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Agenda item 8: Cross-Cutting Issues - the Integration and Aggregation Rules for IMAP Ecological Objectives 5, 9 and 10 and Assessment Criteria for Contaminants, Nutrients and Marine Litter

Background (Assessment) Concentrations (BC/BAC) for Common Indicator 17 and Upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20

UNEP/MAP
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Note by the Secretariat

In line with Decision IG.23/6 related to 2017 Mediterranen Quality Status Report (MED QSR) adopted at COP 20 (Tirana, Albania, December 2017), the Contracting Parties and the Secretariat are encouraged to test the following updated assessment criteria for indicative purposes in the different contexts that exist in the Mediterranean: i) BAC and EAC for trace metals (Cd, Hg, Pb) in sediments and in biota (mussel and fish); ii) BAC for PAHs in biota (mussel); iii) EAC for organochlorinated compounds in sediment and iv) BAC and EAC for biomarkers in mussel. In addition, the Decision IG. 23/6 maintained the following assessment criteria as endorsed by the Decisions IG.22/7 (Athens, Greece, February 2016): i) EAC for sediments and mussel; ii) EAC for a group of organochlorinated compounds in sediment and biota (mussel and fish) complementing updated values and iii) BACs and EACs for biomarkers in mussel, complementing updated values.

Hence new available monitoring data were used to update sub-regional Mediterranean BAC values for heavy metals in biota and sediment in 2019 (UNEP/MED WG.463/Inf.6) in order to contribute to preparation of the State of Environment and Development Report 2019 (SoED). In line with the Programme of Work 2020-2021 adopted by COP21 (Naples, Italy, December 2019), and conclusions of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (Podgorica, Montenegro, 2 - 3 April 2018), the MED POL Programme has undertaken further actions aimed at harmonization and standardization of the monitoring and assessment methods related to IMAP Pollution and Marine Litter Cluster (Activity 2.4.1.4), including the present upgrade of several assessment criteria.

The present document proposes upgraded BC and BAC values for IMAP Common Indicator 17 and possible approaches for upgrade of EAC for IMAP Common Indicators 17, 18 and 20. Their calculation is based on new national monitoring data that have not been previously used for the calculation of the assessment criteria in the 2017 and 2019 assessments.

The proposed upgraded assessment criteria were submitted for review and possible endorsement by the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring– CorMon Pollution that was held from 26 – 28 April 2021.

Considering the evolving nature of this document that addresses the need to further upgrade the assessment criteria for IMAP Common Indicators related to Ecological Objective 9, the Meeting of CorMon Pollution agreed to recommend its use as a basis towards development and testing of the methodologies for GES assessment related to Ecological Objectives 9 and 10, and recommended its submission to the Meeting of the MED POL Focal Points to be held in May 2021, for its consideration, highlighting at the same time the need for its further elaboration, including within the Online Working Group (OWG) on Contaminants.

In order to ensure use of the new assessment criteria within preparation of the inputs for 2023 MED QSR, the Contracting Parties were requested to support present work by: i) undertaking analysis of proposed values of the assessment criteria against the new monitoring data to be reported into IMAP Pilot Info System, as well as to be made available through another relevant sources; ii) supporting improvements of existing methodology for calculation of the assessment criteria; and iii) supporting preparation of agreed and integrated GES assessment methodology for IMAP Ecological Objective 9.

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List of Abbreviations / Acronyms

ADR	Adriatic Sea sub-region
AEL	Aegean and Levantine Seas sub-region
B	Biota
BDL	Below Detection Limit
CEN	Central Mediterranean Sea sub-region
CI	Common Indicator
CORMON	Correspondence Group on Monitoring
COP	Conference of the Parties
BC	Background Concentration
BAC	Background Assessment Concentrations
CEN	Central Mediterranean Sea sub-region
CI	Common Indicator
CORMON	Correspondence Group on Monitoring
COP	Conference of the Parties
CRM	Certified Reference Material
DW	Dry weight
EAC	Environmental Assessment Criteria
EC	European Commission
EMODnet	European Marine Observation and Data Network
EO	Ecological Objective
ERL	Effect range low
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GES	Good Environmental Status
HCB	Hexachlorobenzene
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
MAP	Mediterranean Action Plan
MED	Mediterranean
MB	*Mullus barbatus*
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MG	*Mytilus galloprovincialis*
MSFD	Marine Strategy Framework Directive
NOAA	National Oceanic and Atmospheric Administration
OSPAR	Convention for the Protection of the Marine Environment for the North- East Atlantic
OWG	Online Working Group
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
QSR	Quality Status Report
S	Sediment
SoED	State of Environment and Development Report
TM	Trace metals
TOC	Total Organic Carbon
UNEP	United Nations Environmental Program
USEPA	United States Environmental Protection Agency
WFD	Water Framework Directive
WHO	World Health Organization
WMS	Western Mediterranean Sea sub-region
WW	Wet weight

1 Introduction

1. The criteria established by Decisions IG.22/7 (COP 19)[1] and IG. 23/6 (COP 20)[2] are reviewed in Section 2 of present document, whereas Section 3 provides an in-depth analysis of the data available for present upgrade of the assessment criteria. New upgraded regional and sub-regional Mediterranean BC and BAC values for CI17, as well as a proposal of the criteria for IMAP CI20 are presented in Section 4. This section also proposes an approach to upgrade the Mediterranean EACs.

2. The data used for developing updated assessment criteria were collected in the IMAP Pilot Info System during its testing phase, and in particular after launching a formal call for reporting of monitoring data in June 2020, as well as monitoring data stored in MEDPOL database that have not been previously used for calculation of the assessment criteria applied in the 2017 and 2019 assessments. It also took into account data from EU data center (European Marine Observation and Data Network - EMODnet), as a reliable external data source, as well as data collected from the scientific literature. A detailed compilation of the available new data is given in Section 3.

2 The assessment criteria for IMAP Common Indicators 17 and 18

3. Deriving and setting up criteria to determine environmental status is not an easy task. It gets more complicated going from the local to sub-regional and regional assessments. While there are many methodologies to derive criteria, the first step is aimed at defining the background or reference conditions from which to measure/determine the status and trends. In the framework of UNEP/MAP (UNEP/MAP 2016, 2019), the background concentration (BC) is defined as "The concentration of a contaminant at a "pristine" or "remote" site based on contemporary or historical data". The BC of anthropogenic (man-made) substance was defined as zero.-The same definitions are used by OSPAR and the Marine Strategy Framework Directive (MSFD) based on the Water Framework Directive (WFD) (Tornero et al. 2019)[3].

4. In line with these definitions, the BC determination is the first step of the derivation of indicators that are defined as the measure, index or model used to estimate the current state and future trends, along with thresholds for possible management action.

2.1 Methodology for background concentration (BC) determination

5. Several methods can be used to derive BC values for natural occurring elements/substances in different environmental matrices (i.e. sediment and biota)[4.] Briefly, they include using global average concentrations; pre-industrial age data; current data from pristine sites; data from monitoring programmes, whereas known polluted sites are excluded.

2.2 The methodology for the determination of Background concentration (BC) used by UNEP/MAP

6. The BCs were derived using data from sediment cores compiled from the scientific literature (UNEP/MAP 2011) and data from the MEDPOL database (UNEP/MAP 2011, 2016, 2019). A complete explanation of the used methodologies is given in these documents, as well as in UNEP/MAP WG.492/Inf.11 submitted for consideration of present Meeting.

2.2.1 Trace Metals (Cd, Hg and Pb) in sediments

7. The approved BCs for Trace Metals (TM) in sediments are summarized in Table 1. Briefly, in 2016, the first step was to choose the stations to be considered as reference at a country level. For each country, each parameter was grouped by year and the years without temporal trend chosen. Next, the parameters were grouped by stations and the overall median value computed. Stations where the 75th percentile of the data were below the overall median were chosen as reference stations. Data of the reference stations were aggregated for the whole Mediterranean Sea and the MedBC computed as the median value of all reference stations. In 2019, BC values were computed in a similar way for 3 out of

[1] UNEP/MAP (2015). Decision IG.22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (Annex II), (COP 19, 2015).
[2] UNEP/MAP (2017). Decision IG.23/6 on Mediterranean Quality Status Report (COP20, 2017).
[3] Additional definitions for BC can be found in the literature and are explained in UNEP/MAP WG.492/Inf 11 submitted for information to present meeting.
[4] See document UNEP/MAP WG.492/Inf 11.

the 4 Mediterranean sub-regions[5]: Western Mediterranean (WMS), Adriatic Sea (ADR) and Aegean-Levantine Seas (AEL)[6.] No data were available to calculate BC for the Central Mediterranean (CEN). It was recommended to normalize the concentrations to Al (5%) concentrations[7].

Table 1. Background concentrations (BC) and Background assessment concentrations (BAC) calculated for trace metals (TM) in sediments for the Mediterranean Sea and sub-regions in 2011 and 2019. The table also presents the MedBAC and MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in µg/kg dry wt, as requested by IMAP[8.]

	Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20)			**UNEP/MAP (2011)**		**UNEP/MAP (2019)**			
	MedBAC	MedBAC	MedEAC*	Med BC	Med BC	Med BC	BC	BC	BC
TM	IG.22/7	IG.23/6	IG.23/6	Sed cores	Surf Sed	Ref Stn	WMS	ADR	AEL
Cd	150	127.5	1200	100	20	85	91.2	92.3	56
Hg	45	79.5	150	30	10	53	60	106.8	31.2
Pb	30000	25425	46700	20000	2310	16950	20465	13932	4920

* ERL (Effects Range Low, Long et al. 1995, idem OSPAR values). Sediment (Sed); Surficial (Surf); Reference stations (Ref Stn); Western Mediterranean (WMS); Adriatic (ADR) Aegean; Levantine Sea (AEL). No data were available to set up BCs for the Central Mediterranean (CEN).

8. Further to this work, present document (Section 4) provides updated BC and BAC values for TM in sediments. They were calculated by using the new data and the same methodologies as applied in 2016 and 2019

2.2.2 Naturally occurring organic compounds (PAHs) in sediment

9. MedBC values for PAHs in sediments are summarized in Table 2. The BCs were computed based on data derived from sediment cores compiled from the scientific literature, as well as data available in MEDPOL database (UNEP/MAP 2011). Normalization of organic compounds concentrations to total organic carbon (TOC) (2.5%) was recommended.

Table 2. Background concentrations (BC) calculated for PAHs in sediments for the Mediterranean Sea in 2011. The table also presents the MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in µg/kg dry wt, as requested by IMAP.

	Decisions (COP 19 and COP 20)	**UNEP/MAP (2011)**	
PAH compounds	**EAC* IG.22/7 and IG.23/6**	**BC Sed cores**	**BC Sur sed**
Naphthalene (N)		4	
Acenaphthylene (ACY)		0.5	1.05
Acenaphtene (ACE)		0.38	0.45
Fluorene (F)		0.75	0.33
Phenanthrene (P)	240	4.55	3.95
Anthracene (A)	85	0.8	1.56
Fluoranthene (FL)	600	5.6	6.7
Pyrene (PY)	665	10.28	2.1
Benzo[a]anthracene (BaA)	261	3.45	1.28
Chrysene (C)	384	1.3	6.64

[5]Although sub-regional values for the BCs in sediment were proposed, an updated 2019 assessment used the ones calculated in 2016, awaiting further confirmation of sub-regional values when new reference datasets will be available, whilst for mussels the proposed sub-regional values of BCs were exercised.
[6] The Mediterranean sub-regions and subareas are initially proposed according to availability of database sources for calculation of the assessment criteria (UNEP(DEPI)/MED WG.427/Inf.3; UNEP/MED WG.463/8; UNEP/MED WG.467/7).
[7]Normalization should be used with care, and only if field data support that normalization is valid for the area. An explanation on normalization practice for monitoring of IMAP Common Indicator 17 is provided in Monitoring (Guidelines/Protocols for Sample Preparation and Analysis for sediments (UNEP/MAP WG.482/12) and biota (UNEP/MAP WG.482/14)).
[8]UNEP/MED WG.467/5. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21: New proposal for candidate indicators 26 and 27; UNEP/MED WG.467/8. Data Standards and Data Dictionaries for Common Indicators related to Pollution and Marine Litter.

PAH compounds	Decisions (COP 19 and COP 20) EAC* IG.22/7 and IG.23/6	UNEP/MAP (2011) BC Sed cores	BC Sur sed
Benzo(b)fluoranthene (BbF)		1.1	8.32
Benzo(k)fluoranthene (BkF)		0.53	6.03
Benzo[a]pyrene (BaP)	430	2.55	3.71
Benzo[g.h,i]perylene (GHI)		1.25	3.25
Dibenzo[a,h]anthracene (DA)	63.4	0.18	1.37
Indeno[1,2,3,c,d]pyrene (ID)		1.7	4.49

* ERL. ERL for Naphthalene (160 μg/kg dw) and Total PAHs (4022 μg/kg dw) were derived by Long et al., 1995, but they do not appear in the COPs decisions

10. Further to this work, present document (Section 4) provides updated BC and BAC values for PAHs in sediment. They were calculated by using the new data and the same methodologies as applied in 2016 and 2019 for trace metals.

2.2.3 Naturally occurring trace metals (Cd, Hg and Pb) and organic compounds (PAHs) in biota[9]

11. Unlike the sediments, there are no values of the pristine, pre-industrial concentrations of naturally occurring compounds in biota. In 2011, the BC concentrations were computed based on the whole MEDPOL database (excluding known polluted stations), as the median of the lower 5% of the data. In 2016 and 2019, the BC concentrations were computed as for trace metals in sediments, based on the data sets from the selected reference stations. The calculated BC values for TM are presented in Table 3 for mussel and fish. The calculated BCs for PAHs in mussel are presented in Table 4. It should be emphasized that BC concentrations are species specific as well as tissue specific (i.e. natural concentrations in muscle are different from the natural concentrations in liver). In addition, BC concentration may depend on age of the specimens, with length and weight usually used as a proxy to age[10].

Table 3. Background concentrations (BC) calculated for trace metals in mussel and fish for the Mediterranean Sea and sub-regions in 2016 and 2019. The table also present the MedBAC and MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in the units requested by IMAP.

	Decisions (COP 19 and COP 20)			**UNEP/MAP (2019)**			
TM	**MedBAC IG.22/7**	**MedBAC IG.23/6**	**#MedEAC IG.23/6**	**BC Med**	**BC WMS**	**BC ADR**	**BC AEL**
Mussel soft tissue (*Mytilus galloprovincialis*), μg/kg dry wt							
Cd	1088	1095	5000	730	660.5	782	942
Hg	188	173.2	2500	115.5	109.4	126	110
Pb	3800	2313	7500	1542	1585	1381	2300
Fish muscle (*Mullus barbatus*) μg/kg wet wt							
Cd	16**	*3.7	50	*3.7			
Hg	600**	101.2	1000	50.6	68	150.5	44.6
Pb	359**	*31	300	*31	38		20

* Most values below detection limit, ** Concentrations in μg/kg dry wt as given in Decision IG. 22/7. # EACs are the ECs, the maximum levels for certain contaminants in foodstuffs based on European policy (EC/EU 1881/2006, 1259/2011 Directives and amendments 488/2014 and 1005/2015). Western Mediterranean (WMS); Adriatic (ADR) Aegean; Levantine Sea (AEL). No data were available to set up BCs for the Central Mediterranean (CEN)

Table 4. Background concentrations (BC) calculated for PAHs in mussel (*Mytilus galloprovincialis*) soft tissue for the Mediterranean Sea and sub-regions in 2016 and 2019. The table also present the MedBAC and EAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in μg/kg dry wt, as requested by IMAP.

[9] The mussel *Mytilus galloprovinciallis* (MG) and the fish *Mullus barbatus* (MB), the agreed mandatory species for monitoring
[10] See document UNEP/MAP WG.492/Inf 11

PAH compounds	Decisions (COP 19 and COP 20)		UNEP/MAP (2019)			
	MedBAC	EAC*	BC	BC	BC	BC
	IG.23/6	IG.22/7 and IG.23/6	Med	WMS	ADR	AEL
Naphthalene			(2.4) #	2.24		2.80
Acenaphthylene			(0.6) #			
Acenaphtene			(0.6) #			
Fluorene	2.5		1.0	0.96	1.07	0.60
Phenanthrene	17.8	1700	7.1	4.93	9.04	7.55
Anthracene	1.2	290	0.5	0.52	0.38	0.30
Fluoranthene	7.4	110	3.0	3.38	2.03	6.60
Pyrene	5.0	100	2.0	3.02	0.85	5.90
Benzo[a]anthracene	1.9	80	0.8	1.20	0.53	1.60
Chrysene	2.4		1.0	1.24	0.27	5.20
Benzo(b)fluoranthene						
Benzo(k)fluoranthene	1.4	260	0.6	1.27	0.29	1.50
Benzo[a]pyrene	1.2	600	0.5	0.60	0.32	0.70
Benzo[g.h,i]perylene	2.3	110	0.9	0.90		1.20
Dibenzo[a,h]anthracene	1.3		0.5	0.53		
Indeno[1,2,3,c,d]pyrene	2.9		1.2	1.23		0.90

* EC, maximum levels for certain contaminants in foodstuffs based on European policy (EC/EU 1881/2006, 1259/2011 Directives and amendments 488/2014 and 1005/2015). # most data below detection limit. In red, sub-regional BC values higher than MedBAC (MedBAC= 1.5 MedBC, see Section 2.3.1)

12. Further to this work, present document (Section 4) provides updated BC and BAC values for TM in biota and PAHs in mussel. They were calculated using the new data and the same methodologies as applied in 2016 and 2019.

2.2.4 Synthetic substances (non-naturally occurring) in sediments and biota

13. The BC of any anthropogenic (man-made) substance is defined as zero. However, analytically, it is impossible to measure a concentration that equals zero. Therefore, the BC determination is based on the detection limits of the methods used and its uncertainty (precision and accuracy), as determined from CRMs (Certified reference materials) and proficiency testing. IMAP addresses organochlorinated compounds (PCBs and pesticides) as detailed in Table 5. This table summarizes the EAC values for the Mediterranean, agreed upon in Decisions IG.22/7 (COP19) and IG.23/6 (COP20). No BC nor LC (Low concentrations) were calculated for the Mediterranean in 2016 nor in 2019 (UNEP/MAP, 2016, 2019).

Table 5. EAC values for organochlorinated contaminants in sediments, in mussel (*Mytilus galloprovincialis*) soft tissue and muscle tissue in fish (*Mullus barbatus*) to be used in the Mediterranean Sea. The values were agreed upon in Decisions IG.22/7 and IG.23/6 and follow OSPAR's recommendations. Concentrations are given in the units requested by IMAP.

	Sediments		Mussel	Fish
	EAC* IG.22/7(µg/kg dw)	MedEAC* IG.23/6(µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg lipid)
PCBs				
CB28		1.7	3.2	64
CB52		2.7	5.4	108
CB101		3	6	120
CB118		0.6	1.2	24
CB138		7.9	15.8	316
CB153		40	80	1600
CB156				

	Sediments		Mussel	Fish
	EAC* IG.22/7(µg/kg dw)	MedEAC* IG.23/6(µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg lipid)
PCBs				
CB180		12	24	480
Sum 7 PCBs	11.5			
Pesticides				
γ-HCH (Lindane)	3		1.45	11 µg/kg ww
DDE(p,p')	2.2		5-50	
Hexachlorobenzene	20			
Dieldrin	2		5-50	

* ERL (Effects Range Low, Long et al. 1995, idem OSPAR values).

14. Further to this work, present document (Section 4) shows that the data were not sufficient to provide BC and BAC values for organochlorinated contaminants in sediment and biota.

2.3 The methodologies for thresholds` determination used by UNEP/MAP

15. UNEP/MAP has adopted the threshold assessment methodology, based on the "traffic light" approach, by defining 2 values to classify 3 environmental categories: 1) good (acceptable, not different from BC); 2) above background but with low risk for environment and biota population, or below dietary limits for fish and sea food concerning human health; and 3) unacceptable. The two values defined were i) the Background Assessment Concentration (BAC) (or T_0) and ii) the Environmental Assessment Criteria (EAC) for TM and organic contaminants in sediments and biota, or EC for TM and organic contaminants in biota, (or T_1). The above Tables 1-5 tabulate the values of BAC and EAC adopted or proposed to be used for the assessment of the quality status of the Mediterranean Sea (IMAP Decisions 22/7 (COP 19) and 23/6 (COP 20)).

2.3.1 Background Assessment Concentration (BAC) determination

16. BAC are the concentrations below which no deterioration of the environment can be expected. Observed concentrations are said to be near BC if the mean concentration is statistically significantly below BAC. For calculation of BAC values from BC concentrations UNEP/MAP adopted the methodology that corresponds to the OSPAR methodology. The BAC values were computed as the BC concentration multiplied by a factor that was determined based on the uncertainty (precision and accuracy) of the determinations. The multiplication factors were as follows: MedBAC=1.5 x MedBC (for mussel and sediment matrices); MedBAC=2.0 x MedBC (fish).

17. The MedBAC values endorsed in Decisions IG.22/7 and IG.23/6 are as follows: MedBAC for TM in sediments, mussel and fish (Tables 1,3) and PAHs in mussel (Table 4). In 2019, the same methodology was used to propose derivation of specific sub-regional MedBAC values.

18. Further to work undertaken in 2019, this document proposes updated regional and sub-regional BAC values for the Mediterranean, using the same methodology as in 2019. The proposed values are presented in Section 4.

2.3.2 Environmental Assessment Criteria (EAC) determination

19. EAC values are the concentrations above which significant adverse effect to the environment or to human health are most likely to occur. Conversely, EAC values are defined as the concentrations below which it is unlikely that unexpected or unacceptable biological effects will occur in exposed marine species. Due to that fact that it was not possible to develop EAC for MED at that time, it was agreed to use the criteria developed by OSPAR and NOAA/USEPA (ERL values) (Long et al. 1995), as the EAC values for the Mediterranean. The EAC values agreed in Decisions IG.22/7 and IG.23/6 are as follows: EAC values for TM, PAHs and organochlorinated contaminants (PCBs and pesticides) are provided for sediments in Tables 1, 2 and 5; TM and organochlorinated contaminants are provided for mussel and fish in Tables 3 and 5 and PAHs are provided for mussel in Table 4.

20. A proposal of a new methodology to derive EAC values specific for the Mediterranean Sea is described in Section 4.

2.3.3 European Union regulations (EC)

21. The EAC values for TM and PAHs in biota as endorsed by Decisions IG.22/7 and IG.23/6 (Table 3) are the concentrations in fish and seafood recommended as dietary limits for human consumption concerning human health (EC). EC values are derived from the following EU Directives regulating maximum levels for certain contaminants in foodstuffs: EC/EU 1881/2006, 1259/2011, 488/2014 and 1005/2015. Section 4.3 gives more details about EC values. It should be mentioned that these values were set up to protect human health and may be too lenient to protect the environment.

22. A proposal of new methodology to derive EAC values for the Mediterranean Sea is described in Section 4.

2.4 The assessment criteria for IMAP Common Indicator 18

23. By Decisions IG.22/7 and IG. 23/6, the Contracting Parties endorsed BAC and EAC values for the following biomarkers for the mussel (*Mytilus galloprovincialis*): Acetylcholinesterase activity (AChE), Metallothioneins (MT), Micronuclei frequency (MN), Lysosomal membrane stability (LMS-NRR and LMS-LP methods) and Stress on Stress (SoS). These values are indicative and serve as the initial assessment criteria.

24. Presently there are no new data that can be used to update the biomarkers` assessment criteria. Therefore, they were not addressed in Section 4. More information on biomarkers and related criteria derivation is given in UNEP/MAP WG.492/Inf 11.

3 Survey of relevant data not used previously neither for preparation of the Mediterranean Quality Status Report (2017 MED QSR) nor for the State of Environment and Development Report (2019 SoED)

25. New relevant data not used previously neither for the 2017 MED QSR nor for update of the assessment for EO9 within preparation of the 2019 SoED were collected from the following 4 data sources:

1. New data from IMAP Pilot Info System that include national monitoring data uploaded in the system during its testing phase, and in particular after launching formal call for reporting of data in June 2020.
2. New data from the MEDPOL Database not used previously for calculation of assessment criteria;
3. The EU data center (European Marine Observation and Data Network - EMODnet);
4. Published papers collected from the scientific literature.

26. Details of the available data from these sources are given below.

3.1 IMAP Pilot Info System and MEDPOL Database

27. Tables 6 and 7 provide a detailed examination of the new available data sorted by matrix, country and sampling year. The datasets used in the 2017 and 2019 assessments are given in UNEP/MAP WG.492/inf 11.

28. It can be seen that the IMAP and MEDPOL data included only TM and organic contaminants in sediment and biota (CI17). No new data were available for biomarkers (CI18). New biomarker data were not available also for assessments that contributed to 2019 SoED.

Table 6: An overview of available new data from IMAP Pilot Info System. The numbers next to the years are the number of observations for each parameter, sorted by country and sampling year. The number of below detection limit (BDL) observations is given in parenthesis.

Trace metals	**Species**	**Year**	**Cd**	**Hg**	**Pb**
Bivalve/mollusc					
Lebanon	*Patella sp.*	2019	16 (0)	16 (0)	16 (0)
Morocco	*Callista chione*	2016	10 (0)	10 (0)	10 (0)
		2017	10 (0)	10 (0)	10 (0)
		2018	5 (0)	5 (0)	5 (0)
Slovenia	*M. galloprovincialis*	2018	3 (0)	3 (0)	3 (0)
		2019	3 (0)	3 (0)	3 (0)
Fish					
Croatia	*Conger conger*	2012	4 (4)	4 (0)	4 (0)
Lebanon	*Diplodus sargus*	2019	11 (0)	11 (0)	11 (0)
	Euthynnus alletratus	2019	15 (0)	15 (0)	15 (0)
	Mullus barbatus	2019	14 (0)	14 (0)	14 (0)
Sediment					
Cyprus		2013	2 (0)	2 (2)	2 (0)
		2014	4 (1)	4 (4)	4 (3)
		2015	3 (0)	3 (3)	3 (1)
		2016	2 (0)	2 (2)	2 (0)
		2017	7 (0)	7 (6)	7 (0)
		2018	4 (1)	4 (4)	4 (1)
Morocco		2016	11 (9)	0	11 (4)
		2017	11 (1)	11(11)	11 (7)
		2018	11 (0)	11(11)	11(1)
Slovenia		2019	1(1)	1(0)	1(0)

PAHs and Organochlorinated contaminants										
Bivalves/mollus	Species	Year	Total PAH	Total PCB	HCB*	CB101	CB138	CB153	CB180	CB52
Lebanon	*Patella sp*	2019	15 (0)	15 (8)						
Morocco	*C.chione*	2016			7 (0)	1 (0)	7 (0)	7 (0)	5 (0)	0
		2017			7(0)	0	2(0)	3 (0)	7(0)	0
		2018			5 (0)	5 (0)	6 (0)	5 (0)	6 (0)	1
Slovenia	M. galloprovincialis	2019	3 (3)							
Fish					HCB*	Dieldrin	Aldrin	DDE(p, p’)	DDT(p, p’)	DDD(p, p’)
Croatia	*C. conger*	2012			4 (3)	8 (2)	8 (8)	8 (0)	8 (0)	8 (0)
Lebanon	*D.sargus*	2019	3 (0)	3 (0)						
	E.. alletratus	2019	10 (0)	13 (0)						
	M. barbatus	2019	6 (0)	3 (0)						
Sediment										
Lebanon		2019	19 (0)	19 (9)						

PAHs and Organochlorinated contaminants										
Bivalves/mollus	Species	Year	Total PAH	Total PCB	HCB*	CB101	CB138	CB153	CB180	CB52
Slovenia		2019	1 (1)	1 (1)	1 (1)					

* HCB- Hexaclorobenzene

Table 7: New data available in MEDPOL Database. The numbers next to the years are the number of observations for each parameter, sorted by country and sampling year. The number of below detection limit (BDL) observations is given in parenthesis.

	Species[11]	Year	Cd	Hg	Pb	Total PAHs	Hydrocarbons
Bivalves							
Israel	*MC*	2017	2 (0)	2 (0)	0		
Montenegro	*MG*	2018	8	8	8	9 (5)	
Slovenia	*MG*	2017	3 (0)	3 (0)	3 (0)		
Tunisia	*ML*	2014	0	3 (0)	0		
	RD	2014	0	11(0)	0		
Fish							
Israel	*DS*	2017	13(12)	13(0)	0		
	LM	2017	28(27)	28 (0)	0		
	SR	2017	11(12)	11 (0)	0		
	SRB	2017	10(10)	10 (0)	0		
	DS	2018	9 (4)	9 (0)	0		
	SRB	2018	10 (10)	10 (0)	0		
SEDIMENT							
Israel		2017	14 (0)	14 (0)	14(0)		
Montenegro		2018	6 (0)	6 (0)	6 (0)	5 (0)	5 (5)
Slovenia		2013				7 (0)	
		2014				6 (0)	
		2015				6 (0)	
		2016				7* (0)	
		2018				1* (0)	
Tunisia		2014	9 (9)	9 (0)	9 (9)		6 (0)

* data for 16 individual PAHs.

3.2 Data from the EU data center (European Marine Observation and Data Network - EMODnet)

29. Data from EMODnet used to complement data available in IMAP Pilot Info System and MEDPOL Database are summarized in Table 8.

Table 8. Data from EMODnet used for present update of BC/BAC values, complementing data available in IMAP Pilot Info System and MEDPOL Database. “n” is the number of observations.

Country	Year	Matrix	n	Parameters available*
France	2016	S	33	Cd, Hg, Pb
Croatia	2016	S	35	Cd, Hg, Pb
Italy	2016	S	5	Cd, Hg, Pb
France	2017	B (MG)	3	Cd, Hg, Pb
Italy	2015-2018	B (MG)	61	Cd, Hg, Pb
France	2016	S	29	PAHs, PCBs, Pesticides
Italy	2015-2016	S	5	PAHs, Pesticides
France	2017	B (MG)	2	PAHs, PCBs
Italy	2016-2017	B (MG)	18	PAHs
Italy	2017	B (MG)	2-33	Pesticides

[11] *MC – M. corralina, MG – M. galloprovincialis, RD - R.ruditapes,* , DS - *D. sargus, LM - L. mormyrus, SR- S. rivulatus, SRB-S. rubrum.*

* Not all parameters available for all samples. S-Sediment, B-Biota, MG- *M. galloprovincialis*

3.3 Data from the scientific literature

30. Below Table 9 lists the available scientific papers used in the preparation of this document. It is important to note that the papers are usually limited in scope, both spatially and temporally. Moreover, they usually include contaminated and reference sites, so care should be taken when utilizing the data for BC calculation or verification. The search was geared towards finding recent data, from samples collected since 2012, and towards data from the southern Mediterranean countries. Detailed elaboration of relevant scientific literature is provided in UNEP/MAP WG.492/inf 11 (Annex 2).

Table 9. Data available from the scientific literature. The characterization of information provided in table is as follows: Data – all data could be retrieved from the paper; BC – paper specifies the background concentrations; Statistics – only statistics of the data are given (i.e. mean, standard deviation)

Country	Sampling year	Matrix	Parameter	Data	Reference
Algeria	2015	S	Cd, Pb	Statistics, BC	(Ahmed et al. 2018)
Algeria	2014	B (MG)	Cd, Pb	Statistics	(Benali et al. 2017)
			PCB, PAH	Data*	
Egypt	ng	S	Cd, Pb	range	(El Baz and Khalil 2018)
France	2014	B (MG)	Hg	Data*	(Briant et al. 2017)
Greece	2016-2018	S	Pb	Data*	(Karageorgis et al. 2020)
Italy	2012	B (Fish)	Hg	Data**	(Bonsignore et al. 2015)
Lebanon	2017	S, B (mollusc)	Cd, Hg, Pb	Statistics	(Ghosn et al. 2020b)
Lebanon	2017	B (fish)	Cd, Hg, Pb	Statistics	(Ghosn et al. 2020a)
Morocco	2016	B (MG)	Cd, Pb	Statistics	(Azizi et al. 2016)
Spain	2011,2012, 2015	S	Cd, Hg, Pb	BC	(Martínez-Guijarro et al. 2019)
Tunisia	2011	B	Cd, Hg, Pb	Statistics	(Rabaoui et al. 2014)
Tunisia	2016	S	Cd, Pb	Statistics, BC	(Naifar et al. 2018)
Tunisia	2018-2019	S, B	Org. contam.	Data*	(Jebara et al. 2021)

S-Sediment, B-Biota, ng- not given; *- data used for present update of BC/BAC values; **- data not used since were related to polluted sites

3.4 Examination of the new data

31. The new data available were examined and used for BC and BAC`s calculation, as appropriate. The computed values were then compared with the environmental criteria for the Mediterranean Sea as endorsed in Decision 23/6 (COP 20). Those are presented in section 4.

32. Data were very limited, therefore data from different years were aggregated per country and outliers identified (using box plots) and not considered in the calculation of the median values. When needed, data were transformed to the concentration units requested by IMAP. It should be mentioned that sediment data were not normalized.

33. In addition, for biota, it was not always clear if the concentrations were reported in dry or wet weight. When not specified, it was assumed that the data were reported to IMAP Info System/MEDPOL database as requested by IMAP.

34. This comparison was undertaken in order to confirm data relevance for computing the updated BC and BAC values (Section 4). An in-depth examination of the data is presented in UNEP/MAP WG.492/inf 11 (Annex 3).

4 Critical examination of recommended environmental criteria and proposals for their update

35. In line with Decision 22/7 (COP 19), the assessment criteria for the Mediterranean Sea should follow the "traffic light" system for both contaminant concentrations and biological responses where two thresholds and three status categories are defined. As explained above, the two values defined were the Background Assessment Concentration (BAC) (T_0) and the Environmental Assessment Criteria (EAC) or EC values (T_1), (see Section 2).

4.1 Updated BC and BAC values for IMAP CI 17

36. The new data presented and critically analyzed above in Section 3 were used to calculate BC values for the sub-regional areas of the Mediterranean and for the whole Mediterranean Sea using the same methodology as initially applied in 2016/2017 and replicated in 2019 (see detail explanation in Section 2). BAC values are calculated by multiplying the BCs by a factor, as follows: MedBAC=1.5 x MedBC (for mussel and sediment matrices); MedBAC=2.0 x MedBC (fish). When most of the data originated from one sub-region, and there were significant differences among them, the BC values were calculated for the sub-region(s) only.

37. Tables 10-12 present the new updated BC and BAC values. The tables include also the values of the assessment criteria as endorsed in Decision 23/6 (COP 20), as well as their values updated in 2019.

Table 10. BC and BAC values for trace metals in sediments, calculated from the new data. The table shows also the previously endorsed/updated values. Concentrations are given in μg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BCs appear below the values.

BCs							
TM	Med (cores)	Med (surf)	Med	WMS	ADR	CEN	AEL
	2011[12]		**2019**				
Cd	100	20	85	91.2	92.3		56
Hg	30	10	53	60	106.8		31.2
Pb	20000	2310	16950	20465	13932		4920
Proposed new updated BC values (2021)							
Cd			116	115	166		113
n			135	*56*	*41*		38
Hg			32.6	25.0	54.1	2-69*	50.3
n			113	*33*	*37*	*6*	37
Pb			15900	12000	27066		17700
n			229	*58*	*44*		127
BACs							
		IG.23/6	Med	WMS	ADR	CEN	AEL
		2017	**2019**				
Cd		127.5	127.5	136.8	138.5		84.0
Hg		79.5	79.5	90.0	160		46.8
Pb		25425	25425	30698	20898		7380
Proposed new updated BAC values (2021)							
Cd			158	173	249		169
Hg			49.2	37.5	81.2		75.5
Pb			24269	18000	40599		26550

38. It can be seen that the updated regional Mediterranean BC values for Cd and Hg are very similar to the ones calculated in 2011 from sediment cores while value for Pb is lower. Comparison to the BCs values updated in 2019 shows that presently updated regional BC values for Cd is higher, Hg is lower and Pb slightly lower (4%). Comparison of the sub-regional BC values calculated in 2019 and 2021 shows differences as well. Possible reasons for these differences could be due to different

[12] The values calculated in 2011 are shown for comparison. The values were calculated from data compiled from the scientific literature (UNEP/MAP 2011) and need no recalculation

sediment mineralogical composition and the location of the sampling stations. In addition, for the regional BC values, an unbalanced number of data points among the sub-regions taken for the calculation, possibly gives an unproportionate weight.

Table 11. BC and BAC values for PAHs in sediments, calculated from the new data. The table presents also the previously endorsed/updated values. Concentrations are given in µg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BCs appear to the right of the values. No data were available for the AEL sub-region.

	UNEP/MAP (2011)		**Proposed new updated BC values (2021)**							
PAH compounds	BC, Sed cores	BC, Sur sed	Med	*n*	WMS	n	ADR	*n*	CEN	n
Naphthalene	4		8.0	*36*	8.8	29	2.0	*5*	2.5	*2*
Acenaphthylene	0.5	1.05	0.4	*34*	0	29	1.5	*4*	0.4	*5*
Acenaphtene	0.38	0.45	4.7	*29*	4.7	29	11.5	*8*		
Fluorene	0.75	0.33	7.5	*41*	7.5	29	6.0	*3*	0.4	*5*
Phenanthrene	4.55	3.95	16.8	*42*	22.5	29	15.0	*7*	0.8	*5*
Anthracene	0.8	1.56	3.4	*40*	5.0	29	8.5	*6*	0.7	*7*
Fluoranthene	5.6	6.7	22.1	*43*	32.2	29	12.0	*13*	2.0	*2*
Pyrene	10.28	2.1	15.9	*42*	22.4	29	12.5	*8*	0.4	*5*
Benzo[a]anthracene	3.45	1.28	19.1	*37*	20.9	29	23.0	*13*		
Chrysene	1.3	6.64	25.0	*37*	37.6	29	6.0	*3*	1.6	*5*
Benzo(b)fluoranthene	1.1	8.32	12.8	*44*	9.3	29	9.6	*13*	50	*2*
Benzo(k)fluoranthene	0.53	6.03	8.4	*44*	7.8	29	19.5	*8*	27	*2*
Benzo[a]pyrene	2.55	3.71	2.4	*42*	2.6	29	17.6	*13*	1.8	*7*
Benzo[g.h,i]perylene	1.25	3.25	6.9	*44*	5.0	29	9.0	*8*	100	*2*
Dibenzo[a,h]anthracene	0.18	1.37	0	*37*	0	29	7.0	*12*		
Indeno[1,2,3,c,d]pyrene	1.7	4.49	1.0	*44*	0	29	12.5	*8*	2.0	*2*
Total PAHs			165	*71*	166	29	218	*32*	6.6	*7*

	IG.23/6 (2017)	**Proposed new updated BAC values (2021)**			
PAH compounds	**MedBAC**	Med	WMS	ADR	CEN
Naphthalene		12	13	3	3.8
Acenaphthylene		0.6	0	2.3	0.6
Acenaphtene		7.1	7.1	17	0
Fluorene	2.5	11	11	9	0.6
Phenanthrene	17.8	25	34	23	1.2
Anthracene	1.2	5.1	7.5	13	1.1
Fluoranthene	7.4	33	48	18	3
Pyrene	5.0	24	34	19	0.6
Benzo[a]anthracene	1.9	29	31	35	0
Chrysene	2.4	38	56	9.0	2.4
Benzo(b)fluoranthene		19	14	14	75
Benzo(k)fluoranthene	1.4	13	12	29	41
Benzo[a]pyrene	1.2	3.6	3.9	26	2.7
Benzo[g.h,i]perylene	2.3	10	7.5	14	150
Dibenzo[a,h]anthracene	1.3	0	0	11	0
Indeno[1,2,3,c,d]pyrene	2.9	1.5	0	19	3
Total PAHs		248	249	327	9.9

39. Concentrations of PAH compounds in the sediments were available for 29 - 44 data points, while for Total PAHs, 71 data points were available. The calculated BC values for some of the compounds were higher than the BC concentrations measured in sediment cores and surficial sediments of the Mediterranean Sea in 2011, while for other compounds they were similar. This could be due to the limited number of datapoints used for the calculation both in 2011 and 2021. Therefore, it is proposed to use presently updated values of BC/BAC for preparation of input assessments for 2023 MED QSR, along with further update of the assessment criteria if more data will be reported by

the CPs[13]. Moreover, it is recommended to add the concentration of Total PAHs to the list of parameters.

Table 12. BC and BAC values for trace metals in mussel (*M. galloprovincialis*) and BC values for trace metals in other biota species calculated from the new data[14]. The table presents also the previously endorsed/updated values. The units of concentrations are given as requested by IMAP. The number of data points (n) taken to calculate the values appear below the values.

BCs						
TM		**Med**	**WMS**	**ADR**	**CEN**	**AEL**
Mussel soft tissue (*M. galloprovincialis*), μg/kg dry wt						
		2019				
Cd		730	660.5	782		942
Hg		115.5	109.4	126		110
Pb		1542	1585	1381		2300
TM		**Proposed new updated BC values (2021)**				
Cd		490	1010	88	77.8	>
n		*51*	*30*	*17*	*4*	
Hg		83	118	43	12.3	>
n		*110*	*53*	*49*	*8*	
Pb		1090	1245	100	250	>
n		*51*	*30*	*17*	*4*	
BACs						
	Med	**Med**	**WMS**	**ADR**	**CEN**	**AEL**
TM	IG.23/6 (2017)	**2019**				
Cd	1095	1095	991	1173		1413
Hg	173.2	173.2	164.1	189		165
Pb	2313	2313	2378	2072		3450
Proposed new updated BAC values (2021)						
Cd		735	1515	132	117	>
Hg		124	177	64.5	18.5	>
Pb		1635	1868	150	375	>

BCs						
TM		Med	WMS	ADR	CEN	AEL
Bivalves, soft tissue (various species)[15] μg/kg dry wt, calculated in 2021						
Cd			0.65			
n			*25*			
Hg			0.15		41.5	
n			*25*		*14*	
Pb			1.65			
n			*25*			
Fish muscle (*Mullus barbatus*) μg/kg wet wt, calculated in 2019						
Cd	*3.7#	*3.7				
Hg	101.2#	50.6	68	150.5		44.6
Pb	*31#	*31	38			20
Fish muscle (*Mullus barbatus*) μg/kg wet wt, calculated in 2021						
Cd						2.5
n						*39*
Hg						29.2
n						*60*
Pb						*13.5*
n						*39*

[13] The values for a few of the compounds in Table 11 are 0, meaning that the concentrations measured were BDL. Paragraph 46 below addresses the topic of BDL concentrations.
[14] BAC values were calculated just for *M galloprovincialis*. Data for the other mandatory species (*M. barbatus*) were not enough to calculate Med BACs. To calculate BACs from the BCs the following factors should be applied: BAC=1.5 x BC (mussel); BAC=2.0 x BC (fish).
[15] *C. chione* in the WMS, *ML and R.ruditapes* in the CEN, *M.corralina* in the AEL. See section 4.

BCs						
TM		Med	WMS	ADR	CEN	AEL
Fish muscle (*various species*)[16] µg/kg wet wt, calculated in 2021						
Cd		0.38		51.8		0.31
n		*37*		*4*		*33*
Hg		32.2		20.1	340^	33.4
n		*110*		*4*	*20*	*106*
Pb				224		0.46
n				*3*		*22*

#MedBAC in Decision IG.23/6; * Most values BDL; ^ questionable values, may be related to hot spot stations, therefore not taken for the calculation of regional MedBC; > it is recommendation to use the values calculated in 2019.

40. The regional MedBC values for Cd, Hg and Pb in *M. galloprovinciallis* calculated in 2021 were lower than those calculated in 2019. The subregional BCs for the WMS and the ADR were also different: WMS BC for Cd was higher and for Pb lower in 2021 compared to 2019, while WMS BC for Hg was similar. In the Adriatic the BC concentrations were much lower in 2021 than in 2019: ADR BC for Cd and Pb decreased by about one order of magnitude, while for Hg it was about 3 times lower. The differences in the Adriatic could be due to different locations of the sampling stations and to a temporal decrease. However, the most important point is the differences in concentrations between the WMS and the other sub-regions. The BC concentrations in the WMS were much higher for all three trace metals. Therefore, it is recommended to use the sub-regional BCs for *M. galloprovinciallis*. Since new data were not available in the AEL to update BC/BAC values for *M. galloprovinciallis*, it is recommended to use the values calculated in 2019. Comparison of BC concentrations calculated in 2021 for Cd and Pb in M. barbatus from the AEL to the BCs in Decision IG23/6 showed that they are low and similar. Calculated Hg concentrations calculated in 2021 were lower than the concentration in Decision IG23/6

41. The mussel *M. galloprovinciallis* and the fish *M. barbatus* are agreed as IMAP mandatory species. However, they may not be always found in all the areas of the Mediterranean Sea. Therefore, the addition of other (mandatory area specific) species to the monitoring program is recommended for further consideration. The species should be chosen based on their presence in the sub-regions, and relevance as pollution indicators, what will allow a better environmental assessment. Data from different species are presented in Table 12. It should be noted that the concentrations measured are specific to each species and comparison should be made within the same species (see Section 2).It may be useful to consider in the future an upgrade of IMAP in order to include larger number of species.BC concentrations of organochlorinated contaminants (PCBs and pesticides) in sediments and biota were not calculated either in 2011, 2016 or in 2019. The availability of new data is not sufficient to calculate BC values for these contaminants (see section 3).

42. For determination of BC values for CI17, the following key findings can be provided:

- For some parameters there is a marked difference among the Mediterranean sub-regions. Therefore, it is proposed in those cases (i.e. Pb in sediments, Cd and Pb in *M. galloprovincialis*, sum of PAHs in sediments), to consider using the sub-regional Mediterranean Sea assessment criteria.
- A statistical treatment of BDL data should be agreed upon. It is recognized that the different BDLs make it hard to use half of the BDL concentration for these values. However, it is not reasonable not to take BDL values into consideration.
- An in-depth examination of more data points, that need to be reported by CPs, should be performed in particular when large differences were observed between the BC values calculated in 2016 and in 2021. This is true for TM in sediment and biota in all sub-regions. The examination should include, among others, characterization of the stations used (hot spot, reference, other), analytical methodology, normalization, temporal trends.

[16] *S. pilchardus, B. boops, T. trachurus, S. sphyraena, D. annularis, P. acarne, P. erythrinus, M. barbatus, M. surmuletus, S. notata, S.scrofa, C. conger, D. sargus, L. mormyrus, S. rivulatus, S. rubrum.* See Section 3.

- For the other parameters, such as PAHs in biota, and organochlorinated contaminants in sediment and biota, new additional data are needed to recalculate the BCs. Before new data availability will allow their recalculation, present values remain valid for preparing assessment inputs for the 2023 QSR.

4.2 An upgraded approach for updating EAC values for IMAP CI 17

43. As explained above (see Section 2), the EAC values endorsed for use in the Mediterranean Sea were NOAAs ERLs (for TM, PAH and pesticides in sediments) and the ECs from EU Directives to protect human health (for TM and organic contaminants in biota). They may be too lenient if the goal is to achieve and maintain GES where the contaminants cause no significant impact on coastal and marine ecosystems. However, EAC values cannot be updated based on existing monitoring data. It needs a very specific in-depth research of the ecotoxicological and environmental scientific literature.

44. Therefore, the methodology detailed in European Commision Guidance Document (2018) and in Long et al. (1995) is recommended for the update of Mediterranean EAC values. It includes a thorough examination of the scientific literature conducted to study where data on no effect or adverse biological effects are given in conjunction with chemical data in the environment and in the biota at the same site and time. Those include but are not limited to sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP) and field and mesocosm studies. The data should be assembled into a detailed database and analyzed, as well as the extent of the effect determined. The emphasis should be given to Mediterranean biota species.

45. Upgrade of the EAC values for Mediterranean Sea as recommended above is a long-term task that needs a dedicated, very specific, scientific research.

4.3 Proposal of new EAC values for IMAP CI 20

46. Proposal of the EAC values for IMAP CI 20 related to actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed sea food is based on a survey of existing sources, including Directives of EU related to the maximum permitted levels for contaminants in fish and seafood for the protection of human health. Table 13 details the concentrations cited at different sources for TM (Cd, Hg and Pb) and for organic contaminants (PCBs, dioxin).

47. From Table 13 it is possible to see that the criteria are taxa specific (fish, mussel, crustacean), as well as species specific. For example, maximum allowable Hg concentration in fish muscle is 0.5 mg/kg ww, excluding listed species such as bonito, marlin, halibut, mullet species, among others, in which the maximum allowable Hg concentration in the muscle is 1.0 mk/kg ww (see EC/EU Directive 1881/2006).

48. In addition, Decision IG.23/6 details the indicative regional EAC values for PAHs in mussels (*Mytilus galloprovincialis*) and for organic contaminants in mussel (*Mytilus galloprovincialis*) and fish (*Mullus barbatus*) that are considered biota matrix of IMAP Common Indicator 17. These values are given in Tables 4 and 5. As these values were set up to protect human health, they may be too lenient to protect the environment (see paragraph 22). However, since the values are based on the maximum levels for certain contaminants in foodstuffs as provided in EC/EU Directives 1881/2006, 1259/2011 and amendments 488/2014 and 1005/2015, they are proposed to be also used for IMAP CI 20.

Table 13. Compilation of maximum levels for trace metals in fish and seafood for the protection of human health[17]. The concentrations are presented in mg/kg ww.

[17] The following sources are used in Table 13 and paragraph 52:
NOAA (National Oceanic and Atmospheric Administration) tabulation of the export requirements by country for fish and seafood (among others) (https://www.fisheries.noaa.gov/export-requirements-country-and-jurisdiction-f). Requirements by Australia, Brazil, Chile, China and Equador for trace metals;
EU directives for maximum levels for certain contaminants in foodstuffs (EC/EU 1881/2006 , 1259/2011 Directives and amendments 488/2014 and 1005/2015);
CODEX Alimentarius international food standards, guidelines and codes of practice. Joint FAO/WHO Food Standards Programme .

Source	matrix	Cd	Hg	Pb
		mg/kg ww		
NOAA (see countries below)	fish	0.2	0.5-1	1.5-2
	canned fish (*tuna)		1*	2.5, 5*
	mollusc	2	0.5	2.5
	finfish	0.1		0.5
EU 1881/2006 directive and 488/2014 and 1005/2015 amendments	fish muscle	0.05-0.25	0.5-1	0.3
	cephalopods	1		0.3
	crustaceans	0.5	0.5	0.5
	bivalve mollusc	1		1.5
CODEX Alimentarious (2019)	mollusc, cephalopod	0.05-2		
	fish			0.3
	fish- species dependent		1.2-1.7*	
#MedEAC IG.23/6	Mussel	1	0.5	1.5
	fish	0.05	1	0.3
OSPAR 2017	All species - biota	1	0.5	1.5
Minimum		**0.05**	**0.5**	**0.01**
Maximum		**2**	**1.7**	**2.5**

* methyl-mercury, # Concentrations recalculated in mg/kg wet wt

49. The maximum levels of organic contaminants in fish and seafood for the protection of human health are as follows: NOAA, 0.5 and 2 PCB (mg/kg ww) in fish and other seafood, respectively; EU Directive 1881/2006, 2-5 and 6 (mg/kg ww) of benzo(a)pyrene and 12-30 and 35 (mg/kg ww) for the sum of benzo(a)- pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene in smoked fish muscle and on smoked bivalve mollusc, respectively; EU Directive 1259/2011 – 3.5 pg/g ww for the sum of dioxins in fish muscle and liver and in eel muscle; 6.5, 10 and 20 pg/g ww for the sum of dioxins and dioxin like PCBs in fish muscle, in eel muscle and in fish liver, respectively; and 75, 300 and 200 ng/g of the sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 in fish muscle, in eel muscle and in fish liver, respectively. As for TM, the maximum allowable concentrations are taxa specific.

50. The values as established by above EU Directives are submitted for consideration to present meeting in order to guide the Secretariat and the Parties on their application as EAC values for IMAP CI 20. These values are in the low and mid-range of criteria used around the world and has the advantage to be consistent with regulations of EU. Their consistent application across the region is necessary. It should also be highlighted that these values were agreed at EU level also considering the ecosystem characteristics of Mediterranean Sea.

4.4 The way forward

51. As indicated in this document the work on the assessment criteria is a long way that requires very good quality of data and long time series. There is good progress in the last ten years in developing the assessment criteria, whereby better progress for BC/BAC has been achieved than for EAC. There is room to further reflect on how to upgrade work for calculation of Mediterranean EAC values for IMAP CIs 17 and 18, including by creating a database of scientific literature, as a long-term task, with support of the Online Working Group (OWG) for Contaminants (EO9), in order to complement real-time monitoring data to be reported from the Contracting Parties into IMAP Pilot Info System.

52. Scientific and expert contribution of the OWG for Contaminants is necessary to ensure analysis of the proposed updated sub-regional and regional BC and BAC values, against the new data that are expected to be provided by the members of the OWG or all the Contracting Parties in the IMAP Info System.

53. The criteria presently used for IMAP assessments are single parameter criteria. Each parameter is analysed separately to decide if the concentration is above or below the threshold. In view of the preparation of the assessment inputs for 2023 MED QSR, it is recommended to aggregate thresholds, that would better describe the environmental status and be a step towards determination of the overall

environmental status. To that effect the NEAT and CHASE+ approaches should be considered, taking also into account their additional merit to achieve consistency with the EU MSs (see UNEP/MED WG.492/Inf. 11).

Annex I
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