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Table 1 Temporal Trend Monitoring required in Sediments

Strategy

This monitoring is completed to fulfil the requirements of the following JAMP issues:

JAMP Issue 1.2 What are the concentrations and fluxes of Mercury, Cadmium and Lead in sediment and biota?

JAMP Issue 1.7 Do high concentrations of PCBs pose a risk to the marine ecosystem?

JAMP Issue 1.10 What are the concentrations of PAHs in the maritime area?

JAMP Issue 1.17 Where do pollutants cause deleterious effects?

The following guidelines are relevant to this part of the programme:

JAMP Guidelines for Monitoring Contaminants in Sediments.

JAMP Eutrophication Monitoring Guidelines: Benthos.

JAMP Guidelines for General Biological Effects Monitoring.

This part of the programme also meets some of the requirements of the standstill clause of the EC Dangerous Substances Directive.

It is anticipated that the metals programme will at worst have 90% power to detect a 5% per year change over a period of between 15 and 20 years.

Sediment samples will be collected at the designated sampling point within each strata (on a random or fixed basis) and the exact location of each sample recorded. Replicates will be collected for chemistry, benthic analysis and biological effects, as required (see appropriate Appendix). Samples will be collected between February and June. In order to minimise the effects of seasonal variability in the macrobenthic communities, sampling should be undertaken within a narrow time window within the broader window of February to June. It is recommended that sampling is undertaken +/- 3 weeks of the original sampling date in 1999 or 2000. If sampling is undertaken during May or June then +/- 2 weeks is recommended.

Sampling and sample storage

Information on sampling method and sample storage are required for submission of the data to ICES. Relevant codes and field sheets for recording this information are provided in Appendix 3. Sediments should be analysed for contaminants, macrofauna and biological effects on separate grabs collected from the same location on the same sampling occasion. Details of sample preparation and analysis record requirements are given in Appendix 6,7,8,9, and 10. Parameters to be monitored are detailed in spreadsheet param_uomval.xls and sites to be monitored are listed in STATN.csv.

Contaminant record

This record requires information on the method of preparation and analysis information for the parameters measured (Table 1.1). Samples for trace metal analysis should be sieved to <63 µm however, existing sample preparation methodologies may be maintained where a time series exists. The sieve size used must be noted in the data returns to the NMMP database. Parameter codes and reporting units for sediments are listed in the spreadsheet

param_uomval.xls. Analytical methods should be designed to achieve QUASIMEME performance targets.

Table 1.1. Contaminants in sediments	ICES Code	Status	Units	Targets	
				LOD	P%
Aluminium	AL	M	%	0.1	25
Cadmium	CD	M	µg/kg	200	25
Mercury	HG	M	µg/kg	10	25
Copper	CU	M	mg/kg	1	25
Lead	PB	M	mg/kg	2	25
Nickel	NI	M	mg/kg	1	25
Zinc	ZN	M	mg/kg	2.5	25
Arsenic	AS	M	mg/kg	1	25
Chromium	CR	M	mg/kg	2	25
Lithium	LI	M	mg/kg	0.1	25
Iron	FE	M	%	0.1	25
Manganese	MN	M	mg/kg	0.1	25
TBT	TBTIN	M	µg/kg	1	25
PCB 28	CB28	M	µg/kg	0.1	25
PCB 52	CB52	M	µg/kg	0.1	25
PCB 101	CB101	M	µg/kg	0.1	25
PCB 118	CB118	M	µg/kg	0.1	25
PCB 138	CB138	M	µg/kg	0.1	25
PCB 153	CB153	M	µg/kg	0.1	25
PCB 180	CB180	M	µg/kg	0.1	25
Naphthalene	NAP	M	µg/kg	10	25
Phenanthrene	PA	M	µg/kg	10	25
Anthracene	ANT	M	µg/kg	2	25
Fluoranthene	FLU	M	µg/kg	2	25
Pyrene	PYR	M	µg/kg	2	25
Benzo[a]anthracene	BAA	M	µg/kg	2	25
Chrysene/Triphenylene	CHRTR	M	µg/kg	2	25
Benzo[a]pyrene	BAP	M	µg/kg	2	25
Benzo[ghi]perylene	BGHIP	M	µg/kg	10	25
Indeno[123-cd]pyrene	ICDP	M	µg/kg	10	25
Acenaphthene	ACNE		µg/kg	2	25
Acenaphthylene	ACNLE		µg/kg	2	25
Dibenzothiophene	DBT		µg/kg	10	25
C1-dibenzothiophenes	DBTC1		µg/kg	10	25
C2-dibenzothiophenes	DBTC2		µg/kg	10	25
C3-dibenzothiophenes	DBTC3		µg/kg	10	25
Fluorene	FLE		µg/kg	10	25
1-methylnaphthalene	NAP1M		µg/kg	10	25
2-methylnaphthalene	NAP2M		µg/kg	10	25
C1-naphthalenes	NAPC1		µg/kg	10	25
C2-naphthalenes	NAPC2		µg/kg	10	25
C3-naphthalenes	NAPC3		µg/kg	10	25
Benzo[e]pyrene	BEP		µg/kg	10	25
Dibenz[a,h]anthracene	DBAHA		µg/kg	5	25
Perylene	PER		µg/kg	10	25
Triphenylene	TRI		µg/kg	20	25
C1-phenanthrenes	PAC1		µg/kg	10	25
C2-phenanthrenes	PAC2		µg/kg	10	25
C3-phenanthrenes	PAC3		µg/kg	10	25
Benzo[c]phenanthrene	PABC		µg/kg	10	25
Benzo[b]anthracene	BBA		µg/kg	10	25
Benzo[b+j,k]fluoranthene	BBKF		µg/kg	10	25
Organic carbon	CORG	M	%		25

Particle Size Analysis

Sediment structure as determined by particle size analysis is used to support benthic community analysis and contaminants. The sample used to support benthic community analysis should be a representative collected from a separate grab. The full range of parameters detailed in Table 1.1 should be determined on this sample. A separate sample should be collected for particle size analysis to support the contaminants data. The fraction less than 63µm should be determined on this sample.

Table 1.2 – sediment grain size parameters.

Code	Description	Interpretation	Unit
GSKURT	Grain size kurtosis	Statistical summary	Scale
GSMEA	Grain size mean	Statistical summary	mm
GSSKEW	Grain size skewness	Statistical summary	Scale
GSSORT	Grain size sorting	Statistical summary	Scale
GSMED	Grain size median	Statistical summary	mm
GSMF>8000	Grain Size Mass Fraction >8000	Phi class which may also be used to derive broader classes (% sand, gravel etc)	%
GSMF>4000<8000	Grain Size Mass Fraction >4000<8000	See above	%
GSMF>2000<4000	Grain Size Mass Fraction >2000<4000	See above	%
GSMF>1000<2000	Grain Size Mass Fraction >1000<2000	See above	%
GSMF>500<1000	Grain Size Mass Fraction >500<1000 µm	See above	%
GSMF>250<500	Grain Size Mass Fraction >250<500 µm	See above	%
GSMF>125<250	Grain Size Mass Fraction >125<250 µm	See above	%
GSMF>63<125	Grain Size Mass Fraction >63<125 µm	See above	%
GSMF63	Grain Size Mass Fraction <63 µm	See above	%
GSMF20	Grain Size Mass Fraction <20 µm	Used for chemistry interpretation	%

Benthic community analysis record

Guidelines for the analysis of macrobenthic samples are given in Appendix 10. Macrobenthic species data should be submitted in conjunction in the coding system used (RUBIN or other agreed list) and information on biological community parameters i.e. biomass and abundance. Information on sediment particle size should also be submitted with macrobenthic species data (see Table 1.1).

Table 1.3 Benthic Macrofauna	CODE
Latin name of species (or aggregated genus/family)	
Reference code list used for species ID	ITLN
Abundance number	ABUNDNR
Biomass-wet weight	BMWETWT
Biomass –dry weight	BMDRYWT
Biomass –ash free dry weight	BMAFDWT

Where toxic effects are observed, toxicity-directed analysis of interstitial water fractions should be carried out.

Biological Effects – Sediments

Participating organisations will apply whole sediment bioassays at estuarine sites. Relevant biological effects techniques to be applied to sediments are outlined in Appendix 2 and ICES reporting codes are given in Table 1.4. Biological effects should be associated with contaminant monitoring data.

TABLE 1.4 BIOLOGICAL EFFECTS	CODE	UNIT
<i>Corophium</i> mortality (10 day)	MORT%	%
<i>Arenicola</i> mortality and feeding rate (10 day)	MORT%	%
<i>Tisbe</i> mortality pore water (2 day)	MORT%	%
Redox*	REDOX	mV
Temperature*	TEMP	degC
Ammonia**	AMON	uM
Hydrogen Sulphide**	HSUL	mg/l

* At the time of sample collection

** During the whole sediment bioassay test

Table 1.5 SEDIMENT SAMPLING STATIONS – see STATN.csv

Table 2 - Monitoring required in Shellfish

Strategy

This monitoring is completed to fulfil the requirements of the following JAMP Issues:

JAMP Issue 1.2 What are the concentrations and fluxes of Mercury, Cadmium and Lead in sediment and biota?

JAMP Issue 1.3 To what extent do biological effects occur in the vicinity of major shipping routes, offshore installations, marinas and shipyards?

JAMP Issue 1.7 Do high concentrations of PCBs pose a risk to the marine ecosystem?

JAMP Issue 1.10 What are the concentrations of PAHs in the maritime area?

JAMP Issue 1.11 Do PAHs affect fish and shellfish?

JAMP Issue 1.17 Where do pollutants cause deleterious effects?

The following guidelines are relevant to this part of the Programme:

JAMP Guidelines for Monitoring Contaminants in Biota.

JAMP Guidelines for Contaminant Specific Biological Effects Monitoring.

This part of the programme also meets some of the requirements of the standstill clause of the EC Dangerous Substances Directive, the Shellfish Growing Waters Directive and the Shellfish Hygiene Directive. Analysis of organochlorine residues are only required at selected sites in relation to EC Directive monitoring. The JAMP only requires monitoring for PCBs.

Contaminant monitoring

To minimise duplication of effort, Shellfish Growing Waters or Shellfish Hygiene Directive sites should be used for CSEMP purposes where possible. It is anticipated that this programme will have 90% power to detect at least a 10% per year change in metal concentrations and a 20% per year change in organics concentrations over a 20 year period.

The common blue mussel (*Mytilus edulis*) should be used. Where this species is not available brown seaweed (*Fucus vesiculosus* or *Fucus spiralis*) may be used. The same species should be used henceforth for temporal trend monitoring and should be collected at the same time of year on all sampling occasions.

Samples should be collected from the shore at locations avoiding the influence of point source discharges. Samples should be collected between February / March to avoid the spawning period. Sufficient individual mussels in the size range 3-6 cm should be collected to provide sufficient soft tissue for each analysis. To minimise the effects of natural size related variability, the length range of individuals within this broad band should be minimised as much as possible to, for example, 5 mm. This narrower length band should then be fixed from year to year. In selecting the sample, care should be taken that it is representative of the population and that it can be obtained annually. Average data should be reported with supporting data on species used, mean, maximum and minimum length, % moisture content and % total lipid (wet weight basis).

Appendix 5 details sampling, sample storage and sample preparation procedures and lists appropriate ICES codes. This information must be provided with the data. The Foppes Smedes procedure is recommended for measurement of total lipid. Contaminants to be monitored are detailed in Table 2.1 together with required analytical targets.

Table 2.1 Contaminants in biota	ICES Code	Status	Units	Analytical Targets	
				LOD	P%
Mercury	HG	M	µg/kg wet weight	20 (mussels) 3 (<i>Fucus</i>)	25
Cadmium	CD	M	µg/kg wet weight	50	25
Copper	CU	M	µg/kg wet weight	100	25
Lead	PB	M	µg/kg wet weight	50	25
Nickel	NI	M	µg/kg wet weight	50	25
Zinc	ZN	M	µg/kg wet weight	2000	25
Arsenic	AS	M	µg/kg wet weight	300	25
Chromium	CR	M	µg/kg wet weight	50	25
Silver	AG	M	µg/kg wet weight	10	25
Selenium	SE	M	µg/kg wet weight	10	25
PCB 28	CB28	M	µg/kg wet weight	0.1	25
PCB 52	CB52	M	µg/kg wet weight	0.1	25
PCB 101	CB101	M	µg/kg wet weight	0.1	25
PCB 118	CB118	M	µg/kg wet weight	0.1	25
PCB 138	CB138	M	µg/kg wet weight	0.1	25
PCB 153	CB153	M	µg/kg wet weight	0.1	25
PCB 180	CB180	M	µg/kg wet weight	0.1	25
HCH - alpha	HCHA		µg/kg wet weight	0.1	25
HCH B beta	HCHB		µg/kg wet weight	0.1	25
HCH - gamma	HCHG		µg/kg wet weight	0.1	25
HCH - delta	HCHD		µg/kg wet weight	0.1	25
op-DDT	DDTOP		µg/kg wet weight	0.1	25
pp-DDT	DDTPP		µg/kg wet weight	0.1	25
pp-TDE	TDEPP		µg/kg wet weight	0.1	25
pp-DDE	DDEPP		µg/kg wet weight	0.1	25
Dieldrin	DIELD		µg/kg wet weight	0.1	25
Aldrin	ALD		µg/kg wet weight	0.1	25
Endrin	END		µg/kg wet weight	0.1	25
Isodrin	ISOD		µg/kg wet weight	0.1	25
HCB	HCB		µg/kg wet weight	0.1	25
HCBD	HCBD		µg/kg wet weight	0.1	25
Naphthalene	NAP	M	µg/kg wet weight	1	25
Phenanthrene	PA	M	µg/kg wet weight	1	25
Anthracene	ANT	M	µg/kg wet weight	0.5	25
Fluoranthene	FLU	M	µg/kg wet weight	0.5	25
Pyrene	PYR	M	µg/kg wet weight	0.5	25
Benzo[a]anthracene	BAA	M	µg/kg wet weight	0.5	25
Chrysene	CHRTR	M	µg/kg wet weight	0.5	25
Benzo[a]pyrene	BAP		µg/kg wet weight	0.5	25
Benzo[ghi]perylene	BGHIP		µg/kg wet weight	0.5	25
Indeno[123-cd]pyrene	ICDP		µg/kg wet weight	0.5	25
Acenaphthene	ACNE		µg/kg wet weight	0.5	25
Acenaphthylene	ACNLE		µg/kg wet weight	0.5	25
Dibenzothiophene	DBT		µg/kg wet weight	0.5	25
C1-dibenzothiophenes	DBTC1		µg/kg wet weight	0.5	25
C2-dibenzothiophenes	DBTC2		µg/kg wet weight	0.5	25
C3-dibenzothiophenes	DBTC3		µg/kg wet weight	0.5	25
Fluorene	FLE		µg/kg wet weight	0.5	25
1-methylnaphthalene	NAP1M		µg/kg wet weight	0.5	25
2-methylnaphthalene	NAP2M		µg/kg wet weight	0.5	25
C3-naphthalenes	NAPC3		µg/kg wet weight	0.5	25
Benzo[e]pyrene	BEP		µg/kg wet weight	0.5	25
Dibenz[a,h]anthracene	DBAHA		µg/kg wet weight	0.5	25
Perylene	PER		µg/kg wet weight	0.5	25
Triphenylene	TRI		µg/kg wet weight	0.5	25
C1-phenanthrenes	PAC1				

Table 2.1 Contaminants in biota	ICES Code	Status	Units	Analytical Targets	
			µg/kg wet weight	0.5	25
C2-phenanthrenes	PAC2		µg/kg wet weight	0.5	25
C3-phenanthrenes	PAC3		µg/kg wet weight	0.5	25
Benzo[c]phenanthrene	PABC		µg/kg wet weight	0.5	25
Benzo[b]anthracene	BBA		µg/kg wet weight	0.5	25
Benzo[b+j,k]fluoranthene	BBKF		µg/kg wet weight	0.5	25
C1-naphthalenes	NAPC1		µg/kg wet weight	0.5	25
C2- naphthalenes	NAPC2		µg/kg wet weight	0.5	25
Total lipid	LIPIDWT	M	% wet weight	0.1	25
Dry Weight	DRYWT	M	%		
Tributyl tin (for imposex only)	TBTIN		µg/kg wet weight	20	25

TABLE 2.1 contd. SUPPORTING DATA			
	CODE	Status	UNITS
length (max) (in combination with matrix)	LNMEA	M	mm
length (mean or individual) (in combination with matrix)	LNMAX	M	mm
length (min) (in combination with matrix)	LNMIN	M	mm
Moisture Content	MOCON		%
Dry weight percent	DRYWT		%
weight (max) (in combination with matrix)	WTMAX		g
weight (mean or individual) (in combination with matrix)	WTMEA		g
weight (min) (in combination with matrix)	WTMIN		g
No. Of individuals per batch	NUM	M	g
Extractable Lipids	EXLIP		%
Total lipid	LIPIDWT		%
Species identity	SPECI	M	Full Latin name, (e.g. <i>Mytilus edulis</i>)

Table 2.2 SHELLFISH SAMPLING STATIONS (see STATN.csv)

Biological Effects – Shellfish

Imposex/intersex and TBT Methodology

Sampling should be designed in accordance with the revised OSPAR guidelines on TBT effects monitoring (OSPAR, 2002). The guidelines recommended the use of the common dog whelk (*Nucella lapillus*) for the determination of imposex. In areas where dogwhelks are not present in sufficient numbers, other species can be used (Table 2.3). Imposex in whelks (*Buccinum undatum* and *Neptunea antiqua*) can be determined at offshore sites. Samples should be collected from sites at increasing distances away from point sources (i.e. marinas, ship yards and harbours) to determine gradients of effect. Imposex and intersex data should be supported by analysis of TBT in tissue, where appropriate. Samples should be collected once every three years from designated sites. For sampling requirements and analytical protocols, see Appendix 2.

Laboratories must participate in the QUASIMEME interlaboratory proficiency test exercise for Imposex and report their results to ICES.

The parameters listed in Table 2.3 should be measured and reported to ICES using the units and codes listed in param_uomval.xls.

Table 2.3: Imposex/Imposex parameters required for reporting to ICES

Parameter	Nucella	Buccinum	Neptunea	Littorina
Proportion of females displaying imposex or intersex	1	1	1	1
Vas deferens sequence index (VDSI)	1	1	1	
Proportion of sterile females	1			1
Relative Penis size index (RPSI)	1			
Relative Penis length index (RPLI)				
Intersex index (INTSI)				1
Average length of prostate gland in females (FPrL)				1
Penis classification index (PCI)		1		

Table 3 – Monitoring required in fish

Strategy

This monitoring is undertaken to fulfil the requirements of the following JAMP Issues.

JAMP Issue 1.2 What are the concentrations and fluxes of Mercury, Cadmium and Lead in sediment and biota?

JAMP Issue 1.3 To what extent to biological effects occur in the vicinity of major shipping routes, offshore installations, marinas and shipyards?

JAMP Issue 1.7 Do high concentrations of PCBs pose a risk to the marine ecosystem?

JAMP Issue 1.8 Do high concentrations of non-ortho and mono-ortho CBs in seafood pose a risk to human health?

JAMP Issue 1.10 What are the concentrations of PAHs in the maritime area?

JAMP Issue 1.11 Do PAHs affect fish and shellfish?

JAMP Issue 1.17 Where do pollutants cause deleterious effects?

The following guidelines are relevant to this part of the Programme:

JAMP Guidelines for Monitoring Contaminants in Biota.

JAMP Guidelines for Contaminant Specific Biological Effects Monitoring.

This part of the programme also meets some of the requirements of the EC Fishery Products Directive.

It is anticipated that this programme will have 90% power to detect a 2-10% per year change in metal concentrations in fish muscle over a 20 year period. It is anticipated that the programme for monitoring contaminants in fish liver will have 90% power to detect a 3-10% change per year in both metals and organics over a 20 year period.

Preferred species are dab (*Limanda limanda*) or flounder (*Platichthys flesus*). Other acceptable species include plaice, cod and whiting. Whichever species is chosen it must be analysed throughout the time series dataset, in a consistent strategy, outside the breeding season.

Ideally, about 25 (22 to 28) fish in the size range 18-30 cm (dab), 15-35 cm (flounder), 20-30cm (plaice), 30-45cm (cod) and 20-35cm (whiting) should be collected at a site. Length stratified data are needed from 5 batches of at least 5 fish. If five fish yield insufficient liver tissue for analysis more than five fish may be collected from one or more catches of the 5 fixed length strata. A minimum of 4 batches are required from the 5 fixed length strata. The number of fish pooled in each batch must be the same each year. Visibly damaged fish should not be included. Each batch should correspond to one of the 5 fixed length strata. Data should be reported with supporting data on mean length, % lipid and % wet weight. Analyses should be carried out on both the muscle and the liver. Samples should be collected outside the spawning period and at the same time of the year in each year.

Where there is an insufficient range of fish at a site eg < 10 cm, the sampling strategy may be revised as follows:

Modification 1 Length range 5-10 cm with the fixed length range

Split the length range close to the log mid-point into small and large. Collect a minimum of twenty fish to provide 2 equal replicates of each size group with a minimum of five fish per replicate. Fish should be allocated to replicates before homogenising the tissue.

Modification 2 length range < 5 cm

Collect a random sample of a minimum of twenty fish and randomly allocate them equally to 4 replicates of at least five fish. Again fish should be allocated to replicates before homogenising the tissue.

An alternative to length stratified sampling may be to minimise natural variability. At least 12 single sex fish, preferably female, age 2-3 years should be caught in a narrow length range (i.e. 26-30cm, 31-35cm etc). The length of the individuals collected should be constant from year to year at each station or should at least fall within a very narrow range, such as within 5cm. In selecting the sample, care should be taken that it is representative of the population and that it can be obtained annually (see JAMP guidelines for more detail on length stratified sampling).

Methodology

Fish should be sampled outwith the spawning season and contaminants should be measured on the same samples collected for biological effects. Details of sample location and gear used for trawling should be recorded. Samples should be prepared for analysis as soon as possible after collection (see Appendix 4).

Table 3.1: Determinand	Status	ICES Code	Matrix	Units	NMCAQC target	
					LOD	P%
ANALYSES IN MUSCLE (FM)						
Mercury		HG	MU	µg/kg wet weight	20	25
Arsenic		AS	MU	µg/kg wet weight	300	25
ANALYSES IN LIVER (FL)						
Cadmium		CD	LI	µg/kg wet weight	2	25
Lead		PB	LI	µg/kg wet weight	10	25
PCB 28		CB28	LI	µg/kg wet weight	0.1	25
PCB 52		CB52	LI	µg/kg wet weight	0.1	25
PCB 101		CB101	LI	µg/kg wet weight	0.1	25
PCB 118		CB118	LI	µg/kg wet weight	0.1	25
PCB 138		CB138	LI	µg/kg wet weight	0.1	25
PCB 153		CB153	LI	µg/kg wet weight	0.1	25
PCB 180		CB180	LI	µg/kg wet weight	0.1	25
SUPPORTING DETERMINANDS						
Moisture content	M	MOCON	MU	% wet weight		
Dry weight	M	DRYWT	MU	% dry weight		
Total lipid	M	LIPIDWT	LI	%		
Length (mean)	M	LNMEA	WO	mm		
Length (min)		LNMAX	WO	mm		
Length (max)		LNMIN	WO	mm		
Mean weight		WTMEA	WO	g		
Min weight		WTMIN	WO	g		
Max weight		WTMAX	WO	g		
Species identity	M	SPECI		Full Latin name (e.g. dab is <i>Limanda limanda</i> -)		
Sex		SEXCO		(M, F, X=mixed, I=immature)		
Liver weight		WTMEA	LI	g		
Number in Batch	M	NUM				
Extractable Lipids		EXLIP		%		
Total lipid	M	LIPIDWT		%		

The analysis of arsenic in fish flesh is only required where data is to be reported for the Fisheries Product Directive. Total lipid should be analysed by the Foppes Smedes method.

Biological Effects – Fish

PAHs

The flatfish in estuaries will be flounder, and those offshore will be either plaice or dab. The suite of techniques for analysis includes EROD, bile metabolites and DNA adducts, and these should be augmented by the analysis of PCBs in fish liver and PAHs in sediments. Fish monitoring sites are indicated in STATN.csv . The relevant parameters listed in param_uomval.xls and summarised in Table 3.2 will be reported and the procedures for sampling and analysis are shown in Appendix 2.

Table 3.2 PAH measurements in fish

Description	Code	Units
EROD	EROD	pmol/min/mgprotein
1-hydroxy pyrene	PYR1OH	ng/g
1-hydroxy pyrene equivalent	PYR1OHEQ	ng/g
1-hydroxy phenanthrene	PA1OH	ng/g
3-hydroxy benzo(a)pyrene	BAP3OH	ng/g
2-hydroxy naphthalene	NAP2H	ng/g
Hydroxy-pyrene normaliser at absorbance 380 nm	PYROH-380	ng/g
DNA adducts	DNAAD	nr/1 E+8 UN

Fish Disease

CEFAS will undertake surveys of fish disease in flatfish once per annum as indicated in Appendix 7. Target species will be dab and flounder, although commercial species will be examined where sufficient numbers are caught. Protocol for examination of external disease and gross liver pathology will be according to ICES (1996). Samples will also be taken for the assessment of liver pathology using guidelines according to ICES (1997).

Surveys of fish disease involve FRS work in May-June at St Abbs, Bell Rock, the Beatrice Field and the JONSIS line. The ICES (1997) protocol for dabs will apply. The diseases and parasites detailed in Table 3.3 should be noted.

Table 3.3 Gross disease and parasites noted in fish.

Code	Description	Units
ACAN THO	Acanthochondria sp	afnr (affected number of individuals)
CRYP COT	Cryptocotyle sp	afnr
CLAV ELL	Clavella sp	afnr
EPID PAP	Epidermal hyperplasia/papilloma	afnr
GLUG STE	Glugea sp	afnr
ICHT SPP	Ichthyophonus sp.	afnr
LERN AEO	Lernaeocera sp.	afnr
LYMP CYS	Lymphocystis	afnr
LIVE NOD	Liver disease – nodule/tumour	afnr
LEPE OPH	Lepeophtheirus sp.	afnr
PSEU TUM	Pseudobranchial swelling	afnr
SKEL DEF	Skeletal deformity	afnr
STEP STO	Stephanostomum sp.	afnr
SKIN ULC	Skin ulcer (acute/healing ulcers)	afnr
VISC GRA	Visceral granuloma	afnr
XGIL LES	X-cell gill lesions	afnr
HPIGM	Hyperpigmentation	afnr
M74	M74	afnr
FROT	Fin rot/erosion (acute/healing)	afnr

Other Biomarkers

Development work is being carried out on vitellogenin and AChE (acetyl cholinesterase) .
See Appendix 2 for details.

Table 3.4 FISH SAMPLING STATIONS (see STATN.csv)

Table 4 – Eutrophication monitoring requirements

Strategy

Eutrophication is defined by OSPAR as:

The enrichment of water by nutrients causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and the quality of water concerned.

Indicators of an undesirable disturbance include:

- accelerated growth and changes in species composition of phytoplankton and macroalgae
- depleted oxygen concentration
- changes/kills in zoobenthos and fish kills
- elevated inputs of organic matter to sediments
- increase in incidence of harmful algae (related to the accelerated growth of algae)

Monitoring to determine the eutrophic status of UK marine waters is required by:

The OSPAR Strategy to Combat Eutrophication requires reduction in inputs of nutrients (from both point and diffuse sources) that contribute directly or indirectly to Problem Areas. Preventative action should be taken in Potential Problem Areas. As part of the strategy, an OSPAR Eutrophication Monitoring Programme was recently agreed.

The Urban Waste Water Treatment Directive (91/271/EEC): this directive requires regulatory authorities to determine the impact of nutrients from discharges of urban waste water.

The Nitrates Directive (91/676/EEC): this directive requires regulatory authorities to determine the impact of nutrients from diffuse sources (agriculture).

The Water Framework Directive (2000/60/EEC): this requires water bodies to achieve 'Good Ecological status' by 2015. Eutrophication is not specifically mentioned but the undesirable disturbance to the ecosystem which indicates eutrophication would prevent the water body achieving good ecological status.

The Habitats Directive (92/43/EEC): this directive aims to ensure the maintenance of biodiversity.

The following set of assessment criteria have been agreed for the **OSPAR Comprehensive Procedure**:

Causative parameters

Nutrients (Nitrate, Nitrite, Total Oxidised nitrogen, soluble reactive phosphate, silicate)

Nutrient concentrations vary seasonally in response to uptake by algal growth during the growing season and remineralisation of senescent algae over winter. Nutrients are measured in winter months (Nov - March) to obtain maximum values and facilitate interannual comparison. Winter nutrient concentrations are assessed against a region specific background. Assessment criteria are based on the background concentration of nutrients in coastal waters at a salinity of 34.5. Data gathered from regions of freshwater influence (ROFI) should be normalised against salinity where possible to allow comparison

with this data. Where possible, axial transects of nutrient concentration in estuaries should be completed to allow normalisation against salinity.

Direct and Indirect Effects

Chlorophyll

Spring/ Summer (April - September) chlorophyll concentrations should be determined as an indicator of phytoplankton biomass. Ideally continuous data should be collected as concentrations vary temporally and spatially in response to climatic and physical variables. The depth of the photic zone should also be determined by measuring the secchi disc depth. This gives an indication of whether phytoplankton growth is inhibited by availability of light.

Phytoplankton species composition

This part of the programme is under development, there is no quality control available.

Macrophytes

This part of the programme is under development, there is no quality control available.

Dissolved oxygen

Dissolved oxygen is consumed by the decay of senescent algae. Removal of oxygen by algal decay reaches a maximum during autumn and can lead to fish kills in severe cases. Dissolved oxygen should be measured in bottom waters during the autumn and any fish kills noted.

OSPAR minimum requirements for a eutrophication monitoring programme are specified in Tables 4.1 and 4.2. Contracting Parties should increase the scope and frequency of monitoring as they consider appropriate.

Table 4.1. Nutrient enrichment¹

	Non-problem areas	Potential problem areas	Problem areas
NH ₄ -N ^{2,4} (μmol l ⁻¹)	+	+	+
NO ₂ -N ^{2,4} (μmol l ⁻¹)	+	+	+
NO ₃ -N ^{2,4} (μmol l ⁻¹)	+	+	+
PO ₄ -P ^{3,4} (μmol l ⁻¹)	+	+	+
SiO ₄ -Si ⁴ (μmol l ⁻¹)	-	+	+
Salinity	+	+	+
Temperature	+	+	+
Frequency ⁵	About every three years during winter	Annually during winter when algal growth is at a minimum and during monitoring of direct and indirect effects	

+ Action required

- Action discretionary

1 All parameters should be monitored in conjunction with area-specific ecosystem features.

2 Winter dissolved inorganic nitrogen (DIN) is the sum of NH₄-N, NO₂-N and NO₃-N.

3 Winter dissolved inorganic phosphate (DIP)

4 Monitoring of winter DIN, DIP and Si should be in conjunction with salinity measurements (see Common Procedure, §§ 4.25 and 4.28).

- 5 Monitoring should include sufficient samples to confirm that the maximum winter nutrient concentration has been determined.

Table 4.2. Direct and indirect eutrophication effects¹

	Non-problem areas	Potential problem areas	Problem areas
Phytoplankton chlorophyll <i>a</i> ($\mu\text{g l}^{-1}$)	-	+	+
Phytoplankton indicator species (cells l^{-1} ; species composition)	-	+ species composition: (genera and nuisance/potentially toxic species)	+ species composition: (genera and nuisance/potentially toxic species) + TOC and POC ²
Macrophytes, including macroalgae and angiosperms ³	-	+ biomass	+ biomass + species composition, coverage, and reduced depth distribution
O ₂ concentration (mg l^{-1} ; and % O ₂ saturation)	-	+	+
(zoo)Benthic communities	-	+ biomass and species composition (if time series already exist)	+ biomass, species composition and eutrophication indicator species
Frequency ⁴	-	annually during the algal growing season	

+ Action required

- Action discretionary

1 All parameters should be monitored in conjunction with area-specific ecosystem features.

2 TOC: Total Organic Carbon; POC: Particulate Organic Carbon.

3 In shallow areas, primarily in estuaries and coastal waters.

4 With adequate frequency and area coverage

Methodology

It is recognised that spot water samples for inherently variable determinands such as nutrients, dissolved oxygen and chlorophyll *a* and are of limited value in long term trend monitoring. Continuous monitoring is preferable and should be used in areas of concern if possible. This technology is still in the developmental stage and steps should be taken to ensure that all organisations share experience to lead to best practice.

Table 4.3: Determinand	Units	ICES	NMCAQC Targets	
			LOD	P%
Ammonia	μM	AMON	0.5	12
Nitrate	μM	NTRA	0.5	12
Nitrite	μM	NTRI	0.05	12
Total oxidised nitrogen	μM	NTRZ		
Phosphate	μM	PHOS	0.05	12
Silicate	μM	SLCA	0.5	12
Chlorophyll- <i>a</i>	$\mu\text{g/l}$	CPHL	0.1	25
Dissolved oxygen	mg/l	DOXY		
SUPPORTING DETERMINANDS				
Salinity	PSU	PSAL	0.5	
Temperature	degC	TEMP		
Secchi depth	m	SECCI		

Procedural guidelines for nutrient and chlorophyll sampling and sample preparation are given in Appendix 12 and 13.

Table 4.4. UK Problem areas and potential problem areas identified by the first application of the Comprehensive Procedure

UK	
Ythan Estuary	Problem area
Lindisfarne NNR Area	Problem area
Seal Sands, Tees Estuary	Problem area
Pagham Harbour	Problem area
Chichester Harbour	Problem area
Langstone Harbour	Problem area
Portsmouth Harbour	Potential problem area
Holes Bay (<i>a small part of Poole Harbour embayment</i>)	Problem area
Poole Harbour	Potential problem area
The Fleet	Potential problem area
Truro, Tresillian and Fal Estuaries	Problem area
Taw Estuary	Problem area
Tawe	Problem area
Loughor Estuary	Potential problem area
Quoile Pondage (in Strangford Lough Catchment)	Problem area
Inner Belfast Lough & Tidal Lagan Impoundment	Problem area

Table 5 – Compliance Monitoring of Contaminants in Water**Strategy**

Monitoring for trace metals and organic compounds is undertaken to comply with the requirements of the EC Dangerous Substances Directive and is therefore only completed at National Network background monitoring points. Monitoring is required to determine compliance against national and international Environmental Quality Standards which are usually annual averages. Quarterly monitoring is regarded as the minimum frequency to assess compliance on an annual average basis. Organisations need only submit data collected for their statutory monitoring requirements: List I substances, and List II substances where there is a known source. All samples from the water column are to be taken about 1 metre below the surface. Water samples should be recovered at such a tidal state as gives worst case contaminant concentration or is otherwise practicable. Every effort should be made thereafter to recover samples under similar tidal conditions at each site. Biological effects samples for Oyster Embryo Bioassay should be collected in conjunction with contaminants samples at estuarine sites.

Methodology

Extreme care should be taken to avoid contamination of the sample during sampling and sample preparation. Trace metals samples should be filtered to <0.45 µm to allow comparison with EQS for dissolved metals. Salinity and suspended solids samples should also be collected to provide supporting information. Sampling and sample preparation procedures are outlined in Appendix 13.

Metals

Table 5.1: Determinands	Units	ICES	Target	
DISSOLVED METALS			LOD	P%
LIST I				
Mercury	ng/l	HG	3	25
Cadmium	µg/l	CD	0.04	25
LIST II				
Copper	µg/l	CU	0.2	25
Lead	µg/l	PB	0.04	25
Nickel	µg/l	NI	0.25	25
Zinc	µg/l	ZN	0.4	25
Iron	µg/l	FE	100	25
Boron	µg/l	B	700	25
Arsenic	µg/l	AS	2.5	25
Chromium	µg/l	CR	1.5	25
Vanadium	µg/l	V	10	25
SUPPORTING DETERMINANDS				
Salinity	PSU	PSAL	0.5	
Suspended solids	mg/l	SUSP	2	

Organics

Organics are to be monitored for DSD purposes only. The analysis should be of unfiltered samples. Data must be submitted with supporting salinity and suspended solids data.

Table 5.2: Determinand	Units	ICES Code	NMCAQC Target	
			LOD	P%
ORGANICS				
LIST I				
HCH – alpha	ng/l	HCHA	2	25
HCH – beta	ng/l	HCHB	2	25
HCH – gamma	ng/l	HCHG	2	25
HCH – delta	ng/l	HCHD	2	25
op-DDT	ng/l	DDTOP	1	25
pp-DDT	ng/l	DDTPP	1	25
pp-TDE	ng/l	TDEPP	1	25
pp-DDE	ng/l	DDEPP	1	25
DIELDRIN	ng/l	DIELD	1	25
ALDRIN	ng/l	ALD	1	25
ENDRIN	ng/l	END	0.5	25
ISODRIN	ng/l	ISOD	0.5	25
HCB	ng/l	HCB	3.0	25
HCBD	ng/l	HCBD	10	25
Carbon tetrachloride	µg/l	CCL4	0.1	25
Chloroform	µg/l	CHCL3	0.1	25
1,2 dichloroethane	µg/l	DCE	1	25
1,2,4 trichlorobenzene	ng/l	TRCB	10	25
1,3,5 trichlorobenzene	ng/l	TRCB2	10	25
1,2,3 trichlorobenzene	ng/l	TRCB1	10	25
Perchloroethylene	µg/l	PERCE	0.1	25
Trichloroethylene	µg/l	TRCE	0.1	25
Pentachlorophenol	µg/l	PCP	0.2	25
LIST II				
2,4 – D (total ester)	µg/l	E240	0.1	25
2,4 – D (non ester)	µg/l	240	4.0	25
1,1,1 – trichloroethane	µg/l	TCE	10	25
1,1,2 – trichloroethane	µg/l	2TCE	30	25
Bentazone	µg/l	BENT	50	25
Biphenyl	µg/l	BIPN	2.5	25
4-chloro-2-nitrotoluene	µg/l	4C2N	0.2	25
4-chloro-3-nitrotoluene	µg/l	4C3N	0.2	25
2-chloro-4-nitrotoluene	µg/l	2C4N	0.2	25
2-chloro-5-nitrotoluene	µg/l	2C5N	0.2	25
2-chloro-6-nitrotoluene	µg/l	2C6N	0.2	25
Demeton		DEM		
Demeton – o		DEMO		
Demeton – s		DEMS		
Oxydemeton – methyl	ng/l	ODM	10	25
Demeton – s – methyl	ng/l	DSM	10	25
Demeton – s – methyl sulphone	ng/l	DSME	10	25
Dimethoate	µg/l	DMT	0.1	25
Linuron	µg/l	LIN	2.0	25
MCPA	µg/l	MCPA	0.2	25
Mecoprop	µg/l	MECOP	2.0	25
Toluene	µg/l	TOL	4	25
Triazaphos	ng/l	TRIAZ	0.5	25
Dichlorvos	ng/l	DCV	4	25
Atrazine	ng/l	ATRZ	100	25
Simazine	ng/l	SIMZ	100	25
Azinphos – methyl	ng/l	AZM	1.0	25
Endosulphan (total)	ng/l	ENDOS	0.3	25
Fenitrothion	ng/l	FENT	1.0	25
Malathion	ng/l	MAL	2.0	25
Trifluralin	ng/l	TRF	10	25
Triphenlytin	ng/l	TPTIN	0.2	25
Tributyltin	ng/l	TBTIN	0.8	25
Benzene	µg/l	BENZ	1	25
O – xylene	µg/l	XYLO	1	25
M – xylene	µg/l	XYLM	1	25
P – xylene	µg/l	XYLP	1	25
Diazinon	ng/l	DIAZ	1	25
Chlorfenvinphos	ng/l	CHLOR	1	25

Table 5.2: Determinand	Units	ICES Code	NMCAQC Target	
Propetamphos	ng/l	PROPE	1	25
Naphthalene	µg/l	NAP	0.5	25
4-chloro-3-methyl phenol	µg/l	CMP43	4	25
2-chlorophenol	µg/l	2CP	5	25
2,4-dichlorophenol	µg/l	DCP24	2	25
PCSDs	ng/l	PCSO	5	25
Cyfluthrin	ng/l	CYF	0.1	25
Sulcofuron	µg/l	SUL	2.5	25
Flucofuron	µg/l	FLUCO	0.1	25
Permethrin	ng/l	PERM	1	25

Biological Effects – Water

Oyster embryo bioassay is used to determine toxicity of waters in estuaries. In practice samples should be collected in conjunction with contaminant samples. For sampling procedures and design, see Appendix 2.

Methodology

The parameters in Table 5.3 should be reported.

Table 5.3 Oyster bioassay (*Crassostrea gigas*) parameters

Field	ICES Code	Units
Percent net response	PNR	%
No. Control replicates	NUMCR	
No. Sample replicates	NUMSR	
Source of reference water	SRCWT	A=artificial, L=local, O=offshore
Salinity*	PSAL	PSU

* Sample water at the time of collection

Table 5.4 WATER SAMPLING STATIONS (see STATN.csv)

Table 6. Analytical Quality Control Reporting Requirements

The required accuracy and precision of contaminant data submitted to the NMMP is specified in Tables 1-5. Data meeting these requirements is considered to be 'fit for purpose'. The NMCAQC scheme has developed a data filter to assess the quality of contaminant data submitted to the NMMP using the full spectrum of quality control activities. The data filter incorporates internal and external (QUASIMEME) quality control parameters which are also required by ICES for their assessments (see Table 6). Internal quality control information should be reported annually with the associated contaminant data. External (QUASIMEME) data should be submitted to the NMMP database when it is received together with a note of the laboratory code. QUASIMEME have also agreed with ICES to provide laboratories with a disc containing their data for submission to ICES annually.

Laboratories are assigned a score based on the parameters in Table 6.1 and are required to meet a minimum target for the data to be considered fit for purpose. Data from laboratories which don't achieve the minimum target is flagged and excluded from assessments.

Table 6.1. Quality Control Parameters

CODE	DESCRIPTION
CACCRED	chemical Accreditation status of the laboratory for the specified determinand
METCX	Method of chemical extraction
METOA	Method of analysis of parameter/contaminant (user defined)
DETLI	Detection limit value (use reporting units)
CONCH	Control chart basis (CRM, IRM,LRM,SRM)
CRMCO	Control chart reference material code (QUASIMEME samples acceptable here)
CRMMB	Control chart RM mean value - basis
CRMEV	Control chart expected value
CRMMV	Control chart mean value
CRMNM	Control chart reference material - number of measurements
CRMPE	Control chart reference material - period
CRMSD	Control chart reference material - standard deviation
