Monitoring Specifications

Date: 2011-07-15

Biological Effects

ARGE BLMP - Working Group for the North Sea and Baltic Sea Monitoring Programme

At the 34th North German Environmental Ministerial Meeting held on 17 April 1997, the competent departments of the German Federal Government and of the federal states of Hamburg, Mecklenburg-Vorpommern, Lower Saxony and Schleswig-Holstein agreed to establish a joint working group co-ordinating the monitoring of the marine environment of the North and Baltic Seas (ARGE BLMP Nord- und Ostsee).

Members of ARGE BLMP are:

- Federal Ministry of Food, Agriculture and Consumer Protection
- Federal Ministry of Transport, Building and Urban Development
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Federal Ministry of Education and Research
- Authority for Urban Development and Environment of the Free and Hanseatic City of Hamburg
- Mecklenburg-Vorpommern Ministry for Agriculture, the Environment and Consumer Protection
- Lower Saxony Ministry for the Environment and Climate Protection
- Schleswig-Holstein Ministry for Agriculture, the Environment and Rural Areas

The Monitoring Manual describes the current measuring programme implemented under BLMP. The monitoring requirements of the different EC Directives (Marine Strategy Framework Directive, Water Framework Directive, FFH, Birds Directive), marine protection conventions (OSPAR, HELCOM, Trilateral Monitoring and Assesment Program) and other bodies of regulations have been taken into account in the Manual. The Monitoring Manual is available free of charge on the BLMP website at www.blmp-online.de/Seiten/Monitoringhandbuch.htm

Editorial information

Issued by
Bundesamt für Seeschifffahrt und Hydrographie (BSH)
Sekretariat Bund/Länder-Messprogramm für die Meeresumwelt von Nord- und Ostsee (BLMP)
Bernhard-Nocht-Straße 78
20359 Hamburg

www.blmp-online.de

1 General

1.1 Subject area

Biological Monitoring - Biological Effects

1.2 Definition

Physiological, biochemical, histological and pathological investigations on marine organisms for the surveying of exposures to and/or adverse effects caused by pollutants.

Scope: Marine and coastal areas in the North Sea and Baltic Sea for which the German Federation and the Länder are responsible on the basis of current legislation and the commitments that have been entered into (transitional and coastal waters, including the high sea in the EEZ).

1.3 Competent authority/ies

Federal Government:	UBA, vTI
Hamburg:	BSU
Mecklenburg-Vorpommern:	Lfa-Fischerei MV, LUNG
Lower Saxony:	NLWKN, NLPV NI
Schleswig-Holstein:	LLUR, LKN-SH
D, DK, NL:	CWSS

1.4 Working group

Ad Hoc Working Group on Pollutants and Biological Effects

2 Monitoring requirements

The following international directives, conventions and monitoring programmes include components that involve the monitoring of biological effects, or there are plans for such components to be incorporated into them in the future:

2.1 Necessity

MSFD [1]

Comments

The purpose of the Marine Strategy Framework Directive (MSFD) is implementation of the provisions of the European Marine Strategy (EMS). Suitable programmes and assessment procedures for chemicals are currently being, or have already been, developed by the working groups established under the regional marine conventions and ICES. Regional maritime conventions will be involved in the initial assessment and future monitoring as appropriate.

- problem chemicals,
- sediment contamination,
- hot spots,
- health issues,
- contamination of biota.

The effects of biological pollutants are not mentioned explicitly, but are covered by the references to the current regional programmes and sea conventions that have be taken into consideration. The provisions concerning the implementation of the MSFD are currently being drawn up by a number of expert groups.

HELCOM

Baltic Sea Action Plan [2]

Comments

The Baltic Sea Action Plan stipulates that selected hazardous substances and their effects are to be investigated in the Baltic Sea in future. In this context, the monitoring of biological effects is intended to facilitate a reliable ecosystem health assessment.

COMBINE

Comments

Biological effects monitoring under the COMBINE programme should include and integrate measurements of the effects of pollutant concentrations from the tissue level through to the population level. It should also cover different levels in the food web, as well as different time scales in manifestations of the effects of exposure (acute and chronic responses). Parallel to these studies, levels of relevant pollutants in the indicator organisms and relevant environmental matrices should be measured.

It is important that monitoring data, whether they are contaminant or effect data, are produced with high enough quality. Quality assurance is an important requirement to ensure a consistently high data quality.

OSPAR

JAMP

Comments

Of OSPAR's activities, it is the Coordinated Environmental Monitoring Programme, which covers the monitoring of concentrations of chemical contaminants (not including radionuclides) in marine biota (principally fish and shellfish), sediments and sea waters, biological effects, nutrients, and direct and indirect eutrophication effects, that is relevant to these specifications.

TMAP [3]

Comments

With regard to the effects of pollutants, TMAP requires surveying of the temporal development and spatial distribution of hatching success and reproductive success among birds in the Wadden Sea area.

2.2 Environmental targets

HELCOM

HELCOM's main goal is to protect the marine environment of the Baltic Sea from all sources of pollution, and to restore and safeguard its ecological balance. To this end, pollution of marine areas has to be prevented by reducing inputs, emissions, and discharges of hazardous substances. The aim is to prevent all inputs by 2020 and to achieve concentrations in the marine environment that are close to natural background values for naturally occurring substances or close to zero for artificial substances.

The Baltic Sea Action Plan (2007) has the general aim of achieving a good ecological status for the Baltic Sea by 2021. With regard to hazardous substances, it formulates the following ecological targets:

- Concentrations of hazardous substances close to natural levels
- All fish and other seafood safe to eat
- Healthy wildlife
- Radioactivity at pre-Chernobyl level

The effects of hazardous substances are covered primarily by the target of "healthy wildlife", as well as, to a lesser degree, the target of "fish safe to eat".

OSPAR

The OSPAR members will take all possible steps to prevent and eliminate pollution and will continue making all measurements required to protect the oceans from the adverse effects of human activities. They will safeguard human health and conserve marine ecosystems or restore them if they have been subject to particularly negative impacts.

TMAP

Trilateral policy and management aim to achieve, as far as possible, a natural and sustainable ecosystem. The aim of TMAP is to assess the status and evolution of the Wadden Sea ecosystem.

EMS

The overrriding goal of the European Marine Strategy (EMS) is "to promote sustainable use of the seas and conserve marine ecosystems", given that the marine environment is exposed to numerous threats. (The Water Framework Directive does not deal with the effects of pollutants.)

2.3 Threats

The threats to the marine ecosystem include the loss or degradation of biodiversity and changes in its structure, loss of habitats, contamination by dangerous substances and nutrients, and possible future effects of climate change. They are the consequences of various pressures such as commercial fishing, oil and gas exploration, shipping, waterborne and atmospheric deposition of dangerous substances, waste dumping, physical degradation of the habitat due to interventions such as dredging, and extraction of sand and gravel.

2.4 Spatial allocation

	EEZ	12- nm zone	Coastal waters 1)	Transitional waters
HELCOM	x	x	x	x
OSPAR	x	x	x	x
TMAP	-	-	x	x
EMS	x	x	-	-

1) Under the WFD: baseline plus one nautical mile

3 Monitoring concept

HELCOM

COMBINE

The aims of COMBINE, as decided by HELCOM (HELCOM 14/18, para. 5.27) and further elaborated by BMP-WS 2/96, are to identify the effects of human activities in the Baltic Sea and to quantify them in the context of natural variability, and to identify and quantify changes in the environment as a result of regulatory actions. For that purpose, biological effects measurements will be carried out at selected locations in the Baltic Sea, and levels of pollutants will be determined in water, sediment, suspended particulate matter,and organisms in order to find out whether they have any detrimental effects on biota, for example changes in the structure of communities.

OSPAR

Joint Assessment and Monitoring Programme (JAMP)

JAMP includes biological effects monitoring integrated with the use of chemical analysis. The purpose of JAMP is to identify situations where pollutants cause biological effects, to predict the highest organisational level at which such effects occur, and to determine whether such effects result in harm to living resources and/or marine ecosystems, or otherwise interfere with maritime uses.

- Identification of endangered regions and causes of endangerment;
- understanding the causes of biological effects;
- measures to control pollution;
- monitoring the effectiveness of measures taken.

Measurements of biological effects have the following purposes, inter alia:

- to establish the spatial distribution and extent of biological effects of specific pollutants on marine organisms;
- to identify temporal and spatial changes in such effects.

Co-ordinated Environmental Monitoring Programme (CEMP)

CEMP is aimed at delivering comparable data from across the OSPAR maritime area, which can be used to address the specific questions raised in JAMP.

TMAP

The breeding success of birds is monitored in order to assess birds response to pollution.

3.1 Description of monitoring network

Only some of the parameters included in the following lists are part of the above monitoring programmes. The monitoring of most of the parameters is still voluntary at present. In so far as this is the case, the lists and programmes are subject to constant review and, where necessary, revision.

North Sea

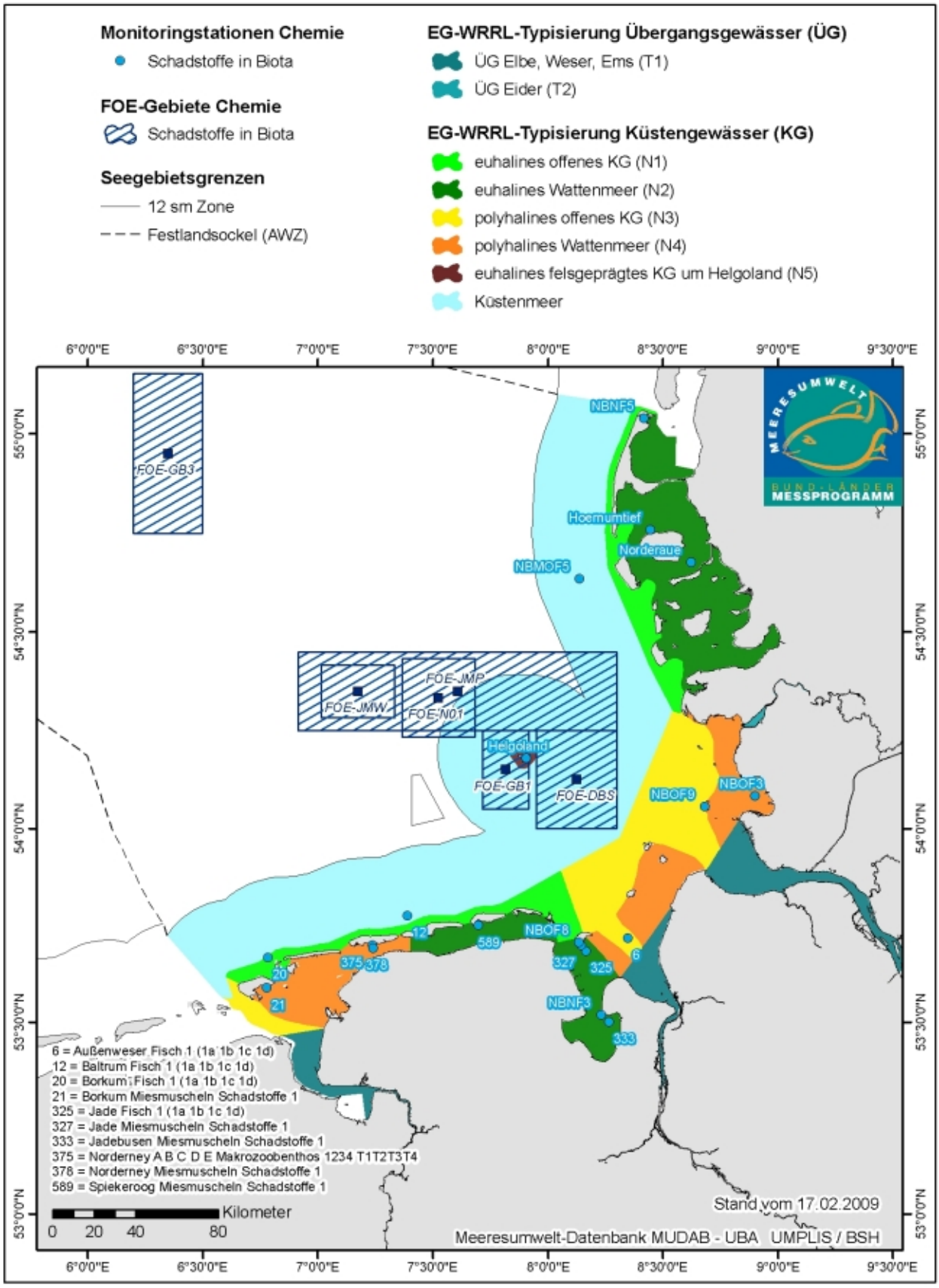

Figure 1: Network for the monitoring of biological effects in the North Sea.

Figure 1 as PDF-document

Baltic Sea

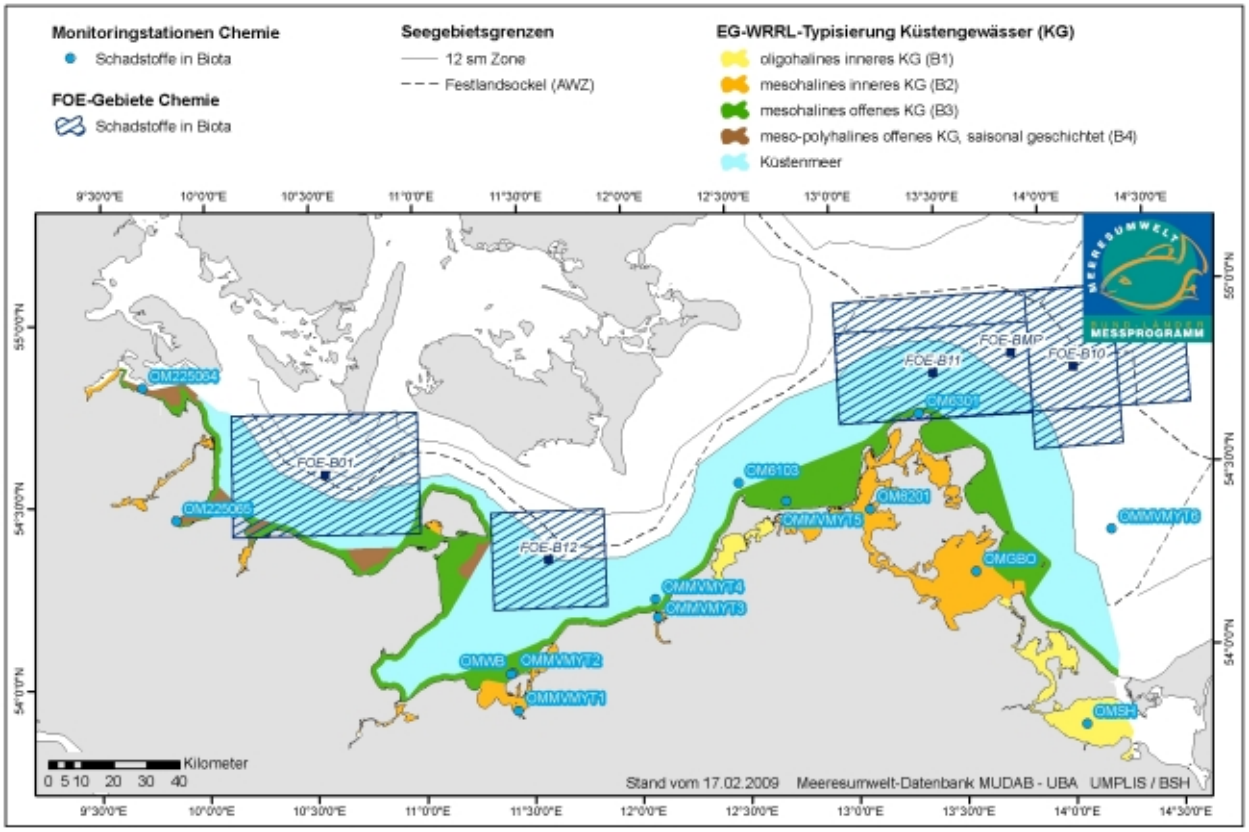

Figure 2: Network for the monitoring of biological effects in the Baltic Sea.

Figure 2 as PDF-document

3.2 Monitoring activities

A final decision on the methods and measures to be used in biological effects monitoring has not yet been made. Additional research is required particularly with respect to data evaluation. The pan-Baltic research project "BEAST" (Biological Effects of Anthropogenic Chemical Stress: Tools for the Assessment of Ecosystem Health) under the BONUS+ funding scheme deals with the development, testing, and application of biomarkers to be used in monitoring the environmental status in different Baltic Sea regions. The international "ICON" workshop (Integrated Assessment of Contaminant Impacts on the North Sea) parallelly covers the North Sea region. Integrated monitoring and a holistic assessment are central to both projects.

North Sea

OSPAR - CEMP and pre-CEMP

Methods:

Co-ordinated Environmental Monitoring Programme (CEMP)

The Co-ordinated Environmental Monitoring Programme is divided into two parts: the mandatory CEMP (Appendices 2-7), and pre-CEMP which is not yet mandatory (Appendices 8-15). The programme is reviewed annually and updated where necessary. As a rule, parameters are included in pre-CEMP if OSPAR considers they should be monitored although the prerequisites for regular, mandatory monitoring are not yet met. However, it is also possible for parameters to be removed from both CEMP and pre-CEMP.

OSPAR - CEMP

Methods:

TBT-specific effects in gastropods

Status	Appendix	Parameter	Comments
CEMP	5	TBT-specific effects (imposex, intersex) in gastropods	In gastropod species for which assessment schemes are available
		TBT in sediment *)	*) Alternative for TBT effects if no suitable organism is available for TBT-specific effects

OSPAR - pre-CEMP

Methods:

Fish, etc.

Status	Appendix	Parameter	(Probable) target date for reclassification as CEMP parameter/remarks
Pre CEMP	14	Metal specific effects: metallothionein, ALA-D and oxidative stress PAH specific effects: cyotochrome P450 (EROD), DNA adducts, PAH metabolites, liver pathology, and macroscopic liver neoplasms.	2010 *JAMP Guidelines for Contaminant-Specific Biological Effects* Technical Annexes 1 and 2.
	15	Bioassays with sediments, pore water and water	Technical Annexes 1-4
		CYP1a (EROD)	Technical Annex 1
		Lysosome membrane stability (LMS)	Technical Annex 6
		Liver histopathology/macroscopic liver neoplasms	2010 Technical Annexes 7-8
		Externally visible fish diseases	2010 Technical Annex 9
		Reproductive success in fish	Technical Annex 10

TMAP

Methods:

Reproductive success of birds

Mandatory TMAP Parameters (covering entire intertidal area):

Para-meters	Monitoring network	Measuring frequency	Method	WFD	BD/HD	OSPAR	OTHER	Coverage
Hatching success (birds)	2-4 Stations per region	Annually (April - July)	After TMAP pilot project	-	X	-	X	15 regions
Re-productive success (birds)	2-4 Stations per region	Annually (April - July)	After TMAP pilot project	-	X	-	X	15 regions

Baltic Sea

HELCOM - COMBINE

Methods:

The HELCOM monitoring programme COMBINE currently (end of 2009) does not yet require monitoring of the biological effects of pollutants. Some states routinely monitor biological effects. Information is available at http://www.helcom.fi/groups/monas/CombineManual/PartD/en_GB/main/#d11.

Substances	Parameters
TBT	TBT in soft tissue of blue mussels *Mytilus edulis* (coastal supporting programme)
	Imposex in whelk (coastal supporting programme)
PAHs, PCDD/Fss, PCDFs, co-planar PCBs	EROD induction, histopathology
Organophosphate and carbamate, pesticides	AChE inhibition

HELCOM - BSAP

Methods:

The "Baltic Sea Action Plan" (BSAP) defines HELCOM's future targets concerning the status of the Baltic Sea. The targets of biological effects monitoring are defined as folows:

"The monitoring of biological effects of hazardous substances provides information on their adverse effects on marine organisms in situ. These effects are visible both as direct physical changes in some animals in the form of sterility and failed breeding among birds, but also as physiological changes measurable as biomarkers and other ecotoxicological tools. Detection of biological effects is of strategic importance to the overall monitoring of hazardous substances since many methods reveal the potential presence of substances (or substance groups) that are not feasible to be measured on a regular basis due to their huge number and technical difficulties in analysis." (HELCOM, 2007).

HELCOM (2007) additionally states: "There is a need to further develop the indicators and targets for healthy wildlife"

3.3 Additional parameters

The following parameters are required additionally for the assessments::

- Current
- Oxygen content
- Salinity
- Temperature

4 Assessment

4.1 Assessment procedures

North Sea

Title

Biological Effects - Gastropods

Guideline:

OSPAR

Comments:

OSPAR Assessment:

Imposex in gastropods: Assessment classes for the genuses *Nucella*, *Littorina*, *Nassarius*, *Buccinum* and *Neptunea* (OSPAR, 2005).

Assessment class	***Nucella***	***Littorina***	***Nassarius***	***Buccinum***	***Neptunea***
Criterion	VDSI	ISI	VDSI	PCI	VDSI
A Imposex level is close to zero.	<0,3	<0,3	<0,3	<0,3	<0,3
B Imposex level indicates exposure to TBT concentrations below EAC	0,3 - <2,0	<0,3	<0,3	<0,3	0,3 - <2,0
C Imposex level indicates exposure to TBT concentrations above EAC.	2,0 - <4,0	<0,3 - <0,7	0,3 - 4,0	0,3 - 4,0	2,0 - 4,0
D Reproductive capacity is affected by the presence of sterile females.	4,0 - 5,0	0,7-2,0	May occur beyond 4,0	May occur beyond 4,0	May occur beyond 4,0
E Populations are unable to reproduce. The majority of females are sterile.	5,0 - 6,0	>2,0	-	-	-
F Populations are absent/extinct	-	-	-	-	-

EAC - Environmental Assessment Concentration: lowest concentration at which detrimental, unacceptable effects and risks are to be expected.

North Sea

Title

Procedure in development

Guideline:

Various directives

Comments:

The assessment criteria in the following table are proposals that are subject to scientific discussion and are still being amended on an ongoing basis.

Bioeffect assessment procedures, still in development			**Assessment criteria**		
Name	**Species/ parameter**	**Source**	**Background**	**Elevated**	**High**
Reproductive success Eelpout (frequency %)	malformed larvae	ICES WKIMON 2007	0 - 1	>1 - 2	>2
	late dead larvae		0 - 2	>2 - 3	>3
	growth retarded larvae		0 - 4	>2 - 6	>6
EROD S9-fraction (pmol/min mg protein)	Dab (f), flounder, plaice	ICES/OSPAR SGIMC 2010	<=178, <=24 <=10	>178, >24 >10	-
EROD Mikrosomal (pmol/min mg protein)	Dab (f), cod, plaice	ICES/OSPAR SGIMC 2010	<=780, <=145 <=255	>780, >145 >255	-
Bioassays sediment (% mortality)	*Corophium*	ICES WKIMON 2008 ICES/OSPAR SGIMC 2009	0 - 30	>30 - <60	>60
	Arenicola		0 - 10	>10 - <50	>50
Bioassays water (% abnormality)	Bivalve embryos		0 - 20	>20 - <50	>50
Bioassays water (% mortality)	Copepods		0 - 10	>10 - <50	>50
	Sea urchins embryos		0 - 10	10 - <100	100
Bioassays water (% abnormality)			0 - 10	10 - <50	50
Bioassays water (% growth)			0 - 20	>20 - <50	>50
Lysosomal stability (min)	Neutral red retention (all species)	ICES WKIMON 2008	>120	<=120 - >=50	<50
	Cytochemical (all species)	ICES WKIMON 2007	>20	<=20 - >=10	<10

PAH-metabolite 1-hydroxypyrene (ng/ml bile; HPLC-F or GC/MS)	Dab	ICES SGIMC 2010	<=16	-	-
	Cod	ICES SGIMC 2010	<=21	21 - 483	>483
	Flounder	ICES SGIMC 2010	<=16	>16	>-
	Haddock	ICES SGIMC 2010	<=13	>13	>-
	Turbot	ICES SGIMC 2010	-	-	>909
	Halibut	ICES SGIMC 2010	-	-	>745
Fish Disease Index - FDI	Alle Spezies	ICES WG PDMO 2010	will be revised	will be revised	will be revised
DNA-adducts (nmol / mol DNA)	Dab	ICES WKIMON 2007	<=7,9	-	-
	Haddock	ICES WKIMON 2007	<=8,6	-	-
	Pollack	ICES WKIMON 2007	<=7,9	-	-
	Dab, haddock, pollack	ICES/OSPAR SGIMC 2009	Limited data available. Further validation and development necessary.		

5 Quality assurance

- BEQUALM ((provider of intercalibration exercises on water and sediment bioassays, fish diseases, luminescence bacteria assays and biomarkers).)
- QUASIMEME ((provider of intercalibration exercises on anorganic and organic pollutants in water, sediments and biota))
- Quality Assurance Panel (at the UBA (workshops, standardisation with DIN, CEN and ISO, support for the establishment of QM systems, drafting of sample SOPs, definition of minimum requirements for analytical procedures).)

Comments

Each of the monitoring institutions bears responsibility for establishing and administering its own DIN EN ISO/IEC 17025 quality management systems. The Quality Assurance Panel at the Federal Environment Agency is responsible for the coordination of quality assurance under the GMMP. The institutions involved in the GMMP coordinate their activities within the framework of the Working Group on Quality Assurance and the Ad Hoc Working Group on Pollutants and Biological Effects.

5.1 Monitoring institutions

- LimnoMar
- IfAÖ
- NLWKN
- vTI

5.2 Guidance documents

- HELCOM COMBINE
- ICES-Times
- JAMP/CEMP
- TMAP

5.3 Standards

- DIN EN ISO/IEC 17025, 2005: General requirements for the competence of testing and calibration laboratories.
- DIN EN 14996, 2006: Water quality - Guidance on assuring the quality of biological and ecological assessments in the aquatic environment.

5.4 Current status

A GMMP Study Group decision (2006) obliged the GMMP laboratories to establish DIN EN ISO/IEC 17025 quality management systems. For this purpose, a Sample Quality Management Manual was drawn up in 2006/2007 by the Quality Assurance Panel in cooperation with the Quality Assurance Sub-Working Group on Quality Management. This manual has been available for subscription from the Quality Assurance Panel at the UBA since mid-2008 and is to be used as the basis for internal QM documentation at laboratories. The manual is designed as a loose-leaf collection, so that regular updates can be added as required. It is to be gradually supplemented with sample SOPs agreed within the GMMP.

In order to guarantee and harmonise the quality and comparability of the analytical results reached under the GMMP, target values for lower limits of application (LOAs) were introduced in 2006 (Study Group decision of 30 January 2006). When the frequency distributions of concentrations of selected chemical parameters were investigated in various matrices, it became apparent that a large proportion of the concentrations measured lay below the limits of application that had been defined and the target values for the LOAs had therefore been set too high. Since, apart from this, sufficient consideration was still not being given to background values and the assessment criteria to be monitored, the target values for lower limits of application were to be replaced by minimum requirements for determination limits, subject to consideration of relevant provisions in the field of water protection, given that clear definitions for such determination limits had been defined internally as validation parameters at laboratories and they had also been introduced into international provisions (decision adopted at the 38th meeting of the Working Group on Quality Assurance on 2 December 2008).

Intercalibration exercises

- BEQUALM EROD Intercalibration 2008
- BEQUALM EROD intercalibration 2004/2005
- BEQUALM Liver Histopathology 2004/2005
- BEEP 2003 - EROD und AChE

Workshops

- BALCOFISH/BEAST practical workshop on eelpout sampling and examinations at Søminestationen, Holbæk, Denmark, 19.-20.10.2009
- UBA/UPB Eelpout Monitoring Workshop, Berlin, 07.-08.09.2009
- ICES/BSRP SEA-GOING WORKSHOP ON FISH DISEASE MONITORING IN THE BALTIC SEA 2005 (WKFDM)
- ICES workshop on biological effects of contaminants in pelagic ecosystems 2001 (Guidelines for Data Reporting)

6 Literature

- Barsiene, J., Lehtonen, K.K., Köhler, A., Broeg, K., Vuorinen, P.J., Lang, T., Pempkowiak, J., Syvokiene, J., Dedonyte, V., Rybakovas, A., Repecka, R., Vuontisjärvi, H. and J. Kopecka, 2006: Biomarker responses in flounder (*Platichthys flesus*) and mussel (*Mytilus edulis*) in the Klaipeda-Butinge area (Baltic sea). Mar Pollut Bull, 53: 422-436.
- Feist, S.W., Lang, T., Stentiford, G.D. and A. Köhler, 2004: Biological effects of contaminants: use of liver pathology of the European flatfish dab (*Limanda limanda* L.) and flounder (*Platichthys flesus* L.) for monitoring. In: ICES Techniques in Marine Environmental Sciences, 38 42.
- Kammann, U., 2007: PAK metabolites in bile fluids of dab (*Limanda limanda*) and flounder (*Platichthys flesus*) - spatial distribution and seasonal changes. Environ Sci Pollut Res, 14(2): 102-108.
- Kammann, U., Lang, T., Berkau, A.-J. and M. Klempt, 2008: Biological effect monitoring in dab (*Limanda limanda*) using gene transcript of CYP1A or EROD ¿ a comparison. Environ Sci Pollut Res, 15(7): 600-605
- Lang, T., Wosniok, W., Barsiene, J., Broeg, K., Kopecka, J. and J. Parkkonen, 2006: Liver histopathology in Baltic flounder (*Platichthys flesus*) as indicator of biological effects of contaminants. Mar Pollut Bull, 53:488-496.
- Lehtonen, K., Schiedek, D., Köhler, A., Lang, T., Vuorinen, P.J., Förlin, L., Barsiene, J., Pempkowiak, J. and J. Gercken, 2006: The BEEP project in the Baltic Sea: Overview of results and outline for a regional biological effects monitoring strategy. Mar Pollut Bull, 53: 523-537.
- Schnell, S., Schiedek, D., Schneider, R., Balk, L., Vuorinen, P.J., Karvinen, H. and T. Lang, 2008: Biological indications of contaminant exposure in Atlantic cod (*Gadus morhua*) in the Baltic Sea. Canadian Journal of fisheries and aquatic sciences, 65: 1122-1134.
- Thain, J.E., Vethaak, A.D. and K. Hylland, 2008: Contaminants in marine ecosystems: developing an integrated indicator framework using biological-effect techniques. ICES JOURNAL OF MARINE SCIENCE, 65:1508-1514.
- van der Oost, R., Beyer, J. and N.P.E. Vermeulen, 2003: Fish bioaccumulation and biomarkers in environmental risk assessment: a review. Environ Toxicol Phar, 13(2): 57-149.

7 Activities required to implement the concept

7.1 Changes to the current monitoring programme

The fact that, within the framework of the international North and Baltic Sea monitoring programmes (OSPAR, HELCOM, MSFD), concepts for an integrative monitoring approach (combination of chemical and biological components) are currently being developed and their practical application is being studied proves the need to include biological effects in the German Marine Monitoring Programme (BLMP). Therefore, the BLMP monitoring programme should take into account international recommendations and, in particular, should include parameters which already are mandatory in the CEMP programme or will become mandatory shortly.

Besides, there are other programmes and projects which are also relevant for future BLMP work: under the BONUS+ funding scheme, the "BEAST" and "BALCOFISH" research projects study the use of biomarkers in monitoring the health status of different Baltic Sea regions and the impacts of chemicals on Baltic Sea fish.

A decision will have to be made on the parameters that should be included in a future BLMP monitoring programme, on the way this should be done, and on the most effective implementation.

Selection of biomarkers for BLMP

As pointed out under 3.2 above, the CEMP programme lists the parameters required to be measured, and pre-CEMP those for which measuring is not yet mandatory because all prerequisites are not yet met. The selection criteria of the CEMP programme can be included in BLMP as a mission statement.

A mandatory biomarker measurement in CEMP meets the following requirements:

- One or more mandatory measuring methods, described in detail, are available and have been published; they have been accepted by expert bodies.
- The measuring method provides for adequate quality control, which includes successful interlaboratory studies. Data from different laboratories are comparable and meet the requirements for inclusion in a common database.
- Clearly defined assessment criteria for the particular parameter which are suitable for operationalisation are available. The criteria allow a distinction to be made between background levels and elevated levels; they mark a limit above which unacceptable effects or risks have to be expected. Several intermediate stages are conceivable.

CEMP is only one of several suitable programmes which BLMP can use as a basis for its selection of biomarkers. Intelligent use of biomarkers at different biological organisation levels may lead to a marked improvement in future environmental monitoring.

7.2 Working steps required

A German BLMP planning body for integrative monitoring has to be established which will allow the data collected during routine monitoring to be related to any biological effects caused by the pollutants monitored, and which will allow an integrated assessment of data applying the assessment criteria. This planning body, on the one hand, will have to keep track of international developments in the field of monitoring and, on the other hand, will have to be capable of making recommendations regarding national monitoring networks and the integration of biological and chemical components. The BLMP working group on pollutants and biological effects ("Ad-hoc-AG") should take part in the discussion.

Targets include the following:

- Definition of issues to be dealt with, review of monitoring network and concept if required;
- selection of biomarkers and other monitoring parameters;
- recommendations for sampling strategies;
- operationalisation of collected data based on available assessment criteria (temporal and spatial delimitation);
- development of a strategy for an integrated evaluation of monitoring data on pollutants and effects (choice, classification, and weighting of parameters, integration stages);
- quality control / intercalibration of biological parameters.

Future environmental monitoring programmes will have to apply a holistic approach. Factors of environmental relevance should not be assessed individually and separated from each other.

Footnotes

(1) Marine Strategy Framework Directive; Directive 2008/56/EC of 17 June 2008. This also applies to transitional waters and coastal waters covered by Directive 2000/60/EC, where pertinent aspects of the protection of the marine environment not dealt with in Directive 2000/60/EC are at issue.

(2) Baltic Sea Action Plan, HELCOM 2007

(3) The monitoring requirements under TMAP were specified in the Wadden Sea Plan (Sylt, 2010) (see also TMAP Manual, section 2).