UNITED
NATIONS

EP

UNEP/MED WG.533/Inf.3

**UNITED NATIONS
ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN**

UNEP

15 April 2022
Original: English

Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Videoconference, 27 and 30 May 2022

Agenda Item 3: Assessment Criteria

Adjusted 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

For environmental and economic reasons, this document is printed in a limited number. Delegates are kindly requested to bring their copies to meetings and not to request additional copies.

UNEP/MAP
Athens, 2022

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 the Programme of Work 2022-2023 adopted by COP22 (Antalya, Turkey, December 2021) , 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 received up to December 31st, 2021, that have not been previously used for the calculation of the assessment criteria in the 2017 and 2019 assessments. In addition, following the OWG on Contaminants recommendation, data since 2015 were used as well in the calculation, even if used in the previous assessment.
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, 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.

Further to the discussion that took place during the resumed session of the Meeting of MEDPOL Focal Points (9 July 2021), the document was recommended for submission to the 8th EcAp Coordination Group Meeting (9 September 2021). Given the short time period between the Meeting of CorMon on Pollution Monitoring and the Meeting of MEDPOL Focal Points (27-28 May 2021), the operating procedures did not allow for the document submitted for consideration of the 8th EcAp CG to include changes undertaken after the Meeting of CorMon Pollution in order to address written comments received during or immediately after this meeting. Given the 8th EcAp CG took note of the that document with the understanding there is a validation process with CORMONS, and on that understanding, to use it as a basis towards development and testing of the methodologies for GES assessment related to Ecological Objectives 9 and 10 within the preparation of the inputs for the 2023

MED QSR. Consequently, this present document UNEP/MED WG. 533/Inf.3 elaborates all the comments received during the Meeting of CorMon Pollution Monitoring, the Meeting of MEDPOL Focal Points and 8th EcAp CG, as well as the findings and comments received from the members of the OWG on Contaminants during its virtual meeting (18 June 2021) and in the subsequent e-mail consultations that took place from June to December 2021. Therefore, the working document UNEP/MED WG. 533/3 is submitted for approval of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring in terms of using upgraded BC and BAC values for IMAP Common Indicator 17 for GES assessment within the preparation of the 2023 MED QSR, along with accepting proposed approaches for future upgrade of EAC for IMAP Common Indicators 17, 18 and 20.

Table of Contents

List of Abbreviations / Acronyms

ADR	Adriatic Sea sub-region
AEL	Aegean and Levantine Seas sub-region
AF	Assessment factor
AVS	Acid Volatile Sulphide
B	Biota
BDL	Below Detection Limit
CEN	Central Mediterranean Sea sub-region
CHASE	Chemical Status Assessment Tool
CI	Common Indicator
CORMON	Correspondence Group on Monitoring
COP	Conference of the Parties
CR	Contamination Ratio
CS	Contamination Score
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 Union Regulations
EMODnet	European Marine Observation and Data Network
EO	Ecological Objective
EqP	Equilibrium partitioning
EQS	Environmental Quality Standard
ERL	Effects Range Low
ERM	Effects Range Medium
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GES	Good Environmental Status
HCB	Hexachlorobenzene
HH	Human Health
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
NEAT	Nested Environmental Status Assessment Tool
NOAA	National Oceanic and Atmospheric Administration
NOAC	No Observed Effect Concentration
NPA	Non Problem Area
OOAO	One Out All Out
OSPAR	Convention for the Protection of the Marine Environment for the North- East Atlantic
OWG	Online Working Group
PA	Problem Area
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl

PHS	Priority Hazardous Substances
PS	Priority Substances
QS	Quality Standard
QSR	Quality Status Report
S	Sediment
SAU	Spatial Assessment Units
Secpois	Secondary Poisoning
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

This revised document updates the original document presented at the Meeting of CorMon on Pollution Monitoring that took place on 26-28 April 2021. It includes a recalculation of the new proposed BCs and BACs concentrations using data that were not available at the time the document was prepared, namely, data received from February 2021 to December 2021. This revised document incorporates also the comments received during the Meeting of CorMon on Pollution Monitoring that took place on 26-28 April 2021, the resuming session of the Meeting of MEDPOL Focal Points that was held on 9 July 2021 and during the 8th EcAp Coordination Group Meeting held on 9 September 2021. It also addressed the findings and comments received from members of the OWG (Online Working Group) on Contaminants during the virtual meeting that took place on June 18th, 2021 and in subsequent e-mail consultations.

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.

Considering new data availability (see Section 3), present upgrade of the assessment criteria may be summarized as follows:

- CI17: Updated BC values are proposed for the whole Mediterranean and sub-regions by using new data and the same methodology used in 2016. This work also follows on initial calculation of the sub-regional values undertaken in 2019 for the purpose of preparation of 2019 SoED.
- CI17: Updated BAC values are proposed for the whole Mediterranean and sub-regions further to updated BC values. Updated BC/BAC values will serve as a basis for GES assessment, that will preferably be based on combined application of CHASE+ and the NEAT methodologies (Anon 2019, Pavlidou et al. 2019)
- CI17 and CI18: EAC values cannot be updated based on existing monitoring data. This endeavor requires a very specific, in-depth research of the ecotoxicological and environmental scientific literature. This research is expected to be useful for updating EACs for CI18 as well.
- CI17 and CI 18: Further work aimed at defining an optimal combination of CHASE+ and the NEAT methodologies will take place in 2021-2022 as to deliver pilot GES assessments for the two sub-regions towards preparation of 2023 Mediterranean Quality Status Report. CHASE+ can be used to calculate contamination ratios and contamination scores, while NEAT applies such calculated ratios/scores on defined spatial assessment units (SAU) and habitats. EAC`s definition should be adjusted towards a more unified criteria for environmental status assessment (e.g. initial steps in NEAT or CHASE+).
- CI 18: Currently there are no new data to update the assessment criteria for biomarkers.
- CI20: New assessment criteria are proposed.

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. Given the request of the OWG on Contaminants, also data reported since 2015 that has previously been used were included in the upgrade of the criteria in order to increase the accuracy of calculation. 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, used to complement data gaps found in IMAP Pilot Info System and MEDPOL data base. A detailed compilation of the available new data is given in Section 3.

[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).

2 The assessment criteria for IMAP Common Indicators 17 and 18

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.-Similar definitions are used by OSPAR and the Marine Strategy Framework Directive (MSFD) based on the Water Framework Directive (WFD) (Tornero et al. 2019[3]).

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

Several methods can be used to derive BC values for natural occurring elements/substances in different environmental matrices (i.e. sediment and biota). Among the relevant methods there are the following:

- Use of global averages concentrations (Turekian and Wedepohl 1961) that is applicable only to metals in sediments.
- Use of pre-industrial age data that is applicable to metals and PAHs in sediments. The BC can be derived from historical data, usually lacking or from data generated from dated sediment cores[4]. BCs derived by this method should be compared to BCs derived from undisturbed sites` data and to BCs derived from data generated from monitoring programs.
- Use of current data from a "pristine'/undisturbed site (or a site with very minor disturbance)" with proper statistical analysis that is applicable to metals and organic contaminants in sediments and biota, biomarkers in biota. In this methodology, the data used should not exhibit a temporal trend in the concentrations.
- Use data from monitoring programs, excluding known polluted sites where BC should be determined in conjunction with rigorous statistical analysis to eliminate outliers along with expert judgement. It is applicable to metals and organic contaminants in sediments and biota, biomarkers in biota.

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

The BCs were derived using the following two methodologies: i) data from sediment cores compiled from the scientific literature (UNEP/MAP 2011)[5] and ii) data from the MEDPOL database (UNEP/MAP 2011, 2016, 2019). The specific methodologies used by UNEP/MAP for the different parameters are described in sections 2.2.1-2.2.4

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

The approved BCs for Trace Metals (TM) in sediments are summarized in Table 1. The BCs were derived using the following two methodologies: i) data from sediment cores compiled from the scientific literature (UNEP/MAP 2011)[6] and ii) data from the MEDPOL database (UNEP/MAP 2011, 2016, 2019).

Data from sediment cores: Published data for concentrations found in sediment cores collected in the Mediterranean Sea were compiled and organized by geographical area. The median for each

[3] For the purpose of this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.
[4] Caution is recommended while setting BC for PAHs from sediment cores data due to selective degradation of the different compounds.
[5] UNEP/MAP (2011). UNEP(DEPI)/MED WG365/Inf.8. Development of assessment criteria for hazardous substances in the Mediterranean.
[6] UNEP/MAP (2011). UNEP(DEPI)/MED WG365/Inf.8. Development of assessment criteria for hazardous substances in the Mediterranean.

area was computed, and the median of the geographical medians taken as the BC. Although data from 32 sediment cores were compiled, most of them did not include all three TM (Cd, Hg and Pb) and the BCs were computed based on fewer data points (Table 4 in the report UNEP/MAP 2011).

Data from MEDPOL data base: The concentrations measured from surficial sediments were used to determine BC in two similar ways. In 2011 known polluted sites were excluded and the data aggregated based on geographical area. The median was calculated for each area based on the lowest 5^{th} percentile of the data and the median of the area medians taken as the BC (UNEP/MAP 2011). In 2016, the first step was to examine the database in order to choose the stations to be considered as reference at a country level. The complete detailed methodology is provided in the report UNEP/MAP (2016). Briefly, 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 75^{th} percentile of the data were below the overall median were chosen as reference stations[7]. 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 the 4 Mediterranean sub-regions[8]: Western Mediterranean (WMS), Adriatic Sea (ADR) and Aegean-Levantine Seas (AEL)[9]. No data were available to calculate BC for the Central Mediterranean (CEN). It was recommended to normalize the concentrations to Al (5%) concentrations[10] (See Section 2.2.5)[11].

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[12].

TM	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
	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).

For comparison, BACs for trace elements in sediments used by OSPAR[13] are 310, 70 and 38000 µg/kg for Cd, Hg and Pb, respectively[14].

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.

---

[7] In OSPAR`s methodology, the stations where the 95th percentile of the data were below the overall median were chosen as reference stations. It should be noted that this value can be very lenient concerning the environment.
[8] 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.
[9] 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).

[11] In this document, data used for calculation of BC values were not normalized, since there were no available data on normalizers (i.e. Al, total organic carbon (TOC)) in the data sets reported by the Contracting Parties. The same is true for the data sets used for an upgrade of the assessment criteria applied in the 2017 and 2019 assessments.
[12] 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.
[13] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/
[14] For the reason of clarity explanation moved from previous footnote 11 into main text.

2.2.2 Naturally occurring organic compounds (PAHs) in sediment

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 (See Section 2.2.5). However, the multiplication factor was not provided for calculation of BACs for PAHs in sediments in the previous UNEP/MAP documents (2011, 2016, 2019). The value of multiplication factor is proposed for present calculation as provided in section 4.1 (Table 11), looking at the OSPAR values for BC and BAC for PAHs in the sediments and considering now calculated relatively higher values of BCs for PAHs in sediments in comparison to the BCs calculated in 2011.

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
Acenaphthene (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)	660[15]	10.28	2.1
Benzo[a]anthracene (BaA)	261	3.45	1.28
Chrysene (C)	384	1.3	6.64
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)	85[16]	1.25	3.25
Dibenz [a,h]anthracene (DA)	[17]	0.18	1.37
Indeno[1,2,3-c,d]pyrene (ID)	240[18]	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.

For comparison, BAC for PAHs in sediments used by OSPAR[19], in units of μg/kg dw in all assessment areas except for the Iberian Sea and Gulf of Cadiz are: 8 (naphthalene), 32 (phenanthrene), 5 (anthracene), 39 (fluoranthene), 24 (pyrene), 16 (benzo[a]anthracene), 20 (chrysene), 30 (benzo[a]pyrene), 80 (benzo[g,h,i]perylene) and 103 (indeno[1,2,3-c,d]pyrene). The EAC values used by OSPAR are the same as in IG.23/6 except that for naphthalene that is 160 μg/kg dw.

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[20]

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

[15] Updated value in IG. 23/6 of the value of 665 as provided in in IG.22/7
[16] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring
[17] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring
[18] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring
[19] https:// https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/contaminants/pah-sediment/
[20] The mussel *Mytilus galloprovincialis* (MG) and the fish *Mullus barbatus* (MB), the agreed mandatory species for monitoring

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 (See section 2.2.5).

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.

TM	Decisions (COP 19 and COP 20)			UNEP/MAP (2019)			
	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	559**[21]	*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. In red, sub-regional BCs higher than regional MedBC.

PAH compounds	Decisions (COP 19 and COP 20)		UNEP/MAP (2019)			
	MedBAC IG.23/6	EAC* IG.22/7 and IG.23/6	BC Med	BC WMS	BC ADR	BC AEL
Naphthalene			(2.4) #	2.24		2.80
Acenaphthylene			(0.6) #			
Acenaphthene			(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(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
Dibenz[a,h]anthracene	1.3		0.5	0.53		

[21] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring

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
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)

For comparison, BACs for trace elements used by OSPAR[22] are: in mussel - 960, 90 and 1300 µg/kg dw for Cd, Hg and Pb, respectively; in oyster 3000, 180 and 1300 µg/kg dw for Cd, Hg and Pb, respectively; Hg in fish muscle 35 µg/kg ww; and 26 µg/kg ww for both Cd and Pb in fish liver. OSPAR BACs for PAHs in mussel and oyster are as follows in units of µg/kg dw: 11.0 (phenanthrene), 12.2 (fluoranthene), 9.0 (pyrene), 2.5 (benzo[a]anthracene), 8.1 (chrysene), 1.4 (benzo[a]pyrene), 2.5 (benzo[g.h,i]perylene) and 2.4 (indeno[1,2,3,c,d]pyrene).

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, as elaborated here-above.

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

The BC of any anthropogenic (man-made) substance is defined as zero. However, analytically, it is impossible to measure a concentration that equals zero[23]. 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 contaminants (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*) for use 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
CB180		12	24	480
Sum 7 PCBs	11.5			
Pesticides				

[22] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/
[23] The BCs for man-made substances should be regarded as zero, and therefore, the so-called low concentrations (LCs) might be used instead to derive assessment criteria. The latter could be derived from reliable datasets of analytical variability information reported from either certified reference materials (CRMs) or independent proficiency testing (PTs) scheme databases. However, the Contracting Parties of Barcelona Convention agreed to use the BC terminology and not LC within UNEP/MAP.

PCBs	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)
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).

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.

2.2.5 Normalization

Normalization is a procedure used to transform data to compensate for existing natural variability and help differentiate between natural variability and contamination. The natural variability may arise from different sediment compositions (grain-size, minerology), or from different biotic taxa analyzed, among others. For example, the natural Pb concentration in sediment depends in its composition (grain-size and minerology): the natural concentrations in sand are lower than the natural concentration in silt; the natural concentrations of Hg in the mussel *M. galloprovincialis* is different from the natural concentration in the fish *M. barbatus* that in turn is lower than the natural concentration measured in tuna fish.

To compensate for natural variability of trace metals in sediments, it is possible to compare concentrations measured in the same grain-size range, assuming similar minerology. In this case normalization is not needed. A second approach is to use geochemical normalization, in which a mathematical relationship between metal concentrations and the concentrations of an abundant conservative element (normalizer) in the same sample is established. The assessment is then performed using the ratios of the measured concentration of the metal divided by the concentration of the normalizer in the sample. It is recommended to use Al (5%) as normalizer for TM and total organic carbon (TOC) (2.5%) for organic contaminants in sediments.

One country[24]firmly requested acceptance of the view according to which the normalization is only adequate if a significant positive correlation exists between the contaminant concentration and the normalizer (i.e. PAHs and TOC) (Annex I). UNEP/MAP is aware that the normalization process should not be automatic but based on the examination of the data and used with care. If there is no correlation between the contaminant and the assigned normalizer, normalization should not be performed. Therefore, when analyzing the GES for Mediterranean region it will be necessary to accommodate areas where no correlation exists with the normalizer along with the areas where a correlation is found with the normalizer. One possible solution is to assess GES at the level of sub-regions/sub-divisions.

In biota, natural concentrations are taxa and species specific. Moreover, in the same species, the concentrations depend on the tissue analyzed. Therefore, contamination assessment must be done on a species and tissue level. In addition, contaminants may accumulate with age. Weight and length of the specimen are usually used as a proxy to age. To avoid the need for normalization, concentrations of contaminants may be measured in specimens from the same species and age. An additional methodology is check for age dependence and if present, normalize to age (weight or length) similar to the normalization in sediments. Organic contaminants, that accumulate through hydrophobic partitioning into the lipids of organisms, may be normalised to lipid content (5% for fish and 1% for bivalves).

[24] Request of the representative of Spain

Normalization should be used with care, and only if field data support that normalization is valid for the area. A detailed explanation on normalization (theory and practice) is provided in the Monitoring Guidelines/Protocols for Sample Preparation and Analysis of Sediment and Biota for IMAP Common Indicator 17 ((UNEP/MAP WG.482/12; and UNEP/MAP WG.482/14).

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

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

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[25]. Briefly, in the document: OSPAR (2008). "Co-ordinated Environmental Monitoring Programme (CEMP) Assessment Manual for contaminants in sediment and biota." OSPAR Commission No. 379/2008, there is an extensive explanation on how to derive BAC, theoretically and pragmatically (page 20): "In an ideal world, the BAC would be set on environmental / ecotoxicological grounds. The monitoring programme would then be designed with sufficient precision to give a high probability of concluding that concentrations are near background when [c] = BC. However, in practice, there is often no firm environmental / ecotoxicological basis for setting the BAC and monitoring budgets will limit the achievable precision. A pragmatic way forward is to consider what is achievable under the CEMP. CEMP data can be assessed to evaluate the precision of the programme. Provisional BACs can then be set to give a high probability of concluding that concentrations are near background when [c] = BC."

The theorical statistical basis for the determination of BAC was explained, but the approach taken by OSPAR was a pragmatic approach in order to calculate the ratio between BAC and BC (the multiplication factor) from known parameters. The pragmatic approach used in order to have 90% probability of concluding that concentration is below provided for BAC,

BAC = BC exp (3.18 CV)

where CV is the precision of the monitoring program (per determinant and matrix). In the case of OSPAR, temporal monitoring data from the UK National Marine Monitoring Programme was considered.

	Sediment	Shellfish	Fish	Water
Metals	11%	14%	21%	11%
CBs	32%	30%	36%	
PAHs	21%	27%		

[25] At present, no statistical assessment was possible for the precision of the monitoring data reported into MEDPOL/IMAP Info system given the quantity of monitoring data reported to IMAP info System/ MEDPOL, In addition, the frequency of analyzing one sample of either biota or sediment within proficiency testing organized in collaboration of UNEP/MAP-MEDPOL and IAEA-MESL is insufficient for calculation of the precision of monitoring data. Therefore, the variability from OSPAR monitoring program was used, following its application for an upgrade of the assessment criteria in in 2017 and 2019. A detailed explanation is given in section 2.3.1 of the present document. .

Therefore, for trace metals in sediments, where the CV was 11%, BAC/BC= exp (3.18*0.11)=1.42 and the multiplication factor to calculate BAC from BC was set as 1.5 and used by OSPAR. Similarly, the multiplication factors were calculated for the other parameters.

The following previous documents of UNEP/MAP provide the same explanation as given in OSPAR (2008): UNEP/MAP (2011) UNEP(DEPI)/MED WG365/Inf.8: "Development of assessment criteria for hazardous substances in the Mediterranean" and UNEP/MAP (2016)UNEP(DEPI)/MED WG.427/9" Report of the Meeting of the Ecosystem Approach Correspondence Group on Pollution monitoring for Contaminants and Eutrophication."

In addition, the following elaborations are provided:

- WG365/Inf.8, page 13: "At this stage a statistical test as described above on the MEDPOL monitoring data is not yet available. Therefore, we could use the above relationships between BC and BAC for metals in sediments, fish and shellfish to assess the BACs levels. Thus, for sediments and shellfish BAC=1.5xBC, for fish BAC=2xBC. It is recommended to perform a statistical test to evaluate the precision of MEDPOL monitoring data (per country), in order to define relationships between BC and BAC for fish and shellfish in the Mediterranean. Regarding the CBs (chlorinated biphenyls), the data availability is very limited, therefore we have been unable to determine corresponding BACs" .
    - WG.427/9, Page 5: "The Background Assessment Criteria (or Concentrations) (BACs) are statistical tools defined in relation to background concentrations (BCs) and monitoring variances, which enable statistical testing of whether, observed concentrations can be considered to be near background concentrations. The observed concentrations are said to be 'near background' if the mean concentration is statistically significant below the corresponding BAC (OSPAR Commission 2008/379 CEMP Assessment Manual). More, the outcome of this method is that, on the basis of what is known about variability in observations, there is a 90% probability (power) that the observed mean concentration will be below the BAC when the true mean concentration is at the BC. BACs are calculated according to the method set out in Section 4 of the CEMP Assessment Manual and summarized below".
    - WG.427/9, Page 5: "At present, a statistical assessment as described above for the MEDPOL monitoring program database could not be produced. Therefore, in this report, we have used the OSPAR monitoring program variability and their relationships between BC and BAC for hazardous chemical substances to determine the BACs for the Mediterranean Sea, as similar monitoring strategies and analytical capabilities exists. In this way, we have chosen the Mediterranean BACs for trace metals in sediments and shellfish to be BAC=1.5xBC and for fish BAC=2xBC, and for PAHs the relationship between BAC and BC is chosen to be 2.5."

In present document, no statistical assessment for the precision of the monitoring could be produced as well given the quantity of data reported to IMAP info System/ MEDPOL. In addition, the frequency of analyzing one sample of either biota or sediment within proficiency testing organized in collaboration of UNEP/MAP-MEDPOL and IAEA-MESL is insufficient for calculation of the precision of monitoring data. Therefore, following the update/upgrade of the BC values, the BAC values were computed as the BC concentration multiplied by the same factor as used in the previous assessment in 2017 and 2019 with following equations : i) MedBAC for trace metals in sediments and shellfish: MedBAC=1.5xMedBC and in fish: MedBAC =2xMedBC; and ii) MedBAC for PAHs in mussel: MedBAC=1.5xMedBC. As explained above for Table 2 no multiplication factor was proposed in previous UNEP/MAP documents for calculation of PAHs in sediment; therefore, no BAC values were calculated for PAHs in sediment in the previous assessments (see also section 4.1, Table 11).The same is true for PCBs and pesticides.

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 sediments and mussel (Tables2, 4). In 2019, the same methodology was used to propose derivation of specific sub-regional MedBAC values.

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. In WG365/Inf.8 (2011) was found that one BC will be used for the whole Mediterranean region, unless scientific evidence suggests a different BC for a specific site. The implementation of IMAP provided scientific evidence of significant variations between the four Mediterranean sub-regions, therefore values of BCs/BACs at the sub-regional level were initially introduced in 2019 and furthermore elaborated in the present document. The proposed values are presented in Section 4.

2.3.2 Environmental Assessment Criteria (EAC) determination

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.

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)

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.

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

Biomarkers are used to infer on a cause-effect relationship between a stressor and a biotic effect. The biotic effects can be biochemical, physiological, toxicological and/or be detected at the ecological/community level. The World Health Organization (WHO, 1993) further defined biomarkers as: (1) a biomarker of exposure (effect measured within an organism) and (2) a biomarker of effect (effect measured as a health impairment or disease) (Lomartire et al. 2021).

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.

The two following general methods can be used to derive BCs for biomarkers:

- Use data from a "pristine'/undisturbed site (or a site with very minor disturbance)" with proper statistical analysis. As for contaminants, in this method there should be no temporal trend on the parameters measured.
- Use data from monitoring programs, excluding known polluted sites in conjunction with rigorous statistical analysis to eliminate outliers, and with the aid of expert judgement.

By Decisions IG.22/7 and IG. 23/6, the Contracting Parties endorsed BACs and EACs for the following biomarkers for the mussel *Mytilus galloprovincialis* (MG): Acetylcholinesterase activity (AChE), Metallothioneins (MT), Micronuclei frequency (MN), Lysosomal membrane stability (LMS-NRR and LMS-LP methods) and Stress on Stress (SoS) (Table A1.1). The proposed values are indicative and serve as the initial assessment criteria.

In 2016, MedBCs both for the whole Mediterranean Sea and two sub-regions were determined using the selected reference stations datasets (Table AI.1). MedBCs were determined as the 10th or 90th

percentile value, the former when the response is a decrease in value and the latter when the biomarker response is an increase in value.

Table A1.1. Mediterranean EAC levels for biomarkers in mussel (*M. galloprovincialis*) as agreed upon during COP19 and COP 20. The values calculated in 2016 BCs and BACs from the Mediterranean Sea, and BC for two sub regions are given as well.

Biomarker/Bioassay		Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20)				UNEP/MAP (2016)			
		BAC	EAC	BAC	EAC	BC	BAC	BC	BC
	Units	IG.22/7	IG.22/7	IG.23/6	IG.23/6	Med	Med	WMS	ADR
Stress on Stress (SoS)	days	10	5	11	5	11	11		
Metallothioneins	ug/g (digestive gland)			247		192	247	191.3	200.5
Lysosomal membrane stability Neutral Red Retention Assay (LNS-NRR)	minutes	120	50	120	50	45	120	45	47.4
Lysosomal membrane stability Cytochemical method (LNS-LP)	minute	20	10	20	10	13	20		16.8
Acetylcholinesterase (AChE) activity in gills (French Mediterranean waters	nmol/min/ mg protein	29	20	29	20				
Acetylcholinesterase (AChE) activity in gills (Spanish Mediterranean waters)	nmol/min/ mg protein	15	10	15	10				
Acetylcholinesterase (AChE) activity in gills	nmol/min/ mg protein					21	15	20.86	12.2
Micronuclei frequency	0/00 in haemocytes	3.9		1		0	1	0	0.5

Peric et al. (2017) measured the changes of acetylcholinesterase activity (AChE), metallothioneins content (MTs), catalase activity (CAT) and lipid peroxidation (LPO) in *M. galloprovincialis* after 4 days exposure to a wide range of sublethal concentrations of chlorpyrifos (CHP, 0.03-100 μg/L), benzo(a)pyrene (B(a)P, 0.01-100 μg/L), cadmium (Cd, 0.2-200 μg/L) and copper (Cu, 0.2-100 μg/L). The control values, a proxy for BCs, ranged from 4 to 13 nmol/min/mg protein for AChE activity in gills and from 90 to 200 ng/g ww for MT in the digestive gland.

Presently there are no new data that can be used to update the biomarkers` assessment criteria. Therefore, they were not addressed in Section 4[26].

[26] The example of positive practice that refers to work undertaken in OSPAR is included in present document UNEP/MED WG. 492 /Infl1/Rev 2. See section 2.4, footnote 25: "It should be noted that within the framework of the Working Group on Biological Effects of Contaminants (WGBEC) of ICES, BAC and EACs have been established for certain biomarkers in the fish *Mullus barbatus.* To that effect please note that Vethaak et al. 2017 and Davies et al 2012. provided BACs and some EACs values for 21 biomarkers. Most of the values are for species other than *M. galloprovincialis* and therefore not applicable with regards IMAP implementation. Most of the relevant biomarkers have the same values as values provided in the Decisions IG.22/7 on IMAP (Athens, Greece, February 2016). Concerning *M. barbatus* (Red mullet) there are some BACs and EACs for some biomarkers in Davies et al., 2012; Vethaak et al., 2017. However, there should be a decision to include the new assessment criteria for *M. galloprovincialis* within some of future amendments of IMAP given present lack of data related to IMAP Common Indicator 18.

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)

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. This updated document takes into account monitoring data reported until December 31st, 2021;
2. Data from the MEDPOL Database since 2015[27];
3. The EU data center (European Marine Observation and Data Network - EMODnet);
4. Published papers collected from the scientific literature.

In view of the consultations with the OWG on Contaminants (Annex I), data from 2015 onwards were included in the calculation, even if they were used previously, in order to increase the number of data points. Details of the available data from these sources are given below. Comparison between the data available in February 2021 and the data available for this revised document showed a large increase in data points. For example, available data for trace metals in sediments from IMAP-IS and MEDPOL database increased by 7-8 times, and there are now data to calculate the proposed BC and BACS for PAHs in mussel and organochlorinated contaminants in sediment and biota for some sub-regions that was not possible with the data available in February 2021. However, it must be noted that level of data reported until 31 December 2021 was still less than 30 % of new data that need to be reported for the preparation of the 2023 MED QSR.

3.1 IMAP Pilot Info System and MEDPOL Database

Tables 6, 7 and 8 provide a detailed examination of the available data, sorted by data source, sub-region, country and sampling year. The datasets used in the 2017 and 2019 assessments are given in UNEP/MAP WG.463/Inf.6 (2019).

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 the data available for trace metals in sediments and biota (*Mytilus galloprovincialis* (MG) and *Mullus barbatus* (MB)) for their use for the preparation of the 2023 QSR. The numbers next to the years are the number of observations for each parameter, sorted by source of data, country and sampling year. When available, IMAP-IS file number is given.

A. SEDIMENT

Source	IMAP_File	Country	Subregion	Year	Cd	Hg	Pb
IMAP_IS	&	Albania	ADR	2020	6	6	6
IMAP_IS	&	Croatia	ADR	2019	30	30	30
IMAP_IS	125	Cyprus	AEL	2013	2	2	2
IMAP_IS	125	Cyprus	AEL	2014	4	4	4
IMAP_IS	125	Cyprus	AEL	2015	3	3	3
IMAP_IS	125	Cyprus	AEL	2016	2	2	2
IMAP_IS	125	Cyprus	AEL	2017	7	7	7
IMAP_IS	125	Cyprus	AEL	2018	4	4	4

[27] In view of the consultations with the OWG on Contaminants (UNEP/MAP WG.533/Inf.3, Annex I), data from 2015 onwards were included in the calculation, even if they were used previously, in order to increase the number of data points.
[27] A more detailed table is presented in UNEP/MAP WG.492/Inf.11 (Table 6).

Source	IMAP_File	Country	Subregion	Year	Cd	Hg	Pb
IMAP_IS	224	France	WMS	2016	23	23	23
IMAP_IS	410	Israel	AEL	2019	16	16	16
IMAP_IS	&	Israel	AEL	2020	14	14	14
IMAP_IS	457	Italy	ADR	2015	29	18	29
IMAP_IS	457	Italy	ADR	2016	90	70	95
IMAP_IS	469	Italy	WMS	2016	98	56	98
IMAP_IS	457	Italy	ADR	2017	74	60	79
IMAP_IS	469	Italy	WMS	2017	55	50	42
IMAP_IS	469	Italy	WMS	2018	98	94	88
IMAP_IS	469	Italy	WMS	2019	55	42	53
IMAP_IS	118	Lebanon	AEL	2019	17	7	17
IMAP_IS	489	Malta	CEN	2017	12	12	12
IMAP_IS	489	Malta	CEN	2018	10	10	10
IMAP_IS	&	Montenegro	ADR	2019	12	12	12
IMAP_IS	&	Montenegro	ADR	2019	17	17	17
IMAP_IS	&	Montenegro	ADR	2020	12	12	12
IMAP_IS	243	Morocco	WMS	2015	11	0	11
IMAP_IS	243	Morocco	WMS	2016	11	0	11
IMAP_IS	243	Morocco	WMS	2017	11	11	11
IMAP_IS	243	Morocco	WMS	2018	11	11	11
IMAP_IS	204	Slovenia	ADR	2019	1	1	1
IMAP_IS	445	Turkey	AEL	2018	33	33	33
IMAP_IS	446	Turkey	AEL	2018	32	32	32
MEDPOL		Israel	AEL	2015	20	20	19
MEDPOL		Israel	AEL	2017	14	14	14
MEDPOL		Montenegro	ADR	2016	5	5	5
MEDPOL		Montenegro	ADR	2017	15	15	15
MEDPOL		Montenegro	ADR	2018	6	6	6
MEDPOL		Tunisia	CEN	2014	9	9	9
MEDPOL		Turkey	AEL	2015	21	21	21
EMODNet		Croatia	ADR	2017	37	37	37
EMODNet		France	WMS	2016	27	27	27
EMODNet		Italy	ADR	2015	1	2	2
EMODNet		Italy	ADR	2016	1	2	2
EMODNet		Italy	ADR	2017	0	1	1
Literature[1]		Lebanon	AEL	2017	2	3	3
Literature[2]		Greece	AEL	2016	0	0	14

Source	IMAP_File	Country	Subregion	Year	Cd	Hg	Pb
Literature[2]		Greece	AEL	2017	0	0	73
Literature[2]		Greece	AEL	2018	0	0	28
Total number of data points					**958**	**821**	**1061**
Total number of data points below LOD or LOQ					**188**	**135**	**71**

&Reported to MEDPOL, to be added to IMAP_IS, [1]Ghosn et al., 2020b, [2]Karageorgis et al., 2020

B. BIOTA

Source	IMAP file	Country	Subregion	Year	Species	Cd	Hg	Pb
IMAP-IS	&	Croatia	ADR	2019	MG	19	19	19
IMAP-IS	&	Croatia	ADR	2020	MG	18	16	18
IMAP-IS	495	France	WMS	2018	MG	23	23	23
IMAP-IS	460	Italy	ADR	2016	MG	8	15	8
IMAP-IS	494	Italy	WMS	2016	MG	0	12	0
IMAP-IS	460	Italy	ADR	2017	MG	10	18	10
IMAP-IS	494	Italy	WMS	2017	MG	0	23	0
IMAP-IS	460	Italy	ADR	2018	MG	8	19	8
IMAP-IS	494	Italy	WMS	2018	MG	0	15	0
IMAP-IS	460	Italy	ADR	2019	MG	0	7	0
IMAP-IS	&	Montenegro	ADR	2019	MG	10	10	10
IMAP-IS	&	Montenegro	ADR	2020	MG	10	10	10
IMAP-IS	&	Slovenia	ADR	2018	MG	3	3	3
IMAP_IS	&	Slovenia	ADR	2019	MG	3	3	3
IMAP_IS	439	Slovenia	ADR	2020	MG	3	3	3
MedPol		France	WMS	2015	MG	24	24	24
MedPol		Montenegro	ADR	2018	MG	8	8	8
MedPol		Slovenia	ADR	2016	MG	6	6	0
MedPol		Slovenia	ADR	2017	MG	3	3	3
EMODNet		France	WMS	2017	MG	3	3	3
EMODNet		Italy	ADR	2015	MG	0	6	0
EMODNet		Italy	ADR	2016	MG	0	15	0
EMODNet		Italy	ADR	2017	MG	0	19	0
EMODNet		Italy	ADR	2018	MG	0	2	0
EMODNet		Italy	CEN	2016	MG	0	2	0
EMODNet		Italy	CEN	2017	MG	4	6	4
EMODNet		Italy	WMS	2015	MG	1	1	1
EMODNet		Italy	WMS	2016	MG	0	2	0
EMODNet		Italy	WMS	2017	MG	2	8	2

Source	IMAP file	Country	Subregion	Year	Species	Cd	Hg	Pb
Literature[3]		France	WMS	2014	MG	0	17	0
Total number of data points						**166**	**318**	**160**
Total number of data points below LOD or LOQ						**2**	**36**	**21**
IMAP-IS	**&**	Croatia	ADR	2019	MB	1	0	1
IMAP-IS	**&**	Croatia	ADR	2020	MB	10	10	10
IMAP-IS	351	Israel	AEL	2015	MB	28	28	0
IMAP-IS	71	Israel	AEL	2018	MB	13	13	0
IMAP-IS	410	Israel	AEL	2019	MB	7	7	0
IMAP-IS	153	Lebanon	AEL	2019	MB	14	14	14
IMAP-IS	489	Malta	CEN	2017	MB	3	3	3
IMAP-IS	489	Malta	CEN	2019	MB	2	2	2
IMAP-IS	323	Turkey	AEL	2015	MB	25	25	25
EMODNet		Montenegro	ADR	2018	MB	8	8	8
Total number of data points						**111**	**110**	**63**
Total number of data points below LOD or LOQ						**41**	**0**	**13**

&Reported to MEDPOL, to be added to IMAP_IS, [3]Briant et al., 2017

Table 7. An overview of the data available for PAHs in sediments and biota (*Mytilus galloprovincialis* (MG) and *Mullus barbatus* (MB)) for their use for the preparation of the 2023 MED QSR. The numbers next to the years are the number of observations for each parameter, sorted by source of data, country and sampling year. When available, IMAP-IS file number is given.

A. SEDIMENT

Source	IMAP file no	Country	Sub-region	Year	naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	benzo(b)fluoranthene	benzo(k)fluoranthene	benzo(a)pyrene	benzo(g,h,i)perylene	Dibenzo[a,h]anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
IMAP_IS	&	Albania*	ADR	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IMAP_IS	457	Italy	ADR	2016	51	43	52	52	55	52	52	40	52	52	38	52	52	52	52	52	23
IMAP_IS	457	Italy	ADR	2017	40	27	27	29	29	40	29	24	29	29	30	39	40	40	29	40	14
IMAP_IS	457	Italy	ADR	2018	30	30	30	30	30	30	30	25	30	30	17	30	30	29	30	30	14
IMAP_IS	457	Italy	ADR	2019	16	16	16	16	16	16	0	16	16	16	0	0	0	0	16	0	0
IMAP_IS	469	Italy	WMS	2016	0	0	25	25	0	78	76	25	25	25	49	56	76	75	25	76	0
IMAP_IS	469	Italy	WMS	2017	0	0	0	0	0	39	38	0	0	0	14	14	38	38	0	38	0
IMAP_IS	469	Italy	WMS	2018	0	0	25	25	0	81	75	25	25	12	56	56	74	75	25	75	0
IMAP_IS	469	Italy	WMS	2019	0	0	25	25	0	38	26	25	25	25	28	28	25	25	24	24	0

IMAP_IS	152	Lebanon	AEL	2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
IMAP_IS	489	Malta	CEN	2017	15	0	0	0	0	15	15	0	0	0	0	0	15	0	0	0	0
IMAP_IS	489	Malta	CEN	2018	9	0	0	0	0	10	10	0	0	0	0	0	10	0	0	0	0
IMAP_IS	&	Montenegro	ADR	2019	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
IMAP_IS	&	Montenegro	ADR	2020	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
IMAP_IS	204	Slovenia	ADR	2019	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0
IMAP_IS	445	Turkey*	AEL	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IMAP_IS	446	Turkey*	AEL	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Med Pol		Montenegro	ADR	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Med Pol		Slovenia	ADR	2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Med Pol		Slovenia	ADR	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Med Pol		Slovenia	ADR	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Med Pol		Slovenia	ADR	2016	0	0	0	0	8	0	8	8	8	8	8	7	8	8	2	8	8
EMODNet		France	WMS	2016	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

EMODNet		Italy	ADR	2015	2	0	0	0	0	2	2	0	0	0	2	2	2	2	0	2	1
EMODNet		Italy	ADR	2016	2	0	0	0	0	2	2	0	0	0	2	2	2	2	0	2	2
EMODNet		Italy	ADR	2017	1	0	0	0	0	0	1	0	0	0	1	1	1	1	0	1	1
Lit1		Israel	AEL	2013	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Lit2		Tunisia	CEN	2019	0	5	0	5	5	5	0	5	0	5	0	0	5	0	0	0	5
Total number of data points					**288**	**243**	**322**	**329**	**265**	**531**	**486**	**315**	**332**	**324**	**368**	**410**	**501**	**470**	**325**	**471**	**234**
Total number of data below LOD or LOQ					**101**	**194**	**227**	**152**	**33**	**347**	**162**	**20**	**74**	**46**	**77**	**163**	**236**	**202**	**158**	**207**	**2**

&Reported to MEDPOL, to be added to IMAP_IS, [1] Astrahan et al. 2017, [2] Jebara et al 2021, * data for Total 4 and Total 5 PAHs

B. BIOTA

Source	**IMAP file no**	**Country**	**Sub-region**	**Year**	**naphthalene**	**Acenaphthylene**	**Acenaphthene**	**Fluorene**	**Phenanthrene**	**anthracene**	**fluoranthene**	**Pyrene**	**Benzo[a]anthracene**	**Chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(a)pyrene**	**benzo(g,h,i)perylene**	**Dibenzo[a,h]anthracene**	**indeno(1,2,3-cd)pyrene**	**TOTAL 16 PAHs**
IMAP_IS	**&**	Albania*	ADR	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IMAP_IS	495	France	WMS	2018	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
IMAP_IS	460	Italy	ADR	2016	0	0	0	0	0	0	4	0	7	0	4	4	4	4	0	4	0

IMAP_IS	460	Italy	ADR	2017	0	0	0	0	0	0	11	0	7	0	11	11	11	11	0	11	0
IMAP_IS	494	Italy	WMS	2017	0	0	0	0	0	0	23	0	0	0	0	0	23	0	0	0	0
IMAP_IS	460	Italy	ADR	2018	0	0	0	0	0	0	8	0	0	0	8	8	8	8	0	8	0
IMAP_IS	494	Italy	WMS	2018	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0
IMAP_IS	494	Italy	WMS	2019	0	0	0	0	0	0	5	0	0	0	0	0	5	0	0	0	0
IMAP_IS	&	Montenegro	ADR	2019	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
IMAP_IS	&	Montenegro	ADR	2020	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
IMAP_IS	364	Slovenia*	ADR	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IMAP_IS	204	Slovenia	ADR	2019	0	0	0	0	0	0	0	0	0	0	3	3	3	3	0	3	0
IMAP_IS	439	Slovenia	ADR	2020	0	0	0	0	0	0	0	0	0	0	3	3	3	3	0	3	0
IMAP_IS	277	Spain	WMS	2015	0	0	0	42	42	42	42	42	42	42	42	42	42	42	42	42	0
MedPol		Montenegro	ADR	2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
MedPol		Slovenia	ADR	2016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

EMODNet		France	WMS	2017	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	0
Lit 1		Algeria	WMS	2014	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Total number of data points					**50**	**50**	**50**	**92**	**94**	**94**	**147**	**93**	**108**	**94**	**123**	**123**	**153**	**123**	**94**	**123**	**64**
Total number of data below LOD or LOQ					16	45	41	39	23	38	60	28	30	11	39	41	87	46	75	73	6

&Reported to MEDPOL, to be added to IMAP_IS, [1] Benali et al., 2017, * data for Total 4 or Total 5 PAHs

Table 8. An overview of the data available for organochlorinated contaminants (PCBs and pesticides) in sediments and biota (*Mytilus galloprovincialis* (MG) and *Mullus barbatus* (MB)) for their use for the preparation of the 2023 QSR. The numbers next to the years are the number of observations for each parameter, sorted by source of data, country and sampling year. When available, IMAP-IS file number is given.

A. SEDIMENT

Source	**IMAP file**	**Country**	**Sub-region**	**Year**	**PCB 28**	**PCB 52**	**PCB 101**	**PCB 118**	**PCB 138**	**PCB 153**	**PCB 180**	**Sum 7 PCBs**	**Lindane**	**p,p'-DDE**	**Hexachloro benzene**	**Dieldrin**
IMAP_IS	457	Italy	ADR	2016	55	41	38	39	41	41	41	0	52	0	52	0
IMAP_IS	457	Italy	ADR	2017	41	27	22	22	22	22	27	0	41	0	41	0
IMAP_IS	457	Italy	ADR	2018	30	16	16	16	16	16	16	0	30	0	30	0
IMAP_IS	457	Italy	ADR	2019	0	0	0	0	0	0	0	0	26	0	10	0
IMAP_IS	469	Italy	WMS	2016	25	25	25	25	25	25	25	32	77	0	77	0
IMAP_IS	469	Italy	WMS	2018	25	25	25	25	25	25	25	25	68	0	68	0
IMAP_IS	469	Italy	WMS	2019	0	0	0	0	0	0	0	0	39	0	0	0
IMAP_IS	469	Italy	WMS	2017	0	0	0	0	0	0	0	0	31	0	31	0
IMAP_IS	152	Lebanon	AEL	2019	0	0	0	0	0	0	0	19	0	0	0	0

IMAP_IS	489	Malta	CEN	2017	0	0	0	0	0	0	0	0	0	0	12	0
IMAP_IS	489	Malta	CEN	2018	0	0	0	0	0	0	0	0	0	0	10	0
IMAP_IS	&	Montenegro	ADR	2019	29	29	29	29	29	29	29	29	12	29	29	29
IMAP_IS	&	Montenegro	ADR	2020	12	12	12	12	12	12	12	12	12	12	12	12
IMAP_IS	446	Turkey	AEL	2018	31	31	31	31	31	31	31	31	31	0	0	31
IMAP_IS	445	Turkey	AEL	2018	33	33	33	33	33	33	33	33	33	0	0	33
EMODNet		France	WMS	2016	29	29	29	29	29	29	29	29	29	29	0	0
EMODNet		Italy	ADR	2015	0	0	0	0	0	0	0	0	5	0	4	0
Literature[1]		Tunisia	CEN	2019	5	5	0	5	5	5	5	5	0	4	0	5
Total number of data points					**315**	**273**	**260**	**266**	**268**	**268**	**273**	**215**	**486**	**75**	**376**	**110**
Total number of data below LOD or LOQ					**108**	**55**	**68**	**35**	**72**	**38**	**81**	**22**	**388**	**42**	**256**	**105**

&Reported to MEDPOL, to be added to IMAP_IS, [1] Jebara et al., 2021

B. BIOTA

Source	**IMAP file**	**Country**	**Sub-region**	**Year**	**PCB 28**	**PCB 52**	**PCB 101**	**PCB 118**	**PCB 138**	**PCB 153**	**PCB 180**	**Sum 7 PCBs**	**Lindane**	**p,p'-DDE**	**Hexachloro benzene**	**Dieldrin**
IMAP_IS	&	Croatia	ADR	2019	19	19	19	19	19	19	19	19	0	0	0	0
IMAP_IS	495	France	WMS	2018	23	23	23	0	23	23	23	0	23	0	23	23
IMAP_IS	460	Italy	ADR	2016	0	8	0	0	8	8	0	0	8	0	15	0
IMAP_IS	460	Italy	ADR	2017	0	10	0	0	10	10	0	0	10	0	18	0
IMAP_IS	460	Italy	ADR	2018	0	7	0	0	12	12	0	0	12	0	16	0
IMAP_IS	460	Italy	ADR	2019	0	0	0	0	0	0	0	0	0	0	7	0
IMAP_IS	494	Italy	WMS	2016	0	0	0	0	0	0	0	0	0	0	12	0
IMAP_IS	494	Italy	WMS	2017	0	0	0	0	0	0	0	0	0	0	23	0
IMAP_IS	494	Italy	WMS	2018	0	0	0	0	0	0	0	0	0	0	13	0

IMAP_IS	494	Italy	WMS	2019	0	0	0	0	0	0	0	0	0	0	2	0
IMAP_IS	**&**	Montenegro	ADR	2020	10	10	10	10	10	10	10	10	0	0	0	0
IMAP_IS	**&**	Montenegro	ADR	2019	11	11	11	11	11	11	11	11	0	0	0	0
IMAP_IS	277	Spain	WMS	2015	14	14	14	14	14	14	14	14	14	14	14	14
Literature[1]		Algeria	WMS	2014	6	6	6	6	6	6	6	6	0	0	0	0
Total number of data points					**83**	**108**	**83**	**60**	**113**	**113**	**83**	**60**	**67**	**14**	**143**	**37**
Total number of data below LOD or LOQ					29	31	13	14	5	4	26	4	62	0	107	29

&Reported to MEDPOL, to be added to IMAP_IS, [1] Benali et al., 2017

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

Data from EMODnet used to complement data available in IMAP Pilot Info System and MEDPOL Database are summarized in Tables 6-8. Some of the data previously available only from EMODNet were now available in IMAP-IS and were used as reported there.

3.3 Data from the scientific literature

Below Table 9 lists the available scientific papers examined for possible use in the preparation of this updated 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. Considering literature sources recommended from the members of OWG on Contaminants, detailed elaboration of relevant scientific literature is provided in Annex II.

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*	
Croatia	2014	S	Total PAH	Statistics	(Mandić et al. 2018)
Eastern Adriatic	2014, 2016	B (MB)	Hg	Statistics	(Sulimanec Grgec et al. 2020)
Egypt	ng	S	Cd, Pb	range	(El Baz and Khalil 2018)
France	2004	S (core)	PAH	Data*	Tronczyński et al. (2008)
France	2006	S (core)	Hg, Pb	Data*	(Elbaz-Poulichet et al. 2011)
France	2014	B (MG)	Hg	Data*	(Briant et al. 2017)
Greece	2016-2018	S	Pb	Data*	(Karageorgis et al. 2020)
Israel	2014	S (deep sea)	PAH	Data*	(Astrahan et al. 2017)
Italy	2012	B (Fish)	Hg	Data**	(Bonsignore et al. 2015)
Italy	2013,2017	S, B (MG, MB)	Hg, PAH, PCB	Data**	(Traina et al. 2021)
Italy	2015	B (MB)	Cd, Hg, Pb	Statistics	(Traina et al. 2019)
Italy	2016	B (MB)	PAH	Statistics	(Frapiccini et al. 2020)
Italy	2016	B (MG)	Cd, Hg, Pb	Statistics	(Cammilleri et al. 2020)
Italy	2008-2018	B (MG)	Cd, Pb	Statistics	(Tavoloni et al. 2021)
Italy	2016-2019	B (MG)	Cd, Hg, Pb, PAH, PCB	Statistics	(Esposito et al. 2020)
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)
Lebanon	2007	S (core)	Hg, Pb, PAH	Data*	(Azoury et al. 2013)
Libya	ng	B (MB)	Cd, Hg, Pb	Statistics	(Al-Kazaghly et al. 2021)
Mediterranean	1980-2019	S	PAH	Statistics	(Rizzi et al. 2021)
Morocco	2016	B (MG)	Cd, Pb	Statistics	(Azizi et al. 2016)
Morocco	2018	B (MG)	Cd	Statistics	(Azizi et al. 2021)
Spain[28]	2011,2012, 2015	S	Cd, Hg, Pb	BC	(Martínez-Guijarro et al. 2019)
Spain	1993-2013	B (MG)	Cd, Hg, Pb	Statistics	(Santos-Echeandía et al. 2021)
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)
Turkey	2016-2017	S	PAH	Data**	(Kucuksezgin et al. 2020)
		B (MG)	PAH	Data**	

S-Sediment, B-Biota, MG- *Mytilus galloprovincialis*, MB – *Mullus barbatus*, ng- not given; *- data used for present update of BC/BAC values; **- data not used since they were related to polluted sites

[28] See also Campillo et al., 2017 and Leon et al.,2020, in Annex II.

3.4 Examination of the new data

The new data available were examined and used for BCs and BACs 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.

The additional data available since the original document was finalized in April 4th 2021 improved the calculation. However, data were still 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.

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 Annex III.

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

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

The new data presented and critically analyzed above in Section 3 and Annex III 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). The calculation was performed using also the limit of detection (LOD) or the limit of quantitation (LOQ) values provided by the countries (see Annexes I and III), addressed as below detection limit (bdl) values. In a separate technical paper, prepared by MEDPOL in consultations with OWG, it was recommended to incorporate into the BC calculations the bdl values and not to exclude them. Exclusion of the bdl concentrations might artificially increase the calculated BC value (see Annex I)29. The bdl values for a specific contaminant in a specific matrix were different, depending on the country and even different for the same country (see Annex III), at time encompassing a wide range.

BAC values for trace metals 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), following methodology as explained above in section 2.3.1. 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.

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 available for upgrade of the criteria in present document marked with 2022). The table shows also the values as calculated in 2021 and presented to the Meeting of CorMon on Pollution Monitoring (26-28 April 2021) (marked 2021). Concentrations are given in μg/kg dry wt, as requested by IMAP. The

[29] In a separate technical paper, prepared by MEDPOL in consultations with OWG, it was suggested to " Replace BDL values with a fraction of the reported value. The fraction could be 1 (BDL value), 0.5 (BDL/2), 0.7 (BDL/SQRT(2)), other" and not exclude bdls in BC calculation. The decision to replace BDL with the reported value or a fraction of it should be based on the available data and expert evaluation. Italy, Spain and France supported the use of LOD/2 or LOQ/2 in the BCs calculation. Israel pointed out that the US- EPA suggests this only when less than 15% of the data is BDLs (Annex I). For this document, the calculation was performed with the reported value and not half of it. This is because the wide range of bdl values for a specific contaminant in a specific matrix, depending on the country and even within the country.

number of data points (n) taken to calculate the BCs appear below the values. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

BCs							
TM	Med (cores)	Med (surf)	MED	WMS	ADR	CEN	AEL
	2011[30]		**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*
Proposed new updated BC values (2022)							
Cd			107	140	120	#	78.9
n			*803*	*351*	*300*	*31*	*158*
Hg			50.0	90.0	50.0	#	31.5
n			641	241	218	24	147
Pb			15000	16000	15700	1805	15674
n			*927*	*318*	*325*	*29*	*272*
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			174	173	249		169
Hg			48.9	37.5	81.2		75.5
Pb			23850	18000	40599		26550
Proposed new updated BAC values (2022)							
Cd			161	210	180	#	118
Hg			75.0	135	75.0	#	47.3
Pb			22500	24000	23550	2708	23511

#All data points for Cd are bdl as well as 72% of the Hg data points.

It can be seen that the proposed new updated regional Mediterranean BC value for Cd is similar to the one calculated in 2011 from sediment cores while value for Hg is higher and 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 similar and Pb slightly lower. Comparison of the sub-regional BC values calculated in 2019 and 2022 shows differences as well, in particular Pb for the AEL sub-region. However, the BC for Pb at the AEL is similar to those calculated for the WMS and ADR. Possible reasons for these differences could be due to different sediment mineralogical composition and the location of the sampling stations, as well as the number of data points used in the calculation. It was possible to calculate BC for Pb at the CEN sub-region in 2022, however with only 29 data points (see Table 10).

Comparison of the new updated BC values among the sub-region showed that for Cd and Hg, the concentrations were higher in the WMS, followed by ADR and then AEL. Pb concentrations were similar. The number of data points among the sub-regions taken for the calculation were similar for the WMS and the ADR sub-regions, and lower for the AEL (ca. half the number of data points for Cd and

[30] 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.

Hg). The BC value for Pb in CEN was about one order of magnitude lower than the BCs calculated for the other sub-regions and should be re-examined when additional data will be available.

Table 11A . BC and BAC values for PAHs in sediments, calculated from the new data available up to February 2021 and presented to the Meeting of CorMon on Pollution Monitoring (26-28 April 2021) (marked 2021). 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[31]	*n*	WMS	n	ADR[32]	*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			0.4	*5*
Acenaphthene	0.38	0.45	4.7	*29*	4.7	29				
Fluorene	0.75	0.33	6.9	*34*	7.5	29			0.4	*5*
Phenanthrene	4.55	3.95	13.0	*42*	22.5	29	11.5	*8*	0.8	*5*
Anthracene	0.8	1.56	3.6	*41*	5.0	29	2.0	*5*	0.7	*7*
Fluoranthene	5.6	6.7	27.8	*44*	32.2	29	23.0	*13*	2.0	*2*
Pyrene	10.28	2.1	18.8	*42*	22.4	29	22.0	*8*	0.4	*5*
Benzo[a]anthracene	3.45	1.28	19.7	*37*	20.9	29	13.5	*8*		
Chrysene	1.3	6.64	21.4	*42*	37.6	29	11.0	*8*	1.6	*5*
Benzo(b)fluoranthene	1.1	8.32	12.8	*44*	9.3	29	18.0	*13*	50	*2*
Benzo(k)fluoranthene	0.53	6.03	7.8	*43*	7.8	29	7.0	*12*	27	*2*
Benzo[a]pyrene	2.55	3.71	2.6	*49*	2.6	29	15.0	*13*	1.8	*7*
Benzo[g,h,i]perylene	1.25	3.25	6.9	*44*	5.0	29	15.0	*13*	100	*2*
Dibenz[a,h]anthracene	0.18	1.37	0	*31*	0	29	5.5	*2*		
Indeno[1,2,3-c,d]pyrene	1.7	4.49	1.0	*44*	0	29	12.0	*13*	2.0	*2*
Total PAHs			165	*62*	166	29	218	*32*	6.6	*7*
			Proposed new updated BAC values (2021)							
PAH compounds	[33]		Med		WMS		ADR		CEN	
Naphthalene			12		13		3		3.8	
Acenaphthylene			0.6		0				0.6	
Acenaphthene			7.1		7.1				0	
Fluorene			10.4		11				0.6	
Phenanthrene			19.5		34		17.3		1.2	
Anthracene			5.4		7.5		3.0		1.1	
Fluoranthene			41.7		48		34.5		3	
Pyrene			28.2		34		33.0		0.6	
Benzo[a]anthracene			29.6		31		20.3		0	
Chrysene			32.1		56		16.5		2.4	
Benzo(b)fluoranthene			19.2		14		27.0		75	
Benzo(k)fluoranthene			11.7		12		10.5		41	
Benzo[a]pyrene			3.9		3.9		22.5		2.7	
Benzo[g,h,i]perylene			10		7.5		22.5		150	
Dibenz [a,h]anthracene			0		0		8.3		0	
Indeno[1,2,3-c,d]pyrene			1.5		0		18.0		3	
Total PAHs			248		249		327		9.9	

Table 11B. BC and BAC values for PAHs in sediments, calculated from data available for upgrade of the criteria in present document (marked with 2022). 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 *(inclined)*. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

[31] Corrected due to an error in alignment of compounds in column that affected the median calculation.
[32] Corrected due to an error in alignment of compounds in column that affected the median calculation
[33] By mistake the BACs for mussel *M. galloprovincialis* were included in the column for PAHs in sediments

PAH compounds	UNEP/MAP (2011)		Proposed new updated BC values (2022)									
	BC, Sed cores	BC, Sur sed	MED	*n*	WMS	*n*	ADR	*n*	CEN	*n*	AEL	*n*
Naphthalene	4		2.00	*217*	8.0	*24*	2.0	*165*	#	22	2.3	*49*
Acenaphthylene	0.5	1.05	(1.0)#	*208*	#	*25*	#	*132*	0.4	5	#	*52*
Acenaphthene	0.38	0.45	(2.0)#	*278*	#	*70*	#	*139*		*0*	#	*52*
Fluorene	0.75	0.33	(2.0)#	*270*	#	*88*	#	*139*	0.4	5	#	*41*
Phenanthrene	4.55	3.95	3.10	*212*	14.9	*25*	3.5	*155*	0.8	5	3.1	*48*
Anthracene	0.8	1.56	(2.2)#	*452*	#	*212*	#	*140*	#	28	#	*35*
Fluoranthene	5.6	6.7	5.00	*357*	#	*204*	7.0	*143*	0.1	23	2.7	*47*
Pyrene	10.28	2.1	6.20	*239*	24.8	*88*	8.0	*132*	0.4	5	3.0	*43*
Benzo[a]anthracene	3.45	1.28	3.38	*262*	19.7	*87*	4.1	*155*		*0*	1.8	*50*
Chrysene	1.3	6.64	2.70	*244*	35.9	*75*	4.6	*156*	1.6	5	1.6	*49*
Benzo(b)fluoranthene	1.1	8.32	5.00	*292*	8.7	*144*	15.0	*121*		*0*	2.6	*50*
Benzo(k)fluoranthene	0.53	6.03	4.00	*335*	#	*147*	3.0	*153*		*0*	#	*46*
Benzo[a]pyrene	2.55	3.71	(4.0)#	*397*	#	*201*	4.0	*154*	#	28	1.0	*48*
Benzo[g,h,i]perylene	1.25	3.25	(4.2)#	*370*	#	*205*	5.7	*155*		*0*	1.8	*49*
Dibenz[a,h]anthracene	0.18	1.37	(1.0)#	*246*	7.0	*89*	#	*143*		*0*	#	*50*
Indeno[1,2,3-c,d]pyrene	1.7	4.49	(4.0)#	*384*	#	*201*	4.4	*155*		*0*	2.1	*51*
Total PAHs			27.4	*178*	160	*26*	41.0	*107*	6.3	5	21.4	*60*
			Proposed new updated BAC values (2022)									
PAH compounds			MED		WMS		ADR		CEN		AEL	
Naphthalene			3.0		12.0		3.0		#		3.5	
Acenaphthylene			(1.5)#		#		#		0.6		#	
Acenaphthene			(3.0)#		#		#				#	
Fluorene			(3.0)#		#		#		0.5		#	
Phenanthrene			4.7		22.4		5.3		1.2		4.7	
Anthracene			(3.3)#		#		#		#		#	
Fluoranthene			7.5		#		10.5		0.2		4.1	
Pyrene			9.3		37.1		12.0		0.6		4.5	
Benzo[a]anthracene			5.1		29.6		6.2				2.7	
Chrysene			4.0		53.9		6.9		2.4		2.4	
Benzo(b)fluoranthene			7.5		13.0		22.5				3.8	
Benzo(k)fluoranthene			6.0		#		4.5				#	
Benzo[a]pyrene			(6.0)#		#		6.0		#		1.5	
Benzo[g,h,i]perylene			(6.3)#		#		8.6				2.7	
Dibenz [a,h]anthracene			(1.5)#		10.5		#				#	
Indeno[1,2,3-c,d]pyrene			(6.0)#		15.0		6.5				3.2	
Total PAHs			41.0		240		61.5		9.5		32.0	

#most data (>50%) below detection limit

The additional data reported by the CPs in the IMAP-IS improved the calculation of the BCs for PAHs in sediments (Table 11). The number of data points used for calculation of BC for the whole Mediterranean increased by 7 times, while for WMS, ADR and CEN by 3-20 times on average. It was possible to calculate new proposed BCs also for the AEL sub-region due to new data as available until February 2021. However, BC for the sub-regions were calculated only when less than 50% of the data points were below the detection, to prevent bias due to different detection limits among countries (see Annex III). The calculated BC values for the whole Mediterranean for most of the compounds were higher than the BC concentrations measured in sediment cores and surficial sediments of the Mediterranean Sea in 2011, while for a few compounds they were similar or lower. However, for 8 compounds, the Mediterranean BC values were calculated with more than 50% values BDL. This could be the one of the reasons for the differences. The BC values calculated for the WMS sub-region were higher than those calculated for the whole Mediterranean. The calculated values for the ADR were lower than for the WMS, and higher or similar to the values of the Mediterranean while for the AEL the values were lower. The lowest values were calculated for the CEN, however the number of data points was low and not representative.

The calculation of the multiplication factor to calculate BACs for PAHs in sediments was not provided in the previous UNEP/MAP documents (2011, 2016, 2019). Looking at the OSPAR values for BC and BAC for PAHs in the sediments, the multiplication factor used depended on the compound and ranged from 1.6 to 2.1. In this document, it is proposed to use the multiplication factor of 1.5, as for trace metals in sediments, based on the relatively higher values of BCs for PAHs in sediments calculated here, in comparison to the BCs calculated in 2011. The proposed BACs are presented in Table 11.

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[34]. Moreover, it is recommended to add the concentration of Total[35] (16) PAHs to the list of parameters in addition to reporting of the concentrations of individual 16 PAHs.

Table 12. BC and BAC values for trace metals in mussel (*M. galloprovincialis*) and in fish (*M. barbatus*)[36] calculated from data available for upgrade of the criteria in present document marked with 2022). The table shows also the values as calculated in 2021 and presented to the Meeting of CorMon on Pollution Monitoring (26-28 April 2021) (marked 2021) and values as calculated in 2019 and presented to the Meeting of CorMon on Pollution Monitoring (21-22 April 2019) (marked 2019). . 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
		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*	
		Proposed new updated BC values (2022)				
Cd		710	1030	629	78	>
N		*165*	*53*	*108*	*4*	
Hg		77.9	85.0	75.4	12	>
N		*300*	*121*	*168*	*8*	
Pb		1100	1260	1000	#	>
N		148	51	94	4	
BACs						
TM	**Med**	**MED**	**WMS**	**ADR**	**CEN**	**AEL**

[34] The values for a few of the compounds in Table 11 are 0, meaning that the concentrations measured were BD; Section 4.1 addresses the topic of BDL concentrations.
[35] In addition to Total PAH (16 compounds), UNEP/MAP DD cites the following Total PAHs from the EEA reference list of contaminants: Total PAHs (4 PAHs: Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) (EEA_33-62-5); Total PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene) (EEA_33-56-7); Total Benzo(b)fluoranthene + Benzo(k)fluoranthene (EEA_32-23-5) and Total Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene (CAS_193-39-5) (EEA_32-24-6.
[36] Data for species other than the mandatory species are presented in Annex IV.

BCs						
TM		**MED**	**WMS**	**ADR**	**CEN**	**AEL**
	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	>
Proposed new updated BAC values (2022)						
Cd		1065	1545	944	117	
Hg		117	128	113	18.4	
Pb		1650	1890	1500	#	

BCs						
TM		MED	WMS	ADR	CEN	AEL
Fish muscle (*Mullus barbatus*) µg/kg wet wt, calculated in 2019						
Cd		*3.7				
Hg		50.6	68	150.5		44.6
Pb		*31	38			20
Proposed new updated BC values (2022)						
Cd		3.9		5.3		3.6
N		*98*		*19*		*87*
Hg		40.6		120		33.7
N		*97*		*18*		*81*
Pb		18.3		40.8		13.5
N		*58*		*19*		*39*
BACs						
	MED	MED	WMS	ADR	CEN	AEL
	IG.23/6 (2017)	**2019**				
Cd	*3.7#	#3.7				
Hg	101.2#	101.2	136	301		89.2
Pb	*31#	#31	76			40
Proposed new updated BAC values (2022)						
Cd		7.8		10.6		7.2
Hg		81.2		240		67.4
Pb		36.6		81.6		27.0

*MedBAC in Decision IG.23/6; # Most values BDL; > it is recommended to use the values calculated in 2019.

The regional MedBC values for Hg and Pb in *M. galloprovincialis* calculated in 2022 were lower than those calculated in 2019, while Cd BCs were similar. The sub-regional BCs for the WMS and the ADR were also different: WMS BC for Cd was higher and Hg and Pb lower in 2022 compared to 2019. In the Adriatic the BC concentrations were lower in 2022 than in 2019. In 2019 the values in the ADR were higher than in the WMS while in 2022 they were lower. The differences in the Adriatic could be due to different locations of the sampling stations and to a temporal decrease. A few data points (4 for Cd and 8 for Hg with 4 Pb, all BDL) were available for the CEN. The calculated BCs were lower than in the other sub-regions, however, the few data is not representative of the CEN. Since new data were not available in the AEL to update BC/BAC values for *M. galloprovincialis*, it is recommended to use the values calculated in 2019.

The main data for trace metals in muscle of *M. barbatus* originated from the AEL sub-region, therefore the comparison for all sub-regions between 2019 and 2022 values were limited. The regional MedBC values for Cd and Hg in the muscle of the fish *M. barbatus* calculated in 2022 were similar to the ones calculated in 2019, while Pb was lower in 2022. The concentrations in the AEL in 2022 were slightly lower than for the whole Mediterranean, while in the ADR the concentrations were higher than in the Mediterranean, in particular Hg and Pb. The concentrations in the ADR were also much higher than in the AEL. Comparison to 2019 showed that in the ADR Hg was lower in 2022 and in the AEL, Hg and Pb were lower in 2022. There were 5 data points available for the CEN, however Cd and Pb were all bdl while the median Hg concentration was 152 µg/kg wet wt, much higher than in the other sub-regions.

Given the lack of data for the CEN, it was not possible to propose values for BC in this sub-region, therefore it is suggested to use the regional MED BC values for GES assessment.

The mussel *M. galloprovincialis* 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 Annex IV. It should be noted that within the framework the concentrations measured are specific to each species and comparison should be made within the same species (see Section 2) and the same tissue. It may be useful to consider in the future an upgrade of IMAP in order to include larger number of species.

The reporting of new data from CPs to the IMAP-IS allowed for the calculation of new proposed BC and BAC values for PAHs in the mussel *M. galloprovincialis* (Table 13). The calculated BC values for the whole Mediterranean for some of the compounds were higher than the BC concentrations calculated in 2019, while for others they were similar or lower. As for sediments, data with bdl values were taken in the calculation of the new proposed BCs (see Annex I). The bdl values were different, depending on the country and even different within the same country. Moreover, bdls values constituted 12-90% of the data points depending on the compound (see Annex III). This could be the one reason for the differences.

Table 13. BC and BAC values for PAHs in the mussel *M. galloprovincialis*, calculated from data available for upgrade of the criteria in present document (marked with 2022). The table shows also the values as calculated in 2019 and presented to the Meeting of CorMon on Pollution Monitoring (21-22 April 2019) (marked 2019). 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 CEN and AEL sub-regions. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

UNEP/MAP (2019) BC								
PAH compounds		MED		WMS		ADR		AEL
Naphthalene		(2.4)#		2.24				2.80
Acenaphthylene		(0.6)#						
Acenaphthene		(0.6)#						
Fluorene		1.0		0.96		1.07		0.60
Phenanthrene		7.1		4.93		9.04		7.55
Anthracene		0.5		0.52		0.38		0.30
Fluoranthene		3.0		3.38		2.03		6.60
Pyrene		2.0		3.02		0.85		5.90
Benzo[a]anthracene		0.8		1.20		0.53		1.60
Chrysene		1.0		1.24		0.27		5.20
Benzo(b)fluoranthene								
Benzo(k)fluoranthene		0.6		1.27		0.29		1.50
Benzo[a]pyrene		0.5		0.60		0.32		0.70
Benzo[g,h,i]perylene		0.9		0.90				1.20
Dibenz[a,h]anthracene		0.5		0.53				
Indeno[1,2,3-c,d]pyrene		1.2		1.23				0.90
Proposed new updated BC values (2022)								
		MED	*n*	WMS	*n*	ADR	*n*	
Naphthalene		0.56	*40*	0.52	*20*	#	*17*	
Acenaphthylene		(0.05)#	*39*	#	*20*	#	*21*	
Acenaphthene		(0.50)#	*49*	#	*23*	#	*21*	

Fluorene		2.50	*88*	7.87	*68*	#	*21*	
Phenanthrene		5.35	*87*	19.9	*68*	2.25	*19*	
Anthracene		1.12	*87*	0.94	*65*	#	*21*	
Fluoranthene		4.83	*130*	10.0	*86*	#	*23*	
Pyrene		2.50	*76*	5.54	*62*	#	*18*	
Benzo[a]anthracene		0.60	*90*	0.69	*56*	#	*35*	
Chrysene		2.54	*72*	2.98	*54*	#	*19*	
Benzo(b)fluoranthene		1.00	*106*	1.36	*56*	#	*39*	
Benzo(k)fluoranthene		1.00	*107*	0.73	*57*	#	*40*	
Benzo[a]pyrene		(1.00)$^{\#}$	*134*	0.94	*80*	#	*40*	
Benzo[g,h,i]perylene		1.00	*107*	0.67	*59*	#	*39*	
Dibenz[a,h]anthracene		(0.10)$^{\#}$	*82*	#	*55*	#	*21*	
Indeno[1,2,3-c,d]pyrene		(0.63)$^{\#}$	*111*	0.29	*51*	#	*40*	
Total 16 PAHs[37]		5.80	*48*	5.60	*19*	6.60	*25*	
UNEP/MAP (2019) BAC								
	MedBAC IG.23/6	MED		WMS		ADR		AEL
Naphthalene		(3.6)$^{\#}$		3.4				4.2
Acenaphthylene		(0.9)$^{\#}$						
Acenaphthene		(0.9)$^{\#}$						
Fluorene	2.5	1.5		1.4		1.6		0.9
Phenanthrene	17.8	10.7		7.4		13.6		11.3
Anthracene	1.2	0.8		0.8		0.6		0.5
Fluoranthene	7.4	4.5		5.1		3.0		9.9
Pyrene	5.0	3.0		4.5		1.3		8.9
Benzo[a]anthracene	1.9	1.2		1.8		0.8		2.4
Chrysene	2.4	1.5		1.9		0.4		7.8
Benzo(b)fluoranthene								
Benzo(k)fluoranthene	1.4	0.9		1.9		0.4		2.3
Benzo[a]pyrene	1.2	0.8		0.9		0.5		1.1
Benzo[g,h,i]perylene	2.3	1.4		1.4				1.8
Dibenz[a,h]anthracene	1.3	0.8		0.8				
Indeno[1,2,3-c,d]pyrene	2.9	1.8		1.8				1.4
Proposed new updated BAC values (2022)								
		MED		WMS		ADR		
Naphthalene		0.84		0.79		#		
Acenaphthylene		(0.08)$^{\#}$		#		#		
Acenaphthene		(0.75)$^{\#}$		#		#		
Fluorene		3.75		11.8		#		
Phenanthrene		8.03		29.8		3.38		
Anthracene		1.68		1.40		#		
Fluoranthene		7.25		15.0		#		
Pyrene		3.75		8.31		#		
Benzo[a]anthracene		0.90		1.04		#		
Chrysene		3.81		4.46		#		
Benzo(b)fluoranthene		1.50		2.04		#		
Benzo(k)fluoranthene		1.50		1.09		#		
Benzo[a]pyrene		(1.50)$^{\#}$		1.42		#		
Benzo[g,h,i]perylene		1.50		1.01		#		
Dibenz[a,h]anthracene		(0.14)$^{\#}$		#		#		
Indeno[1,2,3-c,d]pyrene		(0.94)$^{\#}$		0.43		#		
Total 16 PAHs[38]		8.70		8.40		9.90		

[37] Data dictionary gives 2 additional categories: Total 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Total 5 PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene). It is suggested that they be considered for use in the future data reporting..

[38] Data dictionary gives 2 additional categories: Total 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Total 5 PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene). They may be considered in the future.

#most data (>50%) below detection limit,

The reporting of new data from CPs to the IMAP-IS also allowed for the calculation of BCs for organochlorinated contaminants (PCBs and pesticides) in sediments and in *M. galloprovincialis* (Table 14). BCs for organochlorinated contaminants were not calculated in 2011, nor in 2016 or in 2019. Most of the data for the organochlorinated contaminants were below detection limit (see annex III), therefore the proposed BCs should be re-examined when more data became available.

Table 14. BC values for Organochlorinated contaminants (PCBs and pesticides) in sediments and in the mussel *M. galloprovincialis*, calculated from data available for upgrade of the criteria in present document (marked with 2022).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. For sediments, very limited data were available for the CEN sub-region while for biota, no data were available for the CEN and AEL sub-regions. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

Proposed BC values (2022)										
SEDIMENT	MED	*n*	WMS	*n*	ADR	n	CEN	n	AEL	n
PCBs										
PCB28	0.10	*271*	#	*74*		*137*	#	5	0.09	*57*
PCB52	0.07	*243*	0.10	*69*	0.09	*112*	#	5	0.04	*60*
PCB101	0.10	*227*	0.16	*68*	0.16	*101*		0		*55*
PCB118	0.10	*222*	0.46	*61*	0.18	*105*	#	5	0.01	*55*
PCB138	0.11	*233*	0.26	*66*	0.24	*105*	#	5		*54*
PCB153	0.14	*226*	0.40	*69*	0.28	*102*	#	5	0.02	*54*
PCB180	0.09	*236*	0.13	*67*	0.13	*108*	#	5		*55*
Sum 7 PCBs	0.40	*179*	1.60	*71*	0.21	*31*	#	5	0.19	*68*
Pesticides										
γ-HCH (Lindane)	(0.1)#	*474*	#	*242*	#	*168*		0	0.02	*64*
DDE(p,p’)	(0.1)#	*64*	0.23	*26*	#	*35*	#	5		*0*
Hexachlorobenzene	(0.1)#	*325*	#	*156*	#	*155*	#	22		*0*
Dieldrin	(0)#	*105*		*0*	#	*41*	#	5	#	*64*
BIOTA - MG	MED	*n*	WMS	*n*	ADR	*n*	CEN	n	AEL	n
PCBs										
PCB28	0.20	*66*	0.07	*43*	1.38	*40*				
PCB52	0.38	*102*	0.3	*43*	0.5	*65*				
PCB101	1.20	*76*	1.1	*43*	1.4	*40*				
PCB118	1.23	*56*	1.5	*20*	1.4	*40*				
PCB138	2.31	*102*	2.4	*43*	3.3	*70*				
PCB153	3.45	*104*	4.6	*43*	4.6	*70*				
PCB180	0.50	*73*	0.3	*43*	0.5	*40*				
Sum 7 PCBs	18.4	*58*	28.6	*20*	17.3	*40*				
Pesticides										
γ-HCH (Lindane)	(1.0)#	*67*	#	*37*	#	*30*				
DDE(p,p’)	3.05	*11*	3.05	*11*		*0*				
Hexachlorobenzene	(0.5)#	*135*	#	*87*	#	*56*				
Dieldrin	(1.0)#	*35*	#	*37*		*0*				

most data (>50%) below detection limit

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. Cd and Hg in sediments, Cd in *M. galloprovincialis*, sum of PAHs in sediments), to consider using the sub-regional Mediterranean Sea assessment criteria.
- A statistical treatment of BDL has been recommended by OWG on Contaminants as explained above in this section 4.1 and Annex I. 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. In this document, the calculations were performed with the bdl values as reported by the countries.
- 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, 2019, 2021 and 2022. 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), as requested for mandatory data reporting regarding CI 17 to IMAP-IS, analytical methodology, normalization, temporal trends. The reporting of the new data to IMAP-IS up to 31 December 2021, improved the recalculation of the upgraded BCs that was presented in 2021.
- The reporting of new data to IMAP-IS made it possible to calculate BCs for PAHs in biota, and organochlorinated contaminants in sediment and biota, that was not possible in the previous UNEP/MAP documents from 2016 and 2019 and in 2021. However, many of the data points are bdl and more data need to be reported to improve the recalculation the BCs. Before new data availability will allow their recalculation, present re-calculated values remain valid for preparing assessment inputs for the 2023 MED QSR.

4.2 An upgraded approach for updating EAC values for IMAP CI 17 and CI 18

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.

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 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. Briefly, those include but are not limited to sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP) and field and mesocosm studies. Laboratory results on biomarkers (CI18) are also important for the derivation of the EACs values. 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.

The EU Guidance 27 provides a detailed procedure on how to derive Environmental Quality Standards (EQS) to achieve good surface water chemical status. It also addresses the derivation of EQS for benthic biota and sediments and how to back calculate EQS for seawater from them. EQS for biota and sediments are necessary for substances with low water solubility and a tendency to bioaccumulate through the food web. Due to their very low concentrations in water, their analysis is more feasible in biota and sediment matrices.

The WFD (Directive 2008/105/EC and its amendment, 2013/39/EU) aimed to set out EQS concerning the presence in surface water of certain substances or groups of substances identified as priority pollutants because of the significant risk they pose to or via the aquatic environment. These substances include the metals cadmium, lead, mercury and nickel, and their compounds; benzene; polyaromatic hydrocarbons (PAH); and several pesticides. Several of these priority substances are classed as hazardous. These standards are in line with the strategy and objectives of the EU's Water Framework Directive (Directive 2000/60/EC). The key point in the comparison provided in this document is that the EQS are set for the water matrix: inland surface waters (rivers and lakes) and other surface waters (transitional, coastal and territorial waters). There are no EQS for sediments and only for 8 compounds EQS for biota were established. Within UNEP/MAP, the analysis of contaminants in water matrix is encouraged but not mandatory. Moreover, the WFD addresses 45 priority substances (or group of substances), out of which only 11 substances and 2 groups are relevant for CI-17 (See Table 15). However, the member states of EU may opt to establish EQS for sediment and/or biota instead of those laid down for surface water (Article 3 of WFD 2008/105/EC) as long as they offer at least the same level of protection as the water EQS. The directive also presents EQS for biota - 11 substances out of which only 4 are relevant for UNEP/MAP (see Table 15 below). WFD requires the EQS to protect predators and top predators (such as predatory fish, birds and mammals) from risks of secondary poisoning brought about by consuming contaminated prey ($QS_{biota,\ secpois}$)[39].

The conclusion of this analysis is that the Water EQS do not cover all the mandatory contaminants under CI-17, only 11 substances and 2 groups. For biota, there are 4 EQS of relevance for CI-17. Comparison to the Med BACs and EACs as adopted in decisions IG.22/7 and IG.23/6 showed that EQS for fluoranthene is similar to the MedEAC for mussel; EQS for Hg in fish is lower than the MedBAC and EQS for benzo(a)pyrene is higher than MedBAC and much lower than MedEACs for mussel. There are no Med BACs and EACs for hexachlorobenzene in biota.

Table 15. EQS relevant for CI-17 surface water and biota, as provided in Directive 2013/39/EU of 12 August 2013.

No	Name of substance	CAS number	AA-EQS (2) Inland surface waters (3)	AA-EQS (2) Other surface waters	MAC-EQS (4) Inland surface waters (3)	MAC-EQS (4) Other surface waters	EQS Biota (12)
			µg/l	µg/l	µg/l	µg/l	µg/kg ww
2	Anthracene	120-12-7	0,1	0,1	0,1	0,1	
6	Cadmium and its compounds (depending on water hardness classes) (6)	7440-43-9	≤ 0,08 (Class 1) 0,08 (Class 2) 0,09 (Class 3) 0,15 (Class 4) 0,25 (Class 5)	0,2	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)	
9a	Cyclodiene pesticides		Σ = 0,01	Σ = 0,005	not applicable	not applicable	
	Aldrin (7)	309-00-2					
	Dieldrin (7)	60-57-1					
	Endrin (7)	72-20-8					
	Isodrin (7)	465-73-6					
15	Fluoranthene	206-44-0	0,0063	0,0063	0,12	0,12	30
16	Hexachlorobenzene	118-74-1			0,05	0,05	10
20	Lead and its compounds	7439-92-1	1,2 (13)	1,3	14	14	
21	Mercury and its compounds	7439-97-6			0,07	0,07	20
22	Naphthalene	91-20-3	2	2	130	130	
28	Polyaromatic hydrocarbons (PAH) (11)	not applicable	not applicable	not applicable	not applicable	not applicable	
	Benzo(a)pyrene	50-32-8	$1{,}7 \times 10^{-4}$	$1{,}7 \times 10^{-4}$	0,27	0,027	5
	Benzo(b)fluoranthene	205-99-2	see footnote 11	see footnote 11	0,017	0,017	footnote 11
	Benzo(k)fluoranthene	207-08-9	see footnote 11	see footnote 11	0,017	0,017	footnote 11
	Benzo(g,h,i) perylene	191-24-2	see footnote 11	see footnote 11	$8{,}2 \times 10^{-3}$	$8{,}2 \times 10^{-4}$	footnote 11
	Indeno(1,2,3- cd) pyrene	193-39-5	see footnote 11	see footnote 11	not applicable	not applicable	footnote 11

AA: annual average, MAC: maximum allowable concentration.
(2) This parameter is the EQS expressed as an annual average value (AA-EQS). Unless otherwise specified, it applies to the total concentration of all isomers.
(3) Inland surface waters encompass rivers and lakes and related artificial or heavily modified water bodies.

[39] An additional biota EQS that can be derived is to protect humans from adverse effects resulting from the consumption of chemical contaminated seafood ($QS_{biota,\ hh\ food}$) corresponding to UNEP/MAP CI20.

(4) This parameter is the EQS expressed as a maximum allowable concentration (MAC-EQS). Where the MAC-EQS are marked as "not applicable", the AA-EQS values are considered protective against short-term pollution peaks in continuous discharges since they are significantly lower than the values derived on the basis of acute toxicity.
(6) For Cadmium and its compounds (No 6) the EQS values vary depending on the hardness of the water as specified in five class categories (Class 1: < 40 mg $CaCO_3$ /l, Class 2: 40 to < 50 mg CaCO 3 /l, Class 3: 50 to < 100 mg $CaCO_3$ /l, Class 4: 100 to < 200 mg $CaCO_3$ /l and Class 5: ≥ 200 mg $CaCO_3$ /l).
(7) This substance is not a priority substance but one of the other pollutants for which the EQS are identical to those laid down in the legislation that applied prior to 13 January 2009.
(11) For the group of priority substances of polyaromatic hydrocarbons (PAH) (No 28), the biota EQS and corresponding AA-EQS in water refer to the concentration of benzo(a)pyrene, on the toxicity of which they are based. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA- EQS in water.
(12) Unless otherwise indicated, the biota EQS relate to fish. An alternative biota taxon, or another matrix, may be monitored instead, as long as the EQS applied provides an equivalent level of protection. For substances numbered 15 (Fluoranthene) and 28 (PAHs), the biota EQS refers to crustaceans and molluscs. For the purpose of assessing chemical status, monitoring of Fluoranthene and PAHs in fish is not appropriate. For substance number 37 (Dioxins and dioxin-like compounds), the biota EQS relates to fish, crustaceans and molluscs, in line with section 5.3 of the Annex to Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs (OJ L 320, 3.12.2011, p. 18).
(13) These EQS refer to bioavailable concentrations of the substances.

In contrast to the EQS chemical status, the UNEP/MAP EACs aim to protect against undesirable biotic effects. Some of the adopted EACs were those derived by Long et al., (1995) as the Effects Range Low (ERLs), the concentrations that are associated with biotic effects occasionally (the lower 10th percentile of the data). The methodology described in the EU Guidance 27 is more didactic and extensive, while Long et al. (1995) takes a more hands-on empirical approach, but with similar methodology.

The recommended steps to update MedEACs, adapted from the EQS and ERL derivations, are as follows:

1) Assemble available data on laboratory ecotoxicity data, mesocosm and field studies. For laboratory ecotoxicity data it is preferable to choose studies that report on dietary and oral exposure with developmental or reproductive endpoints that are more sensitive than survival endpoints. Long term mesocosm experiments are preferable to short term experiments. For field studies, measures of any adverse biological effects (such as altered benthic community (species richness, total abundance), histopathological disorders) should be given together with chemical concentration in sediments or other relevant matrix measured at the same time.
2) Each study should include all relevant auxiliary information: citation, type of test, type of biological effect, approach used, study area, test duration, species tested or the benthic community considered, TOC, Acid volatile sulphide (AVS), chemical concentrations, among others.
3) Each study should be assigned an effects/no effect descriptor. Only when concordance is apparent between the observed biological and the measured chemical concentration, the study is considered as an effect study. All the effects data were given equal weights in the guidelines derivation.
4) Extrapolate all available data to estimate the thresholds or criteria. The extrapolation should take into account the uncertainties such as species variations (laboratory test species to wildlife species), laboratory to field conditions extrapolation, short to long term effects. There are two approaches to extrapolate the data to criteria: deterministic and probabilistic. The deterministic approach takes the lowest credible toxicity datum and applies an Assessment factor (AF) to extrapolate to a QS. The higher the uncertainty of the available data, the higher the AF that is used to compensate for it. The probabilistic approach for extrapolation adopts a species sensitivity distribution modelling in which all reliable toxicity (usually no observed effect concentration (NOEC)) data are ranked and a model fitted. This approach is the preferred approach but when data are insufficient, a deterministic approach needs to be adopted.
5) An empirical approach was used by Long et al (1995). The incidence of adverse effect within each range was quantified by dividing the number of effects entries by the total number of entries and expressed as a percent. The ERL and ERM (effects range medium) values were derived with only the effects data and set as the concentration of the 10th and 50th percentile of the data, respectively.

6) Criteria for sediments should account for TOC and mineralogical composition. The criteria for biota should account for lipid contents (hydrophobic substances), individual's dry weight (metals), trophic level (when a substance biomagnifies through the food web). Decision on which trophic level to use for the criteria depends on the purpose – protection of the environment, specific biota species, human health, etc. Emphasis should be given to Mediterranean Sea species.

To summarize, the difference between EQS and EAC is related to above stated purpose: purposed of EQS is to protect predators from ingesting contaminated prey and EAC (or ERL) to prevent undesirable biotic effects. The EQS are derived based on a particular predator in the food web, that needs to be chosen based on the specific location/environment. Once the specific EQS is derived, it is possible to calculate the EQS for other species/taxa and to back calculate to concentrations in water (EU Guidance 27). The ERLs, that were adopted as EAC for the Mediterranean Sea, were derived based on data on all available undesirable biotic effect and statistical analysis. The EQS and the ERL derivations are similar: both use the same available studies (such as sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP) and field and mesocosm studies) for which biotic data are given together with chemical data. EQS applies an Assessment Factor (AF) to account for uncertainty. For example, there is a high uncertainty estimating *in situ* criteria from short term laboratory toxicity tests and the AF will be large. ERLs were developed with a more empirical/pragmatic approach.

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

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 16 details the concentrations cited at different sources for TM (Cd, Hg and Pb) and for organic contaminants (PCBs, dioxin).

From Table 16 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).

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 Section 2.3.3) . 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 16. Compilation of maximum levels for trace metals in fish and seafood for the protection of human health[40]. The concentrations are presented in mg/kg ww.

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

[40] The following sources are used in Table 16 and the elaboration for organic contaminants provided below the table:
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		
EU 1881/2006 directive and 488/2014 and 1005/2015 amendments	finfish	0.1		0.5
	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

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.

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 concept for GES assessment regarding Ecological Objective 9

As indicated in this document the work on the assessment criteria is a long way that requires continuous updates of the values based on 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 for further reflection 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.

Scientific and expert contribution of the OWG for Contaminants is needed to ensure analysis of the proposed updated sub-regional and regional BC and BAC values, against the new data expected to be provided by the members of the OWG or all CPs in the IMAP Info System. This collaboration has been initiated, as described in Annex I.

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. Considering 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.

The term aggregation is used for the combination of comparable elements across temporal and spatial scales, indicators and criteria, within IMAP Ecological Objective/Common Indicator

(UNEP/MAP WG.492/Inf.9)[41]. Aggregation increases the interpretive value of the individual measurements and may improve the assessment of the overall environmental status of an area or region and is the first step in GES assessment. It is therefore recommended to aggregate the parameters of CI 17 in line with the description in the above-mentioned document and as described below.

The aggregation process starts by assessing the status for an individual element (addressed also as measured parameter or determinant), in one specific matrix, at a specific area. In the case of CI17, there are 3 group of contaminants (TMs, PAHs and organochlorine contaminants) measured in 2 matrices i.e. sediment and biota. All the CI17 elements belong to the contamination category, in contrast to those in CI18, that belong to the bioassay/effects category. The first aggregation step requires a threshold, or assessment criteria against which to compare the measured concentration. The criteria used UNEP/MAP are the MedBACs and the EACs. Comparison of the measured concentration to the criteria can be performed in at least two similar ways: 1) comparison of the measured value to the criteria and flag it as above or below them; 2) calculation the ratio Cmeasured/Cthreshold/, where C is the concentration of the individual element; when the ratio is < 1, the measured concentration is below the threshold and when the ratio is >1, the measured concentration is above it.

Following this initial analysis, a classification is given for each element (Vethaak et al. 2017) following the "traffic light" system, used also by UNEP/MAP, to classify each element as blue (below BAC value), red (above EAC value) and green (between BAC and EAC values). In addition, the percentage of each classification was calculated for a specific element and matrix in the assessment area and presented graphically. Next, all elements of one category (i.e. group of contaminants in the case of CI 17) were aggregated and classified, followed by aggregations across all matrices and further classified as blue, red or green. In this stepwise way it is possible to follow the individual elements` contributions to the final result of the assessment.

A similar approach is given in the CHASE+ (Chemical Status Assessment Tool) methodology used by the European Environmental Agency to assess environmental status categories for the European Seas (Andersen et al. 2016, Anon 2019). The first step towards aggregation is to calculate the ratio Cmeasured/Cthreshold called the contamination ratio (CR) for each assessment element in a matrix. Then a contamination score (CS) is calculated as follows:

$$CS=\frac{1}{\sqrt{n}}\sum_{i=1}^{n}CR_i$$

where n is the number of elements assessed for each matrix.

Based on the contamination score, the elements assessed and the area can be classified into non problem area (NPA) and problem area (PA), by applying 5 categories: NPAhigh (CS=0.0-0.5), NPAgood (CS=0.5-1.0), PAmoderate (CS=1.0-5.0), PApoor (CS=5.0-10.0) and PAbad (CS > 10.0).

Both approaches need to define decision rules to determine the quality status. One decision rule used is the "One out all out approach" (OOAO) that says that if one element of the assessment is not in good status, the area is described as not in GES. This decision rule is very stringent. An additional approach is to set a threshold, such a proportion (%) of elements, that should have < EAC to achieve GES.

In addition to the aggregation of elements, it is necessary to define the spatial extent for the assessment (spatial assessment units – SAU) and the habitats present in an assessment area. NEAT (Nested Environmental Status Assessment Tool) uses a combination of high-level integration of habitats and spatial units and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale. The analysis provides an overall assessment for each case study area and a separate assessment for each of the ecosystem components included in the assessment (Borja et al. 2016, Pavlidou et al. 2019; UNEP/MAP WG.492/Inf.9). In NEAT, the status of each

[41] UNEP/MAP WG.492/Inf.9, The Integration and Aggregation Rules and Assessment Criteria for IMAP Ecological Objectives 5, 9 and 10. Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster

element is normalized into a scale of 0 to 1, independently of their original scale. Specific boundaries of the indicators (e.g. boundary between moderate and good status) are also normalized. By default, aggregation is done across all indicators belonging to a SAU. The methodology for NEAT application was detailed and applied in the ADR sub-region, as presented in document UNEP/MED WG.533/Inf.4 and UNEP/MED WG.533/ Inf.5.

The GES assessment follows specific methods which aggregate and integrate the monitoring data/parameters that are subject of assessment (i.e. CHASE+) at appropriate assessment scales and areas (i.e. NEAT). Although GES is not within the scope of the present document and will be elaborated during 2021 and 2022, at conceptual level it is recommended to apply the first two steps of the GES assessment to the data reported to IMAP Info System as follows: 1) comparison to thresholds/criteria for each individual element, and 2) computation of the contamination score (CS). The calculations are straightforward and can be done automatically when data are uploaded into IMAP Info System, based on application of present assessment criteria of UNEP/MAP. Once the values are calculated, they can be used with the "traffic light" approach and give an immediate picture of the environmental condition in the monitored area by individual elements and by the aggregated ones.

4.5 The way forward

Further to above elaborations, the following actions are recommended:

- The work on the assessment criteria is a long way that requires continuous updates of the values based on 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.
- Scientific and expert contribution of the OWG for Contaminants is needed to facilitate further work related to 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 and the Contracting Parties to the IMAP Info System. Further to this recommendation presented in the original document discussed by the Meeting of CorMon on Pollution Monitoring (26-28 April 2021), the OWG for Contaminants conveyed on June 18th, 2021 virtually and continued consultations in subsequent e-mail correspondence. Present revision of the document addressed the requirements of the Meeting of CorMon and the recommendations provided by the members of OWG. Detailed recommendations are presented in Annex I.
- Collection and examination of more monitoring data is needed to proceed with further data aggregation for control of the regional and sub-regional BC and BAC values. The most needed data are for organic contaminants in sediment and biota for all 4 sub-regions, followed by trace metals in biota *(Mytilus galloprovincialis and Mullus barbatus)*. Data for all the parameters are needed for the Central Mediterranean sub-region that is underrepresented in the IMAP database. Further to this recommendation in the original document, more data were reported to the IMAP-IS and they were used to recalculate BCs and BACs as provided in this present revision of the document.
- In that respect, it is important to note that one of the directions for future work of the Online Working Group (OWG) for Contaminants (EO9) needs to be related to the analysis of proposed values of the assessment criteria assessing them against the new data that are expected to be provided by the members of the OWG and reported by the Contracting Parties to the IMAP Info System.
- Meanwhile, presently updated values of the assessment criteria are proposed for their use within preparation of the inputs for 2023 MED QSR.
- In order to undertake further work aimed at upgrade of the EAC values for IMAP CIs 17 and 18, a long-term task needs to be undertaken as to create database of scientific literature that will

complement real time monitoring data to be reported from the Contracting Parties into IMAP Pilot Info System.

- Scientific and expert contribution of the Online Working Group (OWG) for Contaminants (EO9) is also needed to progress towards creating the database of ecotoxicological scientific literature needed for further upgrade of EAC values.
- 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.
- The mussel *M. galloprovincialis* 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 both mandatory and 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.
- Known contaminants of concern, such as As and Cu, and emerging contaminants of concern, such as pharmaceuticals and flame retardants should be considered for inclusion into IMAP monitoring in the future. Their addition will improve the assessment of the environmental status of the Mediterranean Sea and contribute to a more robust analysis. The decision on which contaminant to add should be based on pilot studies checking the probability of their presence in the Mediterranean Sea and sub-regions. UNEP/MED WG.463/Inf.4 reviewed the literature on the Mediterranean Sea (2014-2019) to draft an update on the priority pollutants for further consideration.
- Infaunal community structure could be also used to detect impacts on biota. It could integrate EO9 with EO1, CI2 – Condition of the habitat's typical species and communities. This could be done in conjunction with the CI2 monitoring, by including the infauna community structure as a required parameter. For example, if based on CI2 monitoring an effect on the benthic community is found, CI17 can be useful to complement the findings, in terms of identification of pressures. Conversely, if contamination is identified based on CI17 monitoring, it could guide the selection of monitoring areas for the species and communities within EO1. Moreover, any impact on the infaunal community structure can be considered a biological effect and be integrated with CI18.

–

Annex I :

Reply to comments received during the Meeting of CorMon on Pollution Monitoring (26-28 April 2021), the resuming session of the Meeting of MEDPOL Focal Points (9 July 2021), the 8th EcAp Coordination Group Meeting (September 9th, 2021) and from the OWG (Online Working Group) on Contaminants (June 18th, 2021 and in subsequent e-mail consultations)

	Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring VIDEOCONFERENCE, 26-28 APRIL 2021 **MEETING DOCUMENTS "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/MED WG. 492/ 12 and WG.492/Inf.11**		
	REQUESTS/PROPOSALS PROVIDED DURING THE MEETING SHARED IN WRITTEN FORM (I.E. COLLATED IN WORD FILES AND /OR INTRODUCED IN PDF VERSION OF THE DOCUMENTS SHARED FROM THE CPs WITH THE SECRETARIAT)		
	NAME OF CP AND REPRESENTATIVE OF CP PROVIDING PROPOSAL	**PROPOSALS/REQUESTS OF CPs**	**RESPONSES OF THE SECRETARIAT/POINTS AGREED AT THE MEETING TB FURTHER ADDRESSED**
1	Spain (IEO)., Dr. Martínez-Gómez, C. and Dr. Fernández Galindo, B	**Page 6. Section 2.4. The assessment Criteria for IMAP Common Indicator 18** Spain indicates that BAC and EACs have been established for certain biomarkers in *Mullus barbatus* from Mediterranean waters (AChE activity, MN frequency in erythrocytes and hepatic EROD activity) within the framework of WGBEC (ICES) in the past years using monitoring data (and restrictions linked to, such as size, sampling period, etc.) and research data	The document presents the criteria for CI 18 as adopted in Decisions 22/7 and 23/6 (COPs 19 and 20) for *M. galloprovincialis*. The status of data reporting from Spain as provided in 2019, remained unchanged. It is presented here-below. We did not find new data on biomarkers on the MEDPOL database. Given DDs for CI18 are presently not built into IMAP Info System, data can be submitted in old MEDPOL templates; they can be migrated by INFO/RAC into IMAP Info System when DDs for CI 18 will be operational; otherwise country will be able to report data directly to IMAP Info System when CI 18 data reporting will be operational. The example of positive practice that refers to work undertaken in OSPAR is included in **UNEP/MED WG. 492 /Inf11**. See section 2.4, footnote 25: "It should be noted that within the framework of the Working Group on Biological Effects of Contaminants (WGBEC) of ICES, BAC and EACs have been established for certain biomarkers in the fish *Mullus barbatus.* To that effect please note that

		from some Mediterranean countries (Davies et al., 2012; Vethaak et al., 2017). Biomarker monitoring data from Spain used to calculated this ACs are already partially sent to MED POL database in previous years (excel files) and more will be submitted to the new database (Info System) as soon as reporting formats on CI18 are ready to be used. Similarly, as the data from LMS were adopted from previous works, Spain strongly suggests taking advantage of the work already done on AC values in *Mullus barbatus* (Davies et al., 2012; Vethaak et al., 2017) that surely will help and guide to the Mediterranean monitoring labs that are in charge of the biomarker analysis in *Mullus barbatus*. Spain suggests to adopt the current ACs in *Mullus barbatus* wich should be updated as new data arise from field samplings in new "reference" areas/populations from Mediterranean within the Mediterranean monitoring programs.	Vethaak et al. 2017 and Davies et al 2012. provided BACs and some EACs values for 21 biomarkers. Most of the values are for species other than *M. galloprovincialis* and therefore not applicable with regards IMAP implementation. Most of the relevant biomarkers have the same values as values provided in the Decisions IG.22/7 on IMAP (Athens, Greece, February 2016). Concerning *M. barbatus* (Red mullet) there are some BACs and EACs for some biomarkers in Davies et al., 2012; Vethaak et al., 2017. However, there should be a decision to include the new assessment criteria for *M. galloprovincialis* within some of future amendments of IMAP given present lack of data related to IMAP Common Indicator 18. Once sufficient data are reported, the Sec/MEDPOL can undertake re-calculation of the values already agreed by Decision IG.23/6 related to 2017 Mediterranean Quality Status Report (MED QSR). Please note there will not be a separate OWG for CI 18, but analysis of biomarkers will be elaborated within OWG on Contaminants.

Country	Nutrients	Chl-a	Biota - TM	Biota - OC	Sediment TM	Sediments OC	Rivers - Nutrients	Oceanographic parameters (Temp., etc.)
Spain			2004	2004				
			2005	2005				
			2006	2006				
			2007	2007	2007	2007		
			2008	2008	2008	2008		
			2009	2009				
			2010	2010				
			2011	2011	2011	2011		

		• AChE in muscle tissue BAC=155 EAC=109 nmol/min/mg protein • AChE in brain tissue BAC =118 EAC=83 nmol/min/mg protein (12-18 cm; GSI<1; M/F ; October) • MN in erythrocytes BAC= 0.3 per mil cells • EROD in hepatic tissue BAC = 115 pmol/min/mg microsomal protein (12-18 cm; GSI<1; M/F; October) Spain also remarks the valuable role that the on line working groups on CI18 may play in this subject (updating ACs). Vethaak, A. D., Davies, I. M., Thain, J. E., Gubbins, M. J., Martínez-Gómez, C., Robinson, C. D., ... & Hylland, K. (2017). Integrated indicator framework and methodology for monitoring and assessment of hazardous substances and their effects in the marine environment. Marine environmental research, 124, 11-20.	
2	Spain (IEO)., Dr. Martínez-Gómez, C. and Dr. Fernández Galindo, B	It was stressed by France the fact that technical document WG.492/12 is only submitted	This subject was addressed in the conclusions and recommendations of the meeting, paragraph 17: “Considering the evolving nature of the Meeting document UNEP/MED WG.492/12, addressing the need to further upgrade the assessment criteria for IMAP Common Indicators related to Ecological

		for MEDPOL for information and that additional work must be undertaken should be better reflected in the document background section. Spain and Italy support the French suggestion and agree that the work should go forward, but it is of a crucial importance that this is being done in cooperative way, through OWG and EU cooperation	Objective 9, the Meeting agreed to use this document as a basis for progressing towards development and testing of the methodologies for GES assessment related to Ecological Objectives 9 and 10 towards preparation of the 2023 MED QSR, and recommended its submission to the Meeting of the MED POL Focal Points for its consideration, while work on its further elaboration will continue as indicated in paragraph 16 below, including through OWG on Contaminants." Specific further tasks to be realized in OWG with support of the CPs are specified in paragraph 18. See also paragraph 52 of the document.
3	Spain (IEO)., Dr. Martínez-Gómez, C. and Dr. Fernández Galindo, B	A scientific study recently published reports PAHs levels in sediments Spanish Mediterranean shelf sediments. It should be helpful and convenient to add this reference in the reference list: Víctor M. León, Lucía Viñas, Estefanía Concha-Graña, Verónica Fernández-González, Noelia Salgueiro-González, Carmen Moscoso-Pérez, Soledad Muniategui-Lorenzo, Juan A. Campillo. Identification of contaminants of emerging concern with potential environmental risk in Spanish continental shelf sediments. Science of The Total Environment, Volume 742, 2020, 140505, ISSN 0048-9697	We were aware of this paper. The data presented are not recent respectively from the 2011 (Alboran Sea) and 2012 (Levantine-Balearic Sea). These data correspond with data on PAH reported from Spain in the MEDPOL data base that were used in previous assessments (i.e. 2017 MED QSR and SoED). More details on this paper will be added in **UNEP/MED WG. 492 Inf/11.**

4	France - Emmanuelle Thiesse also presented during the meeting by Janeck Tronczynski	Here are the written comments from France on 21wg.492/12 2.2 The methodology - Point 6. "The BCs were derived using data from sediment cores compiled from the scientific literature (UNEP/MAP 2011)…": the database should be further updated - 2011 – 2021; • 2.2.1 Trace Metals (Cd, Hg and Pb) in sediments - Point 7. Stations where the 75th percentile of the data were below the overall median were chosen as reference stations. For background determination… This is very critical and somewhat too large. In OSPAR methodology the 95th percentile is chosen for the surface sediments with further assessment for the outliers… Table 1. It is suggested to correct this table : eventually to	General reply. Tables 1 to 5 present the current adopted values for the Mediterranean region and brings, when available, BC concentrations calculated in 2011, 2017 and 2019 for the regional and sub-regional scales. We find it useful for the reader to have all available data collated in one paper, but also as a basis for presenting their upgrade undertaken in this paper. Moreover, the methodology applied for upgrade of the criteria follows the methodology and related procedure applied for calculation of the criteria already adopted by the Contracting Countries and applied for the assessment products prepared until now. Specific replies Regarding 2.2.: Paragraph 6 describes the methodology that was used previously to derive BCs using sediment cores. These values were further updated (2016, 2017 and 2019) using data from stations defined as reference stations There were no new data on sediment cores that could be used. In sections 3 and 4 of working document there is a description of all the new monitoring data that were available and used to update the BCs. Regarding 2.2.1: The document follows the methodology and related procedure applied until now that was approved by the Contracting Countries for establishing present assessment. It should be noted that the 75th percentile was already agreed by the Contracting Parties and the present paper follows this approach. Regarding practise of OSPAR region, the following reference note was added to paragraph 7: "**In OSPAR`s methodology the stations were the 95th percentile of the data were below the overall median were chosen as reference stations. It should be noted that this value can be very lenient concerning the environment**." Regarding Table 1, we find it of utmost importance to present all assessment criteria therefore BC, BAC and EAC values, as available both at regional and sub-regional level. For proper understanding of an upgrade undertaken, the reader needs to have all available already adopted/calculated criteria both regional and sub-regional values presented in one tabular form, therefore avoiding looking for them in different chapters/previous documents. Therefore, no change was applied on Table1. Concerning low concentration terminology the following explanation as provided in WG427/Inf.3, 2016 should be taken into account: "The BCs for man-made substances should be regarded as zero, and therefore, the so called low concentrations (LCs) might be used instead to derive assessment criteria. The latter could be derived from reliable datasets of analytical variability information reported from either certified reference materials (CRMs) or independent proficiency testing (PTs) scheme databases". However, the Contracting Parties of Barcelona Convention agreed to use the BC

		withdraw all BAC and EAC values wich will be presented later on in the section where these concentrations are discussed; there is no need to introduce new abbreviations such as MedBAC etc.; The obtained BC levels may be questioned probably because of the method used s; these levels should be rather considered as low reference concentrations of Cd, Hg and Pb in the Mediterranean sediments and not as background concentrations; they will be further discussed with revised 2021 levels; furthermore it should be clearly stated if these values are normalized or not and if yes what normalization was used for BC elaboration; • 2.2.2 Naturally occurring organic compounds (PAHs) in sediment - Point 9. Table 2 It is also suggested to correct this table and withdraw EAC values. Certain of PAH BC levels reported in this table are rather high for the background, whereas others are ok. Therefore, the composition of PAH is inconsistent for instance fluoranthene and pyrene are	terminology and not LC within UNEP/MAP. In line with this, **a footnote was added in para 13 of UNEP/MED 492/12** as to make a clear interrelation with the Decision of the Contracting Parties already undertaken to apply BC and not LC values, as follows: "**The BCs for man-made substances should be regarded as zero, and therefore, the so called low concentrations (LCs) might be used instead to derive assessment criteria. The latter could be derived from reliable datasets of analytical variability information reported from either certified reference materials (CRMs) or independent proficiency testing (PTs) scheme databases . However, the Contracting Parties of Barcelona Convention agreed to use the BC terminology and not LC within UNEP/MAP**." Please note that QSR road map and related Decision do not foresee changing methodologies applied to set the assessment criteria, but use of more data as to undertake upgrade of the assessment criteria. Data used for calculation of BC values were not normalized, since there were no available data on normalizers (i.e. Al, total organic carbon (TOC)) in the data sets reported by the Contracting Parties. The same is true for the data sets used for an upgrade of the assessment criteria applied in 2017 and 2019 assessments. Applying normalization on data reported would require Contracting Parties to report, in addition to the compulsory parameters, also the concentration of Al and TOC in the same sample. In line with this explanation a footnote was added in paragraph 7 of UNEP/MED 492/12, as follows: **"In this document, data used for calculation of BC values were not normalized, since there were no available data on normalizers (i.e. Al, total organic carbon (TOC)) in the data sets reported by the Contracting Parties. The same is true for the data sets used for an upgrade of the assessment criteria applied in the 2017 and 2019 assessments."** Regarding 2.2.2., the same explanation applies on all criteria for PAHs as provided above for trace elements, therefore no change was included in Table 2. The values presented in the table 2 are already adopted, agreed current criteria. Normalization would be possible to perform only if the TOC was known in the sample. However, the CPs were not reporting data to allow the calculation of normalized values. The only countries that reported Al concentrations were Israel (in IMAP Info/System) and France (in EMODnet). No TOC was reported. Paragraph 11 states that "Unlik**e** the sediments, there are not values of pristine, pre-industrial concentrations of naturally occurring compounds in biota". Meaning, that there are values of pristine concentrations for sediments but not for biota. The methodology by which the reference stations were chosen is given at length in WG.427/Inf.3 (2016).

		very high but chrysene and benzo(bj)fluoranthene are ok; the concentrations are not normalized to 2.5 % OC as recommended; it may be suggested to give both normalized and not normalized concentrations; 2.2.3 Naturally occurring trace metals (Cd, Hg and Pb) and organic compounds (PAHs) in biota9 Point 11. There is no "pristine" areas for sediments in the Medietrranean sea? only dated core data may be considred as background; stations were excluded on what criteria? how it was decied – just by expert judgement? Table 3 the table should be revised and keep only BC levels – discussion on the levels will be give with revised 2021 BCs; Table 4 consider to revise and withdraw EAC BACs; the so-called MED "BC" levels seem to be OK while they are not for sediments; 2.2.4 Synthetic substances (non-naturally occurring) in sediments and biota The BAC	Regarding Tables 3 and 4, we find it useful for the reader to have all available criteria in one tabular form; please see explanation provided for table 1, that is also valid for tables 2 and 3. The values in the table for MedBC and sub-regional BCs were calculated in 2019 and applied in SoED, by taking into account the new data that were reported until then and by applying the same methodology used initially to establish BC/BACs values adopted by the CPs in 2016 and 2017. Regarding 2.2.4., it should be noted that the aim is to calculate upgraded BACs. However, at this time, there were not enough data to calculate and propose new updated BACs for synthetic substances (PCBs and pesticides). Tables A3.5 and A3.6 provided in info document UNEP/MED WG.492/Inf 11 present the details of the available data. As more data are collected from the CPs, the more accurate upgrade of the criteria may be undertaken. Regarding 2.3.1, we should keep in mind that the document UNEP/MED WG. 492/12 follows the methodology and related procedure already agreed and applied until now in line with the Decisions 23/6 and 22/7 of the Contracting Parties. The multiplication factors to calculate BACs from BCs used by UNEP/MAP are the factors derived by OSPAR (2008) based on the precision (CV%) of 10 years database of monitoring data from the UK National Marine Monitoring Programme. To the best of our knowledge, this exercise has not been reproduced and the multiplication factors remain the same. In order to assess the multiplication factors from monitoring data of MEDPOL/IMAP Info system, there is a need for long term monitoring datasets from all or majority of the Contracting Parties. These datasets need to be analyzed for calculation of their precision (CV). The quantity of data reported in IMAP info System/ MEDPOL, as well as a frequency of analyzing one sample of either biota or sediment is not sufficient for calculation of CV values. However, the alternative could be for each country to calculate CV values by using national monitoring data sets and submit that values to MAP. Then, MAP can undertake comparison among the countries and the precisions of the presently used values. Only then, the multiplication factors can be adjusted, if necessary. The methodology of OSPAR (2008) regarding derivation of BAC, theoretically and pragmatically, as provided in "Co-ordinated Environmental Monitoring Programme (CEMP) Assessment Manual for contaminants in sediment and biota." OSPAR Commission No. 379/2008, (page 20) and undertaken by UNEP/MAP (WG365/Inf.8 and WG.427/9), is included in Information document UNEP/MAP WG. 492/Inf.11, while related elaboration and a footnote is added in paragraph 16, section 2.31 of the working document UNEP/MED WG. 492/12:

		levels should be calculated for these compounds and should be used for the assessment; it is not clear if this work will be carried-on. 2.3.1 Background Assessment Concentration (BAC) determination Point 16. The method on how to calculate background assessment concentrations BAC should be precisely described including statistics; BAC is a statistical tool allowing to assess if the concentrations are near BC...the definition should be aligned with Ospar BAC; observed concentrations is said to be near BC if its upper confidence limit is below BAC...Please provide presentation on how the multiplication factors for BC were calculated; 2.3.2 Environmental Assessment Criteria (EAC) determination Point 19 Should eventually be further updated according to: HASEC/MIME's 2021 proposal for the use of environmental and human health thresholds as assessment criteria for contaminants in	"**The multiplication factors were computed by applying the following equations : i) MedBAC for trace metals in sediments and shellfish: MedBAC=1.5xMedBC and in fish: MedBAC =2xMedBC; and ii) MedBAC for PAHs in mussel: MedBAC=1.5xMedBC. No BAC values were calculated for PAHs in sediment and therefore, no multiplication factor given in the UNEP/MAP documents (see section 4.1 and Table 11)**". A change related to this aspect has also been included in paragraph 36. Footnote added in paragraph 16:" **At present, no statistical assessment was possible for the precision of the monitoring data reported into MEDPOL/IMAP Info system given the quantity of data reported in IMAP info System/ MEDPOL, as well as a frequency of analyzing one sample of either biota or sediment is insufficient for calculation of the precision of monitoring data. Therefore, the variability from OSPAR monitoring program was used, following its application for an upgrade of the assessment criteria in in 2017 and 2019. A detailed explanation is given in section 2.3.1 of the information document UNEP/MAP WG.492/Inf.11**." Regarding 2.3.2, it should be noted that the controlled laboratory experiments for biomarkers are some of the data that needs to be collected and that can help in the update of the EAC values. This is in addition to other data as specified in paragraph 44. In line with that, the paragraph 44 was amended as follows "**The laboratory results on biomarkers (CI18) are also important for the derivation of the EACs values**." As it was explained during discussion on UNEP/MED WG. 492/6, integration of chemical and biological effects monitoring is complex work that should be undertaken in the future considering the orientations established in this document; however, this work cannot be finalized for preparation of 2023 MED QSR. In UNEP/MAP we do not have an access to 2021 OSPAR's Hazardous Substances & Eutrophication Committee (HASEC) along with its subsidiary working groups on Monitoring & on Trends and Effects of Substances in the Marine Environment (MIME) proposal for the use of environmental and human health thresholds as assessment criteria for contaminants in biota. The Secretariat/MEDPOL is open to consider if this proposal can be beneficial for our present work if it will be elaborated within OWG on EO 9. Regarding 2.3.3, we do not understand well comment provided. Regarding comment 3.3, it should be noted that to the best of our knowledge, Table 9 includes all the relevant, new data (since 2012) that could be used for upgrade of BC/BACs values.

		biota… In an ideal world, the EAC would be set on environmental / ecotoxicological grounds that is within integrated CI17 and CI18 assessement; this should be eventuallay proposed for next QSR if not possible for 2023. 2.3.3 European Union regulations (EC) Point 21. “may be too lenient to protect the environment” or otherwise round too strigent . 3.3 Data from the scientific literature Table 9. could eventually be further updated with core data… 3.4 Examination of the new data Point 32 should be justified why normalization was not done... 4.1 Updated BC and BAC values for IMAP CI 17 Table 10. BC values for trace metals in sediments, calculated from the new data seem to remain relatively high for Cd and Hg; whereas remain ok for Pb.	Regarding 3.4, as already explained above, it should be noted that the normalization could not be done on the reported data because the concentrations of normalizers, such as Al, TOC were not reported by the Contracting Parties, neither for sediments, nor lipids or size/age for biota. Regarding 4.1, it should be noted that upgrade of BC/BAC values was based on new data, using existing methodology already described. Collection and examination of more monitoring data, in particular from stations defined as reference, is essential for further improvement of the proposed updated BCs. CPs are encouraged to report data into IMAP Info System that is a pre-condition for calculation of more accurate criteria. Also, the scientific and expert contribution of the OWG on contaminants can be helpful in providing more data sets that could be further considered for more accurate upgrade of the assessment criteria. Due to the Frances’ comment of high values of BCs calculated from the existing data, they have been re-checked, and found correct (again, based on the existing data) . Therefore, for the calculation of the proposed BACs in this document we used the multiplication factor 1.5, the lower factor used by OSPAR and the same one used for metals in sediments ~~suggested~~ The multiplication factors applied in OSPAR for calculation of BAC values from BC value ranged from 1.6 to 2.1. The footnote 23 was added in paragraph 39 as follows: “The calculation of the multiplication factor to calculate BACs for PAHs in sediments was not provided in the previous UNEP/MAP documents (2011, 2016, 2019). Looking at the OSPAR values for BC and BAC for PAHs in the sediments, the multiplication factor used depended on the compound and ranged from 1.6 to 2.1. In this document, it is proposed to use the multiplication factor of 1.5, as for trace metals in sediments, based on the relative higher values of BCs for PAHs in sediments calculated here, in comparison to the BCs calculated in 2011. The proposed BACs are presented in Table 11” “ Regarding reference values for PAHs in pre- industrial dated sediment cores layers, could you please send us the reference for those values so they may be considered?

		Table 11. BC levels for PAHs in sediments are just too high - can not be considered as background concentrations for the next assessment; Pleas take care for right spelling of organic compounds Here are the example of PAH concentration in pre- industrial dated sediment cores layes. Dated sediment cores FR Compound µg/kg d.w. ranges Naphthalene 0,8 Acenaphthylene <0,1 Acenaphtene <0,1 Fluorene 0,2 Phenanthrene 1,2 - 4,2 Anthracene 0,3 - 1,7 Fluoranthene 1,1 - 7,5 Pyrene 1,4 - 4,0 Benz[a]anthracene 0,6 - 1,9 Chrysene/triphenylene 0,8 - 3,5 Benzo(bj)fluoranthene 1,8 - 7,0 Benzo(k)fluoranthene 0,4 - 1,9 Benzo[a]pyrene 0,3 - 1,9 Benzo[g,h,i]perylene 0,5 - 3,95 Dibenz[a,h]anthracene 0,1 - 0,16 Indeno[c,d 1,2,3,]pyrene 0,6 - 4,1 Table 12. BC values for trace metals in mussel (M. galloprovincialis)… cadmium levels correspond to coastal	Regarding the spelling of organic compounds in Table 11, we have introduced corrections in acenaphthene (missing h following t) and dibenz (a,h)anthracene (deleted o following z), as well as correction of error related to listed BAC values for mussel *M. galloprovincialis* (and not sediments) that were in the column for PAHs Regarding Table 12, the observation concerns the WMS-BC. The upgrade of the criteria was based on new available data, using already agreed methodology described in the document, as explained here-above. Monitoring was traditionally performed in coastal areas. Collection and examination of more monitoring data, in particular from stations defined as reference, is essential for the improvement of the proposed upgraded BCs. CPs are encouraged to report new data into IMAP info System. Also, the scientific and expert contribution of the OWG on contaminants can be helpful in providing more data sets that could be further considered for more accurate upgrade of the assessment criteria.

		areas close to urban centers; for Hg a number of MED coastal sites are lower than this "BC" level; Pb could be considered as low coastal present level concentrations for the area	
5	France - Jacek Tronczynski Comments from document's PDF. Replies to the comments **not** listed above.	Page 5, point 7. The suggestion is to change from approved to proposed	This proposal cannot be accepted since values presented in Table 1 have been approved by the Contracting Parties in the Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20). .
6		Tables 1-5	All the comments on the values presented in those tables are recognized. However, those are the values that have already been adopted by the CPs in the Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20).
	COMMENTS DURING MEETING WITHOUT WRITTEN FILE		
7	Israel- Dror Zurel	Asked why the data from Israel 2019 were not used in the calculation.	Relevant data for TM in sediments and biota for 2019 were added to IMAP info system on 4 May 2021, therefore they could not be used for preparation of UNEP/MED WG. 492/12. We will take them into account in the course of final calculation of the values within this document, in the second half of this year.
8	EU- George Hanke	Use of human health parameters should not be used for environmental assessment. Mentioned that not all BCs are natural background	The objective of CI17 is to protect the environment and achieve GES while the objective of CI20 is to protect human health. Given data scarcity for calculation of new EACs for contaminants in biota matrix of CI 17, it is only possible to use the ECs as the EAC values for PAH and metals in biota, before it would be possible to compute the EACs for CI17 by applying the methodological approach as provided in Meeting document UNEP/MED WG. 492/12. The decision to use the EC values was a result of not having recommended EACs for contaminants in biota. Regarding the assessment criteria for CI 20, the proposal is to use 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. Therefore, the criteria for CI17 and CI20 for trace metals and PAHs in biota are the same. They are actually the maximum levels for certain contaminants in foodstuffs as provided initially in EC/EU 1881/2006 and

		Proposed that UNEP/MAP participate in the meetings of the WFD were they discuss EQS. ~~Your answer was that~~	629/2008 Directives for maximum levels for certain contaminants in foodstuffs (see UNEP(DEPI)/MED WG.427/Inf.3, Section 5). Below is an excerpt from OSPAR Commission publication: "Background Document on CEMP assessment criteria for the QSR 2010" Publication Number: 461/2009, Item 2.2.2, page 7 "There are no recommended EACs for metals in biota and equivalents to ER values are not available for fish and shellfish. Therefore an alternative approach to assessment criteria was required, which needed to be coherent across the range of species addressed in the CEMP programme"…." …."The second approach considered was an assessment of the contaminant concentrations in fish and shellfish with respect to their human health risk. The Commission Regulation (EC) No 1881/2006 (and subsequent additions and amendments) sets maximum concentrations for contaminants in foodstuffs to protect public health, i.e. to ensure that contaminant concentrations are toxicologically acceptable. This regulation includes maximum levels for Pb, Hg and Cd in bivalve molluscs and fish muscle (Tables 3 and 4) on a wet weight basis. Advantages of this approach are that the dietary standards are firmly established within EC statute, and that they can be used to fill the gaps for metals in both fish and shellfish species. Disadvantages include that standards are not directly available for all the matrix/contaminant combinations required for the assessment". We however are aware that the EC values are for the protection of human health and may be too lenient to protect the environment. Therefore, we propose to keep the values in EC/EU Directives 1881/2006, 1259/2011 with amendments 488/2014 and 1005/2015 for CI20. Regarding EACs for biota matrix of CI17 a way to update their values was proposed in the working and information documents, and explained above. The methodology for setting EAC va;ues, as a long-term task, is described fully in info document 11, section 4. *** We agree that values are reference or background concentrations and not natural background nor pristine concentrations. The use of these definitions depends on the data available. The pristine concentrations are those of the pre-industrial age and can be determined only based on dated sediment cores. Natural background concentrations can be determined only in areas away from any anthropogenic influence. Background concentrations used by MEDPOL and reference concentrations used in the scientific literature, are the concentrations calculated based on stations that were identified as background/reference based on the data and methodology used. ****

			Until now the Secretariat/MEDPOL was not invited to participate in the meetings of technical bodies of EU WFD, but in the meetings of technical bodies of EU MSFD.
	WRITTEN COMMENTS PROVIDED DURING THE MEETING THROUGH CHAT BOX, DIFFERENT FROM THOSE ABOVE LISTED		
	NAME OF CP PROVIDING PROPOSAL	**PROPOSALS/REQUESTS OF CP`s**	**RESPONSES OF THE SECRETARIAT/POINTS ADDRESSED/EXPLANATIONS**
9	CROATIA, Jelena Lusic (written)	I have a comment regarding the BC values and proposed BAC values for 2021 for Adriatic region. Croatia did not provide any data so far, however, based on our data from several monitoring programs, the proposed BAC values from 2021 are extremely low – our estimated background data is in the range of the already adopted 2019 BAC values. Therefore, we do not wish to support the proposed new BAC values for Adriatic region until more countries provide there data and the BAC values are established based on the larger amount on data.	We would be glad to receive the new data from Croatia and update the upgraded values for BCs and BACs, during 2[nd] cycle of criteria upgrade to be undertaken in 2021, following also on expected discussion and work within OWG. The data used for the calculation of the sub-regional BCs and BACs are given in detail in information document 11 (Tables A.3.1- A3.2) and includes data from the Adriatic form EMODNET (Croatia 2017, Italy 2016 for TM in sediments), from IMAP and MEDPOL for TM in *M. galloprovincialis* (Montenegro, 2018; Slovenia 2017-2018). The process of 2023 QSR preparation must continue. Therefore, please report all pending data to ensure application of more accurate criteria.

10	MONTENEGRO_Ivana Stojanovic (written comments)		Good afternoon, dear colleagues, we have issues with the connection the entire morning and we are not able to request to speak. We would like to comment on the documents 11 and 12. Above all, it is important to point out that these documents are well prepared and very useful for our furthure work on monitoring and assessment, especially taking into account limited data availibility.. For the document 12, which proposes upgraded regional and sub-regional BC and BAC values for CI 17, as well as criteria for CI 20, icluding the work on the scales of assessment for the pollution cluster and GES assessment. For these assessments, we believe it is important to use the integration approach among EOs and CIs as much as possible, which is something that we have	It is our aim to use the integration approach among EOs and CIs to be able to define GES in the regional and sub-regional scales. This will be done also based on WG492/13 methodology.

		done in the framework of the GEF Adriatic project with support of MEDPOL and PAP RAC. In addition, we support the work done and progress achieved in developing BC and BACs, including the need to define criteria for contaminants in biota.	
11	ITALY - Ginevra Moltedo (ISPRA)	Italy is in agree with Spain about the importance to update data about CI18 (biomarker) also in Mullus barbatus, with data from MSFD. And Italy suggests to re-activate the online group on biomarker in order to try to update the BAC, also taking into account the ICES indications about them.	The document provides the present criteria for CI 18 as adopted in Decisions 22/7 and 23/6 (COPs 19 and 20) for *M. galloprovincialis*. As already explained above in relation to comment provided by Spain, the example of positive practice in OSPAR will be included in UNEP/MED WG. 492 /Inf11. According to decision already undertaken by previous meeting of CorMon, the OWG for contaminants cover entire scope of EO9, therefore also aspects related to biomarkers. Please see above replies provided to Spain and France. Also, scope of further work, including through OWG, is provided in the paragraphs 17 and 18 of the conclusions and recommendations of the meeting. See also paragraph 52 of the document.
12	EU- Victoria Tornero	Sorry, I have still problems with microphone. Please, could you clarify if data for indicator 20 came from a different framework on specific food monitoring? Is the exchange of information efficient ? Or if data come from environmental monitoring, what are the	The objective of CI17 is to protect the environment and achieve GES while the objective of CI20 is to protect human health. The decision to use the EC values was a result of not having recommended EACs for contaminants in biota, as well as scarcity of relevant data to undertake their calculation. Please find explanation in above response to the query of EC. The data for both CI17 and CI20 could be from the same specific monitoring. Please note that the CPs do not report any data on IMAP CI 20, and therefore it was proposed to use as EACs 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; therefore, to use EU maximum levels in fish and seafood and not environmental assessment criteria before sufficient data CI20 will be collected as to establish the assessment criteria by using such reported datasets.

		main differences with indicator 17? Thank you!	
13	Italy_Daniela Berto	Italy request also a confirmation of the data used for to calculation of the BC and BAC in particular metals ..concernig in particular the geographic position, stations , time	The overview and analysis of data is included in Information document; Please check there, there is fully transparent presentation of all datasets used.
14	Slovenia Mateja Poje	Thanks for the presentation. In mentioned, data from the EMODnet database were used, but not all data are available for Slovenia there. Thus, we propose that the document has a technical value as france suggests and the values are carefully reviewed within the working group, which is necessary in this area. This values need to be further discussed and not used directly to prepare the 2023 report.	We would be glad to receive the new data from Slovenia and update the upgraded values for BCs and BACs, during 2nd cycle of criteria upgrade to be undertaken in 2021 following also on the discussion with OWG. The preparation of 2023 MED QSR must continue. The CPs need to report all pending data with not further delay. Otherwise, we have to continue working with the criteria calculated by using all data ever reported to MEDPOL/IMAP Info System, as well as all data that were possible to be retrieved in statistically and technically acceptable format from the scientific literature and EMODnet. The scope of further work, including through OWG, is provided in in the paragraphs 17 and 18 of the conclusions and recommendations of the meeting. See also paragraph 52 of the document
15	MONTENEGRO_Ivana Stojanovic	We support that the document 12 is submitted to Medpol FP as a basis for further use for testing GES assessment in two pilot regions.	We thank for supporting work of the Secretariat/MEDPOL.

16	FR - Laure Ducommun	The fact that this technical document is only submitted for MEDPOL for information and that additional work must be undertaken should be better reflected in the document background section. We agree that the work should go forward, but it is of a crucial importance that this is being done in cooperative way, through OWG and EU cooperation	This subject was addressed in the conclusions and recommendations of the meeting, paragraph 17: "Considering the evolving nature of the Meeting document UNEP/MED WG.492/12, addressing the need to further upgrade the assessment criteria for IMAP Common Indicators related to Ecological Objective 9, the Meeting agreed to use this document as a basis for progressing towards development and testing of the methodologies for GES assessment related to Ecological Objectives 9 and 10 towards preparation of the 2023 MED QSR, and recommended its submission to the Meeting of the MED POL Focal Points for its consideration, while work on its further elaboration will continue as indicated in paragraph 16 below, including through OWG on Contaminants" See also paragraph 52 of the document.

	Meeting of the Online Working Group (OWG) - Contaminants **VIDEOCONFERENCE, 18 JUNE 2021** **MEETING DOCUMENTS "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/MED WG. 492/ 12 and WG.492/Inf.11**		
	REQUESTS/PROPOSALS PROVIDED DURING THE MEETING AND IN SUBSEQUENT E-MAIL CORRESPONDENCE, SHARED IN WRITTEN FORM		
	CP PROVIDING PROPOSAL/COMMENT	**PROPOSALS/REQUESTS OF CPs**	**RESPONSES** OF THE SECRETARIAT, of Jelena Knezevic, MEDPOL Monitoring and Assessment Officer (MAO), and N. Kress (MedPol Expert)/POINTS AGREED AT THE MEETING of during subsequent correspondence

17	France, Spain, Italy, Israel, Croatia and Slovenia	Strong need for undertaking further work on computing the background concentrations	MAO explained that in line with the request of the CPs, the Meeting of CorMon on Pollution Monitoring considered meeting documents UNEP/MED WG. 492/12 and UNEP/MED WG. 492/13 as the documents of evolving nature, including their use as a basis for further upgrade of the assessment criteria for IMAP Common Indicators related to Ecological Objective 9 and ensuring the progress towards development and testing of the methodologies for GES assessment related to Ecological Objective 9 towards preparation of the 2023 MED QSR.
18	France	Certain detailed information needed for BC/BAC values are not provided from the Secretariat, especially those concerning the reference stations and dated sediment cores.	Consultation with the secretariat found that according to the rules of the office, access of the OWG members to data sets stored in IMAP IS cannot be given.
19	Croatia	Highlighted too high BC values for biota matrix computed by using new data	New data available up to Dec 31st , 2021 allowed for the recalculation of BCs. The recalculated values are presented in the revised document.
20	France	Pointed out that certain BC values might be too high and not representative of the natural background levels.	New data available up to Dec 31st , 2021 allowed for the recalculation of BCs. The recalculated values are presented in the revised document.
21	France, Spain, Italy, Israel, Croatia	Pointed out the necessity to have direct access to data used for present upgrade of the assessment criteria.	MAO explained that use of data from IMAP Info System/ MEDPOL DB migrated into IMAP Info System is subject of restricted policy for data use, and therefore she could not confirm that access may be granted to the members of OWG before consulting with the management of UNEP/MAP. Consultation with the secretariat found that according to the rules of the office, access of the OWG members to data sets stored in IMAP IS cannot be given.
22	Israel	Need for an upgrade of the assessment criteria by taking into account the quality-controlled datasets both from the IMAP Info System and additional sources rather than undertaking an upgrade of the	MAO and MedPol Expert explained that only recent data should be used, since 2015, and not the whole dataset that includes data from the 1970s. For the present upgrade of the assessment criteria included in documents UNEP/MED WG. 492/12 and UNEP/MED WG. 492.Inf.11, the Secretariat decided not to use data already used for calculation of the values of the criteria agreed in 2016 and 2017; in such a manner repeated use of the same data sets

		assessment criteria based solely on 2017 and 2019 datasets.	was avoided since previous data sets have already been built-in values of the criteria agreed in 2017, as well as in their update proposed in 2019. However, what could be further considered within the present work of the OWG is to reuse data, starting from 2015, that was already used in the 2017 and 2019 assessments in order to reinforce the present upgrade of the criteria undertaken from the Secretariat. This was performed in the recalculation of the BCs and BACs and presented in the revised documents
23	France, Croatia, Italy, Spain	list of additional references was shared from the participants, indicating their use for further elaboration of the documents UNEP/MED WG. 492/12 and UNEP/MED WG. 492.Inf.11,	Summary of new literature with possible data to be used in the determination (calculation) of new background concentrations for CI-17 was sent on 2 Sept 2021 to the OWG. The summary included the 8 scientific papers were recommended by the OWG and 14 new papers from the literature collected by MAO and MedPol expert. Emphasis was given on the data presented and the possibility to use them in the calculation and not on the scientific questions posed in the papers.
24	OWG Participants	The participants agreed to launch testing of the NEAT tool for GES assessment for EO9. Turkey confirmed a good experience achieved regarding the application of the NEAT tool in the Black Sea.	NEAT has been applied to the Adriatic sub-region (See document UNEP/MAP WG.533/3). The results should be considered in relation to the application of other relevant tools tested meanwhile at the national level, in order to make a recommendation on the use of the optimal tool for the preparation of the 2023 MED QSR assessment. It was underlined that the application of NEAT tool respectively GES assessment for EO9 is conditioned with progress on setting thresholds.
25	OWG Participants	The participants requested from MEDPOL and its expert team to prepare a written explanation that should collate the explanations provided during the first session of OWG regarding adjustments of the NEAT tool to IMAP.	This has been provided in the report of the NEAT application in the Adriatic sub-region
26	Spain	Recheck formulation related to use of TOC as a normalizer for PAHs versus comment provided in that respect for the Monitoring Guideline for CI 17 during Integrated CorMon held in December 2020;	The Secretariat – MAO: the comment of Spain was taken into account; however one more check will be undertaken, considering preferable use of TOC as normalizer in some other countries. A paragraph was added to revised document 492/inf.11 (Section 2.2.5).

27	OWG Participants	Integrated use of data on contaminants and biological effects was specified, including the approach presented in UNEP/MED 492/6	Given the scarcity of data this approach was presented as a direction for the future work; however it cannot be used for the preparation of 2023 MED QSR.
28	Spain	Asked for correction of the note added in UNEP/MED WG.492/12: Table 4 pg 10. ”It is recommended to monitor CI18 (in bivalves) in offshore areas… by replacing “in bivalves” with “in alternative fish target species”.	We could not find this note in the document. Table 4 is not for CI18 and page 10 does not have this note.
	Consultation of the MAO/ MedPol Expert with the OWG member on 2 Sept 2021 (e-mail correspondence)	**Should the pre-industrial concentrations be set as BC, or we should follow more pragmatic and achievable goal to set the criteria as the reference concentrations and not background pre-industrial concentrations**	
	Consultation of the MAO/ MedPol Expert with the OWG member on 10 Sept 2021 (e-mail correspondence)	**Analysis on how to manage/handle BDL (below detection limit) data to calculate background concentrations (BCs) and criteria**	
	REPLIES		
29	France	Pre-industrial concentrations should be set as BC	Pre-industrial levels are a non achievable goal for GES. However, the enrichment factors (concentration in reference areas/ concentration in sediment core) could be used to assess the change from the pre-industrial area to today, and it would be a good exercise. This was added to the revised 492/inf.11 document
30	France	The setting of BC values and related BAC values is continuing process, aiming at better, more precise assessments of chemical pollution in marine environments. Therefore, the BC values must be regularly	That is true. This can be achieved only with more data (QC/QA)

		revised and supplemented with a new data for all regions.	
31	France	This is because, we need to assess how far we are from background for naturally occurring elements (metals) and organic contaminants such as PAHs?	This is a not a question MEDPOL needs to answer. This is a very important scientific questions, however, as you state below, MEDPOL is looking for making the evidence of the needs related to more accurate assessment of the present environmental status
31	France	The importance of work on background concentration cannot be oversized. Our group should clearly recommend for further efforts on this topic.	Agreed, and we hope to get more comments from the OWGs colleagues and more data
32	France	I do not agree that BC values from sediment cores may be not representative of a larger area /region. The metal and PAH BCs from pre-industrial dated sediment cores are quite certainly reference values for sub-regional geological settings (to be defined) and could be considered as reference for sub-regional assessments. Additionally, usually they are obtained with a number of samples – not a single data value.	Each sediment core gives you one value and its standard deviation. Also we need to have data from dated sediment cores from many areas to calculate one value. That may be easier for metals than for PAHs. For PAHs there is an uncertainty about the local environment at the time of sedimentation, changes in concentration due to selective decomposition or degradation of the different compounds
33	France	**There is no comprehensive (common) methodology to determine natural background (pre-industrial) concentrations for the contaminants in biota** Approaches to date have largely focused on using data that is collected from so-called “remote”/ “pristine” areas to determine background concentrations for the assessment region. In this context, we may consider some basic criteria for identifying a remote/pristine area (i.e. likely to have very low anthropogenic inputs). Specifically, such areas should: i) be remote from industry or large costal population	Values computed from biota sampled from reference stations are considered reference concentrations as opposed to background concentrations that are not available from sediment cores. The reference concentrations are used to determine the environmental status of an area.

		urban centres; ii) be subject to limited marine and atmospheric transportation ie. currents and prevailing wind direction; and iii) not be appreciably influenced by major riverine basin discharges. These BC values derived from such areas should be considered as “low concentrations”. However, they are not proposed as natural background concentrations.	
34	France	We are not in a position to quality check, if contributing parties had a uniform understanding of the terms “reference stations / conditions” and choice of the data for BCs derivation.	The data were analyzed statistically, as a whole and not by country, for the determination of the proper reference stations. The methodology used was the same as in the previous assessment. The assumption is that the countries reported QC/QA data.
35	France	A number of alternative methods of estimating pre-industrial BCs in biota were suggested and these may offer possibilities as a further check that any proposed BCs from “remote areas” are in the correct range. These methods, mainly for contaminants in marine mollusks are (not fully developed here): The magnitude of the increase in ambient concentrations of specific substances in a specific area from pre-industrial times to the present day could be estimated from sediment cores. The present-day concentration for mussels in the same area could be divided by this enrichment factor to estimate the pre-industrial concentrations in mussels. This could be applicable for both metals and PAHs. BC in biota ≅ Cbiota-parameter/EFparameter =	The use of the proposed formula BC in biota ≅ Cbiota-parameter/EFparameter = Cbiota-parameter/(Csed current/ Csed pre-in assumes that enrichment factors are the same in sediment and biota. Moreover it assumes to be the same for all biota species. It is known that different species bioaccumulate contaminants differently.

		Cbiota-parameter/(Csed current/ Csed pre-in	
36	France	Pre-industrial concentration of individual contaminants in sediment determined from sediment cores could be used to calculate theoretical BCs for biota. This could be calculated using bioconcentration models; Use of data from deep ocean measurements as potentially pristine areas (probably this is very limited and relatively high concentration of contaminants were found in deep marine species	. The concentration in biota is species dependent and the deep marine species are not found in the monitoring areas set within IMAP/MEDPOL.
37	Italy	Italy with agrees with France for the general approach for sediments. The use of enrichment factor (EF) for sediments could be useful to solve the "Dilemma ". (i) are the BC concentrations found before the industrial revolution or ii) should the BC concentrations be the ones found today at reference areas. The values of the pre-industrial revolution are determined from dated sediment cores while the BCs from reference areas are calculated from surficial sediments). With regards biota we think that the proposal BC calculation BC in biota ≅ Cbiota-parameter/EFparameter = Cbiota-parameter/(Csed current/ Csed pre-in	The enrichment factors (concentration in reference areas/ concentration in sediment core) could be used to assess the change from the pre-industrial area to today, and it would be a good exercise. However, we do not think we should use the pre-industrial concentrations for GES assessment With regards to biota, MedPol do not think that applying an EF factor to biota is scientifically correct.

		could be only valid for benthonic species, not for pelagic species. Could other factors (BAF, BCF etc) be applied?	
38	Italy, Spain, France	BDL values should not be excluded from calculation. They should be replaced with with BDL/2.	The decision to replace BDL with the reported value or a fraction of it should be based on the available data and expert evaluation.
39	Israel	While I also agree to some of the BDL (LOD) considerations, would like to note the following: 1. For acceptable/agreed percentage of BDL values (EPA suggest less than 15% of non-detects), BDL/2 can be used. 2. The use of LOQ/2 may bias the assessment because it is significantly larger than LOD. Suggest using only LOD/2 if possible. 3. If the censored data (all detected and non-detected) includes high percentage of BDLs we may use the statistical approach suggested by the EPA 4. or simplify the approach as above noting a potential lower level of confidence.	1. Yes, that is essentially what we proposed. In the new revised document, annex III gives the percentage of BDLs from the total data 2. You are correct however we have to use the values provided by the CPs. We are looking for CPs to provide LODs. 3. Yes, this is the question. Many statistical approaches are presented in the literature cited. 4. This lower level of confidence could be reflected in the BACs derivation - such as use a larger multiplication factor of the BCs. The choice of the approach to be taken will depend on the available data. The decided approach will be conveyed and transparent to the CPs.
40	**France**		**Specific response to France's comments, sent on October 20th, 2021. See also answers above that address the same topics as in the October's comments**
41		Pre-industrial levels of metals and PAHs from dated sediment cores should be use to derive BC/BAC values for	The pre-industrial level of concentrations is a non achievable goal for GES. Therefore, we as the MEDPOL/Secretariat do not share the opinion regarding the use of the pre-industrial concentrations for GES assessment.

		sediments. Further efforts on this matter are recommended. In the presented document there is no clear distinction between surface sediment data and sediment core data.	However, the enrichment factors (concentration in reference areas/ concentration in sediment core), which is also suggested by France, can be used to assess the change from the pre-industrial area to today, and it would be a good exercise. On a different note, the calculation of EF requires important input information and significant work to be undertaken. Each sediment core gives one value and its standard deviation. Also, there is a need for data from dated sediment cores from many areas to calculate one value. That may be easier for metals than for PAHs. For PAHs, there is uncertainty about the local environment at the time of sedimentation, changes in concentration due to selective decomposition, or degradation of the different compounds. In line with present situation of data available to MAP/MEDPOL from all sources, including scientific literature sources shared from the OWG members, we can confirm that we may pilot calculation of EE for TM and PAHs in sediments. MED POL can start this pilot exercise, upon getting internal approval, however within the limitation as presented above. This work would result in more information on the present status of the marine environment to be shared with the CPs, however not relating the GES goals with pre-industrial concentrations.
42		There is no comprehensive (common) methodology to determine natural background (pre-industrial) concentrations for the contaminants in biota.	This is a correct finding. It is the reason for defining the reference values based on data on the concentrations of the contaminants in biota samples collected at the reference stations.
43		The basic scientifically sound criteria for identifying a reference station/conditions - in remote/pristine area (i.e. likely to have very low anthropogenic inputs) should be clearly stated in the document. The actual method presented in the document does not allow to eliminate stations with relatively high anthropogenic inputs. A list of reference stations with their selection crietria should be prepared.	The methodology used to determine reference concentrations is presented in Section 2.2, WG492/12: "The methodology for the determination of Background concentration (BC) used by UNEP/MAP". More details are provided in UNEP/MAP WG.492/Inf 11. More than presented in that section is impossible for MEPOL/MAP to provide. It is not a new methodology, but it was already defined in the document UNEP(DEPI)/MED WG.427/Inf.3 that served as a basis for setting the assessment criteria that were approved in IMAP Decision. During the revision of the documents discussed at the Meeting of CorMON, the methodology was improved to the maximum possible considering the availability of data reported from the countries.

			Namely, the CPs do not report anthropogenic inputs. In the IMAP_IS Data Dictionaries, there is a requirement to define area typology and pressures. However, data reported from the countries do not include any data related to anthropogenic inputs. Regarding the list of reference stations, please note that IMAP IS also requires reporting types of stations. However, CPs rarely report the type of stations. Therefore, when we use data for calculation of the assessment criteria, we have to consult the Focal Points whether data were reported at the stations that are considered reference stations. Therefore, we could not provide the list of reference stations, since countries do not report the type of stations in IMAP IS. Instead, we cross-check data in direct consultations with the focal points. Regarding criteria for setting reference stations, the specific criteria were not formalized in IMAP Decision. However, during the support provided to the countries to prepare new IMAP Pollution and ML Monitoring Programmes, MEDPOL advised setting reference areas in pristine nature; preferably areas like MPAs, far distant from anthropogenic pressures. Setting these criteria within the present document elaborating the assessment criteria is not appropriate, but these elements may be added in IMAP Decision once the decision is made to amend it.
44		The lack of consensus criteria for reference station selection may lead to imbalanced GES assessment**.**	We do not understand well this comment. Please be re-assured that MEDPOL does not use any data set for calculation of BC/BAC values without checking with the focal point whether data are reported at the reference station in case it is not indicated in the data sets reported to IMAP IS.
45		A number of alternative methods for estimating pre-industrial BCs in biota were suggested and should be further discussed in the frame of GTL and on-going work**.**	This point could be further discussed. However, we provide responses of MEDPOL to points raised by France and Italy (see points 36-37 above). We explained that use of enrichment factors calculated in sediments, is not sound for biota. Namely, that approach assumes the factor is the same in sediment in biota. Moreover, it assumes that it is the same in all species. An additional idea was to use measurements from deep marine species. However, the concentration in biota is species dependent and the deep marine species are not found in the monitoring areas set within IMAP/MEDPOL.

Annex II:
Data from the relevant scientific literature sources

Review of relevant scientific literature

The papers that include data relevant for this document are summarized below. This revised document includes also the papers recommended by the OWG- Contaminants, and new papers from the literature. The specific data retrieved from the documents and used for criteria calculation or as comparison to the criteria are detailed in the tables of Annex II. It is important to note that the scientific 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. The review below is organized by the Mediterranean sea sub-regions and within them, by COPs in alphabetical order. Only parameters relevant to IMAP were elaborated.

Western Mediterranean Sea (WMS)

Algeria

Ahmed, I., B. Mostefa, A. Bernard, and R. Olivier. 2018. Levels and ecological risk assessment of heavy metals in surface sediments of fishing grounds along Algerian coast. Marine Pollution Bulletin 136:322-333.

Trace metals (Cd, Pb) were measured in fifty-one sediment samples collected from the Algerian coast in May-June 2015, from 18 to 562 m depth. The study covered the whole Algerian coast, that was divided into 3 regions. Only the results statistics (average, standard deviation, minimum and maximum concentration) are available for each of the 3 areas along the Algerian coast. In addition, the authors proposed reference background concentrations for the area, derived from the analysis of 3 three sediment cores collected in the Bay of Algiers, between 40 and 100m water depth. The proposed backgrounds for Pb and Cd were higher than the average concentrations measured in the surficial sediments along the coast. The data were used for comparison to the MedBCs in this document.

Benali, I., Z. Boutiba, D. Grandjean, L. F. de Alencastro, O. Rouane-Hacene, and N. Chèvre. 2017. Spatial distribution and biological effects of trace metals (Cu, Zn, Pb, Cd) and organic micropollutants (PCBs, PAHs) in mussels *Mytilus galloprovincialis* along the Algerian west coast. Marine Pollution Bulletin 115:539-550.

Organic contaminants (PCBs, PAHs) and trace metals (Pb, Cd) were measured in wild mussel populations of *M. galloprovincialis* collected from 6 stations along the Algerian West coast during the 2014 winter season. Out of the 6 stations, two were described as possible references and were used in the calculation or comparison of BCs in this document. All data for organic contaminants were available, while for TM only ranges, averages and standard deviations were reported.

France

Briant, N., T. Chouvelon, L. Martinez, C. Brach-Papa, J. F. Chiffoleau, N. Savoye, J. Sonke, and J. Knoery. 2017. Spatial and temporal distribution of mercury and methylmercury in bivalves from the French coastline. Marine Pollution Bulletin 114:1096-1102.

Hg and methyl-Hg concentrations were measured in the mussel *M. galloprovincialis* collected from 17 stations located along the French Mediterranean coast. Sampling took place during the first semester (February and March) of 2014, to avoid seasonal variations of concentrations. The authors also address the possible size dependence of the concentrations. Data were available and used in the calculation of BC in this document.

Elbaz-Poulichet, F.; Dezileau, L.; Freydier, R.; Cossa, D.; Sabatier, P. (2011). A 3500-year record of Hg and Pb contamination in a Mediterranean sedimentary archive (The Pierre Blanche Lagoon, France). Environ. Sci. Technol. 2011, 45 (20), 8642−8647.

One sediment core was collected in 2006 at the eutrophic Pierre Blanche Lagoon, France. The core was sliced, the different slices dated and the concentration of Hg and Pb measured. The concentrations of Hg and Pb were given in the supplement for all the slices. The BC concentrations (pre-industrial) were for Hg 0.017± 0.003 ug/g (17 ± 3 ug/kg) (n=54). For Pb, I calculated BC from the data given, and the result was 24.0 ± 5.2 ug/g (24000 ± 5200 ug/kg) (n=54).

France. Cathalot C., Rabouille C., Tisnerat-Laborde N., Toussaint F., Kerherve P., Buscail R., Loftis K., Sun M.Y., Tronczynski J., Azoury S., Lansard B., Treignier C., Pastor L., Tesi T. (2013). The fate of river organic carbon in coastal areas: A study in the Rhone River delta using multiple isotopic (Δ13C, Δ14C) and organic tracers. *Geochimica et Cosmochimica Acta* 118, 33-55

This paper is not useful for BC calculation because the sediments were collected at an area with anthropogenic influence. The Total PAH concentrations ranged from 2000 to 2400 ug/kg. Sampling was conducted from 2006 to 2009

Chouvelon, T., E. Strady, M. Harmelin-Vivien, O. Radakovitch, C. Brach-Papa, S. Crochet, J. Knoery, E. Rozuel, B. Thomas, J. Tronczynski and J.-F. Chiffoleau (2019). "Patterns of trace metal bioaccumulation and trophic transfer in a phytoplankton-zooplankton-small pelagic fish marine food web." Marine Pollution Bulletin 146: 1013-1030

This paper presents the concentrations of trace metals in seawater, plankton, sardine and anchovy from the Gulf of Lions and is not relevant for setting BC for CI-17. Moreover, the samples were collected in 2010 and 2011

Tronczyński, J., Tixier, C. and Laute, F. (2008). R.INT.DOPL/BE_LBCO/Nantes/08 – 04. Contaminants organiques persistants dans les sédiments de l'étang de Thau : bilan, historique et comportement

A report on the organic pollution of the Thau Lagoon. PAHs, PCBs and organochlorine pesticides were measured in sediments of the Lagoon and surrounding areas. Sampling of surficial sediments and sediment cores took place in 2004. Only data from dated sediment cores should be included in the database. The tables in the report give the pre-industrial concentrations for total PAHs (calculated from the concentrations measured from 62 to 74 cm in the sediment core). They also present the low concentration levels for total PCBs and total DDT as calculated from the concentrations measured from 24 to 26 cm and from 28 to 30 cm, respectively, in the sediment core. These could be added to the database. In addition to the core sampled in 2004 at station T11(near Sete) , an additional core was collected at the same station in 2005. Also, cores were collected from station T12, C4 (center lagoon) and T2 (western side of the Lagoon). The report presents figures with the depth distribution of the contaminants. As PCBs and DDTs are from anthropogenic source, the pre-industrial levels are zero. For PAHs, the report presents the depth distribution of total PAHs (Sum of 13 compounds).

Italy

Esposito, G., A. G. Mudadu, M. C. Abete, S. Pederiva, A. Griglione, C. Stella, S. Ortu, A. M. Bazzoni, D. Meloni, and S. Squadrone. 2021. Seasonal accumulation of trace elements in native Mediterranean mussels (Mytilus galloprovincialis Lamarck, 1819) collected in the Calich Lagoon (Sardinia, Italy). Environmental Science and Pollution Research.

Trace metals (Cd, Hg, Pb) were measured in the mussel *M. galloprovincialis* collected from the euthrophic Calich Lagoon, northwest Sardinia, in 2017. Samplings were conducted in spring, summer and autumn of 2017. The data were given as range, mean and standard deviation for each season. Hg concentrations were higher in the summer, while no significant seasonal variation was found for Cd and Pb. The concentration ranges reported were: Cd – 0.014-0.20 mg/kg ww; Hg- 0.011-0.021 mg/kg ww and Pb- 0.041-0.71 mg/kg ww. Possible seasonal variability in concentrations is an additional factor to be taken into account during BC determination. Data were used for comparison in this document.

Esposito, M., S. Canzanella, S. Lambiase, A. Scaramuzzo, R. La Nucara, T. Bruno, G. Picazio, G. Colarusso, R. Brunetti and P. Gallo (2020). "Organic pollutants (PCBs, PCDD/Fs, PAHs) and toxic metals in farmed mussels from the Gulf of Naples (Italy): Monitoring and human exposure." Regional Studies in Marine **Science** **40:** 101497.

Contaminant (heavy metals (Cd, Hg, Pb), PAHs, PCBs and PCDD/Fs) were measured in mussels (Mytilus galloprovincialis) farmed into the waters of the Gulf of Naples and Domitio littoral (Italy), areas heavily influenced by human activities. Sampling took place from 2016 to 2019. Table 1 presents the range, mean, standard deviation of Cd, Pb and Hg (mg/kg wet weight) in mussel tissues from three sampling sites from January 2016 to December 2019.They also present ranges for PAH and PCBs. No raw data available. The concentrations could be used as "checks" for the BC determination.

Guerranti, C., E. Grazioli, S. Focardi, M. Renzi and G. Perra (2016). "Levels of chemicals in two fish species from four Italian fishing areas." Marine Pollution Bulletin 111(1): 449-452.

PCB's and PAHs only in the liver of M. barbatus, off the Italian coast. Not relevant for BC calculation

Morocco

Azizi, G., M. Layachi, M. Akodad, D. R. Yáñez-Ruiz, A. I. Martín-García, M. Baghour, A. Mesfioui, A. Skalli, and A. Moumen. 2018. Seasonal variations of heavy metals content in mussels (*Mytilus galloprovincialis*) from Cala Iris offshore (Northern Morocco). Marine Pollution Bulletin 137:688-694.

Trace metals (Cd, Pb) concentrations were measured in soft tissues of *M. galloprovincialis* collected from an aquaculture farm in Cala Iris sea of Al Hoceima. The mussels were sampled monthly from January to December 2016. Cd concentrations depended on the season, and ranged from an average 0.89 mg/kg dw in winter to 0.65 mg/kg dw in summer. Pb concentrations were <0.03 mg/kg dw. Data were used for comparison in this document.

Azizi, G., M. Layachi, M. Akodad, A. I. Martin-Garcia, D. R. Yanez-Ruiz, M. Baghour, H. A. Hmeid, H. Gueddari and A. Moumen (2021). "Bioaccumulation and health risk assessment of trace elements in Mytilus galloprovincialis as sea food in the Al Hoceima coasts (Morocco)." E3S Web of Conferences 240, 01002 (2021).

The monthly variations in metal concentration of Cadmium (Cd), Zinc (Zn) and Chromium (Cr) were determined in tissues of *Mytilus galloprovincialis* and seawater obtained from the mussel farm installed along the Al Hoceima coasts, during the sampling period of 2018. No raw data are presented. Average (?) Cd concentration 0.812 mg/kg Dry wt. The concentrations could maybe be used as "checks" for the BC determination

Spain

Campillo, J. A., B. Fernández, V. García, J. Benedicto, and V. M. León. 2017. Levels and temporal trends of organochlorine contaminants in mussels from Spanish Mediterranean waters. Chemosphere 182:584-594.

Organochlorine contaminants (PCBs and Pesticides) were measured in the mussel *M. galloprovincialis* collected along the Spanish Mediterranean coast from, 2000 to 2013. Sampling took place in 24 areas, with varying degrees of contamination during the months of May and June. The designated reference areas were the protected marine reserves (Medas and Columbretes Islands) or the marine protected area of La Herradura. The determinations were performed in pooled samples of 8 specimens within one size interval, 3.0-3.9 cm, showing that size may influence concentration. Most of the data were not recent, but they were used to determine the temporal trends in the concentrations of these contaminants. The authors provided calculated background concentrations for PCBs and p,p'-DDE in the mussel. Those can be used for comparison.

León, V. M., L. Viñas, E. Concha-Graña, V. Fernández-González, N. Salgueiro-González, C. Moscoso-Pérez, S. Muniategui-Lorenzo, and J. A. Campillo (2020), Identification of contaminants of emerging concern with potential environmental risk in Spanish continental shelf sediments, Science of the Total Environment, 742, 140505

Contaminants of emerging concern and "traditional" contaminants such as PAHs, PCBs and organochlorinated pesticides were measured in characterized in 29 surface sediments from two Spanish Iberian continental shelf areas (14 on the Atlantic and 15 on the Mediterranean coasts). Sediment sampling in the Mediterranean took place in 2011 (Alboran subregion) and in 2012 (Spanish

Levantine-Balearic subregion). The data presented are not recent and correspond with data on PAH reported from Spain in the MEDPOL data base that were used in previous assessments (i.e. 2017 MED QSR and SoED) and therefore were not used for the present upgrade. However, the work provides data for contaminants that may be included in future Mediterranean assessment, and may serve as a baseline for them.

Martínez-Guijarro, R., M. Paches, I. Romero, and D. Aguado. 2019. Enrichment and contamination level of trace metals in the Mediterranean marine sediments of Spain. Science of the Total Environment 693:133566.

Trace metals (Cd, Hg, Pb) were measured in sediment samples collected along the Valencian community coastline, in 2010-2012 and 2015. Most of the data were not recent. However, the authors provided the baseline concentrations for the area: Cd- 0.24 mg/kg; Hg- 0.06 mg/kg; Pb- 8.6 mg/kg. Cd concentrations in the North-central areas were higher than in the southern area of the Valencian coast, probably due to natural differences due to different natural minerology. Hg and Pb concentrations were not significantly different among the areas. Data were used for comparison in this document.

Santos-Echeandía, J., J. A. Campillo, J. A. Egea, C. Guitart, C. J. González, C. Martínez-Gómez, V. M. León, C. Rodríguez-Puente and J. Benedicto (2021). "The influence of natural vs anthropogenic factors on trace metal(loid) levels in the Mussel Watch programme: Two decades of monitoring in the Spanish Mediterranean sea." Marine Environmental Research 169: 105382.

The authors use data up to 2013. There are citations of BC and BAC from other programs as well as suggested values based on present study. The concentrations could maybe be used as “checks” for the BC determination.

Adriatic Sea (ADR)

Croatia

Mandic Jelena, Tronczynski Jacek, Kuspilic Grozdan (2018). Polycyclic aromatic hydrocarbons in surface sediments of the mid-Adriatic and along the Croatian coast: Levels, distributions and sources . *Environmental Pollution* , 242(Part A), 519-527 .

PAHs were determined in surficial sediments collected in 2013 from the mid Adriatic, along the Croatian coast and in a transect from Split offshore. The concentrations of the individual PAHs were not presented, only the total concentrations of the parent PAHs and the total concentrations of the alkylated PAHs. The median concentrations along the transect were much lower than the concentrations found along the shore. The concentrations of the summed total PAHs along the transect ranged from 11.7 to 282 ug/kg. For comparison, the BC concentration of total PAHs calculated for the Adriatic Sea and presented in document 492/12 was 218 ug/kg.

Sulimanec Grgec, A., Z. Kljaković-Gašpić, T. Orct, V. Tičina, A. Sekovanić, J. Jurasović and M. Piasek (2020). "Mercury and selenium in fish from the eastern part of the Adriatic Sea: A risk-benefit assessment in vulnerable population groups." Chemosphere 261: 127742.

In total, 717 individuals of 12 fish species were collected by pelagic trawl net at 48 different locations in the coastal and open waters of the eastern part of the Adriatic Sea in September 2014 and 2016, within the framework of the European Union MEDiterranean International Acoustic Survey (MEDIAS) project. Mullus barbatus was one the species. Median and range given in the paper. No raw data in the supplement.

Italy

Frapiccini, E., M. Panfili, S. Guicciardi, A. Santojanni, M. Marini, C. Truzzi and A. Annibaldi (2020). "Effects of biological factors and seasonality on the level of polycyclic aromatic hydrocarbons in red mullet (Mullus barbatus)." Environmental Pollution 258: 113742.

This study evaluates the effects of biological factors of fish and seasonality on Polycyclic Aromatic Hydrocarbon (PAH) accumulation in red mullet (Mullus barbatus) tissue. Specimens were collected monthly in an offshore fishing ground in the Northern and Central Adriatic Sea (Geographical Sub

Area 17 – Italy, northern and central Adriatic) throughout 2016. The edible fillets of 380 individuals were analyzed for the concentrations of individual PAH, total PAH, and low, medium and high molecular weight (MW) PAHs. Table 1 in the paper gives the average and standard deviation of the concentrations for the individual congeners and total PAHs. The supplementary material does not give the raw data. The concentrations could be used as “checks” for the BC determination. It should be noted that there are no data in IMAP-IS for PAH in M. barbatus in the Adriatic.

Spagnoli, F., R. De Marco, E. Dinelli, E. Frapiccini, F. Frontalini and P. Giordano (2021). "Sources and Metal Pollution of Sediments from a Coastal Area of the Central Western Adriatic Sea (Southern Marche Region, Italy)." Applied Sciences 11(3).

This paper presents the concentrations of Pb in surficial sediments collected at different stations in a localized area in the central Adriatic off Italy collected in April 2010. Al concentrations were measured in the samples as well. There was a linear correlation between Al and Pb, indicating the concentrations to be natural. The average Pb concentration, without 3 outliers, was 11.31 ± 3.84 mg/kg (11310 ± 3840 ug/kg). All Cd concentrations were below 0.3 mg/kg and of Hg, below 1 mg/kg

Tavoloni, T., R. Miniero, S. Bacchiocchi, G. Brambilla, M. Ciriaci, F. Griffoni, P. Palombo, T. Stecconi, A. Stramenga and A. Piersanti (2021). "Heavy metal spatial and temporal trends (2008–2018) in clams and mussel from Adriatic Sea (Italy): Possible definition of forecasting models." Marine Pollution Bulletin 163: 111865.

In 2008–2018, 1458 georeferenced samples of clams and 343 of mussels (M. galloprovincialis) were harvested in Italy from classified areas along Marche coast and analyzed. Pb, Cd, (V, Ni, Cr, and As) median levels (mg/ kg wet wt.) were 0.09, 0.08, 0.29, 0.77, 0.35, and 2.35 in clams and 0.16, 0.15, 0.46, 0.48, 0.25, and 3.34 in mussels. The reported levels were comparable with the published ones, and Hg always fell below LOQ (0.025 mg/ kg wet wt). The paper gives the data statistics and temporal trends. The supplement provides one value per time period . The concentrations could maybe be used as “checks” for the BC determination. ADR (800 and 750 ug/kg dry wt, Pb and Cd, respectively)

Montenegro

Jović Mihajlo, Slavka Stanković 2014. Human exposure to trace metals and possible public health risks via consumption of mussels Mytilus galloprovincialis from the Adriatic coastal area Food Chem Toxicol. 2014 Aug;70:241-51.

The concentrations of Cd, Hg and Pb were measured in the mussel M. galloprovincialis collected from 7 locations at the Boka Kotorska Bay, Montenegro, in winter, spring and summer of 2009. Cd ranged from 0.90 to 2.69 mg/kg dry wt (900 to 2690 ug/kg dry wt), Hg from 0.14 to 2.651 mg/kg dry wt (140 to 2651 ug/kg dry wt) and Pb from 1.90-8.91 mg/kg dry wt (1900 to 8910 ug/kg dry wt). Data from Montenegro are in the IMAP database. Moreover, the data is from before 2015 and will not be re-used.

Joksimović Danijela and Slavka Stanković 2012: Accumulation of trace metals in marine organisms of the southeastern Adriatic coast, J. Serb. Chem. Soc. 77 (1) 105–117 (2012).

Sediments and M. galloprovincialis were collected in the fall of 2005 from 5 locations of the Montenegrian coast. The data may be in the IMAP database. In any case, the data are from before 2015 and will not be used in BC calculation.

Central Mediterranean Sea (CEN)

Italy

Bonsignore, M., S. Tamburrino, E. Oliveri, A. Marchetti, C. Durante, A. Berni, E. Quinci, and M. Sprovieri. 2015. Tracing mercury pathways in Augusta Bay (southern Italy) by total concentration and isotope determination. Environmental Pollution 205:178-185.

Hg concentrations were measured in sediment and fish from the Augusta Bay, Sicily, during June 2012. The bay was considered extremely polluted with Hg due to the discharges from a chlor-alkali plant. The data were available from the paper. However, the concentrations in the sediments were very high (14.7 ± 12.3 mg/kg) and not taken into consideration. The concentrations in the various fish species (median of 340 mg/kg ww) were also high. They are mentioned in Annex II but were not taken into the BC calculation.

Cammilleri, G., P. Galluzzo, A. Pulvirenti, I. E. Giangrosso, G. M. Lo Dico, G. Montana, N. Lampiasi, M. A. Mobilia, A. Lastra, M. Vazzana, A. Vella, P. La Placa, A. Macaluso and V. Ferrantelli (2020). "Toxic mineral elements in Mytilus galloprovincialis from Sicilian coasts (Southern Italy)." Natural Product Research 34(1): 177-182.

A total of 3180 samples of *Mytilus galloprovincialis* of similar size were sampled during 2016 from 10 large urban agglomerations, high industrial activities and national interest sites of Sicily (Barcellona Pozzo di Gotto, Catania, Gela, Licata, Messina, Milazzo, Palermo, Siracusa, Termini Imerese and Trappeto). Trappeto samples were considered as control group because of their distance from urban and industrial agglomerations. Graphs of average concentrations are given in the supplement. No raw data. V, Cr, Mn, Hg, As, Cd, Sn, Sb and Pb. The concentrations could be used as "checks" for the BC determination.

Traina, A., G. Bono, M. Bonsignore, F. Falco, M. Giuga, E. M. Quinci, S. Vitale and M. Sprovieri (2019). "Heavy metals concentrations in some commercially key species from Sicilian coasts (Mediterranean Sea): Potential human health risk estimation." Ecotoxicology and Environmental Safety 168: 466-478.

Trace elements were measured in the edible tissues of fish, among them Mullus barbatus, collected in some of the main ports of the Sicilian coast (southern Italy) in 2015. The specimens were collected in fish markets, therefore cannot be given a station position. Although the concentrations should not be used for the determination of BC, due to the missing sampling location, they could be used as "checks" for the BC determination. The paper reports the mean, standard deviation and range for As, Cd, Hg and Pb

Traina, A., A. Ausili, M. Bonsignore, D. Fattorini, S. Gherardi, S. Gorbi, E. Quinci, E. Romano, D. Salvagio Manta, G. Tranchida, F. Regoli and M. Sprovieri (2021). "Organochlorines and Polycyclic Aromatic Hydrocarbons as fingerprint of exposure pathways from marine sediments to biota." Marine Pollution Bulletin 170: 112676

Organochlorine contaminants (PCBs, HCB), PAHs and Hg were analyzed in marine sediments and organisms (finfish, shellfish species and *Mytilus galloprovincialis*) collected from the CONTAMINATED Augusta Bay (Southern Italy). Sediments were sampled in 2017 and mussel in 2013 and 2017. Also there are some data on M. barbatus that were collected from fishermen. Raw data for Hg, PCB and PAH in sediments are given in the Supplement. The area is contaminated. Data cannot be used for BC calculation but could be used for NEAT application.

Tunisia

Jebara, A., V. Lo Turco, A. G. Potortì, G. Bartolomeo, H. Ben Mansour, and G. Di Bella. 2021. Organic pollutants in marine samples from Tunisian coast: Occurrence and associated human health risks. Environmental Pollution 271:116266.

Organic contaminants (PAHs, PCBs and pesticides) were measured in sediments and in fish (*Sparus aurata* and *Sarpa salpa*) muscle tissue collected from five stations along the Tunisian coast between May 2018 and March 2019. No station was characterized as reference or hot spot. The data were presented as an average and standard deviation for each sampling station and compound. In this document, the concentrations reported are the averages of the station's averages for each compound (Tables A3.4-A3.5, Annex II).

Naifar, I., F. Pereira, R. Zmemla, M. Bouaziz, B. Elleuch, and D. Garcia. 2018. Spatial distribution and contamination assessment of heavy metals in marine sediments of the southern coast of Sfax, Gabes Gulf, Tunisia. Marine Pollution Bulletin **131**:53-62.

Trace metals (Cd, Pb) were measured in surface marine sediments collected from the Southern coastal line of Sfax to the northern edge of the Gabes Gulf (south-east of Tunisia) in March 2016. The study was localized, covering an area approximately of 4.3 km^2. Chemical analysis was performed on the particle size fraction of<63 µm. Only ranges, averages and standard deviations were reported. Most of the sites studied were polluted. The authors also report background values for the area, calculated from the concentrations in marine sediments collected 8 km away from the study area. Those were used for comparison in this document.

Zaghden, H., M. Tedetti, S. Sayadi, M. M. Serbaji, B. Elleuch, and A. Saliot. 2017. Origin and distribution of hydrocarbons and organic matter in the surficial sediments of the Sfax-Kerkennah channel (Tunisia, Southern Mediterranean Sea). Marine Pollution Bulletin 117:414-428.

Polycyclic aromatic hydrocarbons (PAHs) and organic matter (OM) were measured in surficial sediments of the Sfax- Kerkennah channel in the Gulf of Gabès. OM and PAH concentrations ranged 2.3–11.7% dw and 175–10,769 ng/g sed. dw, respectively. The sampling took place in January 2005 therefore the data were not taken for the calculation of the updated BC. The study is mentioned here as it could be used for temporal assessment.

Aegean Levantine Sea (AEL)

Egypt

El Baz, S. M., and M. M. Khalil. 2018. Assessment of trace metals contamination in the coastal sediments of the Egyptian Mediterranean coast. Journal of African Earth Sciences 143:195-200.

Trace metals (Cd, Pb) were measured in sediments from the central Egyptian coast, from El Mex to Port Said. The sampling date was not mentioned. The data were reported as ranges and averages. Cd ranged from 0.06 to 0.42 mg/kg with average of 0.16 mg/kg and Pb from 5.3 to 57 mg/kg with average 14.8 mg/kg. The authors used the concentrations in shale as background values. Data were given for comparison in this document.

Greece

Karageorgis, A. P., F. Botsou, H. Kaberi, and S. Iliakis. 2020. Geochemistry of major and trace elements in surface sediments of the Saronikos Gulf (Greece): Assessment of contamination between 1999 and 2018. Science of the Total Environment 717:137046.

Pb was measured in sediments from the Saronikos Gulf, Greece. The paper presents data on a long time series, from 1999 to 2018. For this document, only data since 2016 were taken into account (2016: n = 14; 03/2017: n = 13; 09/2017: n =22; 10/2017: n = 15; 11/2017: n = 23; 01/2018: n = 28). The authors also determined background concentrations using sediment cores. The BCs were different and specific for each of the 5 areas of the Saronikos Gulf.

Israel

Astrahan, P., J. Silverman, Y. Gertner and B. Herut (2017). "Spatial distribution and sources of organic matter and pollutants in the SE Mediterranean (Levantine basin) deep water sediments." Marine Pollution Bulletin 116(1): 521-527.

Surficial sediments were collected in 2013 from 54 station off the Israeli coast at water depths from 250 to about 1700 m. Total PAHs and total PCBs were measured in the samples, together with Total organic carbon (TOC). The supplemental material presents the concentrations of the individual PAHs and the individual PCBs congeners (PCB-28, 52, 101, 118, 138, 153 and 180). Although sampled in 2013, data could be used in the calculation of BC values for PAH in sediments

Lebanon

Ghosn, M., C. Mahfouz, R. Chekri, B. Ouddane, G. Khalaf, T. Guérin, R. Amara, and P. Jitaru. 2020. Assessment of trace element contamination and bioaccumulation in algae (*Ulva lactuca*), bivalves (*Spondylus spinosus*) and shrimps (*Marsupenaeus japonicus*) from the Lebanese coast. Regional Studies in Marine Science 39:101478.

Trace metals (Cd, Hg, Pb) were measured in 3 sediment samples and in the soft tissue of bivalve (*Spondylus spinosus*) collected from 3 sites along the Lebanese coast during the dry and wet seasons in 2017. Saida (site 3) is less impacted and possible reference, however, concentrations in sediments from all 3 stations were taken for the calculation of BCs in this document.

Ghosn, M., C. Mahfouz, R. Chekri, G. Khalaf, T. Guérin, P. Jitaru, and R. Amara. 2020. Seasonal and Spatial Variability of Trace Elements in Livers and Muscles of Three Fish Species from the Eastern Mediterranean. Environmental Science and Pollution Research 27:12428-12438.

Trace metals (Cd, Hg, Pb) were measured in liver and muscle tissue of two demersal fish species (*Siganus rivulatus* and *Lithognathus mormyrus*) and one pelagic species (*Etrumeus teres)* collected from 3 sites along the Lebanese coast during the dry and wet seasons in 2017. Data was given as statistics per site and season. The data presented in Table A3.3, Annex II, are the average of averages concentrations reported for the muscle tissue.

Azoury S., Tronczyński J., Chiffoleau JF., Cossa D., Nakhlé K., Schmidt S., Khalaf G. (2013). Historical records of Hg, Pb and PAH depositions in a dated sediment core from the Eastern Mediterranean. *Environ. Sci. Technol.* 47, 7101-7109.

One sediment core was collected in 2007 off the Lebanese coast at 300 m water depth. The core was sliced, the different slices dated and the concentration of Hg, Pb and PAHs measured. The concentrations of Hg and Pb were given in the supplement for all the slices. The BC concentrations (pre-industrial) were for Hg 0.013± 0.002 ug/g (13 ± 2 ug/kg) (n=39) and for Pb 11.3± 0.74 ug/g (11300 ± 740 ug/kg) (n=39). The concentrations of the individual PAHs were not presented, only the total concentrations of the parent PAHs and the total concentrations of the alkylated PAHs. Those were 10.4 ± 2.8 ng/g and 5.7 ± 1.6 ng/g (ug/kg), respectively (n=23). The authors shared with us an excel file with data for the specific PAHs and also Cd concentrations. Even though the data are from before 2015, because they are from sediment cores they could be used for BC calculation if deemed reasonable

Libya

Al-Kazaghly, R., M. Hamid and K. A. Ighwela (2021). "Bioaccumulation of some Heavy Metals in Red mullet (Mullus barbatus) and Common pandora (Pagellus erythrinus) in Zliten Coast, Libya." Jurnal Ilmiah Perikanan dan Kelautan 13: 91.

Fish purchased from fisherman, no sampling date. Average and standard deviation given for Cu, Zn, Pb, Cd, and Hg in various tissues of the fish. The concentrations were measured by AAS, therefore, not sure about Hg concentrations. In addition, samples were dried at 105 C, not recommended for Hg determination. Concentrations are given in ppm wet wt. The concentrations could maybe be used as “checks” for the BC determination.

Turkey

Kucuksezgin, F., L. T. Gonul, I. Pazi, B. Ubay and H. Guclusoy (2020). "Monitoring of polycyclic aromatic hydrocarbons in transplanted mussels (Mytilus galloprovincialis) and sediments in the coastal region of Nemrut Bay (Eastern Aegean Sea)." Marine Pollution Bulletin 157: 111358. AEL

Sediment samples were obtained from seven stations and three sampling points were used for transplanted mussels. Site 7 was selected as reference site in this study. *Mytilus galloprovincialis* were sampled from a nonpolluted area (Foca) located out of the southern Candarlı Gulf in April 2016 and April 2017. Raw data on the PAHs are given in sediment. Station 7 – reference, could be used for BC calculation. However, looking at the concentrations, the values are way too high to be background – ie. 0.14 mg/kg (140 ug/kg) for naphthalene. The paper presents also concentrations of PAHs in M. galloprovincialis from the Foca reference region, before transplantation, that could be used for BC calculation or as “checks”.

Mediterranean Sea

Rizzi, C., S. Villa, C. Chimera, A. Finizio and G. S. Monti (2021). "Spatial and temporal trends in the ecological risk posed by polycyclic aromatic hydrocarbons in Mediterranean Sea sediments using large-scale monitoring data." Ecological Indicators **129**: 107923.

This paper may be very useful, conceptually. Rizzi et al. collected data from the literature on PAH’s in sediments from the 1980’s to 2019. Data were collected both from locations influenced by anthropogenic activities, such as industrial areas, megacities, and harbours, and from areas not highly impacted by anthropogenic pressure. Each concentration value in the dataset (given in supplement 2) is the mean calculated or reported by the original authors, together with the standard deviation and the number of observations for each sampling site.

The study was aimed (i) to reconstruct spatial and temporal trends in the risk posed by PAHs to benthic communities in Mediterranean sediments and (ii) to identify the prevalent sources of PAH contamination in the Mediterranean Sea. The authors utilized the ERM (effects range median, Long et al., 1995) and PEL (Probable effect level). They also state that they used SQG (sediment quality guidelines) from Directive 2013/39/EU – However, in that directive there are no criteria for sediments.

Annex III:
Critical examination of the new data used to calculate and propose updated BC and BAC values

Critical examination of the new data used to calculate and propose updated BC and BAC values

Details of the data available from the four data sources, as explained in section 3 are given below. They are sorted by parameters (trace metals, organic contaminants, organochlorine contaminants) and matrices (sediment, mussel and fish).

In general, and if sufficient, all data from IMAP, MEDPOL and EMODnet were used in the calculation of proposed updated MedBC. Values identified as outliers were not used in the calculation. The calculation was performed also using the limit of detection (LOD) or the limit of quantitation (LOQ) values provided by the countries (see Annexes I and section 4.1), addressed as below detection limit (bdl) values. In a separate technical paper, prepared by MEDPOL in consultations with OWG, it was recommended to incorporate into the BC calculations the bdl values and not to exclude them. Exclusion of the bdl concentrations might artificially increase the calculated BC value (see Annex I)42. The bdl values for a specific contaminant in a specific matrix were different, depending on the country and even different for the same country (see below), at time encompassing a wide range.

Trace metals (Cd, Hg, Pb) in sediments

An overview of the data available for the calculation of new updated background concentrations (BC) of trace metals in sediments is presented in Table A3.1.

A total of 958, 821 and 1061 data points were available for Cd, Hg and Pb, respectively, in sediments, for the whole Mediterranean. The percentage of bdl values ranged from 7 to 20% of the total data points and the percentage of outliers from 13 to 22%. For all sub-regions bdl values ranged from 0 to 35% of the total data points, except for Cd and Hg in the CEN (100 and 74%, respectively). The percentage of outlier points ranged from 0 to 26% of the total data points in the sub-regions. As expected, the mean values computed from all data points were higher than the medians, due to the presence of the outliers with high concentrations. The proposed BCs taken as the median of the data without the outliers` values were lower than the median calculated from all points, as expected. As stated in section 4 (see also Table 10), the new proposed MedBC is higher for Cd and slightly lower for Hg and Cd than the values endorsed by UNEP/MAP (Decision IG.23/6)

[42] In a separate technical paper, prepared by MEDPOL in consultations with OWG, it was suggested to ” Replace BDL values with a fraction of the reported value. The fraction could be 1 (BDL value), 0.5 (BDL/2), 0.7 (BDL/SQRT(2)), other” and not exclude bdls in BC calculation. The decision to replace BDL with the reported value of a fraction of it should be based on the available data and expert evaluation. Italy, Spain and France supported the use of LOD/2 or LOQ/2 in the BCs calculation. Israel pointed out that the US- EPA suggests this only when less than 15% of the data is BDLs. For this document, the calculation was performed with the reported value and not half of it. This is because the wide range of bdl values for a specific contaminant in a specific matrix, depending on the country and even within the country.

Table A3.1. Overview of the data available for calculation of the assessment criteria for trace metals (Cd, Hg, Pb) in sediments for the whole Mediterranean and for each sub-region. The table presents the total number of data points available from all sources, also shown in Table 6, the number of below detection limit (bdl) and the percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 10 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in µg/kg dw, as requested by IMAP.

	Cd_MED	**Hg_MED**	**Pb_MED**	**Cd_WMS**	**Hg_WMS**	**Pb_WMS**	**Cd_ADR**	**Hg_ADR**	**Pb_ADR**	**Cd_CEN**	**Hg_CEN**	**Pb_CEN**	**Cd_AEL**	**Hg_AEL**	**Pb_AEL**
Data points															
Total number of data points	**958**	**821**	**1061**	**400**	**314**	**375**	**336**	**294**	**349**	**31**	**31**	**31**	**191**	**182**	**306**
Number of bdl values	188	135	71	114	104	59	27	5	1	31	23	11	15	21	0
% bdl from total data points	20	16	7	29	33	16	8	2	0	100	74	35	8	12	0
Number of outlier values	155	180	134	49	73	57	36	76	24	0	7	2	33	35	34
% outliers from total data points	16	22	13	12	23	15	11	26	7	0	23	6	17	19	11
Concentration, all data points															
Median	130	76	17000	210	90	18000	133	67	16500	#	#	2355	102	44.2	19357
Mean	875	331	33352	1703	284	46153	228	527	24861	#	#	10208	420	95.8	29691
Concentration, without outliers															
Median - Proposed BC	**107**	**50**	**15000**	**140**	**90**	**16000**	**120**	**50**	**15700**	#	#	**1805**	**78.9**	**31.5**	**15674**
n	803	641	927	351	241	318	300	218	325	31	24	29	158	147	272
***Med BCs**	**85**	**53**	**16950**												
*Med BACs	127.5	79.5	25425												
*Med EACs	1200	1500	46700												

* Decision IG.23/6. MedBCs were calculated by dividing MedBAC by 1.5. # most data bdl

Trace metals (Cd, Hg, Pb) in biota

An overview of the data available for the calculation of new updated background concentrations (BC) of trace metals in IMAP mandatory biota is presented in Table A3.2 for the soft tissue of the mussel M. galloprovincialis and in Table A3.3 for the muscle tissue of the fish M. barbatus. Data available for other species were given in Annex IV.

A total of 166, 318 and 160 data points for *M. galloprovincialis* were available for Cd, Hg and Pb, respectively for the whole Mediterranean (Table A3.2). In general, the relative number of bdls and outliers were low. The percentage of bdl values ranged from 1 to 13% of the total data points and the percentage of outliers from 1 to 8%. The number of data points was higher for the ADR, followed by the WMS. Only 4-8 data points were available for the CEN. No new data was available for the AEL.

For the WMS and ADR sub-regions, the bdl constituted 0 - 15 % of the total data points, and the outliers 0-9% of the total data points in the sub-regions. Comparison among the proposed values for the different regions is given in section 4 (see also Table 12). The new proposed MedBCs are lower than the ones endorsed by UNEP/MAP (Decision IG.23/6).

Table A3.2. Overview of the data available for calculation of the assessment criteria for trace metals (Cd, Hg, Pb) in the soft tissue of *M. galloprovincialis* for the whole Mediterranean and for available sub-region. The table presents the total number of data points available from all sources, also shown in Table 6, the number of below detection limit (bdl) and the percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 12 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in μg/kg dw, as requested by IMAP.

	Cd MED	**Hg MED**	**Pb MED**	**Cd WMS**	**Hg WMS**	**Pb WMS**	**Cd ADR**	**Hg ADR**	**Pb ADR**	**Cd CEN**	**Hg CEN**	**Pb CEN**
Data points												
Total number of data points	**166**	**318**	**160**	**53**	**128**	**53**	**109**	**182**	**103**	**4**	**8**	**4**
Number of bdl values	2	39	21	1	11	0	0	24	15	1	1	4
% bdl from total data points	1	12	13	2	9	0	0	13	15	25	13	100
Number of outlier values	1	18	12	0	7	2	1	14	9	0	0	0
% outliers from total data points	1	6	8	0	5	4	1	8	9	0	0	0
Concentration, all data points												
Median	710	81.5	1136	1030	94.9	1260	630	80.6	1059			
Mean	743	132	2676	971	123	1241	650	143	3509			
Concentration, without outliers												
Median - Proposed BC	**710**	**77.9**	**1100**	**1030**	**85.0**	**1260**	**629**	**75.4**	**1000**	**78**	**12**	**#**
n	165	300	148	53	121	51	108	168	94	4	8	
***Med BCs**	**730**	**115.5**	**1542**									
*Med BACs	1095	173.2	2313									
*Med EACs	5000	2500	7500									

* Decision IG.23/6. MedBCs were calculated by dividing MedBAC by 1.5. # All data bdl

A total of 111, 110 and 63 data points for *M. barbatus* were available for Cd, Hg and Pb, respectively, for the whole Mediterranean (Table A3.3). In general, the relative number of bdls was low, except for Cd that ranged from 32 to 42% of the total data points. In the CEN, the 5 data points for Cd and for Pb were bdl. The relative number of outliers was low. The main data originated from the AEL (78 and 79% for Cd and Hg, respectively and 62% for Pb), followed by the ADR. The ADR included data only from Croatia and Montenegro, and there were differences between the two countries. Cd and Pb for Montenegro were bdl (< 50 mg/kg wet wt) but higher than the concentrations reported for Croatia, while Hg values for Montenegro were not bdl and about 6 times higher than the concentrations reported for Croatia. Only 5 data points were available for the CEN and none for the WMS sub-region.

Comparison among the proposed values for the different regions is given in section 4 (see also Table 12). Shortly, the proposed BC concentrations were lower in the AEL than in the ADR and CEN. Due to the large contribution of the AEL, the MED BC are only slightly higher than the BC calculated for the AEL The new proposed MedBC for Cd is similar to the BC endorsed by UNEP/MAP (Decision IG.23/6), while for Hg and Pb they are lower.

Table A3.3. Overview of the data available for calculation of the assessment criteria for trace metals (Cd, Hg, Pb) in the muscle tissue of the fish *M. barbatus* for the whole Mediterranean and for available sub-region. The table presents the total number of data points available from all sources, also shown in Table 6, the number of below detection limit (bdl) and the percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 12 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in µg/kg wet wt, as requested by IMAP.

	Cd MED	**Hg MED**	**Pb MED**	**Cd ADR**	**Hg ADR**	**Pb ADR**	**Cd CEN**	**Hg CEN**	**Pb CEN**	**Cd AEL**	**Hg AEL**	**Pb AEL**
Data points												
Total number of data points	**111**	**110**	**63**	**19**	**18**	**19**	**5**	**5**	**5**	**87**	**87**	**39**
Number of bdl values	41	0	13	8	0	8	5	0	5	28	0	0
% bdl from total data points	37	0	21	42	0	42	100	0	100	32	0	0
Number of outlier values	13	13	5	1	0	0		1		0	6	0
% outliers from total data points	12	12	8	5	0	0		20		0	7	0
Concentration, all data points												
Median	4.7	45.6	19.9	5.3	120	40.8	#	161	#	3.6	35.0	13.5
Mean	14.3	116	39.4	23.9	331	37.5		571		7.2	45.7	13.3
Concentration, without outliers												
Median - Proposed BC	**3.9**	**40.6**	**18.3**	**5.3**	**120**	**40.8**		**153**		**3.6**	**33.7**	**13.5**
n	98	97	58	19	18	19		4		87	81	39
***Med BCs**	**#3.7**	**50.6**	**#31**									
*Med BACs	#3.7	101.2	#31									
*Med EACs	50	1000	300									

* Decision IG.23/6. MedBCs were calculated by dividing MedBAC by 2 unless most of the data were bdl. # All data bdl.

The range of the bdl values reported by the CPs for trace metals in sediments and biota are shown in Table A3.4

Table A3.4. Range of limit of detection (LOD) or limit of quantitation (LOQ) values for trace metals, as reported by the contracting parties. Min- Minimum value reported, Max – Maximum value reported. Additional values are the values reported between the Min and Max.

Sediment (µg/kg dw)			
	Min	**Max**	**Additional values**
Cd	0.3	400	10,20,50,90,100,120,200,233,250
Hg	0	100	1.5,4,5,15,20,90
Pb	10	9000	50
Biota, *M. galloprovincialis* (µg/kg dry wt)			
Cd	**Min**	**Max**	**Additional values**
Hg	0.5	5	
Pb	0	100	0.25,0.5,10,20,30
Cd	2.5	250	200
Biota, *M. barbatus* (µg/kg wet wt)			
	Min	**Max**	**Additional values**
Cd	17.5	50	
Hg	No bdls		
Pb	50	250*	

* the highest reported value

Organic contaminants (PAHs) in sediments

An overview of the data available for the calculation of new updated background concentrations (BC) of of PAHs in sediments is presented in Table A3.5. Even though the sum of 16 PAHs is not a parameter endorsed by UNEP/MAP it is recommended to add it as a mandatory IMAP CI-17 monitoring parameter and therefore appears in the table. The number of data points available for the whole Mediterranean ranged from 234 to 530, depending on the compound. The percentage of bdl values ranged from 1 to 80% of the total data points and the percentage of outliers from 14 to 27% for the whole Mediterranean. Data were available for all sub-regions, with most data from the ADR, followed closely by the WMS. The AEL had about a third of the number of data point of the ADR while the CEN had very limited data.
The new proposed MedBCs for 8 compounds (Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Benzo(a)pyrene, Benzo(g,h,i)perylene, Dibenzo[a,h]anthracene, Indeno(1,2,3-cd)pyrene) were calculated with more the 50% of the values below detection limit. Data for 9 compounds in the WMS, 5 in the ADR and 6 in the AEL were constituted of more than 50% bdls. A comparison of the proposed regional and sub-regional BCs is given in section 4 (see also Table 11).

Organic contaminants (PAHs) in biota (*M. galloprovincialis*)

An overview of the data available for the calculation of new updated background concentrations (BC) of PAHs in the mussel *M. galloprovincialis* is presented in Table A3.6. Even though the sum of 16 PAHs is not a parameter endorsed by UNEP/MAP it is recommended to add it as a mandatory IMAP CI-17 monitoring parameter and therefore appears in the table. The number of data points available for the whole Mediterranean ranged from 50 to 153, depending on the compound. The percentage of bdl values ranged from 12 to 90% of the total data points and the percentage of outliers

from 2 to 25% for the whole Mediterranean. Data were available only for the WMS and ADR sub-regions, with more data from the WMS.
The new proposed MedBCs for 5 compounds (Acenaphthylene, Acenaphthene, Benzo(a)pyrene, Dibenzo[a,h]anthracene, Indeno(1,2,3-cd)pyrene) were calculated with more the 50% of the values below detection limit. In the WMS, data for 3 compounds were constituted of more than 50% bdls, while in the ADR, data for all compounds, except Phenanthrene, were mostly bdl. A comparison of the proposed regional and sub-regional BCs is given in section 4 (see also Table 13).

The range of the bdl values reported by the CPs for PAHs in sediments and biota are shown in Table A3.7.

Organochlorinated contaminants (PCBs and pesticides) in sediments

An overview of the data available for the calculation of new updated background concentrations (BC) of PCBs and pesticides in sediments is presented in Table A3.8. The number of data points available for the whole Mediterranean ranged from 75 to 486, depending on the compound. The percentage of bdl values ranged from 10 to 95% of the total data points, the most bdl values for the pesticides. The percentage of outliers ranged from 2 to 17% for the whole Mediterranean. Data were available for all sub-regions, with most data from the ADR, followed by the WMS and the AEL. The CEN sub-region had very limited data.

The new proposed MedBCs for the 4 pesticides (Lindane, p,p'-DDE, Hexachlorobenzene and Dieldrin) were calculated with more the 50% of the values below detection limit.. A comparison of the proposed regional and sub-regional BCs is given in section 4 (see also Table 14). The new proposed MedBCs are much lower than the criteria MedEACs endorsed by UNEP.

Organochlorinated contaminants (PCBs and pesticides) in biota (*M. galloprovincialis*)

An overview of the data available for the calculation of new updated background concentrations (BC) of PCBs and pesticides in the mussel M. galloprovincialis   is presented in Table A3.9. The number of data points available for the whole Mediterranean ranged from 14 to 143, depending on the compound. The percentage of bdl values ranged from 0 to 93% of the total data points. The data for the pesticides (Lindane, Hexachlorobenzene and Dieldrin) were mostly bdl. The percentage of outliers ranged from 0 to 21% for the whole Mediterranean. Data were available only for the WMS and ADR sub-regions, with slightly more data for the ADR.

The new proposed MedBCs for 3 pesticides (Lindane, Hexachlorobenzene and Dieldrin) were calculated with more the 50% of the values below detection limit, while MedBC for p,p'-DDE, was calculated with 11 data points. A comparison of the proposed regional and sub-regional BCs is given in section 4 (see also Table 14). The new proposed MedBCs are much lower than the criteria MedEACs endorsed by UNEP.

The range of the bdl values reported by the CPs for Organochlorinated contaminants in sediments and biota are shown in Table A3.10.

Table A3.5. Overview of the data available for calculation of the assessment criteria for PAHs in sediments for the whole Mediterranean and for each sub-region. The table presents the total number of data points available from all sources, shown also in Table 7, the number data points below detection limit and their percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 11 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in µg/kg dw, as requested by IMAP.

		naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	benzo(b)fluoranthene	benzo(k)fluoranthene	benzo(a)pyrene	benzo(g,h,i)perylene	Dibenzo[a,h]anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
Total number of data points																		
	MED	288	243	322	329	265	531	486	315	332	324	368	410	501	470	325	472	234
	WMS	29	29	104	104	29	265	244	104	104	91	176	183	242	242	103	242	29
	ADR	183	157	166	168	179	184	165	154	176	176	140	175	177	176	170	177	129
	CEN	24	5		5	5	30	25	5		5			30				5
	AEL	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	71
Number of bdl values																		
	MED	101	194	227	152	33	347	162	20	74	46	77	163	236	202	158	207	2
	WMS	0	15	51	39	0	156	122	5	12	2	60	78	139	145	31	148	0
	ADR	80	127	124	75	31	138	26	15	62	43	17	61	64	56	78	59	2
	CEN	21	0		0	0	18	14	0		0			15				0
	AEL	0	52	52	38	2	35	0	0	0	1	0	24	18	1	49	0	0
%bdl from total data points																		
	MED	35	80	70	46	12	65	33	6	22	14	21	40	47	43	49	44	1
	WMS	0	52	49	38	0	59	50	5	12	2	34	43	57	60	30	61	0
	ADR	44	81	75	45	17	75	16	10	35	24	12	35	36	32	46	33	2
	CEN	88	0		0	0	60	56	0		0			50				0
	AEL	0	100	100	73	4	67	0	0	0	2	0	46	35	2	94	0	0
Number of outlier values																		
	MED	71	34	44	59	53	79	129	76	71	80	76	75	104	100	79	88	56
	WMS	5	4	34	16	4	53	40	16	17	16	32	36	41	37	14	41	3
	ADR	18	25	27	29	24	44	22	22	21	20	19	22	23	21	27	22	22
	CEN	2	0		0	0	2	2	0		0			2				0
	AEL	3	0	0	11	4	17	5	9	2	3	2	6	4	3	2	1	11
% outliers from total data points																		
	MED	25	14	14	18	20	15	27	24	21	25	21	18	21	21	24	19	24
	WMS	17	14	33	15	14	20	16	15	16	18	18	20	17	15	14	17	10
	ADR	10	16	16	17	13	24	13	14	12	11	14	13	13	12	16	12	17
	CEN	8	0		0	0	7	8	0		0			7				0

		naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	benzo(b)fluoranthene	benzo(k)fluoranthene	benzo(a)pyrene	benzo(g,h,i)perylene	Dibenzo[a,h]anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
	AEL	6	0	0	21	8	33	10	17	4	6	4	12	8	6	4	2	15
Concentration, all data points																		
Median	MED	2.10	1.00	2.00	2.00	5.00	4.00	10.0	12.0	5.90	7.00	10.0	4.80	5.00	9.10	2.00	7.10	42.0
Mean		13.4	4.25	9.00	13.6	58.8	57.9	348	181	95.2	101	215	87.6	182	144	24.8	151	971
Median	WMS	8.80	0	5.00	5.00	22.5	7.87	10.0	35.5	25.3	46.7	10.0	8.00	10.0	10.0	8.00	10.0	166
Mean		18.4	6.2	10.6	24.8	122	89.1	504	352	196	259	352	158	275	240	55.3	252	724
Median	ADR	2.00	2.00	2.00	2.00	5.00	2.00	8.50	11.0	5.25	6.05	15.0	4.00	5.70	7.60	2.00	5.10	50.1
Mean		12.6	5.07	10.5	10.9	65.9	15.7	121	129	63.2	51.9	123	39.8	72.7	53.9	13.7	55.1	1570
Median	CEN	0.10	0.40		0.35	0.80	0.10	0.10	0.42		1.57			0.77				6.34
Mean		37.6	0.54		0.42	1.13	140	1042	1.37		1.47			396				7.87
Median	AEL	2.30	1.00	1.00	1.00	3.15	1.00	2.70	3.30	1.80	1.60	2.60	1.00	1.00	1.90	1.00	2.10	23.8
Mean		2.32	1.00	1.00	1.00	4.52	0.97	4.65	9.79	1.85	1.76	2.66	1.07	1.16	1.96	0.99	2.15	51.6
Median Concentration, without outliers – Proposed BC																		
	MED	2.0	(1.0)#	(2.0)#	(2.0)#	3.1	(2.2)#	5.0	6.2	3.4	2.7	5.0	4.0	(4.0)#	(4.2)#	(1.0)#	(4.0)#	27.4
	n	*217*	*209*	*278*	*270*	*212*	*452*	*357*	*239*	*262*	*244*	*292*	*335*	*397*	*370*	*246*	*384*	*178*
	WMS	8.0		5.0		14.9			24.8	19.7	35.9	8.7				7.0		160.0
	n	*24*	*25*	*70*	*88*	*25*	*212*	*204*	*88*	*87*	*75*	*144*	*147*	*201*	*205*	*89*	*201*	*26*
	ADR	2.0				3.5		7.0	8.0	4.1	4.6	15.0	3.0	4.0	5.7		4.4	41.0
	n	*165*	*132*	*139*	*139*	*155*	*140*	*143*	*132*	*155*	*156*	*121*	*153*	*154*	*155*	*143*	*155*	*107*
	CEN		0.4		0.4	0.8			0.4		1.6							6.3
	n	22	5		5	5	28	23	5		5			28				5
	AEL	2.3				3.1		2.7	3.0	1.8	1.6	2.6		1.0	1.8		2.1	21.4
	n	*49*	*52*	*52*	*41*	*48*	*35*	*47*	*43*	*50*	*49*	*50*	*46*	*48*	*49*	*50*	*51*	*60*
*Med EACs		160[&]				240	85	600	660	261	384			430	85		240	4022[&]

* Decision IG.23/6. # Most data bdl. & ERL values exist but not endorsed by UNEP

Table A3.6. Overview of the data available for calculation of the assessment criteria for PAHs in the soft tissue of the mussel *M. galloprovincialis* for the whole Mediterranean and for each available sub-region. The table presents the total number of data points available from all sources, shown also in Table 7, the number data points below detection limit and their percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 12 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in μg/kg dw, as requested by IMAP.

		naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	benzo(b)fluoranthene	benzo(k)fluoranthene	benzo(a)pyrene	benzo(g,h,i)perylene	Dibenzo[a,h]anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
Total number of data points																		
	MED	50	50	50	92	94	94	147	93	108	94	123	123	153	123	94	123	64
	WMS	29	29	29	71	73	73	103	72	73	73	73	73	103	73	73	73	29

		naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a] anthracene	Chrysene	benzo(b) fluoranthene	benzo(k) fluoranthene	benzo(a) pyrene	benzo(g,h,i)perylene	Dibenzo[a,h] anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
	ADR	21	21	21	21	21	21	44	21	35	21	50	50	50	50	21	50	35
Number of bdl values																		
	MED	16	45	41	39	23	38	60	28	30	11	39	41	87	46	75	73	6
	WMS	0	25	23	23	20	25	30	15	4	0	0	0	40	5	55	26	0
	ADR	16	20	18	16	3	13	30	13	26	11	39	41	47	41	20	47	6
%bdl from total data points																		
	MED	32	90	82	42	24	40	41	30	28	12	32	33	57	37	80	59	
	WMS	0	86	79	32	27	34	29	21	5	0	0	0	39	7	75	36	
	ADR	76	95	86	76	14	62	68	62	74	52	78	82	94	82	95	94	
Number of outlier values																		
	MED	10	11	1	4	7	7	17	17	18	22	17	16	19	16	12	12	16
	WMS	9	9	6	3	5	8	17	10	18	19	17	16	23	14	18	22	10
	ADR	4	0	0	0	2	0	21	3	0	2	11	10	10	11	0	10	7
% outliers from total data points																		
	MED	20	22	2	4	7	7	12	18	17	23	14	13	12	13	13	10	25
	WMS	31	31	21	4	7	11	17	14	25	26	23	22	22	19	25	30	34
	ADR	19	0	0	0	10	0	48	14	0	10	22	20	20	22	0	20	20
Concentration, all data points																		
Median	MED	0.61	0.30	0.50	2.50	14.23	1.34	7.63	3.60	0.93	4.48	1.42	1.00	1.00	1.00	0.13	1.00	9.50
Mean		4.66	0.81	1.15	11.2	40.3	4.36	15.6	18.9	7.7	18.7	6.2	3.4	3.1	4.3	0.6	3.1	89.3
Median	WMS	0.57	0.05	0.05	8.60	21.1	1.04	10.0	9.38	1.53	6.23	2.56	1.25	1.00	1.80	0.08	0.45	6.61
Mean		5.22	0.34	0.86	14.1	50.9	5.08	21.1	23.5	10.9	23.2	9.55	4.71	3.92	5.92	0.29	4.34	119
Median	ADR	2.50	0.50	1.80	0.80	2.50	2.50	2.00	2.50	0.50	1.85	1.00	1.00	1.00	1.00	2.50	1.00	12.0
Mean		3.88	1.45	1.55	1.50	3.24	1.85	2.66	3.29	1.03	3.13	1.42	1.42	1.28	1.90	1.66	1.27	64.8
Median Concentration, without outliers – Proposed BC																		
	MED	0.56	(0.05)#	(0.50)#	2.5	5.35	1.12	4.83	2.5	0.6	2.54	1	1	(1.00)#	1	(0.10)#	(0.63)#	5.8
	n	*40*	*39*	*49*	*88*	*87*	*87*	*130*	*76*	*90*	*72*	*106*	*107*	*134*	*107*	*82*	*111*	*48*
	WMS	0.52			7.87	19.9	0.94	10	5.54	0.69	2.98	1.36	0.73	0.94	0.67		0.29	5.6
	n	*20*	*20*	*23*	*68*	*68*	*65*	*86*	*62*	*55*	*54*	*56*	*57*	*80*	*59*	*55*	*51*	*19*
	ADR					2.25												6.6
	n	*17*	*21*	*21*	*21*	*19*	*21*	*23*	*18*	*35*	*19*	*39*	*40*	*40*	*39*	*21*	*40*	*25*
***Med BCs**					1.7	11.9	0.8	4.9	3.3	1.3	1.6		0.9	0.8	1.5	0.9	1.9	
*Med BACs					2.5	17.8	1.2	7.4	5	1.9	2.4		1.4	1.2	2.3	1.3	2.9	
*Med EACs						1700	290	110	100	80			260	600	110			

* Decision IG.23/6. MedBCs were calculated by dividing MedBAC by 1.5. # Most data bdl.

Table A3.7. Range of limit of detection (LOD) or limit of quantitation (LOQ) values for Polycyclic Aromatic Hydrocarbons (PAHs), as reported by the contracting parties. Min- Minimum value reported, Max – Maximum value reported. Additional values are the values reported between the Min and Max.

	naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	anthracene	fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	benzo(b)fluoranthene	benzo(k)fluoranthene	benzo(a)pyrene	benzo(g,h,i)perylene	Dibenzo[a,h]anthracene	indeno(1,2,3-cd)pyrene	TOTAL 16 PAHs
Sediment (µg/kg dw)																	
Min	0.1	0.0	0.0	0.0	0.5	0.1	0.1	0.2	0.2	0	0.2	0	0	0	0	0	0.1
Max	10	15	15	5	2	15	10	5	15	5	15	15	15	15	5	15	10
Additional values	0.5, 1,2	0.5,1,2	0.2, 0.5, 1,2, 5	0.2,0.5,1,2	1	0.1,0.2, 0.5,1,2, 2.2,4,5, 10	0.2, 4,5	1	0.5,1, 2,5	0.2, 1, 2	1,4, 5,10	0.2, 1,2, 4,5, 10	0.1,0.2,0.5, 1,2,4, 5,10	0.2,0.5,1, 2,4,5,10	0.2, 0.5, 1,2	0.5,0.8,1,2, 4,5,10	
Biota, *M. galloprovincialis* (µg/kg dry wt)																	
Min	0.5	0.05	0.05	0.0	0.0	0.0	0.5	0.0	0.005	0.5	0.5	0.5	0	0	0	0	0
Max	2.5	2.5	2.5	2.5	2.5	2.5	10	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Additional values		0.2,0.5	0.5	0.08,0.5	0.5, 1	0.07,0.1,0.2,0.5	2,2.5	0.12,0.2, 0.5	0.4, 0.5		1,1.5	1,1.5	0.01,0.02,0.5,0.6, 1,1.5	0.1,0.5,0.6,1,1.5	0.01,0.5,0.6	0.05,0.1,0.2, 0.5,1, 1.5	

Table A3.8. Overview of the data available for calculation of the assessment criteria for Organochlorinated contaminants (PCBs and pesticides) in sediments for the whole Mediterranean and for each available sub-region. The table presents the total number of data points available from all sources, shown also in Table 8, the number data points below detection limit and their percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 13 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in µg/kg dw, as requested by IMAP.

		PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	Sum 7 PCBs	Lindane	p,p'-DDE	Hexachloro benzene	Dieldrin
Total number of data points													
	MED	315	273	260	266	268	268	273	215	486	75	376	110
	WMS	79	79	79	79	79	79	79	86	244	29	176	0
	ADR	167	125	117	118	120	120	125	41	178	41	178	41
	CEN	5	5	0	5	5	5	5	5	0	5	22	5
	AEL	64	64	64	64	64	64	64	83	64	0	0	64
Number of bdl values													
	MED	108	55	68	35	72	38	81	22	388	42	256	105
	WMS	37	33	25	14	17	12	26	10	240	6	117	
	ADR	71	22	8	8	13	16	27	3	125	35	117	41
	CEN	0	0		5	0	0	0	0		1	22	0
	AEL	0	0	35	8	42	10	28	9	23			64
%bdl from total data points													
	MED	34	20	26	13	27	14	30	10	80	56	68	95
	WMS	47	42	32	18	22	15	33	12	98	21	66	
	ADR	43	18	7	7	11	13	22	7	70	85	66	100
	CEN	0	0		100	0	0	0	0		20	100	0
	AEL	0	0	55	13	66	16	44	11	36			100
Number of outlier values													
	MED	44	30	33	44	35	42	37	36	12	11	51	5
	WMS	5	10	11	18	13	10	12	15	2	3	20	
	ADR	30	13	16	13	15	18	17	10	10	6	23	0
	CEN	0	0		0	0	0	0	0		0	0	0
	AEL	7	4	9	9	10	10	9	15	0			0
% outliers from total data points													
	MED	14	11	13	17	13	16	14	17	2	15	14	5
	WMS	6	13	14	23	16	13	15	17	1	10	11	
	ADR	18	10	14	11	13	15	14	24	6	15	13	0
	CEN	0	0		0	0	0	0	0		0	0	0
	AEL	11	6	14	14	16	16	14	18	0			0
Concentration, all data points													
Median	MED	0.10	0.09	0.12	0.17	0.19	0.26	0.10	1.12	0.10	0.10	0.10	0.00
Mean		0.21	0.45	1.21	348	2.20	2.93	1.68	440	0.09	0.56	0.16	0.07
Median	WMS	0.10	0.10	0.23	0.70	0.37	0.48	0.20	2.94	0.06	0.25	0.10	
Mean		0.26	0.64	1.99	1169	2.81	3.60	1.95	1084	0.08	0.81	0.18	
Median	ADR	0.10	0.10	0.20	0.21	0.28	0.34	0.17	0.40	0.10	0.10	0.10	0.10
Mean		0.21	0.54	1.32	1.10	3.00	4.10	2.40	32.26	0.12	0.42	0.16	0.10
Median	CEN	0.11	0.11		0	0.10	0.17	0.13	2.13		0.31		0.63
Mean		0.11	0.11		0	0.10	0.19	0.15	2.13		0.29		0.66
Median	AEL	0.11	0.04	0	0.02	0	0.02	0.003	0.22	0.02			
Mean		0.14	0.06	0.04	0.05	0.09	0.11	0.07	1.13	0.04			
Median Concentration, without outliers – Proposed BC													
	MED	0.1	0.07	0.1	0.1	0.11	0.14	0.09	0.4	(0.1)#	(0.1)#	(0.1)#	(0)#
	n	*271*	*243*	*227*	*222*	*233*	*226*	*236*	*179*	*474*	*64*	*325*	*105*
	WMS		0.1	0.16	0.46	0.26	0.4	0.13	1.6		0.23		
	n	*74*	*69*	*68*	*61*	*66*	*69*	*67*	*71*	*242*	*26*	*156*	*0*
	ADR		0.09	0.16	0.18	0.24	0.28	0.13	0.21				
	n	*137*	*112*	*101*	*105*	*105*	*102*	*108*	*31*	*168*	*35*	*155*	*41*
	CEN	0.11	0.11			0.10	0.17	0.13	2.13		0.37		0.63
	n	5	5	0	5	5	5	5	5	0	4	22	5
	AEL	0.09	0.04		0.01		0.02		0.19	0.02			
	n	*57*	*60*	*55*	*55*	*54*	*54*	*55*	*68*	*64*	*0*	*0*	*64*
*Med EACs		1.7	2.7	3	0.6	7.9	40	12	11.5	3	2.2	20	2

* Decision IG.23/6. # Most data bdl.

Table A3.9. Overview of the data available for calculation of the assessment criteria for Organochlorinated contaminants (PCBs and pesticides) in the soft tissue of the mussel *M. galloprovincialis* for the whole Mediterranean and for each available sub-region. The table presents the total number of data points available from all sources, shown also in Table 8, the number data points below detection limit and their percentage from the total, the number of outliers and their percentage from the total, the median and mean concentrations for all data points and the median concentration calculated without the outliers. The latter is the proposed updated BC concentrations, also given in Table 14 (Section 4). The criteria endorsed by UNEP/MAP is presented for comparison. The concentrations are given in μg/kg dw, as requested by IMAP.

		PCB 28	**PCB 52**	**PCB 101**	**PCB 118**	**PCB 138**	**PCB 153**	**PCB 180**	**Sum 7 PCBs**	**Lindane**	**p,p'-DDE**	**Hexachloro benzene**	**Dieldrin**
Total number of data points													
	MED	**83**	**108**	**83**	**60**	**113**	**113**	**83**	**60**	**67**	**14**	**143**	**37**
	WMS	43	43	43	20	43	43	43	20	37	14	87	37
	ADR	40	65	40	40	70	70	40	40	30		56	
Number of bdl values													
	MED	29	31	13	14	5	4	26	4	62	0	107	29
	WMS	12	8	6	5	0	0	6	0	37	0	56	29
	ADR	17	23	7	9	5	4	20	4	25		51	
%bdl from total data points													
	MED	35	29	16	23	4	4	31	7	93	0	75	78
	WMS	28	19	14	25	0	0	14	0	100	0	64	78
	ADR	43	35	18	23	7	6	50	10	83		91	
Number of outlier values													
	MED	17	6	7	4	11	9	10	2	0	3	3	2
	WMS	0	0	0	0	0	0	0	0	0	3	0	0
	ADR	0	0	0	0	0	0	0	0	0		0	
% outliers from total data points													
	MED	20	6	8	7	10	8	12	3	0	21	2	5
	WMS	0	0	0	0	0	0	0	0	0	21	0	0
	ADR	0	0	0	0	0	0	0	0	0		0	
Concentration, all data points													
Median	MED	0.20	0.40	1.30	1.41	2.83	4.61	0.50	19.4	1.00	4.79	0.80	1.00
Mean		1.66	0.70	2.40	2.02	5.81	8.13	1.43	29.2	3.20	7.41	1.89	0.83
Median	WMS	0.07	0.27	1.12	1.52	2.40	4.61	0.30	28.6	1.00	4.79	0.50	1.00
Mean		0.19	0.51	2.42	2.35	6.32	9.49	1.12	35.6	0.66	7.41	0.63	0.83
Median	ADR	1.38	0.50	1.40	1.41	3.30	4.62	0.50	17.3	5.00		5.00	
Mean		3.25	0.82	2.38	1.86	5.50	7.30	1.76	26.0	6.33		3.84	
Median Concentration, without outliers – Proposed BC													
	MED	0.2	0.38	1.2	1.23	2.31	3.45	0.5	18.4	(1.0)#	3.05	(0.5)#	(1.0)#
	n	*66*	*102*	*76*	*56*	*102*	*104*	*73*	*58*	*67*	*11*	*135*	*35*
	WMS	0.07	0.3	1.1	1.5	2.4	4.6	0.3	28.6		3.05		
	n	*43*	*43*	*43*	*20*	*43*	*43*	*43*	*20*	*37*	*11*	*87*	*37*
	ADR	1.38	0.5	1.4	1.4	3.3	4.6	0.5	17.3				
	n	*40*	*65*	*40*	*40*	*70*	*70*	*40*	*40*	*30*	*0*	*56*	*0*
*Med EACs		3.2	5.4	6	1.2	15.8	80	24		1.45	5-50		5-50

* Decision IG.23/6. # Most data BDL

Table A3.10. Range of limit of detection (LOD) or limit of quantitation (LOQ) values for Polycyclic Aromatic Hydrocarbons (PAHs), as reported by the contracting parties. Min- Minimum value reported, Max – Maximum value reported. Additional values are the values reported between the Min and Max.

	PCB 28	**PCB 52**	**PCB 101**	**PCB 118**	**PCB 138**	**PCB 153**	**PCB 180**	**Sum 7 PCBs**	**Lindane**	**p,p'-DDE**	**Hexachloro benzene**	**Dieldrin**
Sediment (µg/kg dw)												
Min	0	0	0	0	0	0	0	0	0	0	0.05	0
Max	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.25	0.14	0.1	0.28	0.1
Additional values	0.01,0.02	0.003,0.01,0.02			0.02	0.02	0.01,0.02		0.05,0.06,0.1	0.05	0.1,0.15	
Biota, *M. galloprovincialis* (µg/kg dry wt)												
Min	0.1	0.02	0.1	0.1	0.2	0.2	0.1	0.2	0.1	no bdls	0.005	0.2

Max	0.5	0.5	0.5	0.5	0.5	0.5	0.5		10		10	1
Additional values	0.2,0.25	0.1,0.2,0.27	0.2,0.46	0.2			0.2		1,5		0.1,1,5	0.4

Annex IV:

Available data for biota species other than *M. galloprovincialis and M. barbatus*, the mandatory species

Annex IV presents the data available from IMAP-IS and MEDPOL for mussel and fish species, other then the mandatory species (*M. galloprovinciallis and M. barbatus*).

As stated in section 4.5, the mandatory species may not be always found in all the areas of the Mediterranean Sea. Therefore, the addition of other both mandatory and 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. The compilation provided below may help define the additional species that could be added to MEDPOL monitoring.

Table A4.1. An overview of the data available for biota species, other than the mandatory species. The numbers next to the years are the number of observations for each parameter and in parenthesis, the number of values below detection limit. The entries are sorted by source of data, country, and sampling year. When available, IMAP-IS file number is given.

Source	IMAP file	Country	Sub-region	Species	Year	Cd	Hg	Pb	PAH	PCB	HCB
Bivalve/mollusc											
IMAP_IS	351	Israel	AEL	*Donnax trunculus*	2015	7(7)	7(0)	0			
IMAP_IS	71	Israel	AEL	*Mactra corralina*	2018	5(0)	5(0)	0			
IMAP_IS	118	Lebanon	AEL	*Patella sp.*	2019	16 (0)	16 (0)	16 (0)	15# (0)	15# (8)	
IMAP_IS	242	Morocco	WMS	*Callista chione*	2016	10 (0)	10 (0)	10 (0)		1-7 (0)^	7 (0)
					2017	10 (0)	10 (0)	10 (0)		2-7 (0)^	7(0)
					2018	5 (0)	5 (0)	5 (0)		1-7 (0)^	5 (0)
MEDPOL		Israel	AEL	*Mactra corralina*	2017	2 (0)	2 (0)	0			
MEDPOL		Tunisia	CEN	*ML*	2014	0	3 (0)	0			
				R. ruditapes	2014	0	11(0)	0			
Fish											
IMAP_IS	&	Croatia	ADR	*Merluccius merluccius*	2019	3(0)	0	3(0)			
				Mullus surmuletus	2019	1(0)	0	1(0)			
				Pagellus erythrinus	2019	3(3)	0	3(3)			

Source	IMAP file	Country	Sub-region	Species	Year	Cd	Hg	Pb	PAH	PCB	HCB
				Sparus aurata	2019	6(0)	0	8(0)			
IMAP_IS	118	Lebanon	AEL	*Diplodus sargus*	2019	11 (0)	11 (0)	11 (0)	3# (0)	3# (0)	
				Euthynnus alletratus	2019	15 (0)	15 (0)	15 (0)	10# (0)	13# (0)	
IMAP_IS	489	Malta	CEN	*Merluccius merluccius*	2017	4(4)	4(0)	4(4)		4(4) ^	4(4)
MEDPOL		Israel	AEL	*Diplodus sargus*	2017	13(12)	13(0)	0			
				Siganus rivulatus	2017	11(12)	11 (0)	0			
				Sargocentrum rubrum	2017	10(10)	10 (0)	0			
				Diplodus sargus	2018	9 (4)	9 (0)	0			
				Sargocentrum rubrum	2018	10 (10)	10 (0)	0			

* HCB- Hexaclorobenzene, #Total, ^some compounds, &Reported to MEDPOL, to be added to IMAP_IS

Background concentrations (BC) were not calculated for each species due to the lack of data. In biota, background concentrations are taxa and species specific. Moreover, in the same species, the concentrations depend on the tissue analyzed. Therefore, contamination assessment must be done on a species and tissue level. In addition, contaminants may accumulate with age. Weight and length of the specimen are usually used as a proxy to age. To avoid the need for normalization, concentrations of contaminants may be measured in specimens from the same species and age (See section 2.2.5).

Annex V

References

Ahmed, I., Mostefa, B., Bernard, A. and Olivier, R. (2018) Levels and ecological risk assessment of heavy metals in surface sediments of fishing grounds along Algerian coast. Marine Pollution Bulletin 136, 322-333.

Al-Kazaghly, R., M. Hamid and K. A. Ighwela (2021). "Bioaccumulation of some Heavy Metals in Red mullet (Mullus barbatus) and Common pandora (Pagellus erythrinus) in Zliten Coast, Libya." Jurnal Ilmiah Perikanan dan Kelautan 13: 91.

Andersen, J. H., C. Murray, M. M. Larsen, N. Green, T. Høgåsen, E. Dahlgren, G. Garnaga-Budrė, K. Gustavson, M. Haarich, E. M. F. Kallenbach, J. Mannio, J. Strand, and S. Korpinen. 2016. Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. Environmental Monitoring and Assessment 188:115.

Anon (2019) Contaminants in Europe's Seas. Moving towards a clean, non-toxic marine environment. EEA Report No 25/2018.

Astrahan, P., J. Silverman, Y. Gertner and B. Herut (2017). "Spatial distribution and sources of organic matter and pollutants in the SE Mediterranean (Levantine basin) deep water sediments." Marine Pollution Bulletin 116(1): 521-527.

Azizi, G., M. Layachi, M. Akodad, D. R. Yáñez-Ruiz, A. I. Martín-García, M. Baghour, A. Mesfioui, A. Skalli, and A. Moumen. (2018). Seasonal variations of heavy metals content in mussels (Mytilus galloprovincialis) from Cala Iris offshore (Northern Morocco). Marine Pollution Bulletin 137, 688-694.

Azizi, G., M. Layachi, M. Akodad, A. I. Martin-Garcia, D. R. Yanez-Ruiz, M. Baghour, H. A. Hmeid, H. Gueddari and A. Moumen (2021). "Bioaccumulation and health risk assessment of trace elements in Mytilus galloprovincialis as sea food in the Al Hoceima coasts (Morocco)." E3S Web of Conferences 240, 01002 (2021).

Azoury S., Tronczyński J., Chiffoleau JF., Cossa D., Nakhlé K., Schmidt S., Khalaf G. (2013). Historical records of Hg, Pb and PAH depositions in a dated sediment core from the Eastern Mediterranean. *Environ. Sci. Technol.* 47, 7101-7109.

Benali, I., Boutiba, Z., Grandjean, D., de Alencastro, L.F., Rouane-Hacene, O. and Chèvre, N. (2017) Spatial distribution and biological effects of trace metals (Cu, Zn, Pb, Cd) and organic micropollutants (PCBs, PAHs) in mussels Mytilus galloprovincialis along the Algerian west coast. Marine Pollution Bulletin 115(1), 539-550.

Bonsignore, M., Tamburrino, S., Oliveri, E., Marchetti, A., Durante, C., Berni, A., Quinci, E. and Sprovieri, M. (2015) Tracing mercury pathways in Augusta Bay (southern Italy) by total concentration and isotope determination. Environmental Pollution 205, 178-185.

Borja, A., M. Elliott, J. H. Andersen, T. Berg, J. Carstensen, B. S. Halpern, A.-S. Heiskanen, S. Korpinen, J. S. S. Lowndes, and G. Martin. 2016. Overview of Integrative Assessment of Marine Systems: The Ecosystem Approach in Practice. Frontiers in Marine Science 3:20

Briant, N., Chouvelon, T., Martinez, L., Brach-Papa, C., Chiffoleau, J.F., Savoye, N., Sonke, J. and Knoery, J. (2017) Spatial and temporal distribution of mercury and methylmercury in bivalves from the French coastline. Marine Pollution Bulletin 114(2), 1096-1102.

Cammilleri, G., P. Galluzzo, A. Pulvirenti, I. E. Giangrosso, G. M. Lo Dico, G. Montana, N. Lampiasi, M. A. Mobilia, A. Lastra, M. Vazzana, A. Vella, P. La Placa, A. Macaluso and V. Ferrantelli (2020). "Toxic mineral elements in Mytilus galloprovincialis from Sicilian coasts (Southern Italy)." Natural Product Research 34(1): 177-182.

Campillo, J. A., B. Fernández, V. García, J. Benedicto, and V. M. León. 2017. Levels and temporal trends of organochlorine contaminants in mussels from Spanish Mediterranean waters. Chemosphere 182:584-594.

Cathalot C., Rabouille C., Tisnerat-Laborde N., Toussaint F., Kerherve P., Buscail R., Loftis K., Sun M.Y., Tronczynski J., Azoury S., Lansard B., Treignier C., Pastor L., Tesi T. (2013). The fate of river organic carbon in coastal areas: A study in the Rhone River delta using multiple isotopic (Δ13C, Δ14C) and organic tracers. *Geochimica et Cosmochimica Acta* 118, 33-55

Chouvelon, T., E. Strady, M. Harmelin-Vivien, O. Radakovitch, C. Brach-Papa, S. Crochet, J. Knoery, E. Rozuel, B. Thomas, J. Tronczynski and J.-F. Chiffoleau (2019). "Patterns of trace metal bioaccumulation and trophic transfer in a phytoplankton-zooplankton-small pelagic fish marine food web." Marine Pollution Bulletin 146: 1013-1030

Elbaz-Poulichet, F.; Dezileau, L.; Freydier, R.; Cossa, D.; Sabatier, P. (2011). A 3500-year record of Hg and Pb contamination in a Mediterranean sedimentary archive (The Pierre Blanche Lagoon, France). Environ. Sci. Technol. 2011, 45 (20), 8642−8647.

El Baz, S.M. and Khalil, M.M. (2018) Assessment of trace metals contamination in the coastal sediments of the Egyptian Mediterranean coast. Journal of African Earth Sciences 143, 195-200.

Esposito, M., S. Canzanella, S. Lambiase, A. Scaramuzzo, R. La Nucara, T. Bruno, G. Picazio, G. Colarusso, R. Brunetti and P. Gallo (2020). "Organic pollutants (PCBs, PCDD/Fs, PAHs) and toxic metals in farmed mussels from the Gulf of Naples (Italy): Monitoring and human exposure." Regional Studies in Marine Science 40: 101497

Esposito, G., A. G. Mudadu, M. C. Abete, S. Pederiva, A. Griglione, C. Stella, S. Ortu, A. M. Bazzoni, D. Meloni, and S. Squadrone. 2021. Seasonal accumulation of trace elements in native Mediterranean mussels (Mytilus galloprovincialis Lamarck, 1819) collected in the Calich Lagoon (Sardinia, Italy). Environmental Science and Pollution Research.

European Commision, E. (2018) Guidance Document No: 27. Technical Guidance For Deriving Environmental Quality Standards.

Frapiccini, E., M. Panfili, S. Guicciardi, A. Santojanni, M. Marini, C. Truzzi and A. Annibaldi (2020). "Effects of biological factors and seasonality on the level of polycyclic aromatic hydrocarbons in red mullet (Mullus barbatus)." Environmental Pollution 258: 113742.

Guerranti, C., E. Grazioli, S. Focardi, M. Renzi and G. Perra (2016). "Levels of chemicals in two fish species from four Italian fishing areas." Marine Pollution Bulletin 111(1): 449-452.

Ghosn, M., Mahfouz, C., Chekri, R., Khalaf, G., Guérin, T., Jitaru, P. and Amara, R. (2020a) Seasonal and Spatial Variability of Trace Elements in Livers and Muscles of Three Fish Species from the Eastern Mediterranean. Environmental Science and Pollution Research 27(11), 12428-12438.

Ghosn, M., Mahfouz, C., Chekri, R., Ouddane, B., Khalaf, G., Guérin, T., Amara, R. and Jitaru, P. (2020b) Assessment of trace element contamination and bioaccumulation in algae (Ulva lactuca), bivalves (Spondylus spinosus) and shrimps (Marsupenaeus japonicus) from the Lebanese coast. Regional Studies in Marine Science 39, 101478.

Jebara, A., Lo Turco, V., Potortì, A.G., Bartolomeo, G., Ben Mansour, H. and Di Bella, G. (2021) Organic pollutants in marine samples from Tunisian coast: Occurrence and associated human health risks. Environmental Pollution 271, 116266.

Joksimović Danijela and Slavka Stanković 2012: Accumulation of trace metals in marine organisms of the southeastern Adriatic coast, J. Serb. Chem. Soc. 77 (1) 105–117 (2012).

Jović Mihajlo, Slavka Stanković 2014. Human exposure to trace metals and possible public health risks via consumption of mussels Mytilus galloprovincialis from the Adriatic coastal area Food Chem Toxicol. 2014 Aug;70:241-51

Karageorgis, A.P., Botsou, F., Kaberi, H. and Iliakis, S. (2020) Geochemistry of major and trace elements in surface sediments of the Saronikos Gulf (Greece): Assessment of contamination between 1999 and 2018. Science of the Total Environment 717, 137046.

Kucuksezgin, F., L. T. Gonul, I. Pazi, B. Ubay and H. Guclusoy (2020). "Monitoring of polycyclic aromatic hydrocarbons in transplanted mussels (Mytilus galloprovincialis) and sediments in the coastal region of Nemrut Bay (Eastern Aegean Sea)." Marine Pollution Bulletin 157: 111358.

León, V. M., L. Viñas, E. Concha-Graña, V. Fernández-González, N. Salgueiro-González, C. Moscoso-Pérez, S. Muniategui-Lorenzo, and J. A. Campillo (2020), Identification of contaminants of emerging concern with potential environmental risk in Spanish continental shelf sediments, Science of the Total Environment, 742, 140505

Lomartire, S., J. C. Marques, and A. M. M. Gonçalves. 2021. Biomarkers based tools to assess environmental and chemical stressors in aquatic systems. Ecological Indicators 122:107207.

Long, E., Macdonald, D., Smith, S. and Calder, F. (1995) Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19(1), 81-97.

Mandic Jelena, Tronczynski Jacek, Kuspilic Grozdan (2018). Polycyclic aromatic hydrocarbons in surface sediments of the mid-Adriatic and along the Croatian coast: Levels, distributions and sources . *Environmental Pollution* , 242(Part A), 519-527

Martínez-Guijarro, R., Paches, M., Romero, I. and Aguado, D. (2019) Enrichment and contamination level of trace metals in the Mediterranean marine sediments of Spain. Science of the Total Environment 693, 133566.

Naifar, I., Pereira, F., Zmemla, R., Bouaziz, M., Elleuch, B. and Garcia, D. (2018) Spatial distribution and contamination assessment of heavy metals in marine sediments of the southern coast of Sfax, Gabes Gulf, Tunisia. Marine Pollution Bulletin 131, 53-62.

OSPAR 2017. https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/contaminants/

OSPAR (2008) Co-ordinated Environmental Monitoring Programme (CEMP) Assessment Manual for contaminants in sediment and biota. OSPAR Commission No. 379/2008.

Pavlidou, A., N. Simboura, K. Pagou, G. Assimakopoulou, V. Gerakaris, I. Hatzianestis, P. Panayotidis, M. Pantazi, N. Papadopoulou, S. Reizopoulou, C. Smith, M. Triantaphyllou, M. C. Uyarra, I. Varkitzi, V. Vassilopoulou, C. Zeri and A. Borja. 2019. Using a holistic ecosystem-integrated approach to assess the environmental status of Saronikos Gulf, Eastern Mediterranean. Ecological Indicators 96: 336-350.

Pérez-Fernández, B., L. Viñas, and J. Bargiela (2019), New values to assess polycyclic aromatic hydrocarbons pollution: Proposed background concentrations in marine sediment cores from the Atlantic Spanish Coast, Ecological Indicators, 101, 702-709.

Perić, L., V. Nerlović, P. Žurga, L. Žilić, and A. Ramšak. 2017. Variations of biomarkers response in mussels Mytilus galloprovincialis to low, moderate and high concentrations of organic chemicals and metals. Chemosphere 174:554-562.

Rabaoui, L., Balti, R., Zrelli, R. and Tlig-Zouari, S. (2014) Assessment of heavy metals pollution in the gulf of Gabes (Tunisia) using four mollusk species. Mediterranean Marine Science, 15(1), pp.. 15(1), 45-58.

Rizzi, C., S. Villa, C. Chimera, A. Finizio and G. S. Monti (2021). "Spatial and temporal trends in the ecological risk posed by polycyclic aromatic hydrocarbons in Mediterranean Sea sediments using large-scale monitoring data." Ecological Indicators **129**: 107923.

Santos-Echeandía, J., J. A. Campillo, J. A. Egea, C. Guitart, C. J. González, C. Martínez-Gómez, V. M. León, C. Rodríguez-Puente and J. Benedicto (2021). "The influence of natural vs anthropogenic factors on trace metal(loid) levels in the Mussel Watch programme: Two decades of monitoring in the Spanish Mediterranean sea." Marine Environmental Research 169: 105382.

Spagnoli, F., R. De Marco, E. Dinelli, E. Frapiccini, F. Frontalini and P. Giordano (2021). "Sources and Metal Pollution of Sediments from a Coastal Area of the Central Western Adriatic Sea (Southern Marche Region, Italy)." Applied Sciences 11(3).

Sulimanec Grgec, A., Z. Kljaković-Gašpić, T. Orct, V. Tičina, A. Sekovanić, J. Jurasović and M. Piasek (2020). "Mercury and selenium in fish from the eastern part of the Adriatic Sea: A risk-benefit assessment in vulnerable population groups." Chemosphere 261: 127742.

Tavoloni, T., R. Miniero, S. Bacchiocchi, G. Brambilla, M. Ciriaci, F. Griffoni, P. Palombo, T. Stecconi, A. Stramenga and A. Piersanti (2021). "Heavy metal spatial and temporal trends (2008–2018) in clams and mussel from Adriatic Sea (Italy): Possible definition of forecasting models." Marine Pollution Bulletin 163: 111865.

Tornero, V., Hanke, G. and Contaminants, M.E.N.o. (2019) Marine chemical contaminants – support to the harmonization of MSFD D8 methodological standards: Matrices and threshold values/reference levels for relevant substances. EUR 29570 EN, Publications Office of the European Union.

Traina, A., G. Bono, M. Bonsignore, F. Falco, M. Giuga, E. M. Quinci, S. Vitale and M. Sprovieri (2019). "Heavy metals concentrations in some commercially key species from Sicilian coasts (Mediterranean Sea): Potential human health risk estimation." Ecotoxicology and Environmental Safety 168: 466-478.

Traina, A., A. Ausili, M. Bonsignore, D. Fattorini, S. Gherardi, S. Gorbi, E. Quinci, E. Romano, D. Salvagio Manta, G. Tranchida, F. Regoli and M. Sprovieri (2021). "Organochlorines and Polycyclic Aromatic Hydrocarbons as fingerprint of exposure pathways from marine sediments to biota." Marine Pollution Bulletin 170: 112676

Tronczyński, J., Tixier, C. and Laute, F. (2008). R.INT.DOPL/BE_LBCO/Nantes/08 – 04. Contaminants organiques persistants dans les sédiments de l'étang de Thau : bilan, historique et comportement

UNEP/MAP (2011). UNEP(DEPI)/MED WG365/Inf.8. Development of assessment criteria for hazardous substances in the Mediterranean.

UNEP/MAP (2016). UNEP(DEPI)/MED WG.427/Inf.3. Background to the Assessment Criteria for Hazardous Substances and Biological Markers in the Mediterranean Sea Basin and its Regional Scales.

UNEP/MAP (2019). (UNEP/MED WG.463/Inf.6.). Updated Thematic Assessments of the Eutrophication and Contaminants Status in the Mediterranean Marine Environment, as a Contribution to the 2019 State of Environment and Development Report (SoED).

UNEP/MAP WG.462/Inf.4 (2019). Updated List of Priority Contaminants under MAP/Barcelona Convention (Draft). Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring, Podgorica, Montenegro, 2-3 April 2019. Agenda item 3: State of Play of Integrated Monitoring and Assessment Programme (IMAP). Implementation with Regards to EO5 and EO9, MEDPOL Monitoring Programme and Way Forward

UNEP/MAP WG.482/12 (2020). Monitoring Guidelines/Protocols for Sample Preparation and Analysis of Sediment for IMAP Common Indicator 17: Heavy and Trace Elements and Organic Contaminants.Integrated Meetings of the Ecosystem Approach Correspondence Groups on IMAP Implementation (CORMONs) Videoconference, 1-3 December 2020. Agenda item 5: Parallel CORMON Sessions for Pollution, including Marine Litter and Biodiversity

UNEP/MAP WG.482/14 (2020). Monitoring Guidelines/Protocols for Sample Preparation and Analysis of Marine Biota for IMAP Common Indicator 17: Heavy and Trace Elements and Organic Contaminants. Integrated Meetings of the Ecosystem Approach Correspondence Groups on IMAP Implementation (CORMONs) Videoconference, 1-3 December 2020. Agenda item 5: Parallel CORMON Sessions for Pollution, including Marine Litter and Biodiversity

UNEP/MAP WG.492/Inf.9 (2021). Integration and Aggregation Rules for Monitoring and Assessment of (IMAP Pollution and Marine Litter Cluster). Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring, Videoconference, 26-28 April 2021. Agenda item 6: Cross-Cutting Issues - The Integration and Aggregation Rules and Assessment Criteria for IMAP Ecological Objectives 5, 9 and 10

Vethaak, A. D., I. M. Davies, J. E. Thain, M. J. Gubbins, C. Martínez-Gómez, C. D. Robinson, C. F. Moffat, T. Burgeot, T. Maes, W. Wosniok, M. Giltrap, T. Lang, and K. Hylland. 2017. Integrated indicator framework and methodology for monitoring and assessment of hazardous substances and their effects in the marine environment. Marine Environmental Research 124:11-20.

WHO (1993). World Health Organization & International Programme on Chemical Safety. Biomarkers and risk assessment : concepts and principles / published under the joint sponsorship of the United Nations environment Programme, the International Labour Organisation, and the World Health Organization. World Health Organization.

Zaghden, H., M. Tedetti, S. Sayadi, M. M. Serbaji, B. Elleuch, and A. Saliot. 2017. Origin and distribution of hydrocarbons and organic matter in the surficial sediments of the Sfax-Kerkennah channel (Tunisia, Southern Mediterranean Sea). Marine Pollution Bulletin 117:414-428.