

ROINN NA MARA

FISHERIES RESEARCH CENTRE

**Mercury concentration in fish
from Irish waters in 1992**

E NIXON, A ROWE AND D McLAUGHLIN

Fishery Leaflet 156

August 1993

Mercury concentration in fish from Irish waters in 1992

Marine Environmental Series 1/93

by

E. NIXON, A. ROWE AND D. McLAUGHLIN

Fisheries Research Centre, Abbotstown, Castleknock, Dublin 15

Fisheries Leaflet 156

August 1993

Department of the Marine

Dublin 2

Summary

Fish landed at the major Irish ports and molluscs from the main growing areas were sampled during 1992 and analysed for total mercury content. Concentrations in fish species ranged from 0.015 to 1.02 mg/kg wet weight with a mean of 0.1, while in shellfish the concentrations were lower and ranged from 0.005 to 0.049 with a mean of 0.026.

The mercury levels recorded in all fish sampled were within the standards for human health applied by the contracting parties to the Oslo and Paris Convention (OSPARCOM). The mean mercury concentrations in only two samples, redfish and crawfish from the west coast, showed levels close to the limit. These species are generally offshore and levels are associated with naturally-occurring mercury rather than with human activity.

The survey confirms that Irish seafish of all kinds are effectively free from mercury contamination.

Introduction

Mercury occurs in the Earth's crust and is naturally concentrated in geographical belts in three principal forms: sulphides, oxides and native mercury. One of these belts covers the entire Mediterranean area and its rich mercury deposits account for 50% of the world's mercury production (Anon 1984). Another is the Mid-Atlantic Ridge which extends from the Greenland Basin to Antarctica and contains sediments and volcanic rock with high mercury content. Mercury is widely used in industry and agriculture. The main anthropogenic sources of mercury in the environment include mining, chloro-alkali plants, fungicides, paints, dentistry and burning fossil fuels.

Human health may be affected by consumption of seafood containing high levels of mercury. The known toxicity of the metal and the possible exposure to humans through marine foodstuffs has led to its inclusion in the Joint Monitoring Programme (JMP) of the Oslo and Paris Commissions and to a European Commission Decision to agree on analytical methods, sampling plans and maximum limits in fishery products. The Fisheries Research Centre of the Department of the Marine has responsibility for Ireland's national and international monitoring programmes e.g. JMP and EC Directive 79/923/EEC and results of this monitoring have been reported previously (O'Sullivan *et al.*, 1991; Nixon *et al.*, 1991). Monitoring of mercury in marine foodstuffs was expanded during 1992 and the results of this study are presented here.

Methods

Sample collection and preparation:

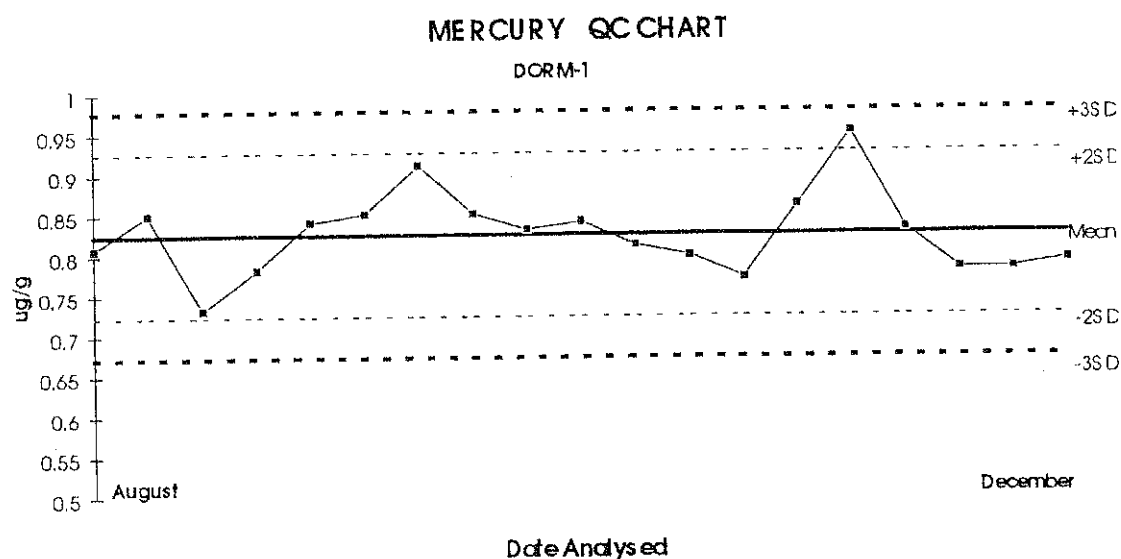
Depending on the species, 25 or 50 molluscs were collected from the main shellfish-growing areas and depurated for 14 hours in seawater taken from the sampling area. The edible portion was removed, washed with distilled deionised water and homogenised. Fish landed at the major Irish fishing ports of Killybegs, Rosaveel, Castletownbere, Dunmore East and Howth were sampled during 1992. Depending on availability, 5 specimens of each of 5 fish species were sampled at each of these ports, for each species a portion of the fillet was removed from each individual fish, stored in acid-washed glass jars and returned to the laboratory. The tail portion of prawn and crawfish was used for analysis.

Before freezing, a subsample from each sample was dried to constant weight at 105°C and the percentage dry weight calculated. The samples were frozen overnight followed by freeze drying for 16 hours and stored in desiccators until analysis.

Mercury analysis:

Freeze dried tissue is refluxed with sulphuric and nitric acid for 3 hours. After cooling, potassium permanganate is added until solution remains coloured. The solution is diluted to approximately 45 ml with distilled deionised water and sufficient hydroxylamine hydrochloride is added to neutralise the potassium permanganate. Following the reduction of samples with stannous chloride (Hatch and Ott 1968), the mercury is determined by cold vapour flameless atomic absorption using a Varian SpectraAA 20 Plus fitted with VGA 76 Vapour Generator.

The quality of the data is assured through the analyses of the certified reference material DORM-1 prepared by the National Research Council of Canada. During the period of analyses the Hg concentration for the certified reference material was determined. The certified concentration for this material is 0.798 ± 0.074 , the concentration measured in this laboratory over period of analyses was 0.82 ± 0.02 mg/kg, (n=19). The QC chart for these analyses is shown in Fig.1.



Results and discussion

In total 167 samples were analysed. The mean concentrations of mercury in 13 fish species and 5 shellfish species are shown in Tables 1 and 2 respectively.

For all samples measured, the mercury concentration ranged from 0.005 to 1.02 mg/kg wet weight, with a mean of 0.14. In finfish and crustaceans the concentrations ranged from 0.015 to 1.02 with a mean of 0.1, while in molluscs the concentrations were lower and ranged from 0.005 to 0.049 with a mean of 0.026.

The mean concentrations measured in each species in all locations was less than 0.5 mg/kg wet weight, the commonly recognised standard for the protection of human health. Of the 20 shellfish-growing areas monitored all fell well within the "lower" level of 0.1 set by the JMP. Seventeen fish samples also fell into this "lower" category, eleven samples into the "medium" category (0.1 - 0.3), while two had mean mercury concentrations greater than the "upper" level of 0.3 mg/kg. These two samples in the "upper" category were crawfish (*Palinurus vulgaris*) and redfish (*Helicolenus dactylopterus*). The crawfish sample, caught off Slyne Head, consisted of a small 85 mm specimen with a mercury concentration of 0.14 mg/kg, and a larger one of 225 mm with 0.69 mg/kg. The redfish sample was caught on the continental slope over 60 miles north west of Ireland at depths of between 600 and 1000 metres. The mercury concentration measured in one of these (1.02 mg/kg) was the highest recorded for any species. The crawfish only comes inshore to mate in late summer and the redfish feed well offshore.

The values reported for molluscs are similar to levels previously reported for Irish coastal waters (O'Sullivan *et al.*, 1991; Nixon *et al.*, 1991) and Scottish waters (Rodger *et al.*, 1991).

As mercury concentrations generally increase with increasing age or length of fish (Clark & Topping 1989) comparison of concentrations measured in fish from different locations are of limited value. Table 3 shows the mean mercury concentrations and fish length for cod from Killybegs, Rosaveel and Dunmore East for 1990 (Nixon *et al.*, 1991) and 1992, although mercury levels were lower at each port for 1992, the mean fish length was also smaller.

Acknowledgements

This study was made possible as a result of equipment purchased under an EC funded STRIDE programme.

References

- Anon, (1984). Fisheries Report No. 325. Meeting on the Biogeochemical Cycle of Mercury in the Mediterranean. Siena, Italy, 27-31 August 1984.
- Clark, C.K. and G.Topping (1989). Mercury concentration in fish from contaminated areas in Scottish waters. *J.Mar. Biol. UK*, 69, 437-445.
- Hatch, W.R. and W.L. Ott (1968). Determination of submicrogram quantities of mercury by atomic absorption spectrophotometry. *Anal. Chem.* 40, 2085 - 2087.
- Nixon, E.R., D. McLaughlin, R.G. Bolens, and G. O'Sullivan (1991). Contaminants in Marine Biota - 1990 Monitoring Programme. *Fishery Leaflet* 151, Department of the Marine, Dublin.
- O'Sullivan, M.P., E.R. Nixon, D. McLaughlin, M. O'Sullivan and Dan O'Sullivan (1991). Chemical Contaminants in Estuarine and Coastal Waters, 1978 to 1988. *Fisheries Bulletin* No. 10, Department of the Marine, Dublin.
- Rodger, G.K., F.M.J. Brown and I.M. Davies (1991). Mercury in Fin and Shellfish Landed at Scottish Ports. *Scottish Fisheries Working Paper*. JMG 17/3/4-E

Table 1: Mercury concentrations (mg/kg wet weight) in edible portion of mollusc species sampled during 1992.

Growing Area	County	Date	Species	Pooled Sample	Mean
Rosmore	Cork	09/11/92	Oyster (Gigas)	25	0.03
Rosmore		09/09/92	Oyster (Gigas)	25	0.02
Roaringwater Bay		02/09/92	Mussel	25	0.02
Bantry Bay		10/11/92	Mussel	50	0.01
Bantry Bay		02/09/92	Mussel	25	0.02
McSwynes Bay	Donegal	07/09/92	Mussel	25	0.03
Lough Foyle		27/10/92	Mussel	50	0.03
Mulroy Bay		02/11/92	Scallop	25	0.01
Mulroy Bay	Galway	02/11/92	Scallop	25	0.01
Bertraghboy Bay		04/11/92	Oyster (Gigas)	25	0.03
Aughinish		15/09/92	Oyster (Gigas)	24	0.03
Aughinish		05/11/92	Oyster (native)	25	0.03
Aughinish		15/09/92	Clam	26	0.03
Killary	Kerry	02/09/92	Mussel	25	0.02
Killary		03/11/92	Mussel	50	0.02
Clarinbridge		05/11/92	Oyster (native)	25	0.02
Mweeloon Bay		01/02/92	Oyster (native)	38	0.04
Kilkieran Bay		09/09/92	Scallop	5	0.02
Kilkieran Bay		09/09/92	Scallop	5	0.03
Kilkieran Bay		04/11/92	Oyster (native)	25	0.04
Kilmackilloge		02/09/92	Mussel	25	0.02
Kilmackilloge		10/11/92	Mussel	50	0.02
Cromane		11/11/92	Mussel	50	0.02
Tralee Bay	Louth	11/11/92	Oyster (native)	25	<0.01
Carlingford Lough		28/10/92	Oyster (Gigas)	25	0.03
Carlingford Lough		09/09/92	Oyster (Gigas)	25	0.04
Carlingford Lough		18/05/92	Oyster (Gigas)	25	0.05
Carlingford Lough		18/05/92	Mussel	33	0.03
Carlingford Lough		18/05/92	Mussel	33	0.04
Carlingford Lough	Mayo	18/05/92	Mussel	33	0.05
Clew Bay		08/09/92	Oyster (native)	24	0.03
Clew Bay		03/11/92	Oyster (native)	25	0.02
Drumcliff Bay	Sligo	16/09/92	Clams	26	0.02
Passage East	Waterford	21/05/92	Mussel	33	0.02
Passage East		21/05/92	Mussel	33	0.02
Wexford Harbour	Wexford	25/09/92	Mussel	25	0.02
Wexford Harbour		29/10/92	Mussel	50	0.02

Table 2: Mercury concentrations (mg/kg wet weight) in edible portion of fish species sampled during 1992.

PORT LANDED	FISHING GROUND	DATE	SPECIES	SAMPLE SIZE	RANGE	Mean
Castletownbere	Hurd Bank	07/08/92	Megrim	5	0.06 - 0.09	0.07
Castletownbere	Hurd Bank	07/08/92	Monk	5	0.07 - 0.22	0.12
Castletownbere	Hurd Bank	07/08/92	Whiting	5	0.06 - 0.09	0.07
Castletownbere	Kinsale Head	07/08/92	Hake	5	0.03 - 0.08	0.06
Cleggan	Slyne Head	23/08/92	Crawfish	2	0.14 - 0.69	0.42
Dunmore East	The Smalls	09/07/92	Hake	4	0.07 - 0.14	0.10
Dunmore East	The Smalls	09/07/92	Lemon Sole	5	0.02 - 0.04	0.03
Dunmore East	The Smalls	09/07/92	Ling	1	-	0.16
Dunmore East	The Smalls	09/07/92	Megrim	5	0.02 - 0.08	0.06
Dunmore East	The Smalls	09/07/92	Whiting	5	0.07 - 0.13	0.10
Dunmore East		21/05/92	Monk	7	0.07 - 0.15	0.11
Dunmore East		21/05/92	Cod	5	0.07 - 0.54	0.21
Dunmore East		21/05/92	Whiting	5	0.05 - 0.16	0.09
Howth	Bay of Bray	20/08/92	Nephrops	25 Pooled	-	0.07
Howth	Bay of Bray	20/08/92	Codling	5	0.04 - 0.06	0.05
Howth	Bay of Bray	20/08/92	Cuckoo Ray	1	-	0.05
Howth	Bay of Bray	20/08/92	Spotted Ray	1	-	0.05
Howth	Bay of Bray	20/08/92	Roker Ray	3	0.04 - 0.06	0.05
Howth	Bay of Bray	20/08/92	Haddock	5	0.01 - 0.02	0.02
Howth	Bay of Bray	20/08/92	Herring	5	0.04 - 0.13	0.09
Howth	Bay of Bray	20/08/92	Plaice	5	0.03 - 0.05	0.04
Killybegs	Continental Slope	08/09/92	Redfish	5	0.14 - 1.02	0.40
Killybegs	Continental Slope	08/09/92	Grenadiers	5	0.05 - 0.19	0.14
Killybegs	Donegal Bay	13/07/92	Whiting	5	0.05 - 0.15	0.13
Killybegs	Rockall	13/07/92	Cod	5	0.03 - 0.12	0.07
Killybegs	Rockall	13/07/92	Haddock	5	0.04 - 0.07	0.05
Killybegs	Rockall	13/07/92	Hake	5	0.03 - 0.06	0.04
Killybegs	Rockall	13/07/92	Megrim	5	0.03 - 0.24	0.11
Rosaveel		12/05/92	Monk	5	0.10 - 0.15	0.13
Rosaveel		12/05/92	Cod	5	0.02 - 0.31	0.12

Table 3: Mean mercury concentration ($\mu\text{g/g}$ wet weight) and mean length (mm) for cod landed in three Irish ports 1990 (Nixon *et al.*, 1991) and 1992.

Port	1990		1992	
	Hg ($\mu\text{g/g}$)	Length (mm)	Hg ($\mu\text{g/g}$)	Length (mm)
Killybegs	0.1	874	0.07	786
Rosaveel	0.3	774	0.12	610
Dunmore East	0.24	785	0.21	707