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Task Group 9 Contaminants in fish and other seafood

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PREFACE

The Marine Strategy Framework Directive (2008/56/EC) (MSFD) requires that the European Commission (by 15 July 2010) should lay down criteria and methodological standards to allow consistency in approach in evaluating the extent to which Good Environmental Status (GES) is being achieved. ICES and JRC were contracted to provide scientific support for the Commission in meeting this obligation.

A total of 10 reports have been prepared relating to the descriptors of GES listed in Annex I of the Directive. Eight reports have been prepared by groups of independent experts coordinated by JRC and ICES in response to this contract. In addition, reports for two descriptors (Contaminants in fish and other seafood and Marine Litter) were written by expert groups coordinated by DG SANCO and IFREMER respectively.

A Task Group was established for each of the qualitative Descriptors. Each Task Group consisted of selected experts providing experience related to the four marine regions (the Baltic Sea, the North-east Atlantic, the Mediterranean Sea and the Black Sea) and an appropriate scope of relevant scientific expertise. Observers from the Regional Seas Conventions were also invited to each Task Group to help ensure the inclusion of relevant work by those Conventions. A Management Group consisting of the Chairs of the Task Groups including those from DG SANCO and IFREMER and a Steering Group from JRC and ICES joined by those in the JRC responsible for the technical/scientific work for the Task Groups coordinated by JRC, coordinated the work. The conclusions in the reports of the Task Groups and Management Group are not necessarily those of the coordinating organisations.

Readers of this report are urged to also read the report of the above mentioned Management Group since it provides the proper context for the individual Task Group reports as well as a discussion of a number of important overarching issues.

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EXECUTIVE SUMMARY

Descriptor 9 considers the presence of hazardous substances (i.e. chemical elements and compounds) or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern, in wild caught fish, crustaceans, molluscs, echinoderms, roe and seaweed harvested in the different (sub) regions destined for human consumption against regulatory levels set for human consumption. Substances for which regulatory levels are in the process of being set are also discussed.

The presence of contaminants in fish and other seafood for human consumption at levels above the regulatory levels established in community legislation for protection of public health will have a negative influence both on the health of the consumer and on the sustainable use of marine resources.

Contaminants in fish and other seafood for human consumption might arise from numerous anthropogenic sources such as land-based industrial activity, discharge, municipalities, pesticide use, nuclear accidents & discharge, aquaculture, heavy shipping lines, petrogenic sources, but natural oceanographic and geological factors including geothermal activity) might also be responsible for elevated levels of contaminants in fish and seafood.

A number of contaminants in marine environment giving rise to concern both from an environmental and public health of view have been selected. Regulatory levels have been laid down for lead, cadmium, mercury, polycyclic aromatic hydrocarbons, dioxins & dioxin-like PCBs and radionuclides. Other substances of concern are arsenic, non-dioxin like PCBs, phthalates, organochlorine pesticides, organotin compounds, brominated flame retardants and polyfluorinated compounds.

The indicators covering the properties of the attribute are basically laid down in the descriptor: "contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards".

Assessment of the indicators should at least take account of the actual levels that have been detected, the frequency that levels exceed the regulatory levels, the number of contaminants for which exceeding levels have been detected in parallel and the origin of the contamination. An intake assessment taking into account the importance in the human diet of the species showing exceeding levels could also be taken into account.

Strictly spoken, Good Environmental Status (GES) would be achieved if all contaminants are at levels below the levels established for human consumption or showing a downward trend (for the substances for which monitoring is ongoing but for which levels have not yet been set). However, it is generally felt that GES for descriptor 9 must be judged in view out the monitoring of descriptor 8, also dealing with contaminants in marine environment.

The report points out the lack of a well-defined established simple quantitative link between levels of contaminants in marine environment and levels in fish and other seafood, clearly demonstrating a general research need on transfer of contaminants from the marine environment to the fish/fishery species. In general, it would be interesting to identify possible relations between contaminant levels in sediment, and tissues of fish and other seafood.

1. INITIAL INTERPRETATION OF THE DESCRIPTOR

1.1. Interpretation of the key terms used in the descriptor "*Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards*"

In view of descriptor 9, the term "**contaminants**" is interpreted as "hazardous substances present in fish as a result of environmental contamination for which regulatory levels have been set for human consumption or for which the presence in fish is relevant". In this interpretation, hazardous substances are substances (i.e. chemical elements and compounds) or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern.

The terms "**fish and other seafood**" are interpreted as only wild caught fish, crustaceans, molluscs, echinoderms, roe and seaweed harvested in the different (sub) regions, all destined for human consumption.

"**Levels established by Community legislation**" are considered to be the regulatory levels set in community legislation for public health reasons.

"**Other relevant standards**" could be other national and international (WHO, FAO…) standards and recommendations set for fish and other seafood which are not in contradiction with the EU legislation.

In order to protect public health, it is essential to keep consumer intake of contaminants in food at levels which are toxicologically acceptable. Maximum levels are set at a strict level which is reasonably achievable following good agricultural, fishery and manufacturing practices and taking into account the risk related to the consumption of the food. This is a dynamic process allowing the lowering of levels in view of a favourable evolution of the contamination. Therefore, initiatives such as the Marine Strategy Framework Directive might in the long run lead to lower levels of contaminants in the marine environment; this then may result in a lowering of the regulatory levels for fish and other seafood.

Although regulatory levels have been set for marine biotoxins, they are not considered as contaminants. Their presence in fish and seafood is not always linked to human activities. Harmful algal bloom events are often due to climatic and hydrographical circumstances although human induced eutrophication from domestic, industrial and agricultural wastes can stimulate harmful algae blooms. Therefore, there is no always consistent link between the levels of marine biotoxins in fish and seafood and the environmental status of the marine environment. In addition, the threat from marine biotoxins is managed in a different manner to toner regulatory levels in seafood, prompting controls on harvesting.

1.2. Coverage of the descriptor

Descriptor 9 explicitly limits the scope to the levels of contaminants in fish and other seafood for human consumption to be set against levels established by Community legislation or other relevant standards.

Contaminants, for which levels in fish and seafood have been set in community legislation for public health reasons, should therefore be monitored for this specific descriptor against these regulatory levels.

1.3. Links and overlaps with other descriptors

The descriptors in the Marine Strategy Framework Directive (MSFD) are very diverse. Some descriptors deal with general status of the environment, others with specific habitat integrity or specific pressures. Two descriptors deal with an ecosystem service (the benefit people obtain from an ecosystem - in this case the fish harvested from the marine environment), of which descriptor 9 is the most prescriptive and the only one directly linked to other legislation, relating to food safety.

Because the occurrence of human health effects would probably also involve a major pollution effect, there is a link with descriptor 8 ("*Concentrations of contaminants are at levels not giving rise to pollution effects*") and thus indirectly, all descriptors influencing descriptor 8 might also touch on Descriptor 9.

1.4. Identification of relevant policies and conventions related to the descriptor

Relevant policies and conventions related to the descriptor are extensively discussed in the report on descriptor 8 ("*Concentrations of contaminants are at levels not giving rise to pollution effects*").

2. REVIEW OF SCIENTIFIC LITERATURE AND EXISTING METHODS FOR QUANTIFYING GOOD ENVIRONMENTAL STATUS (GES)

Since regulatory levels for contaminants are set on the basis of scientific advice provided for by the European Food Safety Authority (EFSA) taking into account their toxicity as well as their potential prevalence in the food chain, it is not needed to review scientific literature relative to the contaminants in this report.

However, although established regulatory levels are adequate for the management of public health protection, they are generally too high to be used as an indicator for the pollution of the marine environment. Thresholds for assessing pollution effects in the marine environment are usually lower. Furthermore, there rarely is a well-defined established simple quantitative link between levels of contaminants in marine environment and levels in fish and other seafood.

Current approach for monitoring fish and other seafood for compliance with levels set for public health protection are very different from monitoring of biota for environmental purposes. Moreover, existing monitoring programmes for fish and sea food for public health reasons generally focus on estimating consumer exposure rather than assessing environmental status. In order to use these programmes for assessing the environmental status of the marine environment, major adaptations would be needed regarding design of the sampling plans, sampling procedures, selected tissues analysis and traceability to the location of catching or harvesting.

Common approaches for monitoring contaminants in marine environment are thoroughly discussed in the report concerning Descriptor 8. Levels of contaminants in fish and seafood for public health reasons however are not the primary focus for monitoring of the environmental status of the marine environment.

An alternative approach such as assessments using environmental quality standards (EQSs) and environmental assessment criteria (EACs) or levels of biological effects response, however, fits more readily within descriptor 8. Since there rarely is a link between levels set for public health protection and GES, the question whether it is actually possible to use these levels set for public health protection for quantifying GES remains an open issue.

Different factors such as historical and present ecosystem health status and local problems such as vicinity of mining sites, industrial or waste-water treatment plants should be taken into account when designing a monitoring plan. The assessment of the specific situation in the (sub) region shall determine the substances in the current report to be retained for the monitoring programme, or on additional substances to be included.

3. IDENTIFY RELEVANT TEMPORAL/SPATIAL SCALES FOR THE DESCRIPTOR

3.1. Temporal scales for the descriptor

Depending on the contaminant a tendency of decreasing, increasing or stable levels can be observed over various time-scales.

In order to not to lose details of temporal trend, levels must be expressed in absolute figures rather than relative to the regulatory level (below, at or above the relevant limit). Because regulatory levels are generally too high to be used as an early indicator of increasing pollution of the marine environment, expressing results relative to the regulatory level would only trigger a change in environmental status at a very late stage. Levels below regulatory levels would not trigger a change in environmental status, but this could not be interpreted as no temporal trend was observed or as a stable situation. Important changes in the contaminant load of the marine environment might occur below these regulatory levels.

3.2. Spatial scales for the descriptor

Regulatory levels are set for public health reasons, and there is no difference between (sub) regions in regulatory levels against which compliance is assessed. Because the regulatory levels are generally too high to be used as an early indicator, most of the spatial distribution patterns will go undetected. Levels of contaminants do vary between (sub) regions, and some contaminants are more important than others for a specific (sub) region, due to differences in activities and inputs. Due to important differences in natural presence for some contaminants, care should be taken when comparing their levels in fish and other seafood between different (sub) regions.

4. GENERAL FRAMEWORK FOR DESCRIBING ENVIRONMENTAL STATUS

4.1. State and pressure indicators

State indicators describe the physical, chemical, and biological conditions of the natural world, and human health and welfare. Through monitoring of state indicators we can measure how ecosystem conditions change. State indicators may be levels of air or water quality, contaminants in fish, wildlife population levels, or diseases in animals or humans. State indicators also give a measure of current ecosystem status to use as a reference when assessing the impact of future activities. State indicators measure impacts of pressure indicators.

Pressure indicators describe direct and indirect pressures, including human activities, which impact the environment. They are driving forces of environmental change such as increased resource use, transportation patterns, pollutant emissions, sprawl, population growth, or the rate at which contaminants and invasive species are being introduced. Pressure indicators measure the factors that cause changes in the ecosystem.

Descriptor 9 explicitly outlines the reference points against which monitoring should be undertaken: levels of contaminants in fish and other seafood should "*...not exceed levels established by Community legislation or other relevant standards"*.

Levels of contaminants in fish and seafood for human consumption mentioned in descriptor 9 are state indicators themselves. Relevant indicators for descriptor 9 are the inputs of contaminants from the marine environment, covered by descriptor 8 "*Concentrations of contaminants are at levels not giving rise to pollution effects*". Descriptors 8 and 9 both measure indicators of contaminants in the marine environment, but focus on different state indicators. While descriptor 8 measures contaminants in the marine environment in a wide range of matrices and using a wide variety of techniques, descriptor 9 only measures levels of contaminants in fish and other seafood using analytical techniques determining those trace elements or compounds for which regulatory limits have been set.

4.2. **Conceptual framework**

Distinction between contaminants should be made between contaminants for which regulatory levels have been set and other contaminants of relevance in fish and other seafood.

Monitoring of descriptor 9 for contaminants for which regulatory levels have been laid down should be done against these levels. Monitoring of descriptor 9 for other contaminants should focus on trend analysis. The significance of an increase for specific contaminants under descriptor 8 should be regarded as an important element for inclusion in monitoring under descriptor 9.

Selection, rejection or even addition of contaminants to address (sub) regional concerns, or concerns at even lower levels, should be motivated and based on an assessment of different factors.

4.3. **Classification & aggregation**

4.3.1. Classification of individual criteria

Concentrations of contaminants in fish or seafood exceeding regulatory levels set for public health reasons clearly are non-compliant. They are doubtless indicators of bad environmental status. However, concentrations below these levels are not necessarily indicators of good environmental status, since environmental effects might be present at lower concentrations. Whether good environmental status is achieved for the contaminants is rather dealt with in Descriptor 8.

4.3.2. Aggregation within descriptor

Because the selection of the criteria will depend on the (sub) region, it is not possible to propose a predefined overall system of aggregation within descriptor 9.

Integration of the data collected during monitoring of descriptor 9 should at least take into account

- the frequency that levels exceed the regulatory levels
- the actual levels that have been detected
- the number of contaminants for which exceeding levels have been detected in parallel
- the origin of the contamination (geological versus anthropogenic, local versus or long distance)

Further an intake assessment taking into account the importance in the human diet of the species showing the exceeding levels could be taken into account.

The "one out, all out" approach doesn't seem applicable. In case one species would show concentrations exceeding the regulatory levels, declaring the (sub) region as a bad environmental status for a descriptor "*Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards*" could easily be interpreted that consumption of all fish and seafood originating in this (sub) region would be dangerous. Therefore, when aggregating information on the different criteria retained, care should be taken not to lose information during the process.

4.3.3. Aggregation between descriptors

Even more than for aggregation within a descriptor, when aggregating information from individual descriptors into an overall assessment, care should be taken not to lose information, nor to oversimplify the outcome of complex monitoring schemes by aggregating numerous individual results into a single score.

An option could be to aggregate between related descriptors, depending on their level of specificity: descriptors dealing with general status of the environment, with specific habitat integrity, with specific pressures or with an ecosystem service.

A joint aggregation of information for descriptors 8 and 9 for contaminants covered by both descriptors might bring a solution to the problem of the unclear situation towards GES at levels below the regulatory levels set for human consumption in descriptor 9.

5. MONITORING

5.1. Data needs for monitoring compliance to GES under the descriptor

For monitoring compliance with GES levels of contaminants in fish and seafood should be compared against the regulatory levels for each (sub) region. It should therefore be possible to trace back these data to a (sub) regional level.

Data should furthermore be obtained on target species both from an environmental and human consumption point of view. An indicative table of fish and other seafood species can be found in Annex II.

5.2. Data needs covered by national monitoring programs

Existing national monitoring programmes often do not cover the data needs for monitoring compliance to GES under descriptor 9. These programmes can be divided in two groups: programmes designed to monitor the marine environment (see descriptor 8) and programmes designed to monitor human exposure due to consumption of fish and other seafood.

Programmes monitoring contaminants in marine environment in general don't use regulatory levels set for public health, but make use of criteria such as environment quality standards, environmental assessment criteria or other approaches.

Programmes monitoring human exposure on the other hand do use regulatory levels set for public health, but they often lack the necessary data to link the samples & results to specific (sub) regions.

Their sampling procedures are mainly designed to assess human exposure: sampling includes all sizes of fish sold for human consumption rather then focusing on a standardised sample offering greater possibilities in comparing degrees of contamination in the marine environment. Since such programmes sample fishes from different sizes and ages, higher levels can not automatically be interpreted as a negative status or evolution of the environmental status.

Programmes monitoring human exposure often rely on retail sampling, at the marketing stage, and can involve both fresh and processed seafood. If the results from such programmes were to be used for monitoring GES for descriptor 9, there would need to be confidence that detected levels of contaminants are solely due to the contamination of the marine environment and that all possible cross contamination during treatment, transport and storage can be excluded.

Furthermore, human health programmes are generally designed to estimate consumer exposure. However, as seafood is widely transported the (sub)-region origin of seafood commonly eaten and therefore important for public health monitoring may not be identifiable. Traceability in the food chain is focused on risk management: unless specific provisions for further traceability exist, the requirement for traceability is limited to ensuring that food business operators are at least able to identify the immediate supplier of the product in question and the immediate subsequent recipient, with the exemption of retailers to final consumers ("one step back – one step forward").

Specific provisions[1] on consumer information relating to traceability are laid down for fish and seafood and impose that these commodities may not be offered for retail sale to the final consumer, irrespective of the marketing method, unless appropriate marking and labelling indicates the commercial designation of the species, the production method (whether the product was caught at sea or in freshwater, or resulted from aquaculture) and, in case of products caught at sea, the catch area. The catch areas defined in these specific provisions however do not impose the level of detail needed to trace back fish and seafood to all subregions laid down in the MSFD.

Therefore, in case results from such programmes would be used for monitoring GES for descriptor 9 in the framework of the MSFD, care should be taken that traceability assures a direct link of the fresh fish or other seafood to the specific (sub) regions laid down in the MSFD. In case further subdivisions are applied, traceability should be assured down to the level chosen.

5.3. **Existing methodological standards covering the data needs**

For contaminants for which regulatory levels have been set, certain provisions as regards sampling procedures and method of analysis are laid down in Regulations (EC) No 333/2007 and No 1883/2006. These methods should preferably be used when determining levels of contaminants in fish and seafood for human consumption in view of monitoring Good Environmental Status of the marine environment. Other guidelines for determining levels of contaminants in biota that are standardized and subject to quality control procedures can be found in the regional sea conventions (for example OSPAR JAMP guidelines for monitoring contaminants in biota) and ICES TIMES (Techniques in Marine Environment Series).

For other contaminants of relevance for fish and other seafood, methods laid down in the regional sea conventions can be used.

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[1] Council Regulation (EC) No 104/2000 on the common organisation of the markets in fishery and aquaculture products (OJ L 17, 21.1.2000, p. 22) and Commission Regulation (EC) No 2065/2001 laying down detailed rules for the application of Council Regulation (EC) No 104/2000 as regards informing consumers about fishery and aquaculture products (OJ L 278, 23.10.2001, p. 6)

5.4. Recommendations to make optimal use of existing monitoring information

Results from monitoring of contaminants under descriptor 8 ("*Concentrations of contaminants are at levels not giving rise to pollution effects*") and descriptor 9 should be integrated. When results from monitoring in descriptor 8 indicate a very low likelihood for elevated levels in fish and seafood for human consumption, additional monitoring under descriptor 9 on these commodities is not justified. Results from monitoring under descriptor 8 are an important element in selecting contaminants for descriptor 9. Since descriptors 8 and 9 largely deal with the same topic, it should be avoided to use different methodologies in parallel trend programmes for these descriptors.

Results from monitoring levels of contaminants in fish and seafood for human consumption for public health reasons should be used in assessing the environmental status of the marine environment, provided sampling and traceability fulfil environmental purpose.

It is important however, that all monitoring should be “fit for purpose” be that assessing compliance with maximum limits for seafood or detecting temporal and spatial trends of contaminants in the marine environment. Biological factors can influence concentrations of contaminants in fish, such as seasonal variation, age, sex. To avoid obscuring real environmental trends, monitoring to detect spatial and/or temporal trends should take account of these factors during sampling design and assessment. It is recognized that while descriptor 9 requires analysis of edible portion (usually muscle tissue of fish) liver may be a preferred matrix for trend detection for many substances (see descriptor 8)

The mutual exchange of information regarding levels of contaminants in fish and seafood between those instances monitoring for environmental reasons and for public health reasons should be strongly encouraged.

5.5. Possible improvements by targeted and focused additional monitoring

Since descriptor 9 focuses on fish and seafood destined for human consumption and commonly eaten / popular species do not necessarily represent a good coverage of the (sub) region, care should be taken to make a selection of species for monitoring in order to assure a correct assessment of the entire (sub) region.

In order to make monitoring results more comparable between (sub) regions, it would be advisable to select a limited number of target species from the most consumed species of fish and other seafood using the table in Annex II.

5.6. Existing quality assurance guidelines and assessment of guidelines which need to be developed

Existing quality assurance guidelines in the food area include proficiency tests organised for several contaminants by the Community Reference Laboratory for contaminants.

Other quality assurance tools and guidelines more focused on environmental monitoring are elaborated in the different regional sea conventions, such as Quality Assurance of Information for Marine Environmental Monitoring in Europe (QUASIMEME), International Atomic Energy Agency (IAEA) quality assurance, quality assurance guidelines in the Baltic Monitoring Programme.

6. RESEARCH NEEDS

There rarely is a well-defined established simple quantitative link between levels of contaminants in marine environment and levels in fish and other seafood, demonstrating a general research need on transfer of contaminants from the marine environment to the fish/fishery species.

In general it would be interesting to identify possible relations between contaminant levels in sediment, and tissues (such as liver and muscle) of fish and other seafood.

In case research would be able to establish a quantitative link between harmful algae blooms, and the levels of marine biotoxins in fish and seafood, such a link might have important predictive value for levels of marine biotoxins in fish and seafood for human consumption.

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ANNEX I: MONITORING OF CONTAMINANTS IN FISH AND OTHER SEAFOOD FOR HUMAN CONSUMPTION FOR DETERMINING GOOD ENVIRONMENTAL STATUS OF THE MARINE ENVIRONMENT UNDER THE MARINE STRATEGY FRAMEWORK DIRECTIVE

Monitoring should at least consider the following contaminants for which regulatory levels have been laid down:

- Heavy metals
    - Lead
    - Cadmium
    - Mercury
- Polycyclic aromatic hydrocarbons
- Dioxins (including dioxin like PCBs)
- Radionuclides

Additionally, the following contaminants of relevance should be monitored:

- Arsenic
- Non dioxin like PCBs
- Phthalates
- Organochlorine pesticides
- Organotin compounds
- Brominated flame retardants
- Polyfluorinated compounds

Generic information on sampling, analysis, GES interpretation of result and reporting can be found in part 1of this annex. Details on monitoring for each of these substances can be found in part 2A for substances with regulatory levels and part 2B for other substances of relevance. This information should be taken into account in addition to the provisions available in the regional sea conventions.

1 GENERAL INFORMATION

1.1 Sampling methods

1.1.1 General provisions on sampling

Sampling provisions for programmes monitoring for food safety reasons are batch linked. In order to be able to take into account results from programmes for monitoring of GES for descriptor 9, the sampled batch must be unambiguously linked to one single (sub) region and be representative for it.

In the course of sampling, precautions shall be taken to avoid any changes which would affect the levels of contaminants, adversely affect the analytical determination or make the aggregate samples unrepresentative.

As far as possible, incremental samples shall be taken. In case aggregate samples are used, these shall be made up by combining the incremental samples.

Each sample shall be placed in a clean, inert container offering adequate protection from contamination, from loss of analytes by adsorption to the internal wall of the container and against damage in transit. All necessary precautions shall be taken to avoid any change in composition of the sample which might arise during transportation or storage.

A record shall be kept of each sampling, assuring each sample to be traced back unambiguously to (sub) regional level and giving the date and place of sampling together with any additional information likely to be of assistance to the analyst.

1.1.2 Sampling strategy / plans / methods

The sampling strategy should take into account the specific objectives of the monitoring programme, including the quantitative objectives. Natural variability within the sample should be reduced by an appropriate sampling design and the performance of the analytical procedures (i.e. the accuracy and precision) must be accurate enough to meet the objective. Attention should be given in the design of the sampling strategy to variability due to the spawning period.

Statistical procedures must be taken into account to estimate the number of samples and sampling sites required to achieve a satisfactory level of confidence.

Absence of (cross) contamination post catch must be guaranteed. Only unprocessed products should be sampled for the purpose of GES MSFD monitoring. Sampling of fish and seafood at retail stage for GES monitoring shall only be done when all necessary conditions (e.g. avoid cross contamination, traceability to (sub) region…) can be guaranteed.

General criteria for the selection of the species to be used for monitoring include species more prone to biomagnify/bio-accumulate specific classes of contaminants, species representative of the different trophic levels or habitats, species representative for (sub) region. Basic prerequisites for selection of species for monitoring of descriptor 9 laid down in the regional sea conventions should be respected. In addition, the target species should be selected representing consumer habits by using the table in Annex III.

Since descriptor 9 focuses on fish and seafood destined for human consumption and commonly eaten / popular species do not necessarily represent a good geographical coverage of the (sub) region, care should be taken to make a selection of species for monitoring in order to assure a correct assessment of the entire (sub) region.

For substances for which no regulatory levels have been set yet, precautions for temporal trend monitoring are of the utmost importance.

1.2 Sample preparation and analysis

1.2.1 Laboratory Quality Standards

Laboratories shall be assessed and accredited and operate in accordance with EN ISO/IEC 17025 on ‘General requirements for the competence of testing and calibration laboratories’. The accreditation and assessment of testing laboratories may relate to individual tests or groups of tests.

Wherever possible the trueness of analysis shall be estimated by including suitable certified reference materials in the analysis. Participation in relevant interlaboratory studies is also encouraged.

1.2.2 Sample preparation

The basic requirement is to obtain a representative and homogeneous laboratory sample without introducing secondary contamination. Fish should be sampled in such a way that contamination after boarding of the fish can be excluded.

Sample preparation should be done according to the guidelines developed at EU level or by the regional sea conventions.

Compliance with maximum levels laid down in Regulation (EC) No 1881/2006 shall be established on the basis of the levels determined in the laboratory samples.

In case additional sample preparation procedures are needed, these are laid down in the specific part for each contaminant.

1.3 Methods of analysis

1.3.1 General requirements

General provision relating to the methods of analysis are laid down in Annex III of Regulation (EC) No 882/2004 of the European Parliament and of the Council on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules.

Methods of analysis should be validated for the determination of the specific contaminants in the specific matrices. Where a limited number of fully validated methods of analysis exist, alternatively, a 'fitness-for-purpose' approach may be used to assess the suitability of the method of analysis.

1.3.2 Performance criteria

Where no specific methods for the determination of contaminants in fish or other seafood is mentioned, laboratories may select any validated method of analysis (where possible, the validation shall include a certified reference material) provided the selected method meets the specific performance criteria set out for the specific contaminant.

1.4 Reporting of results

The analyst shall note the 'Report on the relationship between analytical results, measurement uncertainty, recovery factors and the provisions in EU food and feed legislation'[2].

[2] http://europa.eu.int/comm/food/food/chemicalsafety/contaminants/sampling_en.htm

1.5 GES interpretation of results

In case the analytical result of the laboratory sample exceeds beyond reasonable doubt the respective maximum level taking into account the expanded measurement uncertainty and correction for recovery if an extraction step has been applied, it should be considered as an alert for Good Environmental Status of the Marine Environment.

2 SPECIFIC CHAPTERS FOR EACH SUBSTANCE

As explained in part 1.1., setting regulatory levels of contaminants for public health reasons is a dynamic process. The regulatory levels in the current report reflect the situation as per 01 January 2010. Changes to the legislation can be found on http://ec.europa.eu/food/food/chemicalsafety/contaminants/index_en.htm

2.1 Part 2A: substances for which regulatory levels have been laid down

2.1.1 Heavy metals: lead, cadmium and mercury

Specific sample preparation procedures for lead, cadmium and mercury: the analyst shall ensure that samples do not become contaminated during sample preparation. Wherever possible, apparatus and equipment coming into contact with the sample shall not contain those metals to be determined and be made of inert materials e.g. plastics such as polypropylene, polytetrafluoroethylene (PTFE) etc. These should be acid cleaned to minimise the risk of contamination. High quality stainless steel may be used for cutting edges.

There are many satisfactory specific sample preparation procedures which may be used for the products under consideration. Those described in the European Committee for Standardisation (CEN) Standard EN 13804 'Foodstuffs – Determination of trace elements – Performance criteria, general considerations and sample preparation' have been found to be satisfactory but others may be equally valid.

Specific performance criteria for lead, cadmium and mercury:

Parameter	Value/Comment
Applicability	Foods specified in Regulation (EC) No 1881/2006
LOD	Less than one tenth of the maximum level (for lead levels below 0.1 mg/kg: less than one fifth of the maximum level)
LOQ	Less than one fifth of the maximum level (for lead levels below 0.1 mg/kg: less than two fifths of the maximum level)
Precision	$HORRAT_r$ or $HORRAT_R$ values of less than 2
Specificity	Free from matrix or spectral interferences

Regulatory levels for lead set in community legislation for public health reasons

Maximum levels for lead in fish and other seafood[3] (mg/kg wet weight)	
Muscle meat of fish	0,30
Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (Nephropidae and Palinuridae)	0,50
Bivalve molluscs	1,5
Cephalopods (without viscera)	1,0

[3] extracted from Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

Regulatory levels for cadmium set in community legislation for public health reasons

Maximum levels for cadmium in fish and other seafood[4] (mg/kg wet weight)	
Muscle meat of fish, excluding fish species listed below	0,050
Muscle meat of the following fish: bonito (*Sarda sarda*) common two-banded seabream (*Diplodus vulgaris*) eel (*Anguilla anguilla*) grey mullet (*Mugil labrosus labrosus*) horse mackerel or scad (*Trachurus species*) louvar or luvar (*Luvarus imperialis*) mackerel *(Scomber species)* sardine (*Sardina pilchardus*) sardinops (*Sardinops species*) tuna (*Thunnus species, Euthynnus species, Katsuwonus pelamis*) wedge sole (*Dicologoglossa cuneata*)	0,10
Muscle meat of the following fish: bullet tuna *(Auxis species)*	0,20
Muscle meat of the following fish: anchovy (*Engraulis species*) swordfish (*Xiphias gladius*)	0,30
Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (*Nephropidae* and *Palinuridae*)	0,50
Bivalve molluscs	1,0
Cephalopods (without viscera)	1,0

[4] extracted from Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

Regulatory levels for mercury set in community legislation for public health reasons

Maximum levels for mercury in fish and other seafood[5] [6] [7] (mg/kg wet weight)	
Fishery products and muscle meat of fish excluding species listed below. The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (*Nephropidae and Palinuridae)*.	0,50
Muscle meat of the following fish: anglerfish (*Lophius species*) atlantic catfish (*Anarhichas lupus*) bonito (*Sarda sarda*) eel (*Anguilla species*) emperor, orange roughy, rosy soldierfish (*Hoplostethus species*) grenadier (*Coryphaenoides rupestris*) halibut (*Hippoglossus hippoglossus*) kingklip *(Genypterus capensis)* marlin (*Makaira species*) megrim (*Lepidorhombus species*) mullet (*Mullus species*) pink cusk eel *(Genypterus blacodes)* pike (*Esox lucius*) plain bonito (*Orcynopsis unicolor*) poor cod (*Tricopterus minutes*) portuguese dogfish (*Centroscymnus coelolepis*) rays (*Raja species*) redfish (*Sebastes marinus, S. mentella, S. viviparus*) sail fish (*Istiophorus platypterus*) scabbard fish (*Lepidopus caudatus, Aphanopus carbo*) seabream, pandora (*Pagellus species*) shark (all species) snake mackerel or butterfish (*Lepidocybium flavobrunneum, Ruvettus pretiosus, Gempylus serpens*) sturgeon (*Acipenser species*) swordfish (*Xiphias gladius*) tuna (*Thunnus species, Euthynnus species, Katsuwonus pelamis*	1,0

[5] extracted from Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

[6] With the exclusion of fish liver

[7] Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

2.1.2 PAH Polycyclic aromatic hydrocarbons (PAHs)

Regulatory levels for polycyclic aromatic hydrocarbons set in community legislation for public health reasons currently consider only benzo(a)pyrene, since benzo(a)pyrene is used as a marker for the presence of the whole class.

Specific sample preparation procedures: the analyst shall ensure that samples do not become contaminated during sample preparation. Containers shall be rinsed with high purity acetone or hexane before use to minimise the risk of contamination. Wherever possible, apparatus and equipment coming into contact with the sample shall be made of inert materials such as aluminium, glass or polished stainless steel. Plastics such as polypropylene or PTFE shall be avoided because the analyte can adsorb onto these materials.

Species selection: it is preferred to sample bivalve molluscs, crustaceans and cephalopods. Fish should only be sampled to monitor a follow-up of a contamination incident involving PAHs.

Specific performance criteria:

Parameter	**Value/Comment**
LOD	Less than 0,3 µg/kg
LOQ	Less than 0,9 µg/kg
Precision	$HORRAT_r$ or $HORRAT_R$ values of less than 2
Recovery	50 to 120 %
Specificity	Free from matrix or spectral interferences, verification of positive detection

Maximum levels for benzo(a)pyrene in fish and other seafood [8] (µg/kg wet weight)	
Muscle meat of fish[9]	2,0
Crustaceans, cephalopods. The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (Nephropidae and Palinuridae).	5,0
Bivalve molluscs	10,0

[8] extracted from Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

[9] Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

2.1.3 Dioxins and dioxin-like PCBs

Regulatory levels for dioxins and dioxin-like PCBs set in community legislation for public health reasons consider *sum of dioxins (WHO-PCDD/F-TEQ) and sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ)*.

Specific provisions on sampling: when sampling small fishes (individual fishes weighing < about 1 kg), the whole fish is taken as sample. Samples of small fishes may consist of the middle part, weighing each at least 100 grams. The whole part to which the maximum level is applicable is used for homogenisation of the sample. The middle part of the fish is where the centre of gravity is. This is located in most cases at the dorsal fin (in case the fish has a dorsal fin) or halfway between the gill opening and the anus.

When sampling larger fishes (individual fishes weighing more than about 1 kg), the incremental sample consists of the middle part of the fish. Each incremental sample weighs at least 100 grams. For fishes of intermediate size (about 1-6 kg) a sample is taken as a slice of the fish from backbone to belly in the middle part of the fish.

Specific provision for sample preparation: In the case of fish, the skin has to be removed as the maximum level applies to muscle meat without skin. However it is necessary that all remaining rests of muscle meat and fat tissue at the inner side of the skin are carefully and completely scraped of from the skin and that these rests of muscle meat and fat tissue are added to the sample to be analysed.

The samples must be stored and transported in glass, aluminium, polypropylene or polyethylene containers. Traces of paper dust must be removed from the sample container. Glassware shall be rinsed with solvents, certified to be free from dioxins or previously controlled for the presence of dioxins.

Insofar as relevant, finely grind and mix thoroughly each laboratory sample using a process that has been demonstrated to achieve complete homogenisation (e.g. ground to pass a 1 mm sieve); samples have to be dried before grinding if moisture content is too high.

Specific requirements for laboratories: laboratories shall demonstrate the performance of a method in the range of the level of interest, e.g. 0.5x, 1x and 2x the level of interest with an acceptable coefficient of variation for repeated analysis. Limit of quantification shall be in the range of about one fifth of the level of interest.

Analysis should be performed using high-resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) methods. Following criteria have to be complied with on total TEQ value:

	Screening methods	**Confirmatory methods**
False negative rate	< 1 %	
Trueness		- 20 % to + 20 %
Precision (RSD_R)	< 30 %	< 15 %

Expression of results: dioxins [sum of polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)] are expressed as World Health Organisation (WHO) toxic equivalent using the WHO-toxic equivalency factors (WHO-TEFs). Sum of dioxins and dioxin-like PCBs [sum of PCDDs, PCDFs and polychlorinated biphenyls (PCBs)] are expressed as WHO toxic equivalent using the WHO-TEFs. WHO-TEFs for human risk assessment are based on the conclusions of the WHO meeting in Stockholm, Sweden, 15 to 18 June 1997 [Van den Berg et al., (1998) Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and for Wildlife. Environmental Health Perspectives, 106 (12), 775)].

Maximum levels for dioxins and dioxin-like PCBs in fish and other seafood [10]		
Sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ) (pg/g wet weight)		
Sum of dioxins (WHO-PCDD/F-TEQ) (pg/g wet weight)		
Muscle meat of fish and fishery products and products thereof, excluding eel. The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (*Nephropidae and Palinuridae)*.	4,0	8,0
Muscle meat of eel (*Anguilla anguilla)* and products thereof	4,0	12,0
Marine oils (fish body oil, fish liver oil and oils of other marine organisms intended for human consumption)	2,0	10,0
Fish liver and derived products thereof with the exception of marine oils	--	25,0

[10] extracted from Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

Congener	TEF value	Congener	TEF value
Dibenzo-p-dioxins (PCDDs)		***Dioxin-like PCBs: Non-ortho PCBs + Mono-ortho PCBs***	
2,3,7,8-TCDD	1		
1,2,3,7,8-PeCDD	1	***Non-ortho PCBs***	
1,2,3,4,7,8-HxCDD	0,1	PCB 77	0,0001
1,2,3,6,7,8-HxCDD	0,1	PCB 81	0,0001
1,2,3,7,8,9-HxCDD	0,1	PCB 126	0,1
1,2,3,4,6,7,8-HpCDD	0,01	PCB 169	0,01
OCDD	0,0001		
Dibenzofurans (PCDFs)		***Mono-ortho PCBs***	
2,3,7,8-TCDF	0,1	PCB 105	0,0001
1,2,3,7,8-PeCDF	0,05	PCB 114	0,0005
2,3,4,7,8-PeCDF	0,5	PCB 118	0,0001
1,2,3,4,7,8-HxCDF	0,1	PCB 123	0,0001
1,2,3,6,7,8-HxCDF	0,1	PCB 156	0,0005
1,2,3,7,8,9-HxCDF	0,1	PCB 157	0,0005
2,3,4,6,7,8-HxCDF	0,1	PCB 167	0,00001
1,2,3,4,6,7,8-HpCDF	0,01	PCB 189	0,0001
1,2,3,4,7,8,9-HpCDF	0,01		
OCDF	0,0001		

* Abbreviations used: “T” = tetra; “Pe” = penta; “Hx” = hexa; “Hp” = hepta; “O” = octa; “CDD” = chlorodibenzodioxin; “CDF” = chlorodibenzofuran; “CB” = chlorobiphenyl.

2.1.4 Radionuclides

Regulatory levels for radionuclides set in community legislation are maximum levels of radioactive contamination to be applied immediately following a nuclear accident of any other case of radiological emergency which is likely to lead or has led to significant radioactive contamination of foodstuffs and feedingstuffs.

Maximum permitted levels for fish and other seafood (Bq/kg) [11]	
Isotopes of strontium, notably Sr-90	750
Isotopes of iodine, notably I-131	2 000
Alpha-emitting isotopes of plutonium and transplutonium elements, notably Pu-239, Am- 241	80
All other nuclides of half-life greater than 10 days, notably Cs-134, Cs-137 *	1 250

* Carbon 14, tritium and potassium 40 are not included in this group.

2.2 Part 2B: Other substances of relevance

For the contaminants in this section work relating to the possible setting of regulatory levels is ongoing. It is very likely that a decision regarding the setting of such levels will be taken during the time period of the Marine Strategy Framework Directive and monitoring will be required as levels are implemented in the legislation. The approach to follow in absence of regulatory levels is temporal trend analysis. This could be done in conjunction with requirements for descriptor 8.

Contaminants are discussed in this section in their order of priority.

2.2.1 Non-dioxin like PCBs

Monitoring of non-dioxin-like PCBs in fish and other seafood should be oriented at determining the sum of the concentration of six indicator PCBs (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 and PCB 180).

Specific provisions on sampling: when sampling small fishes (individual fishes weighing < about 1 kg), the whole fish is taken as sample. Samples of small fishes may consist of the middle part, weighing each at least 100 grams. The whole part to which the maximum level is applicable is used for homogenisation of the sample. The middle part of the fish is where the centre of gravity is. This is located in most cases at the dorsal fin (in case the fish has a dorsal fin) or halfway between the gill opening and the anus.

When sampling larger fishes (individual fishes weighing more than about 1 kg), the incremental sample consists of the middle part of the fish. Each incremental sample weighs at least 100 grams.

For fishes of intermediate size (about 1-6 kg) a sample is taken as a slice of the fish from backbone to belly in the middle part of the fish.

Specific provision for sample preparation: In the case of fish, the skin has to be removed as the maximum level applies to muscle meat without skin. However it is necessary that all remaining

11 extracted from COUNCIL REGULATION (EURATOM) No 3954/87 of 22 December 1987 laying down maximum permitted levels of radioactive contamination of foodstuffs and of feedingstuffs following a nuclear accident or any other case of radiological emergency (OJ L 371, 30.12.1987, p. 11)

rests of muscle meat and fat tissue at the inner side of the skin are carefully and completely scraped of from the skin and that these rests of muscle meat and fat tissue are added to the sample to be analysed.

The samples must be stored and transported in glass, aluminium, polypropylene or polyethylene containers. Traces of paper dust must be removed from the sample container. Glassware shall be rinsed with solvents, certified to be free from PCBs or previously controlled for the presence of PCBs.

Insofar as relevant, finely grind and mix thoroughly each laboratory sample using a process that has been demonstrated to achieve complete homogenisation (e.g. ground to pass a 1 mm sieve); samples have to be dried before grinding if moisture content is too high.

Specific requirements for laboratories: laboratories shall demonstrate the performance of a method in the range of the level of interest, e.g. 0.5x, 1x and 2x the level of interest with an acceptable coefficient of variation for repeated analysis. Limit of quantification shall be in the range of about one third of the level of interest.

Trueness	- 30 % to + 30 %
Precision (RSD_R)	≤ 20 %

Monitoring of non-dioxin-like PCBs is ongoing since 2006.

2.2.2 BFRs, Brominated flame retardants

Based on the analytical feasibility to measure the chemical compounds routinely in accredited laboratories, the production volumes, the occurrence of the chemical compounds in food and feed, their persistence in the environment and their toxicity, the following compounds should be included in monitoring of BFR in fish and other seafood whereby

- are preferably analysed:
    - polybrominated diphenyl ethers (PBDEs): BDE congeners #28, 47, 99, 100, 153, 154, 183 and 209.
    - hexabromocyclododecane (HBCD): total amount (isomer specific analysis of a limited number of samples and/or pools in case of significantly elevated levels or increasing trends).
    - polybrominated biphenyls (PBBs): BB congener #153.
- are if possible also analysed:
    - additional PBDE congeners
    - decabromodiphenyl ethane
    - hexabromobenzene
    - 1,2-bis (2,4,6-tribromophenoxy)ethane.

General monitoring is ongoing since 2007. ICES TIMES series documents providing guidance for monitoring of PBDEs and HBCD are in press (Webster et al.)

2.2.3 PFOS/PFOA, Polyfluorinated compounds

When monitoring for the presence of polyfluorinated compounds (PFCs) in fish and other seafood, monitoring should be oriented at the detection of the compounds

- perfluorooctane sulfonate (PFOS)
- perfluorooctanoic acid (PFOA)

If possible monitoring should also include

- PFOS and PFAS precursors, such as
    - perfluorooctane sulphonamide (PFOSA),
    - N-ethyl perfluorooctane sulfonamidoethanol (NEtFOSE)
    - 8:2 fluorotelomer alcohol
- compounds similar to PFOS and PFOA but with different chain length (C4 – C15) and
- polyfluoroalkyl phosphate surfactants (PAPS), such as
    - 8:2 diPAPS and
    - 8:2 monoPAPS

Regarding the performance of analytical procedures, the recovery rates should be in the 70-120% range, with limits of quantitation of 1 ng/g.

Work on PFOS/PFOA in food commodities is ongoing since February 2008. General monitoring of these substances in food of animal origin such as fish, meat, eggs, milk and derived products and food of plant origin in order to enable an accurate estimation of their presence in food and food borne exposure will take place during the years 2010 and 2011.

OSPAR has produced a technical annex for monitoring PFCs in marine biota and guidance for selection of substances. Concentrations of PFOA, NEtFOSE and 8:2 fluorotelomer alcohol are likely to be low in fish.

2.2.4 Arsenic

Monitoring of arsenic for GES should ideally perform analysis for both inorganic and total arsenic and identify typical ratios between inorganic and organic forms. Monitoring should include fish, seafood and algae. Validated methods for speciation between inorganic and organic forms are not widely available. Work on arsenic in food commodities is ongoing since June 2008.

2.2.5 Organotin compounds

Monitoring of organotin compounds should

- Preferably include tributyltin (TBT), triphenyltin (TPT) and dibutyltin (DBT)
- Put emphasis on seafood other than fish more than on fish

- Pay particular attention to assure a correct assessment of the entire (sub) region as not to over represent highly contaminated areas such as harbours or heavily used shipping routes

2.2.6 Organochlorine pesticides in fish and other seafood

Monitoring should include fish and other seafood for the following substances. The MRLs mentioned in the table however are currently only valid for sea weed.

Substance [12]	**MRL (mg/kg)**
Chlordane (sum of cis- and trans-chlordane)	0,01 *
DDT (sum of p,p'-DDT, o,p'-DDT, p-p'-DDE and p,p'-TDE (DDD) expressed as DDT)	0,05 *
Dicofol (sum of p, p' and o,p' isomers)	0,02 *
Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulphate expresses as endosulfan)	0,05 *
Heptachlor (sum of heptachlor and heptachlor epoxide expressed as heptachlor)	0,01 *
Aldrin and Dieldrin (Aldrin and dieldrin combined expressed as dieldrin)	0,01 *
Endrin	0,01 *
Hexachlorocyclohexane (HCH), sum of isomers, except the gamma isomer	0,01 *
Lindane (Gamma-isomer of hexachlorocyclohexane (HCH))	0,01 *
Camphechlor (Sum of the three indicator compounds Parlar No 26, 50 and 62, where Parlar No 26 = 2-endo,3-exo,5-endo,6-exo,8,8,10,10-octachlorobornane, Parlar No 50 = 2-endo,3-exo,5-endo,6-exo,8,8,9,10,10-nonachlorobornane and Parlar No 62 = 2,2,5,5,8,9,9,10,10,-nonachlorobornane	0,1 *
Hexachlorobenzene	0,01 *

(*) Indicates lower limit of analytical determination

2.2.7 Phthalates

Monitoring of phthalates should preferably include butyl-benzyl phthalate (BBP), di-butylphthalate (DBP), bis(2-ethylhexyl)phthalate (DEHP), di-isodecylphthalate (DIDP), di-isononylphthalate (DINP) and di-isobutylphthalate (DIBP).

Work is only at a preliminary stage.

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12 Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC (OJ L 70, 16.3.2005, p. 1)

ANNEX II: INDICATIVE TABLES OF MOST CONSUMED SPECIES OF FISH AND SEAFOOD FOR THE DIFFERENT (SUB) REGIONS

1. Region: Baltic Sea

Fish

Common name	Scientific name	Importance
Baltic herring	*Clupea harengus*	+++
Salmon	*Salmo salar*	+++
Sprat	*Sprattus sprattus*	+++
Perch	*Perca fluviatilis*	+++
Whitefish	*Coregonus lavaretus*	++
Bream	*Abramis brama*	++
Cod	*Gadus morhua*	++
Pike	*Exos lucius*	++
Pike perch	*Sander lucioperca*	++
Vendace	*Coregonus albula*	++
Burbot	*Lota lota*	+
Flounder	*Platichthys flesus*	+
River lamprey	*Lampetra fluviatilis*	+
Roach	*Rutilus rutilus*	+

2. Region: The North-east Atlantic Ocean

2.1. Subregion: the Greater North Sea, including the Kattegat, and the English Channel

Fish

Herring	*Clupea harengus*	+++
Cod	*Gadus morhua*	+++
Horse mackerel	*Trachurus trachurus*	++
Coalfish	*Pollachius virens*	++
Blue Whiting	*Micromesistius poutassou*	++
Sprat	*Sprattus sprattus*	+

Common name	Scientific name	Importance
Plaice	*Pleuronectes platessa*	+
Atlantic mackerel	*Scomber scombrus*	+
Saithe, Pollock	*Pollachius virens*	+
Sole	*Solea solea*	+
Great Sand eel	*Ammodytes personatus* or *Hyperoplus lanceolatus*	+

Other seafood

Mussels	*Mytilus edulis*	+++
North Sea crab	*Cancer pagurus*	++
Shrimps	*Palaemon serratus*	++
Oysters	*Crassostrea gigas*	+

2.2. Subregion: the Celtic Seas

Fish

Cod	*Gadus morhua*	+++
Haddock	*Melanogramus aglefinus*	+++
Whiting	*Merlangius merlangus*	+++
Hake	*Merluccius merluccius*	+++
Monk	*Lophius spp*	+++
Megrim	*Lepidorhombus spp.*	+++
Herring	*Clupea herrangus*	+++
Mackerel	*Scombrus scombrus*	+++
Horse mackerel	*Trachurus trachurus*	+++
Norway lobster	*Nephrops norvegicus*	+++
Albacore tuna	*Thunnus alalunga*	+++
Sole	*Solea solea*	+++
Plaice	*Pleuronectes platessa*	+++

Common name	Scientific name	Importance
Saithe	*Pollachius virens*	+++
Sprat	*Sprattus sprattus*	++
All rajadae	*Raja spp*	++
Blue whiting	*Micromesistius poutassou**	++
Pollock	*Pollachius pollachius*	++

Other seafood

Crab	*Cancer pagurus*	+++
Lobster	*Homarus gammarus*	+++
Mussel	*Mytilus edulis*	+++
Scallop	*Pecten maximus*	+++
Shrimp	*Palaemon serratus*	++
Oyster	*Crassostra Gigas & Ostrea edulis*	+++
Surf Clam	*Spisula spp.*	++
Cockle	*Cerastoderma edule*	++
Velvet crab	*Necora puber*	++
Whelk	*Buccinum undatum*	++
Spider crab	*Maja brachydactyla*	++
Spiny lobster	*Palinurus elephas*	++

2.3. Subregion: the Bay of Biscay and the Iberian Coast

Fish

European anchovy	*Engraulis encrasicolus*	+++
Megrim	*Lepidorhombus boscii*	+++
Megrim	*Lepidorhombus whiffiagonis*	+++
European Squid	*Loliginidae*	+++
Monk	*Lophius spp*	+++

Common name	Scientific name	Importance
Hake	*Merluccius merluccius*	+++
Blue Whiting	*Micromesistius poutassou*	+++
Goatfishes	*Mullus spp*	+++
Octopus	*Octopus vulgaris*	+++
Sardine	*Sardina pilchardus*	+++
Atlantic mackerel	*Scomber scombrus*	+++
Cuttlefish	*Sepia officinalis*	+++
Soles	*Solea spp*	+++
Mackerel	*Trachurus spp*	+++
Albacore tuna	*Thunnus alalunga*	+++
Atlantic blue fin tuna	*Thunnus thynnus*	+++
Atlantic pomfret	*Brama brama*	++

Other seafood

Mediterranean mussel	*Mytilus galloprovincialis*	+++
Norway lobster	*Nephrops norvegicus*	+++
Cockle	*Cerastoderma edule*	+++
Deep-water rose shrimp	*Parapenaeus longirostris*	++
Carpet shells and clams	*Venerupis spp y Ruditapes spp.*	++

2.4. Subregion: in the Atlantic Ocean, the Macaronesian biogeographic region, being the waters surrounding the Azores, Madeira and the Canary Islands

Fish

Hake	*Merluccius merluccius*	+++
Mediterranean moray	*Muraena augusti*	+++
Octopus	*Octopus vulgaris*	+++
Common sea bream	*Pagrus pagrus*	+++
Sardine	*Sardina pilchardus*	+++

Common name	Scientific name	Importance
Salpa	*Sarpa salpa*	+++
Atlantic chub mackerel	*Scomber colias*	+++
Amberjacks	*Seriola spp.*	+++
Blacktail comber	*Serranus atricauda*	+++
Mediterranean parrotfish	*Sparisoma cretense*	+++
Mackerel	*Trachurus spp.*	+++
Skipjack tuna	*Katsuwonus pelamis*	+++
Big eye tuna	*Thunnus obesus*	+++
Albacore tuna	*Thunnus alalunga*	++
Yellow fin tuna	*Thunnus albacares*	++
Atlantic blue fin tuna	*Thunnus thynnus*	++

Other seafood

Pandalid shrimps	*Plesionika spp.*	+++

3. Region: Mediterranean Sea

3.1. Subregion: Western Mediterranean Sea

Sardine	*Sardina pilchardus*	+++
Horse Mackerel	*Trachurus trachurus*	+++
Hake	*Merluccius merluccius*	+++
Anchovy	*Engraulis encrasicolus*	+++
Blue Whiting	*Micromesistius poutassou*	++
Gilt sardine, Spanish sardine	*Sardinella aurita*	++
Mediterranean horse mackerel	*Trachurus mediterraneus*	++
Bullet tuna	*Auxis rochei*	++
Atlantic mackerel	*Scomber scombrus*	++
Swordfish	*Xiphias gladius*	++

Common name	Scientific name	Importance
Octopus	*Octopus vulgaris*	++
Mackerels	*Scomber spp*	++
Red shrimp	*Aristeus antennatus*	++
Atlantic blue fin tuna	*Thunnus thynnus*	++
Angler	*Lophius piscatorius*	++
Red mullet	*Mullus barbatus*	++
Mackerel	*Trachurus spp*	++
Gilthead sea bream	*Sparus aurata*	++
Menhaden	*Brevoortia pectinata*	+
Cuttlefish	*Sepia officinalis*	+
Atlantic saury	*Scomberesox saurus*	+
Common Pandora	*Pagellus erythrinus*	+
Blackspot sea bream	*Pagellus bogaraveo*	+

Other seafood

Spot tail mantis shrimp	*Squilla mantis*	++
Mediterranean mussel	*Mytillus galloprovencialis*	++
Norway lobster	*Nephrops norvegicus*	+

3.2. Subregion: Adriatic Sea

Fish

European anchovy	*Engraulis encrasiculus*	+++
Hake	*Merluccius merluccius*	+++
European Squid	*Loligo vulgaris*	+++
Atlantic bonito	*Sarda sarda*	++
Horse mackerel	*Trachurus trachurus*	++
Red striped mullet	*Mullus surmuletus*	++

Common name	Scientific name	Importance
Atlantic mackerel	*Scomber scombrus*	++

Other seafood

Mediterranean mussel	*Mytilus galloprovincialis*	+++
Clams	*Ruditapes decussates/ philippinarum*	+++
Norway lobster	*Nephrops norvegicus*	++

3.3. Subregion: Ionian Sea and Central Mediterranean Sea

Fish

Common name	Scientific name	Importance
European anchovy	*Engraulis encrasiculus*	+++
Hake	*Merluccius merluccius*	+++
Atlantic blue fin tuna	*Thunnus thynnus*	+++
Atlantic bonito	*Sarda sarda*	++
Red striped mullet	*Mullus surmuletus*	++
Swordfish	*Xiphias gladius*	++
Bullet tuna	*Auxis rokei*	++
Sardine	*Sardina pilchardus*	+
Atlantic mackerel	*Scomber scombrus*	+
Horse mackerel	*Trachurus trachurus*	+

Other seafood

Deep-water rose shrimp	*Parapenaeus longirostris*	++
Norway lobster	*Nephrops norvegicus*	+

3.5. Subregion: Aegean-Levantine Sea

Fish

European anchovy	*Engraulis encrasicolus*	
Sardine	*Sardina pilchardus*	
Gilt sardine, Spanish sardine	*Sardinella spp*	
Cuttlefish	*Sepia officinalis*	
Bogue	*Boops boops*	
Octopus	*Octopus vulgaris*	
Chub mackerel	*Scomber japonicus*	
Mediterranean horse mackerel	*Trachurus mediterraneus*	
Hake	*Merluccius merluccius*	

Common name	Scientific name	Importance
Shad	*Alosa spp*	
Blue Whiting	*Micromesistius poutassou*	
Picarels	*Spicara spp*	
Goatfishes	*Mullus spp.*	
Horse mackerel	*Trachurus trachurus*	
Flathead Mullet (Striped Mullet)	*Mugil cephalus*	
Common sea bream	*Pagrus pagrus*	
Meagre, shade-fish, salmon bass or Stone Bass	*Argyrosomus regius*	
Gilthead sea bream	*Sparus aurata*	
Barracuda	*Sphyraena spp*	
European sea bass	*Dicentrarchus labrax*	
Grouper	*Epinephelus spp*	

Other seafood

Mediterranean mussel	*Mytilus galloprovincialis*	
Caramote prawn	*Penaeus kerathurus*	

4. Region: Black Sea

Fish

Common name	**Scientific name**	**Importance**
Sprat	*Sprattus sprattus*	
Anchovy	*Engraulis encrasicolus*	
Horse Mackerel	*Trachurus trachurus*	
Bonito	*Sarda sarda*	
Turbot	*Psetta maxima*	
Whiting	*Micromesistius poutassou*	
Dogfish	*Scyliorhinus canicula*	

Other seafood

Veined rapa whelk	*Rapana Venosa*	
Mediterranean mussel	*Mytilus galloprovincialis*	

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Abstract

The Marine Strategy Framework Directive (2008/56/EC) (MSFD) requires that the European Commission (by 15 July 2010) should lay down criteria and methodological standards to allow consistency in approach in evaluating the extent to which Good Environmental Status (GES) is being achieved. ICES and JRC were contracted to provide scientific support for the Commission in meeting this obligation.

A total of 10 reports have been prepared relating to the descriptors of GES listed in Annex I of the Directive. Eight reports have been prepared by groups of independent experts coordinated by JRC and ICES in response to this contract. In addition, reports for two descriptors (Contaminants in fish and other seafood and Marine Litter) were written by expert groups coordinated by DG SANCO and IFREMER respectively.

A Task Group was established for each of the qualitative Descriptors. Each Task Group consisted of selected experts providing experience related to the four marine regions (the Baltic Sea, the North-east Atlantic, the Mediterranean Sea and the Black Sea) and an appropriate scope of relevant scientific expertise. Observers from the Regional Seas Conventions were also invited to each Task Group to help ensure the inclusion of relevant work by those Conventions. This is the report of Task Group 9 Contaminants in fish and other seafood.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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ICES International Council for the Exploration of the Sea
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