Assessment of Trace metals in sediments of the LEVS

445. Data were reported for all the 3 TMs in 80 stations, while for 3 stations data were reported only for Cd and Pb. However, the concentrations of Cd in Cyprus were much higher than the MedBACs and even higher than the MedEAC agreed upon in Decision IG.23/6 (Table 3.1.4.1.2.b). In consultation with national representatives and experts of Cyprus, it was explained that although anomalously high, the concentrations are natural, probably due to specific local minerology. Therefore, Cd concentrations in sediments from Cyprus were excluded from this updated assessment, as in the pilot assessment of the LEVS .

446. Out of the 83 stations, 57 (69%) were in-GES (high and good statuses) and 26 (31%) in non-GES classification. Out of the 26 non-GES stations, 24 were classified as in moderate status, with 4 stations borderline to good (green) status (CSs of 1.00-1.01) (Table 3.1.4.1.3.b; Figure LEVS 3.1.4.1.1.C.). Two stations were classified as in poor status. It should be mentioned that the moderate status is the least affected status among the 3 PA (corresponding to non-GES) classification. Examination of the CRs for the individual metals found that 21% of the stations were non-GES regarding Cd, 21% of the stations were non-GES regarding Hg and 7% of the stations were non-GES regarding Pb.

447. The non-GES stations were present in all the countries that reported data: Cyprus, Greece, Israel, Lebanon and Türkiye. A detailed examination of the CSs and CRs (Table 3.1.4.1.3.b) found that stations in moderate status in Cyprus were located in Larnaka Bay, off Zygi and in Chrisochou Bay. Pb concentration in sediments contributed to classification in the moderate status[89]. In Greece, two stations were found in moderate status (Koufonisi (S. Crete), Kastelorizo), with Pb and Cd concentrations contributing to this classification. In Israel, the area classified as moderate status was limited to the northern part of Haifa Bay and concentration of Hg contributed to this classification. The area is known to be still contaminated by legacy Hg, even though there was a vast improvement of the environmental status following pollution abatement measures (Herut et al, 2016, 2021). In Lebanon, the main area in moderate status was off Beirut, in particular the Dora region (with two station in bad status), followed by area in the North Lebanon, with Cd and Hg concentrations contributing equally to the moderate classification. The Beirut area is densely populated and industrialized (Ghosn et al., 2020). In Türkiye, 4 stations were classified as in moderate status: Akkuyu, Taşucu, Anamur, Göksu River mouth. The concentration of Hg contributed to this classification.

448. The decision rule for application of the CHASE + assessment methodology recommends that only if at least 75% of the stations are in-GES, the area should be considered in-GES. Therefore, the northern and eastern LEVS should be classified as non-GES regarding TM in sediments, i.e. in moderate status, as only 69% of the stations were in GES (Figure LEVS 3.1.4.1.1.C**)**.

449. This classification is a result of the contribution from the 2 very limited affected areas i.e., (1) seven stations in the Northern Haifa Bay, and 2) three stations in the Dora region (Beirut). When data from these affected areas, that constitute less than 0.1% of the LEVS, are not taken into account, then 78% of the stations (57 out of 73 stations) are in GES, and the northern and eastern LEVS can be classified as in GES. These 57 stations are distributed evenly across the northern and eastern LEVS, providing a good coverage of this area of the sub-division.

[89] Local minerology should be studied to decide if the high values are anthropogenic or originate from natural sources as for Cd

450. In brief, it can be stated that regarding TM in sediments, non-GES stations were identified across the northern and eastern LEVS and the area was assessed as non-GES, i.e., in moderate status. No assessment could be performed for the southern LEVS as no data were available. When the contribution of two very limited affected areas i.e. (1) the Northern Haifa Bay, and 2) the Dora region (Beirut) are not taken into account, the northern and eastern LEVS can be classified as in-GES

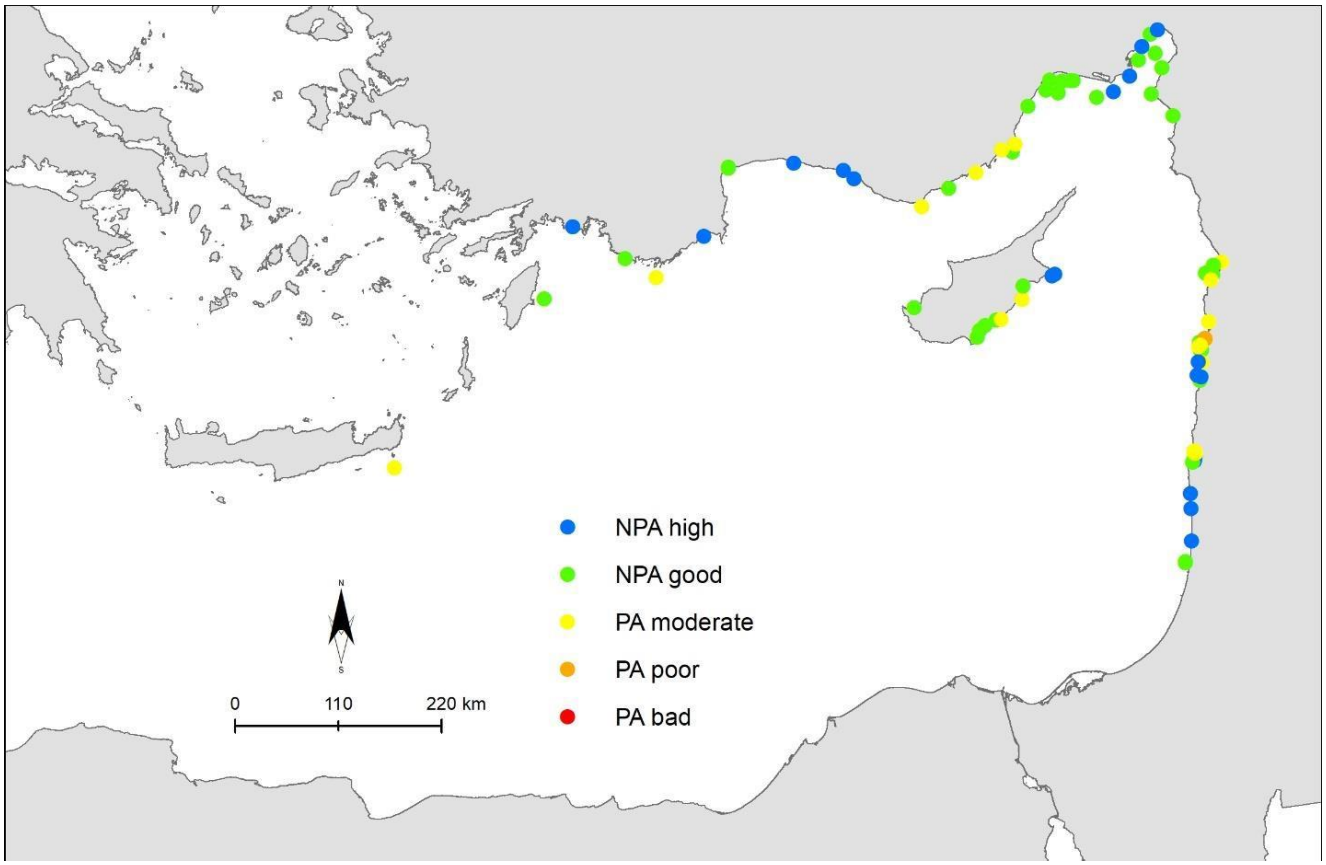

Figure LEVS 3.1.4.1.1.C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the LEVS

451. Σ_{16} PAHs in sediments: There were 75 stations with data for Σ_{16} PAHs in sediments reported by Greece, Israel and Lebanon. Out of the 75 stations, 61 (81%) were classified in-GES in high and good statuses and 14 (19%) stations classified as non-GES (Table 3.1.4.1.3.b; Figure LEVS 3.1.4.1.2.C.). Out of the non-GES stations, 7 stations were classified as moderate, 3 stations as poor and 4 stations as in bad status.

452. There was no large specific area with non-GES status. Two small, geographically limited areas with non-GES status were identified i.e., one in Israel, at stations close to the locations of drilled wells for gas exploration (Astrahan et al., 2017) and one off in Beirut, in Lebanon. Two stations in Greece, off Lindos and Kastelorizo were also classified in moderate status.

453. Data on Σ_{16} PAHs in sediments were not distributed evenly across the LEVS, therefore the sub-division could not be assessed regarding Σ_{16} PAHs concentrations in sediments. As more than 75% of the stations were in GES it is possible to classify the areas with available data as in-GES. Given the limited data availability no conclusion could be provided on GES status at the level of the Levantine Sea Basin.

454. In brief, it can be stated that given the limited data availability, it was not possible to classify the LEVS Sub-division regarding data reported for Σ_{16} PAHs in sediments. As more than 75% of the stations were in GES, it is possible to classify the areas with available data as in-GES regarding Σ_{16} PAHs in sediments.

455. Σ_5 PAHs in sediments: There were 97 stations with data for Σ_5 PAHs in sediments, reported by Cyprus, Greece, Israel and Türkiye. Although Σ_5 PAHs is not a mandatory parameter for CI 17, the assessment based on it was performed due to significant more data availability for Σ_5 PAHs compared to Σ_{16} PAHs encompassing a larger assessment area of the LEVS. Therefore, an exception was made in order to increase confidence of the assessment. Out of the 97 available stations, 88 (91%) were classified as in-GES (75 stations in high status and 13 in good status) and 9 stations (9%) were classified as non-GES, 8 in moderate status and 1 in poor status (Table 3.1.4.1.3.b; Figure LEVS 3.1.4.1.3.C).Therefore, the northern and the eastern part of the LEVS can be classified as in-GES regarding Σ_5 PAHs in sediments.

456. In brief, it can be stated that the northern and the eastern part of the LEVS can be classified as in GES regarding Σ_5 PAHs in sediments.

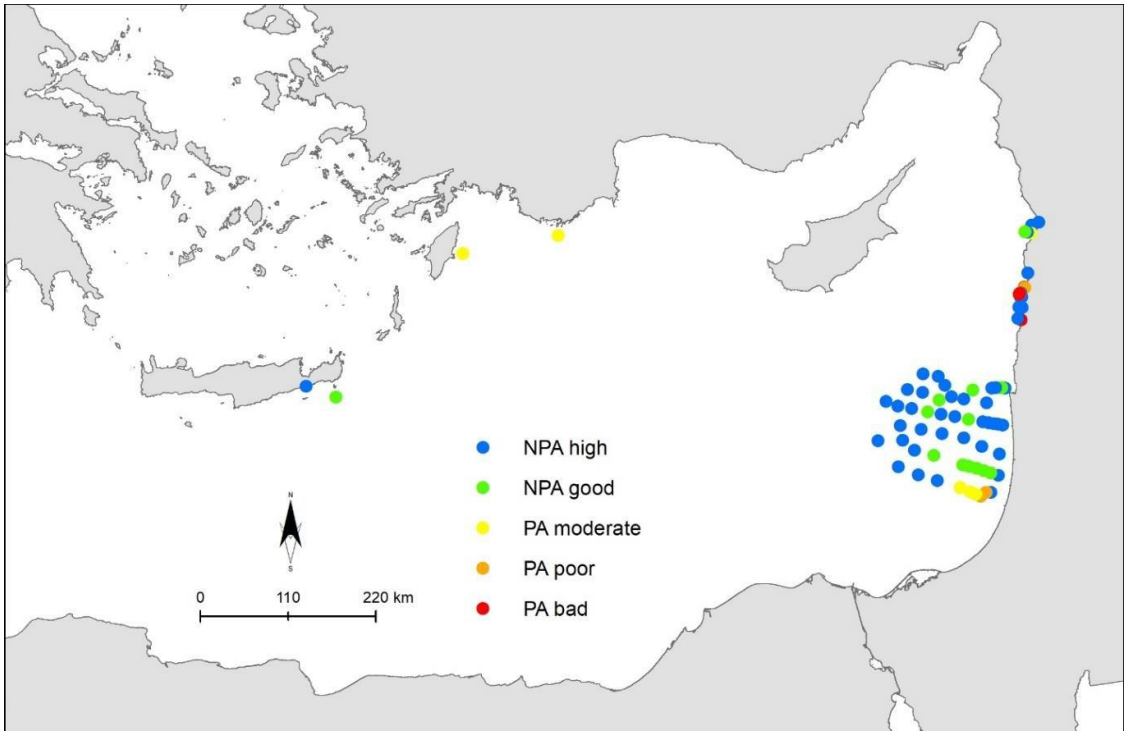

Figure LEVS 3.1.4.1.2.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_{16} PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

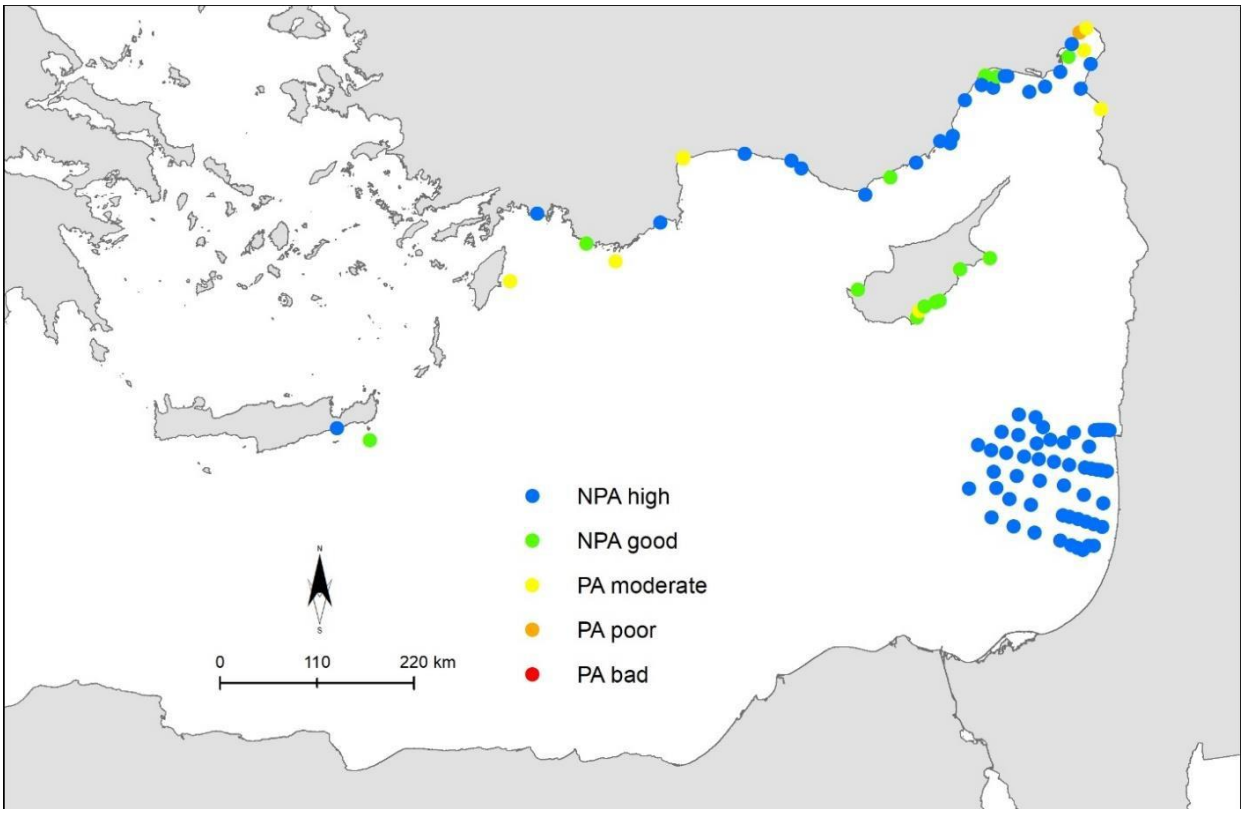

Figure LEVS 3.1.4.1.3.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_5 PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. Here we used the sum of the individual BAC values as provided for the 5 PAHs compounds in UNEP/MED WG. 533/3 as Σ_5 PAHs_BAC. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ7 PCBs in sediments and in M. barbatus of the LEVS

457. Data on Σ_7PCBs in sediments were reported only by Lebanon (19 stations) and Türkiye (33 stations). Out of the 52 stations, 38 (73%) were classified in-GES and 14 stations (27%) were classified as non-GES. Out of the non-GES stations, 3 were in moderate status, 4 in poor status and 7 in bad status (Table 3.1.4.1.3.b; Figure LEVS 3.1.4.1.4.C.).

458. Data on Σ7PCBs in 12 samples of M, barbatus were reported by Cyprus. All data were bdl,

459. The non-GES stations were located mainly at the Dora region (Beirut), as for TM in sediments, but also in additional stations. However, given the limited data availability no conclusion could be provided on environmental status of the LEVS concerning Σ_7 PCBs in sediments.

460. In brief, it can be stated that the LEVS sub-division could not be classified based on assessment of Σ_7 PCBs in sediments due to lack of data and their uneven spatial distribution for sediments and essentially no data for *M. barbatus*. A few affected areas for sediments could be indicated.

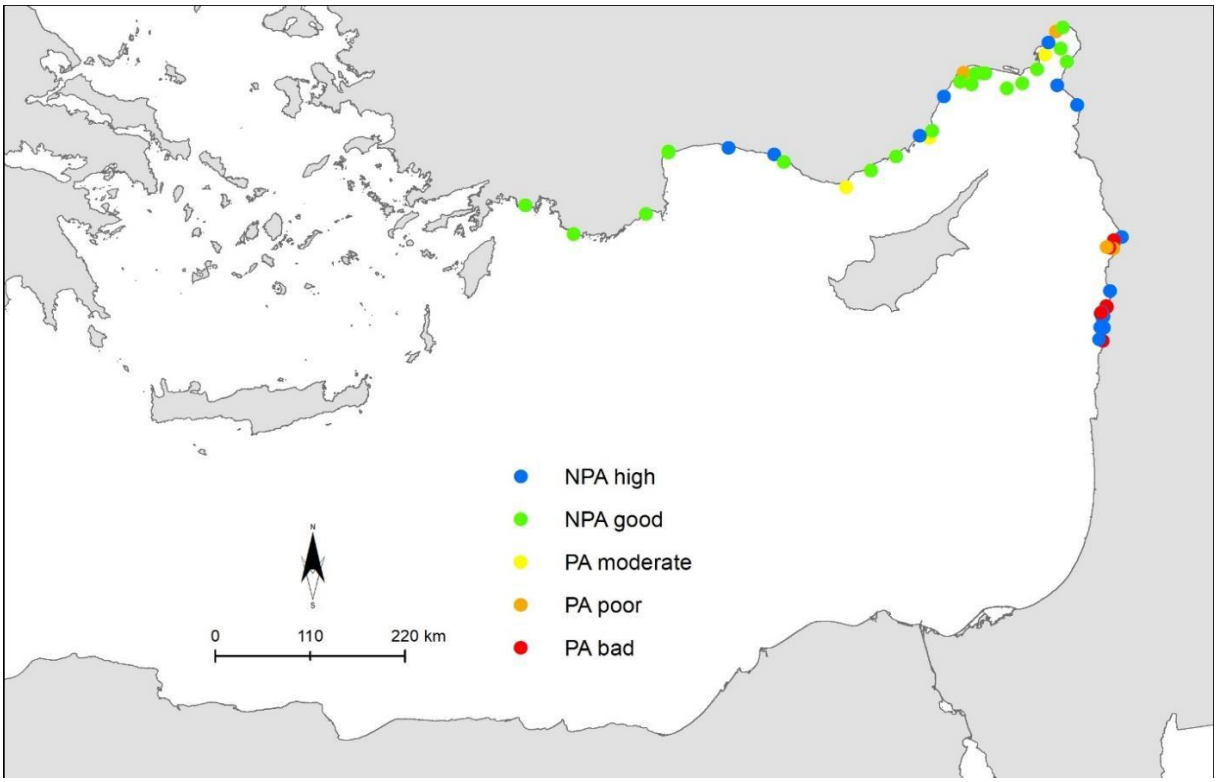

Figure LEVS 3.1.4.1.4.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_7 PCBs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES

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Assessment of Organochlorinated contaminants other than PCBs in sediments and M. barbatus of the LEVS

461. Sediment. Data for Organochlorinated contaminants other than PCBs were reported only by Türkiye. Dieldrin in all 33 stations were below detection limit (reported as 0 µg/kg dry wt) while data for γ-HCH (Lindane) ranged from below detection limit to 0.14 µg/kg dry wt with both average and median concentrations of 0.05 µg/kg dry wt. The BAC value is not set for Lindane. Only EAC of 3 µg/kg dry wt was adopted by Decision IG.22/7. The concentrations reported for Lindane were well below the EAC value.

462. *M. barbatus*. Cyprus reported concentrations of Dieldrin, Lindane, Hexachlorobenzene, p,p'DDE and Σ_7PCBs in 12 samples of *M. barbatus*. All data, except one data point for Σ_7PCBs were bdl. Lebanon reported 3 data points for total PCBs, with concentrations in the range of 122-306 µg/kg dry wt. No BACs were calculated for these organochlorinated contaminants in *M. barbatus* due to lack of data .

463. It can be concluded that the LEVS Sub-division could not be classified based on assessment of organochlorinated contaminants other than PCBs in sediments and in *M. barbatus*.

Assessment of Trace metals in M. barbatus of the LEVS

464. TM in *M. barbatus* were available at15 stations from Cyprus, Israel, Lebanon and Türkiye. As explained above, the CHASE+ assessment was performed based on average concentrations calculated for specimens sampled at the same station in different years.

465. Out of 15 stations, 14 (93%) were classified in-GES and 1 (7%) station as non-GES in poor status. The station in poor status was located off Paphos and this classification was due to the concentration of Hg.

466. The assessment of Trace metals in M. barbatus of the LEVS is shown in Figure LEVS 3.1.4.1.5.C.

467. The northern and the eastern part of the LEVS can be classified as in-GES concerning TM in *M. barbatus* (Figure LEVS 3.1.4.1.5.C).

468. In brief, it can be stated that the northern and the eastern part of the LEVS can be classified as in-GES concerning TM in *M. barbatus* (Figure LEVS 3.1.4.1.5.C).

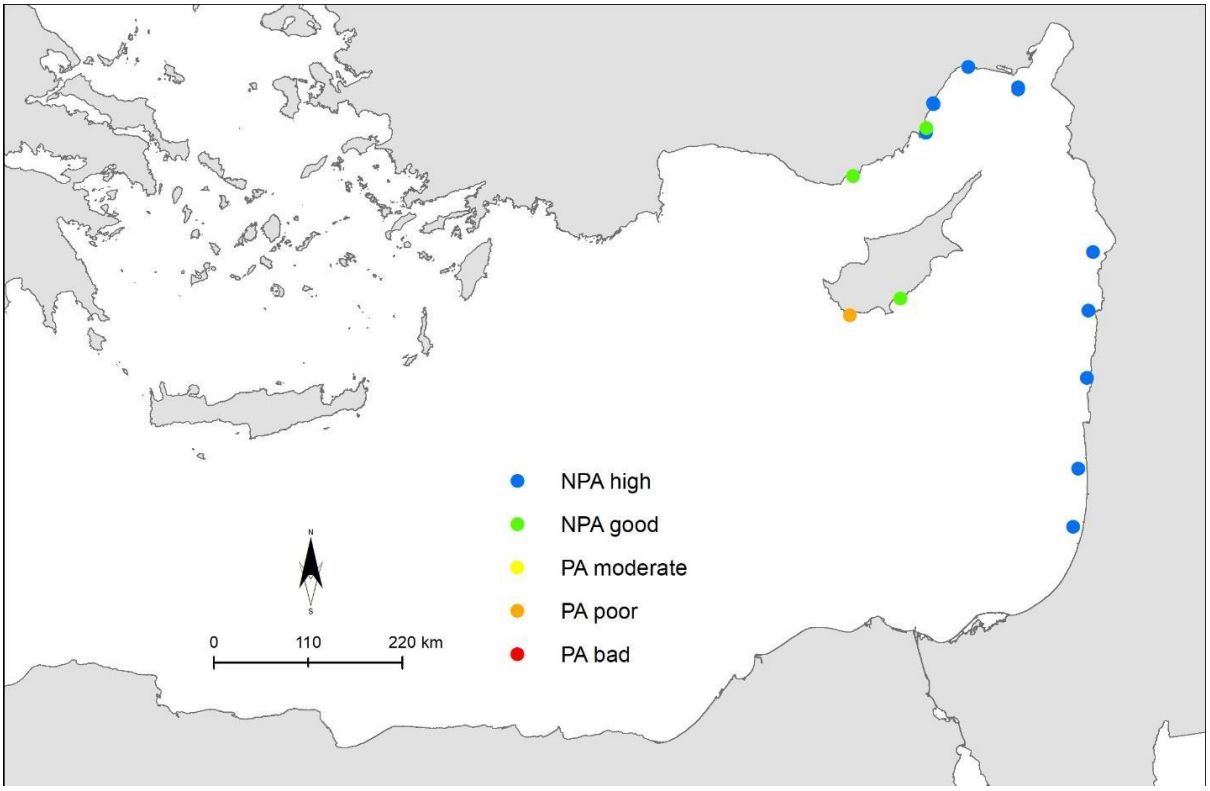

Figure LEVS 3.1.4.1.5.C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in *M. barbatus* in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

2.1.1.1 The IMAP GES assessment of the Central Mediterranean (CEN) Sub-region

469. Due to insufficient data, the two sub-divisions of the CEN, the Ionian Sea (IONS) and Central Mediterranean Sea (CENS) were assessed together, by applying the CHASE+ (Chemical Status Assessment Tool) methodology, and stressing possible similarities/differences between them, if available.

Available data

470. Data for the CEN sub-region were very limited. Table 3.1.4.2.1.summarizes data availability. Trace metals (TM – Cd, Hg and Pb) in sediments were available for 22 stations in Malta, 12 for 2017 and 10 for 2018, belonging to the CENS sub-division, and data for Cd and Pb were available for 4 stations in Greece for 2020, 2 belonging to the IONS sub-division and 2 to the CENS. Concentrations of Σ_{16} PAHs in sediments were available for 21 stations in Greece (20 in the IONS, 1 in CENS), 18 from 2019 and 3 from 2018; and for 5 stations in Tunisia (CENS) for 2019 (Jebara et al. 2021). For Malta (CENS), data for Σ_5 PAHs[90] in sediments were available for 15 stations sampled in 2017 and 10 stations sampled in 2018. Concentrations of total PCBs. i.e. Σ_7 PCBs[91] and individual concentrations for each PCB congener, were reported in sediments for the same 5 stations in Tunisia as for Σ_{16} PAHs (Jebara et al. 2021). Malta reported concentrations of hexachlorobenzene in sediments for 22 stations. Data for trace metals in the fish *M. barbatus* were available for 3 samples from 2017 and 2 samples from 2019 in Malta (CENS). In addition, data for TM in the mussel *M. galloprovincialis* from 2016 and 2017 were retrieved from data reported by Italy to EMODNet: 4 samples with Cd and Pb concentrations and 8 with Hg concentrations.

Table 3.1.4.2.1. Data availability per year and country for the assessment of EO 9 – CI 17 (contaminants) in the Central Mediterranean (CEN) Sub-region, as available by 31st October 2022.

Source	IMAP-File	Country	Sub-division	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs
Sediment										
IMAP-IS	652	Greece	IONS	2018				2	2	
IMAP-IS	652	Greece	CENS	2018				1	1	
IMAP-IS	652	Greece	IONS	2019				18	18	
IMAP-IS	652	Greece	IONS	2020	2	0	2			
IMAP-IS	652	Greece	CENS	2020	2	0	2			
IMAP-IS	489	Malta	CENS	2017	12	12	12		15	
IMAP-IS	489	Malta	CENS	2018	10	10	10		10	
Lit[1]		Tunisia	CENS	2019				5		5
M. galloprovincialis										
EMODNet		Italy	CENS	2016		2				
EMODNet		Italy	CENS	2017	4	6	4			
M. barbatus										
IMAP_IS	489	Malta	CENS	2017	3	3	3			
IMAP_IS	489	Malta	CENS	2019	2	2	2			

[1]Jebara et al., 2021

[90] Σ_5 PAHs is the sum of the concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Benzo(ghi)perylene. Σ_5 PAHs is a non-mandatory parameters for CI 17, whereby Σ_{16} PAHs, is a mandatory parameter.

[91] PCBs congeners 28,52,101,118,132,153,180

471. Data were compiled from the IMAP-IS, as of 31st October 2022. Additional data from the scientific literature (Jebara et al, 2021) and from EMODNet were also used.

472. Based on the available data, the assessment was performed for TM and Σ_{16} PAHs in sediment. In addition, the CEN was assessed based on Σ_5 PAHs in sediments as well. This is not a mandatory parameter, but was included here given significant more data available for Σ_5 PAHs compared to Σ_{16} PAHs (48 vs 28 data points, respectively) encompassing a larger area of the CEN. Therefore, an exception was made to possibly increase confidence of the assessment. A very limited assessment was provided also for the additional parameters: Σ_7 PCBs in sediments, TM in *M. barbatus* and in *M. galloprovincialis* due to the small amount of data available. The 2023 MED QSR needs to be based on data reported as of 2018 onward. However, given limited data availability, an exception was made and data available for 2016 and 2017 were also used in order to increase reliability of the assessment.

Setting the GES/non GES boundary value/threshold for the CHASE+ application in the CEN

473. The thresholds used for the CHASE+ assessment methodology were the updated Mediterranean regional BACs. Table 3.1.4.2.2. summarizes the thresholds values. For most parameters, the sub-regional BACs were not available . Namely, for sediments, only one CEN_BAC is available for TM (Pb), and for Σ_{16} PAHs. Regarding biota matrix, sub-regional CEN_BACs are not available for TM in *M. barbatus*, while for *M. galloprovincialis*, the CEN_BACs are available for Cd and Hg. By having only 4 CEN BACs, it was impossible to ensure homogenous assessment by combing sub-regional and regional BACs, in particular because the sub-regional BACs were calculated with a few data points[92]. For this reason, an exception was made for the CEN assessment and it was decided to use only the Mediterranean regional MED_BACs as thresholds in the assessment. It should also be noted that the four sub-regional CEN_BACs are about one order of magnitude lower than the MED_BACs.

[92] The CEN sub-region, BACs are multiplications of the BCs :

- It was possible to calculate BC for Pb (in sediments) at the CEN sub-region in 2022, however with only 29 data points. 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 (Paragraph 38).
- Σ_{16} PAHs in sediments. The lowest values were calculated for the CEN, however the number of data points was low and not representative (Paragraph 39).
- TM in *M. galloprovincialis* 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 (Paragraph 40).
- TM in *M. barbatus*. 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 (Paragraph 40).

Table 3.1.4.2.2. Summary of the threshold values (MED_BACs) used in application for GES assessment of the Central Mediterranean Sea sub-division. Available CEN_BAC and MedEAC values are given for comparison.

	CEN_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	#	161	1200
Hg	#	75	150
Pb	2708	22500	46700
Σ_{16} PAHs	9.5	41	4022*
Σ_5 PAHs^	#	31.8	
Σ_7 PCBs	#	0.40	68+
***M. barbatus*, µg/kg wet wt**			
Cd	#	7.8	50
Hg	#	81.2	1000
Pb	#	36.6	300
***M. galloprovincialis*, µg/kg dry wt**			
Cd	117&	1065	5000
Hg	18.5&	117	2500
Pb	#	1650	7500

BACs not available for CEN (UNEP/MED WG.533/3). & Based on 4-8 data points, * ERL value derived for the sum of 16 PAHs by Long et al., 1995, do not appear in the Decisions of COP. + Sum of the individual MedEACs values of the 7 PCB compounds as they appear in Decision IG.23/6.^Values do not appear in Decisions of COP. Calculated as a sum from the individual BAC values for each or the 5 PAHs compounds.

Integration of the areas of assessment for the CEN

474. The locations of the sampling stations/ areas are presented in Figures CEN 3.1.4.2.1.C. – CEN 3.1.4.2.3.C.

475. The locations of the sampling stations were sorted by group of contaminants and matrix. As explained above, data were available mainly for the sediment matrix, with a few data points for TM in the fish M. barbatus and the mussel M. galloprovincialis.

476. Further to IMAP implementation, the monitoring stations were considered for grouping in the two main assessment zones i.e., the coastal (within 1 nm from the shore) and offshore zones. All the sediment stations reported by Malta were classified as coastal while the stations where M. barbatus specimens were collected were classified as offshore. The 5 sediment stations from Tunisia were classified as coastal (Jebara et al., 2021). For Greece, 11 sediment stations were classified as coastal and 11 as offshore stations. Six of the offshore stations were located in semi-enclosed areas. M. galloprovincialis in Italy (data from EMODNet) were collected from one coastal location and three offshore locations.

477. Due to the limited number of data points, more so if dividing into coastal and offshore stations, the spatial nesting of stations in spatial assessment units (SAUs) to the level considered meaningful for IMAP CI 17 was not possible in the CEN. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.