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LEVELS OF METALS AND ORGANIC CONTAMINANTS IN MUSSELS *MYTILUS EDULIS* FROM CORK HARBOUR - 1989

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by

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SUMMARY

This study of contaminants in mussels from outer Cork Harbour (Buoy no. 8) has shown that the levels of selected metals and organochlorine substances are generally low and at the lower end of the ranges measured in recent surveys of mussel populations at other European coastal sites.

INTRODUCTION

The blue mussel *Mytilus edulis* is a common species of shellfish in European coastal waters. As a filter-feeding organism, it readily accumulates dissolved and particulate substances from the surrounding seawater. It is this characteristic, and the more or less stationary lifestyle of the adults, which has led scientists to recommend mussels as an indicator of contaminants in the marine environment.

The Department of the Marine's Fisheries Research Centre (FRC) has been monitoring the levels of contaminants in mussels at selected sites around Ireland since 1975 (Crowley and Murphy, 1975). However, recent advances in tissue analysis have shown that much of the data on metals published prior to about 1980 are of questionable accuracy and are therefore unsuitable for comparing trends in contaminant levels from year to year. Most of the difficulties have now been resolved and, as part of it's ongoing monitoring activities, the FRC will be examining mussels in those areas which are suspected of receiving the greatest inputs of contaminants (e.g. ports, urban and industrial areas) on a regular basis. This report presents the results obtained from a mussel bed located at Buoy No. 8 in the outer sector of Cork Harbour (Figure 1) which was sampled in April 1989.

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The Cork Harbour area is one of the most industrialised in the country and includes a number of chemical and pharmaceutical plants. As well as effluents from these industries, the harbour receives municipal sewage discharges and a variety of wastes that are transported seawards by the River Lee. Historically, the harbour has also received contaminants from fossil fuel combustion (atmospheric inputs) and contaminants redistributed by dredging activitites. These inputs, and the semi-enclosed nature of the harbour, might suggest that the quality of the area as a habitat for marine life has steadily deteriorated, but scientific studies to date have been far too limited to draw any firm conclusions in this regard.

Previous studies had not suggested that heavy metals, which occur at varying levels in all wastes, or persistent organic contaminants were elevated in mussel populations inhabiting the area. However, the discovery of a new bed in the main exit channel from the harbour provided a good opportunity to re-evaluate the situation, and to apply improved sampling and analytical techniques, at a location that would be expected to reflect the net contaminant input to the open sea.

METHODS

200 mussels, ranging in length from 35-55cm, were divided into 4 size classes, purged for 24 hours in clean seawater, opened, rinsed with distilled/deionized water and drained; subsequently the soft tissues were removed. After homogenization, portions of the composite samples were extracted and analysed for selected metals (mercury, cadmium, lead, copper and zinc) and a range of organochlorine compounds including pesticides and polychlorinated biphenpyls (PCBs; IUPAC congeners nos 28,52,101,118,153,138,180). The detection systems used were Atomic Absorbtion Spectrometry (AAS) for the metals and Gas Liquid Chromatography (GLC) fitted with an electron capture detector (ECD) for the organic contaminants. Data quality assurance for metal was by reference to a Standardized Oyster Tissue, and for organohalogens by use of a mixed inhouse standard solution.

RESULTS

Based on the standardised materials, the analytical recovery of the contaminants measured was ± 25% or better, apart from mercury (Hg) which showed a recovery of approximately 150%.

A summary of information describing the characteristics of the mussel sample from outer Cork Harbour is given in Table 1. Between the smallest and the largest size classes there was approximately a three-fold increase in the weight of soft tissue (meat), while the lipid (fat) content varied from 0.6-1.09% and did not appear to be related to the size or age of the mussels.

The concentration ranges for metals (ug/g dry weight) and for organic contaminants (ug/kg wet weight) are given in Tables 2 and 3 respectively. In order to simplify presentation of the results, and to facilitate comparison with data from other areas, they have not been broken down on the basis of size classes but the ranges reflect the distribution of concentrations across the four sub-samples. In all cases the results are based on the mean of two replicate determinations for each contaminant in each sub-sample.

DISCUSSION

The concentrations of a majority of contaminants tended to decrease with increasing size of the mussels; there is no immediate explanation for this. However, variation was generally low and within a factor of x2. Cadmium was uniformly distributed throughout the size class while p,p'-DDE and dieldrin showed increasing concentrations with size within the 35-50 cm length range.

The metal concentrations have been compared with published data from both sides of the Irish Sea (ICES 1988a) and the North Sea (Scientific and Technical Working Group for the 2nd North Sea Conference, 1987) obtained during the past 5 years (Table 2). This clearly shows that the levels of contaminants measured in mussels from outer Cork Harbour are well within the ranges generally found within the North-East Atlantic shelf area. Since some of the data reported are for heavily contaminated sites, and others from relatively remote sites, it is interesting and perhaps more relevant to compare the present results to the 90-percentile values for this European data set (i.e. the range when the upper and lower 10% of the ranked data have been removed); the Cork Harbour mussels are still well within this range. This comparison does suggest that zinc concentrations in mussel tissue are higher than average for the region; while this may be a reflection of local geo-chemistry, previous studies of sediments in the estuary of the River Lee have noted elevated zinc concentrations with higher values in the vicinity of Cork City (J.Clancy, EOLAS, pers. comm.).

A similar approach has been taken to the assessment of organic contaminants (Table 3). Comparable data on mussels from the North-East Atlantic region have been obtained from the monitoring programme under the Oslo Convention (OSCOM) which also covers the North-East Atlantic region (ICES 1988b). These show that the concentrations of PCBs, DDT and its isomers, dieldrin and HCHs (including λ- HCH i.e. lindane) are at the lower end of the ranges for the region and, in all cases, significantly below the mean concentrations. To further illustrate the position, the levels of PCB, total DDT and dieldrin in Cork Harbour mussels compared to those in the Liverpool area are lower by factors of 9, 18 and 44 respectively (ICES 1988a).

The levels of contaminants in marine organisms depend on biological and climatic factors as well as the concentrations in the surrounding environment. These sources of variation, as well as those related to analytical procedures (e.g. recovery from standard materials, sample homogeneity etc.)

must be taken into account in the interpretation of monitoring data. The evaluation of comparable data sets obtained over a period of 3-5 years or more is the most reliable means of establishing the contamination status of any particular locality. Nevertheless, the present data provide satisfactory evidence that outer Cork Harbour is not heavily contaminated by the five heavy metals investigated, including the priority contaminants mercury and cadmium which may present hazards to human health when the diet (e.g. seafood) contains significantly elevated amounts.

The general state of contamination by PCBs and pesticides investigated is also low and well below levels known to be of toxicological significance. There are, of course, many other man-made organic compounds that may be present as contaminants but which have not been measured in this study. Because of the cost and complexity associated with the analysis of organic contaminants it is important to identify likely sources of specific compounds before they are added to the list of those to be monitored. The present list includes potentially harmful substances which were extensively used in the past, for example pesticides in agriculture and manufacturing industry, and which are now subject to stringent controls. While environmental residues of these substances are expected to diminish, the large quantities released and their resistance to degradation (e.g. PCBs) dictate that the process will be slow.

The Department of the Marine will continue to monitor contaminants in marine organisms in Cork Harbour and other coastal areas and, by keeping under review the sources and substances released into the marine environment, will modify and extend as necessary the substances to be investigated at each location

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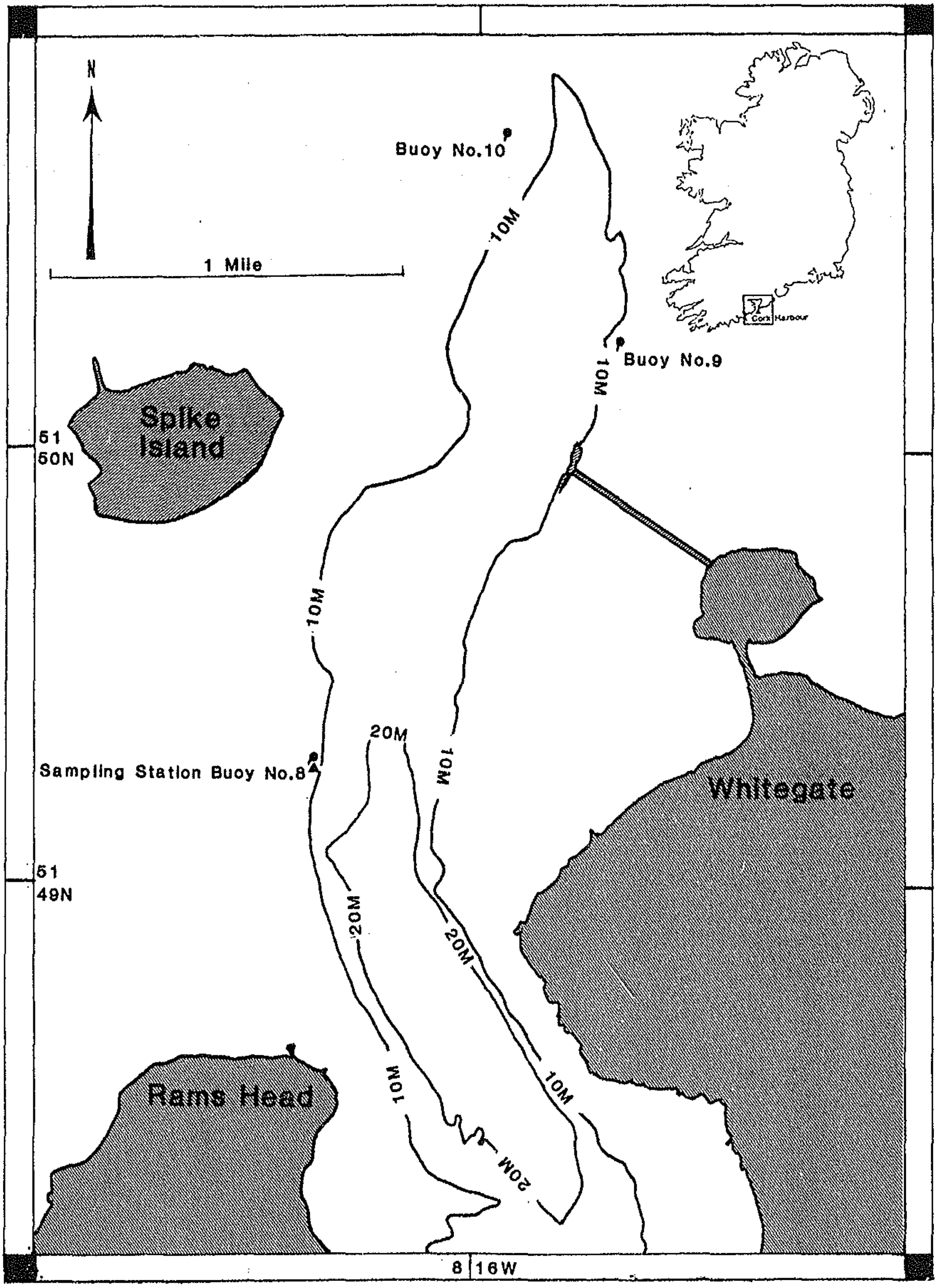

FIGURE 1. Location of mussel sampling site (Buoy No. 8) in outer Cork Harbour (April 1989).

Table 1. Characteristics of the mussel sample

	35-40mm	40-45mm	45-50mm	50-55mm
No. per sample	50	50	50	50
Mean lt. (mm)	37.3	42.6	47.4	52.0
Std. dev. (mm)	1.40	1.18	1.18	1.28
Wt. shell (g)	140	190	240	317
Wt. meat (g)	42.0	63.0	90.2	119
% Moisture	82.9	82.7	82.9	83.3
% Lipid	1.09	0.77	0.60	0.84

Table 2. Heavy metals in tissue of blue mussel <u>Mytilus edulis</u> from outer Cork Harbour compared to over 50 European coastal sites (all data 1980's; Cork data 1989).

	Hg	Cd	Pb	Cu	Zn
			ug/g dry weight		
Outer Cork Harbour					
Range	0.24-0.44	0.94-1.4	6.2-8.9	6.5-12	150-177
50 European Sites					
Range	0.02-1.0	0.50-15	0.5-61	4.6-46	46-450
Upr. & lwr. 90-percentiles(a)	0.06-0.6	0.90-4.7	1.9-15	5.7-20	71-190
Median concentration	0.24	1.9	6.2	7.6	120

(a) The concentrations above which (lower), and below which (upper), 90% of all measured values fall.

Table 3. Organic contaminants in tissue of blue mussel <u>Mytilus edulis</u> from outer Cork Harbour compared to various sites throughout the Oslo Convention area (Cork data 1989; OSCOM data 1985).

PCBs are expressed as 'total' concentrations based on Aroclor 1254 (sum of the 7 congeners is estimated to account for 37.4%).

	Cork Harbour ug/kg wet wt. (ug/g lipid)	OSCOM area ug/kg wet wt.	(Mean)
PCB	11.6 - 21.6 (0.52-0.74)	5 - 290	(85)
ε- DDT	1.2 - 5.9 (0.15-0.54)		
p,p'-DDT	0.18 - 0.61 (0.030-0.06)	N.D.- 12.4	(2.0)
p,p'-DDE	0.36 - 0.53 (0.04-0.06)	0.7 - 15	(2.4)
Dieldrin	0.44 -0.82 (0.052-0.086)	0.2 - 207	(5.2)
α- HCH	N.D.	0.3 - 895	(18)
λ- HCH	N.D. - 0.23	0.1 - 273	(12)
HCB	N.D. - 0.84	0.1 - 231	(9.9)
α- chlordane	N.D.		
λ- chlordane	N.D.		
t-nonachlor	N.D.- 0.30		

Detection limits (ug/kg):

α-HCH	= 0.25	λ-HCH	= 0.20
HCB	= 0.17	t-nonachlor	= 0.16
α-chlordane	= 0.20	λ-chlordane	= 0.27