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NUMBER 2

METALS ORGANOCHLORINE PESTICIDES AND PCB RESIDUE LEVELS IN FISH AND SHELLFISH LANDED IN ENGLAND AND WALES DURING 1974

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Metals, organochlorine pesticides and PCB residue levels in fish and shellfish landed in England and Wales during 1974

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by

A J Murray

1. Introduction

1.1 Background

The Aquatic Environment Protection Division of the Directorate of Fisheries Research is responsible for providing scientific and technical advice to the Ministry of Agriculture, Fisheries and Food (MAFF) in support of its responsibilities related to marine pollution. A section of the Division at the Fisheries Laboratory at Burnham-on-Crouch is concerned with the non-radioactive aspects of marine pollution, and its work includes regular monitoring activities to establish the quality of fish and shellfish for human consumption.

This is the second report in a series recording the results of the MAFF monitoring programmes; the first dealt with monitoring carried out in 1970-73 (Portmann, 1979). This report describes the results of investigations made during 1974 and draws attention to changes and trends which have occurred since the earlier years.

1.2 Description of Routine Programme

The monitoring programme started in 1968 but it was not until 1970 that it was formalised into a routine commitment including metals and chlorinated hydrocarbons, such as PCB's and the chlorinated pesticides. Since 1970 samples of fish have been collected twice yearly (between January and March and July and September) from most of the important fishing grounds around England and Wales. Samples of cod, whiting, plaice, herring and mackerel were collected whenever possible. Almost all samples were collected by fishing boats working within about 25 miles (40 km) of the coast (Figure 1) and were representative of the landings of inshore vessels. The fish were analysed in the laboratory.

1.3 Description of expanded Monitoring Programme (Other Fish Species and Other Areas)

In addition to the routine monitoring programme, an expanded monitoring programme has been developed to meet wider needs than that covered by the routine programme. In 1974 a large proportion of the fish consumed in the UK came from deeper water fisheries. These fish were sampled to provide a baseline level against which concentrations found in coastal waters could be assessed and also to establish the normal dietary intake of contaminants associated with them.

Although the routine programme provided samples from all the coastal regions it did not always specifically include fish from the most heavily contaminated areas, ie in or near industrialised areas. This information is particularly important as an index of the level of pollution of industrial estuaries. Therefore the expanded monitoring programme included samples of fish collected not only from most areas fished commercially by vessels operating from ports in England and Wales, but also from estuaries and near-water grounds; since some species are likely to accumulate specific pollutants more than other species, eg tuna and flounders in relation to mercury (Miller *et al*, 1972; Somer, 1972), a wider range of species was included in this programme than in the routine sampling programme.

1.4 Shellfish Samples

During 1974 most of the commercial shellfisheries around England and Wales were sampled. In addition, some non-commercial species were collected from areas known or suspected to be polluted. They were used in the absence of commercial species or because a species was known to selectively accumulate a pollutant, eg dog whelks (*Nucella lapillus*) and cadmium.

1.5 Monitoring of dumping areas

A statutory function of MAFF, as part of its role in the control of marine pollution, is related to the Dumping at Sea Act, 1974 (Great Britain – Parliament, 1974); this requires the regular monitoring of sites used for the dumping of wastes at sea. Prior to the Act a voluntary system was in operation, MAFF advising on the suitability of wastes and of sites for disposal. Surveys of the various dumping sites were undertaken during 1970-73, and the data related to the fish monitoring surveys conducted in these areas were included in the 1970-73 report. Monitoring surveys continued in 1974 and most of the fish-related data are included in this report. The results of analyses of a variety of benthic (bottom-living) organisms and sediments, and of a few non-commercial fish species collected on and around dumping sites, will be the subject of separate reports.

1.6 Analytical notes

1.6.1 *Pesticide and PCB examination*

The samples were analysed for the organochlorine pesticides α HCH, γ HCH (lindane), dieldrin, DDT (including its metabolites DDD and DDE) and PCB's

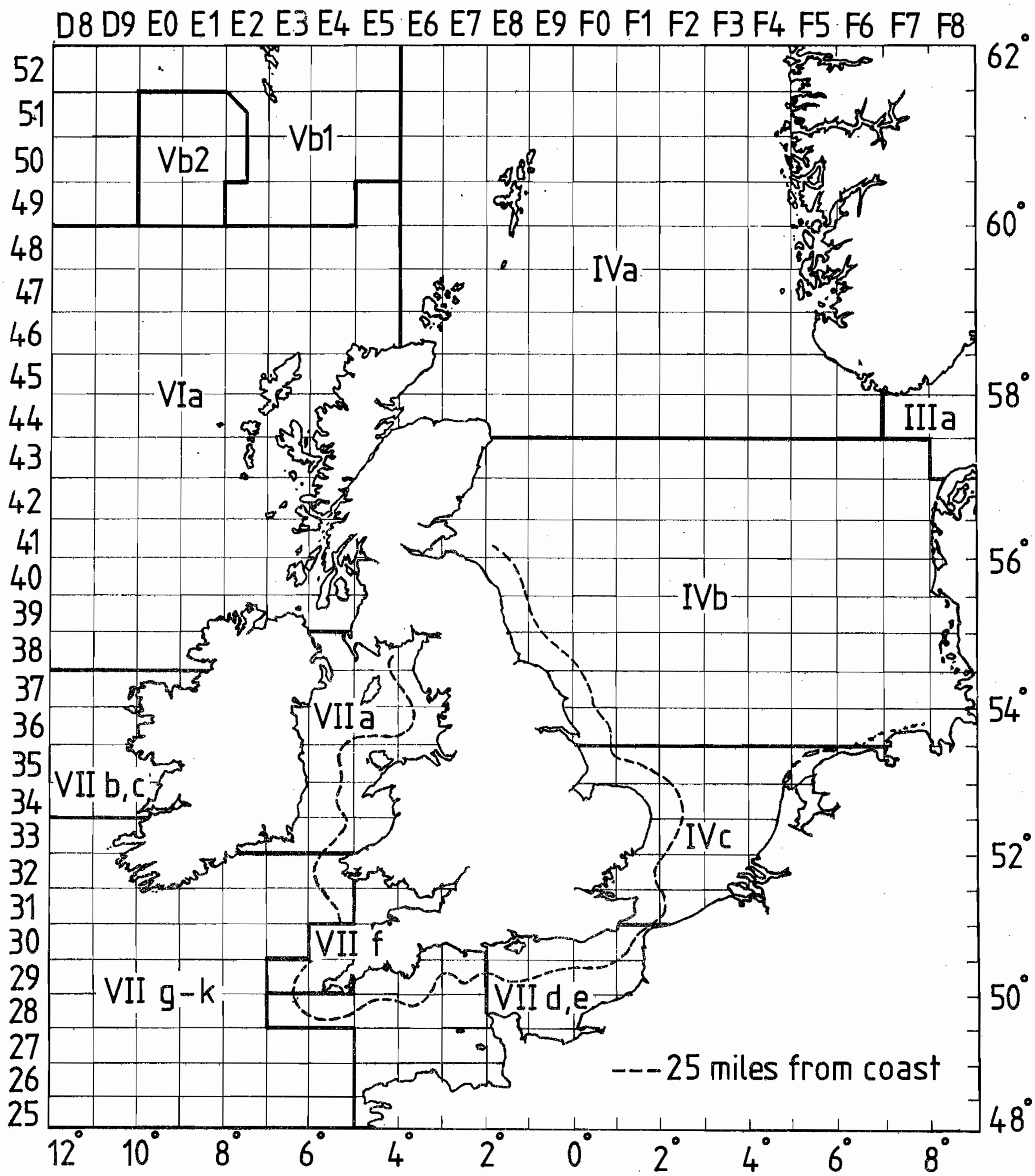

Figure 1 Areas from which most of the fish and shellfish samples were collected, showing ICES sub-areas and statistical rectangle codes.

(polychlorinated biphenyls). There were two reasons for the inclusion of PCB's in the monitoring programmes. Firstly, they have a biological significance, eg they have been implicated in the decline of a number of sea birds and were a possible factor in the major Irish Sea bird kill in 1969 (Holdgate, 1971). Secondly, the extraction procedure used as a precursor to analysis of the organochlorine pesticides also extracts PCB's, and separation is necessary to avoid interference with the determination of the organochlorine pesticide residues. Once separated, identification is relatively easy although quantification is more difficult since each commercial product is a mixture of compounds. Comparison with several of the major gas liquid chromatography peaks in a commercial formulation eg Aroclor 1254 (a formulation most closely matching most of the residue traces) has proved to be the most satisfactory method of quantification. Analysis was carried out by gas liquid chromatography using electron capture detection, and verification was on the basis of comparability of results obtained using two different chromatographic columns.

1.6.2 *Metal examination*

Samples were also analysed for six metals: mercury, lead, cadmium, copper, zinc and chromium. Of these only mercury, lead and cadmium are thought capable of posing any potential risk to man as a consumer. On the other hand, copper, zinc and chromium are all potentially damaging to marine life, and it is therefore important to establish whether levels are rising and which areas are subject to high inputs. Each fish was analysed separately and the determination was carried out using atomic absorption spectrophotometry. A conventional air-acetylene flame was used for all metals except mercury which was measured by a cold vapour method. Concentration and/or background correction was employed routinely in the determination of lead and cadmium, but only when necessary to eliminate interference in the determination of other metals.

1.7 Notes on the presentation of data

Whenever a sample was collected, either for the routine or expanded programme, care was taken to ensure that the date and the source were recorded. The source of the fish samples is usually expressed in relation to the system of statistical rectangles used by the International Council for the Exploration of the Sea (ICES). The positions of the rectangles are shown in Figure 1, and additional information is given with the actual results, which are presented in tabular form. Table 1 presents the results for the routine monitoring programmes and includes both the metal and organochlorine data. Tables 2 and 3 present the results of the expanded fish programme and Tables 4 and 5 the results of the expanded shellfish programme. Tables 6, 7, 8 and 9 summarise the mean concentrations of metals and organochlorine compounds found in all species of fish and shellfish.

The results from the routine samples are tabulated geographically, starting with the samples collected from the fisheries off the north-east coast of England and progressing clockwise around the coast of England and Wales, concluding with the samples from the north-west of England fishing grounds. With the exception of the near water grounds (North Sea, English Channel, Irish Sea, etc) the results for the non-routine fish and shellfish samples from the expanded programme are presented in a similar manner to those for the routine programme.

2. **Results of the routine programme**

The results of analyses for a range of trace metal and organochlorine compound concentrations in up to five species collected from seven ports during the summer and winter sampling period of 1974 are shown in Table 1. Where possible each sample contained a minimum of ten individuals. Bulked muscle and liver samples were analysed for organochlorine pesticide and PCB residues, while individual muscle tissue samples were analysed for metals. Thus minimum, maximum and mean values are given for the metals, whereas single values, each representing a mean concentration, are given for the pesticide and PCB residues.

2.1 Metals

The highest concentration of mercury in an individual fish, 0.44 mg/kg, was found in the summer whiting sample landed at Plymouth; the mean level of which was 0.25 mg/kg. All other mean concentrations were below 0.2 mg/kg, with the exception of two individual fish landed in the winter (a mackerel landed at Plymouth and a cod from Milford Haven, both of which contained 0.3 mg/kg) all the cadmium analysis results indicate concentrations at or below the detection limit of 0.2 mg/kg; these values are consistent with the concentrations measured in previous years. It is suspected from results reported by other laboratories that the true value may well be an order of magnitude less than the detection limit.

The majority of the lead results were at or below the detection limit of 0.2 mg/kg, with the highest concentration of 1.0 mg/kg being found in plaice collected from Newlyn in the summer. No samples were available from Hastings in 1974, so it was not possible to determine if the drop in levels recorded from 1972-73 was maintained (Portmann, 1979). However, the figures do not reveal any change in lead levels and, as for cadmium, the actual levels may be well below the detection limit.

The chromium content of fish was usually less than 0.2 mg/kg, with only four samples containing more than 1.0 mg/kg. This confirms that the consistent error reported in the 1973 survey biased the results and elevated the levels for that year.

Only three individual fish contained more than 10 mg/kg zinc; these were in the summer and winter samples of mackerel from Plymouth and a single herring from Grimsby.

The zinc values are very similar to those found in the previous four years. The range of concentrations of zinc, as in previous years, was small (1.8-13 mg/kg).

All of the concentrations of copper found were low; only one of the means slightly exceeded 2 mg/kg.

2.2 Pesticides and PCB residues

Pesticides being fat soluble tend to accumulate in organs and tissues with a high lipid content. Homogenate samples of both muscle and liver tissue were taken for pesticide analysis. The accumulation of pesticides in the high lipid liver tissue was readily apparent, concentrations often being one or two orders of magnitude higher than in muscle. With the exception of a number of concentrations of PCB and one probably anomalous concentration of DDT, all in liver, all the samples were in the μg/kg range, and many were below the detection limit (1 μg/kg). (1 μg/kg = 0.001 mg/kg).

Low concentrations of hexachlorocyclohexane (HCH) were recorded in 1973, and similar values were obtained in 1974. The concentrations in muscle tissue were in most cases below the detection limit of 0.001 mg/kg and none exceeded 0.01 mg/kg. Concentrations in liver were usually about an order of magnitude higher, with the highest concentration (0.052 mg/kg) occurring in the summer sample of whiting from Grimsby; with the exception of that one sample, concentrations in the liver tissues were 0.04 mg/kg or less and the decline in concentrations recorded in 1973 appears to have been maintained. The gadoid (cod and whiting) samples contained the largest amount of both isomers of HCH. It is also interesting to note that in most instances the more persistent α isomer was apparently present in higher concentrations than its more extensively produced and used γ counterpart.

The highest recorded concentration of dieldrin was 0.21 mg/kg in the liver tissue of the Grimsby winter sample of cod. Concentrations in muscle tissues were mainly in the 2-3 μg/kg range, with samples of herring and mackerel providing the only two values above 0.01 mg/kg. As in 1973, no pattern emerged between summer and winter samples; there was a tendency for high dieldrin and DDT concentrations to be associated, as in previous years. Compared with the 1973 results the mean levels were about the same, except that a few more of the concentrations were above the detection limit. At the upper end of the range the concentrations of dieldrin in liver samples seemed to be somewhat lower, the highest mean value in 1973 being 0.47 mg/kg compared with 0.21 mg/kg in 1974.

The highest recorded concentration of DDT was 1.8 mg/kg in liver tissue of the winter sample of cod from Milford Haven. In the 1971-73 programmes the total DDT concentrations (DDT plus its metabolites) in the liver were highest in the summer samples, but this was not so in 1974. The fish sampled at Grimsby showed the opposite trend, while the highest values found in samples from the other ports were equally divided between the two seasons. In samples taken in previous years the proportion of DDT to its two metabolites did not appear constant and no one residue was generally predominant. However, the 1974 results differed in that the concentration of DDT was greater than that of DDE, which in turn was greater than that of DDD. This trend appeared to apply to both winter and summer samples and to muscle and liver tissue. It should be noted however that the ratio of DDT to DDD content was usually less than 5 : 1. As in the past, the concentrations of total DDT found in the muscle tissues of cod, plaice and whiting were low, often less than the detectable concentration (0.002 mg/kg). Although the concentration of DDT and metabolites found in the muscle of herring and mackerel was generally higher than that in cod, plaice or whiting muscle, the highest concentration, found in herring from Grimsby and Plymouth, was still only 0.10 mg/kg.

Generally, the highest concentrations of PCB's were found in those fish livers which had high concentrations of DDT and metabolites; the largest residues of PCB usually occurred in fish having a generally increased organochlorine burden. The highest concentrations (18 and 7.6 mg/kg) occurred in livers of whiting landed at Plymouth, but even these were somewhat lower than the highest values found in 1971 and 1972; this drop possibly represents a continuation of the trend suggested from the 1973 survey and indicates that the levels of PCB's in fish from coastal waters have been steadily falling. In most samples of fish the PCB content exceeded the sum of the concentrations of the six other pesticides evaluated, often by a factor of five.

3. Results of the expanded monitoring programme

The results of analyses in the expanded programme are presented in Tables 2, 3, 4 and 5 and summarised in Tables 6, 7, 8 and 9. Both fish and shellfish were analysed for metals and organochlorine compounds but, in fish, whereas both the liver and muscle were analysed for organochlorine compounds, only the muscle tissue was analysed for metals.

The larger species of shellfish, eg crab and lobster, were analysed individually for metals; the claws and bodies of crabs and the tails of lobsters were analysed separately. The smaller species were bulked and homogenised for analysis. Analyses for organochlorine pesticides and PCB residues of all species of shellfish were done on homogenates of the tissues or whole samples, each of which usually consisted of several individuals.

3.1 Metals in Fish (Table 2)

3.1.1 *Mercury*

It is not possible in many cases to compare samples collected in the expanded programme from one year to the next, as many factors including size, age, sex, area of capture, time of year etc. can lead to variations in levels of accumulated metals. However, the figures for 1974 provide a good indication of the typical levels present in fish populations. With the exception of a few isolated results normally associated with long-lived species or with fish taken from industrial estuaries, very few mean concentrations above 0.5 mg/kg occurred.

Three species of fish sampled from both inshore and the near-water areas were cod, plaice and dogfish. The previous report noted that species caught in these two zones generally contained decreased concentrations away from the coast. Samples from distant-water grounds were not available for the 1974 survey, but for these three species, samples taken from the inshore areas contained higher levels of contaminants than those taken from the offshore areas. Cod showed the least variation with a mean flesh content of 0.12 mg/kg mercury in inshore fish and of 0.09 mg/kg in near-water fish. Plaice and dogfish both showed an increase in mercury content in fish caught in coastal water as opposed to fish taken further offshore by a factor of 2-3, eg 0.22 and 0.07 mg/kg for plaice, and 0.56 and 0.26 mg/kg for dogfish. This is in agreement with previous results and, unless contaminant levels are such as to cause concern from a public health standpoint, supports the view that the prime commitment for monitoring, once benchmark levels have been adequately established, should be in coastal areas, including those near to industrial estuaries, ie the main purpose should be to follow trends in the areas of major input and thereby establish the effects of control measures.

The previous report (Portmann 1979) noted that relatively elevated mercury concentrations occurred in the muscle tissue of flounders and dabs but not of plaice. Flounders are most abundant in shallow waters and are usually caught in coastal and estuarine areas, and therefore exposed to higher mercury levels than offshore species, and consequently their tissues contain higher than average levels. A sample of dabs collected from Morecambe Bay had a mean mercury content of 0.34 mg/kg, with one individual containing a maximum of 0.44 mg/kg. Although this is above the average concentration of mercury in all inshore fish, ie 0.21 mg/kg (MAFF 1971; 1973), it is a small elevation, when the relatively large local mercury input (since reduced) is considered.

As previously found, the mercury concentrations in plaice were somewhat lower than average, probably reflecting the habitat/diet of this species; the older larger-sized fish live primarily offshore.

Two samples of herring were analysed, one from the Thames Estuary and the other from the north-east coast of England near the Scottish border. The mercury content of the two samples differed markedly, the Thames Estuary sample containing a mean level of 0.35 mg/kg and that from the north-east 0.09 mg/kg; in all probability these values reflected the amount of environmental mercury at the two sites.

The highest individual concentration of mercury (2.4 mg/kg) was found in a bass caught near Plymouth. This same species was found to have the highest levels during the 1970-73 survey. It seems that bass, possibly because of its slow growth rate and the relative age of the individuals sampled, accumulates significantly larger quantities of mercury than some other species of fish. Another species of fish with a relatively high mean concentration of mercury is dogfish; during 1974 three separate samples caught in the Morecambe Bay area contained individuals with maximum concentrations in excess of 1 mg/kg. The predatory and benthic feeding of dogfish may account for these elevated levels.

3.1.2 *Cadmium and Lead*

As found in 1973 and in the 1974 routine monitoring programme, the concentrations of cadmium and lead were consistently below the detection level of the analytical method used. Results from other laboratories (ICES, 1977c) indicate the true levels of these elements in fish to be around 0.05 mg/kg or less for lead and 0.005 mg/kg or less for cadmium. The need to reduce detection limits of these metals in current monitoring programmes depends on the use to which the results are to be put. For the monitoring of environmental trends and to measure the effectiveness of effluent controls it is necessary to have accurate measurements of these metals. For consumer protection and to safeguard commercial species of fish the main objective is to provide an early warning system. This and previous surveys show that the contribution of these metals to the human diet via fish is low and that, providing levels remain below the existing detection limit of 0.2 mg/kg, the protection of both the consumer and fish stocks can be assumed. Thus, whilst it is technically feasible for the detection limits used in this work to be lowered, a change in technique is not justified in view of the excessive demands which would be placed on analytical time.

3.1.3 *Chromium*

The chromium content of fish was usually near or less than the detection limit of 0.2 mg/kg, the maximum value found being 1.9 mg/kg in a sample of dragonet analysed whole.

3.1.4 *Zinc*

As in the routine monitoring programme, the range of zinc concentrations found, especially within species, was relatively small, usually only varying by a factor of two. With the exception of two species, dogfish and dragonet, the zinc concentrations were mainly in the range of 3-5 mg/kg, with little or no evidence of differences between inshore and near-water samples. The mean concentrations in dragonet ranged from 8-12 mg/kg, the probable explanation for these elevated levels being that these small fish were analysed whole rather than only on the basis of their muscle tissue. Concentrations of zinc in dogfish appeared to be at two levels, one at approximately 3 mg/kg, the other at a mean of 10-11 mg/kg. Observation of the latter was in fish taken from the same area (Morecambe Bay) at the same time; subsequent samples from there have shown concentrations of about 3 mg/kg and there is no ready explanation of the earlier results. Samples of herring with a maximum of 7.1 mg/kg, sprat with 15 mg/kg and blue whiting with a maximum of 8.5 mg/kg were the only other species to fall outside the 3-5 mg/kg range. It was noted in 1970-73 that herring and sprat had a somewhat elevated zinc burden. The blue whiting is a species only recently sampled and further work will be necessary before findings for it can be confirmed.

3.1.5 *Copper*

Like zinc, the uptake of copper by fish is probably capable of being regulated, so the concentration in fish muscle at least is likely to be constant for each species irrespective of the degree of exposure (Pentreath, 1973; 1976). As with zinc, the range found in 1974 was very often less than a factor of two within any one sample, there being little difference between inshore and near-water levels; the common range of copper in fish muscle was between 0.4 and 0.9 mg/kg. The copper content of herring, scad, mackerel and dragonet at 1.0-1.2 mg/kg was higher than that of other species. For dragonet this may be due to the fact that whole fish were analysed. The association of zinc compounds with lipid-containing tissues is a possible cause of elevated concentration in certain species. Whether a comparable association is the cause of the higher copper concentrations in mackerel and scad is not clear since species such as dogfish have a higher lipid content and yet contain relatively low copper concentrations. For the mackerel and horse mackerel the reason for the elevation of copper concentrations may possibly be dietary, as the adults feed mainly on pelagic crustaceans and fish such as herring, pilchard and sprat, which were found in 1970-73 to have an enhanced copper content.

3.2 Organochlorine pesticides and PCB residues in fish (Table 3)

In previous years only about 12% of the samples analysed for metals were analysed for pesticides. Although this provided valuable information, efforts were made in 1974 to analyse all samples for pesticides as well as metals. The success of this effort can be gauged from the results, for of the 390 fish analysed for metals, 380 were analysed for pesticides. As previously, muscle tissue from several individual fish in each sample was bulked and homogenised and a sub-sample of this analysed. In most cases the livers were also bulked, homogenised and analysed, thus yielding values for the pesticide and PCB contents of the liver and muscle of each sample of fish.

3.2.1 *HCH*

Over 90% of the results of the analysis of both α and γ HCH in muscle were at or below the detection limit of 0.001 mg/kg. The highest recorded concentrations of these compounds (0.009 mg/kg) occurred in sprat from the southern North Sea, an area known to be more contaminated than most other areas around the UK (ICES, 1974; 1977 a, b and c). This observation agrees well with the results from the routine programme, where the highest HCH residues in muscle were found in mackerel and herring (both 0.009 mg/kg). Concentrations in the liver were usually greater, often by an order of magnitude, but exceptions frequently occurred, eg in plaice, mackerel and scad muscle and liver values were often similar. The gadoids, cod and whiting, were noticeable in having the largest differences between muscle and liver, and ratio being at least 70:1 for α HCH in a sample of cod from the middle of the North Sea. However, although the two tissues differed significantly in their pesticide content, the concentrations of the two isomers in them were similar; this contrasts with the results from the routine programme where the isomer values were quite different.

3.2.2 *Dieldrin*

The samples collected in 1974 indicated a drop in the levels of this pesticide since 1970-73. The mean concentration of dieldrin in fish liver in 1974 was close to 0.1 mg/kg compared with 0.2 mg/kg previously. During 1974 only about 50% of the samples of fish muscle exceeded the 0.01 mg/kg level, all of which were taken from the coastal and estuarine regions. The highest concentration of dieldrin found in muscle tissue (0.02 mg/kg) occurred in an inshore sample of sprat. Liver concentrations were often at least an order of magnitude higher, the highest recorded mean concentration (0.26 mg/kg) being found in cod from the North Sea. This compares with 0.42 mg/kg in a 1970-73 sample of whiting. These results suggest that reduction in the use of dieldrin is beginning to be reflected in biological samples.

3.2.3 *DDT, DDE and DDD*

None of the concentrations of DDT or its metabolites in muscle exceeded 0.07 mg/kg, in contrast with a comparable value of 0.1 mg/kg found in previous samples. A large number of the results were at or below the detection limit (0.001 mg/kg). The higher values occurred in samples of fish with the highest muscle lipid content, eg herring and mackerel, whereas most of the lower values occurred in the gadoid species cod and whiting; 11 out of the 15 cod samples had values of 0.001 mg/kg or less and the highest was 0.005 mg/kg. However, the residue burdens of the gadoid liver tissue were often two orders of magnitude higher, and were closely similar to those noted in 1970-73. The highest single level occurred in dogfish liver tissue, where 1.3 mg/kg of DDE was found. Samples of dogfish taken from coastal waters tended to have higher residue levels than those taken from further offshore. However, the concentrations found in both sets of samples were well above the detection limit and reflect the continuing and widespread distribution in the marine environment of DDT. The apparent preponderances of DDT over DDE and of DDE over DDD noted in the routine programme, was not so evident in the samples from the expanded programme.

3.2.4 *PCB's*

In general, the PCB residue concentrations were roughly equal to or greater than the sum of the other pesticide concentrations, and confirm the results of the routine programme. The highest PCB residue content, found in a fish from inshore waters, was recorded in a dogfish liver which contained 18 mg/kg; the mean value for the whole sample was 5.7 mg/kg, while the same species from near waters had a mean value of 0.41 mg/kg. The highest muscle content of PCB (0.75 mg/kg) occurred in herring muscle. As previously, the highest concentrations of PCB occurred in the organs of fish with the highest lipid content. In comparison with 1970-73 when the mean PCB residue content exceeded 0.1 mg/kg in eight species, the 1974 survey similarly revealed that eight species of fish contained in excess of 0.1 mg/kg in their muscle tissue, and that of those three contained 0.5 mg/kg or above. Although these samples were taken from inshore stations, a number of them came from open coastal sites unlikely to be contaminated by point source emissions. It is thus obvious that, in contrast to dieldrin, PCB contamination is still widespread and there is at present little evidence to show that levels are decreasing, although the maximum values were a little lower in 1974, compared to those recorded in 1970-73.

3.3 Metals in Shellfish (Table 4)

Because of their size, brown and pink shrimps were bulked and homogenised in their shells. The other species were removed from their shells before preparation and analysis; the smaller of these (oyster, whelk, *Neptunea*, mussel, horse mussel and queen) were bulked and the analysis carried out on a sub-sample of the homogenate; the body meat only of hermit crabs was analysed.

3.3.1 *Mercury*

It is convenient to deal with each of the species sampled in turn. Three species of the larger types of shellfish were sampled – lobster, crab and cuttlefish. The body, tail and claw of the lobster were analysed separately as were the body and claw of the crab and the body and tentacles of the cuttlefish. The concentrations of mercury found in the tissue of crabs and lobsters ranged from 0.09 to 0.61 mg/kg in lobsters and 0.07 to 0.40 mg/kg in crabs. The mean mercury concentrations of lobster body, claw and tail were 0.24, 0.20 and 0.40 mg/kg respectively, and the mean concentrations in both the crab body and claw were 0.23 mg/kg. The concentrations of mercury found in cuttlefish were low with a mean value of 0.09 mg/kg.

In pink and brown shrimps the mean concentrations found were 0.14 and 0.09 mg/kg respectively. Since the samples of the two species were collected from the same area at the same time these figures may reflect a species difference, although such was not apparent in the 1971-73 data when both species had a mercury content of close to 0.14 mg/kg.

The mercury content of queens was in all samples very low; those from the commercial fisheries along the south coast at Plymouth and Salcombe had a mean content of 0.05 mg/kg, while even samples taken off the North West Light Float in Liverpool Bay, an area subject to the input of substantial quantities of domestic and industrial wastes, had a mercury content of only 0.09 mg/kg.

Oysters had a mean mercury content of 0.13 mg/kg.

Hermit crabs, although not taken for human consumption, are ubiquitous detrital feeders and have been taken from most of the dumping grounds. The results of the analysis of their contaminant burden provides useful information on the contribution by the dumping activities of the various contaminants. Of the 58 individuals analysed from 11 samples, only one in a sample from Gunfleet (Thames Estuary), with a maximum of 0.21 mg/kg, exceeded 0.2 mg/kg, while the remainder had a mean mercury content of 0.06 mg/kg.

The mean mercury content of the smaller shellfish as a group is similar to concentrations reported previously, the 0.2 mg/kg level being exceeded only exceptionally and the overall mean concentration being well below this. Only two samples of shellfish, both whelks, had a mean content in excess of 0.5 mg/kg; both were collected from areas with known anthropogenic input, so they should be treated as exceptional samples. Mussel samples in the past have been from areas of high input and recorded as having significantly higher mercury contents than other species. All the 1974 mussel samples contained 0.15 mg/kg or less, with a mean value for sites of commercial fisheries of only 0.09 mg/kg.

3.3.2 *Cadmium*

Many of the 1970-73 samples were taken from areas with a known high cadmium input, resulting in an overestimate of the mean level of cadmium in shellfish from the whole of the UK. Sampling was directed elsewhere in 1974 and a more balanced picture was obtained. In 1971-73 the mean concentration of cadmium in the majority of commercially exploited species was found to be below 1 mg/kg. The samples collected in 1974 contained much lower amounts. Only crab body meat, oysters, whelks and one sample of horse mussel contained more than 1 mg/kg, the vast majority of other samples containing less than 0.5 mg/kg.

3.3.3 *Lead*

The pattern for lead was similar to that for cadmium in so far as the 1974 levels seemed, in general, to be significantly lower than previously. All the shrimp samples (pink and brown) taken from the east coast of England contained 1 mg/kg or less, whereas a value of 14 mg/kg was found in a sample of brown shrimp from the north-west coast of England. This confirmed a similar observation made in the 1970-73 surveys. The vast majority of the remaining samples contained 0.5 mg/kg or less, with the exception of mussels and horse mussels, which had mean concentrations of 1 mg/kg, 4.4 mg/kg respectively.

3.3.4 *Chromium*

Analysis of this element in marine environmental samples is technically difficult and there is always some doubt about the validity of the lower concentrations. However, the tendency of the sampling method was to overestimate the concentration of chromium, so the values observed provide an indication of the worst situation likely to occur. Over 95% of the samples contained concentrations of chromium in the range 0.2-3.0 mg/kg. *Neptunea*, mussels, horse mussels and whelks had concentrations at the higher end of the range, while lobsters and cuttlefish had mean concentrations of <0.2 mg/kg.

3.3.5 *Zinc*

Previous surveys have shown that concentrations of zinc found in shellfish were generally higher than those of the other trace metals examined. Of the commercial species of shellfish, in 1974 oysters contained the highest amount of zinc with a mean level of 420 mg/kg. The range of zinc content in whelks was quite wide, 10-300 mg/kg, with a mean of 110 mg/kg, the highest amounts being found in a sample off Rosse Spit, off the mouth of the Humber. A sample from Whitstable, although not containing the highest concentration of zinc (the Whitstable sample did in 1970-73), still contained twice the mean amount. The concentrations found did not appear to follow closely the expected pattern of zinc distribution.

Samples of shrimp, lobster, crab, queen and cuttlefish were all relatively low in zinc and within the range 9-120 mg/kg. Concentrations in the hermit crab were comparable to those found in the edible crab.

The highest recorded concentrations were found in the indicator species *Neptunea* which had a maximum concentration of 1,600 mg/kg and a mean of 490 mg/kg. All samples were collected from the north-east coast in areas where zinc concentrations are expected to be above the natural level due to industrial input.

3.3.6 *Copper*

Like zinc, high values of copper were not uncommon in shellfish. As previously, the highest concentrations were found in lobster body meat and the mean concentration of 200 mg/kg probably reflected the presence of copper rather than iron in the blood. Crab body meat also contained relatively high amounts of copper, maximum 110 mg/kg, mean 62 mg/kg. Concentrations found in hermit crabs were somewhat higher than in edible species (maximum 130 mg/kg, mean 81 mg/kg). The only other crustacean species sampled were pink and brown shrimps (mean concentrations of whole animals 16 and 23 mg/kg respectively): concentrations were in the range 12-32 mg/kg and, as with mercury, there may be evidence of a possible difference between the two species.

The copper content of the various molluscan species varied quite widely. The highest concentration of copper was in *Neptunea* which had a maximum of 250 mg/kg, with a mean of 68 mg/kg; whelks and oysters had very similar mean copper contents, 49 and 46 mg/kg respectively; queens and mussels contained much lower amounts (<3 mg/kg). The concentration of copper in cuttlefish body and tentacles varied by nearly a factor of five (2.9 and 13 mg/kg respectively), in contrast to that of other metals, where they were the same in both tissues.

3.4 Organochlorine pesticide and PCB residues in shellfish (Table 5)

3.4.1 *α HCH, γ HCH and Dieldrin*

In all cases, analysis for organochlorine pesticides and PCB residues was conducted on a bulked sample, although for crabs and lobsters the several edible tissues were analysed separately.

The 1970-73 report indicated that with the exception of crabs and some mussel samples the concentrations of the two isomers of HCH and dieldrin were at or below the detection limit of 0.001 mg/kg. The 1974 results again showed that the crabs and also lobsters (especially the body meat) contained the highest quantities of these pesticides although in no case did the concentration exceed 0.028 mg/kg. However, in the 1974 samples of a number of other species, residues of several pesticides and especially dieldrin were present in amounts well above the detection limit. Excluding crabs and lobsters, the highest concentration of dieldrin (0.006 mg/kg) was detected in pink shrimp samples from the Tyne and Tees areas and in one sample of queens from Salcombe. The two isomers of HCH, although apparently present in larger amounts than previously reported, exceeded the detection limit in only about 25% of the samples. The highest concentration recorded, which was only 0.004 mg/kg, was in samples of horse mussels and pink shrimps. The larger crustaceans contained concentrations less than 0.1 mg/kg, which were usually about five times greater than those found in the molluscs and smaller crustaceans.

3.4.2 *DDT, DDE and DDD*

The results of the analysis for DDT of all samples fell within the range <0.001-0.052 mg/kg, with a large majority at 0.002 mg/kg or less. Higher values occurred in lobster (0.042 mg/kg), hermit crab (0.052 mg/kg), and whelk (0.013 mg/kg).

The results of analyses for DDE fell within the range of <0.001-0.1 mg/kg, most being 0.003 mg/kg or less. The species containing the higher values were: lobster (0.058 mg/kg), hermit crab (0.055 mg/kg), edible crab (0.10 mg/kg), whelk (0.026 mg/kg) and *Neptunea* (0.012 mg/kg).

The results of analysis for DDD all fell within the range <0.001-0.045 mg/kg and, as for DDT and DDE, the great majority were 0.002 mg/kg or less; higher values were found in lobster (0.045 mg/kg), hermit crab (0.026 mg/kg), whelk (0.011 mg/kg) and *Neptunea* (0.011 mg/kg).

The tendency for the larger crustaceans to accumulate higher concentrations of DDT and metabolites was noted in 1970-73. A possible explanation of these relatively high values is the occurrence of large amounts of lipid in the body tissues of these particular species, the mean lipid level of crabs being 14%, of hermit crabs 8% and of lobster body 17%; the smaller crustaceans and molluscs with the exception of *Neptunea* (2.4%) and horse mussel (3.2%) contained about 1% or less. The higher pesticide content is therefore probably a reflection of the affinity of these residues for lipid rather than water.

3.4.3 *PCB's*

As a general rule the concentration of PCB's found in each shellfish sample exceeded the sum of the other pesticide residues, often by more than an order of magnitude. The larger crustacean species again contained the highest amounts. Mean concentrations of PCB's in the edible crab were 0.44 mg/kg for body meat and 0.25 mg/kg for claws. The crab body burdens of PCB were significantly lower than those found in 1970-73; maximum values were nearly an order of magnitude lower, and mean levels lower by a factor of five. However, although the maximum values in crab claw were lower in 1974, the average concentration was nearly double the 1970-73 figure. There was no obvious correlation between PCB concentrations and known inputs, the highest levels being found in edible crabs from Cromer and Whitby with lower amounts in samples from the Tyne and from Rosse Spit, off the Humber. Lobster samples from Whitby also contained high residue levels in their body meats (1.6 mg/kg). Both pink and brown shrimps contained relatively low burdens of PCB with mean values of <0.04 mg/kg.

Mussels from the north-east Irish Sea contained the highest PCB concentrations of the molluscan species sampled, having a maximum of 0.11 mg/kg and a mean of 0.07 mg/kg. A sample of whelks from Liverpool/Morecambe Bay in the same area also contained moderately-high concentrations (0.21 mg/kg) with respect to the other whelk samples. Higher environmental levels in this area are probably the cause of these elevated PCB burdens.

With the exception of one sample of *Neptunea*, all the remaining species contained <0.1 mg/kg and in a number of samples <0.01 mg/kg.

4. Summary of 1974 data

4.1 Fish

4.1.1 *Metals* (Table 6)

The main food species of fish sampled, ie cod, plaice, whiting and mackerel, contained relatively low levels of mercury. Only plaice (0.25 mg/kg) contained mean values in excess of 0.2 mg/kg and only mackerel (0.56 mg/kg) included individuals containing more than 0.5 mg/kg. The longer-lived fish in general contained the highest concentrations of mercury. Some samples of dab and herring also contained relatively high concentrations of this element. However, the samples concerned were caught in Morecambe Bay and the Thames Estuary respectively, areas which at that time were still subject to elevated mercury inputs. The six species of fish of which samples were taken from both inshore and offshore waters generally showed a decrease in levels away from the coast. Lead and cadmium levels were in most samples below the detection level of the method used. The processes of copper and zinc accumulation are known to be readily regulated by fish, and concentrations therefore show little variation within species. The pelagic species, herring, mackerel and scad, contained higher concentrations of copper and zinc than demersal species such as cod and plaice, a feature noted in the 1970-73 report.

4.1.2 *Pesticide and PCB residues* (Table 7)

Levels of organochlorine pesticide residues in fish species were similar for both the expanded and the routine programmes, most being at or less than the detection limit. Dieldrin residue burdens appear to be decreasing, levels having fallen below values quoted in the 1970-73 report by a factor of about two; the previously noted difference between inshore samples and the near-water samples was less marked, possibly due to the decrease in input and concentrations in coastal waters. Levels of DDT and its metabolites were, however, well above the detection limit, all three compounds being present at similar levels. PCB's were readily detectable in both liver and muscle tissue of all species. Samples of eight species contained concentrations in the muscle tissues in excess of 0.1 mg/kg; some came from open coastal sites away from obvious point sources of contamination. It is hoped that this situation represents the peak of levels of PCB's in fish following the introduction of controls in 1972.

4.2 Shellfish

4.2.1 *Metals* (Table 8)

Metal levels in shellfish followed a similar pattern to those noted in 1970-73 with high concentrations of cadmium and copper in crab body tissue and an exceptionally high copper level in lobster bodies. High concentrations of zinc were found in oysters, *Neptunea* and whelks, the latter two species also containing higher than average amounts of cadmium. Mercury concentrations were in general low, exceeding 0.5 mg/kg in very few samples, and cadmium and lead concentrations appeared to be significantly lower than in previous years, although the change of emphasis in the collection sites will have contributed to the apparent decrease in cadmium concentrations. The high copper levels found in crustacea reflected the role of copper rather than iron as the oxygen carrier of crustacean blood. Zinc concentrations, although high in a number of molluscan species, are known to be naturally high in oysters and at the concentrations found are not likely to cause any deleterious effects on the animals or on man as a consumer.

4.2.2 *Pesticides and PCB residues* (Table 9)

Pesticide residue levels in shellfish were generally low; where elevated levels occurred they were normally associated with species containing higher amounts of lipids. The larger crustaceans, edible crabs, lobsters and hermit crabs contained the largest body burdens of pesticides. In most cases the concentrations of pesticides present in shrimps and in the majority of the molluscan samples could either not be detected or just exceeded the detection limit of the method used. One exception was mussels which, at least in some samples, did contain readily detectable levels, however, these samples were collected from an area noted for industrial discharges and should not be taken as an indication of generally high accummulation of pesticides by this species. Concentrations of PCB usually exceeded the sum of the other pesticide residues, often by more than a factor of ten. Of the shellfish species sampled, the larger crustaceans and the molluscs, mussels and whelks, contained the highest concentrations of PCB's. However, the mean levels in the edible crab, the large crustacean species sampled in greatest numbers in previous years, were much lower by a factor of five: this reduction may reflect a difference in the sampling pattern rather than a change in general environmental levels. Most of the other species contained similar concentrations to those noted in previous years, although some of the 1974 data for mussels suggest that somewhat higher concentrations were present in some samples of this species.

5 Conclusions

As might be expected from a consideration of the time-scale involved in marine environmental processes, rapid changes in either metal or pesticide levels are unlikely, except in very localised areas. In this respect, therefore, the conclusions which can be drawn from these latest figures are similar to those from the results in the 1970-73 report.

After several years operation of the monitoring programme a review was made at the end of 1974 and the results assessed in terms of their overall meaning and value and the implications they presented for the planning of future programmes.

The overall conclusion from the review of results was that the level of organochlorine pesticide and PCB residues, although differing from species to species, is low by all standards of safety either for the fish or shellfish species, or for man.

Some shellfish species, eg crab and oyster, contain relatively high concentrations of certain metals and some species of fish appear to accumulate above average concentrations of mercury, especially in particular areas where input of this element is high. However, in no case do these elevated metal levels appear likely to be dangerous to the species concerned. Although most fish consumers in England and Wales do not receive significant amounts of heavy metals from the fish components of their diet, initial examination of the data suggests that some local communities, which consume relatively large quantities of fish or shellfish drawn almost entirely from certain contaminated coastal regions, may have unusually high mercury intakes due to the relatively high mercury content of the fish in their diet.

However, the findings of a recent study (Haxton *et al.* in press) have shown that the level of mercury intake of such individuals does not present an unacceptable risk. With regard to the uptake by man of cadmium and lead, the consumption of fish and shellfish from normal commercial sources does not appear to offer any risk to the consumer, although the Toxicity Subcommittee of the Committee on Medical Aspects of Chemicals in Food and the Environment (MAFF, 1973a) stated that a persistently high dietary consumption of shellfish or brown crab meat with a high cadmium content could conceivably constitute a risk for selected individual consumers.

6 Future programme

The samples collected in 1970-74 were taken in order to fulfil many requirements which ranged from consideration of the effects of particular pollutants in localised areas to the need to acquire a knowledge of the general baseline level of major contaminants in the major species of commercial fish. These differing requirements meant that it was not possible to analyse all samples for the full range of pollutants even though in retrospect this might seem desirable. Nor has it been possible in most instances to look into further points raised by the study, such as the interrelationship of pollutants with environmental factors and their physiological effects. Furthermore, comparisons of concentrations in species in particular areas has often proved difficult owing to sampling differences (samples were not always collected from the same place or were of a different size, age or sex).

It was therefore decided at the end of 1974 that a more carefully designed and integrated national monitoring programme should be developed which would reflect not only the changing requirements for marine environmental data but would build upon the experience of the four years 1971-74. Thus, from 1975 onwards the monitoring programme conducted by the Burnham-on-Crouch Laboratory has been modified to provide additional and more systematic coverage of the marine environment and the major commercial species taken from coastal waters around England and Wales. However, the objective has remained the same – that is to ensure the continuing health and safety of the human and marine communities and to allow trends in the distribution of pollutants to be followed in both space and time.

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Table 1 Results of the routine monitoring programme 1974:
metals and organochlorine pesticides and PCB residues in fish (concentrations in mg/kg wet weight)

Port	ICES Rectangle	Species and Number	Date 1974		Mercury	Cadmium	Lead	Chromium	Zinc
GRIMSBY	37 FO	Cod	Mar	Min	0.04	<0.2	<0.2	<0.2	3.8
(Winter)		(10)		Max	0.10	<0.2	0.7	0.2	5.5
				Mean	0.06	<0.2	<0.3	<0.2	4.6
	"	Plaice	Mar	Min	0.08	<0.2	<0.2	<0.2	4.5
		(9)		Max	0.21	<0.2	0.3	0.2	6.2
				Mean	0.12	<0.2	<0.2	<0.2	5.4
	"	Whiting	Mar	Min	0.07	<0.2	<0.2	<0.2	3.7
		(10)		Max	0.35	0.2	0.7	0.2	6.3
				Mean	0.13	<0.2	<0.3	<0.2	4.9
	"	Herring	Mar	Min	0.02	<0.2	<0.2	<0.2	8.2
		(9)		Max	0.22	0.2	0.4	0.3	13
				Mean	0.09	<0.2	<0.2	<0.2	9.2
(Summer)	38 F1	Cod	Aug	Min	0.03	<0.2	<0.2	<0.2	2.7
		(16)		Max	0.12	<0.2	0.3	1.0	4.5
				Mean	0.07	<0.2	<0.2	<0.3	3.4
	"	Plaice	Aug	Min	0.05	<0.2	<0.2	<0.2	4.0
		(12)		Max	0.19	<0.2	<0.2	<0.2	5.3
				Mean	0.08	<0.2	<0.2	<0.2	4.4
	"	Whiting	Aug	Min	0.01	<0.2	<0.2	<0.2	3.0
		(12)		Max	0.20	0.2	<0.2	0.2	5.0
				Mean	0.11	<0.2	<0.2	<0.2	3.5
	"	Herring	Aug		0.07	<0.2	<0.2	<0.2	4.8
		(1)							
	"	Mackerel	Aug	Min	0.07	<0.2	<0.2	<0.2	4.6
		(6)		Max	0.15	<0.2	<0.2	<0.2	6.5
				Mean	0.09	<0.2	<0.2	<0.2	5.5
LOWESTOFT	37 FO	Cod	Feb	Min	0.07	<0.2	<0.2	<0.2	2.8
(Winter)		(4)		Max	0.13	<0.2	<0.2	0.4	3.2
				Mean	0.09	<0.2	<0.2	<0.3	3.0
	37 E9	Plaice	Feb	Min	0.05	<0.2	<0.2	<0.2	3.3
		(10)		Max	0.40	0.2	0.2	0.2	4.8
				Mean	0.13	<0.2	<0.2	<0.2	3.7
	37 FO	Whiting	Feb	Min	0.07	<0.2	<0.2	<0.2	2.5
		(10)		Max	0.20	<0.2	<0.2	<0.2	3.7
				Mean	0.14	<0.2	<0.2	<0.2	3.3
	"	Herring	Feb	Min	0.04	<0.2	<0.2	0.2	3.3
		(10)		Max	0.10	<0.2	0.2	0.5	7.0
				Mean	0.06	<0.2	<0.2	0.3	4.8

Copper	Organ	αHCH	γHCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
<0.2	Liver	0.040	0.008	0.21	0.40	0.30	0.41	4.8	24.0
0.4	Muscle	<0.001	<0.001	0.003	0.002	0.001	0.006	0.02	0.2
0.3									
<0.2	Liver	0.003	0.002	0.012	0.019	0.014	0.027	0.24	2.8
0.3	Muscle	0.001	<0.001	0.001	0.001	0.001	0.001	1.4	0.2
<0.2									
<0.2	Liver	0.014	0.012	0.17	0.32	0.22	0.41	6.1	61.6
0.4	Muscle	<0.001	<0.001	0.002	0.002	0.001	0.002	0.02	0.4
<0.3									
1.3									
3.3	Muscle	0.008	0.003	0.015	0.019	0.014	0.074	0.25	8.4
2.1									
0.2	Liver	0.043	0.030	0.12	0.20	0.15	0.19	3.0	16.8
1.3	Muscle	0.001	<0.001	0.003	0.002	0.001	0.002	0.02	0.6
0.6									
<0.2	Liver	0.003	0.002	0.010	0.013	0.006	0.005	0.15	2.4
1.1	Muscle	<0.001	<0.001	0.003	0.002	0.001	0.003	0.02	0.6
<0.4									
0.3	Liver	0.052	0.012	0.11	0.46	0.30	0.54	5.0	23.2
0.9	Muscle	<0.001	<0.001	0.003	0.003	0.002	0.004	0.03	0.4
0.6									
1.0	–	–	–	–	–	–	–	–	–
0.2	Liver	0.005	0.005	0.018	0.022	0.016	0.047	0.33	6.8
1.2	Muscle	0.002	0.005	0.008	0.010	0.005	0.021	0.21	4.6
0.7									
0.4	Liver	0.033	0.020	0.15	0.17	0.15	0.18	0.45	19.6
0.6	Muscle	<0.001	<0.001	<0.001	0.003	0.001	<0.001	0.03	< 0.2
0.5									
0.3	Liver	0.004	0.002	0.012	0.034	0.028	0.011	0.68	3.2
1.2	Muscle	<0.001	<0.001	<0.004	0.003	0.001	0.002	0.04	0.6
0.5									
0.5	Liver	0.038	0.014	0.079	0.19	0.26	0.42	2.4	46.0
1.5	Muscle	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.03	0.4
0.8									
1.0	Liver	0.007	0.005	0.010	0.019	0.009	0.016	0.20	2.0
1.7	Muscle	0.009	0.003	<0.011	0.013	0.001	0.020	0.10	5.6
1.3									

Table 1 Continued

Port	ICES Rectangle	Species and Number	Date 1974		Mercury	Cadmium	Lead	Chromium	Zinc
LOWESTOFT	39 F2	Cod	Aug	Min	0.06	<0.2	<0.2	<0.2	2.5
(Summer)		(10)		Max	0.22	<0.2	0.6	2.4	4.0
				Mean	0.08	<0.2	0.4	<0.4	3.1
	"	Plaice	Aug	Min	0.02	<0.2	<0.2	<0.2	2.5
		(10)		Max	0.10	<0.2	0.5	0.2	4.0
				Mean	0.07	<0.2	0.3	<0.2	3.5
	"	Whiting	Aug	Min	0.04	<0.2	<0.2	<0.2	2.2
		(8)		Max	0.14	<0.2	0.4	0.3	3.2
				Mean	0.08	<0.2	<0.3	<0.2	2.7
PLYMOUTH	29 E5	Cod	Apr		0.13	<0.2	0.4	<0.2	1.8
(Winter)		(1)							
	"	Plaice	Apr	Min	0.09	<0.2	<0.2	<0.2	3.0
		(10)		Max	0.21	0.2	0.2	<0.2	4.9
				Mean	0.13	<0.2	<0.2	<0.2	4.0
	"	Whiting	Apr	Min	0.08	<0.2	0.2	<0.2	2.5
		(9)		Max	0.27	0.2	0.3	<0.2	4.8
				Mean	0.14	<0.2	0.2	<0.2	3.0
	"	Herring	Apr		0.21	<0.2	0.3	<0.2	6.1
		(1)							
	"	Mackerel	Apr	Min	0.06	<0.2	<0.2	<0.2	4.4
		(9)		Max	0.14	0.3	0.2	0.3	11
				Mean	0.09	<0.2	<0.2	<0.2	6.3
(Summer)	"	Plaice	Aug	Min	0.03	<0.2	<0.2	0.2	2.3
		(10)		Max	0.13	<0.2	0.4	5.4	4.9
				Mean	0.07	<0.2	<0.3	1.0	3.3
	"	Whiting	Aug	Min	0.11	<0.2	<0.2	<0.2	0.8
		(10)		Max	0.44	<0.2	0.4	4.0	4.0
				Mean	0.25	<0.2	0.3	<0.8	2.7
	"	Mackerel	Aug	Min	0.02	<0.2	<0.2	<0.2	2.5
		(10)		Max	0.17	<0.2	0.3	0.2	11
				Mean	0.06	<0.2	<0.2	<0.2	4.5

Copper	Organ	α HCH	γ HCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.3	Liver	0.036	0.013	0.040	0.25	0.18	0.30	3.8	28.0
1.5	Muscle	<0.001	<0.001	0.003	0.002	0.001	0.002	0.03	<1
0.5									
<0.2	Liver	0.009	0.004	0.018	0.023	0.025	0.048	0.50	9.0
0.7	Muscle	<0.001	<0.001	0.002	0.002	0.001	0.003	0.04	<1
0.4									
<0.2	Liver	0.022	0.024	0.13	0.13	0.13	0.46	3.2	69.0
0.4	Muscle	<0.001	<0.001	0.002	0.001	<0.001	0.002	0.01	<1
0.3									
0.3	Muscle	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.2
0.3	Liver	0.006	0.002	0.049	0.029	0.033	0.051	1.4	5.2
0.9	Muscle	<0.001	<0.001	0.003	0.002	0.002	0.002	0.06	0.2
0.6									
0.4	Liver	0.023	0.005	0.12	0.35	0.17	0.35	7.6	57.6
1.1	Muscle	0.001	<0.001	0.004	0.002	0.001	0.003	0.05	0.2
0.6									
1.3	Muscle	0.002	0.003	0.020	0.030	0.040	0.030	0.30	1.6
0.8	Liver	0.010	0.004	0.016	0.044	0.031	0.090	0.96	7.2
1.7	Muscle	0.009	0.005	0.015	0.011	0.012	0.050	0.34	10.8
1.2									
0.2	Liver	0.009	0.008	0.017	0.025	0.023	0.027	0.63	16.0
1.3	Muscle	<0.001	<0.001	0.002	0.001	<0.001	0.002	0.65	<1
0.5									
0.3	Liver	0.024	0.012	0.074	0.54	0.30	0.40	18	57.0
3.9	Muscle	<0.001	<0.001	0.005	0.004	0.008	0.010	0.20	<1
0.8									
0.6	Liver	0.008	0.006	0.011	0.015	0.016	0.040	0.36	8.8
1.1	Muscle	0.006	0.004	0.008	0.011	0.005	0.028	0.20	9.2
1.0									

Table 1 Continued

Port	ICES Rectangle	Species and Number	Date 1974		Mercury	Cadmium	Lead	Chromium	Zinc
NEWLYN (Summer)	29 E4	Cod (10)	Dec	Min	0.07	<0.2	<0.2	<0.2	2.7
				Max	0.30	<0.2	0.3	0.3	4.3
				Mean	0.15	<0.2	<0.2	<0.2	3.4
	"	Plaice (10)	Dec	Min	0.05	<0.2	<0.2	<0.2	<2.7
				Max	0.19	<0.2	1.0	0.2	5.9
				Mean	0.13	<0.2	<0.3	<0.2	4.1
	"	Whiting (8)	Dec	Min	0.06	<0.2	<0.2	<0.2	2.5
				Max	0.22	<0.2	0.2	<0.2	4.6
				Mean	0.12	<0.2	<0.2	<0.2	3.5
MILFORD HAVEN (Winter)	30 E4	Cod (10)	Feb	Min	0.07	<0.2	<0.2	<0.2	2.2
				Max	0.32	0.3	0.2	<0.2	5.0
				Mean	0.12	<0.2	<0.2	<0.2	3.3
	"	Plaice (9)	Feb	Min	0.03	<0.2	<0.2	<0.2	2.9
				Max	0.37	0.2	0.4	0.5	4.5
				Mean	0.09	<0.2	<0.2	<0.2	3.7
	32 E2	Herring (10)	Jan	Min	0.04	<0.2	<0.2	<0.2	6.4
				Max	0.17	<0.2	<0.2	3.0	8.4
				Mean	0.10	<0.2	<0.2	<0.5	7.4
(Summer)	31 E5	Plaice (10)	Jul	Min	0.04	<0.2	<0.2	<0.2	4.0
				Max	0.13	0.2	0.2	0.4	7.4
				Mean	0.08	<0.2	<0.2	<0.2	5.1
	"	Whiting (10)	Jul	Min	0.06	<0.2	0.3	<0.2	2.7
				Max	0.33	<0.2	<0.2	0.3	4.1
				Mean	0.19	<0.2	<0.2	<0.2	3.3
	"	Mackerel (10)	Jul	Min	0.02	<0.2	<0.2	<0.2	4.5
				Max	0.08	<0.2	<0.2	<0.2	7.0
				Mean	0.05	<0.2	<0.2	<0.2	6.1
FLEETWOOD (Summer)	37 E6	Plaice (9)	Jul	Min	0.05	<0.2	<0.2	<0.2	3.9
				Max	0.21	<0.2	<0.2	0.3	6.6
				Mean	0.10	<0.2	<0.2	<0.2	4.7

Copper	Organ	αHCH	γHCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
<0.2	Liver	0.028	0.020	0.034	0.31	0.18	0.26	7.4	43.0
1.0	Muscle	0.001	0.001	0.002	0.001	0.001	0.001	0.04	1.0
0.5									
<0.2	Liver	0.015	0.007	0.020	0.047	0.10	0.071	1.9	21.0
0.6	Muscle	0.008	0.008	0.002	0.003	0.003	0.002	0.05	1.0
0.5									
0.4	Liver	0.026	0.010	0.050	0.22	0.092	0.25	4.0	71.0
1.0	Muscle	0.001	0.001	0.002	0.002	0.001	0.006	0.04	1.0
0.6									
<0.2	Liver	0.007	0.006	0.022	0.004	0.060	1.8	0.13	2.0
0.6	Muscle	0.001	0.001	0.003	0.001	0.001	0.006	0.02	0.4
<0.2									
<0.2	Liver	0.026	0.010	0.057	0.12	0.099	0.11	3.3	24.8
1.7	Muscle	0.001	0.001	0.002	0.001	0.001	0.001	1.5	0.2
<0.4									
0.7	Liver	0.002	0.001	0.008	0.012	0.005	0.014	0.09	1.4
1.8	Muscle	0.001	0.001	0.017	0.020	0.010	0.026	0.15	4.8
1.1									
0.4	Liver	0.008	0.012	0.050	0.019	0.021	0.052	0.80	14.8
0.9	Muscle	0.001	0.001	0.003	0.001	0.001	0.002	0.04	0.6
0.7									
0.3	Liver	0.022	0.050	0.084	0.29	0.21	0.28	5.7	36.0
1.0	Muscle	0.001	0.001	0.002	0.002	0.001	0.004	0.05	0.2
0.5									
0.9	Liver	0.006	0.005	0.013	0.013	0.008	0.040	0.24	10.4
1.5	Muscle	0.003	0.002	0.010	0.011	0.006	0.023	0.023	10.8
1.2									
0.5	Liver	0.002	0.006	0.020	0.014	0.016	0.014	0.20	7.6
0.8	Muscle	0.001	0.001	0.002	0.001	0.001	0.001	0.01	0.2
0.6									

Table 2 Results of the expanded monitoring programme 1974: metals in fish muscle (concentrations in mg/kg wet weight)

ICES Area	ICES Rectangle	Species	Number in Sample	Date 1974	Mercury			Cadmium		
					Min	Max	Mean	Min	Max	Mean
Inshore										
IV B	37 E9	Cod	3	Feb	0.06	0.09	0.07	<0.2	<0.2	<0.2
"	37 E9	"	1	Feb	–	–	0.10	–	–	<0.2
"	36 F0	"	10	Feb	0.04	0.13	0.09	<0.2	<0.2	<0.2
IV C	33 F2	"	10	Jan	0.05	0.16	0.12	<0.2	<0.2	<0.2
"	32 F1	"	5	Nov	0.12	0.32	0.22	<0.2	<0.2	<0.2
IV C	32 F1	Plaice	8	Nov	0.13	0.25	0.18	<0.2	<0.2	<0.2
VII D	30 F0	"	10	Mar	0.10	0.32	0.18	<0.2	<0.2	<0.2
VII A	36 E6	"	10	Oct	0.13	0.50	0.30	<0.2	<0.2	<0.2
IV C	33 F1	Whiting	10	Oct	0.20	0.47	0.30	<0.2	<0.2	<0.2
IV C	32 F1	"	9	Nov	0.17	0.39	0.28	<0.2	<0.2	<0.2
IV C	32 F1	Pout Whiting	10	Nov	0.17	0.49	0.31	<0.2	<0.2	<0.2
VII D	30 E8	" "	9	Nov	0.04	0.19	0.09	<0.2	<0.2	<0.2
VII A	36 E6	" "	10	Oct	0.16	0.36	0.26	<0.2	<0.2	<0.2
VII E	29 E4	Dogfish	20	Jun	0.12	0.72	0.33	<0.2	<0.2	<0.2
VII A	36 E6	"	2	May	0.80	1.2	1.0	<0.2	<0.2	<0.2
"	"	"	2	May	2.1	2.1	2.1	<0.2	<0.2	<0.2
"	"	"	5	Jun	0.28	1.4	0.75	<0.2	<0.2	<0.2
IV B	39 E9	Dragonet (Whole)	27	Mar	0.02	0.11	0.05	<0.2	<0.2	<0.2
"	"	" "	4	Mar	0.03	0.08	0.05	<0.2	<0.2	<0.2
"	"	" "	2	Feb	0.04	0.17	0.11	<0.2	<0.2	<0.2
"	38 E8	" "	1	Feb	–	–	0.02	–	–	<0.2
"	"	" "	2	Feb	0.06	0.09	0.08	<0.2	<0.2	<0.2
"	36 F0	" "	9	Feb	0.02	0.07	0.05	<0.2	<0.2	<0.2
VII A	36 E6	" "	11	Oct	0.16	0.33	0.24	<0.2	<0.2	<0.2
IV C	32 F1	Lemon Sole	4	Nov	0.06	0.12	0.10	<0.2	<0.2	<0.2
VII A	36 E6	" "	4	Oct	0.20	0.34	0.25	<0.2	<0.2	<0.2
VII F	30 E4	Dab	1	Feb	–	–	0.65	–	–	0.2
VII A	36 E6	"	10	Oct	0.22	0.44	0.34	<0.2	<0.2	<0.2
IV B	40 F6	Herring	10	Sep	0.04	0.17	0.09	<0.2	<0.2	<0.2
IV C	32 F0	"	10	Feb	0.12	0.81	0.35	–	–	–
VII C	38 E5	Scad	3	Jul	0.21	0.40	0.32	<0.2	<0.2	<0.2
VII C	38 E5	Mackerel	4	Jul	0.12	0.56	0.27	<0.2	<0.2	<0.2
VII E	29 E5	Bass	11	Apr	0.60	2.4	1.4	<0.2	<0.2	<0.2
VII A	36 E6	Ray	10	May	0.14	0.26	0.21	<0.2	<0.2	<0.2
IV B	39 E6	Sprat (Whole)	10	Mar	–	–	0.04	–	–	<0.2
IV C	33 F1	Sea Bream	1	1974	–	–	1.5	–	–	<0.2

Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	3.0	3.9	3.4	0.5	1.0	0.7
–	–	<0.2	–	–	<0.2	–	–	3.3	–	–	0.5
<0.2	<0.2	<0.2	<0.2	0.5	<0.3	3.0	4.0	4.0	<0.2	0.8	<0.5
<0.2	0.2	<0.2	<0.3	<0.3	<0.3	3.5	4.8	4.0	<0.3	0.4	<0.3
<0.2	0.6	<0.3	0.3	0.9	0.6	2.0	4.0	3.0	0.4	0.8	0.5
<0.2	0.8	<0.3	<0.2	0.8	0.6	3.0	5.0	4.0	0.4	0.6	0.5
<0.2	<0.2	<0.2	<0.2	0.6	<0.3	2.9	5.4	3.8	0.3	0.9	0.6
<0.2	0.4	<0.3	<0.2	0.5	<0.2	2.2	5.0	3.6	0.2	0.5	0.3
<0.2	<0.2	<0.2	0.2	1.0	0.4	3.0	4.0	3.0	0.4	0.5	0.4
0.2	0.4	0.3	<0.2	0.9	0.7	2.0	8.0	5.0	0.4	0.9	0.7
<0.2	0.7	0.3	<0.2	1.0	0.6	2.0	5.0	3.0	0.5	1.0	0.6
<0.2	0.4	0.3	<0.2	0.6	<0.4	2.0	5.0	3.0	0.6	0.9	0.8
0.3	0.8	0.5	<0.2	0.3	<0.2	2.2	6.0	3.0	0.3	0.9	0.5
<0.2	0.4	<0.4	<0.2	0.9	<0.3	2.2	3.4	2.8	<0.2	3.9	0.6
0.4	0.5	0.5	<0.2	<0.2	<0.2	8.0	12	10	0.4	0.5	0.5
1.0	1.4	1.2	0.5	1.0	0.8	9.0	13	11	0.5	0.7	0.6
<0.2	0.7	<0.3	<0.2	1.6	0.5	2.0	3.0	2.0	0.3	0.6	0.4
<0.2	0.4	<0.2	0.3	1.0	0.6	4.0	16	9.0	0.4	1.4	0.9
<0.2	0.3	<0.2	0.4	0.9	0.7	7.0	9.0	8.0	0.7	1.0	0.8
0.5	0.5	0.5	1.4	1.9	1.7	10	13	12	0.9	1.3	1.1
–	–	0.2	–	–	0.8	–	–	12	–	–	1.1
<0.2	<0.2	<0.2	0.4	0.8	0.6	10	11	11	0.9	1.2	1.1
<0.2	<0.2	<0.2	0.4	1.8	0.7	5.0	16	11	0.6	1.6	0.8
0.2	0.7	0.4	0.3	1.0	0.6	4.2	11	8.0	0.5	1.5	1.0
0.2	0.6	0.4	<0.2	0.9	<0.5	2.0	4.0	3.0	0.5	0.7	0.6
0.3	0.7	0.5	<0.2	1.4	<0.8	3.0	5.0	4.0	0.5	0.9	0.7
–	–	<0.2	–	–	<0.2	–	–	3.2	–	–	<0.2
0.2	0.5	0.3	<0.2	0.5	<0.3	2.4	4.4	3.1	0.3	0.6	0.4
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	3.2	7.1	5.1	1.0	1.4	1.2
–	–	–	–	–	–	–	–	–	–	–	–
<0.2	<0.2	<0.2	<0.3	0.3	<0.3	2.0	4.0	3.0	0.9	1.2	1.0
<0.2	<0.2	<0.2	<0.2	0.4	<0.3	4.0	12	6.0	0.8	1.3	1.2
<0.2	<0.2	<0.2	<0.2	1.6	<0.3	1.6	4.5	3.0	<0.2	0.5	<0.3
<0.3	0.7	0.4	<0.2	<0.2	<0.2	4.3	6.3	4.9	<0.2	1.2	<0.6
–	–	<0.2	–	–	1.2	–	–	15	–	–	0.9
–	–	0.6	–	–	–	–	–	3.0	–	–	0.4

Table 2 Continued

ICES Area	ICES Rectangle	Species	Number in Sample	Date 1974	Mercury			Cadmium		
					Min	Max	Mean	Min	Max	Mean
Near Water										
IV B	37 F3	Cod	1	Jan	–	–	0.13	–	–	<0.4
”	”	”	1	Jan	–	–	0.05	–	–	<0.4
”	”	”	1	Jan	–	–	0.10	–	–	<0.4
”	39 F5	”	1	Jan	–	–	0.20	–	–	<0.4
”	41 F3	”	10	Jan	0.02	0.14	0.08	<0.3	<0.3	<0.3
”	37 F3	Plaice	10	Jan	0.03	0.08	0.05	<0.2	<0.2	<0.2
”	”	”	6	Jan	0.05	0.11	0.07	<0.3	<0.3	<0.3
”	38 F6	”	10	Jan	0.02	0.16	0.07	<0.2	<0.2	<0.2
”	39 F5	Haddock	10	Jan	<0.01	0.04	0.02	<0.2	<0.2	<0.2
”	41 F3	”	10	Jan	0.01	0.07	0.04	<0.2	<0.2	<0.2
”	”	”	1	Jan	–	–	0.07	–	–	<0.4
”	40 F4	Dogfish	12	Jul	0.11	0.64	0.25	<0.2	<0.2	<0.2
VI A	47 E4	”	8	Jul	0.08	0.85	0.28	<0.2	<0.2	<0.2
IV B	41 F2	Witch	1	Jan	–	–	0.11	–	–	<0.3
V B	–	Blue Whiting	14	Mar	0.04	0.13	0.09	<0.2	<0.2	<0.2

Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
–	–	0.3	–	–	<0.2	–	–	4.5	–	–	0.5
–	–	0.1	–	–	0.5	–	–	3.8	–	–	0.4
–	–	0.1	–	–	<0.2	–	–	4.2	–	–	0.4
–	–	0.1	–	–	0.3	–	–	3.8	–	–	0.4
0.1	0.3	0.3	<0.2	<0.2	<0.2	3.0	3.8	3.4	0.1	0.8	0.3
0.1	0.4	0.2	<0.3	1.0	<0.4	3.8	5.4	4.8	<0.3	<0.3	<0.3
0.2	0.4	0.3	<0.2	<0.2	<0.2	3.5	6.8	5.0	0.1	0.9	0.3
<0.1	0.2	<0.1	<0.3	<0.3	<0.3	3.6	5.9	4.6	<0.3	1.8	<0.5
0.1	0.3	0.2	<0.3	<0.3	<0.3	3.1	4.6	3.8	<0.3	<0.3	<0.3
0.1	0.5	0.2	<0.3	<0.3	<0.3	2.6	5.5	3.5	<0.3	0.4	<0.3
–	–	0.2	–	–	<0.2	–	–	3.5	–	–	0.5
<0.2	0.3	<0.2	<0.2	0.5	0.3	2.0	5.0	3.0	0.6	1.0	0.8
<0.2	0.2	<0.2	<0.2	0.8	<0.4	1.0	3.0	3.0	0.3	1.0	0.5
–	–	0.3	–	–	<0.2	–	–	3.3	–	–	0.2
<0.2	0.3	<0.2	<0.2	0.5	<0.3	4.9	8.5	6.2	0.4	1.2	0.7

Table 3 Results of the expanded monitoring programme 1974: organochlorine pesticide and PCB residues in fish (concentration in mg/kg wet weight)

ICES Area	ICES Rectangle	Species	Number in Sample	Date 1974	Organ	αHCH
Inshore						
IV B	37 E9	Cod	3	Feb	Liver	0.009
					Muscle	<0.001
”	”	”	1	Feb	Liver	0.018
					Muscle	<0.001
”	36 F0	”	10	Feb	Liver	0.066
					Muscle	<0.001
IV C	33 F2	”	10	Jan	Liver	0.020
					Muscle	0.002
”	32 F1	”	5	Nov	Liver	0.036
					Muscle	<0.001
IV C	32 F1	Plaice	8	Nov	Liver	0.013
					Muscle	<0.001
VII D	30 F0	”	10	Mar	Liver	0.002
					Muscle	<0.001
VII A	36 E6	”	10	Oct	Liver	0.004
					Muscle	0.003
IV C	33 F1	Whiting	10	Oct	Liver	0.024
					Muscle	0.001
”	32 F1	”	9	Nov	Liver	0.016
					Muscle	<0.001
IV C	32 F1	Pout Whiting	10	Nov	Muscle	<0.001
VII D	30 E8	”	9	Nov	Muscle	0.002
VII A	36 E6	”	10	Oct	Muscle	<0.001
VII E	29 E4	Dogfish	20	Jun	Liver	0.020
					Muscle	0.005
VII A	36 E6	”	2	May	Liver	0.10
					Muscle	<0.001
VII A	”	”	5	Jun	Liver	0.005
					Muscle	<0.001
IV B	39 E9	Dragonet	27	Mar	Whole	0.001
”	”	”	4	Mar	”	<0.001
”	”	”	2	Feb	”	<0.001
”	38 E8	”	1	Feb	”	0.001
”	”	”	2	Feb	”	0.002
”	36 F0	”	9	Feb	”	0.001
VII A	36 E6	”	11	Oct	”	0.003
IV C	32 F1	Lemon Sole	4	Nov	Liver	0.008
					Muscle	0.001
VII A	36 E6	”	4	Oct	Muscle	<0.001
VII F	30 E4	Dab	1	Feb	Muscle	0.001
VII A	36 E6	”	10	Oct	Muscle	<0.001
IV B	40 F6	Herring	10	Sep	Liver	0.001
					Muscle	0.004
VII A	38 E5	Scad	3	Jul	Liver	<0.001
					Muscle	<0.001
VII A	38 E5	Mackerel	4	Jul	Liver	0.002
					Muscle	0.002
VII E	29 E5	Bass	11	Apr	Liver	0.002
					Muscle	<0.001
VII A	36 E6	Ray	10	May	Liver	0.028
					Muscle	<0.001
IV B	39 E9	Sprat	10	Mar	Muscle	0.008
IV C	33 F1	Sea Bream	1	1974	Liver	<0.001
					Muscle	<0.001

γ HCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.031	0.11	0.18	0.19	0.14	2.9	18.4
<0.001	0.001	0.001	<0.001	<0.001	0.01	0.2
0.005	0.054	0.12	0.12	0.048	1.4	13.6
<0.001	0.002	<0.001	<0.001	<0.001	<0.01	0.2
0.016	0.26	0.18	0.14	0.18	2.8	44.8
<0.001	<0.001	<0.001	0.001	0.005	0.04	<1
0.024	0.18	0.20	0.16	0.21	5.0	18.0
<0.001	0.003	0.001	<0.001	0.002	0.02	<0.2
0.024	0.15	0.56	0.31	0.45	13	32.8
<0.001	0.002	0.002	<0.001	0.002	0.02	<0.2
0.009	0.035	0.045	0.024	0.015	0.83	17.6
<0.001	0.002	0.001	<0.001	<0.001	0.02	0.2
0.002	0.014	0.027	0.019	0.018	0.08	1.2
<0.001	0.003	0.001	<0.001	0.002	0.04	<0.2
0.024	0.038	0.090	0.14	0.030	2.0	21.0
0.003	0.008	0.018	0.038	0.010	0.30	<1
0.024	0.18	0.50	0.34	0.51	7.6	69.2
0.002	0.001	0.002	0.001	0.004	0.05	0.8
0.025	0.042	0.028	0.057	0.024	2.5	35.2
<0.001	0.003	0.004	0.003	0.005	0.07	0.4
<0.001	0.002	<0.001	<0.001	<0.001	0.01	<0.2
0.002	0.009	0.028	0.023	0.023	0.03	<0.2
<0.001	0.001	<0.001	<0.001	<0.001	0.01	<0.2
0.017	0.11	0.31	0.15	0.56	5.8	70.9
0.004	0.012	0.036	0.019	0.041	0.44	4.1
0.012	0.13	1.3	0.076	0.16	18	28.0
<0.001	0.003	0.003	<0.001	<0.001	0.05	1.8
0.006	0.030	0.034	0.034	0.057	0.64	6.7
0.002	0.004	<0.001	<0.001	0.002	0.05	7.0
0.001	0.006	0.004	0.002	0.002	0.03	1.6
<0.001	0.008	0.006	0.003	0.002	0.05	1.4
<0.001	0.004	0.005	0.002	0.002	0.04	0.8
0.001	0.009	0.006	0.005	0.007	0.03	2.4
0.002	0.009	0.010	0.004	0.002	0.09	1.4
0.001	0.008	0.009	0.005	0.002	0.05	1.2
0.002	0.014	0.032	0.019	0.005	0.50	3.6
0.006	0.032	0.038	0.015	0.043	0.42	10.0
<0.001	0.002	<0.001	<0.001	<0.001	0.01	<0.2
0.003	0.006	0.009	0.026	0.004	0.19	1.0
<0.001	0.004	<0.001	<0.001	<0.001	<0.02	0.6
<0.001	<0.001	0.070	<0.001	<0.001	0.66	0.8
0.001	0.003	0.019	0.003	0.003	0.15	1.2
0.003	0.010	0.033	0.005	0.020	0.18	4.8
<0.001	0.004	0.095	0.017	0.089	1.1	2.4
<0.001	0.002	0.024	0.014	0.056	0.28	0.8
0.003	0.012	0.035	0.043	0.032	0.50	2.0
0.003	0.012	0.040	0.041	0.064	0.55	1.4
0.004	0.009	0.068	0.023	0.027	1.3	0.8
0.001	0.004	0.027	0.007	0.014	0.05	0.2
0.016	0.10	0.20	0.080	0.052	2.4	20.0
<0.001	0.005	0.002	<0.001	<0.001	0.02	1.2
0.009	0.020	0.035	0.021	0.025	0.03	14.0
0.001	0.004	0.11	0.092	0.002	0.16	1.6
<0.001	0.002	0.026	0.011	0.038	0.03	0.6

Table 3 Continued

ICES Area	ICES Rectangle	Species	Number in Sample	Date 1974	Organ	α HCH
Near water IV B	37 F3	Cod	1	Jan	Liver	0.056
					Muscle	<0.001
"	"	"	1	Jan	Liver	0.054
					Muscle	<0.001
"	"	"	1	Jan	Liver	0.082
					Muscle	0.004
"	39 F5	"	1	Jan	Liver	0.007
					Muscle	0.001
"	41 F3	"	10	Jan	Liver	0.027
					Muscle	<0.001
"	37 F3	Plaice	10	Jan	Liver	0.005
					Muscle	0.001
"	"	"	6	Jan	Liver	0.006
					Muscle	<0.001
"	39 F5	Haddock	10	Jan	Liver	0.065
					Muscle	0.001
"	41 F3	"	10	Jan	Liver	0.054
					Muscle	0.001
"	41 F3	"	1	Jan	Liver	0.048
					Muscle	<0.001
VI A	47 E4	Dogfish	8	Jul	Liver	0.003
					Muscle	<0.001
IV B	41 F2	Witch	1	Jan	Liver	0.005
					Muscle	0.002
V B	"	Blue Whiting	14	Mar	Muscle	<0.001

γ HCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.019	0.017	0.27	0.097	0.22	2.4	52.0
<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	1.6
0.015	0.082	0.62	0.27	0.74	12	49.6
<0.001	<0.001	<0.001	<0.001	<0.001	0.02	1.2
0.035	0.019	0.33	0.30	0.46	3.8	59.2
0.001	0.001	0.001	0.006	0.018	0.01	0.8
0.008	<0.005	0.20	0.012	<0.015	2.3	42.8
<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.2
0.009	0.068	0.47	0.23	0.52	5.0	51.6
<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.2
0.003	0.012	0.030	0.021	0.017	0.31	8.4
<0.001	0.002	0.002	0.001	0.002	0.03	0.4
0.003	0.013	0.022	0.008	0.017	0.28	5.6
<0.001	<0.001	0.002	0.002	0.001	0.03	<0.2
0.024	0.10	0.098	0.055	0.14	1.5	25.2
0.001	0.001	<0.001	<0.001	<0.001	<0.01	<0.2
0.019	0.099	0.11	0.071	0.25	1.6	21.0
0.001	0.002	<0.001	<0.001	<0.001	<0.01	0.6
0.023	0.008	0.11	0.11	0.11	1.3	48.0
<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.2
0.002	0.021	0.037	0.013	0.080	0.43	44.4
<0.001	0.003	0.015	0.004	0.024	0.10	3.0
0.002	0.008	0.020	0.003	0.011	0.17	8.0
<0.001	0.004	0.002	0.001	0.007	0.08	3.8
<0.001	0.002	0.002	<0.001	0.002	0.01	<0.2

Table 4 Results of the expanded monitoring programme 1974: metals in shellfish

(concentrations in mg/kg wet weight)

ICES Area	Position	ICES Rectangle	Species	Number in Sample	Date 1974	Organ	Mercury Min	Mercury Max	Mercury Mean
IV B	Off Tyne	39 E9	Crab	5	Mar	Body	0.07	0.15	0.10
						Claw	0.12	0.32	0.26
,,	Whitby	37 E9	,,	6	Jun	Body	0.22	0.40	0.30
						Claw	0.21	0.40	0.26
IV B	Rosse Spit	36 F0	,,	1	Feb	Body	–	–	0.03
						Claw	–	–	0.07
IV C	Cromer	34 F1	,,	6	May	Body	0.11	0.22	0.14
						Claw	0.13	0.22	0.18
IV B	Whitby	37 E9	Lobster	6	Jun	Body	0.19	0.28	0.24
						Claw	0.09	0.30	0.20
						Tail	0.18	0.61	0.40
			Crab						
IV B	Tees	38 E8	Hermit	3	Feb	Whole	–	–	0.06
,,	,,	,,	,,	6	Feb	,,	–	–	0.15
,,	Outer Humber	36 F1	,,	4	Feb	,,	–	–	0.03
,,	Rosse Spit	36 F0	,,	1	Feb	,,	–	–	0.03
,,	,,	,,	,,	1	Feb	,,	–	–	0.02
,,	Humber	36 F0	,,	3	Feb	,,	–	–	0.03
,,	Rosse Spit	,,	,,	10	Feb	,,	–	–	0.01
IV C	Southwold	33 F1	,,	15	Nov	,,	–	–	0.11
,,	Gunfleet	32 F1	,,	3	Dec	,,	–	–	0.21
VII D	Nab Dumping Ground	30 E9	,,	11	Nov	,,	–	–	0.09
VII A	N W Light Float	36 E6	,,	1	Oct	,,	–	–	0.20
			Shrimp						
IV B	Tyne	39 E9	Brown	40	Feb	Whole	–	–	0.08
,,	,,	,,	,,	60	Feb	,,	–	–	0.07
,,	,,	,,	,,	30	Feb	,,	–	–	0.08
,,	Tees	38 E8	,,	40	Feb	,,	–	–	0.09
,,	,,	,,	,,	42	Feb	,,	–	–	0.12
IV C	Gunfleet	32 F1	,,	56	Dec	,,	–	–	0.15
,,	,,	,,	,,	105	Dec	,,	–	–	0.19
VII A	Lytham	36 E7	,,	100	Feb	,,	–	–	0.18
			Shrimp						
IV B	Tyne	39 E9	Pink	18	Feb	Whole	–	–	0.09
,,	,,	,,	,,	30	Feb	,,	–	–	0.11
,,	,,	,,	,,	31	Feb	,,	–	–	0.08
,,	,,	,,	,,	60	Mar	,,	–	–	0.17
,,	,,	,,	,,	14	Mar	,,	–	–	0.15
,,	Tees	38 E8	,,	38	Feb	,,	–	–	0.09
,,	,,	,,	,,	92	Feb	,,	–	–	0.07
,,	,,	,,	,,	30	Feb	,,	–	–	0.08
,,	,,	36 F0	,,	108	Feb	,,	–	–	0.07
IV B	Tyne	39 E9	Whelk	1	Mar	Whole	–	–	0.41
,,	,,	,,	,,	2	Feb	,,	–	–	0.25
,,	,,	,,	,,	1	Feb	,,	–	–	0.20
,,	,,	,,	,,	2	Feb	,,	–	–	0.15
,,	,,	38 E8	,,	5	Feb	,,	–	–	0.21
,,	,,	,,	,,	3	Feb	,,	–	–	0.04

Cadmium			Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
<0.2	1.7	<0.9	<0.2	0.4	<0.3	<0.2	2.9	<0.9	7.0	43	24	11	65	41
<0.2	<0.2	<0.2	<0.2	0.6	<0.3	<0.2	0.6	<0.3	60	80	67	7.0	15	12
0.8	2.1	1.6	<0.2	0.4	<0.3	0.3	0.9	0.6	22	43	36	50	110	83
<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	0.3	<0.3	63	79	74	13	23	19
–	–	5.2	–	–	<0.2	–	–	0.8	–	–	20	–	–	47
–	–	<0.2	–	–	<0.2	–	–	0.2	–	–	38	–	–	9
2.4	7.2	4.1	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	26	36	30	39	76	59
<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	67	87	79	16	26	20
<0.2	0.5	<0.3	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	13	27	22	100	420	200
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	44	64	51	22	40	30
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	12	17	15	11	24	17
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	0.3	–	–	<0.2	–	–	0.3	–	–	43	–	–	110
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	0.5	–	–	0.3	–	–	0.2	–	–	35	–	–	90
–	–	0.4	–	–	0.8	–	–	0.5	–	–	49	–	–	77
–	–	0.4	–	–	0.5	–	–	0.7	–	–	31	–	–	85
–	–	0.2	–	–	<0.2	–	–	–	–	–	35	–	–	130
–	–	0.2	–	–	0.4	–	–	2.1	–	–	30	–	–	70
–	–	<0.2	–	–	0.6	–	–	1.6	–	–	23	–	–	96
–	–	<0.2	–	–	<0.2	–	–	0.3	–	–	19	–	–	17
–	–	0.4	–	–	<0.2	–	–	<0.2	–	–	18	–	–	20
–	–	<0.2	–	–	0.3	–	–	<0.2	–	–	9.0	–	–	32
–	–	<0.2	–	–	0.8	–	–	1.0	–	–	25	–	–	23
–	–	<0.2	–	–	0.4	–	–	<0.2	–	–	10	–	–	12
–	–	<0.2	–	–	<0.2	–	–	–	–	–	16	–	–	22
–	–	<0.2	–	–	0.2	–	–	–	–	–	21	–	–	30
–	–	0.3	–	–	14.0	–	–	1.0	–	–	40	–	–	24
–	–	<0.2	–	–	0.3	–	–	<0.2	–	–	18	–	–	17
–	–	<0.2	–	–	0.6	–	–	0.5	–	–	18	–	–	20
–	–	<0.2	–	–	0.7	–	–	<0.2	–	–	20	–	–	19
–	–	<0.2	–	–	0.7	–	–	0.4	–	–	20	–	–	12
–	–	<0.2	–	–	0.3	–	–	<0.2	–	–	19	–	–	12
–	–	<0.2	–	–	1.0	–	–	<0.2	–	–	23	–	–	20
–	–	<0.2		–	0.2	–	–	<0.2	–	–	23	–	–	16
–	–	<0.2	–	–	0.4	–	–	<0.2	–	–	15	–	–	13
–	–	<0.2	–	–	0.4	–	–	<0.2	–	–	22	–	–	14
–	–	3.0	–	–	0.2	–	–	0.6	–	–	190	–	–	190
–	–	1.6	–	–	0.4	–	–	1.3	–	–	170	–	–	170
–	–	<0.2	–	–	<0.2	–	–	2.5	–	–	10	–	–	22
–	–	2.2	–	–	<0.2	–	–	1.0	–	–	140	–	–	130
–	–	0.8	–	–	<0.2	–	–	1.1	–	–	110	–	–	20
–	–	0.8	–	–	<0.2	–	–	3.7	–	–	75	–	–	34

Table 4 Continued

ICES Area	Position	ICES Rectangle	Species	Number in Sample	Date 1974	Organ	Mercury Min	Mercury Max	Mercury Mean
IV B	Rosse Spit	36 FO	Whelk	1	Feb	Whole	–	–	0.07
”	”	”	”	3	Feb	”	–	–	0.06
”	”	”	”	5	Feb	”	–	–	0.07
”	”	”	”	4	Feb	”	–	–	0.07
”	”	”	”	1	Feb	”	–	–	0.03
”	Humber	”	”	1	Feb	”	–	–	0.15
”	”	”	”	5	Feb	”	–	–	0.07
”	”	”	”	2	Feb	”	–	–	0.06
”	”	”	”	5	Feb	”	–	–	0.05
IV C	Southwold	33 F1	”	14	Nov	”	–	–	0.08
”	Falls Dumping Ground	32 F1	”	12	Nov	”	–	–	0.48
”	Whitstable	31 F1	”	10	Jun	”	–	–	0.22
”	R. Medway	31 F0	”	19	Jul	”	–	–	0.84
VII D	Nab Dumping Ground	30 E9	”	17	Nov	”	–	–	0.06
VII A	Morecambe Bay	36 E6	”	27	Feb	”	–	–	0.63
IV B	Tyne	39 E9	*Neptunea*	1	Mar	Whole	–	–	0.34
”	”	”	”	2	Feb	”	–	–	0.12
”	”	”	”	1	Feb	”	–	–	0.05
”	”	”	”	5	Feb	”	–	–	0.11
”	”	”	”	2	Feb	”	–	–	0.10
”	”	38 E8	”	15	Feb	”	–	–	0.09
”	”	”	”	1	Feb	”	–	–	0.11
”	Humber	36 F0	”	3	Feb	”	–	–	0.04
VII A	Portmadoc	34 E5	Mussel	12	Mar	Whole	–	–	0.05
”	”	”	”	13	Mar	”	–	–	0.05
”	”	”	”	15	Mar	”	–	–	0.05
”	Conwy	35 E6	”	6	Feb	”	–	–	0.11
”	”	”	”	30	Mar	”	–	–	0.13
”	Heysham	37 E7	”	12	Apr	”	–	–	0.11
”	”	”	”	47	Apr	”	–	–	0.17
”	Roosebeck	37 E6	”	40	Apr	”	–	–	0.15
IV B	Humber	36 F0	Horse Mussel	5	Feb	Whole	–	–	0.11
”	”	”	”	7	Feb	”	–	–	0.05
”	Rosse Spit	”	”	1	Feb	”	–	–	0.14
VII E	Plymouth	29 E5	Queen	9	Jan	Whole	–	–	0.05
”	Salcombe	”	”	28	Apr	Muscle	–	–	0.04
”	”	”	”	28	Apr	Gonad	–	–	0.05
VII A	N W Light Float	36 E6	”	20	Oct	Muscle	–	–	0.09
VII A	Fareham	30 E8	Oyster	6	Feb	Whole	–	–	0.13
VII F	Swansea Bay	32 E6	”	2	Aug	”	–	–	0.36
VII D	Bexhill-on-Sea	30 F0	Cuttlefish	1	Apr	Body	–	–	0.08
”	”	”	”	1	Apr	Tentacles	–	–	0.09
”	”	”	”	1	Apr	Body	–	–	0.14
”	”	”	”	1	Apr	Tentacles	–	–	0.09
”	”	”	”	1	Apr	Body	–	–	0.08
”	”	”	”	1	Apr	Tentacles	–	–	0.07

Cadmium			Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
–	–	2.0	–	–	0.5	–	–	3.0	–	–	300	–	–	46
–	–	<0.2	–	–	<0.2	–	–	2.0	–	–	14	–	–	11
–	–	0.4	–	–	0.3	–	–	0.5	–	–	62	–	–	21
–	–	1.4	–	–	<0.2	–	–	1.6	–	–	50	–	–	24
–	–	0.2	–	–	0.3	–	–	3.8	–	–	15	–	–	17
–	–	1.7	–	–	0.3	–	–	3.8	–	–	130	–	–	29
–	–	0.7	–	–	0.3	–	–	3.0	–	–	100	–	–	25
–	–	1.5	–	–	0.2	–	–	1.6	–	–	60	–	–	32
–	–	0.2	–	–	<0.2	–	–	2.0	–	–	44	–	–	25
–	–	0.3	–	–	0.4	–	–	0.7	–	–	23	–	–	34
–	–	0.2	–	–	0.3	–	–	0.9	–	–	30	–	–	30
–	–	5.0	–	–	0.2	–	–	0.8	–	–	220	–	–	44
–	–	2.5	–	–	0.3	–	–	<0.2	–	–	240	–	–	85
–	–	0.3	–	–	0.3	–	–	0.7	–	–	27	–	–	23
–	–	0.8	–	–	0.8	–	–	0.5	–	–	180	–	–	66
–	–	5.0	–	–	0.4	–	–	1.6	–	–	200	–	–	250
–	–	3.8	–	–	0.9	–	–	6.2	–	–	500	–	–	54
–	–	2.0	–	–	0.4	–	–	1.7	–	–	620	–	–	37
–	–	8.4	–	–	0.5	–	–	3.2	–	–	1600	–	–	60
–	–	5.6	–	–	0.6	–	–	5.3	–	–	660	–	–	75
–	–	2.0	–	–	0.7	–	–	1.7	–	–	270	–	–	70
–	–	1.6	–	–	0.8	–	–	1.4	–	–	360	–	–	59
–	–	0.5	–	–	0.4	–	–	1.0	–	–	29	–	–	25
–	–	0.3	–	–	0.8	–	–	<0.2	–	–	18	–	–	0.7
–	–	0.2	–	–	1.0	–	–	<0.2	–	–	14	–	–	0.3
–	–	0.3	–	–	<0.2	–	–	<0.2	–	–	19	–	–	0.8
–	–	<0.2	–	–	1.3	–	–	0.7	–	–	21	–	–	1.8
–	–	0.4	–	–	0.7	–	–	0.9	–	–	21	–	–	1.0
–	–	0.5	–	–	1.9	–	–	0.7	–	–	20	–	–	1.6
–	–	0.3	–	–	1.8	–	–	1.6	–	–	35	–	–	2.3
–	–	0.4	–	–	2.4	–	–	0.7	–	–	28	–	–	1.9
–	–	0.7	–	–	6.6	–	–	3.8	–	–	120	–	–	7.0
–	–	0.2	–	–	2.8	–	–	1.5	–	–	72	–	–	10
–	–	1.1	–	–	4.0	–	–	3.3	–	–	120	–	–	5.0
–	–	0.3	–	–	0.5	–	–	<0.2	–	–	26	–	–	1.0
–	–	0.9	–	–	0.6	–	–	0.5	–	–	36	–	–	2.3
–	–	0.4	–	–	1.2	–	–	0.5	–	–	49	–	–	2.0
–	–	0.3	–	–	0.4	–	–	0.8	–	–	50	–	–	3.4
–	–	0.4	–	–	0.4	–	–	<0.2	–	–	400	–	–	35
–	–	1.8	–	–	1.3	–	–	<0.2	–	–	430	–	–	80
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	10	–	–	2.5
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	14	–	–	12
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	11	–	–	4.5
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	16	–	–	10
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	14	–	–	1.8
–	–	<0.2	–	–	<0.2	–	–	<0.2	–	–	15	–	–	17

Table 5 Results of the expanded monitoring programme 1974: organochlorine pesticides and PCB residues in shellfish (concentrations in mg/kg wet weight)

ICES Area	Position	ICES Rectangle	Species	Number in Sample	Date 1974	Organ
IV B	Off Tyne	39 E9	Crab	5	Mar	Body
						Claw
"	Whitby	37 E9	"	6	Jun	Body
						Claw
IV B	Rosse Spit	36 FO	"	1	Feb	Body
						Claw
IV C	Cromer	34 F1	"	6	May	Body
						Claw
IV B	Whitby	37 E9	Lobster	6	Jun	Body
						Claw
						Tail
IV B	Tees	38 E8	Crab Hermit	3	Feb	Whole
"	"	"	"	6	Feb	"
"	Outer Humber	36 F1	"	4	Feb	"
"	Rosse Spit	36 FO	"	1	Feb	"
"	Humber	"	"	3	Feb	"
"	Rosse Spit	"	"	10	Feb	"
IV C	Southwold	33 F1	"	15	Nov	"
VII D	Nab dumping ground	30 E9	"	11	Nov	"
VII A	N W Light Float	36 E6	"	1	Oct	"
IV B	Tyne	39 E9	Shrimp Brown	40	Feb	Whole Unpeeled
"	"	"	"	60	Feb	"
"	"	"	"	30	Feb	"
IV B	Tees	38 E8	"	40	Feb	"
"	"	"	"	42	Feb	"
IV C	Gunfleet	32 F1	"	56	Dec	"
"	"	"	"	105	Dec	"
VII A	Lytham	36 E7	"	200	Feb	"
IV B	Tyne	39 E9	Shrimp Pink	18	Feb	Whole Unpeeled
"	"	"	"	31	Feb	"
"	"	"	"	30	Feb	"
"	"	"	"	60	Mar	"
"	"	"	"	14	Mar	"
IV B	Tees	38 E8	"	38	Feb	"
"	"	"	"	92	Feb	"
"	"	"	"	30	Feb	"
IV B	Humber	36 FO	"	108	Feb	"
IV B	Tyne	39 E9	Whelk	1	Mar	Whole
"	"	"	"	2	Feb	"
"	"	"	"	1	Feb	"
"	"	"	"	2	Feb	"

αHCH	γHCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.001	<0.001	0.003	0.001	<0.001	<0.001	0.01	6.8
0.001	0.001	0.003	0.001	0.001	<0.001	0.01	1.2
0.028	0.020	0.015	0.067	<0.005	<0.008	0.58	18.6
0.002	<0.001	0.003	0.003	<0.001	0.002	0.43	0.4
0.002	<0.001	0.003	0.038	0.003	0.002	0.27	27.2
0.010	0.003	0.017	0.007	0.005	0.004	0.07	2.4
0.024	0.021	0.034	0.10	0.013	<0.02	0.63	14.2
0.001	0.001	0.004	0.001	<0.001	<0.001	<0.01	0.2
0.019	0.013	0.095	0.058	0.045	0.042	1.6	17.0
<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.01	0.2
<0.001	<0.001	0.006	<0.001	<0.001	<0.001	0.01	0.4
0.005	0.005	0.028	0.010	0.010	0.006	0.22	4.0
0.002	0.002	0.013	0.005	0.009	0.009	0.14	4.8
0.001	0.003	0.021	0.003	0.005	0.005	0.16	60.0
0.004	0.005	0.023	0.007	0.026	0.005	0.10	4.0
0.003	0.003	0.018	0.003	0.006	0.003	0.08	7.2
0.003	0.002	0.015	0.002	0.013	0.003	0.04	5.2
0.004	0.002	0.022	0.009	0.007	0.002	0.17	7.0
<0.001	0.002	0.012	0.005	0.005	<0.002	0.23	4.4
0.004	0.002	0.018	0.055	0.028	0.052	0.94	67.6
0.002	0.001	0.005	0.003	<0.001	0.003	0.11	<1
<0.001	<0.001	0.001	0.001	<0.001	0.002	0.02	2.8
0.002	<0.001	0.003	0.001	<0.001	0.001	0.02	<1
0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.02	2.0
0.001	0.001	0.002	<0.001	<0.001	<0.004	<0.02	<1
<0.001	<0.001	0.001	0.002	0.002	0.002	0.04	1.0
<0.001	<0.001	0.001	0.003	0.002	0.002	0.02	0.6
0.002	0.001	0.004	0.011	0.012	0.008	0.10	1.2
0.002	0.002	0.006	<0.001	0.002	0.002	0.04	<1
0.002	0.003	0.006	0.002	0.001	<0.001	0.04	<1
0.002	0.004	0.004	0.003	<0.001	<0.001	0.04	<1
0.001	0.001	0.003	0.001	0.001	0.001	0.02	2.4
0.001	0.001	0.005	0.004	0.001	0.004	0.05	1.0
0.001	0.001	0.005	0.003	<0.001	<0.001	0.03	<1
0.002	0.001	0.006	0.003	0.002	0.001	0.04	<1
0.002	0.004	0.005	0.004	<0.001	0.001	0.04	<1
<0.001	<0.001	<0.001	0.004	0.001	0.001	0.05	<1
<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.01	0.4
0.001	<0.001	0.002	0.007	0.005	0.002	0.07	0.8
0.001	0.001	0.002	0.026	0.009	0.003	0.24	0.4
<0.001	0.001	0.003	0.017	0.006	0.002	0.16	1.6

Table 5 Continued

ICES Area	Position	ICES Rectangle	Species	Number in Sample	Date 1974	Organ
IV B	Tees	38 E8	Whelk	5	Feb	Whole
				3	Feb	”
”	Rosse Spit	36 FO	”	1	Feb	”
”	”	”	”	3	Feb	”
”	”	”	”	5	Feb	”
”	”	”	”	4	Feb	”
”	”	”	”	1	Feb	”
”	Humber	36 FO	”	1	Feb	”
”	”	”	”	5	Feb	”
”	”	”	”	2	Feb	”
”	”	”	”	5	Feb	”
IVC	Southwold	33 F1	”	14	Nov	”
	Falls Dumping Ground	32 F1	”	12	Nov	”
VII D	Nab Dumping Ground	30 E9	”	17	Nov	”
VII A	Morecambe Bay	36 E6	”	27	Feb	”
IV B	Tyne	39 E9	*Neptunea*	1	Mar	Whole
”	”	”	”	2	Feb	”
”	”	”	”	1	Feb	”
”	”	”	”	5	Feb	”
”	”	”	”	2	Feb	”
”	Tees	38 E8	”	15	Feb	”
”	”	”	”	1	Feb	”
”	Humber	36 FO	”	3	Feb	”
VII A	Heysham	37 E7	Mussels	12	Apr	Whole
	”	”	”	47	Apr	”
	Roosebeck	37 E6	”	40	Apr	”
IV B	Humber	36 FO	Horse Mussels	5	Feb	Whole
	”	”	”	7	Feb	”
	Rosse Spit	”	”	1	Feb	”
VII E	Salcombe	29 E6	Queens	28	Apr	Muscle
	”	”	”	28	Apr	Gonad
VII A	N W Light Float	36 E6	”	20	Oct	Muscle

αHCH	γHCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
<0.001	<0.001	<0.001	0.002	0.001	<0.001	0.01	0.6
<0.001	0.001	0.005	0.011	0.011	0.003	0.13	1.8
<0.001	<0.001	0.002	0.002	0.003	<0.001	0.02	<0.2
<0.001	<0.001	0.002	0.001	0.001	<0.001	0.01	0.2
<0.001	<0.001	0.001	0.006	0.002	<0.001	0.03	0.2
<0.001	<0.001	0.002	0.002	0.002	<0.001	0.01	<0.2
<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.01	<0.8
<0.001	<0.001	0.002	0.003	0.002	0.001	0.02	0.2
<0.001	<0.001	0.002	0.002	0.002	<0.001	0.01	0.2
<0.001	0.001	0.005	0.003	0.004	<0.001	0.02	0.4
<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.01	0.4
<0.001	<0.001	0.003	0.003	0.002	0.002	0.06	<1
<0.001	<0.001	0.002	0.002	0.001	<0.001	0.06	<0.2
<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.02	<1
0.002	0.003	0.005	0.013	0.014	0.002	0.21	0.6
0.001	<0.001	0.004	0.012	0.011	<0.002	0.14	5.6
0.002	<0.001	0.003	0.009	0.003	<0.001	0.08	3.6
0.001	<0.001	0.003	0.005	0.002	<0.001	0.09	4.4
0.002	<0.001	0.002	<0.001	<0.001	<0.001	0.01	2.8
0.002	<0.001	0.004	0.003	0.007	<0.001	0.04	2.4
0.001	0.002	0.003	0.001	<0.001	<0.002	0.02	2.0
0.001	<0.001	0.004	0.003	0.004	<0.001	0.05	2.8
0.002	0.002	0.002	<0.001	0.001	<0.001	<0.01	<1
0.001	0.001	0.004	0.002	0.007	0.002	0.04	0.6
0.002	0.002	0.005	0.003	0.008	0.003	0.11	0.8
0.002	0.002	0.005	0.003	0.006	0.001	0.04	0.8
0.001	0.002	0.004	0.001	0.002	0.001	0.02	2.2
0.001	0.004	0.005	0.001	<0.001	<0.002	<0.01	4.0
0.003	0.001	0.005	<0.001	0.005	0.002	0.02	2.0
0.003	0.002	0.006	0.002	<0.002	<0.003	0.09	0.7
<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.01	0.2
0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.01	0.2

Table 6 Mean concentration of metals in fish muscle 1974 (concentrations in mg/kg wet weight)

Geographical Zone	Species	Number of Samples	Number of Fish	Mercury Min	Mercury Max	Mercury Mean	Chromium Min	Chromium Max	Chromium Mean
Inshore	Bass	1	11	0.60	2.4	1.4	<0.2	0.2	<0.2
	Cod	10	64	0.04	0.32	0.11	<0.2	<0.2	<0.2
	Dab	2	11	0.22	0.65	0.37	<0.2	0.2	0.2
	Dogfish	4	29	0.12	2.1	0.60	<0.2	<0.2	<0.2
	Dragonet	7	56	0.02	0.33	0.09	<0.2	<0.2	<0.2
	Herring	6	50	0.02	0.80	0.14	<0.2	0.2	<0.2
	Scad	1	3	0.21	0.40	0.32	<0.2	<0.2	<0.2
	Lemon Sole	2	8	0.06	0.34	0.18	<0.2	<0.2	<0.2
	Mackerel	4	33	0.02	0.56	0.09	<0.2	0.3	<0.2
	Plaice	11	105	0.03	0.50	0.25	<0.2	0.2	<0.2
	Pout Whiting	3	29	0.04	0.49	0.24	<0.2	<0.2	<0.2
	Ray	1	10	0.14	0.26	0.21	<0.2	<0.2	<0.2
	Sea Bream	1	1	–	–	1.5	–	–	<0.2
	Sprat (Whole)	1	10	–	–	0.04	–	–	<0.2
	Whiting	8	76	0.06	0.47	0.20	<0.2	0.2	<0.2
Near water	Blue Whiting	1	14	0.04	0.13	0.09	<0.2	<0.2	<0.2
	Cod	7	40	0.03	0.22	0.07	<0.2	<0.4	<0.2
	Dogfish	2	20	0.08	0.85	0.26	<0.2	<0.2	<0.2
	Haddock	3	21	<0.01	0.07	0.05	<0.2	<0.4	<0.2
	Herring	1	1	–	–	0.07	–	–	<0.2
	Mackerel	1	6	0.07	0.15	0.09	<0.2	<0.2	<0.2
	Plaice	5	48	0.02	0.19	0.05	<0.2	<0.3	<0.2
	Whiting	2	20	0.01	0.20	0.10	<0.2	0.2	<0.2
	Witch	1	1	–	–	0.11	–	–	<0.3

Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
<0.2	<0.2	<0.2	<0.2	1.6	<0.3	1.6	4.5	3.0	<0.2	0.5	<0.3
<0.1	0.7	<0.3	<0.2	0.9	<0.3	1.8	5.5	4.0	<0.2	1.0	0.4
<0.2	0.5	0.3	<0.2	0.5	<0.3	2.4	4.4	3.1	<0.2	0.6	0.4
<0.2	1.4	0.5	<0.2	1.6	0.4	2.0	13	3.7	<0.2	3.9	0.6
<0.2	0.7	0.2	0.3	1.9	0.7	4.0	16	9.3	0.4	1.6	0.9
<0.2	0.4	<0.2	<0.2	3.0	<0.3	3.2	13	6.5	0.7	3.3	1.4
<0.2	<0.2	<0.2	<0.3	0.3	<0.3	2.0	4.0	3.0	0.9	1.2	1.0
0.2	0.7	0.5	<0.2	1.4	<0.7	2.0	5.0	3.5	0.5	0.9	0.7
<0.2	0.3	<0.2	<0.2	0.3	<0.2	2.0	11	4.5	0.6	1.7	1.4
<0.2	1.0	0.2	<0.2	5.4	<0.3	2.2	7.4	3.9	<0.2	1.7	0.5
<0.2	0.8	0.4	<0.2	1.0	<0.4	2.0	6.0	3.0	0.3	1.0	0.6
0.3	0.7	0.4	<0.2	<0.2	<0.2	4.3	6.3	4.9	<0.2	1.2	<0.6
–	–	H <0.2	–	–	0.6	–	–	3.0	–	–	0.4
–	–	<0.2	–	–	1.2	–	–	15	–	–	0.9
<0.2	0.7	0.2	<0.2	4.0	<0.3	0.8	8.0	3.5	<0.2	3.9	0.6
<0.2	0.3	<0.2	<0.2	0.5	<0.3	4.9	8.5	6.2	0.4	1.2	0.7
<0.1	0.6	0.2	<0.2	2.4	0.3	2.7	4.5	3.4	0.1	1.5	0.4
<0.2	0.3	<0.2	<0.2	0.8	0.3	1.0	5.0	3.0	0.3	1.0	0.7
<0.1	0.5	0.2	<0.2	<0.3	<0.3	2.6	5.5	3.7	0.3	0.5	0.3
–	–	<0.2	–	–	<0.2	–	–	4.8	–	–	1.0
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	4.6	6.5	5.5	0.2	1.2	0.7
<0.1	0.4	0.2	<0.2	1.0	<0.3	2.5	5.9	4.3	0.1	1.8	<0.4
<0.2	0.4	0.2	<0.2	0.3	<0.2	2.2	5.0	3.2	<0.2	0.9	0.5
–	–	0.3	–	–	<0.2	–	–	3.3	–	–	0.2

Table 7 Mean concentrations of organochlorine pesticide and PCB residues in fish 1974 (concentrations in mg/kg wet weight)

Geographical Zone	Species	Number of Samples	Number of Fish	Organ	∝HCH
Inshore	Bass	1	11	Liver	0.002
				Muscle	<0.001
	Cod	10	64	Liver	0.030
				Muscle	0.001
	Dab	2	11	Liver	–
				Muscle	<0.001
	Dogfish	3	27	Liver	0.020
				Muscle	0.004
	Dragonet	7	56	Whole	0.001
	Herring	6	50	Liver	0.003
				Muscle	0.006
	Scad	1	3	Liver	<0.001
				Muscle	<0.001
	Lemon Sole	2	8	Liver	0.008
				Muscle	<0.001
	Mackerel	4	33	Liver	0.007
				Muscle	0.005
	Plaice	11	105	Liver	0.008
				Muscle	0.002
	Pout Whiting	3	29	Liver	–
				Muscle	0.001
	Ray	1	10	Liver	0.028
				Muscle	<0.001
	Sea Bream	1	1	Liver	<0.001
				Muscle	<0.001
	Sprat	1	10	Liver	–
				Muscle	0.008
	Whiting	8	76	Liver	0.020
				Muscle	0.001

γ HCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.004	0.009	0.068	0.023	0.027	1.3	0.8
0.001	0.004	0.027	0.007	0.014	0.05	0.2
0.016	0.14	0.19	0.18	0.50	5.0	25.9
0.001	0.003	0.001	0.001	<0.003	0.03	0.5
—	—	—	—	—	—	—
<0.001	0.001	0.060	0.001	<0.001	0.60	0.8
0.020	0.090	0.33	0.12	0.44	5.8	55.8
0.003	0.010	0.030	0.030	0.030	0.34	4.5
0.001	0.008	0.010	0.005	0.003	0.13	1.9
0.002	0.007	0.016	0.006	0.010	0.15	1.5
0.004	0.015	0.030	0.010	0.040	0.29	5.9
<0.001	0.004	0.095	0.017	0.089	1.1	2.4
<0.001	0.002	0.024	0.014	0.056	0.28	0.8
0.006	0.030	0.040	0.015	0.043	0.42	10.0
0.002	0.004	0.005	0.014	0.003	0.10	0.6
0.005	0.030	0.020	0.020	0.60	0.51	8.0
0.004	0.020	0.010	0.011	0.040	0.22	9.2
0.008	0.029	0.042	0.047	0.040	1.1	12.2
0.002	0.006	0.003	0.005	0.002	0.36	0.5
—	—	—	—	—	—	—
0.001	0.003	0.009	0.008	0.008	0.09	< 0.2
0.016	0.10	0.20	0.080	0.050	2.4	2.0
<0.001	0.005	0.002	<0.001	<0.001	0.02	1.2
0.001	0.004	0.11	0.002	0.002	0.16	1.6
<0.001	0.002	0.026	0.011	0.038	0.03	0.6
—	—	—	—	—	—	—
0.009	0.020	0.030	0.020	0.030	0.26	14.0
0.20	0.10	0.32	0.21	0.34	6.8	56.3
0.001	0.002	0.002	0.003	0.004	0.06	0.1

Table 7 Continued

Geographical Zone	Species	Number of Samples	Number of Fish	Organ	αHCH
Near water	Blue Whiting	1	14	Liver	–
				Muscle	<0.001
	Cod	7	40	Liver	0.028
				Muscle	<0.001
	Dogfish	1	8	Liver	0.003
				Muscle	<0.001
	Haddock	3	21	Liver	0.60
				Muscle	0.001
	Mackerel	1	6	Liver	0.005
				Muscle	0.002
	Plaice	4	38	Liver	0.006
				Muscle	<0.001
	Whiting	2	20	Liver	0.40
				Muscle	<0.001
	Witch	1	1	Liver	0.005
				Muscle	0.002

γHCH	Dieldrin	DDE	DDD	DDT	PCB	% Lipid
–	–	–	–	–	–	–
<0.001	<0.001	0.002	<0.001	0.002	<0.01	< 0.2
0.016	0.068	0.023	0.13	0.24	3.0	13.1
<0.001	0.002	0.001	<0.001	0.002	0.01	0.3
0.002	0.021	0.037	0.013	0.080	0.43	44.4
<0.001	0.003	0.015	0.004	0.024	0.10	3.0
0.020	0.90	0.10	0.070	0.19	1.5	24.3
0.001	0.002	0.001	0.001	0.001	<0.01	0.4
0.005	0.018	0.022	0.016	0.047	0.33	6.8
0.005	0.008	0.010	0.005	0.021	0.21	4.6
0.010	0.013	0.020	0.020	0.020	0.30	6.2
<0.001	0.002	0.002	0.001	0.002	0.03	0.9
0.010	0.12	0.33	0.23	0.50	4.3	36.8
<0.001	0.003	0.003	0.002	0.003	0.02	0.6
<0.002	0.008	0.020	0.003	0.011	0.17	8.0
<0.001	0.004	0.002	0.001	0.007	0.08	3.8

Table 8 Mean concentrations of metals in shellfish 1974 (concentrations in mg/kg wet weight)

Species	Number of Samples	Number of Shellfish	Mercury Min	Mercury Max	Mercury Mean	Cadmium Min	Cadmium Max	Cadmium Mean
Cockles – Whole	1	50	–	–	<0.01	–	–	<0.2
Crab – Claw	4	18	0.12	0.40	0.22	<0.2	<0.2	<0.2
" – Body	4	18	0.07	0.40	0.12	<0.2	7.2	3.9
Cuttlefish – Body	1	3	–	–	0.10	–	–	<0.2
" – Tentacles	1	3	–	–	0.08	–	–	<0.2
Hermit Crab – Whole	14	71	0.01	0.21	0.15	<0.2	0.5	0.3
Horse Mussel	3	13	0.05	0.14	0.08	0.2	1.1	0.5
Lobster – Body	1	6	0.19	0.28	0.24	<0.2	0.5	<0.3
" – Claw	1	6	0.09	0.30	0.20	<0.2	<0.2	<0.2
" – Tail	1	6	1.8	0.61	0.40	<0.2	<0.2	<0.2
Mussels – Whole	8	240	0.05	0.17	0.15	<0.2	0.5	0.3
Neptunea – Whole	8	30	0.04	0.34	0.10	0.5	8.4	3.4
Oyster – Whole	2	8	0.13	0.36	0.18	0.4	1.8	0.8
Queens – Whole	1	9	–	–	0.05	–	–	0.3
" – Muscle	2	48	0.04	0.09	0.06	0.3	0.9	0.7
" – Gonad	1	28	–	–	0.05	–	–	0.4
Shrimps – Brown, Whole, Unpeeled	11	550	0.07	0.19	0.15	<0.2	0.4	0.3
Shrimps – Pink, Whole, Unpeeled	12	459	0.07	0.17	0.09	<0.2	<0.2	<0.2
Whelks – Whole	22	142	0.03	0.84	0.34	<0.2	5.0	1.2

Lead			Chromium			Zinc			Copper		
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
–	–	0.5	–	–	2.9	–	–	16	–	–	1.3
<0.2	0.6	0.2	<0.2	0.6	0.3	67	87	72	7.0	26	17
<0.2	0.4	0.3	<0.2	2.9	0.6	7.0	43	30	11	110	61
–	–	<0.2	–	–	<0.2	–	–	12	–	–	2.9
–	–	<0.2	–	–	<0.2	–	–	15	–	–	13
<0.2	0.8	0.5	0.2	2.1	0.9	23	49	34	70	130	81
2.8	6.6	4.4	1.5	3.3	2.5	72	120	94	5.0	10	8.5
<0.2	0.2	<0.2	<0.2	<0.2	<0.2	13	27	22	10	420	200
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	44	64	51	22	40	30
<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	12	17	15	11	24	17
<0.2	2.4	1.2	<0.2	1.6	1.3	14	35	26	0.3	2.3	1.6
0.4	0.9	0.6	1.0	6.2	2.4	29	1600	520	25	250	68
0.4	1.3	0.6	<0.2	<0.2	<0.2	400	430	410	35	80	46
–	–	0.5	–	–	<0.2	–	–	26	–	–	1.0
0.4	0.6	0.5	0.5	0.8	0.6	36	50	43	2.3	3.4	2.8
–	–	1.2	–	–	0.5	–	–	49	–	–	2.0
<0.2	14	3.2	<0.2	1.0	0.7	9.0	40	22	12	32	23
0.3	1.0	0.5	<0.2	0.5	0.3	15	23	20	12	20	15
<0.2	0.8	0.4	<0.2	3.8	0.9	10	300	110	11	190	49

Table 9 Mean concentrations of organochlorine pesticide and PCB residues (Concentrations in mg/kg wet weight) **in shellfish 1974**

Specimen	Organ	Number of Samples	Number of Shellfish	αHCH	γHCH
Crab	Claw	4	18	0.002	0.001
"	Body	5	19	0.020	0.010
Hermit Crab	Whole	10	58	0.004	0.004
Horse Mussel	Whole	3	13	0.003	0.003
Lobster	Body	1	6	0.019	0.013
"	Claw	1	"	<0.001	<0.001
"	Tail	1	"	<0.001	<0.001
Mussels	Whole	5	139	0.002	0.002
Neptunea	Whole	8	30	0.001	< .002
Oyster	Whole	1	12	<0.001	<0.001
Queens	Whole	1	28		
"	Muscle	2	48	0.002	0.001
"	Gonad	1	28	<0.001	<0.001
Shrimps – Brown	Whole – Unpeeled	8	573	0.001	0.001
Shrimps – Pink	Whole – Unpeeled	10	441	0.002	0.002
Whelks	Whole	22	142	<0.001	<0.001

Dieldrin	DDE	DDD	DDT	PCB	% Lipid
0.004	0.002	0.001	0.002	0.15	0.7
0.59	0.56	0.007	0.009	0.44	14.1
0.025	0.008	0.010	0.005	0.16	6.8
0.005	0.001	0.002	0.002	0.01	3.2
0.095	0.058	0.045	0.042	1.6	17.0
0.003	<0.001	<0.001	<0.001	<0.01	0.2
0.006	<0.001	<0.001	<0.001	0.01	0.4
0.005	0.004	0.009	0.007	0.16	0.6
0.003	0.002	0.002	0.002	0.03	2.4
0.002	0.003	0.002	0.006	0.07	1.4
0.004	0.001	0.001	0.002	0.05	0.5
0.002	<0.001	<0.001	<0.001	<0.01	0.2
0.003	0.005	<0.05	<0.004	0.02	0.9
0.004	0.003	0.001	0.001	0.04	< 0.6
0.002	0.004	0.004	0.001	0.06	0.5

APPENDIX 1 Common and Scientific names

(a) *Fish*

Bass	*Dicentrachus labrax*
Blue Whiting (Couch's Whiting, Poutassou)	*Micromesistius poutassou*
Cod	*Gadus morhua*
Dab	*Limanda limanda*
Dogfish (Lesser-spotted Dogfish, Rough Hound, Sandy Dog)	*Scyliorhinus caniculus*
Dragonet	*Callionymus lyra*
Haddock	*Melanogrammus aeglefinus*
Herring	*Clupea harengus*
Scad (Horse Mackerel)	*Trachurus trachurus*
Lemon Sole	*Microstomus kitt*
Mackerel	*Scomber scombrus*
Plaice	*Pleuronectes platessa*
Pout Whiting (Bib, Pout, Pouting)	*Trisopterus luscus*
Ray (Roker, Thornback Ray)	*Raja clavata*
Sea Bream	*Pagellus bogaraveo*
Sprat	*Sprattus sprattus*
Whiting	*Merlangius merlangus*
Witch (Pole Dab)	*Glyptocephalus cynoglossus*

(b) *Shellfish*

Cockle	*Cardium edule*
Crab – Edible	*Cancer pagurus*
Cuttlefish	*Sepia officinalis*
Hermit Crab	*Eupagurus bernhardus*
Horse Mussel	*Modiolus modiolus*
Lobster	*Homarus vulgaris*
Mussel	*Mytilus edulis*
Oyster	*Ostrea edulis*
Queen (Queen Scallop)	*Chlamys opercularis*
Shrimp, Brown (Common Shrimp)	*Crangon crangon*
Shrimp, Pink (Aesop Prawn)	*Pandalus montagui*
Spindle Shell	*Neptunea antiqua*
Whelk	*Buccinum undatum*

Bas 55435/0791 3/79 TP