Chemical Contaminant Sampling and Analysis of Shellfish from Classified Harvesting Areas (2012)

Report to the Food Standards Agency in Scotland

July 2012




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Date:	June 2012
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Sponsor's Project Number:	CEFAS MOU C5674
FERA Contract Number:	P6LW
FERA File Reference:	FLN 9201
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Glossary of Main Terms

Term or Acronym	General Meaning Of Term
EU	European Union
EC	European Commission
FSAS	Food Standards Agency in Scotland
WHO	World Health Organisation
PAHs	Polycyclic aromatic hydrocarbons
PAH 4 Sum	Sum of 4 PAHs (benzo[*a*]pyrene, benz[a]anthracene, benzo[b]fluoranthene, chrysene)
PCB	Polychlorinated biphenyl
Ortho-PCB	Ortho-substituted PCB (non planar)
Non-ortho-PCB	Non-ortho-substituted PCB (co-planar)
Dioxins	Collective name for chlorinated Dioxins & Furans
PCDD/F	Polychlorinated dibenzo-*p*-dioxin/ polychlorinated dibenzofuran
TEF	Toxic Equivalency Factor – toxicity expressed for each dioxin-like compound as a fraction of 2,3,7,8-TCDD (2,3,7,8-TCDD = 1).
TEQ	Toxic Equivalence – product of the congener concentration and the TEF
Total TEQ	Total of the Sum of all the Toxic Equivalences (TEQs) for each group of compounds
Sum of ICES 6	Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180
fat weight	Values relevant to the assessed fat content of the sample
whole weight	Values based on the sample as received 'whole' or wet
WHO-TEQ 2005	World Health Organisation - TEQ based on values as set in 2005
LOD	Limit of Detection
LOQ	Limit of Quantification
lower	assumes values at less than the limit of detection are zero (e.g.<0.01=0)
upper	assumes values at less than the limit of detection are equal to the limit of detection (e.g. <0.07=0.07)
Trace Element	An element in a sample that has an average concentration of less than 100 parts per million (less than 100 mg/kg)
Heavy Metals	A loosely defined subset of elements that exhibit metallic properties (some are toxic, some are a nutritional requirement in small amounts), (This survey includes, Cr, Mn, Co, Ni, Cu, Zn, As, Se, Ag, Cd, Hg & Pb, (Chromium, manganese, cobalt, nickel, copper, zinc, arsenic, selenium, silver, cadmium, mercury and lead)
ng/kg	Nanogram per kilogram (x10-9/ part per trillion)
µg/kg	Microgram per kilogram (x 10-6/ part per billion)
mg/kg	Milligram per kilogram (x 10-3/ part per million)
ICP-MS	Inductively coupled plasma-mass spectrometry
HRGC-HRMS	High resolution gas chromatography - high resolution mass spectrometry
HRGC-LRMS	High resolution gas chromatography – unit resolution mass spectrometry

Executive Summary

This study carried out on shellfish from Scottish classified harvesting areas, fulfils part of the requirements of EU member states (EU Regulations (EC) No.1881/2006 and (EC) No. 854/2004) to adopt appropriate monitoring measures and carry out compliance checks on shellfish produced for human consumption. Marine shellfish bio-accumulate environmental contaminants because of their inability to metabolise these during feeding. The study determines concentrations of regulated environmental contaminants in the flesh of edible species with a view to determine current levels of occurrence and to allow estimation of consumer exposure.

The study analysed 19 composite samples of shellfish including mussels, pacific oysters, cockles and razor clams, for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs, dioxins), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and heavy metals. The methodologies used for the analyses were UKAS accredited to the ISO 17025 standard and follow EU commission regulations for data quality criteria.

In general terms the results of the 2012 monitoring study for PCDD/Fs and PCBs, PAHs and heavy metals, are broadly consistent with the data generated for earlier years. In the case of PCDD/Fs and PCBs in particular, contaminant concentrations were all below the regulatory maximum levels (Regulation (EU) No. 1259/2011), and are thus unlikely to pose a risk to public health. The highest observed level of the currently regulated PAH, benzo[a]pyrene at 0.44 µg /kg was well below the MPL of 10 µg/kg (Regulation (EC) No. 208/2005). Similarly, the concentrations of the regulated heavy metals, Mercury, Cadmium and Lead (Commission Regulation (EC) No. 1881/2006 as amended) were below the set maximum limits.

The data contained in this report has also been issued as individual test reports for each of the relevant shellfish producing area local authorities.

1. Study Background

Marine shellfish are an excellent source of protein and are high in essential minerals, and low in calories and fat. In many parts of the UK and in Scotland in particular, the shellfish industry makes a significant contribution to the local economy. Shellfish have a recognised potential for bio-accumulating contaminants and some bivalve species such as mussels, are commonly used as early indicators of local pollution. Bivalves feed by filtering plankton from the surrounding water that washes through their habitat. This feeding mechanism leads to the bio-accumulation of pollutants of anthropogenic and biogenic origin such as of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), heavy metals (trace elements) and polycyclic aromatic hydrocarbons (PAHs) from the surrounding waters. The bio-accumulation potential of the shellfish species used for food is particularly relevant in the case of environmental contaminants with long half-lives such as chlorinated dioxins and PCBs. These contaminants have been the subject of a number of studies (1-4) relating to the occurrence and bio-accumulation in marine species and the resulting potential for human exposure arising from the consumption of the edible species.

In recognising the requirements of food safety, the EU has for a number of years, defined regulation for the control of these contaminants in a range of foods including shellfish. (Commission Regulation (EC) No 1259/2011, Commission Regulation (EU) No 835/2011, Commission Regulation (EC) No 333/2007). Some of the regulations specify new requirements on the controls expected by the competent authority (Food Standards Agency) with respect to classified shellfish production areas. EU member states are required to adopt appropriate monitoring measures and carry out compliance checks with regard to the occurrence of these contaminants in shellfish produced for human consumption.

PCDD/Fs and PCBs are recognised environmental and food contaminants that are known to bio-accumulate in fish and shellfish. The extent of this accumulation is evident by the levels of these contaminants detected in various studies. In the UK Total Diet Studies (TDS) (FSA 2003) carried out over the last 2 decades, fish (including shellfish) has consistently been one of the highest dioxin and PCB containing food groups. Human dietary exposure can therefore be significantly influenced by the fish and shellfish component of the diet, particularly in high level consumers and low body-weight individuals.

Although metabolised in many fish species, PAHs persist in shellfish as filter feeding species appear unable to effect bio-transformation of these contaminants. Other than this bio-accumulation pathway, PAHs can also arise through some methods of processing fish and shellfish – e.g. smoked fish are known to contain elevated levels of PAHs. Some PAH compounds have been shown to be genotoxic and carcinogenic, the most studied of which (benzo[a]pyrene, or B[a]P) is regulated in a range of foods including shellfish, within the EU (SCF Opinion 2002, Commission Regulation (EC) No. 208/2005). However, more recent evaluation by EFSA's CONTAM panel, concluded that a set of 4 compounds, namely benzo[*a*]pyrene, chrysene, benz[*a*]anthracene and benzo[*b*]fluoranthene (collectively referred to as PAH4) were more suitable indicators of PAH toxicity in food (EFSA, 2008). So in addition to maximum levels for benzo[*a*]pyrene, maximum levels for the sum these 4 compounds were therefore included in the updated Commission Regulation (EC) No. 835/2011, which will come into force from September 2012. In a study on bivalve molluscs including mussels, oysters and scallops, the FSA reported positive detection of most PAH compounds in samples taken in England and Wales (FSA 2005). However in comparison to a study carried out about a decade earlier, reported levels were significantly lower and no sample showed levels above the 10 µg/kg EU limit for B[a]P in shellfish.

Some trace elements and in particular, heavy metals are established toxic contaminants. Some elements, such as copper, chromium, selenium and zinc are essential to health but may be toxic at high levels of exposure. Metals and other elements may enter marine and aquatic environments and bio-accumulate in species at any point during growth and harvesting. Some potentially toxic elements occur naturally as part of the local geology, but others may also be found in the location of certain industries, as a result of unauthorised discharge, or as a result of other anthropogenic activity.

As part of its monitoring requirements in support of EU regulations, the FSA in Scotland has overseen the collection of shellfish each year, from classified shellfish sites within relevant local authority areas in Scotland. The production sites are required to have shellfish samples monitored, with the edible tissues analysed for the contaminants described above, as specified in Commission Regulation (EC) No. 1881/2006 or as amended. The analysis is carried out at the Food and Environment Research Agency (FERA) in York.

FERA is an executive agency of the UK Government's Department for Environment, Food and Rural affairs (DEFRA). It is the UK's leading centre of independent research into food safety, sustainable food chains and a healthy natural environment. Located at a purpose built facility in York, supporting state of the art laboratories and infrastructure, FERA has extensive experience in analytical chemistry and the provision of robust data for policy and decision making (by

government and industry). In the current context, FERA has generated environmental contaminant data to FSA Scotland, on shellfish collected from new and existing shellfish sites since 2007. Recently, FERA has also been involved in nutritional studies of Scottish food through the provision of trace element data.

This report collates the results of the individual analyses for dioxins, PAHs and heavy metals in samples of shellfish collected from Scottish sites in the first quarter of 2012.

2. Methodology

2.1 Sample Collection and Preparation

19 samples (individual subsamples from each site were composited) of shellfish including, common mussels, common cockles, pacific oysters and razor clams were collected during March 2012. Sampling is generally timed to coincide with the period of optimal contaminant concentrations in the shellfish.

Details on the locations, with descriptions of the samples and identification are given in Table 1. The broad geographical distribution of Scottish shellfish production areas is given in Figure 1.

On receipt at the laboratory each sample was given a unique laboratory reference number and the sample details were logged into a database. The samples were stored frozen prior to analysis. Sample preparation consisted of shelling followed by compositing of individual sub-samples. The composites were thoroughly homogenised and aliquots taken for PAH and heavy metal analysis, prior to freeze-drying. Freeze-dried sample powders were re-homogenised and aliquots used for dioxin and PCB analysis.

2.2 Contaminants measured – Specific Analytes

The following analytes were determined: Regulated contaminants are highlighted in **bold.**

Dioxins - all 17, 2378-Cl substituted PCDDs and PCDFs.

Dioxin-like PCBs - IUPAC numbers 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189.

Non Dioxin-like PCBs - IUPAC numbers 18, **28**, 31, 47, 49, 51, **52**, 99, **101**, 128, **138**, **153** and **180**. (The **ICES-6** PCBs that are included in current regulation are highlighted in bold)

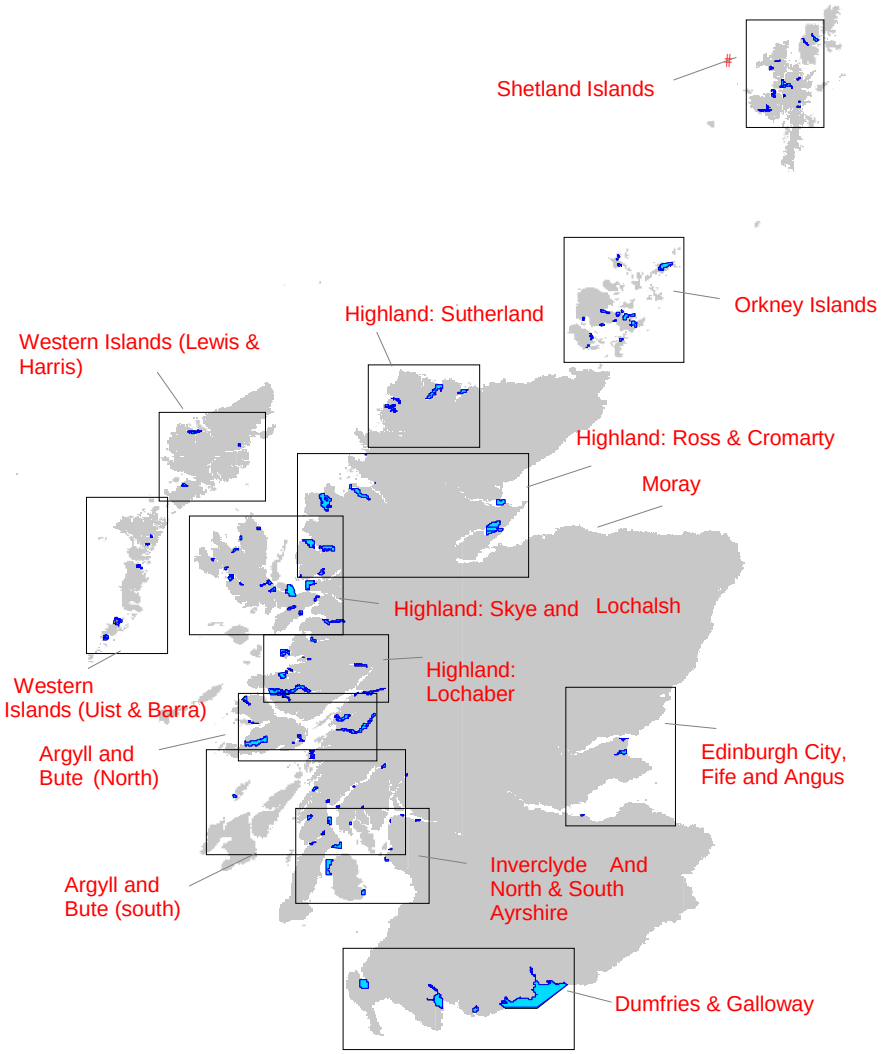
PAHs - The 15 EFSA prioritised compounds and the JECFA recommended inclusion of benzo[*c*]fluorene are indicated in a larger font, and the 4 PAH compounds of legislative interest are shown in bold.

acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, benzo[c]fluorene, pyrene, benzo[e]pyrene, benzo[b]naptho[2,1-d]thiophene, anthanthrene, coronene, benzo[ghi]fluoranthene, **benz[a]anthracene**, **chrysene**, **benzo[b]fluoranthene**, benzo[j]fluoranthene, benzo[k]fluoranthene, **benzo[a]pyrene**, cyclopenta[c,d]pyrene, indeno[123cd]pyrene, dibenzo[ah]anthracene, benzo[ghi]perylene, dibenzo[al]pyrene, dibenzo[ae]pyrene, dibenzo[ai]pyrene, dibenzo[ah]pyrene and the substituted PAH, 5-methylchrysene.

Heavy Metals – Chromium (Cr), Manganese (Mn), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Selenium (Se), Silver (Ag), **Cadmium** (**Cd), Mercury (Hg), Lead (Pb)**

Figure 1: Shellfish Production Areas that have been monitored since 2006

(Not all tested in each year or in 2012 Samples)



2.3 PCDD/F and PCB - Analytical Methodology

(FERA (UK NRL) SOPs FSG 453-460)

The method used for the preparation, extraction and analysis of samples has been reported previously (Fernandes et al 2004) and is part of the CEN prEN 16215 standard. In brief, samples were fortified with ^{13}C-labelled analogues of target compounds and exhaustively extracted using mixed organic solvents. Ortho substituted PCBs were separated from non-ortho substituted PCBs and PCDD/Fs by fractionation on activated carbon. The two fractions were further purified using adsorption chromatography on alumina. Analytical measurement was carried out using high resolution gas chromatography-high resolution mass spectrometry (HRGC-HRMS) for the seventeen, 2,3,7,8-Cl substituted PCDD/F congeners and non-ortho substituted PCBs. High resolution gas chromatography-unit resolution mass spectrometry (HRGC-LRMS) was used for the measurement of the ortho substituted PCBs.

All analyses were UKAS accredited to ISO 17025 standards, with the inclusion of reference material and method blanks which were evaluated prior to reporting. Further quality assurance measures included the successful participation in international inter-comparison exercises such as FAPAS, Dioxins in Food-2009 and Dioxins in Food-2010, on dioxins and dioxin-like PCBs. Additionally, quality control evaluation for the accompanying data follows the criteria specified for chlorinated dioxins and PCBs (Commission Directive 2002/69/EC and amendments)

2.4 Polycyclic Aromatic Hydrocarbons (PAH) - Analytical Methodology

(FERA (UK NRL) SOP FSG 410)

The analytical methodology for the PAHs has been reported before (Rose et al, 2007) and is based on internal standardisation with GC-MS measurement. An aliquot of the homogenised sample was fortified with ^{13}C-labelled analogues of target compounds and saponified with methanolic potassium hydroxide. The extracted PAH solutions were purified in two stages with a DMF/cyclohexane partition followed by adsorption chromatography on activated silica. Purified extracts were sensitivity standardised and measured using high resolution gas chromatography-unit resolution mass spectrometry.

The analytical procedure for PAHs is UKAS accredited to the ISO 17025 standard and includes the assessment of method blanks and reference materials, (e.g. CRM458, PAHs in spiked coconut oil - Luther et al 1997) for compliance with the accreditation criteria. The methodology also meets the

criteria required for evaluating data against the maximum permitted limits for benzo[a]pyrene as specified in EU Commission Regulations.

2.5 Trace Elements - Analytical Methodology

(FERA (UK NRL) SOP FSG 454 and 457)

Aliquots of the homogenised sample were weighed into allotted quartz digestion vessels and a mixture (4:1) of nitric acid and hydrochloric acid added. The vessels were sealed and the contents digested using a high pressure microwave digestion system. Reagent blanks, certified reference materials and a spiked blank were also taken through the procedure. The resulting solutions were transferred to pre-marked acid-clean plastic test tubes and diluted to 10 ml with deionised water. The digest solutions together with a set of standards covering the expected concentration range were internally standardised with indium or rhodium in dilute nitric acid (1 %v/v). Measurements were made using an Agilent 7500ce ICP-MS with collision cell.

In common with the other two sets of analyses, the analytical procedure is accredited to the ISO17025 standard. The criteria used to assess data included checks on instrument drift, spike recovery, replicate agreement, limits of detection and certified reference material values. Regular, successful participation in FAPAS inter-comparison exercises provides further confidence in the data.

Table 1: Overview of samples

LOCAL AUTHORITY	PRODUCTION AREA	SITE NAME	DATE COLLECTED	SPECIES	SIN	OPHA Sample No
Argyll & Bute	Loch Etive	Loch Etive- Spiers	12/03/2012	Common Mussels	AB 316 030 08	20593
Argyll & Bute	West Jura	Jura	25/03/2012	Razors	AB 482 805 16	20623
Argyll & Bute	Sound of Mull: Tobermory	Aros Park	27/03/2012	Common Mussels	AB 258 076 08	20624
Argyll & Bute	Ulva: Loch Tuath Soriby Bay	Loch Tuath Soriby Bay	13/03/2012	Pacific Oysters	AB 285081 13	20602
CNES Lewis & Harris	Loch Roag: Drovnish	Loch Drovnish	19/03/2012	Common Mussels	LH 186 121 08	20613
CNES Lewis & Harris	Seilebost	Seilebost	13/03/2012	Common Cockles	LH 249 129 04	20604
CNES Lewis & Harris	Loch Seaforth	Loch Seaforth	19/03/2012	Common Mussels	LH 193 126 08	20603
CNES Uist & Barra	North Ford	Oitir Mhor	13/03/2012	Common Cockles	UB 493 852 04	20607
CNES Uist & Barra	Traigh Mhor	Traigh Mhor (Barra)	12/03/2012	Common Cockles	UB 282 165 04	20608
Highland Lochaber	Loch Moidart	South Channel	21/03/2012	Pacific Oysters	HL 179 227 13	20615
	Loch Nevis: Ardintigh Point	Ardintigh Bay	28/03/2012	Common Mussels	HL 180 725 08	20626
Highland Skye & Lochalsh	Loch Harport Inner	Carbost	05/03/2012	Pacific Oysters	SL 159 286 13	20588
Highland Sutherland	Loch Eribol	Loch Eribol-MacLennan	21/03/2012	Common Mussels	HS 139 307 08	20614
	Loch Glencoul	Kylesku	13/03/2012	Common Mussels	HS 157 310 08	20601
Shetland Islands	Brindister Voe	Brindister Voe	05/03/2012	Common Mussels	SI 023 406 08	20589
	North Uyea	North	06/03/2012	Common Mussels	SI 230 453 08	20590
	Ronas Voe East	Clifts	12/03/2012	Common Mussels	SI 523 919 08	20591
	South Voe Mussels	South Voe Mussels	12/03/2012	Common Mussels	SI 421 825 08	20592
	The Rona	Aith Ness	19/03/2012	Common Mussels	SI 517 955 08	20605

3. Results

Analyte concentrations are presented in Tables 3.1 to 3.6. Concentration units reflect current convention as required by regulation, and data were rounded to two decimal places or as appropriate. The reporting limits (quoted as "<") for dioxins, PCBs and PAHs are estimated as a dynamic parameter and are therefore the limits of determination that prevail during the course of the measurement. For PCDD/Fs, PCBs, metals and PAHs, the limits are consistent with the requirements of EU regulations. Data on the reference materials that were analysed concurrently with the samples, were all within established acceptable limits, and are available if required.

In addition to the concentration of individual congeners, the dioxin-like toxicity of the samples arising from PCDD/Fs and dioxin-like PCBs has also been reported as a toxic equivalent (WHO-TEQ), which is calculated by multiplying the concentration of each congener of interest by its toxicity equivalency factor (WHO-TEF). The World Health Organisation (WHO) defined a set of TEFs in 1998 (Van den berg et al 1998), but conducted a review and revised some of the values in 2005 (Van den berg et al 2006). The TEQs are presented in terms of the 2005 TEFs, but in order to allow comparison with earlier years, the 1998 TEQs have also been included. Additionally as per the requirements of Regulation 1259/2011, the sum of the ICES-6 PCBs is also provided. The regulations for shellfish are based on whole weight concentrations; however in keeping with previous reports, the results have also been reported on a fat weight basis.

PCDD/Fs and PCBs were detected in all the shellfish samples at varying concentrations. The data are broadly consistent with the results of monitoring from previous years. As observed in earlier studies on shellfish in the UK (Fernandes et al 2009), PCDD/Fs make a proportionately greater contribution to the TEQ than the PCBs. As there were different numbers of samples of the individual species, and a limited data set, it would be inappropriate to compare concentrations across the species, but the data indicate lower contaminant levels in cockles, with higher levels for oysters. The detected concentrations are comfortably below the regulatory limits for PCDD/F and dioxin-like PCB TEQ, and the ICES-6 PCBs.

PAHs were detected in all the shellfish analysed. Phenanthrene, fluoranthene, pyrene, benzo(b)fluoranthene and benzo(e)pyrene were generally the compounds that occurred to the greatest extent in the samples studied. Among the toxicologically significant compounds highlighted by the SCF (SCF 2002), some of the higher molecular weight PAHs (anthanthrene, dibenzopyrenes) were generally not detectable (typically < 0.1 µg/kg). The concentrations of benzo[a]pyrene detected in the samples did not exceed the maximum limit of 10 µg/kg specified in EU regulations (Commission regulation (EC) N. 208/2005). The data is consistent with the results

of monitoring in previous years, and the current range of occurrence for PAH4 (0.43 – 3.89 µg/kg) is very similar to the range observed for the last year (0.48 – 3.83 µg/kg).

Apart from silver (Ag) which was below the limit of detection in some cases, all samples showed the presence of heavy metals. Some metals such as manganese (Mn), zinc (Zn), copper (Cu), and arsenic occurred at higher concentrations, and the oyster samples in particular showed significantly higher concentrations of copper (Cu) and zinc (Zn). This is however consistent with the results of previous years monitoring. The occurrence of the three regulated metals (Commission Regulation EC 1881/2006 as amended by 629/2008) - Mercury (Hg), Cadmium (Cd) and Lead (Pb), were below the regulated maximum limits of 0.5 mg/kg 1.0 mg/kg and 1.5 mg/kg respectively.

4. Conclusions

In general terms the results of the 2012 monitoring for dioxins and PCBs, PAHs and heavy metals, are broadly consistent with the data generated for earlier years.

With respect to the individual compounds that are regulated, contaminant concentrations are comfortably below the regulatory maximum levels, and would thus indicate no risk to public health.

Further analysis of the data in conjunction with details such as the sampling locations and times, would yield information on the spatial distribution of the contaminants, and may allow further conclusions on the study, but this is outside the scope of the current project.

Table 3.1 PCDD/Fs (dioxins) concentrations (Whole weight)

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth
ng/kg whole weight									
2,3,7,8-TCDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
1,2,3,7,8-PeCDD	0.01	0.01	0.01i	0.01	0.01i	0.02	<0.01	0.03	0.02
1,2,3,4,7,8-HxCDD	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.01
1,2,3,6,7,8-HxCDD	0.01	0.01	0.01i	0.02	0.01	0.03	<0.01	0.02	0.02
1,2,3,7,8,9-HxCDD	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.01	0.01
1,2,3,4,6,7,8-HpCDD	0.02	0.04	0.08	0.09	0.09	0.15	0.10	0.04	0.09
OCDD	0.17	0.10	0.43	0.21	0.23	0.38	0.56	0.10	0.49
2,3,7,8-TCDF	0.09	0.08	0.10	0.09	0.13	0.09	0.06	0.18	0.10
1,2,3,7,8-PeCDF	0.01	0.02	0.02	0.01	0.02	0.03	0.01	0.03	0.02
2,3,4,7,8-PeCDF	0.03	0.04	0.05	0.04	0.05	0.07	0.03	0.07	0.05
1,2,3,4,7,8-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
1,2,3,7,8,9-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6,7,8-HxCDF	0.01	0.01	<0.01	0.02	0.02	0.03	0.01	0.02	0.01
1,2,3,4,6,7,8-HpCDF	<0.01	0.01	0.03	0.03	0.04	0.03	0.03	<0.01	0.02
1,2,3,4,7,8,9-HpCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OCDF	0.02	0.01	0.02	0.03	0.02	0.03	0.03	<0.01	0.02
WHO-TEQ $_{2005}$ (ng/kg) lower	**0.03**	**0.03**	**0.04**	**0.04**	**0.04**	**0.07**	**0.02**	**0.09**	**0.05**
WHO-TEQ $_{2005}$ (ng/kg) upper	**0.05**	**0.05**	**0.05**	**0.05**	**0.06**	**0.08**	**0.04**	**0.09**	**0.06**
WHO-TEQ $_{1998}$ (ng/kg) lower	**0.04**	**0.04**	**0.05**	**0.04**	**0.05**	**0.08**	**0.02**	**0.10**	**0.06**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.05**	**0.06**	**0.06**	**0.06**	**0.07**	**0.09**	**0.05**	**0.10**	**0.08**

FERA Sample No.	20604	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006297	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Cockles, Site: Seilebost	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory: Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
ng/kg whole weight										
2,3,7,8-TCDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
1,2,3,7,8-PeCDD	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.04	<0.01	0.01	<0.01
1,2,3,4,7,8-HxCDD	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDD	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.03	<0.01	0.01i	<0.01
1,2,3,7,8,9-HxCDD	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01
1,2,3,4,6,7,8-HpCDD	0.06	0.05	0.05	0.08	0.25	0.02	0.08	0.09	0.10	0.06
OCDD	0.34	0.17	0.30	0.27	1.25	0.15	0.24	0.40	0.44	0.21
2,3,7,8-TCDF	<0.01	0.07	<0.01	0.02	0.07	0.03	0.18	0.05	0.09	0.05
1,2,3,7,8-PeCDF	<0.01	0.01	<0.01	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01
2,3,4,7,8-PeCDF	<0.01	0.03	<0.01	<0.01	0.03	0.01	0.10	0.02	0.04	0.02
1,2,3,4,7,8-HxCDF	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDF	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01
1,2,3,7,8,9-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6,7,8-HxCDF	<0.01	0.01	<0.01	<0.01	0.02	<0.01	0.03	<0.01	0.01	<0.01
1,2,3,4,6,7,8-HpCDF	0.02	0.02	0.01	0.03	0.06	<0.01	0.01	0.03	0.03	0.02
1,2,3,4,7,8,9-HpCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OCDF	0.01	0.01	0.01	0.02	0.05	<0.01	0.01	0.03	0.03	0.01
WHO-TEQ $_{2005}$ (ng/kg) lower	**<0.01**	**0.02**	**<0.01**	**<0.01**	**0.04**	**0.01**	**0.11**	**0.01**	**0.04**	**0.01**
WHO-TEQ $_{2005}$ (ng/kg) upper	**0.03**	**0.04**	**0.03**	**0.03**	**0.05**	**0.03**	**0.11**	**0.04**	**0.05**	**0.04**
WHO-TEQ $_{1998}$ (ng/kg) lower	**<0.01**	**0.02**	**<0.01**	**<0.01**	**0.05**	**0.01**	**0.13**	**0.02**	**0.04**	**0.02**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.03**	**0.05**	**0.03**	**0.04**	**0.06**	**0.04**	**0.13**	**0.04**	**0.06**	**0.04**

Table 3.1 PCDD/Fs (dioxins) concentrations (Lipid weight)

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth
ng/kg fat weight									
2,3,7,8-TCDD	1.01	0.53	0.20	0.50	1.26	1.24	0.54	1.49	0.97
1,2,3,7,8-PeCDD	2.35	1.94	1.22i	1.89	2.61i	4.59	1.18	4.19	2.66
1,2,3,4,7,8-HxCDD	0.95	0.91	0.54	0.93	1.26	3.37	1.37	1.38	1.91
1,2,3,6,7,8-HxCDD	2.50	1.88	1.50i	2.25	2.51	5.77	1.49	3.15	2.65
1,2,3,7,8,9-HxCDD	1.48	0.88	0.69i	0.75	1.25	3.33	1.18	1.86	1.82
1,2,3,4,6,7,8-HpCDD	4.00	7.18	8.02	12.45	16.39	27.08	16.40	5.55	14.84
OCDD	31.64	17.02	45.62	29.41	40.68	70.57	87.09	14.29	79.58
2,3,7,8-TCDF	16.00	12.70	10.61	12.33	22.68	16.26	9.59	25.55	16.82
1,2,3,7,8-PeCDF	1.91	2.53	1.79	2.12	4.01	5.72	1.89	3.81	2.68
2,3,4,7,8-PeCDF	6.08	6.68	5.24	5.57	9.36	12.43	4.17	10.12	7.72
1,2,3,4,7,8-HxCDF	0.12	0.88	<0.38	1.28	1.73	3.30	1.62	0.20	1.15
1,2,3,6,7,8-HxCDF	0.94	0.74	0.34i	0.85i	1.75	3.06	1.04	1.24	0.72
1,2,3,7,8,9-HxCDF	<0.1	<0.11	<0.12	0.40	0.17	0.60	0.22	<0.16	<0.14
2,3,4,6,7,8-HxCDF	2.11	1.88	1.01	2.36	2.76	5.32	1.79	2.76	2.18
1,2,3,4,6,7,8-HpCDF	1.07i	1.81	2.76	4.83	6.35	5.73	4.74	0.95	2.66
1,2,3,4,7,8,9-HpCDF	<0.08	0.17	0.20	0.44	0.35	0.71	0.49	<0.11	0.28
OCDF	3.18	1.90	2.19	3.68	3.44	4.78	5.04	0.95	3.44
WHO-TEQ $_{2005}$ (ng/kg) lower	**7.71**	**6.63**	**4.64**	**6.43**	**10.45**	**14.19**	**5.10**	**12.51**	**8.95**
WHO-TEQ $_{2005}$ (ng/kg) upper	**7.72**	**6.65**	**4.69**	**6.43**	**10.45**	**14.19**	**5.10**	**12.53**	**8.97**
WHO-TEQ $_{1998}$ (ng/kg) lower	**8.96**	**8.02**	**5.71**	**7.58**	**12.40**	**16.77**	**5.96**	**14.61**	**10.54**
WHO-TEQ $_{1998}$ (ng/kg) upper	**8.97**	**8.03**	**5.76**	**7.58**	**12.40**	**16.77**	**5.96**	**14.63**	**10.55**

FERA Sample No.	20604	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006297	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Cockles, Site: Seilebost	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory: Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
ng/kg fat weight										
2,3,7,8-TCDD	<0.32	0.37	0.28i	0.27	0.59	0.48	1.43	0.50	0.65	0.24
1,2,3,7,8-PeCDD	2.29i	0.90i	1.85i	1.33	1.89	0.86	5.38	1.74	1.49	0.54
1,2,3,4,7,8-HxCDD	1.62	0.64	1.29	1.47	2.81	0.68	2.20	1.47	1.06	0.30
1,2,3,6,7,8-HxCDD	3.65	1.39	3.01	2.45	3.60	1.37	4.20	2.36	2.08i	0.78
1,2,3,7,8,9-HxCDD	2.42	0.71	2.40	2.57	4.12	0.55	3.31	2.16	1.08	0.36i
1,2,3,4,6,7,8-HpCDD	36.28	6.86	22.60	23.44	42.40	6.55	10.82	22.74	13.88	5.03
OCDD	221.17	26.12	132.25	79.70	208.45	42.12	32.49	100.14	60.99	18.30
2,3,7,8-TCDF	3.91	10.31	3.86	4.71	12.48	7.89	24.29	13.01	12.63	4.65
1,2,3,7,8-PeCDF	2.52	2.13	1.87	2.07	2.66	1.48	4.69	2.09	2.54	0.72
2,3,4,7,8-PeCDF	3.00	4.75	2.44	2.80	5.56	2.94	13.48	3.92	5.35	1.52
1,2,3,4,7,8-HxCDF	3.42	1.01	2.09	2.76	2.81	0.52	0.27	2.57	1.19	0.39
1,2,3,6,7,8-HxCDF	2.36	1.07i	1.31i	2.20	1.83	0.39	2.32	2.00	0.87	0.25
1,2,3,7,8,9-HxCDF	<0.26	<0.08	<0.33	<0.17	0.41	<0.15	<0.08	<0.23	0.23	<0.08
2,3,4,6,7,8-HxCDF	4.04	1.86	2.64	2.63	3.28	0.74	4.50	2.09	1.66	0.65
1,2,3,4,6,7,8-HpCDF	12.41	2.91	6.41	9.20	9.95	1.17	1.79	8.26	3.85	1.42
1,2,3,4,7,8,9-HpCDF	0.65i	0.17	0.61	0.77	0.72	<0.2	<0.06	0.55	0.42	0.14
OCDF	7.66	2.09	4.75	6.22	7.83	1.39	1.80	7.87	3.86	1.14
WHO-TEQ $_{2005}$ (ng/kg) lower	**5.97**	**4.57**	**4.92**	**4.74**	**7.96**	**3.57**	**15.24**	**6.39**	**6.10**	**2.07**
WHO-TEQ $_{2005}$ (ng/kg) upper	**6.32**	**4.57**	**4.95**	**4.76**	**7.96**	**3.59**	**15.25**	**6.42**	**6.10**	**2.08**
WHO-TEQ $_{1998}$ (ng/kg) lower	**6.57**	**5.55**	**5.41**	**5.33**	**9.08**	**4.18**	**18.02**	**7.20**	**7.21**	**2.38**
WHO-TEQ $_{1998}$ (ng/kg) upper	**6.92**	**5.56**	**5.45**	**5.34**	**9.08**	**4.20**	**18.03**	**7.22**	**7.21**	**2.39**

Table 3.2 Non-*ortho* PCB concentrations

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth
Whole weight Concentrations ng/kg									
ng/kg									
PCB77	0.91	0.60	1.20	0.69	1.17	0.72	0.67	1.49	1.50
PCB81	0.07	0.04	0.08	0.05	0.07	0.04	0.04	0.10	0.09
PCB126	0.20	0.24	0.31	0.24	0.36	0.25	0.19	0.40	0.33
PCB169	0.05	0.08	0.08	0.07	0.09	0.09	0.06	0.11	0.11
WHO-TEQ $_{2005}$ (ng/kg) lower	**0.02**	**0.03**	**0.03**	**0.03**	**0.04**	**0.03**	**0.02**	**0.04**	**0.04**
WHO-TEQ $_{2005}$ (ng/kg) upper	**0.02**	**0.03**	**0.03**	**0.03**	**0.04**	**0.03**	**0.02**	**0.04**	**0.04**
WHO-TEQ $_{1998}$ (ng/kg) lower	**0.02**	**0.02**	**0.03**	**0.02**	**0.04**	**0.03**	**0.02**	**0.04**	**0.03**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.02**	**0.02**	**0.03**	**0.02**	**0.04**	**0.03**	**0.02**	**0.04**	**0.03**
Fat weight Concentrations ng/kg									
PCB77	165.07	98.34	128.13	98.59	207.67	133.07	105.04	217.43	243.72
PCB81	11.80	6.39	8.36	6.82	12.75	8.01	6.73	14.62	14.56
PCB126	36.79	39.17	32.63	34.72	63.70	47.06	29.01	59.00	53.12
PCB169	9.22	12.64	8.29	10.02	15.60	17.03	10.09	16.20	18.22
WHO-TEQ $_{2005}$ (ng/kg) lower	**3.98**	**4.31**	**3.53**	**3.78**	**6.86**	**5.23**	**3.22**	**6.41**	**5.89**
WHO-TEQ $_{2005}$ (ng/kg) upper	**3.98**	**4.31**	**3.53**	**3.78**	**6.86**	**5.23**	**3.22**	**6.41**	**5.89**
WHO-TEQ $_{1998}$ (ng/kg) lower	**3.79**	**4.05**	**3.36**	**3.58**	**6.55**	**4.89**	**3.01**	**6.09**	**5.52**
WHO-TEQ $_{1998}$ (ng/kg) upper	**3.79**	**4.05**	**3.36**	**3.58**	**6.55**	**4.89**	**3.01**	**6.09**	**5.52**

FERA Sample No.	20604	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006297	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Cockles, Site: Seilebost	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
Whole weight Concentrations ng/kg										
PCB77	0.13	0.43	0.22	0.28	0.72	0.62	1.55	0.71	1.05	0.81
PCB81	<0.01	0.03	0.01	0.02	0.05	0.03	0.11	0.03	0.06	0.05
PCB126	0.04	0.16	0.06	0.06	0.27	0.11	0.45	0.11	0.28	0.17
PCB169	0.03	0.05	0.03	0.03	0.10	0.03	0.13	0.03	0.08	0.06
WHO-TEQ $_{2005}$ (ng/kg) lower	**<0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.01**	**0.05**	**0.01**	**0.03**	**0.02**
WHO-TEQ $_{2005}$ (ng/kg) upper	**<0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.01**	**0.05**	**0.01**	**0.03**	**0.02**
WHO-TEQ $_{1998}$ (ng/kg) lower	**<0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.01**	**0.05**	**0.01**	**0.03**	**0.02**
WHO-TEQ $_{1998}$ (ng/kg) upper	**<0.01**	**0.02**	**0.01**	**0.01**	**0.03**	**0.01**	**0.05**	**0.01**	**0.03**	**0.02**
Fat weight Concentrations ng/kg										
PCB77	82.90	64.42	98.54	84.18	119.31	168.43	209.09	178.14	146.79	71.84
PCB81	4.68	5.16	5.10	4.68	7.88	9.10	14.72	8.70	8.05	4.67
PCB126	23.20	23.96	25.37	18.59	45.54	30.36	61.35	28.36	38.50	15.22
PCB169	17.03	8.10	12.86	8.81	15.93	8.59	18.16	7.41	10.49	5.16
WHO-TEQ $_{2005}$ (ng/kg) lower	**2.84**	**2.65**	**2.93**	**2.13**	**5.05**	**3.31**	**6.71**	**3.08**	**4.18**	**1.69**
WHO-TEQ $_{2005}$ (ng/kg) upper	**2.84**	**2.65**	**2.93**	**2.13**	**5.05**	**3.31**	**6.71**	**3.08**	**4.18**	**1.69**
WHO-TEQ $_{1998}$ (ng/kg) lower	**2.50**	**2.48**	**2.68**	**1.96**	**4.73**	**3.14**	**6.34**	**2.93**	**3.97**	**1.58**
WHO-TEQ $_{1998}$ (ng/kg) upper	**2.50**	**2.48**	**2.68**	**1.96**	**4.73**	**3.14**	**6.34**	**2.93**	**3.97**	**1.58**

Table 3.3 *Ortho* PCB concentrations (Whole weight)

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603	20604
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296	S12-006297
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth	Cockles, Site: Seilebost
µg/kg whole weight										
PCB18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB31	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB47	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB49	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB51	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB52	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB99	0.01	0.01	0.02	0.01	0.02	0.01	<0.01	0.02	0.02	<0.01
PCB101	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.03	<0.01
PCB105	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB114	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB118	0.02	0.02	0.04	0.02	0.03	0.02	0.02	0.03	0.03	<0.01
PCB123	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB128	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB138	0.04	0.05	0.07	0.06	0.08	0.06	0.04	0.06	0.07	<0.01
PCB153	0.07	0.07	0.09	0.07	0.11	0.08	0.06	0.11	0.09	<0.01
PCB156	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB157	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB167	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB180	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB189	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SUM of ICES 6 (lower)	**0.13**	**0.14**	**0.20**	**0.15**	**0.22**	**0.16**	**0.12**	**0.19**	**0.19**	**<0.01**
SUM of ICES 6 (upper)	**0.16**	**0.17**	**0.22**	**0.18**	**0.25**	**0.19**	**0.15**	**0.22**	**0.22**	**0.06**
WHO-TEQ $_{2005}$ (ng/kg)lower	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{2005}$ (ng/kg) upper	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{1998}$ (ng/kg) lower	**<0.01**	**<0.01**	**0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**

FERA Sample No.	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory: Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
µg/kg whole weight									
PCB18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB31	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB47	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB49	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB51	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB52	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
PCB99	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.01	0.01
PCB101	0.01	<0.01	<0.01	0.02	0.01	0.03	0.01	0.02	0.02
PCB105	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
PCB114	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB118	0.01	<0.01	<0.01	0.02	0.01	0.03	0.01	0.02	0.02
PCB123	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB128	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB138	0.03	<0.01	<0.01	0.06	0.03	0.09	0.03	0.06	0.05
PCB153	0.04	<0.01	<0.01	0.08	0.03	0.13	0.04	0.08	0.06
PCB156	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB157	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB167	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB180	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
PCB189	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SUM of ICES 6 (lower)	**0.08**	**<0.01**	**<0.01**	**0.16**	**0.07**	**0.28**	**0.08**	**0.16**	**0.13**
SUM of ICES 6 (upper)	**0.11**	**0.06**	**0.06**	**0.19**	**0.10**	**0.29**	**0.11**	**0.19**	**0.16**
WHO-TEQ $_{2005}$ (ng/kg) lower	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{2005}$ (ng/kg) upper	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{1998}$ (ng/kg) lower	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**

Table 3.3 *Ortho* PCB concentrations (Lipid weight)

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603	20604
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296	S12-006297
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth	Cockles, Site: Seilebost
µg/kg Fat weight										
PCB18	0.40	0.24	0.38	0.35	0.35	0.15	0.29	0.19	0.97	<0.67
PCB28	0.78	0.45	0.72	0.53	0.71	0.40	0.45	0.37	1.27	<0.72
PCB31	0.57	0.39	0.72	0.48	0.55	0.34	0.41	0.32	1.15	<0.65
PCB47	0.65	0.48	0.59	0.46	0.67	0.64	0.47	0.62	0.69	0.35
PCB49	0.84	0.48	0.78	0.55	0.75	0.62	0.51	0.57	0.98	0.26
PCB51	0.12	0.05	<0.04	0.05	0.05	<0.07	0.07	0.11	0.06	<0.13
PCB52	1.46	0.88	1.31	1.04	1.48	1.04	0.89	0.92	1.62	0.50
PCB99	2.70	1.95	2.24	1.80	2.91	2.57	1.57	2.65	2.51	0.56
PCB101	4.35	3.09	3.61	3.36	5.35	4.50	2.79	3.55	4.45	0.91
PCB105	0.97	0.83	1.22	0.92	1.58	1.39	0.78	1.20	1.35	0.32i
PCB114	0.10	0.07	0.09	0.08	0.10	0.08	0.04	0.05	0.10	<0.09
PCB118	4.03	3.31	3.76	3.18	6.17	4.35	2.62	4.31	4.18	0.98
PCB123	0.09	0.04	0.07	0.04	0.08	0.10	0.04	0.09	0.10	<0.03
PCB128	0.61	0.82	1.11	0.91	1.47	1.37	0.73	0.77	1.57	0.64
PCB138	7.17	7.83	7.77	7.87	13.95	11.63	6.73	9.07	11.76	2.68
PCB153	11.84	11.64	9.58	10.28	19.56	14.79	8.80	16.32	14.72	2.83
PCB156	0.19	0.30	0.35	0.31	0.61	0.55	0.28	0.23	0.46	<0.17
PCB157	0.13	0.14	0.15	0.11	0.27	0.27	0.15	0.18	0.22	<0.03
PCB167	0.29	0.30	0.30	0.24	0.50	0.45	0.21	0.36	0.39	<0.08
PCB180	0.55	0.53	0.64	0.58	0.96	1.41	0.57	0.90	0.83	1.00i
PCB189	<0.06	<0.03	0.06	<0.07	<0.12	0.10	<0.08	<0.1	0.16i	<0.08
SUM of ICES 6 (lower)	**26.15**	**24.42**	**23.63**	**23.66**	**42.01**	**33.77**	**20.23**	**31.13**	**34.65**	**7.92**
SUM of ICES 6 (upper)	**26.15**	**24.42**	**23.63**	**23.66**	**42.01**	**33.77**	**20.23**	**31.13**	**34.65**	**8.64**
WHO-TEQ $_{2005}$ (ng/kg) lower	**0.17**	**0.15**	**0.18**	**0.15**	**0.28**	**0.22**	**0.12**	**0.19**	**0.21**	**0.04**
WHO-TEQ $_{2005}$ (ng/kg) upper	**0.18**	**0.15**	**0.18**	**0.15**	**0.28**	**0.22**	**0.13**	**0.20**	**0.21**	**0.05**
WHO-TEQ $_{1998}$ (ng/kg) lower	**0.72**	**0.68**	**0.81**	**0.67**	**1.28**	**1.05**	**0.58**	**0.79**	**0.97**	**0.13**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.73**	**0.68**	**0.81**	**0.67**	**1.29**	**1.05**	**0.59**	**0.80**	**0.97**	**0.29**

FERA Sample No.	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Mussels, Site: Aithness	Cockles Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Eribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
µg/kg Fat weight									
PCB18	0.24	0.97	0.50	0.41	<0.21	0.45	<0.32	0.25	0.17
PCB28	0.55	1.44	0.78	0.78	0.53	0.96	0.53	0.48	0.30
PCB31	0.50	1.36	0.76	0.68	0.45	0.53	0.41	0.39	0.25
PCB47	0.39	0.71	0.42	0.59	0.66	0.66	0.54	0.52	0.32
PCB49	0.42	0.60	0.39	0.64	0.74	0.70	0.59	0.53	0.34
PCB51	<0.08	0.12	<0.08	<0.05	0.07	0.16	0.11	0.07	0.05
PCB52	0.78	0.96	0.66	1.02	1.24	1.36	1.00	0.96	0.62
PCB99	1.13	0.68	0.55	2.08	1.74	2.73	1.94	1.83	0.98
PCB101	1.94	1.20	0.93	3.25	3.38	4.01	3.25	3.37	1.77
PCB105	0.59	0.58	0.35	1.10	1.16	1.36	1.10	1.13	0.51
PCB114	0.11	<0.06	<0.08	<0.04	0.08	0.11	0.06	<0.03	0.04
PCB118	1.84	1.59	1.11	3.67	3.32	4.70	3.58	3.47	1.64
PCB123	<0.03	0.05	<0.04	<0.05	0.09	0.04	0.05	0.04	0.04
PCB128	0.60	0.39	0.34	1.09	0.72	1.24	1.13	1.06	0.55
PCB138	4.71	2.76	2.51	9.40	6.86	11.87	8.17	8.30	4.38
PCB153	5.91	2.78	2.63	12.57	8.75	17.85	10.12	10.74	5.60
PCB156	0.18	0.18	0.17	0.42	0.30	0.42	0.32	0.39	0.18
PCB157	0.10	0.10	0.12	0.20	0.12	0.14i	0.15	0.19	0.08
PCB167	0.19	0.15i	<0.08	0.34	0.27	0.56	0.22	0.34	0.16
PCB180	0.39	0.71i	0.72	0.67	0.39	2.06	0.46	0.98	0.47
PCB189	<0.06	<0.07	<0.13	<0.07	<0.13	<0.26	<0.21	<0.07	<0.04
SUM of ICES 6 (lower)	**14.28**	**9.85**	**8.23**	**27.69**	**21.15**	**38.11**	**23.53**	**24.83**	**13.14**
SUM of ICES 6 (upper)	**14.28**	**9.85**	**8.23**	**27.69**	**21.15**	**38.11**	**23.53**	**24.83**	**13.14**
WHO-TEQ $_{2005}$ (ng/kg) lower	**0.09**	**0.08**	**0.05**	**0.17**	**0.16**	**0.22**	**0.16**	**0.17**	**0.08**
WHO-TEQ $_{2005}$ (ng/kg) upper	**0.09**	**0.08**	**0.06**	**0.18**	**0.16**	**0.23**	**0.17**	**0.17**	**0.08**
WHO-TEQ $_{1998}$ (ng/kg) lower	**0.44**	**0.36**	**0.29**	**0.79**	**0.71**	**0.95**	**0.74**	**0.76**	**0.37**
WHO-TEQ $_{1998}$ (ng/kg) upper	**0.45**	**0.40**	**0.35**	**0.82**	**0.72**	**0.98**	**0.76**	**0.78**	**0.37**

Table 3.4 Summary of PCDD/F and PCB WHO-TEQ, and ICES-6 concentrations

FERA Sample No.	20588	20589	20590	20591	20592	20593	20601	20602	20603
LIMS No.	S12-005877	S12-005878	S12-005985	S12-006231	S12-006232	S12-006233	S12-006259	S12-006264	S12-006296
Sample Details:	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth
WHO –TEQ $_{2005}$ ng/kg whole									
Dioxin	0.05	0.05	0.05	0.05	0.06	0.08	0.04	0.09	0.06
non ortho-PCB	0.02	0.03	0.03	0.03	0.04	0.03	0.02	0.04	0.04
ortho-PCB	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sum of WHO-TEQs $_{2005}$ (upper)	**0.08**	**0.09**	**0.09**	**0.09**	**0.11**	**0.12**	**0.07**	**0.14**	**0.11**
WHO –TEQ $_{2005}$ ng/kg Fat									
Dioxin	7.72	6.65	4.69	6.43	10.45	14.19	5.10	12.53	8.97
non ortho-PCB	3.98	4.31	3.53	3.78	6.86	5.23	3.22	6.41	5.89
ortho-PCB	0.18	0.15	0.18	0.15	0.28	0.22	0.13	0.20	0.21
Sum of WHO-TEQs $_{2005}$ (upper)	**11.88**	**11.11**	**8.40**	**10.36**	**17.59**	**19.64**	**8.45**	**19.14**	**15.07**
SUM of ICES 6 µg/kg whole (upper)	**0.16**	**0.17**	**0.22**	**0.18**	**0.25**	**0.19**	**0.15**	**0.22**	**0.22**
SUM of ICES 6 µg/kg fat (upper)	**26.15**	**24.42**	**23.63**	**23.66**	**42.01**	**33.77**	**20.23**	**31.13**	**34.65**
WHO-TEQ $_{1998}$ ng/kg whole									
Dioxin	0.05	0.06	0.06	0.06	0.07	0.09	0.05	0.10	0.08
non ortho-PCB	0.02	0.02	0.03	0.02	0.04	0.03	0.02	0.04	0.03
ortho-PCB	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Sum of WHO-TEQs $_{1998}$ (upper)	**0.09**	**0.10**	**0.11**	**0.10**	**0.13**	**0.14**	**0.09**	**0.16**	**0.13**
WHO-TEQ $_{1998}$ ng/kg Fat									
Dioxin	8.97	8.03	5.76	7.58	12.40	16.77	5.96	14.63	10.55
non ortho-PCB	3.79	4.05	3.36	3.58	6.55	4.89	3.01	6.09	5.52
ortho-PCB	0.73	0.68	0.81	0.67	1.29	1.05	0.59	0.80	0.97
Sum of WHO-TEQs $_{1998}$ (upper)	**13.49**	**12.76**	**9.93**	**11.83**	**20.24**	**22.71**	**9.56**	**21.52**	**17.04**

FERA Sample No.	20604	20605	20607	20608	20613	20614	20615	20623	20624	20626
LIMS No.	S12-006297	S12-006366	S12-006417	S12-006418	S12-006601	S12-006602	S12-006693	S12-016237	S12-016238	S12-016382
Sample Details:	Cockles, Site: Seilebost	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters, SIN: HL 179 227 13,	Razors, West Jura: Jura,	Mussels, Sound of Mull: Tobermory: Aros Park,	Mussels, Loch Nevis: Ardintigh Bay,
WHO –TEQ $_{2005}$ ng/kg whole										
Dioxin	0.03	0.04	0.03	0.03	0.05	0.03	0.11	0.04	0.05	0.04
non ortho-PCB	<0.01	0.02	0.01	0.01	0.03	0.01	0.05	0.01	0.03	0.02
ortho-PCB	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sum of WHO-TEQs $_{2005}$ (upper)	**0.05**	**0.07**	**0.05**	**0.05**	**0.09**	**0.05**	**0.17**	**0.06**	**0.09**	**0.07**
WHO –TEQ $_{2005}$ ng/kg Fat										
Dioxin	6.32	4.57	4.95	4.76	7.96	3.59	15.25	6.42	6.10	2.08
non ortho-PCB	2.84	2.65	2.93	2.13	5.05	3.31	6.71	3.08	4.18	1.69
ortho-PCB	0.05	0.09	0.08	0.06	0.18	0.16	0.23	0.17	0.17	0.08
Sum of WHO-TEQs $_{2005}$ (upper)	**9.21**	**7.31**	**7.96**	**6.95**	**13.19**	**7.06**	**22.19**	**9.67**	**10.45**	**3.85**
SUM of ICES 6 µg/kg whole (upper)	**0.06**	**0.11**	**0.06**	**0.06**	**0.19**	**0.10**	**0.29**	**0.11**	**0.19**	**0.16**
SUM of ICES 6 µg/kg fat (upper)	**8.64**	**14.28**	**9.85**	**8.23**	**27.69**	**21.15**	**38.11**	**23.53**	**24.83**	**13.14**
WHO-TEQ $_{1998}$ ng/kg whole										
Dioxin	0.03	0.05	0.03	0.04	0.06	0.04	0.13	0.04	0.06	0.04
non ortho-PCB	<0.01	0.02	0.01	0.01	0.03	0.01	0.05	0.01	0.03	0.02
ortho-PCB	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Sum of WHO-TEQs $_{1998}$ (upper)	**0.06**	**0.09**	**0.06**	**0.07**	**0.11**	**0.07**	**0.20**	**0.07**	**0.11**	**0.08**
WHO-TEQ $_{1998}$ ng/kg Fat										
Dioxin	6.92	5.56	5.45	5.34	9.08	4.20	18.03	7.22	7.21	2.39
non ortho-PCB	2.50	2.48	2.68	1.96	4.73	3.14	6.34	2.93	3.97	1.58
ortho-PCB	0.29	0.45	0.40	0.35	0.82	0.72	0.98	0.76	0.78	0.37
Sum of WHO-TEQs $_{1998}$ (upper)	**9.71**	**8.49**	**8.53**	**7.65**	**14.63**	**8.06**	**25.35**	**10.91**	**11.96**	**4.34**

Table 3.5 PAH concentrations (µg/kg whole weight)

FERA sample number FERA LIMS No.	20588 S12-005877	20589 S12-005878	20590 S12-005985	20591 S12-006231	20592 S12-006232	20593 S12-006233
Description	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Loch Etive West: Loch Etive Spiers
µg/kg whole weight						
acenaphthylene	<0.35	<1.09	<0.52	<0.75	<0.93	<0.40
acenaphthene	<0.40	<0.41	<0.40	<0.40	<0.41	<0.40
fluorene	<0.40	<0.41	<0.40	<0.41	<0.41	<0.41
phenanthrene	0.72	<0.52	0.69	<0.52	0.55	<0.52
anthracene	0.16	<0.07	0.17	0.13	0.36	0.36
fluoranthene	1.71	0.45	0.59	0.43	1.46	0.97
benzo[c]fluorene	0.12	<0.01	<0.05	0.03	0.15	0.09
pyrene	1.30	0.79	0.45i	0.39i	1.39	0.80
benzo[ghi]fluoranthene	0.69	0.14	0.24	0.25	0.69	0.44
benz[a]anthracene	**0.51**	**0.09**	**0.15**	**0.18**	**0.50**	**0.60**
benzo[b]naphtho[2,1-d]thiophene	0.08	<0.03	0.04	0.05	0.07	<0.11
cyclopenta[c,d]pyrene	0.05	<0.01	0.02	0.02	<0.02	0.03
chrysene	**0.62**	**0.22**	**0.38**	**0.37**	**0.63**	**1.07**
5-methylchrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
benzo[b]fluoranthene	**1.41**	**0.54**	**0.50**	**0.59**	**1.15**	**1.78**
benzo[j]fluoranthene	0.34	0.20	0.20	0.26	0.50	0.68
benzo[k]fluoranthene	0.57	0.15	0.16	0.21	0.39	0.66
benzo[e]pyrene	1.33	0.46	0.58	0.62	1.29	1.43
benzo[a]pyrene	**0.19**	**<0.09**	**<0.09**	**0.11**	**0.30**	**0.44**
indeno[1,2,3-cd]pyrene	0.18	0.18	0.20	0.26	0.49	0.50
dibenz[ah]anthracene	<0.10	<0.05	<0.06	<0.07	<0.11	<0.15
benzo-[g,h,i]perylene	0.30	0.26	0.25	0.33	0.63	0.56
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,e]pyrene	<0.10	<0.10	<0.10	<0.10	<0.15	<0.10
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
coronene	<0.10	<0.10	0.11i	0.13i	0.16i	0.17i
PAH 4 Sum Lower µg/kg	**2.73**	**0.85**	**1.03**	**1.25**	**2.58**	**3.89**
PAH 4 Sum Upper µg/kg	**2.73**	**0.94**	**1.12**	**1.25**	**2.58**	**3.89**

FERA sample number	20601	20602	20603	20604	20605	20607
FERA LIMS No.	S12-006259	S12-006264	S12-006296	S12-006297	S12-006366	S12-006417
Description	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Mussels, Site: Loch Seaforth	Cockles Site: Seilebost	Mussels, Site: Aithness	Cockles, Site: Oitir Mhor
µg/kg whole weight						
acenaphthylene	<0.33	<0.46	<0.71	<0.19	<0.19	<0.17
acenaphthene	<0.41	<0.41	<0.41	<0.41	<0.30	<0.30
fluorene	<0.41	<0.41	<0.41	<0.41	<0.32	<0.32
phenanthrene	0.75	0.64	1.79	<0.52	0.42	<0.41
anthracene	0.16	0.21	0.37	<0.07	0.09	<0.04
fluoranthene	0.75	1.51	1.14	<0.30	0.37	0.34
benzo[c]fluorene	0.04	0.09	0.10	<0.01	<0.03	<0.01
pyrene	0.54i	0.65i	1.26	<0.30	0.27	0.21
benzo[ghi]fluoranthene	0.29	0.49	0.48	<0.07	0.19	0.08
benz[a]anthracene	**0.18**	**0.36**	**0.32**	**0.06**	**0.09**	**0.09**
benzo[b]naphtho[2,1-d]thiophene	<0.05	0.04	0.10	<0.03	<0.04	<0.03
cyclopenta[c,d]pyrene	<0.01	<0.01	0.03	<0.01	<0.02	<0.01
chrysene	**0.21**	**0.67**	**0.47**	**0.10**	**0.20**	**0.22**
5-methylchrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
benzo[b]fluoranthene	**0.56**	**1.59**	**1.09**	**0.18**	**0.46**	**0.24**
benzo[j]fluoranthene	0.23	0.35	0.43	0.10	0.16	0.13
benzo[k]fluoranthene	0.19	0.60	0.38	0.10	0.14	0.12
benzo[e]pyrene	0.75	1.24	1.13	0.16	0.39	<0.13
benzo[a]pyrene	**0.12**	**0.14**	**0.18**	**<0.09**	**<0.09**	**<0.09**
indeno[1,2,3-cd]pyrene	0.26	0.23	0.31	0.19	0.18	0.23
dibenz[ah]anthracene	<0.07	<0.11	<0.10	<0.05	<0.05	<0.06
benzo-[g,h,i]perylene	0.34	0.31	0.49	0.16	0.25	0.20
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,e]pyrene	<0.11	<0.10	<0.11	<0.10	<0.10	<0.10
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
coronene	0.15i	<0.10	0.17i	<0.10	<0.10	<0.10
PAH 4 Sum Lower µg/kg	**1.07**	**2.76**	**2.06**	**0.34**	**0.75**	**0.55**
PAH 4 Sum Upper µg/kg	**1.07**	**2.76**	**2.06**	**0.43**	**0.84**	**0.64**

FERA sample number FERA LIMS No.	20608 S12-006418	20613 S12-006601	20614 S12-006602	20615 S12-006693	20623 S12-016237	20624 S12-016238	20626 S12-016382
Description	Cockles, Site: Traigh Mhor (Barra)	Mussels, Loch Drovinish	Mussels, Loch Erribol	Pacific Oysters SIN: HL 179 227 13	Razors, West Jura: Jura	Mussels, Sound of Mull: Tobermory Aros Park	Mussels, Loch Nevis: Ardintigh Bay
µg/kg whole weight							
acenaphthylene	<0.17	<0.23	<0.34	<0.26	<0.17	<0.49	<0.50
acenaphthene	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
fluorene	<0.31	<0.31	<0.32	<0.32	<0.32	<0.32	<0.32
phenanthrene	<0.40	0.99	2.38	0.71	0.53	0.83	0.99
anthracene	<0.05	0.14	0.37	0.16	0.12	0.29	0.26
fluoranthene	0.38	0.52	2.24	1.68	0.87	1.30	0.54
benzo[c]fluorene	<0.03	<0.05	0.07	0.14	0.08	0.08	<0.05
pyrene	0.27	0.47	1.74	0.79	0.37	0.89	0.38
benzo[ghi]fluoranthene	0.14	0.19	0.25	0.72	0.40	0.46	0.20
benz[a]anthracene	**0.12**	**0.12**	**0.32**	**0.38**	**0.25**	**0.42**	**0.09**
benzo[b]naphtho[2,1-d]thiophene	0.04	<0.04	<0.06	0.09	<0.01	0.04	0.02
cyclopenta[c,d]pyrene	<0.01	0.01	<0.01	0.04	<0.01	0.03	0.01
chrysene	**0.32**	**0.28**	**0.44**	**0.53**	**0.62**	**0.80**	**0.24**
5-methylchrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
benzo[b]fluoranthene	**0.37**	**0.46**	**0.32**	**1.96**	**0.72**	**1.22**	**0.23**
benzo[j]fluoranthene	0.24	0.20	0.16	0.43	0.32	0.45	0.10
benzo[k]fluoranthene	0.22	0.16	0.14	0.76	0.37	0.39	0.09
benzo[e]pyrene	<0.13	0.39	0.22	1.38	0.71	1.41	0.29
benzo[a]pyrene	**0.12**	**<0.09**	**0.10**	**0.19**	**0.21**	**0.27**	**<0.09**
indeno[1,2,3-cd]pyrene	0.39	0.33	0.13	0.32	0.37	0.41	0.15
dibenz[ah]anthracene	<0.09	<0.07	<0.05	<0.14	<0.09	<0.11	<0.05
benzo-[g,h,i]perylene	0.33	0.40	0.17	0.40	0.36	0.59	0.22
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,e]pyrene	<0.10	<0.13	<0.10	<0.10	<0.11	<0.13	<0.10
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
coronene	0.13i	0.22i	<0.10	0.11i	<0.22	0.19i	0.11i
PAH4 Sum Lower µg/kg	**0.93**	**0.86**	**1.18**	**3.06**	**1.80**	**2.71**	**0.56**
PAH 4 Sum Upper µg/kg	**0.93**	**0.95**	**1.18**	**3.06**	**1.80**	**2.71**	**0.65**

Table 3.6 Heavy metal concentrations (mg/kg whole weight)

Local Authority	Argyll & Bute	Argyll & Bute	Argyll & Bute	Argyll & Bute	CNES Lewis & Harris	CNES Lewis & Harris	CNES Lewis & Harris	CNES Uist & Barra	CNES Uist & Barra	Highland Lochaber	Highland Lochaber
FERA LIMS No.	S12-006233	S12-006264	S12-016237	S12-016238	S12-006296	S12-006297	S12-006601	S12-006417	S12-006418	S12-006693	S12-016382
Description	Mussels, Loch Etive West: Loch Etive Spiers	Pacific Oysters, Ulva: Loch Tuath Soriby Bay	Razors, West Jura: Jura	Mussels, Sound of Mull: Tobermory: Aros Park	Mussels, Site: Loch Seaforth	Cockles, Site: Seilebost	Mussels, Loch Drovinish	Cockles, Site: Oitir Mhor	Cockles, Site: Traigh Mhor (Barra)	Pacific Oysters SIN: HL 179 227 13	Mussels, Loch Nevis: Ardintigh Point, Ardintigh Bay
mg/kg whole weight											
Cr	(0.07)	(0.06)	1.10	0.12	0.26	0.22	0.16	0.28	0.50	0.07	0.13
Mn	1.33	1.21	1.90	2.75	1.60	0.74	1.06	0.72	0.67	1.47	3.11
Co	0.021	0.014	0.115	0.037	0.026	0.053	0.036	0.070	0.095	0.023	0.047
Ni	(0.07)	(0.06)	0.49	0.14	0.12	0.84	0.15	1.50	2.04	(0.08)	0.17
Cu	0.51	5.84	4.74	0.58	0.70	0.24	0.68	0.28	0.43	4.48	0.88
Zn	6.52	122.83	14.12	8.72	9.33	1.97	10.52	3.60	6.93	138.21	12.59
As	0.74	1.78	1.74	1.48	1.78	0.74	1.58	1.76	1.53	1.85	1.90
Se	0.222	0.154	0.262	0.351	0.368	0.092	0.432	0.129	0.216	0.270	0.561
Ag	(0.005)	0.279	0.481	0.022	<0.003	<0.003	(0.009)	(0.009)	0.024	0.382	<0.003
Cd	0.059	0.094	0.022	0.075	0.057	0.024	0.064	0.028	0.079	0.149	0.087
Hg	0.015	0.010	0.024	0.011	0.007	(0.004)	0.011	(0.006)	0.007	0.018	0.013
Pb	0.045	0.025	0.078	0.134	0.082	0.019	0.123	0.033	0.060	0.066	0.114

Brackets indicate that the value is between the LoD and LoQ

Local Authority	Highland Skye & Lochalsh	Highland Sutherland	Highland Sutherland	Shetland Islands	Shetland Islands	Shetland Islands	Shetland Islands	Shetland Islands		
FERA LIMS No.	S12-005877	S12-006259	S12-006602	S12-005878	S12-005985	S12-006231	S12-006232	S12-006366		
Description	Oysters, Loch Harport (Inner) - Carbost	Mussels, Site: Loch Glencoul - Kyles Ku, Sutherland	Mussels, Loch Erribol	Mussels, Site: Brindister Voe	Mussels, Site: North Uyea	Mussels, Site: Clifts	Mussels, Site: South Voe	Mussels, Site: Aithness	**Sample LoD**	**Sample LoQ**
mg/kg whole weight										
Cr	0.13	0.13	0.31	(0.07)	0.26	(0.08)	0.12	0.10	**0.03**	**0.10**
Mn	1.65	2.60	6.04	2.98	0.91	0.52	1.27	0.95	**0.01**	**0.03**
Co	0.026	0.032	0.039	0.015	0.042	0.018	0.030	0.019	**0.002**	**0.007**
Ni	0.11	0.16	0.25	(0.08)	0.27	0.11	0.12	0.11	**0.03**	**0.10**
Cu	7.12	0.57	0.41	0.59	0.79	0.77	0.80	1.00	**0.03**	**0.10**
Zn	60.32	6.79	5.33	13.65	14.84	16.48	14.66	15.65	**0.05**	**0.17**
As	1.05	1.34	1.30	1.34	1.64	1.73	1.79	1.65	**0.02**	**0.07**
Se	0.156	0.331	0.197	0.199	0.371	0.328	0.284	0.250	**0.005**	**0.017**
Ag	0.119	(0.003)	(0.004)	<0.003	<0.003	<0.003	(0.004)	<0.003	**0.003**	**0.010**
Cd	0.129	0.050	0.091	0.076	0.217	0.099	0.076	0.150	**0.002**	**0.007**
Hg	(0.007)	0.010	0.015	(0.006)	0.007	(0.006)	0.011	(0.006)	**0.002**	**0.007**
Pb	0.020	0.083	0.080	0.080	0.092	0.107	0.165	0.309	**0.002**	**0.007**

Brackets indicate that the value is between the LoD and LoQ

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