

**Monitoring results for trace metals and organohalogenes in shellfish (2015)
and physicochemical parameters and trace metals in seawater (2016)
in accordance with Shellfish Waters Directive**



Report Number:

CHEMREP 2018-003

Issue date:

December 2018

Version no:

I



**Monitoring results for trace metals and organohalogens in shellfish (2015)
and Physico-chemical parameters and trace metals in seawater (2016)
in accordance with Shellfish Waters Directive**

Issue date: December 2018



The Marine Institute has accreditation for metals (8 of 9) in seawater and mercury, metals (8 of 9), polychlorinated biphenyl congeners (PCBs), polycyclic aromatic hydrocarbons (PAHs), brominated flame retardants (BFRs) and moisture in biota.

Photo Credit : Tomasz Szumski

Acknowledgements

Brendan McHugh, Aaron McKeown, Andrew Morrissey, Brian Boyle, Denis Crowley, Eileen Joyce, Laura Brophy, Rena Garrett, Marissa Parker, Tomasz Szumski, Linda O’Hea and Evin McGovern.

The Marine Institute Acknowledges the assistance of the following in delivering this programme: Environmental Protection Authority, Sea Fisheries Protection Authority, Department of Agriculture, Food & the Marine, Complete Laboratory Solutions, AquaFact International and the ongoing co-operation of the aquaculture industry.

Table of Contents

1. Introduction	5
2. Methods	7
2.1 Seawater Sampling and analysis	7
2.2 Shellfish flesh	9
3. Results.....	11
3.1 Physicochemical parameters and trace metals in seawater	11
3.2 Trace metals and organohalogens in shellfish flesh.....	24
4. Conformance with specific requirements for Shellfish Waters Directive (SI No. 268 of 2006) and the Water Framework Directive (SI 272 of 2009)	49
4.1 Physico-chemical parameters 1 – 7	49
4.2 Parameter 8 Organohalogens and PAHs.....	49
4.3 Dissolved Trace Metals Parameter 9	50
5. Compliance with European Food Safety Maximum Limits for Bivalve Molluscs	54
Annex A: Methods	55
A.1 Measurement of physicochemical and trace metals in seawater.....	55
A.2 Analysis of trace metals and organohalogen substances in shellfish flesh	58
A.3 Quality Assurance	60

List of Tables

Table 1: Parameters, matrices and frequencies of testing for physico-chemical parameters	5
Table 2: Locations of the SW stations designated by SI 268 of 2006, SI 55 of 2009 and SI 464 of 2009	8
Table 3: Mandatory and Guide values in water and shellfish.	9
Table 4: European Communities (Quality of Shellfish Waters) Regulations SI No. 268 of 2006 Guide Values for metal levels in shellfish flesh and Maximum levels for mercury, cadmium and lead, marker PCBs in bivalve molluscs (Commission Regulation (EC) No. 1881/2006 as amended) and six marker PCBs.	10
Table 5: Dissolved trace metal concentrations ($\mu\text{g l}^{-1}$) in surface water samples ($\sim 0.5\text{m}$ depth) and In-situ probe physico-chemical probe readings, secchi depth and laboratory analysed colorimetry and suspended solid concentrations from stations in designated shellfish waters for the year 2016.	12
Table 6: PAH concentrations ($\mu\text{g l}^{-1}$) in surface water samples ($\sim 0.5\text{m}$ depth) in designated shellfish waters for the year 2016.	19
Table 7: Overall median and ranges ($\mu\text{g l}^{-1}$) for SWD specified dissolved trace metals in seawater as measured in Shellfish Waters in 2016.	24
Table 8: Trace metal, polychlorinated biphenyl (PCB), polybrominated diphenyl ether (PBDE) , Polyaromatic Hydrocarbons (PAHs) and organochlorine compound wet weight concentrations in shellfish sampled from designated shellfish growing waters (SGWs) in 2015.	25
Table 9: Summary statistics ($\mu\text{g l}^{-1}$) for trace metals in surface water samples collected at designated shellfish waters in 2016.	51
Table 10: Summary statistics (mg kg^{-1} ww) for trace metals in bivalve molluscs collected at SWs in 2015.	53
Table A1: Limit of Quantification (LOQ), testing laboratory and analytical methods for suspended solids and colorimetry.	55
Table A2: Limit of Quantification (LOQ), Limit of Detection (LOD), testing laboratory and analytical methods for trace metals in seawater.	57
Table A.3: Marine Institute metal Detection Limits (mg kg^{-1} wet weight) and test method details.	59

I. Introduction

Directive 2006/113/EC on the Quality Required of Shellfish Waters, also referred to as the Shellfish Waters Directive (SWD) requires the monitoring of, *inter alia*, certain physicochemical parameters including trace metal contaminants in order to assess and protect the quality of shellfish growing waters and the shellfish harvested from them¹. Sixty-four areas have been designated as Shellfish Waters (SWs) under SI 268 of 2006, SI 55 of 2009 and SI 464 of 2009. The SWD is concerned with the quality of shellfish waters and applied waters designated by the Member States as needing protection or improvement in order to support shellfish (bivalve and gastropod molluscs) life and growth and thus to contribute to the high quality of shellfish products directly edible by man.

This report details the Marine Institute's (MI) monitoring results for physicochemical parameters sampled in seawater and shellfish tissue from designated Shellfish Waters and specifically:

Dissolved trace metal (SWD parameter 9) concentrations and other physicochemical parameters (SWD parameters 1 – 7) in seawater sampled from Irish Shellfish Waters (SWs), in 2016.

Trace metal (SWD parameter 9) and organohalogen (parameter 8) concentrations in shellfish sampled from Irish Shellfish Waters (SWs) in 2015.

Table I: Parameters, matrices and testing frequency for physicochemical parameters. Method details provided in Annex A.

Parameter No.	Parameter	Results Reported	Laboratory or in situ*	Parameter tested	Sampling Frequency
1	pH	Seawater 2016	<i>in Situ</i> probe		4
2	Temperature	Seawater 2016	<i>in Situ</i> probe		4
3	Coloration (true colour)	Seawater 2016	Laboratory		4
4	Suspended solids	Seawater 2016	Laboratory		4
5	Salinity	Seawater 2016	<i>in Situ</i> probe		4
6	Dissolved oxygen	Seawater 2016	<i>in Situ</i> probe		4
7	Petroleum hydrocarbons	Seawater 2016	<i>in Situ</i>	Visible hydrocarbons	4
8	Organohalogen substances and PAH	Shellfish Flesh 2015	Laboratory GCMS	Polychlorinated biphenyls polybrominated diphenylethers organochlorine pesticides and PAHs	1
9	Dissolved trace metals and PAHs Trace Metals	Seawater 2016 Shellfish Flesh 2015	Laboratory ICPMS and CVAFS and GC-MS	Mercury, other trace metals and PAHs	4

¹ Codified version of 1979/23/EC. The SWD was repealed by and subsumed into the Water Framework Directive 2000/60/EC in December 2013.

The Marine Institute undertakes a monitoring programme to meet the requirements of the Water Framework Directive (WFD) 2000/60/EC Transitional and Coastal (TraC) Waters and physico-chemical elements of the SWD. This work is carried out on behalf of the Environmental Protection Agency (EPA) and the Department of Housing, Planning and Local Government (DHPLG). As part of this, the Marine Institute put in place arrangements for sampling and testing for parameters 1 – 9 of the SWD. Table 1 outlines the parameters, matrices and frequencies of sampling.

Results were reported for physico-chemical parameters (1 – 7) in seawater where possible four times per year in 2016 and metals generally twice a year as per the frequencies laid out in SI No. 268/2006. *In situ* measurements and water sampling was undertaken by Complete Laboratory Solutions (CLS) under contract to the Marine Institute and their sub-contractor Aquafact and, in areas where it was identified they were already undertaking quarterly monitoring, the EPA. Samples of shellfish from within or close to designated SWs, were collected by Officers of the Sea Fisheries Protection Authority (SFPA) in November/December of 2015. This was coordinated by the Marine Institute where laboratory analysis for parameters 8 and 9 was also carried out.

The purpose of the monitoring is to assess:

- Water quality with respect to parameters 8 (organohalogen) and 9 (nine trace metals) of the SWD.
- Compliance with maximum permissible limits as established in EC food safety legislation for certain contaminants for bivalve molluscs (Regulation 1831/2003/EC as amended).

This report provides monitoring results and an evaluation of conformance of results with various legislative standards in place for assessing water quality and compliance with seafood standards for bivalve molluscs.

2. Methods

2.1 Seawater Sampling and analysis

There are 65 Shellfish Water stations in 64 designated Shellfish Waters sampled by both CLS and their subcontractor Aquafact on behalf of the Marine Institute as per the agreed monitoring plan, or by the EPA (see Table 2 for locations).

Data are reported here for physicochemical parameters 1 – 7 in water (pH, Temperature, coloration, suspended solids, salinity, dissolved oxygen and visible petroleum hydrocarbons respectively) and parameter 8 (dissolved arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc). Additional physicochemical parameters reported include turbidity, chlorophyll-a (*in situ* probe) and secchi depth and for some samples additional metals cobalt, manganese, uranium and vanadium. SW stations were typically sampled four times per annum generally in April, June, August and December for physicochemical parameters, in accordance with both Marine Institute and EPA schedules and in line with Marine Institute protocols. On generally two or more of these occasions samples were collected for laboratory testing of trace metals. Details of the sampling and testing methodology employed are provided in Annex A.

Standards and Criteria – Water parameters

SI 268 of 2006 sets out the mandatory and guide values for seawater to be complied with for shellfish waters. For parameters 1 – 7, these reflect requirements of the Directive. For parameter 8 & 9 100% compliance is required indicating that values should be interpreted as a Maximum Allowable Concentration Quality Standard (MAC-QS). Furthermore, SI 272 of 2009 and SI 327 of 2012 set Annual Average (AA-QS) and MAC-QS that are applicable to all transitional and coastal waters. Some of these implement the Water Framework Directive Environmental Quality Standards (EQS) adopted by the EC in Directive 2008/105/EC. These are outlined in Table 3.

Table 2: Locations of Designated Shellfish Waters (SW) designated by SI 268 of 2006, SI 55 of 2009 and SI 464 of 2009. Station Code (Marine Institute (M) or Environmental Protection Agency (E)) indicates the agency that completed sampling.

Station Code	County	Lat (Deg)	Long (Deg)	Shellfish Water	Station Code	County	Lat (Deg)	Long (Deg)	Shellfish Water
M1	Donegal	55.2980	7.295	Trawbreaga Bay	M43	Limerick	52.5747	9.487	Shannon Estuary - Ballylongford
M2	Donegal	55.1473	7.8763	Sheephaven Bay	M47	Kerry	52.2712	9.8327	Tralee Bay
E1	Donegal	55.0591	7.5579	Lough Swilly - Inner Lough	M48	Kerry	52.2718	10.0073	Maharees
E2*	Donegal	55.1535	7.6835	Mulroy Bay - Broadwater	E9*	Kerry	51.8975	10.3234	Valentia River
M5	Donegal	54.9422	8.3985	Dungloe Bay	M51	Kerry	52.1410	9.8933	Cromane
M6	Donegal	54.8975	8.3667	Trawenagh Bay	E10	Kerry	51.7776	9.8085	Kenmare/ Kilmackilloge
M10	Donegal	55.0572	8.3228	Gweedore Bay	M56	Kerry	51.7495	9.877	Kenmare/ Ardgroom
E3	Donegal	54.8500	8.39	Gweebarra Bay	E11*	Cork	51.6459	9.8683	Castletownbere
M13	Donegal	54.7583	8.4753	Loughras Beg	M58	Cork	51.6788	9.7247	Adrigole
M14	Donegal	54.6345	8.174	Donegal Bay	M59	Cork	51.7272	9.543	Glengariff
E4	Donegal	54.6190	8.3872	McSwynes Bay - Inner Bay/ Bruckless	M60	Cork	51.6883	9.476	Inner Bantry Bay
M15	Donegal	54.5903	8.393	Inver Bay	M61	Cork	51.6167	9.688	Bantry Bay South
M19	Sligo	54.3372	8.5567	Sligo Bay - Drumcliff	M62	Cork	51.6575	9.5488	League Point
M20	Sligo	54.2893	8.5238	Sligo Bay – Sligo Harbour	M63	Cork	51.6073	9.5515	Dunmanus Inner
M23	Mayo	54.2102	9.191	Killala Bay	E12	Cork	51.5264	9.428	Roaringwater Bay
M24	Mayo	54.1815	9.9513	Blacksod bay	E13	Cork	51.4975	9.4076	Baltimore Hbr/Sherkin
M25	Mayo	53.9798	9.9495	Achill Sound - North	E14	Cork	51.6928	8.5322	Kinsale
M26	Mayo	53.9210	9.9165	Achill Sound - South	M67	Cork	51.7000	8.46	Oysterhaven
E5	Mayo	53.8805	9.6034	Clew Bay (North Station)	E15*	Cork	51.8851	8.2708	Cork Great Island North Channel
E6	Mayo	53.7955	9.6017	Clew Bay (South Station)	M71*	Cork	51.8492	8.1953	Rostellan South
E7	Galway	53.6000	9.782	Killary Harbour – Inner	M72	Cork	51.8577	8.1963	Rostellan North
M29	Galway	53.5728	9.995	Ballinakill Bay	M73	Cork	51.8493	8.205	Rostellan West
M30	Galway	53.5208	10.1193	Streamstown Bay	M74	Cork	51.9005	7.8878	Ballymacoda
M31	Galway	53.4720	10.0362	Clifden Bay - Ardbear Bay	M77	Waterford	52.0680	7.5872	Dungarvan
M32	Galway	53.4587	10.0462	Mannin Bay	E16	Waterford	52.2584	6.9916	Waterford Hbr Duncannon
M33*	Galway	53.3510	9.6892	Kilkieran Bay - North	M81	Wexford	52.2275	6.812	Bannow Bay
M35	Galway	53.2150	9.4558	Galway Bay - Outer / Indreabhán	E17	Wexford	52.3343	6.419	Wexford Harbour Outer
E8	Galway	53.1666	8.9565	Kinvara/ Clarinbridge	E18	Wexford	52.3615	6.4712	Wexford Harbour Inner
M37	Galway	53.1408	9.0808	Ballyvaughan/ Poulnaclogh	E19*	Dublin	53.4457	6.1065	Malahide
M38	Galway	53.1598	9.0563	Galway Bay Aughinish Bay	E20*	Dublin	53.6257	6.1587	Balbriggan - Skerries
M39	Limerick	52.6533	9.5592	Shannon Est - Poulnasherry	E21*	Louth	53.9457	6.3051	Dundalk Bay
M41	Limerick	52.5817	9.7445	Shannon Est - Rinevella	M100	Louth	54.0523	6.182	Carlingford Lough - Inner
M42	Limerick	52.5883	9.7038	Shannon Est - Carrigaholt					

* Station M71 Rostellan South was merged with M73 Rostellan West due to their close proximity.

Table 3: Mandatory and Guide values in water and shellfish, as set in SI 268 of 2006 and additional WFD EQS for trace metals in seawater as set in SI 272 of 2009 for specific pollutant and SI 327 of 2012 (establishing EQS for priority substances as per Directive 2008/105/EC).

Parameter No.	Parameter	Mandatory Standard: Schedule 2 of S.I No. 268/2006 (water only)	Guide Values: Schedule 4 of S.I No.268/2006 (water only)	WFD AA-EQS S.I No. 272/2009	WFD MAC-EQS S.I No. 272/2009
1	pH	≤7 but not >9			
2	Temperature				
3	Coloration (true colour)				
4	Suspended solids				
5	Salinity (Practical Salinity Units)	< 40	No less than 12 or greater than 38 PSU		
6	Dissolved oxygen (%)	≥ 70	≥ 80 (average value)		
7	Visible Petroleum hydrocarbons				
8	Polychlorinated biphenyls Sum ICES 7 CBs (µg kg ⁻¹)	300	100		
9	Dissolved trace metals (µg l ⁻¹)				
	Arsenic	40		20	
	Cadmium	5		0.2	0.45
	Chromium	30		Cr VI 0.6	Cr VI 32
	Copper	10		5	
	Lead	20		7.2	
	Mercury	0.40		0.05	0.07
	Nickel	50		20	
	Silver	10			
Zinc	200			40	

Note: In addition to the above parameters values for turbidity, chlorophyll and secchi readings are also reported where available.

2.2 Shellfish flesh

Bivalve molluscs are known to accumulate contaminants such as trace metals and persistent organic pollutants in their tissues. Consequently, concentrations of these substances in shellfish flesh can provide a good indicator of water quality.

This report presents results for shellfish samples [blue mussels (*Mytilus edulis*), Pacific oysters (*Crassostrea gigas*), native oysters (*Ostrea edulis*) and razor clams (*Ensis siliqua*)]. Parameters reported cover trace metals and organohalogenes, specifically polychlorinated biphenyl congeners (PCBs), various organochlorine compounds (OCs) polybrominated diphenyl ethers (PBDEs) and Polyaromatic Hydrocarbons (PAHs). All analysis was carried out at the Marine Institute laboratories with the exception of mercury which was carried out by FERA Science UK.

Samples were collected in November/December 2015 by officers of the Sea Fisheries Protection Authority (SFPA) and MERC Consultants Ltd. from, or close to, designated SWs (see Figure 1) and brought to the Marine Institute for pooling² and processing. Details of the sampling and testing methodology employed are provided in Annex A.

Standards and criteria - shellfish flesh

Commission Regulation (EC) No. 1881/2006/EC as amended, sets maximum levels for mercury, cadmium, lead, six marker PCBs in bivalve molluscs. The maximum and guide values for parameters 8 and 9 in shellfish flesh as set in SI No. 268 of 2006 are given in Table 4.

Table 4: European Communities (Quality of Shellfish Waters) Regulations SI No. 268 of 2006 Guide Values for metal levels in Shellfish flesh and Maximum levels for mercury, cadmium and lead, marker PCBs in bivalve molluscs (Commission Regulation (EC) No. 1881/2006 as amended) and six marker PCBs

Parameter	Metals Guide Values ¹ Shellfish mg kg ⁻¹ dry weight	Metals Guide Values ¹ Shellfish mg kg ⁻¹ wet weight (Indicative ²)	Max limit ³ Bivalve Molluscs mg kg ⁻¹ wet weight
Arsenic	30	6.0	
Cadmium	5.0	1.0	1.0
Chromium	6.0	1.2	
Copper	400	80	
Lead	7.5	1.5	1.5
Mercury	1.0	0.2	0.5
Nickel	5.0	1.0	
Silver	15	3.0	
Zinc	4000	800	
Sum 6 PCBs ⁴			75

¹ SI No. 268 of 2006 also includes mandatory and guide values for ICES 7 PCBs in shellfish flesh. These are not included in this table as the new stricter standard for seafood (Regulation 1259/2011/EC) takes precedence.

² Indicative wet weight (assuming 80% moisture)

³ Maximum levels for mercury, cadmium and lead, marker PCBs in bivalve molluscs as set out in Commission Regulation (EC) No. 1881/2006 as amended.

⁴ 6 PCBs= CB congeners 28, 52, 101, 138, 153 and 180

² Pooled sample: Individual shellfish provide insufficient test material for analysis. A number of shellfish of the same species and from the same location are then pooled to comprise the test sample.

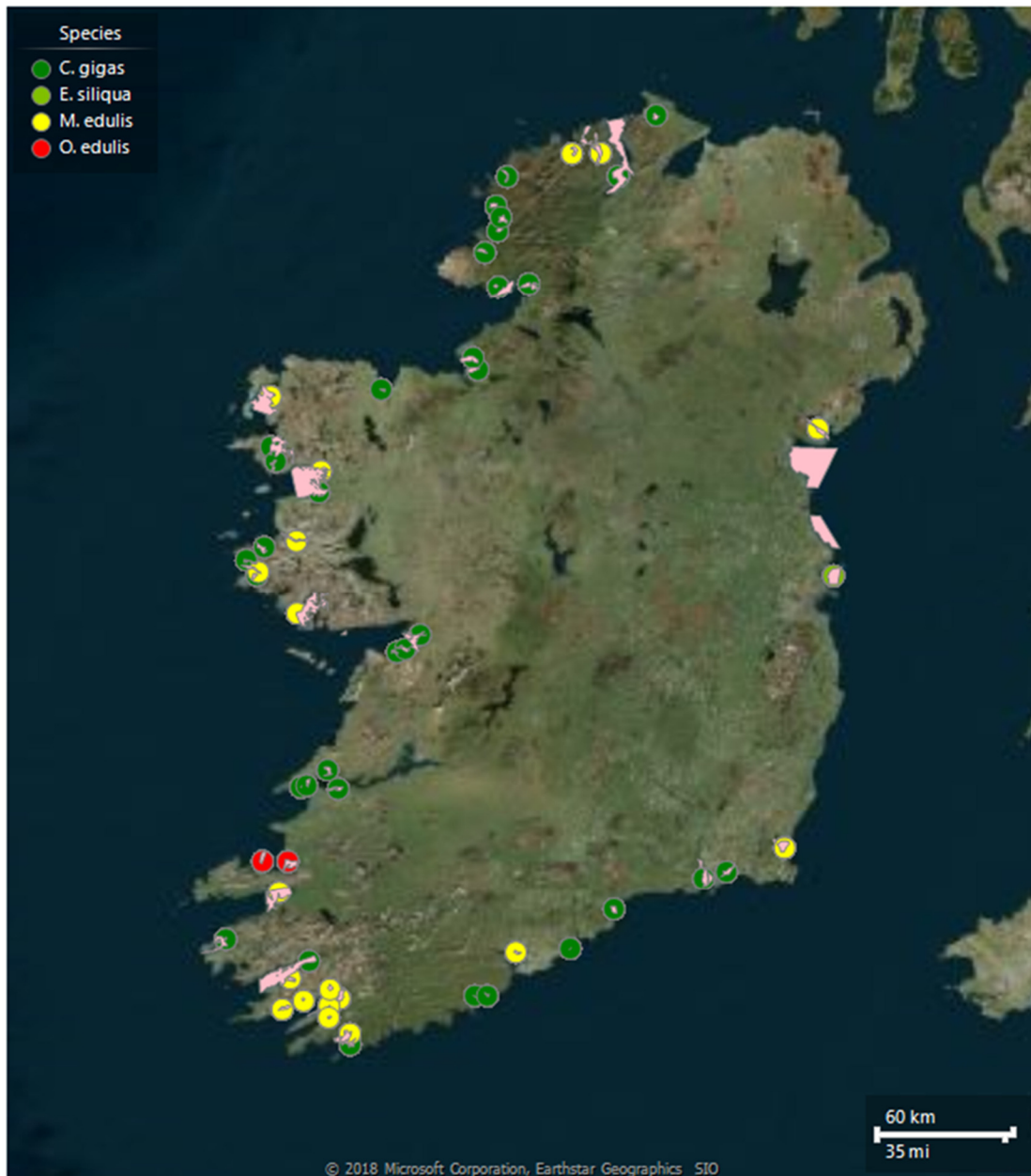


Figure 1: Locations of designated SWD shellfish waters and species sampled in 2015

3. Results

3.1 Physicochemical parameters and trace metals in seawater

SWs were generally visited four times in the year for *in-situ* physicochemical probe measurements, suspended solids and colorimetry. Water samples for metals analysis were taken at each of these SWs on two of the four site visits. Physicochemical measurement values (Parameter 1-6) recorded for 2015 are presented in Table 5. There were no recordings of visible hydrocarbons (Parameter 7) during any site visit in 2015. Results of analysis for trace metals (dissolved phase Parameter 9) are presented in Table 5.

Table 5: (continued to page 18) Dissolved trace metal concentrations ($\mu\text{g l}^{-1}$) in surface water samples ($\sim 0.5\text{m}$ depth) and in-situ probe physicochemical probe readings, secchi depth and laboratory analysed colorimetry and suspended solid concentrations from stations in designated shellfish waters for the year 2016.

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	in-situ probe measurement						laboratory analysis		metal analysis													
					Secchi Depth (m)	Chlorophyll-a ($\mu\text{g/l}$)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	pH (sc)	Salinity (PSU)	Temperature ($^{\circ}\text{C}$)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic ($\mu\text{g/l}$)	Cadmium ($\mu\text{g/l}$)	Chromium ($\mu\text{g/l}$)	Cobalt ($\mu\text{g/l}$)	Copper ($\mu\text{g/l}$)	Lead ($\mu\text{g/l}$)	Manganese ($\mu\text{g/l}$)	Mercury ($\mu\text{g/l}$)	Nickel ($\mu\text{g/l}$)	Silver ($\mu\text{g/l}$)	Uranium ($\mu\text{g/l}$)	Vanadium ($\mu\text{g/l}$)	Zinc ($\mu\text{g/l}$)
E11-Castletownbere	2077	02/02/2016	S	0.5										1.54	<0.05	0.31	0.01	0.19	<0.10	0.52	0.0026	0.14	nd	3.37	1.43	<1.00
	2200	17/05/2016	S	0.5										1.67	<0.05	0.36	0.03	0.33	<0.10	4.29	0.0017	0.24	<0.05	3.59	1.84	<1
E12-Roaringwater Bay Inner	2212	02/06/2016	S	0.44	4.68	0.18	121.1	9.59	8.3	34.7	16.79	<4	<5								0.0017					
			B	5.92	4.68	2.7	125.9	10.41	8.3	34.8	14.57															
	2516	12/12/2016	S	0.35		1.04	96.8	8.83	7.9	33.8	10.58	<4	<5	1.36	<0.05	0.14	0.01	<0.1	<0.1	2.322	0.002	0.23	nd	3.503	1.46	<1
	2202	18/05/2016	S	0.5										1.82	<0.05	0.44	0.04	0.55	<0.10	16.1	0.0019	0.25	<0.05	3.57	1.79	<1
E13-Baltimore Harbour \ Sherkin	2211	02/06/2016	S	0.42	2.98	1.77	113.6	9.32	8.3	33.2	15.45	<4	<5								0.0021					
			B	11.03	2.98	2.71	114.3	9.49	8.3	34.3	14.48															
	2517	12/12/2016	S	0.3		0.79	97.3	8.8	7.8	33.6	11	<4	9	1.52	<0.05	0.15	0.01	<0.1	<0.1	2.288	0.0025	0.2	nd	3.561	1.43	<1
	2201	19/05/2016	S	0.5										1.58	<0.05	0.37	0.07	0.48	<0.10	22.7	0.001	0.3	nd	3.39	1.74	<1
E14-Kinsale	2214	02/06/2016	S	0.5	1.5		125.5	10.18	8.3	28.8	17.1			1.52	<0.05	0.33	0.1	0.63	<0.10	26.8	0.0105	0.28	0.06	2.98	1.3	<1
			B	7	1.5		116.7	9.64	8.2	32.5	14.93															
	2205	07/06/2016	S	0.54	0.98	14.49	116.1	9.29	8.3	28.9	17.97	<4	<5	1.57	<0.05	0.18	0.12	0.49	nd	24.1	0.0025	0.24	nd	2.91	1.23	<1
			B	5.16	0.98	13.49	117	9.35	8.3	31.1	17.34															
	2241	11/07/2016	S	0.5			102.2	8.68	8.1	29.2	14.58			1.51	<0.05	0.17	0.1	0.6	nd		0.0008	0.26	nd	2.8	1.34	<1
			B	9.5			92.5	8.1	8	34	11.65															
	2124	12/04/2016	S	0.5	0.49	1.91	98.7	9.79	8.1	19.6	9.58	19.5	<5	1.25	<0.05	0.32	0.12	0.88	<0.10	31.8	0.0016	0.33	nd	2	1.3	<1.00
			B	7.2	0.49	1.98	99	9.08	8	32.8	9.3															
2299	22/08/2016	S	0.5			88.5	7.17	7.9	31.9	16.15			1.48	<0.05	0.27	0.13	0.42	<0.1	21.2	0.0019	0.34	<0.05	2.95	1.4	<1	
		B	4.9			89.2	7.25	7.9	33.1	15.65																
2466	24/11/2016	S	0.1			90.5	8.42	7.8	31.1	9.75			1.61	<0.05	0.29	0.03	0.269	<0.1	7.94	0.0075	0.39	<0.05	3.33	1.55	<1	
		B	9.91			90.1	8.02	7.9	33.8	11.02																
E15-Cork Harbour North Channel	2213	01/06/2016	S	0.5	1		11.75	8.4	31.1	19.06			1.86	<0.05	0.43	0.1	0.95	<0.10	27.9	0.0089	0.39	0.05	3.26	1.74	1.29	
			B	3.4	1		11.77	8.4	31.4	18.6																
	2076	03/03/2016	S	0.5	0.8		97.4	10.1	7.9	23.2	7.22			1.22	<0.05	0.33	0.05	0.59	<0.10	10.4	0.0019	0.29	nd	2.26	1.1	1.24
			B	3.8	0.8		96.6	9.9	7.1	24.3	7.36															
2298	09/08/2016	S	0.5			110.2	8.8	8.2	34.2	18.18			1.65	<0.05	0.34	0.06	0.57	<0.1	13.9	0.0036	0.31	<0.05	3.16	1.5	<1	
		B	4.3			108.3	8.65	8.2	34.3	16.11																
E16-Duncannon	2078	15/03/2016	S	0.5			92.5	9.57	8	17.8	8.83			1.37	<0.05	0.19	0.06	0.7	0.11	5.96	0.0011	0.53	nd		1.42	<1.00
			B	7.7			94.3	9.01	7.9	30.2	8.82															
	2156	17/05/2016	S	0.5			122.6	11.36	8.2	15.6	14.46			1.16	<0.05	0.22	0.06	0.65	<0.10	8.78	0.0017	0.4	nd	2.81	1.11	<1.00
			B	5.6			126.4	11.48	8.1	15.6	13.6															
	2246	19/06/2016	S	0.5			103.8	8.63	8	23.3	17.48			1.55	<0.05	0.12	0.07	0.75	nd	5.22	0.0015	0.48	nd	2.96	1.47	<1
			B	4.4			104.4	8.67	8	25.3	16.93															
2338	20/09/2016	S	0.5			91	7.54	8.2	29.5	15.81			1.43	<0.05	0.21	0.05	0.46	<0.1	3.48	0.0313	0.3	nd	3.02	1.39	<1	
		B	7.44			96.7	7.9	8.1	32.4	15.57																

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	Secchi Depth (m)	in-situ probe measurement						laboratory analysis		metal analysis													
						Chlorophyl -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)	
E17-Wexford Harbour Outer	2125	13/04/2016	S	0.2	1.3	0.52	105.9	9.79	8.1	26.5	10.78	5.8	<5	1.3	<0.05	0.16	0.06	0.33	nd	7.37	0.0013	0.28	nd	3.31	1.28	<1.00	
			B	1.6	1.3	0.87	107.1	9.82	8.2	28.9	10.45																
	2157	16/05/2016	S	0.4			120.7	10.31	8.2	27.2	15			1.43	<0.05	0.26	0.09	0.55	<0.10	20.33	0.0019	0.35	<0.05	3.23	1.32	<1.00	
			B	3			113.3	9.74	8.2	29.2	14																
	2339	19/09/2016	S	0.1			99.5	8.19	8.2	32	15.78			1.73	<0.05	0.25	0.07	1.37	<0.1	7.34	0.0056	0.24	nd	3.03	1.71	<1	
			B	1.42			100.2	8.17	8.1	32	15.78																
	2247	21/07/2016	S	0.1			108.1	8.06	8.2	33.3	18.63										0.0034						
			B	2.1			104.7	8.03	8.1	33.4	18.97																
2464	23/11/2016	S	0.1			95.8	10.02	7.7	28.6	5.36			1.35	<0.05	0.3	0.07	0.293	<0.1	5.32	<0.0005	0.51	<0.05	3.43	1.4	<1		
		B	1.61			98.3	9.88	7.8	31.1	6.34																	
E18-Wexford Harbour Inner	2126	13/04/2016	S	0.3	>0.5	1.02	112	11.33	8.2	9.8	11.49	17.1	17	1.04	<0.05	0.19	0.11	0.79	<0.10	21.4	0.0013	0.49	nd	2.44	0.71	<1.00	
	2155	16/05/2016	S	0.4			119.4	10.65	8.5	12.5	17.22			1.4	<0.05	0.19	0.14	0.99	<0.10	41.9	0.0023	0.5	nd	2.68	0.99	<1.00	
	2337	19/09/2016	S	0.1			99.5	8.32	8	23.8	17.05			1.89	<0.05	0.22	0.14	0.4	<0.1	10.4	0.02	0.37	nd	2.7	1.71	<1	
			B	4			98.6	8.15	7.8	27.3	16.55																
	2248	21/07/2016	S	0.1			106.3	8.22	8.3	24.7	20.84			2.24	<0.05	0.08	0.15	0.71	nd	12.9	0.0011	0.41	nd	3.06	2.01	<1	
			B	1.7			111.3	8.52	8.3	27.6	20.81																
	2465	23/11/2016	S	0.1			93.3	10.51	7.9	19.3	4.89			1.42	<0.05	0.19	0.11	0.456	<0.1	15.1	0.0069	0.62	nd	3.06	1.12	<1	
			B	2.25			97	10.49	7.8	24	5.02																
E19-Malahide	2527	14/12/2016	S	0.5		1.02	98.6	9	8	33.2	9.97	<4	18	1.55	<0.05	0.15	0.01	0.21	<0.1	2.432	0.0015	0.29	nd	3.53	1.42	<1	
			B	7.84		1.14	97.3	8.88	8	33.2	10																
	2206	15/06/2016	S	0.4	4.2	1.03	111.6	8.99	8.3	33.4	16.19	<4	<5	1.73	<0.05	0.21	0.03	0.49	nd	8.44	0.0157	0.27	nd	3.37	1.49	<1	
			B	5.9	4.2	2.31	112.8	9.18	8.3	33.5	15.65																
	2292	18/08/2016	S	0.49		1.65	96.3	7.7	8.1	33.6	16.04	<4	9														
			B	10.24		3.15	95.9	7.71	8.1	33.6	15.75																
2122	20/04/2016	S	0.44	2.1	2.01	109.2	10.14	8.2	32.2	10.06	<4	<5	1.61	<0.05	0.28	0.02	0.54	<0.10	3.34	0.0009	0.32	<0.05	3.46	1.53	<1.00		
		B	5.9	2.1	4.26	112.5	10.5	8.2	32.3	9.76																	
E1-Lough Swilly Inner	2245	12/07/2016	S	0.5			101.7	8.28	8.2	32.3	15.72			1.34	<0.05	0.17	0.04	0.42	nd	4.21	0.0028	0.25	nd	3.21	1.33	<1	
			B	14.37			96.8	7.91	8.1	33	15.33																
	2025	19/01/2016	S	0.5			96.5	8.54	7.9	25.4	5.92			1.19	<0.05	0.31	0.03	0.38	<0.1	3.12	0.0017	0.2	nd	3	1.03	<1	
			B	15.48			95.7	7.87	7.9	32.4	7.07																
	2319	24/08/2016	S	0.5			97.1	7.74	8.2	32.7	16.71	23.7	<5	1.44	<0.05	0.26	0.03	0.82	<0.1	2.79	0.0229	0.33	nd	2.96	1.4	<1	
			B	17.21			96	7.63	8.2	33	16.71																
2210	30/05/2016	S	0.5	2.75		99	8.12	8.2	32.6	14.64			1.3	<0.05	0.17	0.04	0.28	nd	5.24		0.22	nd	3.24	1.16	<1		
		B	11.06	2.75		94.1	7.91	8.1	33.3	13.22																	
E21-Dundalk Bay	2127	14/04/2016	S	0.2	0.89	5.69	108.7	10.02	8.2	32.7	9.37	<4	10	1.64	<0.05	0.33	0.02	0.54	<0.10	3.23	0.001	0.28	<0.05	3.44	1.31	<1.00	
			B	3.6	0.89	5.8	108.4	9.99	8.2	32.7	9.37																
	2306	15/09/2016	S	0.5										1.75	<0.05	0.28	0.04	0.54	<0.1	8.3	0.0013	0.39	<0.05	3.08	1.36	<1	
			B	4.31											1.76	<0.05	0.19	0.02	0.38	nd	1.23	0.0012	0.23	<0.05	3.41	1.37	<1
	2297	28/07/2016	S	0.5										1.77	<0.05	0.32	0.04	0.5	<0.1	16.5	0.0011	0.32	<0.05	3.25	1.41	<1	

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	Secchi Depth (m)	in-situ probe measurement						laboratory analysis		metal analysis												
						Chlorophyll -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)
E2-Mulroy Bay - Broadwater	2208	02/06/2016	S	0.5	7.5	111.6				33.4	15.07			1.31	<0.05	0.19	0.03	0.26	nd	5.79	0.0038	0.18	nd	3.36	1.32	<1
			B	20.6	7.5	98	7.65			33.7	13.34															
	2335	15/09/2016	S	0.5		95.8	7.65	8.3	33.9	16.26			1.47	<0.05	0.29	0.04	0.21	<0.1	5.45	0.0007	0.13	nd	3.01	1.48	<1	
			B	21.08		90	7.21	8.3	34.2	16																
	2026	18/01/2016	S	0.5		96.4	8.94		30.8	6.26			1.3	<0.05	0.29	0.03	0.38	<0.1	4.03	0.0008	0.13	nd	3.23	1.14	<1	
			B	20.74		92.3	8.47		31.5	6.57																
2318	25/08/2016	S	0.5		104.4	8.21	8.3	32.4	17.08	54.3	6	1.68	<0.05	0.24	0.04	0.21	nd	7.35	0.003	0.17	nd	3.28	1.46	<1		
		B	21.02		87.9	6.98	8.2	34.1	16.41																	
E3-Gweebarra Bay	2120	04/04/2016	S	0.27		1.51	106.9	9.21	7.9	32.7	8.93	<4	<5	1.52	<0.05	0.34	0.01	0.23	<0.10	0.79	0.0008	0.17	nd	3.53	1.54	<1.00
			B	2.09		1.46	106.2	9.19	7.9	32.7	8.92															
	2495	05/12/2016	S	0.73	>2.1	1.5	97.9	8.38	8	34	9.07	<4	<5	1.49	<0.05	0.23	0.01	0.16	<0.1	0.573	0.0012	0.11	nd	3.726	1.44	<1
			B	1.8	>2.1	1.75	97.2	8.32	8	34	9.07															
	2203	10/06/2016	S	0.42		1.25	114.2	8.7	8.1	34.2	14.24	<4	<5	1.47	<0.05	0.23	0.01	0.16	nd	0.88	0.001	0.15	nd	3.46	1.57	<1
			B	1.22		1.22	114	8.69	8.1	34.2	14.24															
2290	24/08/2016	S	0.14		0.22	103	7.59	8.3	34	16.2	<4	<5	1.43	<0.05	0.35	0.01	0.23	<0.1	0.99	0.0014	0.23	<0.05	3.36	1.59	<1	
		B	3.04		1.25	102.8	7.58	8.3	34.1	16.2																
E4-Bruckless	2209	01/06/2016	S	0.5	8	102.7	8.27		34.3	11.64			1.51	<0.05	0.2	0.01	0.14	nd	1.14	0.0015	0.14	nd	3.33	1.44	nd	
			B	15.4	8	79.8	6.65		34.5	9.98																
	2244	13/07/2016	S	0.5		104.6	8.5	8.2	32.4	15.73			1.3	<0.05	0.17	0.02	0.38	nd	3.36	0.0013	0.14	<0.05	3.21	1.23	1.3	
			B	21.2		83.5	6.91	8.1	34.4	14.28																
	2336	14/09/2016	S	0.5		94.1	7.51	8.4	34.1	16.13			1.48	<0.05	0.38	0.02	0.15	nd	1.17	0.0224	0.12	nd	3.16	1.4	<1	
			B	19.65		72.7	5.86	8.3	34.8	15.45																
2027	20/01/2016	S	0.5		98.7	8.29	7.9	29.5	6.96			1.38	<0.05	0.27	0.02	0.42	<0.1	1.54	0.0011	0.18	nd	2.98	1.15	<1		
		B	19.34		89.4	6.86	7.8	34	9.64																	
E5-Clew Bay North	2072	03/03/2016	S	0.5	1.4	100	9.88	8.2	7.49	6.26			0.56	<0.05	0.22	0.06	0.42	<0.10	23.1	0.0013	0.31	nd	0.76	0.45	1.36	
			B	3.74	1.4	98.6	8.14	7.8	31.6	7.14																
	2308	05/09/2016	S	0.5										1.33	<0.05	0.24	0.03	0.19	nd	5.58	0.0029	0.18	nd	2.88	1.31	<1
			B	4.47	3	104.2	7.64		33.8	16.39					1.61	<0.05	0.21	0.03	0.14	nd	5.27	0.0017	0.2	nd	3.32	1.44
	2296	28/07/2016	S	0.5		100.7	8.13	8.2	31.2	16.52			1.21	<0.05	0.23	0.03	0.21	<0.1	5.96	0.0088	0.19	nd	3.03	1.26	1.56	
B			3.53		100.5	8.11	8.2	31.3	16.51																	
E6-Clew Bay South	2073	03/03/2016	S	0.5	1.4	100	8.39	8	30.1	6.84			1.35	<0.05	0.32	0.05	0.32	<0.10	4.85	0.0013	0.4	nd	3.01	1.17	<1.00	
			B	4.24	1.4	99.3	8.23	8	31.5	7																
	2215	14/06/2016	S	0.12	3	0.6	102.7	7.54	8.3	33.6	16.52			1.66	<0.05	0.22	0.05	0.18	nd	11.4	0.0064	0.33	nd	3.31	1.43	<1
			B	4.41		98.9	7.88	8.3	33.7	16.42			1.54	<0.05	0.29	0.02	0.14	<0.1	4.17	0.003	0.24	nd	3.09	1.3	<1	
	2295	28/07/2016	S	0.5		103.3	8.18	8.3	33	16.91			1.53	<0.05	0.29	0.04	0.25	<0.1	8.64	0.0071	0.31	<0.05	3.24	1.35	<1	
B			3.5		102.8	8.15	8.3	33.1	16.87																	

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	Secchi Depth (m)	in-situ probe measurement						laboratory analysis		metal analysis													
						Chlorophyl -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)	
E7-Killary Harbour Inner	2509	02/12/2016	S	0.16	11	0.76	92.5	7.87	8.1	33.5	9.48	5.4	<5	1.41	<0.05	0.18	0.01	<0.1	<0.1	3.871	0.0013	0.23	nd	3.493	1.45	<1	
			B	12.67	11	0.6	93.1	7.77	8.1	34.1	10.21																
	2291	09/08/2016	S	0.18		3.64	100.3	7.76	8.1	29.9	15.03	11.9	<5	1.08	<0.05	0.36	0.05	0.29	<0.1	13.7	0.001	0.41	0.05	2.17	0.98	<1	
			B	14.56		2.56	90.5	6.85	8.1	33.6	15.01																
	2121	13/04/2016	S	0.19	6.5	0.84	102.6	9.3	7.9	26.7	8.61	8.3	<5	1.28	<0.05	0.28	0.02	0.24	<0.100	7.34	0.0013	0.31	nd	2.86	1.27	<1.00	
			B	14.66	6.5	1.13	100.9	8.71	7.9	32.7	9.04																
2204	14/06/2016	S	0.29	7.1	2.2	100.7	7.57	8	34.1	14.94	<4	<5	1.48	<0.05	0.19	0.02	0.13	nd	8.26	0.0012	0.16	nd	3.38	1.31	<1		
		B	12.98	7.1	2.94	100.7	7.65	8.1	34.1	14.45																	
E8-Kinvara	2307	08/09/2016	S	0.5		92.1	7.4	8.2	30.3	17.03				1.51	<0.05	0.27	0.02	0.27	<0.1	4	0.0029	0.27	nd	2.93	1.37	<1	
			B	4.45		93.4	7.43	8.3	32.1	16.9																	
	2216	16/06/2016	S	0.5	4	104.3	7.61		32.8	16.94				1.43	<0.05	0.19	0.02	0.39	nd	3.77	0.0021	0.19	nd	3.28	1.47	<1	
			B	7.24	4	101.2	7.73		32.9	16.95																	
	2294	26/07/2016	S	0.5		97.1	7.73	8.2	30.5	17.4				1.42	<0.05	0.28	0.02	0.31	<0.1	3.26	0.0015	0.27	0.06	2.99	1.33	<1	
			B	5.77		96.7	7.67	8.2	31.2	17.44																	
2074	29/02/2016	S	0.5	1.8	96.1	8.16	7.9	24.3	7.97				1.32	<0.05	0.33	0.02	0.39	<0.10	2.67	0.0012	0.3	nd	2.48	1.18	<1.00		
		B	2.6	1.8	99.1	8.15	7.9	29.3	7.94																		
M100-Carlingford Lough Inner Stn 2	2117	14/04/2016	S	0.5	1.48	9.06	113	10.66	8.2	31	8.85	<4	11	1.43	<0.05	0.29	0.06	0.49	<0.10	25.6	0.0011	0.3	nd	3.3	1.25	<1.00	
			B	3.1	1.48	11.57	111.6	10.52	8.2	31.3	8.76																
	2528	15/12/2016	S	0.53		0.8	92.4	8.67	7.9	32.6	8.94	<4	8	1.38	<0.05	0.13	0.02	0.15	<0.1	3.689	0.0016	0.26	<0.05	3.395	1.43	<1	
			B	4.26		0.8	92.6	8.68	7.9	32.6	8.94																
	2287	19/08/2016	S	0.7		1.87	101.5	8.2	8.1	33.4	15.55	<4	<5														
			B	2.72		2.07	101.6	8.2	8.1	33.4	15.66																
2197	28/06/2016	S	0.4		5.67	104.1	8.54	8.3	33.1	15.01	<4	<5	1.78	<0.05	0.14	0.05	0.36	nd	15.1	0.0014	0.26	nd	3.29	1.69	<1		
		B	2.9		9.52	104.9	8.61	8.3	33.1	14.99																	
M10-Gweedore Bay	2088	02/04/2016	S	0.19	>0.5	3.1	98.7	9.29	8.1	18.9	9.12	27.1	<5	0.89	<0.05	0.12	0.03	0.37	<0.10	6.28	0.0013	0.16	nd		0.88	<1.00	
	2259	04/08/2016	S	0.18		5.58	98.9	7.73	8.2	21.3	17.16	64.5	<5	1.06	<0.05	0.34	0.05	0.57	<0.10	10.2	0.0017	0.23	<0.05	1.93	1.11	<1	
	2167	15/06/2016	S	0.2	>1	2.63	105.6	7.95	8.2	32.6	15.37	7.6	<5	1.39	<0.05	0.27	0.02	0.22	nd	2.97	0.0008	0.16	nd	3.16	1.35	<1	
			B	0.88	>1	2.58	105.7	7.96	8.2	32.6	15.32																
2494	16/12/2016	S	0.24	>0.75	0.69	99	8.58	8.1	32.8	8.83	<4	<5	1.57	<0.05	0.3	0.01	<0.1	<0.1	1.27	0.0029	0.38	nd	3.65	1.6	<1		
M13-Loughras Beg	2262	04/08/2016	S	0.64		12.5	92.4	8.03	8.1	9.29	15.54	191	<5	0.53	<0.05	0.32	0.1	0.7	<0.10	19.7	0.0035	0.45	0.06	0.61	0.6	1.31	
	2091	07/04/2016	S	0.23	0.2	3.99	103	10.08	8.2	17.6	7.84	30.5	17	0.98	<0.05	0.22	0.1	0.53	<0.10	29.82	0.0014	0.28	nd		0.89	<1.00	
	2170	15/06/2016	S	0.27	>0.5	18.93	101.8	8.96	8.3	6.22	15.78	100	<5	0.54	<0.05	0.23	0.1	0.86	<0.1		0.0019	0.42	nd	0.31	0.61	1.09	
	2498	16/12/2016	S	0.38	>0.75	4.69	95.5	9.85	8.1	9.7	7.8	64.7	<5	0.53	<0.05	0.15	0.07	0.53	0.1	23.1	0.0024	0.3	nd	0.971	0.6	1.16	
M14-Donnegal Bay	2263	04/08/2016	S	0.48		2.71	104.5	7.88	8.3	29	16.58	8.1	<5	1.59	<0.05	0.36	0.04	0.46	<0.10	4.63	0.0007	0.3	0.05	3.09	1.65	<1	
	2092	07/04/2016	S	0.3	>0.5	4.16	98.5	8.96	7.9	25.5	8.81	13.1	11	1.26	<0.05	0.22	0.05	0.5	<0.10	10.2	0.0012	0.33	nd		1.24	<1.00	
	2171	15/06/2016	S	0.35	7.5	1.59	106.6	7.93	8.2	32.8	15.85	7.2	<5	1.56	<0.05	0.24	0.05	0.33	nd	11.7	0.0009	0.27	nd	3.07	1.31	<1	
	2499	15/12/2016	S	0.16	>0.75	2.94	96.8	8.76	8.2	29.2	7.95	8.9	<5	1.21	<0.05	0.17	0.04	0.19	<0.1	7.385	0.0012	0.31	nd	3.205	0.98	<1	

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	Secchi Depth (m)	in-situ probe measurement						laboratory analysis		metal analysis												
						Chlorophyll -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)
M15-Inver Bay	2172	10/06/2016	S	0.15	>2	1.9	113.8	8.19	8.1	33.9	17.24	4.9	<5	1.36	<0.05	0.26	0.01	0.2	nd	2.6	0.0009	0.18	nd	3.31	1.37	3.08
			B	22.8	>2	5.71	110.8	8.99	8	34.9	10.96															
	2093	14/04/2016	S	0.14	7.5	1.58	111.1	9.64	8.1	30	9.57	7.9	<5	1.37	<0.05	0.35	0.01	0.37	<0.10	2.08	0.001	0.26	nd		1.41	<1.00
			B	12.57	7.5	0.6	101.3	8.73	7.9	33.3	8.94															
	2500	16/12/2016	S	0.33	>2	2.25	98.5	8.45	8.2	32.4	9.44	4.6	<5	1.34	<0.05	0.15	0.01	0.12	0.16	1.205	0.0011	0.19	nd	3.44	1.3	<1
			B	1.27	>2	2.29	98.6	8.45	8.2	32.4	9.45															
2264	25/08/2016	S	0.17		2.43	106.5	7.87	8.4	30.9	17.07	8.8	<5	1.4	<0.05	0.3	0.04	0.47	nd	3.52	0.0016	0.25	nd	3.01	1.23	<1	
		B	21.75		0.64	78.4	5.88	8.4	34.3	15.25																
M19-Drumcliff	2267	05/08/2016	S	0.18		7.9	97.7	7.6	8.2	23.3	16.74	22.2	<5	1.27	<0.05	0.33	0.09	0.63	<0.10	31.2	0.0011	0.61	nd	1.99	1.37	<1
	2096	07/04/2016	S	0.14	0.3	10.82	96.2	8.96	8	25.8	7.69	11.2	32	1.14	<0.05	0.2	0.04	0.69	<0.10	5.96	0.0013	0.38	nd		1.12	1.29
	2175	14/06/2016	S	0.11	>3	3.2	107.8	7.7	8.3	32.6	17.99	<4	<5	1.49	<0.05	0.2	0.02	0.99	<0.1	5.56	0.0012	0.23	nd	3.02	1.38	1.03
			B	2.61	>3	3.61	107.8	7.74	8.3	32.9	17.65															
	2503	15/12/2016	S	0.2	>0.75	2.22	98.3	8.98	8.2	29.3	7.54	5.9	8	1.29	<0.05	0.14	0.03	0.12	<0.1	3.179	0.0016	0.23	nd	3.246	1.18	<1
M1-Trawbreaga Bay	2250	04/08/2016	S	0.53		4.86	110.9	8.02	8.3	29.3	18.73	29.9	<2	1.67	<0.05	0.31	0.11	0.57	<0.10	24.8	0.001	0.36	<0.05	3.03	1.46	<1
	2079	07/04/2016	S	0.29	0.3	3.76	107	9.7	8.1	21.1	10.17	37.5	14	1.13	<0.05	0.23	0.17	1.54	<0.10	26.16	0.0017	0.53	nd		0.99	<1.00
	2158	15/06/2016	S	0.31	>1	3.24	112.3	8.57	8.2	33.4	14.44	<4	<5	1.47	<0.05	0.46	0.04	0.39	nd	6.27	0.0007	0.19	nd	3.41	1.43	<1
	2485	15/12/2016	S	0.18	>1	1.66	101.7	9.06	8.2	31.2	8.05	<4	<5	1.32	<0.05	0.32	0.06	0.293	<0.1	8.47	0.0007	0.45	nd	3.39	1.01	<1
M20-Sligo Harbour	2097	04/04/2016	S	0.04	>1.3	3.16	99.4	9.5	8	17.2	8.91	29.5	<5	0.86	<0.05	0.35	0.03	0.66	<0.10	3.7	0.0015	0.58	<0.05	1.88	0.74	<1.00
	2504	13/12/2016	S	0.18	>1	2.59	94	8.16	7.8	31.1	9.26	6.2	8	1.28	<0.05	0.15	0.02	0.13	<0.1	2.871	0.0012	0.23	nd	3.241	1.27	<1
			B	0.99	>1	2.61	93.6	8.12	7.7	31.1	9.27															
	2176	14/06/2016	S	0.56	>1.5	9.38	118.5	8.55	8.4	30.7	18.12	8	<5	1.62	<0.05	0.22	0.03	0.33	nd	5.84	0.0013	0.26	nd	2.98	1.46	<1
			B	1.29	>1.5	8.67	118.5	8.54	8.3	32.2	17.72															
2268	30/08/2016	S	0.41		4.35	113.6	8.35	8.4	29.2	17.81			1.76	<0.05	0.28	0.03	0.58	<0.10	4.52	0.0015	0.41	nd	2.78	1.63	1.68	
M23-Killala Bay	2271	05/08/2016	S	0.12		1.44	122.2	8.82	8.4	34.4	17.19	4.7	<5	1.96	<0.05	0.26	0.03	0.33	<0.10	7.37	0.0006	0.2	nd	3.37	2.27	<1
	2100	13/04/2016	S	0.1	>0.5	1.46	133.1	10.94	8.1	30.4	11.98	7.5	<5	1.38	<0.05	0.32	0.03	0.35	<0.10	5.14	0.0009	0.24	nd	3.73	1.78	3.84
	2507	13/12/2016	S	0.12	>1	1.55	96.4	8.13	8	33.2	9.9	<4	7	1.3	<0.05	0.13	0.01	0.1	0.13	2.754	0.0012	0.2	<0.05	3.474	1.32	2.46
	2179	16/06/2016	S	0.2	0.2	3.07	103.5	7.95	8.1	31.6	14.65	<4	5	1.73	<0.05	0.19	0.05	0.2	nd	22.1	0.001	0.25	nd	3.14	1.79	<1
M24-Blacksod bay	2508	02/12/2016	S	0.16	>0.5	3.63	104.7	9.78	8.2	32.3	5.71	6.1	<5	1.29	<0.05	0.13	0.02	<0.1	<0.1	3.18	0.0014	0.17	nd	3.399	1	1.18
	2272	09/08/2016	S	0.09		3.4	108.7	7.82	8.2	33.9	17.47	4.4	<5	1.08	<0.05	0.23	0.02	0.2	<0.1	1.99	0.0008	0.16	nd	3.51	1.16	<1
	2101	13/04/2016	S	0.15	>0.5	1.22	133.5	11.72	8.1	31.2	8.71	5.6	<5	1.06	<0.05	0.26	0.01	0.24	0.1	3.46	0.0006	0.16	nd	3.49	1.17	1.87
	2180	14/06/2016	S	0.12	>1	4.51	98.9	8.17	8.2	18.9	14.98	9.2	7	1.01	<0.05	0.13	0.03	0.28	nd	3.86	0.0014	0.12	nd	1.87	0.98	1.59
M2-Sheephaven Bay	2251	04/08/2016	S	0.16		8.12	105.2	8.12	8.2	13.7	20.08	85.7	7	1.08	<0.05	0.35	0.21	1.15	0.13	30	0.0024	0.67	nd	1.34	1.2	1.45
	2080	05/04/2016	S	0.62	>1.5	2.08	98.8	8.7	8.1	30.7	8.74	<4	<5	1.46	<0.05	0.26	0.02	0.38	<0.10	4.43	0.0008	0.17	nd		1.36	<1.00
	2159	15/06/2016	S	0.39	>1	6.07	107.5	8.22	8.1	27.2	16.24	19.9	7	1.24	<0.05	0.34	0.06	0.4	nd	10.8	0.0013	0.24	nd	2.63	1.16	<1
	2486	16/12/2016	S	0.07	>0.75	3.32	97.3	8.26	8.2	33.9	9.45	5	<5	1.44	<0.05	0.31	0.02	0.492	<0.1	1.91	0.0009	0.35	<0.05	3.64	1.55	<1
M47-Tralee Bay Inner	2182	01/06/2016	S	0.54	>1.89	2.6	112	8.69	8.3	32.9	18.69	<4	<5	1.61	<0.05	0.32	0.07	0.61	<0.10	14.4	0.0019	0.36	0.06	3.56	1.72	<1
			B	1.78	>1.89	3.32	112.9	8.76	8.3	32.9	18.7															
	2103	04/04/2016	S	0.6	1.2	0.64	97.1	8.77	8	31.5	10.19	4.6	<5	1.18	<0.05	0.32	0.02	0.25	nd	3.39	0.0017	0.19	<0.05	3.45	1.22	<1.00
			B	3.8	1.2	3.09	97.2	8.84	8	32	9.73															
	2511	06/12/2016	S	0.46		2.05	98.7	9.36	8	32.3	9.25	<4	9	1.34	<0.05	0.06	0.02	0.16	<0.1	1.856	0.0014	0.26	nd	3.386	1.24	<1
			B	3.11		2.17	98.8	9.37	8	32.3	9.25															
	2274	08/08/2016	S	0.44		3.39	96.9	7.78	8.2	32.5	16.91	5	<5	1.52	<0.05	0.21	0.04	0.33	<0.1	3.69	0.0023	0.24	<0.05	3.34	1.59	1.24
			B	3		5.58	96.5	7.74	8.2	32.5	16.91															

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	in-situ probe measurement							laboratory analysis		metal analysis												
					Secchi Depth (m)	Chlorophyl -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)
M48-Maharees	2183	01/06/2016	S	0.44	>6.3	0.17	116.3	9.16	8.3	34.3	17.43	4.9	<5	1.44	<0.05	0.33	0.02	0.41	<0.10	1.83	0.0014	0.21	<0.05	3.56	1.55	<1
			B	6.33	>6.3	0.13	118.9	9.69	8.4	34.5	15.6															
	2512	06/12/2016	S	0.43		1.28	99.2	9.49	8	33.2	8.59	<4	<5	1.44	<0.05	0.12	0.01	0.13	nd	1.387	0.0017	0.22	nd	3.483	1.4	<1
			B	6.23		1.33	98.9	9.46	8	33.3	8.57															
	2275	08/08/2016	S	0.48		0.75	104.4	8.29	8.3	34.2	16.92	<4	<5	1.57	<0.05	0.26	0.02	0.23	nd	2.54	0.0025	0.19	nd	3.51	1.5	<1
			B	4.15		6.58	106.2	8.43	8.3	34.2	16.93															
2104	11/04/2016	S	0.6	1.5	0.68	99.9	9.19	8	31.7	9.48	4.3	<5	1.11	<0.05	0.28	0.02	0.26	nd	2.27	0.001	0.17	<0.05	3.34	1.19	<1.00	
		B	4.1	1.5	11.38	98.6	9.18	8	33.2	8.53																
M5-Dungloe Bay	2254	04/08/2016	S	0.32		4.59	114	8.38	8.3	32.1	16.95	18.4	<5	1.55	<0.05	0.25	0.04	0.35	<0.10	4.93	0.0009	0.23	0.05	3.15	1.68	<1
	2083	07/04/2016	S	0.13	0.1	84.5	105.7	9.22	8.1	28.7	9.74	14.2	28	1.36	<0.05	0.29	0.03	0.41	<0.10	6.05	0.001	0.23	nd		1.75	<1.00
	2162	15/06/2016	S	0.59	>1	3.38	110.2	7.99	8.2	33.5	16.99	7.8	<5	1.64	<0.05	0.36	0.03	0.21	nd	3.38	0.0008	0.2	nd	3.43	1.76	<1
	2489	16/12/2016	S	0.09	>0.75	2.79	107	9.74	8.2	30.5	7.31	<4	<5	1.34	<0.05	0.3	0.02	0.112	<0.1	2.33	0.0149	0.34	nd	3.56	1.49	<1
M65-Roaringwater Bay Inner	2051	03/02/2016	S	0.5	5.1	0.59	98	8.99	8.1	34.4	9.92			1.65	<0.05	0.33	0.01	0.4	0.34	0.97	0.0009	0.23	nd		1.64	1.05
			B	30.4	5.1	0.87	98	8.99	8.1	34.5	9.92															
M6-Trawenagh Bay	2084	04/04/2016	S	0.15	>1	2.02	105	9.03	8	32.1	9.4	5.2	20	1.36	<0.05	0.27	0.01	0.3	<0.10	1.11	0.0018	0.16	nd		1.46	
			B	2.06	>1	2.13	105	9.06	8	32.6	9.09															
	2490	05/12/2016	S	0.13	>1.3	0.91	97.1	8.79	8	33.4	6.76	<4	<5	1.37	<0.05	0.29	0.02	<0.1	<0.1	1.11	0.0016	0.31	nd	3.63	1.49	<1
			B	0.88	>1.3	1.01	96.6	8.74	8	33.5	6.77															
	2163	10/06/2016	S	0.5	>1	1.6	110	8.3	8.1	34.9	14.81	<4	<5	1.61	<0.05	0.34	0.01	0.7	nd	1.49	0.0008	0.18	nd	3.54	1.71	<1
			B	0.55	>1	1.68	110	8.3	8.1	34.9	14.81															
2255	24/08/2016	S	0.5		0.32	102.5	7.52	8.3	33.6	16.52	<4	<5	1.67	<0.05	0.33	0.02	0.29	<0.10	1.7	0.0014	0.17	<0.05	3.45	1.68	<1	
		B	0.57		0.7	102.3	7.52	8.3	33.6	16.53																
M71-Rostellan South	2189	07/06/2016	S	0.49	1.3	5.48	131.9	10.14	8.4	33.1	18.75	<4	<5	1.68	<0.05	0.22	0.05	0.43	nd	11.1	0.0024	0.22	nd	3.35	1.53	<1
			B	1.16	1.3	7.36	133.8	10.39	8.4	33.3	18.14															
	2279	09/08/2016	S	0.41		6.52	111	9.11	8.2	33	15.77	<4	<5	1.66	<0.05	0.41	0.05	0.46	<0.1	9	0.0025	0.27	nd	3.33	1.47	<1
			B	3.65		10.28	108.8	8.95	8.2	33.1	15.62															
	2109	12/04/2016	S	0.4	0.98	1.42	100.3	9.72	8.1	24.2	9.27	8.5	<5	1.28	<0.05	0.3	0.06	0.77	<0.10	14.56	0.0012	0.27	nd	2.49	1.33	<1.00
			B	4.7	0.98	2.04	100	9.33	8.1	29.7	9.44															
2519	13/12/2016	S	0.47		0.97	95.5	8.84	7.9	30.9	10.03	7.2	<5	1.33	<0.05	0.15	0.02	0.19	<0.1	4.628	0.0016	0.27	<0.05	3.327	1.32	<1	
		B	3.09		0.92	95	8.77	7.9	31.4	9.99																
M74-Ballymacoda	2190	07/06/2016	S	0.5	>2.2	3.12	123.4	9.74	8.3	33.7	17.11	<4	<5	1.44	<0.05	0.23	0.03	0.23	nd	5.65	0.0026	0.18	nd	3.31	1.37	<1
			B	1.25	>2.2	3.27	123.4	9.75	8.3	33.7	17.12															
	2280	09/08/2016	S	0.48		1.33	104.8	8.81	8.1	34	14.22	<4	<5	1.54	<0.05	0.32	0.03	0.31	<0.1	4.48	0.0028	0.27	<0.05	3.43	1.53	<1
			B	2.8		1.64	104.6	8.8	8.1	34	14.21															
	2110	12/04/2016	S	0.1	0.15	6.86	109.7	10.02	8.1	19.9	13.25	18.7	204	1.4	<0.05	0.26	0.09	0.92	<0.10	7.88	0.0018	0.47	<0.05	2.17	1.74	<1.00
2520	13/12/2016	S	0.33		13.95	99.9	9.36	8	31.1	10.19	8.4	772	1.5	<0.05	0.21	0.02	0.11	<0.1	1.743	0.0014	0.25	nd	3.342	1.4	<1	

Shellfish Water Station	MI Ref ENV 2016	Sample date	depth Note	Station Depth	Secchi Depth (m)	in-situ probe measurement						laboratory analysis		metal analysis												
						Chlorophyll -a (ug/l)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	p H (sc)	Salinity (PSU)	Temperature (° C)	True Colour (mg pT/l)	Suspended Solids (mg/l)	Arsenic (ug/l)	Cadmium (ug/l)	Chromium (ug/l)	Cobalt (ug/l)	Copper (ug/l)	Lead (ug/l)	Manganese (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Silver (ug/l)	Uranium (ug/l)	Vanadium (ug/l)	Zinc (ug/l)
M77-Dungarvan Bay	2191	08/06/2016	S	0.49	>3.98	1.12	118.3	9.66	8.4	34.7	15.09	4.6	<5	1.53	<0.05	0.2	0.03	0.36	nd	4.35	0.0039	0.17	nd	3.45	1.61	<1
			B	2.73	>3.98	1.03	118.2	9.86	8.3	34.4	14.18															
	2281	09/08/2016	S	0.5		0.85	120.1	9.74	8.2	34.3	16.09	<4	<5	1.58	<0.05	0.36	0.03	0.41	<0.1	6.69	0.0024	0.25	nd	3.46	1.4	<1
			B	0.86		1	120.5	9.76	8.2	34.3	16.1															
	2111	12/04/2016	S	0.3	0.18	4.57	103.8	9.19	8	31.6	11.27	5.9	12	1.34	<0.05	0.29	0.06	0.44	<0.10	3.2	0.0012	0.26	nd	3.38	1.71	<1.00
			B	0.47		0	96	8.79	8	33.6	10.48	6.3	33	1.38	<0.05	0.12	0.01	0.13	<0.1	0.748	0.0011	0.24	nd	3.511	1.38	<1
2521	13/12/2016	S	0.47		0	96.3	8.82	8	33.6	10.48	6.3	33	1.38	<0.05	0.12	0.01	0.13	<0.1	0.748	0.0011	0.24	nd	3.511	1.38	<1	
		B	1.91		0	96.3	8.82	8	33.6	10.48	6.3	33	1.38	<0.05	0.12	0.01	0.13	<0.1	0.748	0.0011	0.24	nd	3.511	1.38	<1	
M81-Bannow Bay	2114	07/04/2016	S	0.2	0.6	4.47	97.4	9.71	7.9	21.5	9.08	6.2	17.6	1.2	<0.05	0.19	0.14	0.61	<0.100	26.9	0.0013	0.58	nd	2.11	1.27	<1.00
			B	2.1	0.6	5.22	97.4	9.64	7.9	22.4	9.12															
	2194	08/06/2016	S	0.5	>1.1	3.01	121	9.04	8.3	29.9	21.35	6.6	6	1.46	<0.05	0.17	0.17	0.37	nd		0.002	0.42	nd	2.74	1.58	<1
			B	1.1	>1.1	3.03	120.9	9.03	8.3	29.9	21.35															
	2284	10/08/2016	S	0.38		2.09	104	8.56	8.1	34.3	15.09	<4	<5	1.57	<0.05	0.4	0.03	0.43	<0.1	2.57	0.0025	0.27	<0.05	3.33	1.49	<1
			B	2.8		2.06	103.9	8.56	8.2	34.3	15.09															
	2524	13/12/2016	S	0.48		0.79	99.5	9.2	8	33.4	10.11	<4	10	1.42	<0.05	0.1	0.03	0.11	<0.1	1.582	0.0013	0.21	nd	3.498	1.34	<1
			B	3.55		0.86	99.7	9.22	8	33.4	10.09															

Notes:
Depth: S=surface, B=bottom
Colorimetry and suspended solids for E code stations were analysed at the EPA laboratories.
Secchi readings recorded as "visible on bottom" are reported as:>station depth.
Blank cell= sonde reading or analytical results not available.
Results reported < LOQ, please refer to Annex A, Table A.3
For values reported as "nd" Substances were not detected above the Limit of Detection (LOD) (LODs are given in Annex A, Table A.3)
For values reported as "< value", value = Limit of Quantitation (LOQ) for relevant determinand

Table 6: (continued to page 23): Total water PAH concentrations ($\mu\text{g l}^{-1}$) in surface water samples (~ 0.5m depth) from designated shellfish waters for the year 2016. Limits of detection 0.001 to 0.002 ($\mu\text{g l}^{-1}$) for all parameters.

Shellfish Water Station	MI Ref	Sample Date	acenaphthene	acenaphthylene	anthracene	benzo[a]anthracene	benzo[a]pyrene	benzo[b]fluoranthene	benzo[b+k]fluoranthene	benzo[ghi]perylene	benzo[k]fluoranthene	chrysene	dibenz[ah]anthracene	fluoranthene	fluorene	indeno[1,2,3-cd]pyrene	naphthalene	phenanthrene	pyrene	sum of 4 indicator PAHs ²
E11-Castletownbere	2077	02/02/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2200	17/05/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2243	05/07/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
E12-Roaringwater Bay Inner	2202	18/05/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2212	02/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2516	12/12/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
E13-Baltimore Harbour \ Sherkin	2201	19/05/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2211	02/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2517	12/12/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
E14-Kinsale	2124	12/04/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	0.006	nd(<0.002)	nd(<0.001)
	2205	07/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2214	02/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2241	11/07/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2299	22/08/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.002	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.002
	2466	24/11/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
E15-Cork Harbour North Channel	2076	03/03/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.002	nd(<0.002)	nd(<0.002)	0.003	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	0.006	0.003
	2213	01/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.002	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2298	09/08/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
E16-Duncannon	2078	15/03/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2156	17/05/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2246	19/06/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.007	0.014	0.021	0.027	0.015	0.006	nd(<0.002)	nd(<0.002)	0.019	nd(<0.002)	0.01	nd(<0.002)	0.008	0.018	0.025
	2338	20/09/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.003	nd(<0.002)	nd(<0.002)	0.003	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	0.003
E17-Wexford Harbour Outer	2125	13/04/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2157	16/05/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2247	21/07/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2339	19/09/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)
	2464	23/11/2016	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)	nd(<0.002)	nd(<0.002)	nd(<0.002)	nd(<0.001)

Table 7: Overall median and ranges ($\mu\text{g l}^{-1}$) for SWD specified dissolved trace metals in seawater as measured in Shellfish Waters in 2016.

Parameter	Strictest MAC-EQS ¹	AA-EQS ²	Min	Max	Median
Arsenic	40 ³	20	0.53	2.24	1.43
Cadmium	0.45 ⁴	0.2	<0.05	<0.05	<0.05
Chromium	30 ³	0.6 ⁵	0.06	0.46	0.26
Copper	10 ³	5	<0.10	1.54	0.37
Lead	20 ³	7.2	<0.10	0.34	<0.10
Mercury	0.07 ²	0.05	0.0005	0.0313	0.0014
Nickel	50 ³	20	0.11	0.67	0.26
Silver	10 ³		<0.05	0.06	<0.05
Zinc	200 ³	40	<1.00	3.84	<1.00

¹ Strictest MAC-EQS - Strictest Maximum allowable concentration – environmental quality standard as taken from SI 268 of 2006 or SI 272 of 2009

² AA-EQS Annual average concentration – environmental quality standard as set in SI 272 of 2009

³ SWD Mandatory value as set in SI 268 of 2006

⁴ MAC-EQS for transitional and coastal waters as set in SI 272 of 2009

⁵ AA-EQS is for Chromium VI (SI272 of 2009). However, as foreseen in the legislation total chromium rather than chromium VI is actually measured

3.2 Trace metals and organohalogens in shellfish flesh

Table 8 presents all measured concentrations in shellfish for trace metals polychlorinated biphenyl (PCB), polybrominated diphenyl ether (PBDE), Polyaromatic Hydrocarbons (PAH) and organochlorine pesticides concentrations in shellfish flesh. Table 9 presents summary details for trace metals in bivalve mollusc flesh. Samples were collected within designated shellfish areas allowing a 0.1 Km buffer zone. Locations denoted as proximate to SWs are within the buffer zone of the specified shellfish area.

Table 8: (continued to page 48) Trace metal, PCB, PBDE, PAH and organochlorine concentrations in shellfish from designated shellfish growing waters in 2015.

Notes: 1 Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound, 2 Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound, 3 Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound, * sampled outside designated shellfish area but within 0.1 km buffer, blank cell-not analysed.

Shellfish Water Station	Achill Sound - North	Achill Sound - South	Adrigole Harbour	Ardbear Bay	Aughinish Bay
MI Reference	ENV/2015/1294	ENV/2015/1293	ENV/2015/1337	ENV/2015/1335	ENV/2015/1325
Date	11/11/2015	11/11/2015	10/12/2015	08/12/2015	26/11/2015
Latitude (N)	53° 58.36'	53° 55.14'	51° 40.79'	53° 29.01'	53° 09.43'
Longitude (W)	09° 57.20'	09° 54.88'	09° 43.43'	10° 01.72'	09° 04.30'
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	25	50	50	25
Method of Cultivation	trestle	trestle			trestle
Shellfish					
Length range (mm)	65.82 - 116	96.63 - 134	41.46 - 59.96	40.04 - 53.43	72.14 - 119
Mean length (mm)	96.8	118	53.1	43.1	98.6
Length stdev (mm)	11.5	11	4.57	2.65	9.92
Shell weight (%)	93.1	89.1	55.2	60.7	80.6
Meat weight (%)	6.9	10.9	44.8	39.3	19.4
Moisture (%)	84.9	85.4	79.2	83.3	83.6
Total Lipids (%)	0.09	0	0	0.13	0.08
Metals mg kg⁻¹ (ppm)					
Aluminium	10.1	8.15	51.1	35.4	7.97
Arsenic	2.29	1.93	1.28	1.24	2.06
Cadmium	0.15	0.13	0.06	0.04	0.13
Chromium	0.16	0.08	0.1	0.1	0.05
Cobalt	0.02	0.02	0.04	0.03	0.02
Copper	3.92	7.31	0.71	0.73	2.73
Iron	71.2	65.7	37.7	40.5	23.6
Lead	0.06	0.07	0.09	0.15	0.06
Manganese	2.23	2.49	1.29	1.6	2.72
Mercury	0.03	0.03	0.011	0.013	0.02
Nickel	0.09	0.06	0.09	0.09	0.04
Selenium	0.19	0.24	0.37	0.37	0.29
Silver	0.16	0.23	0.01	0.01	0.16
Vanadium	0.16	0.16	0.14	0.17	0.07
Zinc	185	223	12.9	11.8	99.2
PCB µg kg⁻¹ (ppb)					
CB18	<0.005	0.03	0.04	0.02	0.05
CB28	0.014	0.006	0.03	0.005	0.008
CB31	0.02	0.006	0.02	0.007	0.007
CB44	0.006	0.03	0.04	0.03	0.04
CB52	0.01	0.01	0.03	0.02	0.02
CB101	0.02	0.03	0.13	0.05	0.04
CB105	<0.005	0.006	0.03	0.008	<0.005
CB118	0.02	0.03	0.08	0.06	0.03
CB138	0.06	0.03	0.21	0.13	0.03
CB149	0.02	0.03	0.15	0.06	0.03
CB153	0.09	0.12	0.51	0.28	0.13
CB156	<0.005	nd (<0.0014)	<0.005	0.006	nd (<0.0014)
CB170	nd (<0.0014)	0.006	0.009	nd (<0.0013)	0.01
CB180	nd (<0.0014)	nd (<0.0014)	0.04	0.014	nd (<0.0014)
CB194	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)
CB209	nd (<0.0014)	<0.02	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)

Shellfish Water Station	Achill Sound - North	Achill Sound - South	Adrigole Harbour	Ardbear Bay	Aughinish Bay
MI Reference	ENV/2015/1294	ENV/2015/1293	ENV/2015/1337	ENV/2015/1335	ENV/2015/1325
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0025)	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)
BDE47	<0.04	<0.04	<0.04	0.05	<0.04
BDE99	<0.04	<0.04	nd (<0.0028)	<0.03	<0.04
BDE100	nd (<0.0025)	nd (<0.0026)	nd (<0.0026)	<0.03	nd (<0.0026)
BDE153	nd (<0.0025)	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)
BDE154	nd (<0.0025)	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)
BDE183	nd (<0.0025)	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.01	nd (<0.0022)	0.05	0.06	nd (<0.0022)
Hexachlorobutadiene	0.06	<0.04	0.05	0.05	<0.04
DDE (<i>o,p</i>)	nd (<0.0028)	nd (<0.0029)	nd (<0.0029)	<0.03	nd (<0.0029)
DDE (<i>p,p</i>)	0.09	0.06	0.18	0.22	0.17
DDT (<i>o,p</i>)	0.05	0.08	<0.03	<0.03	0.07
DDT (<i>p,p</i>)	nd (<0.0014)	0.09	0.04	0.07	0.14
DDD (<i>o,p</i>)	<0.03	nd (<0.0014)	<0.03	<0.03	<0.04
DDD (<i>p,p</i>)	0.15	0.49	0.24	0.27	nd (<0.05)
<i>cis</i> -chlordane (α -chlordane)	<0.03	nd (<0.0014)	<0.03	0.03	<0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03	nd (<0.002)	<0.03	0.07	nd (<0.002)
<i>trans</i> -nonachlor	<0.03	nd (<0.0014)	0.04	0.03	nd (<0.0014)
Oxychlordane	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)
Aldrin	<0.03	nd (<0.0018)	nd (<0.0018)	<0.03	nd (<0.0018)
Dieldrin	0.03	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)
<i>cis</i> -heptachlorepoxide (α)	nd (<0.0014)	nd (<0.0014)	<0.03	<0.03	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.14	0.06	0.12	0.13	0.08
Acenaphthylene	0.05	0.04	<0.04	<0.03	0.06
Anthracene	0.06	0.07	0.05	0.08	0.1
Benzo[<i>a</i>]anthracene	0.32	0.23	0.16	0.26	0.24
Benzo[<i>a</i>]pyrene	0.06	<0.04	0.1	0.19	0.05
Chrysene	0.61	0.48	0.22	0.46	0.62
Dibenz[<i>ah</i>]anthracene	nd (<0.0029)	nd (<0.003)	<0.04	0.04	nd (<0.0029)
Fluoranthene	1.82	1.66	1.13	1.44	3.03
Fluorene	0.33	0.28	0.28	0.26	0.4
Benzo[<i>b</i>]fluoranthene	0.46	0.31	0.61	0.72	0.45
Benzo[<i>k</i>]fluoranthene	0.14	0.09	0.2	0.25	0.14
Benzo[<i>ghi</i>]perylene	0.1	<0.04	0.37	0.39	0.04
Indeno[1,2,3- <i>cd</i>]pyrene	0.07	<0.04	0.17	0.22	<0.04
Phenanthrene	1.7	1.23	1.19	1.19	2.09
Pyrene	1.18	1.78	0.92	1.4	3.14

Shellfish Water Station	Ballinakill Bay	Ballylongford	Ballymacoda	Ballyvaughan \ Poulnaclogh Bay	Baltimore Harbour \ Sherkin
MI Reference	ENV/2015/1317	ENV/2015/1309	ENV/2015/1287	ENV/2015/1326	ENV/2015/1302
Date	25/11/2015	24/11/2015	11/11/2015	26/11/2015	23/11/2015
Latitude (N)	53° 34.38'	52° 34.42'	51° 53.73'	53° 08.45'	51° 29.46'
Longitude (W)	09° 59.65'	09° 29.11'	07° 53.48'	09° 04.85'	09° 24.30'
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	23	25	25	25
Method of Cultivation	trestle	trestle	trestle	trestle	trestle
Shellfish					
Length range (mm)	112 - 154	91.49 - 136	76.24 - 123	75.81 - 119	87.73 - 143
Mean length (mm)	138	108	95.9	94.5	114
Length stdev (mm)	13.2	11.3	12.4	12	12.9
Shell weight (%)	91.2	88.1	87.3	82.7	84.5
Meat weight (%)	8.8	11.9	12.7	17.3	15.5
Moisture (%)	85.3	87.8	86.9	85.1	85.1
Total Lipids (%)	0.17	0.15	280	0.17	0.01
Metals mg kg⁻¹ (ppm)					
Aluminium	18.3	12.5	23.4	10.7	17.1
Arsenic	1.77	1.41	1.17	2.69	1.64
Cadmium	0.15	0.22	0.17	0.09	0.13
Chromium	0.07	0.16	0.14	0.08	0.45
Cobalt	0.03	0.02	0.03	0.02	0.02
Copper	5.34	17.7	16.7	2.56	7.61
Iron	42.9	26.1	33.5	30.5	28.6
Lead	0.06	0.05	0.09	0.07	0.07
Manganese	3.63	1.75	3.48	2.01	2.51
Mercury	0.03	0.02	0.02	0.012	0.02
Nickel	0.08	0.05	0.07	0.05	0.05
Selenium	0.29	0.26	0.28	0.28	0.23
Silver	0.25	0.29	0.96	0.1	0.29
Vanadium	0.12	0.06	0.12	0.06	0.07
Zinc	242	194	280	105	144
PCB µg kg⁻¹ (ppb)					
CB18	0.02	0.007	<0.006	0.009	0.14
CB28	0.04	0.04	0.04	0.02	<0.005
CB31	0.03	0.014	0.02	0.03	0.04
CB44	0.013	0.02	0.008	0.02	0.04
CB52	0.03	0.04	0.03	0.04	0.04
CB101	0.05	0.06	0.08	0.32	0.16
CB105	0.02	0.02	0.02	0.04	0.04
CB118	0.07	0.08	0.1	0.1	0.15
CB138	0.08	0.1	0.15	0.16	0.16
CB149	0.06	0.11	0.09	0.06	0.13
CB153	0.25	0.38	0.33	0.26	0.51
CB156	<0.005	<0.005	nd (<0.0015)	0.008	nd (<0.0014)
CB170	0.014	<0.005	nd (<0.0015)	0.02	0.012
CB180	0.02	0.04	0.02	0.05	<0.005
CB194	nd (<0.0014)	nd (<0.0014)	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0014)	nd (<0.0015)	<0.006	<0.014

Shellfish Water Station	Ballinacill Bay	Ballylongford	Ballymacoda	Ballyvaughan \ Poulinaclough Bay	Baltimore Harbour \ Sherkin
MI Reference	ENV/2015/1317	ENV/2015/1309	ENV/2015/1287	ENV/2015/1326	ENV/2015/1302
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0026)	<0.04	nd (<0.0028)	<0.04	nd (<0.0025)
BDE47	0.04	0.1	0.07	0.07	0.09
BDE99	<0.04	0.05	<0.04	<0.04	0.04
BDE100	nd (<0.0026)	0.04	<0.04	<0.04	<0.04
BDE153	nd (<0.0026)	nd (<0.0026)	nd (<0.0028)	nd (<0.0026)	nd (<0.0025)
BDE154	<0.04	0.06	nd (<0.0028)	nd (<0.0026)	nd (<0.0025)
BDE183	<0.04	nd (<0.0026)	nd (<0.0028)	nd (<0.0026)	nd (<0.0025)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.007	0.013	0.03	0.02	nd (<0.0022)
Hexachlorobutadiene	0.04	0.1	0.09	0.04	nd (<0.005)
DDE (<i>o,p</i>)	0.06	<0.03	nd (<0.0031)	nd (<0.0029)	<0.03
DDE (<i>p,p</i>)	0.28	0.26	0.29	0.58	0.25
DDT (<i>o,p</i>)	0.47	0.05	0.04	<0.04	0.15
DDT (<i>p,p</i>)	<0.03	0.22	0.06	0.17	0.35
DDD (<i>o,p</i>)	0.17	0.06	<0.04	<0.03	nd (<0.0014)
DDD (<i>p,p</i>)	0.22	0.12	0.1	0.14	nd (<0.048)
<i>cis</i> -chlordane (α -chlordane)	0.04	<0.03	<0.03	0.07	<0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03	<0.03	nd (<0.0022)	<0.03	nd (<0.002)
<i>trans</i> -nonachlor	0.06	<0.03	<0.03	0.11	<0.06
Oxychlordane	nd (<0.0014)	nd (<0.0014)	nd (<0.0015)	<0.03	nd (<0.0014)
Aldrin	0.16	0.03	<0.03	<0.03	nd (<0.0018)
Dieldrin	0.06	<0.03	<0.03	0.05	nd (<0.0014)
<i>cis</i> -heptachlorepoxide (α)	<0.03	nd (<0.0014)	<0.04	<0.04	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.14	0.15	0.14	0.17	0.08
Acenaphthylene	0.07	0.08	<0.04	0.06	0.09
Anthracene	0.13	0.09	0.08	0.07	0.09
Benzo[<i>a</i>]anthracene	0.45	0.47	0.4	0.2	0.68
Benzo[<i>a</i>]pyrene	0.13	0.08	0.14	0.05	0.3
Chrysene	0.73	0.71	0.48	0.59	0.58
Dibenz[<i>ah</i>]anthracene	<0.04	nd (<0.0029)	0.05	nd (<0.0029)	nd (<0.0029)
Fluoranthene	2.46	3.36	2.61	2.45	3.68
Fluorene	0.23	0.49	0.35	0.28	0.3
Benzo[<i>b</i>]fluoranthene	1.02	0.48	1.64	0.45	3.55
Benzo[<i>k</i>]fluoranthene	0.34	0.14	0.51	0.16	1.08
Benzo[<i>ghi</i>]perylene	0.17	0.13	0.35	0.09	0.4
Indeno[1,2,3- <i>cd</i>]pyrene	0.12	0.07	0.25	0.04	0.37
Phenanthrene	1.71	2.6	1.99	1.78	1.22
Pyrene	2.54	2.84	1.84	1.83	3.76

Shellfish Water Station	Bannow Bay	Bantry Bay Inner	Blacksod bay	Bruckless	Carlingford Lough Inner Stn 2
MI Reference	ENV/2015/1284	ENV/2015/1327	ENV/2015/1315	ENV/2015/1328	ENV/2015/1296
Date	10/11/2015	26/11/2015	24/11/2015	26/11/2015	10/11/2015
Latitude (N)	52° 14.20'	51° 41.75'	54° 10.90'	54° 37.46'	54° 04.40'
Longitude (W)	06° 46.51'	09° 28.41'	09° 57.12'	08° 24.17'	06° 14.06'
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>
Number of Individuals	25	50	50	25	50
Method of Cultivation	trestle	rope	trestle	trestle	intertidal
Shellfish					
Length range (mm)	84.85 - 137	43.91 - 59.9	48.65 - 59.96	66.43 - 113	43.1 - 58.01
Mean length (mm)	105	52.7	55.5	89.4	51.1
Length stdev (mm)	12.8	4.09	2.85	10.1	4.13
Shell weight (%)	84.9	58.1	84.8	90.1	80.8
Meat weight (%)	15.1	41.9	15.2	9.9	19.2
Moisture (%)	83.8	78.7	81.4	86.9	80.7
Total Lipids (%)	0.03	0.2	0.1	47.8	5.45
Metals mg kg⁻¹ (ppm)					
Aluminium	8.16	28.9	26.3	17.2	43
Arsenic	1.64	1.37	1.38	1.71	1.78
Cadmium	0.16	0.06	0.06	0.18	0.07
Chromium	0.04	0.08	0.11	0.04	0.19
Cobalt	0.03	0.05	0.04	0.03	0.07
Copper	8.6	0.72	0.38	11.4	0.84
Iron	18.4	28.4	45.3	47.8	48.9
Lead	0.09	0.08	0.05	0.02	0.37
Manganese	3.9	1.59	0.84	2.05	1.31
Mercury	0.01	0.009	0.02	0.02	0.02
Nickel	0.04	0.08	0.09	0.06	0.17
Selenium	0.33	0.46	0.23	0.22	0.28
Silver	0.43	0.01	0.02	0.4	0.003
Vanadium	0.06	0.11	0.16	0.13	0.16
Zinc	131	13.4	11.5	193	11.6
PCB µg kg⁻¹ (ppb)					
CB18	0.02	0.02	0.03	nd (<0.0014)	0.1
CB28	0.08	0.06	0.02	0.02	0.09
CB31	0.03	0.03	0.02	0.02	0.06
CB44	0.14	0.06	0.011	0.02	0.11
CB52	0.11	0.06	0.009	0.02	0.12
CB101	0.35	0.16	0.03	0.03	0.3
CB105	0.06	0.02	0.008	0.008	0.08
CB118	0.21	0.09	0.02	0.04	0.26
CB138	0.32	0.28	0.03	0.05	0.38
CB149	0.3	0.24	0.02	0.04	0.23
CB153	0.69	0.68	0.09	0.17	0.69
CB156	0.012	0.013	nd (<0.0014)	nd (<0.0014)	0.02
CB170	0.007	0.009	0.007	nd (<0.0014)	0.008
CB180	0.05	0.06	nd (<0.0014)	nd (<0.0014)	0.04
CB194	nd (<0.0014)	0.007	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)	<0.005

Shellfish Water Station	Bannow Bay	Bantry Bay Inner	Blacksod bay	Bruckless	Carlingford Lough Inner Stn 2
MI Reference	ENV/2015/1284	ENV/2015/1327	ENV/2015/1315	ENV/2015/1328	ENV/2015/1296
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	<0.04	nd (<0.0025)	nd (<0.0027)	nd (<0.0026)	nd (<0.0026)
BDE47	0.11	0.06	<0.04	<0.04	0.13
BDE99	0.05	<0.04	nd (<0.0029)	<0.04	0.05
BDE100	<0.04	<0.04	nd (<0.0027)	<0.04	<0.04
BDE153	nd (<0.0027)	nd (<0.0025)	nd (<0.0027)	nd (<0.0026)	<0.04
BDE154	<0.04	nd (<0.0025)	nd (<0.0027)	<0.04	nd (<0.0026)
BDE183	nd (<0.0027)	nd (<0.0025)	nd (<0.0027)	nd (<0.0026)	nd (<0.0026)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.006	0.05	0.04	0.01	0.05
Hexachlorobutadiene	<0.03	0.08	0.12	0.1	0.11
DDE (<i>o,p</i>)	<0.03	<0.03	nd (<0.003)	<0.03	0.04
DDE (<i>p,p</i>)	0.77	0.17	0.07	0.2	0.58
DDT (<i>o,p</i>)	0.37	nd (<0.002)	<0.03	0.11	<0.03
DDT (<i>p,p</i>)	0.28	0.12	<0.03	0.08	0.09
DDD (<i>o,p</i>)	0.1	0.06	<0.03	<0.03	0.12
DDD (<i>p,p</i>)	0.39	0.21	0.05	1.3	0.54
<i>cis</i> -chlordane (α -chlordane)	<0.03	<0.03	<0.03	<0.03	<0.03
<i>trans</i> -chlordane (γ -chlordane)	nd (<0.0021)	<0.03	<0.03	0.04	<0.03
<i>trans</i> -nonachlor	<0.03	<0.03	<0.03	0.03	0.03
Oxychlordane	nd (<0.0015)	nd (<0.0014)	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)
Aldrin	0.03	0.03	nd (<0.0019)	<0.03	0.07
Dieldrin	<0.03	0.09	nd (<0.0014)	0.05	0.03
<i>cis</i> -heptachlorepoxide (α)	<0.04	<0.04	<0.03	<0.03	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.27	0.2	0.1	0.19	0.47
Acenaphthylene	0.1	0.07	0.1	0.07	0.19
Anthracene	0.21	0.05	0.2	0.08	0.41
Benzo[<i>a</i>]anthracene	0.99	0.24	0.15	0.56	1.39
Benzo[<i>a</i>]pyrene	0.24	0.08	<0.04	0.18	0.82
Chrysene	1.28	0.23	0.39	1.06	1.4
Dibenz[<i>ah</i>]anthracene	0.06	nd (<0.0028)	<0.04	<0.04	0.19
Fluoranthene	6.46	1.47	1.56	3.2	10.9
Fluorene	0.64	0.37	0.38	0.41	1.13
Benzo[<i>b</i>]fluoranthene	3.17	0.28	0.18	1.03	3.47
Benzo[<i>k</i>]fluoranthene	0.84	0.1	0.07	0.33	1.24
Benzo[<i>ghi</i>]perylene	0.42	0.26	0.14	0.21	1.99
Indeno[1,2,3- <i>cd</i>]pyrene	0.25	0.09	0.07	0.17	0.97
Phenanthrene	3.63	1.48	1.97	2.36	5.45
Pyrene	3.75	1.31	1.14	2.64	9.39

Shellfish Water Station	Carrigaholt	Castletownbere	Clarenbridge	Clew Bay North	Clew Bay South
MI Reference	ENV/2015/1305	ENV/2015/1277	ENV/2015/1314	ENV/2015/1292	ENV/2015/1291
Date	23/11/2015	03/11/2015	24/11/2015	11/11/2015	11/11/2015
Latitude (N)	52° 35.27'	51° 39.33'	53° 12.97'	53° 51.89'	53° 47.16'
Longitude (W)	09° 42.15'	09° 50.28'	08° 55.24'	09° 38.04'	09° 37.15'
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	50	25	50	25
Method of Cultivation	trestle	rope	trestle	rope	trestle
Shellfish					
Length range (mm)	61.42 - 109	41.2 - 59.93	79.64 - 137	45.38 - 59.04	95.37 - 146
Mean length (mm)	87.3	54.6	106	51.4	118
Length stdev (mm)	12.5	5.83	14.4	3.08	13
Shell weight (%)	84.2	53.3	76.9	76.6	85.3
Meat weight (%)	15.8	46.7	23.1	23.4	14.7
Moisture (%)	85.6	78.2	85.9	82.6	85.8
Total Lipids (%)	0.48	0.03	0.03	0.12	0
Metals mg kg⁻¹ (ppm)					
Aluminium	31	18.4	3.42	75.2	10.5
Arsenic	1.4	1.57	1.28	1.64	1.93
Cadmium	0.18	0.11	0.1	0.07	0.16
Chromium	0.48	0.12	0.04	0.35	0.13
Cobalt	0.03	0.05	0.02	0.06	0.03
Copper	12	0.96	1.81	0.9	6.1
Iron	45.6	20.8	29.1	96	24.1
Lead	0.06	0.12	0.04	0.12	0.02
Manganese	4.28	1.86	5.49	2.45	3.49
Mercury	0.02	0.007	0.008	0.02	0.02
Nickel	0.1	0.09	<0.03	0.26	0.1
Selenium	0.32	0.45	0.33	0.39	0.24
Silver	0.74	0.008	0.06	0.02	0.45
Vanadium	0.1	0.12	0.02	0.49	0.09
Zinc	146	19.1	93.3	14.3	148
PCB µg kg⁻¹ (ppb)					
CB18	0.006	0.07	<0.005	0.008	0.12
CB28	0.02	0.04	0.02	0.01	0.008
CB31	0.014	0.04	0.005	0.006	0.008
CB44	<0.005	0.05	<0.005	0.006	0.03
CB52	0.03	0.02	0.02	0.014	0.02
CB101	0.04	0.09	0.1	0.03	0.07
CB105	0.013	0.02	0.011	0.006	0.008
CB118	0.04	0.07	0.04	0.03	0.03
CB138	0.08	0.15	0.06	0.06	0.03
CB149	0.05	0.11	0.04	0.03	0.04
CB153	0.15	0.34	0.13	0.13	0.14
CB156	nd (<0.0013)	<0.005	<0.005	<0.005	0.08
CB170	nd (<0.0013)	nd (<0.0014)	0.008	<0.005	0.011
CB180	0.02	0.01	0.02	0.005	<0.005
CB194	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0013)
CB209	nd (<0.0013)	<0.005	nd (<0.0014)	nd (<0.0013)	nd (<0.0013)

Shellfish Water Station	Carrigaholt	Castletownbere	Clarenbridge	Clew Bay North	Clew Bay South
MI Reference	ENV/2015/1305	ENV/2015/1277	ENV/2015/1314	ENV/2015/1292	ENV/2015/1291
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0025)	nd (<0.0025)	nd (<0.0026)	<0.03	nd (<0.0023)
BDE47	0.04	<0.04	0.05	<0.04	<0.04
BDE99	<0.03	nd (<0.0027)	<0.04	<0.03	<0.03
BDE100	<0.03	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)	nd (<0.0023)
BDE153	nd (<0.0025)	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)	nd (<0.0023)
BDE154	<0.03	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)	nd (<0.0023)
BDE183	nd (<0.0025)	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)	nd (<0.0023)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.013	0.04	0.008	0.04	nd (<0.002)
Hexachlorobutadiene	0.09	0.03	0.09	0.03	<0.03
DDE (<i>o,p</i>)	nd (<0.0028)	<0.03	<0.03	<0.03	<0.03
DDE (<i>p,p</i>)	0.12	0.2	0.3	0.09	0.07
DDT (<i>o,p</i>)	<0.03	<0.03	<0.03	<0.03	0.05
DDT (<i>p,p</i>)	0.05	0.04	0.05	0.03	0.12
DDD (<i>o,p</i>)	<0.03	<0.03	0.04	<0.03	<0.03
DDD (<i>p,p</i>)	0.11	0.23	0.13	0.05	nd (<0.045)
<i>cis</i> -chlordane (α -chlordane)	<0.03	0.04	<0.03	<0.03	<0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03	0.04	<0.03	0.04	nd (<0.0018)
<i>trans</i> -nonachlor	<0.03	<0.03	<0.03	<0.03	<0.05
Oxychlordane	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0013)
Aldrin	0.03	0.04	<0.03	<0.03	nd (<0.0017)
Dieldrin	0.05	0.04	<0.03	0.05	nd (<0.0013)
<i>cis</i> -heptachlorepoxyde (α)	<0.03	<0.03	<0.04	nd (<0.0013)	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.11		0.24	0.12	0.16
Acenaphthylene	0.05	0.06	0.08	0.04	0.1
Anthracene	0.06	0.05	0.12	<0.03	0.09
Benzo[<i>a</i>]anthracene	0.36	0.08	0.27	0.18	0.32
Benzo[<i>a</i>]pyrene	0.13	0.04	0.04	0.08	0.04
Chrysene	0.42	0.19	0.49	0.41	0.8
Dibenz[<i>ah</i>]anthracene	<0.03	<0.04	nd (<0.0029)	nd (<0.0027)	nd (<0.0026)
Fluoranthene	2.42	1.12	3.8	1.45	3.75
Fluorene	0.33	0.52	0.56	0.43	0.58
Benzo[<i>b</i>]fluoranthene	0.56	0.39	0.35	0.31	0.62
Benzo[<i>k</i>]fluoranthene	0.21	0.12	0.13	0.11	0.16
Benzo[<i>ghi</i>]perylene	0.14	0.21	0.07	0.23	0.05
Indeno[1,2,3- <i>cd</i>]pyrene	0.08	0.09	<0.04	0.14	<0.03
Phenanthrene	1.85	1.92	2.68	1.77	2.79
Pyrene	1.61	0.78	2.4	1.03	3.84

Shellfish Water Station	Cork Harbour North Channel	Cromane	Donegal Bay	Drumcliff	Duncannon
MI Reference	ENV/2015/I290	ENV/2015/I332	ENV/2015/I322	ENV/2015/I306	ENV/2015/I285
Date	11/11/2015	30/11/2015	21/11/2015	24/11/2015	10/11/2015
Latitude (N)	51° 53.09'	52° 08.48'	54° 37.57'	54° 20.33'	52° 11.83'
Longitude (W)	08° 14.51'	09° 53.88'	08° 10.26'	08° 33.53'	06° 58.43'
Species Sampled	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	50	50	20	25	25
Method of Cultivation	intertidal	bed	trestle	trestle	trestle
Shellfish					
Length range (mm)	41.09 - 58.57	50.21 - 59.92	83.54 - 117	73.88 - 111	79.58 - 105
Mean length (mm)	48.9	56.5	101	89.6	92.5
Length stdev (mm)	4.74	2.4	7.91	9.52	7.5
Shell weight (%)	71.6	75	83.1	81	91.6
Meat weight (%)	28.4	25	16.9	19	8.4
Moisture (%)	75.4	81.2	82.4	83.6	84.4
Total Lipids (%)	0.35	0.13	0.31	0.86	0.7
Metals mg kg⁻¹ (ppm)					
Aluminium	27.2	42	19	7.05	20.4
Arsenic	1.5	1.2	1.61	2.04	1.39
Cadmium	0.06	0.07	0.17	0.1	0.25
Chromium	0.13	0.14	0.17	0.04	0.07
Cobalt	0.04	0.06	0.02	0.03	0.03
Copper	1.32	1.03	3.3	4.94	22.2
Iron	30.8	61.6	35.9	22	33
Lead	0.3	0.06	0.03	0.04	0.13
Manganese	1.12	2.06	2.95	5.08	3.58
Mercury	0.03	0.014	0.009	0.013	0.013
Nickel	0.09	0.17	0.05	0.03	0.07
Selenium	0.34	0.3	0.27	0.37	0.37
Silver	0.009	0.004	0.14	0.2	0.41
Vanadium	0.1	0.15	0.13	0.09	0.08
Zinc	13.3	10.8	95.1	115	250
PCB µg kg⁻¹ (ppb)					
CB18	0.15	0.19	0.02	0.014	0.03
CB28	0.11	0.01	0.06	0.02	0.18
CB31	0.06	0.011	0.02	0.02	0.04
CB44	0.08	0.03	0.02	0.02	0.23
CB52	0.14	0.03	0.04	0.02	0.21
CB101	0.42	0.11	0.25	0.07	0.51
CB105	0.11	0.014	0.012	0.008	0.1
CB118	0.39	0.07	0.04	0.04	0.4
CB138	0.53	0.14	0.07	0.06	0.6
CB149	0.35	0.09	0.05	0.06	0.61
CB153	0.92	0.25	0.14	0.17	1.47
CB156	0.02	<0.005	nd (<0.0015)	<0.005	0.02
CB170	0.013	nd (<0.0013)	<0.006	<0.005	0.01
CB180	0.05	0.014	0.007	0.012	0.1
CB194	nd (<0.0014)	nd (<0.0013)	nd (<0.0015)	nd (<0.0015)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0013)	nd (<0.0015)	nd (<0.0015)	nd (<0.0014)

Shellfish Water Station	Cork Harbour North Channel	Cromane	Donegal Bay	Drumcliff	Duncannon
MI Reference	ENV/2015/I 290	ENV/2015/I 332	ENV/2015/I 322	ENV/2015/I 306	ENV/2015/I 285
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	<0.04	nd (<0.0025)	nd (<0.0028)	nd (<0.0027)	<0.04
BDE47	0.17	0.07	0.08	0.1	0.19
BDE99	0.06	0.05	<0.04	0.04	0.09
BDE100	<0.04	<0.03	<0.04	<0.04	0.1
BDE153	nd (<0.0026)	nd (<0.0025)	nd (<0.0028)	nd (<0.0027)	nd (<0.0026)
BDE154	nd (<0.0026)	nd (<0.0025)	nd (<0.0028)	<0.04	0.04
BDE183	nd (<0.0026)	nd (<0.0025)	nd (<0.0028)	nd (<0.0027)	nd (<0.0026)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	nd (<0.0022)	0.07	0.02	0.014	0.008
Hexachlorobutadiene	<0.04	0.03	0.04	0.09	0.04
DDE (<i>o,p</i>)	nd (<0.0029)	nd (<0.0028)	<0.03	<0.03	0.04
DDE (<i>p,p</i>)	0.6	0.17	0.19	0.15	1.04
DDT (<i>o,p</i>)	0.06	0.15	0.12	0.04	0.13
DDT (<i>p,p</i>)	0.28	0.05	0.23	0.13	0.7
DDD (<i>o,p</i>)	0.12	0.04	0.05	0.04	0.22
DDD (<i>p,p</i>)	nd (<0.049)	0.29	0.71	0.18	0.75
<i>cis</i> -chlordane (α -chlordane)	<0.04	<0.03	<0.03	0.04	<0.03
<i>trans</i> -chlordane (γ -chlordane)	nd (<0.002)	<0.03	<0.03	<0.03	<0.03
<i>trans</i> -nonachlor	nd (<0.0014)	0.04	0.03	0.04	0.05
Oxychlordane	nd (<0.0014)	nd (<0.0013)	nd (<0.0015)	0.04	nd (<0.0014)
Aldrin	nd (<0.0018)	<0.03	<0.03	<0.03	0.12
Dieldrin	nd (<0.0014)	<0.03	<0.03	<0.03	0.1
<i>cis</i> -heptachlorepoxide (α)	<0.03	<0.03	<0.04	<0.04	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.35	0.13	0.31	0.29	0.32
Acenaphthylene	0.2	0.05	0.18	0.16	0.12
Anthracene	0.33	0.13	0.18	0.32	0.25
Benzo[<i>a</i>]anthracene	1.04	0.25	0.83	0.97	2.52
Benzo[<i>a</i>]pyrene	0.45	0.1	0.22	0.13	0.93
Chrysene	0.79	0.51	1.85	1.73	2.28
Dibenz[<i>ah</i>]anthracene	nd (<0.0029)	<0.04	0.04	nd (<0.0031)	0.19
Fluoranthene	6.99	2.3	7.55	9.49	10.5
Fluorene	0.93	0.32	0.92	0.86	0.74
Benzo[<i>b</i>]fluoranthene	1.87	0.72	1.88	1.07	6.83
Benzo[<i>k</i>]fluoranthene	0.7	0.23	0.5	0.35	2.23
Benzo[<i>ghi</i>]perylene	0.87	0.36	0.26	0.14	1.12
Indeno[1,2,3- <i>cd</i>]pyrene	0.52	0.18	0.18	0.1	0.86
Phenanthrene	4.5	1.93	5.64	5.44	3.51
Pyrene	7.08	1.91	5.82	6.74	8.71

Shellfish Water Station	Dungarvan Bay	Dungloe Bay	Dunmanus Bay Inner	Glengariff	Gweebarra Bay
MI Reference	ENV/2015/1341	ENV/2015/1316	ENV/2015/1279	ENV/2015/1298	ENV/2015/1311
Date	17/12/2015	23/11/2015	04/11/2015	16/11/2015	23/11/2015
Latitude (N)	52° 04.05'	54° 56.30'	51° 36.36'	51° 43.81'	54° 50.44'
Longitude (W)	07° 35.75'	08° 24.00'	09° 33.32'	09° 32.93'	08° 23.12'
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	25	50	50	25
Method of Cultivation	trestle	trestle	rope	rope	trestle
Shellfish					
Length range (mm)	76.43 - 122	77.75 - 137	45.43 - 59.84	40.8 - 58.51	84.06 - 139
Mean length (mm)	105	105	54.6	51.7	106
Length stdev (mm)	9.9	15.7	3.91	4.59	13.9
Shell weight (%)	85.2	91	59.2	59.3	84
Meat weight (%)	14.8	9	40.8	40.7	16
Moisture (%)	83.8	87.3	80.6	81.4	85.7
Total Lipids (%)	0.02	0.2	0.14	0.11	0.15
Metals mg kg⁻¹ (ppm)					
Aluminium	30.3	8.7	27.4	50.7	6.73
Arsenic	1.17	1.87	1.36	1.14	1.48
Cadmium	0.18	0.1	0.08	0.09	0.22
Chromium	0.06	0.04	0.1	0.14	0.05
Cobalt	0.02	0.02	0.06	0.05	0.02
Copper	10	4.33	0.93	0.75	2.96
Iron	35.4	27.4	28.1	41.9	22.5
Lead	0.11	0.04	0.08	0.08	0.03
Manganese	4.43	2.64	2.31	2.05	1.7
Mercury	0.013	0.03	0.011	0.012	0.013
Nickel	0.07	0.06	0.1	0.1	0.05
Selenium	0.27	0.26	0.38	0.39	0.21
Silver	0.47	0.21	0.01	0.01	0.19
Vanadium	0.08	0.07	0.21	0.17	0.07
Zinc	158	130	14.6	15.1	106
PCB µg kg⁻¹ (ppb)					
CB18	0.012	0.02	0.06	0.05	nd (<0.0014)
CB28	0.07	0.04	0.07	0.05	0.011
CB31	0.02	0.04	0.03	0.03	<0.005
CB44	0.04	0.02	0.04	0.04	0.012
CB52	0.04	0.04	0.03	0.04	0.02
CB101	0.18	0.07	0.05	0.12	0.04
CB105	0.05	0.013	0.014	0.014	0.007
CB118	0.17	0.07	0.04	0.07	0.04
CB138	0.21	0.12	0.07	0.19	0.06
CB149	0.15	0.07	0.04	0.16	0.03
CB153	0.51	0.29	0.17	0.56	0.16
CB156	0.009	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)
CB170	<0.005	<0.006	nd (<0.0014)	<0.005	nd (<0.0014)
CB180	0.02	0.01	<0.005	0.04	<0.005
CB194	nd (<0.0013)	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)
CB209	nd (<0.0013)	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)

Shellfish Water Station	Dungarvan Bay	Dungloe Bay	Dunmanus Bay Inner	Glengariff	Gweebarra Bay
MI Reference	ENV/2015/1341	ENV/2015/1316	ENV/2015/1279	ENV/2015/1298	ENV/2015/1311
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0024)	nd (<0.0029)	<0.04	nd (<0.0026)	nd (<0.0026)
BDE47	0.06	0.1	0.09	<0.04	<0.04
BDE99	<0.03	0.07	0.04	<0.04	nd (<0.0028)
BDE100	<0.03	<0.04	nd (<0.0026)	nd (<0.0026)	nd (<0.0026)
BDE153	nd (<0.0024)	nd (<0.0029)	nd (<0.0026)	nd (<0.0026)	nd (<0.0026)
BDE154	<0.03	nd (<0.0029)	nd (<0.0026)	nd (<0.0026)	nd (<0.0026)
BDE183	nd (<0.0024)	nd (<0.0029)	nd (<0.0026)	nd (<0.0026)	nd (<0.0026)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.009	0.05	0.03	0.03	0.007
Hexachlorobutadiene	0.06	0.08	0.04	0.06	<0.03
DDE (<i>o,p</i>)	<0.03	nd (<0.0032)	nd (<0.0029)	nd (<0.0029)	<0.03
DDE (<i>p,p</i>)	0.31	0.17	0.1	0.08	0.15
DDT (<i>o,p</i>)	0.04	<0.04	<0.03	<0.03	<0.03
DDT (<i>p,p</i>)	0.27	0.17	<0.03	<0.03	0.09
DDD (<i>o,p</i>)	0.06	<0.04	<0.03	<0.03	<0.03
DDD (<i>p,p</i>)	0.14	0.14	0.14	0.13	0.15
<i>cis</i> -chlordane (α -chlordane)	0.03	<0.03	<0.03	<0.03	<0.03
<i>trans</i> -chlordane (γ -chlordane)	0.04	<0.03	<0.03	<0.03	nd (<0.0021)
<i>trans</i> -nonachlor	<0.03	<0.03	<0.03	<0.03	0.04
Oxychlordane	nd (<0.0013)	nd (<0.0016)	<0.03	nd (<0.0014)	nd (<0.0014)
Aldrin	<0.03	<0.03	<0.03	nd (<0.0018)	<0.03
Dieldrin	<0.03	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	<0.03
<i>cis</i> -heptachlorepoxide (α)	<0.04	<0.04	<0.03	<0.03	<0.04
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.2	0.2	0.14	0.11	0.15
Acenaphthylene	0.11	0.09	0.04	<0.04	0.05
Anthracene	0.24	0.14	0.05	0.05	0.06
Benzo[<i>a</i>]anthracene	1	0.54	0.09	<0.04	0.31
Benzo[<i>a</i>]pyrene	0.33	0.1	<0.04	0.1	0.06
Chrysene	1.19	1.29	0.18	0.22	0.71
Dibenz[<i>ah</i>]anthracene	0.1	<0.04	<0.04	<0.04	<0.04
Fluoranthene	6.6	5.1	1.03	0.87	3.07
Fluorene	0.49	0.64	0.44	0.28	0.49
Benzo[<i>b</i>]fluoranthene	3.22	1.13	0.4	0.36	0.78
Benzo[<i>k</i>]fluoranthene	0.97	0.34	0.14	0.12	0.23
Benzo[<i>ghi</i>]perylene	0.62	0.19	0.24	0.23	0.12
Indeno[1,2,3- <i>cd</i>]pyrene	0.56	0.14	0.12	0.12	0.08
Phenanthrene	2.99	4.26	1.59	1.12	2.65
Pyrene	4.88	3.43	0.6	0.75	1.77

Shellfish Water Station	Gweedore Bay	Kenmare River Outer Stn 2	Kilkieran Bay	Killala Bay	Killary Harbour Inner
MI Reference	ENV/2015/1312	ENV/2015/1301	ENV/2015/1282	ENV/2015/1310	ENV/2015/1334
Date	23/11/2015	17/11/2015	04/11/2015	24/11/2015	08/12/2015
Latitude (N)	55° 02.11'	51° 52.06'	53° 15.27'	54° 12.58'	53° 35.95'
Longitude (W)	08° 19.45'	09° 39.43'	09° 43.74'	09° 11.53'	09° 45.75'
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>
Number of Individuals	25	25	50	25	50
Method of Cultivation	trestle	trestle	rope	trestle	rope
Shellfish					
Length range (mm)	71.37 - 108	67.61 - 139	44.15 - 59.86	91.65 - 147	44.66 - 58.97
Mean length (mm)	92.1	97.5	55.1	116	51.4
Length stdev (mm)	10.4	14.8	3.93	15.9	4.05
Shell weight (%)	82.7	84.5	67.4	85	73.1
Meat weight (%)	17.3	15.5	32.6	15	26.9
Moisture (%)	85.7	88	81.3	82.5	79.7
Total Lipids (%)	0.19	0	0.28	0.11	0.12
Metals mg kg⁻¹ (ppm)					
Aluminium	5	14.4	7.16	17.6	50.4
Arsenic	1.25	1.14	1.82	1.63	1.32
Cadmium	0.14	0.17	0.07	0.23	0.05
Chromium	0.04	0.07	0.09	0.07	0.21
Cobalt	0.02	0.02	0.03	0.03	0.05
Copper	2.84	7.25	0.81	2.58	0.81
Iron	20.5	30.3	13.3	41.7	76.8
Lead	0.02	0.03	0.1	0.04	0.07
Manganese	1.97	3.13	0.97	2.54	3.4
Mercury	0.02	0.02	0.02	0.011	0.02
Nickel	0.03	0.05	0.08	0.05	0.21
Selenium	0.25	0.22	0.39	0.28	0.34
Silver	0.15	0.18	0.008	0.15	0.01
Vanadium	0.06	0.07	0.11	0.19	0.23
Zinc	111	168	16.6	99.3	12.6
PCB µg kg⁻¹ (ppb)					
CB18	nd (<0.0015)	0.03	0.03	0.18	0.006
CB28	0.04	0.02	0.07	0.009	0.05
CB31	0.03	0.011	0.02	0.02	0.04
CB44	0.03	0.04	0.008	0.03	0.02
CB52	0.02	0.03	0.03	0.013	0.03
CB101	0.04	0.06	0.04	0.12	0.05
CB105	0.012	0.012	0.01	0.011	0.02
CB118	0.04	0.06	0.04	0.03	0.04
CB138	0.07	0.05	0.07	0.03	0.07
CB149	0.05	0.04	0.03	0.04	0.04
CB153	0.14	0.14	0.13	0.12	0.14
CB156	<0.005	nd (<0.0014)	0.006	nd (<0.0014)	<0.004
CB170	<0.005	nd (<0.0014)	nd (<0.0013)	<0.005	nd (<0.0012)
CB180	0.009	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	0.007
CB194	nd (<0.0015)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	nd (<0.0012)
CB209	nd (<0.0015)	<0.014	nd (<0.0013)	nd (<0.0014)	nd (<0.0012)

Shellfish Water Station	Gweedore Bay	Kenmare River Outer Stn 2	Kilkieran Bay	Killala Bay	Killary Harbour Inner
MI Reference	ENV/2015/1312	ENV/2015/1301	ENV/2015/1282	ENV/2015/1310	ENV/2015/1334
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0027)	nd (<0.0026)	<0.04	nd (<0.0026)	nd (<0.0022)
BDE47	0.06	<0.04	<0.04	<0.04	<0.03
BDE99	<0.04	nd (<0.0028)	nd (<0.0027)	<0.04	<0.03
BDE100	<0.04	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)	<0.03
BDE153	nd (<0.0027)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)	nd (<0.0022)
BDE154	<0.04	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)	nd (<0.0022)
BDE183	nd (<0.0027)	nd (<0.0026)	nd (<0.0025)	nd (<0.0026)	nd (<0.0022)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.007	nd (<0.0022)	0.05	nd (<0.0022)	0.05
Hexachlorobutadiene	0.1	<0.03	0.04	nd (<0.0053)	0.08
DDE (<i>o,p</i>)	<0.03	nd (<0.0029)	<0.03	<0.04	<0.03
DDE (<i>p,p</i>)	0.12	0.11	0.14	0.12	0.19
DDT (<i>o,p</i>)	0.19	0.07	<0.03	0.13	0.14
DDT (<i>p,p</i>)	0.26	0.07	0.13	0.11	0.08
DDD (<i>o,p</i>)	0.11	<0.04	<0.03	nd (<0.0014)	<0.03
DDD (<i>p,p</i>)	0.48	0.57	0.05	nd (<0.05)	0.3
<i>cis</i> -chlordane (α -chlordane)	0.04	nd (<0.0014)	<0.03	<0.05	0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03	nd (<0.002)	<0.03	nd (<0.002)	0.04
<i>trans</i> -nonachlor	<0.03	nd (<0.0014)	<0.03	<0.06	0.04
Oxychlordane	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)	nd (<0.0012)
Aldrin	<0.03	nd (<0.0018)	<0.03	<0.04	<0.03
Dieldrin	0.04	nd (<0.0014)	0.08	nd (<0.0014)	nd (<0.0012)
<i>cis</i> -heptachlorepoxide (α)	<0.04	nd (<0.0014)	nd (<0.0013)	<0.03	<0.03
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.19	0.08	0.28	0.11	0.12
Acenaphthylene	0.13	0.04	0.08	0.09	0.04
Anthracene	0.2	<0.04	0.08	0.13	0.09
Benzo[<i>a</i>]anthracene	0.93	0.24	0.16	0.63	0.29
Benzo[<i>a</i>]pyrene	0.11	0.04	<0.04	0.11	0.09
Chrysene	1.69	0.26	0.4	1.26	0.39
Dibenz[<i>ah</i>]anthracene	<0.04	nd (<0.0029)	nd (<0.0028)	nd (<0.003)	<0.03
Fluoranthene	5.62	1.73	1.41	3.99	1.16
Fluorene	0.51	0.22	0.59	0.53	0.33
Benzo[<i>b</i>]fluoranthene	0.94	0.74	0.24	0.89	0.46
Benzo[<i>k</i>]fluoranthene	0.33	0.23	0.08	0.29	0.19
Benzo[<i>ghi</i>]perylene	0.13	0.09	0.12	0.1	0.22
Indeno[1,2,3- <i>cd</i>]pyrene	0.1	0.06	0.06	0.05	0.12
Phenanthrene	3.15	0.96	2.24	2.57	1.32
Pyrene	4.11	1.82	1.01	4.19	1.01

Shellfish Water Station	Kilmakilloge	Kinsale	League Point	Loughras Beg	Maharees
MI Reference	ENV/2015/1340	ENV/2015/1286	ENV/2015/1280	ENV/2015/1308	ENV/2015/1295
Date	15/12/2015	11/11/2015	04/11/2015	23/11/2015	11/11/2015
Latitude (N)	51° 46.17'	51° 42.00'	51° 39.47'	54° 45.28'	52° 16.15'
Longitude (W)	09° 49.10'	08° 32.62'	09° 33.69'	08° 28.24'	09° 59.40'
Species Sampled	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Ostrea edulis</i>
Number of Individuals	50	24	50	25	25
Method of Cultivation	rope	trestle	rope	trestle	bed
Shellfish					
Length range (mm)	45.06 - 59.36	69.27 - 109	42.28 - 59.98	84.48 - 119	63.15 - 83.88
Mean length (mm)	53.6	97.6	55.6	99.1	73.5
Length stdev (mm)	3.46	10.3	4.11	8.67	6.2
Shell weight (%)	56.9	85.9	68.8	83.2	92.4
Meat weight (%)	43.1	14.1	31.2	16.8	7.6
Moisture (%)	80.8	82.7	80.5	84.6	81.9
Total Lipids (%)	0.13	0.45	0	0.09	0.05
Metals mg kg⁻¹ (ppm)					
Aluminium	33.6	9.46	31.5	9.53	7.89
Arsenic	1.29	1.44	1.36	1.35	1.9
Cadmium	0.08	0.1	0.14	0.17	1.25
Chromium	0.22	0.05	0.12	0.9	0.08
Cobalt	0.03	0.03	0.07	0.03	0.03
Copper	0.87	8.02	0.85	5.43	11.6
Iron	32.7	21.9	31.3	35.8	35.6
Lead	0.07	0.09	0.15	0.03	0.03
Manganese	1.26	3.03	2.63	2.85	2.01
Mercury	0.009	0.011	0.009	0.02	0.04
Nickel	0.09	0.05	0.12	0.06	0.05
Selenium	0.38	0.35	0.49	0.25	0.73
Silver	0.004	0.19	0.04	0.18	2.4
Vanadium	0.13	0.07	0.28	0.09	0.08
Zinc	13.9	148	21	134	448
PCB µg kg⁻¹ (ppb)					
CB18	0.009	0.04	0.03	0.24	0.014
CB28	0.02	0.23	0.02	0.02	0.05
CB31	0.012	0.05	0.02	0.02	0.02
CB44	0.009	0.02	0.02	0.02	<0.005
CB52	0.02	0.08	0.03	0.013	0.03
CB101	0.05	0.25	0.11	0.12	0.04
CB105	0.014	0.06	0.011	0.007	0.012
CB118	0.05	0.22	0.06	0.05	0.06
CB138	0.1	0.23	0.22	0.05	0.1
CB149	0.04	0.18	0.1	0.05	0.06
CB153	0.18	0.51	0.37	0.21	0.23
CB156	<0.005	<0.006	0.005	nd (<0.0014)	nd (<0.0013)
CB170	nd (<0.0014)	0.014	nd (<0.0013)	0.02	nd (<0.0013)
CB180	<0.005	0.03	0.02	<0.005	0.006
CB194	nd (<0.0014)	nd (<0.0015)	nd (<0.0013)	nd (<0.0014)	nd (<0.0013)
CB209	nd (<0.0014)	nd (<0.0015)	nd (<0.0013)	nd (<0.0014)	<0.005

Shellfish Water Station	Kilmakilloge	Kinsale	League Point	Loughras Beg	Maharees
MI Reference	ENV/2015/1340	ENV/2015/1286	ENV/2015/1280	ENV/2015/1308	ENV/2015/1295
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0025)	<0.04	nd (<0.0025)	nd (<0.0026)	<0.03
BDE47	<0.04	0.21	<0.03	0.08	0.13
BDE99	nd (<0.0027)	0.08	nd (<0.0027)	0.04	<0.03
BDE100	nd (<0.0025)	0.04	nd (<0.0025)	<0.04	0.05
BDE153	nd (<0.0025)	<0.04	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)
BDE154	nd (<0.0025)	<0.04	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)
BDE183	nd (<0.0025)	nd (<0.0028)	nd (<0.0025)	nd (<0.0026)	nd (<0.0024)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.04	0.03	0.03	nd (<0.0022)	0.005
Hexachlorobutadiene	0.06	0.06	<0.03	<0.04	0.05
DDE (<i>o,p</i>)	nd (<0.0028)	0.08	nd (<0.0028)	nd (<0.0029)	<0.03
DDE (<i>p,p</i>)	0.13	0.8	0.09	0.2	0.14
DDT (<i>o,p</i>)	<0.03	0.21	nd (<0.002)	0.22	0.07
DDT (<i>p,p</i>)	<0.03	0.4	0.09	0.1	0.04
DDD (<i>o,p</i>)	<0.03	0.17	<0.03	nd (<0.0014)	0.04
DDD (<i>p,p</i>)	0.2	1.03	0.04	0.66	0.09
<i>cis</i> -chlordane (α -chlordane)	<0.03	<0.03	<0.03	<0.04	<0.03
<i>trans</i> -chlordane (γ -chlordane)	0.04	nd (<0.0021)	<0.03	nd (<0.002)	0.08
<i>trans</i> -nonachlor	0.03	0.05	0.03	<0.06	0.03
Oxychlordane	nd (<0.0014)	nd (<0.0015)	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)
Aldrin	nd (<0.0018)	0.14	nd (<0.0018)	nd (<0.0018)	0.04
Dieldrin	nd (<0.0014)	0.09	nd (<0.0013)	nd (<0.0014)	<0.03
<i>cis</i> -heptachlorepoxyde (α)	<0.03	<0.04	<0.03	<0.03	<0.04
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.13	0.45	0.13	0.09	0.1
Acenaphthylene	<0.04	0.13	<0.03	0.08	0.03
Anthracene	0.05	0.28	<0.04	0.08	0.1
Benzo[<i>a</i>]anthracene	0.16	2.4	0.07	0.45	0.26
Benzo[<i>a</i>]pyrene	0.09	1.04	0.04	0.14	0.07
Chrysene	0.2	1.44	0.15	1	0.26
Dibenz[<i>ah</i>]anthracene	<0.04	0.15	<0.04	nd (<0.0029)	<0.03
Fluoranthene	1.02	10.1	0.77	3.47	1.17
Fluorene	0.27	0.77	0.38	0.48	0.22
Benzo[<i>b</i>]fluoranthene	0.7	6.19	0.28	1.33	0.38
Benzo[<i>k</i>]fluoranthene	0.23	2.12	0.09	0.36	0.73
Benzo[<i>ghi</i>]perylene	0.4	1.15	0.22	0.11	0.11
Indeno[1,2,3- <i>cd</i>]pyrene	0.2	0.72	0.09	0.08	0.11
Phenanthrene	1.07	4.02	1.3	2.12	1.09
Pyrene	0.86	9.47	0.47	3.68	0.64

Shellfish Water Station	Malahide	Mannin Bay	Mulroy Bay - Broadwater	Oysterhaven	Poulnasherry Bay
MI Reference	ENV/2015/1333	ENV/2015/1319	ENV/2015/1321	ENV/2015/1288	ENV/2015/1299
Date	03/12/2015	25/11/2011	25/11/2015	11/11/2015	16/11/2015
Latitude (N)			55° 09.27'	51° 42.41'	52° 39.12'
Longitude (W)			07° 41.46'	08° 27.68'	09° 33.33'
Species Sampled	<i>Ensis siliqua</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	24	25	50	24	25
Method of Cultivation	bed	trestle	rope	trestle	trestle
Shellfish					
Length range (mm)	139 - 197	70.25 - 118	42.76 - 59.22	90.08 - 152	55.57 - 150
Mean length (mm)	172	91.1	51.5	114	101
Length stdev (mm)	13.3	12.7	4.22	17.9	23.4
Shell weight (%)	0	87.2	67.9	85.5	85.5
Meat weight (%)	100	12.8	32.1	14.5	14.5
Moisture (%)	80	85.7	82.1	84.3	83.1
Total Lipids (%)	0.56	0.16	0.19	0.13	0.21
Metals mg kg⁻¹ (ppm)					
Aluminium	32	6.89	20.7	10.2	21.6
Arsenic	1.65	2.34	1.53	1.74	2.12
Cadmium	0.02	0.12	0.05	0.11	0.15
Chromium	0.07	0.05	0.08	0.07	0.12
Cobalt	0.04	0.02	0.05	0.03	0.03
Copper	0.77	4.75	0.75	6.15	10.6
Iron	36.2	24.2	37.4	24.6	30.7
Lead	0.11	0.04	0.06	0.09	0.06
Manganese	1.08	2.26	2.81	3.6	5.48
Mercury	0.013	0.03	0.02	0.014	0.03
Nickel	0.05	0.04	0.09	0.07	0.09
Selenium	0.23	0.27	0.45	0.31	0.5
Silver	0.32	0.21	0.01	0.18	0.63
Vanadium	0.12	0.05	0.21	0.12	0.07
Zinc	11.4	154	12.6	148	186
PCB µg kg⁻¹ (ppb)					
CB18	0.012	0.007	0.014	0.02	<0.005
CB28	0.08	0.012	0.05	0.06	0.03
CB31	0.05	0.02	0.03	0.03	0.011
CB44	0.07	0.007	0.04	0.05	0.007
CB52	0.1	0.02	0.02	0.05	0.04
CB101	0.17	0.68	0.04	0.36	0.07
CB105	0.06	0.011	0.011	0.04	0.02
CB118	0.15	0.04	0.04	0.16	0.07
CB138	0.19	0.06	0.12	0.19	0.11
CB149	0.13	0.03	0.04	0.14	0.09
CB153	0.27	0.16	0.19	0.48	0.31
CB156	0.005	<0.005	<0.005	0.008	<0.005
CB170	<0.005	nd (<0.0014)	<0.005	0.007	nd (<0.0014)
CB180	<0.005	<0.005	0.006	0.03	0.02
CB194	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)	nd (<0.0015)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0014)	nd (<0.0014)	<0.005	nd (<0.0014)

Shellfish Water Station	Malahide	Mannin Bay	Mulroy Bay - Broadwater	Oysterhaven	Poulnasherry Bay
MI Reference	ENV/2015/1333	ENV/2015/1319	ENV/2015/1321	ENV/2015/1288	ENV/2015/1299
PBDEs $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	<0.04	nd (<0.0026)	nd (<0.0025)	nd (<0.0027)	nd (<0.0027)
BDE47	0.18	<0.04	<0.04	0.11	0.08
BDE99	nd (<0.0028)	nd (<0.0028)	<0.04	0.05	0.05
BDE100	0.04	nd (<0.0026)	nd (<0.0025)	<0.04	<0.04
BDE153	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	<0.04	nd (<0.0027)
BDE154	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	<0.04	<0.04
BDE183	nd (<0.0026)	nd (<0.0026)	nd (<0.0025)	nd (<0.0027)	nd (<0.0027)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.03	0.03	0.05	0.04	0.009
Hexachlorobutadiene	0.17	0.1	0.09	0.45	nd (<0.0053)
DDE (<i>o,p</i>)	<0.03	0.03	<0.03	<0.03	<0.03
DDE (<i>p,p</i>)	0.23	0.11	0.19	0.48	0.21
DDT (<i>o,p</i>)	0.05	<0.03	<0.04	0.05	0.04
DDT (<i>p,p</i>)	0.19	0.14	0.03	0.3	0.07
DDD (<i>o,p</i>)	0.1	<0.03	<0.03	0.04	0.04
DDD (<i>p,p</i>)	0.28	0.13	0.11	0.23	0.11
<i>cis</i> -chlordane (α -chlordane)	<0.03	0.06	<0.03	0.04	<0.03
<i>trans</i> -chlordane (γ -chlordane)	<0.03	0.05	nd (<0.002)	0.06	<0.03
<i>trans</i> -nonachlor	<0.03	<0.03	<0.03	0.05	0.03
Oxychlordane	<0.03	nd (<0.0014)	nd (<0.0014)	<0.03	nd (<0.0014)
Aldrin	<0.03	<0.03	<0.03	<0.03	<0.03
Dieldrin	nd (<0.0014)	<0.03	<0.03	nd (<0.0015)	0.04
<i>cis</i> -heptachlorepoxyde (α)	<0.04	<0.04	<0.04	<0.04	<0.04
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.56	0.16	0.19	0.13	0.21
Acenaphthylene	0.18	0.04	0.1	0.12	0.08
Anthracene	0.17	0.08	0.17	0.15	0.09
Benzo[<i>a</i>]anthracene	1.56	0.38	0.5	0.9	0.45
Benzo[<i>a</i>]pyrene	0.76	0.08	0.15	0.31	0.08
Chrysene	1.76	0.83	0.95	0.73	0.79
Dibenz[<i>ah</i>]anthracene	0.08	0.06	<0.04	0.07	nd (<0.003)
Fluoranthene	5.23	2.67	2.87	5.75	3.63
Fluorene	0.99	0.44	0.58	0.63	0.54
Benzo[<i>b</i>]fluoranthene	2.24	0.84	0.56	2.5	0.63
Benzo[<i>k</i>]fluoranthene	1.02	0.26	0.22	0.81	0.2
Benzo[<i>ghi</i>]perylene	0.56	0.11	0.38	0.49	0.12
Indeno[1,2,3- <i>cd</i>]pyrene	0.49	nd (<0.0024)	0.2	0.38	0.05
Phenanthrene	3.33	2.46	3.02	1.96	2.85
Pyrene	3.58	1.88	2.4	3.97	2.79

Shellfish Water Station	Rinevella	Roaringwater Bay Inner	Sheephaven Bay	Sligo Harbour	Streamstown Bay
MI Reference	ENV/2015/1300	ENV/2015/1278	ENV/2015/1320	ENV/2015/1307	ENV/2015/1318
Date	16/11/2015	03/11/2015	25/11/2015	24/11/2015	25/11/2015
Latitude (N)	52° 34.90'	51° 31.38'		54° 16.93'	53° 31.28'
Longitude (W)	09° 44.62'	09° 26.22'		08° 35.22'	10° 07.08'
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	50	33	25	25
Method of Cultivation	trestle	rope	intertidal	trestle	trestle
Shellfish					
Length range (mm)	96.26 - 130	46.53 - 56.75	44.98 - 59.94	59.6 - 120	65.72 - 124
Mean length (mm)	108	50.6	56.2	91.1	88.2
Length stdev (mm)	7.74	2.56	3.75	14.5	13.5
Shell weight (%)	93.7	60	75.4	79.7	89
Meat weight (%)	6.3	40	24.6	20.3	11
Moisture (%)	85.2	80.3	80.4	84.6	85.5
Total Lipids (%)	0.15	0.11	0.1	0.04	0.1
Metals mg kg⁻¹ (ppm)					
Aluminium	22.1	41.1	17.3	6.35	16.1
Arsenic	2.07	1.21	1.31	1.55	1.8
Cadmium	0.18	0.06	0.06	0.1	0.13
Chromium	0.15	0.15	0.11	0.07	0.4
Cobalt	0.03	0.04	0.04	0.02	0.03
Copper	13.4	0.87	0.76	4.19	3.26
Iron	41.5	35.3	43.3	22	42.4
Lead	0.09	0.11	0.09	0.04	0.06
Manganese	4.37	2.05	1.08	3.02	2.06
Mercury	0.03	0.008	0.03	0.011	0.02
Nickel	0.06	0.1	0.09	0.03	0.09
Selenium	0.31	0.38	0.3	0.28	0.28
Silver	0.85	0.007	0.01	0.17	0.24
Vanadium	0.12	0.21	0.18	0.07	0.12
Zinc	279	11.9	13.7	96.1	160
PCB µg kg⁻¹ (ppb)					
CB18	0.013	0.02	0.04	0.08	0.008
CB28	0.02	0.02	0.013	0.02	0.02
CB31	0.02	0.011	0.011	0.02	0.013
CB44	<0.005	0.03	0.02	0.012	0.011
CB52	0.03	0.02	0.02	0.02	0.02
CB101	0.15	0.08	0.05	0.05	0.04
CB105	0.011	0.02	<0.005	0.005	0.02
CB118	0.05	0.07	0.03	0.05	0.06
CB138	0.06	0.11	0.06	0.05	0.06
CB149	0.05	0.05	0.03	0.05	0.03
CB153	0.22	0.23	0.13	0.16	0.15
CB156	<0.005	<0.005	<0.005	nd (<0.0014)	0.006
CB170	<0.005	nd (<0.0014)	nd (<0.0013)	0.02	<0.005
CB180	0.01	<0.005	<0.005	0.006	0.02
CB194	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	0.02	0.006

Shellfish Water Station	Rinevella	Roaringwater Bay Inner	Sheephaven Bay	Sligo Harbour	Streamstown Bay
MI Reference	ENV/2015/1300	ENV/2015/1278	ENV/2015/1320	ENV/2015/1307	ENV/2015/1318
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	<0.04	nd (<0.0026)	<0.03	<0.04	nd (<0.0026)
BDE47	0.05	0.04	<0.03	0.1	<0.04
BDE99	<0.04	<0.04	<0.03	0.08	<0.04
BDE100	<0.04	nd (<0.0026)	nd (<0.0024)	0.04	nd (<0.0026)
BDE153	nd (<0.0027)	nd (<0.0026)	nd (<0.0024)	nd (<0.0026)	nd (<0.0026)
BDE154	<0.04	nd (<0.0026)	nd (<0.0024)	<0.04	nd (<0.0026)
BDE183	nd (<0.0027)	nd (<0.0026)	nd (<0.0024)	nd (<0.0026)	nd (<0.0026)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	0.008	0.05	0.03	nd (<0.0022)	0.02
Hexachlorobutadiene	0.11	0.06	0.1	nd (<0.0051)	0.05
DDE (<i>o,p</i>)	nd (<0.003)	nd (<0.0029)	<0.03	nd (<0.0029)	<0.03
DDE (<i>p,p</i>)	0.12	0.15	0.13	0.1	0.23
DDT (<i>o,p</i>)	<0.03	<0.03	<0.03	<0.04	<0.04
DDT (<i>p,p</i>)	0.11	0.1	<0.03	0.07	0.04
DDD (<i>o,p</i>)	<0.03	<0.03	<0.03	nd (<0.0014)	<0.03
DDD (<i>p,p</i>)	0.09	0.04	0.21	nd (<0.049)	0.08
<i>cis</i> -chlordane (α -chlordane)	<0.03	<0.03	<0.03	<0.04	<0.03
<i>trans</i> -chlordane (γ -chlordane)	0.06	0.04	<0.03	nd (<0.002)	0.08
<i>trans</i> -nonachlor	0.03	0.03	<0.03	nd (<0.0014)	0.04
Oxychlordane	<0.03	<0.03	nd (<0.0013)	nd (<0.0014)	0.03
Aldrin	<0.03	<0.03	nd (<0.0017)	nd (<0.0018)	<0.03
Dieldrin	<0.03	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	<0.03
<i>cis</i> -heptachlorepoxyde (α)	<0.04	<0.03	<0.03	nd (<0.0014)	0.05
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.15	0.11	0.13	0.1	0.1
Acenaphthylene	<0.04	0.05	0.05	0.12	0.04
Anthracene	0.06	<0.04	0.1	0.1	0.06
Benzo[<i>a</i>]anthracene	0.23	0.15	0.22	0.49	0.3
Benzo[<i>a</i>]pyrene	0.05	0.07	0.09	0.04	0.08
Chrysene	0.47	0.25	0.53	0.82	0.47
Dibenz[<i>ah</i>]anthracene	nd (<0.003)	<0.04	<0.03	nd (<0.0029)	<0.04
Fluoranthene	2.43	1.41	2.29	4.74	1.68
Fluorene	0.38	0.34	0.4	0.4	0.3
Benzo[<i>b</i>]fluoranthene	0.38	0.63	0.44	0.65	0.56
Benzo[<i>k</i>]fluoranthene	0.11	0.21	0.15	0.21	0.18
Benzo[<i>ghi</i>]perylene	0.08	0.36	0.27	0.05	0.14
Indeno[1,2,3- <i>cd</i>]pyrene	0.04	0.2	0.13	<0.04	0.1
Phenanthrene	1.64	1.49	2.33	2.33	1.37
Pyrene	1.43	0.84	1.77	4.87	1.08

Shellfish Water Station	Swilly Estuary	Tralee Bay Inner	Trawbreaga Bay	Trawenagh Bay	Valentia Harbour
MI Reference	ENV/2015/1323	ENV/2015/1281	ENV/2015/1324	ENV/2015/1313	ENV/2015/1297
Date	25/11/2015	04/11/2015	25/11/2015	23/11/2015	12/11/2015
Latitude (N)	55° 09.79'	52° 16.12'	55° 17.73'	54° 53.12'	51° 56.46'
Longitude (W)	07° 30.14'	09° 49.85'	07° 17.51'	08° 20.05'	10° 17.50'
Species Sampled	<i>Crassostrea gigas</i>	<i>Ostrea edulis</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	25	25	25	25
Method of Cultivation	trestle	bed	trestle	trestle	trestle
Shellfish					
Length range (mm)	71.52 - 125	66.57 - 80.51	66.86 - 114	92.07 - 117	75.13 - 103
Mean length (mm)	90	73.2	90.5	103	88.7
Length stdev (mm)	12.2	4.14	13.1	6.74	7.74
Shell weight (%)	86.1	87.4	85.3	78.1	87.5
Meat weight (%)	13.9	12.6	14.7	21.9	12.5
Moisture (%)	84.7	82.1	86.3	84.2	86.4
Total Lipids (%)	0.35	0.76	0.03	0.16	0.07
Metals mg kg⁻¹ (ppm)					
Aluminium	22.6	22.9	12.9	1.69	14.1
Arsenic	1.41	1.47	1.12	1.94	1.33
Cadmium	0.16	0.43	0.16	0.18	0.24
Chromium	0.04	0.1	0.04	0.06	0.09
Cobalt	0.03	0.04	0.02	0.02	0.03
Copper	11.1	16.4	8.9	3.06	7.52
Iron	42.6	33.8	30.5	16	34.5
Lead	0.04	0.04	0.03	0.03	0.03
Manganese	5.46	3.62	3.36	3.32	3.4
Mercury	0.013	0.02	0.011	0.013	0.02
Nickel	0.07	0.05	0.07	<0.03	0.07
Selenium	0.32	0.4	0.24	0.35	0.25
Silver	0.48	0.46	0.32	0.14	0.32
Vanadium	0.09	0.16	0.09	0.06	0.11
Zinc	128	314	130	91.8	168
PCB µg kg⁻¹ (ppb)					
CB18	0.012	0.014	0.013	0.008	0.06
CB28	0.09	0.04	0.04	0.02	0.04
CB31	0.03	0.02	0.011	0.008	0.02
CB44	0.03	0.04	0.02	<0.006	0.05
CB52	0.03	0.04	0.02	0.01	0.03
CB101	0.05	0.04	0.05	0.03	0.07
CB105	0.013	0.013	0.01	<0.006	0.012
CB118	0.05	0.05	0.03	0.03	0.08
CB138	0.06	0.07	0.05	0.05	0.06
CB149	0.06	0.04	0.04	0.04	0.08
CB153	0.21	0.14	0.12	0.14	0.28
CB156	0.006	nd (<0.0014)	<0.005	nd (<0.0014)	nd (<0.0014)
CB170	nd (<0.0014)	nd (<0.0014)	<0.005	nd (<0.0014)	0.012
CB180	0.02	<0.005	<0.005	<0.005	<0.005
CB194	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)
CB209	nd (<0.0014)	nd (<0.0014)	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)

Shellfish Water Station	Swilly Estuary	Tralee Bay Inner	Trawbreaga Bay	Trawenagh Bay	Valentia Harbour
MI Reference	ENV/2015/I323	ENV/2015/I281	ENV/2015/I324	ENV/2015/I313	ENV/2015/I297
PBDE $\mu\text{g kg}^{-1}$ (ppb)					
BDE28	nd (<0.0027)	<0.04	nd (<0.0023)	nd (<0.0027)	nd (<0.0025)
BDE47	0.1	0.09	0.07	<0.04	<0.04
BDE99	0.05	<0.04	<0.03	<0.04	<0.04
BDE100	<0.04	<0.04	<0.03	nd (<0.0027)	nd (<0.0025)
BDE153	nd (<0.0027)	nd (<0.0025)	nd (<0.0023)	nd (<0.0027)	nd (<0.0025)
BDE154	<0.04	<0.04	nd (<0.0023)	nd (<0.0027)	nd (<0.0025)
BDE183	nd (<0.0027)	nd (<0.0025)	nd (<0.0023)	nd (<0.0027)	nd (<0.0025)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)					
Hexachlorobenzene	<0.005	0.01	0.011	0.01	nd (<0.0021)
Hexachlorobutadiene	0.15	0.06	0.06	0.07	nd (<0.005)
DDE (<i>o,p</i>)	<0.03	<0.03	<0.03	<0.03	nd (<0.0028)
DDE (<i>p,p</i>)	0.23	0.12	0.17	0.11	0.15
DDT (<i>o,p</i>)	0.11	0.17	0.09	<0.04	0.07
DDT (<i>p,p</i>)	0.17	0.17	0.14	0.04	0.1
DDD (<i>o,p</i>)	0.09	0.24	<0.03	<0.03	<0.04
DDD (<i>p,p</i>)	0.36	0.29	0.43	0.13	nd (<0.048)
<i>cis</i> -chlordane (α -chlordane)	<0.03	<0.03	<0.03	0.05	<0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03	0.03	0.04	<0.03	nd (<0.0019)
<i>trans</i> -nonachlor	0.04	<0.03	0.03	<0.03	<0.06
Oxychlordane	nd (<0.0015)	<0.03	nd (<0.0013)	nd (<0.0014)	nd (<0.0014)
Aldrin	<0.03	<0.03	<0.03	<0.03	nd (<0.0018)
Dieldrin	0.04	<0.03	<0.03	<0.03	nd (<0.0014)
<i>cis</i> -heptachlorepoxyde (α)	<0.04	<0.04	0.04	0.18	nd (<0.0014)
PAHs $\mu\text{g kg}^{-1}$ (ppb)					
Acenaphthene	0.35	0.54	0.11	0.16	0.07
Acenaphthylene	0.17	0.26	0.14	0.09	0.07
Anthracene	0.24	0.22	0.19	0.1	0.08
Benzo[<i>a</i>]anthracene	1.16	1.06	1.15	0.39	0.52
Benzo[<i>a</i>]pyrene	0.36	0.23	0.17	0.05	0.11
Chrysene	1.56	1.31	2.19	1	0.64
Dibenz[<i>ah</i>]anthracene	0.08	0.07	0.04	nd (<0.003)	nd (<0.0028)
Fluoranthene	8.37	4.4	6.45	4.33	2.52
Fluorene	0.85	0.91	0.48	0.61	0.28
Benzo[<i>b</i>]fluoranthene	2.13	0.81	1.26	0.59	0.89
Benzo[<i>k</i>]fluoranthene	0.84	0.76	0.38	0.18	0.28
Benzo[<i>ghi</i>]perylene	0.45	0.31	0.18	0.09	0.1
Indeno[1,2,3- <i>cd</i>]pyrene	0.36	0.29	0.14	0.06	0.08
Phenanthrene	4.65	4.27	3.41	3.3	1.27
Pyrene	6.8	3.39	4.73	2.4	2.62

Shellfish Water Station	Wexford Harbour Outer
MI Reference	ENV/2015/1343
Date	18/12/2015
Latitude (N)	52° 19.68'
Longitude (W)	06° 26.25'
Species Sampled	<i>Mytilus edulis</i>
Number of Individuals	50
Method of Cultivation	bed
Shellfish	
Length range (mm)	42.96 - 57.09
Mean length (mm)	51.1
Length stdev (mm)	3.03
Shell weight (%)	67.4
Meat weight (%)	32.6
Moisture (%)	80.5
Total Lipids (%)	0.92
Metals mg kg⁻¹ (ppm)	
Aluminium	53.4
Arsenic	1.03
Cadmium	0.03
Chromium	0.12
Cobalt	0.05
Copper	0.92
Iron	91.6
Lead	0.34
Manganese	2.19
Mercury	0.02
Nickel	0.19
Selenium	0.37
Silver	0.004
Vanadium	0.18
Zinc	13.7
PCB µg kg⁻¹ (ppb)	
CB18	0.011
CB28	0.06
CB31	0.03
CB44	0.07
CB52	0.06
CB101	0.2
CB105	0.08
CB118	0.21
CB138	0.37
CB149	0.15
CB153	0.58
CB156	0.02
CB170	0.03
CB180	0.03
CB194	nd (<0.0012)
CB209	nd (<0.0012)

Shellfish Water Station	Wexford Harbour Outer
MI Reference	ENV/2015/1343
PBDE $\mu\text{g kg}^{-1}$ (ppb)	
BDE28	<0.03
BDE47	0.11
BDE99	0.04
BDE100	<0.03
BDE153	nd (<0.0023)
BDE154	nd (<0.0023)
BDE183	nd (<0.0023)
Organochlorines $\mu\text{g kg}^{-1}$ (ppb)	
Hexachlorobenzene	0.06
Hexachlorobutadiene	0.14
DDE (<i>o,p</i>)	<0.03
DDE (<i>p,p</i>)	0.86
DDT (<i>o,p</i>)	<0.03
DDT (<i>p,p</i>)	0.12
DDD (<i>o,p</i>)	0.07
DDD (<i>p,p</i>)	0.36
<i>cis</i> -chlordane (α -chlordane)	0.04
<i>trans</i> -chlordane (γ -chlordane)	<0.03
<i>trans</i> -nonachlor	<0.03
Oxychlordane	nd (<0.0014)
Aldrin	0.03
Dieldrin	0.08
<i>cis</i> -heptachlorepoxyde (α)	<0.04
PAHs $\mu\text{g kg}^{-1}$ (ppb)	
Acenaphthene	0.24
Acenaphthylene	0.11
Anthracene	0.32
Benzo[<i>a</i>]anthracene	0.69
Benzo[<i>a</i>]pyrene	0.27
Chrysene	0.77
Dibenz[<i>ah</i>]anthracene	0.07
Fluoranthene	5.16
Fluorene	0.75
Benzo[<i>b</i>]fluoranthene	1.33
Benzo[<i>k</i>]fluoranthene	0.42
Benzo[<i>ghi</i>]perylene	0.81
Indeno[1,2,3- <i>cd</i>]pyrene	0.59
Phenanthrene	3.04
Pyrene	4.42

4. Conformance with specific requirements for Shellfish Waters Directive (SI No. 268 of 2006) and the Water Framework Directive (SI 272 of 2009)

Section 4 provides an assessment of results compared with legislative standards for water quality and seafood safety. This does not provide a detailed scientific assessment of these parameters.

4.1 Physico-chemical parameters 1 – 7

Full compliance with mandatory values – no water quality issues identified

Where possible sampling events were undertaken four times per annum (typically in April, June, August and December) for physicochemical parameters 1 – 6; *in situ* probe data for pH, temperature, salinity, dissolved oxygen and samples for laboratory measurement of coloration and suspended solids.

All pH values were within the mandatory range of “no less than pH neither 7 nor greater than pH 9” as specified in SI 268 of 2006 and the Directive.

The salinity measurements in the water column ranged from 6.62 to 34.91 psu, with a mean recording of 30.53 psu. No results reported exceed the upper Guide Value of 38 psu. A number of individual surface readings at (Loughras Beg, Clew Bay North and Inner Wexford) were less than the lower guide value of 12 psu (SI 268 of 2006), reflecting the freshwater influence on these sites. However, sub-surface to bottom readings of the water column at the Clew Bay and Wexford Harbour sites were within guide values. Only surface readings were available for Loughros Beg.

Dissolved oxygen was typically close to full saturation and all individual values conformed to the Mandatory Value ($\geq 70\%$ saturation) with just three readings lower than the stricter Guide Value ($\geq 80\%$ saturation set as annual average) established in the directive and SI 268 of 2006.

Elevated chlorophyll-a sonde levels greater than $10 \mu\text{g l}^{-1}$ (WFD High/Good boundary) were seen on ten occasions with 2 exceeding the Good/Moderate boundary of $15 \mu\text{g l}^{-1}$.

No Visible hydrocarbons were noted during any sampling event.

4.2 Parameter 8 Organohalogenes and PAHs

Full compliance – no organohalogen values exceeding standards for shellfish

Due to typically low water solubility and a tendency to accumulate in flesh, organohalogenes are not determined in seawater. Mandatory and Guide (stricter than Mandatory) values have only been set for PCBs in flesh of bivalve molluscs. Due to their persistence and tendency to bioaccumulate, PCBs, PBDEs, PAHs and organochlorine compounds are detected in shellfish despite controls in place for these substances. Indeed, PCBs and organochlorine pesticides have been banned for decades and concentrations detect reflect residual environmental levels. The concentrations of ICES 7 PCBs detected were well below the Guide Values established in SI No. 268 of 2006.

4.3 Dissolved Trace Metals Parameter 9

Trace Metals in Seawater

Full compliance – no trace metals values exceeding standards set for seawater

Water samples for trace metal were typically collected at target stations (at least) twice per annum (winter and summer) by CLS/Aquafact and the EPA. All samples were analysed by the Marine Institute for the nine trace metals (dissolved phase) specified by the Directive, and on occasion a further four non-Directive metals; cobalt, manganese, uranium and vanadium. Results are reported in Table 5.

SI 268 of 2006 set Mandatory Values in seawater {Maximum Allowable Concentrations (MAC)} for arsenic, cadmium, copper, lead, nickel, silver and zinc in water as set for shellfish waters in SI 268 of 2006. Subsequently WFD Daughter Directive 2008/105/EC, as established in SI 327 of 2012, set Environmental Quality Standards as Annual Averages and Maximum Allowable Concentrations (AA-EQS and/or MAC-EQS where applicable) for mercury, cadmium lead and nickel which apply in transitional and coastal waters. SI 272 of 2009 also set new AA-EQS for specific pollutants including arsenic, chromium III and chromium VI, copper and zinc. Dissolved metals concentrations measured in shellfish waters are assessed against these standards (Table 3) and shellfish waters should comply with the strictest of these provisions.

Trace metal results for all samples complied with the mandatory values for trace metals in seawater as set in SI 268 of 2006 and SI 272 of 2009. All nickel and lead results were also below the WFD AA-EQS (see Table 3) as set in the WFD Daughter Directive 2013/39/EC.

All mercury samples were compliant with the WFD EQS of $0.07 \mu\text{g l}^{-1}$.

Table 9: Summary statistics ($\mu\text{g l}^{-1}$) for trace metals in surface water samples collected at designated shellfish waters in 2016. Mean & (Max values in parenthesis)

Shellfish Water Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
E11-Castletownbere	1.605 (1.67)	<0.05 (<0.05)	0.335 (0.36)	0.26 (0.33)	<0.1 (<0.1)	0.0022 (0.0026)	0.19 (0.24)	<0.05 (<0.05)	<1.00 (<1.00)
E12-Roaringwater Bay Inner	1.406 (1.82)	<0.05 (<0.05)	0.17 (0.44)	<0.145 (<0.55)	<0.1 (<0.1)	0.0018 (0.002)	0.232 (0.25)	<0.05 (<0.05)	<1.00 (<1.00)
E13-Baltimore Harbour \ Sherkin	1.526 (1.58)	<0.05 (<0.05)	0.172 (0.37)	<0.138 (<0.48)	<0.1 (<0.1)	0.0022 (0.0025)	0.21 (0.3)		<1.00 (<1.00)
E14-Kinsale	1.4733 (1.61)	<0.05 (<0.05)	0.262 (0.33)	0.5566 (0.88)	<0.1 (<0.1)	0.0038 (0.0105)	0.316 (0.39)	<0.0506 (<0.06)	<1.00 (<1.00)
E15-Cork Harbour North Channel	1.5767 (1.86)	<0.05 (<0.05)	0.3667 (0.43)	0.7033 (0.95)	<0.1 (<0.1)	0.0048 (0.0089)	0.33 (0.39)	<0.05 (<0.05)	<1.1767 (<1.29)
E16-Duncannon	1.3775 (1.55)	<0.05 (<0.05)	0.185 (0.22)	0.64 (0.75)	<0.1033 (<0.11)	0.0089 (0.0313)	0.4275 (0.53)		<1.00 (<1.00)
E17-Wexford Harbour Outer	1.4239 (1.73)	<0.05 (<0.05)	0.2279 (0.3)	0.5774 (1.37)	<0.1 (<0.1)	<0.0024 (<0.0056)	0.3332 (0.51)	<0.05 (<0.05)	<1.00 (<1.00)
E18-Wexford Harbour Inner	1.6574 (2.24)	<0.05 (<0.05)	0.1716 (0.22)	0.6208 (0.99)	<0.1 (<0.1)	0.0071 (0.02)	0.4795 (0.62)		<1.00 (<1.00)
E19-Malahide	1.63 (1.73)	<0.05 (<0.05)	0.2133 (0.28)	0.4133 (0.54)	<0.1 (<0.1)	0.006 (0.0157)	0.2933 (0.32)	<0.05 (<0.05)	<1.00 (<1.00)
E1-Lough Swilly Inner	1.3175 (1.44)	<0.05 (<0.05)	0.2275 (0.31)	0.475 (0.82)	<0.1 (<0.1)	0.0091 (0.0229)	0.25 (0.33)		<1.00 (<1.00)
E21-Dundalk Bay	1.652 (1.77)	<0.05 (<0.05)	0.3233 (0.33)	0.5333 (0.54)	<0.1 (<0.1)	0.001 (0.0013)	0.2833 (0.39)	<0.05 (<0.05)	<1.00 (<1.00)
E2-Mulroy Bay - Broadwater	1.44 (1.68)	<0.05 (<0.05)	0.2525 (0.29)	0.265 (0.38)	<0.1 (<0.1)	0.0021 (0.0038)	0.1525 (0.18)		<1.00 (<1.00)
E3-Gweebarra Bay	1.4715 (1.52)	<0.05 (<0.05)	0.2838 (0.35)	0.1923 (0.23)	<0.1 (<0.1)	0.0012 (0.0014)	0.1654 (0.23)	<0.05 (<0.05)	<1.00 (<1.00)
E4-Bruckless	1.4175 (1.51)	<0.05 (<0.05)	0.255 (0.38)	0.2725 (0.42)	<0.1 (<0.1)	0.0066 (0.0224)	0.145 (0.18)	<0.05 (<0.05)	<1.1 (<1.3)
E5-Clew Bay North	1.1775 (1.61)	<0.05 (<0.05)	0.225 (0.24)	0.24 (0.42)	<0.1 (<0.1)	0.0037 (0.0088)	0.22 (0.31)		<1.23 (<1.56)
E6-Clew Bay South	1.6333 (1.66)	<0.05 (<0.05)	0.2314 (0.32)	0.1881 (0.32)	<0.1 (<0.1)	0.006 (0.0071)	0.3281 (0.4)	<0.05 (<0.05)	<1.00 (<1.00)
E7-Killary Harbour Inner	1.2946 (1.48)	<0.05 (<0.05)	0.2608 (0.36)	<0.1977 (<0.29)	<0.1 (<0.1)	0.0012 (0.0013)	0.2877 (0.41)	0.05 (0.05)	<1.00 (<1.00)
E8-Kinvara	1.42 (1.51)	<0.05 (<0.05)	0.2675 (0.33)	0.34 (0.39)	<0.1 (<0.1)	0.0019 (0.0029)	0.2575 (0.3)	0.06 (0.06)	<1.00 (<1.00)
M100-Carlingford Lough Inner Stn 2	1.4933 (1.78)	<0.05 (<0.05)	0.1353 (0.29)	0.2144 (0.49)	<0.1 (<0.1)	0.0015 (0.0016)	0.2606 (0.3)	<0.05 (<0.05)	<1.00 (<1.00)
M10-Gweedore Bay	1.2817 (1.57)	<0.05 (<0.05)	0.2617 (0.34)	<0.2833 (<0.57)	<0.1 (<0.1)	0.0014 (0.0029)	0.2083 (0.38)	<0.05 (<0.05)	<1.00 (<1.00)

Shellfish Water Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
M13-Loughras Beg	0.645 (0.98)	<0.05 (<0.05)	0.23 (0.32)	0.655 (0.86)	<0.1 (<0.1)	0.0023 (0.0035)	0.3625 (0.45)	0.06 (0.06)	<1.14 (<1.31)
M14-Donegal Bay	1.405 (1.59)	<0.05 (<0.05)	0.2475 (0.36)	0.37 (0.5)	<0.1 (<0.1)	0.001 (0.0012)	0.3025 (0.33)	0.05 (0.05)	<1.00 (<1.00)
M15-Inver Bay	1.3677 (1.4)	<0.05 (<0.05)	0.2715 (0.35)	0.2962 (0.47)	<0.1257 (<0.16)	0.0011 (0.0016)	0.2231 (0.26)		<1.48 (<3.08)
M19-Drumcliff	1.35 (1.49)	<0.05 (<0.05)	0.2087 (0.33)	0.7613 (0.99)	<0.1 (<0.1)	0.0013 (0.0016)	0.315 (0.61)		<1.0875 (<1.29)
M1-Trawbreaga Bay	1.3975 (1.67)	<0.05 (<0.05)	0.33 (0.46)	0.6982 (1.54)	<0.1 (<0.1)	0.001 (0.0017)	0.3825 (0.53)	<0.05 (<0.05)	<1.00 (<1.00)
M20-Sligo Harbour	1.304 (1.76)	<0.05 (<0.05)	0.244 (0.35)	0.394 (0.66)	<0.1 (<0.1)	0.0013 (0.0015)	0.362 (0.58)	<0.05 (<0.05)	<1.068 (<1.68)
M23-Killala Bay	1.5886 (1.96)	<0.05 (<0.05)	0.226 (0.32)	0.2463 (0.35)	<0.11 (<0.13)	0.0009 (0.0012)	0.2217 (0.25)	<0.05 (<0.05)	<2.1057 (<3.84)
M24-Blacksod bay	1.1 (1.29)	<0.05 (<0.05)	0.202 (0.26)	<0.212 (<0.28)	<0.1 (<0.1)	0.001 (0.0014)	0.154 (0.17)		<1.502 (<1.87)
M2-Sheephaven Bay	1.305 (1.46)	<0.05 (<0.05)	0.315 (0.35)	0.6055 (1.15)	<0.11 (<0.13)	0.0013 (0.0024)	0.3575 (0.67)	<0.05 (<0.05)	<1.1125 (<1.45)
M47-Tralee Bay Inner	1.4125 (1.61)	<0.05 (<0.05)	0.2275 (0.32)	0.3375 (0.61)	<0.1 (<0.1)	0.0018 (0.0023)	0.2625 (0.36)	<0.0533 (<0.06)	<1.06 (<1.24)
M48-Maharees	1.41 (1.57)	<0.05 (<0.05)	0.2489 (0.33)	0.2544 (0.41)	<0.1 (<0.1)	0.0017 (0.0025)	0.1967 (0.22)	<0.05 (<0.05)	<1.00 (<1.00)
M5-Dungloe Bay	1.4725 (1.64)	<0.05 (<0.05)	0.3 (0.36)	0.2705 (0.41)	<0.1 (<0.1)	0.0044 (0.0149)	0.25 (0.34)	0.05 (0.05)	<1.00 (<1.00)
M65-Roaringwater Bay Inner	1.65 (1.65)	<0.05 (<0.05)	0.33 (0.33)	0.4 (0.4)	0.34 (0.34)	0.0009 (0.0009)	0.23 (0.23)		1.05 (1.05)
M6-Trawenagh Bay	1.3748 (1.67)	<0.05 (<0.05)	0.282 (0.34)	<0.2105 (<0.7)	<0.1 (<0.1)	0.0017 (0.0018)	0.2329 (0.31)	<0.05 (<0.05)	<26.0087 (<52.87)
M71-Rostellan South	1.4875 (1.68)	<0.05 (<0.05)	0.27 (0.41)	0.4625 (0.77)	<0.1 (<0.1)	0.0019 (0.0025)	0.2575 (0.27)	<0.05 (<0.05)	<1.00 (<1.00)
M74-Ballymacoda	1.47 (1.54)	<0.05 (<0.05)	0.255 (0.32)	0.3925 (0.92)	<0.1 (<0.1)	0.0021 (0.0028)	0.2925 (0.47)	<0.05 (<0.05)	<1.00 (<1.00)
M77-Dungarvan Bay	1.4197 (1.58)	<0.05 (<0.05)	0.1702 (0.36)	0.2427 (0.44)	<0.1 (<0.1)	0.0019 (0.0039)	0.2233 (0.26)		<1.00 (<1.00)
M81-Bannow Bay	1.4052 (1.57)	<0.05 (<0.05)	0.2291 (0.4)	0.4078 (0.61)	<0.1 (<0.1)	0.0018 (0.0025)	0.3822 (0.58)	<0.05 (<0.05)	<1.00 (<1.00)

Notes:

For values reported as “< value”, value = Limit of Quantitation (LOQ) for relevant determinand

Blank- not requiring analysis

nd – not detected

Trace Metals in Shellfish

With the exception of one elevated cadmium concentration in oysters from Maharees (1.25 versus threshold value of 1.0), no other trace metal value exceeded standards in mussels, oysters or clams.

Table 10: Summary statistics (mg kg⁻¹ wet wt) for trace metals in bivalve molluscs collected at SWs in 2015

Parameter	Species	S.I 268/2006 guidance std	1881/2006/EC max limit	min	max	mean	median	stddev	n
Arsenic	Blue mussels	6		1.03	1.82	1.39	1.36	0.2	20
	Clams			1.65	1.65	1.65	1.65		1
	Oysters (Pacific and native)			1.12	2.69	1.67	1.63	0.38	36
Cadmium	Blue mussels	1	1	0.03	0.14	0.07	0.06	0.02	20
	Clams			0.02	0.02	0.02	0.02		1
	Oysters (Pacific and native)			0.09	1.25	0.19	0.16	0.19	36
Chromium	Blue mussels	1.2		0.08	0.35	0.14	0.12	0.06	20
	Clams			0.07	0.07	0.07	0.07		1
	Oysters (Pacific and native)			0.04	0.9	0.13	0.07	0.17	36
Copper	Blue mussels	80		0.38	1.32	0.84	0.83	0.17	20
	Clams			0.77	0.77	0.77	0.77		1
	Oysters (Pacific and native)			1.81	22.2	7.74	6.15	4.97	36
Lead	Blue mussels	1.5	1.5	0.05	0.37	0.14	0.09	0.1	20
	Clams			0.11	0.11	0.11	0.11		1
	Oysters (Pacific and native)			0.02	0.13	0.05	0.04	0.03	36
Mercury ¹	Blue mussels	0.2	0.5	0.01	0.03	0.01	0.01	0.01	20
	Clams			0.01	0.01	0.01	0.01		1
	Oysters (Pacific and native)			0.01	0.04	0.02	0.02	0.01	36
Nickel	Blue mussels	1		0.08	0.26	0.12	0.09	0.05	20
	Clams			0.05	0.05	0.05	0.05		1
	Oysters (Pacific and native)			0.03	0.1	0.06	0.05	0.02	36
Silver	Blue mussels	3		0	0.04	0.01	0.01	0.01	20
	Clams			0.32	0.32	0.32	0.32		1
	Oysters (Pacific and native)			0.06	2.4	0.37	0.23	0.41	36
Zinc	Blue mussels	800		9.87	21	13.71	13.3	2.68	20
	Clams			11.4	11.4	11.4	11.4		1
	Oysters (Pacific and native)			91.8	448	166.69	148	74.93	36

¹ Note: Mercury in shellfish testing was carried out by FERA Science UK

Arsenic, chromium, cadmium, copper, lead, silver, nickel and zinc were all in compliance with Guide Values (Table 4) as set for SWs in SI No. 268 of 2006. Different bioregulation of certain metals (especially

copper, zinc, silver and cadmium) results in often considerably higher concentrations in oysters compared to mussels.

5. Compliance with European Food Safety Maximum Limits for Bivalve Molluscs

All samples of bivalve molluscs reported complied with the maximum limits established for mercury, cadmium and lead (Table 4).

Upperbound concentrations of the sum of 6 marker PCBs (max 3.07 $\mu\text{g kg}^{-1}$ ww) in bivalve molluscs reported were over an order of magnitude below the maximum permissible limit of 75 $\mu\text{g kg}^{-1}$ ww, set for these substances in seafood for all samples and even two orders of magnitude lower for many SWs.

Concentrations of benzo(a)pyrene (range 0.04 – 1.04 $\mu\text{g kg}^{-1}$ ww, n = 52), as a marker PAH, and the sum of four indicator PAH (range 0.54 – 12.56 $\mu\text{g kg}^{-1}$ ww, n = 52) were also well below the established maximum limits for bivalve molluscs in all samples. (Maximum Limits for benzo(a)pyrene and for the sum of four indicator PAHs = 5 and 30 $\mu\text{g kg}^{-1}$ ww respectively).

Annex A: Methods

A.1 Measurement of physicochemical and trace metals in seawater

A.1.1 General physicochemical parameters (Parameters 1 – 7)

As part of each sampling event, *in-situ* physico-chemical profiles of the water column were obtained using calibrated Hydrolab DS5x Multiparameter Sonde for the following parameters: depth (m), chlorophyll (V), chlorophyll ($\mu\text{g/L}$), dissolved oxygen (DO % and $\mu\text{g/L}$), salinity (PSU), turbidity (NTU), temperature ($^{\circ}\text{C}$) and pH. In addition, a secchi reading was taken at each station and a water sample for laboratory determination of colorimetry (true colour) and suspended solids.

The colorimetry (true colour) and suspended solids sample was collected from surface water (approximately $\sim 0.5\text{m}$ depth) in a one litre plastic bottle and sent for analysis to Complete Laboratory Solutions (CLS) or to the EPA laboratories if sampled by the EPA³. True colour is the colour of water from which turbidity has been removed. For true colour to be determined, suspended materials were removed using a $0.45\mu\text{m}$ filter and true colour determined in 10 ml of the resultant filtrate using a Hach DR 5000 Spectrophotometer calibrated with a platinum-cobalt (Pt-Co) solution. To determine suspended solids, a well-mixed sample is filtered through a weighed standard cellulose nitrate GN-6 Grid filter and the residue retained on the filter is dried to a constant weight at $105^{\circ}\text{C} \pm 30^{\circ}\text{C}$ for 1 hour. The increase in weight of the filter represents the total suspended solids.

Table AI: Limit of Quantification (LOQ), testing laboratory and analytical methods for suspended solids and colorimetry.

Parameter	LOQ	Analytical Laboratory	Method of Analysis
True Colour (mg/L Pt Co)	4	CLS, Rosmuc	ISO7887:1994
Suspended Solids (mg/L)	5	CLS, Rosmuc	ISO7027:1999

³ Colorimetry and suspended solids results, where available for E code stations, were analysed by the EPA. Results and analytical methodologies are available from the EPA laboratory.

A 1.2 Trace Metals (Parameter 9)

A one litre seawater sample for trace metals analysis was collected in an HNO₃ acid washed plastic bottle, using a plastic sampling rod at approximately ~ 0.5 m depth. From this bottle:

100 ml of sample was filtered through a 0.45µm Glass Micro Fibre (GMF) filter for mercury analysis into a polypropylene bottle with ultrapure nitric acid (HNO₃) preservative.

50ml of sample was filtered through a 0.45µm methyl cellulose filter for analysis of eight other trace metals (arsenic, cadmium, chromium, copper, silver, lead, nickel and zinc). These were preserved by the pre-addition of ultrapure nitric acid (HNO₃) into a polypropylene bottle.

Blank samples for mercury and the eight of nine metals were also periodically taken in the field as part of the quality control (QC) procedures for the monitoring programme. All trace metal water samples once logged and received at Marine Institute laboratories were refrigerated at 5 °C. Details of Marine Institute methods are referenced below in Table A.2.

Mercury Analysis

Analysed by Cold Vapour - Atomic Fluorescence Spectrophotometer (CV-AFS). The first step involves the oxidation of all commonly occurring organo-mercury compounds to Hg (II) using free bromine. Following reduction of the samples with tin (II) chloride, mercury concentrations were determined by Cold Vapour Atomic Fluorescence Spectroscopy (CV-AFS) using a PSA Millennium Merlin Analyser.

Trace Metal Analysis

For the analysis of dissolved metals, an acidified portion of the 0.45 µm filtrate is analysed directly using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) with a High Matrix Introduction (HMI) system. Sample solutions are pneumatically nebulized into a radio-frequency plasma where ionization occurs. The ions are extracted from the plasma through a differentially pumped vacuum interface and separated on the basis of their mass-to-charge ratio by a quadrupole mass spectrometer. Separated ions are detected by an electron multiplier Faraday detector and the ion information is processed by a data handling system. Isobaric and polyatomic interferences relating to the sample matrix and plasma action are removed using a helium collision cell and appropriate correction equations.

Table A.2: Limit of Quantification (LOQ), Limit of Detection (LOD), testing laboratory and analytical methods for trace metals in seawater.

Parameter	LOD µg l ⁻¹	LOQ µg l ⁻¹	Analytical Laboratory	Method of Analysis
Arsenic	0.023	0.05	MI, Galway	SOP CHE-169 – Metals by ICPMS
Cadmium	0.004	0.05	MI, Galway	SOP CHE-169 – Metals by ICPMS
Chromium	0.015	0.05	MI, Galway	SOP CHE-169 – Metals by ICPMS
Copper	0.021	0.10	MI, Galway	SOP CHE-169 – Metals by ICPMS
Silver	0.002	0.05	MI, Galway	SOP CHE-169 – Metals by ICPMS
Lead	0.004	0.10	MI, Galway	SOP CHE-169 – Metals by ICPMS
Mercury	2x10 ⁻⁴	5x10 ⁻⁴	MI, Galway	SOP CHE-168 – Mercury in Marine Waters by CV-AFS
Nickel	0.019	0.05	MI, Galway	SOP CHE-169 – Metals by ICPMS
Zinc	0.13	1.00	MI, Galway	SOP CHE-169 – Metals by ICPMS

Note: All methods accredited with the exception of Mercury in Marine Waters at time of testing.

A.2 Analysis of trace metals and organohalogen substances in shellfish flesh

Shellfish sample processing

At the Marine Institute laboratories, the lengths of individual shellfish were recorded prior to the soft tissue being removed from the shells to be washed and drained. The percentage meat and shell weights were calculated and recorded. The pooled soft tissue was then homogenised prior to being divided into three sub-samples, two of which were stored in pre-weighed, acid washed glass jars in a freezer at $< -20^{\circ}\text{C}$. One sub-sample from each location was freeze-dried for 24 hours and analysed for trace metals (excluding mercury) and the other sub-sample was analysed for mercury. The remaining sub sample was stored in a solvent washed jar and analysed for organic contaminants. The moisture content was determined by drying approximately 1g of unfrozen tissue overnight at 104°C to constant weight using CHE-52 Test method for Moisture Content Determination in Marine Biota.

Trace Metal Analysis

Arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc (and additional metals aluminium, cobalt, iron, manganese, selenium and vanadium)

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 Mars Xpress). After cooling, samples were diluted to 50mls with deionised water.

Trace metal concentrations were determined by ICP-MS (Agilent 7700x with High Matrix Introduction (HMI) system). Interferences were removed using a helium collision cell and appropriate correction equations.

Mercury Analysis – by Fera Science Ltd, UK

Aliquots of homogenised samples were digested in a mixture of nitric acid and hydrogen peroxide using a high-pressure microwave system. Quantification was by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) with collision cell.

Polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), polybrominated diphenyl ethers (PBDEs) and Polyaromatic Hydrocarbons (PAHs)

Tissue samples were extracted by Smedes Lipid Extraction Techniques (i.e. 'Total' Lipid). All lipid concentrations were determined gravimetrically. Extract clean-up was completed by use of column chromatography prior to analysis. Quantification of PCBs, OCs, PBDEs and PAHs was performed using an Agilent gas chromatograph (GC) coupled to either a 5973N mass spectrometric (MSD) or a triple quadrupole (QQQ) using electron ionisation (EI) mode with helium as a carrier gas. Matrix matched laboratory reference samples were included for quality assurance purposes.

Table A.3 Marine Institute metal Detection Limits (mg kg^{-1} wet weight) and test method details

Metal	Test Method	LOD
Arsenic	CHE-I78 Metals in Marine Biota by ICPMS	0.001
Cadmium	CHE-I78 Metals in Marine Biota by ICPMS	0.001
Chromium	CHE-I78 Metals in Marine Biota by ICPMS	0.008
Copper	CHE-I78 Metals in Marine Biota by ICPMS	0.006
Lead	CHE-I78 Metals in Marine Biota by ICPMS	0.007
Nickel	CHE-I78 Metals in Marine Biota by ICPMS	0.009
Silver	CHE-I78 Metals in Marine Biota by ICPMS	0.0003
Zinc	CHE-I78 Metals in Marine Biota by ICPMS	0.06

Note: All methods accredited to ISO17025

A.3 Quality Assurance

Best practice for sampling the designated shellfish areas was adhered to so as to avoid contamination and ensure integrity of samples in so far as possible including testing of field blank samples. A comprehensive analytical quality assurance programme underpins testing at the Marine Institute and the listed subcontracting laboratories. 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 (PT) scheme. The Marine Institute has ISO 17025 accreditation under the Irish National Accreditation Board (INAB) for the analysis of mercury, trace metals (arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc only), polychlorinated biphenyl congeners (PCBs), polycyclic aromatic hydrocarbons (PAHs) and brominated flame retardants (BFRs) and moisture in marine biota and for trace metals (arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc only) in seawater. CLS have ISO 17025 accreditation for the analysis of colorimetry (true colour) and suspended solids. FERA Science UK is UKAS accredited to ISO 17025 for mercury in fish and shellfish.