Marine Environment & Health Series No. 20 2005

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Foras na Mara

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Marine Environment and Health Series, No. 20, 2005

ABSTRACT

The Marine Institute sample a range of finfish species landed at major Irish ports on an annual basis, in accordance with the monitoring requirements of various European legislation designed to ensure food safety.

During 2003, a total of 45 samples from 22 different species of finfish were collected from five major Irish fishing ports and analysed for total mercury concentration in the edible tissue (Common names and species names are listed in Appendix 3). The concentration of mercury ranged from less than the limit of quantitation (0.03 mg kg^{-1} wet weight) to 0.60 mg kg^{-1} wet weight with a mean and median of 0.08 and 0.06 mg kg^{-1} respectively. The maximum level was found in a dogfish sample (species tentatively identified as Lesser Spotted Dogfish) from Howth. It is most likely that the fish from which this sample was taken were destined for whelk bait and as such there are no human health implications. The remainder of the mercury levels were within the maximum limit of 0.50 mg kg^{-1} wet weight for mercury in fishery products set by the EU (1 mg kg^{-1} for selected species). This survey confirms previous studies, which show that Irish seafoods are effectively free from mercury contamination.

A total of 20 samples were analysed for lead and cadmium. Overall, the levels of lead and cadmium detected in the edible portion of the fish were low and well within the standard values of 0.20 and 0.05 mg kg^{-1} wet weight respectively set by the EU.

Randomly selected samples were also analysed for other trace metals. There are no internationally agreed standards or guidelines available for the remaining trace metals in fishery products. Therefore results are compared with the strictest standard or guidance value for fish tissue, which are applied by contracting countries to the OSPAR Convention. The levels of these additional contaminants are well below the strictest values listed.

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INTRODUCTION

This study provides the results of analysis by the Marine Institute, of total mercury, lead and cadmium concentrations in the edible portion of various fish species. Mercury, which occurs naturally in the earth's crust, can also be introduced into the aquatic environment from mining, agricultural, industrial and other human activities. Once in the aquatic environment mercury can bioaccumulate in fish tissues and biomagnify through the food chain. To protect consumers of marine foodstuffs, the EU set a maximum limit for total mercury of 0.50 mg kg^{-1} wet weight in fishery products. For physiological reasons, certain species accumulate mercury more readily than others (Clark *et al*, 2001) and for these species a higher acceptable limit of 1.0 mg kg^{-1} applies. These species are listed in Appendix 2, Table 1.

Selected samples were also analysed for other trace metals. Trace metals exist naturally in the environment and many, including chromium, cobalt, copper, iron, manganese, molybdenum, vanadium, strontium, and zinc are essential elements for living organisms. However, some trace metals, which may be introduced into the aquatic environment from anthropogenic activities are not required for metabolic activity and are toxic at quite low concentrations. Once in the aquatic environment these metals can be concentrated in fish tissues.

To protect consumers of marine foodstuffs, the EU set maximum limits for total lead and cadmium of 0.20 and 0.05 mg kg^{-1} wet weight respectively, in fish muscle under Commission Regulation (EC) No. 466/2001 as amended by Commission Regulation (EC) No. 221/2002. Species with higher acceptable limits of 0.40 and 0.10 mg kg^{-1} for lead and cadmium are listed in Appendix 2, Tables 2 and 3 respectively.

Previous results for the analysis of finfish species landed at major Irish ports have been reported (Tyrrell *et al*, 2004, 2003b, 2003a; Bloxham *et al*, 1998; Rowe *et al*, 1998; Nixon *et al*, 1995, 1994a, 1993, 1991 and O' Sullivan *et al*, 1991). Results from the monitoring of contaminants in shellfish are reported separately (Glynn *et al*, 2004, 2003b, 2003a; McGovern *et al*, 2001; Bloxham *et al*, 1998; Smyth *et al*, 1997 and Nixon *et al, 1994b*). Data on contaminants in marine biota are also good indicators of water quality (Stapleton *et al*, 2000 and Boelens *et al*, 1999).

Monitoring of contaminants in farmed fish is also carried out by the Marine Institute as part of the implementation of Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products. Results for this programme are compiled as part of the National Residue Programme by Department of Agriculture and Food.

Marine Institute environmental monitoring reports are available on the Marine Institute website www.marine.ie/chem

MATERIALS AND METHODS

Sample Collection and Preservation

During 2003, fish landed at the major fishing ports of Castletownbere, Dunmore East, Howth, Killybegs and Rossaveal were sampled. Depending on availability, 10 fish of each species landed were sampled at each of the ports. The length of each fish was recorded and a portion of edible muscle tissue from each of the 10 fish was pooled to provide a sample. The pooled sample was homogenised prior to being divided into two sub-samples for mercury and trace metal analysis. These were stored in a freezer at < -20ºC in pre-weighed, acid washed and solvent washed glass jars respectively. One sub sample was freeze-dried for 48 hours and analysed for trace metals. The other sub-sample was analysed for mercury. The moisture content was determined by drying approximately 1g of tissue overnight at 105ºC to constant weight. All samples were analysed for mercury and randomly selected samples from each port were analysed for other trace metals.

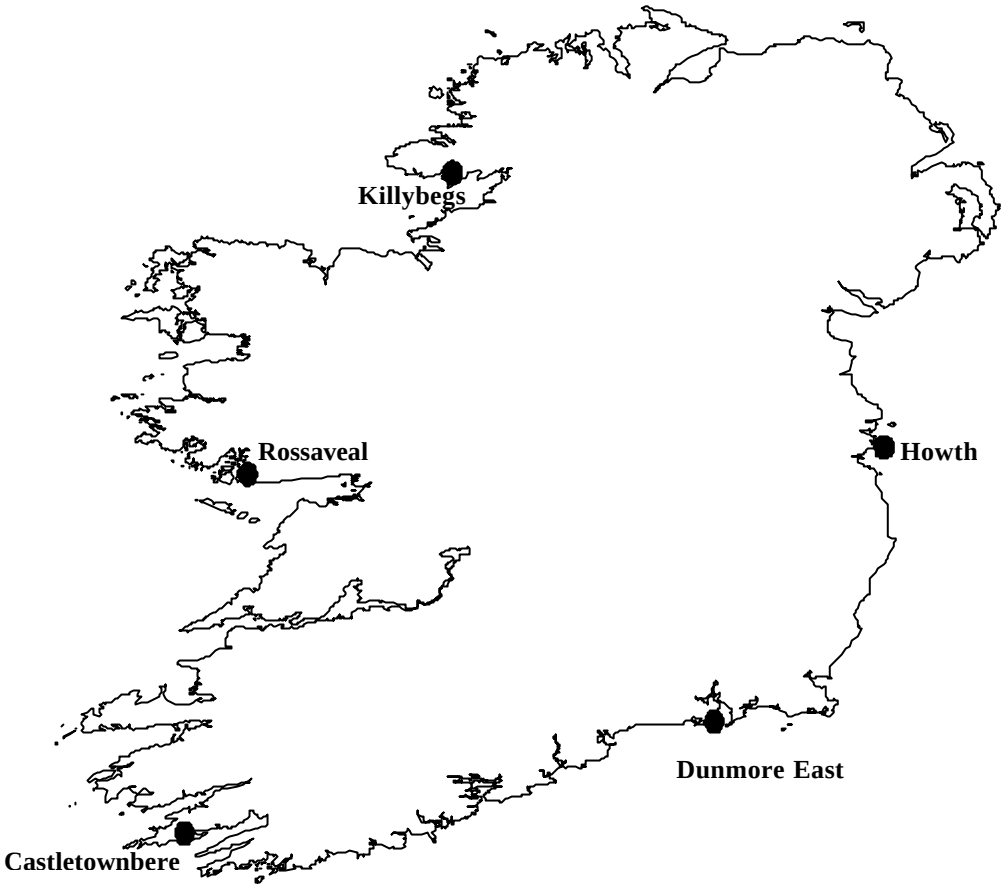

Figure 1. Locations of Irish ports sampled during 2003.

Mercury Analysis

Concentrated nitric acid (4ml) was added to 0.6 - 0.8g of accurately weighed wet tissue, which was then digested in a laboratory microwave oven (CEM Mars5). After cooling, potassium permanganate was added until the purple colour of the solution stabilized. Sufficient hydroxylamine sulphate/sodium chloride solution was added to neutralise the excess potassium permanganate and potassium dichromate was added as a preservative. The solution was diluted to 100mls with deionised water. Following reduction of the samples with tin (II) chloride, mercury concentrations were determined by Cold Vapour Atomic Fluorescence Spectroscopy (CV-AFS) using a PS Analytical Merlin System.

Trace Metal Analysis (cadmium, chromium, copper, lead and zinc)

Concentrated nitric acid (4ml) and hydrogen peroxide (4ml) were added to approximately 0.2g freeze-dried tissue, which was then digested in a laboratory microwave oven (CEM Mars5). After cooling, samples were diluted to 50mls with deionised water. Lead, cadmium, chromium and copper concentrations were determined using Graphite Furnace Atomic Absorption Spectrometry with Zeeman background correction (Varian SpectrAA 220Z). Zinc concentrations were determined using Flame Atomic Absorption Spectroscopy (Varian SpectrAA 20 Plus).

Table 1: Limits of Detection (LOD) for metals (mg kg^{-1} wet weight)

Metal	LOD
Cadmium	0.004
Chromium	0.07
Copper	0.16
Lead	0.02
Mercury	0.01
Zinc	1.21

Quality Assurance

A comprehensive analytical quality assurance programme underpins testing. This involves routine testing of quality control samples such as blanks, replicates and reference materials (including certified reference materials, (CRMs)) and participation in the QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring) international laboratory proficiency-testing scheme. A Z-score between -2 and 2 is generally considered satisfactory for environmental monitoring programmes. The quality assurance results obtained were considered sufficient for the purpose of the monitoring programme and are reported in Table 2. The Marine Institute is accredited to ISO 17025 for the analysis of mercury and moisture content in marine biota.

Table 2: Results of the analyses of different reference materials obtained during the 2003 finfish testing.

a) Certified Reference Materials

Reference Material	Assigned Values	Measured Value (Mean ± SD)	No. of Analyses	Mean |Z| Score[1]	No. –2<Z<2
Mussel Tissue CRM 278R					
Metal (mg kg^{-1} wet weight)					
Cadmium	0.348	0.33 ± 0.02	3	-0.29	3
Copper	9.45	8.00 ± 0.12	3	-1.18	3
Chromium	0.78	0.62 ± 0.09	4	-1.33	4
Lead	2.00	1.93 ± 0.07	6	-0.25	6
Zinc	83.1	83.0 ± 1.00	3	-0.01	3
Dogfish Muscle DORM2					
Metal (mg kg^{-1} wet weight)					
Cadmium	0.043	0.04 ± 0.004	3	0.05	3
Copper	2.34	1.69 ± 0.04	3	-1.89	3
Mercury	4.64	5.16 ± 0.32	11	0.88	11
Silver	0.041	0.03 ± 0.004	3	-0.92	3
Zinc	25.6	28.1 ± 1.34	3	0.60	3
Oyster Tissue SRM1566b					
Metal (mg kg^{-1} wet weight)					
Copper	71.6	72.3 ± 1.95	3	0.07	3
Lead	0.308	0.32 ± 0.04	4	0.17	4
Nickel	1.04	0.84 ± 0.07	4	-1.28	4
Silver	0.666	0.72 ± 0.01	3	0.60	3
Zinc	1424	1524 ± 132	3	0.56	3

[1] **|Z|** scores were calculated using the proportional and constant errors for the determinants applied by QUASIMEME. A **|Z|** score between -2 and 2 is generally considered satisfactory for environmental monitoring programmes.

RESULTS AND DISCUSSION

European Regulation 466/2001/EC (as amended by Regulation 221/2001/EC) sets maximum levels for mercury, cadmium and lead in fish. While the monitoring presented in this report was carried out prior to the adoption of this regulation, results are compared with the values set in the regulation. The maximum levels are set out in the table below.

Table 3: European Regulation 466/2001/EC - Maximum levels for mercury, cadmium and lead in fish (mg kg^{-1} wet weight).

	Mercury	Cadmium	Lead
Muscle Meat of fish	0.5	0.05	0.2
Selected fish species*	1.0	0.1	0.4

Note: * Listed in Appendix 2 for each metal

Table 4: Synopsis of the strictest guidance and standard values applied by various OSPAR countries for contaminants in fish tissue

Contamination	Unit	Qualifiers*	Country
Copper	10 mg kg^{-1}	W/G	Norway
Zinc	50 mg kg^{-1}	W/G	U.K.

*W = wet weight; G = guidance value

Mercury

A total of 45 fish muscle samples were analysed for mercury in 2003. Results are reported in Appendix 1, Table 1a. These samples comprised 22 species of finfish collected from five major Irish fishing ports. The levels of mercury detected ranged from being less than the limit of quantitation (0.03 mg kg^{-1}) to 0.60 mg kg^{-1} wet tissue weight, with an upper bound mean and median of 0.08 and 0.06 mg kg^{-1} respectively. The highest levels detected were found in dogfish (species tentatively identified as Lesser Spotted Dogfish) landed in Howth (0.60 mg kg^{-1}) and red gurnard landed in Howth (0.21 mg kg^{-1}).

Overall, the levels of mercury detected in the edible portion of the fish were within the standard value of 0.5 mg kg^{-1} wet weight set by the EU (1 mg kg^{-1} in selected species listed in Appendix 2, Table 1) apart from the dogfish sample landed at Howth. Due to the high result for mercury, the sample was re-digested in duplicate and analysed to confirm the high result. It is most likely that the fish from which this sample was taken were destined for whelk bait and as such there are no human health implications.

Other Trace Metals

A total of 20 randomly selected samples collected in 2003 were analysed for lead and cadmium, with 15 of these analysed for other trace metals. Results of these analyses are shown in Appendix 1, Table 1b.

Lead
Lead was not detected in 19 of the 20 finfish samples and was present at concentrations below the limits of quantitation in the remaining sample (Prawn *Nephrops novegicus* sampled at Rossaveal).

Cadmium
Cadmium was not present above the limits of detection (0.04 mg kg^{-1} wet weight) in 19 samples tested. Cadmium was measured at 0.07 mg kg^{-1} wet weight in prawns landed in Rossaveal.

Copper
Copper was not detected (LOD 0.16 mg kg^{-1} wet weight) in 3 of the 15 samples tested. Concentrations were below the limit of quantitation (<0.44 mg kg^{-1}) in a further 9 samples. The highest levels were detected prawn (4.35 mg kg^{-1} wet weight) and dogfish (1.21 mg kg^{-1} wet weight) landed in Rossaveal and Howth respectively.

Chromium
Chromium was not detected (LOD 0.07 mg kg^{-1} wet weight) in 12 of the 15 samples tested and was below the limit of quantitation (0.19 mg kg^{-1} wet weight) in a further 2 samples. The highest level measured was 0.22 mg kg^{-1} wet weight in dogfish (species tentatively identified as Lesser Spotted Dogfish) landed in Howth.

Nickel
Nickel was not detected (LOD 0.06 mg kg^{-1} wet weight) in any of the 15 samples tested.

Silver
Silver was not present above the limits of detection (0.01 mg kg^{-1} wet weight) in 14 of the 15 samples tested. Silver was measured at 0.10 mg kg^{-1} wet weight in prawns landed in Rossaveal.

Zinc
Zinc concentrations in finfish samples from 2003 ranged from 2.86 mg kg^{-1} wet weight to 13.3 mg kg^{-1} wet weight, with an upper bound mean and median of 4.06 and 3.36 mg kg^{-1} respectively. The highest levels were detected in prawn landed in Rossaveal (13.3 mg kg^{-1} wet weight) and plaice landed in Dunmore East (4.32 mg kg^{-1} wet weight).

Overall, the levels of lead and cadmium detected in the edible portion of the fish were low and well below the maximum limits set by the EU and outlined in Table 2. There are no internationally agreed standards or guidelines available for copper, chromium and zinc in fish for human consumption. However, there is a compilation of standard and guidance values for contaminants in fish tissue, applied by Contracting Parties to OSPAR (Anon 1992). Values are set out in Table 4. All samples analysed were below the strictest guidance values for copper and zinc in fish listed therein. None of the countries have set guidance values or standards for chromium in fish.

CONCLUSIONS

Based on the analyses of the 2003 samples, total mercury and heavy metal concentrations in the commercial catch landed at 5 major Irish ports are low, which confirms previous studies (Tyrrell *et al*, 2004, 2003b, 2003a; Rowe *et al*, 1998; Nixon *et al*, 1994, 1993 and 1991 and O' Sullivan *et al*, 1991). All samples tested were well within the limits set by the Commission Regulation (EC) No. 466/2001 as amended by Commission Regulation (EC) No. 221/2002 for mercury, cadmium and lead. For copper and zinc, levels were well below the strictest guidance values applied by OSPAR member states.

Acknowledgements

We would like to thank the fishermen and fisheries co-ops for provision of samples for the programme. Thanks are also due to the Marine Institute's Fisheries Assessment Technicians for their assistance at the ports and to Mary Fleming for her editorial assistance.

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Appendix 1 (Page 1 of 3): Results of monitoring of fish species from selected Irish Ports - 2003

Table 1a: Mercury (Hg) concentration (mg kg^{-1} wet weight) in the edible tissue, length statistics (mm) and moisture content (%) of various fish species landed and sampled at selected Irish Ports in 2003. Common and species names are listed in Appendix 3.

	Common Name	MI Reference	Sample Size	Hg	Length Range	Length Mean	Moisture Content
Castletownbere							
	Black Sole	ENV/03/**039**	10	0.04	265 – 325	301	80.4
	Cod	ENV/03/**037**	8	0.08	375 – 535	458	81.3
	Haddock	ENV/03/**038**	10	0.06	355 – 415	381	80.8
	Hake	ENV/03/**036**	10	0.04	365 – 510	446	81.2
	Lemon Sole	ENV/03/**040**	10	0.06	250 – 325	281	79.8
	Megrim	ENV/03/**041**	10	0.06	260 – 380	305	80.8
	Monkfish	ENV/03/**034**	10	0.12	395 – 670	534	81.4
	Plaice	ENV/03/**043**	10	<0.03	260 – 340	304	81.1
	Whiting	ENV/03/**035**	10	0.08	360 – 435	394	82.1
	Witch	ENV/03/**042**	7	0.05	300 – 340	325	81.7
Rossaveal							
	Black Pollock	ENV/03/**049**	10	0.05	370 – 455	412	80.0
	Black Sole	ENV/03/**051**	10	0.09	260 – 300	282	81.6
	Cod	ENV/03/**047**	10	0.08	425 – 550	470	81.5
	Haddock	ENV/03/**056**	10	0.18	310 – 415	344	81.2
	Hake	ENV/03/**052**	10	0.07	350 – 670	455	80.7
	John Dory	ENV/03/**053**	10	0.11	300 – 460	377	79.7
	Monkfish	ENV/03/**054**	10	0.11	360 – 490	413	83.0
	Plaice	ENV/03/**046**	10	0.08	290 – 375	330	81.0
	Pollock	ENV/03/**050**	10	0.06	395 – 570	491	79.9
	Prawn	ENV/03/**045**	25	0.10	324 – 422	374	75.9
	Turbot*	ENV/03/**048**	10	0.06	350 – 445	413	81.4
	Whiting	ENV/03/**055**	10	0.07	340 – 440	395	81.0
Killybegs							
	Black Sole	ENV/03/**117**	10	0.04	270 – 320	297	80.2
	Cod	ENV/03/**113**	2	0.10	400 – 410	405	81.7
	Haddock	ENV/03/**119**	10	0.06	370 – 430	399	79.1
	Hake	ENV/03/**114**	11	<0.03	320 – 360	339	80.3
	Lemon Sole	ENV/03/**112**	10	0.04	245 – 305	267	80.2
	Megrim	ENV/03/**116**	10	<0.03	235 – 370	310	78.0
	Monkfish	ENV/03/**121**	10	0.08	290 – 390	331	82.9
	Ray (Cuckoo)	ENV/03/**115**	9	0.11	440 – 600	542	77.3
	Whiting	ENV/03/**120**	10	0.07	270 – 345	315	81.0
	Witch	ENV/03/**118**	10	0.08	250 – 350	295	80.6

Notes * = QC duplicate samples analysed and mean reported
For values reported as "< value", value = Limit of Quantitation (LOQ) for the relevant determinand

Appendix 1 (Page 2 of 3): Results of monitoring of fish species from selected Irish Ports - 2003

Table 1a (continued): Mercury (Hg) concentration (mg kg^{-1} wet weight) in the edible tissue, length statistics (mm) and moisture content (%) of representative fish species landed and sampled at selected Irish ports in 2003.

	Common Name	MI Reference	Sample Size	Hg	Length Range	Length Mean	Moisture Content
Dunmore East							
	Lemon Sole	ENV/03/**060**	8	0.04	250 – 310	278	78.4
	Mackerel*	ENV/03/**057**	9	0.03	275 – 385	321	72.2
	Plaice	ENV/03/**059**	8	<0.03	290 – 330	313	79.2
	Whiting	ENV/03/**058**	6	0.09	325 – 395	364	82.0
Howth							
	Black Sole	ENV/03/**130**	9	<0.03	260 – 360	312	78.0
	Cod	ENV/03/**125**	10	0.09	310 – 425	356	80.3
	Dab	ENV/03/**129**	8	0.04	275 – 290	284	78.4
	[1]Dogfish	ENV/03/**128**	7	0.60	752 – 1000	846	71.6
	Haddock	ENV/03/**122**	10	0.04	330 – 370	348	78.7
	Plaice	ENV/03/1**26**	10	0.03	275 – 385	345	77.2
	Ray	ENV/03/**127**	10	0.05	485 – 975	630	76.2
	Red Gurnard	ENV/03/**124**	8	0.21	330 – 490	405	77.4
	Whiting	ENV/03/**123**	9	0.05	325 – 405	355	81.0

Notes: [1]Species tentatively identified as Lesser Spotted Dogfish (*Scyliorhinus canicula*)
* = QC duplicate samples analysed and mean reported
For values reported as "< value", value = Limit of Quantitation (LOQ) for the relevant determinand

Appendix 1 (Page 3 of 3): Results of monitoring of fish species from selected Irish Ports - 2003

Table 1b: Heavy metal concentrations (mg kg^{-1} wet weight) in the edible tissue of representative fish species landed and sampled at selected Irish ports in 2003. Common and species names are listed in Appendix 3. (Lengths, moisture content, MI reference number and sample size are as Table 1a)

	Common Name	MI Reference	Sample Size	Pb	Cd	Cu	Cr	Ni	Ag	Zn
Castletownbere										
	Cod	ENV/03/**037**	8	nd	nd	NA	NA	NA	NA	NA
	Haddock	ENV/03/**038**	10	nd	nd	nd	nd	nd	nd	2.86
	Lemon Sole	ENV/03/**040**	10	nd	nd	<0.44	nd	nd	nd	3.50
	Plaice	ENV/03/**043**	10	nd	nd	<0.44	nd	nd	nd	3.70
Rossaveal										
	John Dory	ENV/03/**053**	10	nd	nd	nd	nd	nd	nd	3.36
	Prawn	ENV/03/**045**	25	<0.06	0.07	4.35	nd	nd	0.10	13.3
	Turbot	ENV/03/**048**	10	nd	nd	nd	nd	nd	nd	3.82
	Whiting	ENV/03/**055**	10	nd	nd	NA	NA	NA	NA	NA
Killybegs										
	Black Sole	ENV/03/**117**	10	nd	nd	NA	NA	NA	NA	NA
	Hake	ENV/03/**114**	10	nd	nd	<0.44	nd	nd	nd	3.23
	Monkfish	ENV/03/**121**	10	nd	nd	<0.44	nd	nd	nd	3.07
	Whiting	ENV/03/**120**	10	nd	nd	<0.44	<0.19	nd	nd	2.95
Dunmore East										
	Lemon Sole	ENV/03/**060**	8	nd	nd	NA	NA	NA	NA	NA
	Mackerel	ENV/03/**057**	9	nd	nd	0.53	nd	nd	nd	3.73
	Plaice	ENV/03/**059**	8	nd	nd	<0.44	nd	nd	nd	4.32
	Whiting	ENV/03/**058**	6	nd	nd	<0.44	<0.19	nd	nd	3.15
Howth										
	Cod	ENV/03/**125**	10	nd	nd	NA	NA	NA	NA	NA
	Dogfish*	ENV/03/**128**	7	nd	nd	1.21	0.22	nd	nd	2.96
	Ray	ENV/03/**127**	10	nd	nd	<0.44	nd	nd	nd	3.67
	Red Gurnard	ENV/03/**124**	8	nd	nd	<0.44	nd	nd	nd	3.24

Notes
* = QC duplicate samples analysed and mean reported
nd: Not detected
NA: Not analysed
For values reported as "nd" Substances were not detected above the Limit of Detection (LOD)
LODs are given in Table 1.
For values reported as "< value", value = Limit of Quantitation (LOQ) for the relevant determinand

Appendix 2 (Page 1 of 2): Selected species, as listed by the European Commission Regulation (EC) No 221/2002, where the higher acceptable limit of total mercury, lead and cadmium concentration apply

Table 1: Selected species where the higher acceptable limit (1.0 mg kg^{-1}) total mercury concentration applies

Common Name	***Species Name***
Anglerfish	*Lophius species*
Atlantic Catfish	*Anarhichas lupus*
Bass	*Dicentrarchus labrax*
Blue Ling	*Molva dipterygia*
Bonito	*Sarda sarda*
Eel	*Anguilla species*
Emperor or Orange Roughy	*Hoplostethus atlanticus*
Grenadier	*Coryphaenoides rupestris*
Halibut	*Hippoglossus hippoglossus*
Marlin	*Makaira species*
Pike	*Esox lucius*
Plain Bonito	*Orcynopsis unicolor*
Portuguese Dogfish	*Cantroscymnes coelolepis*
Rays	*Raja species*
Redfish	*Sebastes marinus, S. mentella, S. viviparus*
Sailfish	*Istiophorus platypterus*
Scabbard fish	*Lepidopus caudatus, Aphanopus carbo*
Sharks	*all species*
Snake Mackerel or Butterfish	*Lepidocybium flavobrunneum, Ruvettus pretiousus, Gempylus serpens*
Sturgeon	*Acipenser species*
Swordfish	*Xiphias gladius*
Tuna	*Thunnus species and Euthynnus species*

Appendix 2 (Page 2 of 2): Selected species, as listed by the European Commission Regulation (EC) No 221/2002, where the higher acceptable limit of total mercury, lead and cadmium concentration apply

Table 2: Selected species where the higher acceptable limit (0.4 mg kg^{-1}) total lead concentration applies

Common Name	***Species Name***
Bonito	*Sarda sarda*
Common two-banded seabream	*Diplodus vulgaris*
Eel	*Anguilla species*
Grey Mullet	*Mugil labrosus labrosus*
Grunt	*Pomadasys benneti*
Horse Mackerel or Scad	*Trachurus trachurus*
Sardine	*Sardina pilchardus*
Sardinops	*Sardinops species*
Spotted Seabass	*Dicentrarchus*
Tuna	*Thunnus species and Euthynnus species*
Wedge Sole	*Dicologoglossa cuneata*

Table 3: Selected species where the higher acceptable limit (0.1 mg kg^{-1}) total cadmium concentration applies

Common Name	***Species Name***
Bonito	*Sarda sarda*
Common two-banded seabream	*Diplodus vulgaris*
Eel	*Anguilla species*
European Anchovy	*Engraulis encrasicholus*
Grey Mullet	*Mugil labrosus labrosus*
Horse Mackerel or Scad	*Trachurus trachurus*
Louvar or Luvar	*Luvarus imperialis*
Sardine	*Sardina pilchardus*
Sardinops	*Sardinops species*
Tuna	*Thunnus species and Euthynnus species*
Wedge Sole	*Dicologoglossa cuneata*

Appendix 3: Finfish sampled during 2003 and their corresponding species name

Common Name	***Species Name***
Anglerfish	*Lophius spp.*
Black Pollock/Saithe	*Pollachius pollachius*
Black Sole	*Solea solea*
Cod	*Gadus morhua*
Dab	*Limanda limanda*
Lesser Spotted Dogfish	*Scyliorhinus canicula*
Haddock	*Melanogrammus aeglefinus*
Hake	*Merluccius merluccius*
John Dory	*Zeus faber*
Lemon Sole	*Microstomus kitt*
Mackerel	*Scomber scombrus*
Megrim	*Lepidorhombus whiffiagonis*
Monkfish	*Lophius piscatorius*
Plaice	*Pleuronectes platessa*
Pollock/Pollack	*Pollachius virens*
Prawn	*Nephrophs norvegicus*
Ray	*Raja spp.*
Ray (Cuckoo)	*Raja naevus*
Red Gurnard	*Aspitrigla cuculus*
Turbot	*Psetta maxima*
Whiting	*Merlangius merlangus*
Witch	*Glyptocephalus cynoglossus*

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ISSN 1649 0053

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