

1.5.5.9 Further development of guidance on integrated monitoring and assessment of chemicals and biological effects

Request

Further development of guidance on integrated monitoring and assessment of chemicals and biological effects (OSPAR 8-2008)

To complete the development of JAMP guidance for integrated monitoring of chemicals and their biological effects through preparing technical annexes on:

- (i) survey design. The purpose is to provide guidance on the selection of representative stations, taking into account requirements under the Water Framework Directive and the proposed Marine Strategy Directive, and for the selection of stations for integrated monitoring. This work should build on work by WGSAM 2007 relating to the spatial design of monitoring programmes and should take into account the approach taken by the UK in re-designing their station network;*
- (ii) groups of biological effects methods to be deployed to address specific questions. This should provide guidance on recommended packages of chemical and biological effects [methods(ed.)]for monitoring on determinand basis to ensure that chemical and biological methods were well matched and that chemical analysis underpinned biological effects monitoring.*

Source of information

ICES. 2009a. Report of the ICES/OSPAR Study Group on Integrated Monitoring of Contaminants and Biological Effects (SGIMC 2009)

ICES. 2009b. Report of the Marine Chemistry Working Group (MCWG 2009)

ICES. 2008. Report of the Fourth ICES/OSPAR Workshop on Integrated Monitoring of Contaminants and their Effects in Coastal and Open Sea Areas (WKIMON IV)

Summary

Scientists associated with ICES and OSPAR have been working for several years on the development of biological effects methods for monitoring contaminants in marine ecosystems. While there have been discussions relevant to the design of surveys for integrated monitoring it is not possible to provide guidance on the selection of stations until the exact purpose of the monitoring and assessment programme is defined. This will have to await the acceptance of the criteria and methodological standards for the determination of Good Environmental Status under the MSFD. While it is now apparent that the spatial scale of the assessment will be “OSPAR regional” as for the OSPAR QSR, the metrics to be determined and associated reference points will have to be known before guidance on survey design for integrated monitoring of chemicals and biological effects can be provided.

The work on identification of the groups of biological effects methods to be deployed is in progress and recommendations should be finalised in October 2009. Work still remains to be done on ensuring that the identified biological effects methods are well matched with chemical methods and that the chemical analyses underpin the biological effects monitoring.

ICES Response

ICES and OSPAR have been developing guidance for the implementation of biological effects methods for the OSPAR JAMP since 2001-2002 with a more concentrated effort being in 2005 with the first of 4 ICES/OSPAR Workshops on Integrated Monitoring of Contaminants and their Effects in Coastal and Open-Sea Areas (WKIMON). The present request from OSPAR is for recommendations for the suite of biological effects methods that should be considered for the JAMP and the associated survey design. This is an interim response based on the deliberations of the joint OSPAR/ICES Study Group on Integrated Monitoring of Contaminants in 2009 (ICES, 2009a); there is still considerable work to be done.

A work plan has been developed for 2009 and 2010 that will result in the completion of this task in 2011. Additionally the European Commission as part of the implementation of the Marine Strategy Framework Directive (MSFD) is developing criteria and methodological standards for the determination of Good Environmental Status such that the concentrations of contaminants are at levels not giving rise to pollution effects. These criteria and standards will undoubtedly result in

recommendations on biological effects monitoring for the EU that will be relevant to OSPAR. This advice from ICES will be developed further during those activities.

ICES notes that to date there has not been a significant consideration of the stated requirement that chemical and biological effects methods be well matched to the toxicological impact being studied and that chemical analysis underpin biological effects monitoring.

Background information

(i) Survey design

Completion of the development of JAMP guidance for integrated monitoring of chemicals and their biological effects requires the preparation of a technical annex on survey design. Guidance on the selection of representative stations is needed taking into account requirements under the Water Framework Directive and the proposed Marine Strategy Directive, and for the selection of stations for integrated monitoring. Survey design is highly dependent upon the purpose of the monitoring programme; i.e. the questions being asked or, in scientific terms, the hypotheses to be tested.

Previously discussions on survey design have been dominated by uncertainty over the scale of the assessment area, and the detail of the required assessment. It was uncertain as to whether the survey design should seek to detect gradients (differences) over relatively small areas, develop distributional maps, or seek some generalized expressions over much larger areas.

Developments over the last year in relation to the OSPAR Quality Status Report 2010 (QSR 2010) and the implementation of the EU MSFD provide some guidance. For example, data on contaminant concentrations in sediment and biota for QSR 2010, initially expressed on a station by station basis, were subsequently integrated to the scale of OSPAR regions. Assessment of coastal and offshore areas was provided as an intermediate stage. The MSFD requires that the assessments of GES be evaluated at Sub-regional level; OSPAR Regions being equivalent to sub-Regions under the MSFD. It therefore appears that the primary geographical scale of interest is quite large, although the importance of the localization of many contaminants in coastal areas cannot be disregarded.

A consequence of this clarification of geographical scale is that efforts are now being made to develop and implement schemes to integrate data over large areas. An example is the sub-regional scale assessment of EROD data reported in Section 1.5.5.1

Survey design is dependent *inter alia* on the characteristics of the metrics of interest and the purpose of the assessment, i.e. the hypotheses to be tested. The current OSPAR QSR is based on the value of determined metrics compared to reference values assessed on regional scale; it also considers the temporal trend of the metrics. The assessment for the MSFD is to determine if GES has been achieved on a regional scale and to allow for comparison between Marine Regions or Sub-Regions. Inherent in the both the QSR and MSFD are reference points and associated confidence limits. These reference points and confidence limits will to the extent possible be based on scientific data. Given the hypotheses that

- a. the assessed status of a region is not different than the desired reference point,
- b. the status of one region is not different than another, and
- c. the temporal trend indicates improvement,

it will then be possible to design the necessary sampling program.

A response to the request (i), survey design, must await the completion of the work under request (ii), development of assessment criteria, and should take into account developments for assessments of GES under the MSFD. ICES notes however that due to the inherent high variability of any metrics that are associated with marine ecosystems a strictly rigorous scientific solution may not be logistically or financially feasible.

(ii) Development of assessment criteria.

The development of assessment criteria will be the primary purpose of a joint ICES/OSPAR workshop to be held in October 2009. The present availability of assessment criteria are summarized in Table A and the degree of completeness of Background Documents and the reliability and applicability of assessment criteria are summarized in Table B. A detailed work plan has been developed to address the numerous activities required to make the various biological effects methods operational. While it is expected that on-going research will identify the need for updating the work plan, based on existing knowledge all of the required documentation should be completed by 2011.

Table A

Summary of current larval proposals for assessment criteria (from ICES, 2008).

BIOLOGICAL EFFECT	QUALIFYING COMMENTS	BACKGROUND RESPONSE RANGE	ELEVATED RESPONSE RANGE	HIGH AND CAUSE FOR CONCERN RESPONSE	AND FOR
VTG in plasma; µg/l	Cod	LOD ¹ to 2			
	Flounder	LOD to 2			
Reproduction in eelpout; mean frequency (%)	Malformed larvae	0 - 1	> 1-2	> 2	
	Late dead larvae	0 - 2	> 2-3	> 3	
	Growth / retarded larvae	0 - 4	> 4-6	> 6	
EROD; pmol/mg protein	Cod	≤ 80			
	Dab	≤ 40			
	Flounder	≤ 10			
Bile metabolites; 1-OH pyrene (µg/ml; 341/383 nm fluorescence)	Dab	≤ 220			
	Cod	≤ 0.95			
DNA adducts; nm adducts / mol DNA	Dab	≤ 7.86			
	Haddock	≤ 6.84			
	Saithe	≤ 7.90			
Bioassays; % mortality	Sediment, Corophium	0-30	> 30-< 60	> 60	
	Sediment, Arenicola	0-10	> 10-< 50	> 50	
	Water, copepod	0-10	> 10-< 50	> 50	
Bioassays; % abnormality	Water, bivalve embryo	0-20	> 20-< 50	> 50	
	Water, sea urchin embryo	0-10	> 10-< 50	> 50	
Bioassay; % growth	Water, sea urchin embryo	0-20	> 20-< 50	> 50	
Lysosomal stability; minutes	Cytochemical; all species	> 20	≤ 20-≥ 10	< 10	
	Neutral Red Retention: all species	> 120	≤ 120-≥ 50	< 50	
Fish Disease Index (FDI)	Cutpoints of the FDI assessment statistic are the 2.5% and the 97.5% quantiles of the assessment statistic. Their numerical values depend on the amount of data and are determined by simulation. Values below the 2.5% quantile are considered as “desirable”, values between and including the quantiles are considered as “indifferent”, values above the 97.5% quantile are considered as “undesirable” (raising concern).	< 2.5% quantile	2.5-97.5 quantiles	% > 97.5% quantile	

¹ Limit of Detection

Table B Summary of current position with OSPAR Background Documents and assessment criteria (OSPAR, 2008). *EAC equivalents refer to the Elevated and High Effects ranges in the preceding table.

BIOLOGICAL EFFECT	QUALIFYING COMMENTS	BACKGROUND DOCUMENT	METHOD OF DETERMINATION / EXPRESSION OF ASSESSMENT CRITERIA	DO BAC NEED TO DEVELOPED	ASSESSMENT CRITERIA?	ARRANGEMENTS FOR DEVELOPMENT
VTG in plasma; µg/l	Cod Flounder	Thorough complete	and 90 percentile from reference area / needs to be amended to zero	Needs to be developed but limited data available	Nothing on EAC equivalent*	Collation of existing data
Reproduction in eelpout; mean frequency (%)	Malformed larvae Late dead larvae Growth / retarded larvae	Thorough complete	and 95 percentile of ref sites / control	Already in place	Already in place	Further refinement as more data becomes available
EROD; pmol/mg protein	Cod Dab Flounder	Incomplete	Range of methods used	Needs to be developed	Further development required Nothing EAC equivalent*	No system available / further development of a model with existing dataset.
Bile metabolites; 1-OH pyrene (µg/ml; 341/383 nm fluorescence)	Dab Cod	Short and incomplete / need info on methodology etc	Reported as ranges from one dataset	Further development	Further dev – nothing on EAC equivalents*	NOR and NL preparing doc for SIME 2008 Background document needs updating
DNA adducts; nm adducts / mol DNA	Dab Haddock Saithe	Complete but needs slight amendment for haddock and saithe	90 percentile	Limited data requires further validation / development	Further dev – nothing on EAC equivalents*	UK to update / amend
Bioassays; % mortality	Sediment Corophium Sediment Arenicola Water bivalve embryo Water copepod Water echinoderm	Thorough complete	and 95 percentile of ref sites / control	Already in place	Already in place	Further validation as more data becomes available

BIOLOGICAL EFFECT	QUALIFYING COMMENTS	BACKGROUND DOCUMENT	METHOD OF DETERMINATION / EXPRESSION OF ASSESSMENT CRITERIA	DO BAC NEED TO BE DEVELOPED	ASSESSMENT CRITERIA?	ARRANGEMENTS FOR DEVELOPMENT
Lysosomal stability; minutes	Cytochemical; all species	Thorough complete	and Best professional judgment from extensive literature and laboratory studies	Already in place	Already in place	Further validation as more data becomes available. Currently based on limited dataset from one country.
	Neutral Red Retention: all species	Thorough complete	and Best professional judgment from extensive literature and laboratory studies	Already in place	Already in place	No further development
Fish Disease Index	Combination of externally visible diseases, macroscopic liver neoplasms and liver histopathology	Details in Annex 11 in WGPMO 2007 report; A summary needs to be included in the OSPAR Background Document.	Cutpoints of the FDI assessment statistic: 2.5% and 97.5% quantiles of the assessment statistic. < P 2.5%: desirable, P 2.5%-P 97.5%: indifferent, > P 97.5%: raising concern	Already in place	Already in place	No further development required. May be refined by ICES WGDPMO as appropriate
Scope For Growth	Mussels	Thorough complete	and Best professional judgment from extensive literature and laboratory studies	Already in place	Already in place	Further validation as more data becomes available