

**Monitoring trace metals and organohalogens in shellfish (2014) and  
physicochemical parameters and trace metals in seawater (2015)  
under the Shellfish Waters Directive**



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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) and brominated flame retardants (BFRs) and moisture in biota.

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## 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 them<sup>1</sup>. 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 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 2015.
- Trace metal (SWD parameter 9) and organohalogen (parameter 8) concentrations in shellfish sampled from Irish Shellfish Waters (SWs) in 2014.

**Table I:** Parameters, matrices and testing frequency for physicochemical parameters.

Parameter No.	Parameter	Results Reported	Laboratory or in situ*	Parameter tested	Sampling Frequency
1	pH	Seawater 2015	<i>in Situ</i> probe		4
2	Temperature	Seawater 2015	<i>in Situ</i> probe		4
3	Coloration (true colour)	Seawater 2015	Laboratory		4
4	Suspended solids	Seawater 2015	Laboratory		4
5	Salinity	Seawater 2015	<i>in Situ</i> probe		4
6	Dissolved oxygen	Seawater 2015	<i>in Situ</i> probe		4
7	Petroleum hydrocarbons	Seawater 2015	<i>in Situ</i>	Visible hydrocarbons	4
8	Organohalogen substances	Shellfish Flesh 2014	Laboratory GCMS	Polychlorinated biphenyls polybrominated diphenylethers organochlorine pesticides	1
9	Dissolved trace metals Trace Metals	Seawater 2015 Shellfish Flesh 2014	Laboratory ICPMS and CVAFS	Mercury and other trace metals	2 1

Note: \*method details are provided in Annex A

<sup>1</sup> 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, Community and Local Government (DHPCLG). 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 four times per year in 2015 and metals sampled 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 2014. 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 (organohalogens) and 9 (nine trace metals) of the SWD.
- Assess compliance with maximum permissible limits as established in EC food safety legislation for certain contaminants for bivalve molluscs (Regulation 1881/2006/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. However, a more comprehensive multi-annual assessment of conformance with the SWD will be reported separately.

## 2. Methods

### 2.1 Seawater Sampling and analysis

There are 65 Shellfish Water stations in 64 designated Shellfish Waters. Of these stations, 43 were sampled by CLS and their subcontractor Aquafact on behalf of the Marine Institute as per the agreed monitoring plan, while the EPA sampled 13 stations. Therefore, there were a total of 56 SW stations sampled in 2015 (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. The 56 SW stations were typically sampled four times per annum 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 two of these occasions (June and December) samples were collected for laboratory testing of trace metals. Details of the sampling and testing methodology employed are provided in Annex A.

**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 (MI) 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
<b>M1</b>	Donegal	55.2980	7.295	Trawbreaga Bay	<b>M43</b>	Limerick	52.5747	9.487	Shannon Estuary - Ballylongford
<b>M2</b>	Donegal	55.1473	7.8763	Sheephaven Bay	<b>M47</b>	Kerry	52.2712	9.8327	Tralee Bay
<b>E1</b>	Donegal	55.0591	7.5579	Lough Swilly - Inner Lough	<b>M48</b>	Kerry	52.2718	10.0073	Maharees
<b>E2*</b>	Donegal	55.1535	7.6835	Mulroy Bay - Broadwater	<b>E9*</b>	Kerry	51.8975	10.3234	Valentia River
<b>M5</b>	Donegal	54.9422	8.3985	Dungloe Bay	<b>M51</b>	Kerry	52.1410	9.8933	Cromane
<b>M6</b>	Donegal	54.8975	8.3667	Trawenagh Bay	<b>E10</b>	Kerry	51.7776	9.8085	Kenmare/ Kilmackilloge
<b>M10</b>	Donegal	55.0572	8.3228	Gweedore Bay	<b>M56</b>	Kerry	51.7495	9.877	Kenmare/ Ardroom
<b>E3</b>	Donegal	54.8500	8.39	Gweebarra Bay	<b>E11*</b>	Cork	51.6459	9.8683	Castletownbere
<b>M13</b>	Donegal	54.7583	8.4753	Loughras Beg	<b>M58</b>	Cork	51.6788	9.7247	Adrigole
<b>M14</b>	Donegal	54.6345	8.174	Donegal Bay	<b>M59</b>	Cork	51.7272	9.543	Glengariff
<b>E4</b>	Donegal	54.6190	8.3872	McSwynes Bay - Inner Bay/ Bruckless	<b>M60</b>	Cork	51.6883	9.476	Inner Bantry Bay
<b>M15</b>	Donegal	54.5903	8.393	Inver Bay	<b>M61</b>	Cork	51.6167	9.688	Bantry Bay South
<b>M19</b>	Sligo	54.3372	8.5567	Sligo Bay - Drumcliff	<b>M62</b>	Cork	51.6575	9.5488	League Point
<b>M20</b>	Sligo	54.2893	8.5238	Sligo Bay – Sligo Harbour	<b>M63</b>	Cork	51.6073	9.5515	Dunmanus Inner
<b>M23</b>	Mayo	54.2102	9.191	Killala Bay	<b>E12</b>	Cork	51.5264	9.428	Roaringwater Bay
<b>M24</b>	Mayo	54.1815	9.9513	Blacksod bay	<b>E13</b>	Cork	51.4975	9.4076	Baltimore Hbr/Sherkin



Station Code	County	Lat (Deg)	Long (Deg)	Shellfish Water	Station Code	County	Lat (Deg)	Long (Deg)	Shellfish Water
<b>M25</b>	Mayo	53.9798	9.9495	Achill Sound - North	<b>E14</b>	Cork	51.6928	8.5322	Kinsale
<b>M26</b>	Mayo	53.9210	9.9165	Achill Sound - South	<b>M67</b>	Cork	51.7000	8.46	Oysterhaven
<b>E5</b>	Mayo	53.8805	9.6034	Clew Bay (North Station)	<b>E15*</b>	Cork	51.8851	8.2708	Cork Great Island North Channel
<b>E6</b>	Mayo	53.7955	9.6017	Clew Bay (South Station)	<b>M71**</b>	Cork	51.8492	8.1953	Rostellan South
<b>E7</b>	Galway	53.6000	9.782	Killary Harbour – Inner	<b>M72</b>	Cork	51.8577	8.1963	Rostellan North
<b>M29</b>	Galway	53.5728	9.995	Ballinakill Bay	<b>M73</b>	Cork	51.8493	8.205	Rostellan West
<b>M30</b>	Galway	53.5208	10.1193	Streamstown Bay	<b>M74</b>	Cork	51.9005	7.8878	Ballymacoda
<b>M31</b>	Galway	53.4720	10.0362	Clifden Bay - Ardabear Bay	<b>M77</b>	Waterford	52.0680	7.5872	Dungarvan
<b>M32</b>	Galway	53.4587	10.0462	Mannin Bay	<b>E16</b>	Waterford	52.2584	6.9916	Waterford Hbr Duncannon
<b>M33*</b>	Galway	53.3510	9.6892	Kilkieran Bay - North	<b>M81</b>	Wexford	52.2275	6.812	Bannow Bay
<b>M35</b>	Galway	53.2150	9.4558	Galway Bay - Outer / Indreabhán	<b>E17</b>	Wexford	52.3343	6.419	Wexford Harbour Outer
<b>E8</b>	Galway	53.1666	8.9565	Kinvara/ Clarinbridge	<b>E18</b>	Wexford	52.3615	6.4712	Wexford Harbour Inner
<b>M37</b>	Galway	53.1408	9.0808	Ballyvaughan/ Poulnaclogh	<b>E19*</b>	Dublin	53.4457	6.1065	Malahide
<b>M38</b>	Galway	53.1598	9.0563	Galway Bay Aughinish Bay	<b>E20*</b>	Dublin	53.6257	6.1587	Balbriggan - Skerries
<b>M39</b>	Limerick	52.6533	9.5592	Shannon Est - Poulmasherry	<b>E21*</b>	Louth	53.9457	6.3051	Dundalk Bay
<b>M41</b>	Limerick	52.5817	9.7445	Shannon Est - Rinevella	<b>M100</b>	Louth	54.0523	6.182	Carlingford Lough - Inner
<b>M42</b>	Limerick	52.5883	9.7038	Shannon Est - Carrigaholt					

**Note:** Marine Institute sampled stations (M code) are sampled by CLS or their subcontractor Aquafact. Stations with an E code are sampled by the EPA as part of their transitional and coastal water quality monitoring programme.

\* not sampled in 2015

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

### **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 3:** Mandatory and Guide values for Water parameters in shellfish waters 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 <sup>-1</sup> )	300	100		
9	Dissolved trace metals (µg l <sup>-1</sup> )				
	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 nine trace metals and organohalogenes, specifically polychlorinated biphenyl congeners (PCBs), various organochlorine compounds (OCs) and polybrominated diphenyl ethers (PBDEs). Analysis was carried out at the Marine Institute laboratories.

56 pooled<sup>2</sup> samples, were collected in November/December 2014 by officers of the Sea Fisheries Protection Authority (SFPA) and MERC Consultants Ltd. from, or close to, designated SWs and brought to the Marine Institute for processing. 20 mussel (*M. edulis*), 33 oyster {31 Pacific oyster (*C. gigas*) and 2 native oyster (*O. edulis*)}, two clam {one razor clam (*E. siliqua*), one saltwater clam (*V. philippinarum*)} and one cockle (*C. edule*) sample were collected at sampling locations shown in Figure 1. 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 by European Commission Regulations (EC) No. 629/2008, No. 835/2011 (PAH – applied from 1st September 2012) and No. 1259/2011 (applied from 1st January 2012), sets maximum levels for mercury, cadmium, lead, six marker PCBs in bivalve molluscs. The maximum levels are set out in Table 4. Guide values for parameters 8 and 9 in shellfish flesh as set in SI No. 268 of 2006 are given in Table 4. Poly Aromatic Hydrocarbon (PAH) analytical results are not included in this report and will follow at a later date.

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

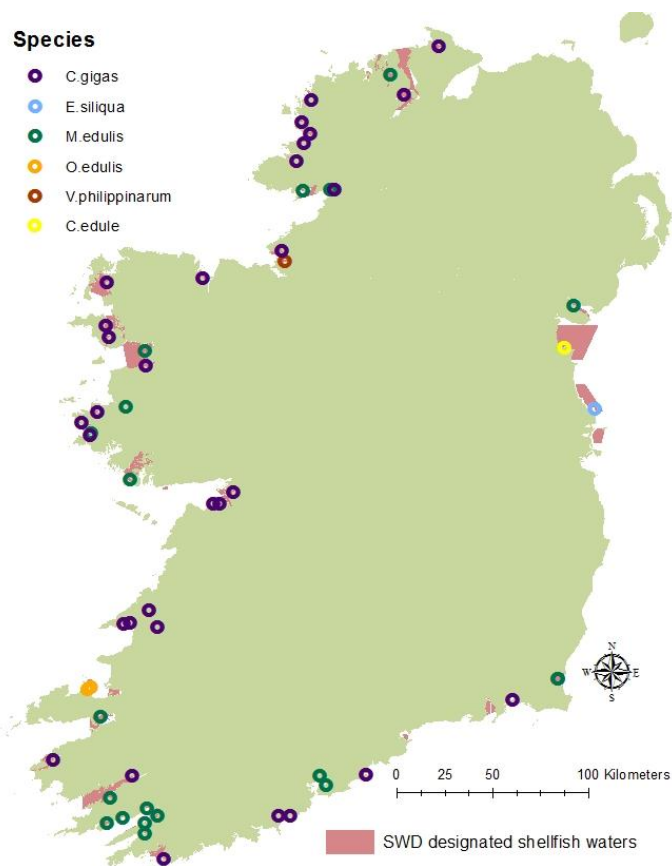
<sup>1</sup> SI No. 268 of 2006 also includes mandatory and guide values for ICES 7 PCBs in shellfish flesh. These are not included in this table as the new stricter standard for seafood (Regulation 1259/2011/EC) takes precedence.

<sup>2</sup> Indicative wet weight (assuming 80% moisture)

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

<sup>4</sup> 6 PCBs= CB congeners 28, 52, 101, 138, 153 and 180

<sup>2</sup> 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 2014

### 3. Results

#### 3.1 Physicochemical parameters and trace metals in seawater

The 56 SWs were 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 the nine trace metals (dissolved phase Parameter 9) are presented in Table 5 also.

**Table 5: (continued to page 19)** 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 56 stations in designated shellfish waters for the year 2015

Shellfish Water Station	MI Ref ENV/ 2015/	Sampling Date	in-situ probe measurement											laboratory analysis				metals analysis									
			Depth (m)	Station depth	Secchi depth (m)	Conductivity	Chlorophyll-a	Dissolved oxygen	Dissolved oxygen	pH (sc)	Salinity (PSU)	Temperature (°C)	Colorimetry-colour	Suspended solids (mg/l)	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Uranium	Vanadium	Zinc
M1- Trawbreaga Bay*	2066	08/04/15	S	0.07	>1.00	0	1.87	159	13.1	8	29.4	13.3	7.5	<5.00													
	2143	17/06/15	S	0.1	>1.00	0	1.81	109	8.46	8.1	33.2	15.3	7.9	33	1.36	<0.05	0.22		0.19	<0.10		0.003	0.21	nd			<1.00
	2236	18/08/15	S	0.18	>1.00	0	3.29	135	9.77	8	29.3	20.2	11.9	<5.00													
	2447	14/12/15	S	0.29	>1.00	0.1	1.36	101	9.31	8.1	24.7	8.37	45.8	<5.00	1.62	<0.05	0.3	0.09	0.44	<0.10	14.8	0.005	0.31	nd	2.8	0.91	1.12
M2- Sheephaven Bay*	2067	08/04/15	S	0.12	>1.50	0	3.94	111	9.9	7.6	33.4	8.32	<4.00	<5.00													
	2144	18/06/15	S	0.49	>1.00	0	1.56	109	8.97	7.9	33.9	12.2	<4.00	<5.00	1.23	<0.05	0.23		0.26	0.21		0.001	0.14	nd		<1.00	
	2237	18/08/15	S	0.26	>1.00	0	5.34	116	8.11	7.9	30.9	21.2	12	<5.00													
	2448	15/12/15	S	0.29	>1.00	0.1	0.26	99.2	8.6	8.1	30.2	9.67	<4.00	<5.00	1.62	<0.05	0.37	0.01	0.18	<0.10	1.09	0.002	0.13	nd	3.55	1.26	<1.00
E1-Lough Swilly- Inner Lough*	2045	25/03/15	S	0.1						7.9	32.5	7.89	2	14	1.3	<0.05	0.13		0.23	<0.10		0.004	0.2	nd			nd
	2510	10/06/15	S	0.1					98.4		8.1	31.1	14.2	2	4												
	2210	08/07/15														1.35	<0.05	0.28		0.64	nd	0.001	0.2	nd			<1.00
	2511	08/07/15	S	0.1					97.6		8	33.8	16.1	2	7												
M5-Dungloe Bay*	2068	07/04/15	S	0.38	>1.00	0	2.34	142	11.4	7.8	31.2	14.4	10.9	6													
	2145	18/06/15	S	0.25	0.5	0	2.67	115	9.18	8	33.6	13.7	6.8	13	1.09	<0.05	0.26		0.14	0.16		0.001	0.15	nd			<1.00
	2238	18/08/15	S	0.22	>1.00	0	0.84	128	9.35	8	33.6	18.2	15.6	<5.00													
	2449	14/12/15	S	0.08	>1.00	0.1	0.19	98.6	8.83	7.8	30.1	8.18	34.9	16	1.55	<0.05	0.31	0.02	0.3	<0.10	1.49	0.001	0.19	nd	3.38	1.34	<1.00
M6- Trawenagh Bay*	2069	07/04/15	S	0.12	>1.00	0	3.34	111	9.51	7.6	31.4	10.9	5.5	<5.00													
	2146	18/06/15	S	0.21	0.5	0.1	10.1	107	8.44	7.7	33.1	14.4	8.4	8	1.41	<0.05	0.26		0.15	0.15		0.001	0.19	nd		<1.00	
	2239	18/08/15	S	0.26	>1.00	0	1.09	108	8.11	7.8	33.6	16.7	<4.00	<5.00													
	2450	14/12/15	S	0.17	>1.00	0.1	0	100	10.4	8.1	10	7.23	78	<5.00	1.01	<0.05	0.23	0.03	0.36	<0.10	8.6	0.002	0.15	nd	1.41	1.08	<1.00
M10- Gweedore Bay*	2073	07/04/15	S	0.61	>1.00	0	3.77	118	10.1	7.6	33.3	9.7	9.3	<5.00													
	2150	18/06/15	S	0.22	>1.00	0	1.27	102	8.43	7.9	31.3	12.6	4.4	<5.00	1.43	<0.05	0.24		0.39	0.24		0.001	0.19	nd		4.56	
	2243	18/08/15	S	0.15	>1.00	0	1.15	115	8.59	7.8	31.5	17.5	20.4	<5.00													
	2454	15/12/15	S	0.52	>1.00	0.1	0.46	98.5	8.75	8.1	27.9	9.18	38.1	<5.00	1.73	<0.05	0.28	0.02	0.21	<0.10	1.72	0.001	0.15	nd	3.11	1.29	<1.00
E3- Gweebarra Bay*	2047	24/03/15	S	0.13	>0.50	0			111	10.9	8.3	25.6	8.72									0.004	0.21	nd			<1.00
	2212	07/07/15														0.99	<0.05	0.26		0.93	<0.10		0.004	0.18	nd		<1.00
M13- Loughras Beg*	2075	07/04/15	S	0.25	>1.00	0	3.18	128	11.3	7.8	24.5	11.7	10.4	<5.00													
	2152	18/06/15	S	0.33	0.5	0	5.66	112	8.82	7.9	30.7	15.1	6.7	<5.00	1.12	<0.05	0.2		0.57	0.2		0.001	0.21	nd		1.31	
	2245	17/08/15	S	0.16	>1.00	0.1	6.93	120	8.68	7.9	31.9	19	<4.00	<5.00													
	2456	14/12/15	S	0.14	>1.00	0.1	1.49	100	9.11	8.1	25.5	8.93	8.5	<5.00	1.29	<0.05	0.28	0.05	0.32	<0.10	15.9	0.0008	0.2	nd	2.8	1.11	<1.00
M14- Donegal Bay*	2076	07/04/15	S	0.16	>1.00	0	1.29	136	11.6	7.6	25.9	12.6	12.5	<5.00													
	2153	18/06/15	S	0.25	0.5	0	4.03	120	9.44	7.9	29.8	15.5	7.5	<5.00	1.21	<0.05	0.24		0.59	0.19		0.001	0.37	nd		1.73	
	2246	17/08/15	S	0.19	>1.00	0	3.53	137	9.79	8.1	29.2	20.8	23.2	<5.00													
	2457	14/12/15	S	0.05	>1.00	0.1	1.46	96.7	9.11	8	22.8	8.04	42.8	<5.00	1.57	<0.05	0.28	0.04	0.61	<0.10	5.93	0.001	0.33	nd	2.69	1.22	1.43
E4-Bruckless*	2048	27/01/15	S	0.1	3				101		7.9	29.4	6.55	12	2	1.23	<0.05	0.15		0.31	<0.10		0.01	0.31	nd		<1.00















Shellfish Water Station	MI Ref ENV/ 2015/	Sampling Date	in-situ probe measurement											laboratory analysis		metals analysis											
			Depth note	Station depth	Secchi depth (m)	Conductivity	Chlorophyll-a	Dissolved oxygen	Dissolved oxygen	pH (sc)	Salinity (PSU)	Temperature (°C)	Colorimetry - true colour	Suspended solids (mg/l)	Arsenic	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Uranium	Vanadium	Zinc
	2499	11/12/15	S	0.44	0.47	0	2.34	92.7	9.58	8.1	18.9	8.62	11.7	42	1.36	<0.05	0.33	0.09	0.66	<0.10	9.11	0.0009	0.54	nd	2.17	1.29	<1.00
			B	1.79		0	3.52	92.9	9.45	8.2	20.7	8.85															
M82-Barrow Suir Nore Estuary*	2538	09/02/15	S	0.4		0	0	97.1	0	7.9	24.7	6.28	7	33													
	2539	14/05/15	S	0.1		0	0	96.5	0	8	12.3	12.5	44	11													
	2225	08/07/15	S	0.3	0.7	0	0	97.4	8.16	8.1	22.7	17.3	5	42	1.34	<0.05	0.2		1.02	<0.10		0.002	0.4	<0.05			1.2
	2060	22/09/15	S	0.1				93.6	0	8	20.3	15.2	6	7	1.28	<0.05	0.15		0.3	<0.10		0.003	0.32	nd			1.05
E17-Wexford Harbour Outer*	2061	12/02/15	S	0.1				99.6	0	8	27.1	5.46	2	2	1.3	<0.05	0.12		0.25	<0.10		0.01	0.25	nd			<1.00
	2540	11/05/15	S	0.1				98.7	0	8	24.1	12.5	12	25													
	2226	21/09/15	S	0.1	2.2			104	0	8.2	31.9	15.3			1.61	<0.05	0.18		0.86	<0.10		0.001	0.26	<0.05			<1.00
E18-Wexford Harbour Inner*	2062	12/02/15	S	0.1				99.1	0	8	21	5.24	7	2	1.04	<0.05	0.29		0.95	<0.10		0.01	1.01	nd			3.58
	2541	11/05/15	S	0.1				96	0	7.8	7.94	13															
	2227	06/07/15	S	0.1	0.7			86.6	0	8.2	24.5	18.7			1.9	<0.05	0.18		1.2	<0.10		0.001	0.38	nd			<1.00
	2292	21/09/15	S	0.1	1.5			98.7	0	8.1	19	15.9	9	2.5	1.81	<0.05	0.17		1.42	<0.10		0.002	0.46	nd			<1.00
E21-Dundalk Bay	2542	13/07/15	S	0.1				107	0	8.1	33.8	14.8															
M100-Carlingford Lough Inner Stn 2*	2123	08/04/15	S	0.27	3.8	0	1.12	111	10.6	8.3	32.5	9.24	<4.00	<5.00													
			B	6.04		0	2.87	112	10.6	8.2	32.7	9.2															
	2195	08/06/15	S	0.31	1.97	0	5.2	102	9.07	8.3	32.8	12.6	<4.00	<5.00	1.6	<0.05	0.26		0.81	<0.10		0.004	0.26	nd			<1.00
			B	4.5		0.1	12.2	109	9.73	8.3	32.8	12.4															
	2286	05/08/15	S	0.32	2.1	0.1	9.14	99.6	8.21	8	32.9	14.4	<4.00	5													
			B	3.5		0.1	29.9	100	8.25	8	32.9	14.4															
2502	10/12/15	S	0.23	0.95	0	1.06	95	9.29	8.1	28	8.5	33.3	<5.00	1.63	<0.05	0.26	0.05	0.75	<0.10	7.56	0.002	0.4	nd	2.69	1.55	<1.00	
		B	3.72		0.1	10.6	94.9	9.06	8.1	29.9	8.98																

Notes:

Depth note: 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:** Overall median and ranges ( $\mu\text{g l}^{-1}$ ) for SWD specified dissolved trace metals in seawater as measured in Shellfish Waters in 2015 (n=56)

Parameter	Strictest MAC-EQS <sup>1</sup>	AA-EQS <sup>2</sup>	Min	Max	Median
Arsenic	40 <sup>3</sup>	20	0.46	1.95	1.39
Cadmium	0.45 <sup>4</sup>	0.2	< 0.05	< 0.05	< 0.05
Chromium	30 <sup>3</sup>	0.6 <sup>5</sup>	0.12	0.37	0.28
Copper	10 <sup>3</sup>	5	0.14	1.42	0.61
Lead	20 <sup>3</sup>	7.2	<0.10	0.24	<0.10
Mercury	0.07 <sup>2</sup>	0.05	<0.0005	0.010	<0.0005
Nickel	50 <sup>3</sup>	20	0.09	1.01	0.22
Silver	10 <sup>3</sup>		< 0.05	< 0.05	< 0.05
Zinc	200 <sup>3</sup>	40	<1.00	4.56	<1.00

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

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

<sup>3</sup> SWD Mandatory value as set in SI 268 of 2006

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

<sup>5</sup> 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 organohalogenes in shellfish flesh

Table 7 presents all measured concentrations in shellfish for trace metals polychlorinated biphenyl (PCB), polybrominated diphenyl ether (PBDE) and organochlorine pesticides concentrations in shellfish flesh. Table 8 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 7:** (continued to page 38) Trace metal, polychlorinated biphenyl (PCB), polybrominated diphenyl ethers (PBDE) and organochlorine compound wet weight concentrations in shellfish sampled from designated shellfish growing waters (SGWs) in 2014

Shellfish Water Station	Achill Sound North	Achill Sound South	Adrigole Harbour*	Annagasan*	Ardbear Bay <sup>1</sup>	Aughinish Bay
MI Reference	ENV/14/1216	ENV/14/1217	ENV/14/1189	ENV/14/1169	ENV/14/1212	ENV/14/1221
Date	25/11/14	25/11/14	17/11/14	05/11/14	24/11/14	25/11/14
Latitude (N)	53° 58.50'	53° 55.21'	51° 40.51'	53° 52.31'	53° 28.21'	53° 09.18'
Longitude (W)	09° 57.01'	09° 54.95'	09° 43.26'	06° 19.03'	10° 02.16'	9° 01.50'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Cerastoderma edule</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>
Number of Individuals	23	24	41	46	50	25
Method of Cultivation	intertidal	intertidal	rope	intertidal	rope	trestle
<b>Shellfish</b>						
Length range (mm)	74.91 - 102	110 - 149	43.39 - 59.99	28.94 - 43.58	44.64 - 59.45	82.57 - 137
Mean length (mm)	88.6	131	55.8	35.8	51.6	105
Length stdev (mm)	7.56	9.82	4.24	3.65	3.47	12.8
Shell weight (%)	88.1	86.0	63.8	73.7	61.4	87.6
Meat weight (%)	11.9	14.0	36.2	26.3	38.6	12.4
Moisture (%)	85.9	85.1	79.8	89.6	79.8	85.9
Total Lipids (%)	1.94	2.22	2.09	0.68	2.15	1.75
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	18.0	28.8	32.1	127	51.3	17.0
Arsenic	1.89	2.58	1.69	0.79	1.88	2.00
Cadmium	0.18	0.09	0.07	0.06	0.06	0.13
Chromium	0.06	0.08	0.09	0.33	0.18	0.10
Cobalt	0.02	0.02	0.04	0.19	0.04	0.02
Copper	5.21	4.02	0.95	0.46	0.87	3.66
Iron	47.0	39.9	30.2	119	59.3	28.0
Lead	0.04	0.05	0.09	0.15	0.14	0.07
Manganese	2.49	2.28	2.77	3.83	2.15	2.12
Mercury	0.010	0.02	0.010	0.010	0.010	0.02
Nickel	0.08	0.06	0.10	2.86	0.12	0.07
Selenium	0.31	0.24	0.57	0.19	0.44	0.28
Silver	0.27	0.12	0.03	0.06	0.010	0.19
Vanadium	0.15	0.11	0.17	0.28	0.29	0.12
Zinc	176	148	16.0	7.38	14.3	147
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	0.006	0.012	<0.005	0.02	0.005	<0.005
CB28	<0.005	<0.005	0.006	0.009	0.014	0.007
CB31	0.009	0.009	<0.005	<0.002	0.005	0.008
CB44	0.008	0.02	0.03	0.02	0.05	0.03
CB52	0.010	0.03	0.03	0.004	0.010	0.03
CB101	0.04	0.03	0.08	0.06	0.06	0.04
CB105	0.006	0.009	0.02	0.03	0.03	0.011
CB118	0.25	0.04	0.06	0.03	0.06	0.02
CB138	0.11	0.10	0.18	0.08	0.16	0.06
CB149	0.05	0.05	0.12	0.07	0.06	0.02
CB153	0.13	0.14	0.34	0.13	0.24	0.16
CB156	0.03	0.02	<0.005	0.004	0.02	<0.005
CB170	0.03	0.006	0.02	0.02	0.008	0.03
CB180	0.04	0.010	0.012	0.04	0.013	0.03
CB194	0.03	0.02	0.009	0.005	<0.005	0.02
CB209	0.007	0.02	0.010	0.02	0.005	0.009
EFSA sum of 6 CBs <sup>1</sup>	0.34	0.32	0.65	0.32	0.50	0.33
ICES sum of 7 CBs <sup>2</sup>	0.59	0.36	0.71	0.35	0.56	0.35

Shellfish Water Station	Achill Sound North	Achill Sound South	Adrigole Harbour*	Annagasan*	Ardbear Bay <sup>1</sup>	Aughinish Bay
MI Reference	ENV/14/1216	ENV/14/1217	ENV/14/1189	ENV/14/1169	ENV/14/1212	ENV/14/1221
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.03	0.03	0.04	0.02	0.013	0.02
BDE47	0.06	0.007	0.03	0.07	0.04	0.10
BDE99	0.06	0.03	0.02	0.014	0.013	0.013
BDE100	0.06	<0.02	0.04	<0.006	0.02	0.02
BDE153	nd (<0.011)	<0.03	<0.03	<0.010	nd (<0.0099)	<0.03
BDE154	0.007	0.010	0.014	0.009	<0.005	0.02
BDE183	<0.02	<0.02	0.02	nd (<0.0019)	0.21	0.02
Sum of 6 PBDEs <sup>3</sup>	0.25	0.15	0.19	0.13	0.31	0.22
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	0.008	0.011	0.03	0.03	0.005	0.006
DDE ( <i>o,p</i> )	0.013	0.02	0.008	0.03	0.006	0.02
DDE ( <i>p,p</i> )	4.86	1.61	0.49	1.24	0.37	0.58
DDT ( <i>o,p</i> )	0.05	0.08	nd (<0.019)	<0.02	nd (<0.018)	<0.04
DDT ( <i>p,p</i> )	<0.05	0.10	0.05	<0.02	nd (<0.018)	<0.04
dieldrin	0.04	0.06	0.02	0.04	0.03	0.02
endrin	nd (<0.021)	nd (<0.021)	nd (<0.019)	nd (<0.0064)	nd (<0.018)	nd (<0.019)
hexachlorobenzene	0.04	0.04	0.05	0.03	0.04	0.013
hexachlorobutadiene	<0.03	0.05	0.04	<0.009	nd (<0.0048)	<0.03
<i>cis</i> -heptachlorepoxyde ( $\alpha$ )	<0.008	0.02	0.013	<0.002	0.009	0.013
$\alpha$ -HCH	0.03	0.03	0.04	0.008	0.05	0.03
$\beta$ -HCH	0.03	0.05	<0.010	0.02	<0.010	0.02
$\delta$ -HCH	0.02	0.05	0.05	0.03	0.02	0.03
$\gamma$ -HCH	0.03	0.02	0.02	0.02	0.011	0.009
heptachlor	0.005	0.08	0.006	0.009	0.005	<0.004
oxychlordane	<0.008	0.010	0.011	0.014	0.008	0.06
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	nd (<0.0054)	<0.013	0.07	nd (<0.0017)	nd (<0.0048)	<0.011
DDD ( <i>o,p'</i> )	<0.008	0.12	0.008	0.008	0.010	0.02
DDD ( <i>p,p</i> )	0.12	0.03	0.03	0.03	0.02	0.07
<i>trans</i> -nonachlor	0.15	0.13	0.06	0.04	0.04	0.11
aldrin	0.009	0.013	nd (<0.0033)	0.009	0.012	0.02

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> 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

nd: not detected (limit of detection in parenthesis).



Shellfish Water Station	Aughinish Bay*	Balbriggan / Skerries	Ballinakill Bay	Ballymacoda*	Baltimore Hbr/ Sherkin	Bannow Bay
MI Reference	ENV/14/1222	ENV/14/1172	ENV/14/1213	ENV/14/1205	ENV/14/1223	ENV/14/1168
Date	25/11/14	05/11/14	24/11/14	24/11/14	26/11/14	04/11/14
Latitude (N)	53° 09.23'	53° 35.23'	53° 34.22'	51° 53.44'	51° 29.47'	52° 14.15'
Longitude (W)	09° 04.50'	06° 05.41'	09° 59.45'	07° 53.29'	09° 24.22'	06° 46.57'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Ensis siliqua</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	10	25	25	25	25	25
Method of Cultivation	intertidal	bed	intertidal	trestle	intertidal	trestle
<b>Shellfish</b>						
Length range (mm)	120 - 178	150 - 195	72.19 - 107	79.1 - 110	71.16 - 134	72.25 - 119
Mean length (mm)	142	169	89.6	96.4	96.1	102
Length stdev (mm)	19.8	10.4	9.12	8.40	12.7	13.4
Shell weight (%)	94.6	38.9	91.8	84.0	87.4	79.4
Meat weight (%)	5.40	61.1	8.20	16.0	12.6	20.6
Moisture (%)	88.8	80.9	85.2	83.4	85.4	80.2
Total Lipids (%)	0.88	1.62	2.53	2.85	2.35	3.68
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	14.2	28.3	19.0	20.6	17.5	23.7
Arsenic	1.21	1.83	1.55	1.93	2.12	2.15
Cadmium	0.31	0.02	0.20	0.14	0.14	0.13
Chromium	0.10	0.16	0.10	0.08	0.08	0.08
Cobalt	0.02	0.04	0.03	0.03	0.03	0.03
Copper	7.11	1.59	9.92	9.22	10.0	4.96
Iron	32.2	30.8	51.4	34.0	28.5	29.8
Lead	0.08	0.10	0.05	0.09	0.08	0.09
Manganese	1.43	1.14	2.82	3.50	4.35	4.15
Mercury	0.03	0.010	0.03	0.010	0.010	0.010
Nickel	0.05	0.05	0.08	0.06	0.06	0.05
Selenium	0.21	0.29	0.32	0.35	0.32	0.43
Silver	0.32	0.18	0.44	0.51	0.34	0.22
Vanadium	0.10	0.11	0.18	0.08	0.07	0.07
Zinc	237	14.4	303	190	238	148
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	0.02	0.008	<0.005	<0.005	0.005	<0.005
CB28	<0.004	0.009	<0.005	0.007	<0.005	<0.005
CB31	<0.004	0.009	0.008	<0.005	0.007	0.008
CB44	0.012	0.014	0.02	0.02	0.03	0.012
CB52	0.013	0.03	0.02	0.07	0.03	0.04
CB101	0.012	0.11	0.05	0.15	0.09	0.14
CB105	0.013	0.13	0.03	0.05	0.05	0.02
CB118	0.03	0.07	0.03	0.17	0.15	0.13
CB138	0.09	0.17	0.10	0.35	0.24	0.28
CB149	0.02	0.12	0.05	0.23	0.12	0.16
CB153	0.04	0.24	0.20	0.66	0.44	0.40
CB156	0.02	0.013	<0.005	0.03	0.006	0.007
CB170	0.02	0.008	0.04	0.05	0.02	0.006
CB180	0.02	0.03	0.02	0.07	0.009	0.02
CB194	<0.004	0.02	0.013	0.008	0.007	0.02
CB209	<0.004	0.008	<0.005	0.005	0.02	0.02
EFSA sum of 6 CBs <sup>1</sup>	0.18	0.59	0.40	1.31	0.81	0.89
ICES sum of 7 CBs <sup>2</sup>	0.21	0.66	0.43	1.48	0.96	1.02

Shellfish Water Station	Aughinish Bay*	Balbriggan / Skerries	Ballinacill Bay	Ballymacoda*	Baltimore Hbr/ Sherkin	Bannow Bay
MI Reference	ENV/14/1222	ENV/14/1172	ENV/14/1213	ENV/14/1205	ENV/14/1223	ENV/14/1168
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.03	0.012	0.03	0.03	0.02	0.03
BDE47	0.11	0.11	0.04	0.14	0.05	0.07
BDE99	0.014	0.02	0.03	0.02	0.02	0.02
BDE100	0.02	<0.02	0.03	0.02	<0.02	<0.02
BDE153	<0.03	<0.03	<0.03	nd (<0.0098)	<0.03	nd (<0.0094)
BDE154	0.012	0.02	<0.006	0.02	0.011	0.012
BDE183	<0.02	nd (<0.0058)	0.03	<0.02	0.02	<0.02
Sum of 6 PBDEs <sup>3</sup>	0.24	0.22	0.20	0.26	0.17	0.18
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	0.03	0.06	0.02	0.03	0.005	0.03
DDE ( <i>o,p</i> )	0.02	0.010	0.03	<0.003	0.02	0.02
DDE ( <i>p,p</i> )	1.60	0.43	1.23	2.98	1.88	2.42
DDT ( <i>o,p</i> )	<0.04	0.05	nd (<0.02)	nd (<0.018)	<0.04	<0.04
DDT ( <i>p,p</i> )	0.05	<0.05	0.07	0.07	0.06	<0.04
dieldrin	0.04	0.12	0.009	0.05	0.05	0.05
endrin	nd (<0.017)	nd (<0.02)	nd (<0.02)	nd (<0.018)	nd (<0.019)	nd (<0.017)
hexachlorobenzene	0.02	0.04	0.04	0.06	0.012	0.012
hexachlorobutadiene	0.04	<0.03	0.04	<0.03	0.03	0.03
<i>cis</i> -heptachlorepoxyde ( $\alpha$ )	<0.006	0.008	0.02	0.02	0.03	0.02
$\alpha$ -HCH	0.03	0.03	0.014	0.03	0.02	0.011
$\beta$ -HCH	0.014	0.02	0.04	0.010	0.02	0.05
$\delta$ -HCH	0.012	0.03	0.02	0.03	0.06	0.02
$\gamma$ -HCH	0.04	0.02	0.03	0.03	0.010	0.02
heptachlor	0.02	nd (<0.0018)	<0.004	0.02	0.007	<0.004
oxychlordane	0.03	nd (<0.0032)	0.07	0.02	0.02	0.009
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	0.04	nd (<0.0052)	nd (<0.0052)	nd (<0.0047)	0.07	<0.011
DDD ( <i>o,p'</i> )	<0.007	0.09	0.02	nd (<0.0031)	0.008	0.03
DDD ( <i>p,p</i> )	0.008	0.009	0.42	0.011	0.18	0.63
<i>trans</i> -nonachlor	0.02	0.09	0.11	0.07	0.06	0.07
aldrin	<0.007	0.03	<0.008	0.03	<0.007	0.012

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Bantry Bay Inner*	Blacksod Bay	Carlingford Inner Stn I*	Castletownbere	Clarinbridge / Kinvara Bay	Clew Bay North
MI Reference	ENV/14/1218	ENV/14/1195	ENV/14/1194	ENV/14/1186	ENV/14/1226	ENV/14/1214
Date	25/11/14	20/11/14	18/11/14	12/11/14	27/11/14	25/11/14
Latitude (N)	51° 41.29'	54° 10.54'	54° 04.14'	51° 39.14'	53° 12.57'	53° 51.55'
Longitude (W)	09° 27.56'	09° 57.06'	06° 14.06'	09° 50.23'	08° 55.13'	09° 38.16'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>
Number of Individuals	50	23	50	50	25	50
Method of Cultivation	rope	trestle	bed	rope	intertidal	rope
<b>Shellfish</b>						
Length range (mm)	47.39 - 59.97	82.99 - 156	44.52 - 55.56	46.06 - 59.44	72.26 - 136	41.83 - 55.53
Mean length (mm)	54.6	116	50.5	53.8	100	48.1
Length stdev (mm)	3.34	19.5	2.85	3.68	16.4	2.99
Shell weight (%)	53.3	91.2	85.1	56.0	79.8	61.2
Meat weight (%)	46.7	8.80	14.9	44.0	20.2	38.8
Moisture (%)	78.9	84.3	84.5	80.2	85.6	79
Total Lipids (%)	2.22	3.40	1.57	2.04	2.32	1.78
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	37.7	16.7	50.8	30.8	6.00	92.4
Arsenic	1.65	4.54	1.78	1.57	1.27	2.07
Cadmium	0.06	0.35	0.11	0.06	0.10	0.05
Chromium	0.11	0.14	0.28	0.10	0.06	0.25
Cobalt	0.04	0.04	0.08	0.04	0.02	0.05
Copper	0.88	16.8	0.81	0.85	3.13	0.99
Iron	35.0	59.9	60.2	27.4	19.5	79.3
Lead	0.09	0.06	0.49	0.12	0.04	0.10
Manganese	2.32	4.35	1.88	1.89	2.65	2.36
Mercury	0.010	0.03	0.02	0.010	0.010	0.010
Nickel	0.10	0.09	0.22	0.09	0.04	0.19
Selenium	0.60	0.54	0.32	0.56	0.28	0.52
Silver	0.010	0.72	0.010	0.010	0.13	0.010
Vanadium	0.16	0.22	0.19	0.17	0.04	0.28
Zinc	11.6	595	13.5	13.4	89.6	10.7
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	<0.005	0.007	<0.005	0.008	<0.005	0.005
CB28	0.006	0.005	0.007	0.009	0.009	0.007
CB31	<0.005	0.005	0.007	0.008	0.009	0.007
CB44	0.04	0.03	0.17	0.02	<0.005	0.04
CB52	0.03	0.013	0.05	0.02	0.02	0.04
CB101	0.17	0.04	0.22	0.12	0.05	0.09
CB105	0.03	0.03	0.07	0.006	0.009	0.05
CB118	0.08	0.07	0.25	0.11	0.03	0.05
CB138	0.35	0.12	0.55	0.25	0.13	0.12
CB149	0.31	0.07	0.25	0.16	0.04	0.12
CB153	0.63	0.19	0.72	0.38	0.16	0.25
CB156	0.03	0.007	0.02	0.04	0.04	0.006
CB170	0.014	0.014	0.013	0.013	0.010	0.02
CB180	0.02	0.008	0.03	0.012	0.008	0.03
CB194	0.02	nd (<0.0013)	0.005	0.02	0.006	0.04
CB209	0.012	0.010	0.008	0.009	0.02	0.02
EFSA sum of 6 CBs <sup>1</sup>	1.21	0.38	1.58	0.79	0.38	0.54
ICES sum of 7 CBs <sup>2</sup>	1.29	0.45	1.83	0.90	0.41	0.59

Shellfish Water Station	Bantry Bay Inner*	Blacksod Bay	Carlingford Inner Stn I*	Castletownbere	Clarinbridge / Kinvara Bay	Clew Bay North
MI Reference	ENV/14/1218	ENV/14/1195	ENV/14/1194	ENV/14/1186	ENV/14/1226	ENV/14/1214
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.03	0.03	0.02	0.007	0.03	0.20
BDE47	0.15	0.03	0.10	0.11	0.67	0.13
BDE99	0.02	0.014	0.02	0.04	0.04	0.03
BDE100	0.02	0.03	<0.02	0.03	0.02	0.08
BDE153	nd (<0.011)	<0.03	<0.03	nd (<0.011)	nd (<0.011)	<0.03
BDE154	0.010	0.013	0.012	0.013	0.011	0.009
BDE183	0.03	<0.02	0.02	0.03	<0.02	0.014
Sum of 6 PBDEs <sup>3</sup>	0.27	0.17	0.22	0.24	0.80	0.49
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	nd (<0.002)	0.05	0.02	0.007	0.02	0.02
DDE ( <i>o,p</i> )	0.013	0.004	0.013	0.04	0.006	0.03
DDE ( <i>p,p</i> )	0.74	1.08	1.48	0.47	2.27	0.22
DDT ( <i>o,p</i> )	<0.05	nd (<0.019)	<0.04	<0.05	nd (<0.021)	nd (<0.019)
DDT ( <i>p,p</i> )	0.06	0.06	0.04	0.07	<0.05	0.08
dieldrin	0.04	0.08	0.06	nd (<0.0027)	0.02	0.008
endrin	nd (<0.02)	nd (<0.019)	nd (<0.018)	nd (<0.021)	nd (<0.021)	nd (<0.019)
hexachlorobenzene	0.06	0.03	0.05	0.07	0.05	0.04
hexachlorobutadiene	0.04	<0.03	0.03	nd (<0.0054)	0.06	<0.03
<i>cis</i> -heptachlorepoxide( $\alpha$ )	0.012	0.007	0.02	0.02	0.02	0.012
$\alpha$ -HCH	0.05	0.04	0.013	0.02	0.03	0.04
$\beta$ -HCH	0.04	0.02	0.04	0.03	0.04	0.02
$\delta$ -HCH	0.02	0.012	0.02	0.013	0.03	0.04
$\gamma$ -HCH	0.02	<0.006	<0.006	0.02	0.02	0.02
heptachlor	0.008	0.04	0.05	0.008	<0.004	0.02
oxychlordane	0.05	nd (<0.0031)	0.009	0.02	0.02	0.06
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	nd (<0.0053)	nd (<0.005)	<0.011	nd (<0.0054)	0.07	0.011
DDD ( <i>o p'</i> )	0.009	<0.008	0.06	0.03	0.011	0.06
DDD ( <i>p,p</i> )	0.27	0.22	0.42	0.16	0.02	0.20
<i>trans</i> -nonachlor	0.06	0.06	0.03	0.10	0.12	0.15
aldrin	<0.008	<0.008	0.011	0.02	0.02	nd (<0.0033)

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Clew Bay South	Cork Great Island N Channel	Cromane	Donegal Bay (Laghey Ch)	Donegal Bay Mountcharles (Wild)	Drumcliff
MI Reference	ENV/14/1215	ENV/14/1203	ENV/14/1220	ENV/14/1229	ENV/14/1230	ENV/14/1201
Date	24/11/14	24/11/14	25/11/14	26/11/14	26/11/14	24/11/14
Latitude (N)	53° 47.37'	51° 53.05'	52° 08.79'	54° 37.34'	54° 37.56'	54° 20.23'
Longitude (W)	09° 37.32'	08° 14.30'	09° 54.21'	08° 08.11'	08° 10.31'	08° 33.41'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	50	50	25	50	25
Method of Cultivation	trestle	intertidal	bed	trestle	intertidal	trestle
<b>Shellfish</b>						
Length range (mm)	82.22 - 122	44.85 - 57.51	42.95 - 59.25	81.91 - 115	49.05 - 73.13	91.93 - 136
Mean length (mm)	102	50.3	53.4	94.8	62.0	112
Length stdev (mm)	9.74	3.11	3.46	8.43	5.77	11.2
Shell weight (%)	89.0	78.1	70.4	84.7	81.0	82.4
Meat weight (%)	11.0	21.9	29.6	15.3	19.0	17.6
Moisture (%)	87.3	76.2	80.5	80.8	84.4	85.6
Total Lipids (%)	1.03	3.32	1.82	4.06	1.25	2.19
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	1.39	45.8	68.4			10.3
Arsenic	1.46	1.65	1.22	1.81	1.57	1.50
Cadmium	0.20	0.06	0.08	0.17	0.09	0.10
Chromium	0.05	0.21	0.25	0.06	0.22	0.06
Cobalt	0.02	0.05	0.06	0.03	0.07	0.02
Copper	6.38	1.30	0.78	5.46	0.56	4.53
Iron	23.8	50.2	84.8	38.4	68.4	26.4
Lead	0.03	0.35	0.09	0.03	0.11	0.05
Manganese	3.89	1.61	2.88	3.57	2.50	4.25
Mercury	0.02	0.02	0.010	0.010	0.02	0.010
Nickel	0.08	0.13	0.16	0.07	0.15	0.05
Selenium	0.29	0.37	0.36	0.35	0.27	0.32
Silver	0.38	0.010	0.010	0.17	0.004	0.18
Vanadium	0.10	0.14	0.22	0.13	0.18	0.09
Zinc	154	12.1	10.2	140	11.6	124
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	0.005	0.007	<0.005	0.006	<0.005	0.008
CB28	0.012	0.005	nd (<0.0015)	0.009	0.011	0.005
CB31	<0.004	0.008	0.006	0.007	<0.005	<0.004
CB44	0.006	0.28	<0.005	0.02	0.008	0.02
CB52	0.008	0.19	0.03	0.02	0.02	0.05
CB101	0.02	0.48	0.12	0.11	0.05	0.07
CB105	0.010	0.14	0.013	0.02	0.04	0.08
CB118	0.03	0.48	0.05	0.05	0.05	0.06
CB138	0.04	0.87	0.19	0.24	0.15	0.10
CB149	0.02	0.45	0.15	0.09	0.05	0.07
CB153	0.06	1.09	0.27	0.19	0.18	0.19
CB156	0.007	0.04	0.02	0.011	0.08	0.02
CB170	0.02	0.03	0.03	0.02	0.013	0.009
CB180	0.02	0.07	0.02	0.03	0.008	0.02
CB194	0.009	<0.005	0.007	0.02	<0.005	<0.004
CB209	0.008	0.006	0.012	0.013	0.011	0.012
EFSA sum of 6 CBs <sup>1</sup>	0.16	2.71	0.63	0.60	0.42	0.44
ICES sum of 7 CBs <sup>2</sup>	0.19	3.19	0.68	0.65	0.47	0.50

Shellfish Water Station	Clew Bay South	Cork Great Island N Channel	Cromane	Donegal Bay (Laghey Ch)	Donegal Bay Mountcharles (Wild)	Drumcliff
MI Reference	ENV/14/1215	ENV/14/1203	ENV/14/1220	ENV/14/1229	ENV/14/1230	ENV/14/1201
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.02	0.04	0.04	0.02	0.02	0.04
BDE47	0.04	0.20	0.21	0.19	0.12	0.10
BDE99	0.02	0.04	0.02	0.03	0.03	0.03
BDE100	0.02	0.02	0.03	0.02	0.03	0.02
BDE153	nd (<0.0093)	<0.03	nd (<0.011)	nd (<0.01)	nd (<0.0096)	nd (<0.0081)
BDE154	0.013	0.008	0.02	0.009	0.011	0.02
BDE183	0.02	nd (<0.0051)	<0.02	<0.02	0.02	0.02
Sum of 6 PBDEs <sup>3</sup>	0.14	0.34	0.35	0.30	0.24	0.24
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
cis-chlordane ( $\alpha$ -chlordane)	<0.004	0.02	<0.005	0.006	0.13	<0.003
DDE ( <i>o,p</i> )	0.010	0.006	0.04	<0.004	0.04	0.02
DDE ( <i>p,p</i> )	2.13	1.97	0.74	2.32	1.16	0.12
DDT ( <i>o,p</i> )	<0.04	<0.04	0.07	0.07	nd (<0.018)	0.04
DDT ( <i>p,p</i> )	<0.04	nd (<0.017)	0.08	<0.04	<0.04	<0.04
dieldrin	0.05	0.13	0.05	0.04	0.04	0.04
endrin	nd (<0.017)	nd (<0.017)	nd (<0.021)	nd (<0.019)	nd (<0.018)	nd (<0.015)
hexachlorobenzene	0.009	0.08	0.10	0.02	0.27	0.07
hexachlorobutadiene	<0.03	nd (<0.0045)	<0.03	<0.03	0.04	0.04
cis-heptachlorepoxyde( $\alpha$ )	0.007	0.02	<0.008	0.008	nd (<0.0029)	0.007
$\alpha$ -HCH	0.007	0.07	0.02	0.04	0.04	0.013
$\beta$ -HCH	0.02	<0.009	0.09	0.04	0.02	0.07
$\delta$ -HCH	0.014	0.06	0.03	0.02	0.06	nd (<0.0015)
$\gamma$ -HCH	0.006	0.02	0.02	0.06	0.04	0.008
heptachlor	<0.004	0.009	0.012	0.02	0.02	0.02
oxychlordane	<0.006	0.02	0.04	0.02	0.14	0.10
trans-chlordane ( $\gamma$ -chlordane)	nd (<0.0045)	0.02	0.02	<0.011	nd (<0.0046)	<0.009
DDD ( <i>o p'</i> )	<0.007	0.06	0.03	0.04	0.04	0.03
DDD ( <i>p,p</i> )	0.03	0.46	0.010	0.95	0.07	0.03
trans-nonachlor	0.07	0.06	0.16	0.15	0.12	0.10
aldrin	nd (<0.0029)	<0.007	0.02	0.04	0.03	0.02

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Dunglow	Dunmanus Inner	Glengarriff Harbour	Gweebarra Bay*	Gweedore Bay	Kenmare R. Sneem/Ardgroom
MI Reference	ENV/14/1198	ENV/14/1209	ENV/14/1181	ENV/14/1196	ENV/14/1197	ENV/14/1179
Date	12/11/14	24/11/14	11/11/14	12/11/14	12/11/14	10/11/14
Latitude	54° 56.34'	51° 36.22'	51° 43.49'	54° 50.41'	55° 02.68'	51° 52.6'
Longitude	08° 24.11'	09° 33.19'	09° 32.56'	08° 23.21'	08° 19.37'	09° 39.60'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	25	50	50	25	25	25
Method of Cultivation	intertidal	rope	rope	intertidal	intertidal	intertidal
<b>Shellfish</b>						
Length range (mm)	102 - 129	45.72 - 58.96	44.13 - 59.98	96 - 144	76.75 - 129	90.26 - 124
Mean length (mm)	113	55.0	53.7	118	103	107
Length stdev (mm)	6.92	3.39	4.32	10.7	12.5	10.9
Shell weight (%)	91.2	56.0	58.0	89.7	88.8	85.4
Meat weight (%)	8.80	44.0	42.0	10.3	11.2	14.6
Moisture (%)	85.4	81.6	79.4	82.1	83.1	86.7
Total Lipids (%)	2.05	1.86	2.35	3.16	3.63	1.98
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	5.30	46.3	16.3	10.9	12.6	12.1
Arsenic	2.78	1.44	1.52	2.41	1.70	1.07
Cadmium	0.16	0.05	0.07	0.30	0.17	0.16
Chromium	0.09	0.14	0.07	0.07	0.05	0.05
Cobalt	0.03	0.05	0.03	0.03	0.02	0.02
Copper	6.15	0.83	0.88	3.72	4.78	6.53
Iron	40.0	43.8	18.0	34.2	33.3	29.5
Lead	0.06	0.08	0.05	0.04	0.04	0.03
Manganese	2.35	3.31	1.64	4.98	2.79	3.69
Mercury	0.03	0.010	0.010	0.02	0.02	0.02
Nickel	0.08	0.13	0.08	0.06	0.06	0.05
Selenium	0.40	0.44	0.58	0.44	0.33	0.26
Silver	0.33	0.010	0.010	0.19	0.27	0.16
Vanadium	0.13	0.20	0.14	0.12	0.09	0.08
Zinc	187	11.8	13.0	113	202	138
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	nd (<0.0013)	<0.005	0.007	0.006	0.007	0.006
CB28	<0.005	0.007	0.008	<0.005	0.007	0.012
CB31	<0.005	0.006	0.006	<0.005	0.011	0.007
CB44	0.006	0.05	0.02	0.006	0.02	<0.005
CB52	0.006	0.02	0.011	0.013	0.006	0.05
CB101	0.03	0.05	0.13	0.04	0.09	0.09
CB105	0.03	0.02	0.05	0.012	0.16	0.03
CB118	0.06	0.11	0.05	0.06	0.12	0.09
CB138	0.14	0.12	0.29	0.08	0.13	0.12
CB149	0.03	0.07	0.24	0.06	0.02	0.08
CB153	0.18	0.17	0.53	0.20	0.31	0.21
CB156	0.008	0.02	0.08	0.011	0.04	0.04
CB170	0.009	0.02	0.09	0.02	0.03	0.012
CB180	0.006	0.011	0.06	0.02	0.07	0.03
CB194	<0.005	0.03	0.03	<0.005	0.011	0.02
CB209	0.02	0.008	0.02	0.02	<0.005	0.013
EFSA sum of 6 CBs <sup>1</sup>	0.37	0.38	1.03	0.36	0.61	0.51
ICES sum of 7 CBs <sup>2</sup>	0.43	0.49	1.08	0.42	0.73	0.60



Shellfish Water Station	Dunglow	Dunmanus Inner	Glengarriff Harbour	Gweebarra Bay*	Gweedore Bay	Kenmare R. Sneem/Ardgroom
MI Reference	ENV/14/1198	ENV/14/1209	ENV/14/1181	ENV/14/1196	ENV/14/1197	ENV/14/1179
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.04	0.03	0.05	0.14	0.05	0.02
BDE47	0.04	0.06	0.03	0.04	0.22	0.07
BDE99	0.03	0.02	0.014	0.08	0.03	0.013
BDE100	<0.02	0.04	<0.02	<0.02	0.03	0.02
BDE153	<0.03	nd (<0.011)	nd (<0.01)	<0.03	<0.03	<0.03
BDE154	0.013	0.03	0.011	0.06	0.02	0.02
BDE183	<0.02	nd (<0.006)	nd (<0.0056)	0.02	nd (<0.0059)	<0.02
Sum of 6 PBDEs <sup>3</sup>	0.19	0.20	0.14	0.39	0.39	0.19
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
cis-chlordane ( $\alpha$ -chlordane)	0.02	0.014	0.010	0.014	<0.005	0.006
DDE ( <i>o,p</i> )	0.007	0.009	0.03	0.06	0.04	0.010
DDE ( <i>p,p</i> )	1.65	0.52	0.49	1.54	0.06	3.22
DDT ( <i>o,p</i> )	<0.04	nd (<0.021)	0.08	<0.05	0.06	<0.05
DDT ( <i>p,p</i> )	<0.04	<0.05	nd (<0.019)	<0.05	<0.05	nd (<0.02)
dieldrin	0.03	0.011	0.02	0.03	0.05	<0.006
endrin	nd (<0.018)	nd (<0.021)	nd (<0.019)	nd (<0.02)	nd (<0.02)	nd (<0.02)
hexachlorobenzene	nd (<0.0013)	0.12	0.05	0.04	0.04	0.03
hexachlorobutadiene	<0.03	<0.03	<0.03	<0.03	<0.03	0.04
cis-heptachlorepoxide( $\alpha$ )	<0.007	0.03	0.02	0.011	<0.008	<0.008
$\alpha$ -HCH	0.005	0.008	0.03	0.02	<0.004	0.02
$\beta$ -HCH	0.014	0.03	<0.010	nd (<0.0045)	0.02	0.02
$\delta$ -HCH	0.03	0.011	0.05	0.03	0.03	0.02
$\gamma$ -HCH	0.02	0.03	0.05	0.04	0.03	0.02
heptachlor	nd (<0.0016)	0.02	0.011	0.03	<0.004	0.02
oxychlordane	0.02	<0.008	0.008	0.05	nd (<0.0033)	0.05
trans-chlordane ( $\gamma$ -chlordane)	nd (<0.0047)	nd (<0.0054)	<0.012	0.04	nd (<0.0053)	nd (<0.0053)
DDD ( <i>o p'</i> )	0.02	0.06	0.03	0.03	0.07	0.02
DDD ( <i>p,p</i> )	0.014	0.02	0.24	0.42	0.02	0.04
trans-nonachlor	0.08	0.10	0.14	0.15	0.17	<0.003
aldrin	0.013	nd (<0.0035)	nd (<0.0033)	0.02	<0.008	0.02

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Kilkieran Bay	Killala Bay*	Killary	Kilmakilloge Harbour	Kinsale	League Point*
MI Reference	ENV/14/1180	ENV/14/1227	ENV/14/1191	ENV/14/1210	ENV/14/1206	ENV/14/1219
Date	11/11/14	27/11/14	18/11/14	24/11/14	24/11/14	25/11/14
Latitude (N)	53° 15.52'	54° 12.40'	53° 35.86'	51° 46.12'	51° 42.00'	51° 39.30'
Longitude (W)	09° 43.44'	09° 11.29'	09° 46.42'	09° 49.12'	08° 32.77'	09° 33.14'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>
Number of Individuals	50	25	50	50	21	50
Method of Cultivation	rope	intertidal	rope	rope	trestle	rope
<b>Shellfish</b>						
Length range (mm)	41.36 - 57.36	83.3 - 127	45.26 - 59.65	42.43 - 52.78	74.95 - 121	40.31 - 55.36
Mean length (mm)	49.7	98.6	52.3	48.0	98.0	47.2
Length stdev (mm)	3.72	11.0	3.53	2.82	10.4	3.93
Shell weight (%)	61.1	90.5	62.7	62.7	83.2	59.1
Meat weight (%)	38.9	9.50	37.3	37.3	16.8	40.9
Moisture (%)	80.5	84.3	79.9	80.3	83.5	81.8
Total Lipids (%)	2.10	2.54	2.18	2.10	3.16	1.61
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	25.9		17.7	26.0	21.1	68.5
Arsenic	2.11	1.45	1.52	1.53	1.47	1.44
Cadmium	0.05	0.25	0.06	0.07	0.17	0.08
Chromium	0.12	0.10	0.12	0.09	0.07	0.12
Cobalt	0.03	0.03	0.03	0.03	0.03	0.05
Copper	0.95	4.75	0.92	0.75	10.6	0.77
Iron	24.1	56.4	37.9	28.2	36.7	34.8
Lead	0.10	0.07	0.05	0.07	0.06	0.12
Manganese	1.12	2.96	1.82	2.42	3.76	2.34
Mercury	0.010	0.010	0.010	0.010	0.010	<0.007
Nickel	0.09	0.10	0.10	0.08	0.07	0.12
Selenium	0.48	0.40	0.34	0.55	0.35	0.60
Silver	0.010	0.29	0.010	0.010	0.34	0.04
Vanadium	0.15	0.15	0.21	0.09	0.07	0.20
Zinc	12.9	163	12.3	11.2	107	12.8
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	0.012	<0.005	0.013	0.011	0.02	0.010
CB28	0.007	0.009	<0.005	0.008	0.006	<0.005
CB31	0.008	<0.005	0.008	0.006	0.02	<0.005
CB44	0.05	0.013	0.014	0.02	0.07	0.006
CB52	0.04	0.04	0.006	0.02	0.05	0.008
CB101	0.08	0.06	0.05	0.05	0.18	0.08
CB105	0.02	<0.005	0.11	0.02	0.03	0.012
CB118	0.04	0.11	0.07	0.07	0.16	0.05
CB138	0.15	0.11	0.08	0.11	0.19	0.20
CB149	0.08	0.07	0.04	0.06	0.17	0.13
CB153	0.24	0.20	0.16	0.17	0.39	0.33
CB156	0.04	<0.005	0.02	0.03	0.06	0.014
CB170	0.007	0.03	0.02	0.04	0.014	0.02
CB180	0.05	0.010	0.03	0.03	0.04	0.013
CB194	0.03	0.02	0.02	0.03	0.04	<0.005
CB209	0.02	<0.005	0.02	0.02	0.013	<0.005
EFSA sum of 6 CBs <sup>1</sup>	0.57	0.43	0.33	0.39	0.86	0.64
ICES sum of 7 CBs <sup>2</sup>	0.61	0.54	0.40	0.46	1.02	0.69

Shellfish Water Station	Kilkieran Bay	Killala Bay*	Killary	Kilmakilloge Harbour	Kinsale	League Point*
MI Reference	ENV/14/1180	ENV/14/1227	ENV/14/1191	ENV/14/1210	ENV/14/1206	ENV/14/1219
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.02	0.04	0.02	0.02	0.04	0.011
BDE47	0.07	0.23	0.05	0.09	0.25	0.02
BDE99	0.02	0.04	0.014	0.02	0.05	0.014
BDE100	0.02	0.03	<0.02	0.03	<0.02	0.02
BDE153	<0.03	nd (<0.011)	nd (<0.011)	nd (<0.011)	nd (<0.01)	<0.03
BDE154	<0.006	0.02	<0.006	<0.006	0.012	0.012
BDE183	nd (<0.0058)	0.04	nd (<0.0059)	nd (<0.006)	0.03	nd (<0.0051)
Sum of 6 PBDEs <sup>3</sup>	0.17	0.41	0.13	0.18	0.41	0.11
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	<0.005	0.04	0.008	0.04	0.06	<0.004
DDE ( <i>o,p</i> )	0.02	0.04	<0.004	0.006	0.004	0.004
DDE ( <i>p,p</i> )	1.14	3.34	0.44	0.33	2.35	0.37
DDT ( <i>o,p</i> )	<0.05	<0.05	<0.05	nd (<0.021)	0.39	<0.04
DDT ( <i>p,p</i> )	<0.05	0.07	<0.05	nd (<0.021)	nd (<0.019)	<0.04
dieldrin	0.03	0.04	0.02	0.04	0.11	0.04
endrin	nd (<0.02)	nd (<0.02)	nd (<0.02)	nd (<0.021)	nd (<0.019)	nd (<0.017)
hexachlorobenzene	0.11	0.05	0.05	0.08	0.02	0.04
hexachlorobutadiene	<0.03	0.04	<0.03	nd (<0.0054)	<0.03	0.04
<i>cis</i> -heptachlorepoxyde( $\alpha$ )	0.011	0.02	0.04	0.03	0.04	0.012
$\alpha$ -HCH	0.04	0.02	0.04	0.02	0.05	0.04
$\beta$ -HCH	0.04	0.03	0.05	0.03	<0.010	0.05
$\delta$ -HCH	0.03	0.03	0.09	0.03	0.04	0.02
$\gamma$ -HCH	0.008	0.04	0.02	0.05	0.04	0.011
heptachlor	0.007	0.006	<0.004	0.02	0.02	<0.004
oxychlordane	nd (<0.0032)	0.07	0.03	0.02	0.05	0.009
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	nd (<0.0052)	0.06	<0.012	0.07	0.03	<0.011
DDD ( <i>o p'</i> )	0.03	0.04	0.15	0.03	<0.008	0.008
DDD ( <i>p,p</i> )	0.02	0.03	0.02	0.012	0.15	0.08
<i>trans</i> -nonachlor	0.17	0.13	0.13	0.10	0.12	0.05
aldrin	0.02	0.012	0.03	0.02	<0.008	0.011

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Lough Swilly	Loughras Beg*	Maharees*	Maharees*	Mannin Bay	McSwynes Bay	Mulroy Bay
MI Reference	ENV/14/1224	ENV/14/1199	ENV/14/1170	ENV/14/1171	ENV/14/1236	ENV/14/1228	ENV/14/1225
Date	26/11/14	12/11/14	05/11/14	05/11/14	04/12/14	27/11/14	26/11/14
Latitude (N)	55° 03.88'	54° 45.38'	52° 16.31'	52° 16.98'	53° 27.48'	54° 37.22'	55° 09.61'
Longitude (W)	07° 34.29'	08° 26.66'	10° 0.44'	09° 59.26'	10° 02.75'	08° 23.29'	07° 41.11'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Ostrea edulis</i>	<i>Ostrea edulis</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>
Number of Individuals	25	25	25	25	25	50	50
Method of Cultivation	trestle	intertidal	bed	bed	intertidal	rope	rope
<b>Shellfish</b>							
Length range (mm)	86.3 - 127	81.9 - 135	70.8 - 90.6	74.45 - 89.5	70.3 - 88.4	40.7 - 50.4	47.5 - 59.9
Mean length (mm)	106	106	78.5	81.3	81.0	45.1	53.1
Length stdev (mm)	10.5	12.8	5.03	3.71	4.82	2.65	3.09
Shell weight (%)	84.4	91.0	90.0	88.6	88.4	73.6	66.0
Meat weight (%)	15.6	9.00	10.0	11.4	11.6	26.4	34.0
Moisture (%)	83	82.4	81	79.7	87.9	80.9	81.4
Total Lipids (%)	2.87	3.74	1.87	2.17	1.21	2.13	2.19
<b>Metals mg kg<sup>-1</sup> (ppm)</b>							
Aluminium	30.6	18.9	17.0	15.0			18.0
Arsenic	1.49	2.07	1.42	1.37	2.16	1.85	1.28
Cadmium	0.16	0.20	0.48	0.45	0.15	0.08	0.04
Chromium	0.10	0.12	0.07	0.06	0.06	0.12	0.08
Cobalt	0.03	0.04	0.03	0.03	0.02	0.05	0.05
Copper	8.45	6.94	18.6	20.0	5.80	0.86	0.80
Iron	42.5	61.1	33.1	28.2	28.8	72.5	37.0
Lead	0.04	0.05	0.03	0.03	0.04	0.07	0.05
Manganese	7.82	5.32	3.58	2.64	1.92	2.24	3.49
Mercury	0.010	0.02	0.02	0.02	0.02	0.010	0.010
Nickel	0.09	0.08	0.06	0.05	0.07	0.14	0.08
Selenium	0.29	0.35	0.47	0.46	0.27	0.47	0.48
Silver	0.39	0.23	0.46	0.53	0.26	0.010	0.010
Vanadium	0.13	0.15	0.14	0.12	0.07	0.24	0.16
Zinc	117	215	353	292	188	18.3	10.1
<b>PCB µg kg<sup>-1</sup> (ppb)</b>							
CB18	0.005	0.008	0.010	0.008	<0.005	0.012	0.004
CB28	nd (<0.0013)	<0.005	0.011	0.02	<0.005	<0.005	0.007
CB31	0.006	0.007	0.02	0.014	0.006	<0.005	<0.004
CB44	0.05	0.03	0.009	0.014	0.007	0.04	0.005
CB52	0.04	0.03	0.05	0.011	0.02	0.04	0.03
CB101	0.12	0.06	0.28	0.08	0.04	0.08	0.10
CB105	0.11	0.09	0.03	0.011	0.05	0.008	0.02
CB118	0.06	0.10	0.16	0.06	0.05	0.08	0.06
CB138	0.13	0.11	0.43	0.12	0.09	0.13	0.13
CB149	0.13	0.11	0.40	0.08	0.07	0.10	0.09
CB153	0.24	0.25	0.62	0.26	0.13	0.22	0.23
CB156	0.03	0.05	0.03	0.011	0.02	0.06	0.02
CB170	0.006	0.03	0.04	0.013	0.03	0.03	0.04
CB180	0.008	0.03	0.04	0.02	0.04	0.02	0.011
CB194	0.02	0.008	0.006	0.007	0.02	0.03	0.006
CB209	0.010	0.008	0.04	0.009	0.008	0.007	0.007
EFSA sum of 6 CBs <sup>1</sup>	0.54	0.49	1.43	0.51	0.33	0.50	0.51
ICES sum of 7 CBs <sup>2</sup>	0.60	0.59	1.59	0.57	0.38	0.58	0.57

Shellfish Water Station	Lough Swilly	Loughras Beg*	Maharees*	Maharees*	Mannin Bay	McSwynes Bay	Mulroy Bay
MI Reference	ENV/14/1224	ENV/14/1199	ENV/14/1170	ENV/14/1171	ENV/14/1236	ENV/14/1228	ENV/14/1225
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>							
BDE28	0.11	0.02	0.07	0.02	0.04	0.013	0.03
BDE47	0.84	0.85	0.23	0.32	0.45	0.20	0.08
BDE99	0.04	0.03	0.011	0.02	0.04	0.03	0.04
BDE100	0.03	0.07	0.03	0.05	0.03	<0.02	0.02
BDE153	nd (<0.0099)	<0.03	<0.03	nd (<0.01)	<0.03	nd (<0.011)	nd (<0.0087)
BDE154	0.011	0.02	0.02	0.06	0.02	0.012	0.02
BDE183	0.02	0.02	0.02	0.07	<0.02	0.02	0.03
Sum of 6 PBDEs <sup>3</sup>	1.06	1.04	0.41	0.55	0.63	0.31	0.23
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>							
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	0.04	0.007	0.02	0.010	0.007	0.09	0.013
DDE ( <i>o,p</i> )	0.05	0.02	0.03	0.03	0.011	0.06	0.02
DDE ( <i>p,p</i> )	0.36	3.84	4.19	2.95	0.03	0.94	0.53
DDT ( <i>o,p</i> )	<0.04	nd (<0.021)	0.05	0.05	<0.05	0.05	0.07
DDT ( <i>p,p</i> )	<0.04	<0.05	0.20	0.05	<0.05	0.09	0.06
dieldrin	0.009	0.04	0.03	0.008	<0.006	0.03	0.02
endrin	nd (<0.018)	nd (<0.021)	nd (<0.02)	nd (<0.019)	nd (<0.02)	nd (<0.02)	nd (<0.016)
hexachlorobenzene	0.03	0.05	0.03	0.03	0.02	0.05	0.07
hexachlorobutadiene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.02
<i>cis</i> -heptachlorepoxide( $\alpha$ )	0.011	<0.008	0.03	0.010	0.009	0.03	0.02
$\alpha$ -HCH	0.011	0.03	0.06	0.04	0.011	0.03	0.02
$\beta$ -HCH	0.12	0.09	0.02	0.03	0.013	0.04	0.02
$\delta$ -HCH	0.02	0.03	<0.005	0.03	0.03	0.011	0.02
$\gamma$ -HCH	0.02	0.02	0.02	0.02	0.04	0.02	0.15
heptachlor	0.03	0.006	0.006	0.03	0.03	0.03	0.02
oxychlordane	0.03	nd (<0.0033)	0.05	0.06	0.03	0.02	0.05
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	0.03	<0.013	<0.012	<0.012	<0.012	0.05	nd (<0.0042)
DDD ( <i>o,p'</i> )	0.04	0.02	0.013	0.03	0.02	0.08	0.03
DDD ( <i>p,p</i> )	0.011	0.79	0.38	0.04	0.07	0.24	0.06
<i>trans</i> -nonachlor	0.11	0.11	0.09	0.09	0.12	0.13	0.12
aldrin	0.02	<0.008	0.06	0.014	0.02	0.03	0.02

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Oyster Haven	Roaringwater Bay	Rostellan South*	Sligo Bay	Streamstown Bay*	Trawbreaga Bay
MI Reference	ENV/14/1202	ENV/14/1185	ENV/14/1204	ENV/14/1207	ENV/14/1211	ENV/14/1193
Date	24/11/14	12/11/14	24/11/14	24/11/14	24/11/14	20/11/14
Latitude (N)	51° 42.0'	52° 19.64'	51° 50.57'	54° 17.32'	53° 31.17'	55° 17.43'
Longitude (W)	08° 27.60'	06° 25.66'	08° 11.38'	08° 32.03'	10° 07.05'	07° 17.11'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA
Species Sampled	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>	<i>Mytilus edulis</i>	<i>Venerupis philippinarum</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>
Number of Individuals	23	50	50	50	35	19
Method of Cultivation	trestle	rope	intertidal	bed	intertidal	trestle
<b>Shellfish</b>						
Length range (mm)	48.12 - 140	43.33 - 55.36	44.83 - 59.88	40 - 47.27	59.45 - 82.56	95.24 - 128
Mean length (mm)	96.3	48.6	53.3	42.1	69.6	110
Length stdev (mm)	20.2	2.60	4.39	1.93	6.37	8.67
Shell weight (%)	83.7	64.7	72.2	77.4	85.7	85.4
Meat weight (%)	16.3	35.3	27.8	22.6	14.3	14.6
Moisture (%)	83.6	81.9	81.6	87.6	86.5	83.1
Total Lipids (%)	3.01	1.70	2.51	0.94	1.71	3.47
<b>Metals mg kg<sup>-1</sup> (ppm)</b>						
Aluminium	29.4	49.1	198	20.4	14.3	14.3
Arsenic	1.52	1.40	1.51	1.26	1.83	2.09
Cadmium	0.10	0.05	0.06	0.02	0.10	0.17
Chromium	0.18	0.15	0.50	0.15	0.05	0.08
Cobalt	0.03	0.04	0.09	0.09	0.02	0.03
Copper	4.72	0.84	1.03	0.55	2.04	10.8
Iron	41.2	43.9	154	40.5	28.8	33.4
Lead	0.11	0.12	0.55	0.04	0.05	0.04
Manganese	3.40	2.74	5.60	0.89	2.12	1.94
Mercury	0.010	0.010	0.02	0.010	0.010	0.010
Nickel	0.07	0.13	0.25	0.55	0.07	0.06
Selenium	0.33	0.53	0.34	0.33	0.25	0.25
Silver	0.13	0.010	0.010	0.13	0.11	0.35
Vanadium	0.10	0.16	0.39	0.11	0.08	0.11
Zinc	98.3	12.3	13.4	12.0	93.7	181
<b>PCB µg kg<sup>-1</sup> (ppb)</b>						
CB18	0.02	0.02	0.009	0.02	<0.005	<0.005
CB28	<0.005	0.008	0.03	0.02	0.006	0.008
CB31	<0.005	0.006	0.007	0.006	<0.005	0.011
CB44	0.05	0.03	0.25	0.17	<0.005	0.02
CB52	0.04	0.02	0.16	0.19	0.012	0.05
CB101	0.13	0.09	0.39	0.34	0.02	0.06
CB105	0.010	0.15	0.06	0.04	0.005	0.013
CB118	0.13	0.06	0.29	0.14	0.04	0.11
CB138	0.22	0.20	0.57	0.38	0.05	0.14
CB149	0.16	0.12	0.41	0.40	0.03	0.11
CB153	0.43	0.34	0.91	0.61	0.13	0.26
CB156	0.02	0.05	0.02	0.05	0.006	0.02
CB170	0.014	0.011	0.006	0.03	0.014	0.03
CB180	0.05	<0.005	0.04	0.05	0.009	0.012
CB194	0.02	0.012	0.03	0.02	nd (<0.0013)	0.014
CB209	0.011	0.02	0.008	0.02	0.009	0.03
EFSA sum of 6 CBs <sup>1</sup>	0.88	0.66	2.10	1.59	0.23	0.53
ICES sum of 7 CBs <sup>2</sup>	1.01	0.72	2.39	1.73	0.27	0.64

Shellfish Water Station	Oyster Haven	Roaringwater Bay	Rostellan South*	Sligo Bay	Streamstown Bay*	Trawbreaga Bay
MI Reference	ENV/14/1202	ENV/14/1185	ENV/14/1204	ENV/14/1207	ENV/14/1211	ENV/14/1193
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
BDE28	0.21	0.02	0.09	0.03	0.02	0.07
BDE47	0.10	0.13	0.15	0.57	0.02	0.19
BDE99	0.02	0.03	0.03	0.03	0.014	0.02
BDE100	0.05	<0.02	0.04	0.03	<0.02	0.03
BDE153	<0.03	nd (<0.011)	<0.03	<0.03	<0.03	nd (<0.011)
BDE154	0.02	<0.006	0.012	0.02	0.007	<0.006
BDE183	nd (<0.0054)	0.03	<0.02	0.03	nd (<0.0054)	<0.02
Sum of 6 PBDEs <sup>3</sup>	0.44	0.25	0.37	0.74	0.12	0.35
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>						
<i>cis</i> -chlordane ( $\alpha$ -chlordane)	0.11	0.006	0.005	<0.005	0.03	0.007
DDE ( <i>o,p</i> )	0.012	0.02	0.02	0.006	0.006	0.04
DDE ( <i>p,p</i> )	0.49	0.66	0.55	0.48	2.53	3.93
DDT ( <i>o,p</i> )	nd (<0.018)	<0.05	<0.05	<0.05	nd (<0.018)	<0.05
DDT ( <i>p,p</i> )	nd (<0.018)	<0.05	<0.05	nd (<0.02)	<0.04	0.09
dieldrin	0.10	0.02	0.03	0.09	0.05	0.014
endrin	nd (<0.018)	nd (<0.02)	nd (<0.02)	nd (<0.02)	nd (<0.018)	nd (<0.021)
hexachlorobenzene	0.06	0.10	0.09	0.08	0.03	0.06
hexachlorobutadiene	<0.03	0.03	0.05	0.05	0.06	0.05
<i>cis</i> -heptachlorepoxide( $\alpha$ )	nd (<0.003)	0.05	0.04	<0.007	0.007	0.02
$\alpha$ -HCH	0.05	0.02	0.05	0.012	0.02	<0.004
$\beta$ -HCH	0.08	0.04	0.17	0.05	0.06	0.04
$\delta$ -HCH	0.009	0.04	0.06	0.03	0.03	0.02
$\gamma$ -HCH	0.03	0.06	0.05	0.03	0.02	0.03
heptachlor	0.03	0.02	0.02	0.006	0.006	0.012
oxychlordane	0.12	0.05	0.06	<0.007	0.012	0.03
<i>trans</i> -chlordane ( $\gamma$ -chlordane)	0.08	nd (<0.0053)	nd (<0.0052)	0.06	<0.011	0.02
DDD ( <i>o,p'</i> )	0.04	0.04	0.02	0.03	nd (<0.0031)	0.03
DDD ( <i>p,p</i> )	0.27	0.07	0.007	0.007	0.02	1.23
<i>trans</i> -nonachlor	0.11	0.13	0.15	0.08	0.04	0.14
aldrin	0.02	0.04	0.02	0.04	0.012	0.010

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

Shellfish Water Station	Trawenagh Bay	Valentia Hbr	Shannon Ballylongford	Shannon Carrigaholt	Shannon Poulinaherry	Shannon Rinevella	Wexford Hbr Outer
MI Reference	ENV/14/1200	ENV/14/1208	ENV/14/1190	ENV/14/1174	ENV/14/1173	ENV/14/1175	ENV/14/1182
Date	12/11/14	24/11/14	18/11/14	06/11/14	06/11/14	06/11/14	12/11/14
Latitude (N)	54° 53.03'	51° 56.39'	52° 34.26'	52° 35.27'	52° 39.12'	52° 34.90'	52° 19.64'
Longitude (W)	08° 20.20'	10° 15.36'	09° 29.05'	09° 42.15'	09° 33.33'	09° 44.62'	06° 25.66'
Sampled By	SFPA	SFPA	SFPA	SFPA	SFPA	SFPA	MERC Ltd.
Species Sampled	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Crassostrea gigas</i>	<i>Mytilus edulis</i>
Number of Individuals	25	25	21	24	25	22	50
Method of Cultivation	intertidal	trestle	trestle	intertidal	intertidal	intertidal	bed
<b>Shellfish</b>							
Length range (mm)	86.8 - 108	82.07 - 124	78.12 - 129	63.31 - 137	58.8 - 113	87.78 - 129	40.1 - 58.3
Mean length (mm)	98.3	103	108	97.1	85.1	104	43.5
Length stdev (mm)	5.06	11.3	11.0	16.6	13.4	12.1	3.85
Shell weight (%)	83.6	86.9	88.0	88.9	88.8	92.7	65.7
Meat weight (%)	16.4	13.1	12.0	11.1	11.2	7.30	34.3
Moisture (%)	81.4	85.3	83.3	82.5	83	84.3	81.6
Total Lipids (%)	3.06	2.28	2.63	2.43	2.76	2.42	1.68
<b>Metals mg kg<sup>-1</sup> (ppm)</b>							
Aluminium	10.4	13.9	19.2	23.1	26.9	27.5	173
Arsenic	2.57	1.43	1.76	2.06	1.67	2.13	2.00
Cadmium	0.22	0.16	0.24	0.19	0.22	0.19	0.06
Chromium	0.06	0.06	0.06	0.10	0.08	0.11	0.36
Cobalt	0.03	0.02	0.03	0.03	0.03	0.03	0.11
Copper	5.56	8.00	19.8	12.3	13.8	10.9	1.28
Iron	35.2	31.9	27.4	36.8	38.9	43.1	143
Lead	0.05	0.05	0.06	0.08	0.09	0.10	0.51
Manganese	5.51	2.71	2.29	3.92	4.87	3.59	3.83
Mercury	<0.007	<0.007	0.010	0.03	0.03	0.03	0.010
Nickel	0.05	0.07	0.08	0.06	0.08	0.07	0.36
Selenium	0.52	0.27	0.36	0.39	0.48	0.36	0.60
Silver	0.34	0.25	0.36	0.62	0.53	0.58	0.010
Vanadium	0.11	0.08	0.07	0.11	0.11	0.15	0.39
Zinc	156	185	230	250	231	273	16.0
<b>PCB µg kg<sup>-1</sup>(ppb)</b>							
CB18	<0.005	0.007	<0.005	nd (<0.0013)	<0.006	0.02	0.02
CB28	<0.005	0.009	0.005	0.009	0.02	0.006	0.009
CB31	<0.005	0.009	<0.005	0.007	0.02	0.010	0.006
CB44	<0.005	0.04	0.04	0.02	0.008	0.008	0.12
CB52	0.014	0.04	0.03	0.009	0.04	0.02	0.06
CB101	0.05	0.12	0.10	0.06	0.09	0.08	0.17
CB105	0.05	0.15	0.03	0.03	0.012	0.02	0.16
CB118	0.06	0.16	0.10	0.08	0.18	0.07	0.16
CB138	0.04	0.21	0.20	0.14	0.19	0.11	0.34
CB149	0.05	0.23	0.14	0.10	0.15	0.11	0.20
CB153	0.17	0.48	0.36	0.37	0.39	0.33	0.47
CB156	<0.005	0.03	0.006	0.008	0.013	0.03	0.03
CB170	0.02	0.02	0.02	0.03	0.03	0.014	0.02
CB180	0.03	0.03	0.06	0.005	0.02	0.006	0.012
CB194	<0.005	0.006	0.006	0.014	nd (<0.0015)	0.02	0.006
CB209	0.007	0.014	0.007	0.02	0.02	0.02	0.02
EFSA sum of 6 CBs <sup>1</sup>	0.31	0.89	0.76	0.59	0.75	0.55	1.06
ICES sum of 7 CBs <sup>2</sup>	0.37	1.05	0.86	0.67	0.93	0.62	1.22



Shellfish Water Station	Trawenagh Bay	Valentia Harbour	Shannon Ballylongford	Shannon Carrigaholt	Shannon Poulasherry	Shannon Rinevella	Wexford Hbr Outer
MI Reference	ENV/14/1200	ENV/14/1208	ENV/14/1190	ENV/14/1174	ENV/14/1173	ENV/14/1175	ENV/14/1182
<b>PBDEs <math>\mu\text{g kg}^{-1}</math> (ppb)</b>							
BDE28	0.010	0.03	<0.006	0.06	0.03	0.012	0.03
BDE47	0.03	0.37	0.11	0.07	0.08	0.12	0.29
BDE99	0.02	0.04	0.03	0.02	0.03	0.03	0.03
BDE100	<0.02	0.02	0.05	<0.02	0.02	0.02	0.03
BDE153	nd (<0.0098)	nd (<0.011)	nd (<0.01)	<0.03	nd (<0.011)	<0.03	nd (<0.011)
BDE154	0.013	0.02	0.02	0.04	0.012	0.02	0.012
BDE183	0.03	<0.02	nd (<0.0054)	<0.02	0.02	<0.02	<0.02
Sum of 6 PBDEs <sup>3</sup>	0.13	0.51	0.23	0.26	0.20	0.25	0.42
<b>Organochlorine pesticides <math>\mu\text{g kg}^{-1}</math> (ppb)</b>							
cis-chlordane ( $\alpha$ -chlordane)	0.008	0.09	0.005	nd (<0.0018)	0.006	0.02	0.06
DDE ( <i>o,p</i> )	0.03	0.04	0.004	0.007	0.03	0.03	0.05
DDE ( <i>p,p</i> )	1.37	5.13	3.40	1.71	0.05	1.71	0.92
DDT ( <i>o,p</i> )	nd (<0.018)	<0.05	<0.04	nd (<0.018)	<0.05	<0.05	<0.05
DDT ( <i>p,p</i> )	0.06	0.06	<0.04	<0.04	nd (<0.021)	<0.05	0.07
dieldrin	0.011	0.02	0.04	0.008	0.04	0.06	nd (<0.0026)
endrin	nd (<0.018)	nd (<0.02)	nd (<0.019)	nd (<0.018)	nd (<0.021)	nd (<0.02)	nd (<0.02)
hexachlorobenzene	<0.005	0.05	0.03	0.03	0.04	0.009	0.05
hexachlorobutadiene	<0.03	0.03	<0.03	<0.03	0.03	<0.03	0.09
cis-heptachlorepoxyde( $\alpha$ )	<0.007	0.02	0.010	0.02	0.02	0.02	0.03
$\alpha$ -HCH	0.03	0.008	0.02	0.02	0.05	0.012	0.04
$\beta$ -HCH	0.03	0.04	nd (<0.0043)	0.014	0.03	0.03	0.02
$\delta$ -HCH	0.04	0.02	<0.004	0.02	0.05	0.03	0.04
$\gamma$ -HCH	<0.005	0.06	<0.006	0.013	0.08	<0.006	0.011
heptachlor	0.02	0.03	0.012	0.005	0.03	0.02	0.05
oxychlordane	0.009	0.04	0.008	0.02	0.012	0.03	0.04
trans-chlordane ( $\gamma$ -chlordane)	<0.011	0.10	<0.011	nd (<0.0048)	<0.013	nd (<0.0052)	0.03
DDD ( <i>o,p</i> )	0.02	0.07	nd (<0.0032)	<0.007	0.05	0.05	0.02
DDD ( <i>p,p</i> )	0.48	0.03	0.34	0.16	0.03	0.009	0.05
trans-nonachlor	0.06	0.17	0.06	0.06	0.12	0.08	0.18
aldrin	0.02	0.08	0.011	nd (<0.0031)	<0.008	0.02	0.05

<sup>1</sup> Sum of 6 PCB congeners (28, 52, 101, 138, 153, 180) upper bound

<sup>2</sup> Sum of 7 PCB congeners (28, 52, 101, 118, 138, 153, 180) upper bound

<sup>3</sup> Sum of 6 PBDE congeners (28, 47, 99, 100, 153, 154) upper bound

\* sampled outside designated shellfish area but within 0.1km buffer.

blank cell-not analysed

nd: not detected (limit of detection in parenthesis).

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

This section provides an assessment of results with compared with legislative standards for water quality and seafood safety described in Section 2. 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.

A mean pH of  $7.17 \pm 0.27$  was recorded and all pH values were within the mandatory range of “no less than pH 7 nor greater than pH 9” as specified in SI 268 of 2006 and the Directive.

The salinity range of the water column ranged from 0.01 to 34.94 psu with a mean recording of 28.35 psu across the sampled sites. No results reported exceed the upper Guide Value of 38 psu. Individual surface readings at 16 areas 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 these sites were within guide values.

Dissolved oxygen was typically close to full saturation (mean  $108 \pm 14.2\%$ ) and all individual values conformed to the Mandatory Value ( $\geq 70\%$  saturation) and 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 at eleven stations with a max of  $13.7 \mu\text{g l}^{-1}$ , with an additional 9 exceeding the Good/Moderate boundary of  $15 \mu\text{g l}^{-1}$  (max  $29.9 \mu\text{g l}^{-1}$ ).

### **4.2 Parameter 8 Organohalogen**

#### ***Full compliance – no organohalogen values exceeding standards for shellfish***

Due to typically low water solubility and a tendency to accumulate in flesh organohalogen 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 and organochlorine pesticides 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 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 Tables 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 new WFD AA-EQS as set in the WFD Daughter Directive 2013/39/EC.

Relatively high mercury concentrations in seawater of  $0.01 \mu\text{g l}^{-1}$  were recorded in five samples collected in February (Bruckless, Westport Bay, Kinvarra, and Wexford Harbour Inner and Outer). However, these samples were fully compliant with the WFD EQS of  $0.07 \mu\text{g l}^{-1}$ . This reason for the elevated concentrations at these few sites in this particular month is not apparent, but possibly may relate to sampling or analysis artefacts.

**Table 8:** Summary statistics ( $\mu\text{g l}^{-1}$ ) for trace metals in surface water samples collected at designated shellfish waters in 2015. Mean & (Max values in parenthesis)

Shellfish Water Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
M1-Trawbreaga Bay*	1.49 (1.62)	<0.05 (<0.05)	0.26 (0.3)	0.32 (0.44)	<0.10 (<0.10)	0.004 (0.005)	0.26 (0.31)	<0.05 (<0.05)	<1.00 (1.12)
M2-Sheephaven Bay*	1.43 (1.62)	<0.05 (<0.05)	0.3 (0.37)	0.22 (0.26)	0.13 (0.21)	0.001 (0.002)	0.14 (0.14)	<0.05 (<0.05)	<1.00 (<1.00)
E1-Lough Swilly- Inner *	1.33 (1.35)	<0.05 (<0.05)	0.21 (0.28)	0.44 (0.64)	<0.10 (<0.10)	0.002 (0.004)	0.2 (0.2)	<0.05 (<0.05)	<1.00 (<1.00)
M5-Dungloe Bay*	1.32 (1.55)	<0.05 (<0.05)	0.29 (0.31)	0.22 (0.3)	0.11 (0.16)	0.001 (0.001)	0.17 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M6-Trawenagh Bay*	1.21 (1.41)	<0.05 (<0.05)	0.25 (0.26)	0.26 (0.36)	<0.10 (0.15)	0.001 (0.002)	0.17 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M10-Gweedore Bay*	1.58 (1.73)	<0.05 (<0.05)	0.26 (0.28)	0.3 (0.39)	0.15 (0.24)	0.001 (0.001)	0.17 (0.19)	<0.05 (<0.05)	2.53 (4.56)
E3- Gweebarra *	0.97 (0.99)	<0.05 (<0.05)	0.19 (0.26)	0.56 (0.93)	<0.10 (<0.10)	0.004 (0.004)	0.2 (0.21)	<0.05 (<0.05)	<1.00 (<1.00)
M13-Loughras Beg*	1.21 (1.29)	<0.05 (<0.05)	0.24 (0.28)	0.45 (0.57)	0.13 (0.2)	0.001 (0.001)	0.21 (0.21)	<0.05 (<0.05)	<1.00 (1.31)
M14-Donegal Bay*	1.39 (1.57)	<0.05 (<0.05)	0.26 (0.28)	0.6 (0.61)	0.12 (0.19)	0.001 (0.001)	0.35 (0.37)	<0.05 (<0.05)	1.58 (1.73)
E4-Bruckless*	1.33 (1.43)	<0.05 (<0.05)	0.22 (0.29)	0.47 (0.63)	<0.10 (<0.10)	0.007 (0.01)	0.25 (0.31)	<0.05 (<0.05)	<1.00 (<1.00)
M15-Inver Bay*	1.58 (1.67)	<0.05 (<0.05)	0.33 (0.37)	0.56 (0.69)	<0.10 (0.11)	0.001 (0.001)	0.29 (0.39)	<0.05 (<0.05)	<1.00 (1.49)
M19-Drumcliff*	1.57 (1.63)	<0.05 (<0.05)	0.31 (0.33)	0.68 (0.7)	<0.10 (0.11)	0.002 (0.002)	0.39 (0.43)	<0.05 (<0.05)	<1.00 (<1.00)
M20-Sligo Harbour*	1.56 (1.66)	<0.05 (<0.05)	0.33 (0.33)	0.54 (0.64)	<0.10 (<0.10)	0.002 (0.003)	0.3 (0.32)	<0.05 (<0.05)	<1.00 (<1.00)
M23-Killala Bay*	1.49 (1.51)	<0.05 (<0.05)	0.3 (0.31)	0.73 (0.79)	<0.10 (0.11)	0.001 (0.001)	0.38 (0.56)	<0.05 (<0.05)	<1.00 (<1.00)
M24-Blacksod Bay*	1.56 (1.73)	<0.05 (<0.05)	0.29 (0.32)	0.44 (0.52)	<0.10 (0.11)	0.001 (0.002)	0.18 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M25-Achill Sound - North*	1.27 (1.31)	<0.05 (<0.05)	0.28 (0.28)	0.52 (0.67)	<0.10 (<0.10)	0.001 (0.001)	0.19 (0.22)	<0.05 (<0.05)	<1.00 (<1.00)
M26-Achill Sound - South*	1.29 (1.47)	<0.05 (<0.05)	0.28 (0.29)	0.51 (0.61)	<0.10 (<0.10)	0.0009 (0.001)	0.22 (0.24)	<0.05 (<0.05)	<1.00 (1.02)
E5-Clew Bay North*	1.33 (1.39)	<0.05 (<0.05)	0.2 (0.25)	0.47 (0.74)	<0.10 (<0.10)	0.004 (0.004)	0.22 (0.22)	<0.05 (<0.05)	<1.00 (<1.00)
E6- Clew Bay South*	1.48 (1.57)	<0.05 (<0.05)	0.21 (0.29)	0.42 (0.66)	<0.10 (<0.10)	0.009 (0.01)	0.34 (0.35)	<0.05 (<0.05)	<1.00 (<1.00)

Shellfish Water Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
E7-Killary Hbr. Inner*	1.09 (1.18)	<0.05 (<0.05)	0.19 (0.24)	0.43 (0.7)	<0.10 (<0.10)	0.004 (0.004)	0.34 (0.34)	<0.05 (<0.05)	<1.00 (<1.00)
M29-Ballinakill Bay*	1.39 (1.39)	<0.05 (<0.05)	0.31 (0.34)	0.53 (0.65)	<0.10 (<0.10)	0.0008 (0.0009)	0.24 (0.3)	<0.05 (<0.05)	<1.00 (<1.00)
M30-Streamstown*	1.48 (1.5)	<0.05 (<0.05)	0.31 (0.32)	0.52 (0.61)	<0.10 (<0.10)	0.0007 (0.001)	0.21 (0.25)	<0.05 (<0.05)	1.24 (1.98)
M31-Ardbear Bay*	1.35 (1.48)	<0.05 (<0.05)	0.25 (0.27)	0.57 (0.7)	<0.10 (<0.10)	0.001 (0.001)	0.19 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M32-Mannin Bay*	1.78 (1.9)	<0.05 (<0.05)	0.31 (0.32)	0.42 (0.49)	<0.10 (<0.10)	0.0008 (0.001)	0.18 (0.2)	<0.05 (<0.05)	<1.00 (<1.00)
M35-Galway Bay Outer/Indreabhan*	1.52 (1.58)	<0.05 (<0.05)	0.35 (0.35)	0.51 (0.68)	<0.10 (<0.10)	0.001 (0.001)	0.18 (0.19)	<0.05 (<0.05)	<1.00 (1.29)
E8-Kinvara*	1 (1.27)	<0.05 (<0.05)	0.23 (0.3)	0.54 (0.56)	<0.10 (<0.10)	0.009 (0.01)	0.36 (0.52)	<0.05 (<0.05)	<1.00 (<1.00)
M37Ballyvaughan Poulnaclogh *	1.37 (1.39)	<0.05 (<0.05)	0.32 (0.32)	0.64 (0.76)	<0.10 (<0.10)	0.003 (0.005)	0.25 (0.25)	<0.05 (<0.05)	<1.00 (<1.00)
M38-Aughinish *	1.29 (1.39)	<0.05 (<0.05)	0.3 (0.31)	0.66 (0.78)	0.12 (0.19)	0.003 (0.005)	0.24 (0.27)	<0.05 (<0.05)	<1.00 (1.13)
M39-Poulnasherry*	1.6 (1.73)	<0.05 (<0.05)	0.32 (0.36)	1.02 (1.11)	<0.10 (<0.10)	0.003 (0.005)	0.61 (0.88)	<0.05 (<0.05)	<1.00 (1.46)
M41-Rinevella*	1.67 (1.95)	<0.05 (<0.05)	0.31 (0.31)	0.76 (0.8)	<0.10 (<0.10)	0.003 (0.004)	0.37 (0.46)	<0.05 (<0.05)	<1.00 (1.21)
M42-Carrigaholt*	1.56 (1.77)	<0.05 (<0.05)	0.28 (0.31)	0.8 (0.89)	<0.10 (<0.10)	0.003 (0.005)	0.4 (0.49)	<0.05 (<0.05)	1.04 (1.58)
M43-Ballylongford*	1.52 (1.73)	<0.05 (<0.05)	0.28 (0.29)	0.77 (0.84)	<0.10 (<0.10)	0.001 (0.001)	0.44 (0.58)	<0.05 (<0.05)	<1.00 (<1.00)
M47-Tralea Bay Inner*	1.47 (1.47)	<0.05 (<0.05)	0.31 (0.32)	0.58 (0.68)	<0.10 (<0.10)	0.001 (0.001)	0.27 (0.34)	<0.05 (<0.05)	<1.00 (<1.00)
M48-Maharees*	1.77 (1.91)	<0.05 (<0.05)	0.31 (0.32)	0.47 (0.63)	<0.10 (<0.10)	0.0007 (0.0009)	0.23 (0.27)	<0.05 (<0.05)	<1.00 (<1.00)
M50-Cromane*	1.03 (1.28)	<0.05 (<0.05)	0.24 (0.27)	0.75 (0.95)	<0.10 (<0.10)	0.002 (0.003)	0.33 (0.49)	<0.05 (<0.05)	<1.00 (<1.00)
E10-Kilmakillogue*	1.25 (1.43)	<0.05 (<0.05)	0.25 (0.25)	0.33 (0.39)	<0.10 (<0.10)	0.002 (0.004)	0.15 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M56-Sneem / Ardgroom*	1.39 (1.4)	<0.05 (<0.05)	0.29 (0.3)	0.52 (0.63)	<0.10 (<0.10)	0.003 (0.004)	0.17 (0.2)	<0.05 (<0.05)	<1.00 (<1.00)
M58-Adrigole Harbour*	1.25 (1.45)	<0.05 (<0.05)	0.28 (0.33)	0.56 (0.6)	<0.10 (<0.10)	0.003 (0.005)	0.2 (0.21)	<0.05 (<0.05)	<1.00 (<1.00)
M59-Glengariff*	1.31 (1.38)	<0.05 (<0.05)	0.28 (0.3)	0.62 (0.8)	<0.10 (<0.10)	0.003 (0.004)	0.21 (0.22)	<0.05 (<0.05)	<1.00 (<1.00)

Shellfish Water Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
M60-Bantry Bay Inner*	1.24 (1.34)	<0.05 (<0.05)	0.29 (0.3)	0.57 (0.63)	<0.10 (<0.10)	0.003 (0.005)	0.23 (0.3)	<0.05 (<0.05)	<1.00 (<1.00)
M61-Bantry Bay South*	1.31 (1.42)	<0.05 (<0.05)	0.35 (0.35)	0.35 (0.44)	<0.10 (<0.10)	0.003 (0.005)	0.14 (0.14)	<0.05 (<0.05)	<1.00 (<1.00)
M62-League Point*	1.41 (1.43)	<0.05 (<0.05)	0.33 (0.37)	0.52 (0.66)	<0.10 (<0.10)	0.003 (0.004)	0.18 (0.19)	<0.05 (<0.05)	<1.00 (<1.00)
M63-Dunmanus Bay Inner*	1.47 (1.51)	<0.05 (<0.05)	0.33 (0.36)	0.49 (0.62)	<0.10 (<0.10)	0.003 (0.005)	0.18 (0.2)	<0.05 (<0.05)	<1.00 (<1.00)
E12-Roaringwater Bay Inner*	1.31 (1.52)	<0.05 (<0.05)	0.22 (0.22)	0.46 (0.77)	<0.10 (<0.10)	0.001 (0.001)	0.14 (0.17)	<0.05 (<0.05)	<1.00 (<1.00)
E13-Baltimore Harbour / Sherkin*	1.26 (1.56)	<0.05 (<0.05)	0.21 (0.23)	0.76 (1.05)	<0.10 (<0.10)	0.002 (0.002)	0.24 (0.29)	<0.05 (<0.05)	<1.00 (<1.00)
E14-Kinsale*	1.08 (1.36)	<0.05 (<0.05)	0.16 (0.19)	0.88 (1.23)	<0.10 (<0.10)	0.003 (0.004)	0.35 (0.39)	<0.05 (<0.05)	<1.00 (<1.00)
M67-Oysterhaven*	1.38 (1.38)	<0.05 (<0.05)	0.29 (0.32)	1 (1.23)	<0.10 (<0.10)	0.003 (0.004)	0.67 (1)	<0.05 (<0.05)	<1.00 (1.29)
M72-Rostellan North*	1.32 (1.47)	<0.05 (<0.05)	0.29 (0.3)	0.84 (0.89)	<0.10 (<0.10)	0.003 (0.005)	0.28 (0.39)	<0.05 (<0.05)	<1.00 (<1.00)
M73-Rostellan West*	1.47 (1.48)	<0.05 (<0.05)	0.28 (0.3)	0.91 (0.91)	<0.10 (<0.10)	0.003 (0.004)	0.3 (0.39)	<0.05 (<0.05)	<1.00 (1.15)
M74-Ballymacoda*	1.43 (1.44)	<0.05 (<0.05)	0.3 (0.31)	0.5 (0.67)	<0.10 (<0.10)	0.003 (0.005)	0.2 (0.23)	<0.05 (<0.05)	<1.00 (<1.00)
M77-Dungarvan Bay*	1.49 (1.5)	<0.05 (<0.05)	0.31 (0.34)	0.57 (0.75)	<0.10 (<0.10)	0.002 (0.004)	0.21 (0.21)	<0.05 (<0.05)	<1.00 (<1.00)
M81-Bannow Bay*	1.41 (1.45)	<0.05 (<0.05)	0.31 (0.33)	0.75 (0.83)	<0.10 (<0.10)	0.003 (0.004)	0.47 (0.54)	<0.05 (<0.05)	<1.00 (<1.00)
M82-Barrow Suir Nore Est*	1.31 (1.34)	<0.05 (<0.05)	0.18 (0.2)	0.66 (1.02)	<0.10 (<0.10)	0.002 (0.003)	0.36 (0.4)	<0.05 (<0.05)	1.13 (1.2)
E17-Wexford Harbour Outer*	1.46 (1.61)	<0.05 (<0.05)	0.15 (0.18)	0.56 (0.86)	<0.10 (<0.10)	0.007 (0.01)	0.26 (0.26)	<0.05 (<0.05)	<1.00 (<1.00)
E18-Wexford Harbour Inner*	1.58 (1.9)	<0.05 (<0.05)	0.21 (0.29)	1.19 (1.42)	<0.10 (<0.10)	0.005 (0.01)	0.62 (1.01)	<0.05 (<0.05)	1.53 (3.58)
M100-Carlingford Inner Stn 2*	1.62 (1.63)	<0.05 (<0.05)	0.26 (0.26)	0.78 (0.81)	<0.10 (<0.10)	0.003 (0.004)	0.33 (0.4)	<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

**Full compliance – no trace metals values exceeding standards in mussels, oysters or clams.**

One elevated nickel concentration was determined in the one cockle sample collected.

**Table 9:** Summary statistics (mg kg<sup>-1</sup> wet wt) for trace metals in bivalve molluscs collected at SWs in 2014

Parameter	Species	S.I 268/2006 mandatory standard	1881/2006/EC maximum limit	Min	Max	Mean	Median	Stdev	n
<b>Arsenic</b>	Blue mussels	6		1.22	2.11	1.63	1.57	0.25	20
	Oysters (Pacific and native)			1.07	4.54	1.89	1.81	0.64	33
	Clams			1.26	1.83	1.55	1.55	0.40	2
	Cockles			0.79	0.79	0.79	0.79	0	1
<b>Cadmium</b>	Blue mussels	1	1	0.04	0.11	0.07	0.06	0.02	20
	Oysters (Pacific and native)			0.09	0.35	0.18	0.17	0.06	33
	Clams			0.02	0.02	0.02	0.02	0	2
	Cockles			0.06	0.06	0.06	0.06	0	1
<b>Chromium*</b>	Blue mussels	1.2		0.07	0.50	0.18	0.13	0.11	20
	Oysters (Pacific and native)			0.05	0.18	0.08	0.08	0.03	33
	Clams			0.15	0.16	0.16	0.16	0.01	2
	Cockles			0.33	0.33	0.33	0.33	0	1
<b>Copper</b>	Blue mussels	80		0.56	1.30	0.90	0.87	0.17	20
	Oysters (Pacific and native)			2.0	19.8	7.6	6.4	4.1	33
	Clams			0.55	1.59	1.07	1.07	0.74	2
	Cockles			0.46	0.46	0.46	0.46	0	1
<b>Lead</b>	Blue mussels	1.5	1.5	0.05	0.55	0.17	0.10	0.16	20
	Oysters (Pacific and native)			0.03	0.11	0.06	0.05	0.02	33
	Clams			0.04	0.10	0.07	0.07	0.04	2
	Cockles			0.15	0.15	0.15	0.15	0	1
<b>Mercury</b>	Blue mussels	0.2	0.5	<0.007	0.02	0.01	0.01	0.00	20
	Oysters (Pacific and native)			0.01	0.03	0.02	0.01	0.01	33
	Clams			0.01	0.01	0.01	0.01	0	2
	Cockles			0.01	0.01	0.01	0.01	0	1
<b>Nickel</b>	Blue mussels	1		0.08	0.36	0.14	0.13	0.07	20
	Oysters (Pacific and native)			0.04	0.10	0.07	0.07	0.01	33
	Clams			0.05	0.55	0.30	0.30	0.35	2
	Cockles			2.86	2.86	2.86	2.86	0	1
<b>Silver</b>	Blue mussels	3		0.004	0.04	0.01	0.01	0.01	20
	Oysters (Pacific and native)			0.11	0.72	0.31	0.29	0.15	33
	Clams			0.13	0.18	0.16	0.16	0.04	2
	Cockles			0.06	0.06	0.06	0.06	0	1
<b>Zinc</b>	Blue mussels	800		10.1	18.3	12.9	12.6	2.05	20
	Oysters (Pacific and native)			89.6	595	188	176	93.1	33
	Clams			12.0	14.4	13.2	13.2	1.70	2
	Cockles			7.38	7.38	7.38	7.38	0	1

Arsenic, chromium, cadmium, copper, lead, silver 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. Nickel was compliant in all mussel, oyster and clam samples with the exception of the one cockle sample at Annagasan ( $2.86 \text{ mg kg}^{-1} \text{ ww}$ ). This was over a magnitude higher than the mean concentration in the other samples analysed. Elevated nickel concentration in cockles has been seen to be species specific (Savedra et al. 2004)<sup>3</sup>.

## **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). Concentrations of the sum of 6 marker PCB (range  $0.16 - 2.71 \text{ } \mu\text{g kg}^{-1} \text{ ww}$ ,  $n = 56$ ) in bivalve molluscs reported were over an order of magnitude below the maximum permissible limit of  $75 \text{ } \mu\text{g kg}^{-1} \text{ ww}$ , set for these substances in seafood for all samples and even two orders of magnitude lower for many SWs.

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<sup>3</sup> Savedra Y., González A., Fernández P. and Blanco J. (2004). Interspecific Variation of Metal Concentrations in Three Bivalve Mollusks from Galicia. Arch. Environ. Contam. and Toxicol., 47, 341-351



## 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 EPA<sup>4</sup>. 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 A1:** 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

<sup>4</sup> 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 HNO<sub>3</sub> 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 (HNO<sub>3</sub>) 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 (HNO<sub>3</sub>) 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 <sup>-1</sup>	LOQ µg/l <sup>-1</sup>	Analytical Laboratory	Method of Analysis
Arsenic	0.023	0.05	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Cadmium	0.004	0.05	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Chromium	0.015	0.05	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Copper	0.021	0.10	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Silver	0.002	0.05	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Lead	0.004	0.10	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Mercury	2×10 <sup>-4</sup>	5×10 <sup>-4</sup>	MI, Galway	SOP CHE-I68 – Mercury in Marine Waters by CV-AFS
Nickel	0.019	0.05	MI, Galway	SOP CHE-I69 – Metals by ICPMS
Zinc	0.13	1.00	MI, Galway	SOP CHE-I69 – Metals by ICPMS

Note: All methods accredited with the exception of Mercury in Marine Waters

## 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°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

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

## Polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), polybrominated diphenyl ethers (PBDEs)

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, and PBDEs was performed using an Agilent 6890 gas chromatograph (GC) coupled to a 5973N mass spectrometric detector (MSD) run in splitless mode with a 50m SGE HT8 column (0.25mm ID, 0.22mm film thickness) 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 ( $\text{mg kg}^{-1}$  wet weight) and test method details

Metal	Test Method	LOD
Arsenic	CHE-178 Metals in Marine Biota by ICPMS	0.001
Cadmium	CHE-178 Metals in Marine Biota by ICPMS	0.001
Chromium	CHE-178 Metals in Marine Biota by ICPMS	0.008
Copper	CHE-178 Metals in Marine Biota by ICPMS	0.006
Lead	CHE-178 Metals in Marine Biota by ICPMS	0.007
Mercury	CHE-32 Mercury in Marine Biota	0.002
Nickel	CHE-178 Metals in Marine Biota by ICPMS	0.009
Silver	CHE-178 Metals in Marine Biota by ICPMS	0.0003
Zinc	CHE-178 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.