ROCK AND BIOGENIC REEF HABITATS: REVIEW OF INDICATORS AND IDENTIFICATION OF GAPS

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Summary

Indictors of rocky and biogenic reefs currently in use are reviewed as a contribution to the Healthy and Biologically Diverse Seas Evidence Group (HBDSEG) Assessment Framework Matrix (Version 2, 06/11/2007). This review focuses on those currently in use in policy and regulatory mechanisms and those developed through research that have potential monitoring application. Over 587 biological indicators of the state of rocky and biogenic reef habitats are currently employed, and these are presented by specific pressure, together with the monitoring methodology, parameters measured and data collected. Pressure indicators were outwith the scope of this review, however, the state indicators are related to specific pressures causing changes in rocky and biogenic reef ecosystems.

Key pressures for which indicators for rocky and biogenic reef habitats are in use include nuclear power stations, land-based pollution, climate change, oil and gas industry, shipping, tourism/recreation, coastal infrastructure, fishing (potting and benthic trawling) and aquaculture. Critical appraisal of indicators against specific pressures revealed that some indicators are responsive to a range of pressures and cannot be used to identify specific stressors or separate synergistic impacts. This is true for high order indicators of species and community change. While molecular and physiological indicators for specific contaminants provide a measure of contaminant availability, health of the organism themselves is not assessed, neither are effects on ecosystem processes or function. Overall, there is a lack of adequate baseline information vital to distinguish natural stochasticity from anthropogenic disturbances and reduce uncertainty in the attribution of causal factors.

A gap analysis identified pressures not currently being monitored by rocky or biogenic reef indicators. Half of all pressures (28) identified by the HBDSEG Assessment Framework Matrix are not currently monitored by indicators in UK waters. For 15 of these, indicators by the scientific research community could potentially be applied to address existing gaps.

Most of the indicators compiled are measures of impacts (contamination by radionuclides, heavy metals, hydrocarbons, synthetic and non-synthetic compounds, microbial pathogens) but others indicate ecosystem state (higher-level community and ecosystem indicators). Several indicators scored highly in terms of their capacity to identify changes in ecosystem structure and function, while most are not designed for this and have limited application. Climate change indictors infer most about ecosystem structure and function, as do other community level indictors (cover, abundance, biomass). However, caution must be extended when using process-based indicators as non-linearities and snap-shot monitoring programmes can distort findings, making interpretation difficult.

For hard substratum habitats, integrated ecosystem indicators involving multiple monitoring methods have proven harder to develop than for soft substratum. There have been two notable advances 1) macroalgal tool and 2) hard substratum benthic invertebrate tool, developed for the Water Framework Directive (WFD). An alternative is a hierarchical approach where indicators selected from different levels of biological organization can be used to address composition, structure and function of the ecosystem (e.g. the weight of evidence approach).

The suite of rock and biogenic reef indicators currently in use in the UK cover four out of five Contributory Marine Objectives (CMOs) with respect to ecosystem structure and function, and contribute to UK, regional and global statutory obligations. The fifth Objective, “Ensure natural biodiversity and ecological interactions are maintained and where appropriate and possible restored” is not addressed by indicators in use in the UK, and will prove difficult to meet, especially in the face of climate change which will drive alterations in biodiversity irrespective of the presence of anthropogenic pressures.

Recommendations include: 1) matching available indicators to management goals; 2) selecting objective metrics of ecosystem health that can be associated to the indicator; 3) selecting the most accurate, sensitive and suitable indicators where duplicates are currently in use; 4) refocusing effort and funding to develop indicators to fill current gaps; 5) establishing UK-wide procedures for aggregation and synthesis of data across spatial and temporal scales and, 6) seeking expert advice to build toolboxes for integrated ecosystem assessment.

Abbreviations

AFBI	Agri-Food and Biosciences Institute Northern Ireland
ASFA	Aquatic Sciences and Fisheries Abstracts
BAP	Biodiversity Action Plan
CCW	Countryside Council for Wales
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CMO	Contributory Marine Objectives
CSEMP	Clean and Safe Seas Monitoring Programme
CSSEG	Clean and Safe Seas Evidence Group
DPSIR	Driver-Pressure-State-Impact-Response Framework
EA	Environment Agency
EC	European Commission
EcoQO	Ecological Quality Objective
EHS	Environmental and Heritage Service Northern Ireland
EN	English Nature (now Natural England)
FRS	Fisheries Research Services
FSA	Food Standards Agency
FSAS	Food Standards Agency Scotland
HBSDEG	Healthy and Biologically Diverse Seas Evidence Group
HPA	Health Protection Agency
IAB	Integrin Advanced Biosystems Ltd
ICES	International Council for the Exploration of the Seas
IECS	Institute of Estuarine and Coastal Studies, Hull
JNCC	Joint Nature Conservation Committee
MarClim	Marine Biodiversity and Climate Change Programme
MarLIN	Marine Life Information Network
MBA	Marine Biological Association of the UK
MCS	Marine Conservation Society
MMPM	Marine Monitoring Protocols Manual
MRAG	Marine Resources Assessment Group
MSD	Marine Strategy Directive
NE	Natural England (formerly English Nature)
NISC	National Information Services Corporation
NMBL	National Marine Biological Library
OSPAR	The Oslo and Paris Commissions Convention on the Protection of the Marine Environment of the North-East Atlantic
PML	Plymouth Marine Laboratory
SACs	Special Areas of Conservation
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SOTEAG	Shetland Oil Terminal Environmental Advisory Group
SPAs	Special Protection Areas
SSSIs	Sites of Special Scientific Interest
TBT	Tributyltin
UKMMAS	UK Marine Monitoring and Assessment Strategy
UNEP	United Nations Environment Programme
WCMC	World Conservation Monitoring Centre
WFD	Water Framework Directive

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ROCK AND BIOGENIC REEF HABITATS: REVIEW OF INDICATORS AND IDENTIFICATION OF GAPS

Introduction

The aim of this contract is to assess the applicability of existing indicators and monitoring programmes, to identify where modifications might be appropriate and to identify significant gaps. Sets of indicators have been mapped to the HBDSEG Assessment Framework Matrix by (Version 2, 06/11/2007); these are taken from a number of key policy mechanisms (e.g. EC Directives) and other sources. It is recognised that there are large numbers of indicators developed through research which could be considered; this review focuses on those in use in policy and regulatory mechanisms and those of potential practical use.

In order to do this, the following work was undertaken:

1. Document the current set of indicators

All indicators currently in use are classified with respect to the purpose, parameters measured, the location of monitoring and the governmental or non-governmental body carrying out the monitoring, according to the format given in Annex 4 of the Contract Specification.

2. Review the indicators against the pressures

Each indicator is critically reviewed against the particular pressure or pressures that it is designed to measure, and the impact(s) of the pressure they are aimed at. For those indicators not intended to address a pressure, the aspect(s) of ecosystem quality they address are identified. The suitability and effectiveness of each indicator with respect to the pressure and its impact(s) it is designed to measure are addressed.

3. Assess which pressures are not adequately addressed by existing indicators

A gap analysis of indicators versus ecosystem components highlights where particular impacts from pressures are not currently being addressed by the current list of indicators. A list of potential indicators (e.g. in use in other countries, used for other monitoring programmes or developed in research) that could be used or adapted to address the specific impacts is suggested.

4. Assess the indicators against ecosystem structure and function issues

As well as aiming to ensure that the indicators can be used to assess the main impacts from human activities, it is important that the suite of indicators can collectively enable an assessment of the state of the ecosystem component. A number of indicators are more directly aimed at assessing aspects of the state of the ecosystem (e.g. population trends for specific species), rather than specific threats and are thus assessed in this review against key aspects of ecosystem structure and function. Important aspects of ecosystem functioning (such as primary production) which are not likely to be measured by the currently identified set of indicators are identified and suitable potential indicators are recommended.

5. Assess the indicators against the Contributory Marine Objectives and obligations

As well as aiming to ensure that the indicators can be used to assess the main impacts from human activities, it is important that the suite of indicators can collectively cover the current set of statutory obligations and meet Government's goals, as reflected in the relevant [draft]

CMOs. This review assesses how well the current suite of indicators meets the CMOs or statutory obligations and identifies those which are not currently addressed.

This report constitutes a systematic and thorough review of published and grey literature on the current set of indicators in use, how they map against pressures, and gaps in current statutory and national monitoring programmes. Where multiple indicators are monitoring the same pressure, recommendation of the most suitable indicators are made. Furthermore, pressures not currently addressed by existing indicators are assessed and potential indicators appraised. Indicators are then classified with reference to the PSR (Pressure-State-Response) framework (OECD, 1993) and considered for integrated ecosystem assessment. Finally indicators are assessed against key aspects of ecosystem structure and function.

Definition of indicator

Indicator: Used here in a very broad sense to encompass aspects of the marine biota (biological and ecological, from molecular and physiological to species, community and habitat levels) which are, or could be monitored to provide some indication of the *State* of the ecosystem. Indicators of Pressures (activity pressures or exposure pressures - the latter classified as *Impacts* in the Assessment Framework Matrix) are considered beyond the scope of this review, as are indicators of management responses. Within the context of this review, 'currently in use' indicates use in statutory monitoring and also includes national programmes such as MarClim.

Properties of good indicators

The ICES Advisory Committee on Ecosystems (www.ices.dk/iceswork/ace.asp) has recommended properties of good indicators (from political to scientific) of environmental quality. A good indicator should be:

- relatively easy to understand by non-scientists and those who will decide on their use;
- sensitive to a manageable human activity;
- relatively tightly linked in space and time to that activity;
- easily and accurately measured, with a low error rate;
- responsive primarily to human activity, with low responsiveness to other causes of change;
- measurable over a large proportion of the area in which the indicator is likely to be used; and
- based on an existing body of time-series of data to allow a realistic setting of objectives.

Definitions of rocky and biogenic reefs

Rocky reef: Intertidal and subtidal rocky substratum occurring in inshore coastal waters of the UK. The definition of these habitats include rocky platforms, walls and boulder fields between depths of 0-200 m.

Biogenic reef: Benthic reefs composed of living organisms including mussels and soft corals that form a biogenically constructed frame, and secondary settling species such as echinoderms and crustaceans.

PSR (Pressure – State – Response) framework

The Pressure - State - Response (PSR) framework is an approach for organizing information relating to environmental issues and can be applied to map pathways from the human to the ecological domains (OECD, 1993). It states that human activities exert Pressures (such as pollution emissions or land use changes) on the environment, which can induce changes in the State of the environment (for example, changes in ambient pollutant levels, habitat diversity, water flows, etc.). Society then responds to changes in pressures or state with environmental and economic policies and programs intended to prevent, reduce or mitigate pressures and/or environmental damage.

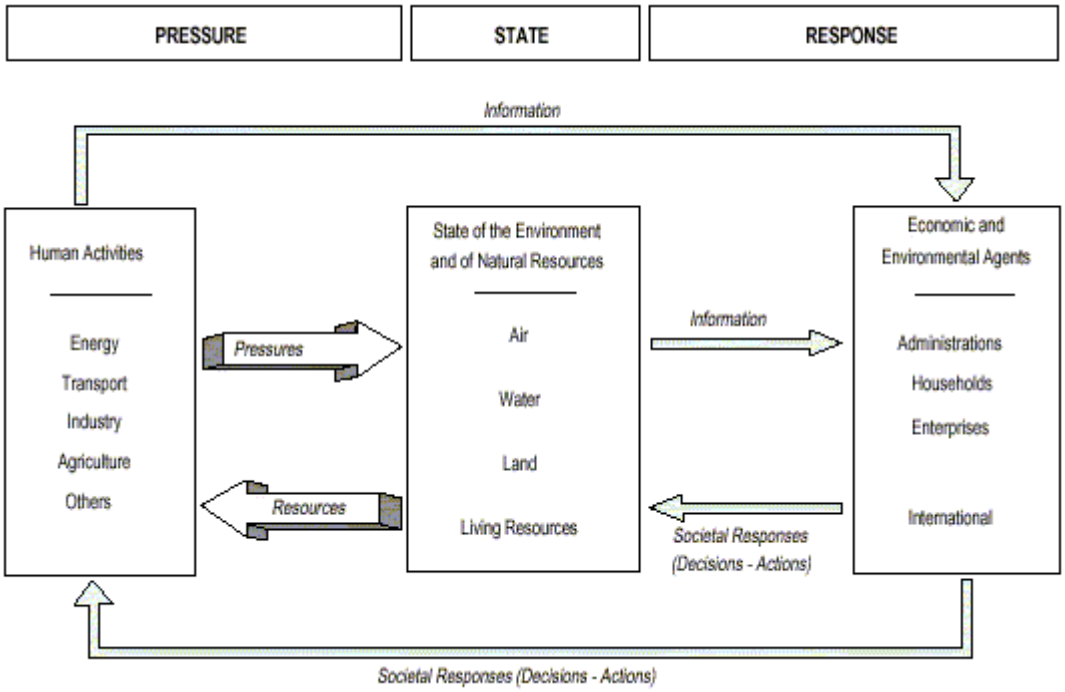

Figure 1. PSR (Pressure-State - Response) framework (OECD, 1993)

Ecosystem structure and functioning

Ecosystem structure and functions have been defined in many ways (Bremner *et al.*, 2006, de Groot *et al.*, 2002, Elliott *et al.*, 2006, 2004, Hiscock *et al.*, 2006, MRAG & UNEP-WCMC, 2007, Wallace, 2007). For the purpose of this review the definition of structure *sensu* Hiscock *et al.* (2006) is applied.

Structure includes the amounts and nature of both biological and non-biological components of the ecosystem and their arrangement of and relation between the parts of something more complex.

A widely accepted summary definition of ecosystem function is activities, processes or properties of ecosystems that are influenced by its biota (Naeem *et al.*, 2004). Within the context of this review, a process based approach is taken. Function describes the processes or groups of processes that link structural elements of an ecosystem together (Elliott *et al.*, 2006).

Policy Drivers

There are several marine environmental protection initiatives that require or would benefit from identification of rock and biogenic reef indicators for either specific pressures or more general changes in quality status. Overall the EU Marine Strategy Framework Directive sets up an integrated policy for the protection of the marine environment across all sectors in order to deliver a high level of protection of the marine environment (particularly outside the 1 nm limit). Additional policy drivers include the following:

The Oslo and Paris Commissions (OSPAR) Convention on the Protection of the Marine Environment of the North-East Atlantic has adopted an Ecological Quality Objectives (EcoQO) approach as a means of applying the Ecosystem Approach to the management of human activities. Ecological quality is defined as *"an overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities."* Within this overall framework, an ecological quality element is defined as *"an individual aspect of overall ecological quality"*. For each ecological quality element, there would then be set an ecological quality objective (EcoQO), which is consequently defined as *"the desired level of an ecological quality (EcoQ)"*. The definition adds that *"such a level may be set in relation to a reference level"*. The overall quality of the marine environment is assessed against a number of different issues. Of these, several are relevant to rock and biogenic reef habitats: benthic communities; threatened and/or declining species; threatened and/or declining habitats; and eutrophication.

In addition OSPAR has compiled an Initial list of Threatened & Declining Species and Habitats under Annex V of the Convention. The OSPAR Commission assesses which species and habitats need to be protected and has developed a set of criteria for the selection of such species, habitats and ecological processes, the Texel/Faial Criteria. Several invertebrate species (including *Megabalanus azoricus, Nucella lapillus, Ostrea edulis, Patella ulyssiponensis aspera*) and habitats (including *Lophelia pertusa* reefs, Maerl beds, *Modiolus modiolus* beds, intertidal *Mytilus edulis* beds, *Ostrea edulis* beds and *Sabellaria spinulosa* reefs) are relevant to rocky and biogenic reef habitats.

The EC Water Framework Directive (WFD) addresses the full range of potential human impacts on aquatic systems. It includes identification of targets (subject to various qualifications) for coastal waters in terms of achieving *"good surface water status"*. *"Good surface water status"* is defined in terms of *"good ecological status"*, coupled with *"good surface water chemical status"*. These in turn are to be defined in relation to a number of factors, which are to be assessed in relation to reference conditions representing the conditions to be expected in undisturbed water bodies, which in consequence are to be regarded as having *"High Ecological Quality"*. The WFD defines High Ecological Quality as *"All the disturbance sensitive taxa associated with undisturbed conditions are present"*.

The EC Habitats and Conservation of Wild Birds Directives require the maintenance of *'favourable conservation status'* within Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) and require the creation of a network of protected areas known as Natura 2000. This is transposed into UK legislation by the Conservation (Natural Habitats &c.) Regulations 1994. That requirement should be informed by a knowledge of what

communities and what species richness should be present in an area against the communities that are present. Change in communities needs to be recorded and interpreted including separation of natural variability and change brought about by anthropogenic activities (over-and-above sample variability).

In addition, rock and biogenic reef indicators outlined in this report are of benefit to monitoring for EC directives related to 1) Toxic contaminants - EC Dangerous Substances Directive; 2) Human health - EC Shellfish Waters Directive, EC Shellfish Hygiene Directive and EC Food Hygiene Regulations; and 3) Nutrients - EC Urban Waste Water Treatment Directive and EC Nitrate Directive, OSPAR Eutrophication Strategy.

In all of the various initiatives aimed at environmental protection, interpreting the results of monitoring or of sudden observed change requires an ability to separate likely natural variability or response to natural extreme events from change brought about by human activities. This constitutes another area of interpretation that should be informed by the study described here.

Methods

Sources of information

A number of information sources were utilised to compile a comprehensive list of indicators currently in use.

1) The Marine Monitoring Protocols Manual (MMPM), created for the UK Marine Monitoring and Assessment Strategy (UKMMAS), published February 2008, was the starting point for collating indicators. This resource provides a list of UK monitoring programmes and the parameters each measure.

2) After initial collation of indicators from the MMPM, further information on indicators currently monitored was gathered by:

i) interrogating websites of nationwide monitoring organizations (including Scottish Environment Protection Agency (SEPA), Environment Agency (EA), Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Food Standards Agency (FSA) including the Food Standards Agency Scotland (FSAS), Fisheries Research Services (FRS) and the Health Protection Agency (HPA).
ii) consulting specific site reports outlining monitoring protocols and implementation (including Regulation 33 (2)'s of the Conservation Regulations 1994, Scottish Natural Heritage (SNH) Commissioned reports and Countryside Council for Wales (CCW) marine monitoring reports).
iii) contacting managers directly, particularly for localised monitoring programmes e.g. Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs).

3) Further information was gathered on indicators through consulting additional website sources for individual programmes not monitored by statutory monitoring organisations such as the Marine Conservation Society (MCS) and Wildlife Trust websites.

4) Having collated all data on indicators covered in the MMPM, OSPAR monitoring policies were investigated along with WFD implementation to elucidate any outstanding indicators omitted, with OSPAR and European Commission websites scrutinised, and recent policy documentation assessed.

5) Finally, having covered indicators currently in use, other potential indicators were included. This involved searching the literature previously viewed and indicator sources, and in addition:

i) searching the NMBL catalogue of peer reviewed journals,
ii) investigating the abstract services provided by the NMBL (including ASFA, the Web of Science, NISC and Science Direct),
iii) searching the MarLIN database for likely sensitive species and marine habitats,
iv) searching previously contracted reports for the JNCC (including Gubbay, 2007, Hiscock & Kimmance, 2003, Hiscock *et al.*, 2005a) and the EA (such as Bremner *et al.*, 2006, Hiscock *et al.*, 2004) and,

v) reviewing a number of current or recent reports with specific indicator relevance such as the English Nature Biomonitoring Report (Long *et al.*, 2004), the European Marine Biodiversity Indicators Report (Feral *et al.*, 2003) and the Proceedings of 42nd European Marine Biology Symposium (EMBS, 2007).

6) On completion of the search for current and potential indicators, expertise was solicited from professionals within the MBA spanning a range of specialities and spanning all levels of indicators from cellular and physiological through to ecosystem level indicators to validate indicators, add additional indicators and refine the compiled information.

Data logging and interpretation

Data were entered into Microsoft Excel spreadsheets using the format outlined by the HBDSEG Contract Indicators Work Programme Review meeting. The following additional columns were added.

- Monitoring Programme.
- Methods / Protocol.
- Organisation coordinating the monitoring programme.

Indicators were categorized by pressures, impacts and ecosystem components using the UK Assessment Framework Matrix (Version 2, 06/11/2007). Pressures (human activities) and their impacts on the marine environment are the likely main issues known to cause damage to the environment and its biodiversity, and are consequently the main focus for any necessary management action. They are based on those used by OSPAR, the MSD and the WFD. Ecosystem components are those that are expected to form the basis for reporting on the state of the marine environment, and have been correlated with the components used by OSPAR and the MSD. Those relevant to this review are: *Intertidal rock & biogenic reef habitats* and *Coastal subtidal rock & biogenic reef habitats*. Indicators were also classified as either quantitative or qualitative, with quantitative indicators classified as directly effective (accurately showing a correlative effect with a specific pressure) and qualitative indicators classified as indirectly effective (showing a change but not correlative with the extent of specific pressures, or responding to multiple pressures).

Classification of indicators with respect to key aspects of ecosystem structure and function

The following biotic elements of ecosystem structure were considered based on the framework proposed by MRAG-WCMC (2007) and sources therein.

- Habitat types
- Habitat preferences
- Substratum types
- General biology
- Range and distribution
- Reproduction and longevity
- Species diversity
- Species richness
- Biomass
- Amounts of chlorophyll
- Functional groups
- Community structure

Ecosystem functions were categorised using the hierarchical approach of Giller *et al.* (2004) (Table 1). This is because the alternative approach of using biological traits as indicators for functioning (*sensu* Bremner *et al.*, 2006, Hiscock *et al.*, 2006) is not readily reconcilable with the multiple levels of biological organization collated in this review.

Table 1. Hierarchical classification of ecosystem functions that can be used to categorize coastal ecosystems (adapted from Giller *et al.*, 2004).

Class of process	**Ecosystem process**
Biomass production	Primary production
	Secondary production
Organic matter transformation	Organic matter decomposition
	Import/export of organic matter
	Organic matter removal
Ecosystem metabolism	Photosynthesis: respiration ratio
	Carbon mineralisation
	Oxygen consumption/production
Elemental cycling	Denitrification/nitrification/nitrogen fixation
	Exchange of limiting nutrients
Physical structuring	Bioturbation
	Reef-building
	Sedimentation
	Microbial film development

Results

The current set of indicators

The current set of indicators for rock and biogenic reef habitats are presented in Appendix 1. Tables a1-a8, and are organized by pressure and impact. Many of these indicators span both relevant ecosystem components: 1) intertidal rock and biogenic reef habitats and 2) coastal subtidal rock and biogenic reef habitats, as many hard substatum organisms occur both inter- and subtidally.

Key anthropogenic pressures, and associated impacts, currently addressed by indicators within rock and biogenic reef habitats include:

- Nuclear power stations - radionuclide contamination; human health;
- Land based pollution - heavy metal contamination; introduction of microbial pathogens; synthetic and non-synthetic compound contamination; input of nitrogen and phosphorus;
- Climate change - regional or national temperature change;
- Oil and gas industry and shipping - hydrocarbon contamination;
- Fishing – potting and benthic trawling;
- Shipping, boating and anchoring - habitat structure changes (abrasion);
- Tourism/recreation - habitat transformation (visual disturbance);
- Coastal infrastructure - habitat transformation (smothering or sealing); and
- Aquaculture - input of nitrogen and phosphorus; de-oxygenation.

Review of indicators against pressures

Of the current indicators assessed, 89% provide quantitative measurements such as americium in crab (Appendix 1: Table a1) which shows a measurable increase with a proportionate increase in the specified pressure. The remaining 11% are qualitative, for example, percent cover of biota (Table a7), which identifies a disturbance but cannot alone be causally linked to a specific pressure.

The effectiveness of all indicators currently in use in large monitoring programmes (Apendix 1: Tables a1-a8) and those that have been developed but are not in use routinely (Appendix 2: Table a9) were critically appraised against the specific pressure, impact and the aspect of ecosystem health that they were designed to monitor within the “Effectiveness” column of the respective tables.

Recommendations are made regarding the most suitable indicators for each of the main impacts identified in the HBDGEG Assessment Framework Matrix (Version 2, 06/11/2007) and mapped against the degree of each Impact as classified in the same document (Table a10). Key indicators are:

Physical Loss:
Species' abundance and/or percentage cover of species or habitat will both show that there has been a positive, negative or no change in extent of the ecosystem component of interest. They cannot, however, attribute the change to a specific pressure or impact. Linking measurements of specific species with known sensitivities to various aspects of physical loss, e.g. smothering, sealing may assist in determining a causal factor.

Physical Damage:
Indicators currently being used to assess physical damage are extent or abundance of specific reef forming species such as *Modiolus modiolus, Serpula vermicularis* and maerl beds, or species such as *Eunicella verrucosa*, the pink sea fan. However, these specific species and associated communities are rare enough for them to be designated as BAP species and therefore limit the detection of physical damage to those few areas around the UK coastline where they occur. No indicator species with geographically extensive distributions are currently being applied to monitor physical damage at a national level in the UK.

Interference with Natural Hydrological Processes (climate change):
The MarClim climate indicator species are monitored annually at approximately 100 sites around the UK coastline. The temporal length of the dataset and annual sampling frequency are sufficient to detect both acute and chronic responses of species and communities to climate change at local, regional and national scales. Relative abundances of cold and warm water species allow the impacts of temperature to be assessed in reef habitats across the UK.

Interference with Natural Hydrological Processes (coastal infrastructure):
Despite this impact being classified as having a medium impact on reef communities, there are no indicators employed to measure the effects in UK waters.

Nutrient & Organic Matter Enrichment (Aquaculture):
Serpulid reefs are currently being used as indicators of organic enrichment derived from aquaculture, but this is only being undertaken at Loch Creeran in NW Scotland, and is thus a measure of extremely localized change within the loch and surrounding waters, with no proxy in other coastal regions of the UK.

Nutrient & Organic Matter Enrichment (land based pollution):
Abundance or tolerance of invertebrate species are the most appropriate indicators being used to monitor the impact of land-based pollution. Measures of "intolerance", defined as the susceptibility of a habitat, community or species (i.e. the components of a biotope) to damage, or death, from an external factor, are assessed relative to change in a specific factor (http://www.marlin.ac.uk/sah/baskitemplate.php?sens_ass_rat) by the MarLIN Project. However, other indicators of "tolerance" are often subjectively determined, as opposed to direct assessment of physiological tolerance to a gradient of pressure, and are at best a qualitative estimate of the effect such compounds are having on the ecosystem.

Biological Disturbance (Fishing):
Potting and creeling result in the removal of crustacean species from rocky and biogenic reefs, and can be monitored to some extent by tracking abundance of these species in targeted subtidal surveys.
Non-target species indicators include abundance and extent of *Modiolus* beds, *Sabellaria spinulosa* reefs and pink sea fan abundance, but their application as indicators of biological disturbance are subject to the same caveats as for Physical Damage.

Biological Disturbance (Non-native species):
The MarClim project is currently recording the geographic distribution and abundance of eight invasive rocky reef species of invertebrates and macroalgae, and their impacts on native community composition, as well as monitoring presence or absence of a further three non-native species on European and UK coastlines that are predicted to bridge the English Channel as the climate continues to warm.

The recommendation for indicators measuring contamination by hazardous substances (Land-based pollution, oil and gas industry, shipping and nuclear power stations) is that a single species is selected from the extensive list for each important trophic guild to attain a quantitative measurement of bioavailability to the ecosystem and bioaccumulation up the food chain. This would remove the excessive repetition of organisms currently monitored and allow a refocus of time and effort into identifying the subsequent biological and ecological impacts of contaminant loads.

Potential weaknesses and shortcomings:

- Molecular and physiological indicators of specific anthropogenic contaminants (exposure biomarkers) provide a direct measure of contaminant availability within the local system, but do not assess the health of the specific organisms themselves.

- Molecular and physiological indicators (effects biomarkers) are unable to provide an indication of the effect of the pressure on ecosystem processes or ecosystem structure.

- Some indicators are induced by multiple anthropogenic compounds and/or elements, making it difficult to identify and quantify specific stressors.

- Indicator species and taxa often do not have adequate baseline information available for their biology and life history, physical tolerance or a confirmed correlation of change in the indicator with changes to the ecosystem.

- Higher-order indicators of species and community change are not often specific to a single pressure and cannot separate isolated from synergistic impacts. They cannot often indicate which specific impact is affecting the system, only that there has been a change in population or community structure. They are most valuable in providing an assessment of general environmental quality.

- Higher-order indicators of species and community change will also detect natural stocasticity resulting from environmental fluctuations but cannot separate these from anthropogenic forcing. They provide an indication that the system has been perturbed and could be used as a broad-brush first step to allow targeted monitoring with more specific inficators at locations identified as having undergone change.

- The resolving capacity (i.e. the spatial or temporal scale of the pressure or impact) of a monitoring programme cannot always be accurately determined due to the methodology, sampling frequency and geographical coverage of sampling.

- It is not currently possible to quantify uncertainty associated with many indicators in use.

Assessment of pressures not adequately addressed by existing indicators

A gap analysis was performed to determine those pressures that are not currently being monitored by rocky or biogenic reef indicators. The findings are summarised as follows:

- Offshore infrastructure, pelagic trawling and introduction of non-indigenous species by terrestrial pest control are not applicable pressures as they do not have a direct impact on rock and biogenic reef habitats.

- Twenty-eight additional pressures are not currently being monitored or measured by rocky or biogenic reef indicators (Appendix 3: Table a10). This amounts to 50% of the pressures identified in the HBDSEG Assessment Framework Matrix.

- Fifteen of these 28 pressures could be monitored using potential indicators that have been developed by the scientific research community but are not currently employed in the UK or are in use as an indicator of other pressures. These are detailed in Appendix 2: Table a9.

- Additional methodologies and protocols that have been developed but are not currently applied as indicators in the UK through national programmes are described in Table a9.

- At present there are no indicators monitored at a national level to tackle biosecurity issues such as the translocation, introduction and spread of non-indigenous species. However, there are several recent initiatives that aim to improve our national approach to the surveillance and response to non-natives. For example, the GB non-native strategy, launched by the non-native secretariat and the Marine Aliens Project (UK).

Assessment of indicators to monitor ecosystem structure and function

Classification of indicators by function as either ecosystem state or impact measures

Indicators were classified according to the Pressure-State-Response (PSR) framework (see Introduction for category definitions). For the indicators of rock and reef habitats collated during this review (Appendix 1), the majority are indicators of state as they demonstrate evidence of exposure such as bioaccumulation but infer little about the consequence of this to the organism or ecosystem (radionuclide contamination, Table a1; heavy metal contamination Table a2, introduction of microbial pathogens, Table a3; synthetic and non-synthetic compound contamination, Table a4, and hydrocarbon contamination, Table a5. Since these are used in monitoring to assess the bioavailability of contaminants they could also be considered proxies for impacts (or exposure pressures). These indicators used alone infer very little about the functioning of species or communities since the biological or ecological responses in almost all cases are not known (the exception being TBT and imposex in gastropod molluscs). Some indicators, notably those in Tables a7 and a8 are solely State indicators, as they indicate the effect of non-specific or multiple pressures on species, community and the ecosystem.

Indicators for integrated assessment of the state of an ecosystem or specific component

For integrated ecosystem assessments, indicators involving multiple monitoring methods are required to address complex ecosystems but for hard substratum habitats this has presented a challenge. By contrast in soft sediments, significant progress has been made in recent years, especially by Ángel Borja and colleagues (see, for instance Borja *et al.*, 2000, Borja *et al.*, 2004) in developing the AZTI Marine Biotic Index (AMBI). Borja *et al.* (2000) identified five ecological groups related to the degree of sensitivity/tolerance to an environmental stress gradient (Figure 2) and, by analysing data from a wide range of soft-bottom benthos in a variety of locations including polluted or disturbed situations, listed a large number of species assigned with their ecological group. This is now widely used as an indicator for WFD monitoring in soft substratum habitats.

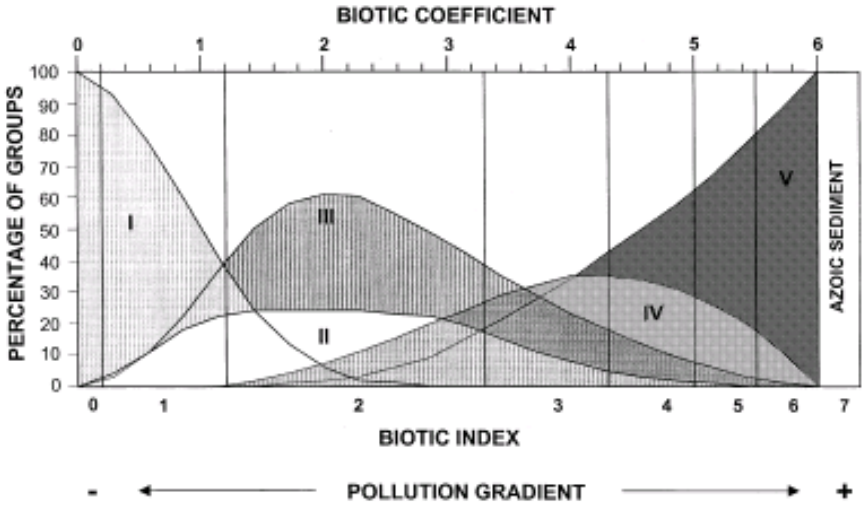

Figure 2. Theoretical model from Borja *et al.*, (2000) that divides the ordination of soft-bottom macrofauna species into five ecological groups according to their sensitivity to an increasing pollution gradient (Group I: very sensitive species; Group II: indifferent species; Group III: tolerant species; Group IV: second-order opportunistic species; Group V: first-order opportunistic species).

Analogues for rocky and biogenic reefs have proven harder to develop for the WFD, although there have been two notable advances: 1) the macroalgal tool and 2) the hard substratum benthic invertebrate tool. The macroalgal tool was developed to determine whether the composition of macroalgal taxa are consistent with undisturbed conditions and designed to detect changes in macroalgal abundance due to anthropogenic activities (Vincent *et al.*, 2002, Wilkinson *et al.*, 2007). The hard substratum benthic invertebrate tool was similarly designed to provide a single metric as a numerical indicator, based on likely indictors of quality (Hiscock *et al.*, 2005b). This has not been fully tested. Further potential indicators for integrated ecosystem assessment include resilience, the ability to recover from or resist being affected by a disturbance (Hughes *et al.*, 2005), though in practice this is rarely practical. Abundance, coverage and biotope indicators can provide information on the distribution and extent of habitats in terms of increase or decrease, but require coupling with specific lower-order indicators in order to attribute the cause of the observed changes, in terms of pressures and impacts.

A hierarchical approach is a potential option for the integrated assessment of rock and biogenic reef ecosystems, whereby a suite of indicators selected from the genetic, population/species, community/ecosystem and regional landscape scales are used to address composition, structure and function of the ecosystem (Noss, 1990).

Assessment of indicators against key aspects of ecosystem structure and function

Some indicators score highly in terms of their capacity to identify aspects of ecosystem structure and function, while others are simply not designed for this and have little if any application (Appendix 4: Table a11). In particular, indicators of climate change developed through the MarClim project and monitored at a UK-wide scale, infer a great deal about ecosystem structure and yield information on the majority of structural attributes (habitat type, general biology, range and distribution, reproduction and longevity, species diversity, species richness, biomass, amount of chlorophyll, functional groups and community

structure). Similarly, the other indicators that can be used to assess ecosystem function are generally those based at higher organization levels such as abundance, cover, biomass or are specific to structural biogenic reef-forming species such as *Modiolus modiolus*, *Serpula vermicularis* and *Sabellaria spinulosa*. In addition, imposex in gastropods can identify changes in reproduction, longevity and general biology; and scope for growth, oyster embryo bioassay and shellfish population condition all give information on general biological attributes.

As with structure, community/habitat level indicators (cover, abundance, biomass) were found to be most informative of ecosystem functions (primary and secondary production, reef-building, organic matter import/export, Appendix 4: Table a11). The MarClim indicators for climate change were also effective for this purpose. Indicators of biogenic reefs are obviously useful in determining reef-building and secondary production. At organism-level, certain indicators show application for metabolic assessments (organic carbon in biota and shellfish).

When using indicators to assess biodiversity, it is vitally important to acknowledge discontinuous and non-linear ecological processes and environmental patterns with respect to the time horizon selected for monitoring. Dynamic ecosystem processes are rarely considered with respect to apparent changes or stasis demonstrated by an indicator, often due to the processes being poorly measured or understood, and this oversight may cause mis-interpretation of the data collected (Eiswerth & Haney, 2001).

Identification of gaps in the current suite of indicators with respect to ecosystem functioning and potential indictors that could be used to address these gaps.

Ecosystem complexity has necessitated the use of indicators as proxy measures of ecosystem health. The current suite of rock and biogenic reef indicators capture many of the key functions that occur in rocky and biogenic reef habitats. Few ecosystem functions can be directly and accurately quantified from survey data but it is possible to estimate some processes (such as primary and secondary productivity) based on known links between community composition/population structure (from survey data) and functioning. The direct measurement of ecosystem function that involve dynamic processes (such as carbon mineralisation, nutrient exchange, decomposition and oxygen production) necessitates the isolation of water bodies surrounding the process-mediating organisms. In open water these processes cannot be easily measured *in situ*, since metabolites diffuse into the surrounding water. Such measurements are tractable within intertidal pools e.g. Nielsen (2001) but would be technically very challenging sub-tidally. Therefore, in lieu of direct measurements of such ecosystem processes, data on the composition of communities may be cautiously used to infer how such processes are changing. These type of indicators could be applied to infer suitable ecosystem status and therefore an absence of or low levels of disturbance or pollution, but extreme caution is advised against assumption of a healthy ecosystem based on these broad, generic measures.

Assess the indicators against the Contributory Marine Objectives and obligations

Decisions regarding what information to collect for what purpose can be made more accurately when the available indicators are characterised and matched to management targets. The current suite of rock and biogenic reef indicators currently in use in the UK

cover four out of the five draft Contributory Marine Objectives (CMOs) with respect to ecosystem structure and function (Appendix 4: Table a11). These are:

1. ensure that ocean processes and their atmospheric interactions continue to maintain natural ecosystem functioning and climate regulation (e.g. climate change indicator species);
2. ensure the chemical characteristics of the marine environment support natural processes, and the natural range, distribution, diversity and health of species and communities (e.g.contaminant concentrations in biota, exposure biomarkers, eutrophication, organic pollutant loads);
3. ensure anthropogenic activities that impact hydrographic conditions do not adversely affect local ecosystem integrity and viability (e.g. marine landscape classification indicators, habitat type, ecological status of transitional waters); and
4. ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored (extent and distribution, fishing and dredging damage to biogenic reefs, biotope composition).

The fifth CMO, “Ensure natural biodiversity and ecological interactions are maintained and where appropriate and possible restored” could be addressed using indicators of change in abundance and coverage of biota (Table a7), but these indicators are non-specific and cannot attribute cause and effect from specific ecosystem pressures, which substantially limits their applicability.

Many of the rock and biogenic reef indicators detailed in Tables a1-a8 are currently employed in monitoring programmes that form part of the UK’s commitment to the current statutory obligations (Annex 1, UNEP-WCMC Collation of existing objectives for Healthy and Biologically Diverse UK Seas). At the national level these include the use of contaminant and pathogenic indicators to address the Food and Environment Protection Act and the Environment Act, and species and habitat indicators that are or could by used to meet obligations including UKBAP (pink sea fan, *Serpula vernicularis* reefs, MarClim), and the WCA (*Modiolus modiolus* beds, MarClim).

Indicators for all main parameters (with the exception of megafauna) are available in the UK to measure the status of ecosystems with respect to regional legislation: molecular and physiological indicators are in use to monitor human health, shellfish hygiene, aquaculture, eutrophication and pollution as a contribution to obligations such as the Shellfish Hygiene and Shellfish Waters Directives, Urban Waste Water Directive and OSPAR via the Clean Seas Environment Monitoring Programme. Species, community and habitat indicators are being used to inform the Water Framework Directive, Strategic Environment Assessment, Habitats Directive and OSPAR Biological Diversity and Ecosystems Strategy. However, in reality, monitoring efforts are focused at the local or regional level, with little commonality between the indicators and methods used in different monitoring schemes, and there is therefore a severe shortfall in the national capability to assess the state of most marine rocky and biogenic habitats.

Global statutory obligations including the United Nations Framework Convention on Climate Change, World Heritage Convention and the Convention on Biological Diversity are or could be informed at the UK level by suites of existing rock and biogenic reef indicators.

Conclusions

Over 587 biological indicators of the state of coastal marine waters and ecosystems have been developed for rock and biogenic reef habitats in the UK and are currently in use, with an additional 82 that have been developed but are not in current usage.

The review indicates that there is an imbalance/mismatch between pressures and their respective indicators; half of the key pressures identified in the HBSDEG Assessment Framework Matrix do not have suitable rock or biogenic reef indicators in use or, in some cases, even developed. In contrast, many indicators in current use represent replication of effort with respect to the specific parameters being measured. For example, seventeen different indicators are all measuring gamma radiation dosage in biota. The impacts that have the most replication of indicators for an individual parameter are; radionuclide contamination (76%), heavy metal contamination (75%), hydrocarbon contamination (56%), synthetic and non-synthetic compound contamination (47%) and non-specific ecosystem impacts (37%). These appear heavily weighted towards contaminants but this in part is an artefact of the method of categorisation, as many 'indicators' could be considered parameters of the same indicator. However, if these had been aggregated, information about the metholology, policy driver, and responsible organisation would have been lost, rendering the tables less meaningful.

Molecular and physiological indicators of specific contaminants (exposure indicators) are not designed to provide an indication of the effect of the pressure and impact on ecosystem processes or ecosystem structure, thus limiting their application to the tracking of specific contaminant levels within the local environment. Neither are they currently monitored with respect to the health and fitness of the organism in question, but are merely used as a suitable proxy for contaminant load and bioavailability within the local area. Little research to date has been carried out on the effects of body burdens of contaminants on reproductive ability, survival and growth of the target organism, or the subsequent impacts at the population and community level. TBT levels in dog whelks and synthetic contaminant loads in mussels are the only impacts for which data on the physiological and ecological consequences are currently known. Biomarkers are designed to detect a suite of xenobiotics, and therefore provide an integrative response at the organismal level via the expression or suppression of molecular processes and cannot attribute physiological performance to specific pressures or impacts.

Many biodiversity indicators monitoring changes in abundance, percentage cover, species/community distributions, size, extent and condition are not specific to a single pressure (Appendix 1: Table a7). Observed changes may be driven by a variety of anthropogenic pressures acting either synergistically or in isolation and cannot be related to a single type of impact. Natural environmental fluctuations may also result in similar alterations in these biological parameters, preventing anthropogenic disturbance from being separated from natural stochasticity. Nonlinear, threshold effects in the future progression of an ecosystem must also be included when making conservation decisions as signals from a given indicator may otherwise be misinterpreted and future change incorrectly forecast.

The indicators reviewed in this report are predominantly recorded at a local scale without integration of methods, protocols or data between sites or organisations, limiting the ability of such indicators to identify the specific drivers of change and the spatial extent of the effects of specific pressures. The most important measure to report on the status of reef habitats, with respect to the impacts most affecting them are; habitat and community extent and composition, species abundance and population structure to determine the spatial extent and key ecological components affected by pressures, in combination with physiological and molecular indicators to identify the specific impact and quantify the extent to which it is affecting the key biological components of the reef ecosystem in question. However, the community and ecosystem level indicators need to be improved in terms of the parameters measured, standardisation of methodology across the UK monitoring networks and the development of more suitable indicators to identify key specific impacts such as point-source contamination, nutrient and organic matter enrichment, physical damage and biological disturbance. In addition, changes identified by indicators must be put into context quantitatively against a fluctuating baseline caused by the rapidly changing climate. Changes detected by higher-order indicators may merely reflect climate-driven alterations to reef ecosystems which are still “pristine” with respect to anthropogenic influences.

Recommendations

1. Match available indicators to management goals
2. Select objective metrics of ecosystem health that can be associated to the indicator
3. Select the most accurate, sensitive and suitable indicators where duplicates are currently in use to cut down on costs associated with replication, and allow meaningful comparisons to be made at wider spatial scales
4. Refocus effort and funding to develop indicators to fill current gaps
5. Establish UK-wide procedures for aggregation and synthesis of data across spatial and temporal scales
6. Seek expert advice to build toolboxes for integrated ecosystem assessment for example the weight of evidence approach

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Appendices

The following footnotes correspond to Appendix 1: Tables a1-a8 and relate to monitoring programmes within Northern Ireland that use the same indicators that are monitored throughout England, Wales and Scotland.

[1]AMP (NI) for radioactivity, monitored by EHS.
[2]Shellfish contaminants monitoring programme (NI) shellfish hygiene, monitored by AFBI and EH
[3]Imposex in marine gastropods (Northern Ireland) (CSEMP), monitored by EHS.

Also in Table a1 gamma spectrometry is listed as an *indicator* rather than a method (which it is). This is a reflection on how it is categorised in the MMPM, and no information on the specific indicator is given.

Appendix 1: Indicators currently in use within UK monitoring programmes

Table a1: Indicators for radionuclide contamination from nuclear power-stations currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Americium in crab	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to crabs	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (crab)
Americium in mussels	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Americium in queen scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to queen scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (queen scallops)
Americium in scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (scallops)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Americium in seaweed	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to seaweed	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (seaweed)
Americium in shrimp	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to shrimp	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (shrimp)
Americium in squat lobster	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to squat lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (squat lobster)
Americium in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium concentration (Bq/kg (wet))	To monitor the extent of americium radionuclide contamination and bioavailability to winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Americium-241 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium-241 concentration (Bq/kg (wet))	To monitor the extent of americium-241 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Antimony-125 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Antimony-125 concentration (Bq/kg (wet))	To monitor the extent of americium-125 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Beta radiation dose rate in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Beta radiation dose rate (Bq/kg)	To monitor the extent of beta radiation dose rate concentrations in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Beta radiation dose rate over lobster Pots	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Beta radiation dose rate (micro sievert per hour)	To monitor the extent of beta radiation dose rate concentrations over lobster pots	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Caesium-134 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Caesium-134 concentration (Bq/kg (wet))	To monitor the extent of Caesium-134 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Caesium-137 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Caesium-137 concentration (Bq/kg (wet))	To monitor the extent of Caesium-137 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Carbon-14 in mussels	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Carbon-14 concentration (Bq/kg (wet))	To monitor the extent of Carbon-14 radionuclide contamination and bioavailability to mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Carbon-14 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Carbon-14 concentration (Bq/kg (wet))	To monitor the extent of Carbon-14 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Cerium-144 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Cerium-144 concentration (Bq/kg (wet))	To monitor the extent of Cerium-144 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Cobalt-60 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Cobalt-60 concentration (Bq/kg)	To monitor the extent of Cobalt-60 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Gamma radiation dose rate in crab	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in crab	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (crab)
Gamma radiation dose rate in lobster	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (micro gray per hour)	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (lobster)
Gamma radiation dose rate in *Nephrops*	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in *Nephrops*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Nephrops*)
Gamma radiation dose rate in oysters	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (micro gray per hour)	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in oysters	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (oysters)
Gamma radiation dose rate in queen scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in queen scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (queen scallops)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Gamma radiation dose rate in scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (micro gray per hour)	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (scallops)
Gamma radiation dose rate in seaweed	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (micro gray per hour)	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in seaweed	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (seaweed)
Gamma radiation Dose Rate in shrimp	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in shrimp	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (shrimp)
Gamma radiation dose rate in squat lobster	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in squat lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (squat lobster)
Gamma radiation dose rate in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg (wet))	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)

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Gamma radiation dose rates in whelks	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation dose rate (Bq/kg)	To monitor the extent of gamma radiation dose rate bioavailability and concentrations in whelks	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (whelks)
Gamma radiation spectrometry (H) in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation spectrometry (L) in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation Spectrometry (U) in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Gamma radiation Spectrometry (W) in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation spectrometry in crab	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in crab	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (crab)
Gamma radiation spectrometry in *Fucus serratus*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in *Fucus serratus*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Fucus serratus*)
Gamma radiation spectrometry in *Fucus vesiculosus*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in *Fucus vesiculosus*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Fucus vesiculosus*)
Gamma radiation spectrometry in lobster	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (lobster)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Gamma radiation spectrometry in mussels	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Gamma radiation spectrometry in *Nephrops*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in *Nephrops*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Nephrops*)
Gamma radiation spectrometry in *Rhodymenia palmata*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in *Rhodymenia palmata*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Rhodymenia palmata*)
Gamma radiation spectrometry in scallops	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (scallops)
Gamma radiation spectrometry in winkles	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Iodine-125 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Iodine-125 concentration (Bq/kg)	To monitor the extent of iodine-125 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Iodine-131 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Iodine-131 concentration (Bq/kg)	To monitor the extent of iodine-131 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Niobium-95 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Niobium-95 concentration (Bq/kg)	To monitor the extent of Niobium-95 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Plutonium in crab	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to crab	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (crab)
Plutonium in queen scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to queen scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (queen scallops)
Plutonium in scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (scallops)
Plutonium in seaweed	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to seaweed	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (seaweed)
Plutonium in squat lobster	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to squat lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (squat lobster)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Plutonium in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium concentration (Bq/kg)	To monitor the extent of plutonium radionuclide contamination and bioavailability to winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)
Plutonium-241 in mussels	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium-241 concentration (Bq/kg)	To monitor the extent of plutonium-241 radionuclide contamination and bioavailability to mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Potassium-40 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Potassium-40 concentration (Bq/kg)	To monitor the extent of potassium-40 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Ruthenium-106 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Ruthenium-106 concentration (Bq/kg)	To monitor the extent of Ruthenium-106 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

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Silver-110 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Silver-110 concentration (Bq/kg)	To monitor the extent of silver-110 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Strontium-90 in mussels	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Strontium-90 concentration (Bq/kg)	To monitor the extent of strontium-90 radionuclide contamination and bioavailability to mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Strontium-90 in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Strontium-90 concentration (Bq/kg)	To monitor the extent of strontium-90 radionuclide contamination and bioavailability to winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)
Strontium-90 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Strontium-90 concentration (Bq/kg)	To monitor the extent of strontium-90 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

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Technetium-99 in crab	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (crab)
Technetium-99 in lobster	Radioactivity Monitoring Programme (Scotland) AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (lobster)
Technetium-99 in mussels	Radioactivity Monitoring Programme (Scotland) AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to mussles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Technetium-99 in queen scallops	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to queen scallops	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (queen scallops)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Technetium-99 in seaweed	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to seaweed	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (seaweed)
Technetium-99 in squat lobster	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to squat lobster	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (squat lobster)
Technetium-99 in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)
Technetium-99 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Technetium-99 in *Fucus vesiculosus*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to *Fucus vesiculosus*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Fucus vesiculosus*)
Technetium-99 in *Nephrops*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to *Nephrops*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Nephrops*)
Technetium-99 in *Rhodymenia palmata*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Technetium-99 concentration (Bq/kg)	To monitor the extent of Technetium-99 radionuclide contamination and bioavailability to *Rhodymenia palmata*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Rhodymenia palmata*)
Total Tritium in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Total tritium concentration (Bq/kg)	To monitor the extent of total tritium radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Transuranics in *Nephrops*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Transuranics concentration (Bq/kg)	To monitor the extent of transuranics radionuclide contamination and bioavailability to *Nephrops*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Nephrops*)
Transuranics in *Rhodymenia palmata*	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Transuranics concentration (Bq/kg)	To monitor the extent of transuranics radionuclide contamination and bioavailability to *Rhodymenia palmata*	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Rhodymenia palmata*)
Transuranics in winkles	AMP (Channel Islands) for radioactivity (Guernsey, Alderney & Jersey) [1]	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Transuranics concentration (Bq/kg)	To monitor the extent of transuranics radionuclide contamination and bioavailability to winkles	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)
Tritinium in mussels	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Tritinium concentration (Bq/kg)	To monitor the extent of tritinium radionuclide contamination and bioavailability to mussels	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Tritium in shrimp	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Tritium concentration (Bq/kg)	To monitor the extent of tritinium radionuclide contamination and bioavailability to shrimp	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (shrimp)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Tritium in winkles	Radioactivity Monitoring Programme (Scotland)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	SEPA	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Tritium concentration (Bq/kg)	To monitor the extent of tritinium radionuclide contamination and bioavailability to whelks	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (winkles)
Zirconium-95 in biota	Radioactivity Monitoring Programme (England and Wales)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	EA	OSPAR Convention Euratom Treaty - Articles 35 and 36 Radioactive Substances Act 1993 Council Directive 96/29 Euratom of 13 May 2001	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Zirconium-95 concentration (Bq/kg)	To monitor the extent of Zirconium-95 radionuclide contamination and bioavailability to biota	Power stations - Nuclear	Radionuclide contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Americuium-241 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Americium-241 concentration (Bq/kg)	To monitor the extent of Americium-241 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Beta radiation dose rate in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Beta radiation dose rate (Bq/kg)	To monitor the extent of beta radiation dose rate concentrations in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

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Carbon-14 (N) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Carbon-14 (N) concentration (Bq/kg)	To monitor the extent of Carbon- 14 (N) concentrations in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Carbon-14 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Carbon-14 concentration (Bq/kg)	To monitor the extent of Carbon- 14 concentrations in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Curium-233 + 244 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Curium-233 + 244 concentration (Bq/kg)	To monitor the extent of Curium-233 + 244 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Curium-242 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Curium-242 concentration (Bq/kg)	To monitor the extent of Curium-242 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation spectrometry (H) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

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Gamma radiation spectrometry (L) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation Spectrometry (U) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Gamma radiation Spectrometry (W) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Gamma radiation spectrometry (Bq/kg)	To monitor the extent of gamma radiation spectrometry bioavailability and concentrations in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
H-3 total tritium in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	H-3 total tritium concentration (Bq/kg)	To monitor the extent of H-3 total tritium contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Iodine-129 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Iodine-129 concentration (Bq/kg)	To monitor the extent of iodine-129 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

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Lead-210 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Lead-210 concentration (Bq/kg)	To monitor the extent of Lead-210 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Neptunium-237 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Neptunium-237 concentration (Bq/kg)	To monitor the extent of Neptunium-237 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
OBT (Organically Bound Tritium) in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	OBT concentration (Bq/kg)	To monitor the extent of OBT radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Plutonium-238 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium-238 concentration (Bq/kg)	To monitor the extent of Plutonium-238 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Plutonium-239 + Pu-240 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Plutonium-239 + Pu-240 concentration (Bq/kg)	To monitor the extent of Plutonium-239 + Pu-240 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Polonium-10 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Polonium-10 concentration (Bq/kg)	To monitor the extent of Polonium-10 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Promethium-147 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Promethium-147 concentration (Bq/kg)	To monitor the extent of Promethium-147 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Sr-90 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Sr-90 concentration (Bq/kg)	To monitor the extent of Sr-90 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Tc-99 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Tc-99 concentration (Bq/kg)	To monitor the extent of Tc-99 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Thorium-228 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Thorium-228 concentration (Bq/kg)	To monitor the extent of Thorium-228 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Thorium-230 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Thorium-230 concentration (Bq/kg)	To monitor the extent of Thorium-230 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Thorium-232 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Thorium-232 concentration (Bq/kg)	To monitor the extent of Thorium-232 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Thorium-234 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Thorium-234 concentration (Bq/kg)	To monitor the extent of Thorium-234 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Total Beta radiation Spectrometry in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Total Beta radiation Spectrometry (Bq/kg)	To monitor the extent of Total Beta radiation Spectrometry radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Total Beta radiation Spectrometry in plants (non-edible)	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Total Beta radiation Spectrometry (Bq/kg)	To monitor the extent of Total Beta radiation Spectrometry radionuclide contamination in plants (non-edible)	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Uranium-234 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Uranium-234 concentration (Bq/kg)	To monitor the extent of Uranium-234 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Uranium-235 + U-236 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Uranium-235 + U-236 concentration (Bq/kg)	To monitor the extent of Uranium-235 + U-236 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Uranium-238 in food	AMP (England and Wales) for radioactivity (FSA)	RIFE 12 report outlines radioactivity monitoring in UK 2007, methodologies outlined in appendicies (http://www.sepa.org.uk/pdf/publications/rife/rife12_app.pdf) and on accompanying CD	CEFAS	OSPAR Convention Radioactive Substances Act (UK)	The first Radioactivity in Food and the Environment (RIFE) report was published in 1995.	UK wide (as RIFE report is UK wide report for radioactivity)	Uranium-238 concentration (Bq/kg)	To monitor the extent of Uranium-238 radionuclide contamination in food	Power stations - Nuclear	Radionuclide contamination Human Health	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a2: Indicators for heavy metal contamination currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under developmen t, under consideratio n, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Arsenic in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Arsenic concentration (µg/kg)	To monitor the extent of arsenic contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Arsenic in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Arsenic concentration (µg/kg (wet))	To monitor the extent of arsenic contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Cadmium in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Cadmium concentration (µg/kg)	To monitor the extent of cadmium contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under developmen t, under consideratio n, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Cadmium in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Cadmium concentration (µg/kg (wet))	To monitor the extent of cadmium contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Chromium in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Chromium concentration (µg/kg)	To monitor the extent of chromium contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Chromium in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Chromium concentration (µg/kg (wet))	To monitor the extent of chromium contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Copper in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Copper concentration (µg/kg)	To monitor the extent of copper contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under developmen t, under consideratio n, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Copper in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Copper concentration (µg/kg (wet))	To monitor the extent of copper contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Lead in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Lead concentration (µg/kg)	To monitor the extent of Lead contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Lead in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Lead concentration (µg/kg (wet))	To monitor the extent of Lead contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Manganese in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	Manganese concentration (µg/kg)	To monitor the extent of manganese contamination and bioavailability to shellfish	Land-based pollution	Heavy metal contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Mercury in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Mercury concentration (µg/kg)	To monitor the extent of mercury contamination and bioavailability to the biota	Land-based pollution	Heavy metal contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Mercury in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Mercury concentration (µg/kg (wet))	To monitor the extent of mercury contamination and bioavailability to shellfish	Land-based pollution	Heavy metal contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under developmen t, under consideratio n, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Metallothionein induction	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. In use in academic and regulatory sectors. (Long *et al.* 2004)	CSEMP integrates national and international monitoring programmes across UK agencies	The induction and concentration of metallothionein: Mussel (Mytilus edulis only) 200 mg hepatopancreas derived from pools of 3 animals At least 20 individuals 40 – 60 mm	To monitor the extent of metal contaminatio n and bioavailabilit y to organisms	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Nickel in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Nickel concentration (µg/kg)	To monitor the extent of Nickel contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Nickel in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Nickel concentration (µg/kg (wet))	To monitor the extent of Nickel contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under developmen t, under consideratio n, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Selenium in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Selenium concentration (µg/kg (wet))	To monitor the extent of selenium contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Silver in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Silver concentration (µg/kg (wet))	To monitor the extent of silver contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Zinc in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporatin g historic surveillance data)	UK wide	Zinc concentration (µg/kg)	To monitor the extent of zinc contaminatio n and bioavailabilit y to the biota	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under developmen t, under consideratio n, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Zinc in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Zinc concentration (µg/kg (wet))	To monitor the extent of zinc contaminatio n and bioavailabilit y to shellfish	Land-based pollution	Heavy metal contaminatio n	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a3: Indicators for the introduction of microbial pathogens currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
E.coli in Shellfish	Shellfish scheme Shellfish Microbiological Contamination Monitoring England/Wales (Shellfish Hygiene) Shellfish Microbiological Contamination Monitoring Scotland (Shellfish Hygiene)	Recommendations for the laboratory testing of bivalve molluscs for the classification of bivalve mollusc harvesting areas under regulation (EC) No. 854/2004 (http://www.nrlcefas.org/Recommendations%20for%20laboratory%20testing%202007.pdf)	CEFAS HPA FSA FSAS FRS	EC Shellfish Hygiene Directive EC Food Hygiene Regulations	1999 (29th April) The EU Council Division defined the roles responsible for co-ordinating the requisite tests for the detection of bacterial and viral contamination of live bivalve molluscs.	UK wide	Concentration of *E.coli* in shellfish flesh and intravalvular liquid (conc./ 100ml conc./100g)	To monitor the extent of bacterial and viral contamination in shellfish. Classification categories under shellfish hygiene directive Class A: 230 *E.coli* per 100g, (can be collected for direct human consumption); Class B: 90% compliacnce with 4600 *E.coli* per 100g (must be purified or relayed to meet class A, may be heat treated by an approved method);	Land-based pollution	Introduction of microbial pathogens	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Faecal coliforms in Shellfish	Shellfish scheme Shellfish Waters Monitoring Programme (Scotland) Shellfish Waters Monitoring Programme (England and Wales)	Recommendations for the laboratory testing of bivalve molluscs for the classification of bivalve mollusc harvesting areas under regulation (EC) No. 854/2004 (http://www.nrlcefas.org/Recommendations%20for%20laboratory%20testing%202007.pdf)	CEFAS HPA SEPA EA	EC Shellfish Hygiene Directive EC Shellfish Waters Directive	1999 (29th April) The EU Council Division defined the roles responsible for co-ordinating the requisite tests for the detection of bacterial and viral contamination of live bivalve molluscs.	UK wide	Concentration of faecal coliforms in shellfish flesh and intravalvular liquid (conc./ 100ml conc./100g)	To monitor the extent of bacterial and viral contamination in shellfish. Classification categories under shellfish hygiene directive Class A: <300 faecal coliforms per 100g, (can be collected for direct human consumption); Class B: 90% compliacnce with 6000 faecal coliforms per 100g (must be purified or relayed to meet class A, may be heat treated by an approved method); Class C: <60,000 faecal coliforms per 100g (must be relayed for long period(at least 2 months) to meet class A or B, may also be heat-treated by approved method	Land-based pollution	Introduction of microbial pathogens	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a4: Indicators for synthetic and non-synthetic compound contamination currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Aldrin in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Aldrin concentration (µg/kg)	To monitor the extent of aldrin contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Aldrin in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Aldrin concentration (µg/kg (wet))	To monitor the extent of aldrin contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Ammonia in biota	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Ammonia concentration (µmol)	To monitor the extent of Ammonia radionuclide contamination in food	land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
BDE 100 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 100 concentration (µg/kg)	To monitor the extent of BDE 100 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 119 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 119 concentration (µg/kg)	To monitor the extent of BDE 119 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
BDE 138 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 138 concentration (µg/kg)	To monitor the extent of BDE 138 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 153 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 153 concentration (µg/kg)	To monitor the extent of BDE 153 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

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BDE 154 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 154 concentration (µg/kg)	To monitor the extent of BDE 154 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 17 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 17 concentration (µg/kg)	To monitor the extent of BDE 17 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
BDE 183 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 183 concentration (µg/kg)	To monitor the extent of BDE 183 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 190 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 190 concentration (µg/kg)	To monitor the extent of BDE 190 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

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BDE 28 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 28 concentration (µg/kg)	To monitor the extent of BDE 28 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 47 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 47 concentration (µg/kg)	To monitor the extent of BDE 47 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
BDE 49 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 49 concentration (µg/kg)	To monitor the extent of BDE 49 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 66 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 66 concentration (µg/kg)	To monitor the extent of BDE 66 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
BDE 71 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 71 concentration (µg/kg)	To monitor the extent of BDE 71 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 75 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 75 concentration (µg/kg)	To monitor the extent of BDE 75 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

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BDE 77 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 77 concentration (µg/kg)	To monitor the extent of BDE 77 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
BDE 85 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 85 concentration (µg/kg)	To monitor the extent of BDE 85 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

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BDE 99 (Polybrominated diphenyl ether) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	BDE 99 concentration (µg/kg)	To monitor the extent of BDE 99 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 101 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 101 concentration (µg/kg)	To monitor the extent of CB 101 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 101 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 101 concentration (µg/kg)	To monitor the extent of CB 101 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 105 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances [2]	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 105 concentration (µg/kg)	To monitor the extent of CB 105 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 110 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 110 concentration (µg/kg)	To monitor the extent of CB 110 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 118 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 118 concentration (µg/kg)	To monitor the extent of CB 118 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
CB 118 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 118 concentration (µg/kg)	To monitor the extent of CB 118 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 128 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 128 concentration (µg/kg)	To monitor the extent of CB 128 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 138 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 138 concentration (µg/kg)	To monitor the extent of CB 138 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 138 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 138 concentration (µg/kg)	To monitor the extent of CB 138 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 149 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 149 concentration (µg/kg)	To monitor the extent of CB 149 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 153 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 153 concentration (µg/kg)	To monitor the extent of CB 153 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 153 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 153 concentration (µg/kg)	To monitor the extent of CB 153 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 156 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances [2]	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 156 concentration (µg/kg)	To monitor the extent of CB 156 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 157 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 157 concentration (µg/kg)	To monitor the extent of CB 157 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 158 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 158 concentration (µg/kg)	To monitor the extent of CB 158 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 170 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 170 concentration (µg/kg)	To monitor the extent of CB 170 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 180 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 180 concentration (µg/kg)	To monitor the extent of CB 180 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 187 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 187 concentration (µg/kg)	To monitor the extent of CB 187 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 189 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 189 concentration (µg/kg)	To monitor the extent of CB 189 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 194 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 194 concentration (µg/kg)	To monitor the extent of CB 194 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 28 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 28 concentration (µg/kg)	To monitor the extent of CB 28 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 28 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 28 concentration (µg/kg)	To monitor the extent of CB 28 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 31 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 31 concentration (µg/kg)	To monitor the extent of CB 31 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 44 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 44 concentration (µg/kg)	To monitor the extent of CB 44 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 49 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 49 concentration (µg/kg)	To monitor the extent of CB 49 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 52 (Polychlorinated biphenyl) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB 52 concentration (µg/kg)	To monitor the extent of CB 52 contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 52 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	CSEMP integrates national and international monitoring programmes across UK agencies Scotland (FRS)	CB 52 concentration (µg/kg)	To monitor the extent of CB 52 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CB 70 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 70 concentration (µg/kg)	To monitor the extent of CB 70 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
CB 74 (Polychlorinated biphenyl) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	CB 74 concentration (µg/kg)	To monitor the extent of CB 74 contamination and bioavailability to mussels	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
CBs (Polychlorinated biphenyls) 7 congeners in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB concentration (µg/kg)	To monitor the extent of CB contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
CB's (Polychlorinated biphenyls) 7 congeners in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	CB concentration (µg/kg)	To monitor the extent of CB contamination and bioavailability to shellfish	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
CB's (Polychlorinated biphenyls) in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	CB concentration (µg/kg)	To monitor the extent of CB contamination and bioavailability to the biota	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
CBs (Polychlorinated biphenyls) in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	CB concentration (µg/kg)	To monitor the extent of CB contamination and bioavailability to shellfish	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Dieldrin in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Dieldrin concentration (µg/kg)	To monitor the extent of Dieldrin contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Dieldrin in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Dieldrin concentration	To monitor the extent of Dieldrin contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Endrin in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Endrin concentration (µg/kg)	To monitor the extent of Endrin contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Endrin in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Endrin concentration (µg/kg (wet))	To monitor the extent of Endrin contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCB in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCB concentration (µg/kg (wet))	To monitor the extent of HCB bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
HCBD in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCBD concentration (µg/kg (wet))	To monitor the extent of HCBD bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCH-alpha in biota (Alpha-HCH)	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	HCH-alpha concentration (µg/kg)	To monitor the extent of HCH-alpha contamination and bioavailability to the biota	land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCH-alpha in shellfish (Alpha - HCH)	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCH-alpha concentration (µg/kg (wet) or (µg/kg))	To monitor the extent of HCH-alpha bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCH-beta radiation in biota (Beta - HCH)	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	HCH-beta radiation concentration (µg/kg)	To monitor the extent of HCH-beta radiation concentrations in shellfish	Land-based pollution	Synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
HCH-beta radiation in shellfish (Beta-HCH)	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCH-beta radiation concentration (µg/kg (wet) or (µg/kg))	To monitor the extent of HCH-beta radiation bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCH-delta in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCH-delta concentration (µg/kg (wet))	To monitor the extent of HCH-delta bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
HCH-gamma radiation in biota (Gamma-HCH)	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	HCH-gamma radiation concentration (µg/kg)	To monitor the extent of HCH-gamma radiation bioavailability and concentrations in the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
HCH-gamma radiation in shellfish (Gamma-HCH)	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	HCH-gamma radiation concentration (µg/kg (wet) or (µg/kg))	To monitor the extent of HCH-gamma radiation bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Hexachlorobenzene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Hexachlorobenzene concentration (µg/kg)	To monitor the extent of Hexachlorobenzene bioavailability and concentrations in the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Hexachlorobenzene in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	Hexachlorobenzene concentration (µg/kg)	To monitor the extent of Hexachlorobenzene bioavailability and concentrations in shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Hexachlorobutadiene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Hexachlorobutadiene concentration (µg/kg)	To monitor the extent of Hexachlorobutadiene bioavailability and concentrations in the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Hexachlorobutadiene -ek in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Hexachlorobutadiene_ek concentration (µg/kg)	To monitor the extent of Hexachlorobutadiene_ek bioavailability and concentrations in the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Hydrogen Sulphide in biota	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Hydrogen Sulphide concentration (mg/l)	To monitor the extent of Hydrogen Sulphide bioavailability and concentrations in the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Imposex in gastropods	Sullum Voe Marine Monitoring programme Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Imposex in Marine Gastropods (Scotland - SEPA) WFD Imposex in Dog whelks monitoring [3]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf) http://www.soteag.org.uk/whatw.html	SOTEAG CEFAS EA HSC	OSPAR EcoQO OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999. Test and Learning period 2006-2009(OSPAR EcoQO) In routine use in academic and regulatory sectors. Successfully used to show links between antifouling compounds and decline in gastropod population in UK (Long *et al.* 2004)	CSEMP integrates national and international monitoring programmes across UK agencies Belgium & Portugal lead for widespread application in North Sea (OSPAR EcoQO)	% female dog whelks displaying imposex (Sullum Voe) Concentration of Tributlytin in shellfish, Vas deferens sequence index (VDSI), Relative penis length index, Relative penis size index, Sterile females (IMP 5-6, INTS 2 or above), Females displaying imposex, Penis classification index (Clean Seas / CSEMP benthic) Gastropod penis length, Gastropod sex, Gastropod shell length, Gastropod vas deferens stage (SEPA) Imposex in dog whelks (Nucella lapillus) (OSPA EcoQO) Dogwhelk shell size / Number of Dog whelks / VDSI (Dog whelks)(WFD Imposex in Dog whelks monitoring)	To monitor TBT contamination and bioavailability to gastropods	Land-based pollution Shipping	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (gastropods)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Isodrin in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Isodrin concentration (µg/kg)	To monitor the extent of Isodrin contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Isodrin in shellfish	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Isodrin concentration (µg/kg (wet))	To monitor the extent of Isodrin contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
op-DDT in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	op-DDT concentration (µg/kg (wet))	To monitor the extent of op-DDT contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
PP-DDD in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	PP-DDD concentration (µg/kg)	To monitor the extent of PP-DDD contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
PP-DDE in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	PP-DDE concentration (µg/kg (wet))	To monitor the extent of PP-DDE contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
PP-DDT in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Shellfish Waters Monitoring Programme (Scotland) [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS SEPA EA	OSPAR Convention EC Dangerous Substances Directive EC Shellfish Waters Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	PP-DDT concentration (µg/kg (wet))	To monitor the extent of PP-DDT contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
PP-DDD in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	PP-DDD concentration (µg/kg)	To monitor the extent of PP-DDD contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
PP-DDE in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	PP-DDE concentration (µg/kg)	To monitor the extent of PP-DDE contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
PP-DDT in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	PP-DDT concentration (µg/kg)	To monitor the extent of PP-DDT contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
TDE in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	TDE concentration (µg/kg (wet))	To monitor the extent of TDE contamination and bioavailability to shellfish	Land-based pollution	synthetic and non-synthetic compound contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a5: Indicators for hydrocarbon contamination currently in use within monitoring programmes in the UK

InIndicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
1-methylnaphthalene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	1-methylnaphthalene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
2-methylnaphthalene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	2-methylnaphthalene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Acenaphthene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Acenaphthene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Acenaphthylene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Acenaphthylene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Anthracene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Anthracene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Anthracene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Anthracene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[a]anthracene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Benzo[a]anthracene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[a]anthracene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[a]anthracene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Benzo[a]pyrene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Benzo[a]pyrene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[a]pyrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[a]pyrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[b]anthracene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[b]anthracene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo [b+j,k]flouranthene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[b+j,k]flouranthene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Benzo [c]phenanthrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[c]phenanthrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[e]pyrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[e]pyrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[ghi] perylene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Benzo[ghi]perylene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Benzo[ghi] perylene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Benzo[ghi]perylene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
C1-dibenzothiophenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C1 - dibenzothiophenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C1-napthalenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C1-napthalenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C1-phenanthrenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C1-phenanthrenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C2-dibenzothiophenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C2-dibenzothiophenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
C2-napthalenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C2-napthalenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C2-phenanthrenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C2-phenanthrenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C3-dibenzothiophenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C3-dibenzothiophenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
C3-napthalenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C3-napthalenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
C3-phenanthrenes in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	C3-phenanthrenes concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Chrysene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Chrysene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Chrysene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Chrysene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Dibenz[a,h] anthracene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Dibenz[a,h]anthracene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Dibenzothiophene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Dibenzothiophene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Fluoranthene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Fluoranthene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Fluoranthene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Fluoranthene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Fluorene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Fluorene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure (s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Indeno[123-cd]pyrene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Indeno[123-cd]pyrene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Indeno[123-cd]pyrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Indeno[123-cd]pyrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Naphthalene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Naphthalene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Naphthalene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Naphthalene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
PAHs (2- to 6-ring parent and branched) in mussels	Reference mussel monitoring for hazardous substances	http://www.frs-scotland.gov.uk/FRS.Web/Uploads/Documents/0802.pdf	FRS	OSPAR Convention	Farmed, rope grown mussels have been collected on a monthly basis since 1999 from Loch Etive and since 2005 from Loch Ewe, on the west coast of Scotland. Wild mussels have also been collected since 2005 from three mussel bed sites; two on the east coast at Shell Bay (Elie, Fife) and Aberdeen Harbour Breakwater and from the Straad (Isle of Bute) on the west coast.	Scotland (FRS)	PAHs (2- to 6-ring parent and branched) concentration	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to mussels	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Perylene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Perylene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Phenanthrene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Phenanthrene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Phenanthrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Phenanthrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

InIndicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure (s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Pyrene in biota	WFD Surveillance Monitoring WFD Operational Monitoring	(SEPA, 2007b, SEPA, 2007c)	SEPA EA	EC Water Framework Directive	Officially implimented January 2007 (incorporating historic surveillance data)	UK wide	Pyrene concentration (µg/kg)	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to the biota	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Pyrene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Pyrene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Triphenylene in shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Triphenylene concentration (µg/kg (wet))	To monitor the extent of polycyclic aromatic hydrocarbon (PAH) contamination and bioavailability to shellfish	Oil & Gas Industry Shipping	Hydrocarbon contamination	Directly Effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a6: Indicators for regional and national temperature changes caused by climate change currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Replicated quadrat counts, barnacles	Marine Biodiversity and Climate Change Project MarClim	http://www.mba.ac.uk/marclim/pdf/Sampling_protocols.pdf	MBA		In use since 2002 in UK	Britain & Ireland, Atlantic Europe	number of adult and juvenile individuals in ten random, replicated 5cm x 5 cm quadrats at each of highsore, midshore and lowshore levels	Monitor effects of climate change on distribution, abundance and community structure.	Climate change	Temperature change - regional/national	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (barnacles)
Replicated quadrat counts, limpets	Marine Biodiversity and Climate Change Project MarClim	http://www.mba.ac.uk/marclim/pdf/Sampling_protocols.pdf	MBA		In use since 2002 in UK	Britain & Ireland, Atlantic Europe	number of adult individuals in ten random, replicated 50cm x 50cm quadrats at midshore	Monitor effects of climate change on distribution, abundance and community structure.	Climate change	Temperature change - regional/national	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (limpets)
SACFOR scale abundance (rocky intertidal invertebrates)	Marine Biodiversity and Climate Change Project MarClim	http://www.mba.ac.uk/marclim/pdf/Sampling_protocols.pdf	MBA		In use since 2002 in UK	Britain & Ireland, Atlantic Europe	semi-logarithmic abundance scale: Superabundant, Abundant, Common, Frequent, Occasional, Rare, Not seen	Monitor effects of climate change on distribution, abundance and community structure.	Climate change	Temperature change - regional/national	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
SACFOR scale abundance (rocky intertidal macroalgae)	Marine Biodiversity and Climate Change Project MarClim	http://www.mba.ac.uk/marclim/pdf/Sampling_protocols.pdf	MBA		In use since 2002 in UK	Britain & Ireland, Atlantic Europe	semi-logarithmic abundance scale: Superabundant, Abundant, Common, Frequent, Occasional, Rare, Not seen	Monitor effects of climate change on distribution, abundance and community structure.	Climate change	Temperature change - regional/national	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Replicatd timed searches, *Osilinus lineatus*, *Gibbula umbilicalis*	Marine Biodiversity and Climate Change Project MarClim	http://www.mba.ac.uk/marclim/pdf/Sampling_protocols.pdf	MBA		In use since 2002 in UK	Britain & Ireland, Atlantic Europe	number and basal diameter in mm of individuals collected during 5 replicated searches each of 3 minutes duration.	Monitor effects of climate change on distribution, abundance, recruitment, organism size, population dynamics and community structure.	Climate change	Temperature change - regional/national	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Osilinus lineatus, Gibbula umbilicalis*)

Table a7: Indicators for changes in species or community distribution, size/extent or condition however have no specific or single impacting activity currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Benthic invertebrate species/taxa abundance	Benthic Invertebrate WFD Monitoring Programme	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EC Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species/taxa present	Benthic Invertebrate WFD Monitoring Programme	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EC Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
UNIS classification (Benthic invertebrates)	Benthic Invertebrate WFD Monitoring Programme	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EC Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present in intertidal sea cave communities	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1994	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present in subtidal sea cave communities	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1995	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Kelp biotopes present	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1996	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of characteristic biotopes within the subtidal faunal communities	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1997	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (faunal communities)
Spatial distribution of Kelp dominated biotopes	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1998	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of characteristic biotopes within the subtidal faunal communities	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1999	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (faunal communities)
Spatial distribution of mussel beds	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2000	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Rocky shore communities present	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2002	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species composition of Kelp dominated biotopes	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2004	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species composition of Kelp forest communities (Abundance)	Berwickshire and North Northumberland Coast European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2005	Berwickshire and North Northumberland Coast European Marine Site designated in 2000	Local (Berwickshire and North Northumberland Coast)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Spatial distribution of rocky shore communities	Berwickshire and North Northumberland Coast European Marine Site Fal and Helford European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2003	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Berwickshire and North Northumberland Coast / Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of mussel beds	Berwickshire and North Northumberland Coast European Marine Site Morecambe Bay European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2001	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Berwickshire and North Northumberland Coast / Morecambe Bay)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Biotope location	Berwickshire and North Northumberland Coast SAC and SSSI Site Condition Monitoring	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Berwickshire and North Northumberland Coast designated SAC and SSSI Site unknown and therefore initiation date of monitoring unknown	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present	Berwickshire and North Northumberland Coast SAC and SSSI Site Condition Monitoring	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Berwickshire and North Northumberland Coast designated SAC and SSSI Site unknown and therefore initiation date of monitoring unknown	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Characteristic species of biotope	Berwickshire and North Northumberland Coast SAC and SSSI Site Condition Monitoring	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Berwickshire and North Northumberland Coast designated SAC and SSSI Site unknown and therefore initiation date of monitoring unknown	Local (Berwickshire and North Northumberland Coast)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Notable species in cave	Berwickshire and North Northumberland Coast SAC and SSSI Site Condition Monitoring	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Berwickshire and North Northumberland Coast designated SAC and SSSI Site unknown and therefore initiation date of monitoring unknown	Local (Berwickshire and North Northumberland Coast)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Number of biotopes	Berwickshire and North Northumberland Coast SAC and SSSI Site Condition Monitoring Firth of Lorn SAC Site Condition Monitoring Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH CCW	EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Berwickshire and North Northumberland Coast / Firth of Lorn / Papa Stour / Pen Llyn a'r Sarnau / Sound of Arisaig / Obain Loch Euphoirt)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
	Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring Obain Loch Euphoirt SAC and SSSI Site Condition Monitoring											
Depth of siltation on *Sabellaria alveolata* reef	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Distance between recognisable *Sabellaria alveolata* reefs	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Percentage cover of *Sabellaria alveolata* in 10 m^2 area	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Percentage of low lying, relict *Sabellaria alveolata* reef	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
				EC Habitat Directive								
Presence of macrofauna	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Presence of other macroalgal species	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Presence of recognisable *Sabellaria alveolata* reef	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Reef condition (Scale 1-7)	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Reef height (*Sabellaria alveolata*)	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Siltation of *Sabellaria alveolata* reefs - % cover	Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Monitored locally at Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC	*Sabellaria alveolata* reef quality	To monitor the extent of anthropogenic impacts on *S. alveolata* reefs	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* reef)
Abundance of zoobenthos on bed	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Reference code list used for species ID	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species ID	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species identity of shellfish	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring	CSEMP integrates national and international monitoring programmes	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
	Contaminants Programme				Programme (NMP) in 1999.	across UK agencies						
AFDW (Ash Free Dry Weight)	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Dry weight	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Wet weight	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Composition and abundance of benthic invertebrate fauna (Benthic invertebrate species/taxa abundance /	Covered and incorporated into various monitoring programmes throughout the UK and Europe	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Biological quality elements for the classification of ecological status (Transitional and Coastal surface waters)	To monitor the ecological status of surface waters	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Species/taxa present / UNIS classification)												
Composition and abundance of other aquatic flora (excluding phytoplankton)	Covered and incorporated into various monitoring programmes throughout the UK and Europe	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Biological quality elements for the classification of ecological status (Transitional and Coastal surface waters)	To monitor the ecological status of surface waters	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Epifauna species present	Disposal Site Monitoring (England and Wales)	http://www.cefas.co.uk/publications/aquatic/aepam13.pdf	CEFAS	Food and Environment Protection Act (UK) OSPAR	Date monitoring initiated unknown	Regional (England and Wales)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Total number of macrofaunal species	Disposal Site Monitoring (England and Wales)	http://www.cefas.co.uk/publications/aquatic/aepam13.pdf	CEFAS	Food and Environment Protection Act (UK) OSPAR	Date monitoring initiated unknown	Regional (England and Wales)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Proportion of stipe length over which *Distomus variolosus* is present	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1998	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of *Distomus variolosus* on kelp stipes	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1999	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Distomus variolosus*)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Abundance of macrofauna in subtidal rock and boulder communities (particularly MCR.ErSEun and ECR.AlcMas biotopes)	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2002	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Abundance of macrofauna present in maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2003	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Macrofaunal species present in subtidal rock and boulder communities (particularly MCR.ErSEun and ECR.AlcMas biotopes)	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2004	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Biotopes present in subtidal rock and boulder habitats	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2005	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Spatial distribution of Maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2006	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Spatial extent of Maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2007	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Rocky shore communities	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2008	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species of macroalgae present in maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2011	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Species of macrofauna present in maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2012	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Species present in kelp forests	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2015	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species present in rockpool communities	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2016	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species present in rocky shore communities	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2017	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of individual species on rocky shores	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2018	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of macroalgae in subtidal rock and boulder communities (particularly MCR.ErSEun and ECR.AlcMas biotopes)	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2020	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Abundance of macroalgae present in maerl beds	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2021	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Abundance of *Sargassum muticum* in rockpools	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2022	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (*Sargassum muticum*)
Macroalgal species present in subtidal rock and boulder communities (particularly MCR.ErSEun and ECR.AlcMas biotopes)	Fal and Helford European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2023	Date Fal and Helford designated a European Marine Site unknown and therefore initiation date of monitoring unknown	Local (Fal and Helford)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species present (macroalgae)	Fal and Helford European Marine Site Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE SNH	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2013 Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Papa Stour)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of macrofauna (per species)	Fal and Helford European Marine Site Pembrokeshire Marine SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE CCW	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2001	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species present (macrofauna)	Fal and Helford European Marine Site Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE CCW	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2014	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Pen Llyn a'r Sarnau)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Density of *Laminaria hyperborea* in kelp forests	Fal and Helford European Marine Site Plymouth Sound and Estuaries European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1994	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Laminaria hyperborea*)
Density of *Laminaria ochroleuca* in kelp forests	Fal and Helford European Marine Site Plymouth Sound and Estuaries European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1994	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Laminaria ochroleuca*)
Proportion of *Laminaria hyperborea* in kelp forests	Fal and Helford European Marine Site Plymouth Sound and Estuaries European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1994	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Laminaria hyperborea*)
Proportion of *Laminaria ochroleuca* in kelp forests	Fal and Helford European Marine Site Plymouth Sound and Estuaries European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 1994	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Laminaria ochroleuca*)
Characterising macrofaunal species	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Presence of notable macrofaunal species (of conservation interest)	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Presence of notable species of macroalgae (of conservation interest)	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotope location	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Depth of biotope	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of biotope	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Substratum description (rocky reef)	Firth of Lorn SAC Site Condition Monitoring	(Howson *et al*. 2006)	SNH	EC Habitats Directive	The Firth of Lohrn was designated an SAC in 2006	Local (Firth of Lorn)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Characterising species of macroalgae	Firth of Lorn SAC Site Condition Monitoring Loch Creran SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Firth of Lorn / Loch Creran)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Species of macrofauna present	Firth of Lorn SAC Site Condition Monitoring Pembrokeshire Marine SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW SNH	EC Habitats Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Firth of Lorn / Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of macrofauna	Firth of Lorn SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH CCW	EC Habitats Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Firth of Lorn / Pen Llyn a'r Sarnau)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of *Archidistoma aggregatum*	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2023	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Archidistoma aggregatum*)
Abundance of bottle-brush hydroid *Thuiaria thuja*	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2024	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Thuiaria thuja*)
Abundance of macrofauna in LhypFt biotopes	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2025	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Presence/absence of ascidian *Archidistoma aggregatum*	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2026	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Thuiaria thuja*)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Presence/absence of bottle-brush hydroid *Thuiaria thuja*	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2027	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Thuiaria thuja*)
Presence/absence of yellow sponge *Polymastia boletiformis*	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2028	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Polymastia boletiformis*)
Abundance of *Calliblepharis ciliata* in kelp forest communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2017	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Calliblepharis ciliata*)
Abundance of *Halurus equisetifolius* in kelp forest communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2018	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Halurus equisetifolius*)
Abundance of macroalgae in LhypFt biotopes	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2019	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Abundance of *Odonthalia dentata* in kelp forest communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2020	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Odonthalia dentata*)
Presence of *Ptilota gunneri* in kelp forests	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2021	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Ptilota gunneri*)
Presence of *Taonia atomaria* in kelp forest communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2022	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Taonia atomaria*)
Circalittoral biotopes present (subtidal faunal turf reef communities)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2029	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Kelp forest biotopes present (kelp dominated infralittoral communities)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2030	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Presence of LhypFt biotopes (kelp forest)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2031	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Rocky shore biotopes present	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2032	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of intertidal chalk cave biotopes (faunal cushion and crust communities)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2036	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Spatial distribution of rocky shore biotopes	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2033	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of specialist intertidal chalk cave algal and lichen biotopes (particularly RhoCv, Chr, Bli, UloUro)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2034	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Specialist intertidal chalk cave algal and lichen biotopes present (particularly RhoCv, Chr, Bli, UloUro)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2035	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Spatial distribution of cliff algal communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2037	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Spatial distribution of intertidal chalk communities	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2038	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Spatial distribution of specialist intertidal chalk cave algal and lichen biotopes (particularly RhoCv, Chr, Bli, UloUro)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2039	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Species composition of LhypFt biotopes (kelp forest)	Flamborough Head European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2040	Flamborough Head European Marine Site designated in 2000	Local (Flamborough Head)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Position of biotope	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Deep limit of all reef types (depth)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Deep limit of all reef types (location)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Deep limit of med and large reefs (depth)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Deep limit of med and large reefs (location)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Depth of reef	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Presence of large reefs (>500 cm^2) in plan view	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Presence of medium reefs (50-500 cm2) in plan view	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Presence of small reefs (5-50 cm^2) in plan view	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Shallow limit of all reef types (depth)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Shallow limit of all reef types (location)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Shallow limit of med and large reefs (depth)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Shallow limit of med and large reefs (location)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of reefs	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Width of Serpulid reef	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (Sepulid reef)
Abundance of zoobenthos (associated species)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Area of *Modiolus* bed	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Biotopes present (surrounding *Modiolus* bed)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Characterising species (macroalgae)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Characterising species (Zoobenthos)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
max *Modiolus* density in 25 m^2 area	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Modiolus modiolus abundance	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Presence of *Modiolus*	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Size frequency of *Modiolus*	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Spatial distribution of *Modiolus* beds	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Spatial extent of *Modiolus* beds	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Species abundance in *Modiolus* biotope	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)
Species present in *Modiolus* biotope	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Modiolus modiolus* bed quality	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef (*Modiolus modiolus* bed)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Abundance of macroalgae (associated with Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Abundance of macroalgae (surrounding Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Abundance of zoobenthos (associated with Sepulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Abundance of zoobenthos (surrounding Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Anthropogenic impacts observed (description)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Biotopes present (surrounding Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Boundary of Serpulid reef boundary	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Characterising species of zoobenthos	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Characterising species of zoobenthos (associated with Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Spatial distribution of Serpulid reefs	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Spatial extent of biotopes (surounding Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
				Countryside Act (GB)								
Spatial extent of Serpulid reefs	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Species of macroalgae present (associated with Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Species of zoobenthos present (associated with Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species of zoobenthos present (surrounding Serpulid reef)	Loch Creran SAC Site Condition Monitoring	(Moore et al., 2006)	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Loch Crerandesignated as an SAC in 2005	Local (Loch Creran)	*Serpula vermicularis* reef quality	To monitor the extent of anthropogenic impacts on Serpulid reefs	Shipping, boating & anchoring Fishing - benthic trawling Aquaculture Land based pollution	Habitat structure changes - abrasion Input of nitrogen and phosphorus	Indirectly effective	Coastal subtidal rock and biogenic reef (*Serpula vermicularis* reef)
Spatial extent of biotopes	Loch Creran SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Loch Creran / Sound of Arisaig)	Biotope Composition	To monitor the extent of anthropogenic impacts on *Modiolus* beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present	Loch Creran SAC Site Condition Monitoring Obain Loch Euphoirt SAC and SSSI Site Condition Monitoring Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring Fal and Helford European Marine Site	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH CCW NE	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB) Conservation (Natural Habitats and c.) Regulations 2009	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Loch Creran / Obain Loch Euphoirt / Papa Stour / Pen Llyn a'r Sarnau / Sound of Arisaig / Fal and Helford)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Species of zoobenthos present	Loch Creran SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Loch Creran / Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of zoobenthos (per species)	Loch Creran SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Loch Creran / Sound of Arisaig)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of maerl	Loch nam Madadh SAC and SSSI (Inc Loch an Duin SSSI) Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Loch nam Madadh / Sound of Arisaig)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Abundance of *Balanophyllia regia*	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2034	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Balanophyllia regia*)

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Abundance of *Caryophyllia smithii*	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2035	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Caryophyllia smithii*)
Abundance of *Eunicella verrucosa*	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2036	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Eunicella verrucosa*)
Species abundance in MCR.ErSEun biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2037	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species abundance in rockpool communities (fauna)	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2038	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Species abundance of subtidal vertical and overhanging circalittoral rock biotopes (fauna)	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2039	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef

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Biotopes present on subtidal bedrock and stable boulders	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2040	Lundy European Marine Site designated in 2000	Local (Lundy)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Frequency of occurrence of MCR.ErSPbolSH biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2041	Lundy European Marine Site designated in 2000	Local (Lundy)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Intertidal rocky shore biotopes present	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2042	Lundy European Marine Site designated in 2000	Local (Lundy)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Spatial distribution of biotopes on subtidal bedrock and stable boulders	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2043	Lundy European Marine Site designated in 2000	Local (Lundy)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Subtidal vertical and overhanging circalittoral rock biotopes present	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2044	Lundy European Marine Site designated in 2000	Local (Lundy)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef

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Proportion of damaged tissue due to epiphytic growth on *Eunicella verrucosa*	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2045	Lundy European Marine Site designated in 2000	Local (Lundy)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Eunicella verrucosa*)
Spatial distribution of *Eunicella* reef	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2046	Lundy European Marine Site designated in 2000	Local (Lundy)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Eunicella verrucosa*)
Spatial extent of *Eunicella* reef	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2047	Lundy European Marine Site designated in 2000	Local (Lundy)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Eunicella verrucosa*)
Species composition of MCR.ErSEun biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2048	Lundy European Marine Site designated in 2000	Local (Lundy)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species composition of MCR.ErSPbolSH biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2049	Lundy European Marine Site designated in 2000	Local (Lundy)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species composition of rockpool communities	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2050	Lundy European Marine Site designated in 2000	Local (Lundy)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Species composition of subtidal vertical and overhanging circalittoral rock biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2051	Lundy European Marine Site designated in 2000	Local (Lundy)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species diversity of rockpool communities	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2052	Lundy European Marine Site designated in 2000	Local (Lundy)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Macroalgal species composition of kelp forest biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2053	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species abundance in MCR.ErSEun biotopes	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2054	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species abundance in rockpool communities (macroalgae)	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2055	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Species abundance of subtidal vertical and overhanging circalittoral rock biotopes (macroalgae)	Lundy European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2056	Lundy European Marine Site designated in 2000	Local (Lundy)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
% cover encrusting and colonial species (algae, barnacles, sponges, bryozoans, ascidians) (top / underside) (as an indication of boulder turning)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of *Actinia equina*	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Actinia equina*)
Dead barnacles on underside of boulder (as an indication of boulder turning)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Presence of *Thia scutellata*	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring	Local (Menai Strait and Conwy Bay)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in	No specific or single impacting activity	Changes in species or community distribution,	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
		2430			initiation date unknown			habitat structure		size/extent or condition		(*Thia scutellata*)
Macroalgal coverage	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of biotopes (within a SAC)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Subtidal biotope classification in sea caves	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Intertidal species composition in sea caves	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Intertidal species composition/ richness	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Live barnacles on underside of boulder (as an indication of boulder turning)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Species composition (macrofauna) (top / underside)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Subtidal species composition in sea caves	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Trapped algae underneath boulder (as an indication of boulder turning)	Menai Strait and Conwy Bay SAC Site Condition Monitoring	Characterisation of underboulder communities for the Menai Strait http://www.jncc.gov.uk/page-2430	CCW	EC Habitats Directive	Date Menai Strait and Conwy Bay designated as an SAC unknown and therefore monitoring initiation date unknown	Local (Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Presence of *Sargassum muticum* (invasive species)	Menai Strait and Conwy Bay SAC Site Condition Monitoring Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Menai Strait and Conwy Bay / Cardigan Bay SAC / Pen Llyn a'r Sarnau SAC)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Sargassum muticum*)
Abundance of macroalgae (per species)	Menai Strait and Conwy Bay SAC Site Condition Monitoring Fal and Helford European Marine Site 5	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2019	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Fal and Helford / Menai Strait and Conwy Bay)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of biotopes (within a sea cave)	Menai Strait and Conwy Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	EC Habitats Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Menai Strait and Conwy Bay / Pen Llyn a'r Sarnau)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Subtidal species composition/ richness in sea caves	Menai Strait and Conwy Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	EC Habitats Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Menai Strait and Conwy Bay / Pen Llyn a'r Sarnau)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Number of berried lobsters	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in	No specific or single impacting activity	Changes in species or community distribution,	Indirectly effective	Coastal subtidal rock and biogenic reef (lobsters)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
						programme unknown		habitat structure		size/extent or condition		
Number of berried, undersized lobsters	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (lobsters)
Number of cocks (edible crabs)	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (eddible crab)
Number of crawfish landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (crawfish)
Number of edible crabs landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (eddible crab)
Number of hens (edible crabs)	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (eddible crab)
Number of lobsters landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (lobsters)
Number of spider crabs landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (spider crab)
Total weight of crawfish landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring	Biomass	To monitor levels of disturbance, changes in	No specific or single impacting activity	Changes in species or community distribution,	Indirectly effective	Coastal subtidal rock and biogenic reef (crawfish)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
						programme unknown		habitat structure		size/extent or condition		
Total weight of lobsters	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (lobsters)
Total weight of spider crabs landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (spider crab)
Species landed	Monitoring crustacean pot fisheries	Monitoring protoco;s unconfirmed	CEFAS	EC Data collection Regulation (1639/2001)	Date monitoring initiated unknown	Exact geographic coverage of monitoring programme unknown	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of Mussel beds	Morecambe Bay European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2054	Morecambe Bay designated a European Marine Site in 2001	Local (Morecambe Bay)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Spatial distribution of *Sabellaria alveolata* beds	Morecambe Bay European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2055	Morecambe Bay designated a European Marine Site in 2001	Local (Morecambe Bay)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* bed)
Species composition of *Sabellaria alveolata* beds	Morecambe Bay European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2058	Morecambe Bay designated a European Marine Site in 2001	Local (Morecambe Bay)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* bed)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species composition of mussel beds	Morecambe Bay European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2059	Morecambe Bay designated a European Marine Site in 2001	Local (Morecambe Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Spatial extent of *Sabellaria alveolata* reefs	Morecambe Bay European Marine Site Cardigan Bay SAC Site Condition Monitoring Pen Llyn a'r Sarnau SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	NE CCW	OSPAR Convention OSPAR List of Threatened and/or Declining Species and Habitats EC Habitat Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2057	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Morecambe Bay / Cardigan Bay SAC / Pen Llyn a'r Sarnau SAC)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Indirectly effective	Coastal subtidal rock and biogenic reef (*Sabellaria alveolata* bed)
Abundance of species from MCR.SFR.Pid biotopes in subtidal animal-bored chalk communities	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2060	North East Kent European Marine Sites were designated as SACs in 2000	Local (North East Kent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Faunal species abundance in intertidal chalk cliff algal and lichen communities on rocky reefs and sea caves	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2061	North East Kent European Marine Sites were designated as SACs in 2001	Local (North East Kent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Faunal species abundance in Kelp dominated communities on animal bored rock - species composition	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2062	North East Kent European Marine Sites were designated as SACs in 2002	Local (North East Kent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present in intertidal chalk cliff algal and lichen communities on rocky reefs and sea caves	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2063	North East Kent European Marine Sites were designated as SACs in 2003	Local (North East Kent)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Biotopes present in Kelp dominated communities on animal bored rock	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2064	North East Kent European Marine Sites were designated as SACs in 2004	Local (North East Kent)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of Kelp dominated communities on animal bored rock	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2065	North East Kent European Marine Sites were designated as SACs in 2005	Local (North East Kent)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of Kelp dominated communities on animal bored rock	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2066	North East Kent European Marine Sites were designated as SACs in 2006	Local (North East Kent)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species present from MCR.SFR.Pid biotopes in subtidal animal-bored chalk communities	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2067	North East Kent European Marine Sites were designated as SACs in 2007	Local (North East Kent)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Abundance of species from MCR.SFR.Pid biotopes in subtidal animal-bored chalk communities	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2068	North East Kent European Marine Sites were designated as SACs in 2008	Local (North East Kent)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Macroalgal species abundance in intertidal chalk cliff algal and lichen communities on rocky reefs and sea caves	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2069	North East Kent European Marine Sites were designated as SACs in 2009	Local (North East Kent)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Macroalgal species abundance in Kelp dominated communities on animal bored rock - species composition	North East Kent European Marine Sites (Thanet Coast cSAC, Sandwich Bay cSAC and Thanet Coast and Sandwich Bay SPA)	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2070	North East Kent European Marine Sites were designated as SACs in 2010	Local (North East Kent)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance macroalgae	Obain Loch Euphoirt SAC and SSSI Site Condition Monitoring	Monitoring protocols outlined: http://www.snh.org.uk/pdfs/publications/commissioned_reports/F02AA409.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Obain Loch Euphoirt designated an SAC and SSSI unknown	Local (Obain Loch Euphoirt)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Notable species of macroalgae (of conservation	Obain Loch Euphoirt SAC and SSSI Site Condition Monitoring	Monitoring protocols outlined: http://www.snh.org.uk/pdfs/publications/commissioned_reports/F02AA409.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Obain Loch Euphoirt designated an SAC and SSSI unknown	Local (Obain Loch Euphoirt)	Abundance Zoobenthos and Macroalgae	To monitor levels of disturbance, changes in habitat	No specific or single impacting activity	Changes in species or community distribution, size/extent or	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
interest)								structure		condition		
Abundance of zoobenthos	Obain Loch Euphoirt SAC and SSSI Site Condition Monitoring	Monitoring protocols outlined: http://www.snh.org.uk/pdfs/publications/commissioned_reports/F02AA409.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Obain Loch Euphoirt designated an SAC and SSSI unknown	Local (Obain Loch Euphoirt)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Cover of opportunistic macroalgae cover at quadrat level	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Cover of opportunistic macroalgae cover at whole site (derived)	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Opportunistic macroalgal density	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Opportunistic macroalgal extent	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Opportunistic species contributing to significant cover (Monitoring Trophic Status for UWWT and Nitrates)	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Total extent of macroalgal bed	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	% Cover	To monitor levels of disturbance, changes in habitat	No specific or single impacting activity	Changes in species or community distribution, size/extent or	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
								structure		condition		
Presence of entrained algae	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
List of opportunistic macroalgal species present over site	Opportunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biomass of opportunistic macroalgae	Oppourtunistic Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species abundance (fauna)	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	ERT (Scotland) Ltd. 2005	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Papa stour SAC monitoring was inititted in 2003	Local (Papa Stour)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species abundance (macroalgae)	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	ERT (Scotland) Ltd. 2005	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Papa stour SAC monitoring was inititted in 2003	Local (Papa Stour)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biotopes present in 1m band around transect	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	ERT (Scotland) Ltd. 2005	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Papa stour SAC monitoring was inititted in 2003	Local (Papa Stour)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial extent of biotope along transect	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	ERT (Scotland) Ltd. 2005	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Papa stour SAC monitoring was inititted in 2003	Local (Papa Stour)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Key biological characteristics of reef	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring	ERT (Scotland) Ltd. 2005	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Papa stour SAC monitoring was inititted in 2003	Local (Papa Stour)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species present (fauna)	Papa Stour SAC (Incl. Sandness Coast SSSI) Site Condition Monitoring Menai Strait and Conwy Bay SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	SNH CCW	EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Papa Stour / Menai Strait and Conwy Bay)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Total cover of barnacles	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitat Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	% cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Abundance of barnacles/species	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitats Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Barnacle species present in 25 cm2 quadrat	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitats Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Number of barnacle species in 25 cm2 quadrat	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitats Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (barnacles)
Number of limpets in a 20x20 cm quadrat	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitats Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef (limpets)
Number of vesicles on *Ascophyllum nodosum* fronds	Pembrokeshire Marine SAC Site Condition Monitoring	(Hull et al., 2005)	CCW	EC Habitats Directive	Pembrokeshire Marine SAC monitoring was initiated in 2004 and occurs annually	Local (Pembrokeshire marine SAC)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat	No specific or single impacting activity	Changes in species or community distribution, size/extent or	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Ascophyllum*

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
								structure		condition		*nodosum*)
Density of anemone colonies in 0.25 m2 quadrat	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (anemone)
Digital video record of anemone density	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (anemone)
Photographic record of anemone density	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (anemone)
Spatial extent of macroalgae	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Estimated number of polyps (anemones)	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (anemone)
Frequency of species occurrence	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Macrofaunal species present	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Presence of *Pectenogamma radiationrus*	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Pectenogamma radiationrus*)
Frequency of species occurrence Macroalgal abundance	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Presence of *Anotrichium, Polysiphonia* and *Crouaria*	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Anotrichium, Polysiphonia* and *Crouaria*)
Frequency of occurrence of a species	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Abundance Zoobenthos and Macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of biotopes in sea caves (within a SAC)	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of each biotope within the area	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of each biotope within the SAC	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Subtidal biotope richness of sea caves	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Frequency of characteristic species	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Intertidal species composition/ richness of sea caves	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Size or age frequency of macrofauna	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Biomass of macrofauna	Pen Llyn a'r Sarnau SAC Site Condition Monitoring	Characterisation of Pen Llyn a'r Sarnau SAC http://www.jncc.gov.uk/page-2430	CCW	EC Habitat Directive	Date Pen Llyn a'r Sarnau designated an SAC unknown	Local (Pen Llyn a'r Sarnau)	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Intertidal biotope richness (in sea caves)	Pen Llyn a'r Sarnau SAC Site Condition Monitoring Menai Strait and Conwy Bay SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Pen Llyn a'r Sarnau / Menai Strait and Conwy Bay)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Species present	Pen Llyn a'r Sarnau SAC Site Condition Monitoring Pembrokeshire Marine SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW	EC Habitat Directive	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Pen Llyn a'r Sarnau / Pembrokeshire marine SAC)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Frequency of biotope occurrence	Pen Llyn a'r Sarnau SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Pen Llyn a'r Sarnau / Sound of Arisaig)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Species of macroalgae present	Pen Llyn a'r Sarnau SAC Site Condition Monitoring Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	CCW SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	Local (Pen Llyn a'r Sarnau / Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance (Pink Sea Fans)	Pink Sea Fan Survey Pembrokeshire Marine SAC Site Condition Monitoring Lundy SAC Site Condition Monitoring	With the monitoring occuring at different SACs there will be various separate methodologies and protocols for each programme	MCS Wildlife Trusts CCW NE	Wildlife and Countryside Act (GB) UK BAP species	Monitoring programmes are curently underway, induction date and frequency varies with each monitoring programme	South-west Britain (North Pembrokeshire to Portland, Dorset)	Number of Pink Sea Fans Density, size structure, colour, fouling, percentage infestation by predators of pink sea fans	To monitor pink sea fan populations to contribute to BAP	Fishing - benthic trawling Fishing - potting Shipping, boating and anchoring	Habitat structure changes - abrasion	Indirectly effective	Coastal subtidal rock and biogenic reef
Density of *Distomus variolosus* on kelp stipe	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2063	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Distomus variolosus*)
Proportion of kelp stipe covered by *Distomus variolosus*	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2066	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	% Cover	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of faunal species in rockpools	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2072	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef

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Abundance of macroalgae in rockpools	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2069	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Abundance of *Sargassum muticum* in $1m^2$ quadrat	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2070	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (*Sargassum muticum*)
Algal species abundance in kelp forests	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2071	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of limestone biotopes SubSoAS and AlcByH.Hia in subtidal rocky reefs	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2073	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Algal species composition in kelp forests	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2074	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Species abundance of AlcByH.Hia biotopes (subtidal rocky reefs)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2075	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species abundance of AlcTub biotopes (subtidal rocky reefs)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2076	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species abundance of ErS.Eun biotopes (subtidal rocky reefs)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2077	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species abundance of SubSoAs biotopes (subtidal rocky reefs)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2078	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef
Species composition of rockpool communities (fauna)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2079	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef

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Species composition of rockpool communities (macroalgae)	Plymouth Sound and Estuaries European Marine Site	Protocol unconfirmed Details of the sampling techniques used in different marine and estuarine habitats are given in Marine Monitoring Handbook 2001, http://www.jncc.gov.uk/PDF/MMH-mmh_0601.pdf	NE	EC Habitats Directive EC Birds Directive Conservation (Natural Habitats and c.) Regulations 2080	Date Plymouth Sound and Estuaries designated a European Marine Site unknown	Local (Plymouth Sound and Estuaries)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef
Number of species from full list	Rocky Shore Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Number of species from reduced list	Rocky Shore Macroalgae Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Epifaunal invertebrate species	Sea Bed Disturbance and Regulated Activities Monitoring (FRS)	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	FRS	London Convention 1972 OSPAR Convention Marine Strategy Directive Seas the Opportunity Food and Environment Protection Act 1986	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	UK wide and Europe	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Epifaunal invertebrates	Sea Bed Disturbance and Regulated Activities Monitoring (FRS)	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	FRS	London Convention 1972 OSPAR Convention Marine Strategy Directive Seas the Opportunity Food and Environment Protection Act 1985	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	UK wide and Europe	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Average catch from hauls with oysters (<35 mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Average catch from hauls with oysters (>64 mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Average catch from hauls with oysters (35-49 mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Average catch from hauls with oysters (50-64 mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Average catch rate of large oysters (>50mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Average catch rate of small oysters (<50mm)	Solent Oyster Survey	Monitoring protocols unknown	CEFAS	Not known	Date monitoring initiated unknown	Local (Solent)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (oysters)
Biotope composition	Solway Firth SAC and SSSI Site Condition Monitoring	Solway Firth SAC and SSSI Site Condition Monitoring http://www.snh.org.uk/pdfs/publications/commissioned_reports/Report No155.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Solway Firth designated an SAC and SSSI unknown	Local (Solway Firth)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Location of biotopes	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Spatial distribution of biotopes	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Biotope Composition	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Spatial distribution of maerl	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Reef habitat quality	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Characteristic species of macroalgae	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Characteristic species of zoobenthos	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species of macroalgae present (associated with maerl)	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Species of macroalgae present 2 m either side of transect	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Species of zoobenthos present (associated with maerl)	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Species of zoobenthos present 2 m either side of transect	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organis-ation	Source (policy driver, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)
Species of zoobenthos present on stones/ associated epifauna	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of zoobenthos (associated with maerl)	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (maerl)
Number of species of zoobenthos	Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) SAC Site Condition Monitoring	Monitoring protocol outlined http://www.snh.org.uk/pdfs/publications/commissioned_reports/CommissionedReportNo071.pdf	SNH	EC Habitats Directive Wildlife and Countryside Act (GB)	Date Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) designated an SAC unknown	Local (Sound of Arisaig)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Macrobenthos	Sullum Voe Marine Monitoring programme	http://www.soteag.org.uk/whatw.html	SOTEAG	Not Known	Monitoring programme was initiated in 1974	Local (Sullum Voe)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Rocky shore parameters	Sullum Voe Marine Monitoring programme	http://www.soteag.org.uk/whatw.html	SOTEAG	Not Known	Monitoring programme was initiated in 1975	Local (Sullum Voe)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Zoobenthos	Western Channel Observatory	L4 zooplankton western channel monitoring http://www.westernchannelobservatory.org.uk/l4/	PML	Marine Environmental Change Network (MECN)	Weekly monitoring occuring since 1989	Local (50°15'N, 04°13'W, water depth ~55m; located 10 nm south-west of Plymouth)	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Mussel shell weight	WFD Operational Monitoring WFD Surveillance Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Biomass	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (mussels)
Abundance of fucoids	WFD Surveillance Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (fucoids)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organis-ation**	**Source** (policy driver, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Abundance of opportunistic green algae	WFD Surveillance Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Abundance of macroalgae	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Full species list	WFD Surveillance Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Reduced species list	WFD Surveillance Monitoring	EC Water Framework Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF	EA	EU Water Framework Directive	Water framework directive published 23 October 2000 Latest compliance date 22 December 2003	UK wide and Europe	Species composition/ richness	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Abundance of commercially important crustaceans - edible crab	Young Fish Survey	The distribution and abundance of young fish on the east and south coast of England http://www.cefas.co.uk/publications/techrep/tech108.pdf	CEFAS	EC Data collection Regulation (1639/2001)	Monitoring was initiated in 1981	Regional (East and South coasts of the UK)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (edible crab)
Abundance of commercially important crustaceans - lobster	Young Fish Survey	The distribution and abundance of young fish on the east and south coast of England http://www.cefas.co.uk/publications/techrep/tech108.pdf	CEFAS	EC Data collection Regulation (1639/2001)	Monitoring was initiated in 1982	Regional (East and South coasts of the UK)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (lobster)
Abundance of commercially important crustaceans - velvet crab	Young Fish Survey	The distribution and abundance of young fish on the east and south coast of England http://www.cefas.co.uk/publications/techrep/tech108.pdf	CEFAS	EC Data collection Regulation (1639/2001)	Monitoring was initiated in 1983	Regional (East and South coasts of the UK)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Coastal subtidal rock and biogenic reef (velvet crab)
Abundance of epibenthos	Young Fish Survey	The distribution and abundance of young fish on the east and south coast of England http://www.cefas.co.uk/publications/techrep/tech108.pdf	CEFAS	EC Data collection Regulation (1639/2001)	Monitoring was initiated in 1984	Regional (East and South coasts of the UK)	Abundance (Zoobenthos species)	To monitor levels of disturbance, changes in habitat structure	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Table a8: Sub organismal level indicators with have no specific or single impacting activity currently in use within monitoring programmes in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)
Amnesic Shellfish Poisoning (ASP) in biota	Shellfish Biotoxin Programme Scotland (Shellfish Hygiene) [7]	EU food safety hygiene regulation methodologies implemented http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:338:0027:0059:EN:PDF	CEFAS FSAS IAB FSA	EC Food Hygiene Regulations	The monitoring was adopted when the EU food hygiene safety regulation was published in 1998	Monitoring occurs throughout the UK in all classified shellfish producing areas	Concentration of Amnesic shellfish poisoning in biota (µg/g)	To monitor the extent of Amnesic shellfish poisoning in biota	No specific or single impacting activity	Human Health	Indirectly effective (what causes some phytoplankton to produce marine biotoxins, and what determines the frequency of toxic algal events is the subject of world-wide research)	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if
Diarrhetic Shellfish Poisoning (DSP) in biota	Shellfish Biotoxin Programme Scotland (Shellfish Hygiene) [7]	EU food safety hygiene regulation methodologies implemented http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:338:0027:0059:EN:PDF	CEFAS FSAS IAB FSA	EC Food Hygiene Regulations	The monitoring was adopted when the EU food hygiene safety regulation was published in 1998	Monitoring occurs throughout the UK in all classified shellfish producing areas	Presence or absence of Diarrhetic shellfish poisoning in biota (negative/positive result) (Recent discoveries have shown that the toxicity previously referred to as diarrhetic shellfish poisoning (DSP) is actually caused by several distinct groups of natural compounds, such as okadaic acid (OA) and dinophysistoxins (DTXs), yessotoxins (YTXs), azaspiracids (AZAs) and pectenotoxins (PTXs). Each has a different mode of action and each causes different types of toxicity. These groups of toxins are now sometimes referred to as 'lipophilic toxins', referring to their chemical characteristics rather than their toxic effect.)	To monitor the extent of Diarrhetic Shellfish Poisoning in biota	No specific or single impacting activity	Human Health	Indirectly effective (what causes some phytoplankton to produce marine biotoxins, and what determines the frequency of toxic algal events is the subject of world-wide research)	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if
Paralytic Shellfish Poisoning (PSP) in biota	Shellfish Biotoxin Programme Scotland (Shellfish Hygiene) [7]	EU food safety hygiene regulation methodologies implemented http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:338:0027:0059:EN:PDF	CEFAS FSAS IAB FSA	EC Food Hygiene Regulations	The monitoring was adopted when the EU food hygiene safety regulation was published in 1998	Monitoring occurs throughout the UK in all classified shellfish producing areas	Concentration of Paralytic shellfish poisoning in biota (µg/100g)	To monitor the extent of Paralytic Shellfish Poisoning in biota	No specific or single impacting activity	Human Health	Indirectly effective (what causes some phytoplankton to produce marine biotoxins, and what determines the frequency of toxic algal events is the subject of world-wide research)	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Phycotoxin species (phycotoxin in biota)	Shellfish Biotoxin Programme Scotland (Shellfish Hygiene) [7]	EU food safety hygiene regulation methodologies implemented http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:338:0027:0059:EN:PDF	CEFAS FSAS IAB FSA	EC Food Hygiene Regulations	The monitoring was adopted when the EU food hygiene safety regulation was published in 1998		Phycotoxin species present in the biota (common name / Sample type; W = Whole ; G =Gonad; S = Shucked; A = Adductor)	To monitor the extent of Phycotoxin species present in biota	No specific or single impacting activity	Human Health	Indirectly effective (what causes some phytoplankton to produce marine biotoxins, and what determines the frequency of toxic algal events is the subject of world-wide research)	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Change in cholinesterase activity	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Increase in AcetylCholinesterase activity: Mussel (*Mytilus edulis* only) 200 mg muscle / brain or haemolymph from mussel 10 or more individuals 40 – 60 mm mussels	To monitor exposure of OP and carbamate pesticides in non- target organisms.	Land-based pollution Oil & Gas Industry Shipping	Heavy metal contamination, Synthetic and non-synthetic compound contamination and Hydrocarbon contamination	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if
Intersex in gastropods	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	intersex stage; length of prostate gland (if present). *Littorina littorea* (Clean Seas)	Monitors the presence of endocrine disrupting compounds in aquatic organisms as there is no definitive group of chemicals with endocrine disrupting activity (intersex), including pesticides, some metals, PAHs, PCBs and industrial chemicals	Land-based pollution Oil & Gas Industry Shipping	Heavy metal contamination, Synthetic and non-synthetic compound contamination and Hydrocarbon contamination	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (gastropods)
Kills in zoobenthos in relation to eutrophication	OSPAR EcoQO	OSPAR EcoQO Handbook http://www.ospar.org/documents/dbase/publications/p00307_EcoQO%20Handbook%202007%201st%20edition.pdf	EUC	OSPAR Convention	Test and Learning period 2006-2009	Netherlands & Norway lead for widespread application in North Sea (OSPAR EcoQO)	Zoobenthos Kills	To monitor the levels of eutrophication in the environment	De-oxygenation	Land-based pollution Aquaculture	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Lysosomal membrane stability	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Neutral red retention time (NRRT): Mussel (*Mytilus edulis* only) 200 µl haemolymph	Monitor the general health of organisms within an ecosystem. Monitor the effectiveness of remedial action upon ecosystems	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if
Organic carbon in biota	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Organic Carbon concentration	To monitor the extent of organic carbon in the biota	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Organic carbon in shellfish	Shellfish Waters Monitoring Programme (Scotland)	(SEPA, 2007a)	SEPA	EC Shellfish Waters Directive	Shellfish Waters Monitoring Programme implimented to address the European Community (EC) Shellfish Waters Directive (79/923/EEC) which came into force in 1979	Scotland	Organic Carbon concentration	To monitor the extent of organic carbon in shellfish	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef
Oyster Embryo Bioassay	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Success of embryo to develop normally to 'D' hinge larvae. (No. of control replicates used in oyster bioassay / No. of sample replicates used in oyster bioassay / Percent net response of oyster embryos in bioassay test / Source of reference water used in oyster bioassay)	Monitor the general health of the ecosystem through ability of organisms to develop normally	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef (oyster)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if
Scope for Growth	Clean Seas Evidence Monitoring Programme	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS	OSPAR Convention EC Dangerous Substances Directive	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	CSEMP integrates national and international monitoring programmes across UK agencies	Scope for growth measures energetic balance between processes of energy acquisition and energy expenditure. C = P+R+U+F Where: C = total consumption of food energy, P = total production of shell,somatic tissue and gametes, R =respiratory energy expenditure, U = energy loss in excreta and F = faecal energy loss.	To monitor the effects of contaminants and disturbance on the energy status of organisms.	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if
Shellfish population condition	Clean Seas Evidence Monitoring Programme CSEMP Benthic and Sediment Contaminants Programme Monitoring crustacean pot fisheries Pembrokeshire Marine SAC Site Condition Monitoring Shellfish Waters Monitoring Programme (Scotland) Solent Oyster Survey Solway Firth SAC and SSSI Site Condition Monitoring WFD Operational Monitoring WFD Surveillance Monitoring [2]	Clean Seas Environment Monitoring Programme Green Book (http://www.sepa.org.uk/pdf/marine/green_book/appendices.pdf)	CEFAS EA CCW SEPA	OSPAR Convention EC Dangerous Substances Directive EC Water Framework Directive EC Habitats Directive Wildlife and Countryside Act (GB) EC Shellfish Waters Directive EC Data collection Regulation (1639/2001)	The Clean Seas Environment Monitoring Programme (CSEMP) was introduced as the second phase of the National Monitoring Programme (NMP) in 1999.	Monitored locally under a number of separate monitoring programmes throughout the UK CSEMP integrates national and international monitoring programmes across UK agencies	Dry weight of shellfish / Extractable lipids in shellfish / Max length of shellfish / Mean length of shellfish / Mean shell weight of shellfish / Min length of shellfish / No. of shellfish per batch / Total lipid in shellfish (Clean Seas evidence monitoring/CSEMP) Landed weight (edible crabs) / Number of undersized lobsters (Monitoring crustacean pot fisheries) Limpet shell length (Pembrokeshire) Mussel shell length (Shellfish Waters) Maximum shell dimensions to the nearest mm below (Solent Oyster Survey) Length of each species (zoobenthos) (Solway Firth SAC) Mussel moisture content / Mussel shell length (WFD Operational Monitoring/WFD Surveillance Monitoring)	To monitor general ecosystem health	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	indirectly effective	Intertidal rock & biogenic reef and Coastal subtidal rock and biogenic reef

Appendix 2: Indicators not routinely monitored in the UK

Table a9: Indicators not routinely montored in the UK

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Increased suspended sediment		*Actinothoe sphyrodeta*	(Saiz Salinas & Urdangarin, 1994)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture Habitat Loss No specific or single acting pressure	Physical disturbance Deoxygenation Synthetic chemicals Substratum loss		*Alcyonium digitatum*	(Devon Wildlife Trust, 1993, Hartnoll, 1998, Hiscock et al., 2005a, Kaiser et al., 2000, Shelton & Rolfe, 1972, Smith, 1968., Veale et al., 2000)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Audouinella purpurea*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Bangia atropurpurea*	
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Berthella plumula*	(Jones, 1973)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Callithamnion sepositum*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture Oil and gas industry Shipping	Synthetic chemicals Hydrocarbons Deoxygenation Industrial effluent (general)		*Carcinus maenas*	(Bryan et al., 1987, Desgarrado Pereira et al., 1997, Diaz & Rosenberg, 1995, Grant & Briggs, 1998, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Caryophyllia smithii*	(Devon Wildlife Trust, 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Ceramium rubrum*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Ceramium shuttleworthianum*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Ceramium tenuissimum*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Chaetopterus variopedatus*	(Hauton et al., 2003)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (briefly describe purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)	References
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture Oil and gas industry Shipping	Synthetic chemicals Hydrocarbons Deoxygenation Industrial effluent (general)		*Delesseria sanguinea*	(Hardy et al., 1993, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Dendrodoa grossularia*	(Jones, 1973)
Abundance or tolerance								Hiscock *et al.* (2005a)	Oil and gas industry Shipping No specific or single acting pressure	Hydrocarbons Smothering		*Enteromorpha sp.*	(Crump et al., 1998, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure Aquaculture Climate Change (greenhouse gas emissions)	Deoxygenation Substratum loss Decreased salinity Physical disturbance		*Eunicella verrucosa*	(Devon Wildlife Trust, 1993, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution No specific or single acting pressure	Smothering Synthetic chemicals Industrial effluent (general)		*Fucus serratus*	(Hardy et al., 1993, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	Aquaculture	Deoxygenation		*Gamma radiationrus tigrinus*	(Diaz & Rosenberg, 1995)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Giffordia granulosa*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture	Nutrients		*Helcion pellucidum*	(Pearson & Black, 2001)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Hymeniacidon perleve*	(Jones, 1973)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Laminaria digitata*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture	Nutrients		*Limaria hians*	(Rees et al., 1992, Rygg, 1985)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Lutraria angustior*	(Hauton et al., 2003)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture Oil and gas industry Shipping	Nutrients Hydrocarbons		*Malacoceros fuliginosus*	(Pearson & Black, 2001)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Mastocarpus stellatus*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Oil and gas industry Shipping	Hydrocarbons		*Melarhaphe neritoides*	(Crump et al., 1998)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Membranoptera alata*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure Aquaculture	Physical disturbance Deoxygenation		*Metridium senile*	(Diaz & Rosenberg, 1995, Tuck et al., 1998, Wahl, 1984)
Abundance or tolerance								Hiscock *et al.* (2005a)	Aquaculture	Deoxygenation		*Modiolula phaseolina*	(Diaz & Rosenberg, 1995)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure Aquaculture	Nutrients Physical disturbance		*Mya truncata*	(Desprez, 2000, Hauton et al., 2003)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture No specific or single acting pressure	Nutrients Heavy metals Industrial effluent (general) Deoxygenation Smothering		*Mytilus edulis*	(Diaz & Rosenberg, 1995, Gray, 1976, Rosenberg, 1977, Shillabeer & Tapp, 1990)
Abundance or tolerance								Hiscock *et al.* (2005a)	Oil and gas industry Shipping	Hydrocarbons		*Patella sp.*	(Crump et al., 1998, Dicks & Levell, 1989)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure Climate Change (greenhouse gas emissions)	Physical disturbance Increased salinity		*Pentapora fascialis*	(Devon Wildlife Trust, 1993, Eno et al., 2001, Hiscock et al., 2005a, Macdonald et al., 1996)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Increased suspended sediment		*Phoronis hippocrepia*	(Saiz Salinas & Urdangarin, 1994)
Abundance or tolerance								Hiscock *et al.* (2005a)	Aquaculture	Deoxygenation		*Phoronis mulleri*	(Diaz & Rosenberg, 1995)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure Climate Change (greenhouse gas emissions)	Physical disturbance Smothering Substratum loss Increased suspended sediment Increased temperature		*Phymatolithon calcareum*	(Hall-Spencer & Moore, 2000, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Plumaria elegans*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Polychaeta indet.*	(Devon Wildlife Trust, 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Polygordius lacteus*	(Hauton et al., 2003)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Polysiphonia urceolata*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	No specific or single acting pressure	Physical disturbance		*Porifera indet. (encr.)*	(Devon Wildlife Trust, 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Aquaculture	Deoxygenation		*Pseudopolydora pulchra*	(Diaz & Rosenberg, 1995)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Ptilota plumose*	(Hardy et al., 1993)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Climate Change (greenhouse gas emmissions)	Salinity changes (rainfall, arctic ice melt) Industrial effluent (general) Smothering		*Saccharina latissima* (fomerly *Laminaria saccharina*)	(Hardy et al., 1993, Hiscock et al., 2005a)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Oil and gas industry Shipping	Hydrocarbons Synthetic chemicals		*Semibalanus balanoides*	(Crump et al., 1998, Dicks & Levell, 1989, Smith, 1968.)
Abundance or tolerance								Hiscock *et al.* (2005a)	Aquaculture	Deoxygenation		*Streblospio benedicti*	(Diaz & Rosenberg, 1995)
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution	Industrial effluent (general)		*Tubulanus annulatus*	(Jones, 1973)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Abundance or tolerance								Hiscock *et al.* (2005a)	Land-based pollution Aquaculture No specific or single acting pressure	Nutrients Physical disturbance Substratum loss		*Venerupis rhomboids*	(Hauton et al., 2003, Read, 1987, Van Moorsel, 1994)
Acid-base balance in *Psammechinus miliaris*							pCO_2 & HCO_3^- concentration in coelomic fluid.	Monitor the effects of ocean pH on organismal health	Climate change	pH changes			(Miles et al., 2007)
Antioxidant enzymes							e.g. changes in superoxide dismutase (SOD), catalase, peroxidase and glutathione reductase	To monitor the general health of an ecosystem throughout the food chain i.e. primary producers through to top predators. May permit detection of early injury in plants, provides a general indication of stress	Various	Ecosystem Health			(Long et al., 2004)and references therein)
Change in locomotory patterns								To monitor the effects of contaminants on the behaviour (e.g. movement and interaction) of an organism.	Various	Ecosystem Health			(Long et al., 2004)and references therein)
Changes in immune system activity								Monitoring presence of compounds that may increase the organisms' susceptibility to disease	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition			(Long et al., 2004)and references therein)
Changes in Phytochelatin concentration								To indicate the presence of metal contamination in plants	Various	Ecosystem Health			(Long et al., 2004)and references therein)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Changes in protein expression (Proteomics)								To monitor the effects of pollutants upon the global change in protein expression	Various	Ecosystem Health			(Long et al., 2004)and references therein)
Changes in vitamin levels								To monitor the health of consumers and top predators of an ecosystem.	Various	Ecosystem Health			(Long et al., 2004)and references therein)
Chemically Activated Luciferase Gene Expression (CALUX) and H4IIE bioassay								Allow the identification of 'unknown' chemicals showing dioxin-like activities.	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition			(Long et al., 2004)and references therein)
Fluctuating Asymmetry (FA)								This is the deviation from perfect bilateral symmetry caused by environmental stresses, developmental instability and genetic problems during development used to establish effect of contaminant exposure upon populations. Monitor health of protected, endangered species without killing the organism.	Various	Heavy metal contamination and Synthetic and non-synthetic compound contamination			(Long et al., 2004)and references therein)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Functional Trait Composition (Biological Traits Analysis (BTA))							Biogenic habitat provision Body design Defence strategy Degree of attachment Degree of flexibility Energy transfer efficiency Exposure potential Food type Horizontal migration Intra-specific sociability Living habitat Living location Environmental position Longevity Maximum growth rate Maximum size Mobility Movement method Predictability of dynamics Propagule dispersal Recruitment variability/success Reproductive method Resource capture method Scale of habitat provision Strength of attachment strength Time to maturity Tissue components Water column migration Fecundity	Uses bilogical traits of benthic taxa as indicators of key aspects of functionality	Various	Ecosystem Functionality			(Bremner et al., 2006)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (briefly describe purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)	References
Hard substratum invertebrate species environment quality index (Quality = (P + (((1-PF) + (1-A))/2) +PI) / 3)							Quality matrix: Where: P = Number of characteristic species present as a proportion of those which are expected for targeted typology (Range 0-1) PF = Number of Pressure-Favoured species present as a proportion of those which may be possibly be present on each type of shore or circalittoral rock (Range 0-1) PI = Number of Pressure-Intolerant species present as a proportion of those which may be possibly be present on each type of shore or circalittoral rock (Range 0-1) A = Number of non-native (Alien) species present as a proportion of those which may be possibly present in targeted typology (Range 0-1)	(e.g. If P =100%, PF = 0%, A = 0%, PI = 100% then Q = 1) (e.g. If P = 50%, PF =80%, A=100% and PI = 20% then Q = 0.27) High quality Q=0.8-1 Good quality Q= 0.6-0.8 Moderate quality Q = 0.4-0.6 Poor quality Q = 0.2-0.4 Bad quality Q =0-0.2	Various	Ecological Quality			(Hiscock et al., 2005b)
Heat Shock (or Stress) Protein expression							e.g. expression of HSP60, HSP70 & HSP 90	Biomarker of general stress/health of an organism	Various	Heavy metal contamination and Synthetic and non-synthetic compound contamination			(Long et al., 2004)and references therein)
Heptachlor in shellfish									Land-based pollution	Synthetic and non-synthetic compound contamination			
Heptachlorepoxide in shellfish									Land-based pollution	Synthetic and non-synthetic compound contamination			
Histopathological changes							e.g. tumour and lesion formation	Monitor effects of long term exposure to pollutants, especially low concentrations of carcinogens	Various	Synthetic and non-synthetic compound contamination and Hydrocarbon contamination			(Long et al., 2004)and references therein)

Indicator	Monitoring programme	Methods/ Protocol	Organisation	Source (policy drivery, reference)	Status (in use, state no. of years, under development, under consideration, used outside UK	Geographic coverage (local, country, UK, Europe)	Parameter(s) measured (including units of measure)	Description (briefly describe purpose and application)	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Effectiveness of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of ecosystem health assessed (state taxon or habitat if relevant)	References
Increase in Cytochrome P450 mixed function oxidase (MFO) enzyme activity or expression (CYP1, 2, 3, 4),							CYP1A - ethoxyresorufin-O-deethylase (EROD) activity, protein or mRNA	To monitor the extent of contamination by organic pollutants within ecosystems	Land-based pollution Oil and gas industry Shipping	Synthetic and non-synthetic compound contamination and Hydrocarbon contamination			(Long et al., 2004)and references therein)
Increase in DNA Adduct formation							Formation of DNA adducts (DNA covalently bonded to a chemical carcinogen)	Monitor organic pollutant contamination and presence of genotoxic compounds	Land-based pollution Oil and gas industry Shipping	Synthetic and non-synthetic compound contamination and Hydrocarbon contamination			(Long et al., 2004)and references therein)
Increase in DNA Strand Breakage and other chromosomal aberrations							e.g. COMET assay	To monitor presence of genotoxic compounds	Various	Synthetic and non-synthetic compound contamination and Hydrocarbon contamination			(Long et al., 2004)and references therein)
Increase in Glutathione S-transferase (GST) activity								To monitor the general health of an ecosystem throughout the food chain i.e. primary producers through to top predators	Land-based pollution Oil and gas industry Shipping	Heavy metal contamination, Synthetic and non-synthetic compound contamination and Hydrocarbon contamination			(Long et al., 2004)and references therein)
Increase in porphyrins								Monitors the presence of organic compounds that interfere with haemoglobin and chlorophyll biosynthesis in animals and plants, respectively	Oil & Gas Industry Shipping	Hydrocarbon contamination			(Long et al., 2004)and references therein)
Inhibition of Calcium ATPase activity								To monitor the general health of an ecosystem. To be used as part of an integrated approach to biomonitoring	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition			(Long et al., 2004)and references therein)
Intertidal *Mytilus edulis* beds on mixed and sandy sediments							TBC		Various	Ecological Quality			

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Littoral chalk communities									Various	Ecological Quality			
Maerl beds									Various	Ecological Quality			
Metabolic profiling using high resolution nuclear magnetic resonance spectroscopy (NMR)								Gives an indication of the presence of compounds that affect the metabolic capacity of organisms	Various	Ecosystem Health			(Long et al., 2004)and references therein)
Nucella lapillus							TBC		Various	Ecological Quality			
Ostrea edulis beds							TBC		Various	Ecological Quality			
Other reporter gene techniques e.g. ER-CALUX, PLHC-1, YES & YAS								Used in conjunction with TIE methods to identify chemicals of interest, e.g. oestrogen-like compounds - ERCALUX, androgen-like compounds - YAS	Land-based pollution	Synthetic and non-synthetic compound contamination			(Long et al., 2004) and references therein)
pp-TDE in shellfish							PP-TDE concentration	To monitor the extent of PP-TDE contamination and bioavailability to the biota	Land-based pollution	synthetic and non-synthetic compound contamination			
Sabellaria spinulosa reef quality							Density (*S.spinulosa*), Elevation, Presence of recognisable reef, Sediment coalescence and stability, Species composition/richness (macrofauna & other macroalgal species), Temporal stability, Total cover (macrophyte species), Total cover (benthic invertebrates),	To monitor the extent of anthropogenic impacts on *S. spinulos*a reefs	Shipping, boating & anchoring Fishing - benthic trawling Sand and Gravel extraction	Habitat structure changes - abrasion Habitat structure changes			(Gubbay, 2007)

Indicator	**Monitoring programme**	**Methods/ Protocol**	**Organisation**	**Source** (policy drivery, reference)	**Status** (in use, state no. of years, under development, under consideration, used outside UK	**Geographic coverage** (local, country, UK, Europe)	**Parameter(s) measured** (including units of measure)	**Description** (briefly describe purpose and application)	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Effectiveness** of indicator to address impact (e.g. directly effective, indirectly effective, ineffective). Give reasons.	Aspect of **ecosystem** health assessed (state taxon or habitat if relevant)	**References**
Serum enzyme activity							e.g. Elevation of sorbitol dehydrogenase, glutamate dehydrogenase, glutamate pyruvate transaminase, lactate dehydrogenase	Gives an indication of changes in the biochemical responses of organisms	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition			(Long et al., 2004) and references therein)
Terminal Deoxynucleotidyl Transferase Biotin dUTP Nick End Labelling (TUNEL) (to measure apoptosis)								To be used as part of an integrated approach to biomonitoring. To establish effect of contaminant exposure on environmentally relevant species	Various	Ecosystem Health			(Long et al., 2004) and references therein)
Transcriptomics - oligonucleotide and cDNA microarrays								To monitor effects of pollutants at the gene level. Gives a holistic view of the effects of pollutant exposure	Various	Ecosystem Health			(Long et al., 2004) and references therein)

Appendix 3: Gap analysis

Table a10: Gap analysis of indicators for rock and biogenic reef habitats in current use against pressures

MSD order	MSD impact themes	Impact	Numbers of indicators in use	Intertidal Rock and Biogenic Reefs Assessment Framework Impact level	Subtidal Rock and Biogenic Reefs Assessment Framework Impact level	Potential Indicator
1	Physical loss	Habitat transformation (by smothering or sealing)	11	High	Medium	
2	Physical damage	Habitat structure changes - abrasion	30	Medium	Medium	*Modiolus* & Maerl bed spatial extent
2	Physical damage	Habitat structure changes - abrasion	30	Medium	Medium	
3	Other physical disturbance	Visual disturbance	11	None	None	
4	Interference with natural hydrological processes	Temperature changes - local/regional/national	5	Medium / High	Medium / High	
4	Interference with natural hydrological processes	Water flow (tidal & ocean currents) rate changes - local/regional/national	0	None	None	
5	Contamination by hazardous substances	Heavy metal contamination	22	Medium	Medium	
5	Contamination by hazardous substances	Synthetic & non-synthetic compound contamination	84	High	Medium	
5	Contamination by hazardous substances	Hydrocarbon contamination	45	Medium	Medium	
	Contamination by hazardous substances	Radionuclide contamination	107	Medium	Medium	
6	Nutrient & organic matter enrichment	De-oxygenation	1	Low	Low	

MSD order	MSD impact themes	Impact	Numbers of indicators in use	Intertidal Rock and Biogenic Reefs Assessment Framework Impact level	Subtidal Rock and Biogenic Reefs Assessment Framework Impact level	Potential Indicator
6	Nutrient & organic matter enrichment	Input of nitrogen & phosphorus	15	Medium	Medium	
6	Nutrient & organic matter enrichment	De-oxygenation	1	Low	Low	
6	Nutrient & organic matter enrichment	Input of nitrogen & phosphorus	15	Low	Low	
7	Biological disturbance	Introduction [spread] of non-indigenous species & translocations	0	Medium	Medium	MarClim UK-wide annual surveys of *Crassostrea gigas* since 2007
7	Biological disturbance	Introduction of microbial pathogens	3	Medium	Medium	
7	Biological disturbance	Removal of target species	0	Medium	Medium	
		Removal of non-target species	4	Medium	Medium	
7	Biological disturbance	Removal of target species	1	Medium	High	
7	Biological disturbance	Introduction [spread] of non-indigenous species & translocations	0	Medium	Medium	MarClim UK-wide annual surveys of *Sargassum muticum*, *Undaria pinnatifida*, *Crassostrea gigas* and *Crepidula formicata* since 2007 National surveillance scheme
7	Biological disturbance	Introduction [spread] of non-indigenous species & translocations	0	Medium	Medium	MarClim UK-wide annual surveys of *Sargassum muticum*, *Undaria pinnatifida*, *Crassostrea gigas* and *Crepidula formicata* since 2007 National surveillance scheme
8	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	274	High	High	

Appendix 4: Indicators to monitor ecosystem structure and function

Table a11: Assessment of indicators against key aspects of ecosystem structure and function

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
E.coli in Shellfish	Land-based pollution	Introduction of microbial pathogens	N/A	Organic matter import / export	2. Ensure the chemical characteristics of the marine environment support the natural processes, and the natural range, distribution, diversity and health of species and communities
Faecal coliforms in Shellfish	Land-based pollution	Introduction of microbial pathogens	N/A	Organic matter import / export	2. Ensure the chemical characteristics of the marine environment support the natural processes, and the natural range, distribution, diversity and health of species and communities
Replicated quadrat counts, barnacles	Climate change	Temperature change - regional/national	Habitat type General biology Range & distribution Reproduction & longevity Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	1. Ensure that ocean processes and their atmoshperic interactions continue to maintain natural ecosystem functioning and climate regulation 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Replicated quadrat counts, limpets	Climate change	Temperature change - regional/national	Habitat type General biology Range & distribution Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	1. Ensure that ocean processes and their atmoshperic interactions continue to maintain natural ecosystem functioning and climate regulation 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
SACFOR scale abundance (rocky intertidal invertebrates)	Climate change	Temperature change - regional/national	Habitat type General biology Range & distribution Reproduction & longevity Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	1. Ensure that ocean processes and their atmoshperic interactions continue to maintain natural ecosystem functioning and climate regulation 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
SACFOR scale abundance (rocky intertidal macroalgae	Climate change	Temperature change - regional/national	Habitat type General biology Range & distribution Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	1. Ensure that ocean processes and their atmoshperic interactions continue to maintain natural ecosystem functioning and climate regulation 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Replicated timed searches, *Osilinus lineatus, Gibbula umbilicalis*	Climate change	Temperature change - regional/national	Habitat type General biology Range & distribution Reproduction & longevity Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	1. Ensure that ocean processes and their atmoshperic interactions continue to maintain natural ecosystem functioning and climate regulation 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
% cover (encrusting and colonial species)	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Abundance (macrophyte species)	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Abundance (Pink Sea Fans)	Fishing - benthic trawling Fishing - potting Shipping, boating and anchoring	Habitat structure changes - abrasion	General biology Range & distribution Reproduction & longevity	Secondary production	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Abundance (Zoobenthos species)	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type General biology Range & distribution Species diversity Species richness Biomass Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Benthic invertebrate total cover	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type Range & distribution Species diversity Species richness Biomass Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Biological quality elements for the classification of ecological status (Transitional and Coastal surface waters)	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type General biology Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production Organic matter import / export Reef building	3. Ensure anthropogenic activities that impact hydrographic conditions do not adversely affect local ecosystem integrity and viability 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Biomass	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Biomass	Primary production Secondary production Organic matter import / export	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored

Indicator	Pressure(s) against which indicator is used	Impact(s) for which indicator is used	Ecosystem Structure Classification from MRAG-UNEP-WCMC review	Ecosystem Function	Contributory Marine Objectives met
Biotope Composition	No specific or single impacting activity	changes in species or community distribution, size/extent or condition	Habitat type Functional groups Community structure	Primary production Secondary production Organic matter import / export	3. Ensure anthropogenic activities that impact hydrographic conditions do not adversely affect local ecosystem integrity and viability 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Imposex in gastropods	Land-based pollution Oil & Gas Industry Shipping	Heavy metal contamination, Synthetic and non-synthetic compound contamination and Hydrocarbon contamination	General biology Reproduction & longevity	Secondary production	2. Ensure the chemical characteristics of the marine environment support the natural processes, and the natural range, distribution, diversity and health of species and communities 5. Ensure natural biodiversity, and ecological interactions are maintained and where appropriate and possible restored.
Kills in zoobenthos in relation to eutrophication	De-oxygenation Habitat transformation (by smothering or sealing)	Land-based pollution Aquaculture	Range & distribution Species diversity Species richness Biomass Functional groups Community structure	Oxygen production Elemental cycling	2. Ensure the chemical characteristics of the marine environment support the natural processes, and the natural range, distribution, diversity and health of species and communities 5. Ensure natural biodiversity, and ecological interactions are maintained and where appropriate and possible restored.

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Modiolus modiolus beds	Shipping, boating & anchoring Fishing - benthic trawling	Habitat structure changes - abrasion	Habitat type Substrate type General biology Range & distribution Species diversity Species richness Biomass Functional groups Community structure	Secondary production Organic matter removal Reef building	3. Ensure anthropogenic activities that impact hydrographic conditions do not adversely affect local ecosystem integrity and viability 4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Organic carbon in biota	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Biomass	Metabolism	
Organic carbon in shellfish	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Biomass	Metabolism	
Oyster Embryo Bioassay	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	General biology	N/A	2. Ensure the chemical characteristics of the marine environment support the natural processes, and the natural range, distribution, diversity and health of species and communities 5. Ensure natural biodiversity, and ecological interactions are maintained and where appropriate and possible restored.

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Reef habitat parameters	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Habitat type Substrate type Range & distribution Reproduction & longevity Species diversity Species richness Biomass Community structure	Primary production Secondary production Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Sabellaria alveolata reef quality	Tourism/ recreation Habitat transformation (smothering or sealing)	Habitat structure changes Coastal infrastructure	Habitat type Substrate type Biomass	Secondary production Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Scope for Growth	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	General biology Biomass	Organic matter import / export Organic matter transformation	
Serpula vermicularis reef quality	Shipping, boating & anchoring Fishing - benthic trawling Input of nitrogen and phosphorus	Habitat structure changes - abrasion Aquaculture Land based pollution	Habitat type Substrate type Biomass	Secondary production Reef building	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored
Shellfish population condition	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	General biology Biomass	N / A	

Indicator	**Pressure(s)** against which indicator is used	**Impact(s)** for which indicator is used	**Ecosystem Structure Classification from MRAG-UNEP-WCMC review**	**Ecosystem Function**	**Contributory Marine Objectives met**
Species composition/ richness	No specific or single impacting activity	Changes in species or community distribution, size/extent or condition	Species diversity Species richness Biomass Chlorophyll Functional groups Community structure	Primary production Secondary production	4. Ensure the natural distribution, extent and character of marine landscapes and habitats are maintained, and where appropriate restored