UNITED NATIONS

EP

UNEP(DEPI)/MED WG.411/Inf.8

UNITED NATIONS
ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN

18 March 2015
Original: English

Meeting of the Integrated Monitoring Correspondence Group

Athens, Greece, 30 March - 1 April 2015

1st Report of the Informal Online Working Group on Contaminants

1st Report of the Informal Online Working Group on Contaminants

1. Introduction

In the framework of the gradual application of the ecosystem approach (EcAp) for the management of human activities in the Mediterranean region, it is necessary to assess the environmental status of marine areas using well defined methodological criteria. In order to decide if a marine area is in "Good Environmental Status" (GES), it is necessary to establish threshold values (which could be also defined as Environmental Assessment Criteria (EAC) for key contaminants in order to distinguish between acceptable (good) and unacceptable (not good) environmental conditions.

To date UNEP/MAP-MED POL work in this direction has resulted in background information on the methodology to be followed for the definition of EAC for the Mediterranean and first estimates have been made of background concentrations for trace metals in sediments and biota and PAHs in sediments. In accordance with the relevant decisions of COP 18, it was identified a need to advance this important work in order to finalize the development of well-defined methodological criteria.

More specifically there is a need to obtain eco-toxicological information on the key species to be used for the establishment of transition points of biological effects and to carry out further examination of the MED POL database in order to obtain more reliable background values as well as statistical tests to evaluate the precision of the MED POL monitoring programmes.

The CorrGEST meeting held in February 2014 in Athens agreed on the following common indicators:

Contaminant common indicators (ecological objective 9)

Common Indicator 11	Concentration of key harmful contaminants measured in the relevant matrix (biota, sediment, seawater)
Common Indicator 12	Level of pollution effects of key contaminants where a cause and effect relationship has been established.
Common Indicator 13	Occurrence, origin (where possible) extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution
Common Indicator 14	Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
Common Indicator 15	Percentage of intestinal enterococci concentration measurements within established standards

2. Objective and composition of the informal online working group on contaminants

The main objective of the work of the informal online working group on contaminants (**Contaminants Working Group**) was to deliver environmental and background assessment criteria based on data availability for some contaminants. Therefore, the work has been focusing on the evaluation of available data to determine EAC, BAC and baseline values.

The Contaminants Working Group is expected to provide advice to the Secretariat regarding the monitoring guidance based on the recommendations of ECAP Coordination group held in Athens in October 2014.

This report is intended to be a living-document drafted by co-chairs during the life time of the Contaminants Working Group.. It is being periodically circulated by the co-chairs to the rest of experts for comments and discussion with the aim to input into the relevant upcoming monitoring related meetings (Integrated Correspondence Group Meeting on Monitoring, Focal Points Meeting of MED POL, EcAp Coordination Group Meeting respectively). . The Contaminants Working Group members have experience in providing practical scientific advice and the range of expertise applicable to the task were nominated by the Contracting Parties to the Barcelona Convention. The nominated experts have scientific background and experience on statistical interpretation of field data. The work of the Contaminants Working Group was co-chaired by Ms. Nevenka Bihari (Croatia) and Ms. C. Martínez-Gómez (Spain). The list of experts is given in Annex I.

The experts of the Contaminants Working Group have exchanged views on various levels and formats, with the following key topics of discussion:

- **Specific recommendations on the Draft Integrated Monitoring and Assessment Guidance**

-Definition of common indicator 12

Experts consider that common indicator 12 should be improved in their definition, with "Level of pollution effects of key contaminants where a cause and effect relationship has been established".

It is recommended to slightly revise the common indicator 12 in order to take into account several and complex aspects of toxic actions. [One alternative indicator would be for example "Levels of pollution effects on the concerned ecosystem components, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored".

Any chemical will not has a single mode of toxic action or a single target organ in the organism. Even at the level of individual cellular enzymes, many environmental contaminants are known to inhibit or stimulate several endogenous enzymes/receptors, although some are more sensitive than others to a given compound.

Most contaminant-related biomarker responses are sensitive to a wide variety of chemical compounds and they are, therefore, particularly useful as integrative indicators of organism health than as indicators of specific exposure to single chemical compounds/class of contaminants. Given the complexity of biological responses and environmental system it is unlikely that a single biological effect response (named biomarkers) would be able to provide measurements of the health status of organisms and therefore the necessity of measure a suite of biomarkers at different levels of biological organizations, as it has been proposed in the two-tier approach.

Experts stressed the importance of understanding that all biomarkers responses established as mandatory or recommended by Regional Conventions have a cause/effect established after validation in laboratory and field studies. Definition of the indicator 12 should not be understood just for the application of specific and exposure effect biomarkers.

- Table 3.1.

Transitions point T0 and T1 for assessing pesticides (dieldrin, HCB, lindane, pp-DDE and α-HCH) should be added for clarity.

Assessing Biological Effects

The Contaminants Working Group discussed the utility of developing a multidisciplinary integrated approach, combining chemical analyses in abiotic matrices, with those reflecting contaminant levels in biota and biological effects (biomarkers), thus fulfilling the EcAp approach.

Different models are becoming available in the Mediterranean region to elaborate various typologies of data with the 5 classes approach, and to aggregate them in a final evaluation, still based on the 5 classes discrimination (Benedetti et al., 2012)

The Contaminants Working Group on contaminants confirmed the importance of the following biomarkers to be analysed in mussels (wild populations or caged), and recognize the importance of corresponding BC and BACs: Lysosomal membrane stability, Stress on Stress, micronucleus frequencyand acetylcholinesterase. In addition, they recommend that biomarkers are analysed also in representative key fish species, i.e. the red mullet (*Mullus barbatus*). For these organisms, priority responses are identified in EROD activity, bile metabolites, micronucleus frequency and acetylcholinesterase. For these biomarkers several mediterranean countries (Greece, Spain, France, Italy and Croatia) have been monitoring in the past years and first BACs can be expected to be obtained within the framework of expert groups on Contaminants along 2015-2016.

Other biomarkers, widely investigated by the scientific community, might be considered for their usefulness within the EcAp approach based on their different biological and ecological characteristics. Future evaluation will involve the possibility to assess BC, BAC or thresholds values for such responses like lipid peroxidation processes (lipofuscin, malondialdehyde), peroxisomal proliferation, antioxidants and total antioxidant capacity, loss of DNA integrity (others than micronucleus frequency), hormonal/ reproductive dysfunction (i.e. vitellogenin in fish/intersex). The overall elaboration of such different responses in synthetic indices can be actually performed by several integrative approaches, which normally consider the sensitivity and toxicological relevance of the responses (Marigómezet al., 2013). The possibility to test or implement similar approaches to develop a specific model for Mediterranean countries needs to be further studied and evaluated on expert level.

On the other hand, experts consider that evaluation of the use of bioassays to assess environmental quality in water and sediments should be also addressed in future.

Development of assessment criteria for the definition of threshold limit values for chemical environmental status monitoring of contaminants in order to be able to determine the achievement of GES.

Experts agreed that although it is biologically inappropriate to evaluate absolute BC, BAC and Environmental Assessment Criteria (EAC) contaminant levels in one species from the parallel levels of even a close relative species new, BCs and BACs levels will be calculated / assessed in the coming month/years using data from the Mediterranean Region. However, the approach of derive EAC levels for the MEDPOL areas from the ratio EAC/BAC levels in compatible OSPAR sentinel species it is found absent of scientific sounds. That was discussed by the working group and it was agreed that would be more convenient to use current established EACs from other regional Conventions until more data are available from specific Mediterranean species.

Reference methods and guidelines for marine pollution monitoring under UNEP/MAP- MEDPOL

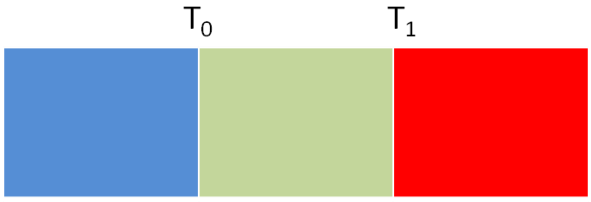
Experts underlined that in coming years the Reference Methods listed in the Annex XI should be revised and if necessary updated. The reference method on Sediment sampling strategy should be discussed in future in a targeted manner in the Contaminants Working Group with the overall aim to be finalized before the EcAp Coordination Group in September.

Comment on Annex on Contaminants Monitoring Fact Sheets (Indicators Monitoring Fact Sheets on Ecological Objective 9: Contaminants)

- PAHs concentration in mussels should be also included as parameters but not in fish
- Aluminium content and Aluminum (Al) and Organic Carbon(OC) measurements should be considered mandatory in sediment for testing normalization purposes
- Change from the 2-tier to the 1-tier the biomarker Stress on Stress in the table of the Annex.
- Indicate that the assessment method of contaminant concentrations in fish (red mullet) should be conducted during the non-spawning period taking into account the future integrated and coordinated sampling to analyses biological effects in red mullet.

- **Addressing and agreeing on common definitions on thresholds, baseline and assessment criteria.**

After consultation between expert members on the report UNEP(DEPI)/MED WG. 365/Inf.8 on Development of Assessment Criteria for Hazardous Substances In the Mediterranean (Athens 2011) it was agreed to follow the OSPAR approach of a "traffic light" system for both contaminant concentrations and biological responses, where there are two "thresholds" T_0 and T_1 to be defined (OSPAR, 2008; Davies et al., 2012).



This is wise from a presentational perspective, as it can give the reader a clear and immediate picture of where environmental conditions are acceptable or not and prompt appropriate environmental management options. That approach involves to specifically assess each chemical and biological determinant against its "threshold" values and to obtain its corresponding synthetic classification or category, allowing therefore an easy comparison and aggregation with other determinants from different regional/sub-regional areas.

The establishment of the transition points T_0 and T_1, requires the definition of a series of reference concentrations, particularly of Background Assessment Concentrations (BACs), derived from the Background Concentrations (BCs), Baseline Assessment responses (BACs) and the Environmental Assessment Criteria (EACs). This needs to be explained where it is a relevant factor in data interpretation.

Common definition of thresholds for contaminants

In the case of contaminants T_0 will be defined in sediments and biota, as the concentration of a contaminant at a "pristine" or "remote" site, where no deterioration of the environment can be expected. In turn, T_1 is the concentration above which significant adverse effects to the environment or to human health are most likely to occur. Between T_0 and T_1, no chronic effects are expected to occur in marine biota species, including the most sensitive, as well as the levels do not pose significant risk to the environment or to human health.

Common definition of thresholds for biological parameters

In the case of biological parameters, T_0 will be defined as the baseline biological response in target species of healthy organism responses. Biological responses $\leq T_0$ will be interpret as the levels of environmental contaminants are not causing deleterious biological effects. In turn, biological responses $>T_1$ will be defined as the in target species above which significant acute and long-term adverse biological effects are most likely to occur. In the case of biomarkers of exposure, only T_0 can be estimated, whereas for biomarkers of effects T_0 and T_1 can be established. Between T_0 and T_1, the biological responses indicate deleterious biological effects are possible although not likely to occur.

Background concentrations (BCs)

BCs are assessment tools intended to represent the concentrations of certain hazardous substances that would be expected in such "pristine" or "remote" sites, based on contemporary or historical data (such as core samples of sediments). For a man-made compound (e.g. PCBs) the background concentration (BC) in environmental matrices should be taken as zero.

Therefore, in order to facilitate precautionary assessments of data against BCs, and following the OSPAR approach (OSPAR Publication 2008/379) it is necessary to develop Background Assessment Concentrations (BACs) for contaminants in the Mediterranean region.

➔ In sediments, two different approaches were agreed to calculate BCs of contaminants:

i) Data from the analysis of pre-industrial layers of dated sediment cores. These data can be obtained from the scientific literature and if possible, organized per Mediterranean geographical areas.

ii) Median value of the median contaminant concentration in sediment samples from sites/areas that contracting parties have considered reference stations/areas (i.e. no known local sources of contamination or those areas which were not considered unequivocally as reference sites but as those less influenced from human and industrial activity).

The second approach differs with the previous approach used to calculate BCs of contaminants in sediments (UNEP(DEPI)/MED WG. 365/Inf. 8), in which BCs were calculated taking the median of the lower 5% of all data available in the MED POL database, excluding well known polluted sites. Experts considered that data from reference sites can be a better approach to calculate BCs of no man-made contaminants in the Mediterranean Region. The reasoning is that has been recognized that natural processes such as geological variability or upwelling may lead to significant variations in background concentrations of contaminants, particularly for trace metals, in certain subregions of the Mediterranean Sea. The natural variability of background concentrations should be taken into account in the interpretation of data, and local conditions should be taken into account when assessing the significance of any exceddance.

Metal concentration in sediments are usually normalized to 5% aluminium content meanwhile organic contaminants are usually normalized to 2.5% organic carbon content (OSPAR, 2008). However, there are already evidences from certain regions of the NW Mediterranean indicating that normalization is not convenient, as these environmental factors are not well correlated with contaminant concentrations (León et al. et al, 2014). The low sedimentation rate in certain subregions of the Mediterranean Sea will partially explain the lack of correlations beween contaminant concentrations and the mentioned factors. However, experts of the Contaminants Working Group recognized that in order to further test if normalization is convenient for sediment particle variability, aluminum (Al) and organic carbon (OC), such parameters should be considered as mandatory ones in the new MAP integrated monitoring programme. It will be also necessary to further investigate subregional differences on sedimentation rate and geocomposition of the sediments. At this stage was therefore agreed by experts to consider and establish preliminary not normalized BCs and BACs of contaminants in sediments from the Mediterranean region, as it is currently established for Spanish sediments within OSPAR area.

➔ Similarly as for sediments, the following approach to calculate BCs in biota (fish and mussels) was considered

1) Median value of the median concentration from organisms sampled at sites/areas which contracting parties consider being reference stations/areas (i.e. no known local sources of contamination or those areas which were not considered unequivocally as reference sites but as those less influenced from human and industrial activity). It should be underlined that selection of reference stations/areas can be different in relation to the contaminant under study (ie. organisms can be sampled in a place where contamination by PAHs is absent but contamination by Hg exists). As mentioned above, this approach differs with the previous used to calculate BCs of contaminants in biota (UNEP(DEPI)/MED WG. 365/Inf. 8), in which BCs in biota were calculated taking the median of the lower 5% of data available in the MED POL database, excluding well known polluted sites.

<u>Background concentrations and baseline assessment criteria (BACs)</u>

i) Concerning contaminants, background assessment criteria (BACs) are statistical tools defined in relation to the background concentrations (BCs), which enable statistical testing of whether observed concentrations can be considered to be near background concentrations. BACs are therefore derived from the BCs, taking into account the analytical precision of the monitoring programme. Observed concentrations are said to be 'near background' if the mean concentration is statistically significantly below the corresponding BAC.

BACs of contaminants can be calculated according to the method set out in Section 4 of the CEMP Assessment Manual (OSPAR Publication 2008/379). The outcome of this method is that, on the basis of what is known about variability in observations, there is a 90% probability that the observed mean concentration will be below the BAC when the true mean concentration is at the BC. Where this is the case, the true concentrations can be regarded as "near background" (for naturally occurring substances) or "close to zero" (for man-made substances). The BAC value for certain contaminants (e.g. PAHs, metals) will depend on the BC and the residual variance in temporal trend series at the BC. The BC for man-made substances is zero, and in this case the variance used to derive BACs is the variance at a low concentration that is small but detectable by common analytical methods.

Up to date, a statistical test to know the analytical precision of the monitoring programme using IAEA and MED POL database has not been performed (scarcity of available data). Therefore it was agreed by experts to use the following relationships between BC and BAC for metals in sediments, fish and shellfish to assess the BACs levels, as it is being used in OSPAR (OSPAR, 2008).

Thus, for sediments and shellfish BAC=1.5xBC, for fish BAC=2xBC.

ii) Concerning background responses of biological measurements (biomarkers), BACs can be calculated following different approaches described by ICES/OSPAR experts (Davies and Vethaak, 2012). These different approaches are linked to the nature of the biological responses under measurement (such as inhibition, deleterious effects, activation, etc.). Mediterranean experts consider adequate these approaches and adopted them.

Similarly as for BCs in sediments and biota, Mediterranean experts agreed that BACs of biomarker responses should be calculate using data from organisms sampled at sites/areas which contracting parties consider being reference stations/areas or kept under control conditions in the laboratory (particularly for those biomarkers of general stress, such as SoS and LMS).

1) Using the 90th percentile of averages/medians values from references sites or control conditions in the laboratory (case of activation or increased responses after exposure to contaminants)

2) Using the 10th percentile of averages/medians values from references sites or control conditions in the laboratory (case of inhibition o decreased responses after exposure to contaminants)

For BACs of biomarker responses, assessment criteria should be defined on regional basis, using available long-term data. However, a scarcity of biomarker data exists in the Mediterranean region in comparison to chemical data.

Unlike contaminant concentrations in sediments, contaminant concentrations and biomarker responses in biota cannot be assessed against BACs in most of cases without consideration of certain biological and environmental factors (such as species, gender, size, maturation state, season or ambient temperature). Therefore it was agreed by experts to consider such factors (whenever possible and necessary) for establishing BACs in organisms from the Mediterranean region.

- **List, identify and review and analyze available data on contaminants and biological effects in the Mediterranean (common indicators).**

The Contaminants Working Group experts were uploading in the InfoMAP groupware MED POL library:

- *relevant national available data and or*
- *available national, sub regional and regional reports, and or*
- *relevant web-site links.*

At the time of the drafting of the current First Report of the Contaminants Working Group(March 2015), experts from several countries made available data on contaminants in sediment and biota and biological effects in biota, most of them from reference areas. These data are listed above and were carefully revised. Only those from reference areas and from specimens sampled from natural populations were used to calculate contaminant BCs and BACs.

Country	TM in sediments	TM in mussels	TM in fish	PAHs in sediments	PAHs in mussels	Biomarker responses in mussels	Biomarker responses in fish
Greece	x	x	x	x	x	x	x
Croatia	x	x	x	-	-	x	x
Italy	x	x	x	x	x	x	x
France	x	x	-	x	x	-	-
Spain	x	x	x	x	x	x	x
Lebanon	x	x	-	x*	x*	-	-
Egypt	x*	x*	x*	x*	x*	-	-
Turkey	x	x	x	x	x	x	x

* No data available from reference sites

During the work of the Contaminants Working Group, experts revised and prepare common excel files with existing data available from reference areas from several countries.

A suite of criteria were adopted to harmonized and facilitate further processing of the data:

- All data from contaminants in sediments and biota were introduced on dry weight basis.

- Contaminant concentrations in sediments were not normalized.

- Trace metal and PAH concentration units were µg/Kg

- Half of the detection limit value was introduced in those cases were measured valued was below detection limit.

- Sampling date were introduced whenever possible

-Supporting environmental (ambient water temperature and salinity, sampling depth, etc) and biological supporting parameters (length, weight, sex) were introduced whenever possible

The work was conducted by the following expert subgroups.

Expert sub-groups	Common excel files created
Martínez-Gómez C. Hatzianestis, I.* Fanfandel, M.*	Trace metal concentration in Sediments
Chiffoleau, J.F. * Hatzianestis, I. Fanfandel, M.*	PAHs concentration in Sediments
Martínez-Gómez, C. * Bihari, N. Fanfandel, M.*	Trace metal concentration in mussels
León V.M.* Hatzianestis, I. Chiffoleau, J.F.	PAHs concentration in mussels
Kukuksezgin, F.* Regoli F. León V.M.	Trace metal concentration in fish
Fernández B Campillo J.A.* Regoli F. Bihari, N. *	Biomarker responses in mussel and fish

*Nominated experts developing interseasonally further work on excel files.

At the time of the drafting of the First Report of the Contaminants Workging Group, 6 common excel files were obtained. Data from these common excel files are now available and were load in the Infomap Groupware by co-chairmans. These files will be used inter-seasonally by nominated experts to analyse and calculate contaminant BCs and BACs (contaminants and biological responses). At this stage, this work has been initiated but still is far from being finished.

To better illustrate of how the work is being conducted is described below an example related with the assessment of trace metals BCs in wild mussels from reference areas of the Mediterranean Region

<u>Assessment of trace metals BCs in wild mussels from reference areas of the Mediterranean Region</u>

Using database created during the discussions of the Contaminants Working Group, and before to calculate BCs, an exploratory study was first performed to find out potential differences on trace metals concentrations caused by environmental and biological factors. Results of this exploratory study showed that data submitted by different Mediterranean countries differs in relation to sampling season, size range of the individuals, number of reference sites considered. Furthermore, two mussel species have to be considered form the Mediterranean region (*Mytilus galloprovincialis* and *Brachiodontes variabilis*[Ψ]).

Country	Sampling season	Number of subregions	Size range of mussels(cm)
Croatia	Spring	Middle A Northern	5.4±0.1 4.5±0.1
France	Winter	Single	Unknown
Italy	Spring, Summer, Autumn, Winter	Adriatic	[5-6]
Turkey	Winter	Izmir Bay	5.8±0.1
Spain	Spring	Levantino-Balear/Estrecho-Alborán	3.5±0.4
Greece	Spring, Winter	Subregion 1 Subregion 3 Subregion 9	3.5 6.1±0.2 Unknown
Lebanon[Ψ]	Unknown	North Lebanon	Unknown

Once the differences, inconsistencies and gaps have been identified, further work will be conducted by experts to fill the gaps and clarify potential inconsistencies with data whenever possible. For each sub-region, the median of the median concentrations from each station within the same subregion will be calculated. The values obtained will be considered species specific BCs at each subregion, sampling season and size range.

Experts agreed that although it is biologically inappropriate to evaluate absolute BC and BAC contaminant levels in one species from the parallel levels of even from a close relative species, Mediterranean experts consider that some of the current contaminant BCs and BACs used in the OSPAR area for areas (OSPAR Commission, Agreement number 2009-2) can be adopted until the new BCs and BACs levels from the Mediterranean Region are calculated. In the case of organic contaminant in sediments, experts considered that BC and BAC established to assess concentrations in sediments from Spain within OSPAR area (not normalized) should be adopted for the Mediterranean region, until strong evidences of normalization requirements are demonstrated. Concerning BC and BACs for metal concentrations in Mediterranean experts agreed that BC and BACs calculated from core sediment samples from the Mediterranean region (UNEP/MAP (2011)) can be adopted until more new data are available. Concerning mussels, expert agreed to adopt the preliminary BACs established for metals and PAHs in *Mytlilus galloprovincialis* from the NW Mediterranean region (Benedicto et al., 2102) and the reference concentrations of metals in *Brachiodontes variabilis* that Lebanon was made available (expert communication) until new BACs are established. Similarly, expert agreed to adopt the preliminary BACs established for metals in *Mullus barbatus* from the NW Mediterranean region (Benedicto et al., 2102) until new BACs are established (see table 1).

Similarly than for contaminants, the Contaminants Working Group experts consider that BACs of biomarker responses in mussels currently established in the OSPAR area (Davies and Vethaak, 2012)

can be adopted for mussels from the Mediterranean region until the new BCs and BACs levels species specific from the Mediterranean Region are calculated (see table 2).

Table 1. Background Assessment Criteria recommended to be used to assess concentrations in Mediterranean sediments, mussels (¥ *Mytilus galloprovincialis*, Ψ *Brachidontes variabilis*) and fish (× Mullus barbatus) from the Mediterranean region.

Trace metals	Sediments BAC (1) µg/kg d.w.	Mussels BAC (2) mg/kg d.w.	Fish BAC(2) mg/kg d.w.
Cd	150	1.088 ¥/1.0 Ψ	0.008 ×
Hg	45	0.188 ¥/0.17 Ψ	0.600 ×
Pb	30000	3.80 ¥/1.0 Ψ	0.558 ×
Polycyclic aromatic hydrocarbon	BAC (3) µg/kg d.w.	BAC(2) µg/kg d.w.	
Phenantrene	7.3	24.3 ¥	
Anthracene	1.8	4.1 ¥	
Fluorantene	14.4	6.8 ¥	
Pyrene	11.3	6.1 ¥	
Benzo[a]anthracene	7.1	1.3 ¥	
Chrysene	8.0	2.4 ¥	
Benzo[k]fluoranthene	-	1.8 ¥	
Benzo[a]pyrene	8.2	1.3 ¥	
Benzo[ghi]perylene	6.9	1.3 ¥	
Indene[123-c,d]pyrene	8.3	0.8 ¥	

Organochlorinated contaminants	BAC (3) µg/kg d.w.	BAC (3) µg/kg d.w.	BAC (3) µg/kg w.w.
CB28	-	0.75	0.10
CB52	-	0.75	0.08
CB101	-	0.70	0.08
CB105	-	0.75	0.08
CB118	-	0.60	0.10
CB138	-	0.60	0.09
CB153	-	0.60	0.10
CB156	-	0.60	0.08
CB180	-	0.60	0.11
Σ7CBS ICES	0.46	-	-
Lindane	0.13	0.19	-
α-HCH	-	0.13	-
pp´DDE	0.09	0.13	0.10
HCB	0.16	0.13	0.09
Dieldrin	0.19	-	-

(1) UNEP/MAP, 2011.
(2) Benedicto et al., 2012
(3) OSPAR Commission, 2009-2

Table 2. Background Assessment Criteria recommended to be used to assess biomarker responses in Mediterranean mussels (¥ *Mytilus galloprovincialis)*

Biomarkers / Bioassays	Mussels BAC (1)
Stress on Stress (days)	10
Lysosomal membrane stability Neutral Red Retention Assay (minutes)	120
Lysosomal membrane stability Cytochemical method (minutes)	20
AChE activity (nmol min-1 mg-1 protein)	
in gills (French Mediterranean waters)	29¥
in gills (Spanish Mediterranean waters)	15¥
Micronuclei frequency ($^0/_{00}$)	
in haemocytes	3,9

(1) Davies et al., 2012.

- **Addressing how to gather eco-toxicological information on key marine species on a sub-regional level, compile this information in a report on the determination of EAC for CBs, PAHs and trace metals (Cd, Hg, Pb) in biota.**

At the time of drafting the First Report of the Contaminants Working Group(March 2015), it was not possible to face up this task, and experts agreed that continuous work it will be necessary along the years to gather the required eco-toxicological information on key marine species on a Mediterranean sub-regional levels. The development of Mediterranean EACs is a difficult task because it requires together with concentrations in biota and sediments of the priority subtsances, ecotoxicological data for autochthonous marine species, which is largely lacking. To this end, Mediterranean and international data should be used to:

• Find out the most appropriate key sensitive species in the Mediterranean that can serve as a proxy for assessment, and

• Propose ecotoxicological studies to fill the gaps.

The approach of derive EAC levels for the MEDPOL areas from the ratio EAC/BAC levels in compatible OSPAR sentinel species proposed previously for the Mediterranean region (UNEP(DEPI)/MED WG. 365/Inf. 8), it was found absent of scientific sounds. That was discussed by the Contaminants Working Group and it was agreed that would be more convenient to use current established EACs from other regional Conventions until more data are available from specific Mediterranean species, deriving from the work of OSPAR, assuming that the EACs defined for one species in the OSPAR region can be used in the Mediterranean (see Table 3 and 4). Specifically:

Mytilus edulis (OSPAR) vs *Mytilus galloprovincialis* (MAP)

A benthic fish (OSPAR) vs *Mullus barbatus* (MAP)

Table 3. Environmental Assessment Criteria recommended to be used to assess concentrations in Mediterranean sediments, mussels (¥ *Mytilus galloprovincialis*, Ψ *Brachidontes variabilis*) and fish (× Mullus barbatus) from the Mediterranean region.

	Mussels (1)	Fish (1)	Sediments (1)
Trace metals	EC mg/kg d.w.	EC mg/kg d.w.	ERL mg/kg d.w.
Cd	5	0.207	1.2
Hg	2.5	4.150	0.15
Pb	7.5	1.245	46.7
PAHs	EAC µg/kg d.w.		EAC µg/kg d.w.
Phenantrene	1700		240
Anthracene	290		85
Fluorantene	110		600
Pyrene	100		665
Benzo[a]anthracene	80		261
Chrysene	-		384
Benzo[k]fluoranthene	260		-
Benzo[a]pyrene	600		430
Benzo[ghi]perylene	110		85
Indene[123-c,d]pyrene	-		240
Organochlorinated contaminants	EAC (1) µg/kg w.w.	EAC (1) µg/kg lipid	ERL(1) µg/kg d.w.
CB28	0.64	64	
CB52	1.08	108	
CB101	1.20	120	
CB105	-	-	
CB118	0.24	24	
CB138	3.16	316	
CB153	16.00	1600	
CB156	-	-	
CB180	4.80	480	
Σ7CBS ICES	-	-	11.5
Lindane	0.29	11[Y]	3.0
α-HCH	-	-	-
pp´DDE	10(2)	-	2.2
HCB	-	-	20.0
Dieldrin	10(2)	-	2.0

(1) OSPAR Commission, 2009-2

(2) OSPAR Commission, 2000

Table 4. Environmental Assessment Criteria for biomarker responses in *Mytilus galloprovincialis* deriving from the work of ICES/OSPAR (Davies et al., 2012)

Biomarkers / Bioassays	*Mytilus galloprovincilais* EAC
Stress on Stress (days)	5
Lysosomal membrane stability Neutral Red Retention Assay (minutes)	50
Lysosomal membrane stability Cytochemical method (minutes)	10
AChE activity (nmol min-1 mg-1 protein)	
in gills (French Mediterranean waters)	20
in gills (Spanish Mediterranean waters)	10

- **Perform a statistical test to evaluate the precision of MED POL Monitoring Programmes (per country) in order to define the relationship between Background Concentration (BC) and Background Assessment Concentration (BAC) taking into consideration the variability of reported data on Certified Reference Materials (sediments and biota) used by Mediterranean Laboratories in proficiency tests and in inter-calibration exercises.**

At the time of the drafting the First Report of the Contaminants Working Group(March 2015), a statistical test to evaluate the precision of MED POL Monitoring Programmes was not possible as variability of reported data on Certified Reference Materials (sediments and biota) used by Mediterranean Laboratories in proficiency tests and in inter-calibration exercises was very limited. This task has to be afforded in future.

- **Perform a quality control examination of the datasets in the MED POL database in order to better assess BAC values**

At the time of the drafting the First Report of the Contaminants Working Group (March 2015), a quality control examination of the datasets in the MED POL database was not possible as such MED POL database was not made available to the experts.

- **To check if there is a significant trace metal concentration/size statistical dependency using the trend monitoring data in order to decide if normalization to organism size (age) is required.**

At the time of the drafting the First Report of the Contaminants Working Group(March 2015), the statistical test to investigate if significant trace metal concentration/size statistical dependency exists was not possible as MED POL trend monitoring data was not made available to the experts.

Concluding remarks

A draft report and joint work on proposed environmental BACs and EACs for selected toxic metals in sediment and biota as well for selected biological responses in target species was initiated during the discussions of the Contaminants Working Group .

Furthermore, experts agreed to conduct further on line seasonal work in order to send a Final report to EcAp Coordination Group before September 2015.

In addition, the Contaminants Working Group agreed on some specific recommendations to be brought to the attention of the Integrated Correspondence Group Meeting on Monitoring, as refected in the “Recommendations of the online informal working groups” (UNEP(DEPI)/MED WG 401/5).

References

Benedetti M.,Ciaprini F., Piva F., Onorati F., Fattorini D., Notti A., Ausili A., Regoli F. (2012). A multidisciplinary weight of evidence approach toward polluted sediments: integrating sediment chemistry, bioavailability, biomarkers responses and bioassays. Environ. Intern. 38: 17-28).

Davies, I.M., Gubbins, M., Hylland, K., Maes, T., Martínez-Gómez, C., Giltrap, M., Burgeot, T., Wosniok, W., Lang, T., Vethaak, A.D. 2012. Technical annex: assessment criteria for biological effects measurements, 209-212. *In* Davies, I.M., and Vethaak, A.D (Eds). 2012. Integrated monitoring of chemicals and their effects. ICES Cooperative Research Report No. 315. 277 pp.

Marigómez, I., Zorita, I., Izagirre, U., Ortiz-Zarragoitia, M., Navarro, P., Etxebarria, N., Orbea, A., Soto, M., Cajaraville, M.P., 2013. Combined use of native and caged mussels to assess biological effects of pollution through the integrative biomarker approach. Aquat. Toxicol. 136-137: 32-48).

OSPAR Commission, 2000. Quality Status Report 2000. London.

OSPAR Commission, 2008. CEMP Assessment Manual. Coordinated Environmental Monitoring Programme Assessment Manual for contaminants in sediment and biota. ISBN 978-1-906840-20-4. Publication Number No. 379/2008. Pp 39.

OSPAR Commission, Agreement number 2009-2. Agreement on CEMP Assessment Criteria for the QSR 2010. Publication number 2009/461.

UNEP/MAP, 2011. Development of Assessment Criteria for hazardous Substances in the Mediterranean. UNEP(DEPI)/MED WG. 365/Inf.8. Athens, 2011.

ANNEX I

COUNTRY	EXPERT	EMAIL ADDRESS	LEADING EXPERTS
Croatia	Ms.Nevenka Bihari Ms. Maja Fafandel	bihari@irb.hr maja@irb.hr	Ms.Nevenka Bihari bihari@irb.hr
Egypt (by correspondence)	Prof. Dr.Samir M. Nasr	samir_nasr@yahoo.com	
France	Jean-François Chiffoleau Bruno Andral (by correspondance)	Jean.Francois.Chiffoleau@ifremer.fr Bruno.Andral@ifremer.fr	
Greece	Ioannis Hatzianestis (contaminants)	jhat@hcmr.gr	
Italy	Mario Carere (by correspondance) Francesco Regoli Daniela Berto and Ginevra Moltedo	mario.carere@iss.it f.regoli@univpm.it	
Lebanon (by correspondence)	Carine Abi Ghanem	carine.abighanem@cnrs.edu.lb	
Spain	Juan A. Campillo Víctor LeónBeatriz Fernández	juan.campillo@mu.ieo.es victor.leon@mu.ieo.es beatriz.fernandez@mu.ieo.es	Concepción Martínez-Gómez concepcion.martinez@mu.ieo.es
Turkey	Filiz Kucuksezgin	filiz.ksezgin@deu.edu.tr	