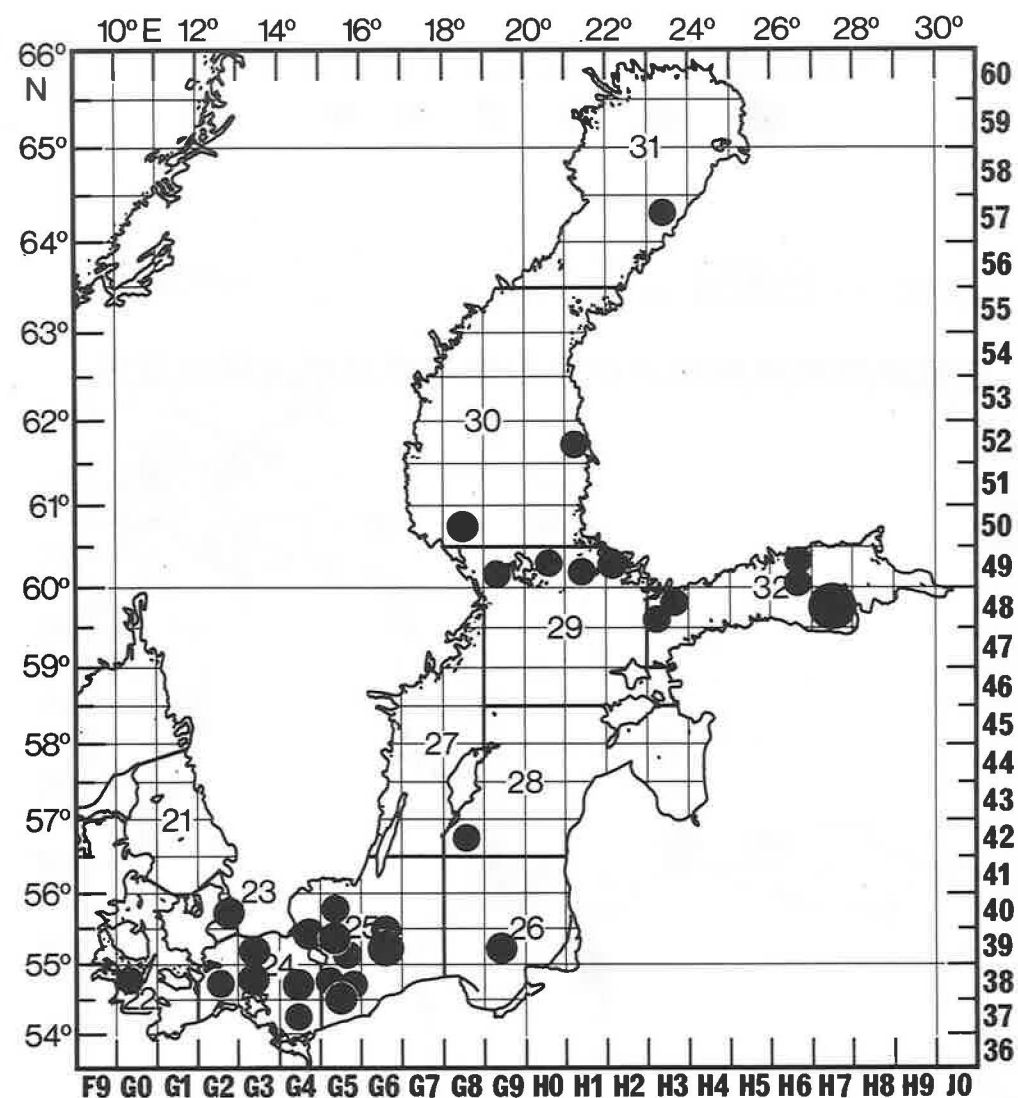


Figure 8. COPPER concentrations in COD relative to locations of catch.

0-20 20-40 40-60 60-80 80-100 100-120 mg/kg

wet weight muscle tissue

0.0-0.3 0.3-0.6 0.6-0.9 0.9-1.2 1.2-1.5 1.5-1.8 mg/kg

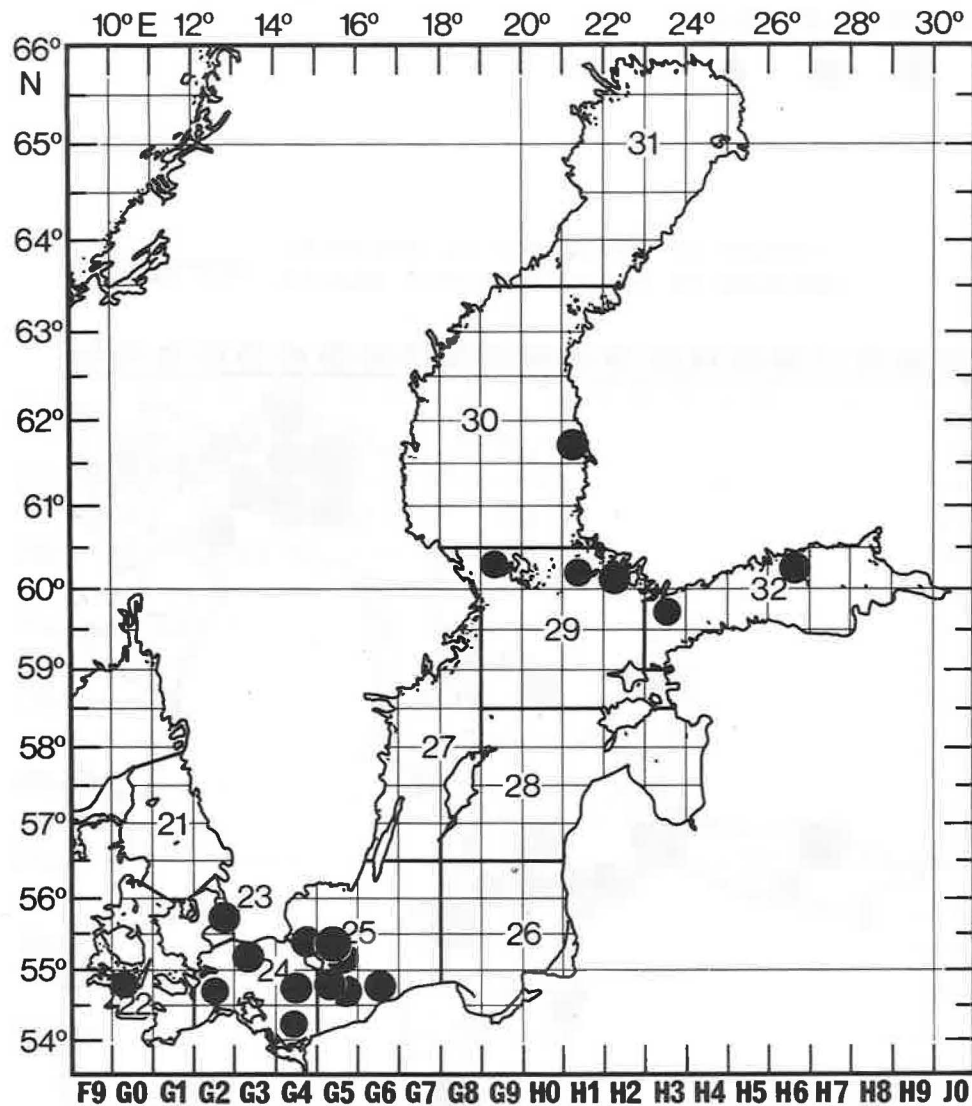


Figure 9. COPPER concentrations in FLOUNDER relative to locations of catch.

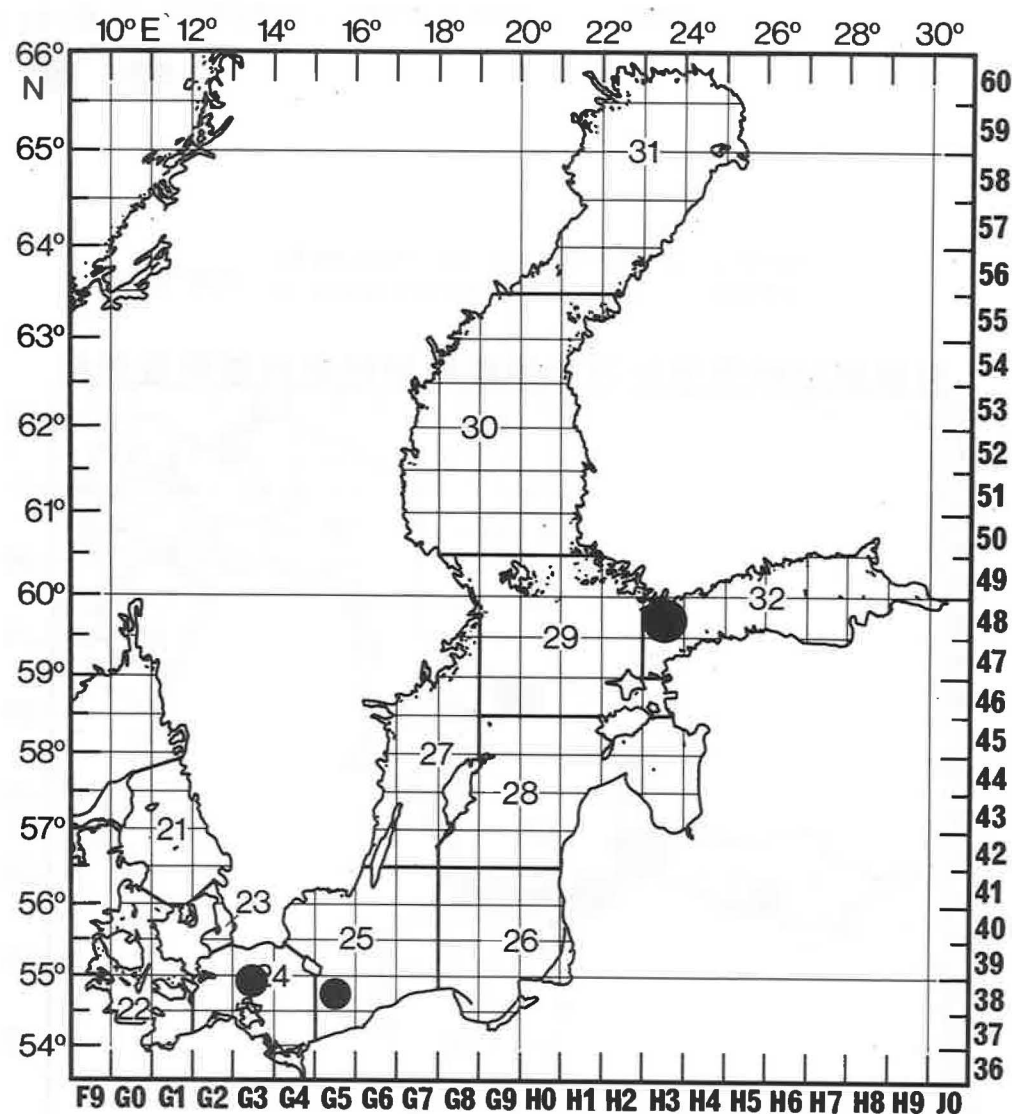


Figure 10. COPPER concentrations in PLAICE relative to locations of catch.



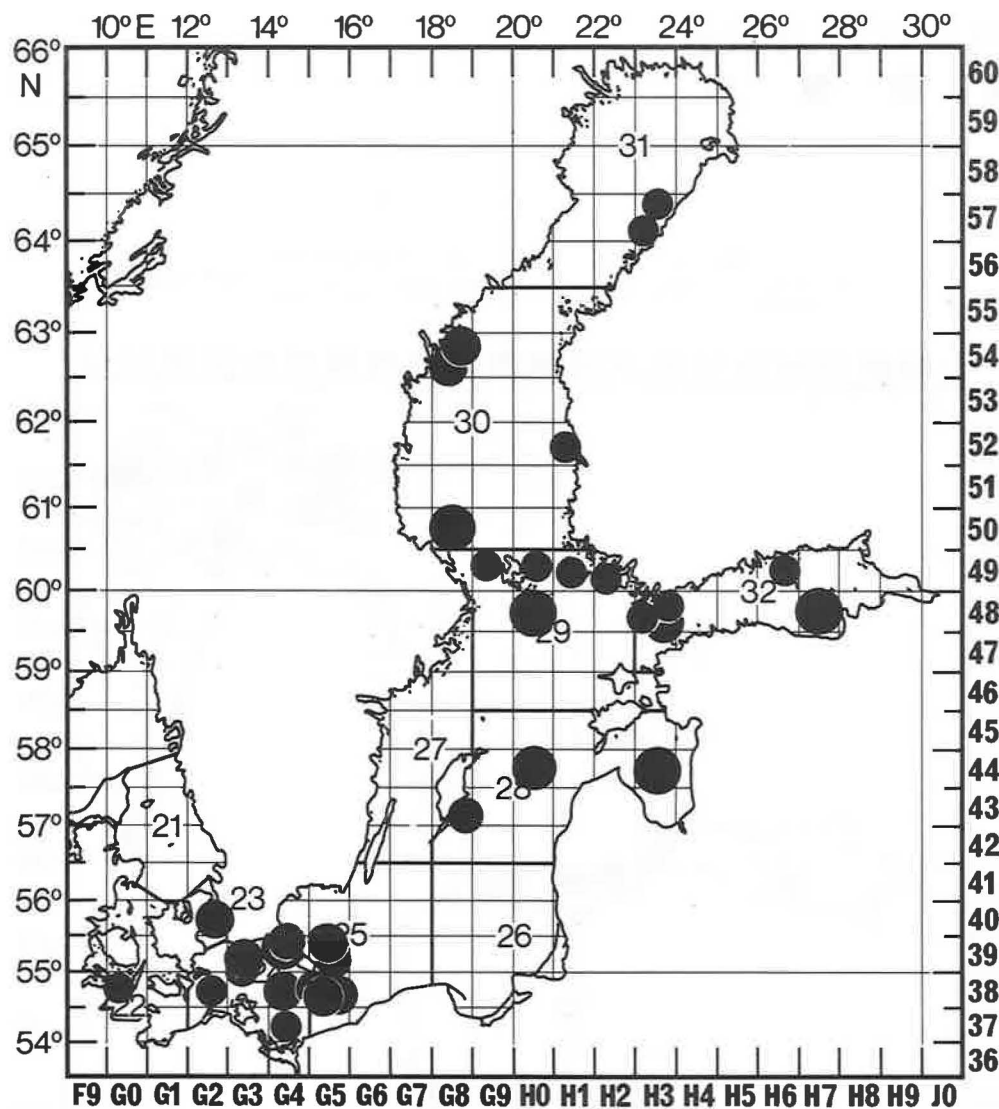


Figure 11. COPPER concentrations in HERRING relative to locations of catch.

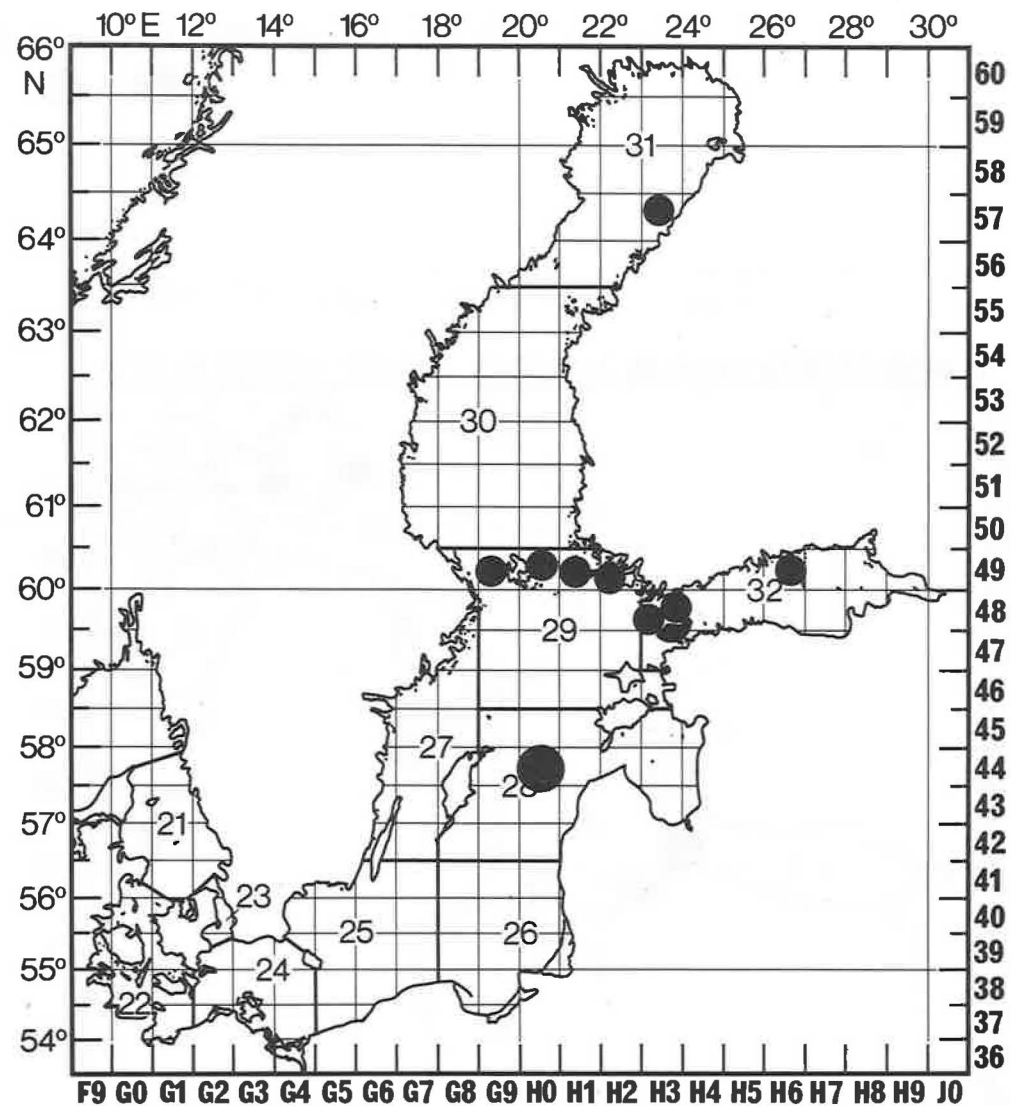


Figure 12. COPPER concentrations in SPRAT relative to locations of catch.



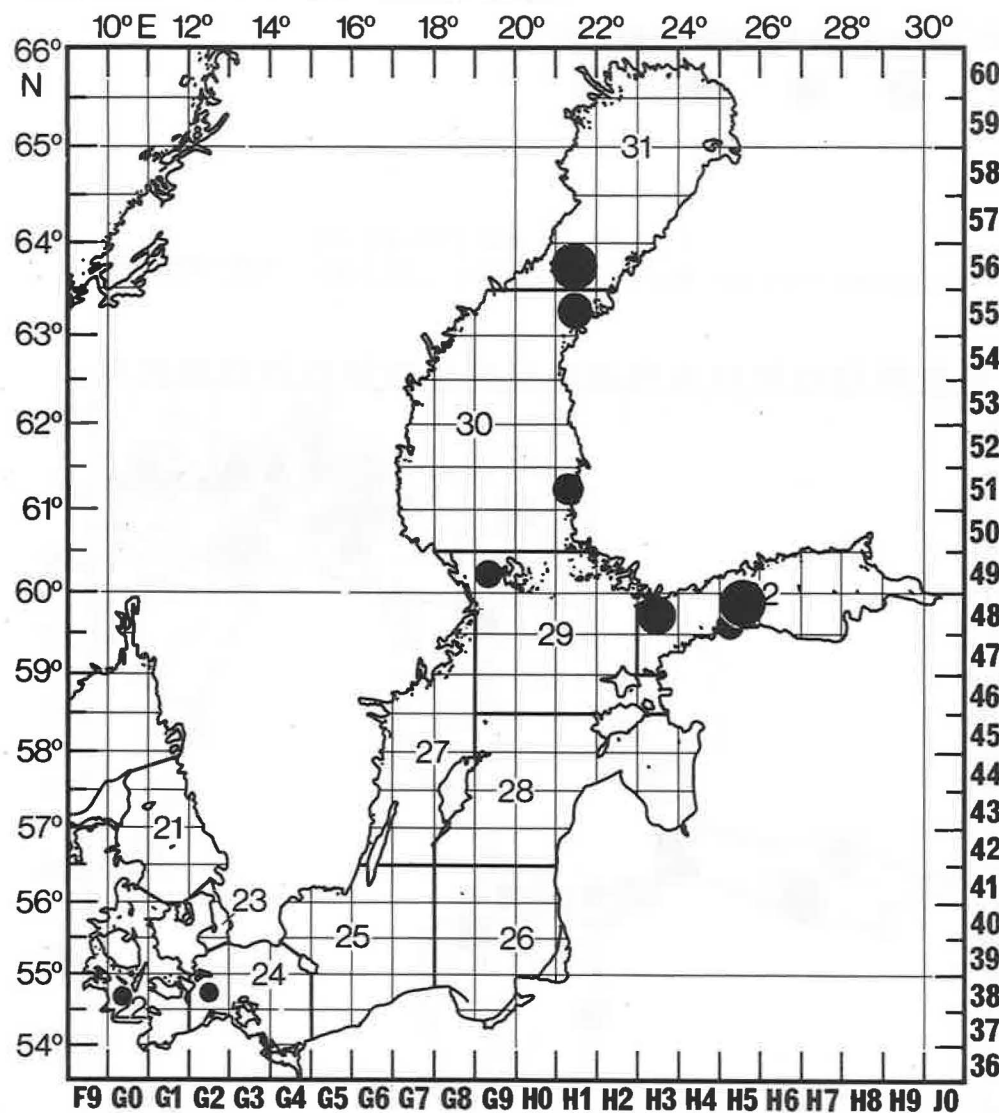


Figure 13. COPPER concentrations in MYTILUS and MACOMA relative to locations of catch.



wet weight muscle tissue

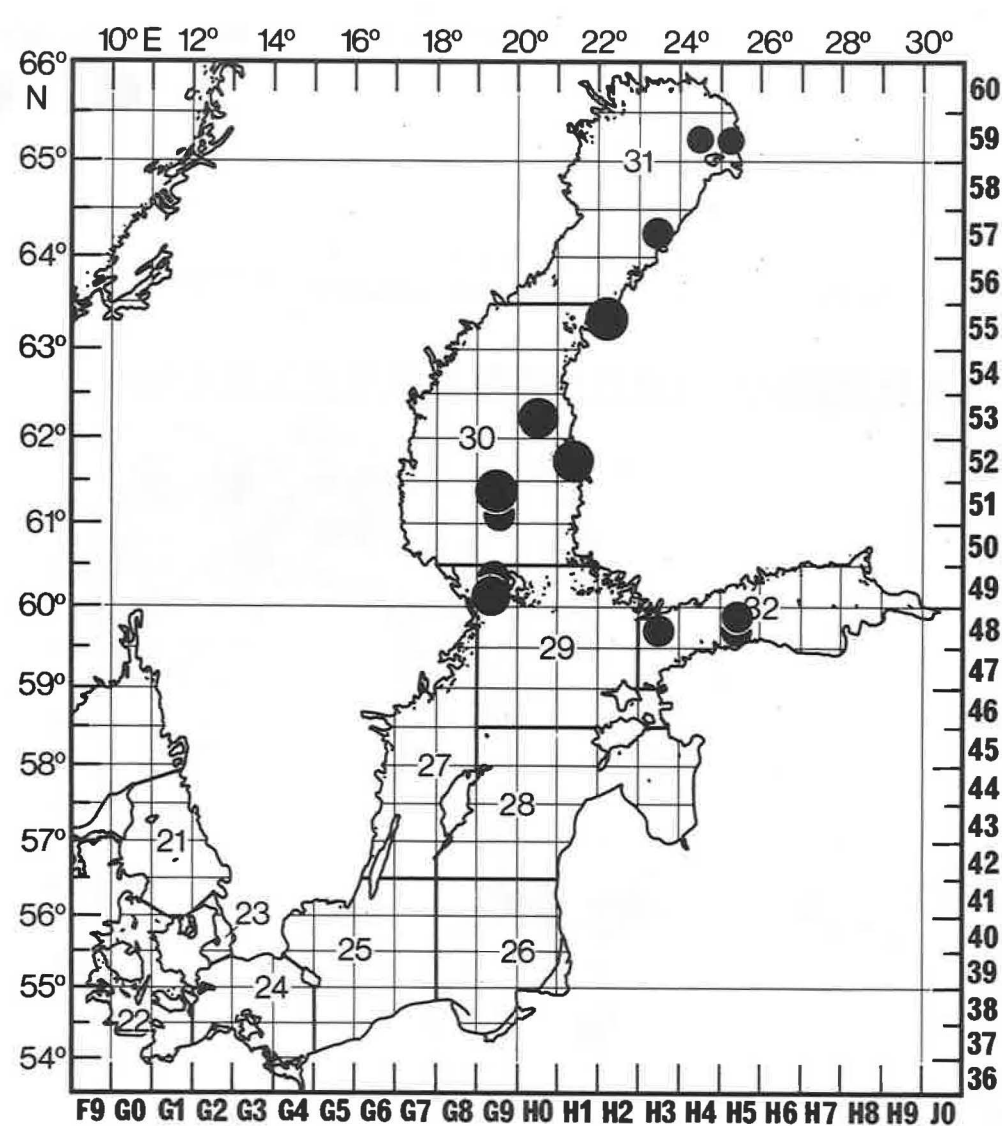


Figure 14. COPPER concentrations in MESIDOTHEA relative to locations of catch.



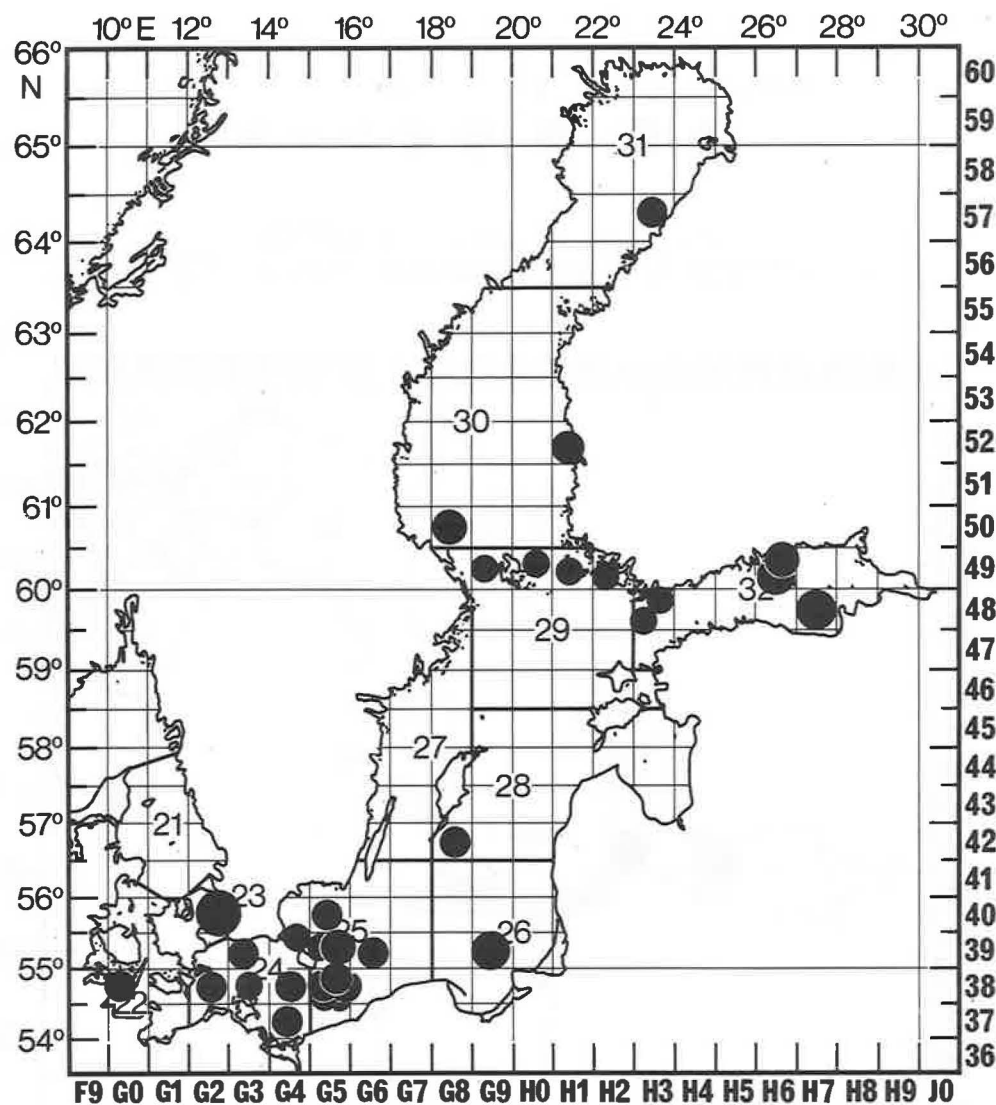


Figure 15. MERCURY concentrations in COD relative to locations of catch.

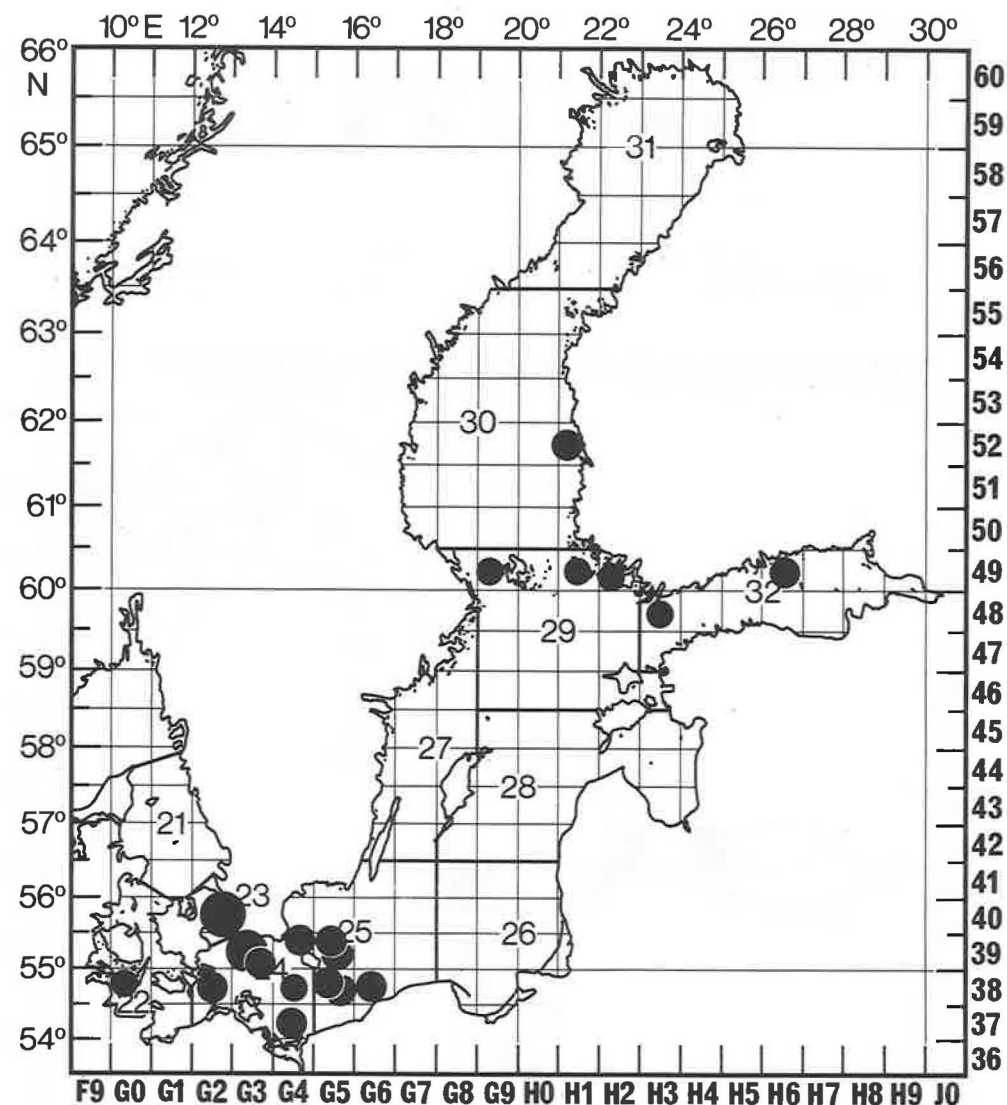


Figure 16. MERCURY concentrations in FLOUNDER relative to locations of catch.



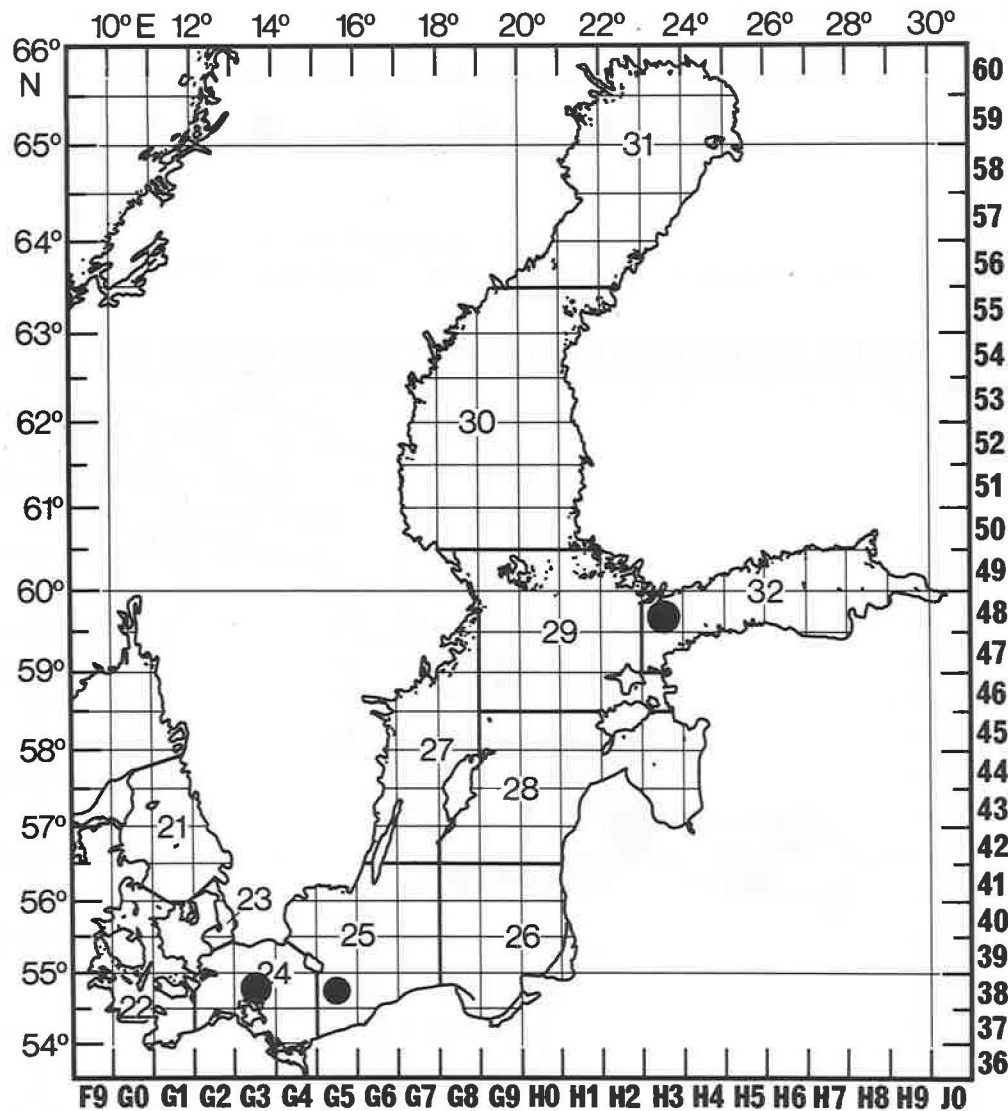


Figure 17. MERCURY concentrations in PLAICE relative to locations of catch

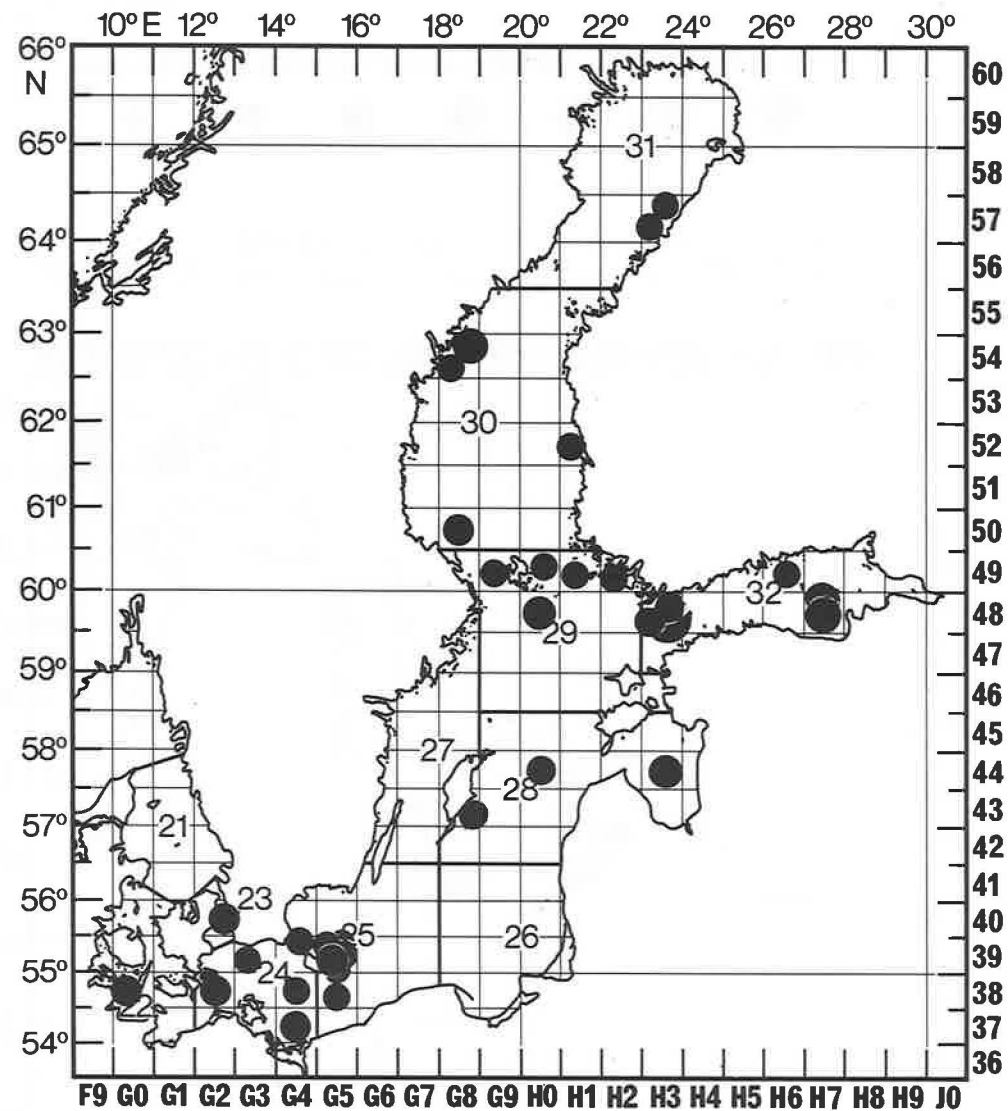


Figure 18. MERCURY concentrations in HERRING relative to locations of catch.



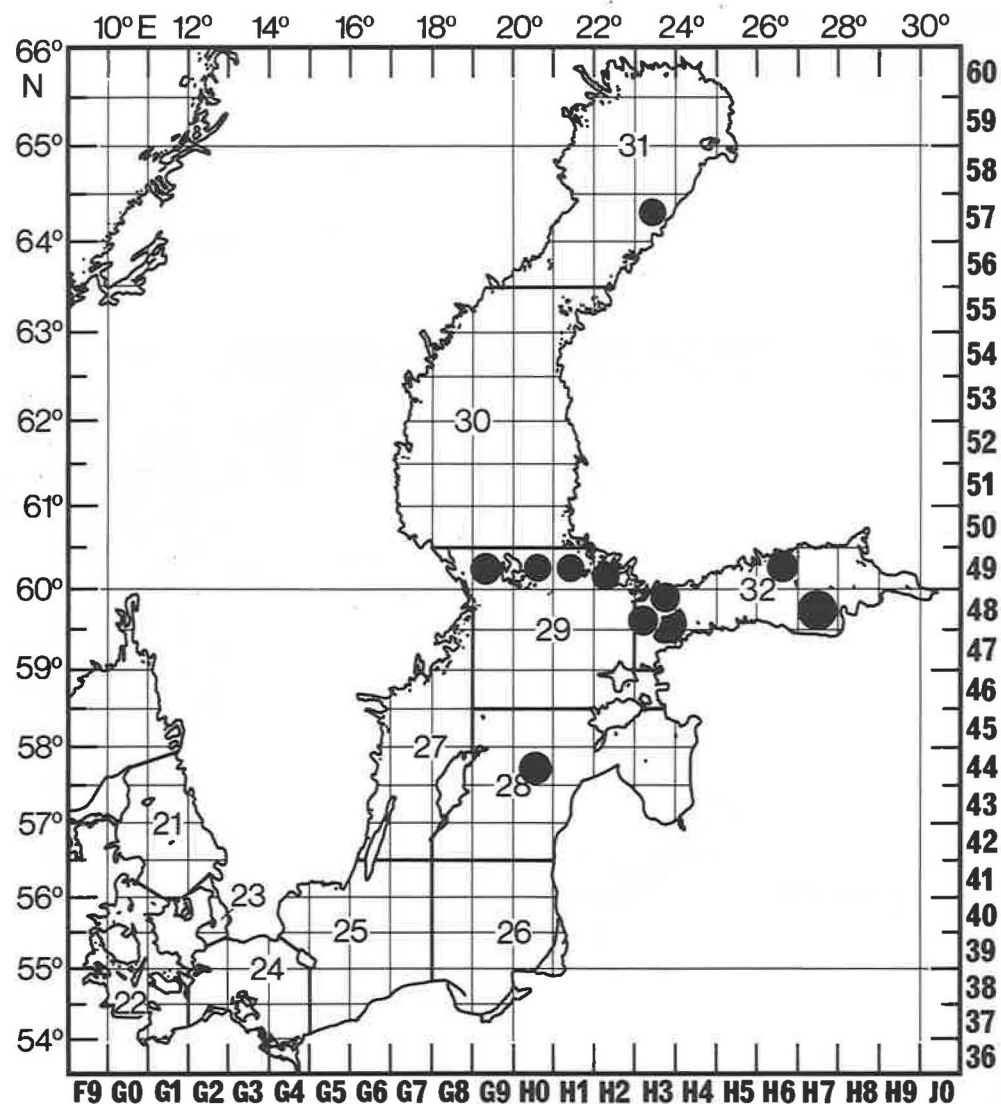


Figure 19. MERCURY concentrations in SPRAT relative to locations of catch.

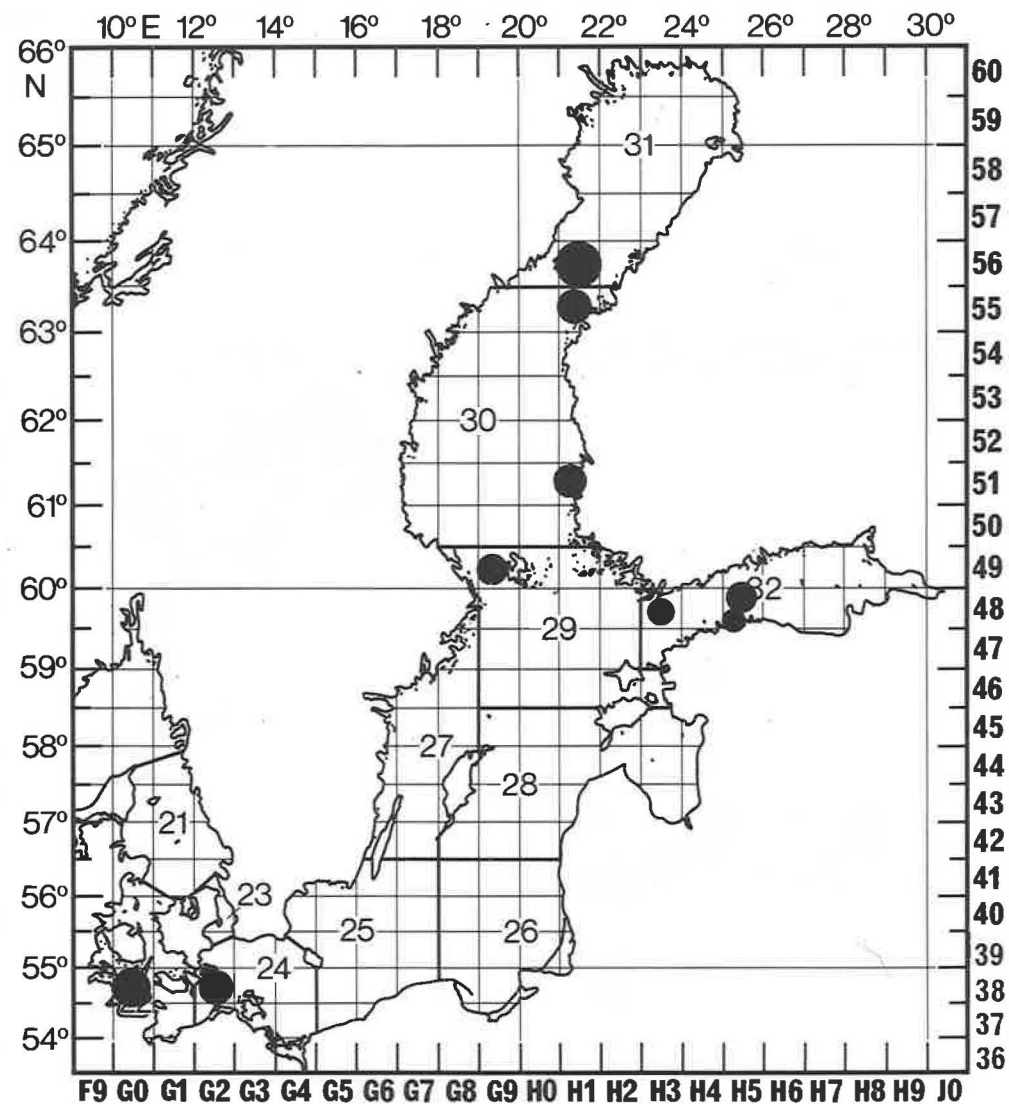


Figure 20. MERCURY concentrations in MYTILUS and MACOMA relative to locations of catch.

0,0-0,06 0,06-0,12 0,12-0,18 0,18-0,24 0,24-0,30 0,30-0,60mg/kg

0,00 - 0,02 0,02-0,04 0,04-0,06 0,06-0,08 0,08-0,10 0,10-0,12 0,12-0,14mg/kg

wet weight muscle tissue

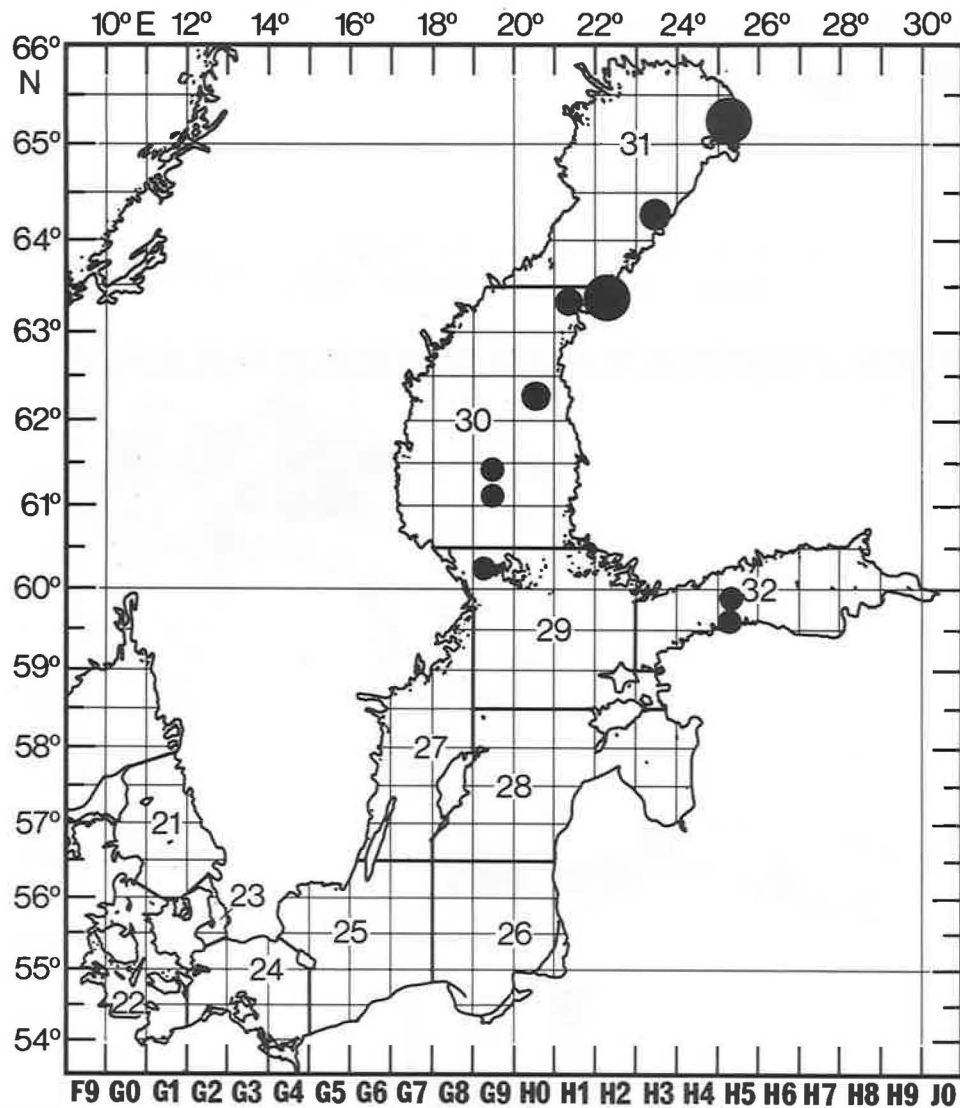


Figure 21. MERCURY concentrations in *MESIDOTHEA* relative to locations of catch.

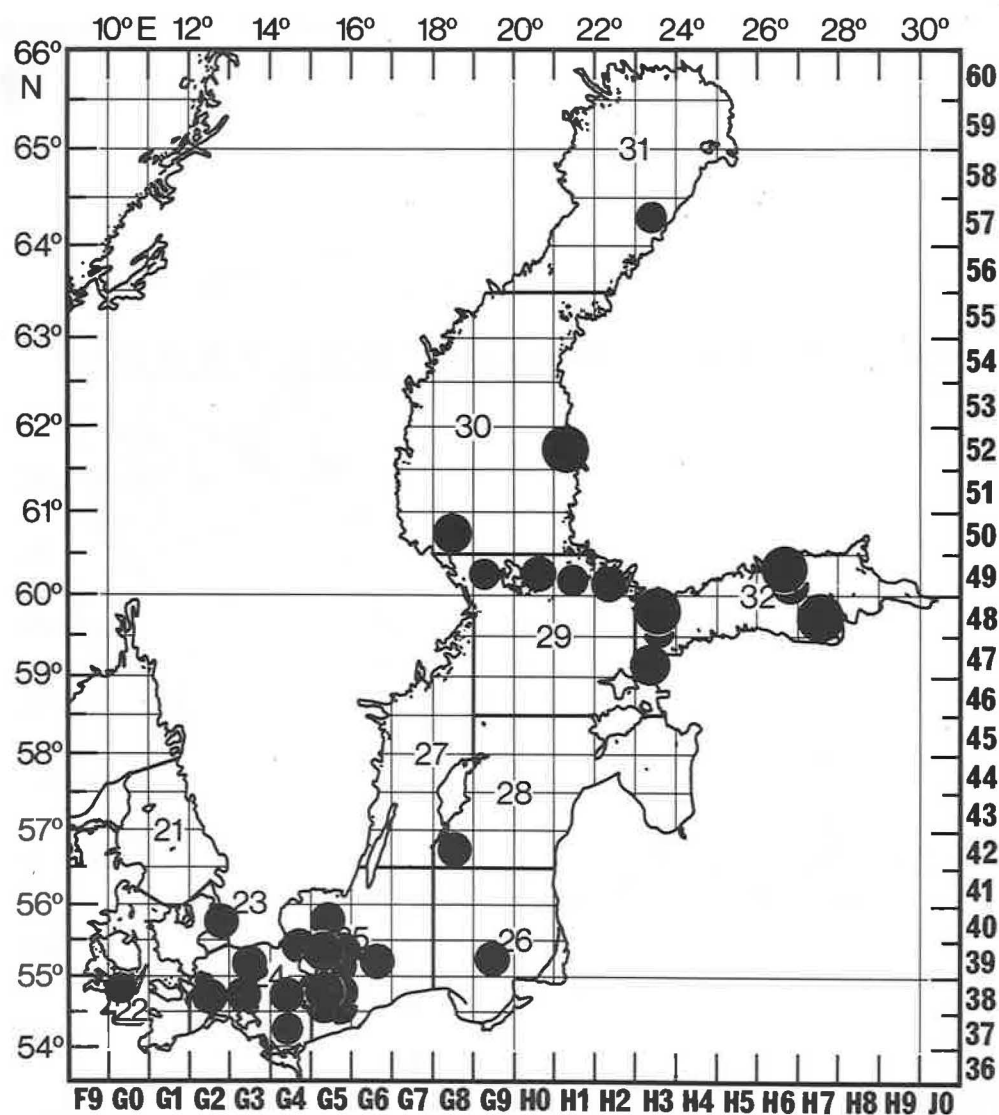


Figure 22. LEAD concentrations in COD relative to locations of catch.

0-20 20-40 40-60 60-80 80-100 100-120 120-140 µg/kg

wet weight muscle tissue

0,0-0,06 0,06-0,12 0,12-0,18 0,18-0,24 0,24-0,30 mg/kg

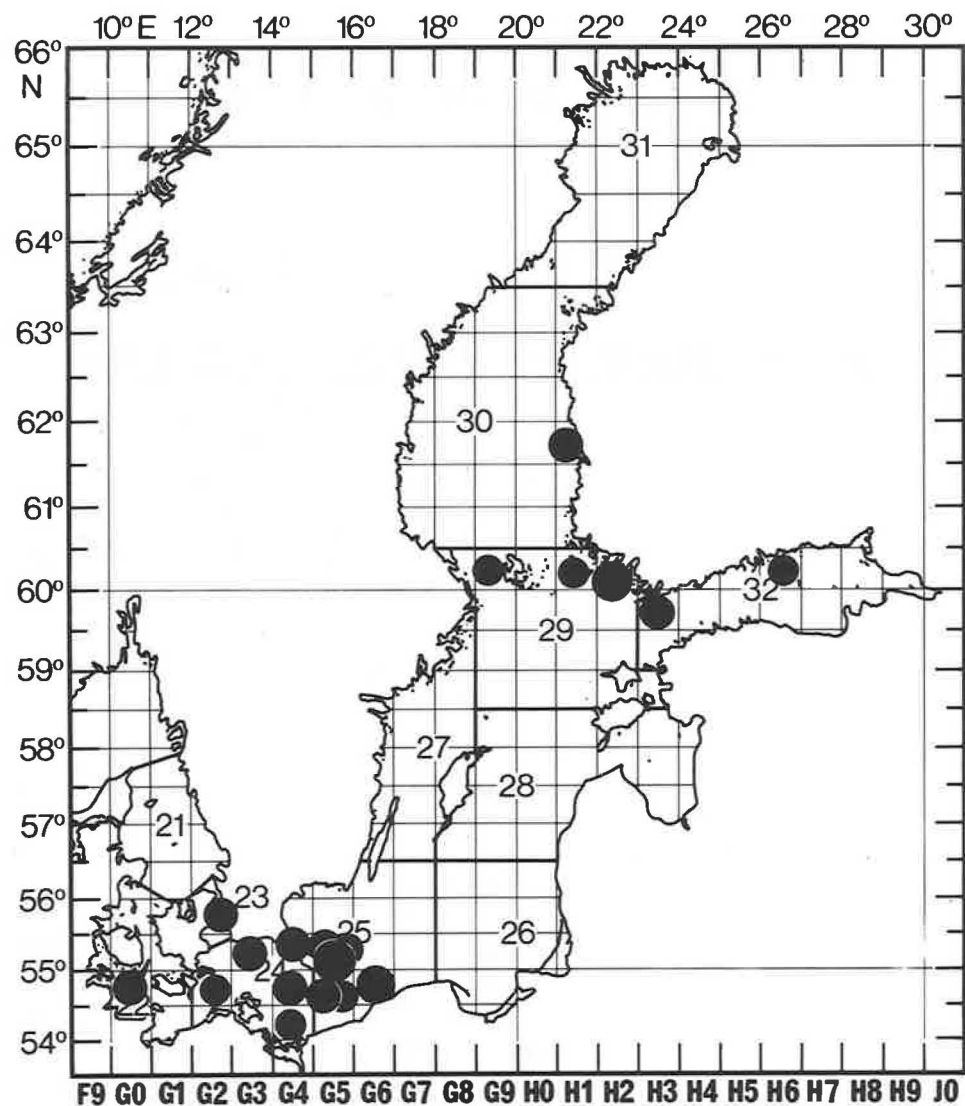


Figure 23. LEAD concentrations in FLOUNDER relative to locations of catch.

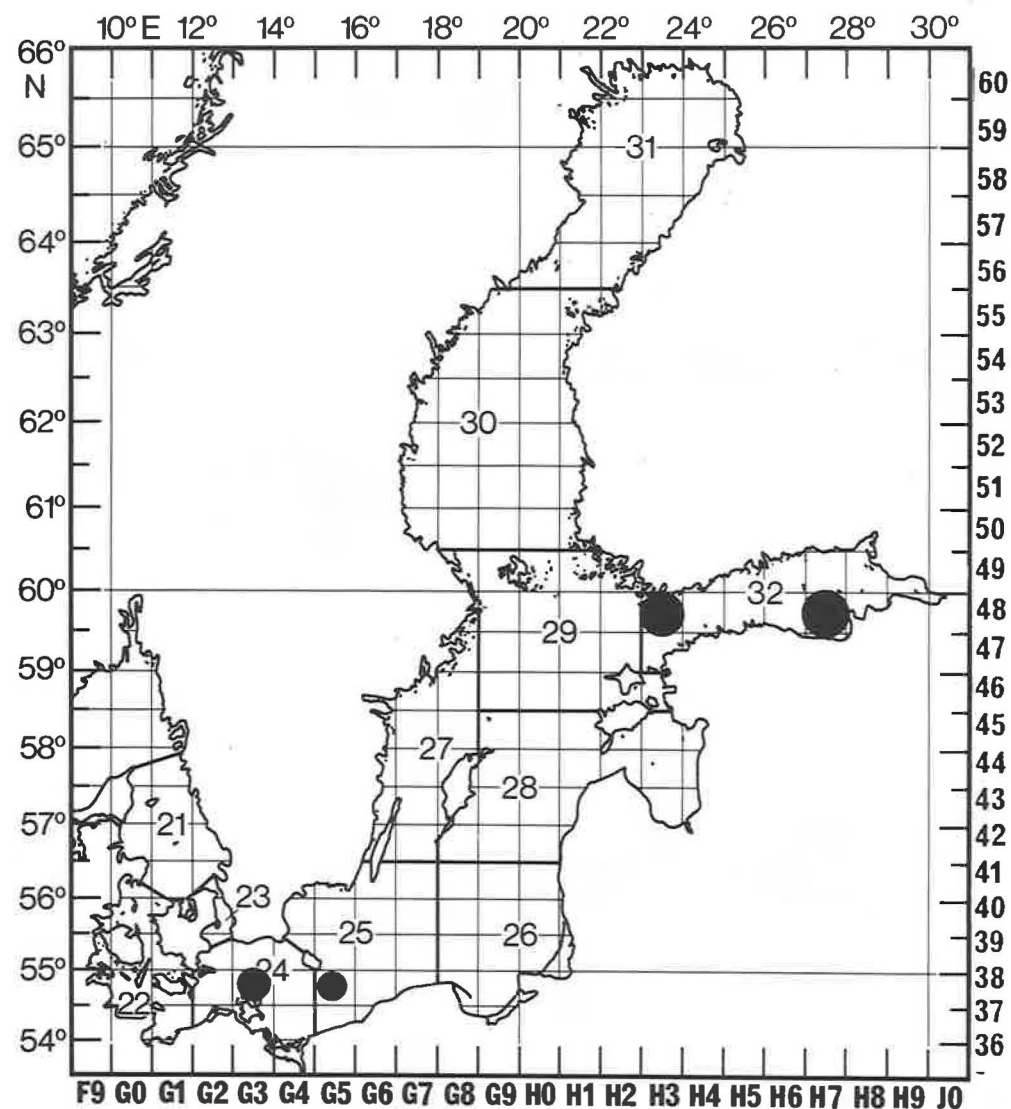


Figure 24. LEAD concentrations in PLAICE relative to locations of catch.



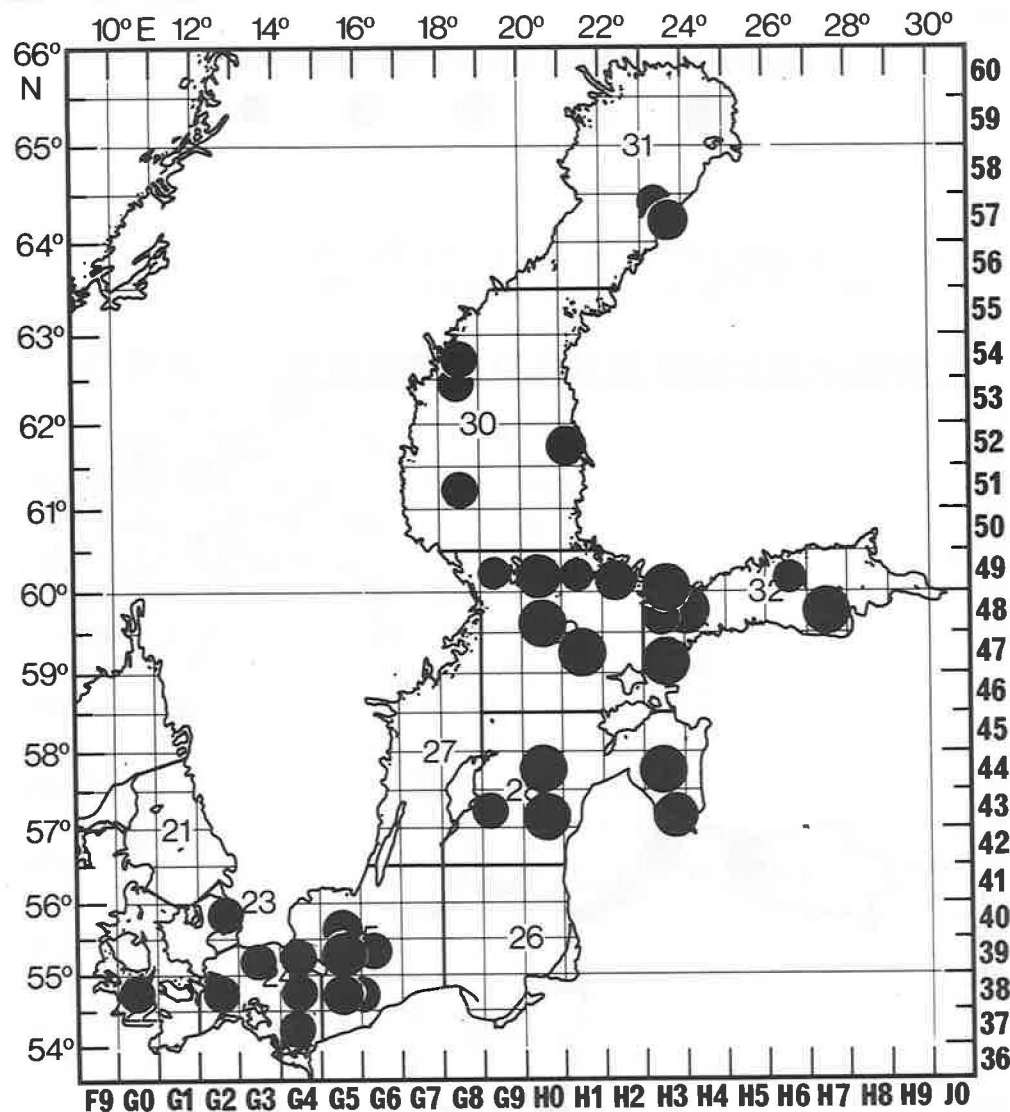


Figure 25. LEAD concentrations in HERRING relative to locations of catch.

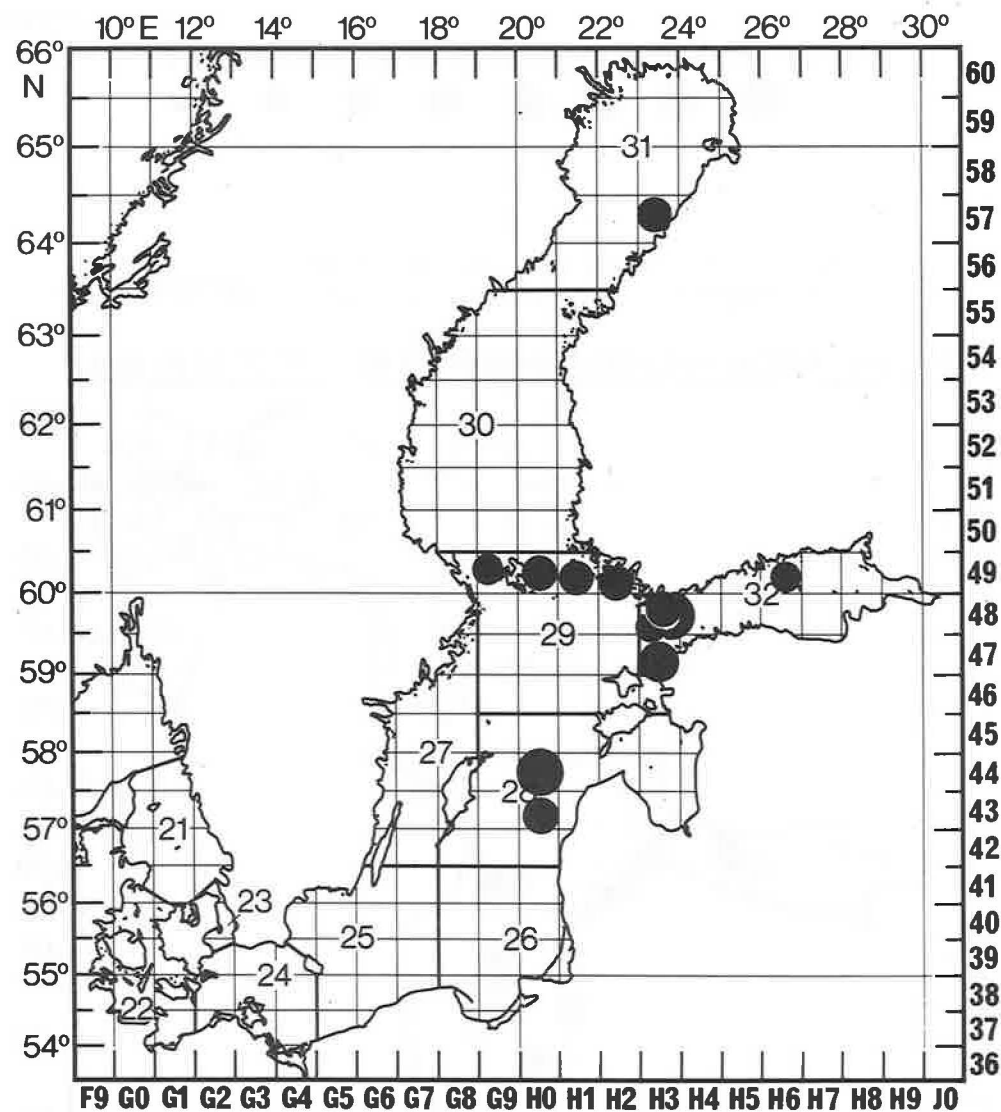


Figure 26. LEAD concentrations in SPRAT relative to locations of catch.

● 0,0-0,06 ● 0,06-0,12 ● 0,12-0,18 ● 0,18-0,24 ● 0,24-0,30 mg/kg wet weight muscle tissue

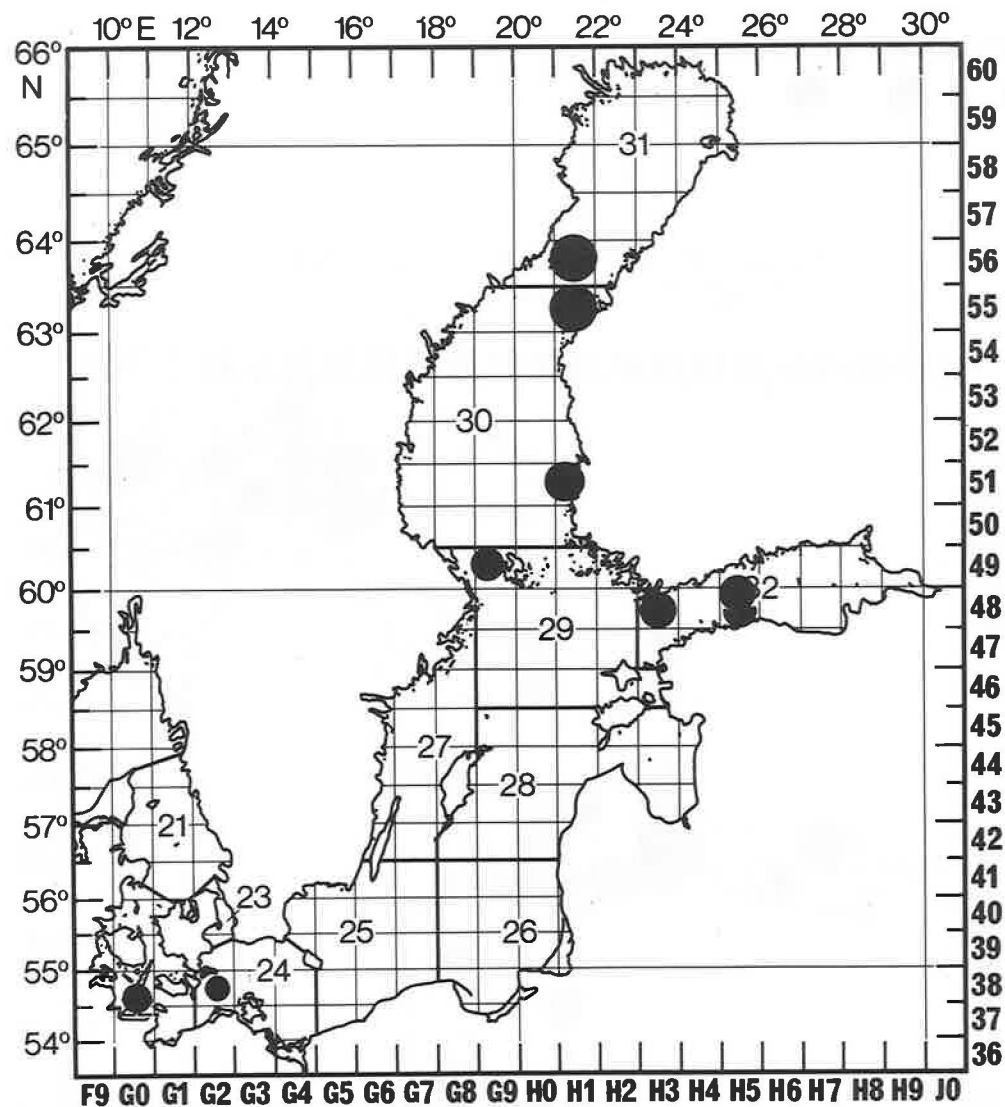


Figure 27. LEAD concentrations in MYTILUS and MACOMA relative to locations of catch.

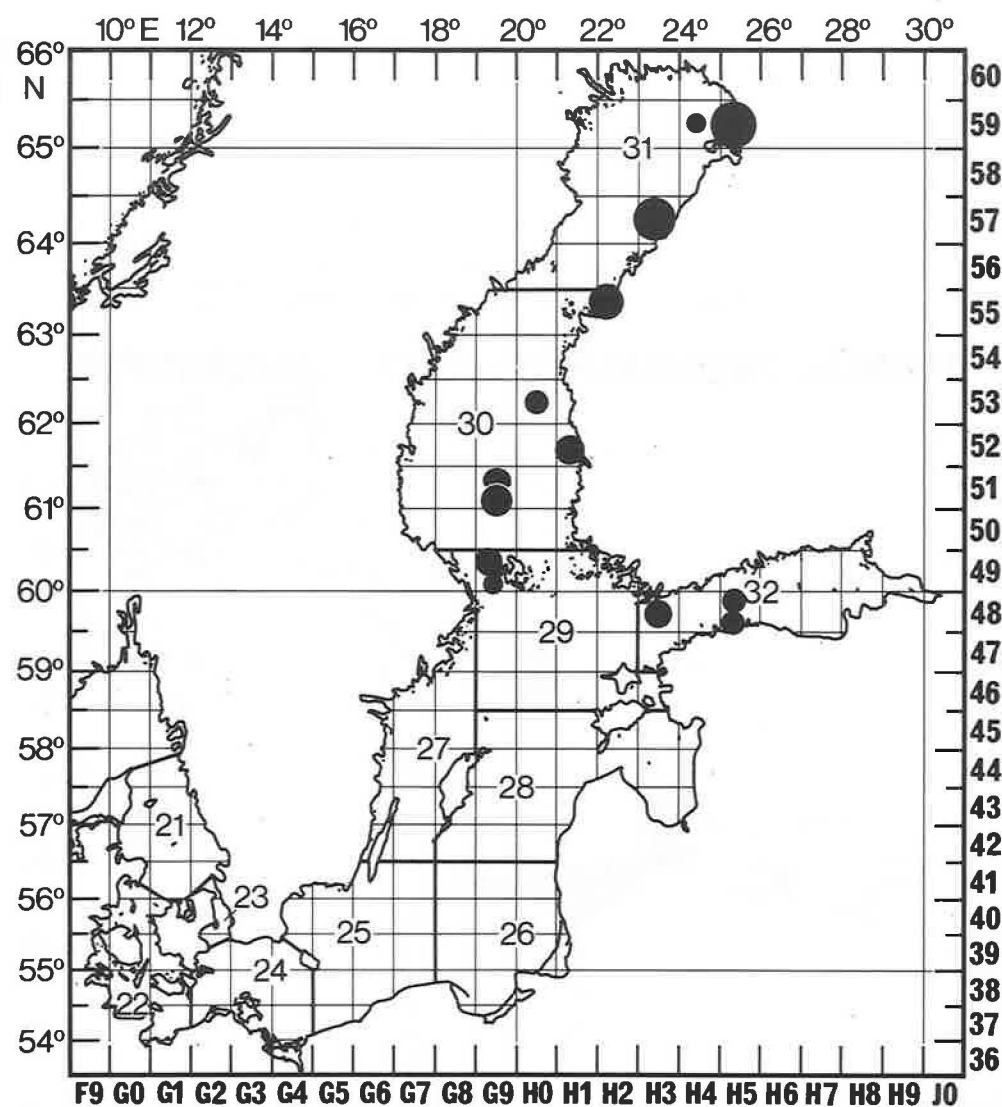


Figure 28. LEAD concentrations in MESIDOTHEA relative to locations of catch.

0,0-0,06 0,06-0,12 0,12-0,18 0,18-0,24 0,24-0,30 mg/kg

0-0,2 0,2-0,4 0,4-0,6 0,6-0,8 0,8-1,0 1,0-1,2 1,2-1,4 1,4-1,6 mg/kg

wet weight muscle tissue

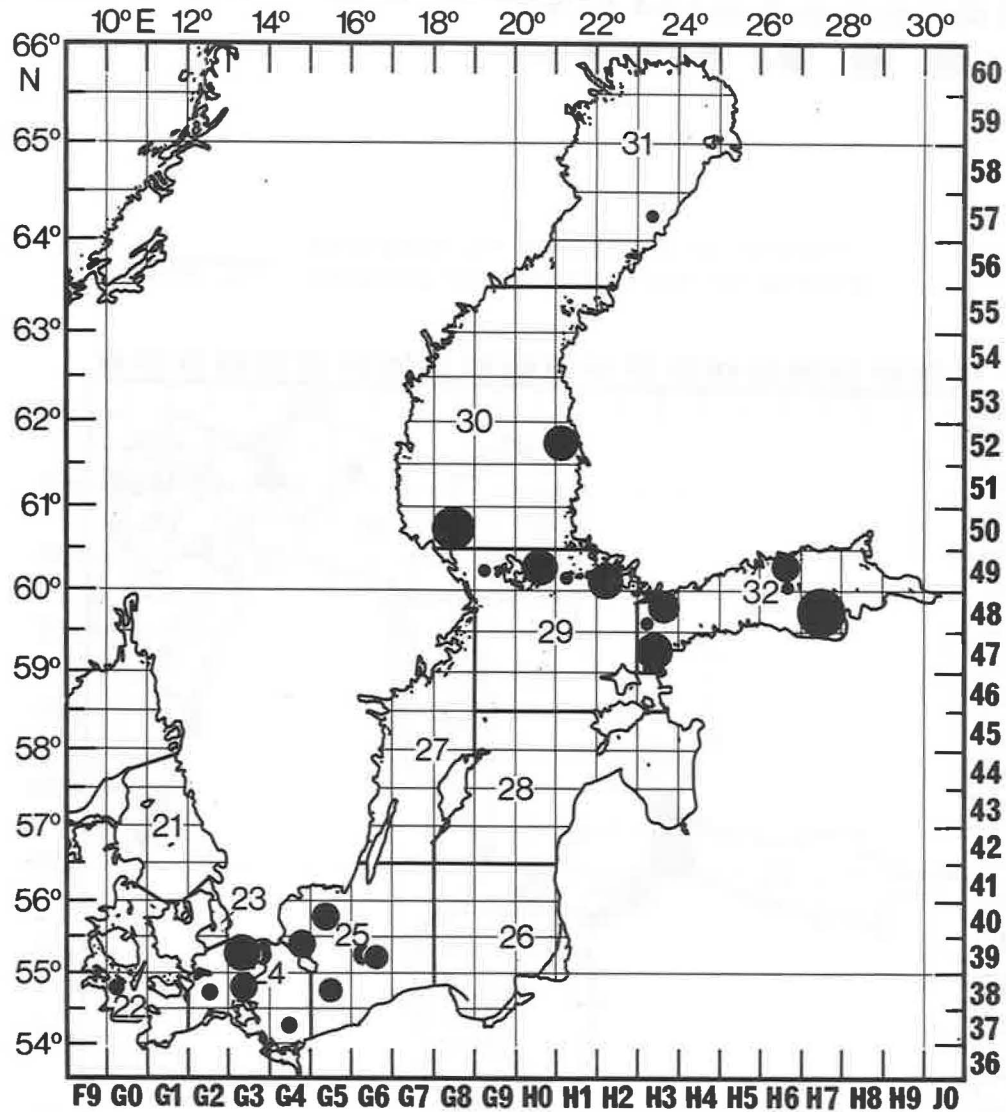


Figure 29. CADMIUM concentrations in COD relative to locations of catch.

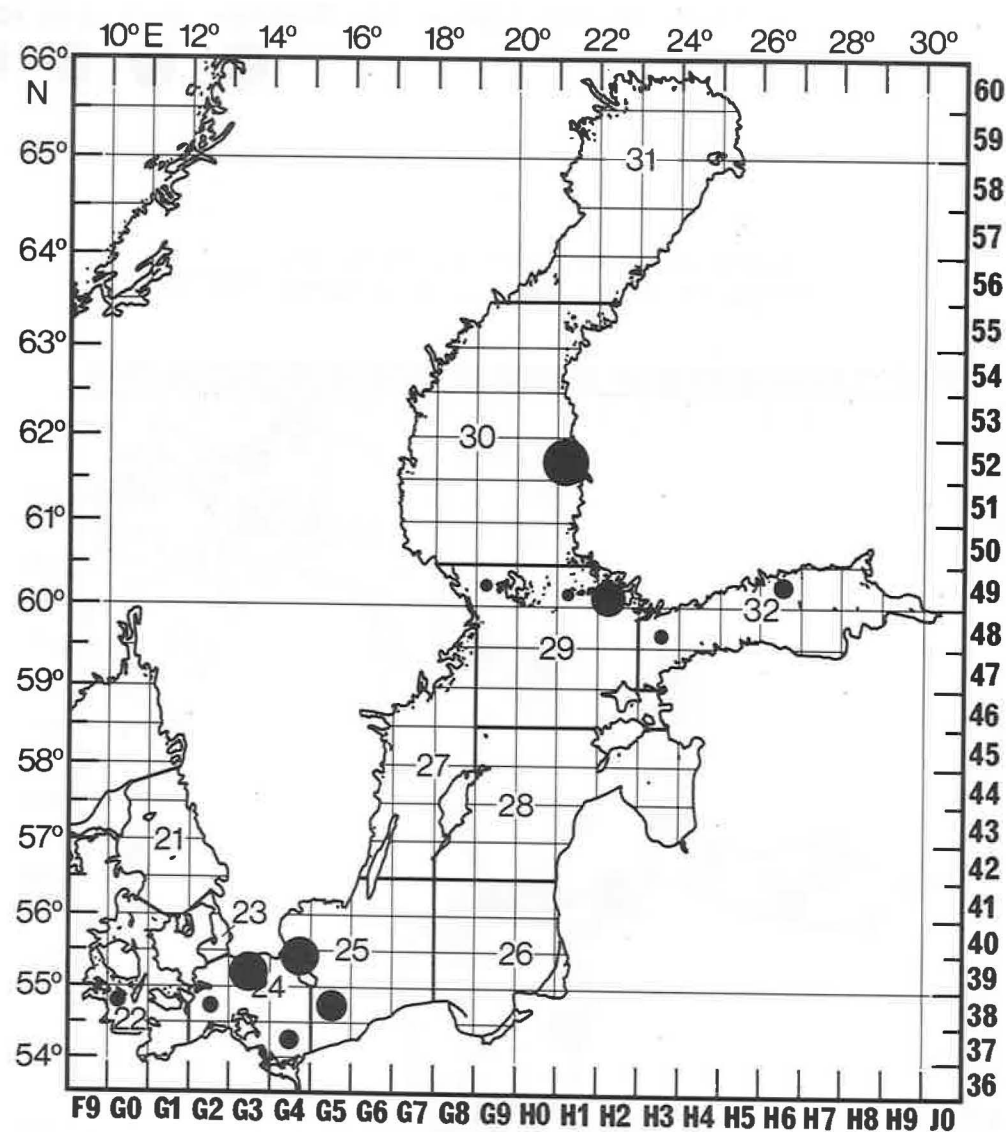
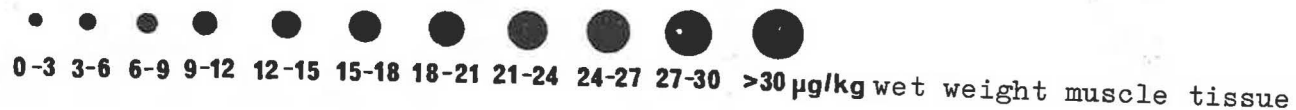


Figure 30. CADMIUM concentrations in FLOUNDER relative to locations of catch.



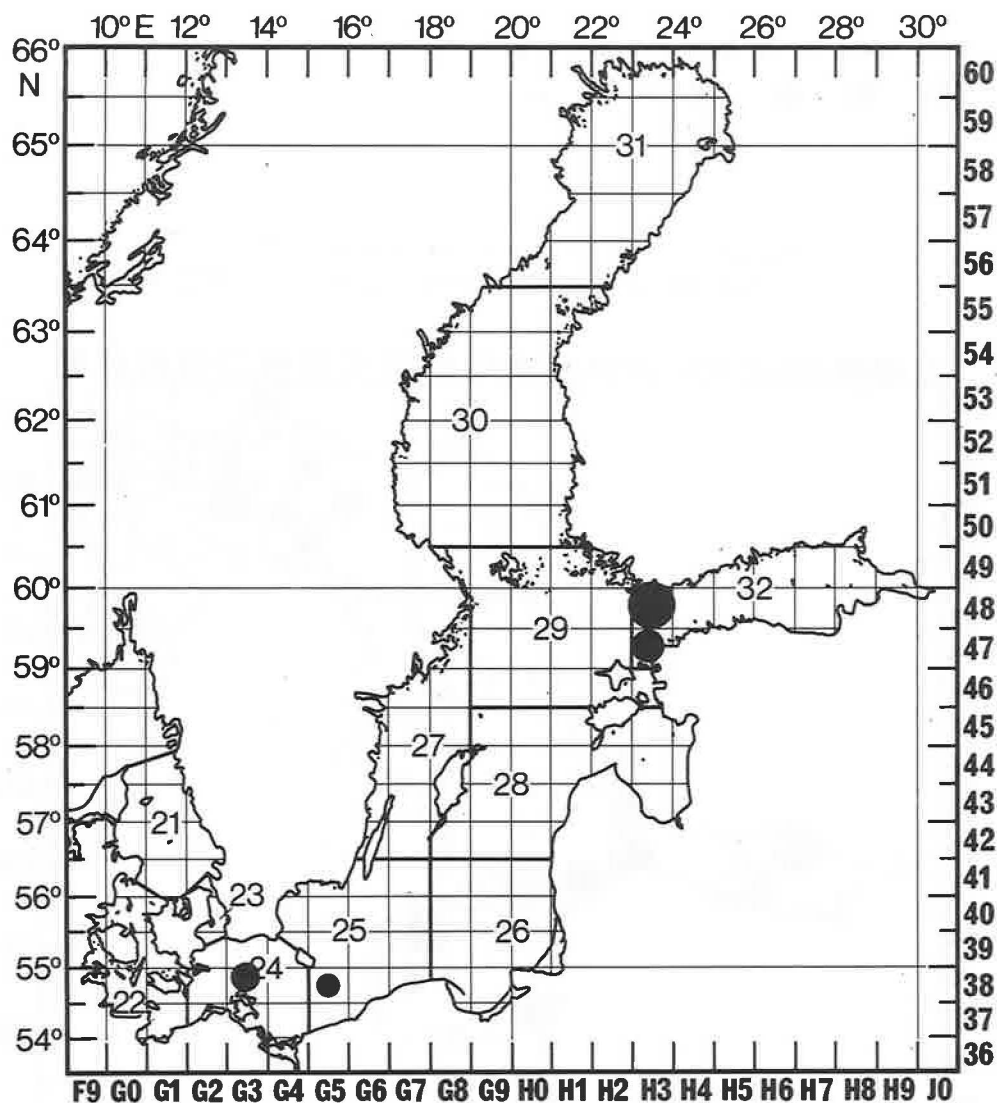


Figure 31. CADMIUM concentrations in PLAICE relative to locations of catch.

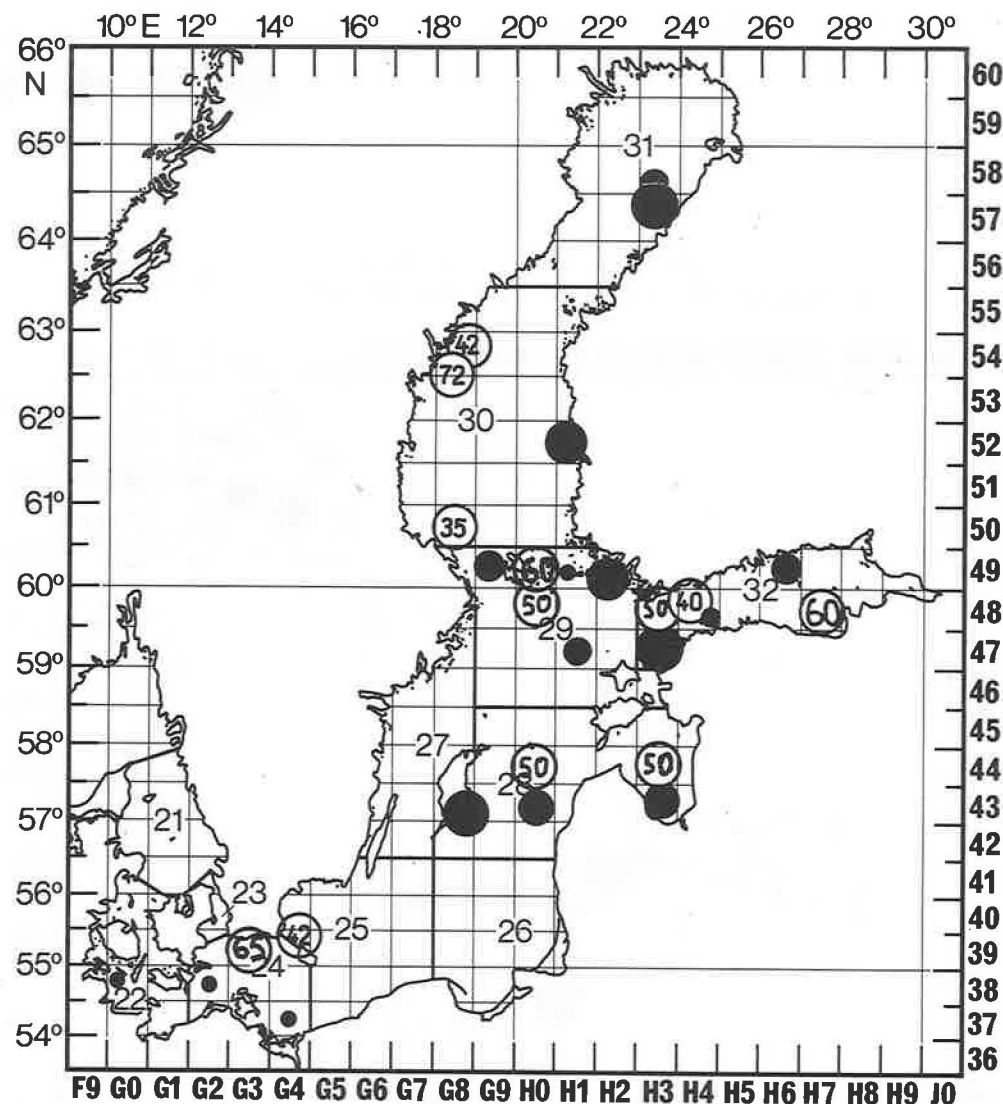


Figure 32. CADMIUM concentrations in HERRING relative to locations of catch.



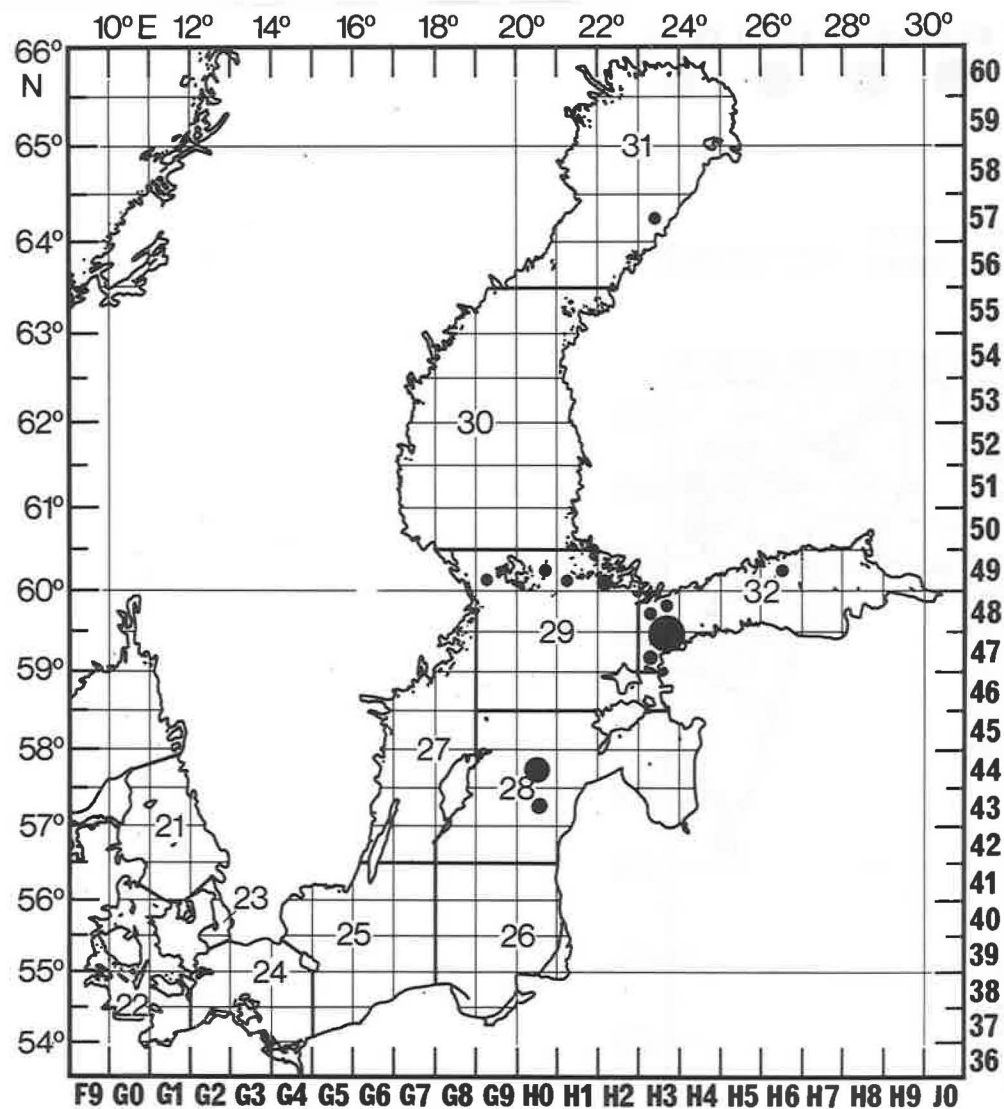


Figure 33. CADMIUM concentrations in SPRAT relative to locations of catch.

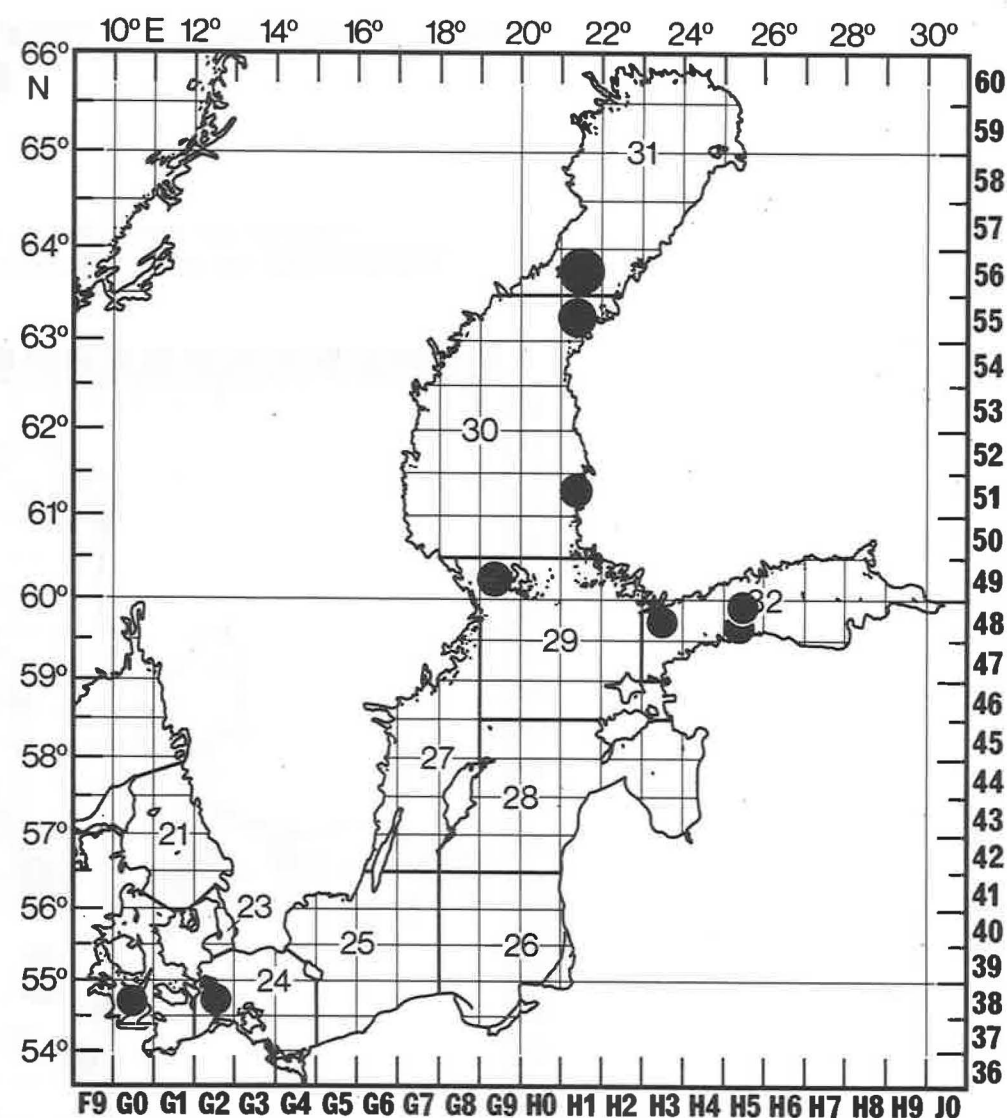


Figure 34. CADMIUM concentrations in MYTILUS and MACOMA relative to locations of catch.

● ● ● ● ●
 0,0-0,06 0,06-0,12 0,12-0,18 0,18-0,24 0,24-0,30mg/kg

wet weight muscle tissue

● ● ● ● ● ●
 0,0-0,1 0,1-0,2 0,2-0,3 0,3-0,4 0,4-0,5 0,5-0,6mg/kg

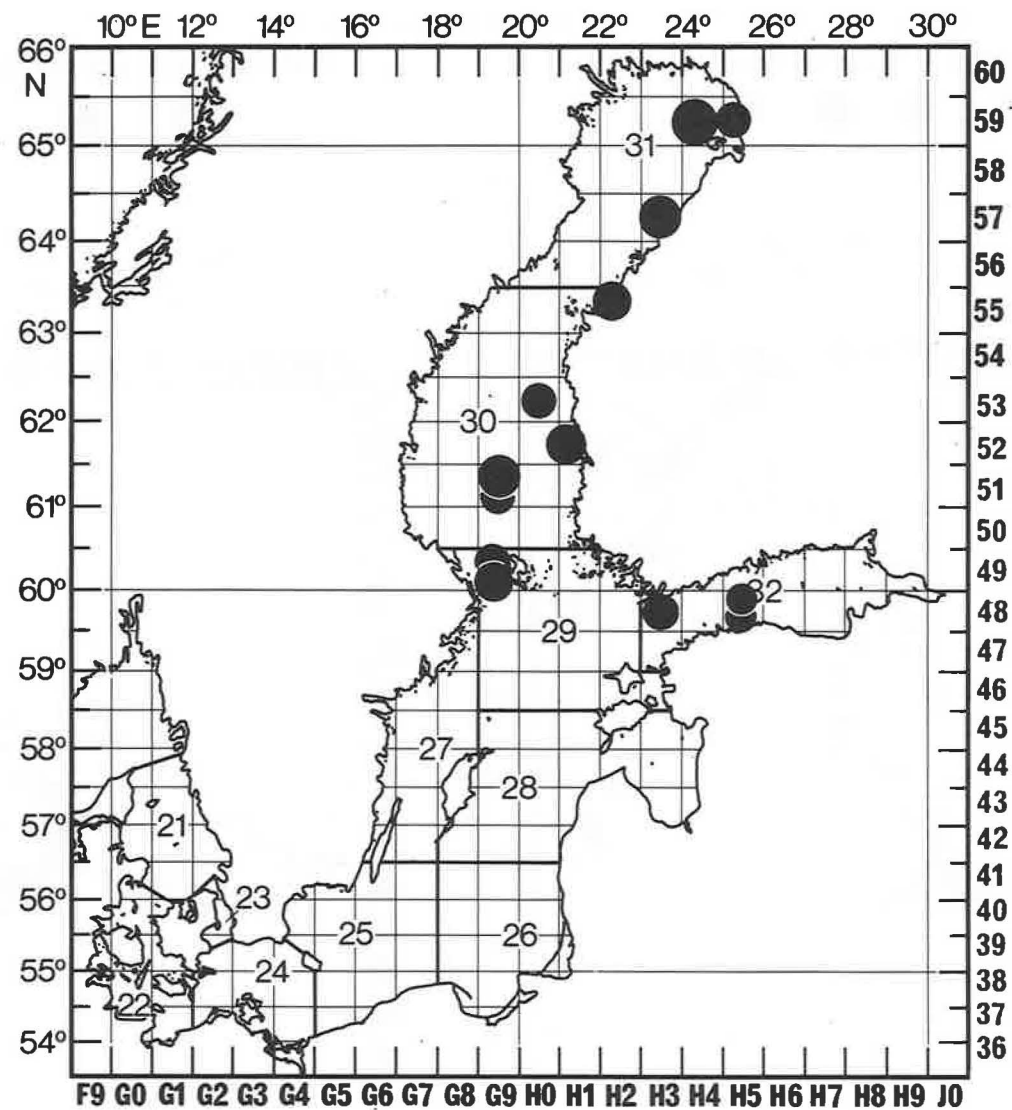


Figure 35. CADMIUM concentrations in *MESIDOTHEA* relative to locations of catch.



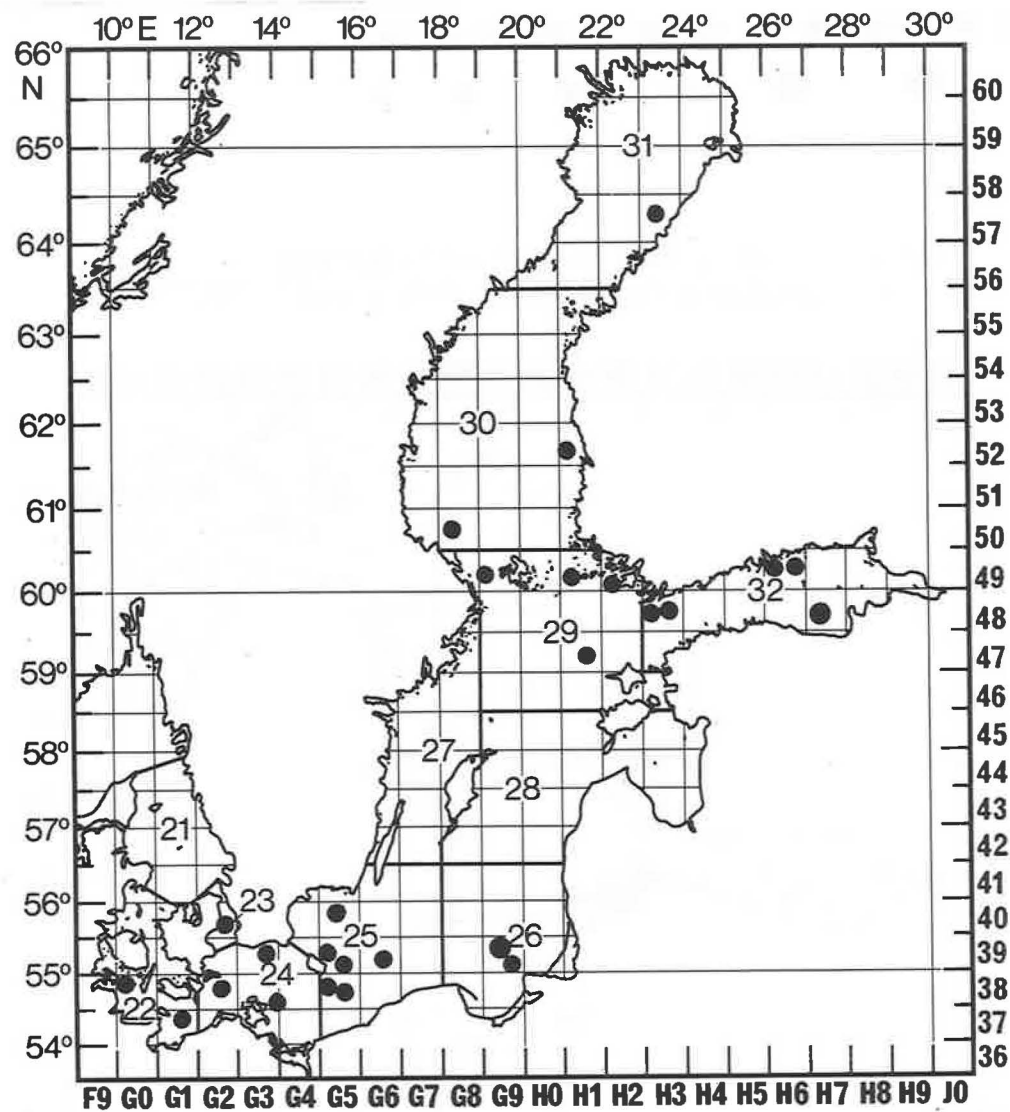


Figure 36. Σ DDT concentrations in COD relative to locations of catch.

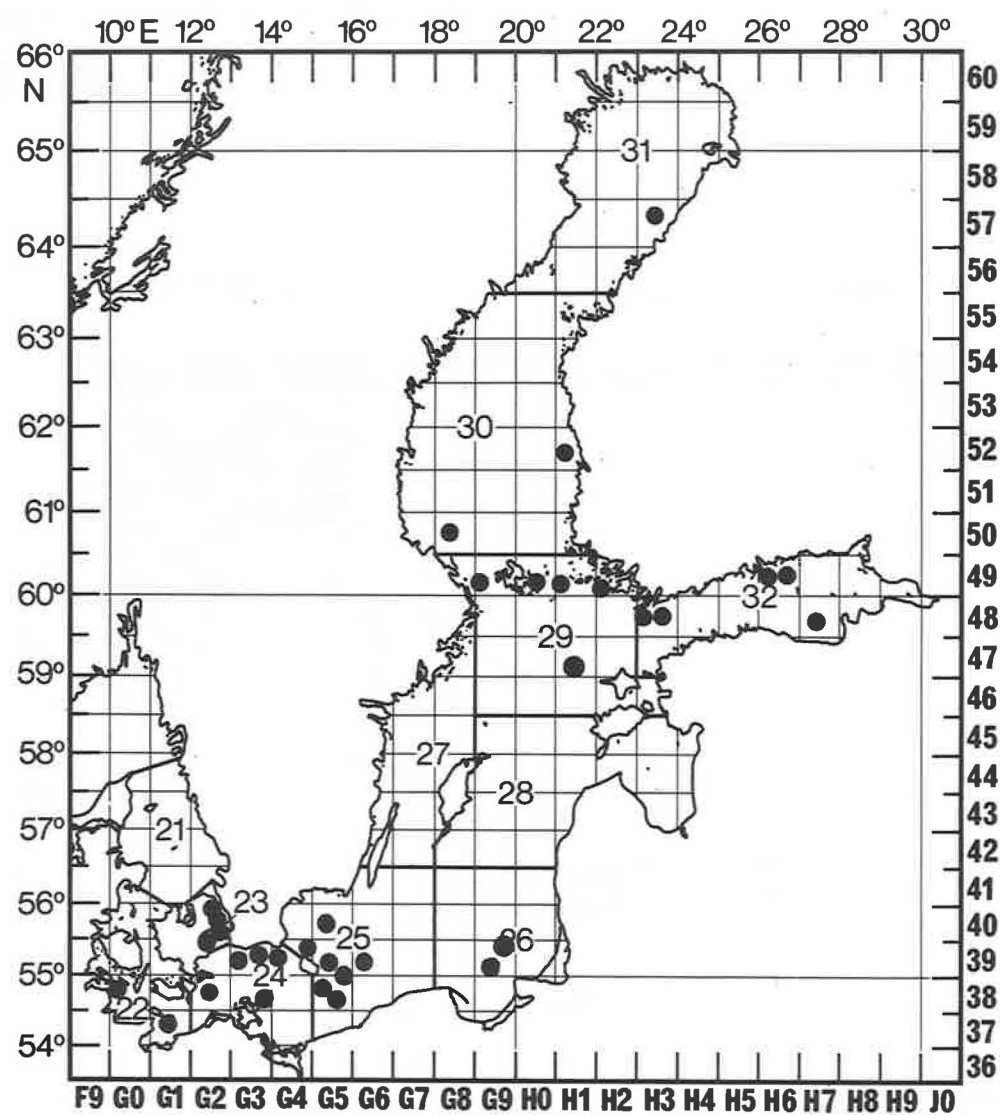


Figure 37. Σ PCB concentrations in COD relative to locations of catch.



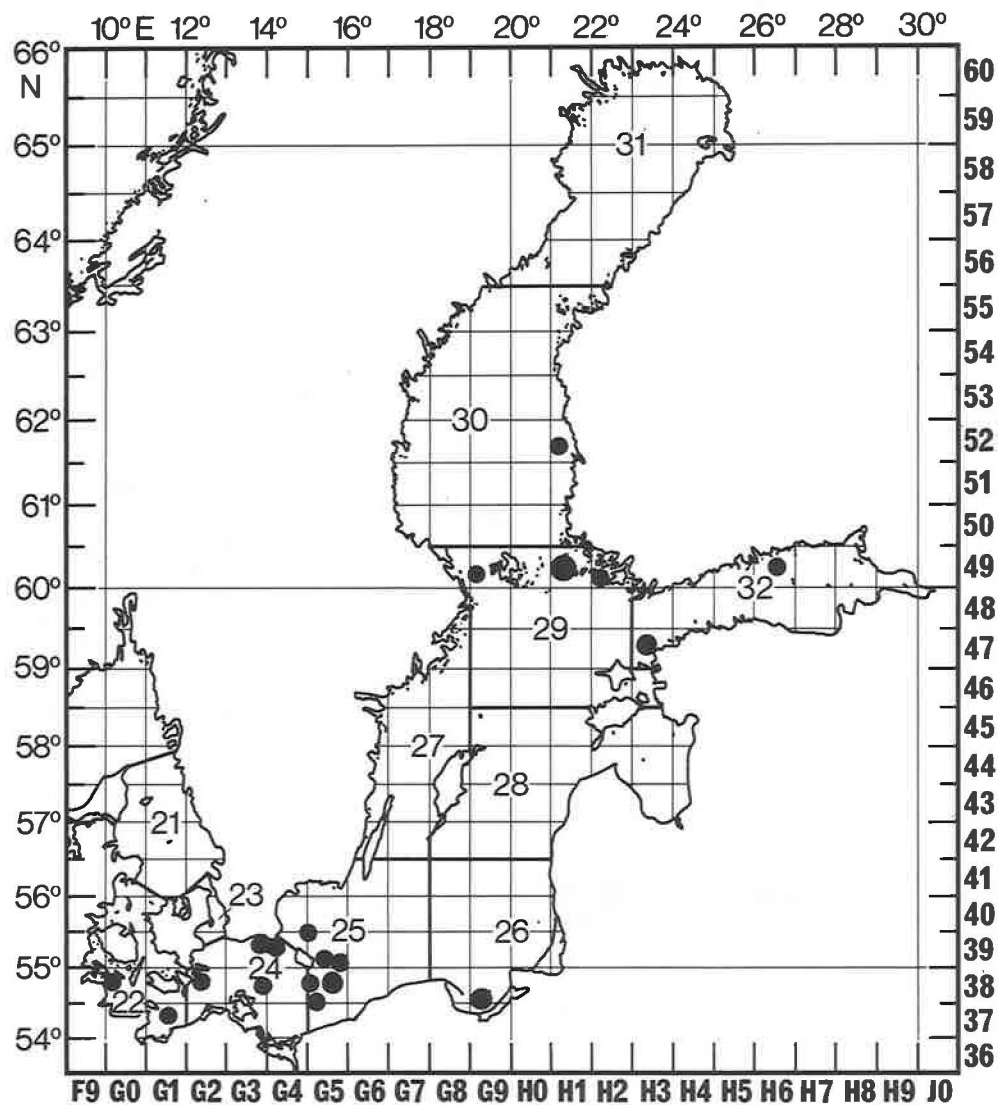


Figure 38. ΣDDT concentrations in FLOUNDER and PLAICE relative to locations of catch.

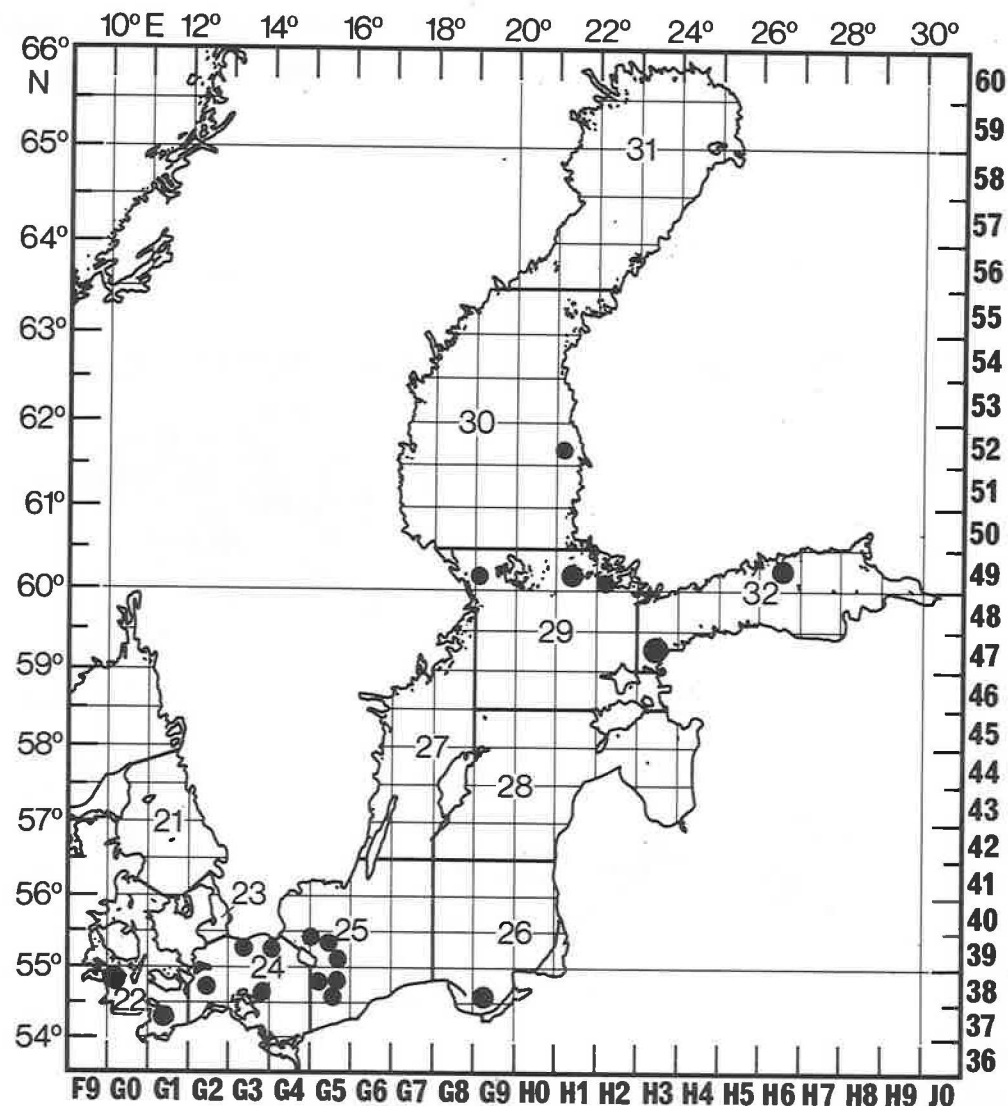


Figure 39. ΣPCB concentrations in FLOUNDER and PLAICE relative to locations of catch.

0-100 100-250 250-500 500-750 750-1000 1000-1500 1500-2000 >2000 µg/kg wet weight muscle tissue

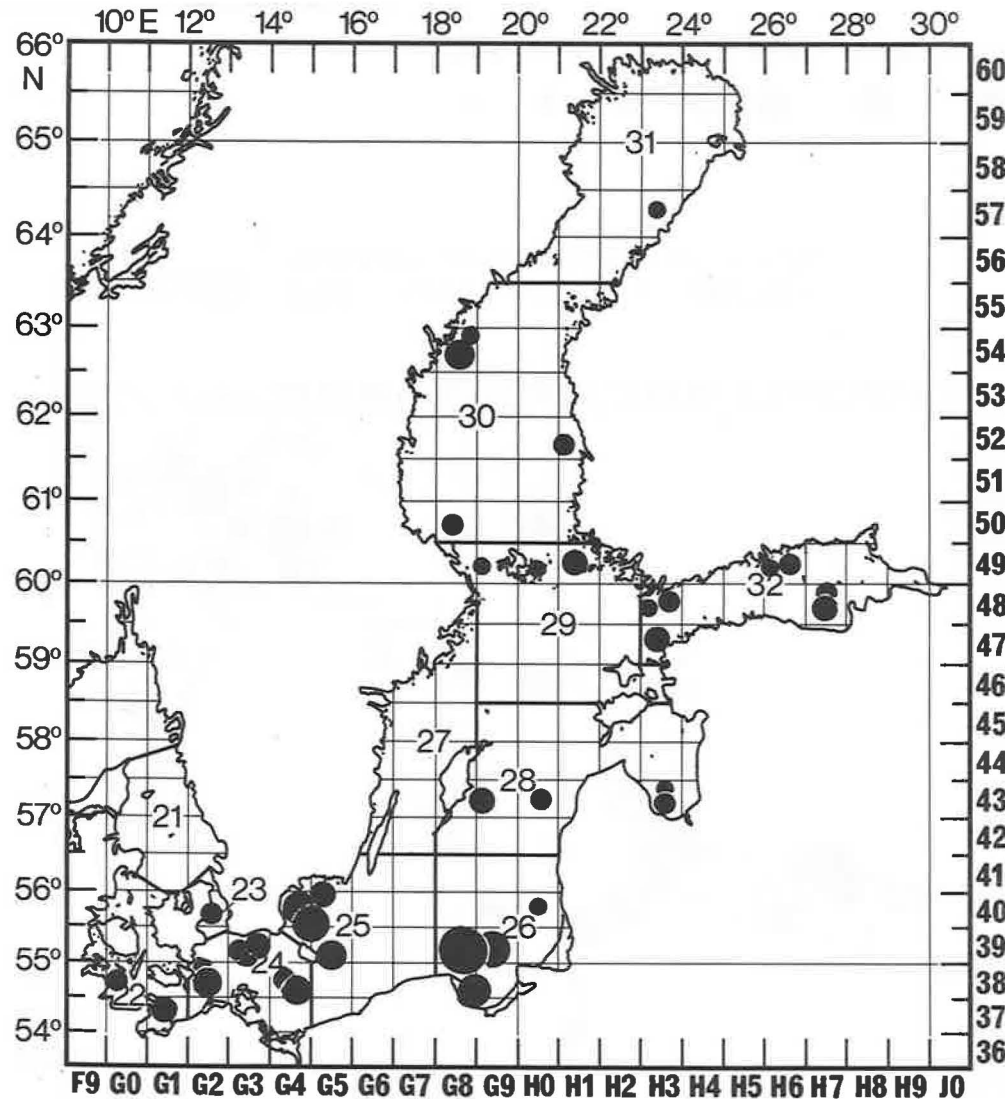


Figure 40. Σ DDT concentrations in HERRING relative to locations of catch.

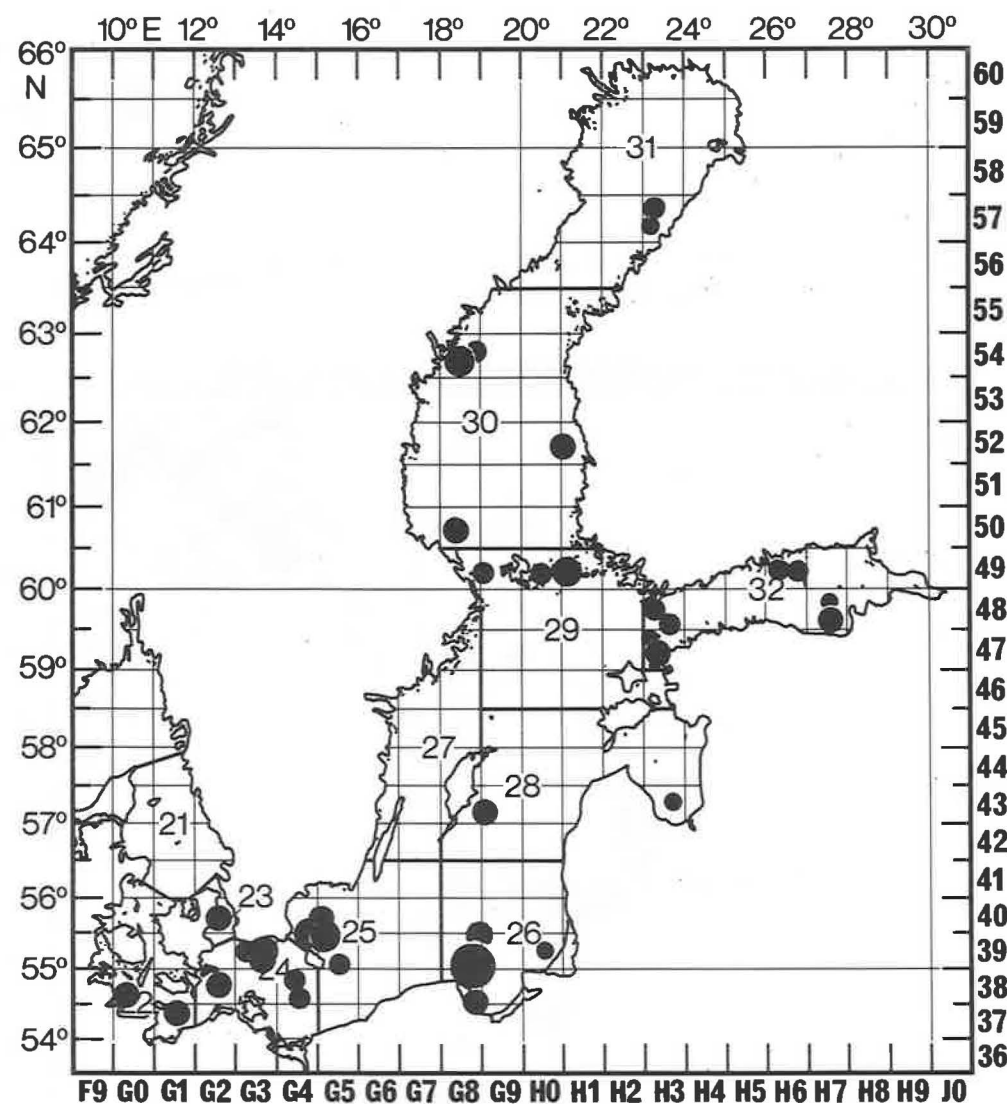


Figure 41. Σ PCB concentrations in HERRING relative to locations of catch.



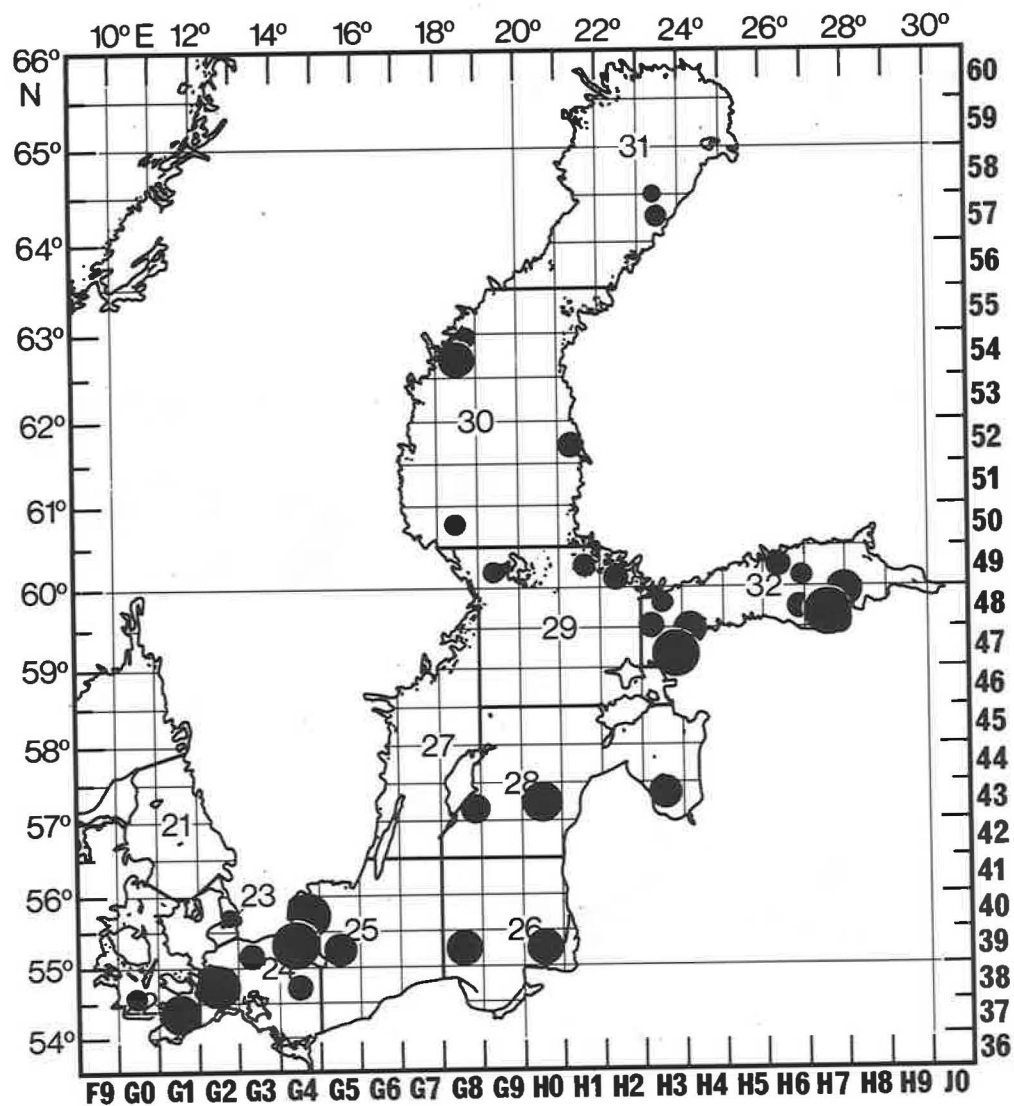


Figure 42. Σ DDT concentrations in HERRING relative to locations of catch.

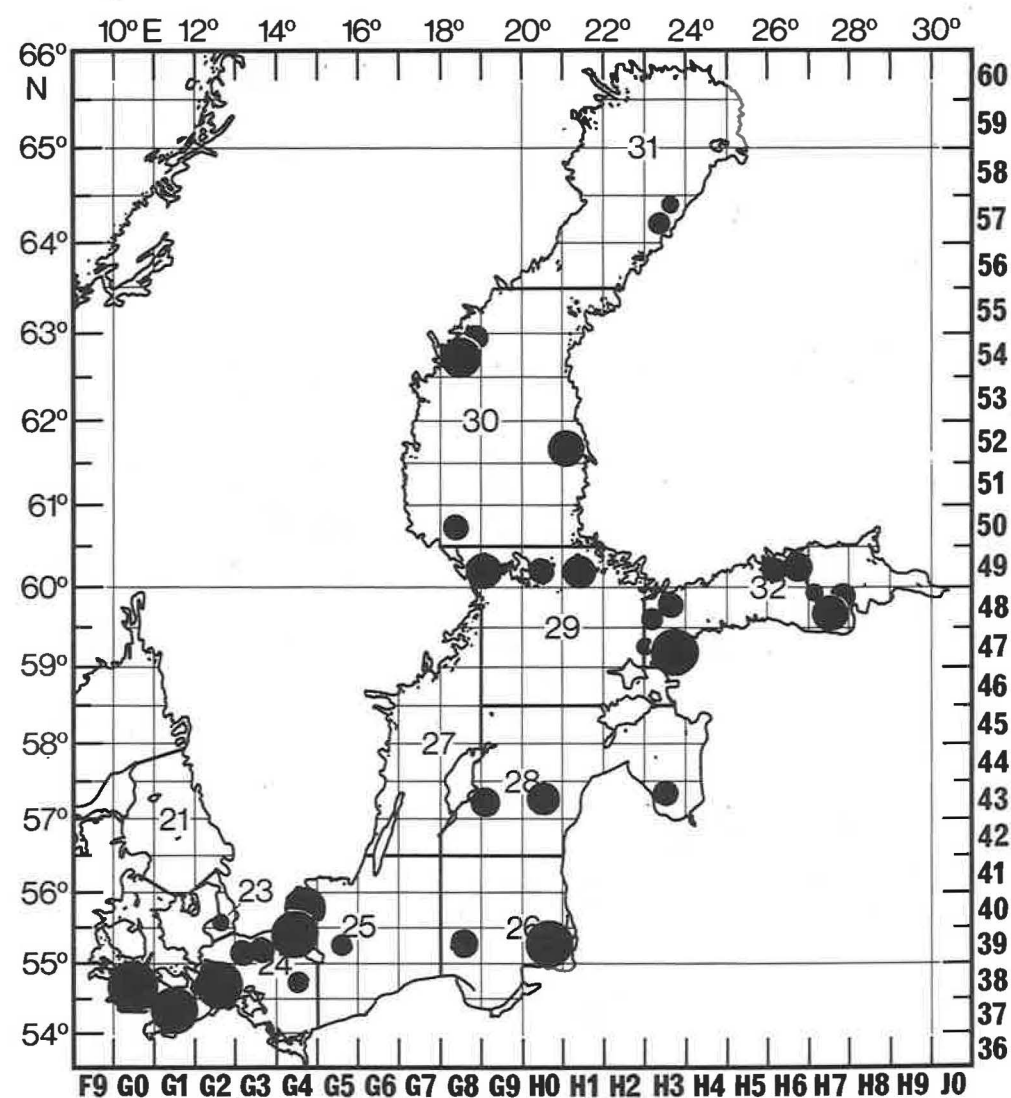


Figure 43. Σ PCB concentrations in HERRING relative to locations of catch.



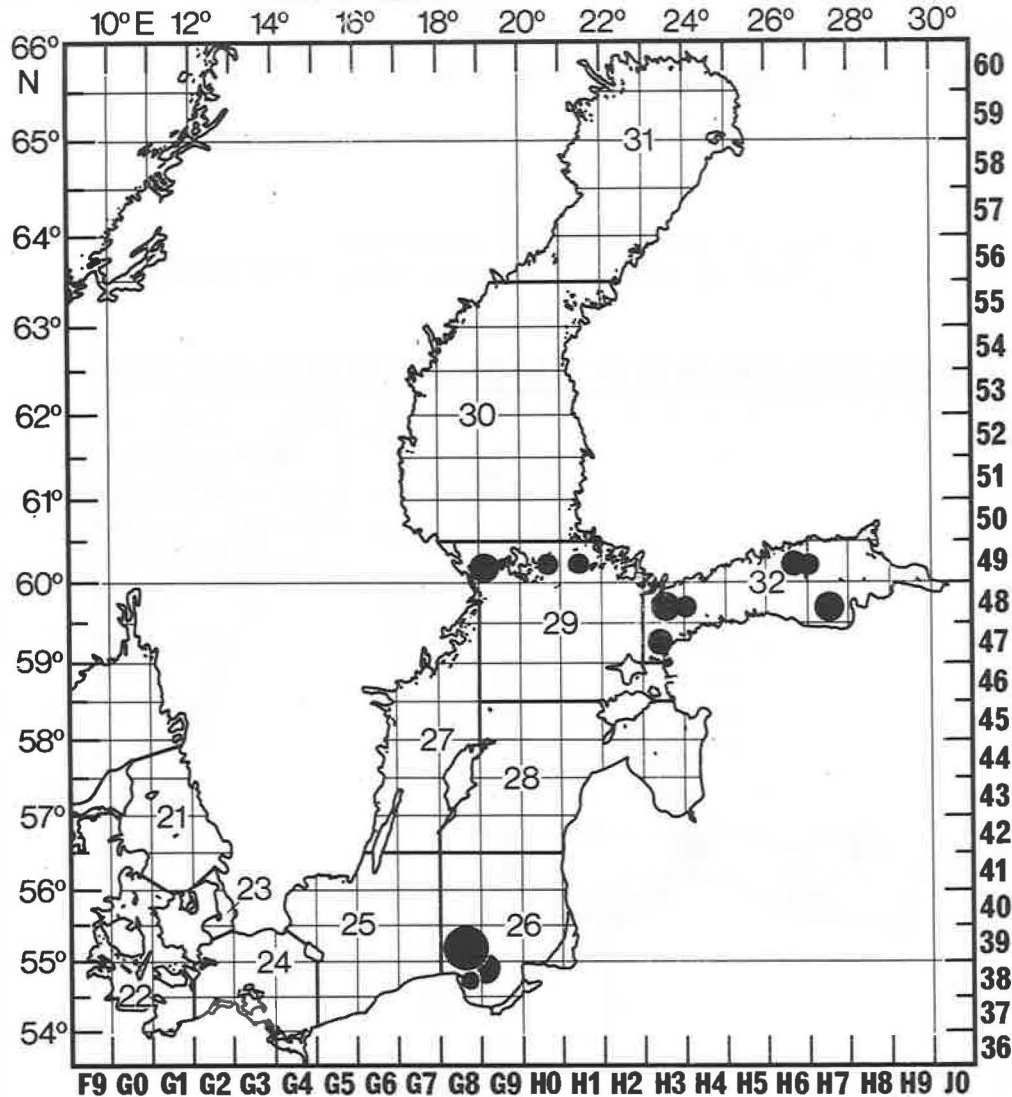


Figure 44. Σ DDT concentrations in SPRAT relative to locations of catch.

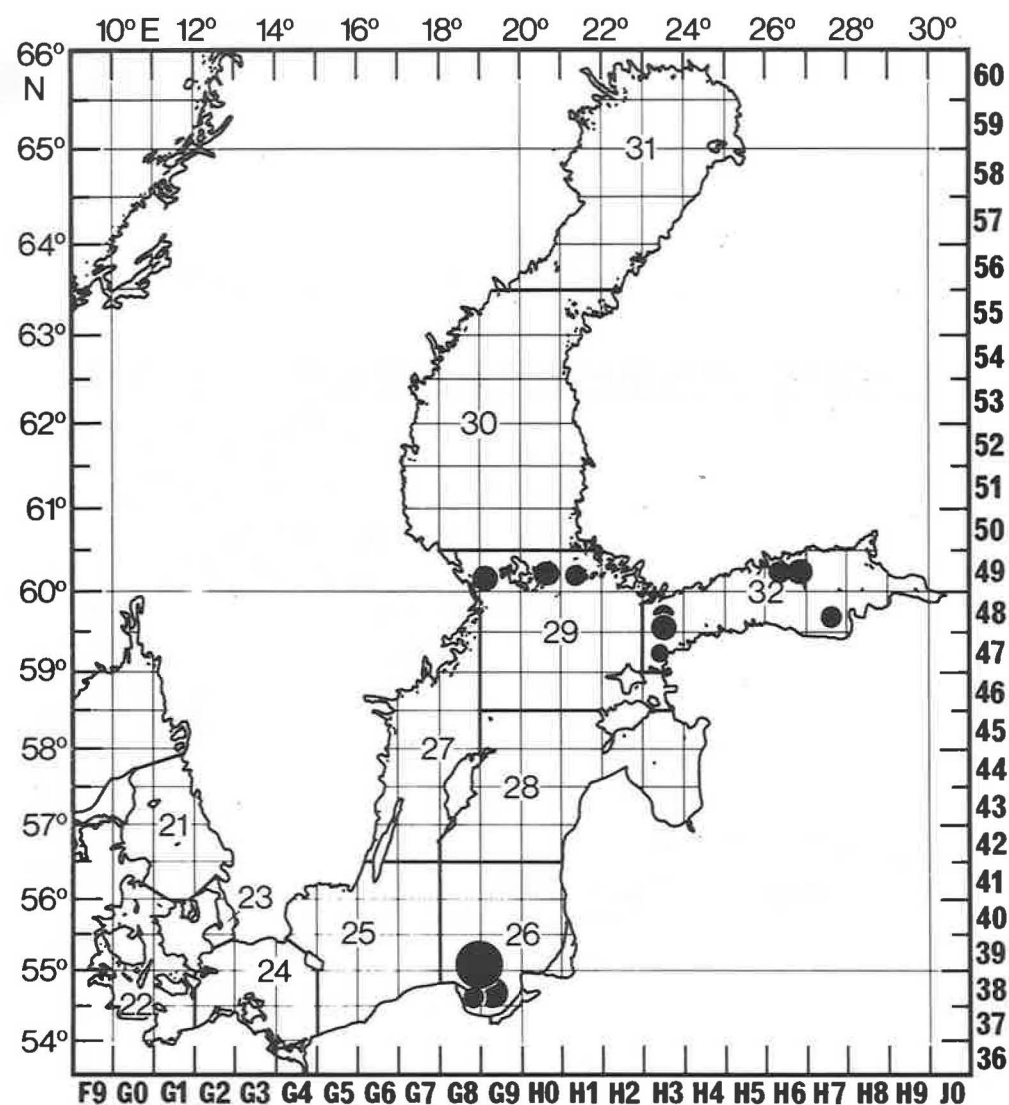


Figure 45. Σ PCB concentrations in SPRAT relative to locations of catch.



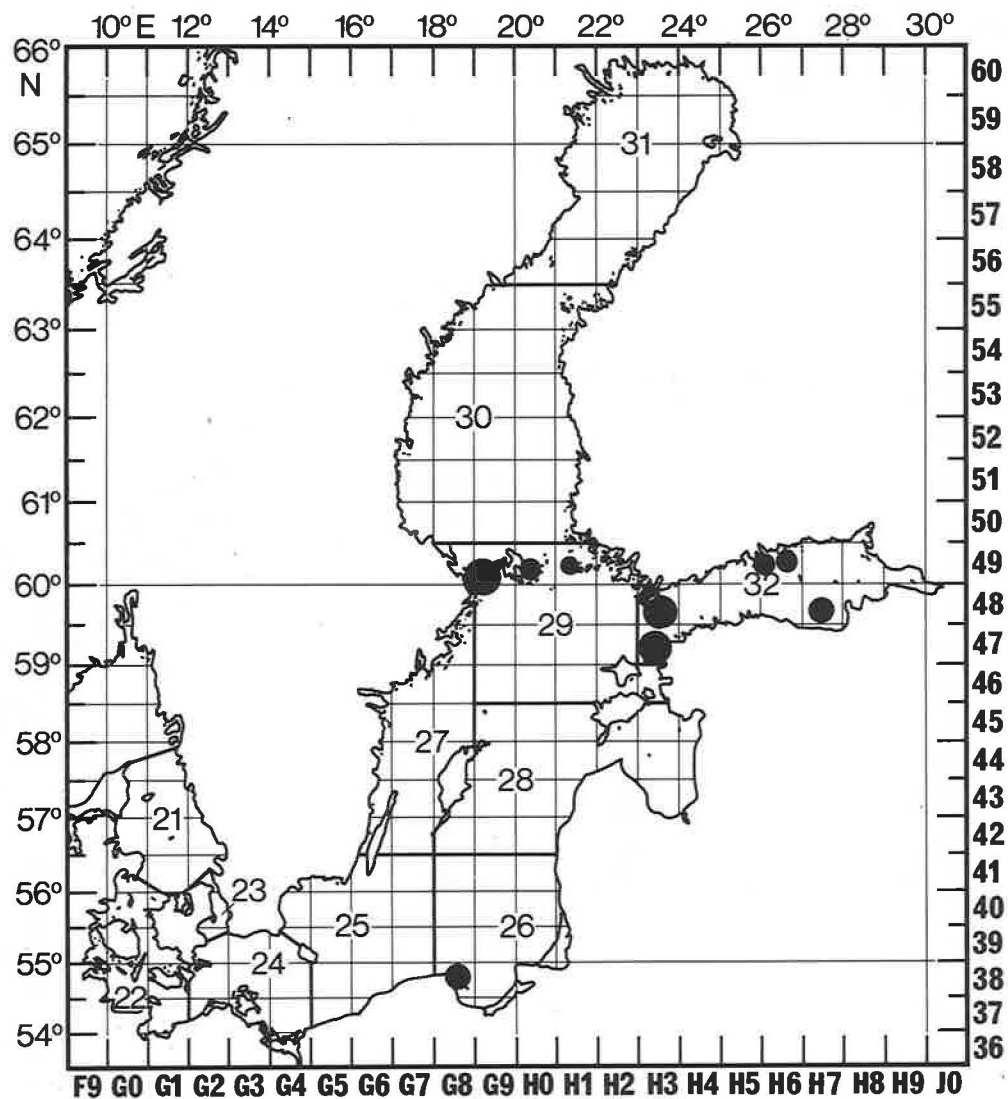


Figure 46. Σ DDT concentrations in SPRAT relative to locations of catch.

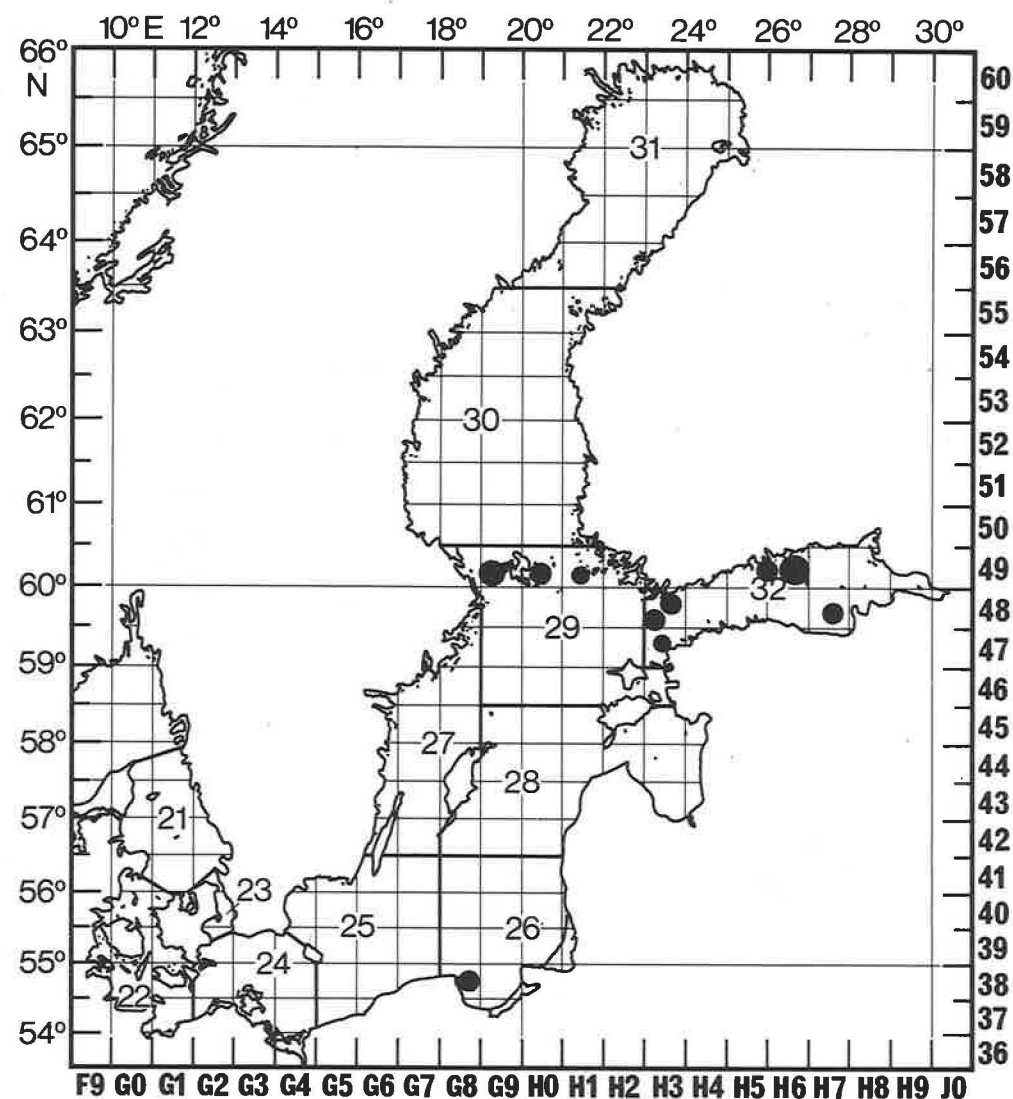
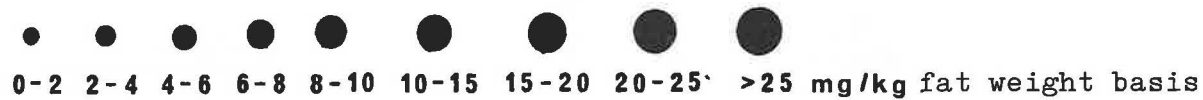


Figure 47. Σ PCB concentrations in SPRAT relative to locations of catch.



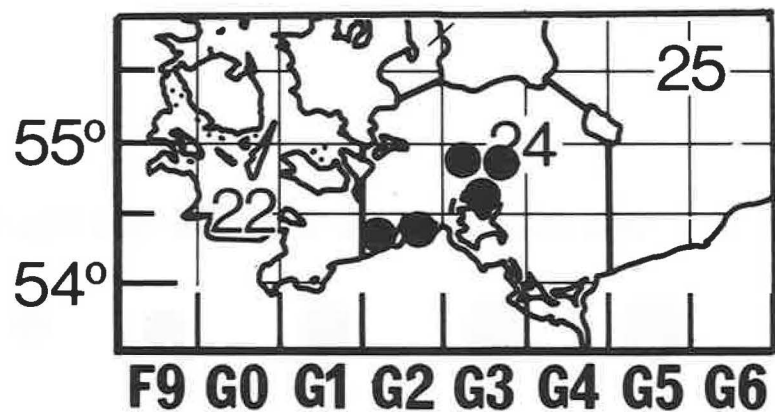


Figure 48. Σ DDT concentrations in COD in relation to locations of catch and year class.

| <u>Location</u> | <u>Year classes</u> |
|-----------------|---------------------|
| 24 G2 54-54.5° | 1, 2 |
| 24 G3 54.5-55° | 2, 3, 4 |

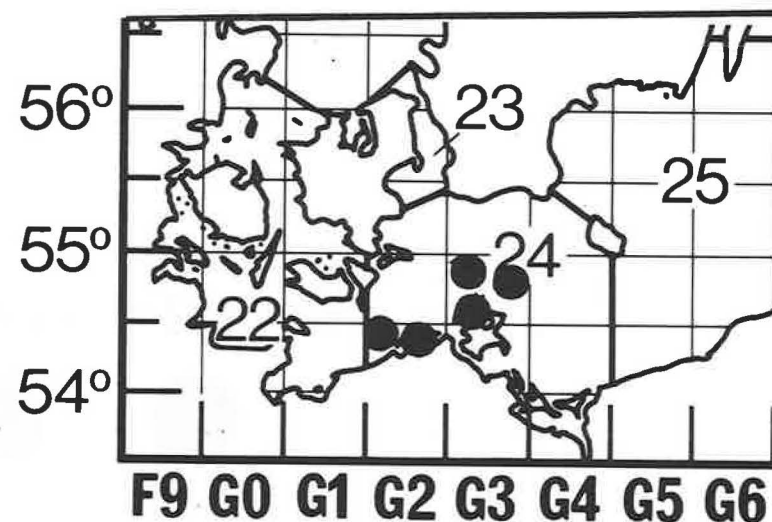
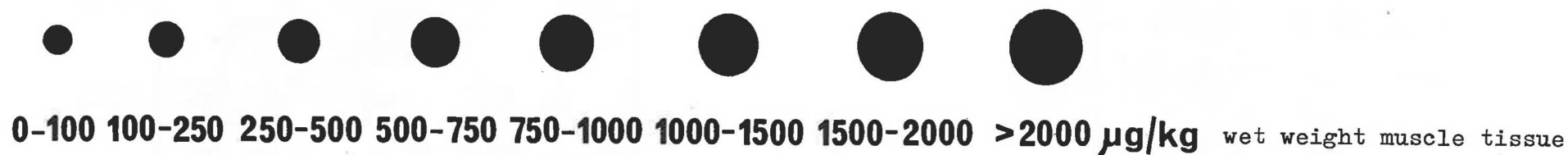


Figure 49. PCB concentrations in COD in relation to locations of catch and year class.

| <u>Location</u> | <u>Year classes</u> |
|-----------------|---------------------|
| 24 G2 54-54.5° | 1, 2 |
| 24 G3 54.5-55° | 2, 3, 4 |



Analysed by the German Democratic Republic

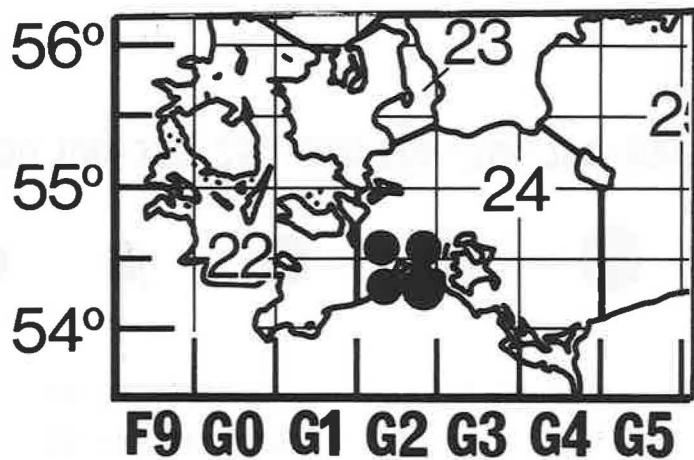


Figure 50. ΣDDT concentrations in FLOUNDER in relation to location of catch and year class.

Year classes: 4, 5, 6, 7

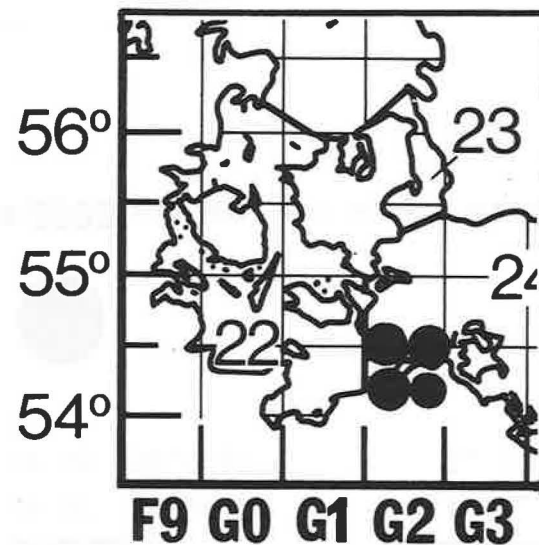
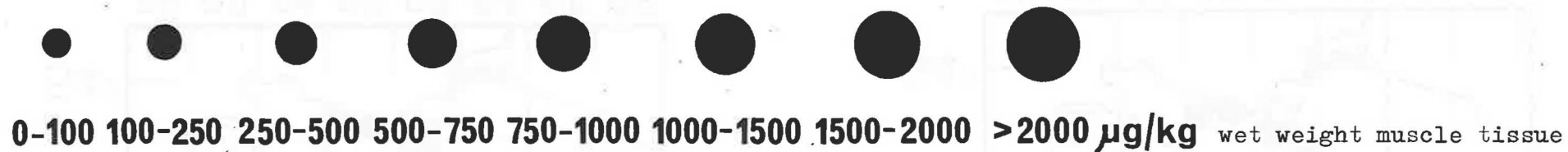


Figure 51. PCB concentrations in FLOUNDER in relation to location of catch and year class.

Year classes: 4, 5, 6, 7



Analysed by the German Democratic Republic

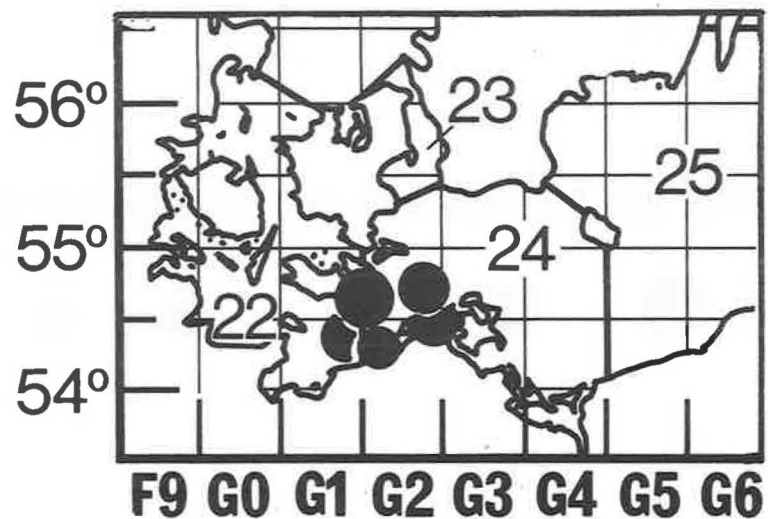


Figure 52. ΣDDT concentrations in HERRING in relation to location of catch and year class.

Year classes: 3, 4, 5, 6, 7

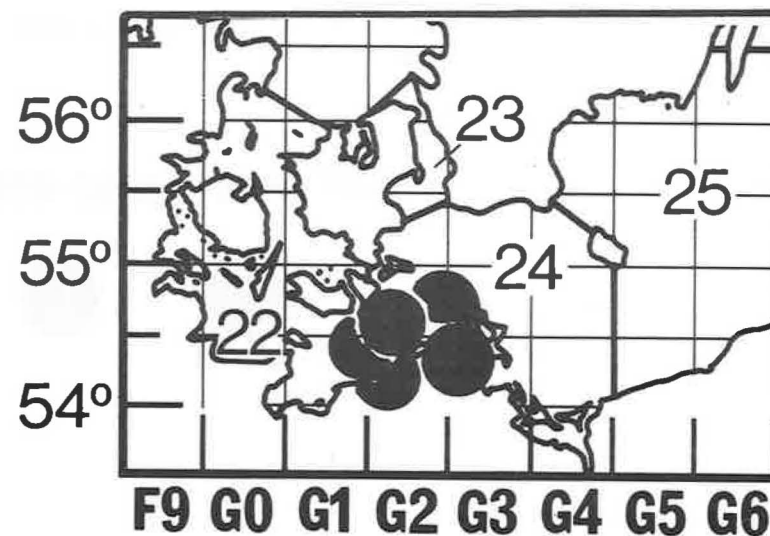
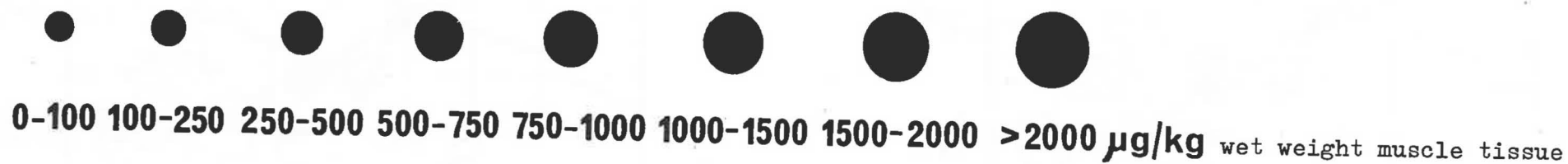


Figure 53. PCB concentrations in HERRING in relation to location of catch and year class.

Year classes: 3, 4, 5, 6, 7



Analysed by the German Democratic Republic

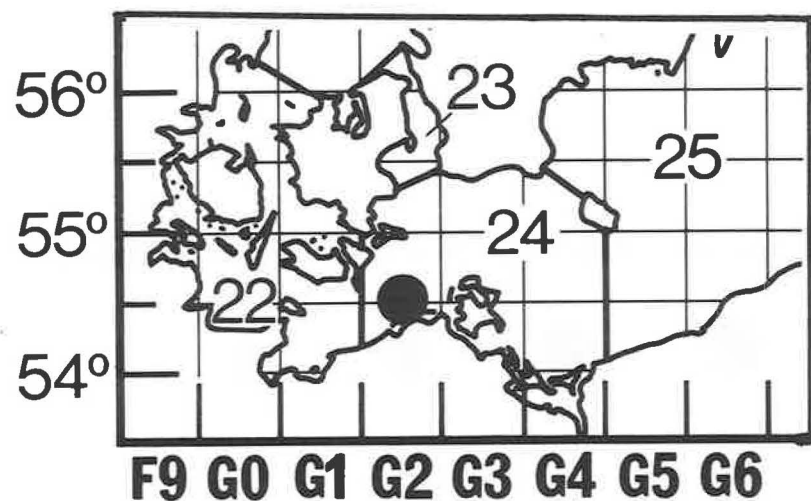


Figure 54. Σ DDT concentrations in SPRAT in relation to location of catch.
(Mean from 14 fish, no year class determined)

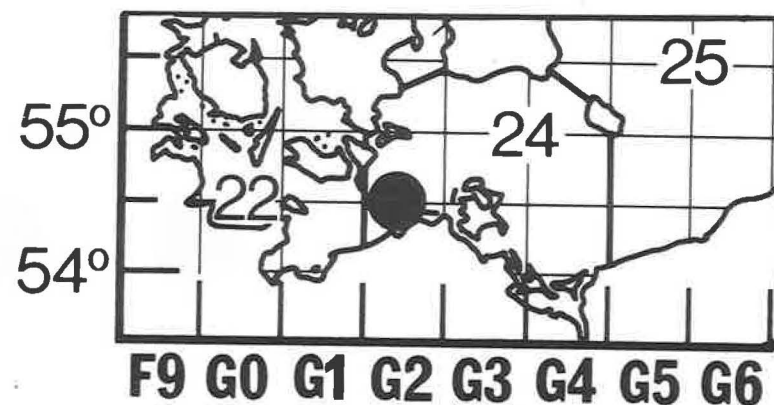
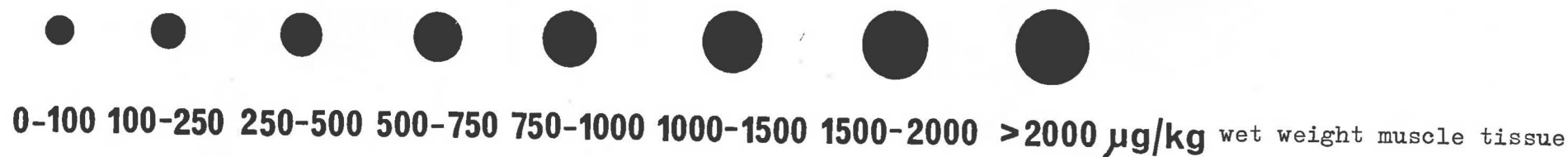


Figure 55. PCB concentrations in SPRAT in relation to location of catch.
(Mean from 14 fish, no year class determined)



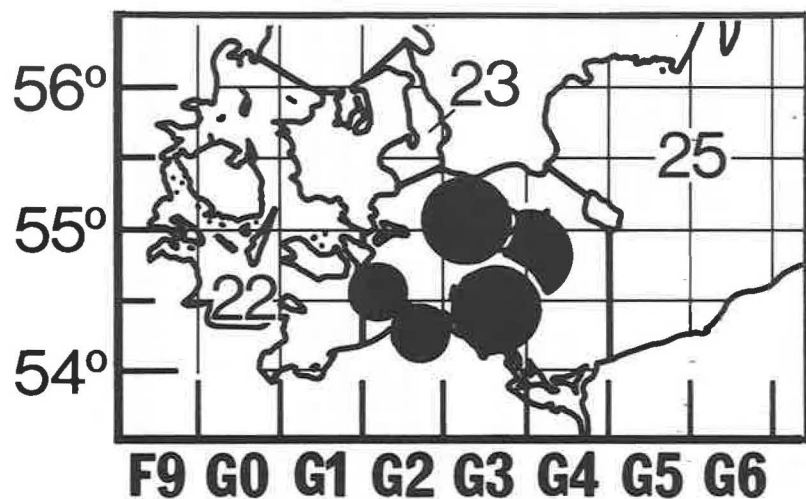


Figure 56. Σ DDT concentrations in COD LIVER in relation to location of catch and year class.

| <u>Location</u> | <u>Year classes</u> |
|-----------------|---------------------|
| 24 G2 54-54.5° | 1, 2 |
| 24 G3 54.5-55° | 2, 3, 4 |

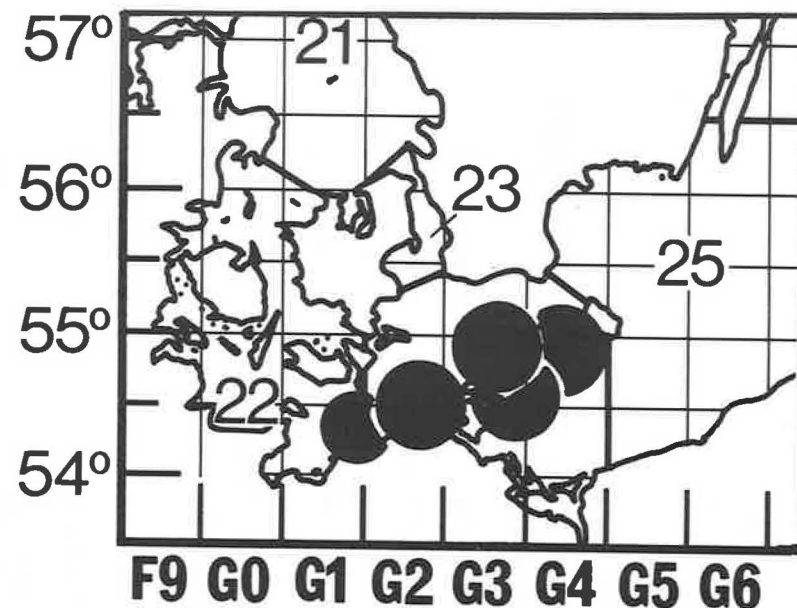


Figure 57. PCB concentrations in COD LIVER in relation to location of catch and year class.

| <u>Location</u> | <u>Year classes</u> |
|-----------------|---------------------|
| 24 G2 54-54.5° | 1, 2 |
| 24 G3 54.5-55° | 2, 3, 4 |



0-100 100-250 250-500 500-750 750-1000 1000-1500 1500-2000 >2000 $\mu\text{g/kg}$ wet weight muscle tissue

Analysed by the German Democratic Republic

APPENDIX I

Participating Institutes

Participants in the Analysts Meeting

Methods applied in the Intercalibration Exercise and in the Baseline Study

A. METALS

1. The following laboratories participated in the Intercalibration Exercise and in the analysis of the samples:

| | | |
|--------------|--|----------------------------------|
| Laboratory 1 | National Food Institute | (Denmark) |
| Laboratory 2 | Fisheries Research Institute | (Federal Republic of Germany) |
| Laboratory 3 | State Veterinary Medical Institute | (Finland) |
| Laboratory 4 | National Food Administration | (Sweden) |
| Laboratory 5 | National Environment Protection Board | (Sweden) |
| Laboratory 6 | Institute of Marine Research | (Finland) |
| Laboratory 7 | National Board of Waters | (Finland) |
| Laboratory 8 | Institute of Meteorology and Water Management, Maritime Branch | (Poland) |
| Laboratory 9 | Dept. of the Baltic Sea of the Institute of Thermophysics and Electrophysics of the Academy of Sciences of the Estonian SSR | (U.S.S.R.) |

2. The following Institutes participated in the Intercalibration Exercise only:

| | |
|--------------------|----------------------------------|
| Hygiene Institute | (German Democratic Republic) |
| Battelle Institute | (Federal Republic of Germany) |

The results from the Battelle Institute were excluded in the determination of means and standard deviation because this Institute did not take part in the Baseline Study.

3. Following a resolution of the 1975 Statutory Meeting of ICES (C.Res.1975/2:7), the analysts met in Copenhagen at the ICES Headquarters from 29 March to 2 April 1976 in order to compile the results from the Intercalibration Exercise and from the Baseline Study. This report was submitted to the ICES/SCOR Working Group on the Study of Pollution of the Baltic.

B. CHLORINATED HYDROCARBONS

Laboratories that participated in the Intercalibration and Analyses
of biological material:

| | |
|--------------|---|
| Laboratory 1 | National Board of Waters, Helsinki, Finland |
| Laboratory 2 | State Veterinary Medical Institute, Helsinki, Finland |
| Laboratory 3 | Institute of Meteorology and Water Management, Maritime Branch, Gdynia, Poland |
| Laboratory 4 | Institute of Hygiene, Rostock, German Democratic Republic |
| Laboratory 5 | Fisheries Research Institute, Hamburg, Federal Republic of Germany |
| Laboratory 6 | National Food Institute, Copenhagen, Denmark |
| Laboratory 7 | National Environment Protection Board, Special Analytical Laboratory, Stockholm, Sweden |
| | National Food Administration, Uppsala, Sweden |
| Laboratory 8 | Institute of Thermophysics and Electrophysics, Tallinn, U.S.S.R. |

C. METHODS*

Part I - METALS

Summary of the individual analytical techniques employed by laboratories participating in the first and second Baltic Intercalibration Exercises:

National Board of Waters, Finland

Mercury: Wet digestion with fuming HNO_3 and conc. H_2SO_4 in a flask connected to a reflux condensor by a capillary.

Determination by cold vapour technique (Coleman Analyzer MAS-50).

Other metals: Wet digestion (stepwise) with conc. HNO_3 and HCl .
Determination by AAS: Zn determined directly by flame method, Cu, Cd, and Pb after extraction with APDC-MIBK at pH 2.8. Background correction (H_2 -lamp).

Institute of Marine Research, Finland

Mercury: Wet digestion with conc. HNO_3 in a sealed bottle (120°C , 1.5 atm.)

Determination by cold vapour technique (Perkin Elmer Hg System 303-0830).

* Abbreviations:

AAS = Atomic Absorption Spectroscopy

GC = Gas Chromatography

GLC = Gas-Liquid Chromatography

Other metals: Autoclaved, as in the case of mercury, and repeated treatment with conc. HNO_3 .

Determination by AAS: Zn and occasionally Cu by flame-AAS, flameless technique with a heated graphite tube (Perkin Elmer HGA 72) for Cu, Pb, and Cd. Background correction.

Bundesforschungsanstalt für Fischerei, Fed. Republic of Germany

Mercury: Wet digestion with conc. HNO_3 and HClO_4 in a modified "Bethge" apparatus.

Determination according to the cold vapour atomic absorption method (Perkin Elmer 300 S). Background correction.

Other metals: Same digestion procedure as in the case of mercury.

Determination of Zn and Cu by means of flame-AAS. Flameless technique for Cd and Pb with a heated graphite tube (Perkin Elmer HGA 72). Background correction.

Hygiene Institut Rostock, German Democratic Republic

Only Cu, Zn, Pb and Cd: Wet digestion with conc. H_2SO_4 and conc. HNO_3 , followed by treatment with H_2O_2 (30%) in a Kjeldahl flask.

Determination by inverse polarography (Polarograph Type OH-102 Radelskis).

Institut f. Meereskunde, Rostock-Warnemünde, German Dem. Republic

Only Cu, Zn, Pb and Cd: Dry ashing 2 hr. at 300°C , 6 hr. at 450°C followed by wet digestion with conc. HNO_3 .

Determination by inverse voltammetry (Polarograph GWP 563).

Institute of Meteorology and Water Management, Maritime Branch, Gdynia, Poland

Mercury: Determination by cold vapour technique (Beckman AAS, mod. 1272, Mercury analyzer). Background correction.

Other metals: For zinc and copper, standard flame-AAS technique was applied with very slow aspiration of the digested sample into the flame. This was due to a high viscosity of the solution. For Cd and Pb, the flameless AAS with a graphite furnace was used. Beckman 1272 atomic absorption spectrophotometer with deuterium background correction was used for all the measurements. Samples were measured against MERCK and ICES standards.

National Food Administration, Sweden

Mercury: Sample material homogenised with NaOH (sol.). Wet digestion at room temperature with acidic KMnO_4 . Determination by means of LDC mercury monitor.

Methyl mercury: Pretreatment with HCl and extraction procedure with toluene. Determination by GLC (EC-detector). (Second intercalibration and mean values of the biological samples include activation analyses.)

Other metals: Pre-ashing according to JAOAC 52, 1035 (1969). Dry ashing in muffle oven (450°C).
Determination of Zn and Cu by flame-AAS (Varian Techtron AA-6, background correction with hydrogen lamp).
Determination of Pb and Cd by flameless AAS (Perkin Elmer mod. 305 B, HGA 72). Background correction.

National Food Institute, Denmark

Mercury: Wet digestion at 60°C (24 hours) with H_2SO_4 , HNO_3 , and $K_2S_2O_8$ in a vessel closed with a bubble stopper filled with $KMnO_4$ solution.
Determination by cold vapour AAS. Background correction.
Other metals: Wet digestion with H_2SO_4 , HNO_3 , H_2O_2 . Extraction (first at pH2 and second at pH5) with APDC and determination by flame-AAS.

Battelle Institute, Frankfurt, Federal Republic of Germany

No digestion needed; dried, ground tissue used.
X-ray fluorescence method with simultaneous registration of the elements employing a Si (Li) semiconductor spectrometer. X-ray source Cd^{109} , 6m Curie, 22.7 KeV. Direct measurement of the fish meal samples and calibration with the same sample with small, known amounts of spikes. Computerized evaluation and background correction.

Institute of Thermophysics and Electrophysics, Tallinn, U.S.S.R.

For analysis of metals the atomic absorption technique was used (Perkin Elmer model 503 atomic absorption spectrophotometer). For copper and zinc, a standard air/acetylene flame was used. Mercury analysis was conducted by the flameless cold vapour techniques. For cadmium and lead a carbon furnace was used. No background correction was used. Wet ashing with nitric acid sulphuric acid 1:1 at 70°C in a closed system for Hg; wet ashing with HNO_3 for 8 hours at 140°C for Zn, Cu, Pb and Cd. Flame-AAS (air/ C_2H_2) for Zn and Cu, flameless AAS with carbon furnace for Cd and Pb.

Part II - SUMMARY OF METHODS USED FOR ORGANOCHLORINE PESTICIDE AND PCB ANALYSES IN THE BASELINE SURVEY AND IN THE INTERCALIBRATION EXERCISE

Finland: National Board of Waters, Helsinki

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Fish tissue dried with Na_2SO_4

Soxhlet extraction with a mixture of hexane, acetone, diethyl ether and petroleum ether

Clean-up

H_2SO_4

Confirmation

KOH, $K_2Cr_2O_7$

GC

A 2 : 1 mechanical mixture of 8% QF1 and 4% SF96 respectively.

PCB

Standard - Clophen A 50

Quantification

14 peaks are obtained. The sum of 13 of these peaks are added and compared to the sum of the same 13 in the sample.

Finland:

Veterinary Medical Institute, Helsinki

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Tissue dried with Na_2SO_4

The dried powder is packed as a column and the fat and pesticides eluted with diethyl ether.

Clean-up

Acetonitrile: hexane partition

Pre-GLC separation

TCL on silica Gel G with hexane/methylene chloride elution.

Fraction I - PCB, DDE, DDT

II - others

Confirmation

KOH

GC

5% SF96

5% (SF96 - QF1, 1: 3)

PCB

Standard - Clophen A 50

Quantification

14 peaks are obtained. The sum of 13 of these peaks are added and compared to the same 13 in the sample.

Poland:

Institute of Meteorology and Water Management,
Maritime Branch, Gdynia

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Chloroform/methanol extraction

Clean-up

H_2SO_4

Confirmation

KOH

GC

1.5% OV17 + 1.95% OV210

PCB

Standard - Clophen A 50

Quantification

14 peaks are obtained. The sum of 11 of these peaks are added and compared to the same 11 in the sample.

German
Democratic
Republic:

Institute of Hygiene, Rostock

Extraction of oil samples

Oil dissolved in n-pentane

Extraction of fish samples

Digestion and mixture with perchloric acid and acetic acid.

Extraction with n-pentane.

Clean-up

H₂SO₄

Confirmation

Conversion of DDT and DDD to DDE and DDMU respectively, by application of microreactor technique with MgO as catalyser.

GC

A 2: 1 mechanical mixture of 8% QF1 and 4% SF96, respectively. 1.95% QF1 and 1.5% OV17.

PCB

Standard - Clophen A 50

Quantification

The sum of 4 peaks in the sample are compared with the sum of the same 4 peaks in the standard.

Federal
Republic of
Germany:

Fishery Research Institute, Hamburg

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Fish tissue dried with Na₂SO₄ - Soxhlet extraction with hexane.

Clean-up

Fat removal on alumina with hexane as eluate

Pre-GLC separation

Silica column with hexane/diethyl ether solution

GC

A 2: 1 mechanical mixture of 8% QF1 and 4% SF96, respectively.

PCB

Standard - Arochlor 1254

Quantification

The sum of 4 peaks in the sample are compared to the sum of the same 4 peaks in the standard.

Denmark:

The National Food Institute, Copenhagen

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Tissue dried with Na_2SO_4

Soxhlet extraction with hexane

Clean-up

DMF/hexane partition. Extract then passed through alumina with hexane.

Pre-GLC separation

Silica column with hexane elution

Fraction I - PCB, DDE

II - others

GC

5% DC200 + 5% QF1 1:4

Above mixture + 1% OV225 1:1

0.5% OV17

PCB

Standard - Arochlor 1260

Quantification

14 peaks are obtained. For 13 peaks the products of the retention time and peak heights are taken. The products are added, and the sample is compared.

Sweden:

Special Analytical Laboratory, National Environment Protection Board, Stockholm

National Food Administration, Uppsala

Extraction of oil samples

Oil dissolved in hexane

Extraction of fish samples

Acetone, hexane, diethyl ether extraction

Clean-up

H_2SO_4 or KOH

Confirmation

KOH, $\text{Na}_2\text{Cr}_2\text{O}_7$

GC

A 2:1 mechanical mixture of 8% QF1 and 4% SF96, respectively.

PCB

Standard - Clophen A 50

Quantification

14 peaks are obtained. The concentration under each standard peak is known. Each peak concentration in the sample is then calculated. The 14 concentrations are added to give Σ PCB.

U.S.S.R.:

Department of the Baltic Sea of the Institute of Thermophysics and Electrophysics of the Academy of Sciences of Estonian SSR.

Extraction

Homogenization of frozen fish in mortar with Na_2SO_4 .
Extraction with 200 ml n-hexane.

Clean-up

Concentrated H_2SO_4 , 10% KOH in methanol, oxidation with CrO_3 -acetic acid

Gas chromatography

Gas- N_2 ; packing - 5% DC200 on Gas Chrom Q, 80-100 mesh; length and ID-4.0m, 2.0mm; temperature - 210° ; detector - Ni^{63} .

Quantification

For the analysis of organochlorine pesticides and PCB, gas-liquid chromatography with electron capture detector was used (Perkin Elmer model 910 gas chromatograph with Ni^{63} source).

Among organochlorine pesticides, DDT and its two main metabolites, DDE and DDD, were estimated. These compounds were estimated separately, but in the result values of total DDT are also given. As for PCB, they were estimated as the total value of all isomers. The quantities of DDE were estimated before KOH treatment, while DDT and DDD amounts were calculated from the peak height differences before and after KOH treatment. The quantity of PCB was estimated on the basis of the sum of the heights of peaks no.2, 3, 7, 8, and 10 of standard (Clophen A 50) after oxidation of DDE with chromic acid.

D. THE ANALYSTS' MEETING

The following scientists participated in the Analysts' Meeting in Charlottenlund:

| | |
|----------------------------------|---|
| Prof. Dr. K Grasshoff (Convenor) | (Inst.Mar.Res.Kiel, F.R.G.) |
| Dr. S Jensen | (National Env. Protect.Bd., Sweden) |
| Dr. W Slaczka | (Inst.Meteorol. and Water Management, Poland) |
| Dr. R Vaz | (Nat.Food Administr., Sweden) |
| Mr B Larsson | (" " " ") |
| Mrs B Ohlin | (" " " ") |
| Dr. A Engberg | (Nat.Food Inst., Denmark) |
| Dr. U Harms | (Fish.Res.Inst., F.R.G.) |
| Dr. E Huschenbeth | (" " " ") |
| Mr Vagn Olsen | (Fish.Inst., Denmark) |

Dr. F Koroleff

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Mrs I Mäkinen

(Nat.Bd. of Waters, Finland)

Mrs K Erkomaa

(" " " " ")

The Analysts' Meeting split into two sub-groups, one dealing with the chlorinated hydrocarbons (Chairman: Dr Jensen) and one for the heavy metals (Chairman: Dr U Harms). The main task of the group was to compile and analyse the data from the intercalibration experiments and to harmonise the data from the Baseline Study.

The ICES reporting format with the sub-division of the Baltic Sea area into squares was used for the data presentation and localisation of the sampling.

APPENDIX II

RECOMMENDED METHODS FOR THE SAMPLING AND PRE-TREATMENT OF BIOLOGICAL MATERIAL IN THE BALTIC BASELINE STUDY

The following recommendations have been worked out at the Swedish Water and Air Pollution Research Laboratory with the intention that they might help others to eliminate contamination, as much as is possible when handling biological samples.

These recommendations are applicable to two kinds of samples to be used for analyses of heavy metals and chlorinated hydrocarbons. The methods described have been in use at the Swedish Water and Air Pollution Research Laboratory since July 1973. At present, the working time on sample preparations has increased by about 20% according to the far greater precision demanded from the biologists. With a large series of samples, the working time can be shortened considerably after becoming accustomed to the routine of the various procedures.

Methodology

Immediately after landing, the fish should be deep-frozen in a plastic bag at maximum -18°C . Extreme care should be taken when handling the fish in order to keep the skin intact.

Other materials, such as algae, bottom fauna and sediment should be deep-frozen in acid-washed (nitric acid, HNO_3 , p.a. (1+6) and rinsed with double distilled H_2O) polyethylene tubes or capsules. The material should be kept in insulated boxes with dry ice during transportation.

If the material is brought from an area with a known or suspected high concentration of ions in the water, non-fish samples should be rinsed with distilled water before deep-freezing. However, fish should not be treated in this manner.

Careful marking of the samples is necessary for future identification. The marking must include date of sampling, station identification, and, if possible, identification of species.

The material should be kept deep-frozen until sub-sampling and dissection.

An alternative way of preservation of materials other than fish for metal analysis is carried out with a 4% formaldehyde solution, buffered with 10% hexamethylenetetramine (1,6 diaminohexane). When using this procedure, the contaminated formaldehyde as well as the fresh formaldehyde must be analysed in order to determine the extent of extraction of the metals. However, the formaldehyde preservation method is compatible with freeze-drying when both sample and formaldehyde are freeze-dried.

The "freezing out" effects should be taken into consideration when freezing the fresh samples. At the freezing point, the metal ions pass through the medium and are adsorbed on the glass.

In a few samples which were frozen, we have found a considerable loss of metals in the material compared with the materials preserved with formaldehyde. This, of course, also concerned the freeze-drying technique, where the loss of metals could be avoided by using polyethylene plates or slides under the samples. These slides are piled in dessicators, which are directly connected to the freeze-dryer.

The choice of tools is an important and often-discussed item when sub-sampling or dissection of biological materials is necessary.

The methods for sub-sampling differ when analysing the metals and the hydrocarbons.

Weighing and measuring the fish, as well as sampling for age determination, is best carried out in a room which in some way is separated from the actual dissection laboratories. The bench should be covered with laboratory paper. Tools which are used for this purpose are to be washed in laboratory detergent, followed by rinsing with nitric acid HNO_3 (p.a. 1+1) and double distilled water. This is not applicable to equipment that is likely to corrode, such as weight scales, etc., which should, as well as the hands of the personnel, be rinsed with 96% ethanol without any additives.

During sub-sampling of other materials, such as algae, etc., the risk of bacterial contamination is far less, and the work can be carried out in the dissection room.

The dissection of fish is easiest when the material is half frozen, at least concerning the surface layers of muscle tissue. For dissection of other organs, the thawing must proceed further, but it is an advantage if, for example, the liver is still frozen, as the loss of liquid makes the determination of dry weight less accurate.

The fish should be thawed in a separate room. When the fish is ready for dissection, it is taken to the dissection room and worked on immediately. The dissection room should not be used for thawing the material.

The dissection room should be kept clean and the air should be freed from particles as much as possible. It is an advantage if the work can be carried out in a hood or under some shelter in order to prevent a direct fall-out of particles onto the sample.

The worker should be dressed in a clean white coat, which should be changed every day. The floor of the working area should be covered with laboratory paper.

The dissection is made on a clean glass plate, which is prevented from slipping by covering the bench underneath with laboratory paper.

People working with these materials should not use plastic gloves and should not touch the fish without a laboratory paper between the hands and the fish.

The dissection is carried out with a sharp piece of glass and with uncoloured polyethylene tweezers and haemostats. A manual for dissecting fish is published by the Swedish Museum of Natural History in Stockholm.

At the same time that samples are prepared for various chemical analyses, samples should be taken separately for dry weight determination.

Metal Analysis

If the material is to be freeze-dried, the weighed material is placed on polyethylene plates or in other kinds of open polyethylene receptacles which can be placed directly in the freeze-drying unit. The material must be quick-frozen first, and then placed in a freezer where the samples are frozen on to the surface. The samples should be covered to prevent dust contamination. For freeze-drying of fish, the time required is between 1.5 - 4 days, depending on the fat content and the size of the samples.

Samples which are treated fresh are weighed and put into clean polyethylene capsules.

Chlorinated Hydrocarbon Analysis

The procedure is the same as above, except that no polyethylene or plastic materials are used. Use glassware instead.

Tool Handling during Dissection and Sub-Sampling

1) Sub-sampling for metal analysis

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|---------------------|---|
| Cutting tools: | cut or crushed pieces of glass. |
| Tools for grinding: | porcelain mortar with acid-resistant glaze or glass mortar with glass pestle. |
| Tools for holding: | uncoloured polyethylene tweezers or haemostats. Laboratory paper. |

After each sample has been prepared, including the preparation of samples of different organs from the same individual, the tools should be changed and washed.

- I. Washing in laboratory detergent and distilled water.
- II. Acid washing in HNO_3 (p.a. 1+1) diluted with double distilled water. Tweezers and haemostats in (1+6) acid.
- III. Rinsing with double distilled water.

The underlayer is cleaned in the same manner. The tools must be kept dustfree between working hours, preferably in a dessicator. Plastic tweezers and haemostats are disposable tools and should be replaced after one or two days of work.

2) Sub-sampling for analysis of chlorinated hydrocarbons

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|---------------------|--|
| Cutting tools: | cut or crushed pieces of glass or, alternatively, acid-resistant steel scalpels. |
| Tools for grinding: | same as above. |
| Tools for holding: | acid-resistant steel tweezers. |

- I. Washing in laboratory detergent and distilled water.
- II. Acid washing in HNO_3 (p.a. 1+1) diluted with double distilled water.
- III. Rinsing with dichloromethane.
- IV. Rinsing in double distilled water.

Be observant when cleaning the tweezers because the notches on them are difficult to clean. The glass plate used during dissection is cleaned in the same way. The tools should be kept dustfree.

Indication of spine colours

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| Liaison Committee Reports | Red |
| Reports of Advisory Committee on Marine Pollution | Yellow |
| Fish Assessment Reports | Grey |
| Pollution Studies | Green |
| Others | Black |

