UN environment programme | Mediterranean Action Plan Barcelona Convention

MEDITERRANEAN QUALITY STATUS ASSESSMENTS

POLLUTION & MARINE LITTER

MED QSR 2023

2. Mediterranean Quality Status Assessments

2.1 Pollution and Marine Litter

2.1.1 Pollution

Key messages related to Ecological Objectives 5 and 9

The Aegean – Levantine Sea Sub-region
Aegean Sea Sub-division

187. **EO 5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** Available literature indicates the presence of drivers and pressures with impacts related to eutrophication in the two areas found in non-good status in the present assessment, i.e., in the 1 non-good status subSAUs out of 16 subSAUs, as elaborated in 3.1.3. The non-good status in the Izmir province is related to the Izmir Bay and the southern coast of the province. Drivers that could impact eutrophication are: i) urban wastewater discharge, although many treatment plants were put into operation; ii) agriculture; iii) riverine discharge: Küçük, Menderes, Bakırçay and Gediz rivers, as the most important rivers of the Aegean Region. The main tributary of the Gediz River ,and the main streams feeding it, are considered to be under pressure in terms of point and diffuse pollution; iv) tourism; v) port operations: Izmir Port is the largest port in Turkeye after Mersin Port and vi) aquaculture. There are 66 fish farms, and 8 mussel farms operating on the coasts of İzmir province. In addition, available literature indicates the presence of drivers and pressures with impacts related to eutrophication in other areas of the AEGS which were classified in non-good status in the present assessment (see below assessment findings), for example, the Saronikos Gulf and Elfesis Bay, with extensive urbanization, industry and port activities and the Thermaikos Gulf impacted by agricultural discharges from the heavily polluted Axios River, and fish and shellfish mariculture.

188. **EO 9 – CI 17 (TM, Σ_{16}PAHs, Σ_5PAHs and Σ_7PCBs in sediments):** Using CHASE+, the AEGS was classified as in-GES for TM in sediments when the contribution of the two very limited affected areas (Elfesis Bay and inner Saronikos Gulf and area near Aliaga and Yenisakran) were not taken into account (see below assessment findings). It was not possible to classify the AEGS sub-division for Σ_{16} PAHs due to insufficient data while for Σ_5 the AEGS was classified as non-GES. It was not possible to classify the AEGS regarding Σ_7 PCBs in sediments due to insufficient data.

189. Regarding TM in sediments, one of the very limited non-GES areas was the Elfsis Bay/ inner Saronikos Gulf. Drivers and pressures in the area are extensive urbanization (metropolitan areas of Athens), Port activities and maritime traffic (Piraeus port), Industries located in the coastal area of the Elefsis Bay, such as oil refineries, steel and cement industries, and shipyards, Discharges of wastewater treatment plant. TM pollution decreased from 1999 to 2018 in some areas due to environmental policy enforcement combined with technological improvements by big industrial polluters (Karageorgis et al., 2020 and references therein). A second limited non-GES area was near Aliaga and Yenisakran. Possible drivers and pressures are port operations, industry, tourism and agriculture Further to input provided by Turkiye[43], the possible drives and pressures are mapped in the expanded area of the Balıkesir district and the Izmir province, where stations were classified as non-GES in this assessment. Those include: i) Urban waste water pressure due to increased population during the touristic summer seasons; ii) Port operations: Izmir Port is the largest port in Turkiye after Mersin Port; iii) Aquaculture is also present at some locations along the coast; iv) Agriculture also generates some pressures; v) Riverine inputs where the main streams generate pressures in terms of point and diffuse pollution.

[43] Submitted after the Meeting of CORMON Pollution that took place in Athens, 1-2 March 2023

190. It was not possible to classify the AEGS Sub-division regarding data for Σ16 PAHs in sediment due to insufficient data. There are indications that the offshore zone is in GES while the enclosed areas might be found as non-GES. Regarding Σ5 PAHs in sediments, the AEGS was classified as non-GES. The same limited areas classified as non-GES for TM in sediments are also non-GES for Σ5 PAHs, with the same drivers and pressures as for TM. Additional stations were found non-GES in the northern and central part of the AEGS, mainly in enclosed areas that are more sensitive to land-based sources pollutants.

191. The AEGS Sub-division could not be classified regarding assessment of Σ_7 PCBs in sediments due to lack of data. An affected, non-GES area was identified in the coast around Aliaga, Yenisakran and Candarli, as for TM. Possible drivers and pressures are port operations, industry, tourism and agriculture.

192. IMPACTS. No data on biota were available for the AEGS. Drivers and pressures that can impact biota were found in the AEGS.

193. **CI 18 - Level of pollution effects of key contaminants where a cause-and-effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI 18, were identified in the AEGS, no data were available at IMAP-IS to check for impacts in biota. Only two relevant studies in the scientific literature reported data on biomarkers in the AEGS, both for Türkiye. Both showed indications of possible effect of TM and/or pesticides on the molluscs *Mytilus galloprovincialis* and *T. decussatus* collected from Homa Lagoon (Aegean Sea) (Uluturhan et al. 2019) and in the fish *M. barbatus, B. boops and T. trachurus* collected off the coast of Türkiye (Dogan et al., 2022).

194. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** See DPSIR assessment for the LEVS sub-division.

195. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** See DPSIR assessment for the LEVS Sub-division.

Levantine Sea Sub-division

196. **EO5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** Drivers that could impact CIs 13 and 14 are present in the LEVS: Agriculture, Tourism and maritime activities, Coastal urbanization, Sewage discharge, Seawater Desalination, Ports operation and maritime traffic, gas and oil exploration.

197. The complete GES assessment of the AEL Sub-region for CIs 13 and 14 was impossible given the lack of quality-assured, homogenous data that prevented the application of both EQR and simplified EQR assessment methodologies. Therefore, at this stage of 2023 MED QSR preparation, the assessment of eutrophication was performed by evaluating data only for Chl*a* available from the remote sensing COPERNICUS data by applying the simplified G/M comparison assessment methodology (see below assessment findings). The assessment results show that all evaluated assessment zones can be considered in good status regarding satellite derived Chl*a*.

198. Detailed examination showed that only 1 out of 18 SAUs, in the open waters (OW), was classified in non-good status. The SAU is located in the easternmost part of the southern Levantine Sea. The drivers and pressures in this SAU that could impact CI 14 are related to the area being one of the most densely populated areas in the world. Moreover, untreated or partially treated wastewater are discharged along the shoreline, polluting the coastal zone (Abualtayef et al., 2016).

199. **EO 9 – CI 17 (TM in sediments and biota, Σ_{16}PAHs, Σ_5PAHs and Σ_7PCBs in sediments):** Using CHASE+, the northern and eastern (NE) LEVS was classified as in-GES for TM in sediments, when the contribution of the two very limited affected areas (off Haifa and off Beirut, see

below see below assessment findings) were not taken into account. No assessment could be performed for the southern LEVS as no data were available. The NE LEVS was in-GES for Σ_{16} PAHs in sediments in Israel, Greece and Lebanon and in-GES for Σ_5 PAHs in sediments in Israel, Greece and Türkiye. The LEVS could not be classified based on assessment of Σ_7 PCBs in sediments due to lack of data and their uneven spatial distribution.

200. Regarding TM in sediments, non-GES stations were identified across the NE LEVS as follows: 1) In Israel, Northern Haifa Bay was non-GES (moderate status) and the main element contributing to this classification was Hg. The area is known to be still contaminated by legacy Hg, a pressure resulting from industry driver by ways of contaminated wastewater discharge. Even though there was a vast improvement following pollution abatement measures (Herut et al, 2016, 2021), the area is still contaminated; 2) In Lebanon, the main area in non-GES (moderate and poor) was off Beirut, in particular the Dora region, followed by area in the North Lebanon, with Cd and Hg concentrations contributing equally to the moderate classification. In Beirut, the drivers contributing to the pressures and state of the coast are urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge of the Beirut River. In addition, dumpsites are present in the Dora region (Ghosn et al., 2020). Tripoli, in northern Lebanon, is known for its artisanal fishing and boat maintenance activities (Ghosn et al., 2020), the latter a driver for TM introduction.

201. Stations in moderate status regarding TM in sediments were found in Cyprus in Larnaka Bay, off Zygi and in Chrisochou Bay Possible drivers are maritime activities and port operations among others. In Greece, two stations were found in moderate status (Koufonisi (S. Crete), Kastelorizo), with Pb and Cd concentrations contributing to this classification. Possible drivers are maritime activities and traffic, and fishing. In Türkiye, 4 stations were classified as in moderate status: Akkuyu, Taşucu, Anamur, Göksu River mouth. Possible drivers are agriculture, marine activities, riverine discharge.

202. Although the areas with data for Σ_{16} PAH in sediments were overall characterized as in-GES, two geographically limited areas with non-GES status were identified. In Israel, at stations close to the locations of drilled wells for gas exploration (Astrahan et al., 2017). The driver was defined as maritime activities, offshore platforms of gas exploration. In Lebanon, off in Beirut. The same drivers contributing to the status of TM in sediments apply also for Σ_{16} PAH.

203. 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. The Dora region off Beirut was affected with possible drivers similar to TM in sediments: urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge of the Beirut River.

204. IMPACTS. Although drivers and pressures and non-GES statuses were identified for the CI 17 in the LEVS, essentially no impact was detected in the environmental status classification fish and the NE LEVS was classified as in-GES for TM in *M. barbatus*. The only non-GES station (1 out of 15) in poor status was located off Paphos, Cyprus and this classification was due to the concentration of Hg. No data were available for TM in sediments in this area. It should be emphasized, that concentrations not in-GES do not necessarily imply a biotic effect.

205. **CI 18- Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the LEVS, no data were available at IMAP-IS to check for impacts in biota. Only two relevant studies in the scientific literature reported data on biomarkers in the LEVS. Both showed indications of possible effect of TM on various biomarkers in the mussel *Ruditapes* decussatus from Port Said (Egypt) (Gabr et al. 2020) and in the fish *M. barbatus, B. boops and T. trachurus* off the coast of Türkiye (Dogan et al., 2022).

206. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** The CI 20 DPSIR analysis was performed at the level of the entire AEL Sub-region due to the lack of

data for the separate analysis of LEVS and AEGS Sub-divisions. Drivers that could exert pressure and cause impact on CI 20 were detected in the AEL. The examination of CI 17 results showed no impact on biota in the LEVS and while no data were reported for biota in the AEGS. In addition, data reported to IMAP-IS for CI 17 for biota in the LEVS were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI 17 assessment. No impact was detected on CI 20.

207. Out of the 23 studies found in the literature for the AEL, 87% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU, 4% reported concentrations above the limits but without risk to human health and 9% reported concentrations above the limits for the regulated contaminants with probable risk to human health.

208. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** The CI21 DPSIR analysis was performed at the level of the entire AEL Sub-region due to the lack of data for the separate analysis of LEVS and AEGS Sub-divisions. Drivers that could exert pressure and cause impact on CI 21 are present in the AEL, among them: Urban coastal development, Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, data were available only for Israel (2021) and Lebanon in 2019-2021 in the LEVS. All stations in Israel were in excellent category. In Lebanon, 4 out of 38 stations were classified in bad category, all in the Beirut area. Possible drivers are urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge.

The Adriatic Sea Sub-region

209. **EO 5 – CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** The detailed status assessment results show that all the SAUs achieve GES conditions (high and good status). For all three parameters, the results show that all SAUs and sub-SAUs are in GES. The only exceptions are the results for TP in a part of CAS in the Italian offshore coast (Abruzzo region), and the TP on the SAS coastal and offshore zones (Apulia region), that were classified in moderate status. The Abruzzo and Apulia regions were identified as having aquaculture and coastal and maritime tourism (Gissi et al., 2017). Both drivers were identified as high impact to CIs 13 and 14 (Table I, Annex IV (CH 3)). Nutrients might be introduced to the area causing pressure and have the possibility to cause eutrophication and impact habitats and biodiversity. In the case of moderate status for TP, it was a localized effect, not affecting the overall assessment status and all SAUs fall under the GES status (high, good). A natural process of nitrogen limitation in the area and subsequent accumulation of phosphorus may be an additional explanation to the moderate assessment. Although the two drivers, aquaculture and coastal and maritime tourism, are present in other areas of the Adriatic Sea, they did not impact CI 13 nor CI 14, as represented by the available data.

210. **EO 9 – CI 17 (TM in sediments and biota, Σ_{16}PAHs in sediments and Σ_7PCBs in sediments and biota):** Overall, the aggregation of the chemical parameters data per SAU in the Adriatic Sub-region classified 80% of the SAUs as in GES (High or Good status), and 20% of the SAUs as non-GES under moderate status.

211. The detailed status assessment results per contaminant per SAU at the 1st level of assessment (no aggregation or integration) showed that in most cases (80% of SAUs) GES conditions are achieved; 9% of the SAUs are classified in moderate status, 6% in poor status and 5% in bad status.

212. For the sediment matrix, the highest contamination is observed from PCBs, PAHs and Hg resulting in non-GES status for 60%, 57% and 27 % of the sub-SAUs, respectively. For the mussels matrix, the highest contamination is observed from PCBs which results in 39% of sub-SAUs in non-GES status.

213. In the NAS, 19% of sub-SAUs are classified as non-GES. The most affected sub-SAUs in the NAS are HRO-0313-BAZ, HRO-0412-PULP and HRO-0423-RILP in Croatia; Emiglia-Romana', 'Fruili-Venezia-Giulia-1' and 'Veneto-1' in Italy. Also, offshore SAUs IT-NAS-O and MAD-Sl-MRU-12 are affected. The NAS subdivision suffers from Hg contamination (moderate status) in sediments and mussels and PCBs (poor status) contamination in sediments.

214. In the CAS, 12% of the SAUs are classified as non-GES. The most affected sub-SAUs are HRO-0313-KASP, HRO-0313-KZ, HRO-0423-KOR in Croatia. The CAS sub-division suffers from Hg (poor status) and PCBs (moderate status) contamination in mussels.

215. In the SAS, 22 % of the SAUs are classified as non-GES. The most affected SAUs are HRO-0313-ZUC, HRO-0423-MOP and HRO-0313-ZUC in Croatia; and MNE-1-N, MNE-1-C, MNE-1-S, MNE-Kotor, in Montenegro which are found in poor or bad conditions regarding several contaminants. The SAS sub-division is affected by Pb (moderate status) and PCBs (moderate status) contamination in mussels.

216. The main drivers that could put pressure on TM in sediments are industry (waste discharge and dumping of waste), tourism (litter, domestic waste water discharge), ports and maritime works (accidental discharges, dredging), shipping traffic (accidental discharges, solid waste disposal). Shipping traffic is extensive in the Adriatic Sea. In addition, Gissi et al., 2017 identified coastal and maritime tourism in Abruzzo, Apulia, Emilia Romagna, Marche, Molise, Veneto and Slovenia, although tourism is well developed in Croatia as well. They also identified dumping area for dredging in Emilia Romagna. See also Annex V (CH 3) with an extensive study on the DPSIR in the Adriatic Sea.

217. In the southern Adriatic Sea, Albania's coast and offshore SAUs are non-GES concerning Hg in sediments. In Montenegro, Hg, Pb, Σ_{16}PAHs and Σ_7PCBs in sediments were classified as non-GES in the central coastal SAU as well in the Kotor Bay. The project GEF (*Global Environment Facility):* Adriatic Implementation of the Ecosystem Approach in the Adriatic Sea through Marine Spatial Planning, examined in detail the DPSIR elements for Albania and Montenegro marine environment. Those support the results of the NEAT assessment achieved with IMAP monitoring data. In Albania, about 15% of the coastline is urbanized, and tourism is increasing (drivers and pressure). Status. The initial assessment of pollution shows established significant concentrations of mercury and organochlorinated compounds in some of the assessed areas on the northern and central coast (status). In Montenegro, about 32.5% of the coastline is urbanized, while tourism consists mainly beach goers. Nearshore activities, such as shipyards and ports are also of concern (drivers and pressures). Status. The preliminary assessment of pollution shows higher concentration of contaminants in the coastal area, particularly in Boka Kotorska Bay. The levels of some contaminants exceed the established limit, specifically legacy pollutants such as heavy metals and organohalogen compounds in sediments.

218. IMPACTS. Although drivers and pressures and non-GES statuses were identified for CI 17 in the Adriatic Sea, a few impacts were detected in the environmental status classification of the biota. Moreover, the non-GES status of a contaminant in the biota usually did not correspond to a non-GES status for the contaminant in sediment in the same sub-SAU. In the NAS, sub-SAUs for biota were in non-GES status for Hg and PCBs, with no corresponding non-GES status in the sediment or no data for PCBs in sediments. In 3 instances there was a correspondence between non-GES status for Hg in biota and sediment. In several sub-SAUs, Pb in sediments were non-GES while in-GES in biota. In the CAS there was no correspondence between the status of the sediments and the status of the biota. In the SAS, for 2 sub-SAUs, non-GES status for Pb in sediments corresponds to non-GES status for Pb in biota.

219. **CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers, that could exert pressure and cause impact on CI 18, were identified in the Adriatic Sea, no data were available at IMAP-IS to check for impacts in biota. One study from the scientific literature reported impact of PAHs on some of the biomarkers

measured in the specimens of the fish *Mullus barbatus* collected in an important fishery area in the North Adriatic Sea coming from Rimini to Ancona at a depth of 70 m (Frapiccini et al. 2020).

220. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the Adriatic Sea Sub-region. The examination of CI 17 results showed no impact on biota. In additions, data reported to IMAP-IS for CI 17 for biota were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI 17 assessment. No impact was detected on CI 20.

221. Out of the 25 studies found in the literature, 80% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU, and 8% reported concentrations above the limits but without risk to human health. Possible impact was detected in 12% of the studies that reported concentrations above the limits for the regulated contaminants with probable risk to human health.

222. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** Drivers that could exert pressure and cause impact on CI21 were detected in the Adriatic Sea, and among them the following: Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, essentially no impact was detected. Most of the bathing waters in the Adriatic were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor: 1.7% in Italy and 3.5% in Albania.

The Central Mediterranean Sea Sub-region

223. **EO 5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** The complete GES assessment of the CEN Sub-region for CIs 13 and 14 was impossible given the lack of quality-assured, homogenous data that prevented the application of both EQR and simplified EQR assessment methodologies. Therefore, the assessment of eutrophication was performed by applying the simplified G/M comparison assessment for evaluation of Chl *a* available from the remote sensing COPERNICUS data (see below assessment findings).

224. The assessment results show that despite the good status assigned to the assessment zones, the 7 out of 36 sub-SAUs are in the good status i.e., GREA, GREAMB, GREPAT, LBY_E, LBY_W, LBY_W; TUN_B in the Eastern and the Southern parts of the CEN Sub-region.

225. The subSAUs in Greece are located in Bays as are Ambracian Gulf (GREAMB), with pressure mainly from agriculture and Gulf of Patras (GREPAT) with pressures that include harbor operations, industries and agriculture. The more Northern subSAU (GREA) is probably influenced by the local sources of pollution (Igumenitsa port and intense aquaculture).

226. Along the Lybian coast, the influenced marine waters are in the western part of Libyan OW (subSAU LBYW), influenced by waters coming from the Gulf of Gabes where human activities contributed to the impact of eutrophication and by the city of Tripoli; in the eastern part of CW (subSAU LBYE). Several pressures that cause impacts of eutrophication are present in the Gulf of Gabes i.e., the subSAU TUNB located in CW: i) Large hurban center, ii) untreated domestic discharges, iii) industrial discharges, among them phosphogypsum, iv) agrochemical industry, v) agriculture.

227. **EO 9 – CI 17 (TM, Σ16PAHs, and Σ5PAHs in sediments)**: It was not possible to classify the Sub-region based on the CHASE+ application due to very limited available data and they uneven areal distribution in the CEN. The assessment was performed by station. Most of the stations were in-GES with respect to TM in sediments. Stations with non-GES status for Σ_{16}PAHs and Σ_{5}PAHs in sediments were identified.

228. Non-GES stations regarding Σ_5PAHs in sediments were located at the north-eastern and south-eastern part of Malta, in particular at the Port il- Kbir off Valetta and at the Operational Wied Ghammieq. Drivers and pressures in these areas are industrial plants and marine traffic. Non-GES stations were also located at the in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

229. IMPACTS. Drivers and pressures and non-GES statuses were identified for the CI17 in the CEN. However, there were almost no data for contaminants in biota in the CEN. Eight samples of *M. galloprovincialis* were in-GES for TM and 5 samples of *M. barbatus* were classified as non-GES for Hg.

230. **CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the CEN, no data were available at IMAP-IS to check for impacts in biota.

231. Examination of the scientific literature on the impact of pollution on biota biomarkers in the CEN found 5 studies for Tunisia and 1 from Italy. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

232. It should be emphasized that the studies used different biomarkers, with different biota species, measuring in different tissues, and different methodologies. The biomarkers studied were not listed by IMAP, and if listed, not analyzed in the organ or tissue as required by IMAP. Most of the studies measured various biomarkers in the same station, with some showing an effect and others not. All the studies below reported an impact on some of the biomarkers. Therefore, the text below addresses only the areas and species studied, and possible specific drivers, if available, with the knowledge that impact was detected in some of the biomarkers.

233. Tunisia. One mesocosm experiment was performed in Mytilus spp. exposed to sediment contaminated by PAH and TM collected from the Zarzis area (Ghribi et al. 2020), while the effects of hydrocarbons were studied in the mollusc *Ruditapes decussatus* collected from the southern Lagoon of Tunis (Mansour et al. 2021). The effect of TM on the mollusc *Patella caerulea* was studied in specimens collected from 4 sites in the CEN (Zaidi et al. 2022). The effect of microplastic ingestion was studied in the fish *Serranus scriba* collected from 6 sites along the Tunisian coast (Zitouni et al. 2020) and on the seaworm *Hediste diversicolor* collected from 8 sites along the Tunisian coast (Missawi et al. 2020).

234. Italy. The effect of plastic ingestion was studies in the fish *Trachurus trachurus* collected for the Sicily straits (Chenet et al. 2021).

235. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the CEN. TM data were present for Hg in 5 specimens of *M. barbatus* in IMAP-IS. The concentrations were higher than the thresholds for CI17 but lower than the limits for the regulated Hg in the EU. No studies were found in the literature.

236. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards.** Drivers that could exert pressure and cause impact on CI 21 are present in the CEN, among them: Urban coastal development, Tourism, sporting and recreational activities; ports and maritime works, maritime activities. No data were available for CI 21 in IMAP-IS.

The Western Mediterranean Sea Sub-region

237. **EO5 – CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chl*a* – Chlorophyll a):** The complete GES assessment of the WMS Sub-region for CIs 13 and 14 was impossible given the lack of quality-assured, homogenous data that prevented the application of both EQR and simplified EQR assessment methodologies. Therefore, the assessment of Common Indicator 14: Chl *a* was undertaken in the three Sub-divisions of the Western Mediterranean Sub-region as follows: i) in the Central Sub-division of the Mediterranean Sea Sub-region (CWMS): the Waters of France and the Southern part of the Central CWMS; the Alboran (ALB) and the Levantine Balearic (LEV-BAL) Sub-division: the Waters of Spain by applying the Simplified G/M comparison assessment methodology on the satellite-derived Chl *a* data; and ii) the Tyrrhenian Sea Sub-division and part of the CWMS: the Waters of Italy by applying both the Simplified G/M comparison assessment methodology on the satellite-derived Chl *a* data and the simplified EQR assessment methodology on *in situ* measured Chl a data.

238. Despite the good status assigned to the assessment zones, the assessment findings indicate some sub-SAUs in non-good status. The present assessment of the waters of Spain (see below assessment findings) showed there are 8 out of 70 subSAUs which are non-good status (the evaluation was performed on 70 out of 149 SubSAUs), and which are located close to the Mar Menor; in the Segura River mouth; near Valencia; close to the Ebro River mouth; one area close to the French border; and on the Mallorca Island in the Alcudia Gulf. There is a slight difference between the thresholds calculated from the satellite-derived data used for the present assessment and the assessment criteria calculated from *in situ* measurements (see below assessment findings), which resulted in the regional assessment findings which do not fully match the eutrophication evaluation performed by Spain by applying the assessment criteria calculated from *in situ* measurements. In the waters of Italy, there are 9 out of 54 subSAUs that are in non-good status, and they are located as follows: in front of the Arno River mouth; in front of the Tiber River mouth; close to the Napoli urban agglomeration and SW part of Sardinia Island. In the waters of France, there is 1 subSAU (Golfe de Porto Vecchio) out of the 46 SubSAU in non-good status. For four subSAUs located in the FRD_E Assessment Zone and two in the Corsica Island assessment zone (FRE), the assessment was reconsidered as in good status. In fact, a discrepancy that appeared between the national and sub-regional assessments was addressed further to the justification provided by France which is based on i) the presence of WT I in water body DC04; ii) the presence of WT IIIW in water bodies DC06A; DC07I; DC08B; EC01C; EC04B and DC04; iii) the specific national knowledge of the local hydrological and environmental conditions. Among these 6 water masses, four are located in the FRD-E assessment zone namely DC04 (Golfe de Fos), DC06A (Petite Rade de Marseille), DC07I (Cap de L'estéral – Cap de Brégançon) and DC08B (Ouest Fréjus- Saint Raphaël). Two water masses are located in Corsica Island (FRE) and correspond to EC04B (Golfe D'Ajaccio) and EC01C (Golfe de Saint Florent). Water mass DC04 (Golfe de Fos) is a highly modified water mass characterised by a high spatial heterogeneity in chl *a* distribution. For other water masses (DC06A, DC07I and DC08B; EF04B and EC01C in Corsica), hydrodynamic studies revealed a very low annual renewal of water masses thus explaining slight accumulation of low phytoplankton biomass levels (Ganzin et al. 2010[44])

239. The below findings derived from literature sources support the assessment findings as presented in assessment findings which indicate a few spatial assessment units in non-good status[45].

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[44] https://archimer.ifremer.fr/doc/00028/13931/11104.pdf

[45] The present assessment undertaken at the regional level, by using the satellite-derived Chl *a* data, indicates also weakened status in a few assessment areas along the coast of France, however, national authorities found that some regional assessment findings do not fully match the national assessments based on the use of *in situ* measurements. A presence of non-optimal matching of the regional and national assessments was also expressed by the authorities of Spain.

Drivers and pressures with impacts on eutrophication are found in the WMS[46]. The Spanish Mediterranean coastal zone may be affected by eutrophication mainly due to anthropogenic pressures, like agriculture (e.g., in Ebro Delta, rice field cultivation covers up to 65% of the area resulting in outputs of inorganic nutrients to nearby bays through drainage channels and the IMAP sub-SAUs ES100MSPFC32 in the vicinity was likely non-GES), but also by aquaculture, tourism, construction of harbors, intense urbanization, and industrialization. In French Mediterranean coast, the Gulf of Lion is one of the most historically known areas as influenced by natural and anthropogenic inputs of nutrients, receiving a large inputs of rural, urbanized, and industrialized discharges through the Rhone River. However, all sub-SAUs in the area were classified as in good status. The northern coasts of the Balearic Archipelago may be affected by the productivity imported from the Gulf of Lion, showing slightly higher concentration in the offshore north-eastern waters. Indeed, IMAP sub-SAU ES110MSPFMAMCp02 on the Mallorca Island in the Alcudia Gulf was classified as likely non-GES.

240. The Italian Western Mediterranean coast may be affected by riverine discharge e,g., the Arno river (subSAUs ITCWTCD and ITOWTCDoff Livorno), and the Tiber River (sub-SAUs ITCWLZ and ITOWLZC, Rome), as well as by the extensive population, tourism, port operations and industries, like the area of Naples (sub-SAUs ITOWCMC, ITOWCMD, ITCWCMC and ITCWCMD).

241. The Mediterranean Sea hosts around 400 coastal lagoons covering a surface of over 640 000 ha, that are important drivers for regional economies by way of fisheries, aquaculture, tourism, recreation and increased urbanization. One example of a well-studied lagoon is the Mar Menor located in the region of Murcia. The drivers and pressures on Mar Menor include tourism and agriculture along its shoreline and drainage area. In the present assessment the IMAP subSAU. ES070MSPF010300030, located close to the Mar Menor and IMAP subSAU ES080MSPFC017 located near the Segura River mouth were classified in non-good status. In addition, the area of the Gulf of Oristano in western Sardinia, is connected to the Cabras lagoon and may be influence by it (sub-SAU ITCWSDWB).

242. The present regional assessment using satellite-derived Chl *a* classified in non-good status one sub SAU EC03B close to Golfe de Porto Vecchio, located along the northern part of Corsica coast. As elaborated in the assessment findings, the assignment of non-good status can be explained in the context of the low number of pixels integrated into the assessment based on the use of the satellite-derived data along with the water properties complexified with sediment resuspension resulted in the uncertain computation of the mean Chl-a values. Additionally, the enclosed feature of the Gulf of Porto Vecchio with very low water renewal contributes to relatively high Chl concentrations observed in the area[47].

243. Mariculture is also well developed in Italian waters, for example off Genoa and in the Gulf of Follonica, the latter south of Livorno that was classified in non-good status in the present assessment (subSAUs ITCWTCD and ITOWTCD).

244. Although the non-good status was not found in the present assessment of the Southern part of the CWMS, it must be recognized that the assessment was impossible at the level of the finest spatial assessment units (subSAUs) due to the absence of finer water bodies delineation and related water typology characterization as for other Sub-divisions in the WMS. Given a less confidential assessment in this part of the WMS, some specific examples of drivers and pressures were mapped

[46] Agriculture (runoff and riverine discharge), industry (land based sources; industrial wastewater discharge), aquaculture (coastal shellfish and fish farming activities), coastal urbanization and tourism (domestic wastewater discharge), seawater desalination, ports and maritime operations (dredging).

[47] Giret O., Mayot H., Porcheray C., Salou K., Le Bourhis K. (2023). Bilan des schémas régionaux de développement de l'aquaculture marine. Cerema – DIRM Méditerranée. 38 p.

from the scientific literature. The Oran harbor (Algeria) which receives the discharge of wastewater, while the Ghazaouet harbor is exposed to chemicals coming mainly from industrial activities. In addition, the high rate of urbanization around the harbor contributes to anthropogenic contamination (Kaddour et al. 2021). Algeria also has seawater desalination plants along its shoreline such as the Bousfer desalination plant in Oran Bay and the Beni Saf desalination plant.

245. **EO 9 - CI 17 (TM in sediments and biota (*M. galloprovincialis)* (ALBS); TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota (TYRS); TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota (CWMS)):** The assessment was conducted using NEAT in the ALBS and the TYRS Sub-divisions. A simplified application of NEAT (1st level, without any further spatial integration) was applied to the CWMS. Data were available only for some SAUs for the northern coast sub-division (Spain, France, Italy). No data were available for the southern CWMS coast (Algeria and Tunisia). The WMS assessment was made for the coastal zone, as 91% of data were coastal.

246. Overall, the Alboran Sea (ALBS) and the Tyrrhenian Sea (TYRS) were classified as in GES, in good status regarding all available parameters and SAUs. In the Central Western Mediterranean (CWMS) Sub-division, 6 out of 7 SAUs were classified in high or good statuses and one SAU was classified as non-GES, in moderate status regarding all available parameters.

247. A detailed examination of these classifications is presented here-below.

248. ALBS. The ALBS Sub-division was in GES (high and good statuses) for TM in sediments and for Cd and Pb in biota, and non-GES (moderate status) for Hg in biota sampled along the Spanish coast. In addition, off Morocco, one SAU was in moderate status for Cd in sediments and one in moderate status for Pb in sediments.

249. TYRS. The TYRS Sub-division was in GES (high and good statuses) for TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota. For the Italian coast several non-GES parameters were identified for some SAUs, as follows: one SAU was in moderate status regarding Cd and Hg in sediments, one SAU in moderate status for Cd in sediments and in poor status for Hg in sediments, and one SAU in moderate status for Cd and Σ_7PCBs.

250. CWMS. Non-GES SAUs for several parameters were identified in the CWMS sub-division as follows: One SAU with moderate Pb in sediment in Spain; in France, one SAU with poor status of Hg in sediments, moderate status for Cd and Hg in biota and poor status for Σ_{16}PAHs in biota; 2 SAUs with poor and moderate statuses for Σ_{16}PAHs in biota; in Italy, one SAU with moderate status for Cd in sediment and poor status for Σ_{16}PAHs and Σ_7PCBs in sediments.

251. Drivers and pressures are found in the WMS: Large Ports and maritime traffic, Coastal urbanization, Tourism, Riverine discharge, Agriculture and aquaculture, Desalination. Some specific examples for drivers and pressures can be found in the scientific literature.

252. IMPACTS. Drivers and pressures and non-GES statuses were identified for CI17 in the WMS however, essentially no impact was detected in the environmental status classification of biota. In the CWMS, for France, moderate status was found for Hg and Pb in biota, at the same SAU with poor status for Hg in the sediment. In addition, moderate and poor statuses were assigned to Σ_{16}PAHs in biota in three SAUs. No concentration of Σ_{16}PAHs in sediment were reported. In the ALBS, for Spain, Hg in biota was in moderate classification. No concentration was reported for Hg in the sediment. It should be emphasized, that concentrations not in-GES do not necessarily imply a biotic effect.

253. **CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the WMS, no data were available at IMAP-IS to check for impacts in biota.

254. Examination of the scientific literature on the impact of pollution on biota biomarkers in the WMS found 4 relevant studies from Algeria, 2 from Italy, 5 from Spain and 4 from Tunisia. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

255. It should be emphasized that the studies used different biomarkers, with different biota species, measuring in different tissues, and different methodologies. The biomarkers studied were not listed by IMAP, and if listed, not analyzed in the organ or tissue as required by IMAP. Most of the studies measured various biomarkers in the same station, with some showing an effect and others not. All the studies below reported an impact on some of the biomarkers. Therefore, the text below addresses only the areas and species studied, and possible specific drivers, if available, with the knowledge that impact was detected in some of the biomarkers.

256. Algeria: Mussel *Donax trunculus* from Annaba Bay, from 2 impacted sites (Sidi Salem and Echatt) and one reference site (El Battah) (Amamra et al. 2019); fish, *Mullus barbatus* from two impacted sites (Oran, Ghazaouet) and a control site (Kristel), along the Algerian west coast (Kaddour et al. 2021); mussel *Perna perna* transplanted to three sites in the Gulf of Annaba (Laouati et al. 2021); mussel *Patella rustica* from four sites (3 affected and one reference) off the Bousfer desalination plant (Oran Bay, Algeria) (Benaissa et al. 2020).

257. Italy: Fish *Parablennius Sanguinolentus* collected from the port of Bagnara Calabra on the western Calabrian coast of Italy and from a reference site, Jancuia Cove. Stressor – pesticides. (Parrino et al. 2020); mussel, *Mytilus galloprovincialis*, and fish, *Mullus barbatus, Pagellus erythrinus* and *Diplodus vulgaris*, from different stations at the Bay of Pozzuoli, within the Gulf of Naples. Stressors: TM and PAHs (Morroni et al. 2020).

258. Spain: Three studies conducted near Integrated Multi-Trophic Aquaculture cages in Palma de Majorca as possible driver: two with *Mytilus galloprovincialis,* (Capo et al. 2021; Rios-Fuster et al. 2022) and one with the fish *Sparus aurata* (Capó et al. 2022). In addition, fish, *Seriola dumerili* collected around the Pityusic Islands, (Eivissa and Formentera; Balearic Islands) (Solomando et al. 2022); and European anchovy (*Engraulis encrasicolus*) collected at three areas off Catalonia (Spain): Barcelona, Tarragona and Blanes (Rodríguez-Romeu et al., 2022).

259. Tunisia: Scallop *Flexopecten glaber* were collected from the entrance to the Bizerte Lagoon and a site located near Menzel Abderrahmen, contaminated by inputs from the surrounded industrial manufactories and urban agglomerations (Telahigue et al. 2022); polychaete *Perinereis cultrifera* collected from the port of Rades and the Punic port of Carthage, S2 (Bouhedi et al. 2021); fish *Serranus scriba* were sampled from 6 sites along the Tunisian coast (2 WMS and 4 CEN). Stressor, microplastic ingestion as a potential vector for the transmission of adsorbed environmental chemicals to marine organisms (Zitouni et al. 2020); seaworm (*Hediste diversicolor)* from eight sites along the Tunisian coasts (2 WMS and 6 CEN), affected by different anthropogenic stresses. Stressor analyzed – microplastic ingestion (Missawi et al. 2020).

260. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the Western Mediterranean Sea. The examination of CI 17 results showed no impact on biota. In additions, data reported to IMAP-IS for CI 17 for biota were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI17 assessment. No impact was detected on CI-20.

261. Out of the 37 studies found in the literature, 78% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU and 11% reported concentrations above the limits but without risk to human health. Possible impact was detected in 11% of the studies that reported concentrations above the limits for the regulated contaminants with probable risk to human health.

262. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards**: Drivers that could exert pressure and cause impact on CI 21 were detected in the Western Mediterranean Sea, and among them the following: Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, essentially no impact was detected. Most of the bathing waters in Spain, France and Italy were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor category: 0.1% in Spain, 1% in France, 1.7% in Italy. In Morocco, 20 out of 131 stations (15%) were classified as in bad status. Data were not available for Algeria and Tunisia.

Quality status assessments of the Mediterranean regarding Common Indicators of Ecological Objectives 5 and 9

263. In the region of Mediterranean Sea, four main sub-regions have been recognized for practical reasons and for the purpose of the UNEP/MAP 2011 Initial Integrated Assessment and the Med QSR 2017 assessment, namely: the Western Mediterranean Sea, the Adriatic Sea, the Central Mediterranean, and the Aegean and Levantine Seas in the Eastern Mediterranean part. The sub-divisions (i.e., subareas/seas) for IMAP Pollution Cluster have been initially identified according to availability of database sources for the purpose of development of the assessment criteria for pollution and the assessments within the preparation of the 2017 MED QSR.

264. Sub-divisions were further analyzed to support optimal application of the assessment criteria in the four Mediterranean sub-regions by considering data aggregation for update of the assessment criteria, as well as relevant sources. The nesting scheme of the Mediterranean sub-regions and sub-divisions aggregation is as follows: (i) coastal/ onshore waters; (ii) national sub-divisions; (iii) regional sub-divisions; (iv) sub-regions; (v) Mediterranean Region.

265. The distribution of the assessment methodologies used for assessment of IMAP CIs 13, 14, 17, 18, 19 , 20, 21, as well as for assessment of IMAP Candidate Common Indicators 26 and 27 in the four Mediterranean sub-regions and related sub-divisions is shown in Table 3.1.2.1.

Table 3.1.2.1. The methodologies used for assessment of the four Mediterranean Sub-regions

CIs 13&14		
Sub-region	**Sub-division**	**Methodology**
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS)	G/M comparison
	Levantine Sea (LEVS)	G/M comparison
Adriatic Sea (ADR)	North Adriatic (NAS) *	IMAP NEAT assessment methodology
	Central Adriatic (CAS) *	
	South Adriatic (SAS) *	
Central Mediterranean Sea (CEN)	Central Mediterranean (CENS)	G/M comparison
	Ionian Sea (IONS)	G/M comparison
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS) and Levantine – Balearic Sea (LAVS-BAL) Sea Sub-division	G/M comparison
	Central Western Mediterranean Sea (CWMS): Central and Southern Parts	
	Tyrrhenian Sea (TYRS)	G/M comparison and EQR assessment
CI 17		
Sub-region	**Sub-division**	**Methodology**
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS)	CHASE+ assessment methodology
	Levantine Sea (LEVS)	
Adriatic Sea (ADR)	North Adriatic (NAS) *	IMAP NEAT assessment methodology
	Central Adriatic (CAS)*	
	South Adriatic (SAS) *	
Central Mediterranean Sea (CEN)	Central Mediterranean Sea (CENS)	CHASE+ assessment methodology
	Ionian Sea (IONS)	
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS)	IMAP NEAT assessment methodology
	Central Western Mediterranean Sea (CWMS)	
	Tyrrhenian Sea (TYRS)	
CI 18		
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS		The assessment approach for biological effects based on the use of the literature sources only
CI 19		
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS)	CHASE-like approach applied, considering frequency of spill occurrence trend.
	Levantine Sea (LEVS)	
Adriatic Sea (ADR)	North Adriatic (NAS)	
	Centrale Adriatic (CAS)	
	South Adriatic (SAS)	
Central Mediterranean Sea (CEN)	Central Mediterranean Sea (CENS)	
	Ionian Sea (IONS)	
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS)	
	Central Western Mediterranean Sea (CWMS)	
	Tyrrhenian Sea (TYRS)	

CI 20	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The assessment approach for contaminants in seafood based on the concentration limits for the contaminants regulated in EU Regulations
CI 21	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The assessment approach for bathing water quality based on complementary use of the assessment results as presented in the Assessment report from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020 and the assessment of monitoring data reported for IMAP
cCI 26	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure metrics and assessment methodology as provided in the document “Setting of EU Threshold Values for impulsive underwater sound – Recommendations” from the Technical Group on Underwater Noise (TG Noise), available at this URL The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 26.
cCI 27	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure metrics and assessment methodology as provided in the document “Setting of EU Threshold Values for continuous underwater sound – Recommendations” from the Technical Group on Underwater Noise (TG Noise), available at this URL The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 27.

* Referred to as NAS (Northern Adriatic Sea), CAS (Central Adriatic Sea) and SAS (Southern Adriatic Sea) in NEAT assessment, instead of NADR (North Adriatic), MADR (Middle Adriatic) and SADR (South Adriatic), respectively.

Assessment of IMAP Common Indicators 13 and 14

Geographical scale of the assessment	Sub-regional based on integration and aggregation of the assessments at sub-division levels
Contributing countries	Croatia, Italy, Slovenia and Montenegro
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicators	CI13. Key nutrients concentration in water column CI14. Chlorophyll-a concentration in water column
GES Definition (UNEP/MED WG 473/7) (2019)	**CI 13**: Concentrations of nutrients in the euphotic layer are in line with prevailing physiographic, geographic and climate conditions **CI 14**: Natural levels of algal biomass, water transparency and oxygen concentrations in line with prevailing physiographic, geographic and weather conditions
GES Targets (UNEP/MED WG 473/7) (2019)	**CI 13** • Reference nutrients concentrations according to the local hydrological, chemical and morphological characteristics of the un-impacted marine region. • Decreasing trend of nutrients concentrations in water column of human impacted areas, statistically defined. • Reduction of BOD emissions from land-based sources. • Reduction of nutrients emissions from land-based sources **CI 14** • Chlorophyll a concentration in high-risk areas below thresholds • Decreasing trend in chl-a concentrations in high risk areas affected
GES Operational Objective (UNEP/MED WG473/7) (2019)	**CI 13** Human introduction of nutrients in the marine environment is not conducive to eutrophication **CI 14** Direct and indirect effects of nutrient over-enrichment are prevented

The IMAP Environmental Assessment of the Aegean and Levantine Seas Sub-region (AEL)

266. Given the lack of quality-assured, homogenous data prevented the application of both the EQR and the simplified EQR assessment methodologies, the assessment of eutrophication within the preparation of the 2023 MED QSR was undertaken in the sub-divisions of the Aegean-Levantine Sea (AEL), the Central Mediterranean Sea (CEN) and the Western Mediterranean Sea (WMS) by evaluating only data for Chla available from the remote sensing sources, whereby the typology-related assessment was impossible to apply.

267. The application of the Simplified methodology based on G/M comparison in the AEL Sub-region relied on the use of COPERNICUS data for Chl*a* obtained by remote sensing.

Along with the application of the IMAP NEAT GES assessment methodology in the Adriatic Sea Sub-region, the application of the Ecological quality ratio (EQR); the Simplified EQR methodology, and the Simplified methodology based on G/M comparison was also explored in another three Mediterranean Sub-regions with insufficient data for the IMAP NEAT GES assessment.

The ecological quality ratio (EQR) is a dimensionless measure of the observed value of an indicator compared with reference conditions. The ratio goes from 0 (large deviation) to 1 (when the observed value is equal or better than the reference conditions).

The application of the EQR method was found relevant for assessment of IMAP Common Indicators 13 & 14 where full set assessment criteria for Chl*a*, DIN and TP exist. Typology related assessment needs to be performed.

Given the lack of data reported by the CPs, this methodology was impossible to apply within the preparation of the 2023 MED QSR. However, key aspects of this methodology, as presented here-below, are developed for future application within the implementation of IMAP.

The EQR, which is set as the relative deviation from the reference conditions (RC), must be calculated for every boundary value using the simple equation:

$$EQR_{actual} = RC/Chla_{annual\ G\text{-}mean} \qquad (1)$$

where for $Chla_{annual\ G\_mean}$, the Chl*a* concentrations defined for every boundary value must be used.

As Chl*a* concentrations are derived using non-linear relationships, the corresponding EQRs are not on a linear equidistant scale. To calculate the EQRs values normalized (Anon, 2005) to the scale from 0 to 1 (EQR_{norm}) and set them equidistantly, with respect to the calculated values designated as EQR*actual*, the following conversion functions need to be used:

Chl*a* - $EQR_{norm} = 0.2586 \ln(EQR_{actual}) + 0.9471$	for Type I coastal waters	(2)
TP - $EQR_{norm} = 0.3183 \ln(EQR_{actual}) + 0.9521$	for Type I coastal waters	(3)
Chl*a* - $EQR_{norm} = 0.1824 \ln(EQR_{actual}) + 1.0253$	for Type I open waters	(4)
DIN - $EQR_{norm} = 0.1216 \ln(EQR_{actual}) + 1.0209$	for Type I open waters	(5)
Chl*a* - $EQR_{norm} = 0.1488 \ln(EQR_{actual}) + 1.0385$	for Type I Montenegro	(6)
DIN - $EQR_{norm} = 0.0966 \ln(EQR_{actual}) + 1.0378$	for Type I Montenegro	(7)
Chl*a* - EQRnorm = 0.246 ln(EQRactual) + 0.981	for Type II A Adriatic coastal waters	(8)
TP - EQRnorm = 0.333 ln(EQRactual) + 0.979	for Type II A Adriatic coastal waters	(9)

The actual and normalized EQRs for all boundary values of Types I, and II A Adriatic are shown in Tables I and II, Annex II (CH 2), respectively.

Finally, for each considered variable, sampling station or area is classified in GES or non-GES, comparing the EQR value of the indicator to the class boundary value.

The application of the simplified EQR methodology was found relevant where complementary data availability i.e. *in situ* and from remote sensing is found for Chla only and the typology related assessment is not possible to apply. Given the lack of homogenous quality assured data reported by the CPs even for Chla only, an application of the simplified EQR method was impossible for any sub-region/sub-division within the preparation of the 2023 MED QSR.

For the application of the simplified EQR method within the IMAP implementation, thresholds need to be used to define the boundary limits between an acceptable and unacceptable environmental status (i.e., Good Environmental Status (GES) or non-Good Environmental Status (non-GES)). In the absence of the assessment criteria for nutrients, application of the simplified EQR method is foreseen by relying on the experiences gained in the Baltic Sea (Andersen et al. 2011; HELCOM 2010). For an indicator showing a positive response (i.e., nutrients and Chl*a*), it indicates that the threshold has an upper limit of +50 % deviation from reference conditions. Setting the threshold to 50 % implies that low levels of disturbance (defined as less than +50 % deviation), resulting from human activity, are considered acceptable, while moderate (i.e., greater than +50 %) deviations are not considered acceptable for the water body in question.

Given the lack of quality-assured homogenous data prevented the application of NEAT, EQR and simplified EQR assessment methodologies, the assessments within the 2023 MED QSR were prepared only by evaluating data available for Chla from remote sensing sources, whereby the typology-related assessment is impossible to apply. The application of **the simplified methodology based on G/M comparison** relied on the use of satellite-derived data for Chl*a* (e.g. COPERNICUS, ARGANS, SMED algorithm).

Data were aggregated as a 5-year geometric mean and normalized in order to ensure their comparability between the areas of assessment. For normalization, the bestNormalize package in R was used. The best normalization transformation was identified as the Ordered Quantile normalizing transformation (Bartlett, 1947, Beasley et al., 2009). From the normalized values, the following values are back-transformed: the 10^{th} percentile as the reference condition, the 50^{th} percentile as the mean value of the distribution, and the 85^{th} percentile ~ mean +1 SD that represents the G/M threshold.

Finally, each considered observation point or area was classified in GES or non-GES status, comparing the value of the indicator to the boundary limit between G/M i.e. back transformed the 85^{th} percentile of the normalized distribution.

Available data.

268. A detailed data analysis was performed in order to decide on applying the assessment methodologies that can be found optimal for specific sub-region/sub-division in the present circumstances related to the lack of data reporting. Table 3.1.3.1.1 informs on data availability in AEL by considering data reported by the Contracting Parties by 31st October, the cut-off date for data reporting. Figure 3.1.3.1.1 shows the locations of sampling stations in the AEL Sub-region.

Table 3.1.3.1.1. Data availability by country and year for the Aegean Levantine Sea (AEL) Sub-region showing data reported by the CPs for the assessment of EO5 (CI13 and CI14) up to 31st Oct 2022.

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Cyprus	2016	182	172	197	89	-	17	180	205	203	186
	2017	38	15	48	14	-	28	141	150	150	131
	2018	39	27	41	41	-	36	56	93	91	109
	2019	45	22	49	49	-	49	37	38	38	62
	2020	84	67	82	82	-	39	86	72	71	72
	2021	-	-	-	-	-	-	136	112	112	107
Greece	2016-2021	No data provided									
Egypt	2016-2021	No data provided									
Israel	2017	15	15	15	15	-	15	15	15	15	15
	2018	14	14	14	14	-	14	14	13	13	13
	2019	14	14	14	14	-	14	14	14	14	14
	2020	14	14	14	14	-	14	14	14	14	14
Lebanon	2017	-	225	225	225	-	-	195	224	224	-
	2018	-	286	286	286	-	-	247	285	285	-
	2019	-	547	547	547	-	40	386	538	538	-
	2020	-	268	268	268	-	-	160	268	268	-
	2021	-	291	291	291	-	-	154	291	291	-
Syria	2016-2021	No data provided									
Turkiye	2016	342	209	341	342	341	342	209	342	342	307
	2019	1460	1055	1479	1138	1545	972	1052	994	17713	1558

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – Temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

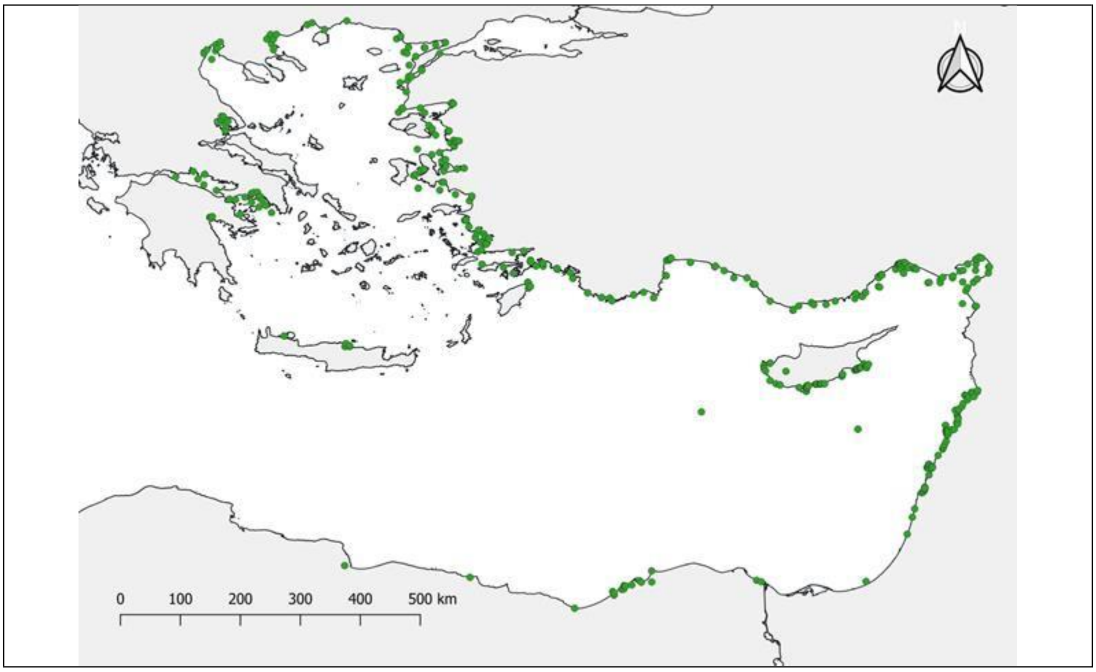

Figure 3.1.3.1.1. The locations of sampling stations in the AEL Sub-region

269. Given the lack of homogenous and quality assured data reported in line with IMAP requirements, as shown in Table 3.1.3.1.1, it was necessary to explore the use of alternative data sources. The COPERNICUS source was found relevant regarding the existence of a systematic repository of remote sensing data for Chl a. Using only Chl a data, with a good geographical coverage (1 x 1 km) and high sensing frequency (daily), it was possible to tentatively develop a simple assessment method, by applying ecological rules and a comparison of the obtained values to the defined G/M threshold. Chlorophyll a data for the Levantine Sea Sub-division, comprising of 22 million records, and for the Aegean Sea Sub-division, comprising of 20 million records, were downloaded from the Copernicus web-site[48].

270. For the Levantine Sea the Copernicus product with ID: OCEANCOLOUR_MED_BGC_MY_009_78 was downloaded for the period from Apr 2016 to Mar 2021. It consists of Level 4 monthly values of Chlorophyll a concentration (CHL) with a resolution of 1 x 1 km. The file format is NetCDF-4 (.nc).

271. For the Aegean Sea the Copernicus product with ID: OCEANCOLOUR_MED_BGC_MY_009_144 was downloaded for the period from Jan 2016 to Dec 2020. It consists of Level 4 monthly values of Chlorophyll a concentration (CHL) with a resolution of 1 x 1 km. The file format is NetCDF-4 (.nc).

272. Data elaboration was performed by using R, an open-source language widely used for statistical analysis and graphical presentation (R Development Core Team, 2022)[49]. Maps are elaborated using QGIS 3.28, an open-source GIS tool.

273. For every point of the grid (Figure 3.1.3.1.2.a and b), a GM annual value was calculated, as required in the COMMISSION DECISION (EU) 2018/229[50]. The parameter values were expressed in µg/l of Chlorophyll a, for the geometric mean (GM) calculated over the year in at least a five-year period. These GM annual values were later used as a metric for the development of the assessment criteria for the present CI 14 assessment.

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[48] https://data.marine.copernicus.eu/product/OCEANCOLOUR_MED_BGC_L4_NRT_009_142/description
[49] R Development Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. http://www.R-project.org
[50] Commission Decision (EU) 2018/229 of 12 February 2018 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration

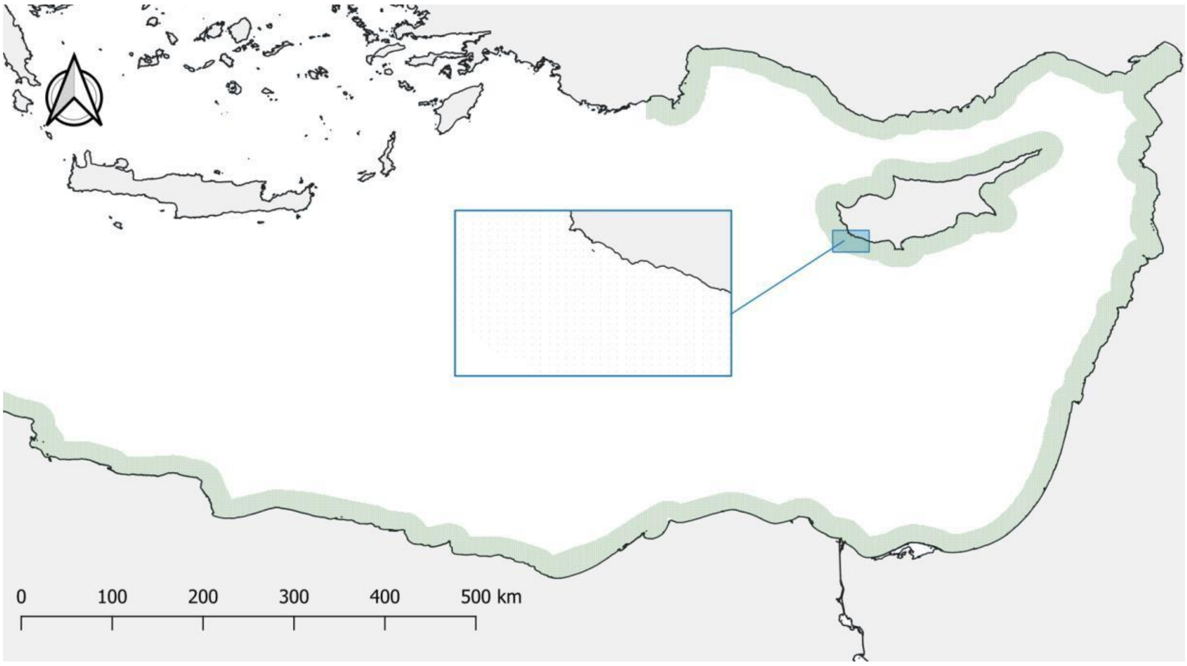


Figure 3.1.3.1.2.a. The Levantine Sea Sub-region: The dots in the assessment zones represent data in the grid (1 x 1 km). In the small rectangle a detailed view of the sensing grid is presented.

Figure 3.1.3.1.2.b. The Aegean Sea Sub-division: The dots in the assessment zones represent data in the grid (1 x 1 km). The blue lines demark the three spatial assessment units set within the Aegean Sea Sub-division for the purpose of data grouping for the present assessment.

Setting the areas of assessment.

274. Following the rationale of the IMAP national monitoring programmes related to distribution of the monitoring stations, as well as the rules for integration and aggregation of the assessment products, in the Levantine Sea Sub-divisions for the purposes of the present work the two zones of assessment were defined, i.e., : i) the coastal zone and ii) the offshore zone; and given the lack of information on water typologies present in national waters, for the present assessment in the Aegean Sea Sub-division only the coastal zone was assessed.

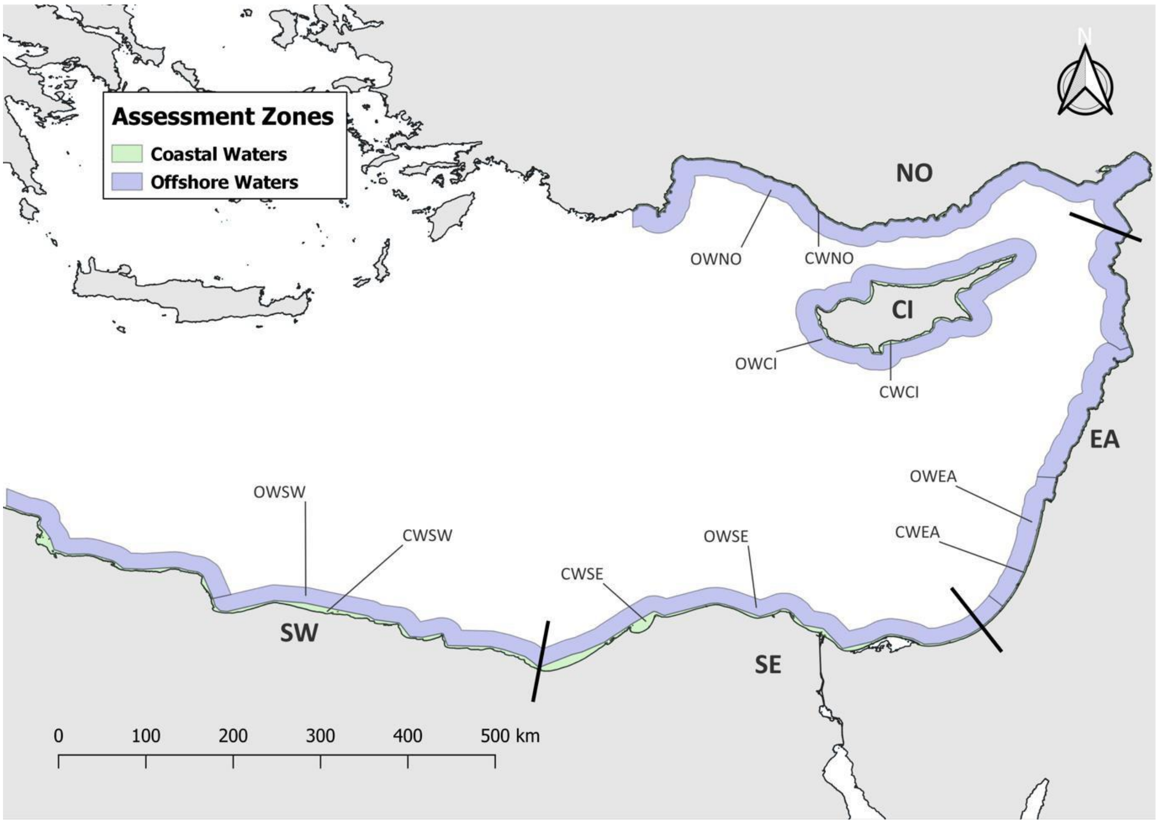
275. For purpose the of present work, it should also be recalled that GIS layers collected from different sources (International Hydrographic Organization – IHO Seas subdivisions, European Environment Information and Observation Network – EIONET (WFD delimitation (2018)); VLIZ marine subregions.

Levantine Sea

276. The principle of the NEAT IMAP GES assessment methodology applied in the Adriatic Sea Sub-region, as well as in the Western Mediterranean Sea Sub-region regarding CI 17, for setting of the spatial assessment units (SAUs) within the two main assessment zones along the IMAP nesting scheme, was also followed for setting the coastal (CW) and the offshore monitoring zones (OW) in the Levantine Sea Sub-division. The CW included internal waters and one Nautical Mile outward. The offshore waters in the LEV start at the outward border of CW and extend to 20 km outward given this coverage corresponds to the area where national monitoring programmes are performed as shown in Figure 22: Pressures exerted by agriculture on the marine environment.

277. The AZ were divided between the five areas Northern, Eastern, Cyprus Island and the two Southern (West and East), which delimitations are shown on Figure 3.1.3.1.3. (upper map). It resulted in eight SAUs (i.e., CWNO – Northern CW; OWNO – Northern OW; CWEA – Eastern CW; OWEA – Eastern OW; Cyprus Island CW – CWCI; Cyprus Island OW – OWCI; Southern East CW – CWSE; Southern East OW – OWSE; Southern West CW – CWSW; and Southern West OW – OWSW). The finest IMAP SAUs were further set on the base of nested assessment areas (AZs, five areas) by considering the national areas of monitoring and hydrographic characteristics.

278. The finest IMAP sub SAUs set in the Levantine Sea Sub-division for the purpose of the present CI 14 assessment are depicted in. Figure 3.1.3.1.3 (lower map), including their nesting in the two main assessment zones i.e. CW and OW of the Levantine Sea Sub-division.



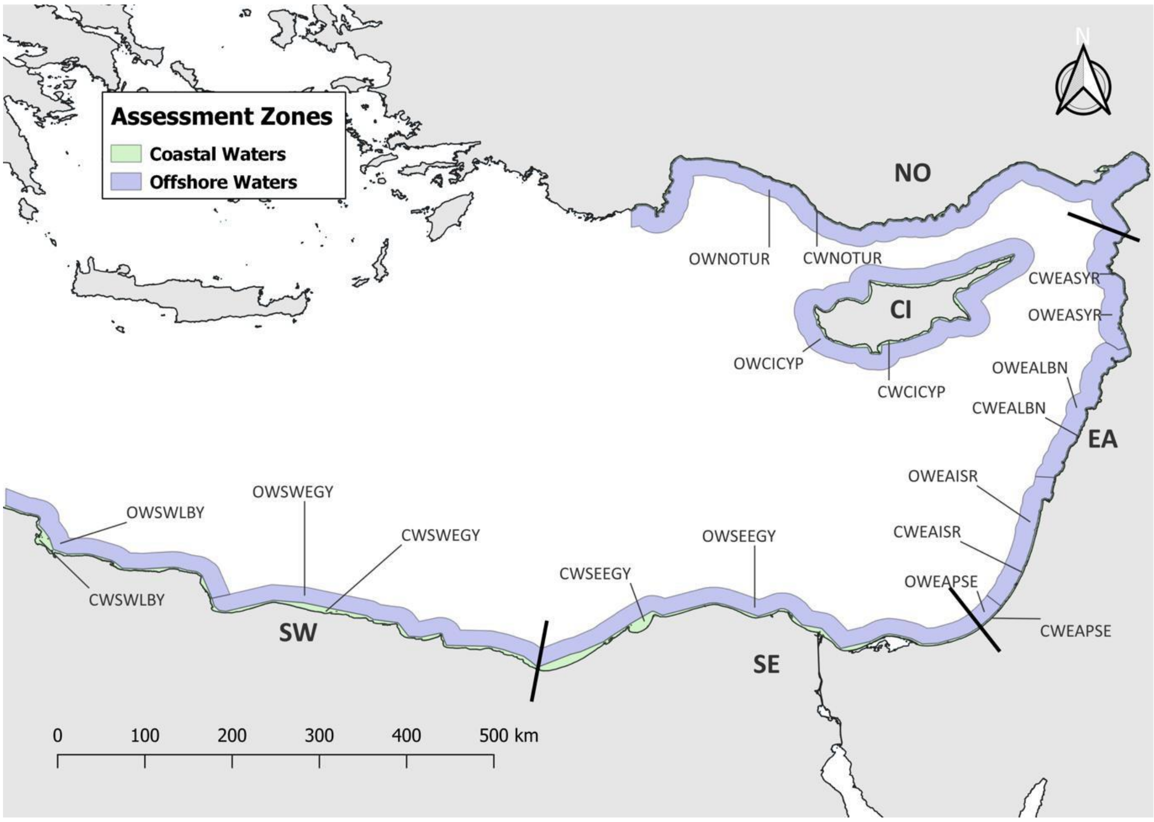


Figure 3.1.3.1.3.a. The nesting of IMAP spatial assessment units set in the coastal (CW) and the offshore assessment (OW) zones of the Levantine Sea Sub-division by SAU (upper map); and depiction of the finest IMAP subSAUs (lower map).

Aegean Sea

279. In addition, available literature indicates waters in front of Mersin and in the Iskenderun Bay as impacted areas. A slight impact can also be identified along the coast of Israel and in the OW in the southern part of the Eastern Levantine Sea, as well as in front of Port Said and Alexandria. The influence of the Nile River through the river Delta is weak and confirms the changes in the area caused by construction of the Aswan dam. There is also an indication of a coastal impact in the Tobruk area in the waters of Libya.

280. The Coastal Assessment Zone was divided into three spatial assessment units (SAUs) within the Aegean Sea Subdivision: the North Aegean (NA), the Central Aegean (CA) and the South Aegean (SA) as shown in Figure 3.1.3.1.3.b. Then the finest spatial assessment units (sub SAUs) were obtained in the three SAUs by taking account of the definition of the Greek (EIONET) and the Turkish51 national waterbodies for assessment of eutrophication.

281. The finest IMAP subSAUs set in the Aegean Sea Sub-division for the purpose of the present CI 14 assessment are depicted Figure 3.1.3.1.3.b. It shows their nesting in the Aegean Sea Sub-division. Namely, the following sub SAUs were set: i) 8 along the coast of Greece: AEG_C_ARG, AEG_C_ISL, AEG_C_SOR, AEG_N_HAL, AEG_N_HAL_O, AEG_N_ISL, AEG_N_THE and AEG_S_KRE; and 7 along the coast of Turkiye EGE_C, EGE_S, EGE04, EGE09, AEG_N, EGE_N and EGE13_2.

Figure 3.1.3.1.3.b. The nesting of the finest IMAP spatial assessment units (sub SAUs) in the coastal (CW) zone of the Aegean Sea Sub-division.

[51] NEAT, BEAST, Lusival Index, Ecological Quality Index Evaluation Report of Turkish Eagean Coasts

Setting the good/non-good boundary value/threshold for the Simplified G/M comparison assessment methodology application in the AEL Sub-region

282. The definition of baseline and threshold values for IMAP CIs 13 and 14 in the Mediterranean Sea is an ongoing process. The setting of GES-nonGES boundary limits within GES assessment of the Adriatic Sea Sub-region for IMAP CIs 13 and 14 were based on the boundary and reference values defined for TP and DIN, and updated ones for Chl a.

283. The attributes were added to all new satellite derived Chl*a* data points in order to allow their use for calculation of the assessment criteria by the CW and OW, and SAUs in the Levantine Sea Sub-division, and by the CW and SAUs in the Aegean Sea Sub-division.

284. The use of a new parameter for assessment i.e. satellite derived Chl*a* imposes calculation of a new set of assessment criteria given absence of any tested relationship of the satellite derived Chl*a* data with *in situ* measured Chl*a* data based on effects-pressures relationship. Namely, the use of reference and boundary water types related values[52], , was impossible for the present work.

285. In order to calculate the assessment criteria applicable within the present work, the annual GM values for satellite derived Chl*a* data were normalized using the R package *bestNormalize*. Then, the normalization process was tested for usual normalisation transformation, log x, boxcox, yeojohnson and Ordered Quantile normalizing transformation (orderNorm). The best normalisation was obtained with *orderNorm()*, and it was used for calculation of the assessment criteria applied to deliver the present CI 14 assessment.

286. For the assessment of CI 14, the Reference conditions (RC) were calculated from the normalized values and were represented by the 10^{th} percentile. For setting the G/M threshold, a modification of the rule applied in the Baltic Sea (Andersen et al. 2011[53]; HELCOM 2010[54]) was applied within the present work given the 50^{th} percentile represents the mean value of the distribution, and the 85^{th} percentile ~ mean +1 SD represents the G/M threshold. It was necessary to use this criterion given expert - based analysis of the satellite derived Chl*a* preliminary indicates that most of the assessed waters are in the high status.

287. The transformation of percentile to z-scores were obtained using the pnorm() an qnorm() functions in R. The RC values (oN10) and the G/M thresholds (oN85) were calculated from the normalized values through the predict function. The results of calculation are presented in Table 3.1.3.1.2.a, and are obtained by the AZs and SAUs set in the Levantine Sea Sub-division, and in Table 3.1.3..1.2.b in the Aegean Sea Sub-division. In the absence of information on water typologies present in national waters, the assessment criteria were provided only at the level of SAUs.

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[52] The water typology was applied as set by the Decision IG.23/6 of COP 20 (MED QSR)

[53] Andersen, J. H., Axe, P., Backer, H., Carstensen, J., Claussen, U., Fleming-Lehtinen, V., et al. (2011). Getting the measure of eutrophication in the Baltic Sea: towards improved assessment principles and methods. Biogeochemistry, 106(2), 137–156.

[54] HELCOM. (2010). Ecosystem health of the Baltic Sea 2003-2007: HELCOM Initial Holistic Assessment.

Table 3.1.3.1.2 a.: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP Assessment zones (AZ) and Spatial Assessment Units (SAU) in the Levantine Sea Sub-division.

AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	CI	0,047	0,071	0,075	0,034	0,065	0,039
CW	EA	0,462	0,692	1,762	0,125	1,402	0,209
CW	NO	0,152	0,227	2,156	0,066	1,454	0,089
CW	SE	1,769	2,653	5,675	0,059	4,773	0,174
CW	SW	0,038	0,056	0,161	0,025	0,104	0,029
OW	CI	0,039	0,059	0,051	0,029	0,049	0,034
OW	EA	0,061	0,092	0,142	0,042	0,110	0,051
OW	NO	0,064	0,095	0,170	0,044	0,140	0,052
OW	SE	0,227	0,341	1,495	0,042	0,990	0,093
OW	SW	0,031	0,047	0,037	0,023	0,035	0,028

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile

Table 3.1.3.1.2. b. Reference conditions (oN10) and G/M threshold (oN85) set by IMAP Assessment zones (AZ) and Spatial Assessment Units (SAU) in the Aegean Sea Sub-division.

AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	CA	0,074	0,111	0,142	0,053	0,12	0,06
CW	NA	0,126	0,189	0,625	0,085	0,436	0,097
CW	SA	0,056	0,084	0,079	0,046	0,07	0,051

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile

288. By selecting the 85th percentile of the normalized distribution as G/M boundary limit, therefore as the limit between the acceptable and the unacceptable statuses i.e. good and non-good , the compatibility of the present classification was achieved with a five classes GES/non GES scale set in the Adriatic Sea Sub-region. It should be noted that the two status classes i.e., good and non-good are assigned to the units assessed by applying the simplified G/M assessment methodology. Since the assessment findings are based on the use of only one parameter i.e., Chl-a, and therefore, the integrated consideration of the minimum of parameters needed to assess the good environmental status for IMAP CIs 13 and 14 was impossible, only classification in good and non-good status was provided.

Results of the Simplified G/M comparison assessment methodology application in the LEVS.

a) The Levantine Sea (LEVS) Sub-division

289. Upon setting the reference conditions and the G/M threshold, each observation point, or area were classified in good or non- good status , by comparing the value of the indicator i.e., the satellite derived Chla to the G/M threshold, i.e. the back transformed 85th percentile of normalized distribution.

290. The results of CI 14 assessment using the satellite derived Chla data are presented in Tables 3.1.3.1.3.a. and 3.1.3.1.4.a., and Figure LEVS 3.1.3.1.5.E. The good status corresponds to the RC conditions, as well as to the values below the 85th percentile of normalized distribution set as good/non good statusboundary (i.e. blue coloured cells in the last column of Tables 3.1.3.1.3.a and 3.1.3.1.4.a). The good status corresponds to the class above G/M boundary limit (i.e. red coloured cell in the last column of Table 3.1.3.1.4.a.).

291. The assessment results show that all evaluated assessment zones can be considered in good status regarding assessment of the satellite derived Chla data. Further to good status assigned to the assessment zones, it can be preliminary found that only 1 out of 18 subSAUs is in non-good status. However, it must be noted that the present subSAUs are set at an insufficient level of fineness for a reliable assessment (Table 3.1.3.1.4 and Figure LEVS 3.1.3.1.5.E). This subSAU in non-good status is located in the OW in the southern part of the Eastern Levantine Sea. The local sources of pollution are probably the main driver contributing to the weakened status of this subSAU.

292. In addition, available literature indicates waters in front of Mersin and in the Iskenderun Bay as impacted areas. A slight impact can also be identified along the coast of Israel and in the OW in the southern part of the Eastern Levantine Sea, as well as in front of Port Said and Alexandria. The influence of the Nile River through the river Delta is weak and confirms the changes in the area caused by construction of the Aswan dam. There is also an indication of a coastal impact in the Tobruk area in the waters of Libya.

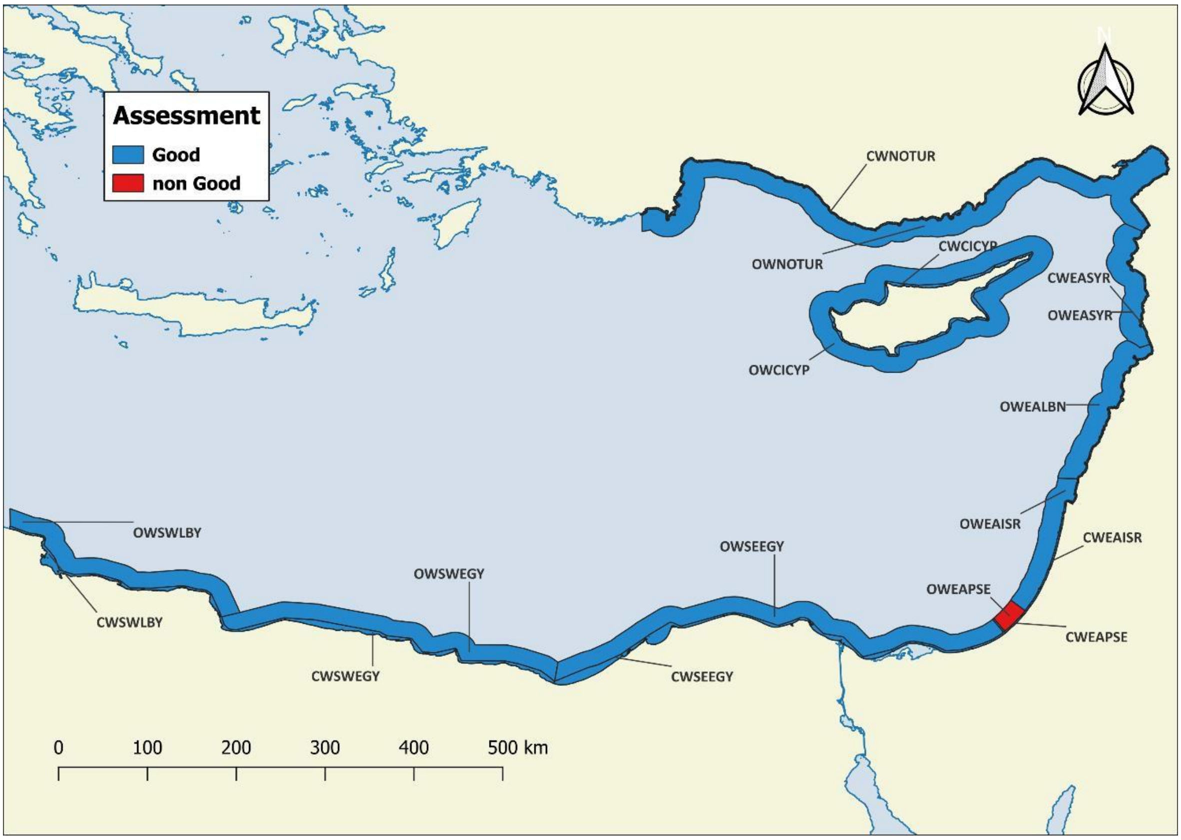


Figure AEL 3.1.3.1.5.E: The assessment results for CI 14 in the Levantine Sea Sub-division by applying he simplified G/M method at the level of SAUs.

Table 3.1.3.1.3.a. Results of the assessment (G_NG.oN85 – the good status corresponds to all values below the 85th percentile set as G/M i.e., good/noon-good boundary limit) of the Levantine Sea Sub-division by Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blue coloured SAUs indicate good status.

AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_NG.oN85
CW	CI	677	0,050	0,047	0,071	0,034	0,065	**G**
CW	EA	257	0,458	0,462	0,692	0,125	1,402	**G**
CW	NO	163	0,199	0,152	0,227	0,066	1,454	**G**
CW	SE	853	1,111	1,769	2,653	0,059	4,773	**G**
CW	SW	1281	0,050	0,038	0,056	0,025	0,104	**G**
OW	CI	10383	0,040	0,039	0,059	0,029	0,049	**G**
OW	EA	9178	0,074	0,061	0,092	0,042	0,110	**G**
OW	NO	12598	0,083	0,064	0,095	0,044	0,140	**G**
OW	SE	7568	0,331	0,227	0,341	0,042	0,990	**G**
OW	SW	10458	0,032	0,031	0,047	0,023	0,035	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions)

Table 3.1.3.1.4.a. Result of the assessment (G_NG.oN85- the good status corresponds to all values below the 85th percentile set as G/M i.e., good/noon-good boundary limit) of the Levantine Sea Sub-division for the finest Spatial Assessment Units (SAUs). Blue coloured SAUs indicate good status; Red coloured SAU indicates non-good status.

AZ	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
CW	CI	CWCICYP	677	0,050	0,071	0,034	0,065	**G**
CW	EA	CWEAISR	95	0,498	0,692	0,125	1,402	**G**
CW	EA	CWEALBN	91	0,360	0,692	0,125	1,402	**G**
CW	EA	CWEAPSE	26	1,362	0,692	0,125	1,402	**G**
CW	EA	CWEASYR	45	0,331	0,692	0,125	1,402	**G**
CW	NO	CWNOTUR	163	0,199	0,227	0,066	1,454	**G**
CW	SE	CWSEEGY	853	1,111	2,653	0,059	4,773	**G**
CW	SW	CWSWEGY	725	0,035	0,056	0,025	0,104	**G**
CW	SW	CWSWLBY	556	0,080	0,056	0,025	0,104	**G**
OW	CI	OWCICYP	10383	0,040	0,059	0,029	0,049	**G**
OW	EA	OWEAISR	2724	0,086	0,092	0,042	0,11	**G**

AZ	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
OW	EA	OWEALBN	3243	0,067	0,092	0,042	0,11	**G**
OW	EA	OWEAPSE	486	0,158	0,092	0,042	0,11	**NG**
OW	EA	OWEASYR	2725	0,062	0,092	0,042	0,11	**G**
OW	NO	OWNOTUR	12598	0,083	0,095	0,044	0,14	**G**
OW	SE	OWSEEGY	7568	0,331	0,341	0,042	0,99	**G**
OW	SW	OWSWEGY	5843	0,030	0,047	0,023	0,035	**G**
OW	SW	OWSWLBY	4615	0,033	0,047	0,023	0,035	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5 year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions);

b) The Aegean Sea (AEGS) Sub-division

293. The assessment results show that all three evaluated assessment zones can be considered in good status regarding assessment of the satellite derived Chla data. Further to this likely good status assigned to the assessment zones, it can be preliminary found that only 2 out of 16 subSAUs are in noon-good status. However, it must be noted that the present subSAUs are set at an insufficient level of fineness for a reliable assessment (Table 3.1.3.1.4.b, and Figure AEL 3.1.3.1.5.E). The following two non-good status subSAUs are located in the CA SAU in the waters of Turkiye in the Aegean Sea: EGE09 (Izmir Bay) and EGE_C (coast strip south of Izmir Bay). The local sources of pollution are probably the main driver contributing to the weakened status of these two subSAUs.

294. In addition, available literature indicates the presence of drivers and pressures with impacts related to eutrophication in the areas as elaborated here-below.

295. In the Saronikos Gulf and Elfesis Bay, there is evidence of a few following drivers and pressures: i) extensive urbanization in the metropolitan areas of Athens and Piraeus hosting about 1/3 of the Greek population; ii) port activities and maritime traffic (Piraeus port); and iii) industries located in the coastal area of the Elefsis Bay, such as oil refineries, steel and cement industries, and shipyards. Since 2012, the eastern Elefsis Bay receives treated domestic and industrial wastewaters from the Thriasio wastewater treatment plant. The small island of Psyttaleia hosts the wastewater treatment plant of metropolitan Athens, however with pre-treatment, primary and secondary treatment, including biological nitrogen removal, and sludge treatment. Treated wastewaters are discharged into the Inner Saronikos Gulf via a system of three pipelines to the south of the island, at 62m depth (Karageorgis et al., 2020 and references therein).

296. Similarly, the national assessment by applying the NEAT tool to Saronikos Gulf[55] classified this area into good status, with the pelagic habitat components contributing strongly to its overall environmental status. Sediment, benthic fauna and vegetation, mammals and alien species were the most impacted ecological components in Saronikos Gulf. The most affected areas, Elefsis Bay and Psittalia (wastewater submarine outfall), were assessed as in poor and moderate status, respectively.

297. There are also other areas where certain impacts are registered. In the Thessaloniki Bay, these are the Thessaloniki harbour, impacted by industrial, treated or partly treated sewage discharges; the Inner Thermaikos Gulf impacted by agricultural discharges from the heavily polluted Axios River, and fish and shellfish mariculture; as well as the Evoikos Gulf impacted by agriculture, mariculture, and industry. Industrial discharges, port activities, sewage discharges, aquaculture activities, and fishing are the most important pressures affecting the coastal areas of Greece. In fact, mariculture seems to have the highest impacts, and is followed by fishing, other activities and industrial discharges (Pavlidou et al., 2015).

298. A review of the existing pressures and assessment was provided by Turkiye56. The analysis indicated the following drivers and pressures relevant to EO5: i) tourism population density; ii) urban wastewater; iii) agriculture; and iv) port operations, especially in Port of Izmir.

[55] Pavlidou, A., Simboura, N., Pagou, K. et al., (2019) Using a holistic ecosystem-integrated approach to assess the environmental status of Saronikos Gulf, Eastern Mediterranean, Ecological Indicators, 96 (1), 336-350.
[56] Submitted after the Meeting of CORMON Pollution that took place in Athens, 1-2 March 2023

299. As for the Levantine Sea Sub-division, the results of the present CI 14 assessment in the Aegean Sea Sub-division represents only an indication of possible good/non-good status at the level of sub SAUs, whereby they are not set at the same level of spatial finesse.

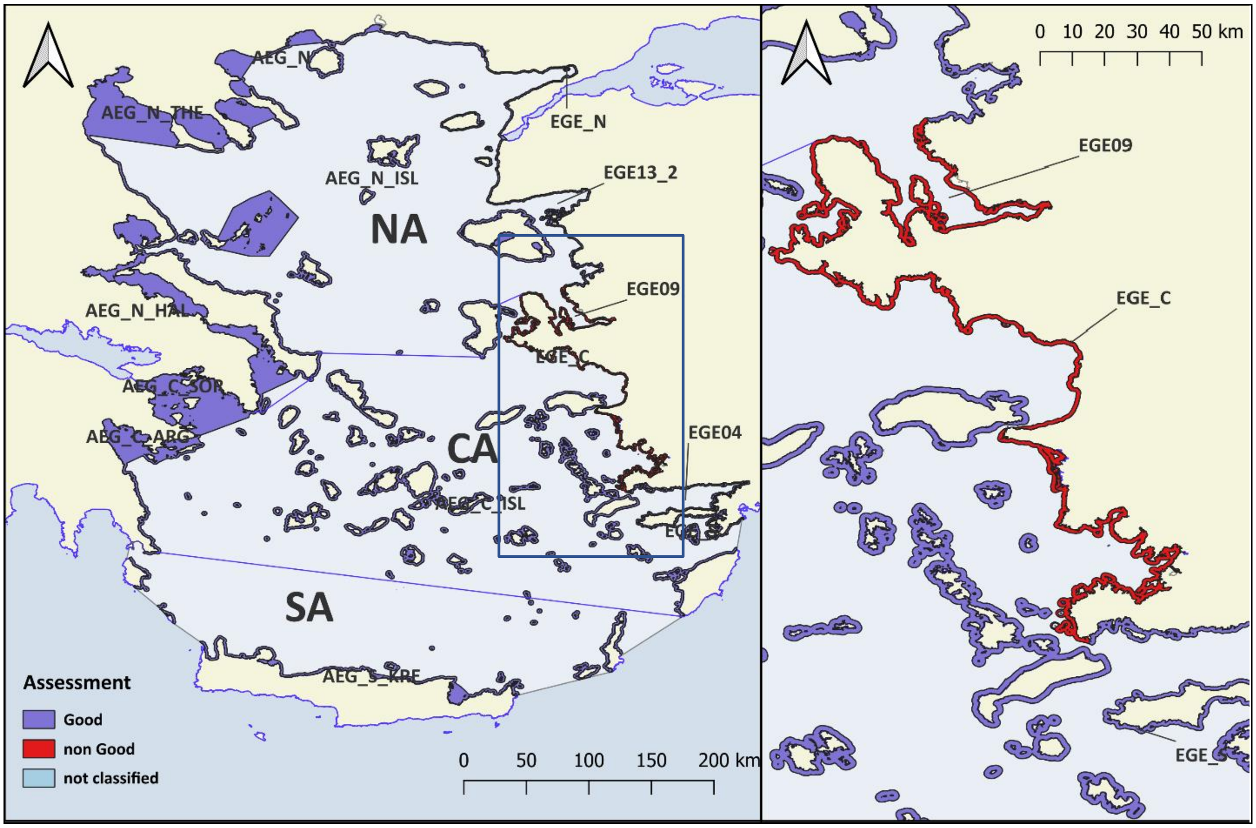


Figure AEL 3.1.3.1.5.E: The assessment results for CI 14 in the Aegean Sea Sub-division by applying the simplified G/M method on the satellite-derived COPERNICUS data at the level of subSAUs.

Table 3.1.3.1.3.b. Results of the assessment (G_NG.oN85 – the good status corresponds to all values below the 85th percentile set as G/M i.e., good/noon-good boundary limit) of the Aegean Sea Sub-division by Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blue coloured SAUs indicate likely GES.

AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_NG.oN85
CW	NA	53613	-	0,126	0,189	0,085	0,436	G
CW	CA	39229	0,093	0,074	0,111	0,053	0,12	G
CW	SA	5091	0,062	0,056	0,084	0,046	0,07	G

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions)

Table 3.1.3.1.4. b. Result of the assessment (G_NG.oN85- the good status corresponds to all values below the 85th percentile set as G/M i.e., good/noon-good boundary limit) of the Aegean Sea Sub-division for the finest Spatial Assessment Units (subSAUs). Blue coloured SAUs indicate good status; Red coloured SAU indicates non-good status.

Country	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
GRE	CA	AEG_C_ARG	5190	0,095	0,111	0,053	0,12	G
GRE	CA	AEG_C_ISL	19245	0,066	0,111	0,053	0,12	G
GRE	CA	AEG_C_SOR	10338	0,115	0,111	0,053	0,12	G
GRE	NA	AEG_N_HAL	11469	0,315	0,189	0,085	0,436	G
GRE	NA	AEG_N_HAL_O	943	0,156	0,189	0,085	0,436	G
GRE	NA	AEG_N_ISL	15510	-	0,189	0,085	0,436	G
GRE	NA	AEG_N_THE	12128	0,279	0,189	0,085	0,436	G
GRE	SA	AEG_S_KRE	5091	0,062	0,084	0,046	0,07	G
TUR	CA	EGE_C	2032	0,324	0,111	0,053	0,12	NG
TUR	CA	EGE_S	711	0,058	0,111	0,053	0,12	G
TUR	CA	EGE04	748	0,068	0,111	0,053	0,12	G
TUR	CA	EGE09	965	1,057	0,111	0,053	0,12	NG
TUR	NA	AEG_N	11192	0,228	0,189	0,085	0,436	G
TUR	NA	EGE_N	1759	0,405	0,189	0,085	0,436	G
TUR	NA	EGE13_2	612	0,238	0,189	0,085	0,436	G

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions);

The IMAP GES Assessment of the Adriatic Sea Sub-region (ADR)

300. The GES assessment of EO 5 is provided at IMAP CIs 13 and14 level per TP, DIN and Chl a, as mandatory parameters measured within monitoring of these two indicators. Other parameters were not considered given lack of data reported by the CPs. The results of aggregation and integration within the nested scheme are provided at i) the IMAP national SAUs & subSAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of SubDivisions (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (the Adriatic Sea). Given Albania, Bosnia and Herzegovina, and Greece faced the lack of data for CIs 13 and 14, they were not considered in the GES assessment for IMAP EO5.

The comparison and harmonization of the assessment methodologies applied for IMAP CI 14: By selecting the 85^{th} percentile of the normalized distribution as G/M boundary limit, therefore as the limit between the acceptable and the unacceptable statuses i.e. GES and non GES/ good and non-good, the compatibility of the classification within application of the Simplified assessment methodology based on G/M comparison was achieved with a five classes GES/non GES scale set for IMAP NEAT GES assessment of the Adriatic Sea Sub-region. The harmonization was achieved to the maximum possible extent given the Simplified assessment methodology based on G/M comparison and NEAT GES assessment methodology are different methodologies which application across the Mediterranean Sub-regions/Sub-divisions was conditioned with the statuses of data reported by the CPs.
Therefore, the bias assessment of CI 14 within the 2023 MED QSR was avoided as the Simplified G/M method relay on the assessment criteria corresponding to RC and G/M as stated in the Decision 22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria . Based on statistical calculations and related selection of the 85^{th} percentile ~ mean +1 SD represents the G/M threshold, the synchronization was achieved to the maximal possible extent between the classification statuses assigned in the AEL, CEN and WMS , and those in the Adriatic Sea Sub-region .
Assessment classification for harmonized IMAP/NEAT and IMAP/Simplified G/M assessment methodologies application for CIs14 in the Mediterannean Sea sub-regions:

	GES			non-GES		
IMAP/NEAT	RC	High	Good	Moderate	Poor	Bad
Boundary limits and normalized NEAT scores	< RC/H limit, not in score scale	1 < score ≤ 0.8	0.8<score≤ 0.6	0.6<score ≤ 0.4	0.4< score ≤0.2	Score<0.2
IMAP/Simplified G/M						
Boundary limits*	≤10^{th} %	>10^{th}% CHL_GM ≤85^{th}%		CHL_GM >85^{th} %		
G/nG threshold			G/M			
*** Percentile are calculated from normalized (with Ordered Quantile transformation) annual geometric mean (for at list 5 year)**						

Available data.

301. Data reported to the IMAP Pilot Info System by the Contracting Parties bordering the Adriatic Sea i.e. Croatia, Italy, Montenegro, and Slovenia for the period 2015-2020, as shown in Table 3.1.3.2.1, were used for the sub-regional assessment for Chl a, TP and DIN, within present NEAT GES assessment

for IMAP CIs 13 and14. Data reported by Albania, Bosnia and Herzegovina and Greece were missing or were insufficient or not reported in line with mandatory data standards. [57]

302. Data elaboration was done only for the surface layer as the main layer of eutrophication impact. Namely, freshwaters are the main pressure driver and mostly contribute to the stratification of the water column, therefore they confine the newly fetched nutrients mainly to the surface layer.

Table 3.1.3.2.1: Data availability by country and year for the Adriatic Sea (ADR) Sub-region showing data reported by the CPs for the assessment of EO5 (CI 13 and CI 14) up to 31st Oct 2022.

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Albania	2016-2021	No data provided									
Bosnia and Herzegovina	2016	12	12	12	12	12	12	12	12	12	12
	2017	4	4	4	4	4	4	4	4	4	4
	2018	4	4	4	4	4	4	4	4	4	4
	2019	12	12	12	12	12	12	12	12	12	12
	2020	5	5	5	5	5	5	5	5	5	5
	2021	3	3	3	-	3	3	3	3	3	3
Croatia	2016	72	72	72	72	72	72	72	63	63	63
	2017	144	144	144	144	144	144	144	132	132	132
	2018	94	94	94	94	94	94	94	83	83	83
	2019	216	216	216	216	216	216	216	203	203	203
	2020	177	177	177	177	177	177	177	165	165	165
	2021	-	-	-	-	-	-	-	-	-	-
Greece	2016-2021	No data provided									
Italy	2016	803	803	803	803	803	803	17171	17180	17180	17171
	2017	783	783	783	777	777	783	15612	15631	15632	15631
	2018	809	809	809	809	809	807	16669	16670	16670	16670
	2019	729	729	729	729	729	728	15995	16020	16020	16020
	2020	-	-	-	-	-	-	430	430	430	430
	2021	-	-	-	-	-	-	-	-	-	-
Montenegro	2016	80	80	80	80	80	80	80	80	80	80
	2017	82	82	82	82	82	82	82	82	82	82
	2018	103	103	103	103	103	103	103	103	103	103
	2019	116	116	116	116	116	116	116	116	116	116
	2020	-	-	-	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-	-	-	-
Slovenia	2016	99	99	99	99	99	99	99	99	99	99
	2017	160	160	160	160	160	160	160	288	288	288
	2018	184	184	184	184	184	184	184	296	296	296
	2019	160	160	160	160	160	160	160	240	240	240
	2020	141	141	141	141	141	141	162	165	165	165
	2021	150	150	150	150	150	150	180	180	180	180

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – Temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

[57] UNEP/MED WG. 550/15, Table IV in Annex VIII (CH 4.2.2 & 4.3.2) provides the spatial distribution of monitoring stations for IMAP CIs13&14 by the spatial assessment units (SAUs, km2)) in the Adriatic Sea Sub-region; Table V in Annex VIII (CH 4.2.2 & 4.3.2) provides the detailed temporal coverage of the monitoring data collected for the Adriatic Sea shown against the finest areas of assessment (IMAP subSAUs), including the years of data collected per SAU.

303. For the application of the NEAT software for assessment of CIs 13&14, data were grouped per parameters, ecosystem and SAUs in all the Adriatic sub-divisions (NAS, CAS, SAS). Average concentrations (geometric means) and respective geometric standard deviation, and standard error of geometric means were then calculated in the respective groups as presented here-below.

The NEAT GES Assessment of IMAP CIs 13&14:
The geometric mean (*GM*) is defined as the n[th] root of the product of n numbers, i.e., for a set of numbers x_1, x_2, ..., x_n, the geometric mean is defined as

$$GM[x] = (\prod x_i)^{\frac{1}{n}} \quad (1)$$

or, equivalently, as the arithmetic mean (*AM*) in logscale:

$$GM[x] = e^{AM[\log x]} \quad (2)$$

The geometric standard deviation (GSD) is calculated as the regular statistic on the log data, $SD[logx]$ then rescaled back:

$$GSD[x] = e^{SD[\log x]} \quad (3)$$

The standard error of geometric mean (SEGM): Since the through mean of the population (μ_G) is not normally known the sample mean $GM[x]$ is used, but then, like with the regular standard deviation and error formulas N−1 instead of N is used:

$$SEGM[x, N] = \frac{GM[x]}{\sqrt{N-1}} SD[\log x] \quad (4)$$

A difference between EO9/CI 17 and EO5/CIS 13&14 must be noted. For the NEAT assessment different metrics were used. For CI 17 as a measure of central tendency, the arithmetic mean and standard error were used, on opposite to the use of geometric mean and the standard error of geometric mean for CIs 13&14. It was necessary given the assessment criteria for EO5 were developed by applying the later metrics.

The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach.

304. For setting the IMAP areas of assessment for IMAP CIs 13 and 14, the 4 levels nesting approach was followed as elaborated for IMAP CI 17 (amended for the purpose of CIs 13 and 14) and presented here-below. However, the finest areas of assessment set for CI 17 were further adjusted to serve the purpose of EO5 assessment. One additional GIS layer was created within 3rd step of nesting scheme. This layer shows a distribution of the water classes within the coastal and offshore zones. It was overlaid on the IMAP sub-SAUs defined for IMAP CI 17, which resulted in an adjustment of the finest areas of assessment for IMAP CIs 13 and 14. In that regard, distribution of the finest areas of assessment is mainly related to the scientific knowledge which takes into account the specifics of the monitoring and assessment of national waters. Where it was possible, the distribution of water types existing in the Adriatic Sea Sub-region (I, IIA and IIIW) also guided the adjustment of the finest areas of assessment for IMAP EO5. Namely, the three types of water are mainly discriminated by freshwater content which on the other side is correlated with the pressures from land. This leaded to a separate aggregation of the assessment results per water types in order to get the status of CIs 13 and 14 in different water types for all SAUs. Accordingly, details on setting the finest areas of assessment for IMAP EO 5 were provided per countries.

305. After setting the finest IMAP areas of assessment, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken in the same manner applied for IMAP CI 17. The approach followed for the nesting of the areas is 4 levels nesting scheme (1 - being the finest level, 4 - the highest):

a) 1st level provided nesting of all national IMAP SAUs and subSAUs within the two key IMAP assessment zones per country i.e. coastal and offshore zone;
b) 2nd level provided nesting of the assessment areas set in IMAP assessment zones i.e. the coastal and offshore zones, on the subdivision level i.e. i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
c) 3rd level provided nesting of the areas of assessment within the 3 subdivisions (NAS, CAS, SAS);
d) 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub Region.

306. This nesting scheme is shown schematically in Figure 3.1.3.2.1**.**

307. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, the scope of all Adriatic SAUs and subSAUs were defined. All of them were introduced in the NEAT tool along with their respective codes and surface of the areas (km2).

308. Within each SAU under ‘habitats' the water types are introduced. Under ‘ecosystem component' the 3 measured parameters i.e. DIN, TP and Chl a are assigned.

309. For each SAU and ‘Ecological Component' and ‘Habitat' (Water type), geometric mean and standard error of the geometric mean per parameter are inserted.

310. Boundary limits and class threshold values per SAU per parameter and per matrix (i.e. NEAT habitat) are applied. The tool obligatory requires 2 limits which define the best and the worse conditions and one threshold discriminating between GES-nonGES status. A five classes assessment scale ‘High-Good-Moderate-Poor-Bad' is then produced. The GES-nGES threshold discriminates between the Good-Moderate classes. Details on boundary limits and threshold values are given in Chapter 4 and in Tables 4 and 5.

Setting the GES/non-GES boundary value/threshold for the IMAP NEAT GES Assessment in the ADR.

311. The definition of baselines and threshold values for IMAP CIs 13 and 14 in the Mediterranean Sea is an ongoing process. The setting of GES-nonGES boundaries within NEAT GES assessment for IMAP CIs 13 and 14 are based on the boundary values defined for TP and DIN, and updated ones for chlorophyll a, in the Adriatic Sea, as approved by the Meeting of CorMon on Pollution Monitoring (17 and 30 May 2022).

312. Following the methodology applied for setting GES-nonGES threshold for IMAP CI17, the NEAT GES assessment of IMAP CIs 13 and 14 in the Adritic Sea sub-region considers that the range of concentrations equal to or below the G/M values corresponds to the good environmental status i.e. in GES, and the range of concentrations above the G/M values corresponds to non-good environmental status i.e. non-GES. This principle was also used for application of the traffic light approach within the 2017 MED QSR.

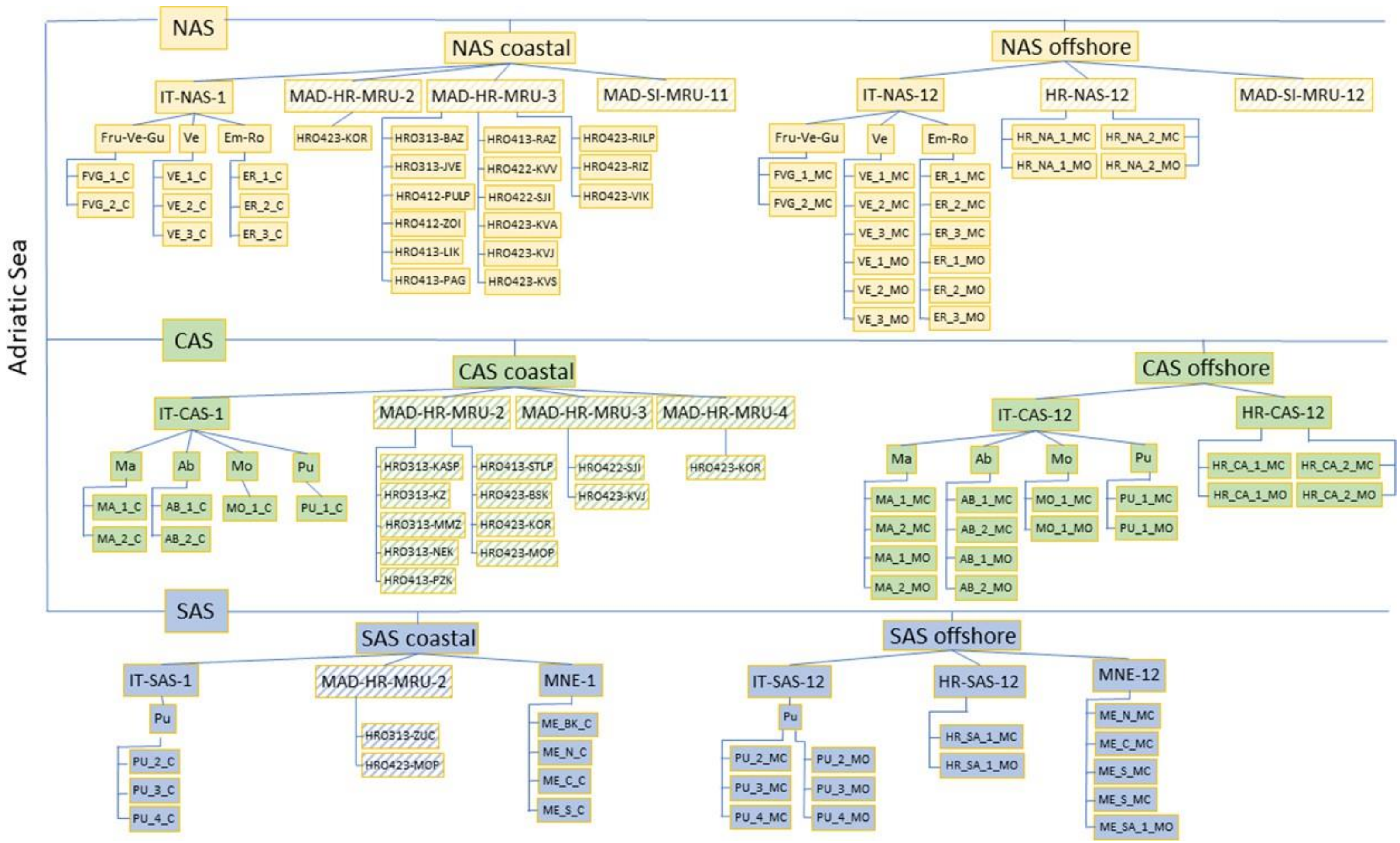


Figure 3.1.3.2.1: The nesting scheme of the SAUs defined for the Adriatic Sea based on the available information. Shaded boxes correspond to official MRUs declared by the countries that are EU MSs and that were decided to be used as IMAP SAUs.

313. The use of NEAT tool for IMAP GES status requires in total five status classes i.e. high, good, moderate, poor, bad, in order to optimally discriminate the status related to different classes. The NEAT application also requires the two boundary limit values for the best and worse conditions (these are not threshold values but minimum and maximum values that determine the scale of the GES assessment) and one threshold value for the GES – nonGES status. These are mandatory by the tool which then produces five status classes linearly, depending on the distance of the concentrations from the two boundary limit values and the GES-nonGES threshold.

314. The two boundary limit values were applied: i) Reference Conditions (RC); and ii) for maximum concentration of nutrients and chlorophyll a, the value calculated from the relationship (equation) of DIN and TP (the parameters of CI 13) with a value of 8 that is supposed to be highest one for TRIX (as internal standard). For CI14 (Chla) the equation is related to the pressure variable in our case DIN and TP where possible. All the equations and boundary values by water type are given in Table 3.1.3.2.2.

315. In line with such defined the two boundary limits, the following five status classes are produced: i) the high status (H) referring to RC (best conditions) < good status; ii) the good status (G); iii) the moderate status (M); iv) the poor status (P); v) the bad status (B) referring to values > than poor state and < than the maximum concentration. The five classes are divided by the boundary between them as follows: H/G; G/M (also the GES-nonGES threshold); M/P; and P/B.

Table 3.1.3.2.2: Boundary limits of the NEAT GES Cis 13 & 14 assessment scale and threshold values between five status classes.

Type	**Equation**	RC	H/G	**G/M**	M/P	P/B	Worst
Coastal							
I	**[TRIX]**		4.25	**5.25**	6.25	7	8
	[TP] = exp [(TRIX – 6.064)/1.349]	0.19	0.26	**0.55**	1.15	2.00	4.20
	[Chla] = 10.591 [TP]^1.237	1.4	2.01	**5.02**	12.56	24.99	62.5
IIA	**[TRIX]**	-	4	**5**	6	7	8
	[TP] = exp [(TRIX – 6.148)/1.583]	0.16	0.26	**0.48**	0.91	1.71	3.2
	[Chla] = 3.978 [TP]^1.347	0.33	0.64	**1.50**	3.51	8.21	19.2
IIIW	**[TRIX]**	2	3	**4**	5	6	7
	[TP] = exp [(TRIX – 6.148)/1.583]	0.07	0.14	**0.26**	0.48	0.91	1.7
	[Chla] = 3.978 [TP]^1.347	0.12	0.27	**0.64**	1.50	3.51	8.2
Offshore							
I	**[TRIX]**		4.25	**5.25**	6.25	7	8
	[DIN] = 10^[(TRIX – 3.08)/1.61]	0.15*; 0.29**	5.33	**22.28**	93.1	272	1 137
	[Chla] = 0.4295 [DIN]^0.64	0.21*; 0.66**	1.25	**3.13**	7.82	15.53	38.79
IIA	**[TRIX]**	-	4	**5**	6	7	8
	[TP] = exp [(TRIX – 6.148)/1.583]	0.16	0.26	**0.48**	0.91	1.71	3.22
	[Chla] = 3.978 [TP]^1.347	0.33	0.64	**1.50**	3.51	8.21	19.23
IIIW	**[TRIX]**	2	3	**4**	5	6	7
	[TP] = exp [(TRIX – 6.148)/1.583]	0.07	0.14	**0.26**	0.48	0.91	1.71
	[Chla] = 3.978 [TP]^1.347	0.12	0.27	**0.64**	1.50	3.51	8.21

*ME; **HR. IT

316. Data (i.e. average values), as well as limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level.

317. Threshold concentrations are normalized in a 0 to 1 scale as follows:
$0 \leq$ bad $< 0.2 \leq$ poor $< 0.4 \leq$ moderate $< 0.6 \leq$ good $< 0.8 \leq$ high ≤ 1

318. The NEAT tool further aggregates data by calculating the average of normalized values of indicators (DIN, TP; Chla) on the SAU level. This can be done either per each indicator per habitat separately or for all indicators i.e. parameters per habitats within the specific SAU. The first option leads to one value for each indicator separately for the specific SAU.

319. The process is then repeated for all nested SAUs (in a weighted or non- weighted mode). At the end one NEAT value for the highest area of assessment is obtained (i.e. for the Adriatic Sea) either for all ecosystem components i.e, indicators/parameters assessed (TP, DIN – CI 13, chl a – CI 14) separately, or for all ecosystem components by habitat (water). In the weighted mode a weighting factor based on the surface area of each SAU is used.

320. The NEAT values are values between 0 to 1 and correspond to an overall assessment status per contaminant according to the 5-class scale.

321. The decision rule of GES/ non-GES is by comparison to the boundary class defined by the G/M threshold, and this is above/below Good (0.6).

Results of the IMAP NEAT GES Assessment of CIs 13 and 14 in the ADR.

322. Detailed assessment results for EO5 are provided per TP, DIN and Chl a, as mandatory parameters measured for CIs 13 and 14 level and also spatially integrated within the nested scheme at i) the IMAP national SAUs & sub-SAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of SubDivisions (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (Adriatic Sea) are presented in Table 3.1.3.2.3.

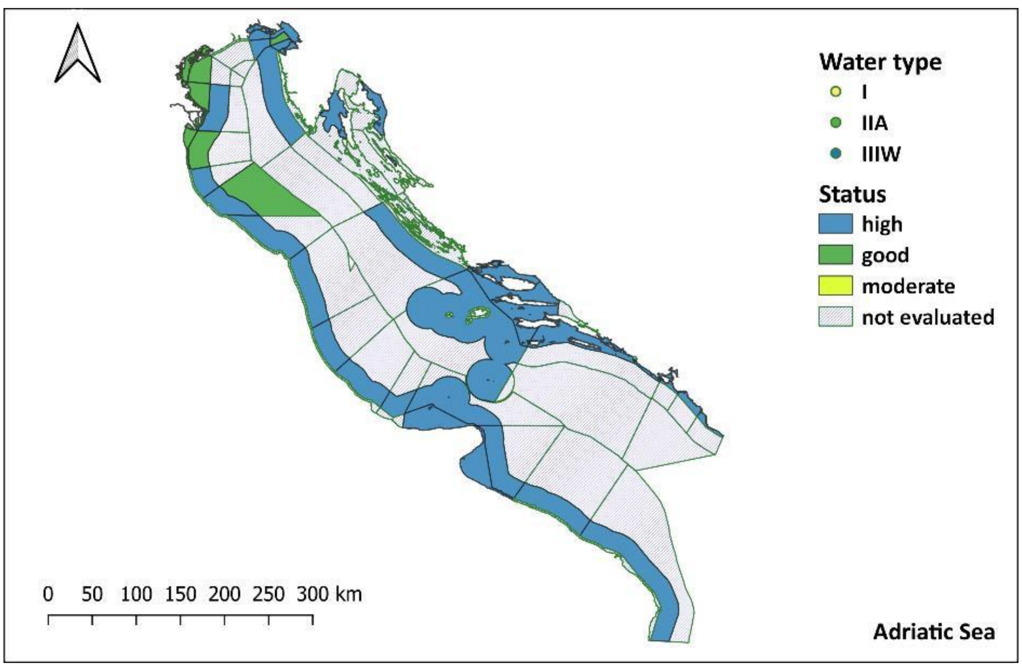
323. The aggregation of TP, DIN and Chl a was undertaken to obtain one status value (NEAT value) for all the levels of the nesting scheme. The aggregation of the assessment findings for these three parameters resulted in the NEAT value per specific SAUs. Then NEAT values per SAUs were spatially integrated to the sub-divisions and regional levels. Data matrix in Table 3.1.3.2.3 shows the results per indicator for all nesting levels. The integrated results for the sub-divisions (NAS, CAS, SAS) are shown in bold. The NEAT classes are marked per all three parameters to show the status.

324. Along with the aggregation of the parameters per SAUs, the NEAT tool has the possibility to provide assessment results by aggregating data per habitat in this case water types and then to provide their spatial integration within the nested scheme. This possibility was not used for the present assessment since the water types are more relevant in the coastal waters and less in the offshore waters. The final integrated result per SAUs (NEAT value) are expected to be the same irrespective of the two ways of aggregation of the assessment results (i.e. per indicator or per habitat).

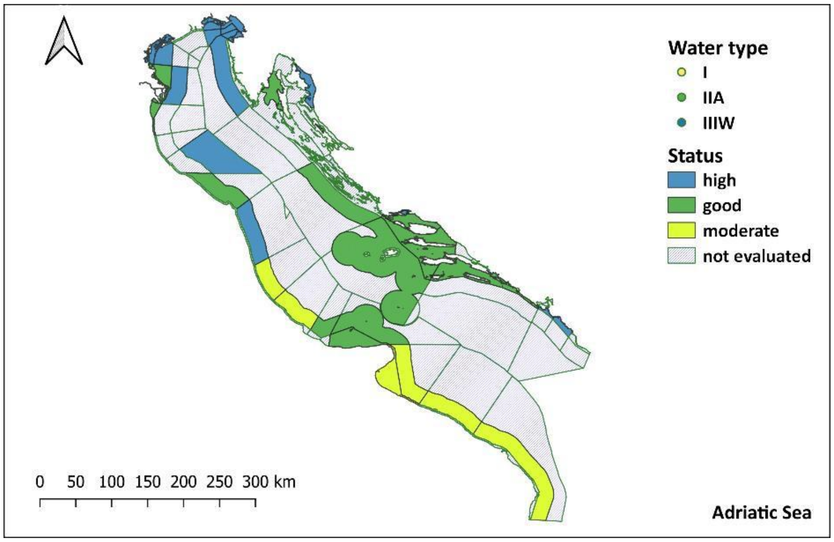
325. The detailed status assessment results show that all the SAUs achieve GES conditions (high, good status) that is indicated by the blue and green cells in Table 3.1.3.2.3. The GES status per assessment units and parameter is also shown on Figure 3.1.3.2.2. For all three parameters (CI 13 – DIN, TP and CI 14 – Chla), the results show that all SAUs and subSAUs are in GES. The only exception is the results for TP in a part of CAS and the SAS along the Italian coast, where a few subSAUs (AB_1_MC,

AB_2_MC, PU_2_MC, PU_3_MC, PU_4_MC) are in moderate status. The assessment status for TP was possible for the whole Adriatic Sea given data availability at the level of subSAUs. The results of TP assessment indicate that probably an accumulation of phosphorus is present in the area. It is necessary to explore if the problem is related to nitrogen limitation of the area and subsequent accumulation of phosphorus, or a local source of pollution contribute to the generation of the pressure on marine environment. Non-GES status of a few subSAUs do not affect the overall assessment status and all SAUs fall under the GES status (high, good). The absence of some SAUs evaluation is related to the decision of the countries to monitor areas that are found relevant for the assessment of eutrophication and therefore excluding the areas where problems were not historically observed.

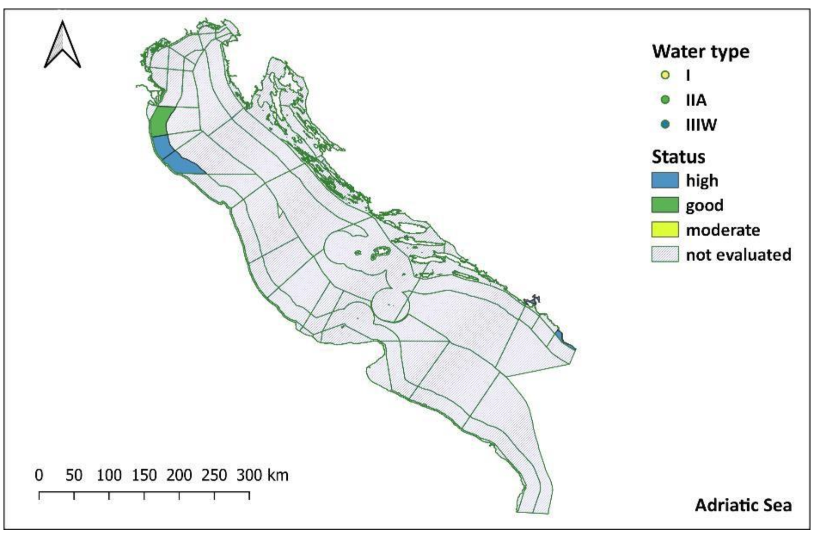
326. As observed for IMAP CI17, the present integrated assessment status results produced by applying the NEAT tool on the sub-division (NAS, CAS, SAS) and/or the Adriatic Sub-region level can only be considered as an example of how the tool works (4th and 3rd nesting levels). This is related to the fact that many SAUs lack data (blank cells in Table 3.1.3.2.3). The lack of data can be related to the recognition that many CPs monitor an area of interest, therefore excluding the areas where problems were not historically observed. However, the assessment per SAUs and integrated assessment on the two key nesting IMAP assessment zones i.e., coastal and offshore (NAS-1, NAS-12; CAS-1, CAS-12; SAS-1, SAS-12) (1st and 2nd nesting levels) can be considered more detailed for decision making.



Chl *a*



TP



DIN

Figure 3.1.3.2.2: The NEAT assessment results for IMAP CI13 (TP, DIN) and CI14 (Chl *a*), in the Adriatic Sea. Blank area corresponds to non-assessed subSAUs.

Table 3.1.3.2.3. Status assessment results of the NEAT tool applied on the Adriatic nesting scheme for the assessment of IMAP CIs 13 and 14. The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis.

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
Adriatic Sea	**128180**	**0**	**0.815**	**high**	**99.8**	**0.954**	**0.673**	**0.845**
Northern Adriatic Sea	**30865**	**0**	**0.888**	**high**	**100.0**	**0.892**	**0.890**	**0.84**
NAS-1	**9130**	**0**	**0.866**	**high**	**100.0**	**0.896**	**0.837**	
MAD-HR-MRU-3	6302	0	0.900	high	100.0	0.952	0.847	
HRO313-JVE	73	0						
HRO313-BAZ	4	0	0.787	good	56.9	0.760	0.814	
HRO412-PULP	7	0						
HRO412-ZOI	467	0						
HRO413-LIK	7	0						
HRO413-PAG	30	0.001	0.898	high	100.0	1.000	0.795	
HRO413-RAZ	10	0						
HRO422-KVV	494	0						
HRO422-SJI	1924	0						
HRO423-KVA	687	0.029	0.848	high	90.2	0.919	0.777	
HRO423-KVJ	1089	0						
HRO423-KVS	577	0						
HRO423-RILP	6	0						
HRO423-RIZ	475	0						
HRO423-VIK	455	0.019	0.979	high	100.0	1.000	0.958	
IT-NAS-1	2576	0	0.783	good	92.7	0.759	0.806	
IT-Em-Ro-1	372	0	0.682	good	99.6	0.757	0.608	
ER_1_C	254	0.003	0.682	good	99.6	0.757	0.608	
ER_2_C	64	0						
ER_3_C	54	0						
IT-Fr-Ve-Gi-1	560	0	0.958	high	100.0	0.917	1.000	
FVG_1_C	277	0.002	0.916	high	100.0	0.832	1.000	
FVG_2_C	283	0.002	1.000	high	100.0	1.000	1.000	

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
IT-Ve-1	1646	0	0.746	good	100.0	0.706	0.785	
VE_1_C	88	0						
VE_2_C	905	0.008	0.792	good	63.5	0.755	0.828	
VE_3_C	653	0.005	0.682	good	99.9	0.638	0.726	
MAD-Sl-MRU-11	85	0.001	0.923	high	100.0	0.903	0.942	
MAD-HR-MRU-2	166	0						
HRO423-KOR	166	0						
NAS-12	**21735**	**0**	**0.897**	**high**	**100.0**	**0.890**	**0.917**	**0.840**
IT-NAS-12	11141	0	0.832	high	98.8	0.777	0.898	0.840
IT-Em-Ro-12	7144	0	0.814	high	82.3	0.750	0.888	0.840
ER_1_MC	858	0.009	0.752	good	99.4	0.735		0.770
ER_2_MC	586	0.006	0.824	high	92.8	0.805		0.860
ER_3_MC	893	0.010	0.869	high	100.0			0.869
ER_3_MO	2888	0.031	0.814	high	67.9	0.739	0.888	
ER_2_MO	600	0						
ER_1_MO	1319	0						
IT-Fr-Ve-Gi-12	410	0	0.945	high	100.0	0.890	1.000	
FVG_1_MC	139	0.001	0.895	high	100.0	0.791	1.000	
FVG_2_MC	271	0.002	0.971	high	100.0	0.941	1.000	
IT-Ve-12	3588	0	0.854	high	95.9	0.811	0.898	
VE_1_MC	714	0						
VE_2_MC	467	0						
VE_3_MC	1041	0.028	0.854	high	95.9	0.811	0.898	
VE_1_MO	234	0						
VE_2_MO	190	0						
VE_3_MO	941	0						
MAD-Sl-MRU-12	129	0.001	0.935	high	100.0	0.870	1.000	
HR-NAS-12	10465	0	0.965	high	100.0	1.000	0.930	
HR_NA_1_MC	2057	0.082	0.965	high	100.0	1.000	0.930	
HR_NA_2_MC	2183	0						

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
HR_NA_1_MO	2566	0						
HR_NA_2_MO	3659	0						
Central Adriatic	**48802**	**0**	**0.832**	**high**	**100.0**	**0.984**	**0.680**	
CAS-1	**7582**	**0**	**0.853**	**high**	**100.0**	**0.995**	**0.712**	
MAD-HR-MRU-2	5240	0	0.870	high	100.0	0.994	0.747	
HRO313-NEK	253	0						
HRO313-KASP	44	0.001	0.783	good	66.7	0.750	0.816	
HRO313-KZ	34	0	0.938	high	100.0	0.991	0.886	
HRO313-MMZ	56	0						
HRO413-PZK	196	0						
HRO413-STLP	1	0						
HRO423-BSK	613	0.008	0.844	high	91.1	0.985	0.702	
HRO423-KOR	1564	0						
HRO423-MOP	2480	0.033	0.877	high	100.0	1.000	0.755	
IT-CAS-1	2091	0	0.811	high	66.6	1.000	0.623	
IT-Ab-1	282	0						
AB_1_C	103	0						
AB_2_C	179	0						
IT-Ma-1	320	0						
MA_1_C	172	0						
MA_2_C	148	0						
IT-Mo-1	229	0						
MO_1_C	229	0						
IT-Ap-1	1261	0	0.811	high	66.6	1.000	0.623	
PU_1_C	1261	0.017	0.811	high	66.6	1.000	0.623	
MAD-HR-MRU-4	184	0						
HRO422-VIS	184	0						
MAD-HR-MRU-3	67	0						
HRO422-SJI	14	0						
HRO423-KVJ	53	0						

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
CAS-12	**41219**	**0**	**0.828**	**high**	**100.0**	**0.981**	**0.674**	
HR-CAS-12	18797	0	0.845	high	100.0	1.000	0.691	
HR_CA_1_MC	2337	0.034	0.852	high	94.6	1.000	0.703	
HR_CA_2_MC	7745	0.113	0.843	high	100.0	1.000	0.687	
HR_CA_1_MO	5328	0						
HR_CA_2_MO	3388	0						
IT-CAS-12	22422	0	0.813	high	90.4	0.966	0.661	
IT-Ab-12	7526	0	0.719	good	100.0	1.000	0.438	
AB_1_MC	1056	0.027	0.705	good	100.0	1.000	0.411	
AB_2_MC	1250	0.032	0.731	good	100.0	1.000	0.461	
AB_1_MO	2480	0						
AB_2_MO	2741	0						
IT-Ap-12	5096	0	0.842	high	87.9	1.000	0.685	
PU_1_MC	2618	0.04	0.842	high	87.9	1.000	0.685	
PU_1_MO	2478	0						
IT-Ma-12	8097	0	0.871	high	100.0	0.907	0.835	
MA_1_MC	1480	0.03	0.822	high	90.0	0.870	0.775	
MA_2_MC	1629	0.033	0.915	high	100.0	0.941	0.890	
MA_1_MO	1391	0						
MA_2_MO	3597	0						
IT-Mo-12	1702	0	0.868	high	100.0	0.992	0.745	
MO_1_MC	654	0.013	0.868	high	100.0	0.992	0.745	
MO_1_MO	1048	0						
Southern Adriatic Sea	**48514**	**0**	**0.753**	**good**	**99.9**	**0.963**	**0.540**	**0.920**
SAS-1	**4793**	**0**	**0.765**	**good**	**98.7**	**0.928**	**0.583**	**0.920**
MAD-HR-MRU-2	1769	0	0.813	high	59.7	0.989	0.637	
HRO313-ZUC	13	0						
HRO423-MOP	1756	0.016	0.813	high	59.7	0.989	0.637	
IT-SAS-1 (Ap-1)	1810	0	0.677	good	99.8	0.869	0.485	
PU_2_C	1140	0.016	0.677	good	99.8	0.869	0.485	

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
PU_3_C	172	0						
PU_4_C	498	0						
MNE-SAS-1	568	0	0.892	high	100.0	0.920	0.823	0.920
MNE-1-N	86	0.001	0.828	high	85.0	0.852	0.804	
MNE-1-C	246	0.002	0.884	high	100.0	0.937	0.830	
MNE-1-S	151	0.001	0.945	high	100.0	0.956		0.933
MNE-Kotor	85	0.001	0.887	high	100.0	0.877		0.896
AL-SAS-1	646	0						
SAS-12	**43721**	**0**	**0.752**	**good**	**99.5**	**0.967**	**0.536**	
IT-SAS-12	22695	0	0.752	good	99.5	0.967	0.536	
PU_2_MC	1753	0.084	0.729	good	93.9	0.928	0.530	
PU_3_MC	1760	0.085	0.702	good	99.9	0.940	0.465	
PU_4_MC	3581	0.172	0.787	good	81.2	1.000	0.574	
PU_2_MO	2619	0						
PU_3_MO	6066	0						
PU_4_MO	6915	0						
MNE-SAS-12	5772	0						
MNE-12-N	468	0						
MNE-12-C	653	0						
MNE-12-S	781	0						
ME_SA_1_MO	3870	0						
AL-SAS-12	716	0						
MAD-EL-MS-AD	2253	0						
HR-SAS-12	12286	0						
HR_SA_1_MC	3397	0						
HR_SA_1_MO	8889	0						

327. The final GES assessment findings for all the IMAP SAUs in the Adriatic Sea, as provided in Table 3.1.3.2.3. are shown by the respective colour in the maps included in Figures ADR 3.1.3.2.1.E-ADR 3.1.3.2.5.E. The maps depict the integrated NEAT value for each SAU i.e. aggregated NEAT value for the three parameters assessed i.e., TP, DIN and chlorophyll a.

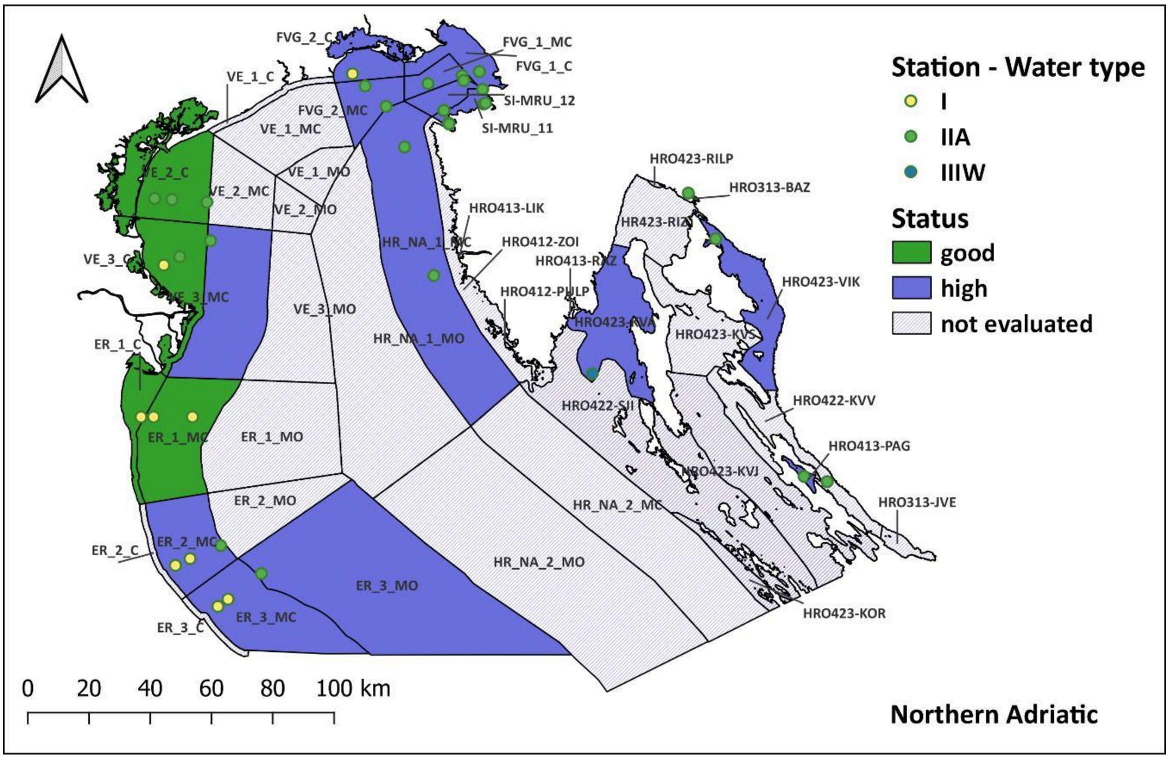


Figure ADR 3.1.3.2.3.E: The NEAT assessment results for IMAP CIs 13 and 14 in the North Adriatic Sea. All IMAP SAUs are in GES characterized by High or Good status. Blank area corresponds to not evaluated subSAUs.

328. The overall status of IMAP CI 13 and CI 14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, on the sub-division level for NAS, is Good and in GES. Thirteen out of 20 SAUs are classified under High status and six under Good.

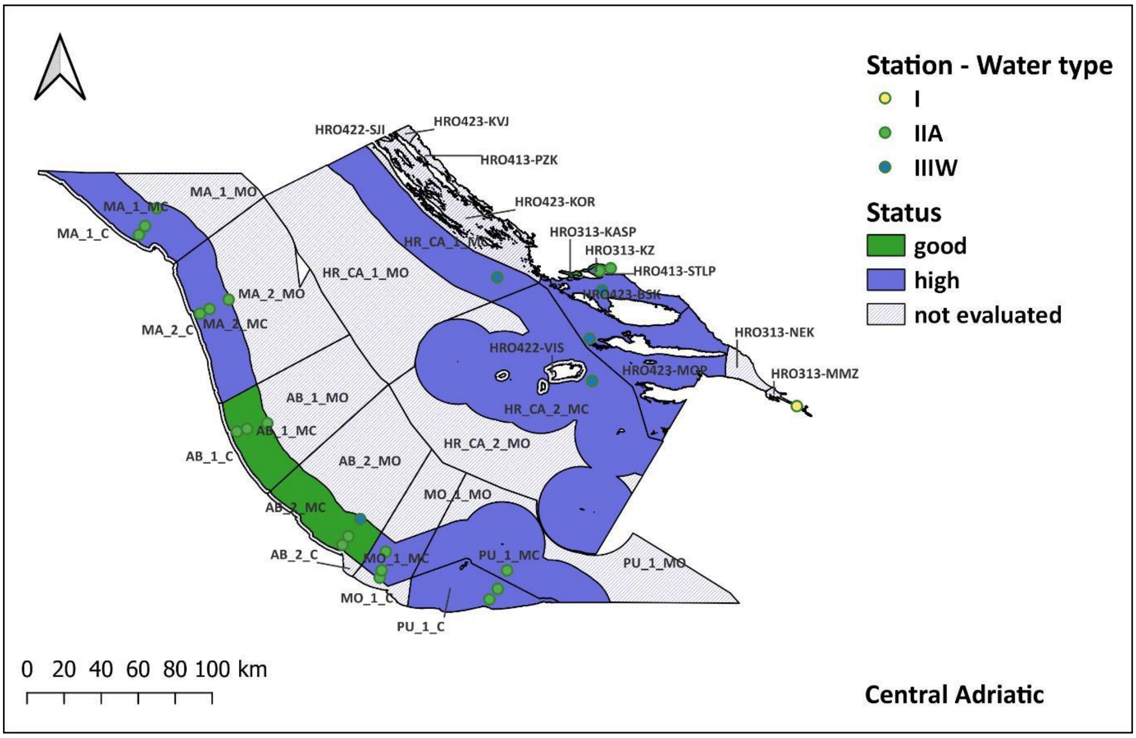


Figure ADR 3.1.3.2.4.E: The NEAT assessment results for IMAP CIs 13 and 14 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

329. The overall status of IMAP CIs 13 and 14 CI14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, on the sub-division level for CAS is High and in GES. Nine out of fourteen SAUs are classified under High status and five under Good.

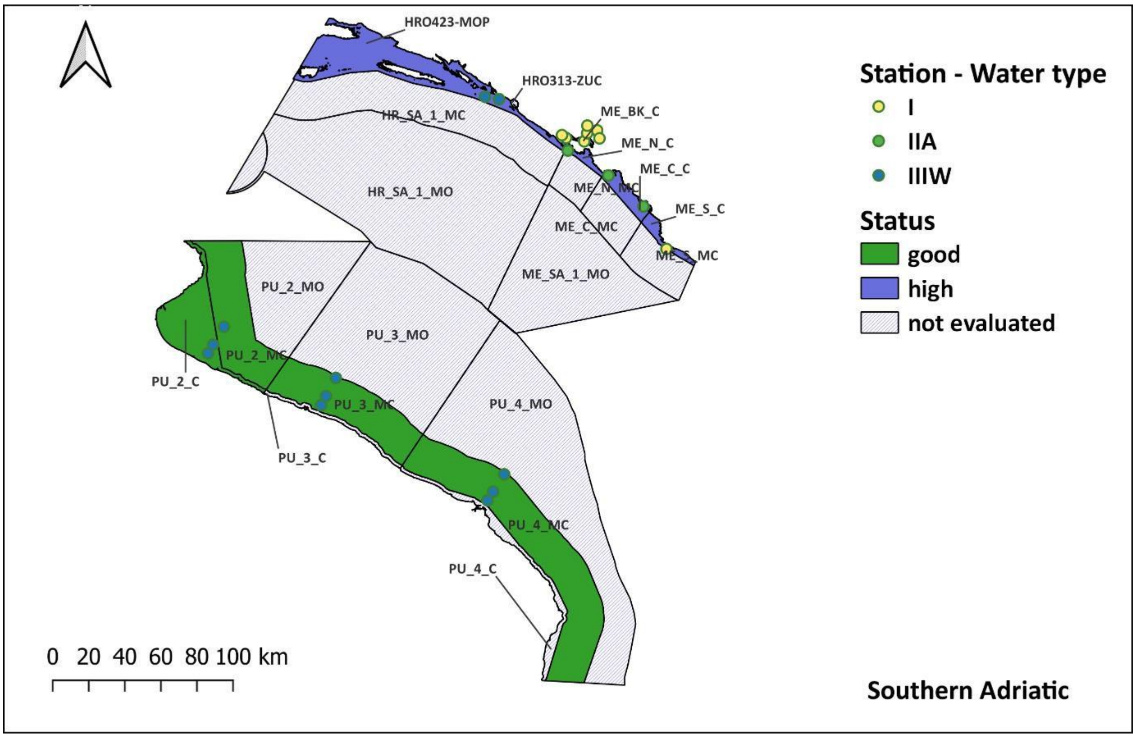


Figure ADR 3.1.3.2.5.E: The NEAT assessment results for IMAP CIs 13 and 14 in the South Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status. Blank area corresponds to no available data.

330. The overall status for CIs 13 and 14 on the sub-division level for SAS, CI 14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, is in GES. Four out of 14 SAUs are classified under Good conditions the rest under High. The Good status is observed along the Italian coast

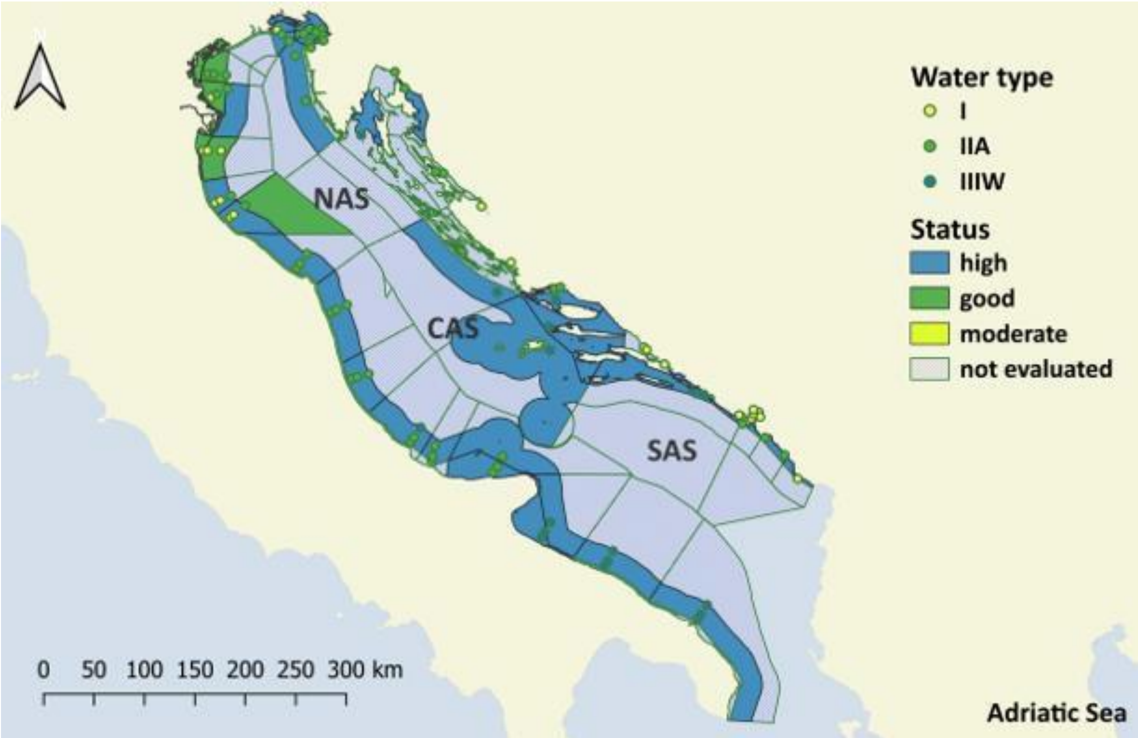


Figure ADR 3.1.3.2.6.E: The NEAT assessment results for CIs 13 and 14 in the Adriatic Sea sub-region. Aggregation of all contaminants per sub-SAU. Blank area corresponds to not evaluated subSAUs due to no available data or not established monitoring.

The IMAP Environmental Assessment of the Central Mediterranean Sea (CEN) Sub-region

331. Given the lack of quality-assured, homogenous data prevented the application of both EQR and simplified EQR assessment methodologies, the assessment of eutrophication within the preparation of the 2023 MED QSR was undertaken in the sub-divisions of the Aegean-Levantine Sea (AEL), the Ionian Sea and Central Mediterranean Sea (CEN) and the Western Mediterranean Sea (WMS) by evaluating only data for Chla available from the remote sensing sources, whereby the typology-related assessment was impossible to apply.

332. The application of the Simplified G/M comparison assessment methodology for Common Indicator 14 in the CEN relied on the use of COPERNICUS data for Chl a obtained by remote sensing.

<u>*Available data.*</u>

333. The application of the Simplified G/M comparison assessment methodology for Common Indicator 14 in the CEN relied on the use of COPERNICUS data for Chl a obtained by remote sensing.

334. A detailed data analysis was performed for the Central Mediterranean Sea Sub-region (CEN) in order to decide on the assessment methodologies that can be found optimal at the level of Sub-divisions given the present circumstances related to the lack of data reporting.

335. Table 3.1.3.3.1. informs on data availability in CEN by considering data reported in IMAP IS by 31st October, the cut-off date for data reporting. Figure 3.1.3.3.1.a. shows the locations of sampling stations in the WMS Sub-region.

Table 3.1.3.3.1: Data availability by country and year for the Central Mediterranean Sea Sub-region (CEN) Sub-region showing data reported by the CPs for the assessment of EO5 (CI 13 and CI 14) up to 31st Oct 2022.

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Greece	2016-2021	No data provided									
Italy	2016	By 31st October 2022, Italy reported data relevant to the Central Mediterranean Sea Sub-region, in 4 data files with all together 260 208 data points up to 2018-2019 On 16 Dec 2022 data for 2020 were also provided. Without building of a dedicated quality assured database, it is impossible to analyse data availability and ensure their use for the assessment. It should be noted that quantum of data reported guarantees a near monthly sampling frequency on 11 profiles with 4 stations.									
	2017										
	2018										
	2019										
	2020										
	2021										
Libya	2016-2021	No data provided									
Malta	2016	-	-	-	-	-	-	-	-	-	-
	2017	93	93	107	93	93	93	263	263	263	263
	2018	165	165	186	165	165	165	480	481	481	473
	2019	59	59	66	59	59	59	78	77	77	77
	2020	-	-	-	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-	-	-	-
Tunisia	2016-2021	No data provided									

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – Temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

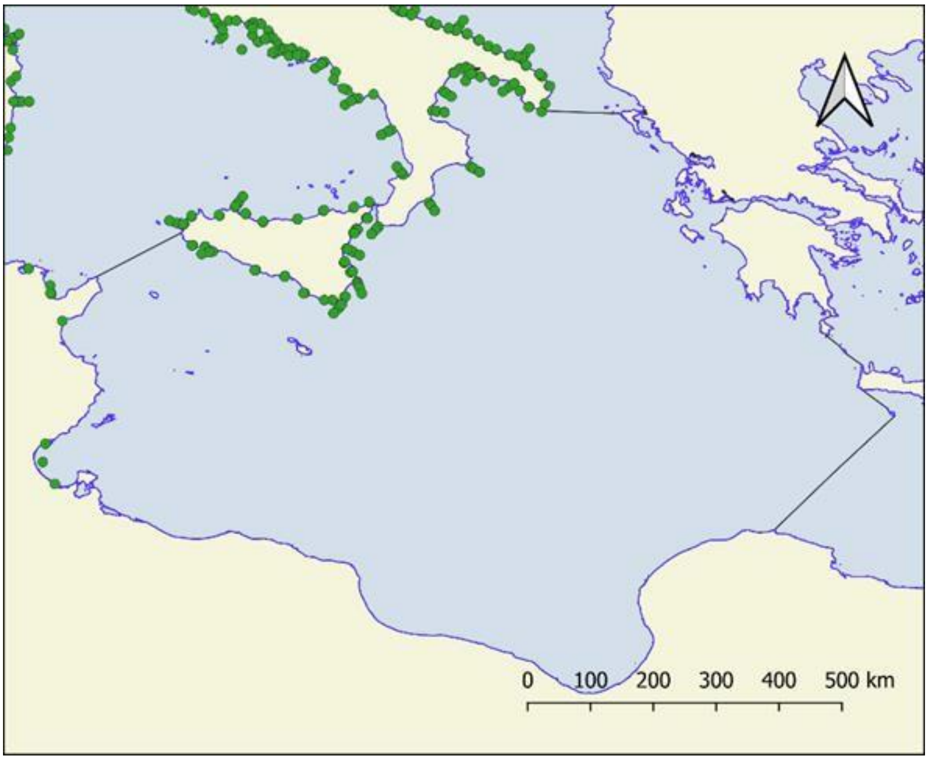


Figure 3.1.3.3.1.a. The locations of sampling stations in the CEN Sub-region.

336. As elaborated above for the AEL, in the CEN there was also the lack of homogenous and quality assured data reported in line with IMAP requirements, as shown in Table 3.1.3.3.1. Therefore, the Copernicus source was found relevant regarding the existence of a systematic repository of remote

sensing data for Chl a, with a good geographical coverage (1 x 1 km) and high sensing frequency (daily).

337. Chlorophyll a data for the CEN were downloaded from the Copernicus site (OCEANCOLOUR_MED_BGC_L4_MY_009_144).

338. The Copernicus product with ID: OCEANCOLOUR_MED_BGC_MY_009_144 was downloaded for the period from Jan 2016 to Dec 2021. It consists of Level 4 monthly values of Chlorophyll a concentration (CHL) with a resolution of 1 x 1 km. The file format is NetCDF-4 (.nc).

339. Data elaboration was performed by using R, an open-source language widely used for statistical analysis and graphical presentation (R Development Core Team, 2023)58. Maps are elaborated using QGIS 3.30, an open-source GIS tool. For the elaboration all relevant R

340. After download from the Copernicus site, as NetCDF file- .nc, data were transferred to R data table using the tidync package. The transfer and data elaboration were very time demanding as the dataset comprise 52 358 577 records.

341. For every point of the grid (Figure 3.1.3.3.1.b), a geometric annual mean (GM) was calculated (Attila et al, 2018)59. The parameter values were expressed in µg/L of Chl *a*, for the *GM* calculated over the year in at least a five-year period as required in the COMMISSION DECISION (EU) 2018/229[60] . These *GM* annual values were later used as a metric for the development of the assessment criteria and present assessment of CI 14.

Setting the areas of assessment.

342. The application of the Simplified G/M comparison assessment methodology for Common Indicator 14 in the CEN relied on the use of COPERNICUS data for Chl a obtained by remote sensing.

343. The two zones of assessment were defined in the CEN for the purpose of the present work: i) the coastal zone and ii) the offshore zone.

344. The GIS layers for the Assessment Areas were provided by France and Spain, as well as from other relevant sources (International Hydrographic Organization – IHO Seas subdivisions, European Environment Information and Observation Network – EIONET (WFD delimitation (2018)); VLIZ marine subregions).

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[58] R Development Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. http://www.R-project.org

[59]Attila, J., Kauppila, P., Kallio, K.Y., Alasalmi, H., Keto, V., Bruun, E and Koponen, S. Applicability of Earth Observation chlorophyll-a data in assessment of water status via MERIS — With implications for the use of OLCI sensors. Remote Sensing of Environment 212 (2018) 273–287. https://doi.org/10.1016/j.rse.2018.02.043

[60] Commission Decision (EU) 2018/229 of 12 February 2018 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration.

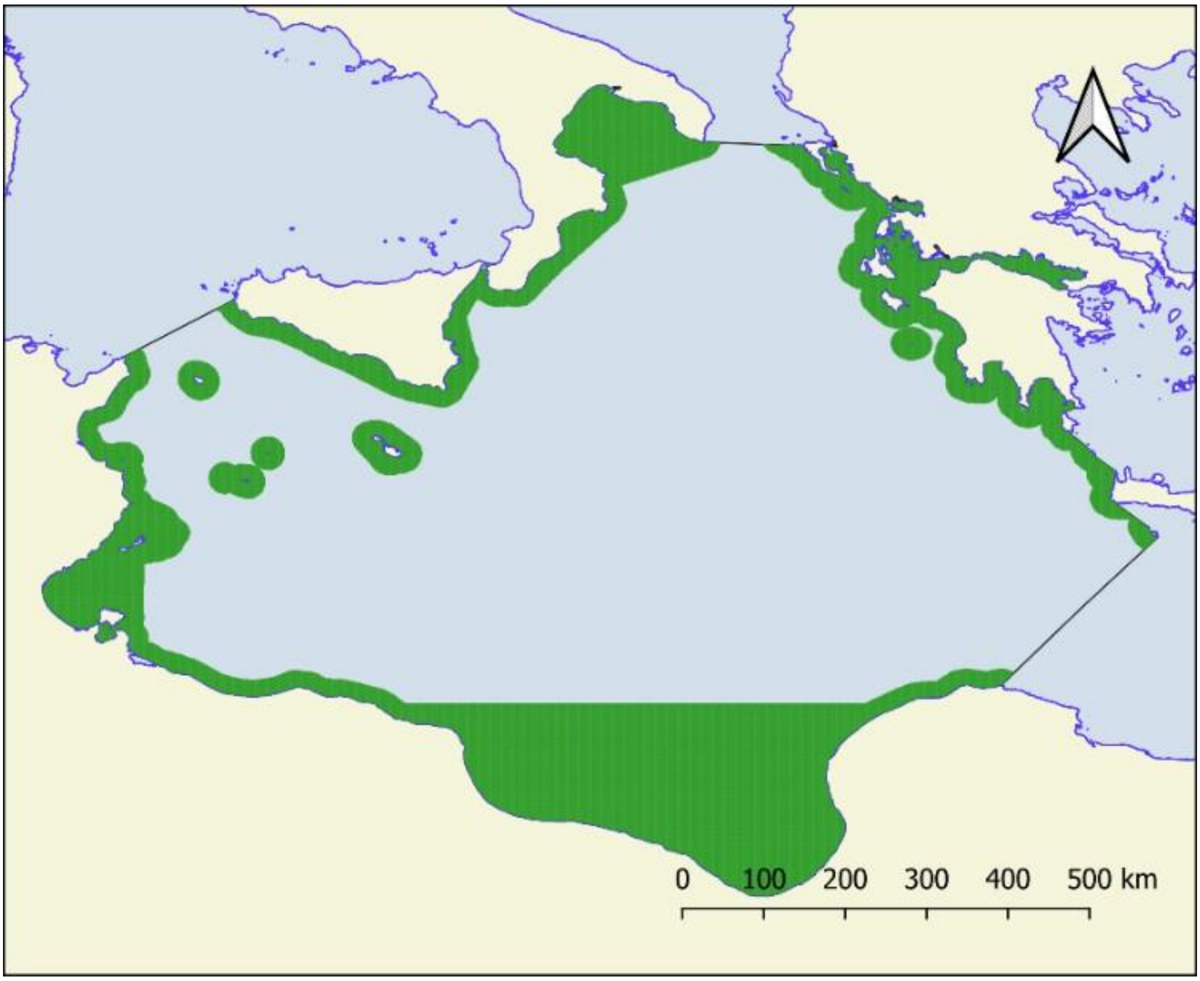
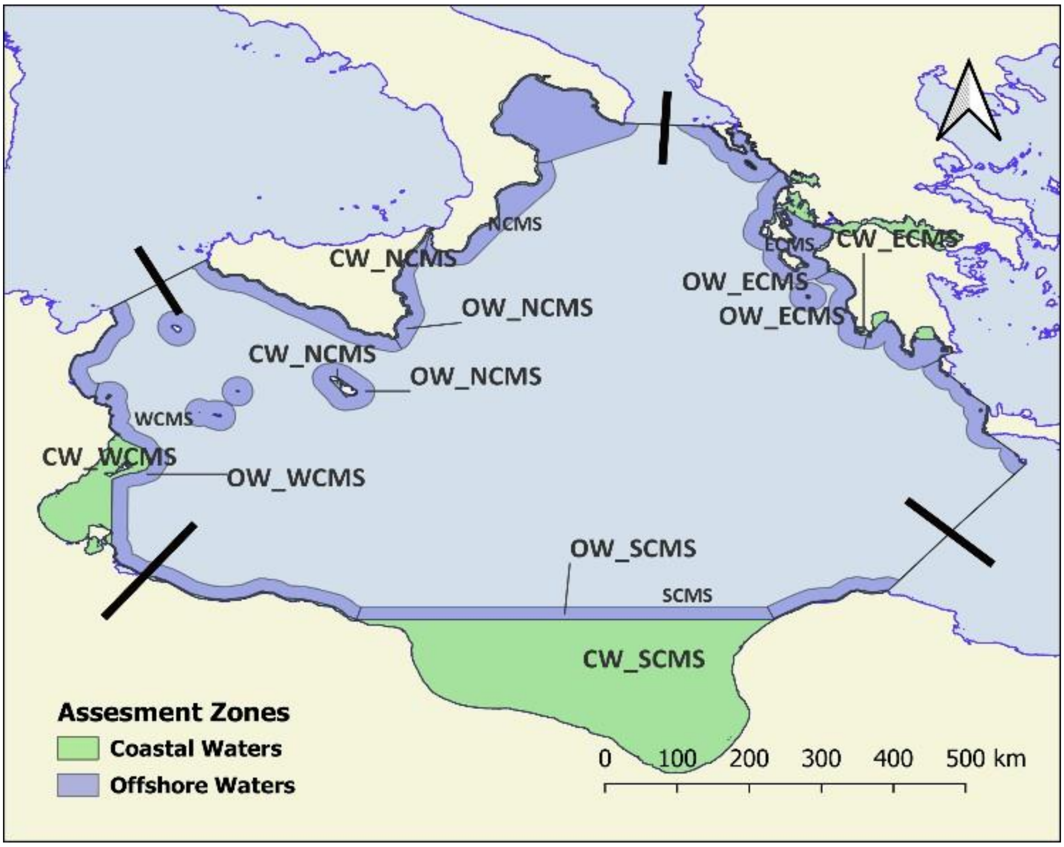


Figure 3.1.3.3.1.b The CEN Sub-region: The dots in the assessment zones represent data in the grid (1 x 1 km).

345. The principle of the NEAT IMAP assessment methodology applied in the Adriatic Sea Sub-region, as well as in the Western Mediterranean Sea Sub-region regarding CI 17, for setting of the spatial assessment units (SAUs) within the two main assessment zones along the IMAP nesting scheme, was also followed for setting of the coastal (CW) and the offshore monitoring zones (OW) in the CEN Sub-region. The CW included internal waters and one Nautical Mile outward. The offshore waters in the CEN start at the outward border of CW and extend to 20 km outward given this coverage corresponds to the area where national monitoring programmes are performed as shown in Figure 3.1.3.3.1.a.

346. Within the two Sub-divisions i.e., the Central Mediterranean Sea and the Ionian Sea, the CW and OW AZs were divided in the four areas: Northern, Western, Eastern and Southern, which delimitations are shown on Figure 3 (upper map). It resulted in eight SAUs (i.e., CW_NCEN – Northern CW; OW_NCEN – Northern OW; CW_WCEN – Western CW; OW_WCEN – Western OW; CW_ECEN – Eastern CW; OW_ECEN – Eastern OW; Southern CW – CW_SCEN and Southern OW – OW_SCEN). The finest IMAP subSAUs were further set on the base of nested assessment areas (AZs, four areas) by considering the national areas of monitoring and hydrographic characteristics.

347. The finest IMAP subSAUs set in the CEN Sub-region for the purpose of the present CI 14 assessment are depicted in Figure 3.1.3.3.2 (lower map) along their nesting in the two main assessment zones i.e., CW and OW of the CEN Sub-region.



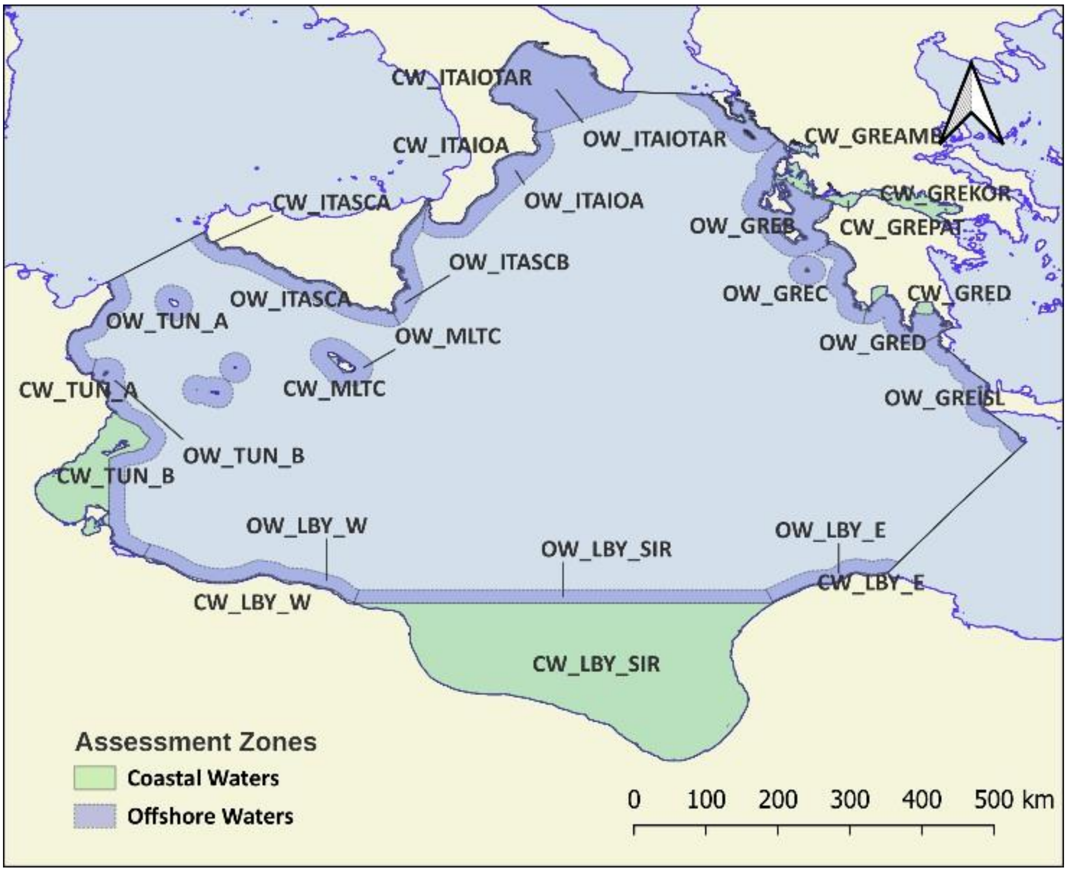


Figure 3.1.3.3.2. The nesting of IMAP SAUs set in the coastal (CW) and the offshore assessment (OW) zones for the CEN (upper map); and depiction of the finest IMAP subSAUs (lower map).

Setting the good/non good boundary value/threshold for the Simplified G/M comparison assessment methodology application in the CEN Sub-region.

348. The same approach for the statistical elaboration of satellite-derived Chla and the methodology for calculation of the assessment criteria were applied in the CEN, as elaborated above for the AEL. In order to calculate the assessment criteria applicable within the present work, the annual GM values were calculated. The results of calculation are presented in Table 3.1.3.3.2 and are obtained by the AZs and SAUs. As for the AEL, the two status classes i.e. good and non-good are assigned to the units assessed in the CEN by applying the simplified G/M assessment methodology since the assessment findings are based on the use of only one parameter and therefore, the integrated consideration of the minimum of parameters needed to assess the good environmental status for IMAP CIs 13 and 14 i.e. the GES was impossible.

Table 3.1.3.3.2: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP Assessment zones (AZ) and Spatial Assessment Units (SAU) in the CEN Sub-region.

AZ	SAU	CHL_N	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	CW_ECEN	17376	0,147	0,221	0,351	0,06	0,264	0,081
CW	CW_NCEN	4618	0,329	0,493	0,957	0,102	0,78	0,182
CW	CW_SCEN	298502	0,038	0,057	0,064	0,034	0,053	0,036
CW	CW_WCEN	41726	1,209	1,813	4,859	0,275	3,844	0,555
OW	OW_ECEN	98360	0,058	0,086	0,08	0,049	0,071	0,053
OW	OW_NCEN	152883	0,091	0,136	0,143	0,061	0,127	0,073
OW	OW_SCEN	80305	0,039	0,059	0,083	0,035	0,072	0,036
OW	OW_WCEN	46725	0,142	0,213	0,789	0,091	0,497	0,103

CHL_N – Number of calculated GM annual values, oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile

Results of the Simplified G/M comparison assessment methodology application in the CEN Sub-region

349. The results of CI 14 assessment using the satellite derived Chl a data are presented in Tables 3.1.3.3.3 and 3.1.3.3.4, and Figure CEN 3.1.3.3.3.E. The good status corresponds to the RC conditions, as well as to the values below the 85th percentile of normalized distribution set as G/M i.e., good/non-good boundary limit (i.e., blue coloured cells in the last column of Tables 3.1.3.3.3 and 3.1.3.3.4). The non-good status corresponds to the class above G/M boundary limit (i.e., red coloured cells in the last column of Table 3.1.3.3.4).

350. The assessment results show that all evaluated assessment zones can be considered likely in good status regarding the assessment of the satellite-derived Chl *a* data. Further to this good status assigned to the assessment zones, it can be preliminarily found that 7 out of 36 subSAUs are likely in non-good status. However, it must be noted that the subSAUs are set at an insufficient level of fineness for a reliable assessment (Tables 3.1.3.3.3 and 3.1.3.3.4). The likely non-good status subSAUs (GREA, GREAMB, GREPAT, LBY_E, LBY_W, LBY_W; TUN_B) are in the Eastern and the Southern parts of the CEN Sub-region.

351. The subSAU GREAMB is located in Ambracian Gulf and subSAU GREPAT in Gulf of Patras. These sites were also classified as moderate or a poor status by Greek research studies61. In subSAU GREAMB, the highest GM value of Chl a was observed (4,8 µg/L). The Northern subSAU GREA is probably influenced by the local sources of pollution (Igumenitsa port and intense aquaculture). The level of the finesse of the subSAU definition contributes to the lower confidence of the assessment findings, i.e., the assessment of the larger area is less confident. A finer-designed approach will contribute to a more accurate assessment of the local processes, contributing to the understanding of the very localized problem.

352. Along the coast of Libya, the marine waters impacted by eutrophication are located in the western part of Libyan OW (subSAU LBYW) and in the eastern part of CW (subSAU LBYE). It must be noticed that the G/M threshold for the Libyan waters is very low which questions the evaluation of the Southern part of the CEN Sub-region. The western part of the coast of Libya is influenced by the waters coming from the Gulf of Gabes where human activities contribute to the impacts of eutrophication[62]. The local influence of Tripoli should also be taken into account.

353. Further to calculations undertaken for the Gulf of Gabes, the subSAU TUNB located in CW can be indicated as an area in good status. However, it must be recognized that using the 50th percentile for the development of the assessment criteria is not applicable in heavily impacted areas, such as the Gulf of Gabes. Therefore, an adjustment by using the 25th percentile of the calculated values resulted in the classification of the subSAU TUNB in non-good status, as also recognized in the existing literature.

354. The results of the present CI 14 assessment in the Central Mediterranean Sea Sub-region represent only an indication of possible good/non-good status at the level of the subSAUs, whereby they are not set at the same level of spatial finesse.

[61] Simboura et al. (2015) Assessment of the environmental status in the Hellenic coastal waters (Eastern Mediterranean): from the Water Framework Directive to the Marine Strategy Framework Directive. Medit. Mar. Sci., 16/1, 46-64
[62] Annabi-Trabelsi, N., Guermazi, W., Leignel, V., Al-Enezi, Y., Karam, Q., Ali Mohammad Ayadi, H., Belmonte, G. (2022). Effects of Eutrophication on Plankton Abundance and Composition in the Gulf of Gabès (Mediterranean Sea, Tunisia). Water. 14. 2230. 10.3390/w14142230.

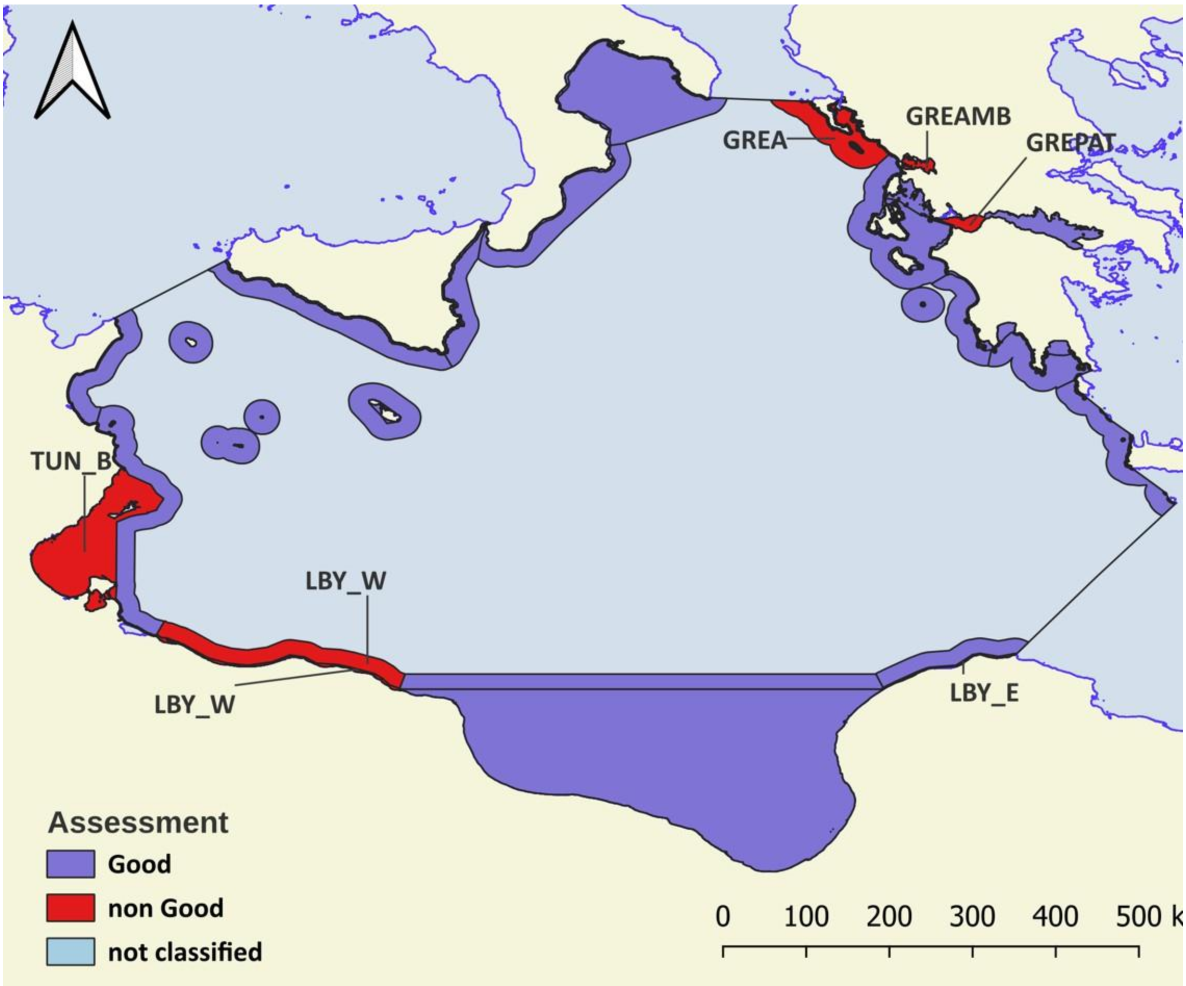


Figure CEN 3.1.3.3.3.E: The assessment results for CI 14 in the CEN Sub-region by applying the simplified G/M method at the level of subSAUs.

Table 3.1.3.3.3. Results of the assessment (G_NG.oN85 - the good status corresponds to all values below the 85th percentile set as G/M i.e., good/non-good boundary limit) of the CEN Sub-region by Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blue coloured SAUs indicate good status.

AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_NG.oN85
CW	CW_ECEN	26254	0,174	0,147	0,221	0,060	0,264	**G**
CW	CW_NCEN	8893	0,330	0,329	0,493	0,102	0,78	**G**
CW	CW_SCEN	300536	0,045	0,038	0,057	0,034	0,053	**G**
CW	CW_WCEN	44184	1,297	1,209	1,813	0,275	3,844	**G**
OW	OW_ECEN	99313	0,061	0,058	0,086	0,049	0,071	**G**
OW	OW_NCEN	154096	0,094	0,091	0,136	0,061	0,127	**G**
OW	OW_SCEN	80305	0,049	0,039	0,059	0,035	0,072	**G**
OW	OW_WCEN	46845	0,198	0,142	0,213	0,091	0,497	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions)

Table 3.1.3.3.4. Result of the assessment (G_NG.oN85- the good status corresponds to all values below the 85th percentile set as G/M i.e., good/non-good boundary limit) of the CEN Sub-region for the finest Spatial Assessment Units (subSAUs). Blue coloured subSAUs indicate good status; Red coloured status indicate non-good status.

Coun.	AZ	SAU	subSAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
GRE	CW	CW_ECEN	GREA	1702	0,167	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GREAMB	1303	4,8	0,221	0,06	0,264	NG
GRE	CW	CW_ECEN	GREB	6773	0,122	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GREC	1214	0,129	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GRED	3753	0,091	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GREISL	998	0,056	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GREKOR	8157	0,191	0,221	0,06	0,264	G
GRE	CW	CW_ECEN	GREPAT	2354	0,31	0,221	0,06	0,264	NG
ITA	CW	CW_NCEN	ITAIOA	1421	0,227	0,493	0,102	0,78	G
ITA	CW	CW_NCEN	ITAIOTAR	2630	0,382	0,493	0,102	0,78	G
ITA	CW	CW_NCEN	ITASCA	2784	0,615	0,493	0,102	0,78	G
ITA	CW	CW_NCEN	ITASCB	1535	0,198	0,493	0,102	0,78	G
MLT	CW	CW_NCEN	MLTC	523	0,071	0,493	0,102	0,78	G

Coun.	AZ	SAU	subSAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
LBY	CW	CW_SCEN	LBY_E	1170	0,097	0,057	0,034	0,053	NG
LBY	CW	CW_SCEN	LBY_SIR	296417	0,044	0,057	0,034	0,053	G
LBY	CW	CW_SCEN	LBY_W	2949	0,348	0,057	0,034	0,053	NG
TUN	CW	CW_WCEN	TUN_A	995	0,431	1,813	0,275	3,844	G
TUN	CW	CW_WCEN	TUN_B	43189	1,33	1,813	0,275	3,844	NG
GRE	OW	OW_ECEN	GREA	16138	0,076	0,086	0,049	0,071	NG
GRE	OW	OW_ECEN	GREB	32001	0,068	0,086	0,049	0,071	G
GRE	OW	OW_ECEN	GREC	18781	0,056	0,086	0,049	0,071	G
GRE	OW	OW_ECEN	GRED	14808	0,055	0,086	0,049	0,071	G
GRE	OW	OW_ECEN	GREISL	17585	0,05	0,086	0,049	0,071	G
ITA	OW	OW_NCEN	ITAIOA	23686	0,092	0,136	0,061	0,127	G
ITA	OW	OW_NCEN	ITAIOTAR	53598	0,114	0,136	0,061	0,127	G
ITA	OW	OW_NCEN	ITASCA	25605	0,112	0,136	0,061	0,127	G
ITA	OW	OW_NCEN	ITASCAI	22978	0,07	0,136	0,061	0,127	G
ITA	OW	OW_NCEN	ITASCB	13608	0,095	0,136	0,061	0,127	G
MLT	OW	OW_NCEN	MLTC	14621	0,057	0,136	0,061	0,127	G
LBY	OW	OW_SCEN	LBY_E	13675	0,04	0,059	0,035	0,072	G
LBY	OW	OW_SCEN	LBY_SIR	43480	0,038	0,059	0,035	0,072	G
LBY	OW	OW_SCEN	LBY_W	23150	0,089	0,059	0,035	0,072	NG
TUN	OW	OW_WCEN	TUN_A	14645	0,11	0,213	0,091	0,497	G
TUN	OW	OW_WCEN	TUN_B	32200	0,258	0,213	0,091	0,497	G

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5 year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10^{th} percentile (Reference conditions);

The IMAP Environmental Assessment of the Western Mediterranean Sea (WMS) Sub-region

355. Given the lack of quality-assured, the assessment of Common Indicator 4: Chl a was undertaken in the three Sub-divisions of the Western Mediterranean Sub-region as follows: i) in the Central Sub-division of the Western Mediterranean Sea Sub-region (CWMS): the Waters of France; the Alboran (ALB) and the Levantine-Balearic (LEV-BAL) Sub-division: the Waters of Spain, and the Southern part of the Central Western Mediterranean Sea Sub-division: the Waters of Algeria, Morocco and Tunisia, by applying the Simplified G/M comparison assessment methodology on the satellite-derived Chl a data; and ii) the Tyrrhenian Sea Sub-division and part of CWMS Sub-division: the Waters of Italy by applying both the Simplified G/M comparison assessment methodology on the satellite-derived Chl a data and the simplified EQR assessment methodology on in situ measured data.

356. The assessment of the Common Indicator CI 14, based on the simplified G/M comparison method applied on the satellite-derived Chl a data, was harmonized at the level of the WMS.This simplified method has the advantage to overcome the lack of in situ data, relying on satellite-derived products for surface Chl a concentration at a daily frequency. Even though this assessment is useful to provide a picture at the regional scale, in some cases finer methods are available at the local scale. For the sake of consistency with scientific work undertaken at the national level, the assessment of the French part of CWMS, as well as assessment of the Spanish waters, also takes account of the comparison between the regional and national assessments, whereby in the case of discrepancy, precedence was given to the national scientific expertise[63].

Available data.

357. A detailed data analysis was performed for the Western Mediterranean Sea (WMS) in order to decide on the assessment methodologies that can be found optimal at the level of Sub-divisions given the present circumstances related to the lack of data reporting.

358. Table 3.1.3.4.1. informs on data availability in WMS by considering data reported in IMAP IS by 31st October, the cut-off date for data reporting. Figure 3.1.3.4.1 shows the locations of sampling stations in the WMS Sub-region

[63] HERLORY O., BRIAND J. M., BOUCHOUCHA M., DEROLEZ V., MUNARON D., CIMITERRA N., TOMASINO C., GONZALEZ J.-L., GIRAUD A., BOISSERY P. (2022) Directive Cadre sur l'Eau. Bassin Rhône Méditerranée Corse - Année 2021. RST.ODE/UL/LER-PAC/22-11. 89pp. https://archimer.ifremer.fr/doc/00820/93161/99746.pdf

Table 3.1.3.4.1. Data availability by country and year for the Western Mediterranean Sea Sub-region (WMS) Sub-region showing data reported by the CPs for the assessment of EO5 (CI 13 and CI 14) up to 31st Oct 2022.

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Algeria	2016-2021	No data provided									
France	2016	-	-	-	-	-	-	130	179	179	74
	2017	66	-	66	66	-	43	130	324	340	116
	2018	56	-	56	56	-	56	129	326	326	108
	2019	126	-	126	126	-	126	126	344	342	117
	2020	102	-	102	102	-	95	120	349	350	129
Morocco	2016-2021	No valid data provided									
Italy	2015-2020	By 31st October 2022, Italy reported data relevant to the WMS Sub-region, in 4 data files with all together 1,081,853 data points up to 2019. On 17 Nov 2022 data for 2020 were also provided. It should be noted that quantum of data reported guarantees a near monthly sampling frequency on 27 profiles with 4 stations in the 5-year period. All IMAP mandatory parameters were measured.									
Spain	2019	8	86	86	95	-	-	95	95	95	95
	2020	306	311	311	295	-	-	290	304	304	310
	2021	300	300	300	141	-	-	294	302	302	302
	2022	274	322	322	168	-	-	291	318	318	318
Tunisia	2016-2021	No data provided									

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

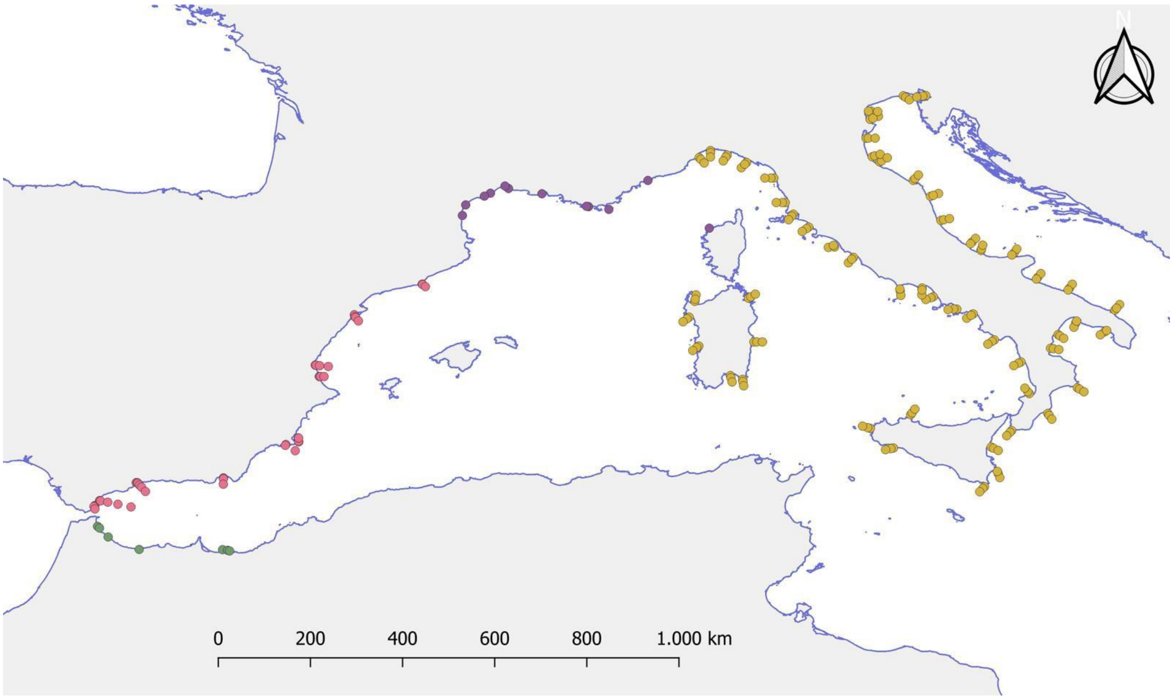


Figure 3.1.3.4.1. The locations of sampling stations in the WMS Sub-region

359. As explained for the AEL and CEN, given the above explained status of data reported in the WMS, in particular the lack of homogenous and quality assured data reported in line with IMAP requirements, the use of alternative data sources i.e. the satellite-derived data was explored. For Spanish waters, remote sensing data for surface Chl a concentrations in the Alboran Sea and the Levantine-Balearic Sub-divisions were received from the SMED algorithm (Gómez-Jakobsen et al,

2018), by combining data from the sensors MODIS-Aqua and VIIRS-SNPP in a coherent way, according with the procedure published in Gómez-Jakobsen et al. 2022. Chl a data for French waters were provided by ARGANS France. Data sets consists of Level 4 monthly values of concentration of Chl a with a resolution of 1 x 1 km for the period from April 2016 to March 2021. The file format was NetCDF-4 (.nc). Chl a concentration data were daily evaluated via the OC5 algorithm developed by IFREMER and maintained/improved by ARGANS.

360. For the Southern part of the Central Western Mediterranean Sea Sub-division, data were also provided by ARGANS France.

361. For Italian waters, the Copernicus satellite Chl*a* dataset were used. The Copernicus services - the Mediterranean Sea Ocean Satellite Observations, the Italian National Research Council (CNR – Rome, Italy), elaborated the Bio-Geo_Chemical (BGC) regional datasets. Chl a concentration (CHL) were evaluated via region-specific algorithms (Case 1 waters: Volpe et al., 201964, with new coefficients; Case 2 waters, Berthon and Zibordi, 2004[65]), and the interpolated gap-free Chl concentration (to provide a ""cloud free"" product) was estimated by means of a modified version of the DINEOF algorithm (Volpe et al., 2018[66]).

362. Using only satellite-derived Chl *a* data, with a good geographical coverage (1 x 1 km) and high sensing frequency (daily), a simple assessment methodology was applied based on the ecological rules and a comparison of the obtained values to the defined Good/Moderate (G/M) boundary.

363. Data elaboration was performed by using R, an open-source language widely used for statistical analysis and graphical presentation (R Development Core Team, 2022)[67.] Maps are elaborated using QGIS 3.28, an open-source GIS tool.

364. The transfer and data elaboration were time demanding as data were comprised of i) 8,840,786 data records for the Spanish waters; and ii) 17,319 data points and 1,059,486 observations for the French Waters, and 31,507 data points and 1,941,429 observations for the Southern part of the CWMS, altogether extracted from a WMS dataset consisting of 46,277,527 observations. For the elaboration of Tyrrhenian data 64,851 data point were used pertaining to 3,678,959 observation and extracted from 22,269,588 observations.

365. The parameter values were expressed in μg/L of Chl a, for the geometric mean (GM) calculated over the year in at least a five-year period as required in the COMMISSION DECISION (EU) 2018/22968. These GM annual values were later used as a metric for the development of the

[64] Volpe, G., Colella, S., Brando, V. E., Forneris, V., Padula, F. L., Cicco, A. D., ... & Santoleri, R. (2019). Mediterranean ocean colour Level 3 operational multi-sensor processing. Ocean Science, 15(1), 127-146
[65] Berthon, J.-F., Zibordi, G. (2004) Bio-optical relationships for the northern Adriatic Sea. Int. J. Remote Sens., 25, 1527-1532.
[66]Volpe, G., Buongiorno Nardelli, B., Colella, S., Pisano, A. and Santoleri, R. (2018). An Operational Interpolated Ocean Colour Product in the Mediterranean Sea, in New Frontiers in Operational Oceanography, edited by E. P. Chassignet, A. Pascual, J. Tintorè, and J. Verron, pp. 227–244
[67] R Development Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. http://www.R-project.org
[68] Commission Decision (EU) 2018/229 of 12 February 2018 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration.

assessment criteria and present assessment of CI 14. An annual GM[69] value was calculated for every point of the satellite derived Chl a data grid as shown in Figure 3.1.3.4.2.a. for the French waters; Figure 3.1.3.4.2.b. for the Southern part of the WMS; Figure 3.1.3.4.2.c. for the Spanish waters and Figure 3.1.3.4.2.d. for the Italian wasters.

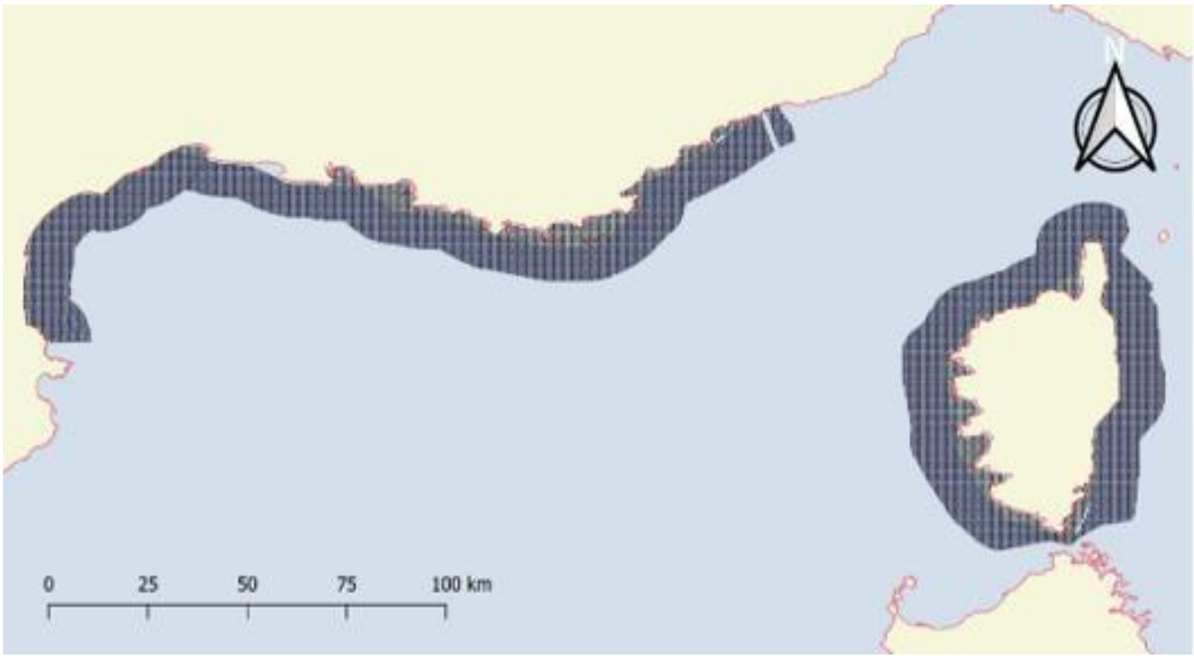


Figure 3.1.3.4.2.a. The French part of the Central Western Mediterranean Sea Sub-division (CWMS): The dots in the Assessment Zones represent data in the grid (1 x 1 km).

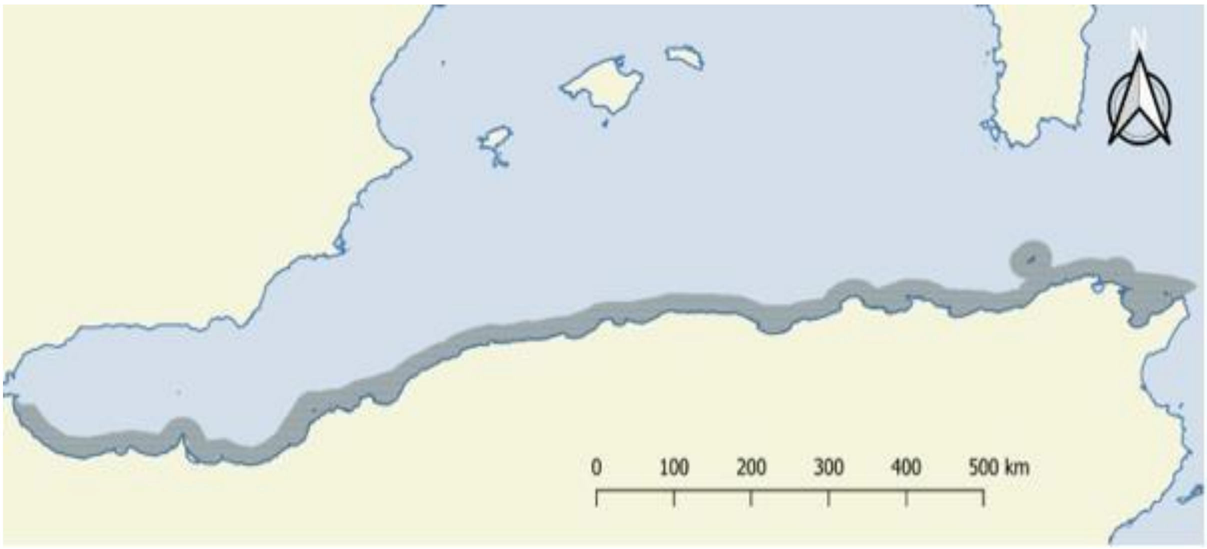


Figure 3.1.3.4.2.b. The Southern part of the Central Western Mediterranean Sea Sub-division (CWMS) - the Waters of Algeria, Morocco and Tunisia: The dots in the Assessment Zones represent data in the grid (1 x 1 km).

[69] Attila, J., Kauppila, P., Kallio, K.Y., Alasalmi, H., Keto, V., Bruun, E and Koponen, S. Applicability of Earth Observation chlorophyll-a data in assessment of water status via MERIS — With implications for the use of OLCI sensors. Remote Sensing of Environment 212 (2018) 273–287. https://doi.org/10.1016/j.rse.2018.02.043

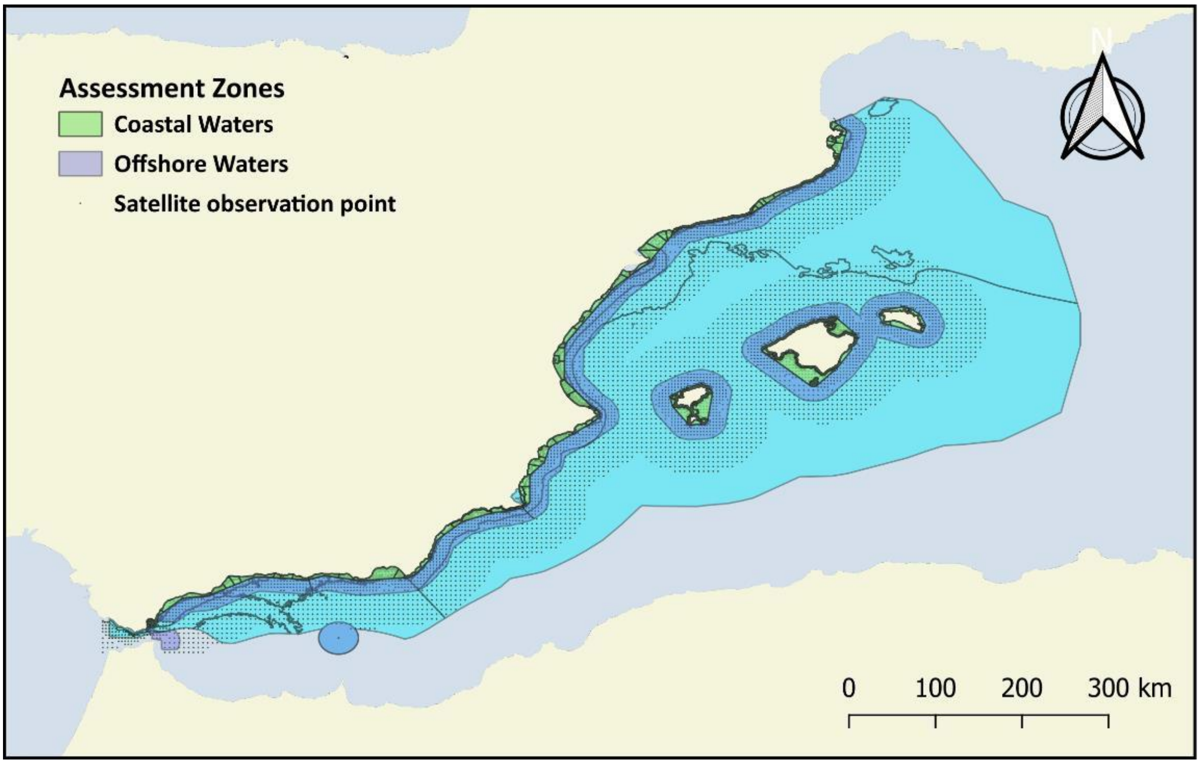


Figure 3.1.3.4.2.c. The Spanish assessment zones in the Alboran Sea and the Levantine - Balearic Sea Subdivision: The dots in the assessment zones represent data in the grid (1 x 1 km) near the coast and in the open waters (4 x 4 km).

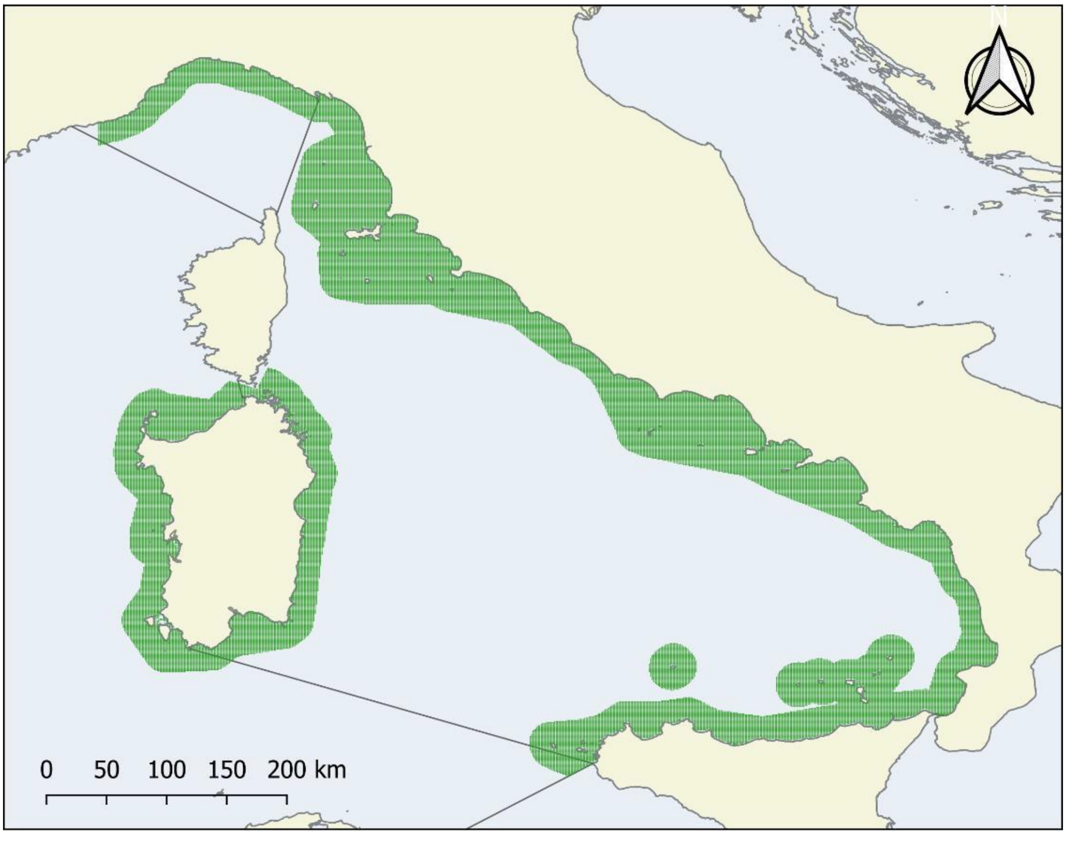


Figure 3.1.3.4.2.d. The Tyrrhenian Sea Sub-division and Italian part of the Central Western Mediterranean Sea Sub-division: The dots in the assessment zones represent data in the grid 1 x 1 km.

Setting the areas of assessment.

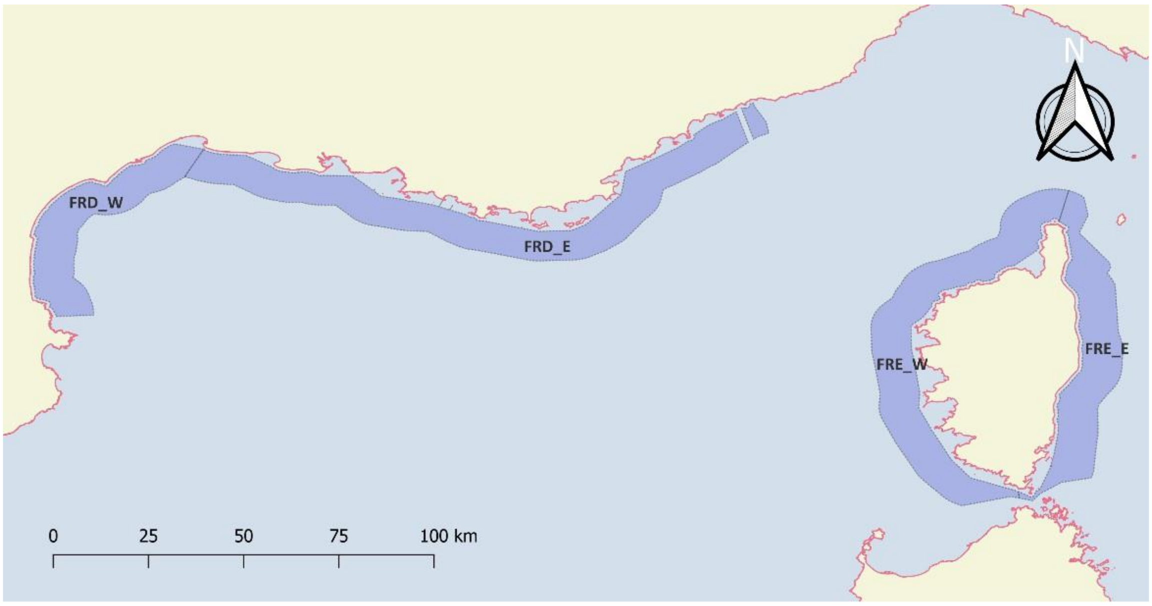
366. The two zones of assessment were defined in the Western Mediterranean Sea Sub-divisions for the purposes of the present work: i) the coastal zone and ii) the offshore zone by applying the same approach as applied to the AEL and the CEN Sub-regions.

367. The principle of the NEAT IMAP GES assessment methodology was also followed for setting of the coastal (CW) and the offshore monitoring zones (OW) in the Western Mediterranean Sea Sub-divisions. The CW included internal waters and one Nautical Mile outward. The offshore waters start at the outward border of CW and extend to 20 km outward given there is no eutrophication issues further in offshore70, but also due to correspondence of this coverage to the area where national monitoring programmes are performed (as shown in Figure 3.1.3.4.1.). In addition, the IMAP Spatial Assessment Units (SAUs) were set in the waters of Spain by taking account of the specific circulation pattern in the Spanish waters which influences the biogeochemical processes in the area.

368. The GIS layers for the Assessment Areas were provided by France and Spain, as well as from other relevant sources (International Hydrographic Organization – IHO Seas subdivisions, European Environment Information and Observation Network – EIONET (WFD delimitation (2018)); VLIZ marine subregions).

369. The French Offshore Waters (OW) were divided in the FRD_E (East of Rhone waters) and the FRD_W (West of Rhone waters) as shown in Figure 3.1.3.4.3.a - upper map. For the French Coastal Waters (CW), the division to water bodies (WB) set for implementation of the EU WFD was also used for setting IMAP SAUs and subSAUs. Consequently, the WFDs coding was used for present work (Figure 3.1.3.4.3.a - lower map). The finest IMAP subSAUs set in the French part of the CWMS for the purpose of the present CI 14 assessment are nested in the two main assessment zones i.e., CW and OW of the French part of the CWMS (Figure 3.1.3.4.3.a)

[70] See Lefebvre and Devreker 2020



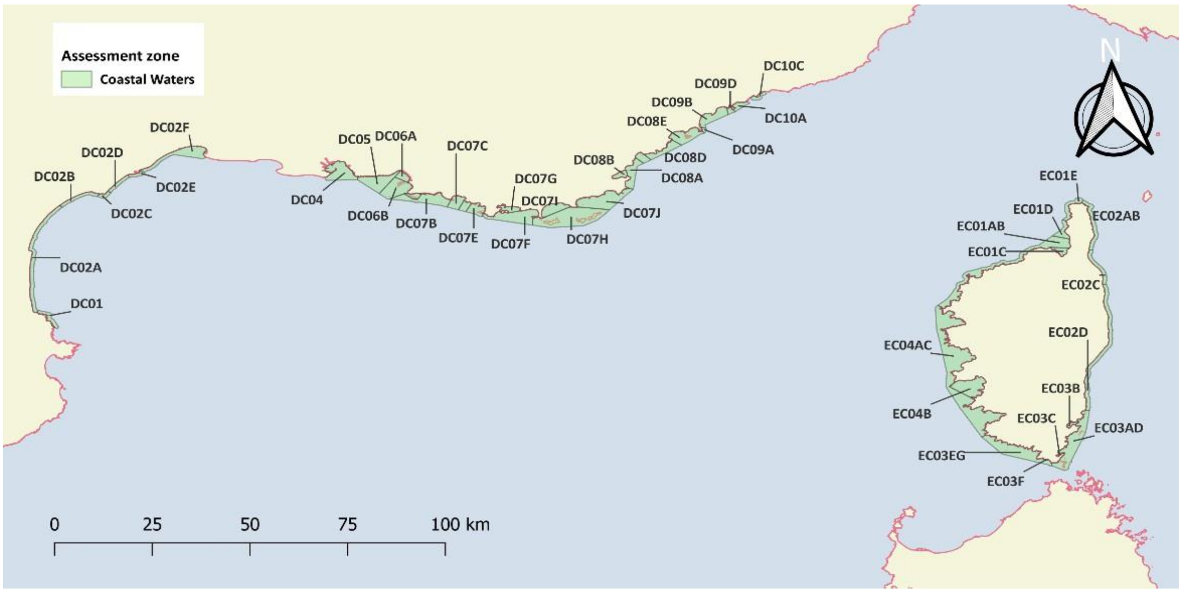


Figure 3.1.3.4.3.a. The nesting of the finest IMAP subSAUs set for the French OW assessment zone (upper map); and depiction of the finest IMAP subSAUs set in CW assessment zone (lower map). For setting IMAP subSAUs along the coast of France, the WFD water bodies were considered.

370. The IMAP Spatial Assessment Units (SAUs) were set in the waters of Spain by taking account of the specific circulation pattern in the Alboran Sea which influences the biogeochemical processes in the area, as shown in Figure 3.1.3.4.3.b1. (Sánchez-Garrido and Nadal, 2022[71]).

[71] Sanchez-Garrido JC and Nadal I (2022) The Alboran Sea circulation and its biological response: A review. Front. Mar. Sci. 9:933390. doi: 10.3389/fmars.2022.933390

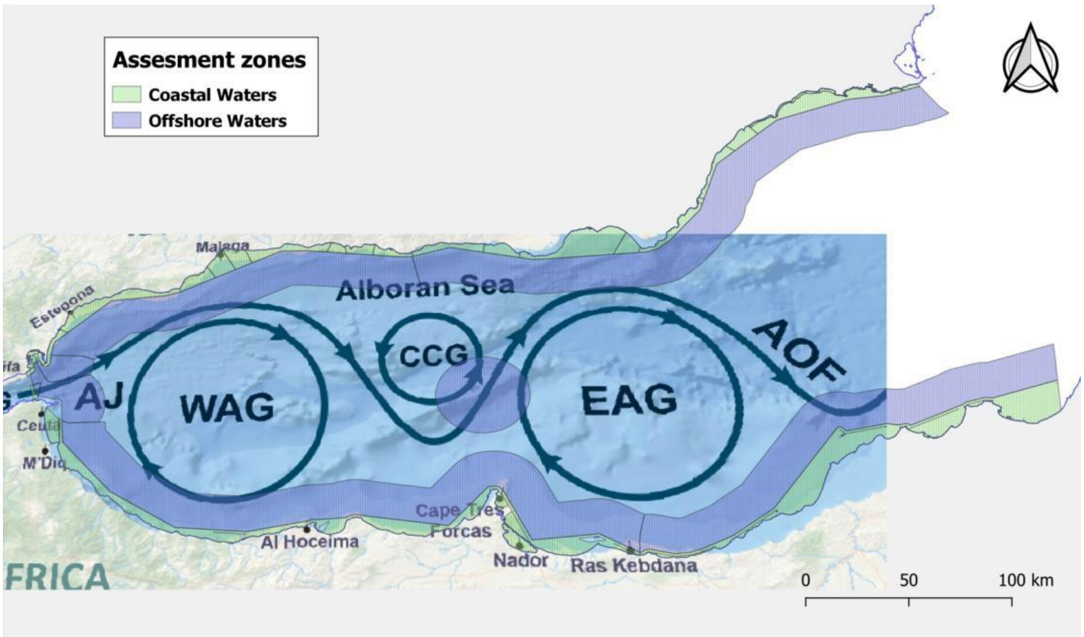


Figure 3.1.3.4.3.b1. A circulation scheme superimposed on the CW and OW assessment zones in the Alboran Sea Sub-division (Sánchez-Garrido and Nadal, 2022)

371. The Spanish OWs were divided in the ESPE (East of Motril) and the ESPW (West of Motril) in the ALB Subdivision, and ESPL (mainland) and ESPI (islands) of the LEV-BAL Subdivision, as shown in Figure 3.1.3.4.3. b2**.**. For the Spanish CW, the division to water bodies (WB) set for implementation of the WFD was also used for setting IMAP SAUs by considering an input submitted by the national authorities. Consequently, the WFDs coding was used for present work Figure 3.1.3.4.3.b3). The MSFD Assessment Water Units of Spain were considered as well as proposed by the national authorities (Figure 3.1.3.4.3.b4).

372. The finest IMAP SAUs set in the ALB and LEV-BAL Sub-divisions for the purpose of the present CI 14 assessment are nested in the CW of the ALB and LEV-BAL Subdivisions (Figure 3.1.3.4.3.b3).

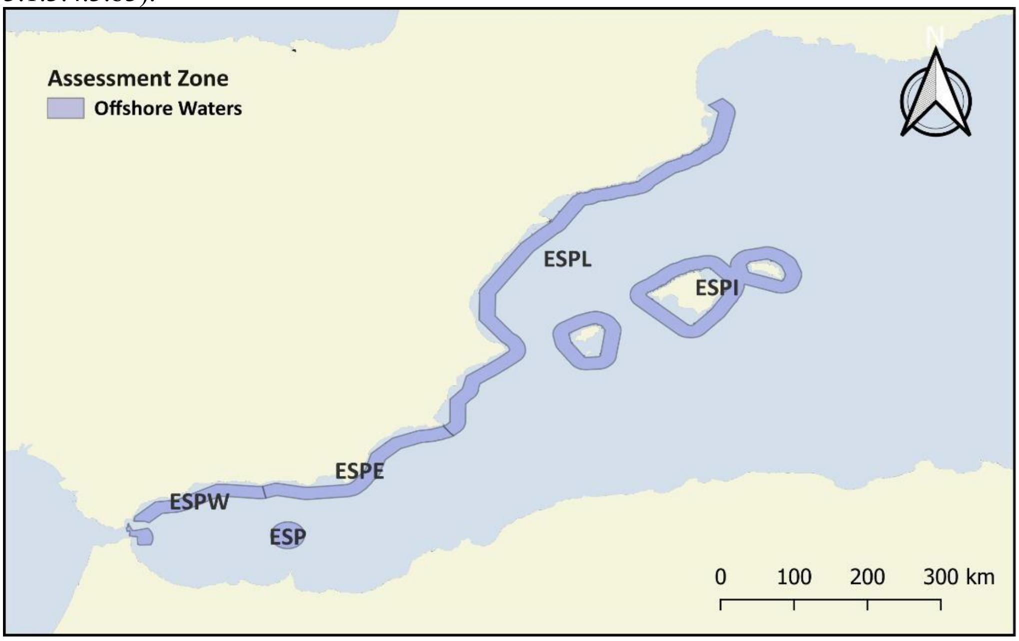


Figure 3.1.3.4.3. b2. The nesting of the finest IMAP SAUs, as set for the ALB and LEV-BAL subdivisions in the OW assessment zone.

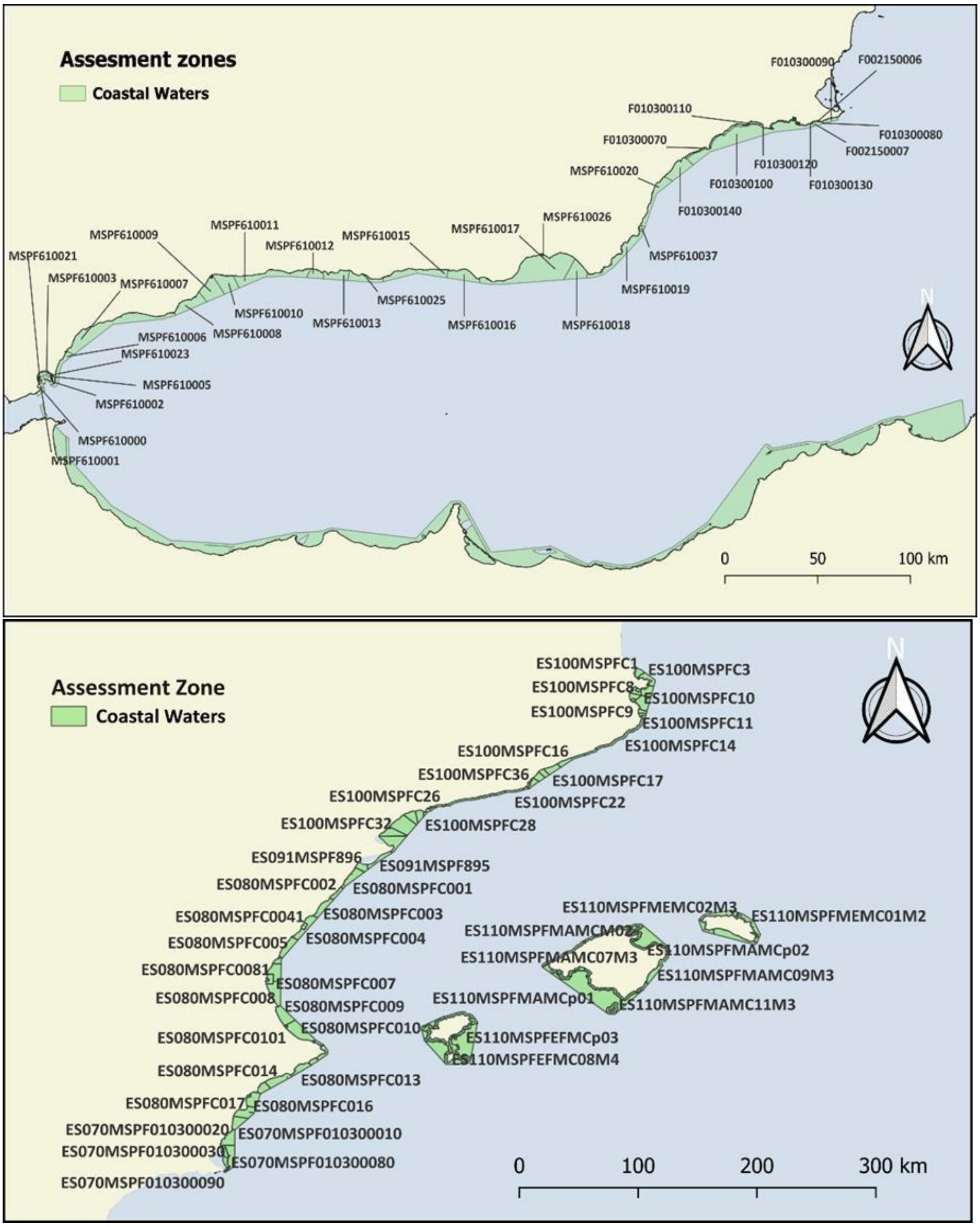


Figure 3.1.3.4.3.b3. The nesting of the finest IMAP SAUs set for the ALB Sub-division (upper map) and for the LEV-BAL Sub-division (lower map), in CW assessment zone. For setting IMAP SAUs along the coast of Spain, the WFD water bodies were considered in order to determine dominating assessment water typology for setting the assessment criteria.

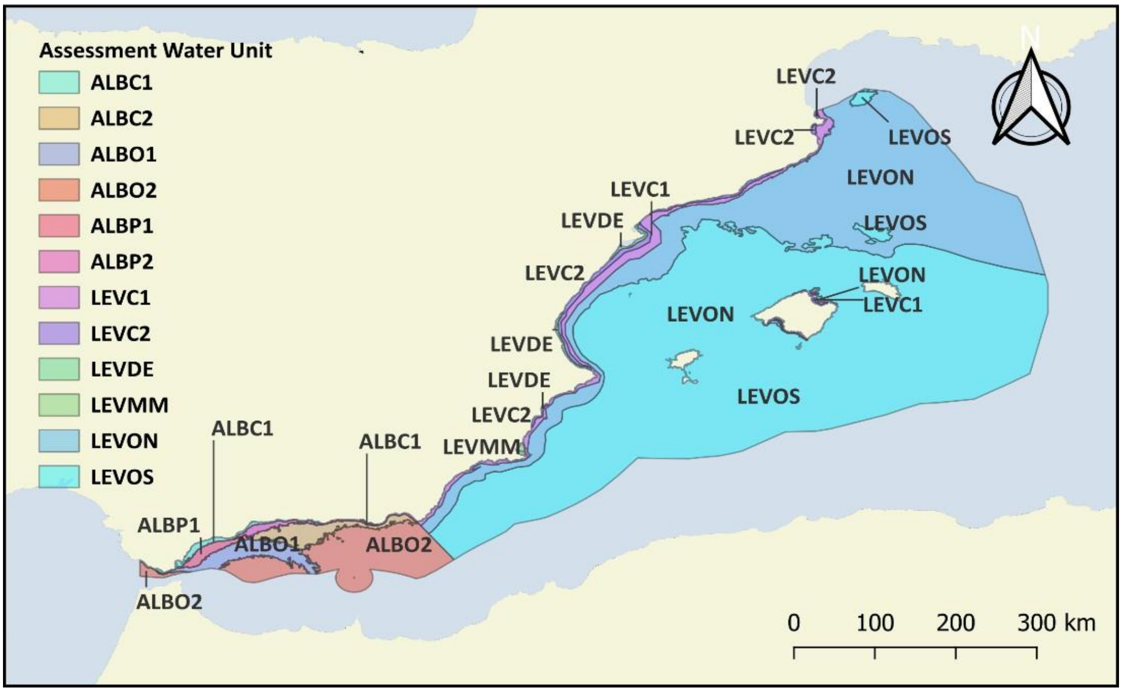
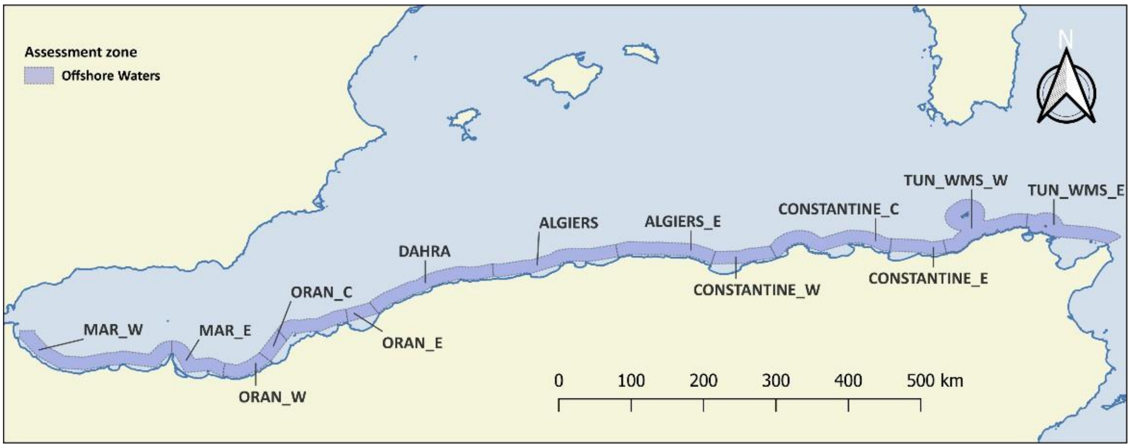


Figure 3.1.3.4.3.b4. The MSFD Assessment Water Units of Spain.

373. The Moroccan Coastal (CW) and Offshore Waters (OW) were divided in the 4 SAUs i.e., the CW and OW MAR_W (West of the Cape of the Three Forks) and the CW and OW MAR_E (East of the Cape of the Three Forks). The Western part of the Moroccan CW and OW mainly encompasses the Western Alboran Gyre (Sánchez-Garrido and Nadal, 2022)[72]. For the Algerian CW and OW, division in the SAUs follows the delimitation of the coastal river basins. For each AZ, the following nine SAUs were obtained: ORAN_W, ORAN_C; ORAN_E, DAHRA, ALGIERS; ALGIERS_E, CONSTANTINE_W, CONSTANTINE_C and CONSTANTIE_E. The Tunisian CW and OW in the WMS were divided in the four SAUs i.e., the CW and OW TUN_WMS_W (west of Cap Blanc) and the CW and OW TUN_WMS_E (east of Cap Blanc). The eastern SAUs are influenced by the Bizerte Lagoon and the Gulf of Tunis.

374. The IMAP SAUs set in the Southern part of the WMS for the purpose of the present CI 14 assessment are nested in the two main assessment zones i.e. CW and OW of the Southern part of the CWMS Sub-division (Figure 3.1.3.4.3.c).

[72] Sanchez-Garrido, J.C., Nadal, I. (2022) The Alboran Sea circulation and its biological response: A review. Front. Mar. Sci. 9:933390. doi: 10.3389/fmars.2022.933390



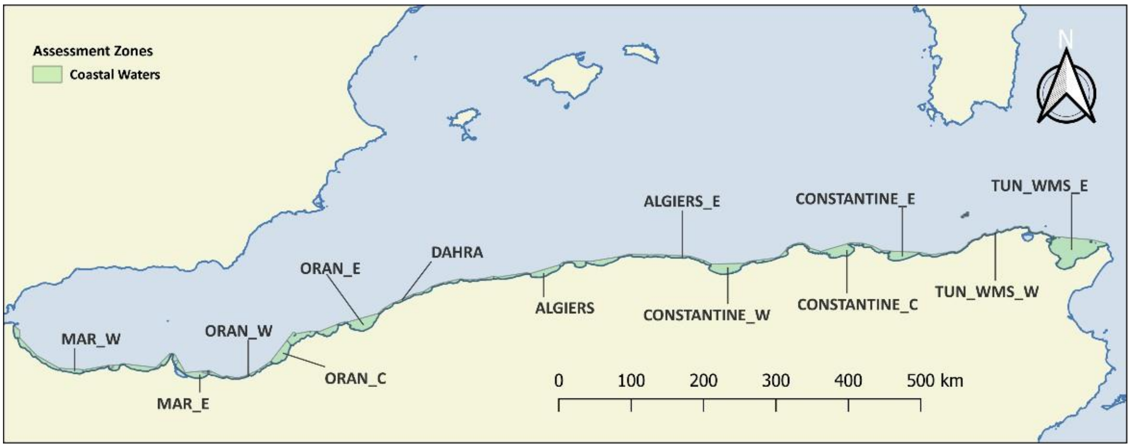


Figure 3.1.3.4.3.c. The nesting of the IMAP SAUs set for the OW assessment zone (upper map) in the Southern part of the CWMS Sub-division; and depiction of the IMAP SAUs set in CW assessment zone (lower map).

375. The Italian Coastal (CW) and Offshore (OW) waters were divided in eight assessment units (SAUs) located North of Civitavecchia (IT_TYR_N), out of the main Tyrrhenian circulation patterns); and South of Civitavecchia (IT_TYR_S), as shown in Figure 11 (upper map). For the Sardinia Island, the assessment units are IT_ISL_W (West coast) and IT_ISL_E (East coast). To obtain the codes of eight SAUs, the prefix AZ was added resulting in the following coding of the SAUs: CW_IT_TYR_N, OW_IT_TYR_N, etc.

376. Figure 3.1.3.4.3.d. depicts the finest IMAP subSAUs nesting in the two main assessment zones i.e., CW and OW.

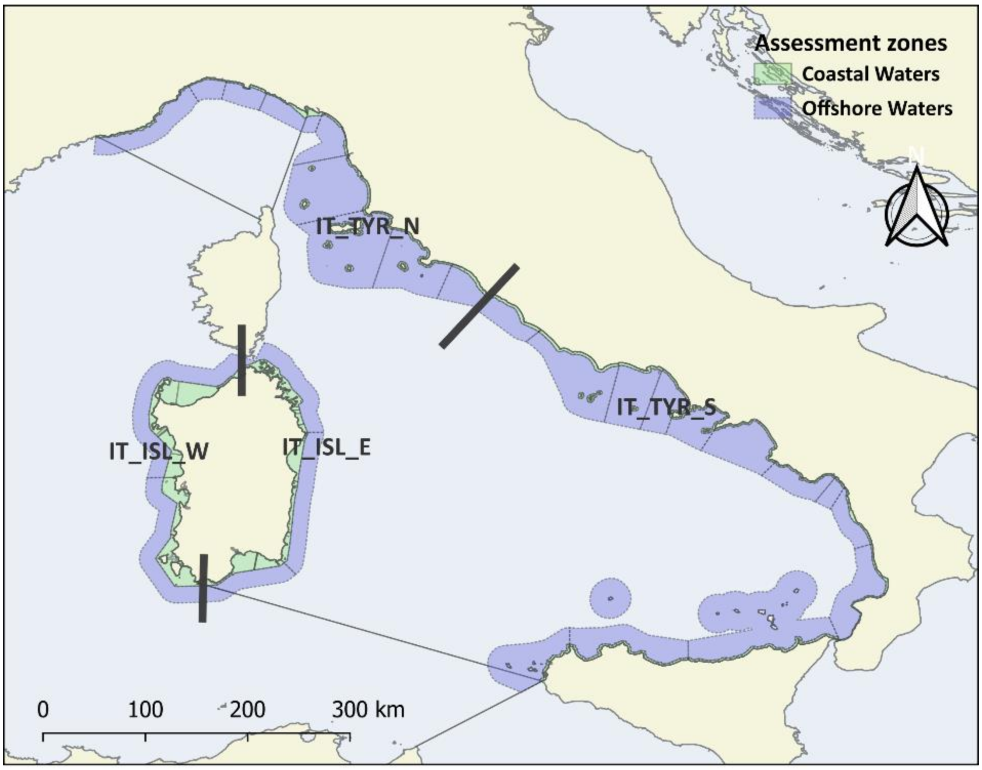


Figure 3.1.3.4.3.d. The nesting of the IMAP SAUs set for OW and CW in the Tyrrhenian and Italian part of the CWMS Sub-division (upper map); and depiction of the finest IMAP subSAUs (lower map).

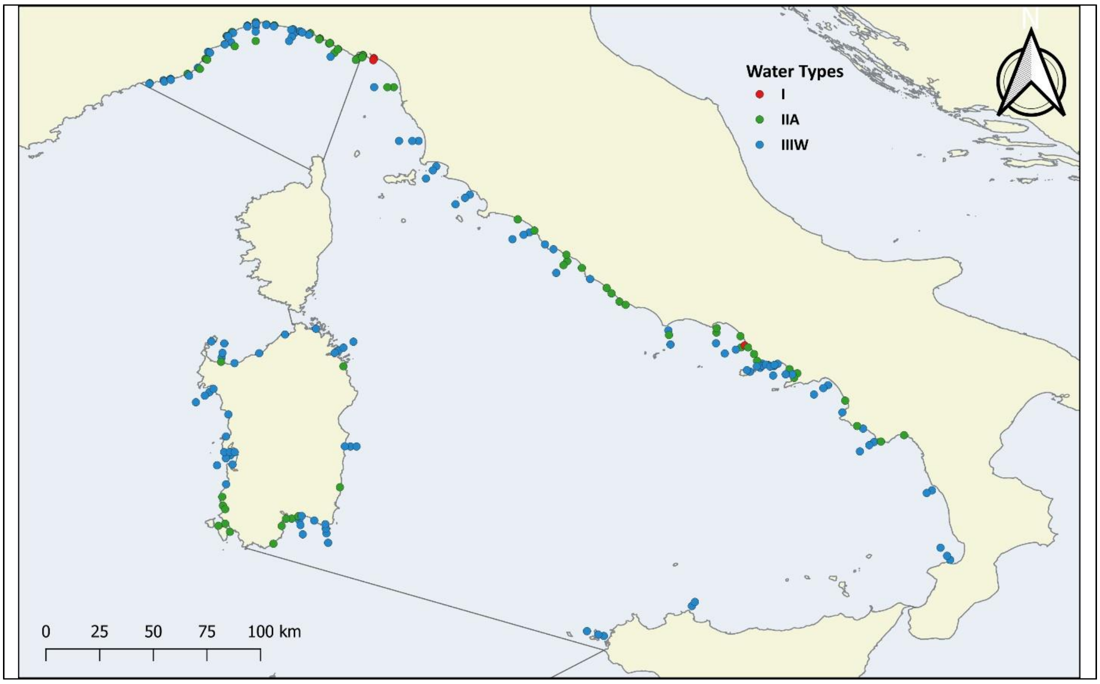


Figure 3.1.3.4.3.d: The water types along the Tyrrhenian Sea Sub-division and part of the CWMS:

The Waters of Italy.

Setting the good/non good boundary value/threshold for the Simplified G/M comparison assessment methodology application in the WMS Sub-region

377. Given the use of reference and boundary water types related values, as set by the Decision IG.23/6 of COP 20 (MED QSR), was impossible for the present work in the Western Mediterranean Sea Sub-region, the calculation of the assessment criteria applicable within the present work was undertaken, along with the normalized transformation (as elaborated above for the AEL Sub-region and for the CEN). Namely, the use of a new parameter for assessment i.e., the satellite derived Chl a imposes calculation of a new set of assessment criteria if there is no tested relationship of the satellite derived Chl a data with in situ measured Chl a data based on effects-pressures relationship. Namely, the use of reference and boundary water types related values, as set by the Decision IG.23/6 of COP 20 (MED QSR), was impossible for the present work based on the use of the satellite-derived data.

378. As explained above, setting the threshold to 50 % implies that low levels of disturbance (defined as less than +50 % deviation) resulting from human activity are considered acceptable, while moderate (i.e., greater than +50 %) deviations are not considered acceptable for the water body in question. A further modification to this rule was applied within the present work in the Western Mediterranean Sea Sub-region given the 50th percentile represents the mean value of the distribution, and the 85th percentile ~ mean +1 SD represents the G/M threshold.

379. For the French part of the CWMS, an additional modification to the above rule was applied further to the recent expert-based analysis of the satellite derived products for Chla, realised at the local scale of coastal water masses[73], over the period 2016-2021. It indicates that most coastal waters are in either good or very good status regarding Chl *a* concentrations. Although waters above the G/M threshold (oN85), set for satellite derived chl *a* data, should be classified as non-good, in the present

[73] Technical justification provided by France

case they were classified as good if the calculated values were very close to the G/M threshold (oN85) by taking account of the water masses features. In addition, the status assigned by applying the criteria as provided in Table 3.1.3.4.2 was adjusted further to the justification provided by France in relation to the national assessments derived by applying the G/nonG back transformed threshold based on *in situ* measurements i.e., the national assessment criteria which correspond to 90th percentile transformed to G/M, as also provided by UNEP/MAP Decision 22/7.

380. The transformation of percentile to z-scores were obtained using the pnorm() an qnorm() functions in R. The RC values (oN10) and the G/M thresholds (oN85) were calculated from the normalized values through the predict function. The assessment criteria calculation as presented in Tables 4.2.4.2; 4.2.4.3, 4.2.4.4. and 4.2.4.5.a. show the results obtained by the Assessment zones and SAUs.

381. To obtain the assessment criteria for the subSAUs in Spanish waters, they are paired with the assessment water types (AWT), considering that the predominant AWT in the subSAU determined the selection of the assessment criteria. The codes assigned to AWTs are the same as the codes of the MSFD AWUs. At the SAU level, many AWTs coexist, and therefore, different strategies must be considered; for example, one strategy can be to consider that if no more than 10% of subSAUs, normalized by their surface are in non-good status, then the SAU related to these subSAUs is considered in non-good status.

382. As it is elaborated above, there is a difference between the thresholds calculated from the satellite-derived data used for the present assessment and the assessment criteria calculated from in situ measurements, i.e., both national thresholds of Spain which are in compliance with the Marine Strategy Framework Directive (2008/56/EC) and Water Framework Directive (2000/60/EC), and the assessment criteria as adopted by IMAP Decision 22/7. Given this difference, the regional assessment findings do not fully match the eutrophication evaluation performed by Spain by applying the assessment criteria calculated from in situ measurements[74].

[74] https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/estrategias-marinas/

Table 3.1.3.4.2: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP spatial assessment units in the French part of the CWMS Sub-division. Dominant water type out of all Water Types (WT) assigned to different sub-SAUs within related SAUs are also presented. Table shows the Coastal water masses typology (WT) and corresponding G/M threshold (oN85), based on the use of satellite-derived Chl *a* data, as well as back transformed G/M threshold based on *in situ* measurements i.e., the national assessment criteria which correspond to 90th percentile transformed to G/M, as also provided in UNEP/MAP Decision 22/7.

AZ	SAU	WT	oN50	oN50+50	oN90	oN10	oN85	oN25	good/non-good	
									P90	GM
		I							10	4,12
CW	FRD_E	IIIW	0,258	0,388	0,562	0,193	0,415	0,22	1,89	0,78
CW	FRD_W	IIA	1,039	1,558	1,544	0,612	1,409	0,772	3,5	1,44
CW	FRE_E	III Isl.	0,212	0,318	0,414	0,161	0,327	0,185	1,22	0,50
CW	FRE_W	III Isl.	0,168	0,253	0,251	0,133	0,222	0,147	1,22	0,50
OW	FRD_E	IIIW	0,228	0,343	0,676	0,189	0,589	0,207	1,89	0,78
OW	FRD_W	IIA	0,447	0,67	0,757	0,321	0,674	0,372	3,5	1,44
OW	FRE_E	III Isl.	0,16	0,24	0,187	0,144	0,179	0,15	1,22	0,50
OW	FRE_W	III Isl.	0,158	0,237	0,186	0,14	0,181	0,148	1,22	0,50

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile i.e. G/M threshold based on use of satellite-derived data, oN25 – 25th percentile; P90 – G/M threshold from 90th percentile of *in situ* measurements ; GM - G/M threshold set as GM back transformed from 90th percentile of *in situ* measurements.

Table 3.1.3.4.3. Reference conditions (oN10) and G/M threshold (oN85) calculated from satellite-derived Chl *a* data and set by Spanish Water Types. The codes assigned to the assessment water types (AWT) are the same as the codes of the MSFD AWUs. oN85 represents G/M boundary threshold calculated from the satellite-derived Chl *a* data (shared by Spain). P90 represents 90th percentile back transformed from oN85. FP90 represents G/M threshold calculated from the satellite-derived Chl *a* data (as shared by Spain) by using 90th percentile annual values and applying the same calculation method as for calculation of oN85. ESP represents national G/M threshold values of Spain, expressed as 90th percentile, and calculated from *in situ* measurements (national reports for ALB and LEV-BAL as shared by Spain). There are no significant differences between thresholds calculated from satellite-derived data and thresholds calculated from *in situ* measured data, although they cannot be identical.

AWT	oN50	oN50+50	oN90	oN10	oN85	oN25	P90	FP90	ESP
ALBC1	0,702	1,052	0,957	0,544	0,915	0,617	2,218	2,403	2,47
ALBC2	0,297	0,445	0,407	0,241	0,378	0,258	0,916	0,942	1,65
ALBO1	0,332	0,498	0,390	0,261	0,379	0,288	0,919	0,579	1,99
ALBO2	0,225	0,338	0,293	0,177	0,276	0,198	0,669	0,539	0,68
ALBP1	0,465	0,698	0,612	0,377	0,569	0,419	1,379	1,186	2,89
ALBP2	0,448	0,673	0,611	0,327	0,571	0,376	1,384	1,542	2,03
LEVC1	0,269	0,404	0,374	0,192	0,347	0,226	0,841	0,714	1,80
LEVC2	0,498	0,746	0,711	0,375	0,658	0,420	1,595	0,976	2,00
LEVDE	0,823	1,234	0,949	0,741	0,944	0,769	2,289	1,236	2,30
LEVON	0,179	0,269	0,230	0,139	0,218	0,157	0,529	0,435	0,60
LEVOS	0,123	0,184	0,158	0,103	0,150	0,110	0,364	0,312	0,26

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile, P90 – 90th perc. back transformed from oN85, FP90 – 90th perc. calculated from mean annual values of the 90th perc., ESP – 90th perc. represents G/M threshold values calculated from in situ measurements for the Spanish waters

Table 3.1.3.4.4.: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP spatial assessment units in the Southern part of the CWMS.

Country	AZ	oN50	oN50+50	oN90	oN10	oN85	oN25
MAR	CW	6017	0,449	0,674	0,713	0,277	0,637
MAR	OW	22360	0,294	0,441	0,389	0,227	0,363
DZA	CW	20982	0,319	0,478	0,74	0,205	0,592
DZA	OW	73665	0,21	0,316	0,283	0,167	0,267
TUN	CW	8787	0,229	0,344	0,577	0,162	0,477
TUN	OW	25350	0,162	0,243	0,208	0,132	0,193

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90^{th} percentile, oN10 – 10^{th} percentile, oN85 – 85^{th} percentile i.e., G/M threshold based on use of satellite-derived Chl *a* data, oN25 – 25^{th} percentile

Table 3.1.3.4.5.a.: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP SAUs in the Italian waters in the Tyrrhenian Sea and the part of CWMS.

AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	CW_ITA_ISL_E	0,095	0,142	0,213	0,067	0,151	0,074
CW	CW_ITA_ISL_W	0,104	0,156	0,225	0,079	0,169	0,087
CW	CW_ITA_TYR_N	0,348	0,522	1,074	0,085	0,882	0,117
CW	CW_ITA_TYR_S	0,263	0,395	1,389	0,085	1,124	0,121
OW	OW_ITA_ISL_E	0,074	0,112	0,099	0,059	0,095	0,063
OW	OW_ITA_ISL_W	0,083	0,124	0,102	0,068	0,098	0,075
OW	OW_ITA_TYR_N	0,095	0,143	0,209	0,079	0,156	0,084
OW	OW_ITA_TYR_S	0,077	0,116	0,146	0,061	0,111	0,067

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90^{th} percentile, oN10 – 10^{th} percentile, oN85 – 85^{th} percentile i.e., G/M threshold based on use of satellite-derived Chl *a* data, oN25 – 25^{th} percentile

383. As explained above, the compatibility of the present classification was achieved with a five classes GES/non GES scale set in the Adriatic Sea Sub-region.

An application of the EQR Methodology in the Tyrrhenian Sea Sub-division and part of the CWMS: the Waters of Italy

384. The EQR assessment methodology was applied on in situ Chl a data reported by Italy to IMAP IS. However, in situ data available for nutrients were not evaluated given the lack of assessment criteria developed for nutrients in the Tyrrhenian Sea. The application of the EQR methodology was also based on typology related assessments. The water type was determined as a five-year arithmetic mean of salinity and compared to the ranges as shown in Table 3.1.3.4.5.b. The water types distribution in the Tyrrhenian Sea is presented in Figure 3.1.3.4.3.d.

385. The likely GES or likely non GES classes are assigned to the assessment units for the assessment of the Tyrrhenian Sea Sub-division and part of the CWMS by applying the EQR assessment methodology. Namely, an application of this methodology allows the use of the reference conditions and boundaries for the five ecological quality classes and therefore supports the assessment undertaken to be considered as the assessment of good environmental status. Although only one parameter was assessed the assessment is considered likely GES/non-GES given the finest discrimination of the assessment classes is possible by application of the EQR. As explained above, for the application of the simplified G/M comparison, the two status classes i.e. good and non-good expressed as good and moderate status (i.e. G/M) are assigned to the units assessed regarding Chl *a*, as only one parameter assessed.

Table 3.1.3.4.5.b: Major coastal water types with density and salinity boundary

	Type I	Type IIA Tyrrhenian	Type IIIW
σ_t (density)	<25	25<d<27	>27
S (salinity)	<34.5	34.5<S<37.5	>37.5

386. The actual and normalized EQRs for all boundaries of Water Types I and II A in the Tyrrhenian Sea are shown in Tables 3.1.3.4.5.c and d, respectively.

Table 3.1.3.4.5.c: Reference conditions and boundaries of ecological quality classes expressed by different parameters for Water Type I in coastal and open waters of the Tyrrhenian Sea. Normalized EQRs were used for ecological quality assessment.

Boundaries	**TRIX**	$c(\mathbf{Chl}a_{aGM})/\mu g\ L^{-1}$	**Chla$_{aGM}$**	
			EQR$_{actual}$	**EQR$_{normalized}$**
RC		1.40	1.00	1.00
H/G	4.25	2.0	0.70	0.85
G/M	**5.25**	**5.0**	**0.28**	**0.62**
M/P	6.25	12.6	0.11	0.38
P/B	7	25.0	0.06	0.20

Table 3.1.3.4.5.d: Reference conditions and boundaries of ecological quality classes expressed by different parameters for Water Type IIA in coastal and open waters of the Tyrrhenian Sea. Normalized EQRs were used for ecological quality assessment.

Boundaries	**TRIX**	$c(\mathbf{Chl}a_{aGM})/\mu g\ L^{-1}$	**Chla$_{aGM}$**	
			EQR$_{actual}$	**EQR$_{normalized}$**
RC		0.32	1.00	1.00
H/G	4	0.48	0.66	0.84
G/M	**5**	**1.2**	**0.27**	**0.62**
M/P	6	2.9	0.11	0.40
P/B	7	7.3	0.04	0.18

387. By applying the above shown assessment criteria, the assessed subSAU were classified in GES/non GES status, comparing the EQRnormalized to the G/M boundary of 0.62 set as the good/non good status boundary limit.

388. Contrarily to the five ecological classes approach adopted for Water Types I and II A in the Tyrrhenian Sea, a single threshold approach is used for Water Type III W. The GES/non GES threshold value applied was 0.48 µg/L representing an annual GM value of H/G boundary for Water Types II A.

Results of the Simplified G/M comparison assessment methodology application in the WMS Sub-region

389. As for the AEL and the CEN, the two status classes i.e. good and non-good are assigned to the units assessed in the WMS by applying the simplified G/M assessment methodology since the assessment findings are based on the use of only one parameter and therefore, the integrated consideration of the minimum of parameters needed to assess the good environmental status for IMAP CIs 13 and 14 i.e. the GES was impossible.

390. Upon setting the reference conditions and the G/M threshold, each observation point, or area were classified in good and non-good status , by comparing the value of the indicator i.e., the satellite derived Chla to the G/M threshold, i.e. the back transformed 85th percentile of normalized distribution.

391. In addition, to decide on good/non-good status in the French waters, the local scientific expertise regarding ecosystem functioning, water masses characteristics (hydrology, water renewal, confinement of the water mass) and satellite-derived product analyses were taken into account as provided by France.

The Central WMS Sub-division: The Waters of France

392. The results of CI 14 assessment using the satellite-derived Chl *a* data in the Central WMS Sub-division i.e., in the French waters are presented in Tables 3.1.3.4.6 and 3.1.3.4.7, and Figure WMS 3.1.3.4.4.E. Despite good status assigned to the assessment zones, it should be noted that in the French CW assessment zone, for which the finest SAUs were defined in line with WFD, one out of the 46 SubSAU namely EC03b (Golfe de Porto Vecchio) was in non-good status though the low number of pixels (n=13) included in the assessment reflects the high uncertainty associated to mean computation. The Gulf of Porto Vecchio is a small embayment characterised by the presence of both muddy and sandy sediments. In such shallow coastal environments, resuspension processes complexify water optical properties leading to overestimation of Chl *a* concentration when using satellite-derived products (Gohin et al. 2020[75]). Also, Ganzin et al. (2010) observed that satellite-derived products in the area can be 30% higher than the mean values computed over a 6-year period. Water renewal is also very low in this area making it more sensitive to pressures and basin derived inputs.

393. Six out of 46 SubSAUs were above the G/M threshold (oN85) but were still classified in good status given the calculated values were very close to the G/M threshold (oN85), and taking also account of the water masses features. For the present assessment, the national G/nonG back transformed values (90th percentile > GM, based on in situ measurements, corresponding to UNEP/MAP Decision 22/7) were also used. Amongst these 6 water masses, the four are located in the FRD-E assessment zone namely DC04 (Golfe de Fos), DC06A (Petite Rade de Marseille), DC07I (Cap de L'estéral – Cap de Brégançon) and DC08B (Ouest Fréjus- Saint Raphaël). The two revised water masses are located in Corsica Island (FRE) and correspond to EC04B (Golfe D'Ajaccio) and EC01C (Golfe de Saint Florent). Water mass DC04 (Golfe de Fos) is a highly modified water mass characterised by a high spatial heterogeneity in Chl *a* distribution. For other water masses (DC06A, DC07I and DC08B; EF04B and EC01C in Corsica), hydrodynamic studies revealed a very low annual renewal of water masses thus explaining slight accumulation of low phytoplankton biomass levels (Ganzin et al. 2010[76]).

394. The results of the present CI 14 assessment in the French part of the CWMS represent only an indication of possible good/non-good status at the level of the subSAUs, whereby subSAUs are not set at the same level of spatial finesse. Namely, the reliability of the assessment was negatively affected by the lack of data reported by the CPs in IMAP IS, and therefore impossibility to use the IMAP NEAT GES assessment as applied to the Adriatic Sea Sub-region.

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[75] J. Mar. Sci. Eng. 2020, 8, 665; https://doi.org/10.3390/jmse8090665
[76] https://archimer.ifremer.fr/doc/00028/13931/11104.pdf

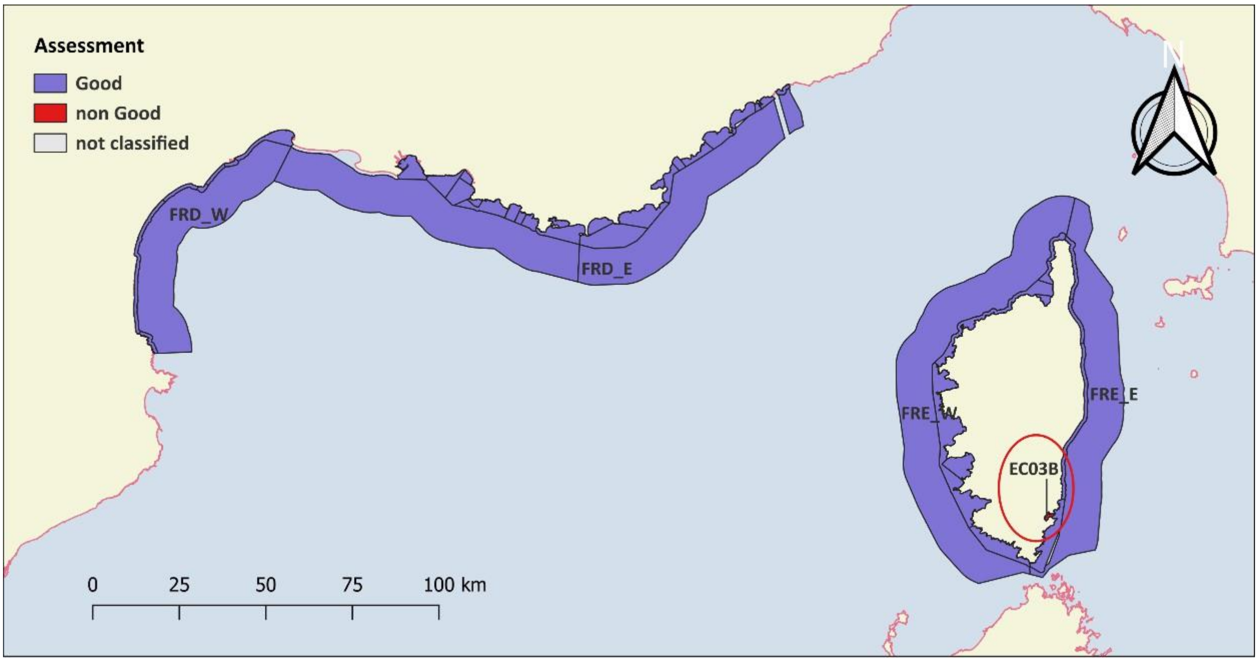

Figure WMS 3.1.3.4.4.E: The assessment results for CI 14 in the French waters of the CWMS.

Table 3.1.3.4.6.:Results of the assessment (G_NG.oN85 - the good status corresponding to all values below the 85th percentile set as good/non-good boundary limit) of the French part of the CWMS provided for the Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blue coloured AZs indicate good status.

Country	**AZ**	**SAU**	**CHL_N**	**CHL_GM**	**oN50**	**oN50+50**	**oN10**	**oN85**	**G_NG.oN85**
France	CW	FRD_E	8347	0,316	0,258	0,388	0,193	0,415	**G**
France	CW	FRD_W	1784	0,990	1,039	1,558	0,612	1,409	**G**
France	CW	FRE_E	2358	0,249	0,212	0,318	0,161	0,327	**G**
France	CW	FRE_W	5733	0,208	0,168	0,253	0,133	0,222	**G**
France	OW	FRD_E	30648	0,303	0,228	0,343	0,189	0,589	**G**
France	OW	FRD_W	13656	0,478	0,447	0,67	0,321	0,674	**G**
France	OW	FRE_E	16698	0,178	0,160	0,24	0,144	0,179	**G**
France	OW	FRE_W	24450	0,179	0,158	0,237	0,140	0,181	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions); oN85 – 85th percentile set as G/M threshold based on the use of satellite-derived Chl *a* data; G/NG oN85 - the good status corresponding to all values below the 85th percentile set as good/non-good boundary limit.

Table 3.1.3.4.7. Result of the assessment (G_NG.oN85- the good status corresponding to all values below the 85th percentile set as G/M i.e. good/non-good status boundary limit based on satellite-derived Chl *a* data) of the French coastal waters (CW) in the CWMS provided for the finest Spatial Assessment Units (SAUs). Blue coloured subSAUs indicate good status; Red coloured subSAU indicates non-good status. Light blue colour corresponds to subSAUs reconsidered as in good status following justification provided by French authorities; * - indicates the subSAUs reconsidered as in good status given the water mass typology, and WB evaluated as Type I; 90th percentile was used as included in the national assessment criteria, based on *in situ* measurements, further to the request and justification of local hydrological conditions (e.g. highly modified water mass characterised by a strong spatial heterogeneity but no eutrophication processes exist), as provided by French authorities (it corresponds to 90th percentile transformed to G/M, as provided in UNEP/MAP Decision 22/7); ** - indicates subSAUs reconsidered as in good status following expert-based justification provided by French authorities, and WBs are in WT IIIW; since the assessment values are close to the good/non-good boundary limit set by using satellite derived Chl *a* data i.e., oN85 – 85th percentile (G/NG oN85 threshold), the national assessment criteria, based on *in situ* measurements, were used further to the justification of local hydrological conditions (e.g. semi-enclosed bay or confined areas with very low annual water renewal, slight accumulation of phytoplankton biomass without eutrophication), as provided by French authorities (the national G/nG assessment criteria correspond to 90th percentile transformed to G/M, as provided in UNEP/MAP Decision 22/7).

Country	AZ	SAU	subSAUs (WFD_WB)	CHL_N	CHL_GM	oN50+50	oN10	oN85	G/nG	G_NG.oN85	G/nG**.
France	CW	FRD_W	DC01	162	0,545	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02A	654	0,855	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02B	149	1,375	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02C	78	1,041	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02D	135	0,947	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02E	78	1,026	1,558	0,612	1,409		**G**	
France	CW	FRD_W	DC02F	528	1,297	1,558	0,612	1,409		**G**	
France	CW		DC04*	553	1,108				**4,12**	**G**	
France	CW	FRD_E	DC05	525	0,371	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC06A**	93	0,525	0,388	0,193	0,415	**0,780**	**NG**	**G**
France	CW	FRD_E	DC06B	586	0,411	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07A	61	0,290	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07B	547	0,261	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07C	192	0,239	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07D	114	0,236	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07E	190	0,396	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07F	685	0,302	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07G	82	0,409	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07H	1577	0,243	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC07I**	276	0,448	0,388	0,193	0,415	**0,780**	**NG**	**G**

Country	AZ	SAU	subSAUs (WFD_WB)	CHL_N	CHL_GM	oN50+50	oN10	oN85	G/nG	G_NG.oN85	G/nG**.
France	CW	FRD_E	DC07J	871	0,21	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC08A	385	0,287	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC08B**	119	0,470	0,388	0,193	0,415	**0,780**	**NG**	**G**
France	CW	FRD_E	DC08C	116	0,274	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC08D	298	0,242	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC08E	437	0,342	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC09A	30	0,275	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC09B	372	0,300	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC09C	53	0,226	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC09D	**NOT EVALUATED – NO CONSISTENT SATALLITE DATA**							
France	CW	FRD_E	DC10A	114	0,215	0,388	0,193	0,415		**G**	
France	CW	FRD_E	DC10C	71	0,252	0,388	0,193	0,415		**G**	
France	CW	FRE_W	EC01AB	1229	0,195	0,253	0,133	0,222		**G**	
France	CW	FRE_W	EC01C**	116	0,252	0,253	0,133	0,222	**0,500**	**NG**	**G**
France	CW	FRE_W	EC01D	144	0,189	0,253	0,133	0,222		**G**	
France	CW	FRE_W	EC01E	168	0,184	0,253	0,133	0,222		**G**	
France	CW	FRE_E	EC02AB	360	0,174	0,318	0,161	0,327		**G**	
France	CW	FRE_E	EC02C	240	0,273	0,318	0,161	0,327		**G**	
France	CW	FRE_E	EC02D	672	0,307	0,318	0,161	0,327		**G**	
France	CW	FRE_E	EC03AD	1056	0,234	0,318	0,161	0,327		**G**	
France	CW	FRE_E	EC03B	19	1,233	0,318	0,161	0,327		**NG**	
France	CW	FRE_E	EC03C	11	0,291	0,318	0,161	0,327		**G**	
France	CW	FRE_W	EC03EG	771	0,200	0,253	0,133	0,222		**G**	
France	CW	FRE_W	EC03F	**NOT EVALUATED – NO CONSISTENT SATALLITE DATA**							
France	CW	FRE_W	EC04AC	2715	0,205	0,253	0,133	0,222		**G**	
France	CW	FRE_W	EC04B**	590	0,272	0,253	0,133	0,222	**0,500**	**NG**	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10^{th} percentile (Reference conditions); oN85 – 85^{th} percentile (G/M threshold)

The Alboran Sea and Levantine-Balearic Subdivision of the WMS: The Waters of Spain

395. The results of CI 14 assessment using the satellite-derived Chl a data in the Alboran Sea and Levantine-Balearic Subdivision of the WMA i.e., in the Spanish waters are presented in Tables 3.1.3.4.8. and 3.1.3.4.9., and Figure WMS 3.1.3.4.5.E.

396. The evaluation was performed on 70 out of 149 subSAUs. Despite good status assigned to the assessment zones, it should be noted that in the CW assessment zone, for which the finest subSAUs were defined in line with WFD, there are 8 out of 70 subSAUs which are in non-good status.

397. These 8 subSAUs are located as follows: one subSAU close to the Mar Menor (ES070MSPF010300030) one subSAU ES080MSPFC017 of the Segura River mouth; two subSAUs (ES080MSPFC006 and ES080MSPFC0081) near Valencia; two subSAUs ES080MSPFC001 and ES100MSPFC32 close to the Ebro River mouth; one subSAU ES100MSPFC3 close to the French border; and one subSAU ES110MSPFMAMCp02 on the Mallorca Island in the Alcudia Gulf.

398. The local sources of pollution are probably the main driver contributing to the weakened status of most non-good subSAUs. The most important problem that needs to be addressed is the non-good status in the Mallorca Island area. A more detailed analysis indicates that the ranges of observed values in the Islands area is very low 0,05-0,20 µg/L. At narrow ranges the statistics is not always performed in acceptable manner. This suggests a necessity to use the satellite-derived data in these areas with caution or different elaboration strategies need to be provided.

399. As it is explained above for setting the good/non-good boundary limit there is a slight difference between the thresholds calculated from the satellite-derived data used for the present assessment and the assessment criteria calculated from *in situ* measurements, which resulted in the regional assessment findings which do not fully match the eutrophication evaluation performed by Spain by applying the assessment criteria calculated from *in situ* measurements.

400. The results of the present CI 14 assessment in the ALB and LEV-BAL Sub-divisions of the WMS represent only an indication of possible good/non-good status at the level of subSAUs, whereby the subSAUs are not set at the same level of spatial finesse.

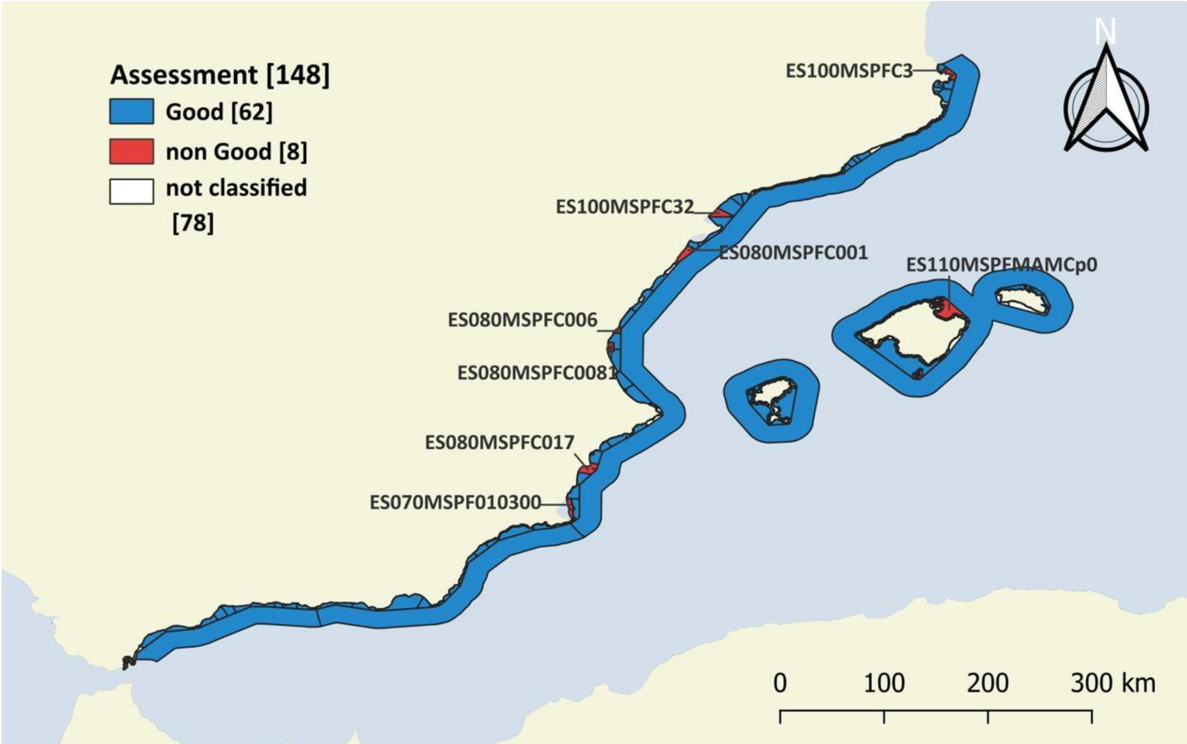

Figure WMS 3.1.3.4.5.E: The assessment results for CI 14 in the Alboran Sea and Levantine-Balearic Subdivision of the WMS.

Table 3.1.3.4.8. Result of the assessment (G_NG.oN85- the good status class corresponding to all values below the 85^{th} percentile set as the good/non-good boundary limit) of the Spanish OW and CW in the ALB and LEV-BAL Subdivision at the level of Spatial Assessment Units (SAUs). Blue coloured SAUs indicate good status, Red coloured SAUs indicate noon-good status. For CW, as in the SAU a multiplicity of Assessment Water Types can coexist, further adjusted assessment approach was used. The SAU is in good status if less than 10 % of the area of the SAU is in non-good status. For the calculation of the affected area, the number of observation points (CHL_N) per SAU was used since these points represent the observation grid (1x1 km) and their surface is very close to the area of the SAU (expressed in km^2). The sum of the observation points in non-good (**∑N (NG)**), along with the percent of the SAU in non-good (%G/NG) from the total sum of the observation points (**∑N**) in SAU, were calculated.

AZ	**SAU**	**CHL_N**	**CHL_GM**	**oN50+50**	**oN10**	**oN85**	**G_NG.oN85**	
OW	ESPW	904	0,385	0,571	0,265	0,508	**G**	
OW	ESPE	1580	0,196	0,288	0,133	0,276	**G**	
OW	ESPL	3752	0,213	0,306	0,149	0,276	**G**	
OW	ESPI	3644	0,115	0,17	0,1	0,137	**G**	
		∑N	**∑N (NG_{oN85})**	**%G/NG_{oN85}**	**∑N ($NG_{oN50+50}$)**	**%G/$NG_{oN50+50}$**	**G/NG_{oN85}**	**G/$NG_{oN50+50}$**
CW	ES060	532	0	0,0	0	0,0	**G**	**G**
CW	ES070	500	16	3,2	16	3,2	**G**	**G**
CW	ES080	540	80	14,8	40	7,4	**NG**	**G**
CW	ES091	104	0	0,0	0	0,0	**G**	**G**
CW	ES100	340	56	16,5	0	0,0	**NG**	**G**
CW	ES110	668	96	14,4	0	0,0	**NG**	**G**

Table 3.1.3.4.9. Result of the assessment (G_NG.oN85- the good status class corresponding to all values below the 85th percentile set as the good/non-good boundary limit) of the Spanish OW and CW in the ALB and LEV-BAL Subdivision at the level of the finest Spatial Assessment Units (subSAUs). Blue coloured subSAUs indicate good status, Red coloured subSAUs indicate non-good status.

AZ	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
OW	ESPW		904	0,385	0,571	0,265	0,508	G
OW	ESPE		1580	0,196	0,288	0,133	0,276	G
OW	ESPL		3752	0,213	0,306	0,149	0,276	G
OW	ESPI		3644	0,115	0,17	0,1	0,137	G
CW	ES060	ES060MSPF610007	72	0,765	1,178	0,577	0,959	G
CW	ES060	ES060MSPF610008	32	0,532	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610009	32	0,549	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610010	32	0,565	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610011	36	0,506	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610012	24	0,401	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610013	28	0,384	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610014	12	0,368	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610015	36	0,359	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610016	24	0,328	0,688	0,307	0,604	G
CW	ES060	ES060MSPF610017	148	0,286	0,378	0,213	0,39	G
CW	ES060	ES060MSPF610018	36	0,242	0,378	0,213	0,39	G
CW	ES060	ES060MSPF610019	12	0,19	0,36	0,165	0,309	G
CW	ES060	ES060MSPF610020	8	0,195	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300010	32	0,274	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300020	44	0,226	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300030	16	0,331	0,36	0,165	0,309	NG
CW	ES070	ES070MSPF010300080	112	0,227	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300080	112	0,227	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300100	152	0,18	0,36	0,165	0,309	G
CW	ES070	ES070MSPF010300140	32	0,19	0,36	0,165	0,309	G
CW	ES080	ES080MSPFC001	28	0,544	0,588	0,274	0,516	NG
CW	ES080	ES080MSPFC003	20	0,389	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC004	52	0,41	0,588	0,274	0,516	G

AZ	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
CW	ES080	ES080MSPFC005	28	0,451	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC006	12	0,541	0,588	0,274	0,516	NG
CW	ES080	ES080MSPFC007	40	0,377	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC008	68	0,356	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC0081	8	0,613	0,588	0,274	0,516	NG
CW	ES080	ES080MSPFC009	48	0,433	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC010	96	0,366	0,588	0,274	0,516	G
CW	ES080	ES080MSPFC013	16	0,216	0,36	0,165	0,309	G
CW	ES080	ES080MSPFC014	36	0,184	0,36	0,165	0,309	G
CW	ES080	ES080MSPFC015	24	0,207	0,36	0,165	0,309	G
CW	ES080	ES080MSPFC016	32	0,26	0,36	0,165	0,309	G
CW	ES080	ES080MSPFC017	32	0,364	0,36	0,165	0,309	NG
CW	ES091	ES091MSPF894	72	0,523	0,904	0,334	0,775	G
CW	ES091	ES091MSPF895	16	0,77	0,904	0,334	0,775	G
CW	ES091	ES091MSPF896	16	0,658	0,904	0,334	0,775	G
CW	ES100	ES100MSPFC1	8	0,348	0,588	0,274	0,516	G
CW	ES100	ES100MSPFC10	52	0,283	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC12	4	0,268	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC14	4	0,269	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC17	16	0,272	0,588	0,274	0,516	G
CW	ES100	ES100MSPFC18	8	0,316	0,588	0,274	0,516	G
CW	ES100	ES100MSPFC19	12	0,314	0,588	0,274	0,516	G
CW	ES100	ES100MSPFC20	8	0,33	0,588	0,274	0,516	G
CW	ES100	ES100MSPFC28	4	0,283	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC29	20	0,305	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC3	32	0,314	0,36	0,165	0,309	NG
CW	ES100	ES100MSPFC30	28	0,278	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC31	68	0,26	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC32	24	0,355	0,36	0,165	0,309	NG
CW	ES100	ES100MSPFC5	32	0,268	0,36	0,165	0,309	G
CW	ES100	ES100MSPFC7	12	0,315	0,588	0,274	0,516	G

AZ	SAU	subSAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
CW	ES100	ES100MSPFC8	8	0,312	0,588	0,274	0,516	G
CW	ES110	ES110MSPFEFMCp03	156	0,129	0,17	0,1	0,137	G
CW	ES110	ES110MSPFEFMCp04	104	0,126	0,17	0,1	0,137	G
CW	ES110	ES110MSPFEIMC01M2	4	0,114	0,17	0,1	0,137	G
CW	ES110	ES110MSPFEIMCp01	8	0,117	0,17	0,1	0,137	G
CW	ES110	ES110MSPFEIMCp02	4	0,121	0,17	0,1	0,137	G
CW	ES110	ES110MSPFFOMC09M3	8	0,126	0,17	0,1	0,137	G
CW	ES110	ES110MSPFMAMC01M2	4	0,103	0,17	0,1	0,137	G
CW	ES110	ES110MSPFMAMCp01	280	0,111	0,17	0,1	0,137	G
CW	ES110	ES110MSPFMAMCp02	96	0,144	0,17	0,1	0,137	NG
CW	ES110	ES110MSPFMEMC01M2	4	0,117	0,17	0,1	0,137	G

oN50+50 – Mean + 50%, oN10 – 10^{th} percentile – RC boundary, oN85 – 85^{th} percentile – G/M threshold

The Southern Part of the CWMS Sub-division: The Waters of Algeria, Morocco and Tunisia

401. All the SAUs assessed in the Southern part of the CWMS Sub-division were in good status (Tables 3.1.3.4.10. and 3.1.3.4.11., and Figure WMS 3.1.3.4.6.E). The non-good status which would correspond to the class above G/M boundary limit was not found in the assessment of the Southern part of WMS. It must be noted that the assessment was not possible at the level of the finest spatial assessment units i.e., subSAUs, as for other sub-divisions in the WMS, therefore, resulting in a less confidential assessment, given the absence of finer water bodies delineation and related water typology characterization.

402. The results of the present CI 14 assessment in the Southern part of the WMS represent only an indication of possible good/non-good status at the level of SAUs, whereby the SAUs are not set at the same level of spatial finesse. Namely, the reliability of the assessment was negatively affected by the lack of data reported by the CPs in IMAP IS, as well as the lack of finer water bodies delineation, and therefore impossibility to use the IMAP NEAT GES assessment as applied to the Adriatic Sea Sub-region.

403. Due to a less confidential assessment in this part of the WMS, some specific examples of drivers and pressures were mapped from the scientific literature, for example, the Oran harbor (Algeria) which receives the discharge of wastewater; the Ghazaouet harbour which is exposed to chemicals coming mainly from industrial activities; the shoreline such as Bousfer under the impact of the seawater desalination plant in Oran Bay and the Beni Saf desalination plant.

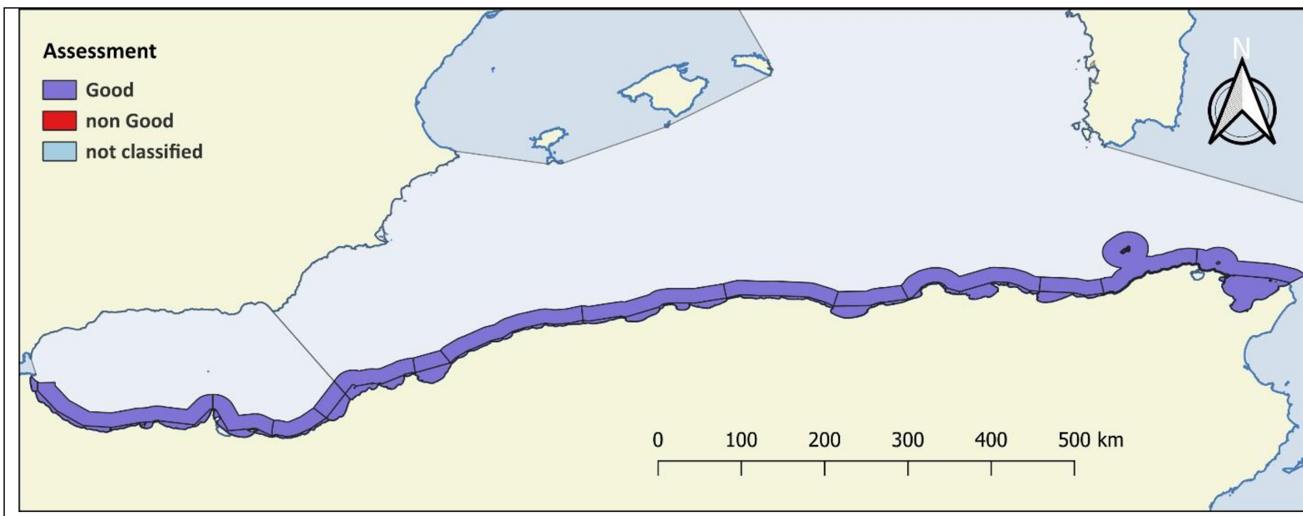

Figure WMS 3.1.3.4.6.E: The assessment results for CI 14 in the Southern Part of the CWMS.

Table 3.1.3.4.10. Results of the assessment (G_NG.oN85- the good status class corresponding to all values below the 85th percentile set as good/non-good boundary limit) of the Southern part of the CWMS provided for the Assessment Zones (AZ). Blue coloured AZs indicate good status.

Country	AZ	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_NG.oN85
MAR	CW	6035	0,450	0,449	0,674	0,277	0,637	**G**
MAR	OW	22360	0,297	0,294	0,441	0,227	0,363	**G**
DZA	CW	21189	0,361	0,319	0,478	0,205	0,592	**G**
DZA	OW	73665	0,215	0,21	0,316	0,167	0,267	**G**
TUN	CW	8859	0,278	0,229	0,344	0,162	0,477	**G**
TUN	OW	25350	0,166	0,162	0,243	0,132	0,193	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions); oN85 – 85th percentile (G/NG threshold)

Table 3.1.3.4.11. Result of the assessment (G_NG.oN85- the good class corresponding to all values below the 85th percentile set as good/non-good boundary limit based on satellite-derived Chl *a* data) of the Southern part of the CWMS provided for the Spatial Assessment Units (SAUs). Blue coloured SAUs indicate the good status.

Country	AZ	SAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
MAR	CW	MAR_W	4345	0,499	0,674	0,277	0,637	**G**
MAR	CW	MAR_E	1690	0,343	0,674	0,277	0,637	**G**
MAR	OW	MAR_W	16070	0,320	0,441	0,227	0,363	**G**
MAR	OW	MAR_E	6290	0,245	0,441	0,227	0,363	**G**
DZA	CW	ORAN_W	648	0,43	0,478	0,205	0,592	**G**
DZA	CW	ORAN_C	3913	0,311	0,478	0,205	0,592	**G**
DZA	CW	ORAN_E	2226	0,368	0,478	0,205	0,592	**G**
DZA	CW	DAHRA	1565	0,523	0,478	0,205	0,592	**G**
DZA	CW	ALGIERS	3480	0,486	0,478	0,205	0,592	**G**
DZA	CW	ALGIERS_E	1315	0,346	0,478	0,205	0,592	**G**
DZA	CW	CONSTANTINE_W	2629	0,340	0,478	0,205	0,592	**G**
DZA	CW	CONSTANTINE_C	3483	0,261	0,478	0,205	0,592	**G**
DZA	CW	CONSTANTINE_E	1930	0,389	0,478	0,205	0,592	**G**
DZA	OW	ORAN_W	4380	0,237	0,316	0,167	0,267	**G**
DZA	OW	ORAN_C	9840	0,225	0,316	0,167	0,267	**G**

Country	AZ	SAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
DZA	OW	ORAN_E	2695	0,238	0,316	0,167	0,267	**G**
DZA	OW	DAHRA	12320	0,244	0,316	0,167	0,267	**G**
DZA	OW	ALGIERS	12050	0,232	0,316	0,167	0,267	**G**
DZA	OW	ALGIERS_E	9250	0,214	0,316	0,167	0,267	**G**
DZA	OW	CONSTANTINE_W	5685	0,202	0,316	0,167	0,267	**G**
DZA	OW	CONSTANTINE_C	12310	0,183	0,316	0,167	0,267	**G**
DZA	OW	CONSTANTINE_E	5135	0,171	0,316	0,167	0,267	**G**
TUN	CW	TUN_WMS_W	811	0,334	0,344	0,162	0,477	**G**
TUN	CW	TUN_WMS_E	8048	0,273	0,344	0,162	0,477	**G**
TUN	OW	TUN_WMS_W	15335	0,159	0,243	0,132	0,193	**G**
TUN	OW	TUN_WMS_E	10015	0,176	0,243	0,132	0,193	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions); oN85 – 85th percentile (G/NG threshold)

<u>The Tyrrhenian Sea Sub-division and part of the CWMS: The Waters of Italy</u>

404. Despite likely good status assigned to the assessment zones in the waters of Italy, there are 9 out of 54 subSAUs that are in non-good status (Tables 3.1.3.4.12. & 3.1.3.4.13, and Figure WMS 3.1.3.4.7.E).

405. These 9 subSAUs are located as follows: in front of the Arno River mouth (ITCWTCD and ITOWTCD); in front of the Tiber River mouth (ITCWLZ and ITOWLZC); close to the Napoli urban agglomeration (ITOWCMC, ITOWCMD, ITCWCMC and ITCWCMD) and SW part of Sardinia Island (ITCWSDWB). The evaluation shows the impact of the Arno and Tiber Rivers, the two main rivers in the area related to their nutrient inputs' contribution. Both the CW and OW are under impacts of the Napoli metropolitan area (4,250,000 residents), whereby the propagation of their effects toward the north is evident due to the water circulation77. The local effect of the Oristano lagoon, as anthropogenically heavily impacted area, probably contributes to the weakened classification of CW in SW Sardinia Island.

406. Further to the assessment of the CW in the area of Napoli, the subSAUs ITCWCMC and ITCWCMD can be indicated as in good status. However, it must be recognized that using the 50th percentile for the development of the assessment criteria is not applicable in heavily impacted areas, such as the heavily impacted urban coastal areas. Therefore, an adjustment by using the 25th percentile of the calculated values resulted in the classification of the subSAUs ITCWCMC and ITCWCMD B in non-good status, as also recognized in the existing literature sources.

407. Given the significant quantum of data reported in IMAP IS for the waters of Italy, the assessment results provided by the application of the simplified G/M comparison based on the use of satellite-derived Chl *a* data were complemented with the assessment results derived from the application of the EQR methodology.

408. The evaluation was possible only at the subSAU level since the SAU wider area of integration does not support the evaluation of different water types which coexist in the same space. Specifically, the water type IIIW cannot be evaluated by applying the EQR methodology, but by providing a simple comparison of the measured concentrations to a threshold. Namely, a five classes scale could not be set for water type IIIW since the discrimination limit between the two contiguous Chl a annual G_mean values would not allow for proper and safe classification (Giovanardi et al., 2018). Therefore, the boundary values for WT III are based on the H/G values for WT II. Mixing the assessment methods is not statistically permitted.

409. The results of assessment by applying the EQR methodology are presented in Table 3.1.3.4.14, and Figures WMS 3.1.3.4.8.E & 3.1.3.4.9.E. The 43 subSAUs were evaluated out of the 54 subSAUs. All evaluated subSAUs were in GES with the exception of one (ITCWLZC) located in front of the Tiber River mouth indicating the influence of freshwater input of nutrients in that area. As expected, a more accurate assessment is obtained at the level of monitoring stations. The non-GES is confirmed for the Tiber River mouth, both for CW and OW which are under the impact of the Napoli metropolitan area, as well as for CW in SW Sardinia Island close to Oristano lagoon which is an anthropogenically heavily impacted area.

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[77] Iacono, R.; Napolitano, E.; Palma, M.; Sannino, G. The Tyrrhenian Sea Circulation: A Review of Recent Work. Sustainability 2021, 13, 6371. https://doi.org/10.3390/su13116371

410. The results obtained from an application of the simplified G/M comparison assessment methodology based on the use of satellite-derived Chl a data were confirmed by an application of the EQR methodology based on in situ Chl a data reported to IMAP IS, both at the level of subSAUs and monitoring stations. This confirms the accuracy of data obtained from the remote sensing for the assessment of EO5. This also encourages future decision-making regarding inclusion of an additional sub-indicator i.e., a parameter within the monitoring of CI 14. Namely, coupling of satellite-derived Chl *a* data with Chl *a* concentrations *in situ* measured would greatly enhance the IMAP monitoring and assessment.

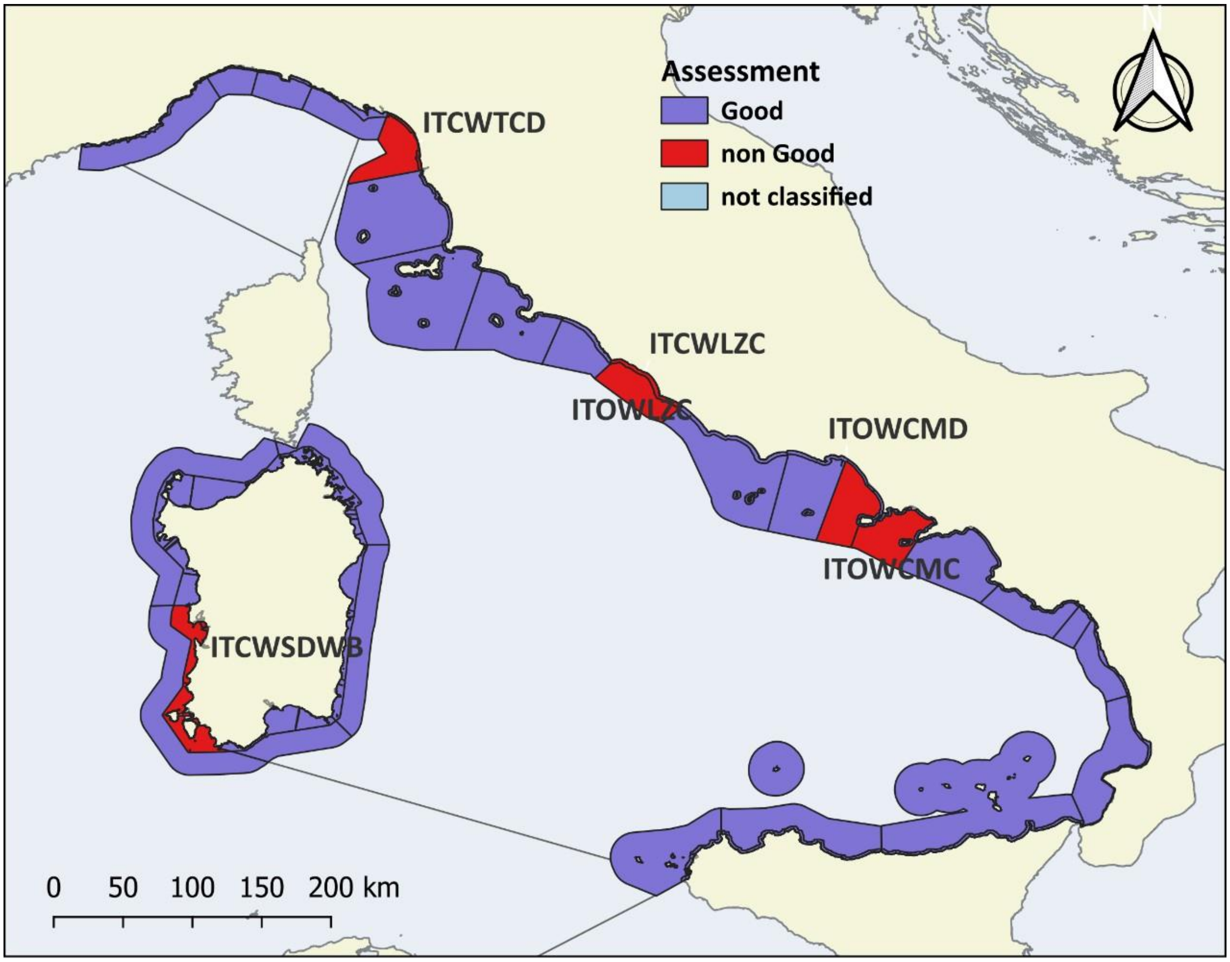

Figure WMS 3.1.3.4.7.E: The assessment results for CI 14 in the Italian waters in the Tyrrhenian Sea and the CWMS.

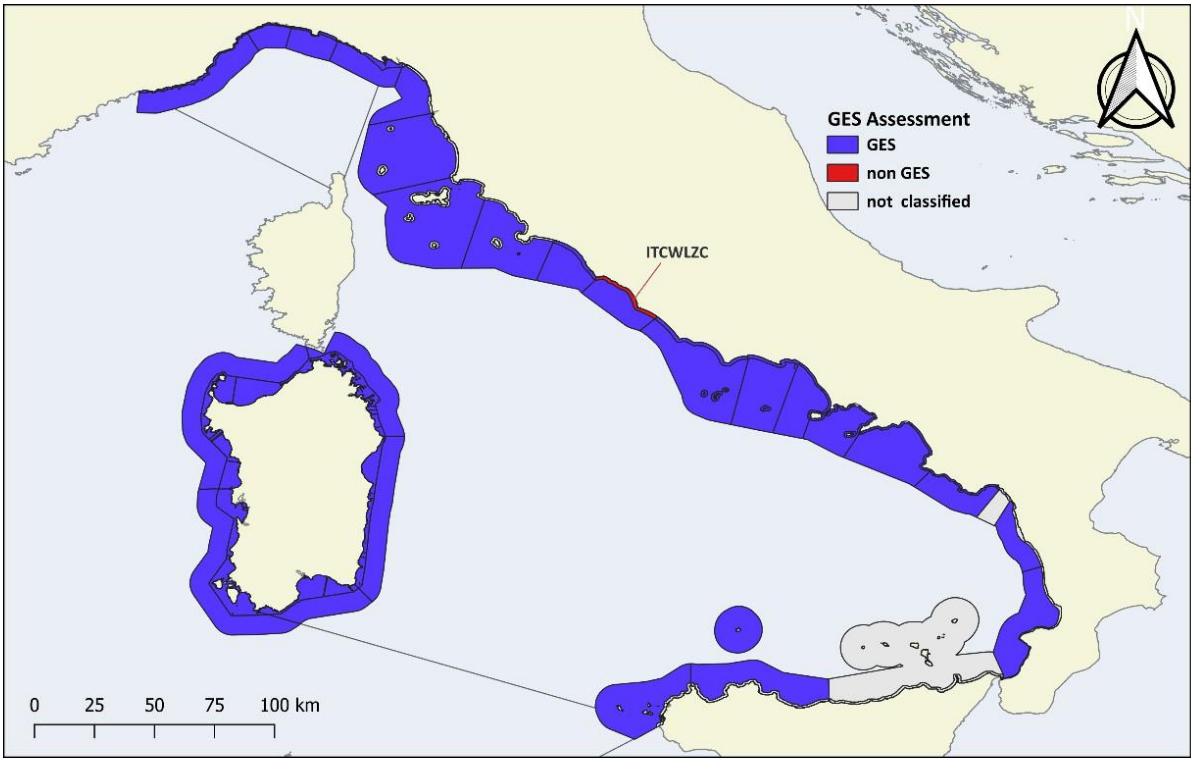

Figure WMS 3.1.3.4.8.E: Result of the GES assessment by applying the EQR methodology in the Italian waters in the Tyrrhenian Sea and CWMS at the level of subSAUs.

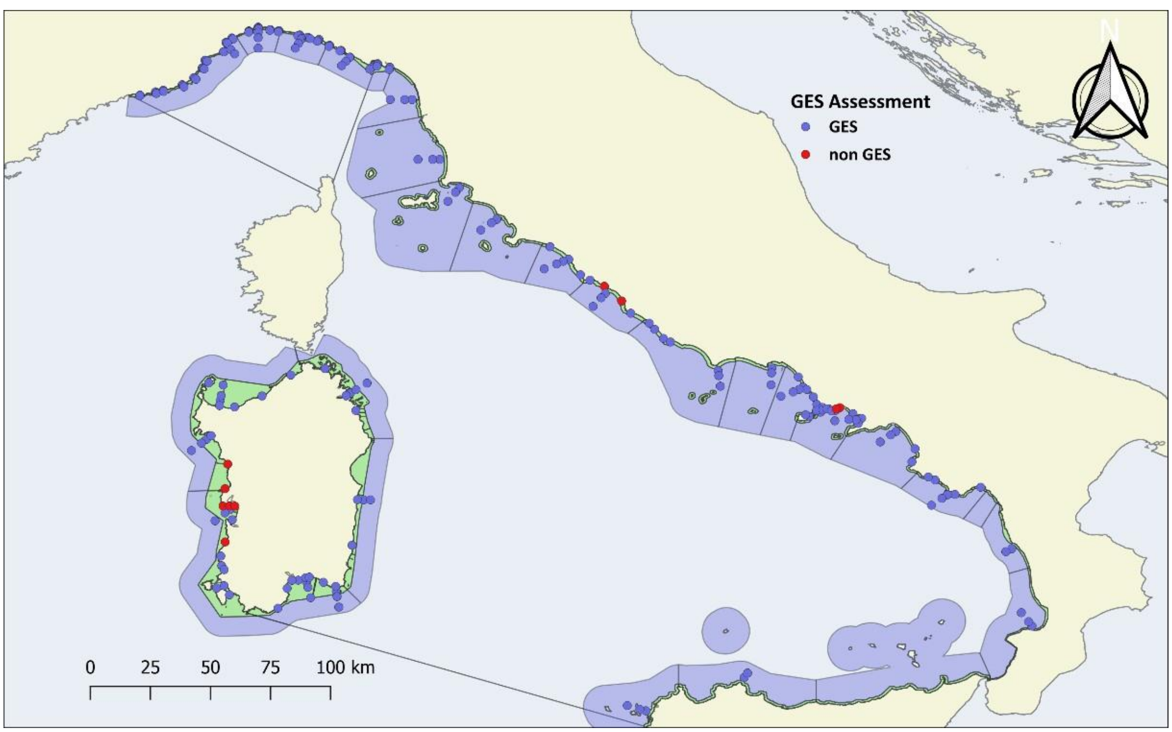

Figure WMS 3.1.3.4.9.E: Result of the GES assessment by applying the EQR method for the Italian part of the Tyrrhenian Sea and CWMS at the level of monitoring stations.

Table 3.1.3.4.12. Results of the assessment (G_NG.oN85- the good status class corresponding to all values below the 85th percentile set as the good/non-good boundary limit) for the Italian waters in the Tyrrhenian Sea and part of the CWMS provided at the level of the Spatial Assessment Units (SAUs). Blue coloured SAUs indicate good status.

AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_NG.oN85
CW	CW_ITA_ISL_E	8552	0,123	0,095	0,142	0,067	0,151	G
CW	CW_ITA_ISL_W	14080	0,141	0,104	0,156	0,079	0,169	G
CW	CW_ITA_TYR_N	5771	0,392	0,348	0,522	0,085	0,882	G
CW	CW_ITA_TYR_S	8772	0,319	0,263	0,395	0,085	1,124	G
OW	OW_ITA_ISL_E	24780	0,075	0,074	0,112	0,059	0,095	G
OW	OW_ITA_ISL_W	30285	0,084	0,083	0,124	0,068	0,098	G
OW	OW_ITA_TYR_N	85659	0,114	0,095	0,143	0,079	0,156	G
OW	OW_ITA_TYR_S	143789	0,088	0,077	0,116	0,061	0,111	G

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions); oN85 – 85th percentile (G/NG threshold)

Table 3.1.3.4.13. Result of the assessment (G_NG.oN85- the good status class corresponding to all values below the 85th percentile set as the good/non-good boundary limit based on satellite derived Chl *a* data) for the Italian waters in the Tyrrhenian Sea and part of the CWMS at the level of the finest Spatial Assessment Units (subSAUs). Blue coloured subSAUs indicate good status. Red coloured SAUs indicate non-good status.

AZ	SAU	subSAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
CW	CW_ITA_ISL_E	ITCWSDEA	2259	0,121	0,142	0,067	0,151	G
CW	CW_ITA_ISL_E	ITCWSDEB	2887	0,109	0,142	0,067	0,151	G
CW	CW_ITA_ISL_E	ITCWSDEC	3406	0,137	0,142	0,067	0,151	G
CW	CW_ITA_ISL_W	ITCWSDWA	8314	0,116	0,156	0,079	0,169	G
CW	CW_ITA_ISL_W	ITCWSDWB	5766	0,185	0,156	0,079	0,169	NG
CW	CW_ITA_TYR_N	ITCWLGA	761	0,616	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWLGB	276	0,522	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWLGC	143	0,409	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWLGD	534	0,253	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWLZD	599	0,787	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWTCA	1014	0,43	0,522	0,085	0,882	G
CW	CW_ITA_TYR_N	ITCWTCB	1311	0,176	0,522	0,085	0,882	G

AZ	SAU	subSAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
CW	CW_ITA_TYR_N	ITCWTCC	789	0,317	0,522	0,085	0,882	**G**
CW	CW_ITA_TYR_N	ITCWTCD	344	1,730	0,522	0,085	0,882	**NG**
CW	CW_ITA_TYR_S	ITCWBCA	64	0,212	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWCMA	432	0,162	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWCMB	702	0,275	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWCMC	801	0,327	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWCMD	495	1,014	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWLBA	572	0,233	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWLBB	478	0,198	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWLZA	654	0,409	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWLZB	1468	0,390	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWLZC	844	1,253	0,395	0,085	1,124	**NG**
CW	CW_ITA_TYR_S	ITCWSCA	378	0,322	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWSCB	883	0,178	0,395	0,085	1,124	**G**
CW	CW_ITA_TYR_S	ITCWSCC	1001	0,133	0,395	0,085	1,124	**G**
OW	OW_ITA_ISL_E	ITOWSDEA	8730	0,090	0,112	0,059	0,095	**G**
OW	OW_ITA_ISL_E	ITOWSDEB	10495	0,066	0,112	0,059	0,095	**G**
OW	OW_ITA_ISL_E	ITOWSDEC	5555	0,072	0,112	0,059	0,095	**G**
OW	OW_ITA_ISL_W	ITOWSDWA	15955	0,084	0,124	0,068	0,098	**G**
OW	OW_ITA_ISL_W	ITOWSDWB	14330	0,083	0,124	0,068	0,098	**G**
OW	OW_ITA_TYR_N	ITOWLGA	4859	0,126	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWLGB	3545	0,109	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWLGC	2720	0,112	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWLGD	7785	0,105	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWLZD	5559	0,141	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWTCA	13450	0,116	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWTCB	22405	0,098	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWTCC	19399	0,098	0,143	0,079	0,156	**G**
OW	OW_ITA_TYR_N	ITOWTCD	5937	0,267	0,143	0,079	0,156	**NG**
OW	OW_ITA_TYR_S	ITOWBCA	1929	0,075	0,116	0,061	0,111	**G**

AZ	SAU	subSAU	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_NG.oN85
OW	OW_ITA_TYR_S	ITOWCMA	5617	0,074	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWCMB	11225	0,094	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWCMC	6385	0,123	0,116	0,061	0,111	**NG**
OW	OW_ITA_TYR_S	ITOWCMD	7155	0,171	0,116	0,061	0,111	**NG**
OW	OW_ITA_TYR_S	ITOWLBA	10334	0,075	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWLBB	4301	0,071	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWLZA	10625	0,099	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWLZB	16280	0,100	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWLZC	5465	0,202	0,116	0,061	0,111	**NG**
OW	OW_ITA_TYR_S	ITOWSCA	12688	0,090	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWSCB	17915	0,074	0,116	0,061	0,111	**G**
OW	OW_ITA_TYR_S	ITOWSCC	33870	0,067	0,116	0,061	0,111	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions); oN85 – 85th percentile (G/NG threshold)

Table 3.1.3.4.14. Result of the assessment derived by application of the EQR methodology in the Tyrrhenian Sea and CWMS: the Waters of Italy provided at the level of the subSAUs. Blue-coloured subSAUs indicate likely in GES. Red-coloured subSAUs indicate likely in non-GES. Only the evaluated subSAUs are presented. For the present application of the EQR methodology, the following GES/non GES boundary values were applied: $EQR_{normalized}$ <0,62 – non GES; * type IIIW: GM > 0,48 non GES.

AZ	subSAU	CHL_GM/µg L^{-1}	$EQR_{normalized}$	GES/non GES
CW	ITCWCMA	0,131	1,00	G
CW	ITCWCMB	0,205	1,00	G
CW	ITCWCMC	0,529	0,74	G
CW	ITCWCMD	0,705	0,74	G
CW	ITCWLGA	0,241	0,99	G
CW	ITCWLGB	0,199	1,00	G
CW	ITCWLGC	0,247	0,97	G
CW	ITCWLGD	0,167	1,00	G
CW	ITCWLZA	0,347	0,94	G
CW	ITCWLZB	0,637	0,78	G
CW	ITCWLZC	0,994	0,53	NG
CW	ITCWLZD	0,478	0,69	G
CW	ITCWSDEA	0,116	1,00	G
CW	ITCWSDEB	0,098	1,00	G
CW	ITCWSDEC	0,045	1,00	G
CW	ITCWSDWA	0,139	0,93	G
CW	ITCWSDWB	0,624	0,83	G
OW	ITOWCMA	0,117	*	G
OW	ITOWCMB	0,151	*	G
OW	ITOWCMC	0,279	*	G
OW	ITOWCMD	0,260	0,87	G
OW	ITOWLBA	0,125	*	G
OW	ITOWLBB	0,094	*	G
OW	ITOWLGA	0,166	1,00	G
OW	ITOWLGB	0,185	*	G
OW	ITOWLGC	0,203	0,99	G
OW	ITOWLGD	0,195	0,98	G
OW	ITOWLZA	0,242	0,98	G
OW	ITOWLZB	0,251	0,95	G
OW	ITOWLZC	0,200	0,98	G
OW	ITOWLZD	0,173	0,63	G
OW	ITOWSCA	0,129	*	G
OW	ITOWSCB	0,082	*	G
OW	ITOWSDEA	0,164	*	G
OW	ITOWSDEB	0,170	*	G
OW	ITOWSDEC	0,034	*	G
OW	ITOWSDWA	0,153	*	G
OW	ITOWSDWB	0,217	*	G
OW	ITOWTCA	0,129	*	G
OW	ITOWTCB	0,138	*	G
OW	ITOWTCC	0,119	*	G
OW	ITOWTCD	0,295	0,93	G

Assessment of IMAP Common Indicator 17

Geographical scale of the assessment	The Sub-regions within the Mediterranean region based on integration and aggregation of the assessments at Sub-division levels
Contributing countries	In alphabetical order: Albania, Algeria*, Croatia. Cyprus, France, Greece. Israel, Italy, Lebanon, Malta, Montenegro. Morroco, Slovenia, Spain, Tunisia*, Türkiye (*data from the literature)
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI17. Level of pollution is below a determined threshold defined for the area and species
GES Definition (UNEP/MED WG 473/7) (2019)	Level of pollution is below a determined threshold defined for the area and species
GES Targets (UNEP/MED WG 473/7) (2019)	• Concentrations of specific contaminants below Environmental Assessment Criteria (EACs) or below reference concentrations • No deterioration trend in contaminants concentrations in sediment and biota from human impacted areas, statistically defined • Reduction of contaminants emissions from land-based sources
GES Operational Objective (UNEP/MED WG473/7) (2019)	Concentration of priority contaminants is kept within acceptable limits and does not increase

The IMAP Environmental Assessment of the Aegean and Levantine Seas (AEL) Sub-region

411. The assessment of the of the Aegean and Levantine Seas (AEL) Sub-region is provided by using the CHASE+ (Chemical Status Assessment Tool) methodology for the Aegean Sea (AEGS) Sub-division and the Levantine Sea (LEVS) Sub-division.

412. Data were grouped per parameter, matrix, station location and sampling year. In the cases where a station was sampled during various years, and/or there were more than one data point for the station at a certain year, the average concentrations (i.e., arithmetic mean) were calculated and used in the CHASE+ assessment. Average concentrations were also used in the NEAT application in the ADR.

CHASE+ (Chemical Status Assessment Tool) methodology was tested and then applied for assessment of IMAP CI 17 further to its application by the European Environmental Agency (EEA) to assess environmental status categories for the European Seas (Andersen et al. 2016, EEA 2019)[78]. This assessment methodology uses just one threshold, compared to the two used in the traffic light system.
The first step in this tool is to calculate the ratio $C_{measured}/C_{threshold}$ (C is the concentration) called the contamination ratio (CR) for each assessment element in a matrix. Then a contamination score (CS) is calculated as follows[79]:

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

where n is the number of elements assessed for each matrix.
Based on the contamination ratio (CR) or on contamination score (CS), the elements are assessed. In line with the results of assessments, the stations/areas can be classified into non problem area (NPA) and problem area (PA), by applying 5 categories: NPAhigh (CR or CS=0.0-0.5), NPAgood (CR or CS =0.5-1.0), PAmoderate (CR or CS =1.0-5.0), PApoor (CR or CS =5.0-10.0) and PAbad (CR or CS > 10.0). NPA areas are considered in GES while PA areas are considered as non-GES. The boundary limit of 1 between GES and non-GES is based on the choice that only values that are equal or below the threshold are considered in GES.
Both methodologies i.e. the NEAT and CHASE+ 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 whole area is described as not in GES. This decision rule is very stringent. An additional approach is based on setting a limit, such as a proportion (%) of elements, that should each be in GES for the area to be classified as in GES. Within the present work it was recommended that if at least 75% of the elements are in GES, the station should be considered in GES. The same recommendation was given when assessing certain areas or the whole Sub-region or Sub-division i.e., when 75% of the stations are in GES for a certain parameter, the whole Sub-region is in GES for this particular parameter and not the overall status of the Sub-region or Sub-division. This more lenient approach for the GES-non GES decision rule compensates for stricter thresholds applied within the CHASE+ methodology. This approach was discussed and approved by the Meeting of CorMon Pollution Monitoring, 2022, and therefore it is also applied in the 2023 MED QSR assessments.

a) The Aegean Sea (AEGS) Sub-division

Available data

413. Data for the AEGS were available only for the sediment matrix. Table 4.3.1.1.a summarizes the available data. Trace metals (TM – Cd, Hg and Pb) in sediments were reported for 32 stations by Türkiye (2018), while data for Cd and Pb were reported for 34 stations by Greece, i.e. for 5 stations in 2019 and 29 stations in 2020. In addition, Pb data were available for 28 stations located in the area of the Saronikos Gulf and Elefsis Bay for 2018 (Karageorgis et al. 2020a, Karageorgis et al. 2020b). Individual concentrations of each of the 16 required PAHs were reported by Greece (11 stations in 2019 and 10 stations in 2020) as well as for Σ_{16} PAHs. Data for Σ_5 PAHs[80] were reported by Türkiye for 32 stations

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[78] Andersen, J.H., Murray, C., Larsen, M.M., Green, N., Høgåsen, T., Dahlgren, E., Garnaga-Budrė, G., Gustavson, K., Haarich, M., Kallenbach, E.M.F., Mannio, J., Strand, J. and Korpinen, S. (2016) Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. Environmental Monitoring and Assessment 188(2), 115.
EEA (2019) Contaminants in Europe's Seas. Moving towards a clean, non-toxic marine environment. EEA Report No 25/2018.
[79] The contamination sum minimizes the problem of 'dilution' of high values when several substances from an area are analyzed, and takes to some extent possible synergistic effects of contaminants into account by using square root of 'n' instead of 'n'.
[80] 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. Turkiye reported also the concentration of Σ_4PAHs that is the sum of the first 4 compounds in Σ_5 PAHs. Both Σ5 PAHs and Σ4 PAHs are non-mandatory parameters for CI 17, whereby Σ16 PAHs, is a mandatory parameter.

sampled in 2018. Concentrations of total PCBs (Σ_7 PCBs[81]), individual concentrations for each PCB congener, Lindane and Dieldrin were reported for 31 stations by Türkiye (2018).

414. Data were compiled from the IMAP-IS, as reported by 31st October 2022. As mentioned, additional data from the scientific literature were also used (Karageorgis et al., 2020 a,b).

Table 3.1.4.1.1.a. Data available for the assessment of the AEGS sub- division. Only data for the sediment matrix were available.

Source	IMAP-File	Country	Sub-division	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin
Sediment												
IMAP_IS	446	Turkiye	AEGS	2018	32	32	32	0	32	31	31	31
IMAP_IS	652	Greece	AEGS	2019	5	0	5	11	11	11	0	0
IMAP_IS	652	Greece	AEGS	2020	29	0	29	10	10	10	0	0
Lit[1]		Greece	AEGS	2018	0	0	28	0	0	0	0	0

[1]Karageorgis et al, 2020 a,b

415. Based on the available data, the assessment was performed for TM, Σ_{16} PAHs and Σ_7 PCBs in sediment. In addition, the AEGS was assessed based on Σ_5 PAHs as well. This is not a mandatory parameter but was included in the assessment given significant more data available for Σ_5 PAHs compared to Σ_{16} PAHs (53 vs 21 data points, respectively) encompassing a larger area of the AEGS. Therefore, we made an exception to possibly increase confidence of the assessment. When possible, a qualitative description was provided for the additional parameters or stations.

Setting the GES/non-GES boundary value/threshold for the CHASE+ application in the AEGS.

416. The thresholds used for the CHASE+ assessment methodology were the updated sub-regional BACs [82]. Table 4.3.1.2.a summarizes the thresholds values, the same ones used in the assessment of LEVS subdivision within the Aegean Levantine Seas Sub-region (AEL).

Table 3.1.4.1.2.a. Summary of the threshold values used in present pilot application for GES assessment of the Levantine and Aegean Seas sub-divisions. MedEACs are presented for comparison.

	AEL_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	118	161	1200
Hg	47.3	75	150
Pb	23511	22500	46700
Σ_{16} PAHs	41	32	4022*
Σ_5 PAHs^	17.2	31.8	
Σ_7 PCBs	0.19	0.40	68+

* 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 are not set by Decision IG.22/7, therefore the BAC value for Σ_5 PAHs is calculated as a sum of the individual BAC values as provided for the 5 PAHs compounds.

[81] PCBs congeners 28,52,101,118,132,153,180
[82] MED_BACs were adopted by 2017 COP, while the use of sub-regional BACs within the preparation of the 2023 MED QSR was approved by the Meeting of CorMon Pollution held on 27 and 30 May 2022

Integration of the areas of assessment for the AEGS.

417. The locations of the sampling stations are presented in Figures AEGS 3.1.4.1.1.C - AEGS 3.1.4.1.4.C.

418. The locations of the sampling stations were sorted by group of contaminants. As explained above, data were available only for the sediment matrix. Data for TM, PAHs were reported by Türkiye at each of the 32 sampling stations, as well as for PCBs in sediments at 31 out of the 32 sampling stations. Data for Cd and Pb were reported by Greece at 34 stations and for PAHs at 15 of these stations. In addition, data for 6 stations with only PAHs concentration were reported. Additional data from the literature (Karageorgis et al., 2020) for Pb only were available for 28 stations.

419. 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. Twenty-one stations in Türkiye were coastal and 11 belonged to the offshore zone. In Greece, 35 stations were classified as coastal and 31 as offshore. 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 AEGS. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment of the Aegean Sea Sub-division. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

Results of the CHASE+ Assessment of CI 17 in the Aegean Sea Sub-division.

420. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the updated sub-regional AEL_BACs (Table 3.1.4.1.2.a). CHASE+ methodology in the AEGS was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation was possible only for TM in sediments, and only partially. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 3.1.4.1.3.a. summarizes the results of the CHASE+ application.

Table 3.1.4.1.3.a. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the new AEL_BACs..

CHASE+		**Blue High**	**Green Good**	**Yellow Moderate**	**Brown Poor**	**Red Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	94*	23	40	18	11	2
% from total number of data points		*24*	*43*	*19*	*12*	*2*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	21	3	6	3	4	5
% from total number of data points		*14*	*29*	*14*	*19*	*24*
Σ_5 PAHs	53	19	9	7	10	8
% from total number of data points		*36*	*17*	*13*	*19*	*5*
Σ_7 PCBs	31	17	5	3	3	3
% from total number of data points		*55*	*16*	*10*	*10*	*10*

*32 stations reported all the 3 TMs, 34 only Cd and Pb and 28 only Pb.

Assessment of Trace metals in sediments of the AEGS.

421. The 16 stations classified as non-GES (out of the 31) were distributed in the northern and central part of the AEGS. Most stations were located in bays (Table 3.1.4.1.1.a; Figure AEGS 3.1.4.1.1.C), where usually the water exchange is slower than in open waters, promoting accumulation of land-based source contaminants. The 67 stations classified in GES (high and good status) were distributed along the whole AEGS sub-division (Figure AEGS 3.1.4.1.1.C).

422. Only for 32 stations data were reported for all the 3 TMs. For 34 stations data were reported only for Cd and Pb and for 28 stations only for Pb. A detailed examination of the CRs for the individual metals, found that mainly Pb and to a lesser degree Cd, contributed to the classification of 2 out of 94 stations, as in bad status. One was located in the inner Saronikos Gulf (CW36) and one in the Northern Aegean (CW54) (Figure AEGS 3.1.4.1.1.C). Eleven stations were classified as in poor status: 8 in the Elfsis Bay and inner Saronikos Gulf, due to elevated Pb concentrations, one (CW32) in the Elfsis Bay due to Pb and to a lesser degree Cd. Two stations, i.e. ALISW2, CABSSW1, in the vicinity of Aliaga and Yenisakran, were classified as poor mainly due to elevated Hg concentrations. Using CS, 18 stations were classified as moderate and they were distributed across the AEGS. No specific, demarcated area could be classified as non-GES based on these 18 stations. The 63 remaining stations were classified in the high and good statuses (in-GES). Six stations for which data were reported by Türkiye, defined as reference stations, were in the high status (2 stations) and in the good status of classification (4 stations).

423. Fifteen out of the 31 stations classified as non-GES were located in the Elfsis Bay and inner Saronikos Gulf, known to be impacted by anthropogenic activities . This area is the seaward boundary of the metropolitan areas of Athens and Piraeus port, hosting 1/3 of the current Greek population (3.2 million people; Census 2011). More than 40% of the Greek industries are located in the coastal area of the Elefsis Bay, including some of the biggest plants of the country, such as oil refineries, steel and cement industries, and shipyards (Karageorgis et al., 2020 and references therein). Increased concentrations of trace elements in this area, resulting from the discharges of domestic and industrial effluent, have been documented since the late 1970s. The major sources of pollution were identified as the Psyttaleia wastewater treatment plant, a fertilizer plant- operating in the Inner Saronikos Gulf until 1999, steel mills and shipyards in the Elefsis Bay. The contamination found in the bay has resulted in the accumulation of metals in mussel tissues, which followed a spatial gradient related to land-based sources. Karageorgis et al. 2020 found maximal Pb concentrations (in conjunction with Cu, Zn and As) in the Elefsis Bay and the Psyttaleia Island region, with N-S decreasing trends. Minor Pb enrichment was recorded at the deeper sector of the Outer Saronikos Gulf. A temporal (1999–2018) decrease in metal concentrations was found for 2 out of the 14 stations sampled in the Elefsis Bay. Several polluting industries have ceased their operation during the last decade. Therefore, the decreasing trend in the most industrialized part of the study area is connected to the reduction of metal discharges in the coastal environment. Furthermore, environmental policy enforcement combined with technological improvements by big industrial polluters, such as the steel-making industry have contributed to the improvement of sediment quality.

424. The 28 stations reported by Karageorgis et al. (2020 a,b) were located in a very limited area of the Saronikos and Elfesis Gulf, that correspond to about 0.5% of the total AEGS area. Moreover, they reported only the concentrations of Pb in sediments. This emphasis of a small area could introduce a bias in the whole sub-division assessment. Therefore, for comparison, the assessment was performed without taking these stations into consideration. The assessment found that 20% of the stations were in high status, 53% in good status, 20% in moderate status, 4% in poor status and 3% in bad status. In this case, 73% of the stations were classified in-GES, and the status of the AEGS remains marginally non-GES, therefore the exclusion of these stations did not change the overall assessment of the sub-division.

425. The whole AEGS is classified as non-GES (Figure AEGS 3.1.4.1.1.C). In brief, only 67% of the stations were in GES for TM in sediments. Therefore, by applying the decision rule agreed for CHASE + assessment methodology which recommends that only if at least 75% of the elements are in GES, the area should be considered in GES, the whole AEGS is classified as non-GES regarding TM in sediments. However, this is a result of the contribution from only 2 limited affected areas (1) the Elfesis Bay and inner Saronikos Gulf, and 2) the two stations near Aliaga and Yenisakran. When data from these affected areas, that constitute less than 1% of the AEGS, are not taken into account, then 82% of the stations (65 out of 79 stations) are in GES, and the AEGS sub-division can be classified as in GES. These 79 stations are distributed evenly across the AEGS sub-division, providing a good coverage of the sub-division.

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

426. Σ_{16} PAHs in sediments: There were only 21 stations with data for Σ_{16} PAHs in sediments, and data for all of them were reported by Greece. It can be seen (Table 3.1.4.1.1.; Figure AEGS 3.1.4.1.2.C) that the stations located offshore are in-GES (8 stations, 38% of total stations), while the stations located in enclosed areas, except one, are classified as non-GES (12 stations, 57% of total stations). However, this is based on data from only 21 stations, which is not enough for a confident assessment. Additional data are needed to improve the assessment and to better delimit possible non-GES areas.

427. Σ_5 PAHs in sediments: There were only 21 stations with data for Σ_{16} PAHs in sediments, however Türkiye reported data for Σ_5 PAHs[83] for 32 stations. Although Σ_5 PAHs is not a mandatory parameter, the assessment based on it was performed due to significant more data availability for Σ_5 PAHs compared to Σ_{16} PAHs (53 vs 21 data points, respectively) encompassing a larger area of the AEGS. Therefore, an exception was made in order to increase confidence of the assessment.

428. For the stations with available data for Σ_{16} PAHs, the assessment performed using Σ_5 PAHs was identical to the assessment based on Σ_{16} PAHs (Figure AEGS 3.1.4.1.2.C), except for one station, CW41 that was now classified as in good status instead of in moderate status. Out of the 53 available stations, about half (28 stations, 53% of the total stations) were classified in-GES (high and good statuses) for Σ_5 PAHs in sediments, and about half (25 stations, 47% of the total stations) as not in-GES (moderate, poor and bad statuses) (Figure AEGS 3.1.4.1.3.C).

[83] Σ_4 PAHs was also reported, but it was decided to assess the status based on Σ_5 PAHs given it encompasses all 4 PAHs; Both Σ5 PAHs and Σ4 PAHs are non-mandatory parameters for CI 17, whereby Σ16 PAHs, is a mandatory parameter.

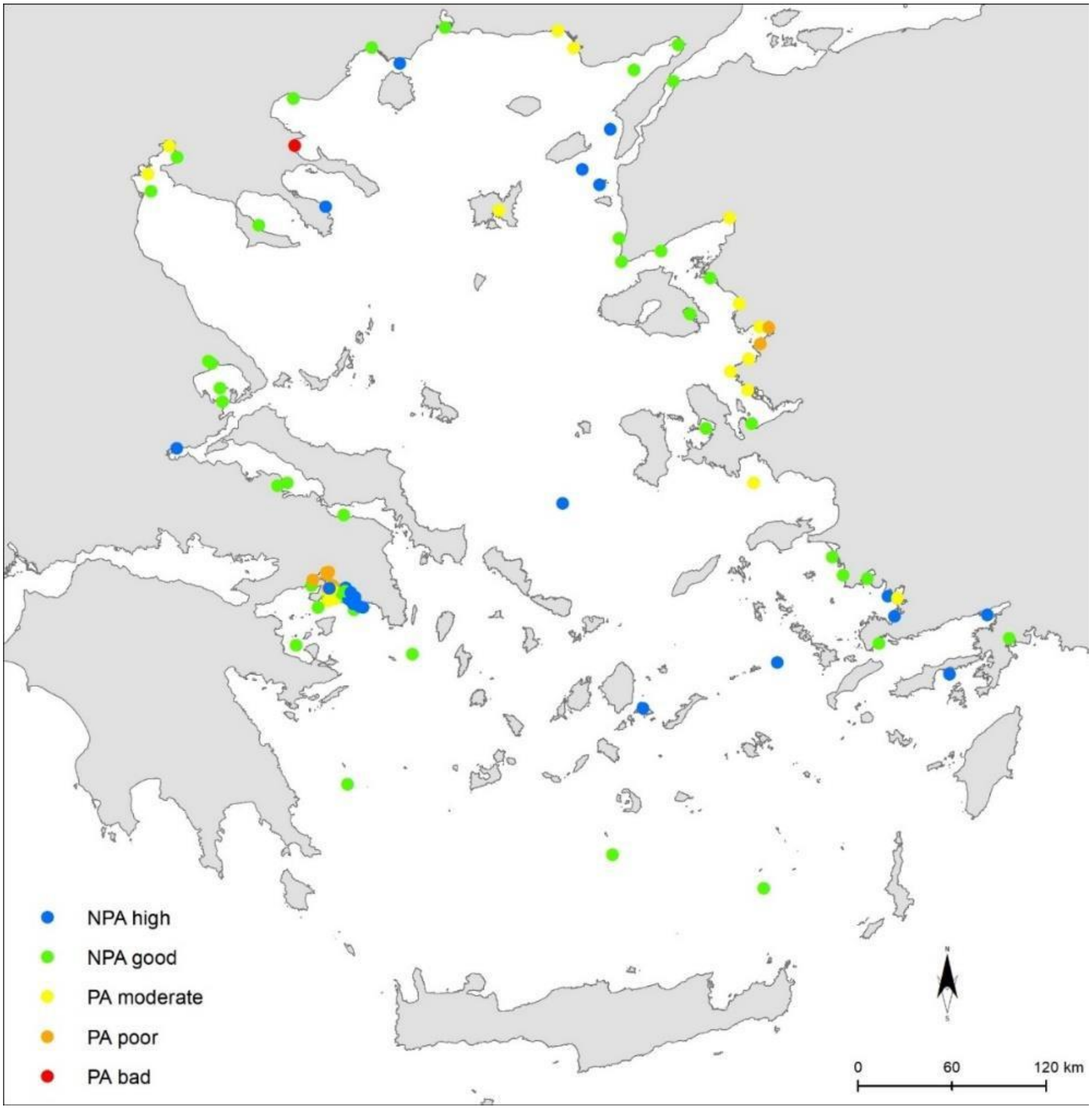

Figure AEGS 3.1.4.1.1.C. Results of the CHASE+ assessment methodology to assess the environmental status of TM in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations 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.

429. Therefore, there are indications that AEGS might be classified as non-GES regarding Σ_5 PAHs in sediments. However, only 2 limited affected areas were identified in non-GES, similarly to the assessment of TM in sediments: 1) the Elfsis Bay and inner Saronikos Gulf and 2) the area encompassing the coast around Kucukkoy, Dikili, Candarli, Aliaga, and Yenisakran. The southern part of the AEGS can be classified as in GES, as all stations, except the two, were in high and good statuses (Figure AEGS 3.1.4.1.3.C).

430. It was not possible to classify the AEGS sub-division regarding data for Σ_{16} PAHs in sediments (Figure AEGS 3.1.4.1.2.C.). There are indications that the offshore zone is in GES while the enclosed areas might be found as non-GES. Additional data are needed to improve the assessment and delimit possible affected areas.

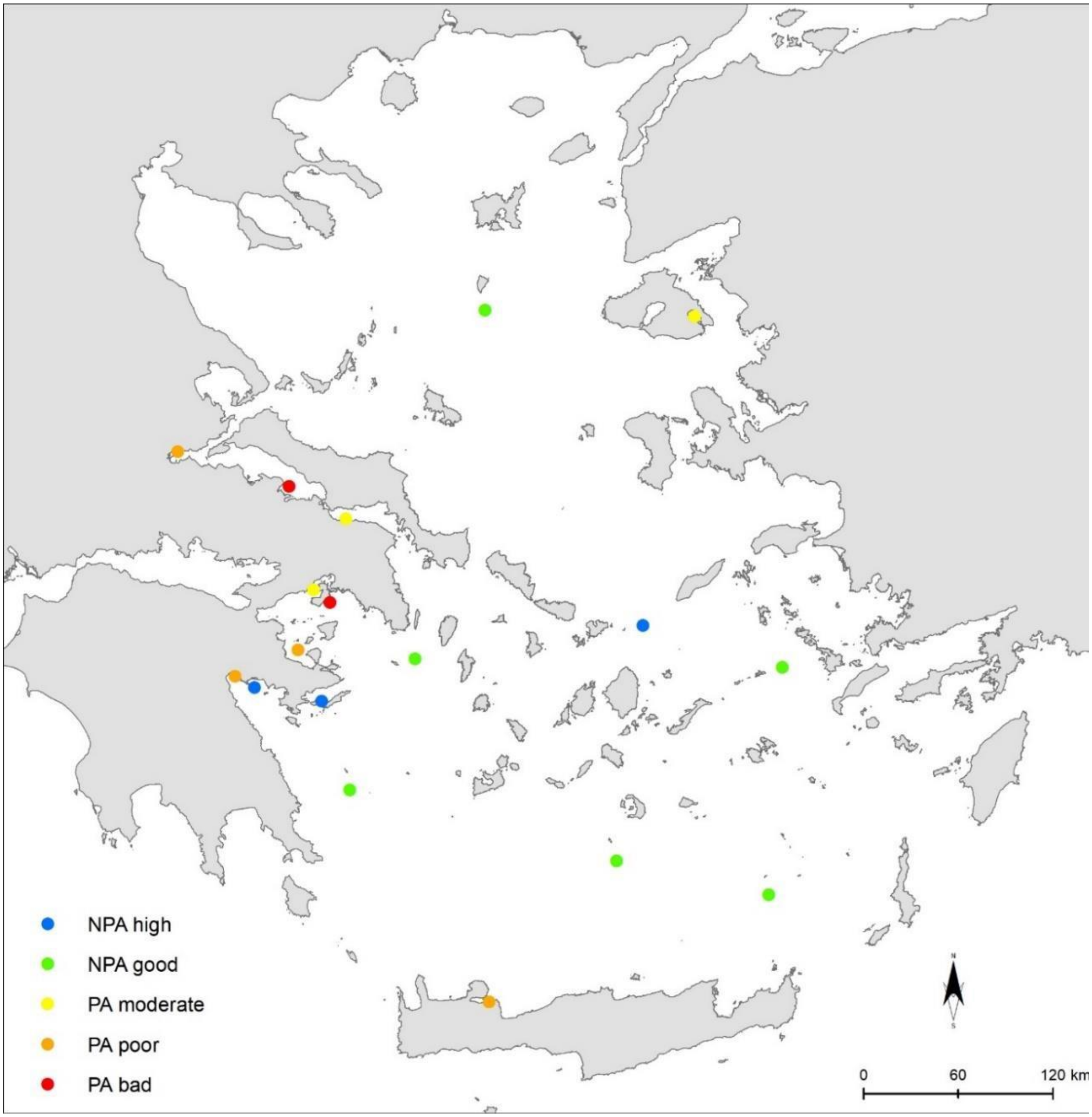

Figure AEGS 3.1.4.1.2.C. Results of the CHASE+ assessment methodology to assess the environmental status of Σ_{16} PAHs in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); 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.

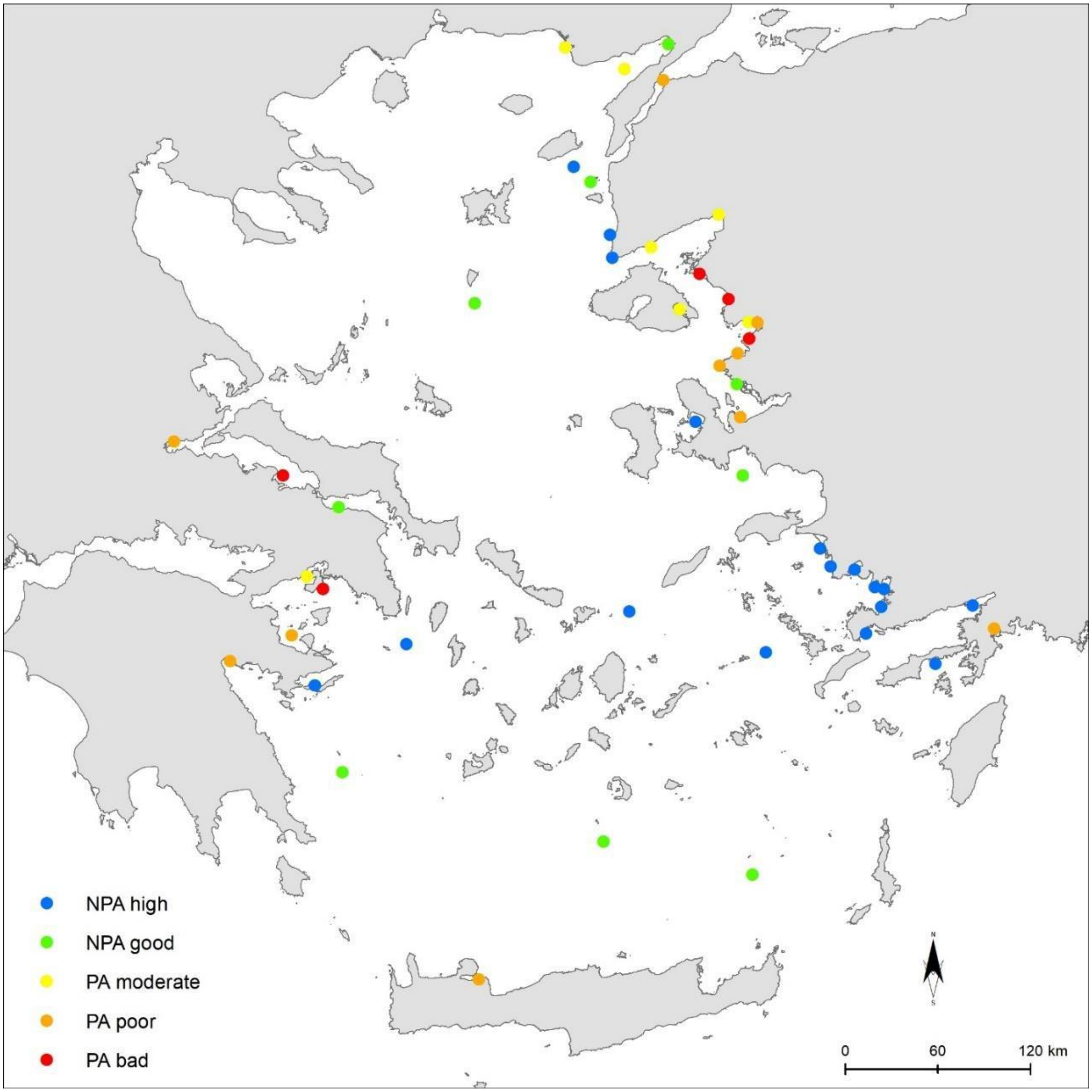

Figure AEGS 3.1.4.1.3.C. Results of the CHASE+ assessment methodology to assess the environmental status of Σ_5 PAHs in sediments in the AEGS, using AEL_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. 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 Σ_7 PCBs in sediments of the AEGS

431. Data on PCBs were reported only by Türkiye. The northern (except station D7 in the Dardanelles Strait) and southern part of the coast were in GES regarding Σ_7 PCBs in sediments (22 stations, 71% from the total number of stations) (Figure AEGS 3.1.4.1.4.C). The mid area, encompassing the coast around Aliaga, Yenisakran and Candarli was classified as non-GES, in particular the stations inside the bay (9 stations, 29% from the total number of stations) which determined this area as an affected one. There are not enough data to classify the whole AEGS sub-division regarding data reported for Σ_7 PCBs in sediments.

432. The AEGS sub-division could not be classified regarding assessment of Σ_7 PCBs in sediments due to lack of data. An affected, non-GES area was identified in the coast around Aliaga, Yenisakran and Candarli. The north-eastern and south-eastern coast were in-GES regarding assessment of data on Σ_7 PCBs in sediments.

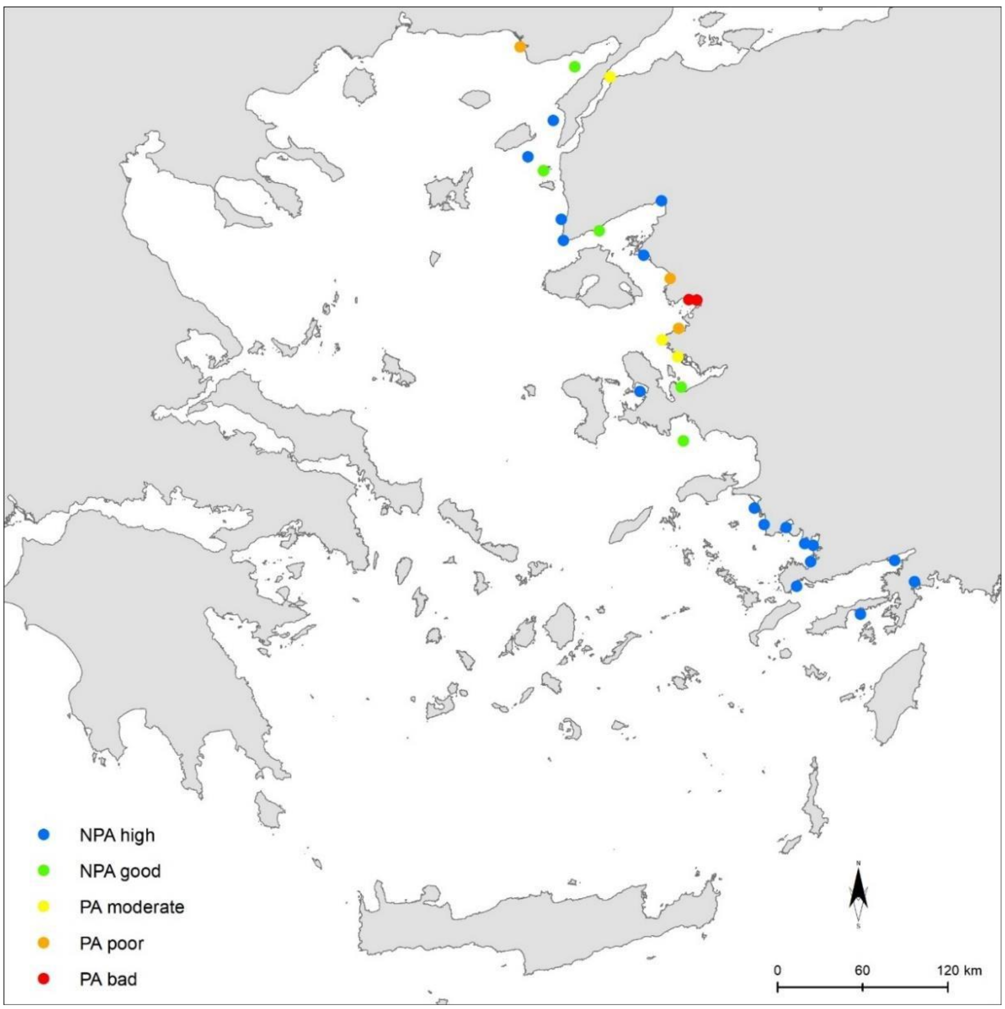

Figure AEGS 3.1.4.1.4.C. Results of the CHASE+ assessment methodology to assess the environmental status of Σ_7 PCBs in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); 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.

Organochlorinated contaminants other than PCBs in sediments of the AEGS

433. Data for Organochlorinated contaminants were reported only by Türkiye. Dieldrin in all 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 an average and median concentration of 0.036 and 0.013 µg/kg dry wt, respectively. 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.

434. Therefore, the AEGS sub-division could not be classified regarding assessment of Organochlorinated contaminants other than PCBs in sediments due to lack of data.

b) The Levantine Sea Sub-division (LEVS)

Available data.

435. The available data for the assessment of the Levantine Sea are presented in Table 3.1.4.1.1.b. Data were available for TM (Cd, Hg and Pb) in sediments as available for Cyprus, Greece, Israel, Lebanon, Türkiye; TM in the fish *M. barbatus* as available for Cyprus, Israel, Lebanon, Türkiye; PAHs in sediments as available for Greece, Israel, Lebanon and Türkiye; some PAH compounds for *M. barbatus* as available for Cyprus and Türkiye; organochlorinated contaminants in sediments as available for Lebanon and Türkiye; and organochlorinated contaminants in *M. barbatus* as available for Cyprus, Lebanon and Türkiye.

436. No data were available for the southern coast nor for the southern offshore area of the LEVS.

437. The most data were available for TM in sediments. There were 136 data points in the database, with 135 data points for Cd, 133 for Hg and 136 for Pb. Data for TM in *M. barbatus* were as follows: 83 data points for Cd, 85 data points for Hg and 53 data points for Pb. Data for PAHs in sediments were available for 112 stations. Data on total 16 PAHs (Σ_{16} PAHs) in sediments were reported for 75 stations while for 33 stations data available were for Σ_5 PAHs[84]. Data for some of the PAHs compounds in *M. barbatus* were reported in 18 specimens. Data for total PCBs (Σ_7 PCBs[85]) in sediments were available for 52 stations. Data for Lindane and Dieldrin in sediments were available for 33 stations. In *M. barbatus* data for Σ_7 PCBs, Lindane, Dieldrin, Hexachlorobenzene and p,p'DDE were available in 12 samples.

438. Data were compiled from the IMAP-IS, as reported by 31st October 2022. As mentioned, additional data from the scientific literature were also used (Astrahan et al. 2017, Ghosn et al, 2020).

[84] 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. Turkiye reported also the concentration of Σ_4PAHs that is the sum of the first 4 compounds in Σ_5 PAHs. Both Σ_5 PAHs and Σ_4 PAHs are non-mandatory parameters for CI 17, whereby Σ_{16} PAHs, is a mandatory parameter.
[85] PCBs congeners 28,52,101,118,132,153,180

Table 3.1.4.1.1.b. Data availability by country and year for the assessment of EO 9 – CI 17 (contaminants) in the Levantine Sea Sub-division (LEVS) Sub-division of AEL, as available by up to 31st Oct 2022.

Source	IMAP_File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin
Sediment											
IMAP_IS	497	Cyprus	2017	7	7	7					
IMAP_IS	497[86]	Cyprus	2018	4	4	4					
IMAP_IS	634	Cyprus	2019	2	2	2		2			
IMAP_IS	634	Cyprus	2020	6	6	6		6			
IMAP_IS	634	Cyprus	2021	6	5	6					
IMAP_IS	652	Greece	2019	3	0	3	4*	4			
MED POL		Israel	2017	14	14	14					
IMAP_IS	585	Israel	2018	11	11	11					
IMAP_IS	531[87]	Israel	2019	16	16	16					
IMAP_IS	588	Israel	2020	14	14	14					
Lit[1]		Israel	2013&				52*	52			
IMAP_IS	118	Lebanon	2019	17	17	17	19		19		
Lit[2]		Lebanon	2017	2	3	3					
IMAP_IS	445	Türkiye	2018	33	33	33		33	33	33	33
M. barbatus											
IMAP_IS	636	Cyprus#	2020	6	6	6		6	8	8	8
IMAP_IS	636	Cyprus#	2021	8	8	8		6	4	4	4
IMAP_IS	585[88]	Israel	2018	13	13	0					
IMAP_IS	410	Israel	2019	7	7	0					
IMAP_IS	588	Israel	2020	10	12	0					
IMAP_IS	152	Lebanon	2019	14	14	14		6	3		
IMAP_IS	323	Türkiye	2015	25	25	25	25^				

[1]Astrahan et al. 2017; [2]Ghosn et al, 2020; * Data for individual concentrations for all congeners are available; ^Data for 8 congeners available for 25 samples in 5 stations; # Additional data available for Hexachlorobenzene and DDE(p,p'). & Data from 2013 were used because no newer data were available; In addition, the stations are located offshore, at depths deeper than 100 m, so that temporal changes are not expected.

439. Based on the available data, the assessment was performed for TM, Σ16 PAHs and Σ7 PCBs in sediment and for TM in M. barbatus. In addition, the LEVS was assessed regarding Σ5 PAHs as well. This is not a mandatory parameter, but it was included in the assessment given data availability for Türkiye, that increased the coverage of the assessment over a larger area of the LEVS. Therefore, an exception was made to possibly increase confidence of the assessment. When possible, a qualitative description was provided for the additional parameters or stations.

Setting the GES/non-GES boundary value/threshold for the CHASE+ application in the LEVS.

440. The thresholds used for the CHASE+ assessment methodology were the updated sub-regional BACs .If the Sub-regional BAC was not available, the regional MED_BACs were used as thresholds in the present assessment. Table 3.1.4.1.2.b. summarizes the thresholds values, the same ones used in the assessment of AEGS sub-division within the Aegean Levantine Seas Sub-region (AEL).

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[86] Replaced IMAP file 125
[87] Replaced IMAP file 410
[88] Replaced IMAP file 71

Table 3.1.4.1.2.b. Summary of the threshold values used in present pilot application for GES assessment of the Levantine and Aegean Seas sub-divisions. MedEACs are presented for comparison.

	AEL_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	118	161	1200
Hg	47.3	75	150
Pb	23511	22500	46700
Σ_{16} PAHs	41	32	4022*
Σ_5 PAHs^	17.2	31.8	
Σ_7 PCBs	0.19	0.40	68+
***M. barbatus*, µg/kg wet wt**			
Cd	7.2	7.8	50
Hg	67.4	81.2	1000
Pb	27	36.6	300

* 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 are not set by Decision IG.23/6, therefore the BAC value for Σ5 PAHs is calculated as a sum of the individual BAC values as provided for the 5 PAHs compounds.

Integration of the areas of assessment for the LEVS

441. The locations of the sampling stations are presented in Figures LEVS 3.1.4.1.1.C– LEVS 3.1.4.1.5.C.

442. The locations of the sampling stations were sorted by group of contaminants. TM, PAH and Organochlorinated contaminants in sediments for Lebanon and Türkiye were determined in samples collected from the same stations at the same date. PAHs in sediments from Israel were collected from stations different from the stations sampled for TM in sediments and at a different date. The sampling sites for the fish *M. barbatus* in Lebanon, Israel and Türkiye were located in the areas close to the sediment samples, but did not encompass one specific station, only a fishing area. In Cyprus, one of the two sampling sites for the fish *M. barbatus* was located close to sediment stations and one far from sediment stations.

443. 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. The sampling stations for TM in sediments for Israel can be considered all coastal, except 2 stations that can be considered offshore stations. In Lebanon, 5 out of 20 stations can be considered offshore stations. In Cyprus, 8 stations can be considered coastal and 3 stations as offshore. In Greece, 1 station was coastal and 3 stations were offshore stations. In Türkiye, four stations can be considered offshore stations. The stations in Iskenderun Bay, Antalya Bay, the bay off Mersin and Erdemli and inlets can be considered coastal stations. No stations with data for PAHs in sediments in Israel can be considered coastal i.e. there were 52 stations that can be considered offshore stations. The grouping of stations for PAHs and organochlorinated contaminants in sediments for Lebanon and Türkiye was the same as for TM. TM in *M. barbatus* were determined in samples collected from stations that can be considered offshore stations in Israel, Cyprus and Lebanon. In Türkiye all stations can be considered coastal, with exception of one station that can be classified as offshore station. 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 LEVS. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment of the Levantine Sea Sub-division. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

Results of the CHASE+ Assessment of CI 17 in the Levantine Sea Basin

444. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the updated sub-regional AEL_BACs (Table 3.1.4.1.2.b.). CHASE+ methodology in the LEVS was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation was possible only for TM in sediments and in *M. barbatus*. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 3.1.4.1.3.b. summarizes the results of the CHASE+ application.

Table 3.1.4.1.3.b. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the new AEL_BACs.

CHASE+		**Blue High**	**Green Good**	**Yellow Moderate**	**Brown Poor**	**Red Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
*Cd, Hg, Pb	83	19	38	24	2	0
% from total number of data points		*23*	*46*	*29*	*2*	*0*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	75	45	16	7	3	4
% from total number of data points		*60*	*21*	*10*	*4*	*5*
Σ_5 PAHs	97	75	13	8	1	0
% from total number of data points		*77*	*14*	*8*	*1*	*0*
Σ_7 PCBs	52	18	20	3	4	7
% from total number of data points		*35*	*38*	*6*	*8*	*13*
M. barbatus	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	15	11	3	0	1	0
% from total number of data points		*73*	*20*	*0*	*7*	*0*

* Without anomalous Cd concentrations for Cyprus

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

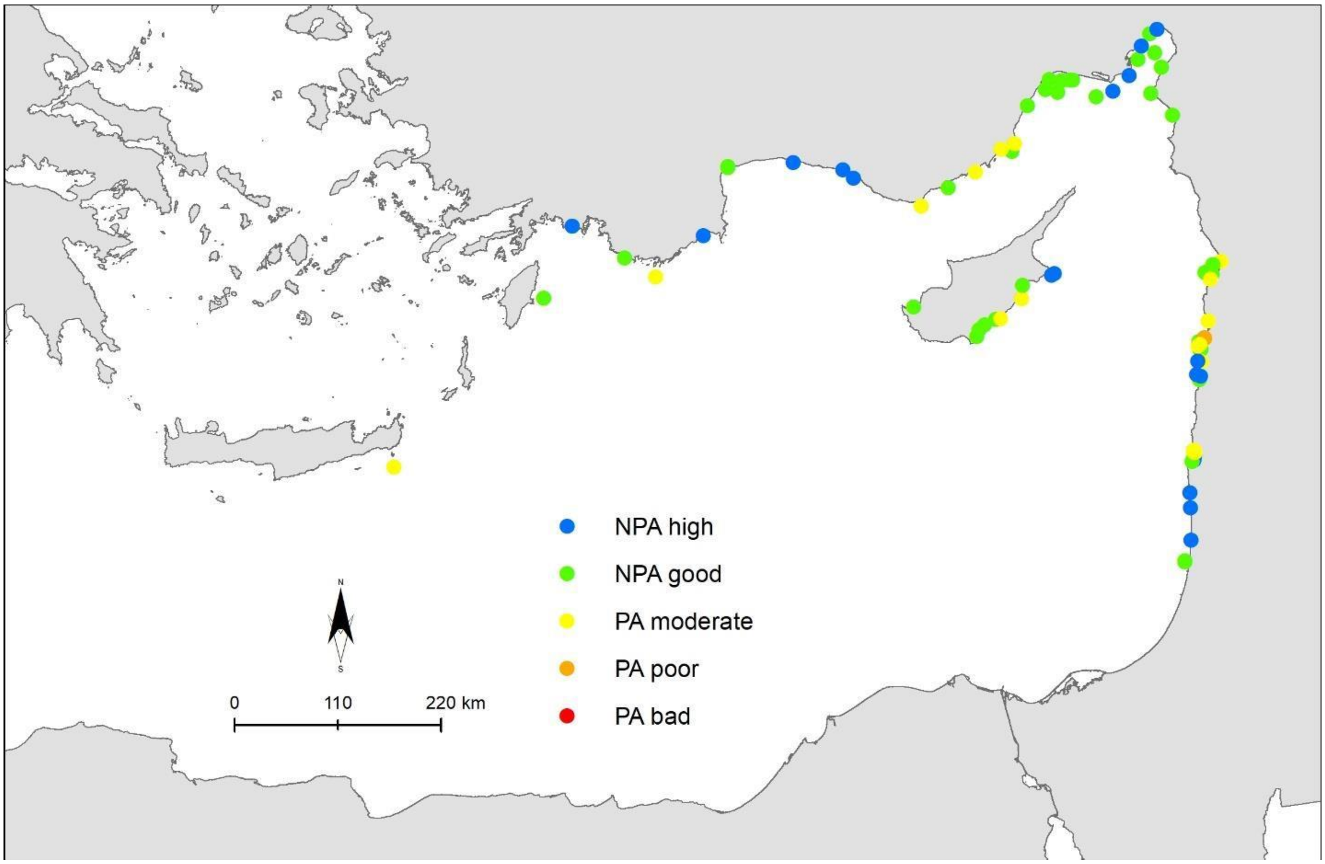

Figure LEVS 3.1.4.1.1.C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); 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. <u>Σ_5 PAHs in sediments:</u> 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.

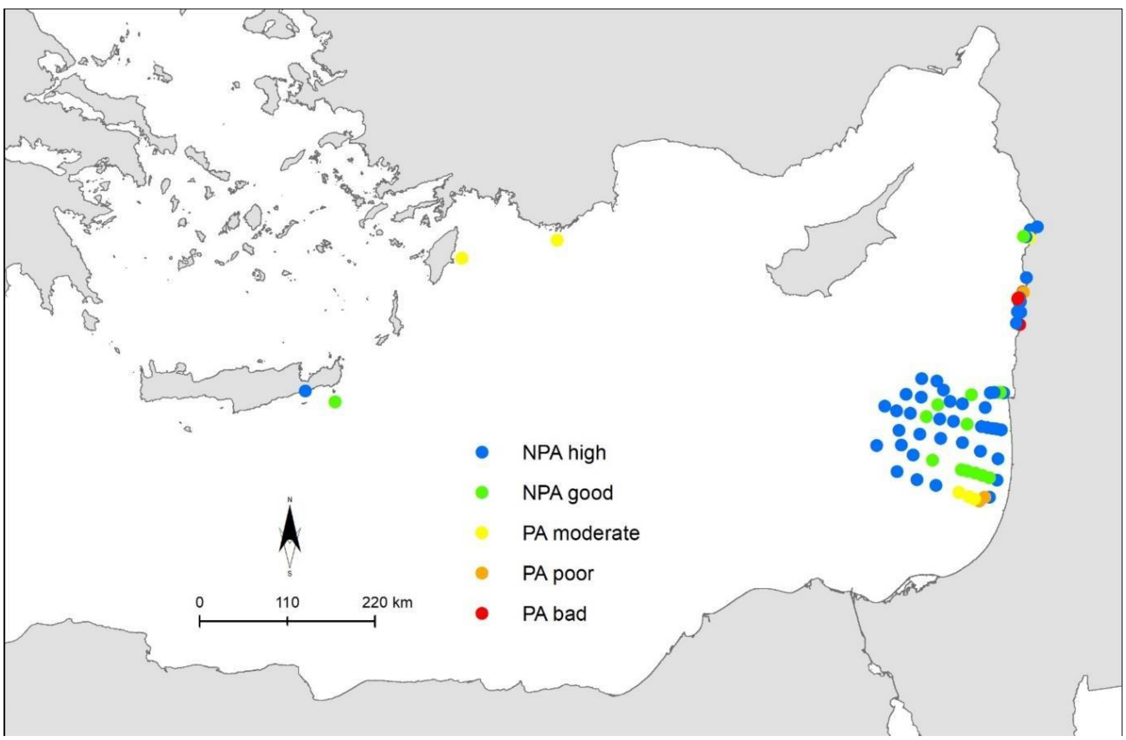

Figure LEVS 3.1.4.1.2.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_{16} PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow-PAmoderate (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.

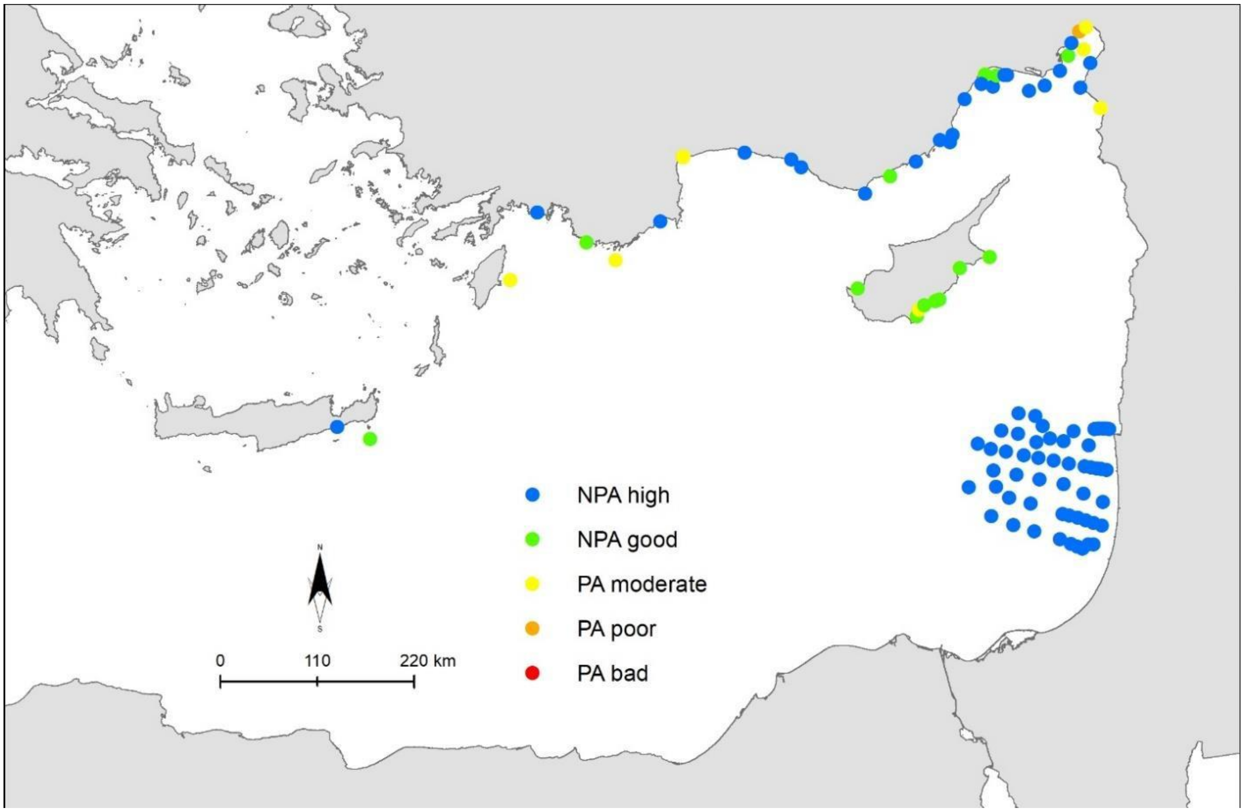

Figure LEVS 3.1.4.1.3.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_5 PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED 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.

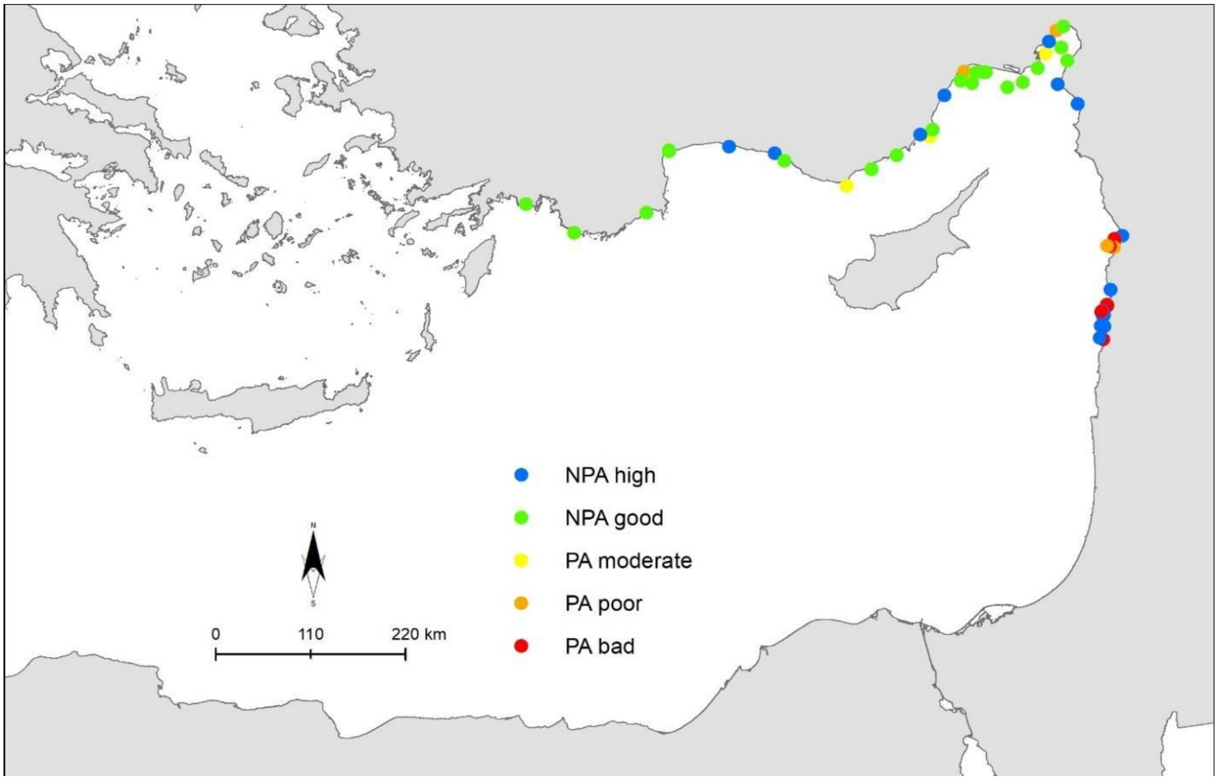

Figure LEVS 3.1.4.1.4.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_7 PCBs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =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).

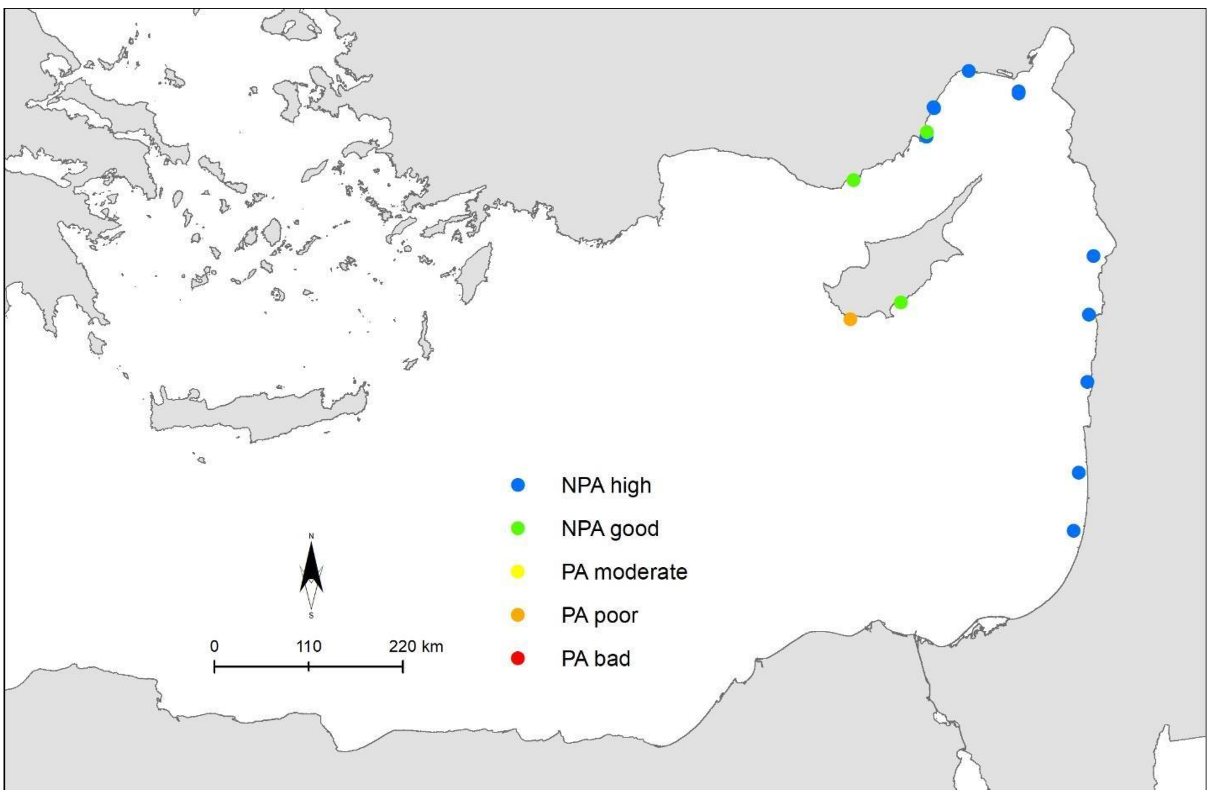


Figure LEVS 3.1.4.1.5.C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in *M. barbatus* in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =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.

Results of the CHASE+ Assessment of CI 17 in the the Central Mediterranean Sub-division.

478. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the MED_BACs as explained above. CHASE+ assessment methodology in the CEN was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation was possible only for TM in sediments, and only partially. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 3.1.4.2.3 summarizes the results of the CHASE+ application, while detailed calculation of the assessment results is presented in Figures CEN 3.1.4.2.1.C. – CEN 3.1.4.2.3.C.

Table 3.1.4.2.3. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the proposed new MED_BACs.

CHASE+		**Blue High**	**Green Good**	**Yellow Moderate**	**Brown Poor**	**Red Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	26*	23	0	1	0	2
% from total number of data points		*88*	*0*	*4*	*0*	*8*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	26	12	4	4	5	1
% from total number of data points		*46*	*15*	*15*	*19*	*4*
Σ_5 PAHs	46	25	6	5	6	4
% from total number of data points		*55*	*13*	*11*	*13*	*9*

* 4 stations with Cd and Pb only.

Assessment of Trace metals in sediments of the CEN

479. Data for TM were available for 26 stations: 22 from Malta with all three TM (Cd, Hg and Pb) and 4 from Greece with Cd and Pb only. Most stations (23) were classified in high status (Figure 3.1.4.2.1.C). One station, in the IONS offshore, was classified in moderate status due to the concentration of Cd. Two stations were classified in poor status due to the high concentrations of Hg and Pb. These two stations were located at the Port il- Kbir off Valetta, an area affected by industrial plants and marine traffic.

480. Although most of the stations (88%) were in-GES, it is not possible to classify the Sub-region nor the sub-division as a whole. Twenty-two sampling stations were located along the coast of Malta (CENS), 2 on the offshore area of the IONS and 2 on the offshore of the CENS. Due to the uneven distribution of the stations, it is not possible to assess an environmental status to the whole sub-region regarding TM in sediments.

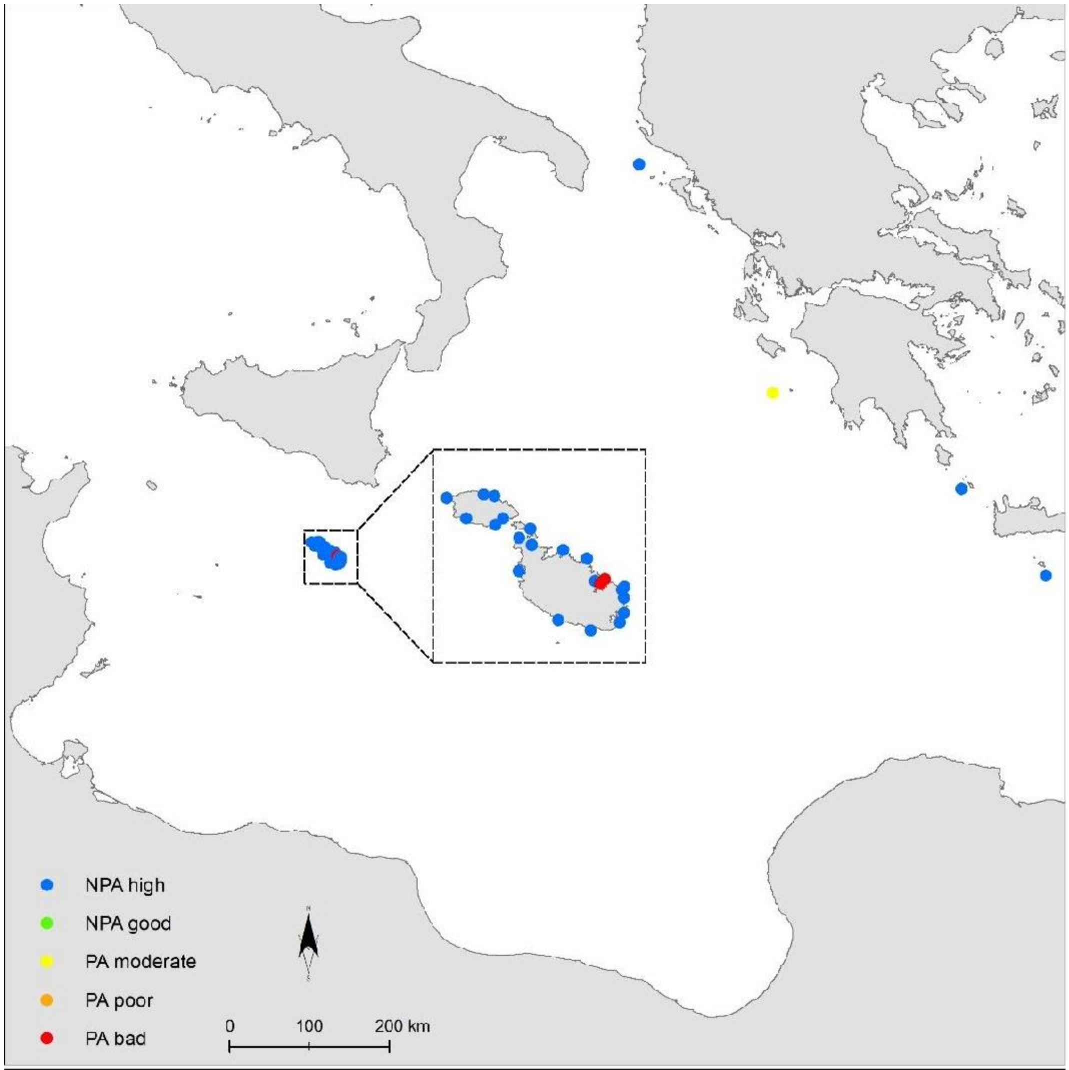


Figure CEN 3.1.4.2.1.C. Results of the CHASE+ approach to assess the environmental status of TM in sediments in the CEN, using MED_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (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. The coastal area of Malta was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

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

481. *Σ_{16} PAHs in sediments* were available only for 21 stations in Greece (20 in the IONS, 1 in CENS) and 5 stations in Tunisia (CENS)[93]. All the stations in Tunisia were classified in-GES and assigned a high environmental status. Out of the 21 stations reported by Greece, 12 stations (52%) of the stations were in-GES and 10 were non-GES (48%), with 4 stations in moderate status, 5 stations in poor status

[93] Jebara et al., 2021

and 1 station in bad status (Figure 3.1.4.2.2.C). The non-GES stations were located along the eastern Ionian coast, in the Gulf of Patras and the Gulf or Corinth, with 4 stations in poor status and one station in bad status in Kerkyraiki.

482. In brief, due to the lack of data it was impossible to classify the environmental status of the CENS sub-divisions nor of the CEN Sub-region for Σ_{16} PAHs in sediments. Non-GES stations were located in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

483. *Σ_5 PAHs in sediments* were available only for 21 stations in Greece (20 in the IONS, 1 in CENS) and 25 stations in Malta (CENS). The classification of the stations reported by Greece were better using Σ_5 PAHs compared to Σ_{16} PAHs: 16 stations (76%) of the stations were in-GES and 5 were non-GES (24%), with 3 stations in moderate status, 2 stations in poor status and no station in bad status. Non-GES stations were located in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki. Out of the 25 stations reported by Malta, 15 stations (60%) of the stations were in-GES and 10 were non-GES (24%), with 2 stations in moderate status, 4 stations in poor status and 4 stations in bad status (Figure CEN 3.1.4.2.3.C). The non-GES stations were located at the north-eastern and south-eastern part of Malta, in particular two stations were located at the Port il- Kbir off Valetta, an area affected by industrial plants and marine traffic, and impacted by TM in sediments as well, as explained for Trace metals. Two additional stations in bad status were located at the Operational Wied Ghammieq, affected by industrial plants. However, due to the lack of data and uneven distribution of the stations it was not possible to classify the environmental status to the whole sub-division nor the sub-region with respect to Σ_5 PAHs in sediments. It must also be noted that in the absence of data reported for Σ_{16} PAHs, as mandatory parameter, these initial findings were provided as indicative for Σ_5 PAHs, as non-mandatory parameter reported by the two CPs.

484. In brief, due to the lack of data and uneven distribution of the stations it was impossible to classify the environmental status of the whole sub-division nor the sub-region with respect to Σ_5 PAHs in sediments. Stations with non-GES status were located in Port il- Kbir off Valetta, Operational Wied Ghammieq, in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

Assessment of Σ_7 PCBs in sediments of the CEN

485. Σ_7 PCBs in sediments were available only for 5 stations in Tunisia (CENS)[94]. Four of the stations were classified in-GES, in good status while only one, Chebba, was classified as non-GES, in moderate status. Concentrations of all individual PCBs were higher at the location of Chebba than those from other locations, which could be linked to the discharge of wastewater from the neighboring fishing port in this area (Jebara et al., 2021).

486. The meagre data on Σ_7 PCBs in sediments in the CEN does not allow for the regional assessment of the CEN nor of its sub-divisions.

[94] Jebara et al., 2021

Assessment of Organochlorinated contaminants other than Σ_7 PCBs in sediments of the CEN

487. Malta reported the concentration of hexachlorobenzene in sediments, one of the mandatory organochlorine contaminants, for 22 stations. All the concentrations were below the detection limit of 0.05 µg/kg dry wt.

488. Given only Malta reported the concentration of hexachlorobenzene in sediments, one of the mandatory organochlorine contaminants, only this compound could not be used for GES assessment.

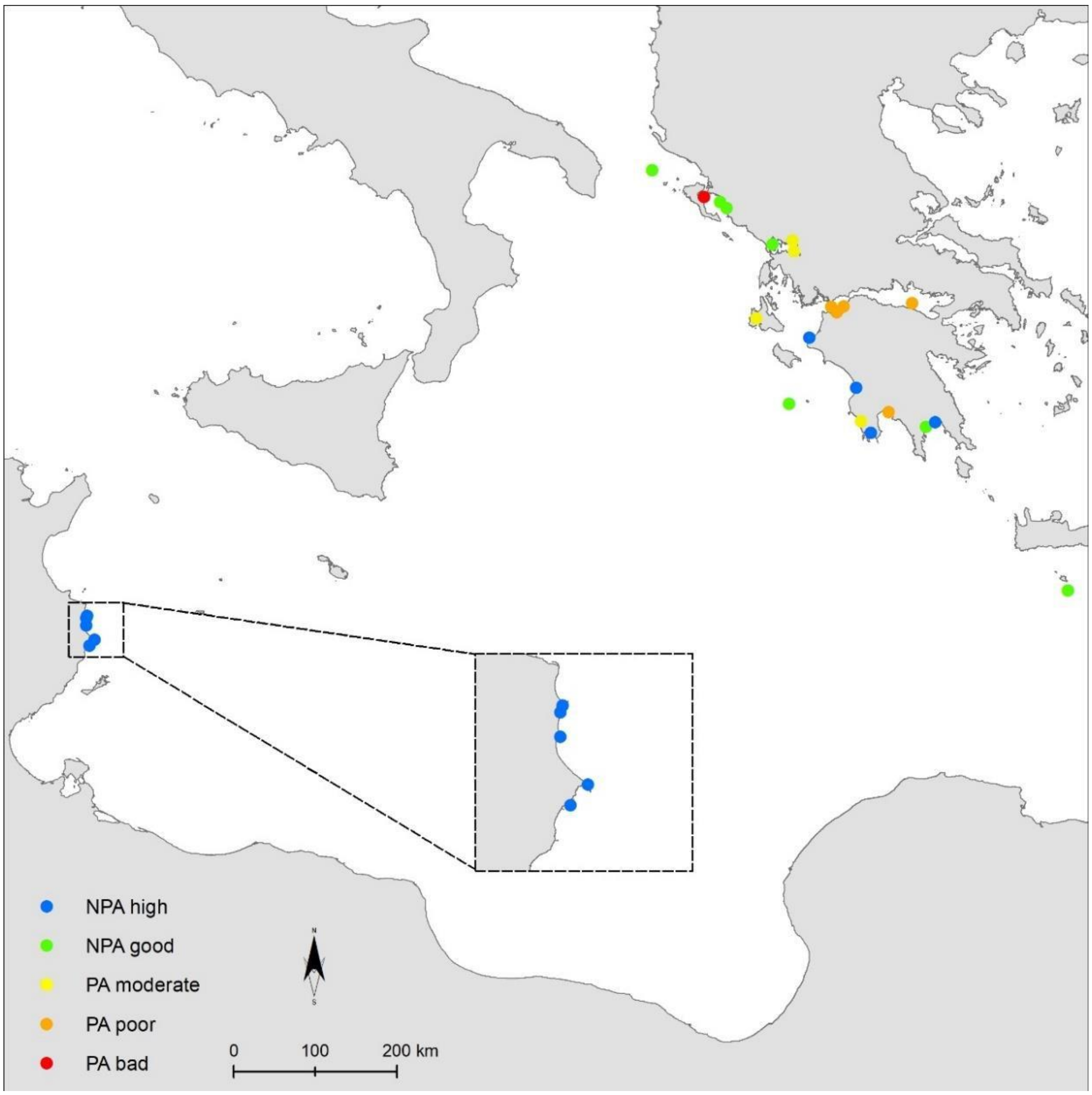


Figure CEN 3.1.4.2.2.C. Results of the CHASE+ approach to assess the environmental status of $\underline{\Sigma_{16}}$ PAHs in sediments in the CEN, using MED_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); 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. Part of the coastal area of Tunisia was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

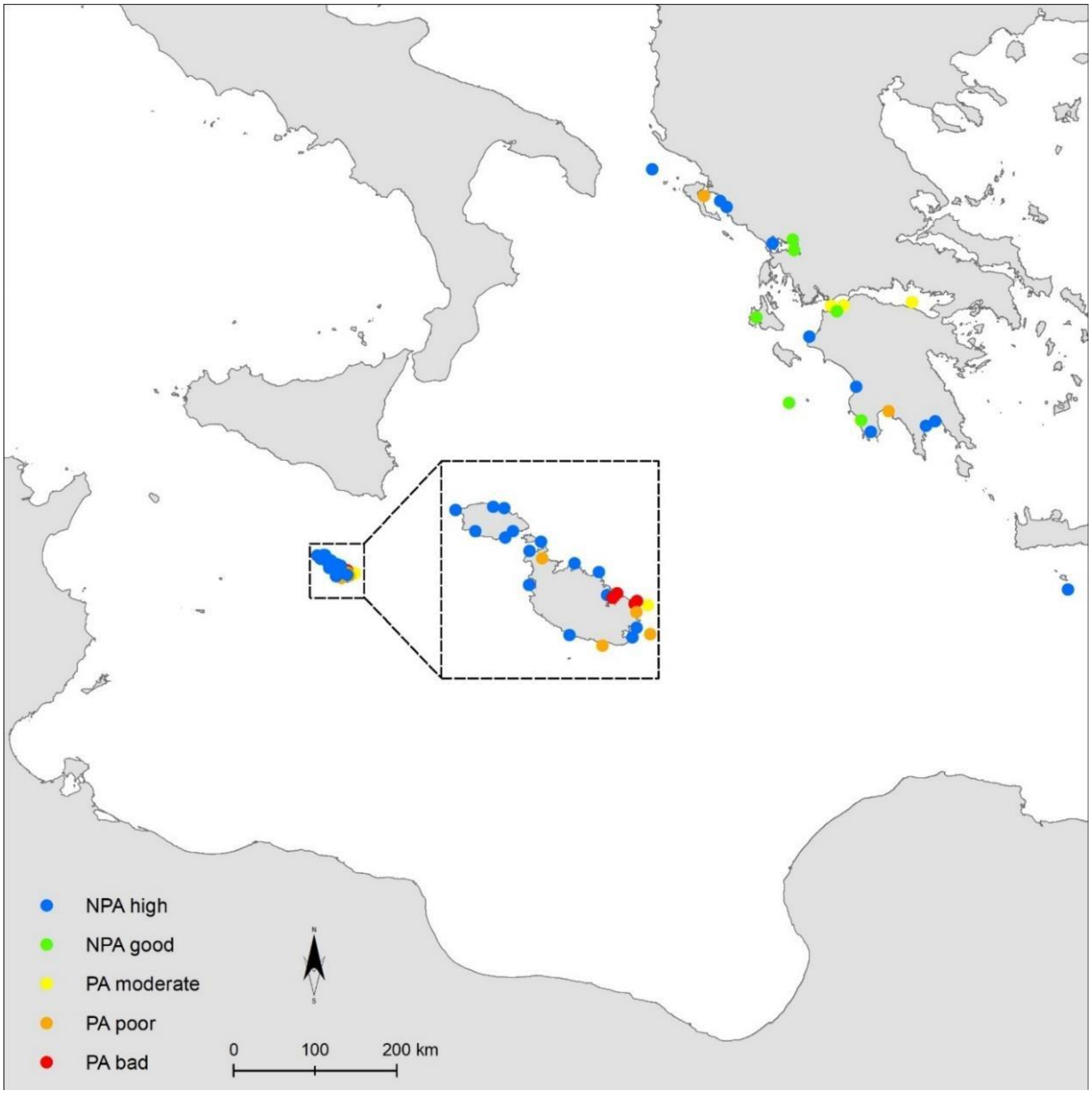


Figure CEN 3.1.4.2.3.C. Results of the CHASE+ approach to assess the environmental status of Σ_5 PAHs in sediments in the CEN, using MED_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. Here we used 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. The coastal area of Malta was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

Assessment of Trace metals in biota of the CEN

489. *M. barbatus*: Cd and Pb in all the 5 samples for which Malta reported data were below the detection limit (100 and 250 for Cd and Pb, respectively). The detection limits were much higher than the MED_BACs for these metals in *M. barbatus* (Table 3.1.4.2.2.). Hg in all the 5 samples were non-GES, with 3 samples classified in moderate status, one in poor status and one in bad status.

490. *M. galloprovincialis*. Data were available only for Italy (EMODNet). All the 8 samples were in-GES, 7 classified in high status and one in good status .

491. The meagre data on biota for the CEN does not allow for the regional assessment of the CEN nor of its sub-divisions.

2.1.1.2 The IMAP GES assessment of the Adriatic Sea Sub-region (ADR)

492. The integration and aggregation rules were elaborated in the context of the NEAT tool application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region, including optimal temporal and spatial integration and aggregation of the assessment findings within nested approach agreed for IMAP implementation. The GES was assessed by applying the NEAT tool on the Adriatic nested scheme. The Contaminants' data were aggregated and integrated per habitat (sediments, mussels) while the various levels of spatial integration (nesting) are provided to ensure scaling of the assessment findings i.e., integration of the assessment findings to the level that is considered meaningful for CI 17. The NEAT IMAP GES Assessment methodology was applied on the spatial scope of the finest areas of assessment and the areas of assessment nested to the levels of integration that are considered meaningful.

NEAT is a structured, hierarchical tool for making marine status assessments (Berg et al., 2017; Borja et al., 2016), and freely available at www.devotes-project.eu/neat. The use of NEAT is not limited to the assessment of biodiversity but can be used for assessment of pollution impact. 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. The final value has an associated uncertainty value, which is the probability of being determinative in a certain class status (GES - nonGES) (Uusitalo et al., 2016). Essentially, the final assessment value is calculated as a weighted average. The weighting factors are based on the respective surface of the areas and are combined with the respective monitoring data for the indicator/chemical contaminant in question. The total weight of a SAU is not the simple ratio of each SAU area to the total area of the parent SAU. The process of distributing the weight is more complex. SAU weighting by the NEAT tool has two options: i) do not weight by SAU area: weights are calculated based just on the nesting hierarchy of the SAUs; ii) weight by SAU area: weights are calculated based on the nesting hierarchy and the SAU surface area. For the present assessment the option ii) was followed.

The IMAP NEAT GES assessment methodology was tested, and thereafter applied, first to the assessment of contaminants (CI 17), and then to chl*a* (CI 13) and nutrients (CI 14) in the Adriatic Sea Sub-region. The first step in implementing the nested approach was the delimitation of the areas of assessment within the Adriatic Sea Sub-region and later on within the Western Mediterranean Sub-region based on the areas of monitoring defined by concerned Contracting Parties, along with the harmonization of the scales approach between the Contracting Parties (CPs) i.e., scaling up the marine assessment to sub-regional and regional scales within the integration process as required under IMAP. The definition of the areas of assessment is undertaken as indicated in IMAP by applying relevant criteria, e.g. representativeness/importance of the areas of monitoring for establishing areas of assessment; presence of impacts of pressures in monitoring areas; sufficiency of quality assured data for establishing the areas of assessment covering as many as possible IMAP Common Indicators to the extent possible, and ensuring that adequate consideration is given to the risk based principle (both in pristine areas and areas under pressure). The existing monitoring and assessment areas defined by the concerned CPs were used, in case they were compatible with IMAP requirements; in case inconsistency appeared, the necessary adjustments were undertaken.

The IMAP Spatial Assessment Units (SAUs) were defined in the 3 steps approach per each of the Adriatic countries separately; afterward, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken i.e., in the North, Central and South Adriatic. Following the methodology applied in the Adriatic Sea Sub-region, the same approach was applied to the Western Mediterranean Sub-region. For the step of nesting, the areas of assessment were first classified under the 3 sub-divisions of the Western Mediterranean Sea (i.e. ALBS, CWMS, TYRS). Relevant geographical information in the form of GIS-based layers were coupled, along with application of the rules of integration and aggregation.

In order to assess the uncertainty in the final assessment value, the standard error/ standard deviation of every observed indicator value is used (Borja et al., 2016). Therefore, the standard deviation values as obtained from the monitoring data play a major role in the uncertainty associated with the final assessment result. This emphasizes the importance of the standard deviation for the accuracy and evaluation of the final assessment result. The NEAT approach ensures that a balance is achieved between a too broad scale, that can mask significant areas of impact in certain parts of a region or subregion, and a very fine scale that could lead to very complicated assessment processes.

Available data

493. Data on contaminants (Cd, Hg, Pb, PAHs and PCBs) have been collected from all Contracting Parties bordering the Adriatic Sea for the years 2015 to 2021, except from Bosnia and Herzegovina[95] that does not monitor contaminants in marine environment. Details on the temporal and spatial availability of data per IMAP SAUs, per environmental matrix (sediments, biota) and per contaminants group (trace metals (TM), PAHs, PCBs) are provided here-below in Table 3.1.4.3.1 .The spatiotemporal coverage varies largely among the various IMAP SAUs. Sediments stations have in general higher spatial coverage. For some IMAP SAUs data are not existent or correspond to only 1 or 2 stations sampled once. Trace metals in sediments are monitored in the highest number of stations (205) and all SAUs have at least one station sampled once, followed by PAHs stations (125) and PCBs (59). The Central Adriatic subdivision is the least monitored for PAHs in sediments while it is not at all monitored for PCBs in sediments. All monitoring stations for biota refer to samplings of the mussel species, *Mytilus galloprovincialis*, therefore no data on organic compounds are available for fish matrix. Regarding the spatial coverage of monitoring stations for biota this is by far lower than that in sediments. Trace metals are monitored in 64 stations, PAHs in 29 and PCBs in 38. Contaminants' data in fish were scarce, reported only for trace metals in 27 stations in Croatian waters and 4 stations in Montenegrin waters. In addition, not always the same fish species was sampled making comparisons and harmonized assessment difficult.

494. A set of criteria was applied to propose the scope of the areas of monitoring. To better understand differences in the spatial coverage of the SAUs the ratio of number of stations to surface of the area (no of stations/km^2) is calculated. This ratio was calculated to support application of the criteria related to representativeness of the areas of monitoring for establishing areas of assessment. It is understood that the highest the ratio, the better the spatial coverage. However, in areas with limited presence of pressures a low ratio may be equally suitable for the purposes of a sound assessment. For this reason, the calculated ratios are only indicative and comparisons among them should be made keeping in mind the specific features of the SAUs. On the Adriatic sub-division level, the North Adriatic Sea is better covered by monitoring stations. Further to this criterion, the spatial distribution of monitoring

[95] Bosnia and Herzegovina has not been included in the present GES assessment due to lack of data on contaminants, however IMAP SAUs were set for this CP

stations and its comparison with the sufficiency of quality-assured data as collated for NEAT application were analyzed, i.e., the spatial coverage of monitoring data collected per each SAU in the Adriatic Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately. Table 4.3.2.1. provides the temporal coverage of monitoring data used again per each SAU in the Adriatic Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately.

Table 3.1.4.3.1. Data availability per year and country for the assessment of EO 9 – CI 17 (contaminants) in the Adriatic Sea (ADR) Sub-region, as available by up to 31st Oct 2022.

Source	**IMAP-File**	**Country**	**Year**	**Cd**	**Hg**	**Pb**	**Σ_{16} PAHs**	**Σ_{5} PAHs**	**Σ_{7} PCBs**	**Lindane**	**Dieldrin**	**Hexachlorobenzene**	**p.p' DDE**
Sediment													
IMAP_IS		Albania	2020	6	6	6		6					
IMAP_IS	520	Croatia	2017	37	37	37							
IMAP_IS	520	Croatia	2019	30	30	30							
IMAP_IS	652	Greece	2018	1		1	1						
IMAP_IS	457	Italy	2016	42	42	42	23	38	38	52		52	
IMAP_IS	457	Italy	2017	40	40	40	14	30	22	41		41	
IMAP_IS	457	Italy	2018	24	24	24	14	17	16	30		30	
IMAP_IS	457	Italy	2019	11		26				26		10	
EMODNet		Italy	2016	90	72	97							
EMODNet		Italy	2017	74	61	80							
MED POL		Montenegro	2016	5	5	5							
MED POL		Montenegro	2017	15	15	15							
MED POL		Montenegro	2018	6	6	6	6						
IMAP_IS		Montenegro	2019	29	29	29	29	29	29	12	29	29	29
IMAP_IS		Montenegro	2020	12	12	12	12	12	12	12	12	12	12
IMAP_IS		Montenegro	2021	19	19	19							
MED POL		Slovenia	2016				7	7					
IMAP_IS	204,657	Slovenia	2019	5	5	5	5	5	5	5	5	5	5
M. galloprovincialis													
IMAP_IS	520	Croatia	2019	19	19	19			19				
IMAP_IS	520	Croatia	2020	18	16	18							
IMAP_IS	460	Italy	2016	8	15	8		4		8		15	
IMAP_IS	460	Italy	2017	10	18	10		11		10		18	
IMAP_IS	460	Italy	2018	8	19	8		8		12		16	
IMAP_IS	460	Italy	2019		7							7	
EMODNet		Italy	2016		15								
EMODNet		Italy	2017		19								
EMODNet		Italy	2018		2								
MED POL		Montenegro	2018	8	8	8	8						
IMAP_IS		Montenegro	2019	10	10	10	11	11	11				
IMAP_IS		Montenegro	2020	10	10	10	10	10	10				
MED POL		Slovenia	2017	3	3	3							
IMAP_IS		Slovenia	2018	3	3	3							
IMAP_IS	204,657	Slovenia	2019	3	3	3	3	3					
IMAP_IS	439,658	Slovenia	2020	3	3	3	3	3					
IMAP_IS	656	Slovenia	2021	3	3	3	3	3					
M. barbatus													

Source	IMAP-File	Country	Year	Cd	Hg	Pb	Σ16 PAHs	Σ5 PAHs	Σ7 PCBs	Lindane	Dieldrin	Hexachlorobenzene	p.p' DDE
IMAP_IS	520	Croatia	2019	1		1							
IMAP_IS	520	Croatia	2020	10	10	10							
MED POL		Montenegro	2018	8	8	8							

495. For the application of the NEAT software, data on contaminants were grouped per parameters, ecosystem components (i.e. for the purpose of present NEAT application these are considered biota and sediment matrixes) and SAUs in all the Adriatic sub-divisions (NAS, CAS, SAS). Average concentrations (arithmetic means) and their respective standard errors were then calculated in the respective groups.

Arithmetic mean concentration: $C = \frac{\sum_{i=1}^{n} C_i}{n}$,

Standard Deviation: $SD = \sqrt{\frac{\sum_{i=1}^{n}(C_i - C)^2}{n-1}}$,

Standard Error : $SE = \frac{SD}{\sqrt{n}}$

where, C is the average (arithmetic mean) concentration for each SAU, C_i is the individual contaminant concentration measured in each station/date in the SAU, and n is the total number of concentration records for each SAU; SD is the sample standard deviation for a specific contaminant and SAU and SE is the standard error for a specific contaminant and SAU.

496. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or were left blank. In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate into the BC and BAC calculations of the BDL values and not to exclude them[96]. For the present application of NEAT these cases were substituted by the BDL/2 value, given a rather small quantum of data available, this does not influence the calculation of the assessment findings. In the Slovenian data, the BDL values were left blank so these were substituted by a value equal to 1µg/kg which corresponds to the average BDL/2 value from the whole data set. Furthermore, due to this fact, but also considering the list of substances the monitoring of which is mandatory according to IMAP[97], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_7PCBs) was taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants. A detailed data matrix was prepared and used for the NEAT software application.

__The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach__

497. Following the rules of integration of assessments within the nested approach, for the assessment of EO9 Common Indicators, the coastal monitoring zone is equal to the respective assessment zone as

[96] In a separate technical paper, prepared by MEDPOL in consultations with OWG on Contaminants, 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 BDL values from 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 data is BDLs. Therefore, the calculation for the assessment criteria 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 it varies even within the country.

[97] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

defined for the purposes of the present work. For the offshore zone, monitoring areas may be representative of broader assessment areas beyond territorial waters and in these cases the offshore monitoring areas are not necessarily equal to the offshore assessment areas. The stations positioned within the offshore zone are considered representative of a wider offshore area, as officially declared by the countries.

498. In the absence of declared areas of monitoring by all the concerned CPs, following the rationale of the IMAP national monitoring programmes and distribution of the monitoring stations, as well as the NEAT assessment methodology, the two zones of areas of monitoring are defined for the purposes of the present work: i) the coastal zone and ii) the offshore zone.

499. Detailed explanation on data sources used and methodology followed for setting of the two zones (coastal and offshore) is provided for the purpose of the present work. In summary, GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) by the MEDCIS project were used for the present work for Slovenia, Croatia and Italy; for Albania, Montenegro and Greece these data were not accurate or do not include the relevant information and therefore were replaced/corrected in line with relevant national sources i.e. results of GEF Adriatic Project and provisions of relevant national legal acts. The MEDCIS work takes into consideration the existence of bays and inlets which are numerous in particular in the east part of the Adriatic Sea and calculates the baseline using the straight baseline method by joining appropriate points.

500. For IMAP CI 17, integration of assessments up to the subdivision level is considered meaningful. Therefore, the three main subdivisions of the Adriatic Sea, namely, North, Central and South Adriatic (NAS, CAS, SAS) have been chosen following the specific geomorphological features as available in relevant scientific sources (e.g. bottom depths and slope areas, existence of deep depression, salinity and temperature gradient, water mass exchanges) (Cushman-Roisin et al., 2001). The coverage of the 3 sub-divisions is shown in Figure 3.1.4.3.1.

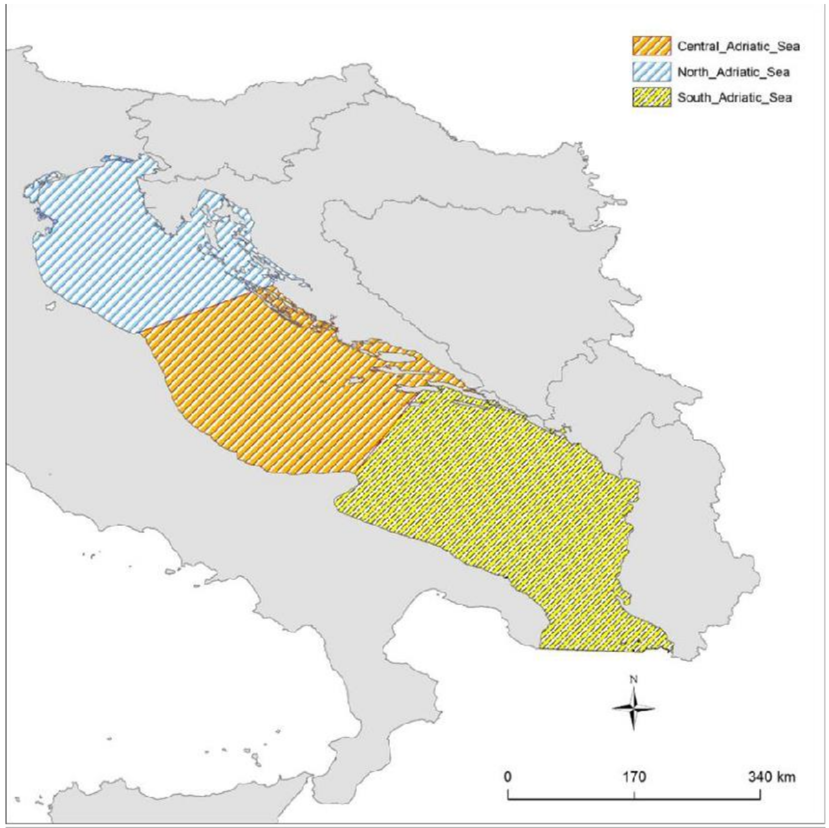


Figure 3.1.4.3.1. The 3 subdivisions of the Adriatic subregion defined based on Cushman-Roisin et al. (2001).

501. The four following steps for integration of the areas of assessment was followed to accomplish the objectives of the NEAT IMAP GES Assessment :

- Step 1 "Defining coastal and offshore waters";
- Step 2 "Recognizing scope of IMAP areas of monitoring";
- Step 3 "Setting IMAP area of assessment":
- Step 4 "Nesting of the areas of assessment within application of NEAT tool" by applying the 4 levels nesting scheme where 1st level is the finest and 4th level is the highest:
  - 1st level provided nesting of all national IMAP SAUs & sub-SAUs within the two key IMAP assessment zones per country, i.e. coastal and offshore zones;
  - 2nd level provided nesting of the assessment areas set in the key IMAP assessment zones i.e. coastal and offshore zones, on the sub-division level i.e. i) NAS coastal, NAS offshore; ii) CAS coastal, CAS offshore; iii) SAS coastal, SAS offshore);
  - 3rd level provided nesting of the areas of assessment within the 3 sub-divisions (NAS, CAS, SAS);
  - 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region

502. Similarly, the integration of the assessment results is conducted following the 4 levels nesting approach:

- 1st level: Detailed assessment results provided per sub-SAUs and SAUs;
- 2nd level: Integrated assessment results provided per i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
- 3rd level: Integrated assessment results provided per subdivision NAS, CAS, SAS;
- 4thlevel: Integrated assessment results provided for the Adriatic Sea Sub-region.

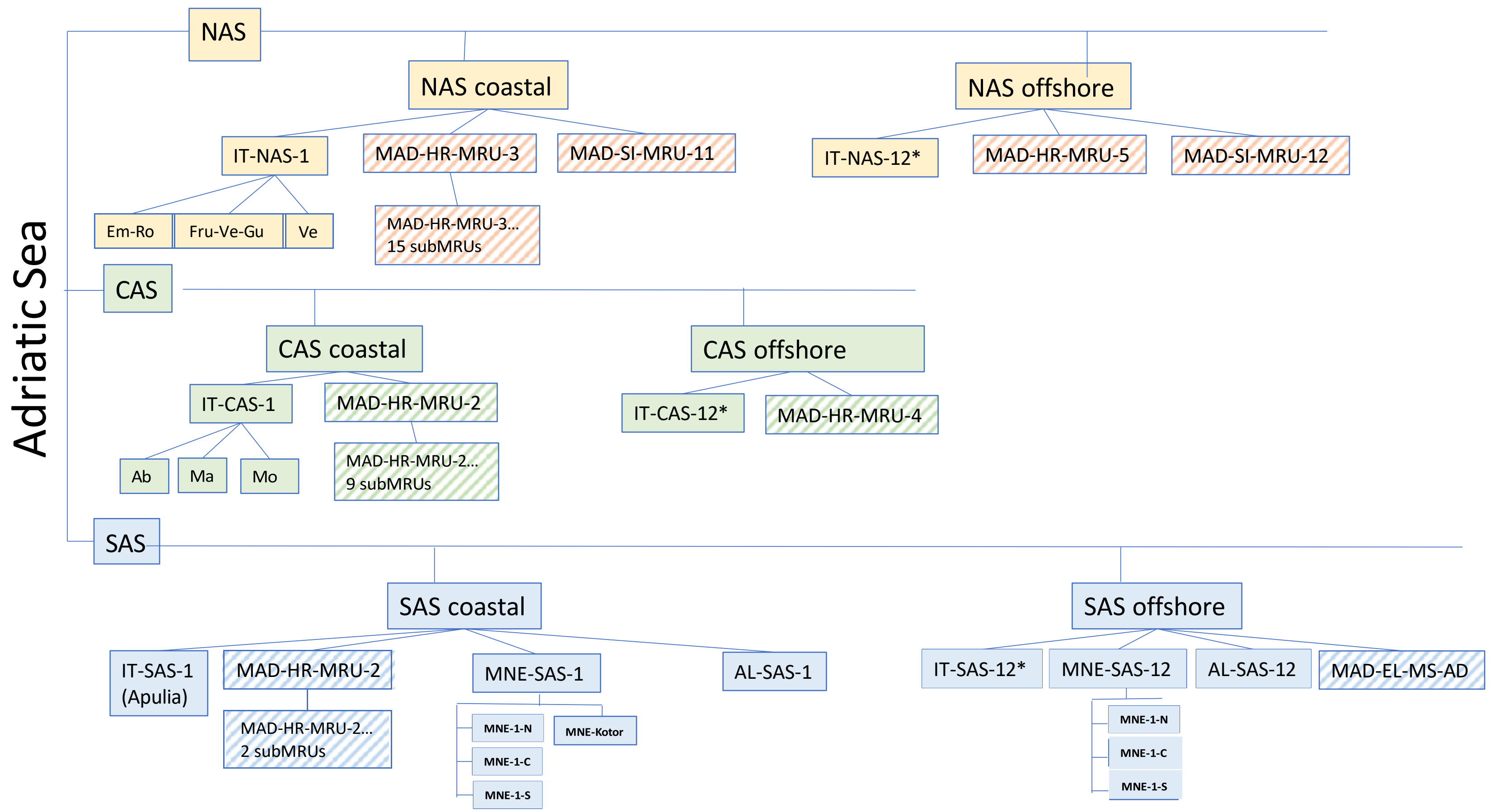
503. The graphical depiction of this nesting scheme is shown in Figure 3.1.4.3.2. .

504. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, , the scope of all Adriatic SAUs and subSAUS were defined. All of them were introduced in the NEAT tool along with their respective codes and surface area (km^2).

505. Within each SAU under ‘habitats’ the sediments and biota are introduced. Under ‘ecosystem component’ the 5 chemical compounds of EO9/CI17 are assigned. For each SAU and ‘Ecological Component’ (EO9 contaminants in our case) and ‘Habitat’ (sediments, biota), average value and standard deviation per chemical compound is inserted.

506. The use of NEAT tool requires two boundary limit values for the best and worse conditions (these are not threshold values but the minimum and maximum values that determine the scale of the assessment) and one threshold value for the GES – non GEs status. For the present analysis, the two boundary limit values are: i) zero contaminant concentration for the best conditions; ii) the maximum concentration of contaminants used for the present analysis for the worse conditions.

507. These boundary limits are mandatory by the tool which then produces five status classes linearly, depending on the distance of the concentrations from the two boundary limit values and the GES-non GES threshold. However, the user may also assign threshold values for all other status classes as appropriate. A 5-class assessment scale ‘High-Good-Moderate-Poor-Bad’ is then produced.



*For Italy the offshore IMAP SAUs areas (IT-NAS-O, IT-CAS-O, IT-SAS-O) is calculated by subtracting the surface of area of the coastal zone from the surface area of the 3 official MRUs (IT-NAS-0001, IT-CAS-0001, IT-SAS-0001).

Figure 3.1.4.3.2.: The nesting scheme of the SAUs defined for the Adriatic Sea based on the available information. Shaded boxes correspond to official MRUs declared by the countries that are EU MSs and that were decided to be used as IMAP SAUs.

Setting the GES/non GES boundary value/threshold

508. Upgrading of the baselines and threshold values for IMAP CI 17 in the Mediterranean Sea is an ongoing process. The present assessment analysis applying the NEAT tool was conducted for each subdivision using the assessment criteria for the GES-non GES threshold, based on BAC values shown in Table 3.1.4.3.2.

Table 3.1.4.3.2: The BAC values calculated for the Adriatic Sea and used for the present assessment

	Adriatic BAC (µg/kg dry wt)	
	Sediments	**Biota (MG)**
Cd	180	944
Hg	75	113
Pb	23550	1500
$^{*}\Sigma_{16}$ PAHs	61.5	9.9
$^{+}\Sigma_{7}$ PCBs	0.21	17.3

509. The final marine environment quality status assessment regarding CI17 in the Mediterranean Sea provides in a consolidated manner the individual assessments for each of the sub-regions and/or sub-divisions. Therefore, all individual assessments were harmonized to the extent possible in order to ensure the compatibility of the assessments.

510. In line with an updated assessment classification for a harmonized application of NEAT and CHASE+ tools in the four Mediterannean Sea sub-regions , the Boundary limits of the 5-class assessment scale and class Threshold values were applied for NEAT GES Assessment of the Adriatic Sea-Sub-region (Table 3.1.4.3.3).

Table 3.1.4.3.3: Boundary limits of the assessment scale and class Threshold values used for the application of the NEAT tool for IMAP.

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/poor	**Threshold** Poor/Bad	**Upper Boundary Limit**
Sediments	**(µg/kg)**	**0.5 (xBAC) (µg/kg)**	**xBAC (µg/kg)**	**2(x BAC) (µg/kg)**	**5(xBAC)**	**Max. conc. (µg/kg)**
Cd	0	135	270	540	1350	9000
Hg	0	56.5	113	225	563	14200
Pb	0	17662	35325	70650	176625	356000
$^{*}\Sigma_{16}$ PAHs	0	61.5	123	246	615	26649
$^{+}\Sigma_{7}$ PCBs	0	0.21	0.42	0.8	2.1	434
Biota (*M. galloprovincialis*)						
Cd	0	708	1416	2832	7080	9000
Hg	0	85	170	339	848	10000
Pb	0	1125	2250	4500	11250	167884
$^{+}\Sigma_{7}$ PCBs	0	17.3	34.6	69	173	180

*sum of the individual BACs or xBACs values of the 16 PAH compounds
$^{+}$ sum of the individual BACs or xBACs values of the 7 PCB compounds

511. The two boundary limit values, mandatory by the NEAT tool, were applied: i) zero contaminant concentration for the best conditions; ii) the maximum concentration of contaminants used for the present analysis for the worse conditions.

512. In line with such defined the two boundary limits, a five-class assessment scale 'High-Good-Moderate-Poor-Bad' was linearly set, depending on the distance of the concentrations from the two boundary limit values and the GES-nonGES threshold.

513. The data (i.e. average values inserted), as well as boundary limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level, as follows:

$$0 \leq \text{bad} < 0.2 \leq \text{poor} < 0.4 \leq \text{moderate} < 0.6 \leq \text{good} < 0.8 \leq \text{high} \leq 1$$

514. The decision rule of GES/ non-GES is by comparison to the boundary class defined by the (xBAC) and this is above/ below Good (0.6).

515. NEAT aggregated data by calculating the average of normalized values of contaminants (Cd, Pb, PAHs, etc.) on the SAU level. This can be done either per each contaminant per habitat (i.e., sediments, biota) separately or for all contaminants per habitats (i.e. sediments, biota) within specific SAU. The first option leads to one value for each chemical compound separately for a specific SAU.

516. The process is then repeated for all nested SAUs (in a weighted or non- weighted mode) for all ecosystem components - contaminants separately, or for all ecosystem components by habitat (sediments, biota). In the weighted mode a weighting factor based on the surface area of each SAU is used.

Results of the IMAP NEAT GES Assessment of CIs 17 in the Adriatic Sea Sub-region

517. The results obtained from the NEAT tool are shown below in Tables 3.1.4.3.4.a and 3.1.4.3.4.b. Table 3.1.4.3.4.a provides detailed assessment results on the EO9/CI 17 level per contaminant and also spatially integrated within the nested scheme at i) the IMAP national SAUs & subSAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of sub-divisions (NAS Coastal, NAS Offshore, CAS Coastal, CAS Offshore, SAS Coastal, SAS Offshore); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (Adriatic Sea).

518. At the same time aggregation of all contaminants data is done in order to obtain one chemical status value (NEAT value) for all the levels of the nesting scheme. In other words data matrix in Table 3.1.4.3.4.b. shows the results per contaminant per habitat per SAU in the finest level which are i) integrated along the nesting scheme (in columns A - I bold lines); and ii) are aggregated for all contaminants and habitats per SAU (in rows) leading to one NEAT value per SAU (column EO9). The latter is further integrated along the nesting scheme (column EO9 bold lines).

519. The NEAT tool has the possibility also to provide assessment results by aggregating data per habitat in this case sediments and biota (mussels) and then spatially integrated within the nested scheme.

520. The final integrated result per SAU (NEAT value) is the same for the two ways of assessment (i.e. per contaminants (Table 3.1.4.3.4.a) or per habitats (Table 3.1.4.3.4.b) as expected.

521. The detailed status assessment results per contaminant per SAU at the 1st level of assessment (no aggregation or integration) show that in most cases GES conditions are achieved (High, Good status) i.e., for 80% of SAUs, which are indicated by the blue and green cells in Table 3.1.4.3.4.a; 9% are classified under the moderate status, 6% under the poor and 5% under the bad. For the sediment matrix,

the highest contamination is observed from PCBs, PAHs and Hg resulting in non-GES status for 60%, 57% and 27 % of sub-SAUs respectively. For the mussels matrix, the highest contamination is observed from PCBs which results in 39% of sub-SAUs in non-GES status. In the NAS, 19% of sub-SAUs are classified as non-GES, in the CAS 12% are classified as non-GES, while in the SAS 22 % are classified as non-GEs. The most affected sub-SAUs in the NAS are HRO-0313-BAZ, HRO-0412-PULP and HRO-0423-RILP in Croatia; Emiglia-Romana', 'Fruili-Venezia-Giulia-1' and 'Veneto-1' in Italy. Also, offshore SAUs IT-NAS-O and MAD-Sl-MRU-12. In the CAS, most affected sub-SAUs are HRO-0313-KASP, HRO-0313-KZ, HRO-0423-KOR in Croatia. In the SAS, affected sub-SAUs are HRO-0313-ZUC and HRO-0423-MOP in Croatia; and MNE-1-N, MNE-1-C, MNE-1-S, MNE-Kotor in Montenegro which are found in moderate conditions due to impacts of several contaminants. Regarding the status of subSAU MNE-1-C, the present assessment does not match the good environmental status corresponding to the status of Marine Protected Area Katic located in this assessment unit, due to non-harmonized data reporting among the countries, and consequent non-harmonized use of data from different types of monitoring stations including hot spot stations, along with non-optimally harmonized size of spatial assessment units among the countries which resulted in inaccurately downgraded status of the small MNE-1-C assessment unit from good to moderate class.

522. Overall, it can be seen from Tables 3.1.4.3.4.a and Table 3.1.4.3.4.b. that TM in sediments have the largest spatial coverage with 49 out of 49 SAUs covered. For the other compounds and 'habitats' (sediments, mussels) several SAUs totally lack of data. In these cases, the integrated assessment result on the sub-division level (NAS, CAS, SAS) is based on only a few SAUs and cannot be considered representative. This is true for the assessment of Σ_{16}PAHs in sediments which is based on 14 out 49 SAUs and data delivered by from Italy, Slovenia, Montenegro; Σ_7PCBs in sediments which is based on 10 out of 49 SAUs and data delivered by Italy and Montenegro. In addition, Σ_7PCBs data in sediments for the CAS are non-existent. For the mussels, TM have the largest coverage and are measured in 28 out of the 49 SAUs, based on data delivered by Croatia, Italy, Slovenia and Montenegro (only in the coastal SAUs). Σ_7PCBs in mussels are measured in 22 out of 49 SAUs based on data delivered by Croatia and Montenegro, however most of the SAUs have been sampled only once.

523.

The comparison and harmonization of the assessment methodologies applied for IMAP CI 17:

To avoid possible bias in the Mediterranean regional assessment that may occur as a result of the use of different assessment methodologies in different areas, comparisons were performed i.e., between i) the "traffic light" and the CHASE+ in the LEVS Sub-division; ii) the NEAT and the CHASE+ in the ADR Sub-region and iii) the NEAT and the CHASE+ in the WMS Sub-region. The comparisons were performed to decrease uncertainty and to harmonize among assessments performed in different sub-regions and sub-divisions, with different number of sampling locations and measurements.

It was shown in the assessment of the Levantine Sea basin that the traffic light system is more lenient than CHASE+ and may mask the classification as non-GES of possible problematic areas for certain contaminants. Therefore, the "traffic light" was not further utilized.

Further to setting of the compatible GES/nGES threshold values for all sub-regions/sub-divisions, the approach described here-below is followed to overcome the above-described discrepancies and to ensure compatible assessments for all subregions/sub-divisions of the Mediterranean Sea on the SAU and on station levels for the purposes of the preparation of 2023 MED QSR. The approach is based on the application of a tailor-made assessment based on the general rationale of the CHASE+ tool while ensuring compatibility with the NEAT tool:

i) For sub-regions where the CHASE+ assessment methodology is applicable: Calculation of contamination ratios (CRs) based on the (xBAC) thresholds;

ii) For sub-regions where the CHASE+ assessment methodology is applicable: Calculate the CS for the overall CI17 aggregated assessment per station as a simple average of CRs and not as used by the EEA, where CS is calculated as the sum of CR divided by the square root of the number of CRs in the sum;
iii) For all Sub-regions and for both NEAT and CHASE+ assessment methodologies: The GES/non-GES boundaries are based on the BAC values. The BAC values (xBAC) multiplied by 1.5 for Cd, Hg, Pb and by 2 for PAHs and PCBs were approved This approach was chosen because it is based on the Mediterranean sub-regional background concentrations of contaminants, therefore having the boundary limits based on the values calculated from monitoring data reported by the CPs, and because it is more stringent than the Med_EAC approach. At the same time, it corresponds to the definition of the GES CI 17 target according to which the concentrations of specific contaminants need to be kept below Environmental Assessment Criteria (EACs) or below reference concentrations. In many cases the Med_EAC thresholds are higher than the maximum value recorded for a particular contaminant, resulting in a very lenient classification of the SAUs/stations. In this way biased assessments in different Mediterranean sub-regions are avoided.
iv) For all Sub-regions: Align the moderate/poor and the poor/bad boundary limits/thresholds between the two assessment methodologies. For the moderate/poor the use of 2(xBAC) value is proposed and for the poor/bad the 5(xBAC) value. In this way, a fine classification in line with the precautionary principle is provided. The NEAT tool is flexible and accepts either calculated thresholds values by the tool itself (based on the GES/nGES and the maximum concentration of contaminants), or threshold values predefined by the user. In the present assessment all thresholds are user defined. In the CHASE+ tool the CR or CS ratios for the moderate/poor and poor/bad are set at 2x and 5x times the GES/nGES threshold, instead of 5x and 10x that are suggested by the tool.

A comparison between the NEAT and CHASE+ results for the WMS sub-region was performed by applying above approach. Briefly all thresholds used were identical in the two methodologies, while the CHASE+ methodology was adapted regarding the calculation of the CS score for compatibility reasons. The harmonization of the two tools gives identical results for the classification (in-GES or non-GES) of the individual contaminants assessments per SAU. There are very small differences between the statuses found for the individual contaminants per SAU, regarding delineation between high and good statuses, the in-GES classification, and between moderate and poor, the non-GES classification. When aggregation is conducted for all contaminants on the individual SAU level comparisons differ by 5% and still can be considered acceptable.

The harmonization of the NEAT and CHASE+ assessment methodologies was as good as possible. They are still different methodologies and the results will not be identical, however the harmonization ensured their alignment to the extent which prevents bias assessment of the four Mediterranean sub-regions within the preparation of the 2023 MED QSR. The NEAT is the methodology which properly supports efforts aimed at the GES assessment in line with the Decision IG. 23/6 on the 2017 MED QSR, and therefore its further application across all four Mediterranean sub-regions should be foreseen within preparation of the future QSR. The CHASE+ assessment methodology may continue being used in specific cases, i.e., for the local areas and limited assessments with insufficient data reported for the GES assessment to guide decision making.

Assessment classification boundary limits/thresholds for a harmonized application of IMAP NEAT and CHASE+ assessment methodologies for IMAP CI 17 in the Mediterannean Sea sub-regions.

	GES		non-GEs		
IMAP – traffic light approach	Good	Moderate	Bad		
NEAT tool	High	Good	Moderate	Poor	Bad
	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤GES/nGES threshold	GES/nGES<meas. conc. ≤ moderate/poor threshold	moderate/poor threshold <m conc. ≤ max. conc.	**Max. conc.**
Boundary limits and NEAT scores	**0** 1 < score ≤0.8	0.8<score≤ 0.6	0.6<score ≤ 0.4	0.4< score ≤0.2	Score<0.2
Thresholds	**BAC**	**(xBAC)**	**2 (xBAC)**	**5 (xBAC)**	
CHASE+ tool	High	Good	Moderate	Poor	Bad
Thresholds	**1/2(xBAC)**	**(xBAC)**	**2(xBAC)**	**5(xBAC)**	
CHASE+ Scores	0 <CR,CS ≤0.5	0.5<CR,CS≤ 1	1<CR,CS ≤ 2	2< CR,CS ≤5	CR,CS> 5

524. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 3.1.4.3.4.a (4th column). It is clear that the above described non-GES classifications affect the overall chemical status and 80% of the SAUs are classified as in GES (High or Good), while 20% of the subSAUs are classified under moderate status.

525. The integration of SAUs data per chemical parameter (Table 3.1.4.3.4.a, bold lines), shows that: i) the NAS subdivision suffers from Hg contamination (moderate status) in sediments and mussels and PCBs (poor status) contamination in sediments; ii) the CAS sub-division suffers from Hg (poor status) and PCBs (moderate status) contamination in mussels; iii) finally, the SAS sub-division is affected by Pb (moderate status) and PCBs (moderate status) contamination in mussels.

526. In Table 3.1.4.3.4.b the NEAT assessment results are aggregated per habitat (sediments, mussels). It is apparent that both the sediments and the mussels matrices are equally affected by chemical contaminants with 27% and 24% of Sub-SAUs classified as non-GES respectively. All other cases are classified in GES (High, Good status).

527. With the exception of TM in sediments, based on the availability of data for contaminants as delivered by the CPs in the Adriatic Sea sub-region, the present integrated assessment status results produced by applying the NEAT tool on the sub-division (NAS, CAS, SAS) and/or the Adriatic sub-Region level (shown in Tables 3.1.4.3.4.a and 3.1.4.3.4.b) can only be considered indicative. This is related to the fact that several SAUs either lack of data or the countries eventually decided not to monitor the areas that are found irrelevant for the assessment of contaminants and therefore excluded the areas where problems were not historically observed (blank cells in Tables 3.1.4.3.4.a and 3.1.4.3.4.b).

528. , The final GES assessment findings for all the IMAP SAUs in the Adriatic Sea, as provided in Table 3.1.4.3.4.a, are shown by the respective color in the maps included in the Figures ADR 3.1.4.3.3.C - 3.1.4.3.6.C. The maps depict the integrated NEAT value for each sub-SAU (i.e., aggregated value for all contaminants as provided in the 4th column of Table 3.1.4.3.4.a).

Table 3.1.4.3.4.a. Status assessment results of the NEAT tool applied on the Adriatic nesting scheme for the assessment of EO9/CI17. The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. * Light green coloured cell corresponds to subSAU MNE-1-C reconsidered as in good status following justification provided by authorities of Montenegro. The status of this unit was adjusted from moderate to good i.e., color was changed from yellow to light green, without changing the NEAT values, further to the justification related to the status of marine protected area Katic as provided by national authorities**.**
The % confidence is based on the sensitivity analysis.

			EO9				**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**		**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
Adriatic Sea	**139783**	**0**	**0.738**		**good**	**88**	**0.841**	**0.807**	**0.878**	**0.786**	**0.346**	**0.821**	**0.421**	**0.748**	**0.631**
Northern Adriatic Sea	**31856**	**0**	**0.592**		**moderate**	**84**	**0.842**	**0.466**	**0.827**	**0.733**	**0.236**	**0.835**	**0.47**	**0.842**	**0.743**
NAS coastal	**9069**	**0**	**0.774**		**good**	**100**	**0.838**	**0.739**	**0.814**	**0.4**	**0.199**	**0.834**	**0.809**	**0.842**	**0.743**
MAD-HR-MRU-3	6422	0	0.829		high	100	0.891	0.887	0.833			0.811	0.813	0.818	0.696
HRO-0313-JVE	73	0.001	0.726		good	100	0.853	0.872	0.711			0.754	0.574	0.709	0.522
HRO-0313-BAZ	4	0	0.51		moderate	100	0.684	0.333	0.513						
HRO-0412-PULP	7	0	0.477		moderate	100	0.803	0.166	0.462						
HRO-0412-ZOI	473	0.003	0.864		high	100	0.894	0.861	0.874			0.89	0.857	0.859	0.803
HRO-0413-LIK	7	0	0.791		good	86	0.886	0.763	0.623			0.846	0.809	0.85	0.792
HRO-0413-PAG	30	0	0.796		good	69	0.832	0.837	0.761			0.84	0.853	0.814	0.618
HRO-0413-RAZ	10	0	0.825		high	100	0.852	0.883	0.741						
HRO-0422-KVV	494	0.004	0.798		good	57	0.867	0.915	0.849			0.806	0.709	0.768	0.598
HRO-0422-SJI	1923	0.014	0.859		high	100	0.916	0.944	0.906			0.825	0.855	0.816	0.688
HRO-0423-KVA	686	0.005	0.849		high	100	0.879	0.893	0.817			0.847	0.85	0.862	0.78
HRO-0423-KVJ	1089	0.008	0.826		high	97	0.888	0.907	0.791			0.752	0.835	0.992	0.734
HRO-0423-KVS	577	0.004	0.797		good	72	0.903	0.853	0.847			0.831	0.789	0.704	0.58
HRO-0423-RILP	6	0	0.538		moderate	100	0.398	0.626	0.589						
HRO-0423-RIZ	475	0.003	0.766		good	89	0.877	0.861	0.728			0.758	0.677	0.669	0.734

			EO9				A	B	C	D	E	F	G	H	I
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**		**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
HRO-0423-VIK	455	0.003	0.783		good	71	0.869	0.7	0.737			0.785	0.811	0.721	0.873
IT-NAS-C	2592	0	0.638		good	100	0.703	0.284	0.761	0.398	0.199	0.925	0.917	0.938	0.908
IT-Em-Ro-1	371	0.003	0.587		moderate	71	0.801	0.647	0.869	0.416	0.199				
IT-Fr-Ve-Gi-1	575	0.004	0.543		moderate	100	0.843	0.159	0.627						
IT-Ve-1	1646	0.012	0.684		good	100	0.495	0.272	0.87	0.39	0.199	0.925	0.917	0.938	0.908
MAD-SI-MRU-11	55	0	0.752		good	100	0.886	0.351	0.975	0.446		0.87	0.453	0.881	
NAS offshore	**22788**	**0**	**0.52**		**moderate**	**100**	**0.845**	**0.262**	**0.835**	**0.769**	**0.24**	**0.869**	**0.446**	**0.833**	
MAD-HR-MRU-5	5571	0				0									
IT-NAS-O	10540	0.161	0.519		moderate	100	0.844	0.263	0.84	0.775	0.24		0.445		
MAD-SI-MRU-12	129	0.002	0.477		moderate	0	0.889	0.188	0.574	0.375					
Central Adriatic	**63696**	**0**	**0.728**		**good**	**80**	**0.82**	**0.852**	**0.892**	**0.938**		**0.84**	**0.336**	**0.752**	**0.513**
CAS coastal	**9394**	**0**	**0.833**		**high**	**100**	**0.831**	**0.868**	**0.874**	**0.938**		**0.84**	**0.823**	**0.752**	**0.513**
MAD-HR-MRU-2	7302	0	0.83		high	100	0.854	0.894	0.845			0.84	0.823	0.752	0.513
HRO-0313-NEK	253	0.003	0.803		high	67	0.784	0.824	0.689			0.858	0.865	0.883	0.757
HRO-0313-KASP	44	0	0.595		moderate	55	0.724	0.266	0.686			0.875	0.691	0.762	0.2
HRO-0313-KZ	34	0	0.639		good	100	0.816	0.291	0.81						
HRO-0313-MMZ	55	0.001	0.805		high	60	0.837	0.896	0.788			0.828	0.816	0.755	0.676
HRO-0413-PZK	196	0.002	0.733		good	97	0.887	0.737	0.766			0.844	0.842	0.584	0.406
HRO-0413-STLP	1	0	0.644		good	100	0.778	0.335	0.82						
HRO-0423-BSK	613	0.006	0.788		good	76	0.8	0.705	0.792			0.81	0.819	0.804	0.803
HRO-0423-KOR	1564	0.016	0.791		good	85	0.886	0.893	0.888			0.848	0.819	0.731	0.377
HRO-0423-MOP	2480	0.025	0.883		high	100	0.854	0.941	0.852						

			EO9				**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**		**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
IT-CAS-C	2092	0	0.845		high	100	0.779	0.742	0.94	0.938					
IT-Ab-1	282	0.005	0.886		high	100	0.809	0.867	0.932	0.938					
IT-Ma-1	319	0.006	0.836		high	100	0.724		0.947						
IT-Mo-1	229	0.004	0.808		high	61	0.864	0.626	0.934						
CAS offshore	**54303**	**0**	**0.71**		**good**	**80**	**0.817**	**0.85**	**0.896**	**0.925**			**0.32**		
MAD-HR-MRU-4	18963	0.178	0.897		high	100	0.887	0.909	0.894						
IT-CAS-O	22393	0.21	0.551		moderate	69	0.7	0.749	0.899	0.925			0.32		
Southern Adriatic Sea	**44231**	**0**	**0.858**		**high**	**100**	**0.868**	**0.859**	**0.877**	**0.853**	**0.795**	**0.778**	**0.883**	**0.573**	**0.548**
SAS coastal	**7276**	**0**	**0.769**		**good**	**99**	**0.837**	**0.793**	**0.797**	**0.204**	**0.348**	**0.778**	**0.883**	**0.573**	**0.548**
MAD-HR-MRU-2	4252	0	0.73		good	100	0.843	0.877	0.733			0.777	0.745	0.583	0.516
HRO-0313-ZUC	13	0	0.792		good	68	0.843	0.888	0.903			0.769	0.841	0.724	0.487
HRO-0423-MOP	1756	0.031	0.73		good	100		0.877	0.732			0.777	0.744	0.582	0.516
IT-SAS-C (Ap-1)	1810	0.013	0.931		high	100	0.804	0.944	0.943				0.965		
MNE-SAS-C	483	0	0.618		good	99	0.7	0.665	0.667	0.204	0.348	0.791	0.871	0.47	0.884
MNE-1-N	86	0.001	0.7		good	81	0.813	0.928	0.932	0.198	0.629				
MNE-1-C	246	0.002	0.494*		good*	92	0.52	0.525	0.396	0.237	0.2	0.648	0.816	0.15	0.838
MNE-1-S	151	0.001	0.812		high	94	0.852	0.867	0.931	0.182	0.383	0.986	0.973	0.978	0.986
MNE-Kotor	85	0.001	0.546		moderate	99	0.722	0.183	0.446	0.164	0.15	0.858	0.848	0.492	0.838
AL-SAS-C	646	0.005	0.686		good	95	0.917	0.199	0.943						
SAS offshore	**36955**	**0**	**0.875**		**high**	**100**	**0.87**	**0.869**	**0.888**	**0.876**	**0.841**				
IT-SAS-O	22715	0.216	0.876		high	100	0.861	0.877	0.891						
MNE-SAS-O	2076	0	0.882		high	100	0.91	0.924	0.83	0.905	0.841				
MNE-12-N	513	0.005	0.869		high	100	0.927	0.928	0.845	0.863	0.781				
MNE-12-C	713	0.007	0.891		high	100	0.886	0.941	0.809	0.941	0.876				

			EO9				A	B	C	D	E	F	G	H	I
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**		**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
MNE-12-S	849	0.008	0.883		high	100	0.92	0.907	0.839	0.899	0.848				
AL-SAS-O	716	0.007	0.78		good	61	0.924	0.5	0.915						
MAD-EL-MS-AD	2253	0.021	0.886		high	100	0.914		0.884	0.86					

Table 3.1.4.3.4.b: Status assessment results of the NEAT tool applied on the Adriatic nested scheme for the assessment of EO9/CI 17. Contaminants' data are aggregated and integrated per habitat (sediments, mussels). The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. * Light green coloured cell corresponds to subSAU MNE-1-C reconsidered as in good status following justification provided by authorities of Montenegro. The status of this unit was adjusted from moderate to good i.e., color was changed from yellow to light green, without changing the NEAT values, further to the justification related to the status of marine protected area Katic as provided by national authorities**.** The % confidence is based on the sensitivity analysis .

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
Adriatic Sea	**139783**	**0**	**0.738**	**good**	**88**	**0.825**	**0.48**
Northern Adriatic Sea	**31856**	**0**	**0.592**	**moderate**	**84**	**0.637**	**0.545**
NAS coastal	**9069**	**0**	**0.774**	**good**	**100**	**0.741**	**0.814**
MAD-HR-MRU-3	6422	0	0.829	high	100	0.87	0.787
HRO-0313-JVE	73	0.001	0.726	good	100	0.812	0.64
HRO-0313-BAZ	4	0	0.51	moderate	100	0.51	
HRO-0412-PULP	7	0	0.477	moderate	100	0.477	
HRO-0412-ZOI	473	0.003	0.864	high	100	0.877	0.852
HRO-0413-LIK	7	0	0.791	good	86	0.757	0.824
HRO-0413-PAG	30	0	0.796	good	69	0.81	0.781
HRO-0413-RAZ	10	0	0.825	high	100	0.825	
HRO-0422-KVV	494	0.004	0.798	good	57	0.877	0.72
HRO-0422-SJI	1923	0.014	0.859	high	100	0.922	0.796
HRO-0423-KVA	686	0.005	0.849	high	100	0.863	0.835
HRO-0423-KVJ	1089	0.008	0.846	high	97	0.862	0.828
HRO-0423-KVS	577	0.004	0.797	good	72	0.868	0.726
HRO-0423-RILP	6	0	0.538	moderate	100	0.538	
HRO-0423-RIZ	475	0.003	0.766	good	89	0.822	0.709
HRO-0423-VIK	455	0.003	0.783	good	71	0.769	0.797
IT-NAS-C	2592	0	0.638	good	100	0.507	0.922
IT-Em-Ro-1	371	0.003	0.587	moderate	71	0.587	
IT-Fr-Ve-Gi-1	575	0.004	0.543	moderate	100	0.543	

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
IT-Ve-1	1646	0.012	0.684	good	100	0.445	0.922
MAD-SI-MRU-11	55	0	0.7	good	100	0.664	0.735
NAS offshore	**22788**	**0**	**0.52**	**moderate**	**100**	**0.591**	**0.449**
MAD-HR-MRU-5	5571	0			0		
IT-NAS-O	10540	0.161	0.519	moderate	100	0.592	0.445
MAD-SI-MRU-12	129	0.002	0.477	moderate	0	0.477	
Central Adriatic	**63696**	**0**	**0.728**	**good**	**80**	**0.855**	**0.367**
CAS coastal	**9394**	**0**	**0.833**	**high**	**100**	**0.859**	**0.732**
MAD-HR-MRU-2	7302	0	0.83	high	100	0.864	0.732
HRO-0313-NEK	253	0.003	0.803	high	67	0.766	0.841
HRO-0313-KASP	44	0	0.595	moderate	55	0.559	0.632
HRO-0313-KZ	34	0	0.639	good	100	0.639	
HRO-0313-MMZ	55	0.001	0.805	high	60	0.84	0.769
HRO-0413-PZK	196	0.002	0.733	good	97	0.797	0.669
HRO-0413-STLP	1	0	0.644	good	100	0.644	
HRO-0423-BSK	613	0.006	0.788	good	76	0.766	0.809
HRO-0423-KOR	1564	0.016	0.791	good	85	0.889	0.694
HRO-0423-MOP	2480	0.025	0.883	high	100	0.883	
IT-CAS-C	2092	0	0.845	high	100	0.845	
IT-Ab-1	282	0.005	0.886	high	100	0.886	
IT-Ma-1	319	0.006	0.836	high	100	0.836	
IT-Mo-1	229	0.004	0.808	high	61	0.808	
CAS offshore	**54303**	**0**	**0.71**	**good**	**80**	**0.854**	**0.32**
MAD-HR-MRU-4	18963	0.178	0.897	high	100	0.897	
IT-CAS-O	22393	0.21	0.551	moderate	69	0.783	0.32
Southern Adriatic Sea	**44231**	**0**	**0.858**	**high**	**100**	**0.866**	**0.748**
SAS coastal	**7276**	**0**	**0.769**	**good**	**99**	**0.787**	**0.748**
MAD-HR-MRU-2	4252	0	0.73	good	100	0.805	0.655
HRO-0313-ZUC	13	0	0.792	good	68	0.878	0.705

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
HRO-0423-MOP	1756	0.031	0.73	good	100	0.805	0.655
IT-SAS-C (Ap-1)	1810	0.013	0.931	high	100	0.897	0.965
MNE-SAS-C	483	0	0.618	good	99	0.517	0.754
MNE-1-N	86	0.001	0.7	good	81	0.7	
MNE-1-C	246	0.002	0.494*	good*	92	0.375	0.613
MNE-1-S	151	0.001	0.812	high	94	0.643	0.981
MNE-Kotor	85	0.001	0.546	moderate	99	0.333	0.759
AL-SAS-C	646	0.005	0.686	good	95	0.686	
SAS offshore	**36955**	**0**	**0.875**	**high**	**100**	**0.875**	
IT-SAS-O	22715	0.216	0.876	high	100	0.876	
MNE-SAS-O	2076	0	0.882	high	100	0.882	
MNE-12-N	513	0.005	0.869	high	100	0.869	
MNE-12-C	713	0.007	0.891	high	100	0.891	
MNE-12-S	849	0.008	0.883	high	100	0.883	
AL-SAS-O	716	0.007	0.78	good	61	0.78	
MAD-EL-MS-AD	2253	0.021	0.886	high	100	0.886	

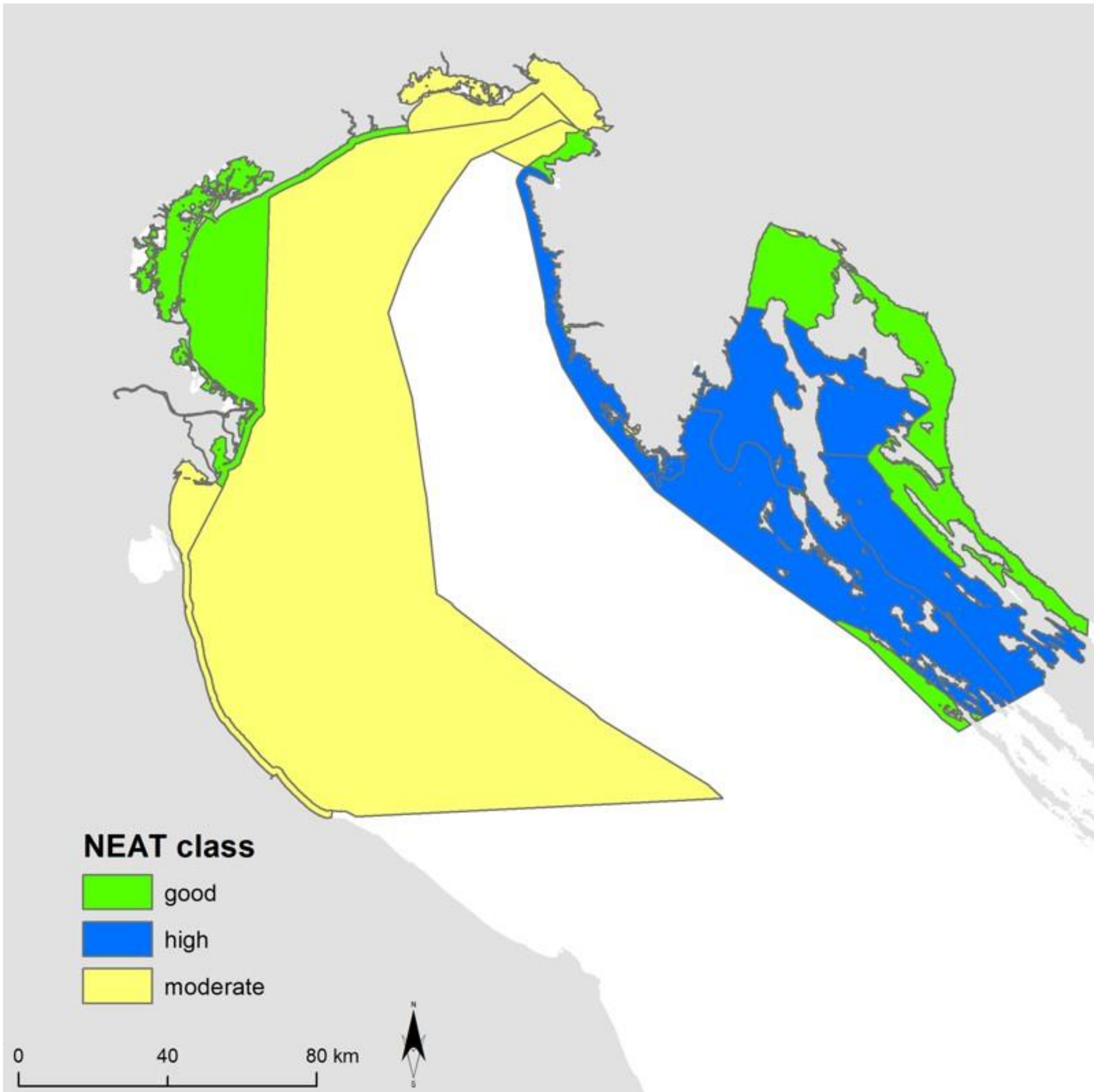


Figure ADR 3.1.4.3.3.C: The NEAT assessment results for IMAP CI17 in the North Adriatic Sea. Aggregation of all contaminants per sub-SAU. Blank area corresponds to no available data/decision or not established monitoring.

529. When all contaminants are aggregated, most sub-SAUs in the NAS Sub-division, are classified under High or Good status and in-GES. Six (6) sub-SAUs are classified under Moderate status, namely the three small coastal sub-SAUs HRO-0313-BAZ, HRO-412-PULP, HRO-0423-RILP in Croatia, two coastal sub-SAUs IT-Em-Ro-1, IT-Fr-Ve-Gi-1 and one offshore SAU IT-NAS-O in Italy.

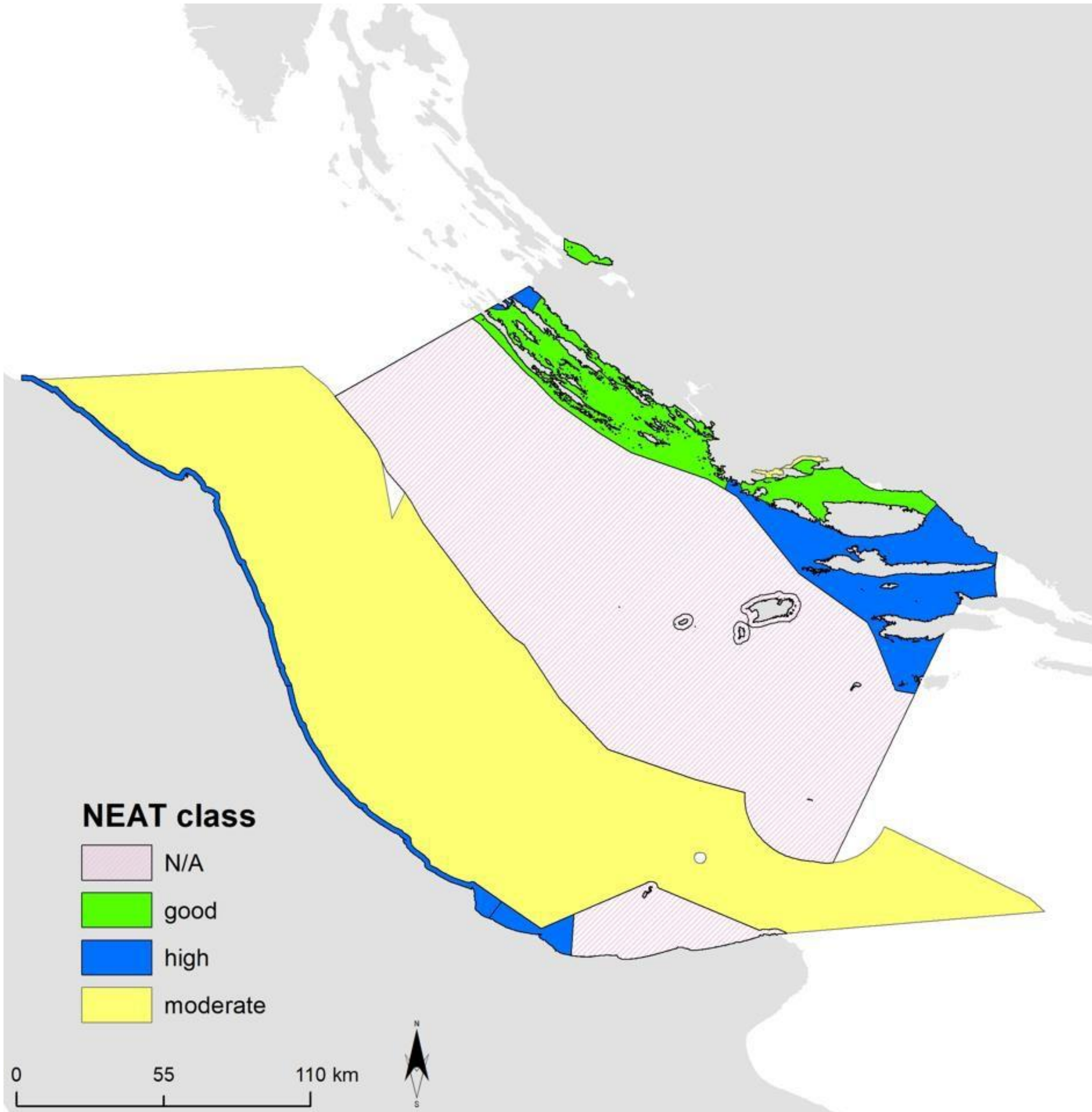


Figure ADR 3.1.4.3.4.C: The NEAT assessment results for IMAP EO9/CI17 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

530. When all contaminants are aggregated, most sub-SAUs in the CAS Sub-division, are classified under High or Good status and in-GES. Only one coastal sub-SAU is classified under Moderate status, namely the coastal sub-SAUs HRO-0313-KASP, HRO-412-PULP, HRO-0423-RILP in Croatia, two coastal sub-SAUs IT-Em-Ro-1, IT-Fr-Ve-Gi-1 and one offshore SAU IT-NAS-O in Italy.

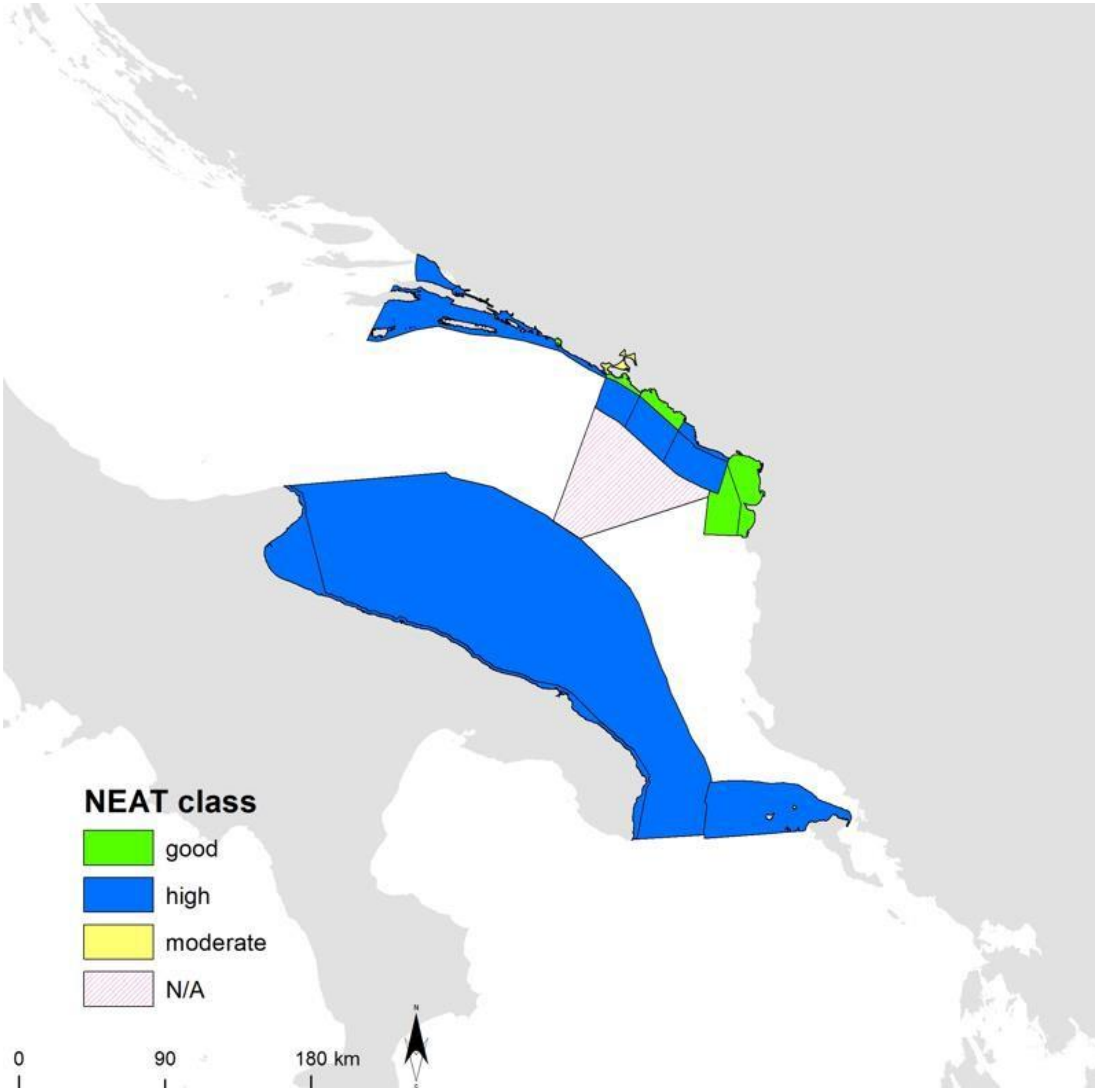


Figure ADR 3.1.4.3.5.C: The NEAT assessment results for IMAP CI17 in the South Adriatic Sea. Aggregation of all contaminants per sub-SAU. Blank area corresponds to no available data/decision or not established monitoring.

531. When all contaminants are aggregated, most sub-SAUs in the SAS Sub-division, are classified under High or Good status and in-GES. Only one coastal sub-SAU is classified under Moderate status, namely the coastal sub-SAU MNE-Kotor in Montenegro.

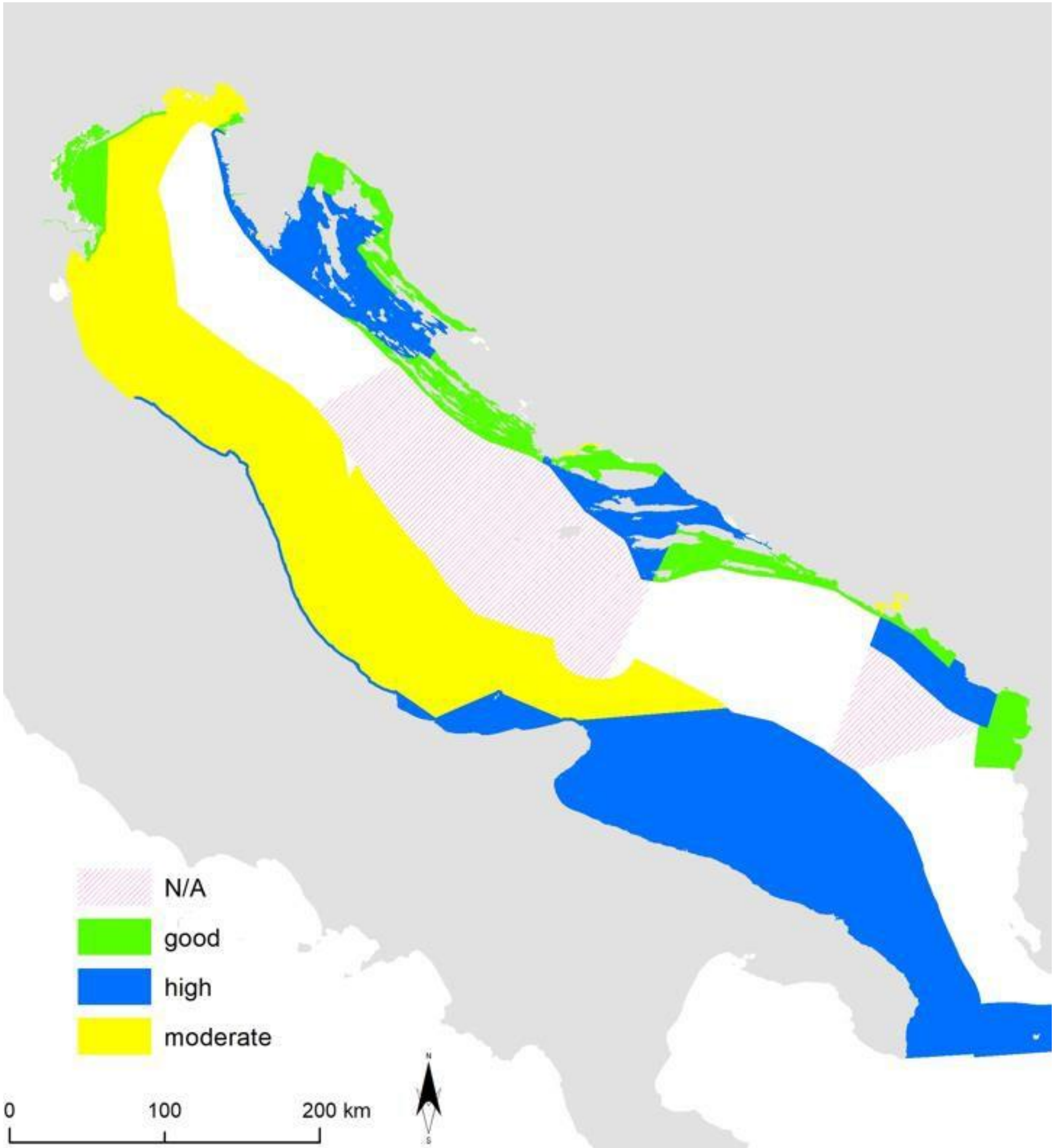


Figure ADR 3.1.4.3.6.C: The NEAT assessment results for IMAP CI17 in the Adriatic Sea sub-region. Aggregation of all contaminants per sub-SAU. Blank area corresponds to no available data/decision or not established monitoring.

The IMAP GES assessment of the Western Mediterranean Sea (WMS) Sub-region

532. The GES for IMAP CI 17 was assessed by applying the NEAT tool on the Western Mediterranean nested scheme in line with the elaboration of the integration and aggregation rules provided for the NEAT tool application in the Adriatic Sea Sub-region, including optimal temporal and spatial integration and aggregation of the assessment findings within nested approach agreed for IMAP implementation. For the purposes of the present work data on contaminants produced within implementation of the national monitoring programmes of the CPs and reported to the IMAP IS or

submitted to UNEP/MAP have been gathered. IMAP SAUs have been defined for the whole WMS, however, based on data availability it was possible to obtain reliable assessment results by using the NEAT tool only for the coastal assessment zones of the Alboran and the Tyrrhenian sub-divisions (ALBS, TYRS), whereby a simplified application of the NEAT tool was chosen only for the IMAP SAUs for which data exist without any spatial integration on the CWMS level.

<u>*Available data*</u>

533. Data on contaminants (Cd, Hg, Pb, PAHs and PCBs) have been collected from the following Contracting Parties bordering the Western Mediterranean Sea for the years 2017 to 2022: France, Italy, Morocco, Spain. In addition, some data for sediments acquired in 2016 and not used in previous assessment have been included in the present work, in order to increase the amount of data, i.e. reliability of the assessment findings. Details on the temporal and spatial availability of data per IMAP SAUs, per environmental matrix (sediments, biota) and per contaminants group (trace metals (TM), PAHs, PCBs) are provided here-below in Table 3.1.4.4.1. The biota matrix is monitored for mussels *Mytilus galloprovincialis* in all cases. The spatiotemporal coverage varies largely among the various IMAP SAUs. Data for the Alboran Sea were reported for 5 out of 8 coastal SAUs, and no data were reported for any offshore SAUs. Data reported by Morocco refer to Cd, Hg, Pb in sediments and biota, while data reported by Spain refer to Cd, Hg, Pb and PCB on biota only. Algeria has not reported any data for the period 2017-2022. Data for the Central part of the Western Mediterranean Sea (CWMS) have been reported only by France, Spain and Italy. France and Spain reported data mostly for biota and only for stations situated in the coastal zone, i.e. France on Cd, Hg, Pb, PAHs and PCBs, and Spain on Cd, Hg, Pb and PCBs. Data for sediments were reported by France (Cd, Hg, Pb) and Spain (PAHs, PCBs, Cd, Hg, Pb) for 2016 only, mostly in coastal waters. Italy in CWMS reports data for sediments only (Cd, Hg, Pb, PAHs, PCBs). In the Tyrrhenian Sea (TYRS) for 6 out 7 coastal SAUs data were reported on contaminants. These are data reported by Italy for sediments on Cd, Hg, Pb, PAHs and PCBs, and data reported by France for biota on Cd, Hg, Pb, PAHs and PCBs and for sediments on Cd, Hg, Pb. Data for biota reported by Italy are very limited, confined to only 2 coastal SAUs and only for Hg, hexachlorobenzene and fluoranthene, hence they were not included in the assessment. Overall, for all sub-divisions of the WMS no data were reported for offshore IMAP SAUs, with the exception of one station sampled once for metals in biota in ES-CWM-LEV1-O SAU and 9 stations sampled for PAHs, PCBs, Cd, Hg, Pb in ES-CWM-LEV1-O SAU and one station in ES-CWM-LEVOS-O SAU, all during 2016.

534. A set of criteria (e.g. representativeness/importance of the areas of monitoring for establishing areas of assessment; presence of impacts of pressures in monitoring areas; sufficiency of quality assured data for establishing the areas of assessment covering as many as possible IMAP Common Indicators to the extent possible, and ensuring that adequate consideration is given to the risk based principle (both in pristine areas and areas under pressure) was applied to propose the scope of the areas of monitoring. Namely, the first element that was considered for the implementation of the nested approach is the definition of the areas of assessment within the Western Mediterranean Sea based on the areas of monitoring. The existing monitoring and assessment areas defined by the concerned CPs were used, in case they were compatible with IMAP requirements; in case of the Contracting Parties that are EU MSs, if inconsistency appeared between IMAP requirements and MSFD MRUs, the necessary adjustments were undertaken.

535. The percentage (%) of surface area of the IMAP SAUs with monitoring data reported to the total area of the coastal assessment zone was calculated in order to better understand differences in the spatial coverage of the SAUs,. Further to this criterion, the spatial distribution of monitoring stations and its comparison with the sufficiency of quality-assured data as collated for NEAT application were analyzed as provided here-below further to the analysis provided regarding the spatial coverage of monitoring data collected per each SAU in the Western Mediterranean Sea and per environmental matrix

(sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately. Table 3.1.4.4.1 provides the temporal coverage of monitoring data used again per each SAU in the Western Mediterranean Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately.

536. For the scope of CI17 monitoring in the Western Mediterranean Sea, the CPs have set 91.5% of the monitoring stations in the coastal zone and no data on contaminants were reported for the period 2017-2022 for any of the offshore stations. Only some data on sediments in Spanish offshore waters were reported for 2016 corresponding to 4% of total number of records. Despite that data were reported for 67% of the coastal IMAP SAUs in the CWMS by France, Spain and Italy, whereby there is a lack of data for whole southern coasts of Algeria and Tunisia. Hence the integrated assessment using the NEAT tool for this subdivision would be unreliable. In addition, based on the highest spatiotemporal coverage of data per matrix and per contaminant, reliable assessments using the NEAT tool can be made for the coastal zone of ALBS subdivision for metals in sediments and biota and for the coastal zone of TYRS subdivision for metals, PAHs and PCBs in sediments. The coastal part of the subdivision CWMS corresponding to French, Spanish and Italian monitoring areas was assessed just for the 1st level using the NEAT tool without any further spatial integration.

Table 3.1.4.4.1. Data availability per year and country for the assessment of EO 9 – CI 17 (contaminants) in the Western Mediterranean Sea (WMS) Sub-region, as available by 31st October 2022.

Source	**IMAP-File**	**Country**	**Year**	**Cd**	**Hg**	**Pb**	**Σ_{16} PAHs**	**Σ_5 PAHs**	**Σ_7 PCBs**	**Lindane**	**Dieldrin**	**Hexachlorobenzene**	**p,p' DDE**
Sediment													
IMAP_IS	224	France	2016	23	23	23							
EMODNet		France	2016	27	27	27	29	29					
IMAP_IS	469	Italy	2016	98	56	98		49	7	77		77	
IMAP_IS	469	Italy	2017	55	50	42		14		31		31	
IMAP_IS	469	Italy	2018	98	94	88		56	25	68		68	
IMAP_IS	469	Italy	2019	55	42	53		24		25		15	
IMAP_IS	243	Morocco	2016	11		11							
IMAP_IS	243	Morocco	2017	11	11	11							
IMAP_IS	243	Morocco	2018	11	11	11							
IMAP_IS	593	Spain	2016	54	54	54			54	54	54	54	54
IMAP_IS	623	Spain	2016					54					
M. galloprovincialis													
IMAP-IS	495	France	2018	23	23	23	23	23		23	23	23	
Reported to UNEP/MAP ('Extraction_RNOMV_2018_2022.csv'		France	2018	19	38	19	7		7				
Reported to UNEP/MAP		France	2019	20	40	20	15		15				
Reported to UNEP/MAP		France	2020	30	30	30	13		13				
Reported to UNEP/MAP		France	2021	28	28	28	15		15				
IMAP-IS	494	Italy	2016		12							12	
IMAP-IS	494	Italy	2017		23							23	
IMAP-IS	494	Italy	2018		15							13	

Source	IMAP-File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_{5} PAHs	Σ_{7} PCBs	Lindane	Dieldrin	Hexachlorobenzene	p,p' DDE
IMAP_IS	494	Italy	2019									2	
IMAP_IS	650	Morocco	2019	4	4	4							
IMAP_IS	650	Morocco	2020	4	4	1							
IMAP_IS	650	Morocco	2021	4	4	4							
IMAP_IS	517	Spain	2017						25	25	25	25	25
IMAP_IS	619	Spain	2017	25	25	25							
IMAP_IS	620	Spain	2019	45	45	45							
M. barbatus													
IMAP_IS	516	Spain	2016						73	73	73	73	73

537. For the application of the NEAT software, data on contaminants were grouped per parameters, ecosystem components (i.e. for the purpose of present NEAT application these are considered biota and sediment matrixes) and SAUs in the Western Mediterranean sub-divisions. Average concentrations (arithmetic means) and their respective standard errors were then calculated in the respective groups as explained above for the Adriatic Sea Sub-region.

538. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or were left blank. In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate into the BC and BAC calculations of the BDL values and not to exclude them. For the present application of NEAT these cases were substituted by the BDL/2 value, given a rather small quantum of data available, this does not influence the calculation of the assessment findings. In the Slovenian data, the BDL values were left blank so these were substituted by a value equal to 1µg/kg which corresponds to the average BDL/2 value from the whole data set. Furthermore, due to this fact, but also considering the list of substances the monitoring of which is mandatory according to IMAP[98], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_{7}PCBs) was taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants.

539. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or equal to the limit of quantification (LOQ). In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate the calculations of the BDL values into the calculation of the BC and BAC and not to exclude them[99]. For the present application of NEAT, BDL were substituted by the BDL/2 value for data reported by Morocco for Hg in sediments. All data reported by Spain are above DL. In data reported by Italy, LOQ values were reported, and these were not uniform for the whole data set. LOQs for the same chemical parameter varied from 0.1 to 10 µg/kg. To compensate the high variability in the LOQs, the LOQ/2 value was used only for those records with reported LOQs equal to 5 and 10 µg/kg. The LOD, LOQ values were analyzed in detail, as reported by the CPs in tdata files. Furthermore, considering the list of substances the monitoring of which is

[98] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

[99] In a separate technical paper, prepared by MEDPOL in consultations with OWG on Contaminants, 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 BDL values from 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 data is BDLs. Therefore, the calculation for the assessment criteria 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 it varies even within the country.

mandatory according to IMAP[100], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_7PCBs) were taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants, similarly to the CI17 assessment made for the Adriatic Sea subregions.

The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach

540. Following the rules of integration of assessments within the nested approach, for the assessment of EO9 Common Indicators, the coastal and the offshore monitoring zones were set as explained above .

541. Detailed explanation on data sources used and methodology followed for setting of the two zones (coastal and offshore) along with SAUs was provided for the purpose of the present work in the Western Mediterranean. In summary, GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase; EEA Marine Regions portal) were used for the present work for Italy, France, Spain, Morocco, Algeria, Tunisia.

542. For IMAP CI 17, integration of assessments up to the subdivision level is considered meaningful. Therefore, three main subdivisions of the Western Mediterranean Sea, have been considered: The Alboran Sea (ALBS); The Tyrrhenian Sea (TYRS) and the Central part of the Western Mediterranean Sea (CWMS), following the specific geomorphological features based on the IHO data[101]. The coverage of the 3 sub-divisions is shown in Figure 3.1.4.4.1.

[100] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

[101] Limits of oceans and seas (1953). 3rd edition. IHO Special Publication, 23. International Hydrographic Organization (IHO): Monaco. 38 pp.

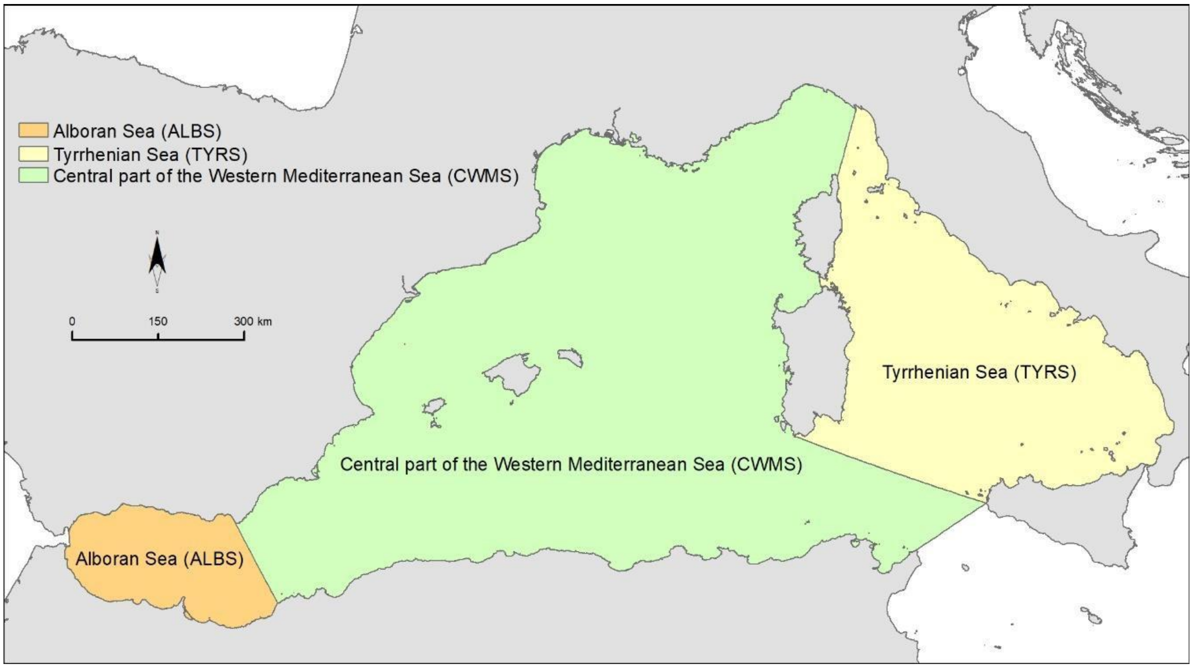


Figure 3.1.4.4.1. The 3 subdivisions of the Western Mediterranean Sub-Region defined, based on IHO data.

543. The four following steps for integration of the areas of assessment was followed to accomplish the objectives of the NEAT IMAP GES Assessment :

- Step 1 “Defining coastal and offshore waters”;
- Step 2 “Recognizing scope of IMAP areas of monitoring”;
- Step 3 “Setting IMAP area of assessment”:
- Step 4 **“**Nesting of the areas of assessment within the application of NEAT tool”: For this step of nesting, the areas of assessment were first classified under the 3 subdivisions of the Western Mediterranean Sea (i.e. ALBS, CWMS, TYRS). A 4 levels nesting approach, as applied in the Adriatic Sea Sub-region was also set for the Western Mediterranean Sub-region (Figure 3.1.4.4.2a), where the 1st level is the finest, providing nesting of all the finest areas of assessment i.e. the national IMAP SAUs & subSAUs within the two key IMAP assessment zones per country i.e. coastal and offshore zones and the 4th level is the highest.

544. However, for the scope of CI17 monitoring in the Western Mediterranean Sea, the CPs have set 91,5% of the monitoring stations in the coastal zone and no data on contaminants were reported for the period 2017-2022 for any of the offshore stations. In addition, only 53% of the coastal IMAP SAUs & sub SAUs for the CWMS reported data (by France and Spain) which makes any spatial integrated assessment using the NEAT tool unreliable for this subdivision. For these reasons, it was not considered meaningful to proceed with a 4 levels’ nesting scheme in all 3 sub-divisions as shown in Figure 3.1.4.4.2.a.

545. Therefore, only the coastal SAUs were considered and nested under a 2 levels` hierarchical scheme and the integration of the assessment results was conducted for the coastal zone of the Alboran (ALBS) and Tyrrhenian Seas (TYRS) sub-divisions as follows:

- 1st level provided nesting of all national IMAP subSAUs within the coastal IMAP assessment zone per country;
- 2nd level provided nesting of the national coastal IMAP assessment zones on the subdivision level i.e., i) ALBS coastal; ii) TYRS coastal.

546. Similarly, the integration of the assessment was conducted in 2 levels as follows:

- 1st level: Detailed assessment results provided for all national coastal subSAUs and SAUs (ALBS, TYRS, some IMAP subSAUs of CWMS)
- 2nd level: Integrated assessment results provided for the coastal zone: i) ALBS coastal; ii) TYRS coastal.

547. The graphical depiction of this nesting scheme for the ALBs and TYRS is shown in Figure 3.1.4.4.2.b. The description of the IMAP SAUs and details on specificities for each country are also provided..

548. Given the integrated assessment up to the 2nd level using the NEAT tool was unreliable for CWMS, the assessment of this subdivision was undertaken just for the 1st level and only for those IMAP subSAUs for which data exist.

549. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, the scope of all WMS SAUs and subSAUS were defined. All of them were introduced in the NEAT tool along with their respective codes and surface area (km^2).

550. The procedure for use by the NEAT tool of data related to SAUs surface, boundary limits, the class threshold values, the concentrations of the group of contaminants assessed, along with normalization of the values, is explained above for the Adriatic Sea Sub-region.

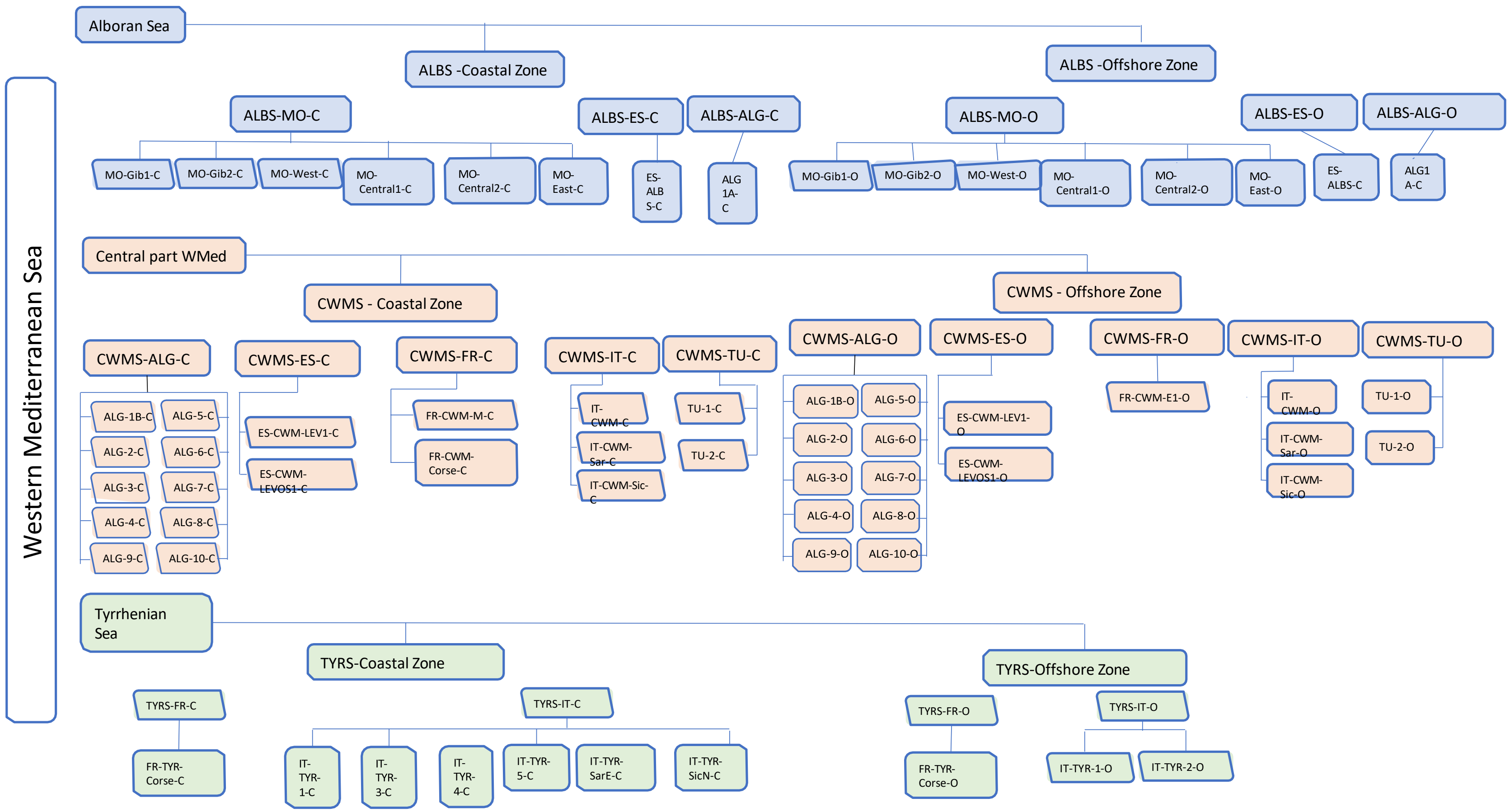


Figure 3.1.4.4.2 (a): The nesting scheme of the SAUs defined for the Western Mediterranean Sea Sub-region based on the available information.

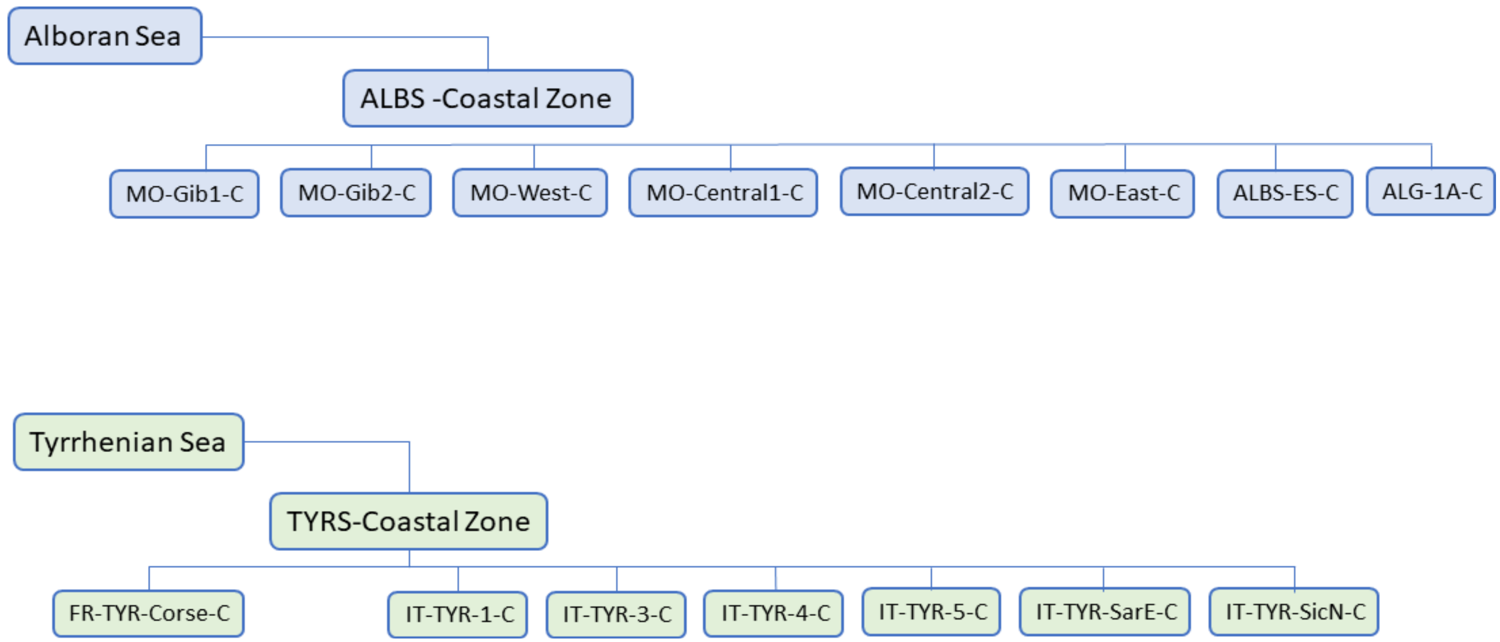


Figure 3.1.4.4.2(b): The 2-level nesting scheme for the Alboran and Tyrrhenian Seas Sub-divisions used for the present assessment of CI17 by applying the NEAT tool.

Setting the GES/non GES boundary value/threshold

551. As explained, the present assessment analysis applying the NEAT tool was conducted for each subdivision using the assessment criteria for the GES-non GES threshold, based on BAC values are shown in Table 3.1.4.4.2.

Table 3.1.4.4.2: The BAC values calculated for the Western Mediterranean Sea and used for the present assessment

	WMED BAC (µg/kg dry wt)	
	Sediments	**Biota (MG)**
Cd	210	1545
Hg	135	120
Pb	24000	1890
$^{*}\Sigma_{16}$ PAHs	240	8.4
$^{+}\Sigma_{7}$ PCBs	1.6	28.6

552. In line with an updated assessment classification for a harmonized application of NEAT and CHASE+ tools in the four Mediterannean Sea sub-regions, the Boundary limits of the 5-class assessment scale and class Threshold values were applied for NEAT GES Assessment of the Western Mediterranean Sea-Sub-region (Table 3.1.4.4.3).

Table 3.1.4.4.3: Boundary limits of the assessment scale and class Threshold values used for the application of the NEAT tool for IMAP. All concentrations are in dry weight.

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/Poor	**Threshold** Poor/Bad	**Upper Boundary Limit**
Sediments	**(µg/kg)**	**0.5(xBAC) (µg/kg)**	**xBAC (µg/kg)**	**2(xBAC) (µg/kg)**	**5(xBAC) (µg/kg)**	**Max. conc. (µg/kg)**
Cd	0	157	315	630	1575	1600
Hg	0	101	202	404	1013	1950
Pb	0	18000	36000	72000	180000	190000
$^{*}\Sigma_{16}$ PAHs	0	240	480	960	2400	30690
$^{+}\Sigma_{7}$ PCBs	0	1.6	3.2	6.4	16	120
Biota (*M. galloprovincialis*)						
Cd	0	1159	2318	4635	11588	12000
Hg	0	90	180	*360*	900	1214
Pb	0	1417	2835	*5670*	14175	15000
$^{*}\Sigma_{16}$ PAHs	0	8.4	16.8	33.6	84	286
$^{+}\Sigma_{7}$ PCBs	0	28.5	57	114	285	290

*sum of the individual BACs or xBACs values of the 16 PAH compounds
$^{+}$ sum of the individual BACs or xBACs values of the 7 PCB compounds

553. Data (i.e. average values inserted), as well as boundary limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level.

Results of the IMAP NEAT GES Assessment of CIs 17 in the Western Mediterranean Sea Sub-region

554. The assessment was conducted in the Alboran Sea subdivision (ALBS) for Cd, Hg, Pb in sediments and biota and in the TYRS for Cd, Hg, Pb, Σ_{16}PAHs and Σ_{7}PCBs in sediments. The simplified application of the NEAT tool (1st level nesting) was applied for the IMAP SAUs of the

CWMS for which data on contaminants exist (Cd, Hg, Pb, Σ_{16}PAHs and Σ_7PCBs in sediments and biota).

555. The results obtained from the NEAT tool using the (xBAC) threshold for the ALBS are shown below in Table 3.1.4.4.4.

556. The detailed status assessment results per contaminant show that most SAUs achieve GES conditions (high, good status) indicated by the blue and green cells. Exceptions to this are moderate classifications for SAUs MO-East-C and ALBS-ES-C for Pb in sediments, MO-Gib2-C for Cd in sediments, and SAU ALBS-ES-C for Hg in mussels.

557. The results obtained from the NEAT tool using the (xBAC) thresholds for the Tyrrhenian Sea subdivision (TYRS) are shown below in Table 3.1.4.4.5.

558. Detailed assessment results for the TYRS subdivision show that SAUs IT-TYR-1-C, IT-TYR-3-C and IT-TYR-4-C fall into moderate status regarding Cd in sediments; regarding Hg in sediments SAUs IT-TYR-1-C and IT-TYR-3-C fall into moderate and poor statuses respectively. Finally, SAU IT-TYR-4-C is classified as moderate regarding Σ_7PCBs.

559. The results obtained from the simplified application of NEAT for the coastal sub-SAUs with data in the CWMS are shown below in Table 3.1.4.4.6, and Figure WMS 3.1.4.4.6.C. Detailed assessments per contaminant per SAU indicate non-GES status for several cases. In sediments, SAU ES-CWM-LEV1-C is classified under moderate status for Pb and SAU FR-CWM_E2-C under poor for Hg. The Italian SAU IT-CWM-C is classified under moderate for Cd and under poor status for Σ_{16}PAHs and Σ_7PCBs. Monitoring data for mussels show that SAU FR-CWM-E2-C is classified under moderate status for Hg and Pb and under poor for Σ_{16}PAHs; SAUs FR-CWM-C-C and FR-CWM-W-C are classified under poor and moderate status respectively regarding Σ_{16}PAHs.

Table 3.1.4.4.4. Status assessment results of the NEAT tool applied on the 2 levels nesting scheme in the Alboran Sea Sub-division, using the xBAC as GES-nGES threshold for the assessment of EO9/CI17. The 2nd level of spatial integration (nesting) on the coastal zone is marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis.

SAU	Area (km^2)	Total SAU weight	NEAT value	Status class	% Confidence	CI17_Cd_seds	CI17_Hg_seds	CI17_Pb_seds	CI17_Cd_mus	CI17_Hg_mus	CI17_Pb_mus
ALBS-coastal	**4900**	**0**	**0.757**	**good**	76.5	**0.621**	**0.971**	**0.754**	**0.909**	**0.592**	**0.749**
MO-East-C	700	0.211	0.846	high	100	0.635	0.98	0.572	0.941	0.977	0.972
MO-Central1-C	805	0									
MO-Central2-C	361	0.109	0.824	high	97.5	0.606	0.98	0.924	0.908	0.733	0.79
MO-West-C	286	0.086	0.824	high	94.2	0.628	0.931	0.968	0.894	0.74	0.783
MO-Gib2-C	67	0.02	0.779	good	67.4	0.573	0.98	0.785			
MO-Gib1-C	71	0									
ALBS-ES-C	1908	0.574	0.701	good	79.9				0.905	0.497	0.702
ALBS-ALG-1A-C	702	0									

Table 3.1.4.4.5. Status assessment results of the NEAT tool applied on the 2 levels nesting scheme in the Tyrrhenian Sea Sub-division, using the xBAC as GES-non GES threshold for the assessment of EO9/CI17. The 2nd level of spatial integration (nesting) on the coastal zone is marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis.

SAU	Area (km^2)	Total SAU weight	NEAT value	Status class	% Confidence	CI17_Cd_seds	CI17_Hg_seds	CI17_Pb_seds	Σ_{16}PAHs_seds	Σ_7PCBs_seds	CI17_Cd_mus	CI17_Hg_mus	CI17_Pb_mus	Σ_{16}PAHs_mus	Σ_7PCBs_mus
TYRS-C	**27511**	**0**	**0.739**	**good**	99.9	**0.66**	**0.674**	**0.786**	**0.873**	**0.72**	**0.711**	**0.68**	**0.813**	**0.619**	**0.99**
FR-TYR-Corse-C	648	0	0.821	high	92.3	0.949	0.913	0.778			0.711	0.68	0.813	0.619	0.99
IT-TYR-1-C	6363	0.263	0.738	good	99.7	0.552	0.582	0.771	0.969	0.816					
IT-TYR-3-C	4122	0.17	0.712	good	100	0.489	0.398	0.806	0.933	0.934					
IT-TYR-4-C	8072	0.334	0.64	good	89.7	0.578	0.75	0.709	0.725	0.44					
IT-TYR-5-C	2685	0													
IT-TYR-SarE-C	2598	0.107	0.832	high	74.7	0.88	0.81	0.806							
IT-TYR-SicN-C	3023	0.125	0.939	high	100	0.971	0.804	0.967	0.983	0.972					

Table 3.1.4.4.6. Status assessment results of the NEAT tool applied on the 1st level IMAP subSAUs in the Central part of the Western Mediterranean Sea Sub-division, using the xBAC as GES-non GES threshold for the assessment of EO9/CI17. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis.

SAU	NEAT value	Status class	% Confidence	CI17_Cd_seds	CI17_Hg_seds	CI17_Pb_seds	Σ_{16}PAHs_seds	Σ_7PCBs_seds	CI17_Cd_mus	CI17_Hg_mus	CI17_Pb_mus	Σ_{16}PAHs_mus	Σ_7PCBs_mus
ES-CWM-LEV1-C	0.788	good	79.6	0.823	0.804	0.598	0.935	0.875	0.896	0.749	0.639		0.796
FR-CWM-M-C	0.677	good	99.2	0.898	0.475	0.688			0.856	0.624	0.676	0.315	0.867
FR-CWM-Corse-C	0.816	high	81.4	0.924	0.888	0.661			0.729	0.698	0.813	0.81	0.99
IT-CWM-C	0.476	moderate	100	0.484	0.675	0.716	0.2	0.304					

560. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs for the ALBS, as shown in Table 3.1.4.4.4. (4th column). It is clear that all SAUs achieve High or Good status and can be considered in GES regarding trace metals. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Alboran subdivision (ALBS-C), results in Good GES status regarding trace metals (shown in bold in Table 3.1.4.4.4).

561. The integration of SAUs data per chemical parameter (Table 3.1.4.4.4., 1st line in bold), shows that the coastal zone of the Alboran Sea (ALBS-C) achieves High or Good status regarding trace metals with the exception of Hg in mussels for which it is classified under Moderate status. The aggregation-integration of data for the coastal zone of the Alboran sub-division (ALBS-C) results in Good GES status regarding trace metals.

562. The results of the assessment findings for the Alboran Sea provided per contaminants of EO9/CI 17 without aggregation per habitat, i.e. sediment and biota, as presented in Table 3.1.4.4.4. Also, the final GES assessment findings for the coastal IMAP SAUs in the Alboran Sea, as provided in Table 3.1.4.4.4.are shown by the respective color in the map included in the following Figure WMS 3.1.4.4.3.C. The map depicts the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants assessed as provided in the 4th column of Table 3.1.4.4.4).

563. The overall status for the coastal assessment zone of the Alboran Sea is Good. Assessment is integrated for metals in sediments and biota.

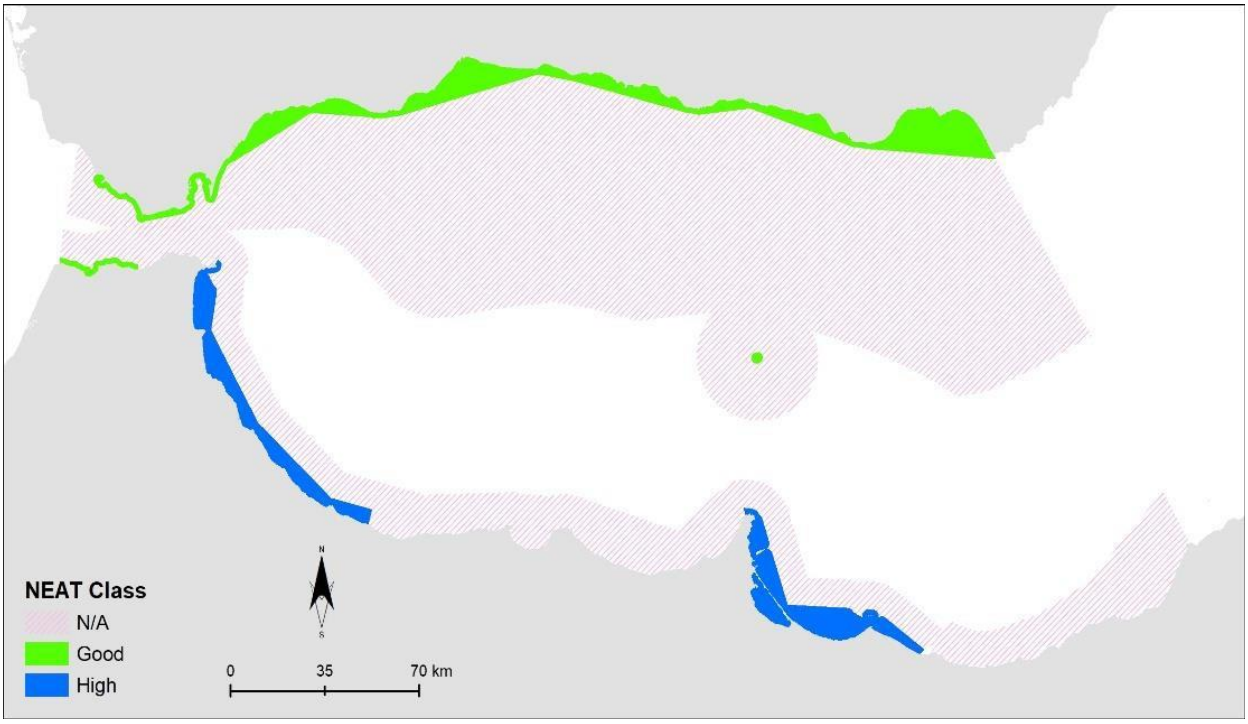


Figure WMS 3.1.4.4.3.C: The NEAT assessment results for trace metals TM in sediments and biota in the coastal assessment zone of the Alboran Sea. Assessment conducted using the xBAC GES-non GES threshold. All IMAP SAUs are in GES characterized by High or Good status. Shaded area corresponds to no available data for the assessment. An absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

564. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs in the TYRS as shown in Table 3.1.4.4.5 (4th column). . All SAUs achieve High or Good status and are in GES regarding contaminants assessed. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Tyrrhenian

subdivision (TYRS-C) however, results in Good GES status regarding contaminants assessed (shown in bold in Table 3.1.4.4.5.).

565. The integration of SAUs data per chemical parameter (Table 3.1.4.4.5., 1st line in bold), shows that the coastal zone of the Tyrrhenian Sea (TYRS-C) achieves High or Good status regarding chemical contaminants assessed. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Tyrrhenian subdivision (TYRS-C) as a whole indicates it can be considered in Good GES status regarding chemical contaminants assessed (shown in bold in Table 3.1.4.4.5.).

566. The final GES assessment findings per contaminants for sediments in the coastal IMAP SAUs in the Tyrrhenian Sea, as provided in Table 3.1.4.4.5., are shown by the respective color in the map included in Figure WMS 3.1.4.4.4.C. The map depicts the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants assessed as provided in the 4th column of Table 3.1.4.4.5).

567. The overall status for the coastal assessment zone of the Tyrrhenian Sea is Good regarding contaminants assessed. Assessment is integrated for metals, Σ_{16}PAHs and Σ_{7}PCBs in sediments.

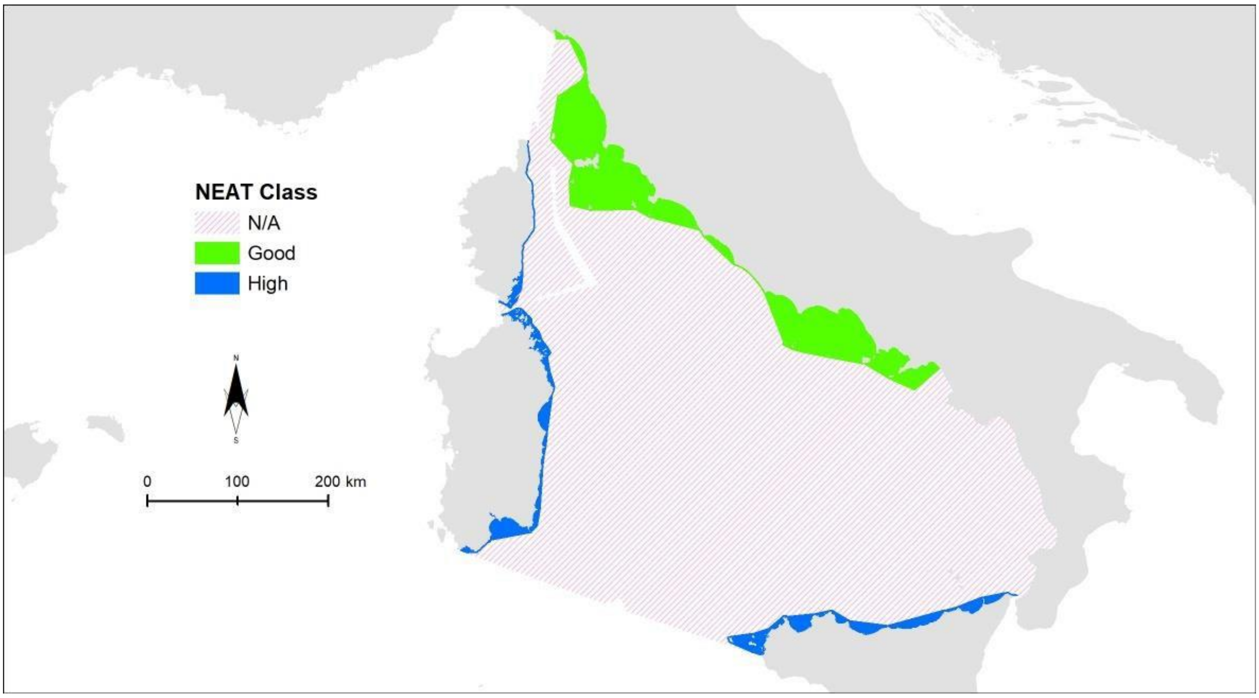


Figure WMS 3.1.4.4.4.C: The NEAT assessment results for trace metals TM, Σ_{16}PAHs and Σ_{7}PCBs in sediments in the coastal assessment zone of the Tyrrhenian Sea. Assessment conducted using the xBAC GES-non GES threshold. All IMAP SAUs are in GES characterized by High or Good status. Shaded area corresponds to no available data for the assessment. An absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

568. The aggregation of the chemical parameters data per SAU in the CWMS leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 3.1.4.4.6. (4th column) and Figure WMS 3.1.4.4.5.C for the CWMS. All SAUs achieve High or Good status and are in GES with the exception of SAU IT-CWM-C where only sediments are monitored, and the overall status for this SAU is moderate regarding contaminants assessed.

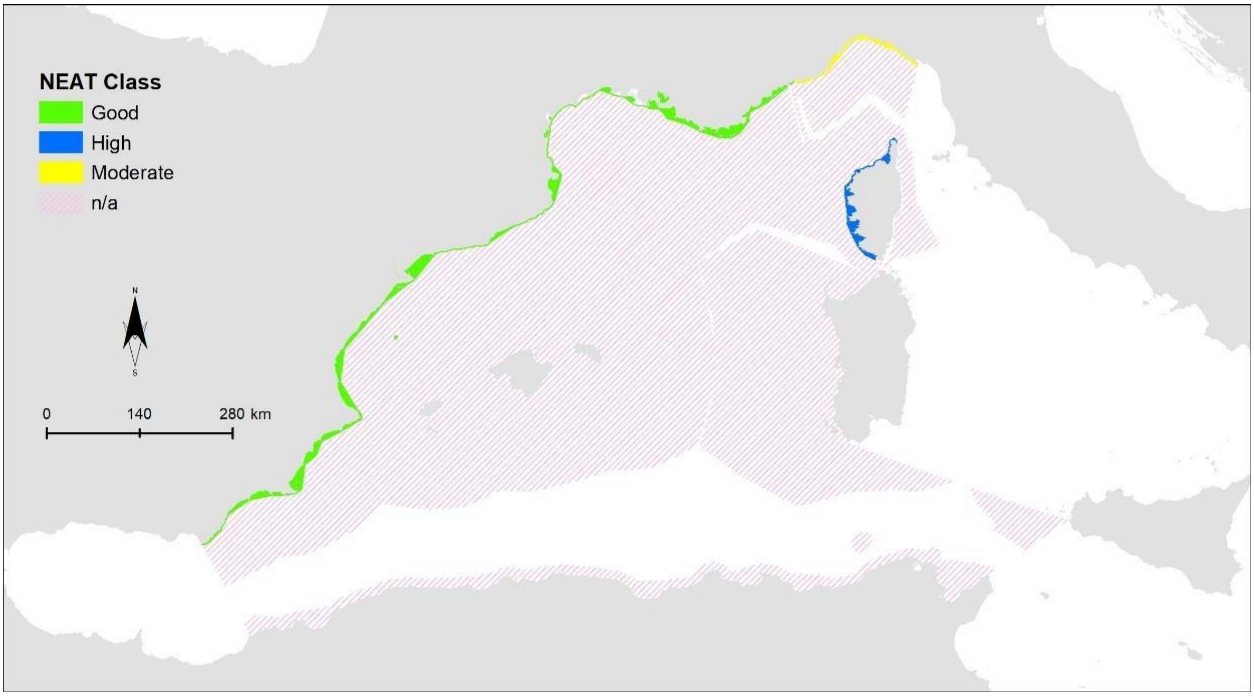


Figure WMS 3.1.4.4.5.C. The NEAT assessment results for trace metals TM, Σ_{16}PAHs and Σ_{7}PCBs in sediments and mussels in the SAUs of France and Spain and in sediments in the SAU of Italy in the CWMS. Assessment conducted using the xBAC GES-nGES threshold. All IMAP SAUs are in GES characterized by High or Good status except sediments assessment in IT-CWM-C which shows moderate status. Shaded area corresponds to no available data for the assessment. An absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

569. Based on the availability of data for contaminants as delivered by the CPs in the Western Mediterranean Sea Sub-region, the present integrated assessment status results produced by applying the NEAT tool on the sub-divisions ALBS and TYRS (shown in Tables 3.1.4.4.4. and 3.1.4.4.5;) can only be considered as an example of how the tool works. This is related to the fact that offshore SAUs lack of data, hence integration is meaningful only up to the 2nd level, i.e. the coastal assessment zone (ALBS-coastal and TYRS-coastal) [102]. Furthermore, several coastal SAUs lack data or the countries eventually decided not to monitor the areas that are found irrelevant for the assessment of contaminants and therefore excluded the areas where problems were not historically observed (blank cells in Tables 3.1.4.4.4., 3.1.4.4.5 and 3.1.4.4.6).

[102] Given lack of data for some SAUs, integration at a higher level that also includes these SAUs makes the uncertainty high.

Assessment of IMAP Common Indicator 18: Level of pollution effects of key contaminants where a cause and effect relationship has been established

Geographical scale of the assessment	The Sub-regions within the Mediterranean region by using scientific literature sources
Contributing countries	Countries in alphabetical order: Algeria, Egypt, Italy, Spain, Tunisia, Türkiye based on scientific literature sources
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI18. Level of pollution effects of key contaminants where a cause and effect relationship has been established
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are not giving rise to acute pollution events
GES Targets (UNEP/MED WG473/7) (2019)	• Contaminants effects below threshold • Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and off-shore activities.
GES Operational Objective (UNEP/MED WG473/7) (2019)	Effects of released contaminants are minimized.

Available data

570. The list of bibliographic studies on biomarkers used for the preparation of the 2023 MED QSR is sorted alphabetically by country as shown in Table 3.1.5.1.

571. Based on the literature search results it can be concluded that a comparison among the studies is hard or mostly impossible. This is due to the use of different biomarkers, with different biota species, using different tissues, and different methodologies. Moreover, as found in the 2017 QSR, there are confounding factors that hinders environmental status assessment such as species, gender, maturation status, season and temperature. In addition, an inherent bias exists in publications towards studies showing an effect. Authors and journals do not usually publish studies showing lack of effect or response. Italy submitted national data for CI 18 following the Meeting of CorMon Pollution that took place in Athens, 1-2 March 2023[103].

[103] Data included biomarkers (Acetylcholinesterase activity, Lysosomal membrane stability on cryostat sections, Micronuclei frequency, Metallothioneins, EROD-microsomal, EROD-S9, Fulton's Condition Factor, Gonadosomatic Index and Hepatosomatic Index) were measured in the fish M. barbatus sampled in 2019 and 2020. Data were not uploaded in the IMAP-Info System because they were found not compliant given the lack of data related to the 'maturation key' and of the 'tissue weight', which are considered mandatory. The national data could not be integrated into the CI 18 assessment as the 2023 MED QSR for CI18 was based on the use of regional scientific literature sources, using the evaluation provided by the authors. The newly submitted data of Italy were all for M. barbatus, for which no criteria were adopted yet, by the CPs. The assessment criteria for the biological effects on *M. barbatus* might be set in the future conditional to optimal data reporting by the CPs. Moreover, no conclusions were also set in the scientific literature.

Table 3.1.5.1: Studies on biomarkers in the Mediterranean Sea since 2016 reviewed in present assessment of CI 18. The list is sorted alphabetically by country.

Reference	Country	Sub-region	Sampling year	Taxa	Species	Organ/tissue	Stressor	Biomarker
Kaddour et al. 2021	Algeria	WMS	2019-2020	Fish	*Mullus barbatus*	blood	non specific	MN, NRRT
Amamra et al. 2019	Algeria	WMS	2016	mollusc	*Donax trunculus*	gonad, mantle, digestive gland	non specific	AChE, GST, MDA
Benaissa et al. 2020	Algeria	WMS	2016	mollusc	*Patella rustica*	Soft tissue	desalination brine	AChE, CAT, SOD, GR, GPx, GST, LPO, Genotox
Laouati et al. 2021	Algeria	WMS	2017	mollusc	*Perna perna*	digestive gland and gills	non specific, TM	AChE, CAT, GSH, GST, MDA
Gabr et al. 2020	Egypt	AEL	2018-2019	mollusc	*Ruditapes decussatus*	soft tissue	TM	AChE, SOD, GPx, MDA
Salvaggio et al. 2019	Italy	FAO Area 37	not reported	Fish	*Lepidopus caudatus*	liver, gonads	Microplastic, TM	VTG, MT
Frapiccini et al. 2021	Italy	ADR	2019	Fish	*Mullus barbatus*	muscle	PAH	CAT,SOD,GST,LPO
Chenet et al. 2021	Italy	CEN	2018	fish	*Trachurus trachurus*	liver	plastic	VTG, MT
Morroni et al. 2020	Italy	WMS	2017	Fish	*Diplodus vulgaris*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Morroni et al. 2020	Italy	WMS	2017	Fish	*Mullus barbatus*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Morroni et al. 2020	Italy	WMS	2017	Fish	*Pagellus erythrinus*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Parrino et al. 2020	Italy	WMS	not reported	Fish	*Parablennius Sanguinolentus*	Brain and blood	pesticides	AChE, BChE
Morroni et al. 2020	Italy	WMS	2017	mollusc	*Mytilus galloprovincialis*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Capo et al. 2022	Spain	WMS	2019	Fish	*Sparus aurata*	blood, plasma, liver	microplastic, plasticizers	CAT,SOD,GRd,GPx, MPO, GST, MDA, EROD, BFCOD, CE
Solomando et al. 2022	Spain	WMS	2020	Fish	*S. dumerili*	liver	microplastic	CAT,SOD,GST, EROD, MDA
Rios-Fuster et al. 2022	Spain	WMS	2019	mollusc	*Mytilus galloprovincialis*	Soft tissue	Anthrop. Particles, bisphenols , phthalate	CAT,SOD,GRd,GPx, GST, TES, GLY, CE, LPO, CARB, GSH
Capo et al 2021	Spain	WMS	not reported	mollusc	*Mytilus galloprovincialis*	gills	microplastic	CAT,SOD,GRd,GPx, GST,MDA, ROS
Rodríguez-Romeu et al., 2022	Spain	WMS	2019	Fish	*Engraulis encrasicolus*	Muscle and liver	Anthopogenic items ingestion	AChE, LDH, CS, CE, CAT, GST, EROD
Mansour et al. 2021	Tunisia	CEN	2016	mollusc	*Ruditapes decussatus*	Soft tissue	hydrocarbons	CAT,SOD,GRd,MDA, AChE

Reference	Country	Sub-region	Sampling year	Taxa	Species	Organ/tissue	Stressor	Biomarker
Zaidi et al. 2022	Tunisia	CEN	2018	mollusc	*Patella caerulea*	soft tissue	TM	CAT,SOD,GPx,GST,MDA
Ghribi et al. 2020	Tunisia	CEN	2017 mesocosm	mollusc	*Mytillus spp*	hemolymph, gills, and digestive gland	non specific PAH, TM	CAT, GPx, GST, AChE
Missawi et al. 2020	Tunisia#	CEN	2018	Seaworm	*Hediste diversicolor*	whole (gut cleaned)	Microplastic	CAT,GST,MDA, AChE
Zitouni et al. 2020	Tunisia*	WMS	2018	Fish	*Serranus scriba*	gastrointestinal tract	Microplastic	CAT,GST,MDA, AChE,MT
Telahigue et al. 2022	Tunisia	WMS	2020-2021	mollusc	*Flexopecten glaber*	gills, digestive gland	TM	CAT,SOD,GPx,GSH, MT, MDA
Bouhedi et al 2021	Tunisia	WMS	not reported	polychaete	*Perinereis cultrifera*	whole body	TM	CAT,GST, AChE, MT, GSH, TBARS
Uluturhan et al. 2019	Türkiye	AEL	2015	mollusc	*Mytilus galloprovincialis*	Hepatopancreas	TM, Pesticides	CAT,SOD,GPx, AChE
Uluturhan et al. 2019	Türkiye	AEL	2015	mollusc	*Tapes decussatus*	Hepatopancreas	TM, Pesticides	CAT,SOD,GPx,AChE
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Mullus barbatus*	muscle, liver	TM	CAT, MDA
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Boops boops*	muscle, liver	TM	CAT, MDA
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Trachurus trachurus*	muscle, liver	TM	CAT, MDA

#data related to the WMS as well; * data related to the CEN as well.
Biomarkers Abbreviations: AChE-Acetylcholinesterase, BChE-Butyrylcholinesterase, BFCOD-7-benzyloxy-4-[trifluoromethyl]-coumarin-O-debenzyloxylase, CAT-Catalase, CE-Carboxylesterase, CS-Citrate synthase,EROD-Ethoxyresorufin-O21 deethylase, ETS-Electron Transport System, GLY-Glycogen, GPx-Glutathione peroxidase, GRd-Glutathione reductase, GSH- Glutathione, GST-Glutathione-S-transferase, LDH-Lactate dehydrogenase, LMS-Lysosomal Membrane Stability, LPO-Lipid peroxidation, MDA-Malondialdehyde, MN-Micronucleus Assay, MT-Metallothionein, NRTT-Neutral red retention time, SOD-Superoxide dismutase, SoS-Stress on Stress,VTG-Vitellogenin

Results of the IMAP Environmental Assessment of CI 18 in the Mediterranean region.

Due to absence of any data reporting by the CPs, data for present assessment were retrieved from the scientific literature. The studies surveyed do not include the parameters assessed in the 2017 MED QSR in mussel. The only exception is Morroni et al., 2020 that measured LMS, AChE and MN in *M. galloprovincialis* but not in the same organs except for MN that was measured in haemocytes with a value of 0.3 permil in reference area and a maximal value of 1.3 permil. The maximal value is slightly higher than 1 permil, the MED BAC adopted in Decision IG.23/6. Ghribi et al., 2020 and Uluturhan et al, 2019 reported AChE in haemolymph and hepatopancreas, respectively and not in gills.

572. Given GES assessment was not possible for CI 18 within the preparation of the 2023 MED QSR, the regional overall assessment findings were provided for the Mediterranean as presented here-below. Instead of providing GES /non-GES classification, the assessment for IMAP CI 18 was based on the determination of biomarkers that were affected by contamination.
573. A summary of reviewed studies is sorted by sub-regions and countries. The biomarkers that were affected by contamination are marked in red, those that were not affected are marked in green, while inconclusive results are marked in blue. Moreover, the biomarkers included in the DDs and DSs are highlighted in yellow, but with no differentiation among species or tissues studied.

a) AEL sub-region (Egypt, Türkiye)

574. Egypt. One study was reviewed. The effect of TM was studied in the mussel *Ruditapes decussatus* collected from Alexandrian Port and Port Said (Gabr et al. 2020). The concentrations of metals were higher in samples from the Alexandrian Port (Site I). Malondialdehyde (MDA) and SOD were higher in samples from Site I while GPx, Total protein and AChE were lower. The reported values in this study are considered as basic data to monitor of the anthropogenic influence on the coastal environment.

575. Türkiye**.** Two studies were reviewed for Türkiye: one from 2015 and one from 2022[104]. The effect of TM and pesticides was studied on the molluscs *Mytilus galloprovincialis* and *T. decussatus* collected from Homa Lagoon (Aegean Sea). The study showed marked differences on the biomarkers (CAT, SOD, GPx, and AChE) but the differences were mainly attributed to seasonal variations and to differences among the two species (Uluturhan et al. 2019). The effect of TM was also studied in the fish *M. barbatus, B. boops and T. trachurus* collected along the coast of Türkiye in the Levantine and the Aegean Seas. Correlations were found between CAT and MDA and some of the trace metals measured in the fish specimens.

b) ADR sub-region (Italy)

576. Italy. One study reported the effect of PAHs in the fish *Mullus barbatus* collected in the northern Adriatic (Frapiccini et al. 2020). The expressions of CAT and GST in *M. barbatus* were dependent on the season, lower in the winter and higher in the summer. SOD expression did not depend on the season. LPO was higher in the winter. CAT showed a significant negative correlation with total

[104] Submitted to Research Square, not peer reviewed by a scientific journal

PAH concentrations, especially total LMW-PAH, in individuals collected during winter. Both GST and SOD did not show any significant correlation with PAH levels.

c) CEN sub-region (Tunisia, Italy)

577. Seven studies were reviewed for Tunisia: 2 from the WMS , 3 from the CEN and 2 with data from both the WMS and the CEN. In the CEN, one mesocosm experiment was performed in *Mytilus spp*. exposed to sediment contaminated by PAH and TM collected from the Zarzis area (Ghribi et al. 2020), while the effects of hydrocarbons were studied in the mollusc *Ruditapes decussatus* collected from the southern Lagoon of Tunis (Mansour et al. 2021). The effect of TM on the mollusc *Patella caerulea* was studied in specimens collected from 4 sites in the CEN (Zaidi et al. 2022).

578. *Mytilus spp* exposed to contaminated sediments in a mesocosm experiment presented the highest values of the tested oxidative stress biomarkers (CAT, GST, GPx) and a significant inhibition of AChE activity in comparison with the unpolluted reference site.

579. Hydrocarbons were found to affect the biomarkers CAT, GR, SOD, MDA and AChE activities in *Ruditapes decussatus.*

580. SOD and GPx activities measured in *P. caerulea* were different among sites (higher in more affected stations), while CAT was similar on all four stations. MDA was inducted but no differences were found among the sites.

581. Italy. In the CEN, the effect of plastic ingestion was studies in the fish *Trachurus trachurus* collected for the Sicily straits (Chenet et al. 2021).

582. Vitellogenin was highly expressed in *T. trachurus* females as expected, there is also a significant expression of the VTG gene in 60% of the males analyzed, from both sampling sites. Moreover, females in Lampedusa island showed a lower expression of vitellogenin than in Mazara del Vallo (with one female sample, TT54, not expressing VTG at all). The endocrine disruption represented by the alteration of VTG expression in specimens observed in this work can be caused by microplastic ingestion, as well as by the interactions between the marine organisms and the wide variety of endocrine-disrupting chemicals possibly present in seawater.

d) WMS sub-region (Algeria, Spain, Tunisia, Italy)

583. Algeria. Four studies reviewed for Algeria studied the effects of non-specific stressor in the mollusc *Donax trunculus* from Annaba Bay (Amamra et al. 2019) , in the fish *Mullus barbatus* along the Algerian west coast (Kristel, Oran, Ghazaouet) (Kaddour et al. 2021), on the mollusc *Perna perna* transplanted to the Gulf of Annaba initianorth-eastern coast) (Laouati et al. 2021) and on the mollusc *Patella rustica* affected by the brine of the Bousfer desalination plant in Oran Bay (Benaissa et al. 2020).

584. *Donax trunculus* specimens showed a significant inhibition of AChE and induction of GST and MDA in individuals of Sidi Salem and Echatt as compared to El Battah with significant effects of both site and season. The effects were more pronounced during summer and spring compared to the other seasons. In addition, the comparison between tissues revealed a more marked response in gonad than mantle and digestive gland.

585. In *M. barbatus*, a significant increase in the frequency of micronuclei (MN) occurrence in the summer period correlated with significantly shorter NRRT. In addition, the erythrocytes of *M. barbatus populations* from polluted areas presented statistically higher MN frequencies and shorter NRRT than those of the reference site.

586. GSH decreased in the gills and digestive glands of *P. perna* specimens transplanted to two of the sites affected by anthropogenic input while GST and CAT activities showed no significant variation. The MDA content in the mussel digestive glands, but not in the gills, increased significantly after the deployment period in the three caging sites, and were significantly different among the 3 sites. AChE activity was significantly inhibited registered in the gills of mussels from the 3 sites and in the digestive glands from one site.

587. A multibiomarker approach (oxidative stress, biotransformation enzyme, lipid peroxidation, neurotoxicity and genotoxicity) were applied in the soft tissue of *P. rustica* . This biomonitoring confirmed the negative impact of brine discharges of the desalination plant, with samples collected close to the outfall more affected. by all the environmental disturbances than ones from the other sites. CAT, TGPx, GR, GST, CSP-3like activities were increased in samples from the outfall. AChE was lower however not significantly different from samples collected from the reference site. Genotoxic effect revealed by ADN and lipid damages.

588. Spain. Five studies were reviewed for Spain: four studies studied the effect of microplastic ingestion and of plasticizers on the biomarker responses, while one studied the effect of anthropogenic items ingestion. Three studies were conducted in the Integrated Multi-Trophic Aquaculture cages in Palma de Majorca, where specimens of the mussel *Mytilus galloprovincialis* and of the fish *Sparus aurata* were transplanted to and analyzed at time 0, after 60 days (T_{60}) and after 120 days (T_{120}) of exposure (Capó et al. 2022, Capo et al. 2021, Rios-Fuster et al. 2022). One study was performed with *S. dumerili* collected around the Balearic Islands (Solomando et al. 2022). Anthropogenic items ingestion was studied in *E. encrasicolus* collected off Catalunia (Rodríguez-Romeu et al. 2022).

589. No effects of time were observed in CAT, SOD, and GRd activities *M. galloprovincialis*, but they were significantly higher in specimens sampled from the cages than in specimens from the controls. GST activity did not change with time, and it increased significantly only in samples for the cages at T_{60}. In T_{120} activity was higher in the cages only if compared to one of the control sites. GPx activity was modulated by both sampling site and time: higher activities in specimens from the cages at T_{120}. MDA was higher in samples from the cages compared to the controls at T60. In a different study with *M. galloprovincialis* higher expressions were observed in the biomarkers CAT, SOD, GPx and LPO in specimens from the aquaculture cages. Those could be triggered by the presence of bisphenol but also by other possible contaminant inputs from the aquaculture.

590. MDA increased throughout the study both in liver and blood cells of *S. aurata* but with a progressive decrease in plasma. EROD, BFCOD and CE, showed a comparable decrease at T_{60} with a slight recovery at T_{120}. In contrast, GST activity was significantly enhanced at T_{60} compared to the other sampling stages.

591. SOD, CAT, and GST activity were significantly higher in *S. dumerili* with higher microplastic (MP) load, while no significant differences were observed for MDA, and EROD enzyme activity.

592. AChE, CAT and GST were lower in *E. encrasicolus* collected off Barcelona, compared to specimens collected Blanes and Tarragona; Terragona LDH, CE and EROD were higher in Terragona

than in the other two locations; Blanes CS was higher than in Tarragona. These differences could not be correlated with any potential stressors nor with fish size Catalunia (Rodríguez-Romeu et al. 2022).

593. Italy. Five studies were reviewed for Italy: 2 from the WMS, 1 from FAO zone 37 (not further specified), 1 from the CEN, 1 from the ADR . In the WMS, the effect of pesticides were studied in the fish *Parablennius sanguinolentus* from the port of Bagnara (western Calabria) (Parrino et al. 2020), and the effect of TM and PAHs on mollusc (*Mytilus galloprovincialis*) and fish (*Mullus barbatus, Pagellus erythrinus* and *Diplodus vulgaris)*from the bay of Pozzuoli (Naples)(Morroni et al. 2020). Microplastics and TM effects were studied on the fish *Lepidopus caudatus* collected from FAO area 37 (area not further specified) (Salvaggio et al. 2019).

594. AChE activity in the brain and BChE activity in blood were significantly inhibited in specimens of *P. sanguinolentus* from the affected port area, by 23.5 and 72.0%, respectively. The esterase inhibition was primarily due to carbamate and organophosphorus insecticides presence.

595. In the Bay of Pozzuoli, the effect of pollution varied by species and biomarkers. In *M. galloprovincialis*, there was a decreased LMS and increased MN at two sites compared to organisms from other areas while no variations were observed for the AChE in haemolymph, nor for MT in digestive gland of mussels from various sites. AChE activity was not affected in *M. barbatus* sampled in the industrial area while a decrease of this biomarker AChE was observed in *P. erythrinus* and *D. vulgaris*. The EROD enzymatic activity was significantly induced in *M. barbatus* and *P. erythrinus* sampled in the industrial area compared to specimens from the reference site, while the cytochrome P450 biotransformation pathway was unaffected in *D. vulgaris*. At the same time, all the fish species exhibited higher levels of aromatic metabolites, particularly B[a]P-like and pyrene-like, in organisms sampled in the industrial compared to reference area. MN increased in gills of *M. barbatus* from the industrial area.

596. Immunohistochemical analysis for anti-metallothionein 1 antibody in *L. caudatus* showed a strong positivity of liver cells, both in females and males, showing a strong stress that activated a cell detoxification system. The immunohistochemical analysis for the anti-vitellogenin antibody showed in females a strong positivity both in the liver cells, and in the gonads, as expected. The analysis of the liver and gonadal preparations of the male specimens was found to be always negative except for one specimen.

597. Tunisia. Seven studies were reviewed for Tunisia: 2 from the WMS, 3 from the CEN and 2 with data from both the WMS and the CEN. In the WMS, the effect of TM was studied in the mollusc *Flexopecten glaber* collected from the Bizerte Lagoon (Telahigue et al. 2022) and on the polychaete *Perinereis cultrifera* collected from the port of Tades and the Punic port of Carthage (Bouhedi et al. 2021). The following 2 studies have data from the two sub-regions: WMS and CEN. The effect of microplastic ingestion was studied in the fish *Serranus scriba* collected from 6 sites along the Tunisian coast (Zitouni et al. 2020) and on the seaworm *Hediste diversicolor* collected from 8 sites along the Tunisian coast (Missawi et al. 2020).

598. The distribution of most analyzed metals in *F. glaber* tissues varied significantly between sites, seasons, and organs. The highest levels were recorded at the polluted site during the warm period. Moreover, the digestive gland was found to accumulate greater concentrations of TM than the gills. The biomarkers (MDA, GSH, GPx, SOD, CAT) in gills were higher in the polluted site while MT was not affected. In the digestive gland, only CAT and MDA showed an increase activity in the polluted site.

599. Higher level of thiobarbituric acid were found in *P. cultrifera specimens* from polluted site. In addition, CAT, GST, SOD, glutathione and MT were enhanced and AChE activities decreased in *specimens from* the contaminated site compared to those from the reference (or less contaminated site).

600. Biomarkers of oxidative stress (MT, CAT, GST, MDA) and neurotoxicity (AChE) responses in *S. scriba* were dependent on site and on the size of the microplastic. High content of microplastic in the gastrointestinal track increased MT levels and GST activity. CAT activity and MDA accumulation were positively related with the medium size class MP A significant negative correlation was found between AChE activity and the small size class of microplastic (MP). The study could not rule out some influence of other pollutants that may be present in some of the sites on biomarker response.

601. In the seaworm *Hediste diversicolor,* responses increased with increased microplastic tissue concentration, in particular CAT but also MDA. A decrease of GST activity was reported in the same sites. AChE was significantly inhibited indicating neurotoxicity.

602. ***Figures 3.1.5.1 and 3.1.5.2*** depict the sampling areas. Figure 3.1.5.1 shows the whole Mediterranean Sea, while Figure 3.1.5.2 shows in detail the study areas off eastern Algeria and Tunisia, where many of the reviewed studies were performed.

Figure 3.1.5.1. Areas of study for biomarkers, reviewed in the recent (since 2016) scientific literature for the Mediterranean Sea. When no coordinates were presented in the papers, the general area was marked in the map.

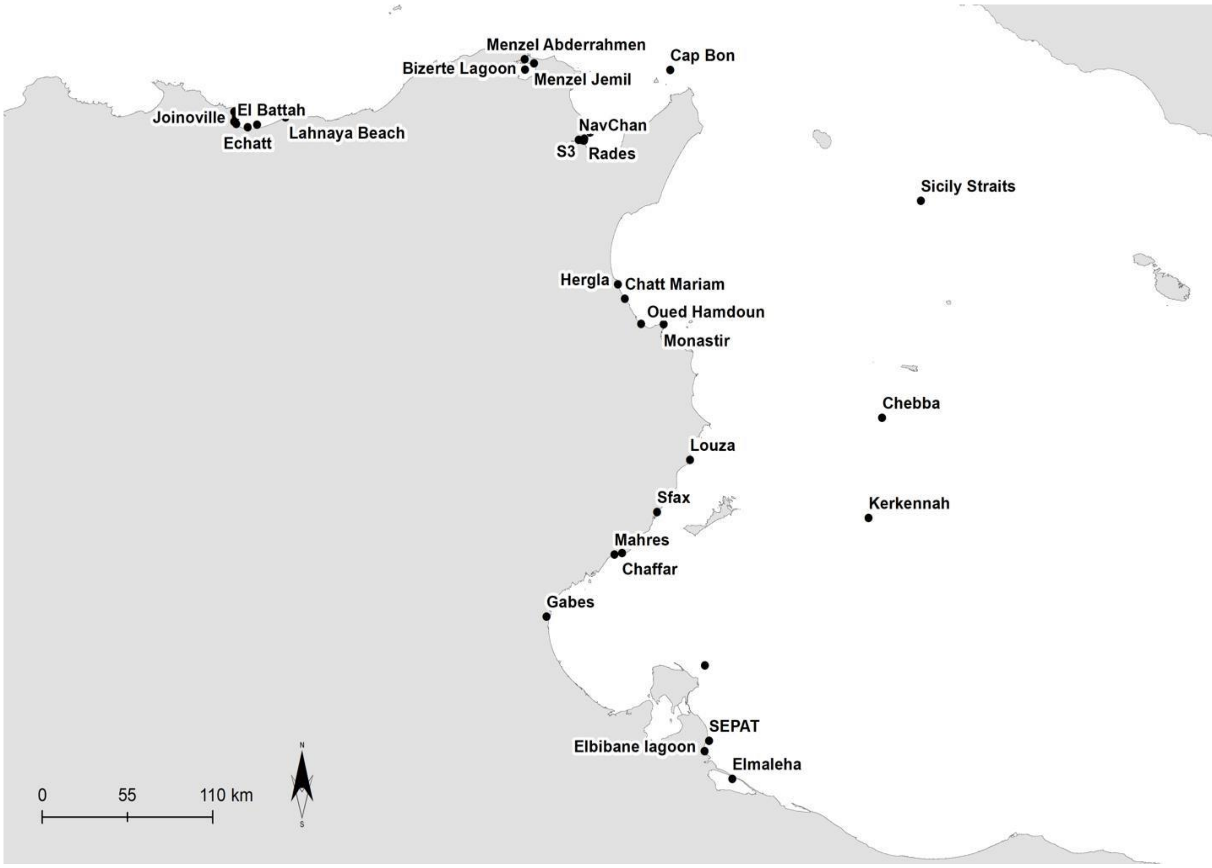


Figure 3.1.5.2. Detailed map of the study areas for biomarkers reviewed in the recent (since 2016) scientific literature for eastern Algeria and Tunisia coasts. Many stations were occupied in this area of the Mediterranean Sea.

603. Further to the above results based on a review of the studies by sub-regions and countries, it can be concluded that twenty-four studies were retrieved from the scientific literature as follows: 4 studies from Algeria (WMS), 1 from Egypt (AEL), 5 from Italy (2 from WMS, 1 from ADR, 1 from CEN and one from FAO zone 37), 5 from Spain (WMS), 7 from Tunisia (2 from WMS, 2 from CEN and 3 with data from both the WMS and CEN), and 2 from Türkiye (AEL).

604. The sub-region most represented is the WMS, followed by the CEN. In the CEN all studies except one were performed in Tunisia. There was one study from the ADR and three in the AEL.

605. The monitoring species, M. galloprovincialis and M. barbatus, appeared in 5 and 4 studies, respectively. In addition, 10 fish species, 6 mollusc species and 2 polychaeta species were also studied.

606. Of the mandatory biomarkers as defined in in the DDs and DSs for IMAP CI-18, AChE appeared in 13 studies, MT in 5 studies (2 with molluscs, 2 with fish and one with a polychaete species), MN in 2 and LMS-NRTT in 1 study.

607. Data from studies cannot be compared to BAC and EACs values as agreed by Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) because they were not measured in the specific tissue of M. galloprovincialis.

608. The most common additional biomarkers measured in the reviewed studies were: CAT (15 studies), MDA (12 studies), GST (11 studies), SOD (9 studies), and GPx (8 studies).

609. The anthropogenic stressors identified were: Trace metals (10), Plastic/microplastic (8), non-specific (4), PAHs (3), Pesticides (2), hydrocarbons (1), anthropogenic items, and one study with desalination brine as a source.

610. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Most of the studies described the environmental conditions at the sampling areas. The exemption was for microplastics, where the source was not determined, and microplastics were considered ubiquitous in the environment.

611. Most biomarkers studied showed a response to anthropogenic stressor. In the case of microplastics, the size of the microplastic also influenced the response.

612. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

Assessment of IMAP Common Indicator 19: Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution

Geographical scale of the assessment	Sub-regions within the Mediterranean region based on integration of the assessments at Sub-divisions level
Contributing countries	Data from MEDGIS-MAR, Lloyd List Intelligence Seasearcher, CleanSeaNet Service
Mid-Term Strategy (MTS) Core Theme	1-Land and Sea Based Pollution
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI19. Common Indicator 19: Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution
GES Definition (REMPEC/WG.51/9/1)	Occurrence of acute pollution events are reduced to the minimum.
GES Targets (REMPEC/WG.51/9/1)	1. Decreasing trend in the occurrence of acute pollution events
GES Operational Objective (REMPEC/WG.51/9/1)	Acute pollution events are prevented, and their impacts are minimized

Available data

613. Three major datasets are available to extract data on oil and HNS spills at the Mediterranean scale: MEDGIS-MAR, Lloyd List Intelligence Seasearcher (hereafter Lloyd), CleanSeaNet Service.

614. The Mediterranean Integrated Geographical Information System on Marine Pollution Risk Assessment and Response (MEDGIS-MAR) is a database managed by REMPEC containing national data about response equipment, accidents, oil and gas installations, and oil handling facilities. Data on

accidents are collected in MEDGIS-MAR since 1977. For this assessment, MEDGIS-MAR data were filtered considering the events causing pollution ("Pollution" = YES) and located into the sea or within a 1 km inland buffer (to include events in any case occurring close to the sea, as for example in port areas).

615. The Lloyd List Intelligence Seasearcher, privately managed, gathers several data on shipping, including ship incidents, recorded since the 70s. The exportable tables do not include information about the spilled substances and volumes. Several incidents registered in the Lloyd database are also included in MEDGIS-MAR. For this assessment, Lloyd data were filtered considering the events causing pollution ("Pollution indicator = YES") and located in the Mediterranean Sea (thus, excluding those in the Black Sea).

616. CleanSeaNet is a European satellite-based service for oil spills and vessel detections managed by the European Maritime Safety Agency (EMSA). The full access to CleanSeaNet database is granted to Member States National Competent Authorities, while the open access website provides access to the so-called yearly "Detection and Feedback data", for the period 2015-2021. These pdf documents have been used for this assessment and include the parameters of interest for the assessment. The available dataset does not include information enabling to distinguish the spilled substance. For the assessment Class A events (high confidence of detection) were considered.

617. The above databases are based on the two different approaches: MEDGIS-MAR and Lloyd are populated with incident reports provided by ships or countries. CleanSeaNet includes satellite observations of possible spills. The number of events reported in each database is therefore very different: MEDGIS-MAR and Lloyd register tens of events per year in the Mediterranean while CleanSeaNet registers hundreds of events per year in the sea basin. CleanSeaNet detections can be caused by mineral oil and other pollutants, but may also indicate naturally occurring features (e.g. algae blooms, areas of upwelling, etc.). CleanSeaNet includes observations spills of different sizes, including also very small ones, not only related to incidents but also to accidental or illicit discharges. In addition to that, it should be observed that spills recorded by CleanSeaNet can derive from offshore (O&G prospections and extractions) or coastal activities, not linked to maritime transport. The datasets extracted from the three databases provide different and complementary information and were therefore assessed separately.

618. With reference to MEDGIS-MAR and Lloyd, the two databases show some overlaps (this means that some incidents are present in both databases). For recent data, integration between the two datasets has been carried out by REMPEC. Despite this, several differences between the two databases still remain and need to be considered by the Contracting Parties and others. A full integration of the two datasets remains outside the scope of this assessment.

619. CleanSeaNet data are considered in the study in order to accomplish for operational pollution events. Such events refer to voluntary or accidental release of oil or other substances. They can result from human decision, error or technical failure. In the Mediterranean any discharge into the sea of oil or oily mixture from the cargo area of an oil tanker is prohibited, according to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL). Notwithstanding this, operational pollution and, particularly, illicit discharges, is recognized as a major problem in the region. With the worldwide and regional decrease in the number of big spills caused by important ship accidents, the issue of small but very numerous spills has become an important element to be considered when assessing the state of this indicator in the Mediterranean (REMPEC, 2022).

620. When considering CleanSeaNet dataset, uncertainty related with oil spill detection should be considered. Percentage of correctly detected slicks is known to vary with sensor type, data processing and slick recognition methods, as well as their temporal evolution. Such a percentage is reported to generally rank above 80% (e.g. Carvalho et al., 2021; Shaban et al., 2021; Huang et al., 2022). A fixed correction factor cannot be applied to the entire Mediterranean and to the whole temporal range considered, because this percentage not only depend on above elements but may vary also in relation with several local conditions. Thus, for the purpose of the present study, all reported CleanSeaNet Class A records (observations) have been considered in the assessment. In addition, CleanSeaNet datasets might be biased by increasing monitoring effort from 2015 to the present. Within present assessment of CI 19, it was possible to obtain information on this aspect. Based on these considerations, it is recognised that the adopted methodological approach can lead to an overestimation of the number of oil spills events detected by CleanSeaNet and of their extension. To cope with this possible overestimation, CleanSeaNet data have been used in relative terms (as detailed further below), to identify the areas with the highest spill occurrence and to calculate differences between time periods. In addition to that, in the integrated evaluation of the three datasets and formulation of the final assessment, CleanSeaNet data have been considered with a lower weight than data reported by MEDGIS-MAR and Lloyd. This approach is considered to be in line with the precautionary principle and with the need to account for small spills and illicit discharges.

The integrated assessment of datasets related to CI 19

621. For the purpose of the present assessment of CI 19, the four main sub-regions and related sub-divisions have been established namely: the Western Mediterranean Sea (including the Alboran Sea characterized by the exchange of the Mediterranean waters with the Atlantic Ocean), the Adriatic Sea (which is a double semi-enclosed area by itself and the Mediterranean Sea), the Central Mediterranean (acting as the nexus for the eco-regions and located in the centre of the basin with a low anthropogenic influence), and the Aegean and Levantine Sea in the Eastern Mediterranean part.

622. The application of the environmental assessment methodology for CI 19, is based on the integration of evidences from all the three analyzed datasets.

The assessment for CI 19 in the period 2018-2021 jointly considers: (1) the information on the frequency of spill occurrence i.e., yearly average number of spills/10000 km^2 and yearly average extension of areas interested by pollution/10000 km^2, and (2) the information on the trend of such frequency i.e., increasing, decreasing, stable with no spill, represented by the variation in % in comparison with the previous assessment period (2013-2017). This element (variation of spill density) is based on a CHASE-like approach and capitalizes some elements of the methodology adopted by HELCOM for the assessment of oil spill in the Baltic Sea (HELCOM 2018). The spatial component of the analysis was detailed: the 2023 MED considers the sub-regions and the relative sub-divisions identified in the Mediterranean Sea.
For each of three datasets, the assessment was based on the following steps:

i. Quantification of the average number of oil spills per year in the period 2018-2021 for the entire Mediterranean Sea and its sub-divisions.
ii. The average number of oil spills was standardised on the extension of each sub-division, thus enabling to calculate the average number of spills per 10000 km2 in the assessment period for the entire Mediterranean and its sub-divisions.
iii. The three sub-divisions characterised by higher values of the indicator calculated in step 2 were highlighted in dark red/red/orange to remark the three highest oil spill occurrences.
iv. Percentage of variation (2018-2021 vs. 2013-2017) of average yearly spill occurrence was then calculated for the entire Mediterranean and for each sub-division.
v. Based on the computed percentage variation, the following colour-based classes were defined for variation in percentage: blue = no spills recorded in the sub-division, in the period of assessment (2018-2021) nor in the previous reference period (2013-2017); green = decreased frequency of spill occurrence in the sub-division; yellow = increased frequency of spill occurrence ≤ 100% in the sub-division; red = increased frequency of spill occurrence > 100% in the sub-division.

In the case of CleanSeaNet dataset, the same assessment above described was implemented also for the extension of areas interested by pollution due to oil spills, still comparing 2018-2021 with the previous 2015-2017 period. MEDGIS-MAR enabled to implement the same assessment also on the number of spills of substances other than oil: Hazardous and Noxious Substances (HNS), other substances (non-HNS) and Unknown substances.
This integrated assessment of the evidences from the three data sets was based on the following three criteria:

a) Occurrence of spills reported through MEDGIS-MAR and Lloyds, which are mainly linked to relatively large pollution events and to incidents. Occurrence of reported events is considered as a “negative” factor in the overall assessment of the quality status of a given sub-division, while the absence of reported events is considered as “positive”. As additional element to the sub-divisions ranked among the first three for frequency of occurrence of spills, an additional “negative” factor was considered.
b) CleanSeaNet data are used as an indicator of relatively smaller spills, related to minor incidents or illicit discharges. This second criterion has been weighted less than the previous one, to take into consideration the possibility of overestimation of the number and extension of spills reported in this dataset. Thus, a negative contribution to the overall status was considered for the sub-divisions ranking among the first three in terms of average extension of areas affected by oil pollution.
c) The temporal variation of the average number of spills (for all the three datasets) and their extension (for CleanSeaNet) between the assessment period (2018-2021) and the previous reference period (2013-2017 for MEDGIS-MAR and Lloyds; 2015-2017 for CleanSeaNet) was considered. An increasing trend was considered as negative for the overall assessment of the quality status, while a decreasing trend provided a positive indication.

Results of the IMAP Environmental Assessment of CI 19 in the Mediterranean region

623. Table 3.1.6.1. provides an overview of the assessment results based on synthetic data extracted from datasets and used for the assessment. Considering the spills reported by the ships and countries regarding the incidents, MEDGIS-MAR and Lloyd List data indicate for the entire Mediterranean in the assessment period an average occurrence frequency of 0.033 and 0.051 n/y/10000 km2, respectively. The most affected sea is the Aegean Sea, followed by the Ionian Sea, according to MEDGIS-MAR (no incidents reported by Lloyd List, instead) and the Alboran Sea according to Lloyd List (no incidents reported by MEDGIS-MAR, instead). The Northern Adriatic Sea ranks third for occurrence of incidents, according to the Lloyd List (no incidents reported by MEDGIS-MAR, instead). These results are in accordance with the relative intensity of vessel traffic (hours/km), that indicates the Aegean Sea, the Alboran Sean and the Northern Adriatic as the most trafficked areas of the Mediterranean.

624. Focusing on the spills detected by satellite monitoring (CleanSeaNet data), the Adriatic Sea is the area with the highest standardised (per 10000 km2) frequency of spill occurrence and the area where the largest extension of polluted areas is detected. This could be explained by the fact that satellite monitoring enables to detect also small spills, (including small, non-reported incidents, illicit discharges, spills due to other offshore activities. These are particularly numerous in the Adriatic where, beside significant traffic density due to cargos, tankers and passenger vessels, other type of vessels are present in large number,including fishing vessels.

625. The temporal variations in spill occurrence computed from the three different databases are very different. According to MEDGIS-MAR a general improvement of the status can be observed for this indicator, with Alboran Sea, Tyrrhenian Sea and the whole Adriatic Sea reporting no spills both in the considered and in the previous assessment period. Considering Lloyd, a general worsening of the status of the indicator can be observed in the Alboran Sea, Western Mediterranean, the Tyrrhenian Sea, the Northern Adriatic the Aegean Sea showing increased spill occurrence. These findings mostly agree with the ones from CleanSeaNet which additionally highlight an increase of spill occurrence also for the Central Mediterranean, the Middle Adriatic Sea, the Ionian Sea and the Levantine Sea.

626. It is worth noting that CleanSeaNet datasets might be biased by increasing monitoring effort from 2015 to the present. Within present assessment of CI 19, it was possible to obtain information on this aspect.

627. MEDGIS-MAR is the only datasets among the three considered in this assessment allowing to describe the trend in the number of spills of substances other than oil. In MEDGIS-MAR, such substances are categorized as Hazardous and Noxious Substances (HNS), other substances (non-HNS) and Unknown substances. Decrease in number of events with respect to the previous period, or no events recorded, was observed in the last four year in all sub-divisions, with the exception of Ionian Sea and the Aegean Sea. The Levantine sea scores third in number of events, even if with a decreasing trend. iLarge (above 700t) and medium size spills (7-700t) have not been reported since 2018. The last four years are characterised only by small spill events, although several events with unknow size (4 in 2019) have been registered.

Table 3.1.6.1.: CI 19 assessment. (1) average number of oil spills in the assessment period (2018-2021) per 10000 km^2 for the three datasets; (2) average extension of areas interested by oil pollution in the assessment period (2018-2021) per 10000 km^2 (from CleanSeaNet) - the three highest values only are highlighted; (3) average number of other substances spills in the assessment period (2018-2021) per 10000 km^2 (from MEDGIS-MAR); (4) % of variation compared to the previous period of the above indicators for oil spills; (5) % of variation compared to the previous period of the above indicator on other substance spills. Colour code for spill frequency and variation in the extension of the area affected by pollution: dark red = highest value; red = second highest; orange = third highest. Colour code for % variations: blue = no spills recorded, in the assessment period, nor in the previous period; green = decreased frequency of spill occurrence; yellow = increased frequency of spill occurrence <= 100%; red = increased frequency of spill occurrence > 100%. Data sources: MEDGIS-MAR, Lloyd List Intelligence Seasearcher, CleanSeaNet.

Frequency of spills / total polluted area (average values in the period 2018-2021, per 10000 km^2)											
	TOT MED	**ALBS**	**WMS**	**TYRS**	**CEN**	**NADR**	**MADR**	**SADR**	**IONS**	**AEGS**	**LEVS**
Oil											
(1) MEDGIS-MAR	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.089**	**0.334**	0.000
(1) LLOYD	0.051	**0.178**	0.039	0.012	0.000	**0.075**	0.000	0.000	0.000	**0.371**	0.028
(1) CleanSeaNet (n)	9.3	11.3	9.0	6.8	5.9	**16.5**	**15.4**	**15.6**	9.6	10.9	11.3
(2) CleanSeaNet (km^2)	68.2	57.5	76.6	44.6	62.8	**104.7**	**130.5**	**120.3**	54.4	39.6	75.9
Other substances											
(3) MEDGIS-MAR	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.104**	**0.284**	**0.004**
Summary of variation %											
	TOT MED	**ALBS**	**WMS**	**TYRS**	**CEN**	**NADR**	**MADR**	**SADR**	**IONS**	**AEGS**	**LEVS**
Oil											
(4) MEDGIS-MAR	-57	-	-100	-	-100	-	-	-	25	-56	-100
(4) LLOYD	12	67	41	25	-100	-	-	-100	-100	34	-27
(4) CleanSeaNet (n)	85	32	62	22	139	207	100	79	137	60	108
(4) CleanSeaNet (km^2)	103	64	106	24	244	197	48	87	141	12	99
Other substances											
(5) MEDGIS-MAR	-14	-100	-100	-	-100	-	-100	-	192	31	-89

628. The combined application of the three assessment criteria defined above (a, b, c) led to the classification of the quality status of CI 19 in the Mediterranean sub-divisions in five classes: bad (red), poor (brown), moderate (yellow), good (green), high (blue). As provided in Table 3.1.6.2, and mapped in Figure 3.1.6.1, according to the adopted methodology, four sub-divisions are classified as bad or poor, five as moderate, one as good and none as high.

629. It is worth noting that the methodology applied is subjected to uncertainty, mostly linked to the heterogeneity of the datasets it is based on. The results from the assessment should be interpreted as best knowledge-based indications on the status of CI 19, aiming at providing a relative indication of priority areas for future monitoring, assessment and, most importantly, pollution prevention measures.

Table 3.1.6.2: Assessment of the marine environment status for CI 19 for sub-divisions of the Mediterranean Sea

Sub-division	Considerations for the assessment	Status of CI 19
ALBS	Spills reported, second highest | Increase (in most of the datasets)	POOR
WMS	Spill reported | Increase (in most of the datasets)	MODERATE
TYRS	Spills reported | Increase (in most of the datasets)	MODERATE
CEN	No spills reported | Increase (only CSN)	GOOD
NADR	Spills reported, third highest | Third ranked for satellite observation (area extension) | Increase (in most of the datasets)	POOR
MADR	No spills reported | First ranked for satellite observation (area extension) | Increase (only CSN)	MODERATE
SADR	No spills reported | Second ranked for satellite observation (area extension) | Increase (only CSN)	MODERATE
IONS	Spills reported, second highest | Increase (for most of the datasets)	POOR
AEGS	Spills reported, first highest in two datasets | Increase (for most of the datasets)	BAD
LEVS	Spills reported | Increase (only CSN)	MODERATE

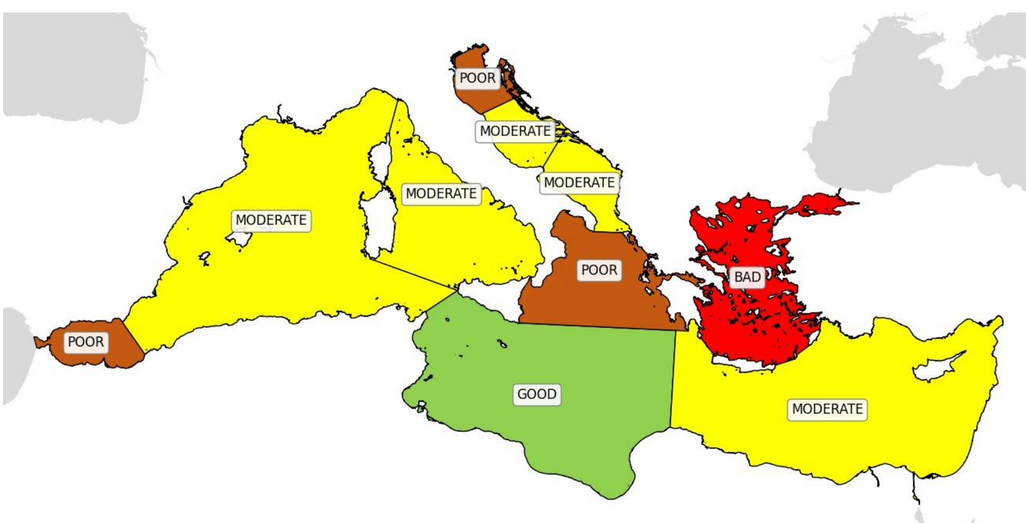


Figure 3.1.6.1. Map of the assessment of the marine environment status for CI 19 for sub-divisions of the Mediterranean Sea

630. The assessments of the ten subdivisions (Table 3.1.6.1) have been aggregated (Figure MED 3.1.6.2.), in order to obtain the assessment for the four Sub-regions of the Mediterranean Sea. This resulted in the following integrated assessment findings:

a) the (Entire) Western Mediterranean Sea (WMS) Sub-region, is assigned to "Moderate", because this category prevails in its sub-divisions (WMS and TYRS), while the "Poor" status value characterises only the Alboran Sea (ALBS);
b) "Moderate" has been assigned to the Adriatic Sea (ADR) Sub-region, considering the prevalence of this category in its sub-divisions (MADR and SADR).
c) "Moderate" has been assigned to the (Entire) Central Mediterranean Sea (CEN) Sub-region, by qualitative averaging of the poor status of the Ionian Sea (IONS) and the good status of the Central Mediterranean (CEN);
d) In the case of the Aegean and Levantine Seas (AEL) Sub-region, the qualitative average evaluation led to d a" poor" status for this Sub-region.

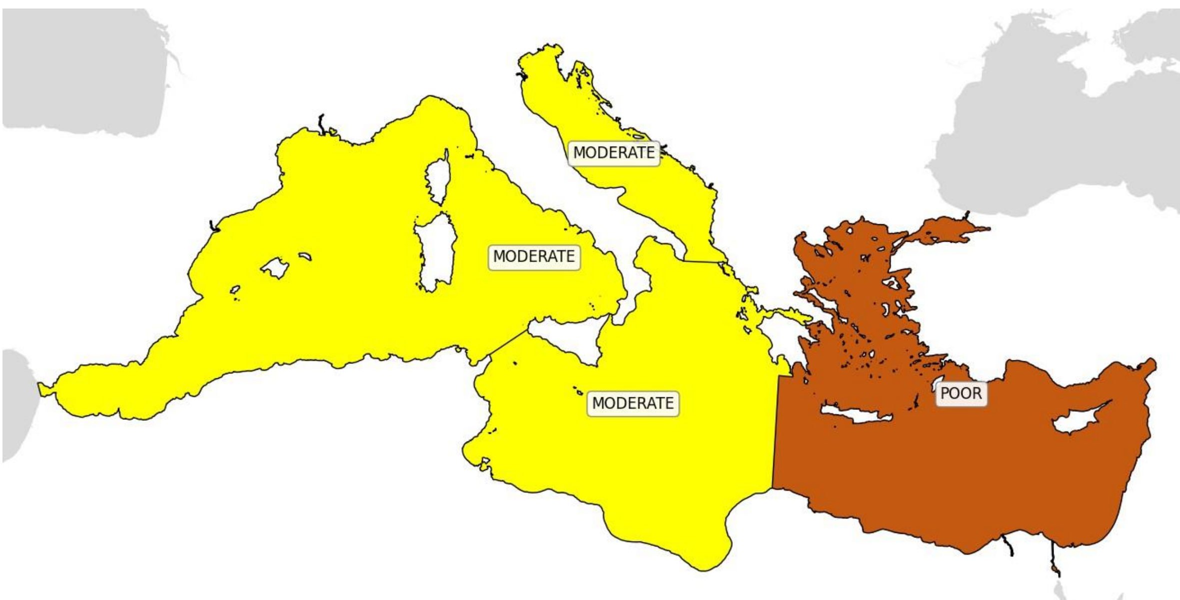


Figure MED 3.1.6.2. Map of the integrated assessment of the marine environment status for CI 19 in the four Sub-regions of the Mediterranean Sea

631. CI 19 assessment: impact on biota. Common Indicator 19 is defined as "Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution (EO9)". In the Mediterranean the data presently available do not allow to include in the assessment of this indicator the component related to the impacts on biota. In fact, as described above, a few examples are available of monitoring of oil spill impacts in the Mediterranean (e.g. spill in Baniyas, Syria in 2021- REMPEC, 2021; sinking of the Agia Zoni II, Piraeus, Greece in 2017 - REMPEC, 2019; spill from the Jieh power plant in Lebanon in 2006 - Saab et al., 2006). From available guidelines (e.g., the UK PREMIAM initiative: Kirby et al., 2018) and the experience available at European level (e.g. Belgium - Tornero et al. 2022), as well as from the above cases, monitoring of the following elements are recommended: visual survey of macroscopic evidences of pollution both on land and underwater (presence and extension of oil layers, tar-patches, dead or contaminated animals); chemical contamination of waters and sediments (total petroleum

hydrocarbons, IPA, heavy metals); benthic communities (phytobenthos and zoobenthos); fish community; bioaccumulation in bivalves and fish. Based on such guidelines and experiences, REMPEC has recently prepared a revision of the Data Dictionary and Data Standard for CI19, by including also data aimed at assessment of impact on biota. Based on the data that will be collected as indicated in the revised version of the Data Dictionary and Data Standard for CI19, the future QSR assessments is expected to consider the impacts on biota too.

Assessment of IMAP Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	**Countries reporting IMAP CI-17 data:** Albania, Croatia, Cyprus, France, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Türkiye. **Scientific literature**. Algeria, Croatia, Egypt, France, Greece, Italy, Lebanon, Morocco, Spain, Tunisia, Türkiye
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are within the regulatory limits for consumption by humans
GES Targets (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are within the regulatory limits set by legislation
GES Operational Objective (UNEP/MED WG473/7) (2019)	Levels of known harmful contaminants in major types of seafood do not exceed established standards

Available data.

632. The two groups of data were collected i.e. i) data reported to IMAP - IS for CI-17 contaminants in biota, and ii) data from scientific literature. The relevant data from IMAP-IS consisted of the concentrations of trace metals (Cd, Hg and Pb) in fish and molluscs; PAHs in molluscs and PCBs in fish and molluscs. It should be emphasized that these data were collected within IMAP monitoring programs to assess the status of the marine environment and not to protect human health. Italy submitted CI 20 data after the Meeting of CorMon Pollution (1-2 March 2023, Athens) that included contaminants in different species of fish, molluscs, crustaceans and echinoderm and tunicates sampled in 2020[105].

[105] Data included, among others, concentrations of all the contaminants regulated by the EU, as listed in Annex I of document 556/Inf.12/Rev.1. Those were measured in different species of fish, molluscs, crustaceans and echinoderm and tunicates sampled in 2020. The national data of Italy were not uploaded on the IMAP Info System because they were found not compliant given the

633. CI 17 data available from IMAP-IS for the monitoring species (M. galloprovincialis and M. barbatus) are shown in Table 3.1.7.1.

Table 3.1.7.1. Number of data points extracted from CI-17 database, relevant for CI-20 Assessment. MG – *Mytilus galloprovincialis*; MB- *Mullus barbatus*. Table is sorted by species and alphabetical order of CPs.

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Albania	2020	MG	2	2	2			2
Croatia	2019-2020	MG	37	35	37			19
France	2015, 2017-2018	MG	50	50	50	25	25	23
Italy	2015-2019	MG	33	170	33		53	
Montenegro	2018-2020	MG	28	28	28	21	21	21
Morocco	2017-2021	MG	27	27	27	6	6	
Slovenia	2016-2021	MG	21	21	15	12	12	
Spain	2015-2017,2019	MG	70	70	70	42	42	40
Croatia	2019-2020	MB	11	10	11			
Cyprus	2020-2021	MB	14	14	14	12	12	12
Israel	2015, 2018-2020	MB	58	60				
Lebanon	2019	MB	14	14	14			
Malta	2017, 2019	MB	5	5	5			
Montenegro	2018	MB	8	8	8			
Türkiye	2015	MB	25	25	25		8	

634. Relevant data for additional species other than the mandatory species reported to IMAP-IS were available as presented here-below under assessment of data reported for the mandatory monitoring species.

635. The literature search on seafood quality in the Mediterranean Sea focused on the studies that reported data from 2016/2017 onward, emphasizing contaminants that are regulated in the EU. Previous studies have been used in the preparation of the 2017 MED QSR.

636. The bibliographic studies reported concentrations of contaminants and compared them to EU regulation while some also addressed national regulation as well as international regulations or advisories (De Witte et al. 2022). Most of the studies provided also risk assessments to human health from

lack of complementary data (D.O., T, S) that are considered mandatory for the system. Out of 3785 relevant entries (including all species and relevant EU contaminants), 11 entries (0.3%) were found to exceed the EU regulations for the protection of human health. The analyzes of additional national data of Italy confirmed the assessment based on CI17 and on the scientific literature, which found in the Mediterranean Sea that most of the measured concentrations were below the concentration limits for the regulated contaminants in the EU.

consumption of the seafood by calculating the estimated daily intake (EDI), target hazard quotient (THQ), total risk (HI), Cancer risk, among others.

637. This emphasizes the fact that the risk to human health (and hence GES- non GES statuses) should not be evaluated based on concentration of a single contaminant but evaluated together with other factors such as synergy with other contaminants, temporal and spatial scales.

638. Another point to make is that recent literature emphasizes the connection between seafood safety and quality and the presence of microplastics in the marine environment (i.e.Wakkaf et al. 2020 among many others). Human health may be impacted either by consuming seafood with microplastic content, or seafood with contaminants that were leached from the microplastic to the organism. This sets an interrelation of CI 20 with CI 23 and should be further pursued.

639. Table 3.1.7.2 provides a summary of the studies published in the peer-reviewed literature. Thirty-six studies from 11 CPs were found relevant for the present work, with 1-4 studies each, except for Italy that had 14 studies. Most (25) reported concentrations of trace metals (TM) and 12 on organic contaminants (PAHs, PCBs, PBDEs, PCDD/Fs). Concentrations in fish were reported in 26 studies and concentrations in molluscs were reported in 17 studies.

Table 3.1.7.2. The number of studies, per country, on seafood quality and safety in the Mediterranean which findings were used to support present assessment.

Country	Total Number of studies	Number of studies reporting on:		Number of studies reporting on:		
		Trace metals	Organic contaminants	Fish	Mollusc	Other (crustaceans, cephalopods)
Algeria	3	3	0	3	0	0
Croatia	2	2	0	2	0	0
Egypt	1	0	1	1*	1	1
France	1	0	1	1	0	0
Greece	2	2	0	2	0	0
Italy	14	9	7	9	9	3
Lebanon	3	3	0	2	2	2
Morocco	3	3	0	1	2	0
Spain	1	1	0	1	0	0
Tunisia	2	0	2	2	1	1
Türkiye	4#	2	1	2	2	1

*fresh water fish; #one study on radioactivity as contaminants in fish.

Results of the IMAP Environmental Assessment of CI 20 in the Mediterranean region

Given the complete lack of data reported for CI 20, the environmental assessment of CI 20 was performed, by using the following two approaches: i) assessment of the status based on data reported to IMAP-IS for CI 17 contaminants in biota up to 31st, October 2022, the cutoff date for data reporting to be used in the 2023 MED QSR, using the EU concentration limits for regulated contaminants, and ii) assessment of present status based on bibliographic studies, following the same approach applied for preparation of the 2017 MED QSR, however by using newer available scientific literature.

a) Assessment of the status based on data reported to IMAP-IS for contaminants in biota (CI 17)

640. Data reported to IMAP-IS for CI-17 was investigated and the relevant data extracted and used for present initial marine environment assessment for IMAP CI 20. The relevant data consisted of the concentrations of trace metals (Cd, Hg and Pb) in fish and molluscs; PAHs in molluscs and PCBs in fish and molluscs. It should be emphasized that these data were collected within IMAP monitoring programs to assess the status of the marine environment and not to protect human health.

a.1. Assessment of data reported for the mandatory monitoring species Mytilus galloprovincialis (MG) and Mullus barbatus (MB)

641. For the assessment of CI 20, based on data reported for CI 17 contaminants in biota, the available data for the mandatory species M. galloprovincialis and M. barbatus are summarized in Table 3.1.7.3., along with the number of data points that exceeded the concentration limits for human consumption.

642. It was found that most of the measured concentrations were below the concentration limits for the regulated contaminants in the EU, with a few exceptions in Cyprus, Montenegro, and Spain. The maximal percentage of values above the EU criteria for one specific contaminant was low (14%). Examination of the national data submitted by Italy confirmed the assessment based on CI 17 and on the scientific literature .

643. Examination of CI 17 data i.e., data for TM and organic contaminants per sub-regions (Table 3.1.7.3.) showed that data for *M. galloprovinciallis* were available only for the WMS and the ADR. Values above the concentration's limits were found for only 14 data points out of 1002 (1.4%).

644. Examination of the CI-17 data i.e. only data related to TM were available, per sub-regions (Table 3.1.7.3.) showed that data for *M. barbatus* were available for the ADR (56 data points), CEN (15 data points) and AEL (213 data points). All concentrations were below the EU concentration limits.

a.2. Assessment of data reported to IMAP-IS for other species

645. The biota files from the IMAP-IS database were screened again for species other than the mandatory monitoring species, M. galloprovincialis and M. barbatus, for CI 17. Additional species were reported as shown here-below.

646. Cyprus (2020-2021). Cd, Hg and Pb were measured in the muscle of the fish Boops boops (n=13), Thynnus alalunga (n=52) and Merluccius merluccius (n=1). All the concentrations were below the concentration limits for the regulated contaminants in the EU, except for Hg in 6 samples of T.

alalunga. Σ4 PAHs and Σ6 PCBs were reported for Boops boops (n=10) and T. alalunga (n=15). All concentrations were below detection limit and for Σ6 PCBs also below the concentration limits in the EU. No criteria were given for PAHs in fish.

647. Croatia (2019). Cd and Pb were measured in the muscle of the fish Merluccius merluccius (n=3), Mullus surmuletus (n=1), Pagellus erythrinus (n=3), Sparus aurata (n=9). All concentrations were below the concentration limits for the regulated contaminants in the EU.

648. France (2017)[106]. Cd, Hg, Pb (n=6 each) and Σ4 PAHs and Σ6 PCBs (n=4 and n=2, respectively) were measured in the mollusc (bivalve) Crassostrea gigas and Cd, Hg, Pb were measured in 7 samples of the mollusc (bivalve) Venerupis decussata. All concentrations were below the concentration limits for the regulated contaminants in the EU.

649. Israel (2015, 2018, 2020). Cd and Hg were measured in 6 samples of the mollusc (bivalve) Donax trunculus, and Cd and Hg were measured in 26 samples of the mollusc (bivalve) Mactra corallina. All concentrations were below the concentration limits for the regulated contaminants in the EU.

650. Lebanon (2019). Cd, Hg, Pb (n=11 each) and Σ6 PCBs (n=3) were measured in the fish Diplodus sargus and Cd, Hg, Pb (n=15 each) and Σ6 PCBs (n=13) were measured in the fish Euthynnus alletratus. All concentrations were below the concentration limits for the regulated contaminants in the EU.

651. Malta (2017 and 2019). Cd, Hg, Pb (n=4 each), dioxin like PCBs and Total dioxins and furans (n=1 each) were measured in the fish Merluccius merluccius. All concentrations were below the concentration limits for the regulated contaminants in the EU.

652. Morocco (2019-2021). Cd, Hg, Pb (n=30 each) were measured in the mollusks Callista chione (n=30) and petite praire (n=6). All concentrations were below the concentration limits for the regulated contaminants in the EU. Σ4 PAHs were reported for C. chione (n=15) and petite praire (n=3). All concentrations were below the concentration limits for the regulated contaminants in the EU.

b) Assessment of the status based on bibliographic studies

653. In the context of CI 20, to protect human health, trace metals in fish were reported for many species across the Mediterranean countries: Algeria, Croatia, Greece, Italy, Lebanon, Morocco, Spain and Türkiye. Trace metals in molluscs were reported in various species from Italy, Lebanon, Morocco and Türkiye. Organic contaminants in fish were reported for various species from France, Italy and Tunisia, and in molluscs for Egypt, France, Italy, Tunisia and Türkiye. Trace metals and organic contaminants were reported also for some crustaceans and cephalopod species. Information on consumers` health risk was available for Algeria, Croatia, Italy, Tunisia and Türkiye, only. The literature review is summarized here-below and in Table 3.1.7.4 and Figure 3.1.7.1.

654. Algeria (WMS): Cd, Hg, Cu were reported in Sardina pilchardus and in Mullus barbatus collected from the Algerian coast (2017-2018). Concentrations were below the concentration limits for the regulated contaminants in the EU, except concentrations of Cd in some specimens from the bay of

[106] Data from EMODNet.

Algiers that were higher than the EU regulatory threshold. The average Pb concentrations did not exceed the regulatory value, although some specimens had concentrations higher than the threshold. Consumption of S. pilchardus from Algerian coast was not likely to have adverse effect on human health and a few risks were assigned to the consumption of contaminated M. barbatus (Hamida et al. 2018, Aissioui et al. 2021, Aissioui et al. 2022).

655. Croatia (ADR): Cd, Hg and Pb were reported for fish from 11 species107 purchased in 2016 from supermarkets located in different Croatian cities. Hg and Pb concentrations were below the concentration limits for the regulated contaminants in the EU. Mean Cd levels in bluefin tuna exceeded the EU limit. Consumer health risk calculated from the dietary intakes for Cd was low, with exception of bluefin tuna. For Hg, frequent consumption of European sea bass, carp and bluefin tuna over a long period may have toxicological consequences for consumers. In a different study in 2016, the concentration of Hg did not exceed EU regulations in European pilchard and European anchovy (Bilandžić et al. 2018, Sulimanec Grgec et al. 2020).

656. Egypt (AEL): Persistent organic pollutants were reported in the mollusc Donax trunculus at the Rosetta Nile branch estuary. PCBs levels were well below tolerable average residue levels established by FDA and FAO/WHO for human fish consumption (Abbassy 2018).

657. France (WMS): Persistent organic pollutants (POP108s) were evaluated in six fish and two cephalopods species from an impacted area in NW Mediterranean Sea (Rhone river estuary vicinity). For Atlantic bonito (Sarda sarda) and chub mackerel (Scomber colias), the estimated weekly intakes of dioxin-like POPs for humans overpassed the EU tolerable weekly intake. Concentrations of nondioxin-like PCBs in S. sarda were above the EU maximum levels in foodstuffs, pointing to a risk (Castro-Jiménez et al. 2021).

658. Greece (AEL): Cd, Hg and Pb were reported in 4 fish species109. Concentrations in S. aurata and D. labrax were below the concentration limits for the regulated contaminants in the EU. In sardine and anchovy, nutritional benefits seem to outweigh the potential risks arising from fish metal content (Renieri et al. 2019, Sofoulaki et al. 2019).

659. Italy (ADR, CEN, WMS) (TM in fish and mussel): Hg, Cd, Pb were determined in 160 specimens of fish belonging to sixteen species collected in 2018 from commercial centers of South Italy. The concentrations were below the EU regulation, except for Cd in bluefin tuna, which exceeded the tolerable value. The estimated hazard quotient of Hg indicated a high probability of experiencing non-carcinogenic health risks (Storelli et al. 2020). Hg was measured in 42 commercial fish species caught off the Central Adriatic and Tyrrhenian coasts of Italy and in 6 aquaculture species. Hg levels exceeding the EC regulation limits were found in large-size specimens of high trophic-level pelagic and demersal

[107] Hake (Merluccius merluccius, n=7), Atlantic mackerel (Scomber scombrus, n=7), cod (Gadus morhua, n=7), chub mackerel (Scomber japonicas, n=7), fresh and canned sardine (Sardina pilchardus, n=7), European sea bass (Dicentrarchus labrax, n=13), gilthead sea bream
(Sparus aurata, n=11), bluefin tuna (Thunnus thynnus, n=8), salmonbass (Argyrosomus regius, n=8), rainbow trout (Oncorhynchus mykiss, n=7) and carp (Cyprinus carpio, n=7).
[108] Polybrominated diphenyl ethers (PBDEs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), polychlorinated biphenyls (PCBs)
[109] Seabream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*) sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*)

species. An estimation of the human intake of mercury associated to the consumption of the studied fish and its comparison with the tolerable weekly intake is provided (Di Lena et al. 2017). Hg measured in European hake (Merluccius merluccius) caught in the northern and central Adriatic Sea were lower than the level set by EU regulations (Girolametti et al. 2022). Cd, Pd measured in the swordfish Xiphias gladius muscles were lower than the levels set by EU regulations. Hg in 32% of samples exceeded European maximum limits. Risk assessment indicates hazardous state concerning Hg (Di Bella et al. 2020).

660. Cd, Hg, Pb in Mytilus galloprovincialis did not exceed the maximum limits as established by EU regulation from the Gulf of Naples and Domitio littoral (2016-2019) nor in specimens from the Claich Lagoon (Sardinia, 2017), the Marche (2016-2017) nor in Sicily (2016) (Esposito et al. 2020, 2021; Cammilleri et al. 2020).

661. Italy (ADR, CEN, WMS) (Organic contaminants in fish and mollusc). PAHs were measured Sardina pilchardus and Solea solea caught in the Catania Gulf (Sicily, 2017) (Ferrante et al. 2018). EU criteria for PAH the protection of human health exist only for mollusc and not for fish. Polychlorinated dioxins and furans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (dl-PCBs) measured in fish110 were below the maximum limits set by the EC for human consumption (Barone et al. 2021). Σ6 PCBs and dioxins and dioxin-like PCBs were lower than the values in the EU regulation in specimens of 3 edible fish species111 samples in 2017 in the Northern Tyrrhenian Sea (Bartalini et al. 2020). PCDD/Fs, PCBs, measured in fish112 from Taranto (2016) and PCDD/Fs and dl-PCBs) measured in fish113 from Southern Italy (2019) were below the regulatory limits specified for these contaminants within the EU (Ceci et al. 2022, Barone et al. 2021). Σ6 PCBs in in marine organisms114 collected from the contaminated Augusta Bay (Southern Italy, 2017) showed variable concentrations with a mean value above EU regulation in 2 fish species. Benzo[a] Pyrene (BaP) in mussels exceed threshold limit of the EU regulation. No risk analysis was performed. (Traina et al. 2021).

662. PCBs, dioxins and PAHs in Mytilus galloprovincialis, farmed in the waters of the Gulf of Naples and Domitio littoral (2016 to 2019), did not exceed the maximum limits as established by EU regulation, except for PAHs in a localized area in the winter (Esposito et al. 2020). Concentrations of Benzo(a)pyrene (BaP) and Σ4PAHs115 exceeded the limit reported in EC in the Regulation for the mollusk Donax trunculus, caught in the Catania Gulf (Sicily, 2017). Risk assessment indicated concern for the health of high frequency molluscs consumers (Ferrante et al. 2018). PCDD/Fs and dl-PCBs in seafood116 from Southern Italy (2019) and in mussel from Taranto (2016) were below the maximum limits set by the EC for human consumption except for a single sample taken from a known specific contaminated site in Taranto (Barone et al. 2021; Ceci et al. 2022).

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[110] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna
[111] Sardine (*Sardina pilchardus*), anchovy (*Engraulis encrasicolus*) and bogue (*Boops boops*).
[112] hake, mullet, sea bream, bogue, red mullet mackerel, sardines and sand steenbras
[113] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna
[114] In 2017, mussels (*Mytilus galloprovincialis*) obtained from a commercial farm and transplanted to two sites in Augusta Bay and resampled after 5 weeks and 7 months. Fish: 96 specimens of finfish (*Sphyraena sphyraena*, *Trigla lucerna*, *Mullus barbatus*, *Pagellus* spp., *Diplodus* spp.) and shellfish (*Parapaeneus kerathurus* and *Sepia* spp.) were obtained through local fishermen
[115] benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH)
[116] (cephalopods: common octopus, common cuttlefish, European squid), (shellfish: Mediterranean mussel, striped venus clam, common scallop), (crustaceans: red shrimp, spottail mantis shrimp, Norway lobster)

663. Lebanon (AEL): Pb, Cd, and Hg were determined in three fish species (Siganus rivulatus, Lithognathus mormyrus and Etrumeus teres), in shrimp (Marsupenaeus japonicus) and in bivalve (Spondylus spinosus) commonly consumed by the local population. Trace metals concentrations were found to be below the maximum levels set by the EU (Ghosn et al. 2019).

664. Morocco (WMS): Cd and Pb concentrations were measured in soft tissues of M. galloprovincialis. Concentrations did not exceed EU regulations (Azizi et al. 2018; 2021). Cd, Hg and Pb concentrations measured in the fish Liza ramada were also below the values set in the EU regulation (Mahjoub et al. 2021).

665. Spain (WMS): The concentrations of Pb, Cd and Hg measured in the highly migratory Thunnus alalunga and Katsuwonus pelamis were below the tolerable limits considered by EU regulation (Chanto-García et al. 2022).

666. Tunisia (CEN): Organic contaminants (PAHs, PCBs and pesticides) were measured in fish (Sparus aurata and Sarpa salpa) muscle tissue collected from five stations along the Tunisian coast between (2018-2019). Σ6 PCBs for the fish were below the EC regulations. (Jebara et al. 2021). Concentrations of 21 legacy and emerging per- and polyfluorinated alkyl substances (PFAS)117 were measured in in 9 marine species (3 fish, 2 crustaceans and 4 mollusks)118 collected from Bizerte lagoon, Northern Tunisia (2018). Exposure to PFAS through seafood consumption indicates that it should not be of concern to the local consumers (Barhoumi et al. 2022).

667. Türkiye (AEL): Concentrations of Cd, Pb and Hg levels were measured in 9 fish, 1 mollusc and 1 shrimp species119 from the Aegean and Levantine Seas. All the results were found compatible with the Turkish Food Codex and EU Regulation limits except for Cd in two samples from the Mediterranean Sea. As a whole, the seafood was found to be safe for human consumption (Kuplulu et al. 2018). Cd and Pb measured in the fish Trachurus mediterraneus, Sparus aurata and Pegusa lascaris were below the values set in the EU regulation (Karayakar et al. 2022). Mytilus galloprovincialis, were transplanted from a clean site to the 3 sites in Nemrut Bay, known to be impacted by of industrial activities. Benzo(a)pyrene and Σ_4 PAHs levels in the mussels from the clean site were below the EU regulations[120] (Kucuksezgin et al. 2020).

668. Türkiye (AEL): Specific natural radionuclide (^{226}Ra, ^{232}Th and ^{40}K) concentrations were measured in wild and farmed European seabass collected from the Mediterranean coast of Türkiye (AEL) in 2018. From the radiological point of view, the radioactivity doses measured and the consumption of both wild and farmed seabass from the Mediterranean coast of Türkiye do not pose any risk to human health (Ozmen and Yilmaz 2020).

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[117] PFASs are not addressed in the EU regulation
[118] Fish: European eel (*Anguilla anguilla*), common sole (*Solea solea*), sea bass (*Dicentrarchus labrax*); crab (*Carcinus maenas*), shrimp (*Penaeus notialis*), common cuttlefish (*Sepia officinalis*) gastropod mollusc- banded dye-murex (*Hexaplex trunculus*), clam (*Ruditapes decussatus*) and farmed mussel (*Mytilus galloprovincialis*)
[119] Fish: mullet (Mugil cephalus), shad (Alosafallax), hake (Merluccius merluccius), whitting (Merlangius euxmus), seabass (Dicentrarchus labrax), turbot (Scophthalmus maximus), red mullet (Mullus barbatus), blue fish (Pomatomus saltatrix), seabream (Sparus auratus). Mussel: (Mytilus galloprovincialis). Shrimp (Penaeus indicus)
[120] Mussels transplanted from the clean site to the impacted Nemrut bay exhibited in certain occasions PAHs concentrations higher than the concentrations in the EU regulation. Mussels from this area are not used for human consumption.

669. From the above elaboration, it can be concluded that the assessment of CI 20 based on recent peer reviewed literature included 36 relevant studies. Most (25) reported concentrations of trace metals while 12 studies reported on organic contaminants. Concentrations in a wide variety of fish species were reported in 26 studies and concentrations in molluscs in 17 studies. Data on crustaceans and cephalopods were reported in 8 studies.

670. Most of the studies found that the concentrations of the contaminants were below the concentration limits for the regulated contaminants in the EU (24 studies), or if some of the contaminants were higher than regulation, risk analysis showed no risk to human health (7 studies). Only 6 studies reported on possible risk for human health from the consumption of seafood.

671. Examination of the literature data per sub-regions was performed by counting the number of times contaminants (Cd, Hg, Pb, B(a)P) and the number of group of contaminants (Σ4 PAHs, Σ6 PCBs, PCDD/Fs and Σ (PCDD/F and dl PCBs)) (Table 3.1.7.4) were addressed in the literature. There were 37 entries for the WMS, 25 for the ADR, 24 for the CEN and 23 for the AEL sub-region. The percentages of blue status from the total entries were high: 78, 80, 71 and 87% for the WMS, ADR, CEN and AEL, respectively. Red status was assigned to 11, 12, 8 and 11% of the entries for the WMS, ADR, CEN and AEL, respectively (Figure 3.1.7.1).

Table 3.1.7.3. Number of data points extracted from IMAP-IS CI 17 database, of relevance for IMAP CI 20, are shown in black. Assessment findings are shown in red and indicate the number of data points exceeding the criteria i.e. the concentration limits for the regulated contaminants in the EU. Table is sorted by species and alphabetical order of CPs. MG – *Mytilus galloprovincialis*; MB- *Mullus barbatus*. No criteria are specified in the EU regulations for Hg and Σ_6 PCBs in *M. galloprovincialis* nor for PAHs in *M. barbatus*.

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Albania	2020	MG	2	2	2			2
			0		0			
Croatia	2019-2020	MG	37	35	37			19
			0		0			
France	2015, 2017-2018	MG	50	50	50	25	25	23
			0		0	0	0	
Italy	2015-2019	MG	33	170	33		53	
			0		0		0	
Montenegro	2018-2020	MG	28	28	28	21	21	21
			0		4	0	0	
Morocco	2017-2021	MG	27	27	27	6	6	
			0		0	0	0	
Slovenia	2016-2021	MG	21	21	15	12	12	
			0		0	0	0	
Spain	2015-2017,2019	MG	70	70	70	42	42	40
			0		6	6	1	
Croatia	2019-2020	MB	11	10	11			
			0	0	0			
Cyprus	2020-2021	MB	14	14	14	12	12	12
			0	1	0			0

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Israel	2015, 2018-2020	MB	58	60				
			0	0				
Lebanon	2019	MB	14	14	14			
			0	0	0			
Malta	2017, 2019	MB	5	5	5			
			#	0	0			
Montenegro	2018	MB	8	8	8			
			0	0	0			
Türkiye (AEL)	2015	MB	25	25	25		8	
			0	0	0			

#All data were reported to IMAP-IS as below detection limit. Detection limit was higher than the EU maximum regulatory level criteria.

Table 3.1.7.4. Summary of the findings from the scientific literature, used to support present assessment, arranged alphabetically by country. The findings of some of the studies were summarized in more than one row, to allow for the separation of taxa (i.e. fish from mollusc) and contaminants (trace metals from organics). It includes sum of 4 PAHs (benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH) (Σ_4 PAHs); Benzo(a)Pyrene (B(a)P); sum of 6 non dioxin like PCBs (Σ_6 PCBs); sum of polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and Σ (PCDD/Fs and dioxin like (dl)) PCBs).
Cells in blue: values below EU criteria; cells in green: values above EU criteria but no health risk detected; cells in yellow: values above EU criteria, risk analysis was not reported; cells in red: above EU criteria with risk to human health.

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Hamida et al. 2018	**Algeria**		sardines	Bay of Boumerdés	□		□					
Aissioui et al. 2022	**Algeria**	2017-2018	*S. pilchardus*	Algiers, Dellys and Bejaia	□□	□	□					
Aissioui et al. 2021	**Algeria**	2017-2018	*M. barbatus*	Algiers, Dellys and Bejaia	□□	□	□□					
Bilandžić et al. 2018	**Croatia**	2016	11 fish species	Purchased from supermarkets (Croatian cities)	□□	□	□					
Sulimanec Grgec et al. 2020	**Croatia**	2016	European pilchard, European anchovy	Eastern ADR	□							
Abbassy, 2018	**Egypt**	2017	*Donax trunculus*	Rosetta, Nile branch estuary						□		
Castro-Jiménez et al. 2021	**France**		Fish and cephalopods	Rhone river estuary vicinity, known as impacted						□□	□□	
Renieri et al. 2019	**Greece**	2017-2018	*Sparus aurata, Dicentrarchus labrax*	Aquaculture sites and fish market, Heraklion	□	□	□					
Sofoulaki et al. 2019	**Greece**		*Sardina pilchardus, Engraulis encrasicolus*	From 6 Greek coastal areas	□	□	□					

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Storelli et al. 2020	**Italy**	2018	16 fish species	Purchased from commercial centers of South Italy (Apulia)	□□	□□	□					
Di Lena et al. 2017	**Italy**		42 fish species	Central Adriatic and Tyrrhenian coasts of Italy and from aquaculture		□□						
Girolametti et al. 2022	**Italy**	2018-2019	*M. merluccius*	Northern and central ADR		□						
Di Bella et al. 2020	**Italy**	2017	*Xiphias gladius*	Adriatic and Tyrrhenian Seas	□	□□	□					
Esposito et al. 2020	**Italy**	2016-2019	*M. galloprovincialis*	Gulf of Naples and Domitio littoral, known impacted areas	□	□	□					
Esposito et al. 2021	**Italy**	2017	*M. galloprovincialis*	Euthrophic Calich Lagoon, Sardinia	□	□	□					
Tavoloni et al. 2021	**Italy**	2016-2017	*M. galloprovincialis*	Areas along Marche coast	□	□	□					
Cammilleri et al. 2020	**Italy**	2016	*M. galloprovincialis*	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)	□	□	□					
Ferrante et al. 2018	**Italy**	2017	*S. pilchardus, S. solea*	Fish market in Catania Gulf (Sicily				□□				
Barone et al. 2021	**Italy**	2019	5 fish species	Bari, Lecce, Taranto, Foggia, Brindisi and Matera							□	□

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Bartalini et al. 2020	**Italy**	2017	3 fish species	Northern Thyrrenian Sea						□		□
Ceci et al. 2022	**Italy**	2016	7 fish species	coasts of Abruzzo, Apulia and Sicily						□	□	
Traina et al. 2021	**Italy**	2017	5 fish species	contaminated Augusta Bay (Southern Italy)		□□				□□		
Esposito et al. 2020	**Italy**	2016-2019	*M. galloprovincialis*	Farmed in the Gulf of Naples and Domitio littoral, areas heavily influenced by human activities				□□		□		□
Ferrante et al. 2018	**Italy**	2017	*Donax trunculus*	Fish market in Catania Gulf (Sicily				□□	□□			
Barone et al. 2021	**Italy**	2019	Cephalopods, shellfish and crustaceans	Bari, Lecce, Taranto, Foggia, Brindisi and Matera							□	□
Ceci et al. 2022	**Italy**	2019	*M. galloprovincialis*	□ussel farm, Taranto Area						□	□	
Traina et al. 2021	**Italy**	2017	*M. galloprovincialis*	Augusta Bay (Southern Italy Known as impacted				□	□□	□		
Ghosn et al. 2019	**Lebanon**	2016-2017	3 fish, 1 shrimp, 1 bivalve species	coastline: Tripoli, Beirut and Saida	□	□	□					
Ghosn et al. 2020b	**Lebanon**	2017	1 bivalve, 1 shrimp species	3 sites along the Lebanese coast	□	□	□					
Ghosn et al. 2020a	**Lebanon**	2017	2 fish species	3 sites along the Lebanese coast	□	□	□					
Azizi et al. 2018	**Morocco**	2016	*M. galloprovincialis*	aquaculture farm in Cala Iris sea of Al Hoceima	□		□					
Azizi et al. 2021	**Morocco**	2018	*M. galloprovincialis*	farm installed along the Al Hoceima	□							
Mahjoub et al. 2021	**Morocco**	2018	*L. ramada*	port of Béni Ansar and Ras Kebdana	□	□	□					

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Chanto-García et al. 2022	**Spain**		*T. alalunga, K. pelamis*	Not mentioned	□	□	□					
Jebara et al. 2021	**Tunisia**	2018-2019	*S. aurata,* S. *salpa*	five stations along the Tunisian coast						□		
Barhoumi et al. 2022	**Tunisia** ^^	2018	3 fish, 2 crustaceans and 4 mollusks species	Bizerte lagoon								
Kuplulu et al. 2018	**Türkiye**	Not reported	9 fish, 1 mollusc and 1 shrimp species	purchased from fishermen of fish markets	□□	□	□					
Kucuksezgin et al. 2020	**Türkiye**	2016-2017	*M. galloprovincialis*	Transplanted into Nemrut bay Known as impacted				□□	□□			
Karayakar et al. 2022	**Türkiye**	2016-2017	3 fish species	bought from local fishermen in the Karatas region (Adana)	□		□					

* Specific sampling area or organism or size class, no health risk detected; # Cd exceeded EU regulation in bluefin tuna; & Risk for human consumption, specific species and size class; % No EU regulation concerning PAHs in fish, only in mollusc; + Exceeded EU regulation, specific organism or size class, no risk analysis performed; ^^Study measured organics not addressed in EU regulations, no risk to health detected.

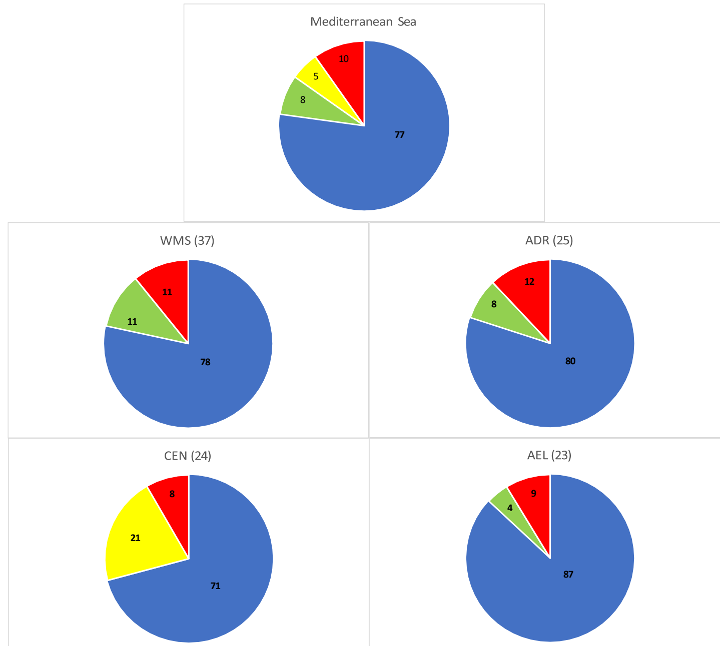

Figure 3.1.7.1. Assessment of CI 20 in the Mediterranean Sea and sub-regions based on recent peer-reviewed literature. Seventeen studies from Italy had results for 2 different sub-regions. Numbers in the chart are the percentage from total entries in each status. Number in parenthesis is the number of studies for each sub-region. Blue: values below EU criteria; green: values above EU criteria but no health risk detected; yellow: values above EU criteria, risk analysis was not reported; red: above EU criteria with risk to human health.

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Assessment of IMAP Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards

Geographical scale of the assessment	The Sub-regions within the Mediterranean region by using scientific literature sources
Contributing countries	Countries in EEA 2020 assessment (Albania, Croatia, Cyprus, France, Greece, Italy, Malta, Slovenia, Spain), and, from IMAP-IS, Bosnia and Herzegovina, Israel, Lebanon, Montenegro, Morocco
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI21. Percentage of intestinal enterococci concentration measurements within established standards
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of intestinal enterococci are within established standards
GES Targets (UNEP/MED WG473/7) (2019)	Increasing trend in the percentage of intestinal enterococci concentration measurements within established standards
GES Operational Objective (UNEP/MED WG473/7) (2019)	Water quality in bathing waters and other recreational areas does not undermine human health

Available data

672. In the 2017 MED QSR, it was recommended to prepare the future assessments of IMAP CI 21 based on the statistics from datasets submitted by national authorities or/and the corresponding agencies. However, only a few data sets were reported to the IMAP-IS. Those are presented in Table 3.1.8.1.

Table 3.1.8.1. Available data for IMAP CI 21 in IMAP-IS starting from 2015 and up to October 31st, 2022, the cutoff date for data reporting for the 2023 MED QSR.

Source	IMAP file	Country	Sub-region	Year
IMAP-IS	403	Morocco	WMS	2018
IMAP-IS	404	Morocco	WMS	2019
IMAP-IS	616	Morocco	WMS	2020-2021
IMAP-IS	547-551	Spain	WMS	2017-2021
IMAP-IS	262; 535	Bosnia and Herzegovina	ADR	2015-2021
IMAP-IS	385	Croatia	ADR	2016-2020
IMAP-IS	653	Croatia	ADR	2021
IMAP-IS	655	Croatia	ADR	2022
IMAP-IS	#	Montenegro	ADR	2017-2021
IMAP-IS	146	Slovenia	ADR	2019
IMAP-IS	440	Slovenia	ADR	2020
IMAP-IS	642	Slovenia	ADR	2021
IMAP-IS	490	Malta	CEN	2016-2020
IMAP-IS	147	Lebanon	AEL	2019
IMAP-IS	649	Lebanon	AEL	2017-2021
IMAP-IS	605	Israel	AEL	2021

Reported directly to MED POL, still to be uploaded in the IMAP-IS

673. Given lack of data reported by the CPs prevents implementation of the recommendations of COP 19, the assessment of IMAP CI 21 within the 2023 MED QSR was performed using the approach applied for the 2017 MED QSR. Namely, it combines the assessment results as presented in the assessment report[121] from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020[122] and the assessment of monitoring data reported for IMAP CI 21 from Bosnia and Herzegovina, Israel, Lebanon, Montenegro and Morocco (Table 3.1.8.1).

674. Recent data of Croatia (2021-2022) and Slovenia (2021) were reported into IMAP-IS. However, for consistency, the status of Croatia and Slovenia were not re-assessed by applying the approach used for the dataset reported by Montenegro, Morocco and Lebanon and the assessment was based on the EEA 2020 assessment of the state of bathing water quality. Data were analyzed only to check for possible problem areas.

Table 3.1.8.2. Details of data on CI 21 available from IMAP_IS.

Source	IMAP file	Country	Sub-region	Year	Number stations	Number of data points per station
IMAP-IS	403-404	Morocco	WMS	2018-2019	129	10*
IMAP-IS	616	Morocco	WMS	2020-2021	147	15
IMAP-IS	262	Bosnia and Herzegovina	ADR	2017-2020	3	9,10,13
IMAP-IS	#	Montenegro	ADR	2017-2020	23	30-39
IMAP-IS	605	Israel	AEL	2021	105	20-184
IMAP-IS	649	Lebanon	AEL	2017-2021	38^	12-47

Reported directly to MED POL, still to be uploaded in the IMAP-IS, *9 stations with less than 10 data points. ^ Not all stations available for all years.

[121] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/state-of-bathing-water/state-of-bathing-waters-in-2020

[122] The updated IMAP Guidance fact sheet for CI 21 provided in 2019 mentions the EEA as an available data source for some Mediterranean countries European and non-European.

Results of the IMAP Environmental Assessment of CI 21 in the Mediterranean region

The IMAP Guidance fact sheet for CI 21 **provides the methodology for assessment of this indicator**, This methodology is also aligned with Directive 2006/7/EC.

The methodology used in the EEA 2020 assessment of the state of bathing water quality was as defined in the EU 2006/7 Directive and in IMAP decision IG.20/9, i.e. the classification of the bathing waters was provided according to the 90th or 95th percentile of the log10 normal probability density function of microbiological data. The number of data points for each location was at least 16, over 4 bathing seasons[123], at least 4 for each bathing season.

It should be mentioned that the EU 2006/7 Directive defines two indicators: Intestinal enterococci (IE) (cfu/100 ml) and Escherichia coli (E. coli) (cfu/100 ml). Therefore, the classification of the bathing waters is based on the combination of both microbiological parameters, classifying the stations based on the worse status between the two criteria[124]. For example, if status for IE is excellent but for E. coli the status is poor, the station is classified as poor.

The same methodology used in the EEA 2020 of the state of bathing water quality was applied to data set reported by Montenegro, Morocco and Lebanon, using just intestinal enterococci as indicator.

This methodology could not be applied to data from Bosnia and Herzegovina and Israel because 16 data points for 4 consecutive bathing seasons were not available. Therefore, for these 2 CPs, the classification was based on the geometric mean calculated for each location. The geometric mean was chosen because it reduces the effect of outliers on the mean and is not influenced by skewed distribution as the arithmetic mean.

Comparison between the methodology used by the EEA and the methodology used in present document for the assessment of Bathing waters quality (CI 21)

Assessment methodology	EEA	Present assessment of IMAP CI 21*
Assessment Category	Based on Intestinal enterococci and Escherichia coli (cfu/100 mL)	Based on Intestinal enterococci (cfu/100 mL)
Number of data points	At least 16	Less than 16, depending on the CP*
Number of monitoring years	4	Less than 4, depending on the CP*
Classification of station	percentile evaluation of the log10 normal probability density function	Geometric mean

*Bosnia and Herzegovina and Israel. Lebanon, Montenegro and Morocco were classified using the same methodology as the EEA, based on 16 data points over 4 consecutive bathing seasons, but related to Intestinal enterococci values, only and by applying percentile evaluation of the log10 normal probability density function.

675. The results of the assessment of the state of bathing water quality for Mediterranean countries, EU Member States and Albania are presented in Figure 3.1.8.1. Most (>90%) of the bathing waters in all countries were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor D category: 0.1% in Spain, 1% in France, 1.7% in Italy and 3.5% in Albania.

676. The analysis of data reported into IMAP-IS by Croatia (2021-2022) and Slovenia (2021) indicated that the classification status of bathing water quality for both countries are the same as the status provided in the EEA 2020 assessment shown below in Figure 3.1.8.1.

[123] Exceptions are outlined in Directive 2006/7/EC and in Decision IG.20/9. Shortly, bathing water quality assessments may be carried out on the basis of three bathing seasons if the bathing water is newly identified or any changes have occurred that are likely to affect the classification of the bathing water. Sets of bathing water data used to carry out bathing water quality assessments shall always comprise at least 16 samples. Only 12 samples may be used to assess bathing water quality in special circumstances when the bathing season does not exceed 8 weeks or location is situated in a region subject to special geographical constraints (Annex IV, paragraph 2).
[124] EEA Guidelines for the assessment under the Bathing Water Directive Prepared by: ETC/ICM (Lidija Globevnik, Luka Snoj, Gašper Šubelj), October 2021

677. The results of the assessment of the status of bathing water quality performed with data available from IMAP-IS for Lebanon, Montenegro and Morocco are presented below in Figure 3.1.8.1, and for Bosnia and Herzegovina and Israel in Figure 3.1.8.3.

678. Lebanon. Data were available for 38 stations for the years 2017-2021, although 7 stations had no data available for all years (Table 3.1.8.2) and therefore were not classified due to insufficient data. Out of the 31 available stations, 6 stations were classified as in excellent category, 13 stations as in good category, 4 as in sufficient category, and 8 in bad category. The percentage of the stations in GES (excellent, good and sufficient category) was 74%. Four out of the 8 stations in bad category were classified as such based on data reported for almost all sampling days during all years. The stations were: Dbayeh Public Beach (DBY-2), Antelias – River Mouth (ANT-2), and Beirut (BEY-4, light house and BEY-6 Ramlet-El-Bayda Public Beach). If the 7 stations with insufficient data were considered, the percentage of the stations in-GES would be 61%.

679. Montenegro: Data were available for 23 stations for the years 2017-2020 (Table 3.1.8.2.). As explained, bathing waters quality in Montenegro was classified using the same methodology as the EEA, at least16 data points over 4 seasons related to Intestinal enterococci values only and by applying percentile evaluation of the log10 normal probability density function. Four stations had data available for only 3 bathing seasons, but they were classified in the same way, based on the exceptions outlined in Directive 2006/7/EC and in Decision IG.20/9. Out of the 23 available stations, 21 were classified in excellent category and 2 in good category.

680. Morocco: Data were available for 129-147 stations for the years 2018-2021 (Table 3.1.8.2). Sixteen stations were not sampled at each year and therefore could not be classified[125]. Out of the 131 available stations, 45 stations were classified in excellent category, 49 stations in good category, 17 in sufficient category and 20 in bad category. The percentage of the stations in GES (excellent, good and sufficient category) was 85%. If the 16 stations with insufficient data were taken into account, the percentage of the stations in-GES would be 76%.

681. Bosnia and Herzegovina: Data were available for 3 stations for the years 2017-2021 (Table 3.1.8.2). All 3 available stations were classified in excellent category.

682. Israel: Data were available for 105 stations for 2021 (Table 3.1.8.2). All the stations were classified in excellent category.

683. In line with the findings on the status of bathing water, as elaborated above, and shown in Figures 3.1.8.1; 3.1.8.2; 3.1.8.3, the Mediterranean bathing waters can be classified in GES (excellent, good and sufficient status), whereby percentage are higher than 85% for the CPs for which the assessment was undertaken. Only for Lebanon the percentage of stations in GES were 74%, however, mainly due to 4 stations. The confidence of this evaluation is high for areas with sufficient data points and bathing seasons, and less so for areas with less data. Some areas of the Mediterranean could not be assessed given no data were reported.

[125] Stations can be classified only if at least 12 sample results, spread over 3-4 bathing seasons, are available. Non-classified stations could be either in-GES or non-GES.

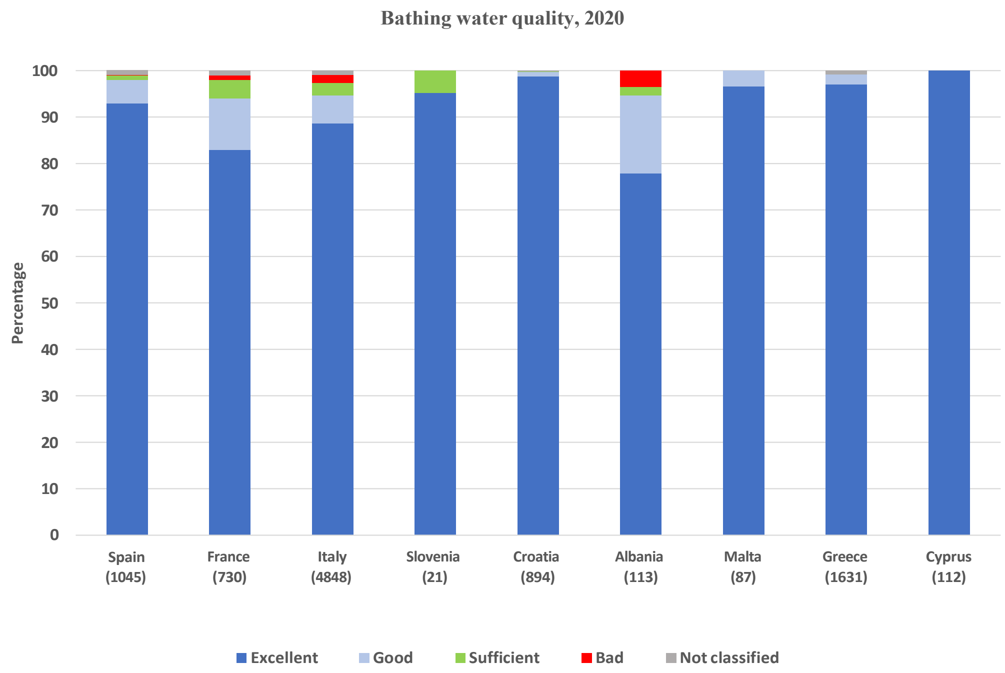

Figure 3.1.8.1: The 2020 bathing water quality assessment related to IMAP CI 21, for a group of the Contracting Parties to the Barcelona Convention. (Source: EEA, 2020). In parenthesis, the number of stations.

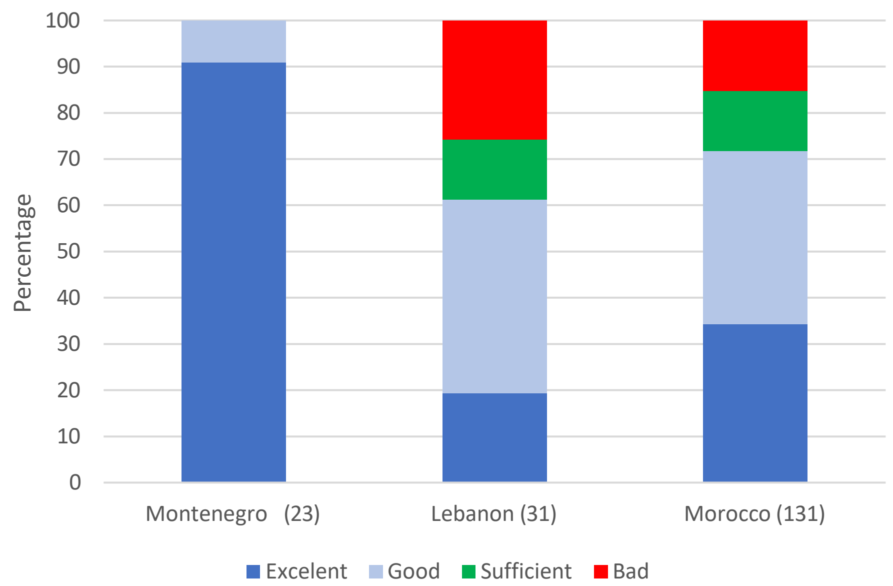

Figure 3.1.8.2: The bathing water quality assessment related to IMAP CI 21,for Lebanon, Montenegro and Morocco (Source IMAP Info System). In parenthesis, the number of stations.

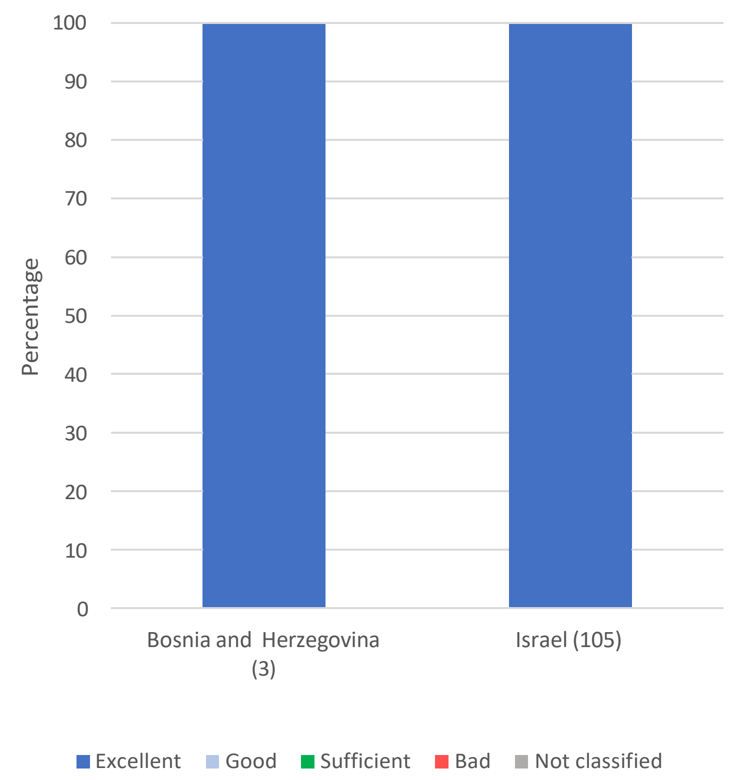

Figure 3.1.8.3: The bathing water quality assessment related to IMAP CI 21 for Bosnia and Herzegovina, and Israel. (Source: IMAP Info System). In parenthesis, the number of stations.

684. The sub-regions with good representation were the Adriatic Sea Sub-region (ADR) with data from all the Adriatic countries (partial data for Bosnia and Herzegovina); and the Western Mediterranean Sea Sub-region (WMS) (with data from Morocco, Spain, France and Italy). The Central Mediterranean Sea Sub-region (CEN) had data from Italy, Malta and Greece, while the Aegean and Levantine Seas (AEL) Sub-region had data from Greece, Cyprus, Lebanon and Israel (partial).

685. Most of data were available through EEA and not through IMAP IS, even up to October 31st, the cut off data for reporting for the 2023 MED QSR. It must be noted that the lack of data reporting for IMAP CI 21 into IMAP IS is a key obstacle to undertake related assessments for the preparation of the 2023 MED QSR. The evaluation of the state of the Mediterranean bathing waters should be improved by reporting additional data from the sub-regions/ sub-divisions with low quantity of data or no data reported. Therefore, the present assessment findings call on CPs to report monitoring data related to IMAP CI 21 so that they can be considered in the future, especially in the case of the countries that have established monitoring programs for CI 21 and regularly implement them.

686. It also must be noted that sufficient data reporting i.e., 16 data points for 4 consecutive bathing seasons would allow the application of uniform assessment methodology across the Mediterranean, therefore increasing the comparability and consistency of the assessment findings.

687. Compared to the 2017 MED QSR, the current assessment includes five CPs instead of one CP with data reported to IMAP IS, along with the CPs assessed within the EEA 2020 assessment of the state of bathing water quality. However, lack of data reporting to IMAP IS implies the use of different assessment approaches that may bring certain discrepancy. Although the present situation is better than in 2017, more data must be reported by the CPs in order to provide comparable and consistent assessment findings.

<u>Assessment of IMAP Candidate Common Indicator 26: Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animal</u>

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	Data for the following countries available either reported to the International Noise Register (INR-MED) of through the Noise Hotspots project led by ACCOBAMS: Algeria, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Lybia, Monaco, Malta, Montenegro, Morocco, Spain, Tunisia, Türkiye,
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO11. Energy including underwater noise
IMAP Common Indicator	cCI26. Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animal
GES Definition (UNEP/MED WG473/7) (2019)	Noise from human activities causes no significant impact on marine and coastal ecosystems
GES Targets (UNEP/MED WG.473/7) (2019)	Number of days with impulsive sounds sources, their distribution within the year and spatially within the assessment area, are below thresholds
GES Operational Objective (UNEP/MED WG.473/7) (2019)	Energy inputs into the marine, environment, especially noise from, human activities, are minimized

<u>Available data</u>

688. Data are initially obtained from the Impulsive Noise Registry (INR-MED) managed by ACCOBAMS. The registry is a tool defined in the Proposal of IMAP Guidance Factsheet for cCI26 . The INR-MED collates data reported by the countries in a standard format that is aligned with the requirements indicated in the Proposal of the IMAP Guidance Factsheet for cCI 26.

689. Data have been provided through the INR-MED by a few countries so far i.e. by France, Greece, Malta, Greece, Lebanon and Montenegro. They are related to three kinds of sound sources: seismic surveys, explosions, sonar or acoustic deterrents. These data cover, with many gaps, the period since 2016 onwards. They concern 247 explosions, 13 seismic surveys and 9 occurrences of sonar or acoustic deterrent use. These are official data which are reported in the correct format and most of them (92%) satisfy the minimum IMAP quality requirements.

690. To complete this process, data from the ACCOBAMS Noise Hotspot assessments i.e. from the 2nd edition which was issued in 2022 and covers the period from 2016 to 2021 (ACCOBAMS-MOP8/2022/Inf.43), are also used. These data were collected directly by a group of experts appointed by the ACCOBAMS Secretariat for the period 2016-2021 and follow theoretically the same standards used for the impulsive noise registry. However, only 170 out of 388 impulsive noise events (43%) collected under the Noise Hotspot initiative were considered good enough to be used for the present initial assessment. These noise events are mainly seismic surveys (N = 53) and port extension works for which pile driving and/or explosions were used (N = 117). They are distributed in the four Mediterranean Sub-regions and concern almost all countries bordering the Mediterranean Sea, thus completing data available from the INR-MED.

691. Globally, 439 impulsive noise events were used for analyses. The annual distribution of noise events is mapped in Figures 4.8.1 to 4.8.6 hereafter using a 20 km x 20 km spatial grid. It should be noted that a 20-km fixed buffer was used from point noise source (e.g. pile driving in ports) in order to account for propagation of noise. The 20-km buffer is selected based on scientific literature (Merchant et al., 2017; Tougaard et al., 2009). Furthermore, for noise sources described with polygons (such as seismic surveys), it was considered that using polygons for describing a moving point source (the seismic vessel using the airguns) is already an overestimation of the area where the noise is produced, and hence no additional buffer was applied. Hence, the below figures show the distribution, over a 20 km x 20 km spatial grid, of buffered point sources for port works and polygons for seismic surveys and sonar and acoustic deterrents.

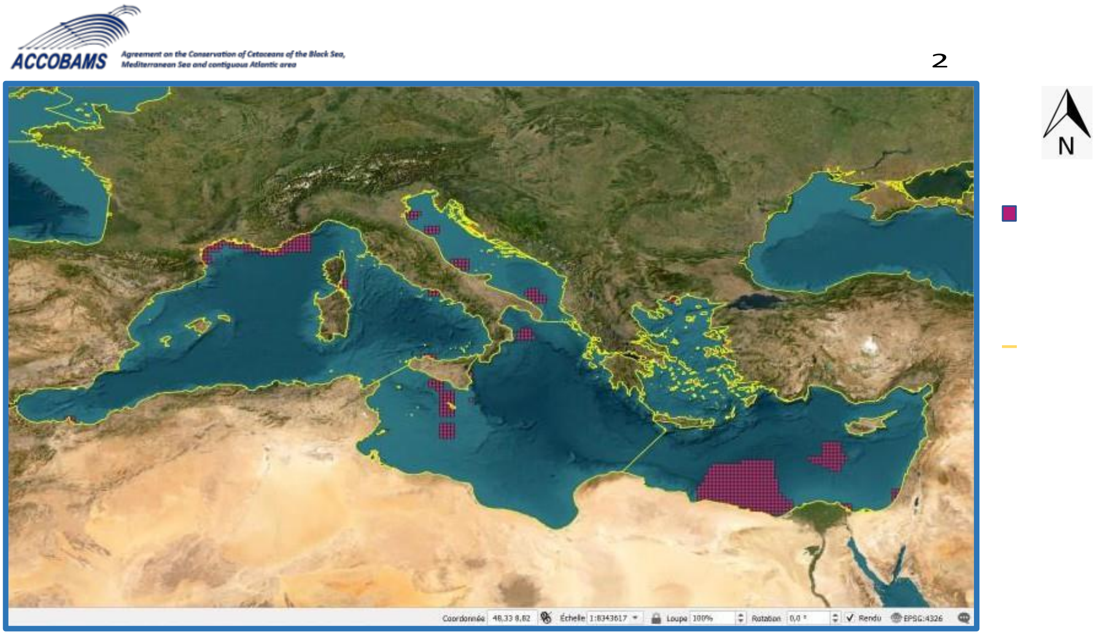

Figure 3.1.9.1. Impulsive noise events data for 2016. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell (ACCOBAMS-MOP8/2022/Inf.43).

Figure 3.1.9.2. Impulsive noise events data for 2017. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 3.1.9.3. Impulsive noise events data for 2018. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 3.1.9.4. Impulsive noise events data for 2019. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 3.1.9.5. Impulsive noise events data for 2020. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 3.1.9.6. Impulsive noise events data for 2021. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Setting the GES/non GES boundary value/threshold for the initial environmental assessment of cCI 26

The assessment for Candidate Indicator 26 is based on data of impulsive noise events reported by the Contracting Parties to the ACCOBAMS through the International Noise Register for the Mediterranean Sea region managed by ACCOBAMS (INR-MED), as well as by using data on further impulsive noise events generated through dedicated activities coordinated by the ACCOBAMS Secretariat which are aimed at enhancing the gathering of impulsive noise event data. For the initial assessment of the noise, the following low and mid-frequency impulsive noise events considered: underwater explosions, geophysical surveys with the use of airguns, sonar or acoustic deterrents, pile driving. The geographical position of such noise sources, the duration of the event (start and end date) and the intensity (in dB re 1µPa or proxy) are the necessary data for the analysis of the geographical and temporal distribution of noise events. This analysis served as an indication of the anthropogenic pressures. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of the negative impacts occurring on populations of such species is acceptable. The definition of the GES target proposed by EU TG-Noise was applied for the present initial assessment of cCI 26 within the preparation of the 2023 MED QSR. Considering the available data on impulsive noise events, the statistical calculations related to proportion of days and geographical distribution of low, and mid-frequency impulsive sounds were undertaken as far as possible in line with the Proposal of the IMAP Guidance fact sheet for cCI 26, while for performing the assessment it was necessary to calculate the extent of exposure, an additional indicator, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE), on average over a year, as outlined in the TG-Noise methodology (2022). For the calculation of the extent of exposure, it is necessary to account for the propagation of noise from the source (either by modelling or other methods such as applying a buffer zone) and to consider the footprint of an impulsive noise event, where the footprint is limited by the isoline at which the LOBE is reached.

692. For the purposes of the 2023 MED QSR a Tolerable Status of the environment is considered when 10% or less of the habitat of noise-sensitive species is impacted by impulsive noise events over a year. For the present initial assessment, this threshold (10%) is used for the four IMAP Sub-regions in the Mediterranean Sea.

693. Based on scientific works which indicate that when the exposure to underwater sound is permanent, the displacement of animals due to acoustic disturbance can be considered as a habitat loss (e.g., Brandt et al., 2018; Graham et al., 2019; Thompson et al., 2013), it was considered that the present initial assessment methodology translates the loss of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by Tougaard et al., 2013.

694. In other words, if the 10% of the habitat of a representative noise-sensitive species is impacted by noise, it is expected that the population will decline by 10% in the long-term. Considering the risk of extinction, 10% is considered sufficiently conservative and precautionary to be selected as the boundary between tolerable and non-tolerable status of a Sub-region i.e., as the boundary value/threshold between the GES and non GES.

Results of the initial IMAP Environmental Assessment of cCI 26 in the Mediterranean region

695. Data collected through the Noise Register lacked geographical representativeness (data from only 5 countries: France, Malta, Greece, Lebanon and Montenegro) and had to be integrated with data collected from dedicated activities led by ACCOBAMS (Noise Hotspot data[126]). Under the 'Noise Hotspot' project, data related to impulsive noise events were found for the period 2016-2021 in waters in front of most Mediterranean countries. However, these data presented uncertainties or gaps in the

[126] ACCOBAMS-MOP8/2022/Inf.43

source level and duration in days of activities that made it impossible either to apply propagation modelling to noise events and compute refined noise footprints, or to compute the number of days with impulsive noise events in the Mediterranean region, as whole, or in its Sub-regions.

696. By pooling together data from the International Noise Register (data from reporting countries) and the Noise Hotspot project (data from scientific study), a database was obtained covering the four Mediterranean Sub-regions, and with sufficient quantity and quality of data to carry out an initial assessment for cCI26.

697. The value of LOBE was not assigned due to heterogeneity of data, preventing the use of refined acoustic propagation modelling to calculate the noise footprint of the impulsive noise events. Instead, as mentioned above, a 20-km fixed buffer was used from point noise source (e.g. pile driving in ports) in order to account for propagation of noise. The 20-km buffer is selected based on scientific literature (Merchant et al., 2017; Tougaard et al., 2009). Furthermore, for noise sources described with polygons (such as seismic surveys), it was considered that using polygons for describing a moving point source (the seismic vessel using the airguns) is already an overestimation of the area where the noise is produced, and hence no additional buffer was applied. Moreover, without consideration of the duration in days for many noise events (the duration in day lacks in 38% of data), it was impossible to calculate the daily cumulated area affected by noise (daily exposure), which is at the basis of the calculation of the average extent of habitat affected by noise over a year i.e. the extent of exposure.

698. Considering these issues, the annual surface of the four Mediterranean Sub-regions with impulsive noise events was computed by summing up the areas of all the noise events described by polygons and buffered point sources, per sub-region. Subsequently, the proportion of potentially usable habitat area (PUHA i.e. Potentially Usable Habitat Area, following habitat models developed by Azzellino et al., 2011), found on areas concerned by noise events, is computed for selected cetacean species, namely the fin whale for the Western Mediterranean sub-region, while the bottlenose dolphin, the sperm whale and the Cuvier's beaked whale for the four Sub-regions. The result of this calculation is the amount of habitat impacted by noise per Sub-regions and for the whole Mediterranean since 2016 i.e., the extent of exposure, which provides an insight of the risk of decline in population of selected species of cetaceans.

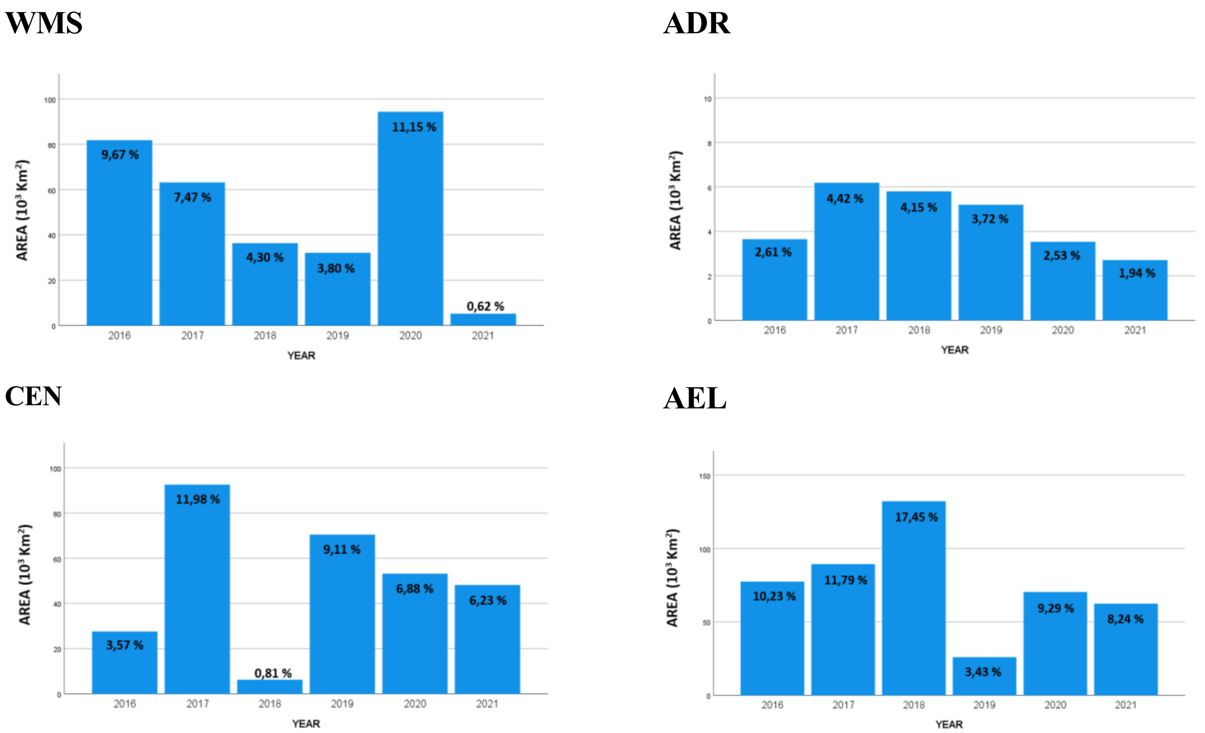

Figure 3.1.9.7. % of sub-regions covered by noise events per year since 2016: **WMS**= Western Mediterranean; **ADR** = Adriatic Sea; **CEN** = Ionian and Central Mediterranean Seas; **AEL**= Aegean and Levantine Seas.

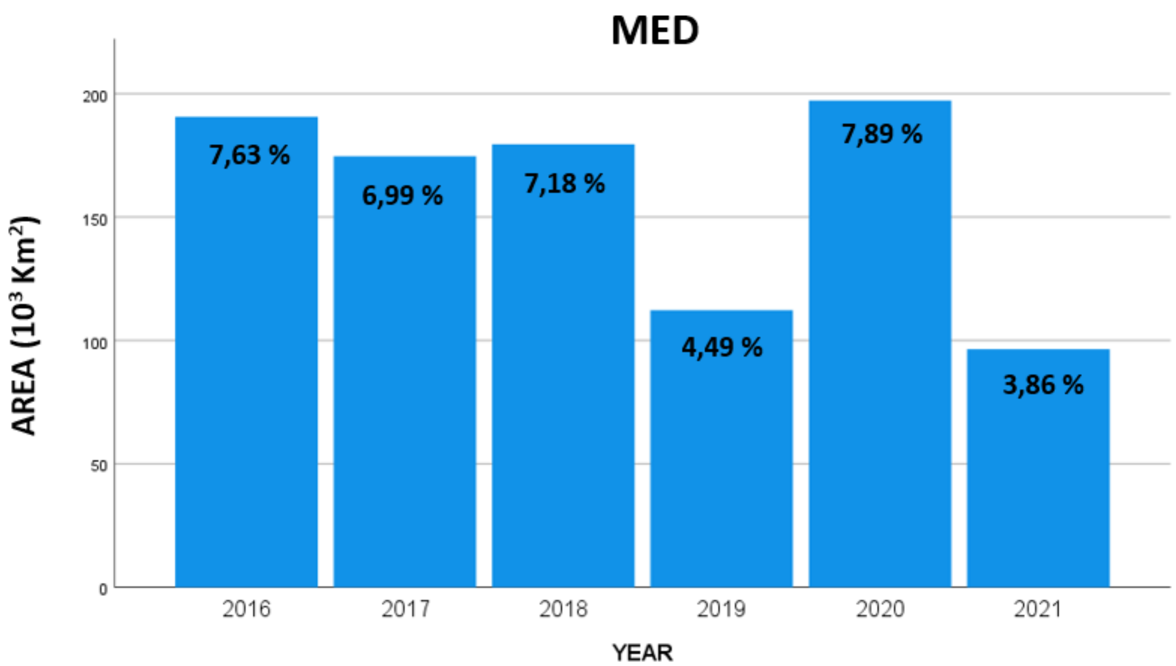

Figure 3.1.9.8. % of the Mediterranean region covered by noise events per year since 2016.

699. To overlap noise event areas to the species habitat an analysis grid is used of about 20 km mesh size (i.e. 10’ x 10’ grid cells) and the concept of PUHA, here applied as habitat proxy. The PUHA is computed from presence/absence habitat models using physiographic predictors as covariates (depth and slope statistics) which estimate the presence probability of the representative cetacean species in the area of interest. Based on the presence probability for a species, called Habitat Suitability (HS), the usable habitat (in km²), is calculated in every cell unit of the analysis grid by multiplying the HS for the area (km²) of the cell unit. The PUHA is then calculated (in km²) for the subregions by summing up the usable habitats from single grid cells in the different subregions.

700. Table 3.1.9.1 shows the percent of habitat (PUHA) of a species which is affected by impulsive noise for every year from 2016 to 2021. Four species are considered: bottlenose dolphin, sperm whale and Cuviers’ beaked whale, and only for the WMS subregion the fin whale.

Table 3.1.9.1: Summary of the percent impacted PUHA for the four selected cetacean species (e.g. bottlenose dolphin, sperm whale and Cuviers’ beaked whale, and fin whale). For the year 2018, the percent of impacted PUHA for sperm whale and Cuvier’s beaked whale is highlighted in red and percent of impacted PUHA of bottlenose dolphin, being close but lower than the 10% GES/non GES boundary limit is highlighted in light blue.

IMAP SUB-REGIONS	AFFECTED AREA (% POTENTIALLY USABLE HABITAT AREA IMPACTED BY IMPULSIVE NOISE) PER YEAR IN THE PERIOD 2016-2021						
	Bottlenose dolphin						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	4,81	6,59	6,48	6,27	3,03	2,88	5,54
AEL	4,76	5,21	**8,62**	1,17	4,27	1,39	4,52
CEN	1,28	1,45	0,66	4,02	2,9	2,48	1,97
WMS	1,52	1,34	1,26	1,48	1,63	0,45	1,41
	Fin whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
WMS	0,99	1,02	0,67	0,74	1	0,23	0,87
	Sperm whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	1,48	2	1,97	1,77	0,69	0,64	1,63
AEL	**8,2**	2,59	**11,51**	0,88	3,36	2,12	3,11
CEN	0,63	0,83	0,55	7,39	5,62	5,47	3,15
WMS	0,84	0,94	0,47	0,49	0,78	0,16	0,63
	Cuvier's beaked whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	1,41	2,44	2,37	1,78	0,25	0,28	1,59
AEL	6,18	4,77	**10,15**	0,97	4,75	1,95	4,76
CEN	1,27	1,64	0,83	6,1	4,88	4,41	3,02
WMS	1,22	1,17	0,99	1,19	1,49	0,38	1,18

701. It can be observed that in the 2016-2021 average scenario (median level), the 10% GES/non GES boundary limit was not exceeded, being very far for all the considered species. However, for some year (e.g. in 2018), the 10% GES/non GES boundary limit might have been exceeded in the Aegean-Levantine Sub-region (AEL) concerning the habitat of sperm whale and Cuvier's beaked whale. In such a case, the environmental status may be considered non tolerable for the year 2018 i.e., the non GES can be indicated.

702. For the Western Mediterranean (WMS), the Adriatic Sea (ADR) and the Central Mediterranean Sea (CEN), the environmental status appears as tolerable for all years.

703. For the years 2016, 2017, 2019, 2020, 2021 and for all the 4 cetacean species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), all subregions are below threshold, i.e., less than 10% of the potentially usable habitat area is affected by noise events as calculated following the adapted assessment methodology.

704. For the year 2018 and for all the 4 species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), 3 sub-regions are below threshold of affected habitat (ADR, CEN, WMS).

705. In 2018, the proportion of affected habitat was higher than 10% i.e. the GES/non GES boundary value/threshold in the Aegean and Levantine Sea Sub-region (AEL) considering sperm whale and Cuvier's beaked whale habitats, but was lower than 10% considering the bottlenose dolphin habitat. AEL Sub-region presents the higher likelihood to be in non-tolerable i.e., non-GES based on available data and adapted assessment methodology (Figure 3.1.9.9).

706. , The proportion of affected habitat was higher than 10% i.e. the GES/non GES boundary value/threshold in the Aegean and Levantine Sea Sub-region (AEL) considering sperm whale and Cuvier's beaked whale habitats, but was lower than 10% considering the bottlenose dolphin habitat. AEL Sub-region presents the higher likelihood to be in non-tolerable i.e., non-GES based on available data and adapted assessment methodology (Figure 3.1.9.9).

707. Overall, for the Mediterranean Sea region, the environmental status is probably acceptable based on the present preliminary assessment findings, since the whole Mediterranean seems to comply with the 10% GES/non-GES boundary value of impacted habitat of cetaceans selected for this assessment. This conclusion is also supported by the computation of the simple coverage (i.e., without considering the habitat of cetaceans) of the Mediterranean Sea by impulsive noise events, which is below 10% for all year considered (Figures 3.1.9.7.and Figure 3.1.9.8).

708. Figures 3.1.9.9 and 3.1.9.10. provide a mapping of main assessment findings, especially highlighting potential non-GES situations found for the year 2018. It is noteworthy that the red areas highlighted in those maps do not correspond to non-tolerable, i.e., non-GES, positions, but are simply the position of all noise events for periods and areas considered (2018, all sub-regions). Tolerable or non-tolerable status is derived by dividing the extent of habitat of a species which is covered by impulsive noise events in the sub-region by the overall extent of the habitat area in that subregion. Tolerable or non-tolerable status is therefore indicated by one number (i.e., the proportion of affected habitat, in % which is assigned to a sub-region plotted and is plotted in Figures 3.1.9.9 and 3.1.9.10. Beyond this, highlighting the areas that determine the exceedance of the 10% threshold (non-tolerable, i.e. non-GES areas) during a year will be possible when the ACCOBAMS International Noise Register will be fed with enough data to allow for an optimal assessment. However, from a management perspective the way the red areas are interpreted has little importance as bringing a sub-region below thresholds will imply to take measures to reduce the extent of the red areas, wherever they are found.

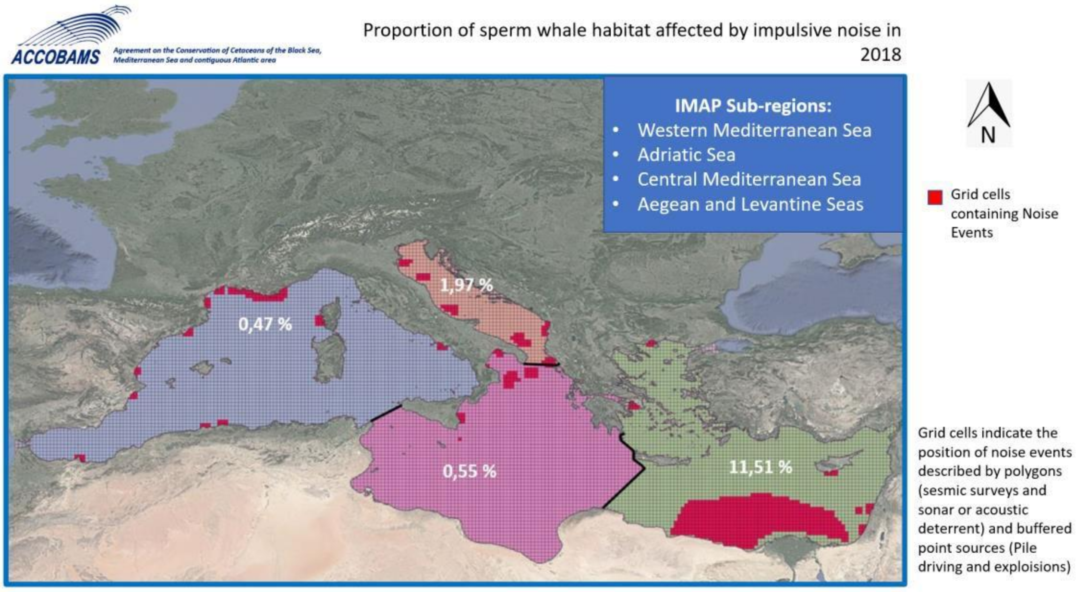

Figure 3.1.9.9. Percentages of habitat (PUHA) exposed to impulsive noise events, in 2018, per four IMAP Sub-regions in the Mediterranean and considering sperm whale as target species. Red grid cells indicate the position of noise events in 2018, irrespective if they are classified as GES or non-GES. The 4 sub-regions are indicated in different colours.

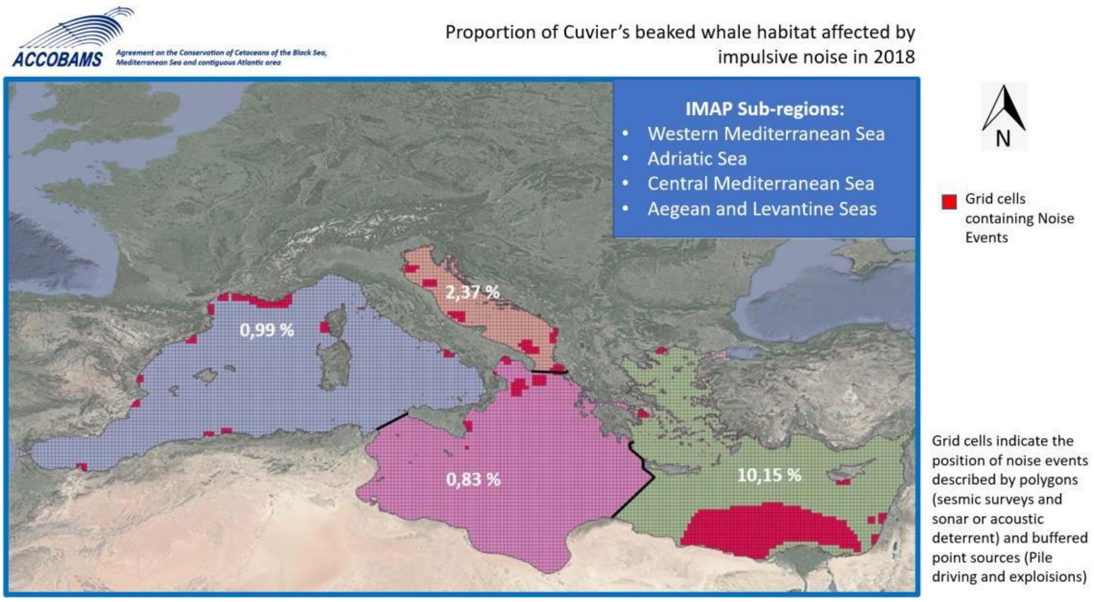

Figure 3.1.9.10. Percentages of habitat exposed to impulsive noise events, in 2018, per four IMAP Sub-regions and considering Cuvier's beaked whale habitat. Red grid cells indicate the position of noise events in 2018. The 4 sub-regions are indicated in different colours.

709. The refinement of the assessment, when the INR-MED will reach a higher level of completeness, should enable simulation of the effect of the concurrent activities of impulsive noise sources through appropriate simulation techniques (including acoustic modelling), and application of the optimal methodological framework .

Assessment of IMAP Candidate Common Indicator 27: Levels of continuous low frequency sounds with the use of models as appropriate

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	**All ACCOBAMS Contracting Parties** which participate in setting and maintenance of the NETCCOBAMS platform: Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Georgia, Greece, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Portugal, Romania, Slovenia, Spain, Syria, Tunisia, Türkiye, Ukraine
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO11. Energy including underwater noise
IMAP Common Indicator	cCI27. Levels of continuous low frequency sound with the use of models as appropriate
GES Definition (UNEP/MED WG473/7) (2019)	Noise from human activities causes no significant impact on marine and coastal ecosystems
GES Targets (UNEP/MED WG473/7) (2019)	Noise levels at monitoring stations are below thresholds; The extent (% or km^2) of the assessment area which is above levels causing disturbance to sensitive marine animal is below limits, or such limits are exceeded for a limited amount of time
GES Operational Objective (UNEP/MED WG473/7) (2019)	Energy inputs into the marine, environment, especially noise from, human activities, are minimized

Available data

710. For cCI27 data are obtained from the NETCCOBAMS Platform, the digital information tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The platform contains maps of shipping noise distribution over the entire Mediterranean basin in the two out of the five frequency bands of interest (1/3 octave bands centered at 63 Hz and 125 Hz). Shipping noise maps were obtained from modelling techniques which corresponds to requirements indicated in the Proposal of the IMAP Guidance Factsheets for cCI27.

711. Availability of these NETCCOBAMS maps of shipping noise in the two frequencies is also aligned with the ACCOBAMS Monitoring Strategy (2015) on underwater noise monitoring and the EU recommendations contained in the Monitoring Guidance prepared by TG-Noise for the MSFD-D11 (Dekeling et al, 2014).

712. These maps are produced by modelling tools provided by SINAY, a company specialized in underwater acoustics which developed the necessary technologies to set up the NETCCOBAMS platform (ACCOBAMS-SC14/2021/Doc36) which include modeling techniques widely used in environmental studies on noise pollution (e.g., Maglio et al., 2015, 2017; Drira et al, 2018). Such techniques are based on the RAM model (Collins, 1993) and inputs data available from the AIS data for ships parameters and ship traffic (source: Spire Group, a US based company), as well as in EMODnet and COPERNICUS data platforms (EMODNet and Copernicus) providing environmental variables influencing the propagation of noise.

713. An overview of the available data on ship traffic patterns is shown in Figure 3.1.10.1. This map, available in NETCCOBAMS, was produced based on the ship traffic density provided based on AIS data in 2017. Ship traffic patterns appears quite stable year-to-year and the ship density maps that can be obtained from AIS data generally shows the same picture overall, regardless of the period chosen for analysis. Major ship lanes are found indeed between the Gibraltar Strait and the Suez Canal as well as in other lanes connecting the major ports in the Mediterranean Sea area. High traffic areas are especially located in the northern side of the Mediterranean.

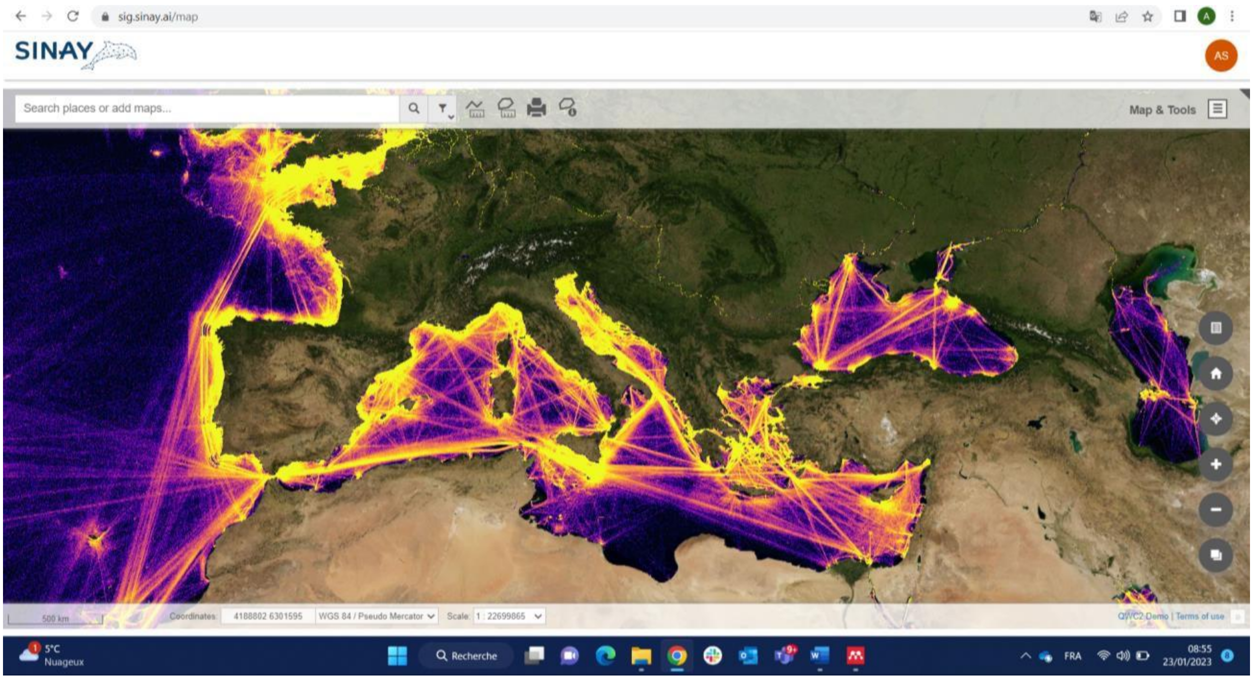

Figure 3.1.10.1: Ship traffic density as total count of AIS messages per grid cell (0.01° in latitude and longitude) for 1 year (2017 in this case). The patterns shown in this map (ship lanes, traffic hotspots, low- and high-density areas) are quite stable year-to-year and can be considered representative of usual ship traffic conditions in the Mediterranean Sea. Source of raw AIS data used in NETCCOBAMS: Spire Group.

714. The noise map used for this assessment referred to the median ambient noise levels for the month of July 2020. The use of median level over 1 month satisfies the minimum requirements for the assessment related to cCI27 according to the 2022 TG-noise guidance. This map is presented below in this document. Given the relative stability of the ship traffic levels and characteristics within a time window of a few years, and that the ship traffic is at the highest levels during summer months, the assessment produced for month of July 2020 can be generalized to other years, and can be seen as the worst case scenario within a year[127].

715. Other relevant sources of data are indirectly explored. These are the ambient noise levels from in-situ measurements in the Balearic Sea collected within the QUIETMED project (quietmed-project.eu) which were used to calibrate the models implemented in NETCCOBAMS. Despite additional in-situ measurements are required to continue improving the model which would estimate situation in the four Mediterranean subregions. The first validation was achieved from field data which do not directly contribute to the assessment, and therefore they are not shown in the 2023 MED QSR.

[127] Furthermore, a new noise map for the month of July 2021 should be available in NETCCOBAMS in the coming months. The noise map for July 2021 will allow to compare the status in July 2020 with the status in July 2021, to test assumptions described in this assessment.

Additional information on data and the calibration process of the acoustic models is found in QUIETMED Deliverable 3.3 (Taroudakis et al., 2018).

716. Finally, data produced under national programs as well as from sub-regional cooperation projects (e.g. the INTERREG-SOUDSCAPE project in the northern Adriatic Sea), were listed and can be used to put into context and compare with assessment findings produced here, thus allowing more robust conclusions. This activity is currently ongoing and will complete the present document at a later stage of the 2023 MED QSR development process.

Setting the GES/non GES boundary value/threshold for the initial environmental assessment of cCI 26

The assessment of IMAP Candidate Indicator 27 was performed by using data obtained from the NETCCOBAMS Platform, a digital information tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The quality of available data was sufficient and allowed to produce the first assessment findings of cCI 27 in the four Sub-regions of the Mediterranean Sea. For this initial assessment of cCI 27, the methodology served as an indication of the anthropogenic pressures. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of that negative impacts occurring on populations of such species is acceptable. Specifically, the methodology for cCI27, which was based on monthly extent of exposure, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE) on a monthly basis, ensured addressing the risk of extinction of a population due to exposure to underwater noise. This concept is at the basis of the noise assessment methodology developed by the MSFD TG-Noise.

The Proposal of IMAP Guidance Factsheet for cCI 27 indicates the following target: “the extent (% or km²) of the assessment area which is above levels causing disturbance to sensitive marine animals is below limits”. Further to the finalisation of the work from EU TG-Noise in 2022, it is found that this GES target still stands. Therefore, it was applied for the initial cCI 27 assessment within the preparation of the 2023 MED QSR.

717. The overall assessment methodology developed by TG-Noise (2022) could be fully implemented for IMAP cCI27 for the month of July 2020, which is taken as basis for assessing the status i.e., tolerable/non-tolerable that might be considered correspondent to GES/non GES status of marine waters at the sub-regional level.

718. The average noise level for the month of July 2020 is defined as the median ambient noise level. The median is calculated from the statistical distribution of noise values obtained from the acoustic modelling (N = 93 noise maps corresponding to shipping noise levels at 93 instants, 1 every 8 hours for the period of 31 days).

719. The Level of Onset of Biological Effect (LOBE) was set at as a sound pressure level of 125 dB re 1 μPa in the 1/3 octave band centered at 63Hz and each grid cell. The value of 125 dB re 1 μPa was defined based on the models developed by Gomez et al 2016.

720. The frequency band centered at 63 Hz is selected from the list of frequency bands indicated in the Proposal of the IMAP Guidance Factsheets for cCI27 (1/3 octave bands centered at 20, 63, 125, 250, 500, 2 000 Hz) as shipping noise in this frequency bands generally dominates in the underwater ambient noise.

721. With regards to cetacean species selected for the assessment, the fin whale is selected for the Western Mediterranean Sea Sub-region, and the bottlenose dolphin for the other three Mediterranean Sub-regions. The proportion of the potentially usable habitat areas (PUHA, following Azzellino et al, 2011) of these species, found on areas with median shipping noise higher than LOBE (125 dB re 1 μPa), is computed. The result of this calculation is the amount of habitat affected by noise i.e., the extent of exposure, which provides an estimate of the risk of decline of the selected species’ population.

722. A Tolerable Status of the environment is defined when 20% or less of the habitat of noise-sensitive species is impacted by continuous noise on a monthly basis. It is used for all four Mediterranean sub-regions. Based on the scientific works demonstrating that the exposure to underwater continuous noise induce adverse effects (e.g. behavioral disturbance, stress, reduced communication space, and temporary or permanent habitat loss) which in turn could reduce the fitness, and hence the reproductive success of individuals (e.g. CBD, 2012), it was considered that the present initial assessment methodology translates the degradation of portions of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by Tougaard et al (2013). In other words, if the 20% of the habitat of a representative noise-sensitive species is impacted by high levels of continuous noise, it is expected that the population will decline by 20% in the long-term.

723. An acceptable status i.e. the GES relative to continuous noise is achieved if in every month over a year, the area exposed to noise level higher than LOBE is equal to or below 20% of the habitat of a selected species. If one month is above 20%, the environmental status is considered non tolerable. This is found as an optimal boundary value after considering that shipping is nowadays a permanent characteristic of the habitats and it has probably shaped the carrying capacity of habitats and hence the size of populations since decades. This consideration, along with the fact that the scientific literature about the noise effects does not suggest any strong relationship of the shipping-related noise with any dramatic reduction of the population sizes, determines the setting for continuous noise of a less restrictive threshold than for the impulsive noise. This threshold of 20% of habitat of a species exposed to continuous noise in the long term is hence used as a baseline to assess whether at least this initial minimum target is achievable. It should ensure the viability of a population size at 80% of the carrying capacity. This number is therefore subject to further possible adjustments.

Results of the initial IMAP Environmental Assessment of cCI 27 in the Mediterranean region.

724. Figure 3.1.10.2 shows the distribution of median noise levels in the 1/3 octave band centered at 63 Hz for the month of July 2020. Considering that the median divides a distribution of values sorted from lowest to highest in the two parts, each containing 50% of the values, the median noise informs that during 50% of the time the levels are higher than those shown at each point of the area as depicted in Figure 3.1.10.2, and in the other 50% the values are lower. The median value is a good indicator of a ‘typical’ ambient noise value that can be measured in a zone because it is not influenced by small portions of very high or very low values, as it would be the case by applying the arithmetic mean.

725. Beyond indication of the typical values of ambient noise of an area, the median noise can also indicate where the values are high enough to induce the negative effects in individuals of sensitive marine species, they are even higher for the 50% of the time. In such a case, the exposure to the levels inducing negative effects would occur very frequently i.e. during 50% of the time and potentially for a long period of time (e.g. hours to days of continuous habitats` exposure), eventually increasing the risk for populations.

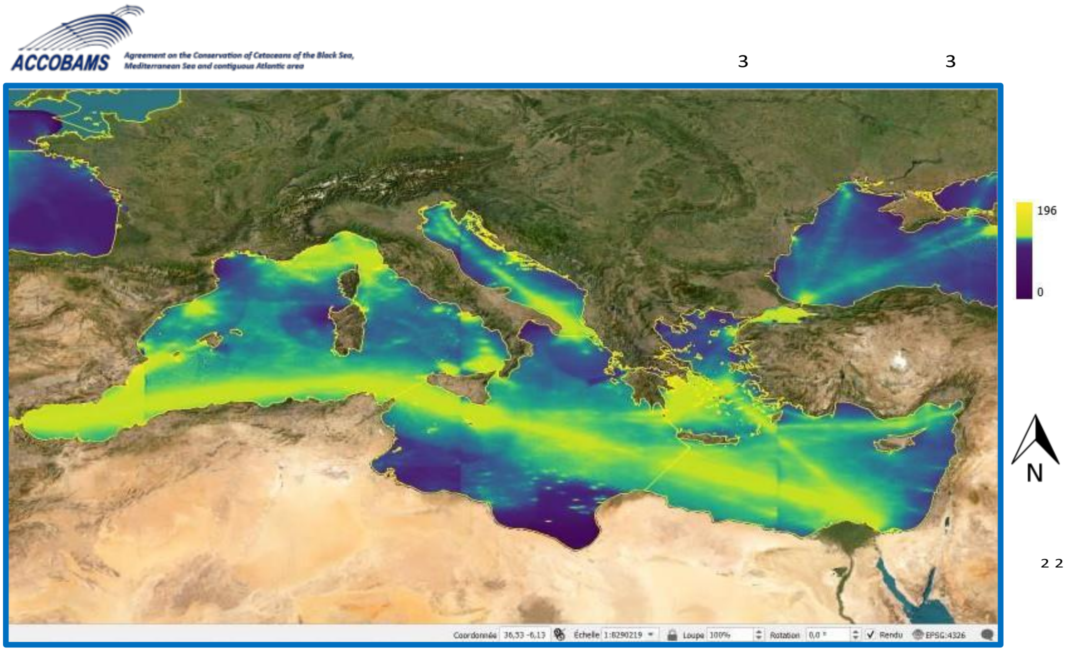

Figure 3.1.10.2: Median shipping noise levels in month of July 2020 based on the acoustic model RAM (Collins, 1996), contained in the NETCCOBAMS platform.

726. By analyzing Figure 3.1.10.2. on the median shipping noise, the main ship lanes can be distinguished (e.g., Gibraltar to Suez) from the areas of diffused noise around port areas, where the median noise levels are estimated at around 140 dB re 1µPa or higher. Also, the areas with lower or very low ship traffic levels (e.g. offshore waters between Sardinia, the Balearic Islands and southern French coast) present median noise levels in the range 100-110 dB re 1µPa. A few areas present the median values below 100 dB re 1µPa, and especially those in Libyan waters due to very low ship traffic and the distance from heavy traffic areas. Also, some high vessel traffic areas do not correspond to high median noise levels (e.g. waters around Cyprus, the Central and the Northern Adriatic Sea).

727. The percentage of habitat of the fin whale and the bottlenose dolphins which is found where the median shipping noise is higher than 125 dB re 1µPa is calculated for the Western Mediterranean Sea Sub-region, and for all four Mediterranean Sub-regions, respectively. The results of the assessment indicating tolerable/ non-tolerable i.e. GES/non GES are summarized here-below in Table 3.1.10.1.

Table 3.1.10.1: Summary of the percent impacted habitat (PUHA) for the two selected cetacean species (i. bottlenose dolphin for all subregions, and ii. fin whale for Western Mediterranean Sea,) for the month of July 2020. The 20% threshold is exceeded in the Western Mediterranean Sea with relationship to both bottlenose dolphin and fin whale habitats, and in the Aegean and Levantine Seas with the relationship of bottlenose dolphin habitat.

BOTTLENOSE DOLPHIN		
IMAP SUB-REGION	**Affected habitat**: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	**Result of the assessment**
WMS	**35.02%**	Non tolerable
ADR	15.53%	Tolerable
CEN	15.84%	Tolerable
AEL	**27.59%**	Non tolerable

FIN WHALE		
IMAP SUB-REGION	**Affected habitat**: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	**Result of the assessment**
WMS	**31.53%**	Non tolerable

728. The computation of the extent of exposure results in non-tolerable i.e. in non GES for the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions i.e., % affected habitat > 20%, while the status is tolerable i.e., GES in the Adriatic Sea and Central Mediterranean Sea Sub-regions.

729. The overlap between continuous noise (median noise in July 2020) and the habitat of cetacean species clearly shows the exceedance of the 20% boundary value/threshold of the habitat area affected by continuous low frequency noise in the Western Mediterranean Sea and the Aegean Levantine Seas Sub-regions. Given that the implementation of the methodology for cCI 27 is overall complete for the month of July 2020, it can be concluded that these two sub-regions were in non-tolerable status i.e., non-GES during that one month. While it cannot be said much regarding the status during other months, one single month exceeding the 20%, is sufficient to induce non tolerable environmental status, i.e. nonGES for continuous noise, for the entire year. Therefore, the assessment finding for 2020 appears to be non-tolerable status, i.e. non-GES, for WMS and AEL sub-regions.

730. Figures 3.1.10.3 and 3.1.10.4 provide such mapped assessment findings. It is worth noting that tolerable/non tolerable, i.e. GES/non-GES status is indicated by the proportion of affected habitat to see whether the value is above the 20%. Red areas determine the non-tolerable status of a sub-region but are not to be considered non-GES areas. However, from a management perspective the way red areas are interpreted has little importance as bringing a sub-region below thresholds will induce taking actions to reduce the extent of the red areas, wherever they are found.

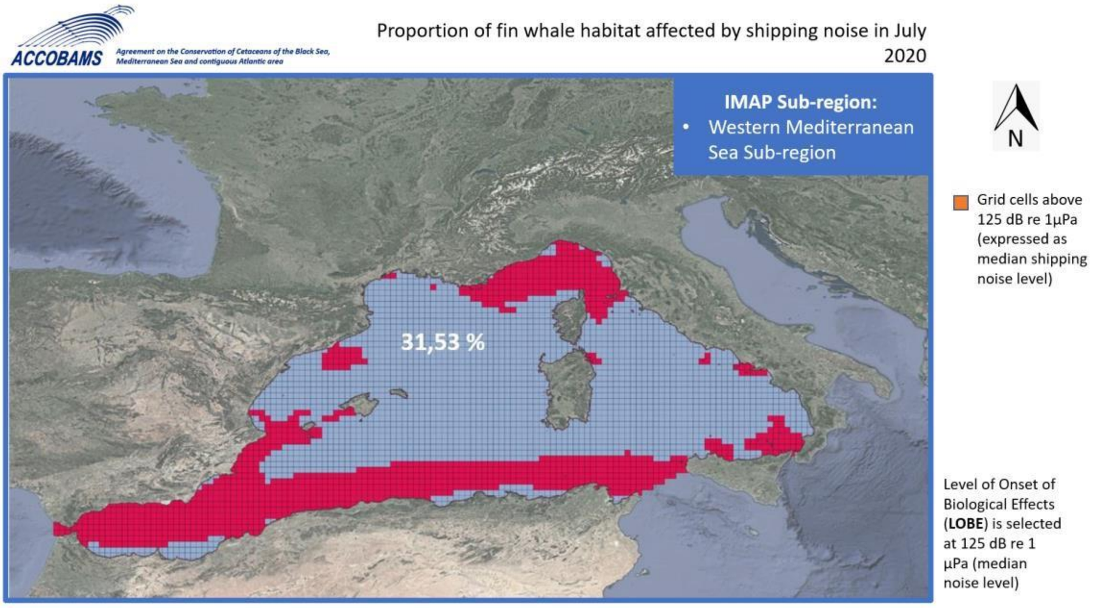

Figure 3.1.10.3. Percent of fin whale habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 μPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS). Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1μPa) is exceeded for the month of July 2020.

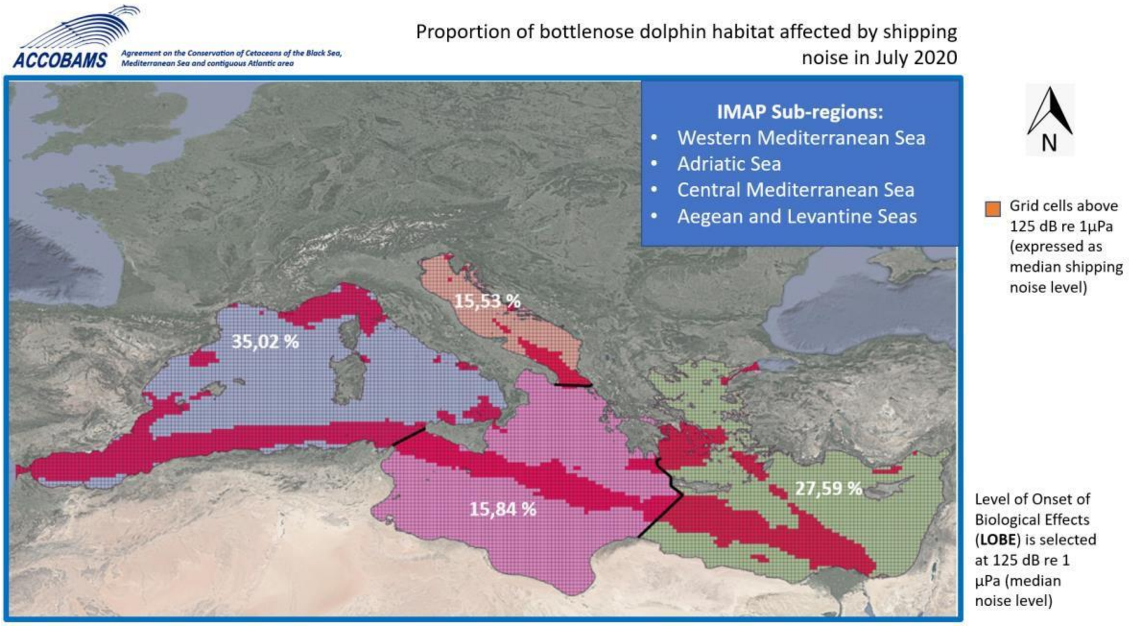

Figure 3.1.10.4. Percent of bottlenose dolphin habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 μPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS), Adriatic Sea (ADR), Central Mediterranean (CEN) and Aegean and Levantine Sea (AEL) sub-regions. The picture shows exceedance of thresholds (20% of habitat affected by continuous noise) in the WMS and AEL sub-regions, and compliance in the ADR and CEN sub-regions. Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1μPa) is exceeded for the month of July 2020. Different sub-regions are indicated in different colours.

731. For the Adriatic Sea (ADR) and Central Mediterranean (CEN) sub-regions, the result of the assessment was a tolerable status, i.e. GES for continuous noise, considering that the proportion of habitat of the species considered (bottlenose dolphin) affected by continuous noise was below 20%. As elaborated above, the summer months are those with the highest levels of vessel traffic and hence the analysis done on a month of July 2020 can be seen as the worst-case scenario. Therefore, even

though quantitative data were not produced for other months, it is possible to conclude that if the month representing the worst case scenario results in tolerable status, i.e., GES for continuous noise, this result can be generalized for the entire year, i.e., the ADR and CEN sub-regions were likely in GES in 2020.

732. Finally, based on these preliminary results, the environmental status of the Mediterranean Sea region is not fully in tolerable status i.e., GES status since the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions do not comply with the 20% threshold of impacted habitat over the monthly scenario.

Measures and actions required to achieve GES

The knowledge gaps common to IMAP Ecological Objectives 5 and 9

Lack of data for nutrients, contaminants and biomarkers, as well as the lack of capacities of National IMAP Pollution competent laboratories:

733. There was a vast improvement in the spatial coverage of data reported for IMAP Pollution Common Indicators into IMAP IS since the last 2017 MED QSR. However, data availability is characterized by significant data inhomogeneity, and uneven data distribution along the Mediterranean region, with areas with satisfactory data availability and with areas for which only a few or no data were reported. The following key observations pertain to specific IMAP Pollution Common Indicators:

- CIs 13&14. The data most lacking are for total phosphorous. Data for all mandatory parameters i.e., the concentration of ammonium, nitrite, nitrate, total nitrogen, orthophosphate, total phosphorus, orthosilicate and chlorophyll a, temperature, salinity, dissolved oxygen and water transparency (Secchi depth), are needed for the Central Mediterranean Sea Sub-region (CEN); the southern part of the Levantine Sea, the sub-division of the Aegean-Levantine Sea Sub-region; and the southern part of the Central part of the Western Mediterranean Sea Sub-region (WMS) which are underrepresented in the IMAP database.
- CI 17. The data most lacking were for organic contaminants in sediments and biota for all four Mediterranean Sub-regions, followed by trace metals in biota *(M. galloprovincialis and M. barbatus)*. As well as for CIs 13&14, data for all the parameters of CI 17 are needed for the CEN Sub-region; the southern part of the LEVS sub-division; and the southern part of the Central part of the Western Mediterranean Sea (CWMS) sub-division.
- CI 18. No data were available in IMAP IS for the preparation of the 2023 MED QSR. Therefore, no improvement in the assessment of CI 18 was achieved since the 2017 MED QSR, and the GES assessment was impossible within the preparation of the 2023 MED QSR. Instead, the assessment was performed based on bibliographic studies, as in the 2017 MED QSR, using newer available scientific literature i.e., the studies on biomarkers in the Mediterranean Sea since 2016. It should also be emphasized that data from studies could not be compared to BACs and EACs values as agreed for CI 18 by Decisions IG.22/7 (COP 19) and IG.23/6 (COP 20) as they were not measured in the specific tissue of *M. galloprovincialis*. Moreover, comparison among the bibliographic studies was mostly impossible. This is due to using different biomarkers, with different biota species, using different tissues, and different methodologies. The confounding factors that hinder environmental status assessment i.e., species, gender, maturation status, season, and temperature were re-confirmed as found in the 2017 MED QSR. In addition, an inherent bias exists in publications toward studies showing an effect. Authors and journals do not usually publish studies showing the lack of effect or response.
- CI 20. No data were available in IMAP IS to undertake GES CI 20 assessment within the preparation of the 2023 MED QSR. Therefore, the environmental assessment could only be performed by combining the two approaches: i) assessment of the status based on data reported to IMAP IS for CI 17 contaminants in biota, and ii) assessment of the present status based on bibliographic studies, following the same approach applied for preparation of the 2017 MED QSR; however, by using newer available scientific literature. It should also be recognized that due to the lack of data, the rule was not set for assigning the GES/non-GES to the areas assessed further to the use of the EU maximum levels for certain contaminants in foodstuffs, approved as the assessment criteria for CI 20.
- CI 21. Very limited data were available in IMAP IS to undertake GES CI 21 assessment within the preparation of the 2023 MED QSR. Most of the data were available through EEA and not through IMAP IS.

734. The lack of data reporting is likely to be related to:

- Lack of expertise and/or instrumentation and/or funding to perform the sampling and analytical determination of the contaminants and nutrients.

- The lack of consistency with monitoring programmes adopted at the national scales as well as with routine measurements undertaken on parameters (e.g. for nutrients).
- The mandatory species for monitoring i.e., the mussel M. galloprovincialis and the fish M. barbatus, may not have a harmonized presence or have low availability in different sub-regions and/or sub-divisions. Therefore, these species could not be sampled and analyzed in all areas, and lack of monitoring data were evident.
- There is an evident lack of accessibility to quality assurance tools, such as interlaboratory comparisons (ILCs), proficiency tests (PTs), or certified reference materials (CRMs), along with a lack of knowledge for use of adequate laboratory equipment.
- Deviations from the IMAP monitoring methodologies, for example, inconsistent biota sampling and discrepancy in the samples preparation negatively affect the performance of IMAP Pollution competent laboratories.

Hindered data use by missing database management tools:

735. IMAP IS platform operates as a repository of data in Excel file format. It is not a quarriable database, with no data export formats or mapping capability. The platform is easy to use for searching and retrieving files, but no QC/QA categories and data flagging are available. All these imposed additional workloads to create the offline databases in order to ensure data control and use for the preparation of the 2023 MED QSR IMAP Pollution and Marine Litter assessments. The files reported by the CPs do not always report all the necessary metadata and data, as specified in the DDs and DSs. At the same time, the CPs reported that the preparation of the files for an upload into the IMAP IS was complicated and time-consuming, lacking an inter-facing modality to ensure data transfer to IMAP IS from national databases.

Absence of optimal integration and aggregation among CIs and EOs:

736. Given the lack of data reporting as required by Decision IG. 23/6 (COP 20), it was impossible to ensure optimal application of the integration and aggregation rules in order to provide the integrated assessments of the EOs and CIs.

The measures to address the common knowledge gaps related to IMAP Ecological Objectives 5 and 9, as well as IMAP Ecological Objectives 10

737. The measures to address common knowledge gaps include the policy and technical measures that are common at the level of IMAP Pollution and Marine Litter Cluster, as provided here below.

The policy measures to address the common knowledge gaps

Increase of data availability and capacity building programmes to address the knowledge and technical gaps of national IMAP Pollution competent laboratories:

738. Submission of good quality data, striving for their uniform distribution across the Mediterranean Sub-regions should be encouraged, and support given to the CPs to enable it. A thorough mapping of the specific needs of each CP should be performed and a tailored capacity building process drawn and executed. The following specific knowledge, technical and financial needs of IMAP Pollution competent laboratories should be addressed:

i) further harmonization of laboratories' performance in line with the IMAP Monitoring Guidelines in order to increase the representativeness and accuracy of the analytical results for generation of quality-assured monitoring data;
ii) improving availability of appropriate analytical equipment to strengthen technical capacities of national IMAP Pollution competent laboratories;
iii) increasing consistency of biota sampling along with the application of Quality Assurance measures;

iv) increasing accessibility to quality assurance tools, such as inter-laboratory comparisons (ILCs), proficiency tests (PTs), or certified reference materials (CRMs).

739. The assessment of the capacities of national IMAP Pollution competent laboratories should continue as a biennial effort aimed at gradual improvement of their performances with a view of reaching optimal compliance of data processing and reporting with the methods provided in Monitoring Guidelines for IMAP Common Indicators 13,14,17, 18, 20 and 21.

740. Further to the results achieved in proficiency testing over a 25-year period, the UNEP/MAP-MED POL in collaboration with the IAEA/MESL continues implementation of the traditional proficient testing (PT) related to the determination of trace metals and organic contaminants in sediment and biota matrixes, along with the organization of the training courses;[128] however, by ensuring their adjustment to the requirements of IMAP CI 17. Along with the continual strengthening of the quality assurance for trace metals and organic contaminants, national capacities need to be further upgraded by undertaking regular inter-laboratory comparisons/proficiency testing for the analysis of nutrients, biomarkers, and contaminants in commonly consumed seafood and intestinal enterococci in bathing waters within ongoing and planned activities of UNEP/MAP - MED POL. The technical missions organized to the IMAP competent laboratories in the greatest need should continue addressing specific technical knowledge gaps.

741. Capacity building needs of the Contracting Parties regarding the use of the IMAP Pollution and Marine Litter assessment methodologies need to be also addressed.[129.] This could be in the form of additional training courses, including the use of environmental assessment tools (NEAT and CHASE+), as well as by supporting the purchase of analytical instrumentation.

Improve DPSIR analysis:

742. DPSIR analysis needs to be improved by supporting the CPs to regularly provide relevant information and share the knowledge which in principle may be ensured by i) reporting information on DPSIR, along with national monitoring data, and compatibly with data reporting for National Action Plans` indicators; ii) ensuring assistance of the local experts, through the CPs, regarding the identification of specific DPs and their impacts; and iii) complementing DPSIR information reporting with data from the scientific literature and national reports.

Monitor the effectiveness of the technical and policy measures:

743. Areas classified as likely non-GES were identified in the 2023 MED QSR Pollution assessments (UNEP/MED WG. 563/Inf.11) for EOs 5 and 9 in the four Sub-regions of the Mediterranean. However, only for a few non-GES areas, DPs were identified. The CPs should identify DPs affecting the environmental classification along the contaminants found responsible for the non-GES classification, therefore, ensuring responses to be derived from integral consideration of GES/environmental assessment findings and DPSIR analysis. Once the DPs are identified, practical measures, both technical and policy oriented should be put in place. For example, if the area will be found in non-GES due to the high concentration of Hg in sediment, the source of Hg should be traced, and pollution abatement measures undertaken. Following the introduction of the measures, tailored to tracing the DP impacts responsible for the non-GES status of the area, their effectiveness should be monitored, to make sure that they improve the environmental status of the non-GES areas. This needs to be provided through environmental monitoring, and reassessment of the environmental status of the non-GES areas.

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[128] UNEP/MED WG. WG.492/10
[129] UNEP/MED WG.556/4/L.2.

Optimally address the impacts of DPs and tailor the responses within the regional plans and national action plans to the needs of continual improvement of the marine environment status:

744. Within the IMAP Pollution Cluster assessments, the most important DPs which negatively impacted the status of the Mediterranean marine environment were related to: agriculture, industry, aquaculture, tourism including sporting and recreational activities, utilization of specific natural resources, infrastructure, energy facilities, ports and maritime works and structures, and maritime activities. Multiple DPs may be present in a specific area, while measures and responses may be common to various DPs. Although the evaluation of the responses i.e. the measures was hindered by the lack of specific local information, the overall responses and measures to abate and prevent pollution, and improve environmental status were already mapped in the UNEP/MAP documents. The regional policies are in place and present a framework for the responses in line with the Barcelona Convention and its Protocols[130]. The present proposals of the Regional Plan for Agriculture Management, the Regional Plan for Aquaculture Management and the Regional Plan for Stormwater Management, along with the adopted Regional Plan for Urban Wastewater Treatment and the Regional Plan for Sewage Sludge Management, as well as the updated Regional Plan for Marine Litter Management in the Mediterranean and the National Action Plans to implement the LBS Protocol and Regional Plans provide the measures of relevance for addressing impacts of drivers and pressures which badly affect the status of marine environment.

745. Further elaboration of the below proposed overall and specific measures should primarily target the likely non-GES areas found within the assessment of IMAP Pollution Cluster (UNEP/MED WG. 563/Inf.11).

a) *The general measures to prevent and abate pollution towards the good environmental status of the Mediterranean*
:

746. Pollution prevention needs to be encouraged instead of environmental remediation. This could be achieved by reducing and eliminating the use and discharge of known harmful substances, regulating the emergence of new substances with mandatory environmental and social impact assessments, recycling and using biodegradable green compounds, along with planning emergency responses in case of accidental pollution events.

747. Identification of legacy pollutants[131] in the environment is needed, whereby it should be ensured that they are not currently being introduced into the environment. While the mitigation of current pollutants entails measures at the source of pollution, the mitigation of legacy pollutants takes place *in situ*. The latter includes the study of transport and distribution of pollutants in the environment, the use of technologies for pollutants removal from the environment, and bioremediation.

748. Strengthened use of the Best available technology (BAT) is needed to prevent and control pollution, along with the Best environmental Practice (BEP) to support the most appropriate combination of environmental control measures and strategies to prevent and control pollution.

749. Transition to the blue economy needs to support the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem.

[130] The Land-Based Sources Protocol, Dumping Protocol, Hazardous Wastes Protocol, Offshore Protocol, Prevention and Emergency Protocol and Integrated Coastal Zone Management Protocol.
[131] Legacy pollutants are substances that remain in the environment long after they were introduced and after pollution abatement measures were applied or their use was banned.

750. Move towards the circular economy and sustainability needs to support the achievement of zero pollution through recycling. It entails markets that give incentives to reusing products, rather than disposing and then extracting new resources. Major changes in production and consumption patterns are needed, with a focus on climate change concerns, biodiversity protection and ecosystem restoration.

751. Regional policy integration is of utmost importance since marine pollution has no borders, and therefore strengthening regional cooperation is necessary, advocating common environmental policies.

b) *The specific measures to prevent and abate pollution towards the good environmental status of the Mediterranean:*

752. Aquaculture. There are several strategies and guidelines developed by FAO to assist a sustainable growth for aquaculture sector, including the Ecosystem-based Approach to Fisheries and Aquaculture aiming to assist and set limits for aquaculture production given the environmental limits and social acceptability of sector. In this context it is recommended to apply the following key three principles of the FAO/GFCM strategy:

- Aquaculture development and management should take account the full range of ecosystem functions and services and should not threaten the sustained delivery of these to society;
- Aquaculture should improve human well-being and equity for all relevant stakeholders; and
- Aquaculture should be developed in the context of other sectors, policies and goals. In this regard, UNEP/MAP-MED POL is preparing a Regional Plan for Aquaculture Management for adoption by COP 23 advocating the below measures.

753. Nutrient reduction, of relevance to addressing several DPs, should follow a more cyclic approach to produce, use and treat nutrients in treatment plants, where recycling and reuse are enhanced instead of environmental discharge. This is true for nitrogen and in particular for phosphorus, which has finite reserves in the environment. Policy and regulatory instruments could include more strict regulation of nutrient removal from wastewater, mandatory nutrient management plans in agriculture, and enhanced regulation of manure.

754. Tourism and Coastal urbanization. Measures should focus on the improvement of waste treatment, sustainable management of coastal areas to reduce disruption of coastal ecosystems, investment in habitat conservation and restoration to provide ecosystem services, along with implementation of the ICZM tools. Sustainable tourism and urbanization require monitoring and decision-making feedback, improvement of communal infrastructure, environmental coastal spatial and marine spatial planning, as well as the optimal environmental impact assessments, carrying capacity, adaptation to impacts of climate changes, etc.

755. Industry. Measures should focus on the improvement of waste treatment and on upgrade of the industry to the use of BAT and BEP. In addition, resources should be used in the context of a circular economy, with the reduction, reuse and recycling of waste, and shifting towards the production and use of greener substances.

756. Agriculture. Responses to the impacts of agriculture are difficult to manage because of the diffusive i.e. non-point sources introduction of nutrients and agrochemicals into the marine environment. Responses should include the management of river runoffs, the reduction of the use of toxic and bio accumulative agrochemicals, the transition to greener fertilizers and biodegradable pesticides and organic farming.

757. Marine traffic and marine and port operations. The responses should focus on improving the technology of ships and ports operations and of ports infrastructure. Use of BAT and BEP to ensure effective onboard and port pollution control facilities, to prevent accidental discharges and spillages. Specifically, for marine traffic, the designation of restricted areas for anchorage and protection of

sensitive areas are encouraged. Implementation of the measures related to the designation of the Mediterranean Sea as a Sulphur emission control area (SECA) is expected to generate significant benefits in both pollution reduction and ecosystem protection. However, the introduction of exhaust gas cleaning systems EGCS – scrubbers on ships in the Mediterranean, as alternative abatement technology for air emission of Sulphur region, may generate a new stream of shipping liquid wastes, in which metals and PAH discharges dominate from ships, that is the chemical pollution transferred from air to marine waters.

Strengthen the science policy interface:

758. In order to improve the delivery of IMAP the following measures should guide addressing the gaps identified during the preparation of the 2023 MED QSR:

a) Strengthen the use of unprecedented achievements in science and technology in order to ensure that the growing development demands and a healthy ocean co-exist in harmony by identifying the most relevant innovative knowledge and technologies that are of utmost importance for reliable and cost-effective monitoring and assessment of the state of Mediterranean Sea with a focus on:
   i) Promotion of inter-disciplinary research aimed at understanding and prediction in the Mediterranean Sea;
   ii) Mapping of all components of the Mediterranean marine environment, along with the anthropologic pressures across time scales;
   iii) Application of observing and remote techniques to strengthen the IMAP-based monitoring practices and improve forecasts of the state of the marine environment;
   iv) Application of holistic view within the "source-to-sea" framework to structure the assessment of the land-based pressures in conjunction with their impacts on the oceans.
b) Enhance partnerships and support the transfer of ocean knowledge for science-based management, with a focus on strengthening:
   i) The national capacities related to monitoring and data analysis;
   ii) The use of the scientific networks to support the objectives of partnerships for the science-policy interface;
   iii) The synergies for marine science in the Mediterranean.
   iv)

Update the IMAP Pollution and Marine Litter Cluster:

759. The IMAP Pollution and Marine Litter Cluster needs to be updated to include the following:

i) The achievements within the implementation of the IMAP initial phase, both regarding the monitoring and assessment practices and methodologies.
ii) The revision of the list of common indicators and addressing the knowledge gaps as identified within the preparation of the assessments for the 2023 MED QSR.
iii) The transition from the present five-year assessment cycle to the eight-year assessment cycle; such revised frequency of Mediterranean marine assessment should be guided by the current practice of most CPs which set their national programmes based on a 3 years cycle of data collection and reporting which is not in line with the present phase of IMAP implementation.
iv) A multi-fold increase of the resources of the Secretariat, as well as the support to CPs' capacity building within the implementation of the IMAP Pollution and Marine Litter.

The technical measures to address the common knowledge gaps

Increase the efficiency of IMAP implementation regarding Pollution and Marine Litter Cluster:

760. To increase the efficiency of the monitoring and assessment of the Mediterranean marine environment, the following specific actions need to be enforced:

- Advance integrated implementation of the National IMAPs pertaining to Pollution, Biodiversity and Coast and Hydrography Clusters, as well as the GES assessments at the regional/sub-regional level by applying the rules for integration of monitoring efforts within relevant monitoring units. For example, integration can be explored between EO9 and EO1. If based on monitoring of EO1, CI 2 – Condition of the habitat's typical species and communities, an effect on the benthic community is found, EO9, CI 17 can be useful to complement the findings, in terms of the identification of pressures. Conversely, if contamination is identified based on CI 17 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 EO9, CI18. The importance of the interrelation between seafood safety and quality i.e., EO9, CI 20 and the presence of microplastics in the marine environment i.e., EO10, CI 23 should be further pursued. In addition, there may be an interrelation between EO9, CI 13 and EO9, CI 21. Namely, the introduction of nutrients into the marine environment can be attributed to the marine discharge of untreated domestic waste, which in turn can introduce intestinal enterococci (IE) to the bathing waters.
- Pilot implementation of the Joint Monitoring Surveys within the specific sub-divisions, as appropriate, to increase equitable access to resources and balance in strengthening of human and technical capacities of the CPs. Pilot implementation of the Joint Monitoring Surveys should be strongly supported by detailed implementation plans.
- Support collaboration among the countries to promote a transfer of knowledge.

Improve IMAP IS database management:

761. IMAP-IS should be significantly improved. It should be restructured from the repository of data reported by the CPs into an advanced information system which supports integrated assessments and ensure the validation of uploaded data, first technically and then scientifically. It needs to provide a quarriable database, with export formats (vertical and horizontal) for scientific evaluation and presentation, therefore allowing IMAP users and data evaluators to sort, retrieve and export data based on any available parameter of the metadata and data. The formats of the extracted data should be compatible, to the extent possible with other standard analysis methodologies and presentation/mapping tools.

762. Most importantly, the QA/QC mechanism of the IMAP IS needs to be significantly strengthened including operational and scientific quality control of data. The implementation of QC/QA controls and data flagging is necessary. The online tools supporting assessments should also be integrated into IMAP IS.

763. DDs and DSs should be updated, as appropriate, further to the experience built during the present IMAP cycle of data reporting and the preparation of the 2023 MED QSR Pollution and Marine Litter assessments.

764. It is also necessary to invest significant resources to ensure IMAP IS interoperability with national databases This has to be followed by significant improvement of data quality control and quality assurance at the national level.

Improve the GES assessment:

765. For further improvement of the integrated GES assessment of IMAP Pollution and Marine Litter Cluster, it is necessary to continue streamlining the assessment methodologies applied for the environmental status assessment for the Pollution and Marine Litter Cluster within the 2023 MED QSR. To that effect the following priority needs should be addressed:

- Revise/update the Spatial Assessment Units (SAUs) in close collaboration and in agreement with the CPs.
- Eliminate uneven presentation of the assessment findings in different areas of assessment, associated not only with an inhomogeneity of monitoring data both in terms of quality and quantity, but also with the lack of the present assessment methodologies in particular related to pending agreement on :
  - i) The size of the offshore areas of assessment, by considering for example presently applied guiding principle of demarcating IMAP offshore assessment units by the most distant monitoring station set by the CPs in the offshore (open) wasters;
  - ii) The representativeness of the number of stations in the areas of assessment; for example, in large pristine areas, a low number of stations might be adequate in contrast to small areas with pressures where a higher number of stations might be needed.
- Expand the monitoring to include the deep-sea environment. Although IMAP already includes offshore areas, defined as areas more than 1 nautical miles (NM) distance from the coastline, monitoring of the offshore is rarely implemented, and when implemented, is of limited areal scope. Monitoring of offshore areas in the deep-sea is especially important when non-GES areas are identified, in order to trace the possible impact of pressures away from the coastline.
- Revise the use of data reported from different types of monitoring stations for assessments. For example, this action should address the use of data reported from a) reference and master monitoring stations located in i) marine and ii) transitional waters; b) (hot spot) monitoring stations located in the modified water bodies (e.g., ports), in order to define the rules for use of data reported from different types of monitoring stations. This needs to be followed by setting the rules for the classification of monitoring stations by considering the guiding principles presently applied within the initial phase of IMAP implementation.
- Apply additional assessment tools. In that context, remote sensing (e.g., for CI 14 and CI 21) and modelling tools should be standardized for future use. Remote sensing can strengthen monitoring practices and data acquisition nationally and sub-regionally. These observations can in turn be integrated into existing assessment methodologies not only to contribute to the assessment of the present status, but also to forecast the trends in the marine environment.
- Modelling tools are often specific to a given ecosystem and are difficult to standardize. Their use should be associated to relevant uncertainties and acknowledged gaps (e.g. for CI 13 and CI 14).

The technical measures specifically related to the knowledge gaps identified for IMAP Common Indicators of Ecological Objectives 5 and 9

766. In addition to the above policy and technical measures that are common at the level of IMAP Pollution and Marine Litter Cluster, the specific knowledge gaps were identified per individual Common Indicators and therefore the specific technical measures are proposed as provided here below.

Common Indicators 13 and 14

Improve the availability of the assessment criteria for CIs 13 and 14:

767. Upon setting the reference conditions and boundary values for DIN and TP in the Adriatic Sea Sub-region, actions need to be undertaken to improve the availability of the assessment criteria for nutrients in the AEL, the CEN and the WMS Sub-regions. To that purpose three continuous years of monitoring need to be provided with a minimum monthly frequency for Water types I and II and bimonthly to seasonal for Type III. It should also be noted that other supporting parameters (i.e., temperature, salinity and dissolved oxygen) need to be available for defining the water typology. Further update of the assessment criteria for CI 14 should be undertaken as appropriate. The specific knowledge needs to be also built regarding the use of statistical tools for data validation and calculation of the assessment criteria.

Improve the GES assessment:

768. Further to the above elaborated common measures, the GES assessment for CIs 13 & 14 needs to be also improved, including the use of the remote sensing and modelling tools to complement in situ monitoring and adding additional sub-indicator i.e., the satellite-derived Chla data for GES assessment.

Upgrade present policy measures:

769. For the development of the adaptive eutrophication management strategies, the following specific actions should also be undertaken:

- Extend the scope of research and monitoring programs to characterize the effects of eutrophication;
- Implement regulations to mitigate inputs of nutrient to the marine environment, such as standards, technology requirements, or pollution caps for various sectors.
- Preserve and restore natural ecosystems that capture and cycle nutrients.

Common Indicator 17

Update of Environmental Assessment Criteria (EACs):

770. In order to update EACs, the methodology, as detailed in the European Commission Guidance Document (2018) and in Long et al. (1995), should be considered. This entails the creation of a database of scientific literature which elaborates where adverse biological effects, or no effect, are presented in conjunction with chemical data, in the environment and 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. The literature would then be analysed by experts and conclusions drawn. Laboratory results on biomarkers (CI18) are also important for the derivation of the EAC values. The emphasis should be given to the Mediterranean Sea biota species.

Undertake regular updates of Sub-regional and regional Background Concentrations (BCs) and Background Assessment Criteria (BACs):

771. As more data will be submitted to IMAP IS, the Sub-regional and regional BCs should be updated. It is proposed to undertake their regular updates at least 2 years prior to the QSRs preparation. This will allow for sufficient time to analyse the data, detect data gaps and ensure the submission of missing data, to perform a more robust update of the criteria for reliable assessments.

772. The methodology for BACs calculation should be revised and updated. BACs are calculated from BCs by applying the multiplication factors. Due to the lack of Mediterranean data, UNEP/MAP adopted the pragmatic methodology used by OSPAR.[132] Therefore, the precision of monitoring per CP should be calculated and used to set the multiplication factors specific for the Mediterranean.

Improve the GES assessment:

773. Revision of IMAP needs to support the improvement of the good environmental status assessment and contribute to a more robust analysis, and facilitate integration and aggregation of CI 17 with other CIs and EOs, by undertaking the following priority actions:

- Update list of priority pollutants. Measurements of 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 in the IMAP Pollution monitoring. This process should follow the initial steps undertaken in 2019.[133] The updated List of Priority Contaminants could provide the basis for a prioritization of substances to be further included in the IMAP Guidance Factsheets related to Ecological Objective 9, and complement presently agreed mandatory or recommended substances for CIs 17 and 20. The decision on which contaminant to add should be based on pilot studies checking the probability of their presence in the Mediterranean Sea sub-regions.
- Extend the list of commonly agreed IMAP Pollution mandatory species. Species, other than species (*M. galloprovincialis* and *M. barbatus*) presently mandatory, should be added to the IMAP list. The species should be chosen based on their presence in the Sub-regions and their relevance as pollution indicators, which in turn will allow for an improved environmental assessment. Harmonization of the use of different species in different Sub-regions needs to be followed by setting the criteria (BCs and BACs) specific to each species.
- Utilize tools to perform Environmental Risk Analysis, to integrate chemical and biological data, as elaborated here-below for CI 18.
- Revise sediments` temporal monitoring requirements. For hot spot stations, the monitoring should remain every year or 2 years, while for other stations, the monitoring once or twice during the 6-year cycle should be considered.
- Harmonize national efforts regarding contaminants monitoring. As a minimum, it is necessary to ensure that every CP reports all mandatory parameters in mandatory matrixes, including the wet weight for mussels, LOD or LOQ values, the grain size of samples for sediments, and spatial and temporal monitoring requirements. The significant differences among the countries in terms of LOD and LOQ values, as well as differences among the areas of monitoring in the

[132] OSPAR calculated 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.

[133] UNEP/MED WG.463/Inf.4. The List of Priority Contaminants under MAP/Barcelona Convention within the MED POL Monitoring Programme and IMAP have been revised according the latest lists of priority contaminants development in the EU region and internationally and shows no major changes compared to other RSCs.

same CP, need to be analyzed and drivers of the unsatisfactory analytical performance identified.

Common Indicator 18

Ensure the GES assessment for CI 18:

774. Revision of IMAP needs to support the good environmental status assessment for CI 18 and facilitate its integration and aggregation with other CIs and EOs, by undertaking the following priority actions:

- Review and update the list of CI 18 biomarkers, along with the monitoring species;
- Review and update, as appropriate, the assessment criteria as adopted by Decisions IG.22/7 (COP 19) and IG.23/6 (COP 20), as well as the assessment methodologies;
- Further to the initial work undertaken in 2021[134] towards the development of the Biomonitoring related to IMAP CI 18, the following further actions should be tested:
  i) An application of new biomarkers should be explored to support the strengthening of CI 18 monitoring and assessment.
  ii) Use of the Environmental Risk Analysis should be provided by combing the chemical and ecotoxicological data, to support the evaluation of the risk related to marine organisms exposed to contaminated waters and sediments. It should result in objective risk values which allow national and regional policymakers and environmental managers to decide on the actions to decrease marine contamination, or to remediate a polluted area.

Common Indicator 19

Improve quantity and quality of data for CI 19

- REMPEC to continue soliciting the submission of the report on incidents and spills from the Countries, underlining the importance to make use of the latest version of the Data Dictionary and Data Standard (DD&DS) prepared by REMPEC jointly with INFORAC and providing to any extent possible all the data required in DD&DS, including estimation of quantity and volume of oil or other substances released.
- The Countries to start collecting data on impacts on biota with reference to the above-mentioned updated version of DD&DS for CI 19.
- The UNEP/MAP – REMPEC to align the definition of the minimum threshold for reporting with the one used under other regional sea conventions and in the framework of MSFD.
- UNEP/MAP - REMPEC to continue to integrate newly available Lloyds data in MEDGIS-MAR database. UNEP/MAP - REMPEC to prepare a comprehensive, integrated database, considering also old data, based on these two databases, cross-checking and resolving data duplication and inconsistencies.
- UNEP/MAP - REMPEC to continue acquiring information and understanding about CleanSeaNet dataset and assessing the feasibility to integrate CleanSeaNet data for the Mediterranean in MEGIS-MAR.

Improve the GES assessment of CI 19

- The definition of "acute pollution events” is highly debated under the Marine Strategy Framework Directive and other Regional Sea Programmes and Agreements, in particular the Bonn agreement. It remains a complex issue for which consensus has yet to be reached.

[134] UNEP/MED WG.492/6

Additional work should be undertaken by UNEP/MAP - REMPEC and the Contracting Parties to define operational criteria for the identification of acute pollution events. An integrated and escalating approach should be adopted, considering, among others, factors like the spilled volume, the nature of the spilled product(s), the proximity and sensitivity of threatened areas and/or human activities, the environmental conditions (i.e. evidence of an environmental impact), and the need for response operations.

- Based on data collected on impacts on biota, UNEP/MAP - REMPEC and the Contracting Parties should work towards the definition of assessment criteria for CI 19 including biota as component, if possible, in coordination with other regional sea conventions.

Common Indicator 20

Ensure the GES assessment for CI 20:

775. A multidisciplinary approach will be needed to ensure GES assessment for CI 20 by undertaking the following priority actions:

- Agree on the maximal percentage of detected regulated contaminants exceeding regulatory limits in seafood, above which non-GES needs to be assigned to the area assessed;
- Incorporate the risk assessments to human health from consumption of seafood by calculating the estimated daily intake (EDI), the target hazard quotient (THQ), the total health risk (HI), and the cancer risk, among others;
- Incorporate into the overall evaluation the suite of contaminants analyzed, together with other factors such as synergy among contaminants, and temporal and spatial scales.
- Harmonize the choice of species among the CPs, whereby data from national reports on seafood safety and cooperation with national health authorities should be used to complement data reporting to IMAP IS;
- Examine and coordinate monitoring protocols, risk-based approaches, analytical testing, and assessment methodologies between the CPs; the national food safety authorities; research organisations and/or environmental agencies;
- Determine the applicability of CI 20 beyond food consumer protection and public health, although it intuitively reflects the health status of the marine environment in terms of delivery of benefits (e.g., fisheries industry).

Common Indicator 21

Improve the GES assessment for CI 21:

776. An optimal GES assessment for CI 21 needs to be strengthened by optimal data reporting which will ensure the confidence of the assessment. At least, 16 data points for 4 consecutive bathing seasons are needed for the application of the uniform assessment methodology across the Mediterranean; therefore, increasing the comparability and consistency of the assessment findings.

Candidate Common Indicators 26 & 27

Improve underwater noise data quality and availability

777. For the improvement of underwater noise data quality and availability, the following specific actions should be undertaken by the Parties:

778.

- A contribution should be provided to the ACCOBAMS regional register for impulsive noise sources, especially by sharing national data, along with the development of a cooperation mechanism to identify the source of long-distance underwater noise in order to address its long-distance effects;
- Reporting noise generating military activities is needed to provide an actual and precise assessment reflecting the real situation;
- An alternative approach needs to be tested by applying specific assessments for species and their habitats. For such an exercise, Important Marine Mammal Areas (IMMA) could be used as defined habitats.

2.1.2 Marine Litter

779. Given the seriousness of the marine litter issue, most of the important relevant global and regional processes including the 2030 Agenda for sustainable Development and SDGs called for its assessments and urgent action to address it. In the Mediterranean, marine litter has been an issue of concern since 1970s and the importance of dealing with it was explicitly recognized by the Contracting Parties to the Barcelona Convention when adopting in 1980 the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources. Annex I of the Protocol, as amended in 1996, defined Litter as "any persistent manufactured or processed solid material which is discarded, disposed of, or abandoned in the marine and coastal environment".

780. The Mediterranean Sea is one of the special areas established under MARPOL Annex V (Regulations for the Prevention of Pollution by Garbage from Ships). In April 2008, the Marine Environment Protection Committee (MPEC) of IMO adopted its Resolution MEPC.172(57) by which it decided "that the discharge requirements for Special Areas in regulation 5 of MARPOL Annex V for the Mediterranean Sea area Special Area shall take effect on 1 May 2009, in accordance with the requirements set out in regulation 5(4)(b) of MARPOL Annex V".

781. At their 18th Meeting (Istanbul, Decembre 2013), the Contracting Parties of the Barcelona Convention adopted the Regional Plan on the Management of Marine Litter in the Mediterranean. It provides for programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment.

782. In relation to the IMAP Ecological Objective 10 (Marine and coastal litter do not adversely affect coastal and marine environment), the Contracting Parties to the Barcelona Convention adopted the following Indicators:

Common Indicator 22: Trends in the amount of litter washed ashore and/or deposited on coastlines (CI22);
Common Indicator 23: Trends in the amount of litter in the water column including microplastics and on the seafloor (CI23);
Candidate Indicator 24: Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles.

783. Since 2016, the Mediterranean countries with the support of UNEP/MAP and the EU-funded EcAp MED II Project have supported the Mediterranean Countries to establish national IMAP-based monitoring programmes for the 2 IMAP Common Indicators, i.e., Common Indicator 22 (CI22) and Common Indicator 23 (CI23). The focus for CI22 has been given on monitoring beach macro litter, whereas the focus for CI23 has been given on monitoring seafloor macro-litter and floating microplastics. Monitoring for CI22 has been also supplemented by numerous pilots in the Adriatic and South Mediterranean areas, having as a prerequisite the inclusion and integration of the respective IMAP methodology. Moreover, the regional data repository (IMAP InfoSystem) has been developed and is operational, including the development of reporting templates for CI22 (M1 Module) and CI23 (M2 and M3 Modules).

784. Two additional EU-funded projects, i.e., the Marine Litter MED (2016-2019) and Marine Litter MED II (2020-2023) projects have supported IMAP implementation through the development of knowledge for IMAP Candidate Indicator 24, as well as touching upon, new novel aspects of marine litter monitoring (e.g., monitoring riverine inputs of marine litter and monitoring microplastics coming from wastewater treatment plants).

Methodology for GES Assessment for IMAP Ecological Objective 10

Given the assessed data availability for EO10 CI22 and CI23 for the Mediterranean Sea, the following approach is followed for the quality status assessment. For each CI and each measured parameter (Beach litter, Seafloor Litter, Floating Microplastics) temporal data are averaged per monitoring station. The resulting average value is compared against the respective TV and the score ratio is calculated. No further aggregation on the EO 10 level or spatial integration is conducted for the Mediterranean region as a whole. For the Adriatic sub-region, for which spatial assessment units have been defined in 2022 for the Eutrophication-Pollution and Marine litter cluster, the application of the NEAT methodology was made possible for the 2 IMAP Common Indicators on marine litter (CI22 and CI23).

The assessment focuses one 3 main elements: (a) GES – nonGES assessment; (b) quantitative findings and assessment, and (c) qualitative findings and assessment.

Assessment Criteria for IMAP Ecological Objective 10

UNEP/MAP established in 2016 Baseline Values (BV) and environmental targets for IMAP EO10 Common Indicators (COP19, Decision IG.22/10). Further to the advancement of marine litter monitoring within IMAP EO10 and the acquisition of relevant data, UNEP/MAP, in cooperation with the Contracting Parties of the Barcelona Convention, undertook an update for the 2016 BV and established Threshold Values (TV) for the IMAP Common Indicators 22 and 23.

Baseline Values (BV) and Threshold Values (TV) as adopted in 2021 by COP22.

IMAP Indicators	Categories of Marine Litter	BV-2021	TV-2021
CI22	Beach Marine Litter	**369 items/100m**	**130 items/100m**

Baseline Values and Threshold Values for IMAP CI23, seafloor macrolitter and floating microplastic, 2016 (Agreed) and 2023 (Proposed/Updated).

CI23	Seafloor Macro-litter	130-230 items/km^2	135 items/km^2	38 items/km^2
CI23	Floating Microplastics	0.2–0.5 items/m^2	0.044338 items/m^2	0.000845 items/m^2

Monitoring Floating marine litter with aerial observation survey (ACCOBAMS)

The ACCOBAMS Survey Initiative (ASI) project was launched in 2016 and carried out large-scale surveys in summers 2018 and 2019 (ACCOBAMS, 2021). Its primary aim was to establish an integrated, collaborative and coordinated monitoring system for the status of cetaceans and other species of conservation concern at the whole ACCOBAMS area level (sea turtles, seabirds, fishes). The ASI project also aimed at better understanding the presence and distribution of anthropogenic activities (ships), as well as of floating marine litter (FML), known to acutely plague the Mediterranean.

The Mediterranean was divided into large blocks, subsequently divided into sub-blocks within which the observation transects were laid out. The data collection on the target species and floating marine litter was ensured by eight teams of trained observers each of them was associated to a plane, operating in a predefined sector of the survey. To ensure all observers follow the same principles and carry out the protocol similarly, training flights were operated to simulate real field conditions.

Application of the NEAT Assessment Tool for EO10 for the Adriatic Sub-region

The use of the NEAT tool for the Adriatic Sub-region should be considered as an example showing how the tool should be applied for GES assessment further to sufficient data reporting by the Contracting Parties. the nested approach ensures that a balance is achieved between a too broad scale, that can mask significant areas of impact in certain parts of a region or subregion, and a very fine scale that could lead to very complicated assessment processes. The first element that needs to be considered for the implementation of the nested approach is the delimitation of the areas of assessment based on the areas of monitoring.

The used methodologies as well as information about data availability are detailed in the following sections of Document UNEP/MED WG.550/12:

- 4.2.1 GES Assessment / Alternative Assessment for IMAP EO10 Common Indicator 22
- 4.2.2.1 GES Assessment for Floating Microplastics (IMAP EO10 CI23
- 4.2.2.2 The Mediterranean litterscape assessed from the air during the ACCOBAMS survey initiative
- 4.3.1 Application of the NEAT Assessment Tool for EO10 for the Adriatic Sub-region

Key messages for IMAP EO10 Common Indicator 22:

a) The monitoring efforts in the Mediterranean region and within each sub-regions vary significantly and further alignment and strengthening of IMAP EO CI22 is required from the Mediterranean Countries.
b) Overall, 16% of the monitored beaches achieve GES, 79% do not achieve GES of which 29% fall into the poor status class and 25% in to the bad one.
c) Plastic/polystyrene pieces (2.5 cm – 50 cm) are the most commonly found marine litter items in the Mediterranean, followed by cigarette butts and filters, and plastic caps and lids. These 3 items account for approximately 60% of the recorded marine litter.

Key messages for IMAP EO10 Common Indicator 23:

A. Floating Marine Litter:
    a) Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.36 ± 1.9 items/m^2.
    b) Almost all stations (99%) that have been monitored do not achieve GES, and most of them fall into the poor (44 %) and bad (49 %) status classes.
    c) The Mediterranean region and its subregions suffer from elevated microplastics concentrations in surface waters, reaching up to 100 times and 1000 times higher than the IMAP TV.
    d) From the recorded floating microplastics, Sheets (37%), followed by Filaments (30%), Pellets (21%), Fragments (7%), Foam (4%), and Granules (1%).
    e) Some 41,000 floating mega-litter were recorded in total during the ACCOBAMS Aerial Survey Initiative, with an average encounter rate of 0.8 mega-debris per km, ranging between 0 and 111 litter items per km.
    f) The total number of floating mega-litter was estimated at 2.9 million items (80% confidence interval was 2.7 to 3.1 million) and average density 1.5±0.1 items per km2.
    g) More than two thirds of the mega-litter recorded were identified as plastics (68.5%; e.g., plastic bags, bottles, tarpaulins, palettes, inflatable beach toys, etc.), while 1.7% were fishery debris and 1.9% were anthropogenic wood-trash. The remaining quarter (27.9%) was anthropogenic mega-litter of an undetermined nature.

B. Seafloor Marine litter:
   a) The average seafloor litter concentration on the Mediterranean coastline is found equal to 570 ± 2,588 items/km^2.
   b) The majority (88%) of the seafloor stations monitored do not achieve GES, and most of them fall into the poor and bad status classes (23% and 53% respectively).
   c) Fisheries-related items comprise up to 10% of the total recorded marine litter.
   d) 3 items are the most recorded within the fisheries related items: (i) Synthetic ropes/strapping bands (L1i) with 39%; Fishing nets (polymers) (L1f) with 27%; and Fishing lines (polymers) (L1g) with 25%.

GES Assessment / Alternative Assessment for IMAP EO10 Common Indicator 22

Geographical scale of the assessment	Regional and Sub-regional
Contributing countries	Bosnia-Herzegovina, Cyprus, Croatia, France, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Spain, Slovenia, Türkiye
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO10: Marine and coastal litter do not adversely affect coastal and marine environment
IMAP Common Indicators	Common Indicator 22 (CI22): Trends in the amount of litter washed ashore and/or deposited on coastlines (including analysis of its composition, spatial distribution and, where possible, source)
GES definition	Number/amount of marine litter items on the coastline do not have negative impact on human health, marine life and ecosystem services
Related Operational Objective	10.1 The impacts related to properties and quantities of marine litter in the marine environment and coastal environment are minimized
GES **Target(s)**	Decreasing trend in the number of/amount of marine litter (items) deposited on the coast
Baseline and Threshold Values	BV: 369 items/100m | TV: 130 items/100m

785. **Beach Litter (CI22)** data are reported in the IMAP InfoSystem from 13 CPs covering all 4 sub-divisions (ADR, CEN, EM, WM). In total 191 beaches are monitored during the period 2017-2021 in the following countries: Bosnia-Herzegovina, Croatia, Cyprus, France, Greece, Italy, Israel, Lebanon, Morocco, Montenegro, Spain, Slovenia, Türkiye. A total of 931 surveys were stored and uploaded to IMAP InfoSystem reflecting the collection and removal of ~300,000 marine litter items from the Mediterranean coastline. In line with the agreement of the Contracting Parties in 2021[135]on a unified list of marine litter items under IMAP, the Secretariat for the purpose of this report discarded those items which could not be categorized in accordance with the IMAP/ MED POL list for beach marine litter items.

[135] Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring (CORMON Marine Litter), 30 March 2021 (UNEP/MED WG.490/6).

786. Concentrations of Beach Litter (items/100m) are highly variable fluctuating between 8 and 47,361 items /100m. Average beach litter concentration on the Mediterranean coastline is found equal to 961 ± 3664 items/100 m.

787. Following the assessment methodology explained in Chapter 2.2, and using the TV of 130 items/100m, temporal average data from the 191 beaches are compared against the threshold, resulting in their classification under 5 status classes (high, good, moderate, poor, bad) shown in Table 13.

788. . Overall, 79% of the beaches monitored do not achieve GES, and most of them fall into the moderate (24 %) and poor (29 %) and bad (25 %) categories, i.e., beach litter concentrations are up to two to five times higher than the TV. In Table 14 the classification results are given for each sub-Region separately.

Table 13: The GES – nonGES classification of the 192 monitored beaches in the Mediterranean Region.

		Mediterranean Region		
Boundary limits	**GES- nonGES classes**	**No of Beaches**	**% of Beaches**	
≤ 0.5xTV	HIGH	10	**5**	**16% GES**
0.5xTV< ≤ 1xTV	GOOD	23	**11**	
1xTV< ≤2xTV	MODERATE	49	**24**	**79 % nonGES**
2xTV< ≤5xTV	POOR	59	**29**	
> 5xTV	BAD	51	**25**	
		192 beaches		

789. On the sub-Region level, the Central Mediterranean appears the least affected by beach litter with 32 % out for the 22 beaches monitored falling into the GES category The Adriatic, Eastern and Western Mediterranean sub-regions show an equal distribution of beaches under GES (14 -16 %) and non-GES (84 -86 %) classes. These results are depicted spatially in the maps of Figure 23 to Figure 26.

Table 14: The GES – nonGES classification of the monitored beaches in the 4 Mediterranean sub-Regions

Boundary limits	**GES- nonGES classes**	**No of Beaches**	**% of Beaches**	
Adriatic sub-Region				
≤ 0.5xTV	HIGH	3	**7**	**16% GES**
0.5xTV< ≤ 1xTV	GOOD	4	**9**	
1xTV< ≤2xTV	MODERATE	11	**24**	**84 % nonGES**
2xTV< ≤5xTV	POOR	17	**38**	
> 5xTV	BAD	10	**22**	
		45 beaches		
Central Mediterranean sub-Region				
≤ 0.5xTV	HIGH	0	0	**32% GES**
0.5xTV< ≤ 1xTV	GOOD	7	32	
1xTV< ≤2xTV	MODERATE	8	36	**68% nonGES**
2xTV< ≤5xTV	POOR	3	14	
> 5xTV	BAD	4	18	
		22 beaches		
Eastern Mediterranean sub-Region				
≤ 0.5xTV	HIGH	3	**5**	**14% GES**
0.5xTV< ≤ 1xTV	GOOD	5	**9**	
1xTV< ≤2xTV	MODERATE	13	**22**	**86% nonGES**
2xTV< ≤5xTV	POOR	16	**28**	
> 5xTV	BAD	21	**36**	
		58 beaches		
Western Mediterranean sub-Region				
≤ 0.5xTV	HIGH	4	6	**16% GES**
0.5xTV< ≤ 1xTV	GOOD	7	10	
1xTV< ≤2xTV	MODERATE	17	25	**84% nonGES**
2xTV< ≤5xTV	POOR	23	34	
> 5xTV	BAD	16	24	
		67 beaches		

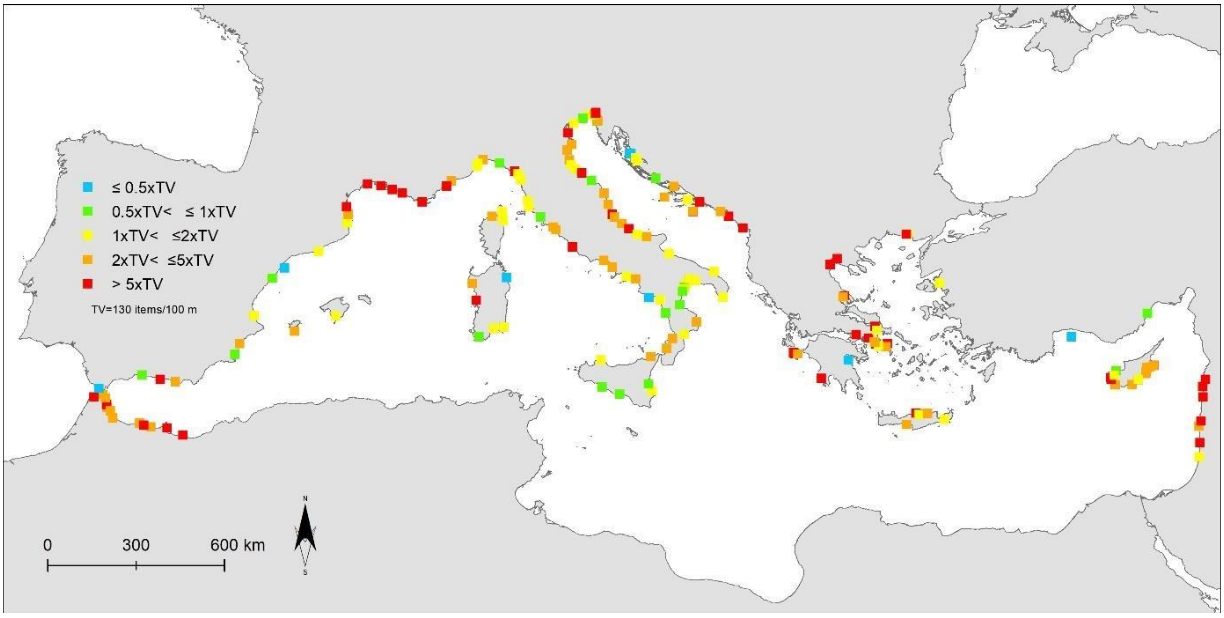


Figure 23: GES assessment classification of the beaches monitored for marine litter in the Mediterranean Region.

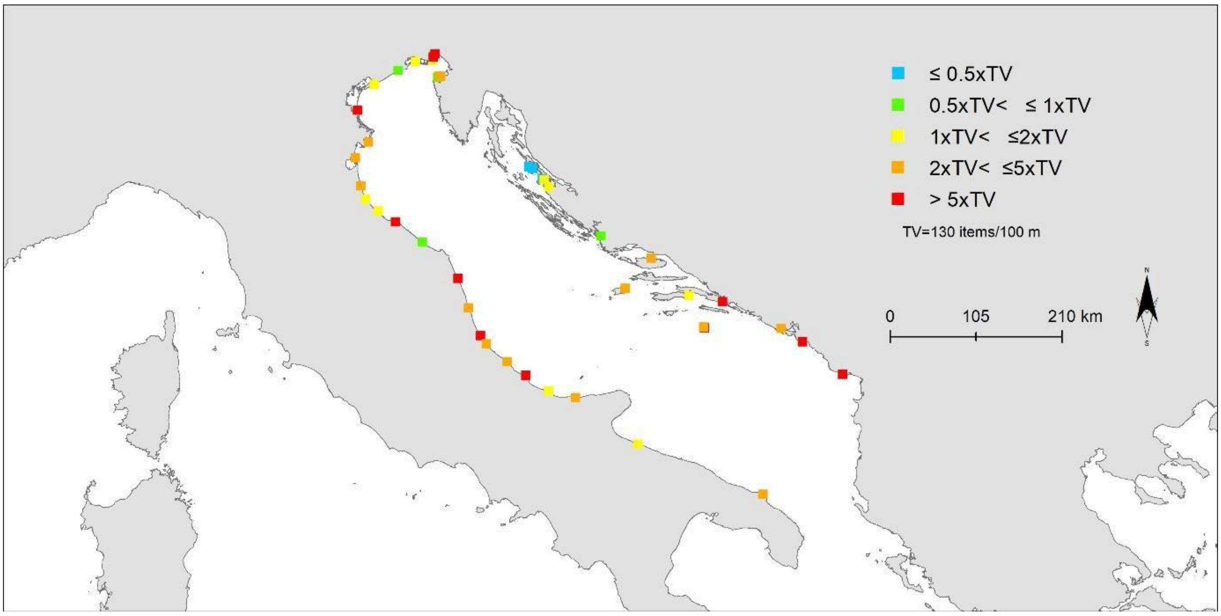


Figure 24: GES assessment classification of the beaches monitored for marine litter in the Adriatic and Central Mediterranean sub-regions.

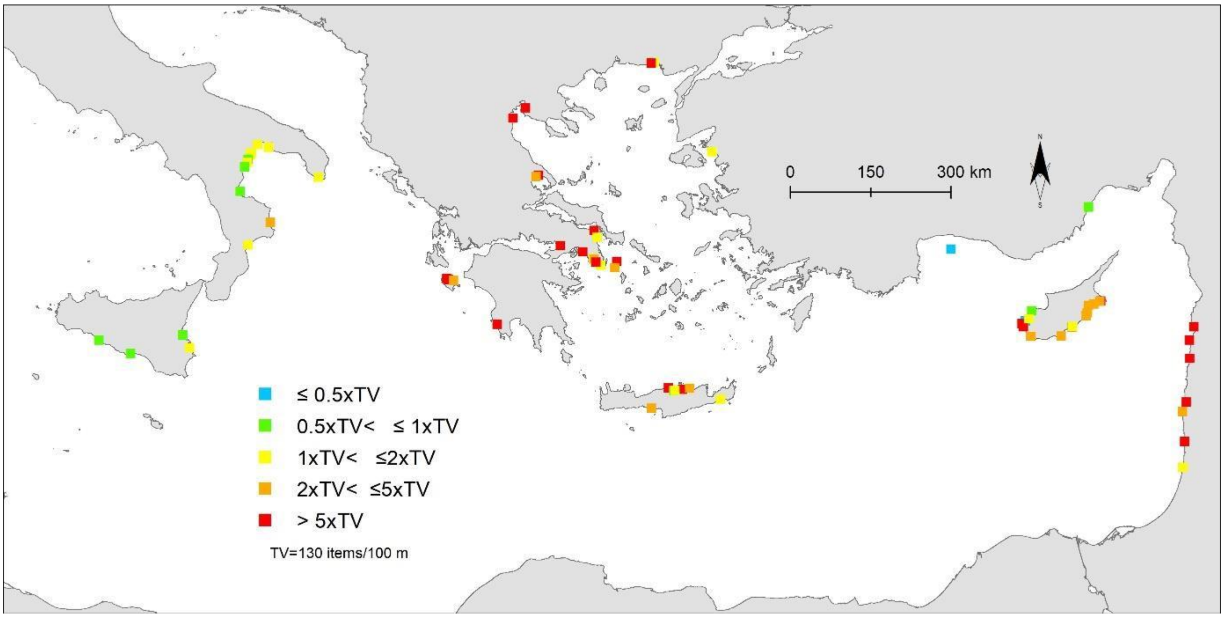


Figure 25**:** GES assessment classification of the beaches monitored for marine litter in the Eastern and Central Mediterranean sub-Regions.

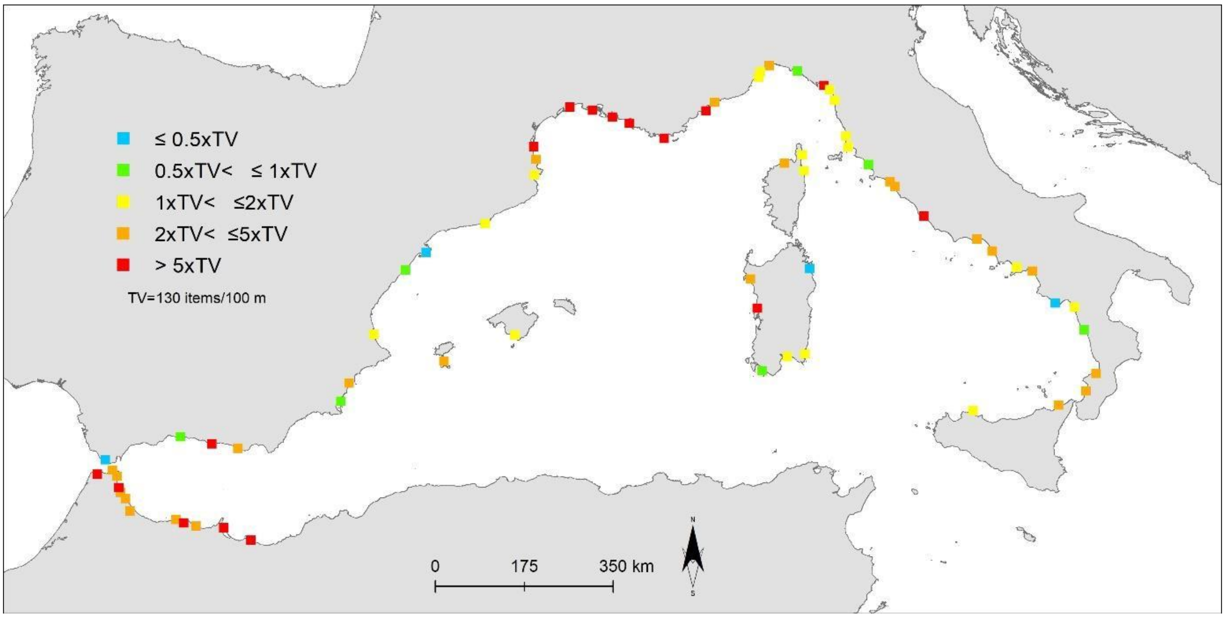


Figure 26**:** GES assessment classification of the beaches monitored for marine litter in the Western Mediterranean sub-Region.

790. The average beach marine litter density from the 10 countries varied between a maximum of 5,716 to 105 items/100m. The average beach marine litter densities are presented hereunder (Table 15).

Table 15: Average beach marine litter densities in the Mediterranean Countries

Country	Average Density (items/100m)
Bosnia & Herzegovina (BA)	1,443 (±1743) items/100m
Croatia (HR)	258 (±1743) items/100m
Cyprus (CY)	396 (±301) items/100m
France (FR)	1,499 (±1,253) items/100m
Greece (GR)	1,232 (±1,203) items/100m
Israel (IL)	483 (±251) items/100m
Italy (IT)	435 (±1352) items/100m
Lebanon (LB)	5,716 (±3252) items/100m
Montenegro (ME)	680 (± 106) items/100m
Morocco (MA)	697 (±343) items/100m
Slovenia (SI)	436 (±240) items/100m
Spain (ES)	265 (±267) items/100m
Türkiye (TR)	105 (±46) items/100m

791. An analysis was undertaken on the Top-10 items that have been recorded in the respective countries. For 11 countries, the top-10 item list represents more than 70% of the collected litter items, and for 2 Countries represents slightly lower share (approximately 68-69%) of the collected litter items. Bosnia and Herzegovina gave an extreme value of 97.4%, followed by Lebanon (86.9%), Slovenia (81.6%), Croatia (81.1%), Italy (79.2%), France (78%), Cyprus (77.1%), Montenegro (73.8), Greece (72.2%), Israel (72.0%), Türkiye (71.5%), Spain (68.9%), and Morocco (67.7%). The analysis and detailed list of the Top-10 item list per country is provided hereunder (
792. Table *16*).

Table 16: Top-10 item list of beach marine litter found in the Mediterranean Countries

Bosnia and Herzegovina			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	4,864	56.2%
2	G178	1,080	12.5%
3	G76	677	7.8%
4	G21/24	646	7.5%
5	G5	514	5.9%
6	G30/31	231	2.7%
7	G145	151	1.7%
8	G158	104	1.2%
9	G165	96	1.1%
10	G53	68	0.8%

Croatia			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G76	3,331	26.6%
2	G27	1,938	15.5%
3	G95	1,719	13.7%
4	G21/24	1,380	11.0%
5	G3	540	4.3%
6	G30/31	318	2.5%
7	G35	313	2.5%
8	G50	235	1.9%
9	G7/G8	201	1.6%
10	G124	193	1.5%

France			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G76	74,288	36.03%
2	G21/24	15,046	7.30 %
3	G124	13,198	6.40 %
4	G30/31	12,349	5.99 %
5	G95	11,672	5.66 %
6	G27	10,550	5.12 %
7	G208a	9,818	4.76 %
8	G200	5,608	2.72 %
9	G73	4,351	2.11 %
10	G145	3,680	1.78 %

Greece			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G76	5465	25.1%
2	G124	2,661	12.2%
3	G21/24	2,128	9.8%
4	G7/G8	1,643	7.5%
5	G27	1,313	6.0%
6	G45	1,157	5.3%
7	G35	738	3.4%
8	G210a	708	3.2%
9	G50	687	3.2%
10	G171	606	2.8%

Israel			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G76	6,202	18.3%
2	G4	3,648	10.7%
3	G21/24	2,867	8.4%
4	G33	2,755	8.1%
5	G37	2,014	5.9%
6	G10	1,590	4.7%
7	G30/31	1,540	4.5%
8	G27	1,535	4.5%
9	G35	1,433	4.2%
10	G50	876	2.6%

Lebanon			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	5,975	34.8%
2	G76	2,029	11.8%
3	G21/24	1,654	9.6%
4	G208a	1,619	9.4%
5	G124	1,322	7.7%
6	G30/31	1,182	6.9%
7	G35	451	2.6%
8	G--	387	2.3%
9	G7/G8	382	2.2%
10	G3	368	2.1%

Morocco			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	17,539	25.1%
2	G30/31	9,619	13.8%
3	G21/24	8,189	11.7%
4	G7/G8	3,526	5.0%
5	G124	2,875	4.1%
6	G5	1,929	2.8%
7	G76	1,525	2.2%
8	G33	1,512	2.2%
9	G4	1,442	2.1%
10	G19	1,198	1.7%

Slovenia			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	1,334	25.5%
2	G76	886	16.9%
3	G4	377	7.2%
4	G21/24	354	6.8%
5	G45	324	6.2%
6	G30/31	270	5.2%
7	G95	258	4.9%
8	G10	176	3.4%
9	G124	161	3.1%
10	G50	133	2.5%

Spain			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	12,116	15.8%
2	G76	9,235	12.0%
3	G50	7,868	10.3%
4	G21/24	6,876	9.0%
5	G95	4,701	6.1%
6	G124	4,260	5.6%
7	G30/31	3,092	4.0%
8	G73	2,112	2.8%
9	G3	1,506	2.0%
10	G204	1,148	1.5%

Türkiye			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G21/24	123	26.3%
2	G7/G8	60	12.8%
3	G76	31	6.6%
4	G30/31	20	4.3%
5	G152	19	4.1%
6	G3	18	3.9%
7	G178	18	3.9%
8	G50	17	3.6%
9	G33	15	3.2%
10	G49	13	2.8%

Italy			
Top 10	Beach Litter Item	Total Items	%
1	G76	89,895	51.2%
2	G21/24	9,393	5.4%
3	G27	7,976	4.5%
4	G95	5,884	3.4%
5	G67	5,755	3.3%
6	G73	5,147	2.9%
7	G45	3,999	2.3%
8	G30/31	3,712	2.1%
9	G124	3,638	2.1%
10	G3	3,531	2.0%

Cyprus			
Top 10	Beach Litter Item	Total Items	%
1	G27	9,338	22.5%
2	G21/24	7,610	18.4%
3	G26	3,844	9.3%
4	G4	3,490	8.4%
5	G30/31	1,616	3.9%
6	G35	1,542	3.7%
7	G7/G8	1,273	3.1%
8	G50	1,253	3.0%
9	G3	1,087	2.6%
10	G158	909	2.2%

Montenegro			
Top 10	Beach Litter Item	Total Items	%
1	G27	2043	36.8%
2	G76	511	9.2%
3	G21/24	419	7.5%
4	G30/31	318	5.7%
5	G7/G8	230	4.1%
6	G124	190	3.4%
7	G175	102	1.8%
8	G154	101	1.8%
9	G198	101	1.8%
10	G3	97	1.7%

793. The aforementioned analysis provides very interesting results for the top item list at the level of the Mediterranean. The Top-item lists from the 13 countries, extracts into 39 common items of which:

- 3 items have a share of more than 10%, respectively: *Plastic/polystyrene pieces 2.5 cm > < 50 cm* (G76) with 38.6%, *Cigarette butts and filters* (G27) with 13.4%, and *Plastic caps and lids* (including rings from bottle caps/lids) (G21/24) with 10.7%.
- 2 items have a share between 5-10%, respectively: *Crisps packets/sweets wrappers/Lolly sticks* (G30/31) with 6.2% and *Other plastic/polystyrene items (identifiable) including fragments* (G124) with 5.0%.
  10 items have a share between 5-1%: *Cotton bud sticks* (G95) with 4.8%, *Foam sponge [items (i.e. matrices, sponge, etc.)]* (G73) with 2.4%, *Glass fragments >2.5cm* (G208a) witg 2.4%, *String and cord (diameter less than 1 cm)* (G50) with 2.1%, *Small plastic bags, e.g. freezer bags incl. pieces* (G4) with 1.7%, *Shopping bags incl. pieces* (G3) with 1.5%, *Straws and stirrers* (G35) with 1.2%, Sheets, industrial packaging, plastic sheeting (G67) with 1.2%, *Glass Bottles (including identifiable fragments)* (G200), and *Drink bottles* (G7/G8) with 1.0%.
- 24 items have a share of less than 1%, respectively: G45, G33, G26, G145, G5, G10, G37, G95, G100, G204, G178, G158, G153, G70, G--, G28. G158, G175, G154, G198, G165, G53, G152, G49.

2.1.3 GES Assessment / Alternative Assessment for IMAP EO10 Common Indicator 23

Geographical scale of the assessment	Regional and Sub-regional
Contributing countries	Bosnia-Herzegovina, Croatia, Cyprus, France, Greece, Israel, Israel, Italy, Lebanon, Malta, Slovenia, Spain, Tunisia and Türkiye
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO10: Marine and coastal litter do not adversely affect coastal and marine environment
IMAP Common Indicators	Common Indicator 23 (CI223): Trends in the amount of litter in the water column including microplastics and on the seafloor
GES definition	Number/amount of marine litter items in the water surface and the seafloor do not have negative impacts on human health, marine life, ecosystem services and do not create risk to navigation
Related Operational Objective	10.1. The impacts related to properties and quantities of marine litter in the marine and coastal environment are minimized
GES **Target(s)**	Decreasing trend in the number/amount of marine litter items in the water surface and the seafloor
Baseline and Threshold Values	BV: 0.044338 items/m^2 | TV: 0.000845 items/m^2

2.1.4 GES Assessment for Floating Microplastics (IMAP EO10 CI23)

794. **Floating microplastics (CI23)** data are reported in the IMAP InfoSystem from 10 CPs covering all sub-divisions of the Mediterranean region (ADR, CEN, EM, WM). In total 679 surface manta net trawls/stations are monitored during the period 2016-2022 in the following countries: Bosnia-Herzegovina, Croatia, France, Greece, Israel, Italy, Lebanon, Türkiye, Slovenia, Spain.

795. Concentrations of Floating Microplastics (items/m^2) are highly variable fluctuating between 0 and 31 items /m^2. Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.355 ± 1.99 items/m^2.

796. Following the assessment methodology explained in Chapter 2.2 and using the TV of 0.000845 items/m^2, temporal average data from the 679 stations are compared against the TV, resulting in their classification under 6 status classes (high, good, moderate, poor, bad, very bad) shown in Table 17. Practically all stations monitored (99%) do not achieve GES, and most of them fall into the poor (5244 %) and bad (45 %) classes, i.e., floating microplastics litter concentrations are up to 100 and 1000 times higher than the TV respectively. In Table 15 the classification results are given for each sub-Region separately.

Table 17: The classification of the 679 stations monitored for surface floating microplastics in the Mediterranean Region

Mediterranean Region				
Boundary limits	GES- nonGES classes	No of stations	% of stations	
≤ 0.5xTV	HIGH	4	1	1 % GES
0.5xTV< ≤ 1xTV	GOOD	1	0	
1xTV< ≤10xTV	MODERATE	40	6	99 % non-GES
10xTV< ≤100xTV	POOR	297	44	
100xTV< ≤1000xTV	BAD	306	45	
>1000x TV	VERY BAD	31	5	

797. It is clear from Table 18 that all Mediterranean subregions suffer from elevated microplastics concentrations in surface waters 100 times and 1000 times higher than the IMAP TV. In particular, in the EM, the 44% of monitored stations exceed the bad class with concentrations more than 1000 times the TV and are classified as ‘very bad’. In the ADR and WM only 1% and 2 % of stations respectively are found above 1000xTV. These results are depicted spatially in the maps of Figure 27 to Figure 30.

Table 18: The classification of the monitored stations for surface floating microplastics in all Mediterranean sub-Regions

Boundary limits	**GES- nonGES classes**	**No of station**	**% of Beaches**	
		Adriatic sub-Region		
≤ 0.5xTV	HIGH	2	3	**3 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	0	
1xTV< ≤10xTV	MODERATE	0	0	**97 % non-GES**
10xTV< ≤100xTV	POOR	23	32	
100xTV< ≤1000xTV	BAD	45	63	
>1000x TV	VERY BAD	1	1	
		71 stations		
		Central Mediterranean sub-Region		
≤ 0.5xTV	HIGH	0	0	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	0	
1xTV< ≤10xTV	MODERATE	0	0	**100 % non-GES**
10xTV< ≤100xTV	POOR	4	36	
100xTV<≤1000xTV	BAD	7	64	
>1000x TV	VERY BAD	0	0	
		11 stations		
		Eastern Mediterranean sub-Region		
≤ 0.5xTV	HIGH	0	0	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	0	
1xTV< ≤10xTV	MODERATE	0	0	**100 % non-GES**
10xTV< ≤100xTV	POOR	4	11	
100xTV< ≤1000xTV	BAD	16	44	
>1000x TV	VERY BAD	16	44	
		36 stations		
		Western Mediterranean sub-Region		
≤ 0.5xTV	HIGH	2	0.4	**0.6 % GES**
0.5xTV< ≤ 1xTV	GOOD	1	0.2	
1xTV< ≤10xTV	MODERATE	40	7	**99.4 % non-GES**
10xTV< ≤100xTV	POOR	266	47	
100xTV< ≤1000xTV	BAD	238	42	
>1000x TV	VERY BAD	14	2	
		561 stations		

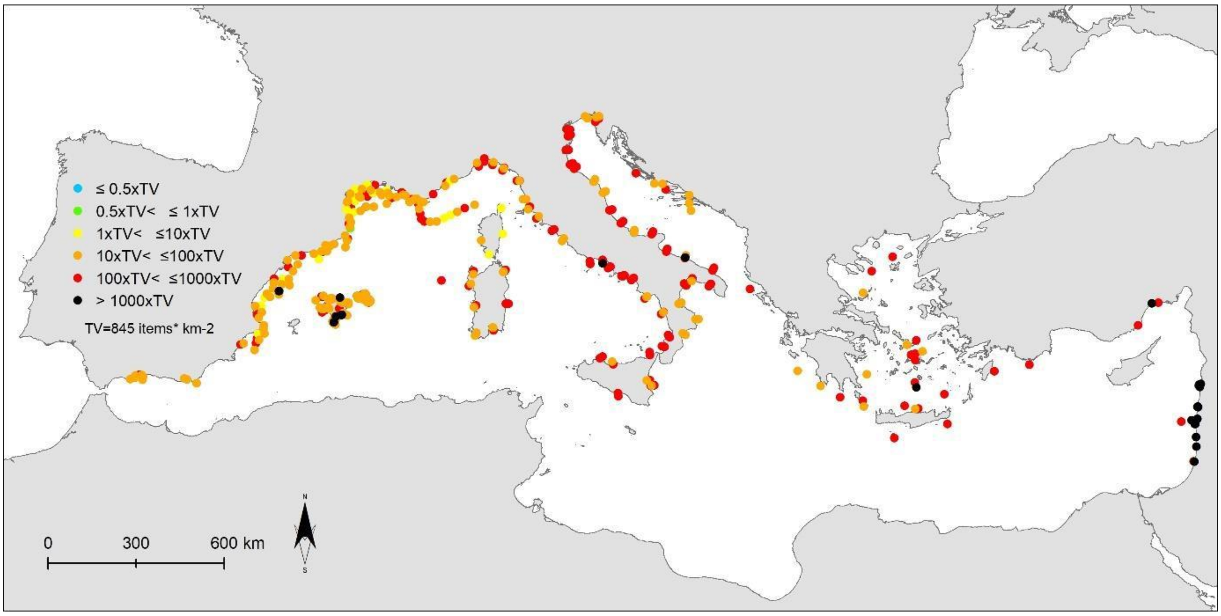


Figure 27**:** GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Mediterranean Region.

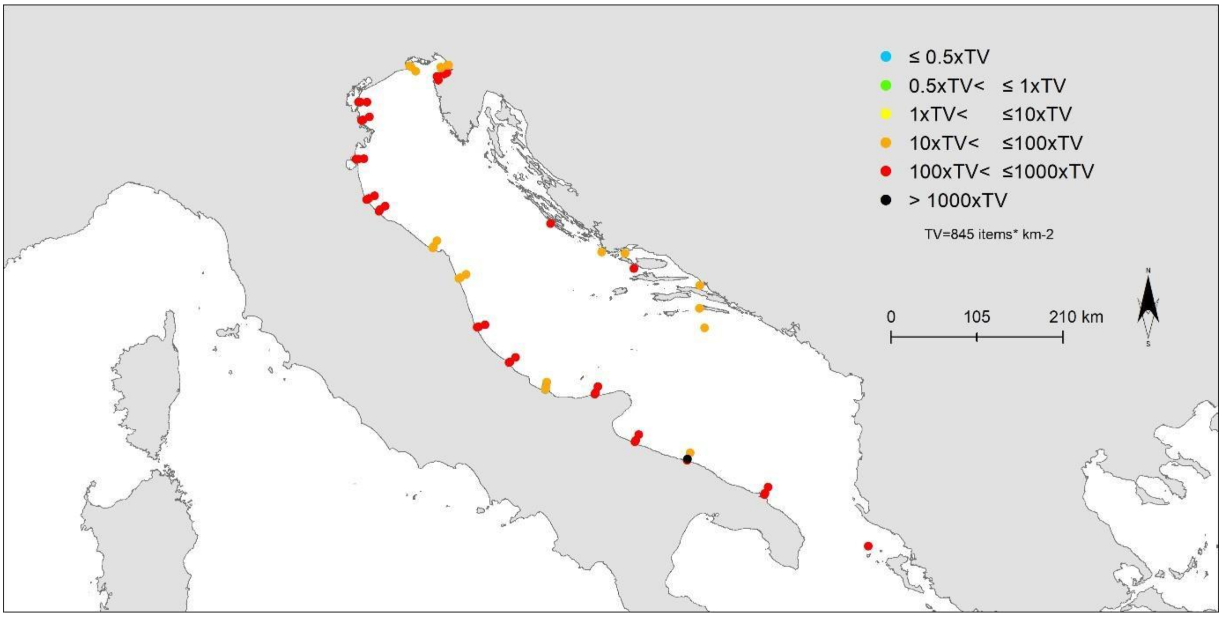


Figure 28**:** GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Adriatic Mediterranean sub-region.

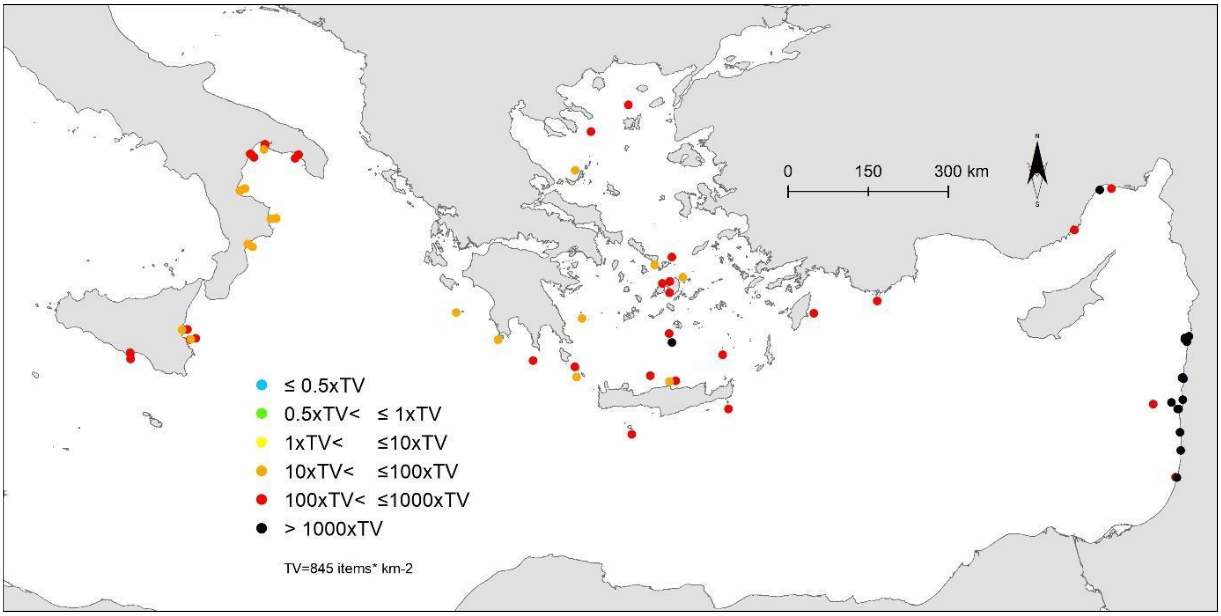


Figure 29**:** GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Eastern and Central Mediterranean sub-regions.

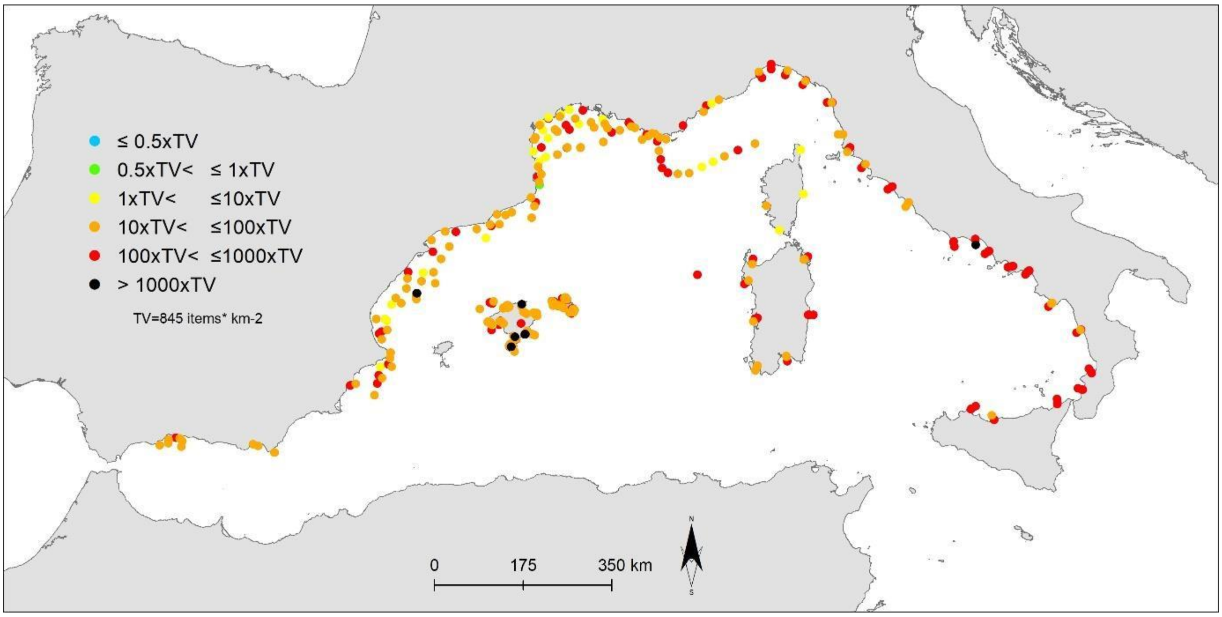
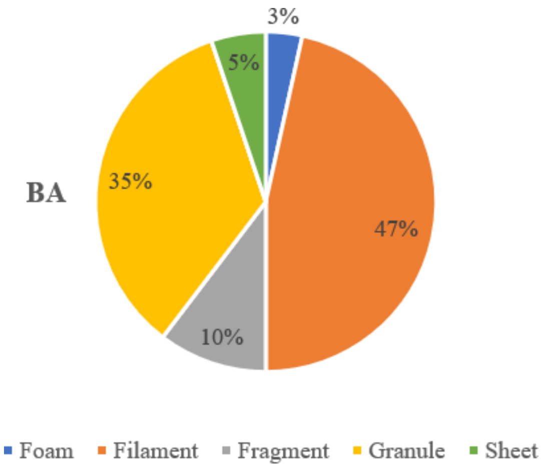
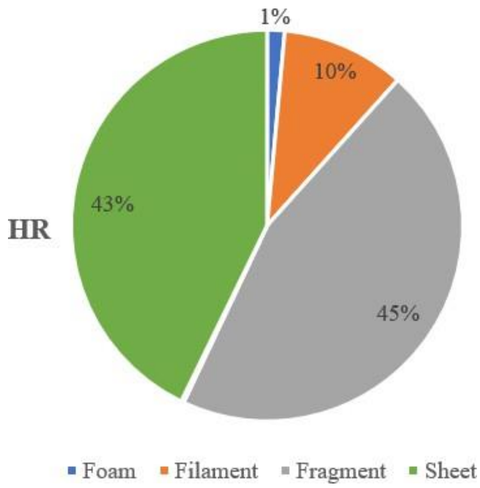


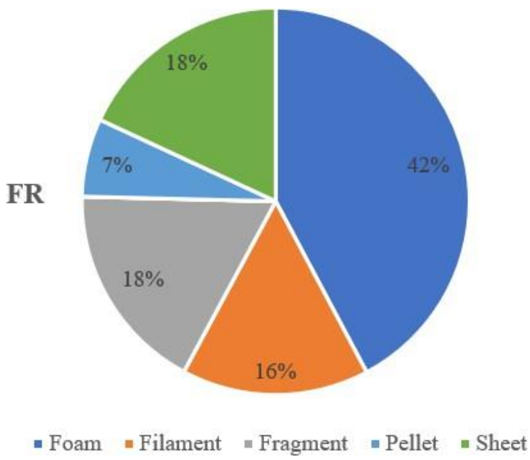
Figure 30**:** GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Western Mediterranean sub-region.

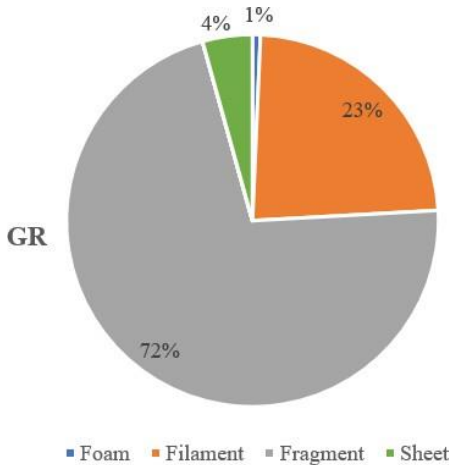
798. The data submitted for floating microplastics from the 10 countries, also provide interesting results regarding the qualitative composition and the different types of microplastics. Predominant in abundance are the Sheets (37%), followed by Filaments (30%), Pellets (21%), Fragments (7%), Foam (4%), and Granules (1%).

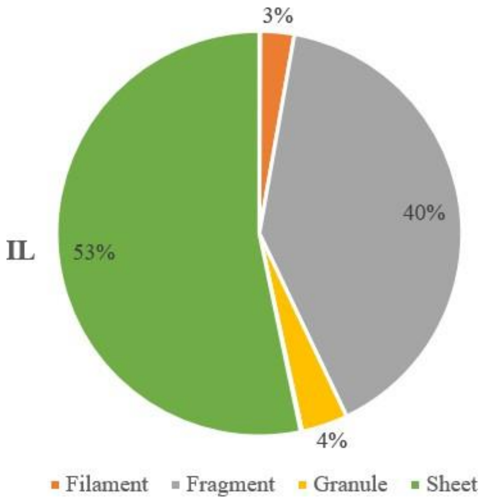
799. The graphs below are representing the qualitative composition (different types of microplastics) per respective country:

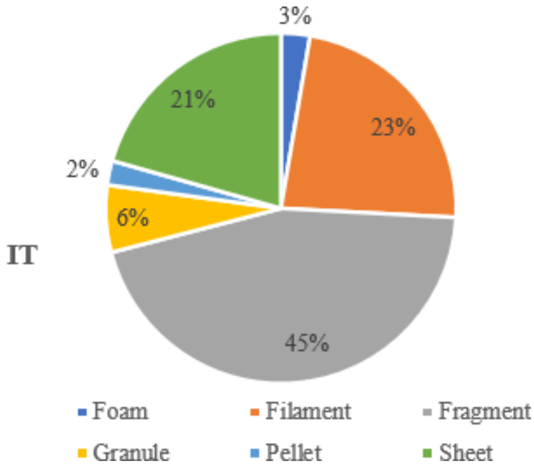

BA
3%
5%
35%
47%
10%
Foam Filament Fragment Granule Sheet

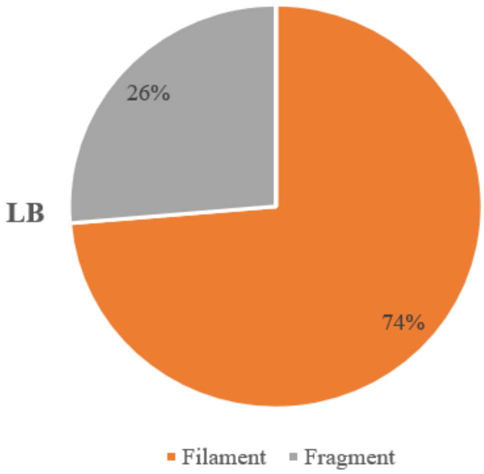

HR
1%
10%
43%
45%
Foam Filament Fragment Sheet

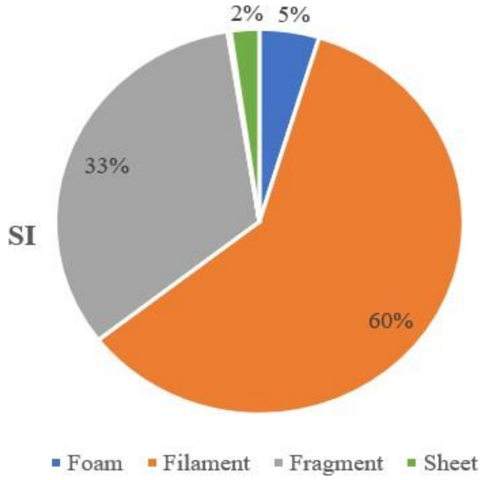

FR
18%
7%
42%
18%
16%
Foam Filament Fragment Pellet Sheet

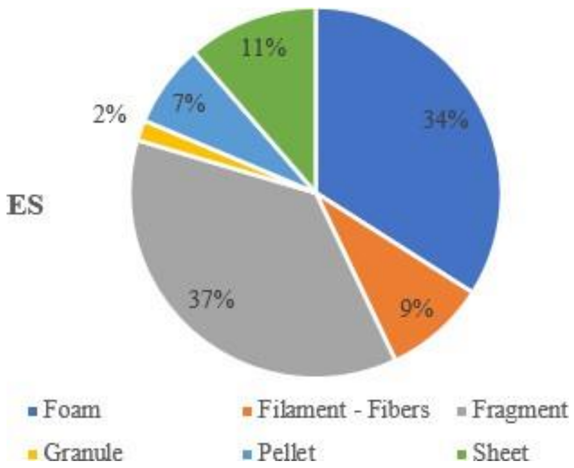

GR
4%
1%
23%
72%
Foam Filament Fragment Sheet

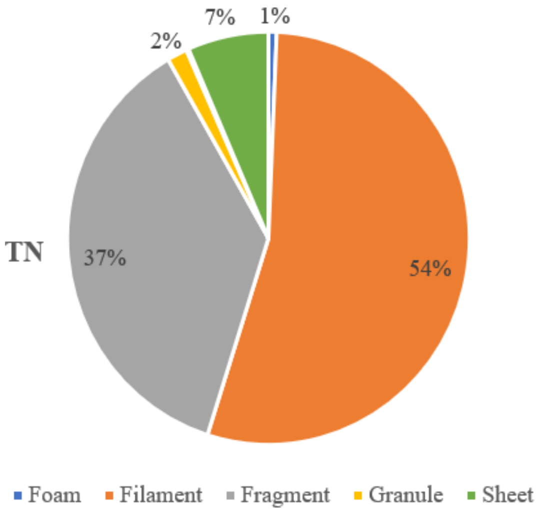

IL
3%
40%
53%
4%
Filament Fragment Granule Sheet

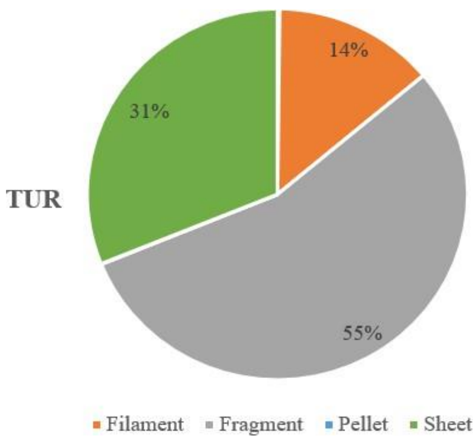

IT
3%
21%
23%
2%
6%
45%
Foam Filament Fragment
Granule Pellet Sheet


LB
26%
74%
Filament
Fragment


SI
2%
5%
33%
60%
Foam
Filament
Fragment
Sheet


ES
11%
7%
2%
34%
37%
9%
Foam
Filament - Fibers
Fragment
Granule
Pellet
Sheet


TN
2%
7%
1%
37%
54%
Foam
Filament
Fragment
Granule
Sheet


TUR
14%
31%
55%
Filament
Fragment
Pellet
Sheet

The Mediterranean litterscape assessed from the air during the ACCOBAMS survey initiative.

800. Detection and presence probabilities of mega-debris were estimated over the entire Mediterranean Sea and abundance estimate was eventually derived from the presence probability. Some 41,000 floating mega-litter items were recorded in total during the ASI (Figure 32), with an average encounter rate of 0.8 mega-litter per km (standard deviation 3.2), ranging between 0 and 111 debris per km. More than two thirds of the mega-litter recorded were identified as plastics (68.5%; e.g., plastic bags, bottles, tarpaulins, palettes, inflatable beach toys, etc.), while 1.7% were fishery debris and 1.9% were anthropogenic wood-trash. The remaining quarter (27.9%) was anthropogenic mega-debris of an undetermined nature. Plastic litter was largely dominant in all blocks. Beaufort sea state, turbidity and glare extent had a negative effect on detection, whereas subjective conditions had a positive one and detection probability differed among the eight observer teams. Overall, the estimated probability of detecting floating mega- litter during the ASI ranged from 0.1 in the worst conditions to 0.9 in optimal observation conditions: i.e., about 90% of debris actually present are not detected when seas are rough, while near perfect detection is probable when seas are calm, which was the case in 73% of the total survey effort.

801. During the ASI, only 20% of the Mediterranean was free of floating mega-litter. The estimated presence probability was highest in the central and western Mediterranean, in the Tyrrhenian, northern Ionian, and Adriatic Seas and in the Gulf of Gabes (> 80%). The lowest presence probabilities occurred in the Levantine basin, in the southern Ionian Sea and in the Gulf of Lion (< 50%). The total number of floating mega-litter was estimated at 2.9 million items (80% confidence interval was 2.7 to 3.1 million and average density 1.5±0.1 items per km^2), taking into account imperfect detection. Considering that items larger than 30 cm represent only one fourth of the complete load of anthropogenic debris (>2 cm) in the Mediterranean, it scales up the estimate to 11.5 million floating debris.

802. The spatially explicit modelling of mega-litter presence revealed a very heterogeneous distribution of floating mega-debris during summer: highest densities of litter were observed in the central Mediterranean (Tyrrhenian Sea, Adriatic Sea, northern Ionian Sea, off north-eastern Algeria and the Gulf of Gabes; Fig.11), while the lowest densities were found in the eastern basin. Highest densities occurred along the Tyrrhenian coast of Italy and in the Adriatic Sea, with up to 20 items per km^2. This acute marine pollution might disrupt entire ecosystems through its impact on marine fauna (entanglement, ingestion, contamination), eventually impacting associated ecosystem services such as the tourism industry and the well-being of Mediterranean populations. The higher prevalence of litter in the western and central basin compared to the relatively spared eastern basin mimics that of the megafauna, which is both more abundant and more diversified in the western basin. This general overlap suggests that the threat to Mediterranean fauna would be maximum in the western Mediterranean.

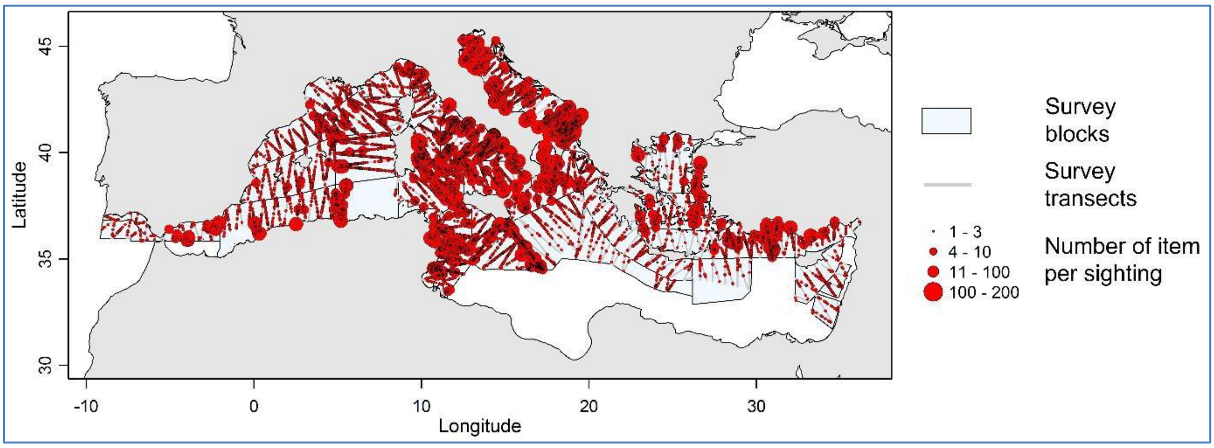


Figure 31**:** ACCOBAMS Survey Initiative (ASI) blocks, sampled transects and distribution of sighted floating mega-litter. Transects were sampled once by 14 different teams operating 8 planes simultaneously in different areas. There was no aerial survey effort off the coasts of Morocco, Libya, Egypt and east of Cyprus where the ASI survey was conducted by boat.

803. Many endangered or vulnerable species, some of them endemic to the area, are at risk of entanglement or of ingesting debris. This work sets a reference situation allowing the efficiency of future plastic pollution remediation strategies to be assessed. It constitutes the first ground-truthing of previous numerical simulations based on surface debris drifting simulations. On a methodological point of view, the present work showed that departing from sea-state 0 to 3 resulted in a drop of c. 31% in the detection probability of mega-debris, violating the assumption, inherent to strip transect approaches, that detection is perfect across the sampled strip.

804. Therefore, accounting for imperfect detection in density estimation procedure based on strip-transect visual surveys is crucial. The line-transect protocol, which is the standard methodology to be used in case of varying detectability of objects with distance from the transect line and observations conditions, cannot readily be implemented in aerial surveys for floating mega-debris, because those are too numerous to allow the necessary distance data to be collected without disrupting the observers' observation capabilities. The use of strip-transect protocol has proven to be operationally effective for collecting debris along with marine fauna and anthropogenic activities, provided that the analytical procedure can take imperfect detection into account.

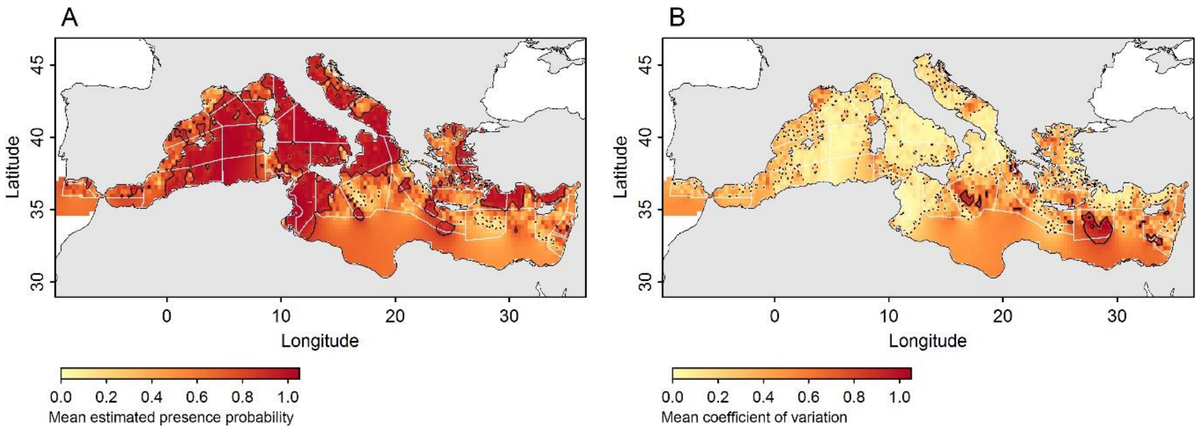


Figure 32**:** (A): Estimated presence probability (posterior mean) of floating mega-debris. (B): Uncertainty in estimated presence probability (coefficient of variation). Isolines corresponding to contours 20% probabilities are shown in dotted black lines and 80% contours in solid black lines. ASI survey blocks are shown in solid white lines.

GES Assessment for Seafloor Macrolitter (IMAP EO10 CI23)

805. **Seafloor marine litter (CI23)** data are reported in the IMAP InfoSystem from 11 CPs covering all sub-divisions of the Mediterranean region (ADR, CEN, EM, WM). In total 367 seafloor trawls/stations are monitored during the period 2017-2021 in the following countries: Croatia, Cyprus, France, Israel, Malta, Montenegro, Morocco, Slovenia, Spain, Tunisia, Türkiye. Most samplings (364) are situated on fishing grounds and were conducted by fishing trawls, thus in most of the cases in soft-bottom grounds, and only 3 samplings in Morocco were conducted by scuba diving in sub-littoral seafloor and correspond to maximum outlier seafloor macro-litter concentrations.

806. Concentrations of seafloor marine litter (items/km^2) excluding the scuba diving outlier data are highly variable fluctuating between 0 and 28,228 items /km^2. Average seafloor litter concentration on the Mediterranean coastline is found equal to 570 ± 2,588 items/km^2. The outlier seafloor concentrations are 662,500 items/km^2, 1,882,500 items/km^2, and 372,500 items/km^2 and are not included in the analysis below because they are based on a different monitoring methodology.

807. Following the assessment methodology and using the TV of 38 items/km^2, temporal average data from the 367 seafloor stations are compared against the threshold, resulting in their classification under 5 status classes (high, good, moderate, poor, bad) shown in

808. Table *19*. Overall, 88% of the seafloor stations monitored do not achieve GES, and most of them fall into the bad (53 %) and moderate (23 %) categories, i.e., seafloor litter concentrations are up to five times higher than the TV. In

809.

811. Table *20* the classification results are given for each sub-Region separately.

Table 19: The classification of the 364 seafloor stations monitored in the Mediterranean Region

Boundary limits	GES- nonGES classes	No of stations	% of stations	
		Mediterranean Region		
≤ 0.5xTV	HIGH	23	**6**	**11 % GES**
0.5xTV< ≤ 1xTV	GOOD	19	**5**	
1xTV< ≤2xTV	MODERATE	44	**12**	**88 % nonGES**
2xTV< ≤5xTV	POOR	85	**23**	
> 5xTV	BAD	193	**53**	

812. On the sub-region level the Western Mediterranean appears highly affected by seafloor marine litter since all stations monitored (100%) are classified in the nonGES category. The Central Mediterranean sub-region appears also highly affected with 81% of stations monitored classified under nonGES. The Adriatic and Eastern Mediterranean sub-regions follow with 65 and 68% of the stations monitored falling into the nonGES class respectively. The Eastern Mediterranean is the only area where a considerable percentage (24 %) of trawling stations achieve high status. These results are depicted spatially in the maps of Figure 33 to Figure 37 from where the uneven distribution of stations within each sub-region, attributed to limitations in data submission, can be seen, for example the CEN is covered only by Malta and Tunisia.

Table 20: The classification of the monitored seafloor stations in Mediterranean sub-Regions

Boundary limits	**GES- nonGES classes**	**No of seafloor stations**	**% of Stations**	
		Adriatic sub-R gion		
≤ 0.5xTV	HIGH	2	**9**	**35% GES**
0.5xTV< ≤ 1xTV	GOOD	6	**26**	
1xTV< ≤2xTV	MODERATE	8	**35**	**65 % non-GES**
2xTV< ≤5xTV	POOR	14	**4**	
> 5xTV	BAD	6	**926**	
		23 stations		
		Centr l Mediterranea n sub-Region		
≤ 0.5xTV	HIGH	1	**2**	**16% GES**
0.5xTV< ≤ 1xTV	GOOD	7	**17**	
1xTV< ≤2xTV	MODERATE	16	**38**	**81 % non-GES**
2xTV< ≤5xTV	POOR	17	**40**	
> 5xTV	BAD	1	**2**	
		42 stations		
		Easter n Mediterranean sub-Region		
≤ 0.5xTV	HIGH	20	**24**	**32% GES**
0.5xTV< ≤ 1xTV	GOOD	6	**7**	
1xTV< ≤2xTV	MODERATE	17	**21**	**68% non-GES**
2xTV< ≤5xTV	POOR	16	**20**	
> 5xTV	BAD	23	**28**	
		82 stations		
		Wester Mediterranea n sub-Region		
≤ 0.5xTV	HIGH	0	**20**	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	**0**	
1xTV< ≤2xTV	MODERATE	3	**1**	**100 % non-GES**
2xTV< ≤5xTV	POOR	51	**24**	
> 5xTV	BAD	163	**75**	
		217 stations		

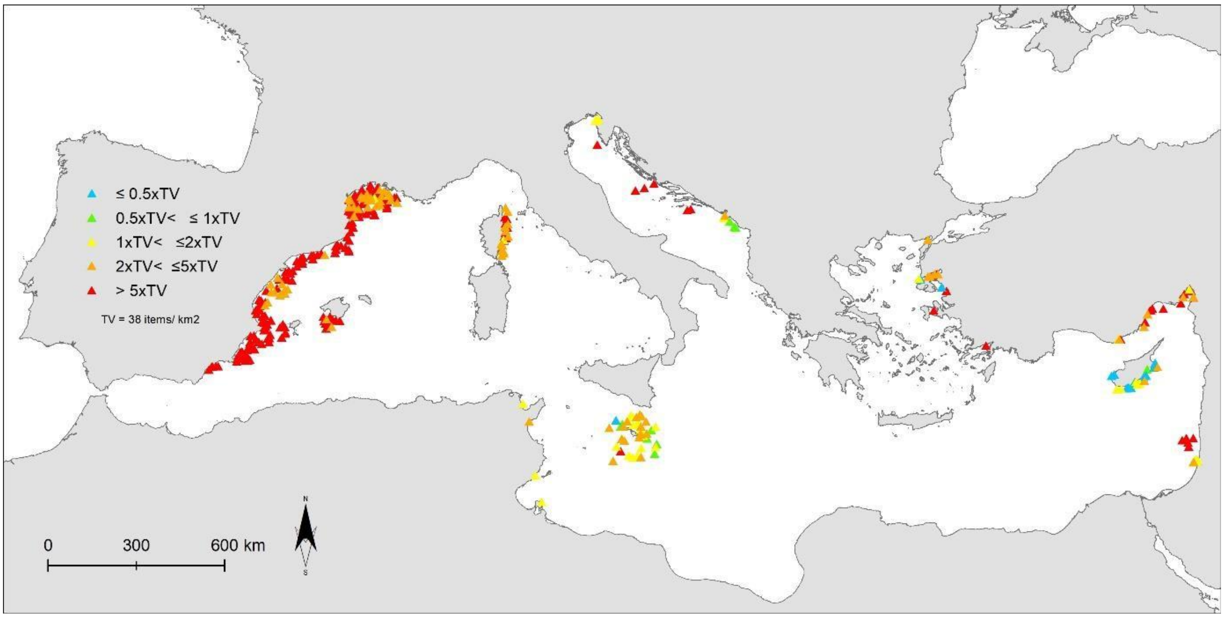


Figure 33**:** GES assessment classification of the seafloor stations monitored for marine litter in the Mediterranean Region.

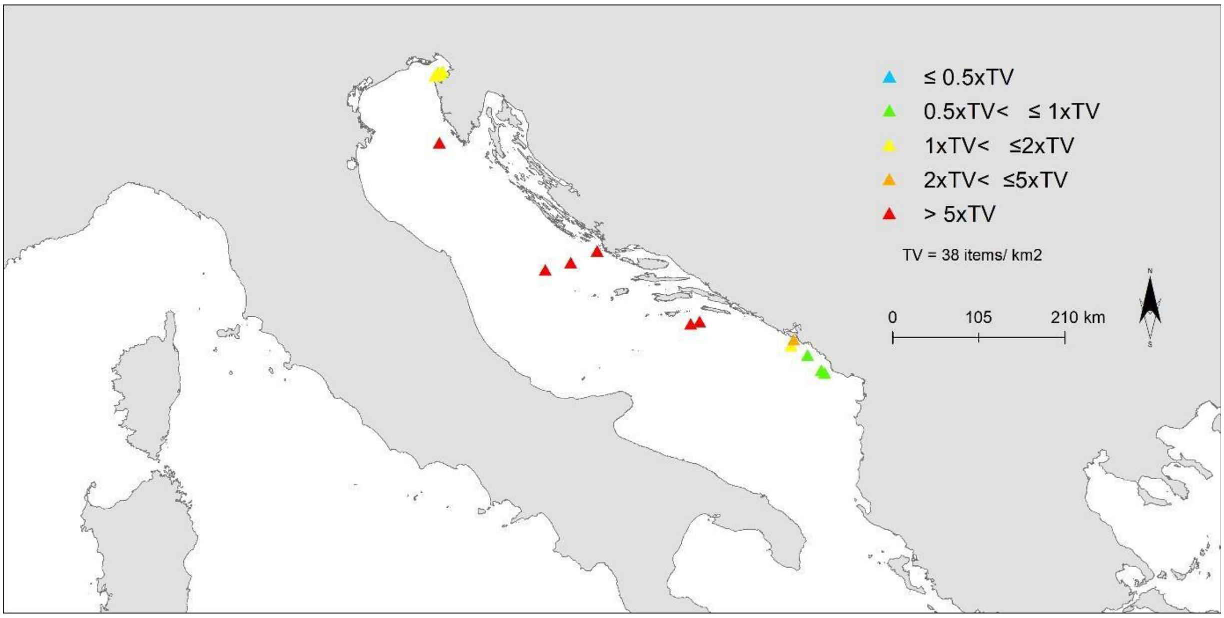


Figure 34**:** GES assessment classification of the seafloor stations monitored for marine litter in the Adriatic Mediterranean sub-regions.

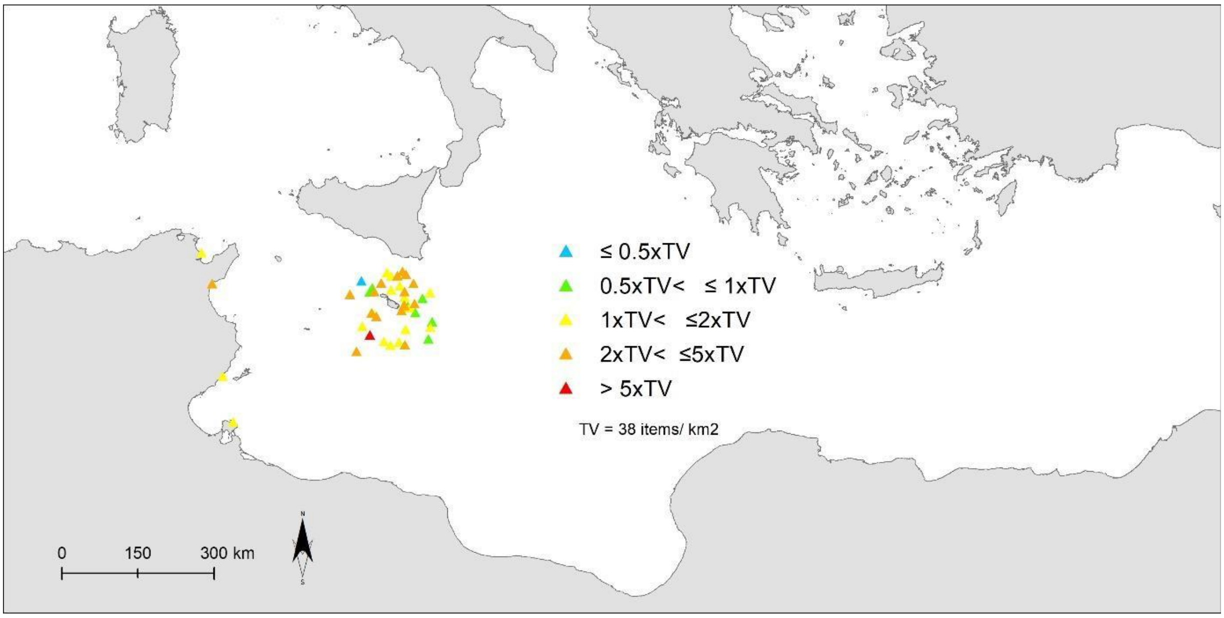


Figure 35**:** GES assessment classification of the seafloor stations monitored for marine litter in the Central Mediterranean sub-region.

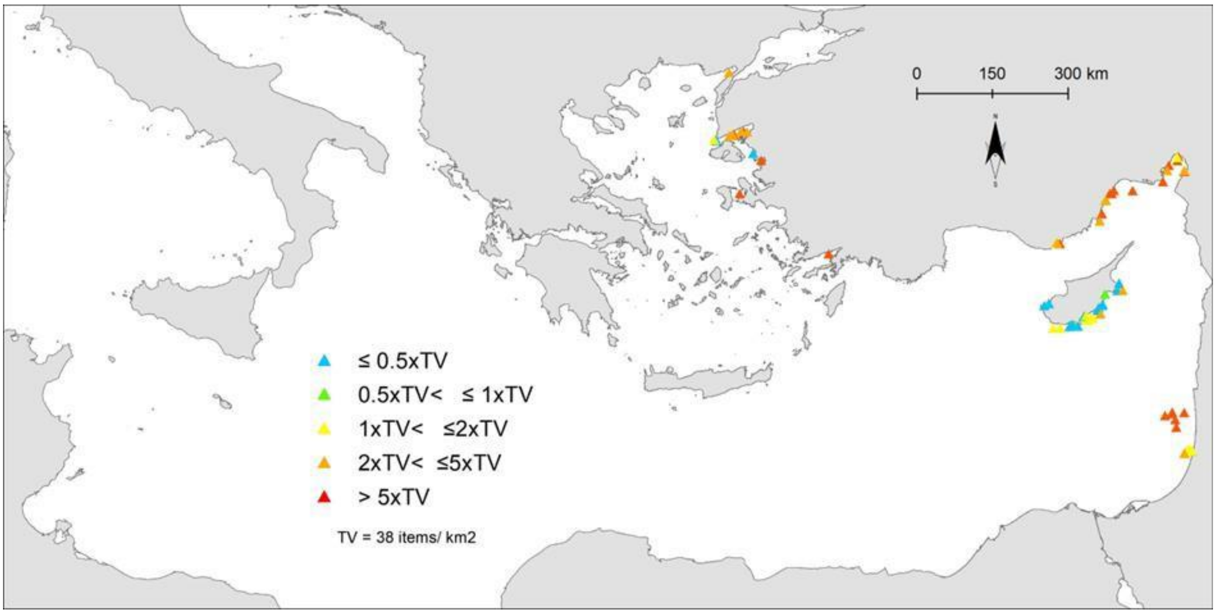


Figure 36**:** GES assessment classification of the seafloor stations monitored for marine litter in the Eastern Mediterranean sub-region.

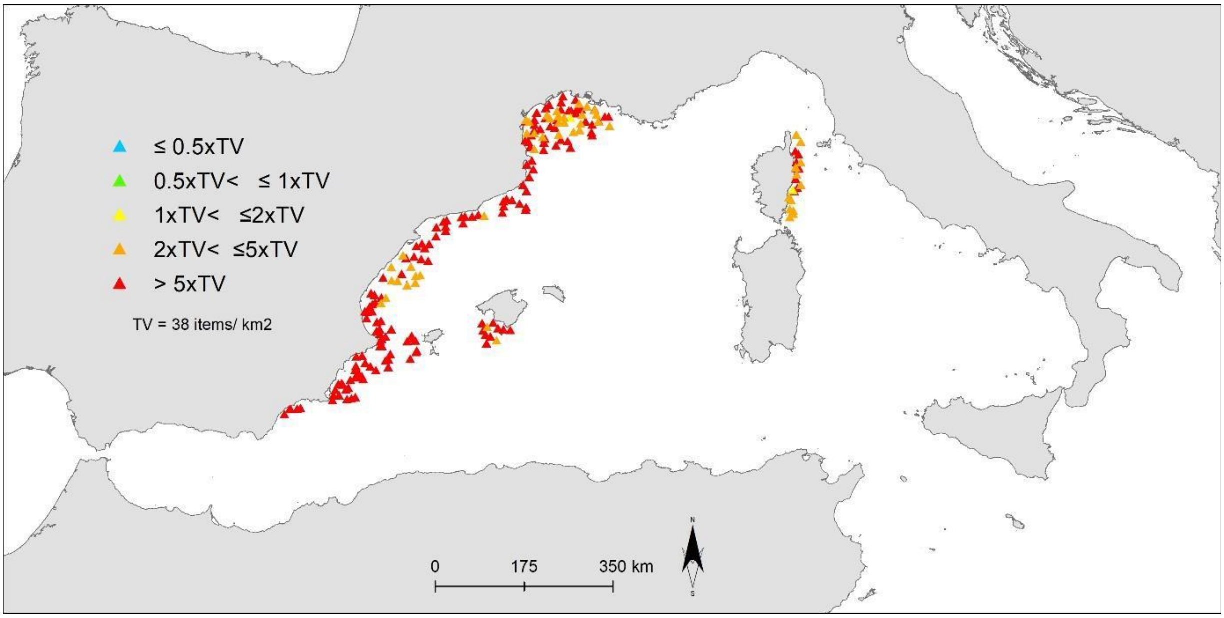


Figure 37**:** GES assessment classification of the seafloor stations monitored for marine litter in the Western Mediterranean sub-region.

813. Further to the submission of data for seafloor macro-litter, an analysis was undertaken with an explicit focus on fisheries-related items. The purpose of this analysis is to identify hotspot areas in the Mediterranean where high abundance rates can be associated with impact on biota (e.g., through ghost fishing, Abandoned Lost or Otherwise Discarded Fishing Gear (ALDFG). Seafloor litter can harm marine organisms of all sizes by various mechanisms, including entanglement, smothering (i.e., in soft bottom environments) and ingestion.

814. A small component (10%) of seafloor macrolitter was represented by fishery-related items. The most common items recorded from the trawl surveys are:

a) "L1i - Synthetic ropes/strapping bands" (39%);
b) "L1f - Fishing nets (polymers)" (27%);
c) "L1g - Fishing lines (polymers)" (25%);
d) "L5c - Natural fishing ropes" (6%);
e) "L1h - Other synthetic fishing related" (2%); and
f) "L3f - Fishing related (hooks, spears, etc.)" (1%).

815. Fishery-related marine litter items varied among countries, from a mean value of approximately 26 items/km^2 in France to approximately 1 item/km^2 in Israel. Intermediate values have been recorded in Türkiye approx. 19 items/km^2, Malta approx. 15 items/km^2, Tunisia approx. 8, and Croatia with approx. 3 items/km^2.

816. In Morocco, fishery-related litter monitored through SCUBA diving represented just the 4% of all the items found. The most common litter item was "L1j - Fishing lines (polymers)" (34%), followed by "L1f - Fishing nets (polymers)" (19%), "L1h – Other synthetic fishing related" (12%), "L3f – Fishing related (hooks, spears, etc.) (12%), "L5c – Natural fishing ropes " (12%) and "L1i – Synthetic ropes/strapping bands" (9%). The distribution of the fisheries-related items in 3 Mediterranean sub-regions is provided under Figure 38, Figure 39 and Figure 40, below:

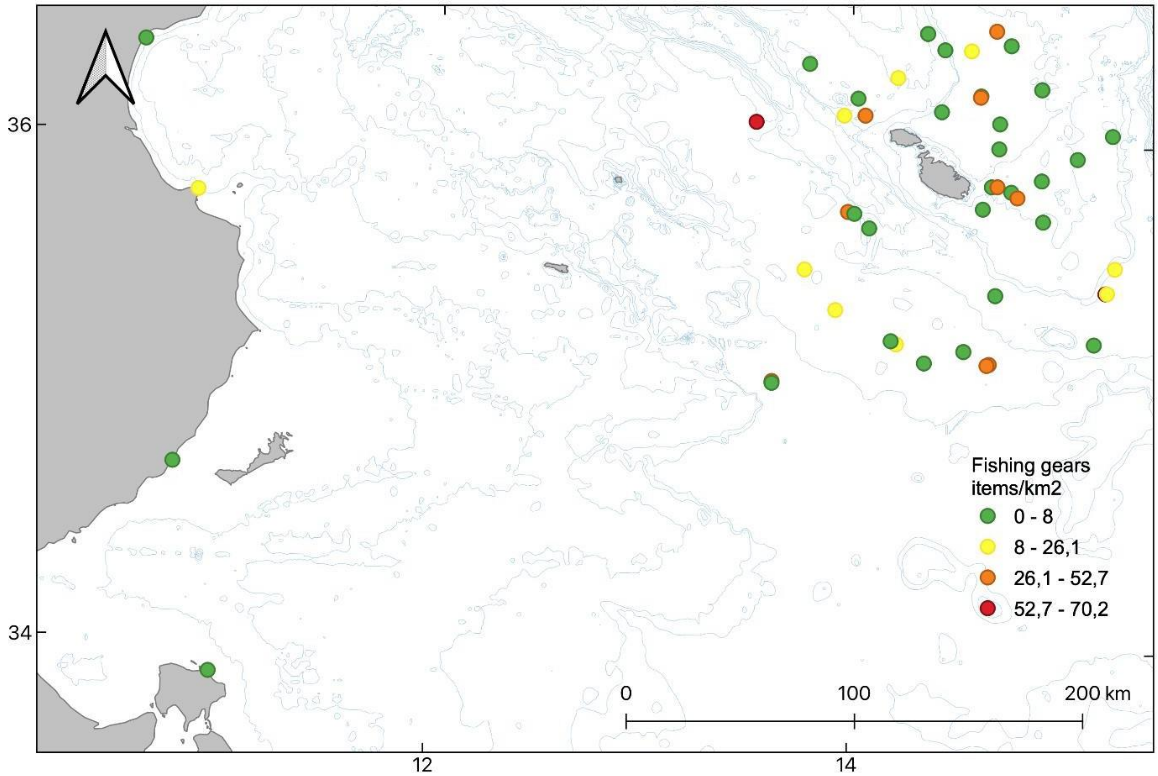


Figure 38: Fishing gear distribution on the seafloor of the Central Mediterranean sub-region.

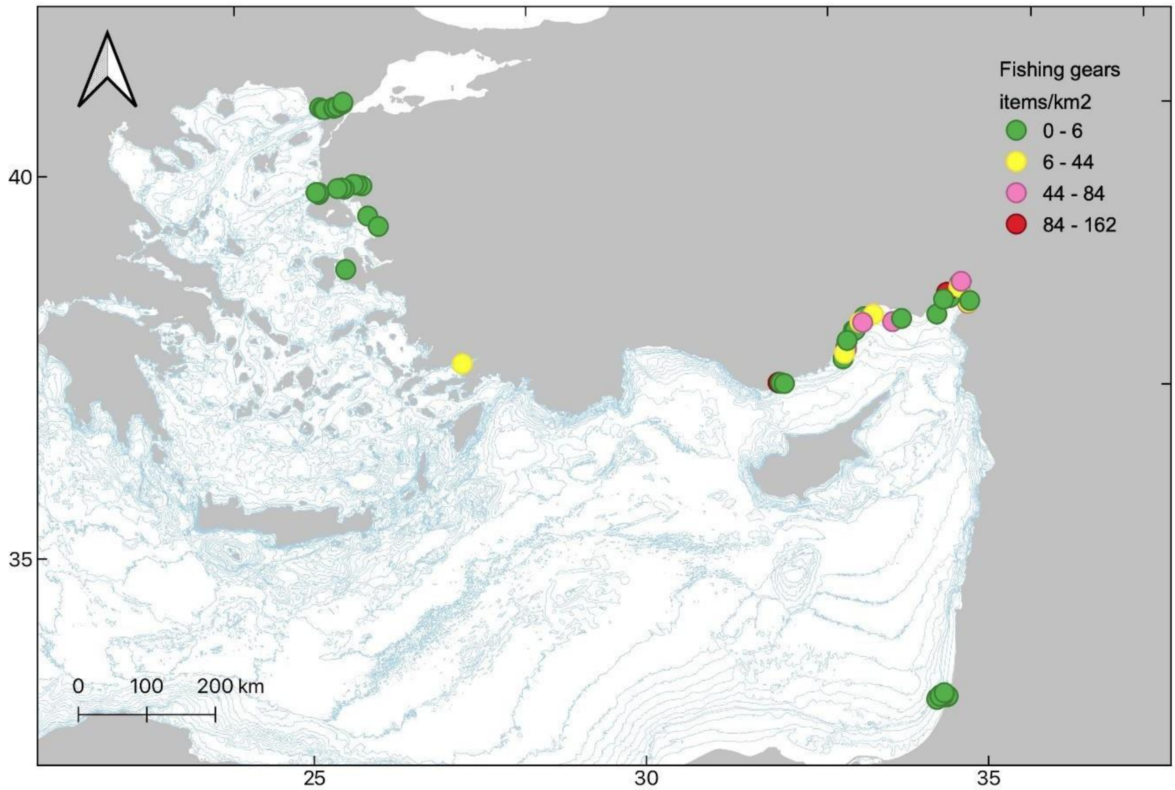


Figure 39: Fishing gear distribution on the seafloor of the Eastern Mediterranean sub-region.

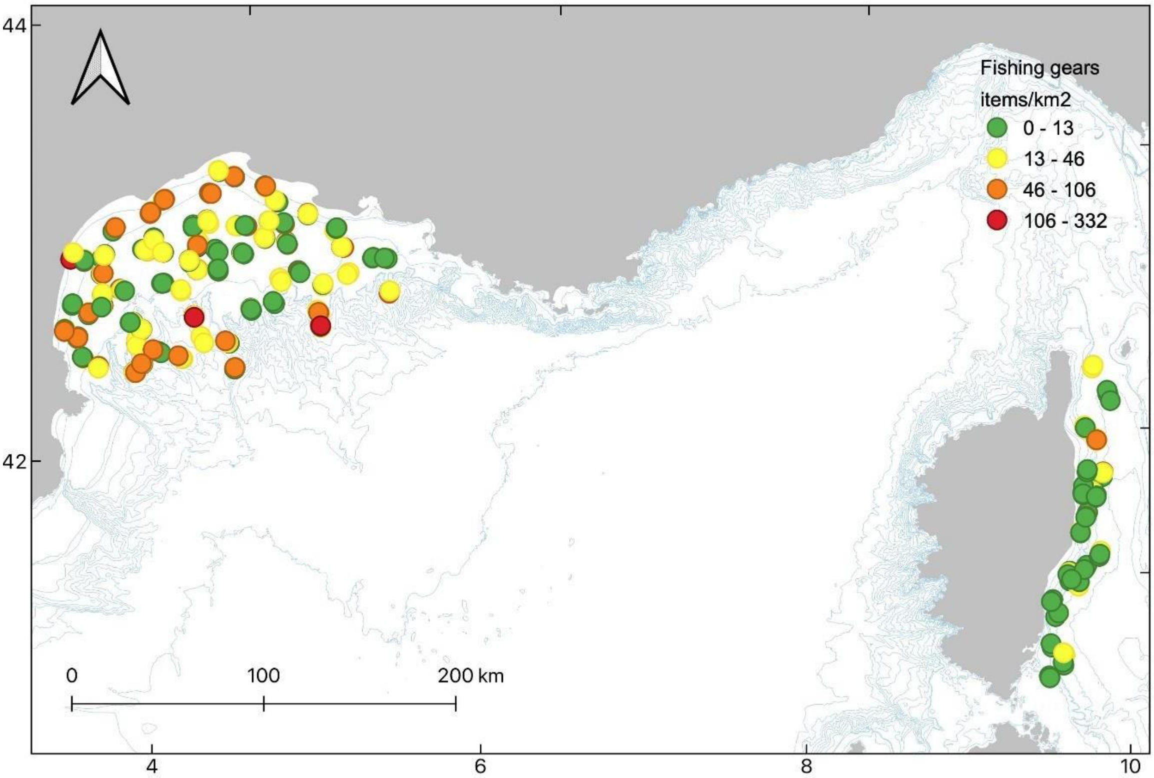


Figure 40**:** Fishing gear distribution on the seafloor of the Western Mediterranean sub-region.

<u>Application of the NEAT Assessment Tool for EO10 for the Adriatic Sub-region</u>

<u>Defining the assessment areas</u>

817. For IMAP EO10/CI 22, integration of assessments up to the subdivision level is considered meaningful. Three main subdivisions of the Adriatic Sea, namely, North, Central and South Adriatic have been chosen following the specific geomorphological features as available in relevant scientific sources (e.g., bottom depths and slope areas, existence of deep depression, salinity and temperature gradient, water mass exchanges).

818. Geographical data for the 3 Adriatic subdivisions have been retrieved from (Cushman-Roisin et al., 2001). The coverage of the 3 sub-divisions is shown in Figure 41. The 3 sub-divisions are nested under the Adriatic Sea, while within each of them are nested the areas of assessment set further to the spatial coverage of the areas of monitoring of each of the CPs. Following the rationale of the IMAP national monitoring programmes as well as the methodology described in UNEP/MAP 2021, two zones for integration of areas of monitoring are defined. These two zones are set based on monitoring stations distribution and anticipation of the relevant IMAP monitoring areas as follows: (i) the coastal zone including monitoring stations within 1nm from the coastal line; and (ii) the offshore zone including monitoring stations beyond 1 nm up to 12nm from the coastal line (i.e., the area 1 nm < <12 nm).

819. For the nesting of the areas, these were first classified under the 3 subdivisions of the Adriatic Sea (North: NAS, Central: CAS, South: SAS), then a nesting scheme was followed. The approach followed for the nesting of the areas is 4 levels nesting scheme (1 - being the finest level, 4 - the highest): 1st: nesting of all national IMAP SAUs & subSAUs under key IMAP assessment zones per country (i.e. coastal and offshore); 2nd: IMAP assessment zones (i.e. coastal, offshore) on the subdivision level (NAS coastal, NAS offshore; CAS coastal, CAS offshore; SAS coastal, SAS offshore); 3rd: under the 3 subdivisions (NAS, CAS, SAS); 4th: under the Adriatic Sea Sub Region. Similarly, the integration of the assessment results is conducted as follows: 1st Detailed assessment results per subSAUs and SAUs; 2nd Integrated assessment results per NAS coastal, NAS offshore;

CAS coastal, CAS offshore; SAS coastal, SAS offshore; 3rd Integrated assessment results per subdivision NAS, CAS, SAS; 4th Integrated assessment results for the Adriatic Sub Region.

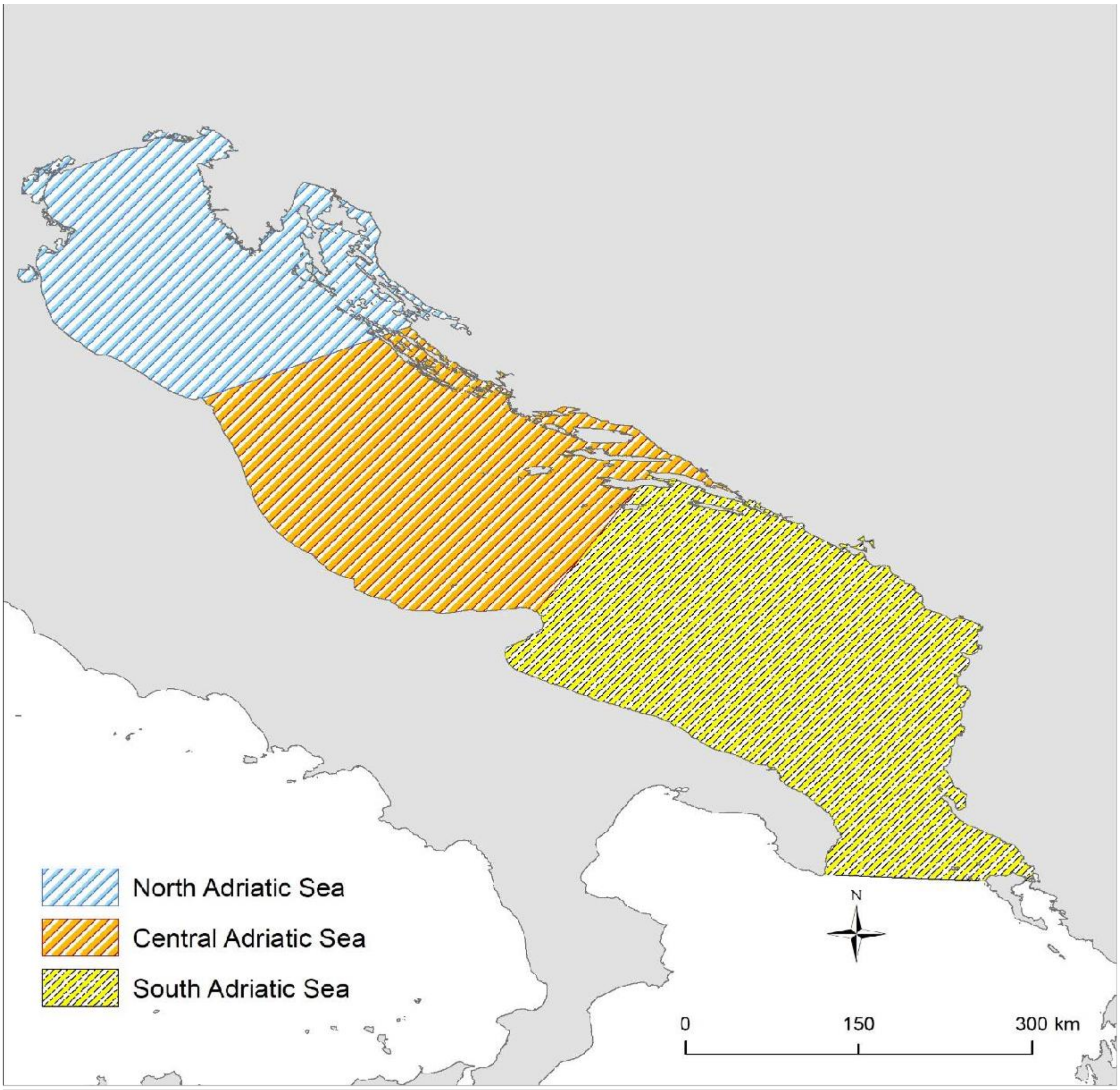
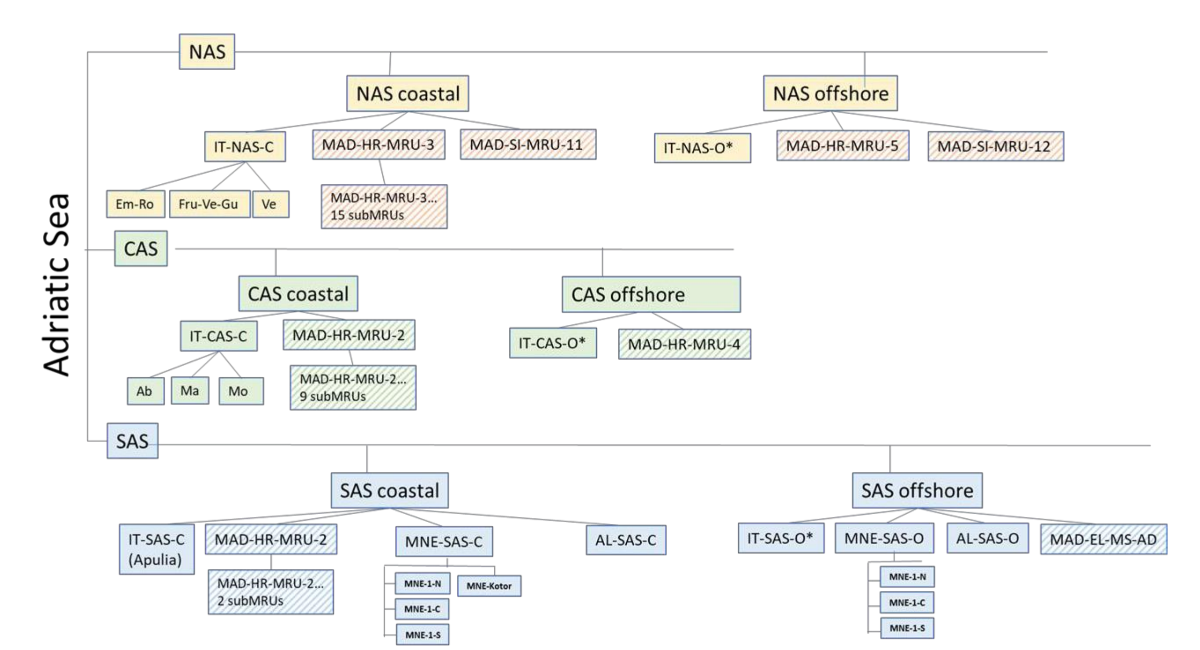


Figure 41: The 3 subdivisions of the Adriatic subregion.

820. The suggested nesting scheme of the IMAP SAUs leads to the aggregation of data on the subdivision level within the coastal and offshore IMAP monitoring/assessment zones and follows the regional/sub-regional approach as required by the IMAP. In line with the integrated assessment approach at the level of Pollution-Marine Litter Cluster, for EO10 CI22/CI23 the assessment is conducted for the same IMAP SAUs and subSAUs (the finest coastal assessment areas on the national level) and the respective nesting scheme, in line with the approach used for IMAP EO9 (Figure 42). The NEAT assessment methodology is applied on the nesting scheme of SAUs and SubSAUs which has the ability to provide aggregated-integrated assessment results.

Data availability

821. Data on IMAP EO10/CI22-Beach Litter have been collected from 6 CPs bordering the Adriatic Sea for the years 2016 to 2021 (i.e. Albania, Bosnia & Herzegovina, Croatia, Italy, Montenegro, Slovenia), except from Greece. Beach Litter data used were either reported by the CP to the IMAP IS or shared with the IMAP Secretariat. Data on IMAP EO10/CI23- Seafloor Litter were reported to the IMAP IS only by Slovenia, Croatia and Montenegro. IMAP EO10/CI23- Sea surface floating microplastics (MPs) data sets were reported by 5 CPs (Bosnia & Herzegovina, Croatia, Greece, Italy, Slovenia).



* For Italy the offshore SAUs areas (IT-NAS-12, IT-CAS-12, IT-SAS-12) is calculated as the difference of the coastal- intercoastal ones from the official MRUs (IT-NAS-0001, IT-CAS-0001, IT-SAS-0001)

Figure 42**:** The nesting scheme of the SAUs defined for the Adriatic Sea based on the available information. Shaded boxes correspond to official MRUs declared by the countries that are EU MS and that were decided to be used as IMAP SAUs. The finest SAUs nested under national coastal waters are the subSAUs.

Setting the assessment criteria

822. The baseline and threshold values for IMAP CI 22 in the Mediterranean Sea have been endorsed by COP22 (Antalya, Türkiye, 7-10 December 2021) and have been annexed to Decision IG.25/9. The respective values for IMAP CI23 in the Mediterranean were first submitted for review to the CORMON Meeting for Marine Litter Monitoring on 3 March 2023 and an updated version was prepared for the Integrated CORMON Meeting (27-28 June 2023). The threshold value between Good and non-Good Environmental Status used in the NEAT assessment is the TV equal to 130 items/100m for beach litter, the TV equal to 135 items/km^2 for seafloor litter, and the TV equal to 0.000845 items/m2 for floating microplastics.

823. According to the IMAP implementation all stations/beaches having concentrations equal or below the TVs are considered in GES, and those with concentrations higher than the TV value are considered not in GES (nonGES). Apart from the GES-nonGEs threshold/boundary values and their interrelation with the threshold/assessment criteria values, the NEAT tool requires also two more boundary values within the nonGES range of concentrations which defines the 'worse' conditions. In this way a 5-status class is produced which further discriminates the above GES threshold

concentration range into two more classes depending on the distances from the GES threshold value. For this boundary (worse conditions) the maximum concentration value of the data set was used.

824. The 5 NEAT status classes for CI22 and CI23_SFL are: the high status with concentrations in the range 0 < ≤0.5xTV; the 'good' status with concentrations in the range 0.5xTV< ≤TV; the moderate status with concentrations in the range TV< ≤2xTV; the poor status with concentrations in the range 2xTV< ≤5xTV. Finally, the 'bad' status is defined by concentrations falling above the 5xTV boundary value. For CI23_ Sea surface MPs the boundary values for the 5 classes are modified as follows: high status with concentrations in the range 0 < ≤0.5xTV; the 'good' status with concentrations in the range 0.5xTV < ≤TV; the moderate status with concentrations in the range TV< ≤10xTV; the poor status with concentrations in the range 10xTV< ≤100xTV. Finally, the 'bad' status is defined by concentrations falling above the 100xTV boundary value.

825. Following the IMAP methodology, NEAT class named 'high' is considered as 'good' *sensu* IMAP i.e., in GES; NEAT classes named 'moderate' and 'poor' *sensu* NEAT are considered as 'Bad' *sensu* IMAP i.e., not in GES. These boundary values and their relation to the IMAP and the NEAT status classes are shown in

826. Table *21* and Table 22.

Table 21: Relation of assessment status classes between the IMAP methodology and NEAT tool and respective colour coding. The position of the 3 required thresholds for the NEAT tool are shown.

	GES		non-GES		
IMAP – traffic light approach	Good	Moderate	Bad		
NEAT tool	High	Good	Moderate	Poor	Bad
Boundary limits and NEAT scores	1<score ≤0.8	0.8<score ≤ 0.6	0.6<score ≤ 0.4	0.4<score ≤0.2	Score<0.2
Thresholds for CI22 Beach and CI23 Seafloor Litter	**1/2(TV)**	**TV**	**2(TV)**	**5(TV)**	
Thresholds for CI23 Sea surface Floating Microplastics	**1/2(TV)**	**TV**	**10(TV)**	**100(TV)**	

Table 22: Boundary/Threshold values introduced in the NEAT tool.

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/poor	**Threshold** Poor/Bad	**Upper Boundary Limit**
Beach Litter (items/100m)	0	65	130	260	650	2000
Seafloor Litter (items/km²)	0	67.5	135	270	675	2000
Floating Microplastics (items/m²)	0	0.000422	0.000845	0.00845	0.0845	1.076

827. A data matrix to be used for the NEAT software was prepared and given below in

828. Table *23*.

Table 23: Average values and standard error for beach litter (items/100 m) per SAU of the Adriatic subregion. (n: the number of records per SAU, i.e., station number x times visited)

Sub-division	Zone	SAU	Sub-SAU	Beach Litter (items/100m)	Seafloor Litter (items/km^2)	Sea surface Floating Microplastics (items/m^2)
North Adriatic (NAS)						
	NAS coastal					
		MAD-HR-MRU-3				
			HRO-O423-KVJ	99 ± 31 n=7		
		IT-NAS-C				
			Emilia Romagna	233 ± 21 n=40		0.330 ± 0.093 n=4
			Friuli Venezia Giulia	759 ± 167 n=40		0.042 ± 0.006 n=4
			Veneto	363 ± 61 n=38		0.270 ± 0.046 n=6
		MAD-Sl-MRU-11		436 ± 120 n=12	59 ± 3 n=2	0.1250 ± 0.023 n=24
	NAS Offshore					
		MAD-Sl-MRU-12			33 ± 7 n=10	0.123 ± 0.027 n=8
		MAD-HR-MRU-5			491 n=1	
		IT-NAS-O				0.144 ± 0.027 n=7
Central Adriatic (CAS)						
	CAS coastal					
		MAD-HR-MRU-2				
			HRO-0423-BSK	484 n=1		0.083 n=1
			HRO-0423-KOR	93 n=1	1103 n=1	0.085 n=1
		IT-CAS-C				
			Abruzzo	694± 92 n=40		0.122 ± 0.026 n=4
			Marche	1556 ± 908 n=37		0.151 ± 0.009 n=4
			Molise	150 ± 26 n=10		0.025 ± 0.015 n=3

Sub-division	Zone	SAU	Sub-SAU	Beach Litter (items/100m)	Seafloor Litter (items/km^2)	Floating Microplastics (items/m^2)
	CAS offshore					
		MAD-HR-MRU_4			654 ± 178 n=4	0.056 n=1
		IT-CAS-O				0.066 ± 0.014 n=10
South (SAS)	**Adriatic**					
	SAS coastal					
		IT-SAS-C	Puglia	305 ± 31 n=30		0.195 ± 0.026 n = 14
		MAD-HR-MRU-2				
			HRO-O423-MOP	852 ± 599 n=4		0.114 ± 0.047 n=2
			HRO-0313-NEK			0.028 n=1
		MNE-SAS-C				
			MNE-1-N	1129 ± 281 n=5		
			MNE-1-S	802 ± 293 n = 2		
			MNE-Kotor	968 ± 190 n=2		
		AL-SAS-C		757 ± 187 n=4		
		BiH-SAS-C		1240 ± 611 n=2		0.011 n=1
	SAS offshore					
		IT-SAS-O				0.391 ± 0.230 n=4
		MNE-SAS-O				
			MNE-12-N		118 ± 66 n = 2	
			MNE-12-C		22 n = 1	
			MNE-12-S		25 ± 1 n = 2	
		MAD-EL-MS-AD				0.168 n=6

<u>Results of the NEAT tool for the Assessment of the IMAP EO10/CI22/CI23 status in the Adriatic subregion</u>

829. The results obtained from the NEAT tool are shown in Table 24 and in Figure 43 to **Error! Reference source not found.**

830. On the individual parameter level the classification results of subSAUs regarding CI22-Beach Litter show that three subSAUs in Croatia are classified under 'Good' status (HRO-0423-KVJ, HRO-0423-KOR) and three under 'Moderate' (MAD-HRU-MRU-2, IT-Em-Ro-1, IT-Mo-1). All other subSAUs are classified under 'Poor' or 'Bad' status. For the case of CI-23 Seafloor Litter the subSAUs monitored in Slovenia and Montenegro (MAD-SI-MRU-12, MNE-12-C, MNE-12-S) are classified under'Good' status while all other subSAUs are classified under 'Poor' or 'Bad' status. . Finally, for CI23 Sea surface floating MPs all subSAUs monitored are classified as non-GEs and under 'Poor' and 'Bad' status classes.

831. Integration of data per each EO10 parameter on higher levels within the nesting scheme (bold lines in Table 7) shows that the NAS subdivision is classified under 'Good' status regarding Beach Litter, under 'Bad' regarding Seafloor Litter and Floating MPs. The CAS subdivision is classified as 'Poor' regarding Beach Litter and Sea surface Floating MPs and under 'Bad' regarding Seafloor Litter. Finally, the SAS subdivision is classified under 'Poor' status for Beach Litter, 'Good' status for Seafloor Litter and 'Bad' status for Sea surface Floating MPs.

832. When aggregating all EO10 parameters data per SubSAU, the SubSAUs HRO-0423-KVJ and MNE-12-C, MNE-12-S fall into 'Good' status class and the subSAUs IT-Mo-1, MAD-SI-MRU-12 into 'Moderate'. All other subSAUs are classified under 'poor' or 'bad' status classes.

833. Based on the data available the assessment results obtained by the NEAT methodology show that most areas of the Adriatic subregion do not achieve GES regarding EO10.

Table 24: Results of the NEAT tool on the assessment of IMAP EO10 in the Adriatic subregion (CI22_BL:Beach Litter; CI23_SFL:Seafloor Litter; CI23_MP:Floating Microplastics). The various levels of spatial integration within the nested scheme are shown in bold. Blank cells denote absence of data.

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence %	CI22_BL	CI23_SFL	CI23_MPs
Adriatic Sea	**139783**	0	0.234	poor	94.7	0.38	0.223	0.2
Northern Adriatic Sea	**31856**	0	**0.292**	**poor**	**100**	**0.632**	**0.173**	**0.189**
NAS-Coastal	**9069**	0	**0.569**	**moderate**	**67.8**	**0.632**	**0.489**	**0.194**
MAD-HR-MRU-3	6422	0	0.695	good	69	0.695		
HRO-0313-JVE	73	0						
HRO-0313-BAZ	4	0						
HRO-0412-PULP	7	0						
HRO-0412-ZOI	473	0						
HRO-0413-LIK	7	0						
HRO-0413-PAG	30	0						
HRO-0413-RAZ	10	0						
HRO-0422-KVV	494	0						
HRO-0422-SJI	1923	0						
HRO-0423-KVA	686	0						
HRO-0423-KVJ	1089	0.046	0.695	good	69	0.695		
HRO-0423-KVS	577	0						
HRO-0423-RILP	6	0						
HRO-0423-RIZ	475	0						
HRO-0423-VIK	455	0						
IT-NAS-C	2592	0	0.259	poor	100	0.324		0.194
IT-Em-Ro-1	371	0.003	0.296	poor	99.9	0.442		0.15
IT-Fr-Ve-Gi-1	575	0.004	0.248	poor	99.9	0.184		0.312
IT-Ve-1	1646	0.012	0.255	poor	100	0.347		0.163
MAD-Sl-MRU-11	55	0	0.336	poor	100	0.327	0.489	0.191
NAS-Offshore	**22788**	0	**0.183**	**bad**	**99.3**		**0.172**	**0.188**
MAD-HR-MRU-5	5571	0.056	0.167	bad	100		0.167	
IT-NAS-O	10540	0.106	0.188	bad	98.9			0.188
MAD-Sl-MRU-12	129	0.001	0.425	moderate	75.3		0.653	0.196
Central Adriatic	**63696**	0	**0.239**	**poor**	**100**	**0.273**	**0.141**	**0.253**
CAS-Coastal	**9394**	0	**0.299**	**poor**	**100**	**0.464**	**0.099**	**0.236**
MAD-HR-MRU-2	7302	0	0.315	poor	100	0.555	0.099	0.236
HRO-0313-NEK	253	0.005	0.349	poor	100			0.349
HRO-0313-KASP	44	0						
HRO-0313-KZ	34	0						
HRO-0313-MMZ	55	0						
HRO-0413-PZK	196	0						
HRO-0413-STLP	1	0						
HRO-0423-BSK	613	0.013	0.245	poor	100	0.285		0.204
HRO-0423-KOR	1564	0.034	0.338	poor	100	0.714	0.099	0.2
HRO-0423-MOP	2480	0						
IT-CAS-C	2092	0	0.242	poor	95.9	0.248		0.235
IT-Ab-1	282	0.005	0.193	bad	71.8	0.193		0.192

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence %	CI22_BL	CI23_SFL	CI23_MPs
IT-Ma-1	319	0.006	0.126	bad	85.1	0.066		0.187
IT-Mo-1	229	0.004	0.463	moderate	93.7	0.569		0.356
CAS-Offshore	**54303**	**0**	**0.229**	**poor**	**96.4**	**0.191**	**0.149**	**0.254**
MAD-HR-MRU-4	18963	0.178	0.205	poor	74.3	0.191	0.149	0.275
IT-CAS-O	22393	0.21	0.249	poor	91.6			0.249
Southern Adriatic Sea	**44231**	**0**	**0.185**	**bad**	**61**	**0.218**	**0.646**	**0.146**
SAS-Coastal	**7276**	**0**	**0.206**	**poor**	**58.1**	**0.218**		**0.189**
MAD-HR-MRU-2	4252	0	0.182	bad	55.3	0.17		0.194
HRO-0313-ZUC	13	0						
HRO-0423-MOP	1756	0.031	0.182	bad	55.3	0.17		0.194
IT-SAS-C (Ap-1)	1810	0.013	0.277	poor	100	0.377		0.178
MNE-SAS-1	483	0	0.181	bad	68.3	0.181		
MNE-1-N	86	0.002	0.129	bad	95.4	0.129		
MNE-1-C	246	0						
MNE-1-S	151	0						
MNE-Kotor	85	0.002	0.234	poor	69	0.234		
AL-SAS-C	646	0.005	0.184	bad	72.7	0.184		
BiH-SAS-C	12.9	0	0.113	bad	84.9	0.113		
SAS-Offshore	**36955**	**0**	**0.181**	**bad**	**69.6**		**0.646**	**0.142**
IT-SAS-O	22715	0.222	0.138	bad	90.2			0.138
MNE-SAS-O	2076	0	0.646	good	94.8		0.646	
MNE-12-N	513	0.005	0.326	poor	62.3		0.326	
MNE-12-C	713	0.007	0.768	good	100		0.768	
MNE-12-S	849	0.008	0.737	good	100		0.737	
AL-SAS-O	716	0						
MAD-EL-MS-AD	2253	0.022	0.183	bad	100			0.183

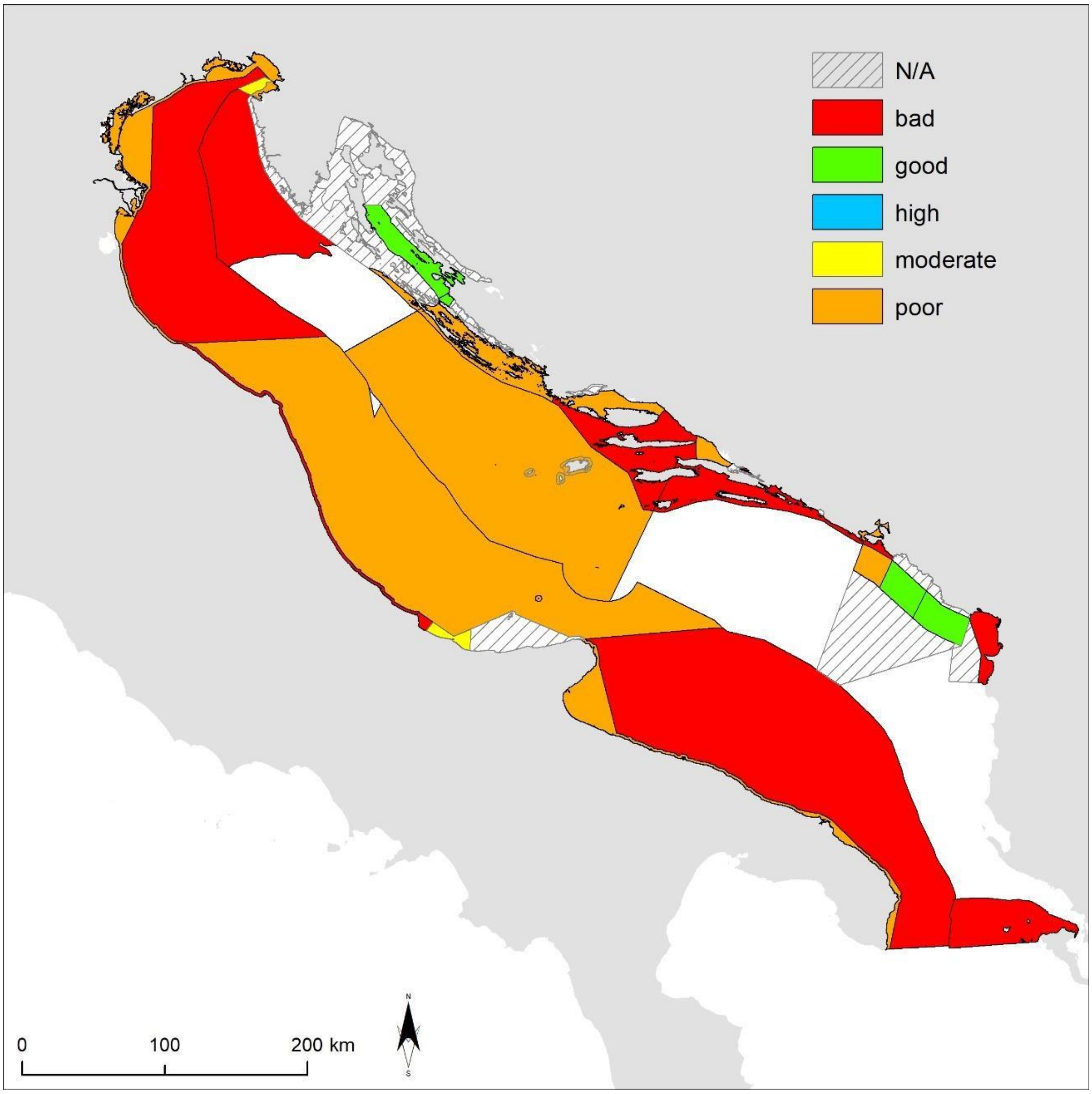


Figure 43: The aggregated-integrated assessment of EO10 in the Adriatic sub-Region following the NEAT assessment methodology.

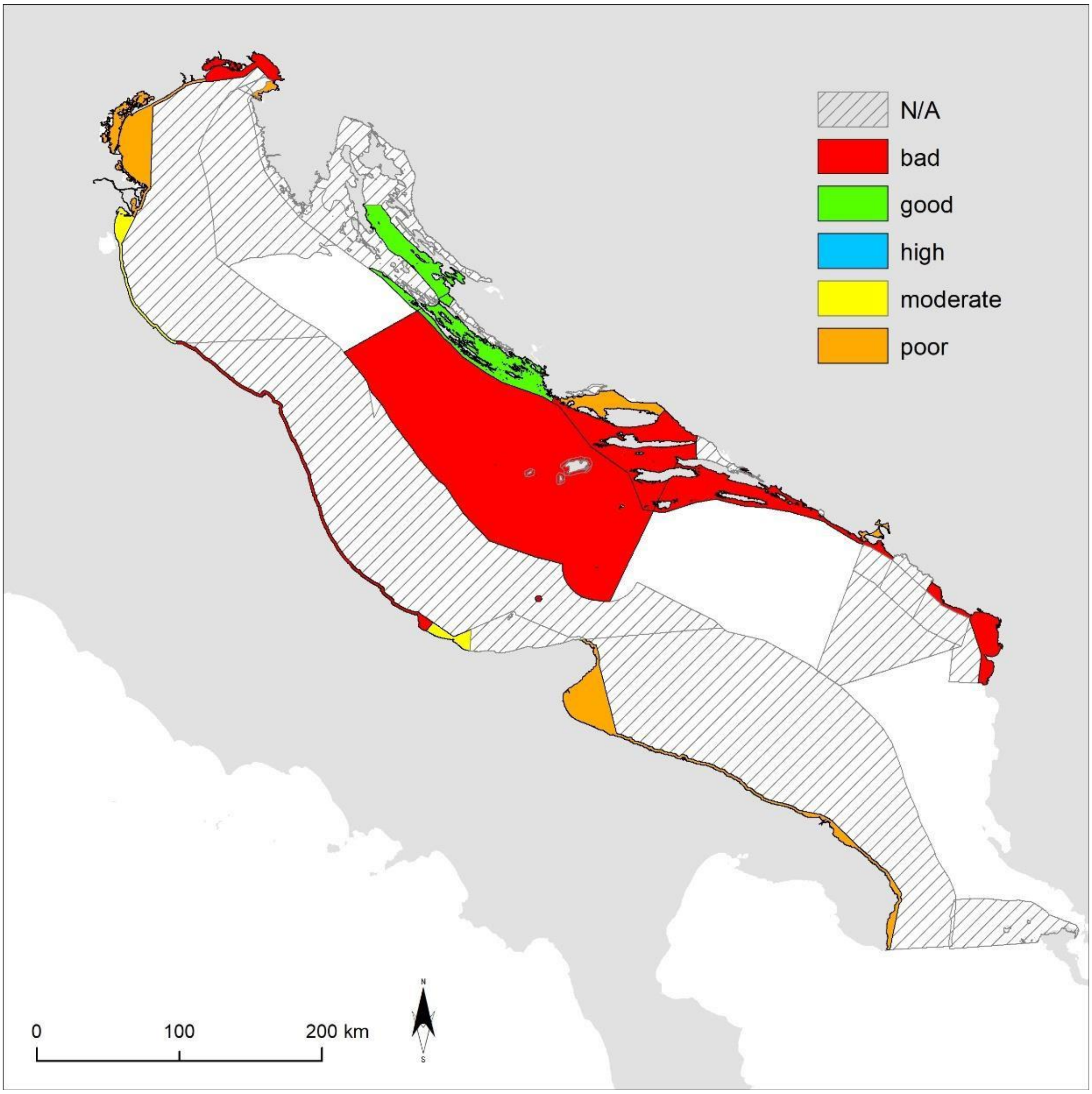


Figure 44: The assessment of CI22-Beach Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

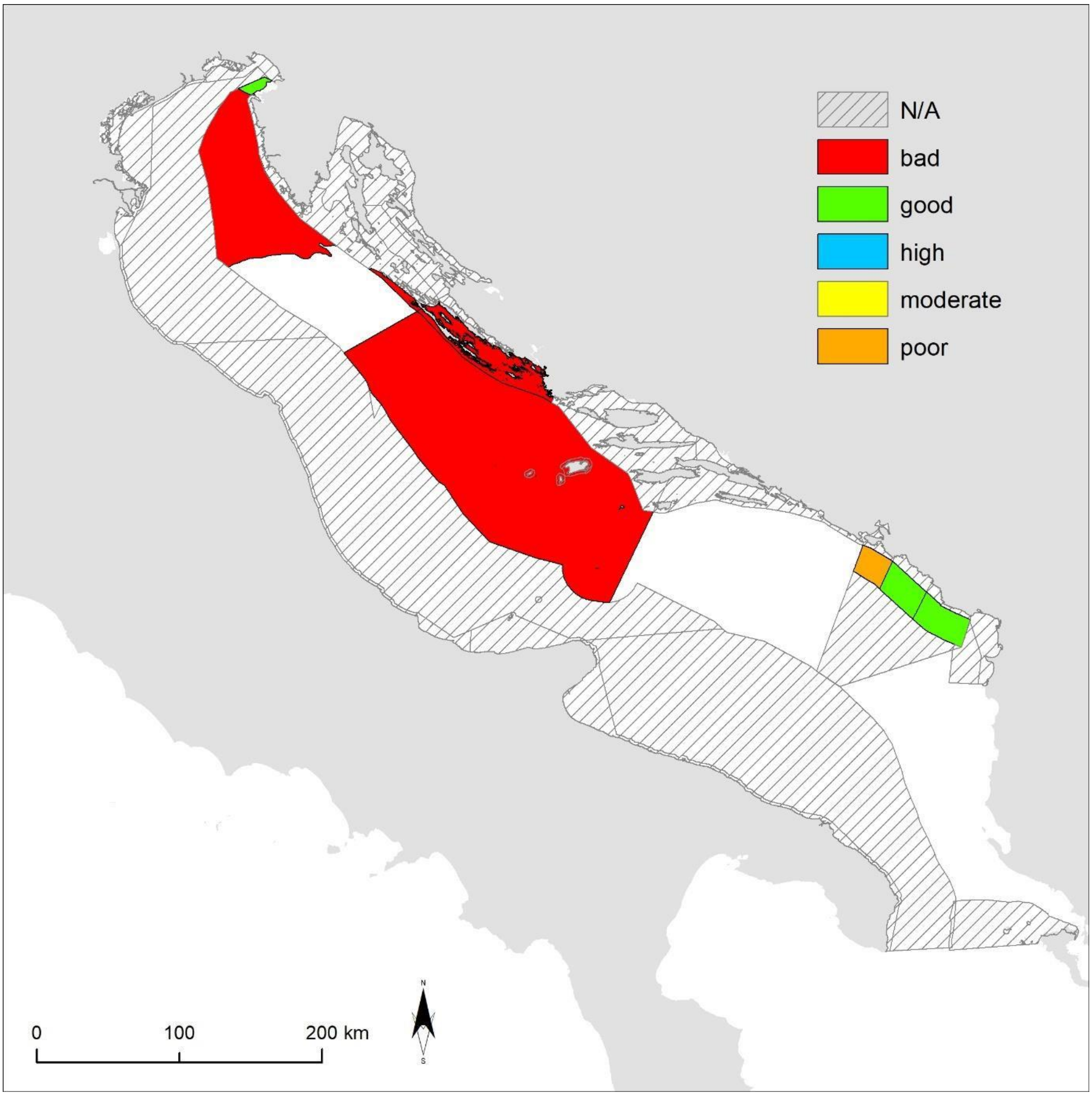


Figure 45: The assessment of CI22-Seafloor Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

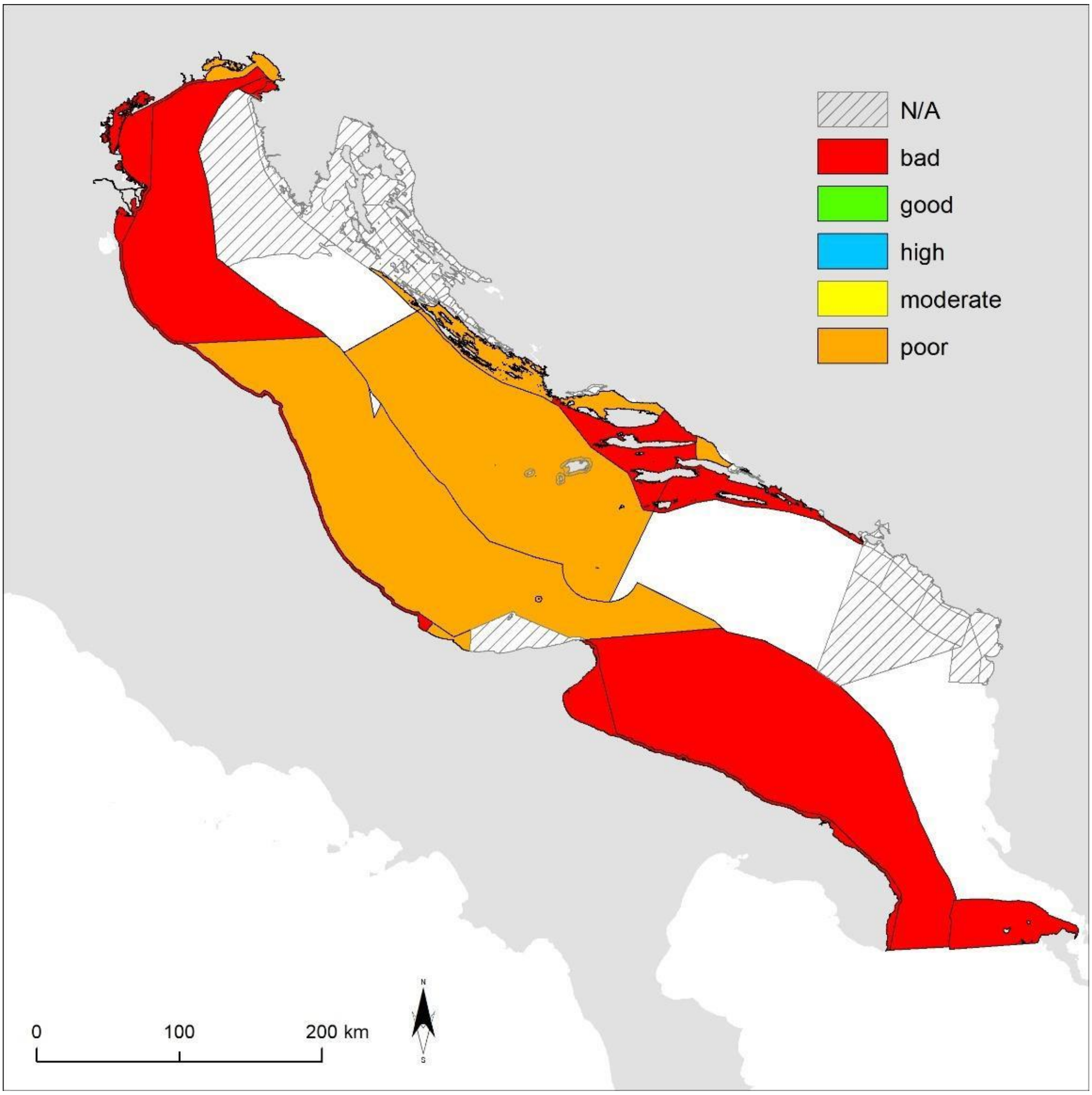


Figure 47: The assessment of CI23-Seasurface Floating MPs spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

Sensitivity analysis of the assessment results

834. Based on the standard deviation of beach litter per SAU the NEAT tool provides a sensitivity analysis for calculating the uncertainty of the assessment results using a Monte-Carlo simulation model for 1000 iterations. In

835. Table *25* the results of the error analysis are presented.

836. In other words, 1000 assessments are run using different random combinations of the data. Instead of using the average value of the parameters inserted by the user, other random values are used by the tool to run the assessment. The selection of these random values is done based on the standard deviation and it is repeated 1000 times. The resulting assessment value of each of these 1000 assessment runs is recorded and may lead to a different assessment classification. The number of times (out of 1000) of the appearance of these different assessments is given in

837. Table *25*. For example, the overall status for the SAU MAD-HRU-MRU-3 is reported as 'good'. However, from

838. Table *25*, it is understood that out of 1000 iterations, 690 lead to Good status, and 164 to Moderate and 146 to High Status. These results imply a rather high uncertainty (confidence 69%), in contrast to MAD-HRU-MRU-5 where all 1000 iterations led to High status (confidence 100%).

Table 25: Confidence assessment of all SAU/assessment class combinations as absolute counts falling into the specified classes (maximum possible count = 1000).

SAU	bad	poor	moderate	good	high	Confidence %
Adriatic Sea	4	947	49	0	0	94.7
Northern Adriatic Sea	0	1000	0	0	0	100
Southern Adriatic Sea	610	335	5	37	13	61
Central Adriatic	0	1000	0	0	0	100
NAS-C	0	0	678	322	0	67.8
NAS-O	993	7	0	0	0	99.3
SAS-C	325	581	93	1	0	58.1
SAS-O	696	248	6	0	50	69.6
CAS-C	0	1000	0	0	0	100
CAS-O	36	964	0	0	0	96.4
MAD-HR-MRU-3	0	0	164	690	146	69
IT-NAS-C	0	1000	0	0	0	100
MAD-Sl-MRU-11	0	1000	0	0	0	100
MAD-HR-MRU-5	1000	0	0	0	0	100
IT-NAS-O	989	11	0	0	0	98.9
MAD-Sl-MRU-12	0	247	753	0	0	75.3
MAD-HR-MRU-2	553	333	89	23	2	55.3
IT-SAS-1 (Ap-1)	0	1000	0	0	0	100
MNE-SAS-C	683	316	1	0	0	68.3
AL-SAS-C	727	271	2	0	0	72.7
BH-SAS-C	849	104	17	7	23	84.9
IT-SAS-O	902	42	6	0	50	90.2
MNE-SAS-O	0	0	0	948	52	94.8
MAD-EL-MS-AD						
MAD-HR-MRU-2	1000	0	0	0	0	100
IT-CAS-C	0	1000	0	0	0	100
MAD-HR-MRU-4	0	959	41	0	0	95.9
IT-CAS-O	257	743	0	0	0	74.3

SAU	bad	poor	moderate	good	high	Confidence %
HRO-0423-KVJ	84	916	0	0	0	91.6
IT-Em-Ro-1						
IT-Fr-Ve-Gi-1						
IT-Ve-1						
HRO-0423-MOP						
MNE-1-N						
MNE-1-S						
MNE-Kotor						
MNE-12-N						
MNE-12-C						
MNE-12-S						
HRO-0313-NEK	0	0	164	690	146	69
HRO-0423-BSK						
HRO-0423-KOR						
IT-Ab-1						
IT-Ma-1						
IT-Mo-1	0	999	1	0	0	99.9

839. As for any assessment results, the accuracy of the results described above, is dependent also on the amount of data available for each SAU. Many subSAUs totally lack data, so that the integrated results on the SAU level actually reflect the status of one or two subSAUs and cannot be considered indicative of the overall SAU status with confidence.

Comparison of the two assessment methodologies applied for the Adriatic sub-region

840. Given the assessed data availability for EO10 CI22 and CI23 for the Mediterranean Sea as described in Chapters 2.1 and 2.2 the following approach is followed for the quality status assessment. For each CI and each measured parameter (Beach litter, Seafloor Litter, Floating Microplastics) temporal data are averaged per monitoring station. The resulting average value is compared against the respective TV and the score ratio (CR) is calculated. No further aggregation on the EO 10 level or spatial integration is conducted for the Mediterranean region as a whole. For the Adriatic sub-division, for which spatial assessment units have been defined in 2022 for the Eutrophication-Pollution and Marine litter cluster, the application of the NEAT methodology was made possible for the 2 IMAP Common Indicators on marine litter (CI22 and CI23).

841. For the Adriatic sub-region a comparison was made between the two assessment approaches, i.e. the assessment results on the CI level based on the CHASE+ methodology (Chapters 4.2.1; 4.2.2.1; 4.2.2.3) and the results on the EO10 level using the NEAT methodology (Chapter 4.3.1), further to the recommendations for the harmonization of the two assessment.

842. The first assessment approach on the CI level (Chapters 4.2.1; 4.2.2.1; 4.2.2.3) provides assessment per individual stations, while the second one, using NEAT, provides assessments either on the EO10 or CI level spatially integrated (Chapter 4.3.1) along a predefined hierarchical nesting scheme of assessment areas. Therefore, the comparison of the results obtained from the two methods was made possible only on the first level of aggregation i.e. on the subSAUs, for each of the EO10 components separately (CI22-BeachLitter, CI23-Seafloor Litter, CI23-Seasurface MPs). The score ratios (CR) for each of the EO10 components as obtained from the first assessment approach, were grouped for all stations belonging to a specific subSAU and averaged to get one CR per subSAU per

EO10 component. Then the subSAU was classified following the rationale already described in Chapters 4.2.1; 4.2.2.1; 4.2.2.3 and shown here below in

843. Table *26* for both methods. All thresholds used were identical in the two methodologies (

844. Table *26*). The resulting classification is then compared to the respective NEAT value of the subSAU (Table 24). The two alternative assessment results per subSAU and per EO10 component are shown in Table 27.

Table 26: Assessment classification boundary limits/thresholds for a harmonized application of NEAT and simplified CHASE+ tools in the Adriatic Sea sub-region.

	GES		non-GEs		
IMAP – traffic light approach	Good	Moderate	Bad		
NEAT tool	High	Good	Moderate	Poor	Bad
	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤GES/nGES threshold	GES/nGES<meas. conc. ≤ moderate/poor threshold	moderate/poor threshold <meas. conc. ≤ max. conc.	
Boundary limits and NEAT scores	1 < score ≤0.8	0.8<score≤ 0.6	0.6<score ≤ 0.4	0.4< score ≤0.2	Score<0.2
Thresholds CI22; CI23_SFL	**½**	**T**	**2**	**TV 5**	
CI23_MPs	**½**	**T**	**10**	**TV 100 TV**	
CHASE+ tool	High	Good	Moderate	Poor	Bad
Thresholds CI22; CI23_SFL	**½**	**T**	**2**	**V 5**	**V**
CI23_MPs	**½**	**T**	**10**	**V 100**	
CHASE+ Scores	0 <CR ≤0.5	0.5<CR ≤ 1	1<CR ≤ 2	2< CR ≤5	CR > 5

Table 27: Comparison of the two assessment methodologies applied in the Adriatic sub-region for the status assessment of EO10 components. Discrepancies in assessment results marked in bold.

CI22_Beach Litter		
SAU	**Average subSAU score ratio (CR)**	**NEAT Score**
MAD-Sl-MRU-11	3.4	0.31
MAD-HR-MRU-4	**3.7**	**0.191**
HRO-0423-BSK	3.7	0.285
HRO-0423-KOR	0.7	0.714
HRO-0423-KVJ	0.7	0.695
HRO-0423-MOP	**4.2**	**0.17**
IT-Em-Ro-1	1.8	0.442
IT-Fr-Ve-Gi-1	8.5	0.184
IT-Ve-1	2.9	0.347
IT-Ab-1	5.3	0.193
IT-Ma-1	12.3	0.066
IT-Mo-1	1.2	0.569
IT-SAS-1 (Ap-1)	2.3	0.377
BH_SAS_1	9.5	0.113
MNE-1-N	5.7	0.129
MNE-1-S	6.2	0.129
MNE-Kotor	4.6	0.234
AL-SAS-1	5.8	0.184

CI23_Seafloor Litter		
SAU	**Average subSAU score ratio (CR)**	**NEAT Score**
MAD-Sl-MRU-11	1.57	0.489
MAD-Sl-MRU-12	**1.09**	**0.653**
MAD-HR-MRU-4	17.22	0.149
HRO-0423-KOR	8.17	0.099
MAD-HR-MRU-5	**3.64**	**0.167**
MNE-12-N	3.09	0.326
MNE-12-C	0.6	0.768
MNE-12-S	0.66	0.737

CI23_Sea surface MPs		
SAU	**Average subSAU score ratio (CR)**	**NEAT Score**
MAD-SI-MRU-11	148	0.191
MAD-SI-MRU-12	134	0.196
MAD-HR-MRU-4	66	0.275
HRO-0423-BSK	98	0.204
HRO-0423-KOR	**101**	**0.2**
HRO-0423-MOP	135	0.194
HRO-0313-NEK	33	0.349
IT-Em-Ro-1	390	0.15
IT-Fr-Ve-Gi-1	49	0.312
IT-Ve-1	319	0.163
IT-Ab-1	144	0.192
IT-Ma-1	**35**	**0.187**
IT-Mo-1	29	0.356
IT-SAS-1 (Ap-1)	231	0.178
IT-NAS-12	170	0.188
IT-CAS-12	78	0.249
IT-SAS-12	463	0.138
BH_SAS_1	13	0.393
MAD-EL-MS-AD	198	0.183

845. The comparison of the two methodologies (Table 27) shows that out of the 45 individual assessments per subSAU per EO10 component only 6 discrepancies were found, most of them between the 'poor' and 'bad' classes. The two methods agree on 87 % of cases, while the GES/nGES classification, with the exception of one SAU, is identical between methods and thus results can be considered comparable.

Key findings for IMAP EO10 Common Indicator 22:

a) The monitoring efforts around the region and between the sub-regions vary significantly and further alignment and strengthening of IMAP EO CI22 is required from the Mediterranean Countries.
b) Concentrations of beach marine litter are highly variable around the region ranging between 8 and 12,842 items/100m.
c) Overall, 16% of the monitored beaches achieve GES, 79% do not achieve GES of which 29 % fall into the poor status class and 25% in to the bad one. (i.e., beach litter concentrations are up to two to five times higher than the TV).
d) The Central Mediterranean appears the least affected by beach litter with 32% out for the 22 beaches monitored falling into the GES category.
e) The Adriatic, Eastern and Western Mediterranean sub-regions show equal distribution between GES and non-GES classes with only ~14-16 %% of the beaches monitored falling into the GES class, with the highest percentages of beaches (34 - 38%) being classified under the poor or bad classes.
f) For 11 countries, the top-10 item list represents more than 70% of the collected litter items (Bosnia and Herzegovina Lebanon, Slovenia, Croatia, Italy, France, Cyprus, Montenegro, Greece, Israel, and Türkiye), and for 2 Countries represents slightly lower share (approximately 68-69%) (Spain and Morocco).
g) At the level of the Mediterranean Plastic/polystyrene pieces (2.5 cm – 50 cm) are the most commonly found marine litter, followed by cigarette butts and filters , and plastic caps and lids. These 3 items account for more than 60% of the recorded marine litter.
h) The predominant source seems to be human activities on beaches, whereas the “beaching” process seems to play an important role, especially through the fragmentation process.

Key findings for IMAP EO10 Common Indicator 23:

A. Floating Marine Litter:

a) Monitoring efforts are evident in several parts of the Mediterranean, however monitoring efforts for IMAP EO10 CI23 floating microplastics should be further strengthened also in the Southern part of the Mediterranean.
b) Concentrations of Floating Microplastics (items/km^2) are highly variable fluctuating between 0 and 31 items /m^2.
c) Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.36 ± 1.9 items/m^2.
d) Almost all stations (99%) that have been monitored do not achieve GES, and most of them fall into the poor (44 %) and bad (49 %) classes (i.e., floating microplastics litter concentrations are up to 100 and 1000 times higher than the TV respectively).
e) The Mediterranean region and its subregions suffer from elevated microplastics concentrations in surface waters, reaching up to 100 times and 1000 times higher than the IMAP TV.
f) In the Eastern Mediterranean 44% of monitored stations exceed the bad class with concentrations more than 1000 times the TV and are classified as ‘very bad’.
g) In the Western Mediterranean only 2 % of stations are found above 1000xTV.
h) From the recorded floating microplastics, Sheets (39%) have been found to be predominant, followed by Filaments (29%), Pellets (21%), Fragments (5%), Foam (5%), and Granules (1%).
i) The ACCOBAMS Survey Initiative (ASI), was the first international basin-wide survey of the Mediterranean Sea for floating mega-litter (>30cm) following an opportunistic approach while the main interest was to provide estimations about the mega-fauna.
j) ACCOBAMS (ASI) has developed a well-elaborated monitoring protocol for monitoring mega-litter through aerial surveys.
k) Some 41,000 floating mega-litter items were recorded in total during the ASI, with an average encounter rate of 0.8 mega-litter per km, ranging between 0 and 111 litter per km.

l) The total number of floating mega-litter was estimated at 2.9 million items (80% confidence interval was 2.7 to 3.1 million) and average density 1.5±0.1 items per km^2.
m) More than two thirds of the mega-litter recorded were identified as plastics (68.5%; e.g., plastic bags, bottles, tarpaulins, palettes, inflatable beach toys, etc.), while 1.7% were fishery debris and 1.9% were anthropogenic wood-trash. The remaining quarter (27.9%) was anthropogenic mega-debris of an undetermined nature.
n) During the ASI, only 20% of the Mediterranean was free of floating mega-debris.
o) Many endangered or vulnerable species, some of them endemic to the area, are at risk of entanglement or of ingesting debris.

B. <u>Seafloor Marine litter:</u>

a) Concentrations of seafloor marine litter are highly variable fluctuating between 0 and 28,228 items /km^2.
b) The average seafloor litter concentration collected by seafloor trawling on the Mediterranean is found equal to 570± 2,588items/km^2.
c) The majority (88%) of the seafloor stations monitored do not achieve GES, and most of them fall into the poor and bas categories (23 % and 53 % respectively) (i.e., seafloor litter concentrations are up to five times higher than the TV).
d) The Western Mediterranean highly appears affected by seafloor marine litter since all stations monitored (100%) are classified in the nonGES category.
e) The Central Mediterranean is highly affected by seafloor litter with 81 % of stations monitored classified under nonGES classes.
f) In the Adriatic sub-region 65% of the stations monitored falling into the nonGES class with the highest percentage of seafloor stations to be classified under the moderate (35%) and poor (26 %) classes.
g) The Eastern Mediterranean subregion is also affected by seafloor litter, since 68 % of the monitored stations are classified under nonGES class, with more or less equal share among the 3 nonGES classes.
h) An uneven spatial distribution of stations within each sub-region is evident in the present study, for example the CEN is covered only by Malta and Tunisia.
i) Fisheries-related items comprise up to 10% of the total recorded marine litter.
j) 3 items are the most commonly recorded among fisheries related items : (i) Synthetic ropes/strapping bands (L1i) with 39%; Fishing nets (polymers) (L1f) with 27%; and Fishing lines (polymers) (L1g) with 25%.
k) Another set of 3 items are recorded in minor percentages: (i) Natural fishing ropes (L5c) with 6%; (ii) Other synthetic fishing related" (L1h) with 2%; and (iii) Fishing related (hooks, spears, etc.) (L3f) with 1%.
l) Interesting results have been obtained from limited scuba-dive surveys (972,500 ± 801,311 items/km^2) and IMAP should further provide additional support and guidance to further expand this monitoring component for marine litter (IMAP EO10).

Measures and actions required to achieve GES

846. The legally binding Regional Plan on Marine Litter Management in the Mediterranean was introduced in 2013 (Decision IG.21/7, COP18); entered into force in 2014; and updated in COP 22 (Antalya, Turkey, 7-10 December 2022; Decision IG.25/9) to further reflect global and regional agenda relevant to marine litter management.

847. The Updated Regional Plan on Marine Litter Management includes stronger links to global agenda, i.e. the United Nations Environmental Assembly (UNEA) Resolutions on marine plastic litter, microplastics and single-use plastic products pollution; UNEP marine litter partnerships and initiatives like the Global Partnership on Marine Litter (GPML) and the Clean Seas Campaign; the IMO Action Plan to Address Marine Plastic Litter from Ships; the Basel Convention - Plastic Waste Partnership (PWP); as well as the EU Policies on Marine Litter and Plastic.

848. The Updated Regional Plan on Marine Litter Management:

a. Introduces a number of new, region-wide agreed definitions on marine litter (e.g., ALDFG, BAT-BEP, Circular Economy, EPR, Fishing Gear, Lightweight plastic carrier bags, monitoring, micro-litter/plastics, primary/secondary microplastics, SUPs etc.);
b. Expands the scope of measures in four key areas: (i) economic instruments, (ii) circular economy of plastics, (iii) land-based and (iv) sea-based sources of marine litter;
c. Introduces ambitious, amended targets for plastic waste and microplastics; and
d. Introduces two new appendices with lists on (i) single-use-plastic items, and (ii) chemical additives of concern used in plastic production further to the Stockholm Convention.

849. The Regional Plan also incorporates a number of additional, important principles and measures, including:

- Phasing out single-use plastic items and promote reuse options;
- Setting targets for plastic recycling and other waste items;
- Introducing economic instruments such as environmental taxes, bans and design requirements, and Extended Producer Responsibility (EPR) schemes (land and sea-based sources);
- Promoting new technologies and measures for the removal of marine litter;
- Applying prevention measures to achieve a circular economy for plastics addressing the whole life cycle of plastics;
- Reducing packaging;
- Promoting voluntary agreements with industry;
- Integrating the informal sector into regulated waste collection and recycling schemes;
- Strengthening measures related to Sustainable Consumption and Production (SCP) programmes;
- Phasing-out chemical additives used in plastic products, in particular those under Stockholm Convention;
- Introducing concrete measures on microplastics reduction;
- Implementing measures to prevent and reduce marine litter in Marine Protected Areas (MPAs);
- Minimizing the input of marine litter associated with fisheries and aquaculture;
- Establishing national marine litter monitoring programmes as part of IMAP EO10, including on riverine inputs and wastewater treatment plants (WWTP);
- Enhancing public awareness and education; and
- Introducing measures to Specially Protected Areas of Mediterranean Importance in the (SPAMIs) to combat marine litter.

850. Monitoring and assessment should be further linked and connected with the implementation of measures. Specific and well-elaborated findings can provide the basis for the implementation of targeted measures.

851. The presence of marine litter in the Mediterranean is variable, however tackling few items may yield promising and encouraging results pertinent to the health status of the marine and coastal environment.

852. Based on the assessment findings for both IMAP CI22 and CI23, most of the stations are under nonGES status and urgent action is required.

853. Cigarette butts and filters are predominant in the Mediterranean beaches and primarily require a behavioral change along with the implementation of strong anti-smoking policies and measures, including a strengthen communication campaign linking the damage in human health with the damage in the marine environment. Cigarette filters do not contain only plastic, but also a cocktail of toxic substances (e.g., arsenic, lead, nicotine and pesticides, etc.) for which their effects in the marine biota and the marine environment still are unknown. The engagement of the cigarette companies in this process is of great importance, including their potential inclusion in a "polluters-pay" principle.

854. The vast presence of plastic bottles is documented by the third main item on the Mediterranean beaches, comprising of plastic caps and lids. The introduction of sound alternatives and incentivizing the use of re-use caps could be among the possible options. Strengthening recycling and Extended Producer Responsibility schemes, targeted and tailored to tackle plastic bottles are also part of the solution, including the minimization of the small-sized bottles (<0.5 liters) which are easier to escape in the marine and coastal environment.

855. Microplastics of various types and shapes are escaping into the marine and coastal environment through wastewater treatment plants (WWTP). At the Mediterranean level, the Contracting Parties to the Barcelona Convention in their 22nd COP (Antalya, Turkey, 7-10 December 2021) adopted Decision IG.25/8 related to the Regional Plans on Urban Wastewater Treatment and Sewage Sludge Management in the framework of Article 15 of the Land-based Sources Protocols. Among several measures to ensure their sustainable and safe use and discharge of wastewaters, the regional plan on wastewater treatment addresses for the first time in its scope microplastics. The updated Regional Plan calls for the introduction of emission limit values for emerging pollutants considering the identification of potential microplastic sources and adoption of related policy and methodology further to state of the art on related research on this topic.

856. The Regional Plan on Sewage Sludge Management gives particular attention to the presence and effective management of microplastics on Pharmaceuticals and Personal Care Products (PPCP) (e.g., lotions, soaps, facial and body scrubs and toothpaste) being present in sewage sludge and proposes methods for reduction at the source as provided hereunder:

a) Regulatory approvals for new products potentially harmful to the environment to be introduced for most/all of personal care materials or detergents. However, the said measure may be difficult to be applied for medication products.
b) Education on the correct use of substances containing drugs, and especially the use of the right dose without excess, including ecolabels to raise awareness of ecological impacts of PPCPs.
c) Encouraging the return of unused or expired pharmaceuticals to specific collection points; and
d) Subjecting wastewater originating from pharmaceutical industries, hospitals or healthcare centres to regulations that limit the concentration of organic pollutants in their effluents.

857. Wastewater treatment plants (secondary + tertiary levels of treatment with adequate sludge management) to efficiently remove microplastics from sewage, trapping the particles in the sludge and preventing of entrance into aquatic environments. Treatment plants are essentially taking the microplastics out of the wastewater and concentrating them in the sludge (Corradini et al., 2019).

Therefore, sludge management is of great importance for microplastic removal. Controls should be exercised however on the subsequent use of sludge.

858. Measures that can contribute toward reducing sewage concentrations of microplastics include:

a) Bans on single-use plastics and microplastics in personal care and cosmetic products;
b) Behavior changes and campaigns to reduce the use of such products;
c) Certain textile designs can reduce microfibre generation during washing;
d) Development of household-based systems to prevent microplastics from being released into sewer lines or directly into the environment; and
e) Incineration of sewage sludge to avoid soil and water contamination by microplastics. Care should be exercised however to monitor and regulate pollutants in air emissions with a view to minimise these emissions as much as possible.

859. As rivers in most of the cases is the final repository of litter coming from the various land-based sources the application of measures on land are very relevant for the control and effective management of litter in riverine systems.

860. A Conceptual flow of plastic from production to consumption, waste management and leakage into the environment (i.e., land, rivers and ocean), including possible points of action for policies should be considered. Minimizing leakage on land will subsequently minimize the riverine inputs deriving from wind and rain transportation, as well as from direct dumping and sewerage, and will further reduce the amount of plastics (incl. microplastics) entering the ocean.

861. The updated Regional Plan on Marine Litter Management in the Mediterranean:

a) Takes into consideration the occurrence and extent of marine litter accumulations, and calls for identification and assessment by the year 2025, on the impacts of these accumulations in upstream regions of rivers and their tributaries, and to apply measures to prevent or reduce their leakage into the Mediterranean, particularly during flood seasons and other extreme weather events;
b) Envisages the application of enforcement measures to prevent, reduce and sanction illegal dumping and illegal littering in accordance with national and regional legislation, in particular on coastal zones and rivers, in the areas of application of the Regional Plan; and
c) Couples the aforementioned provisions with aspects related to monitoring of marine litter originating from riverine inputs.

862. Storm water is an important contributor of riverine inputs of marine litter especially for the Mediterranean where seasonal, on several occasions extreme, weather events take place such as flash floods. And with the impacts of climate change, this aspect is becoming more significant as the Mediterranean is experiencing rainfalls, more intense and in shorter periods of time, the impact of which is less infiltration into the ground and more surface run-off.

863. A more systematic approach should be also offered when developing urban storm water management plans. Those plans typically address how urban storm water quantity and quality should be managed to protect ecological, social/cultural, and economic values. Urban storm water management plans are used to assist decision making to ensure that remedial measures (structural and non-structural) in existing developed areas are undertaken in a cost-effective, integrated and coordinated manner, and that decisions in relation to areas of new expansion (including redevelopment) are made with the implications for storm water impacts taken into account in order to achieve the quality goals for water bodies.

864. Urban storm water management (USWM) plans have been developed to a various extent across the Mediterranean. This ranges from major cities having USWM Plans to smaller municipalities where such plans are non-existent, or at best are under preparation. USWM Plans in the Mediterranean mostly include only flooding control segments, i.e., no pollution control, while segments on risk management and information on location of land-based activities are covered only on a basic level. In some cases, some elements of the USWM plans are incorporated into Urban Plans but only to a limited extent, such as collection systems layout, principles and recommended techniques regarding flood and pollution control management, as well as principles on how to achieve environmental water quality goals for water bodies.

865. The Establishment of separate collection systems for surface water run-off should be also promoted. A separate storm water sewer system is a collection of structures, including retention basins, ditches, roadside inlets and underground pipes, designed to gather storm water from built-up areas and discharge it, with or without treatment, into local water bodies, e.g., streams, rivers, coastal waters (National Research Council. 2009). Separate collection prevents the overflow of sewer systems and treatment stations during rainy periods and the mixing of the relatively little polluted surface run-off with chemical and microbial pollutants from municipal wastewater. Separate storm water systems allow for design of sewers and treatment plants that consider the volume of the wastewater only, while surface run-off and rainwater can be reused after a simplified treatment (e.g., for landscaping or agriculture).

866. Measures for combined collection systems are of great importance. Combined collection systems are sewer networks designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a wastewater treatment plant (WWTP) where it is treated and then discharged to a water body (National Research Council, 2009). During periods of heavy rainfall, however, the wastewater volume in a combined collection system can exceed the capacity of the sewer system or the treatment facilities, for which reason the combined collection systems are designed to overflow occasionally and discharge excess wastewater directly into nearby streams, flood drainage canals rivers, lakes or coastal waters.

867. A variety of additional measures could be also proposed with the aim of reducing the occurrence and impacts of storm water overflows and associated floods and pollution (Milieu, 2016), including the following:

a) End-of-pipe solutions such as building water storage capacity to optimising the use of the wastewater treatment plant and sewer system (e.g., using sewer networks for additional storage and optimising pumping operations);
b) Reduction of clean storm water entering a sewer system (e.g., de-connecting impervious areas from combined sewer systems);
c) Alternative green infrastructures as potentially cost-effective measures to reduce storm water (e.g., retention basins, infiltration trenches).

868. In addition, it would be valuable to close the knowledge gaps by gathering comparable information across the Mediterranean on the extent of storm water overflows from combined collection systems, which should include inventory of the locations of overflow structures, inventory of functioning of the overflow structures, inventory of sewage storage capacity structures (e.g. starting with agglomerations of more than 100,000 p.e.), with the aim of acquiring better understanding of the occurrence of storm water overflows and their impacts on the quality of receiving water bodies.

869. Promoting Sustainable Urban Drainage Systems (SUDS) is another measure which aims to minimize the impervious cover by promoting infiltration, ponding, and harvesting of storm water runoff. Furthermore, in this decentralized management approach, storm water runoff and pollution are primarily controlled by measures located near the source to strive towards well-integrated measures that perform multiple functions, including flood protection, pollution removal and groundwater recharge, as well as recreation, biodiversity and urban aesthetics.

870. The Fisheries sector, including both fishing and aquaculture activities have a contribution on marine litter generation.

871. In the past years, considerable attention has been brought to the scale of abandoned, lost and discarded fishing gear (ALDFG), the impacts on the marine environment through ghost fishing, and possible measures for reducing its occurrence like the FAO Voluntary Guidelines on the Marking of Fishing Gear. Given that aquaculture now supplies over half the seafood produced worldwide, it is considered of great importance that this issue is also examined at farm level, especially given the continued expansion of global aquaculture development (Huntington, 2019).

872. Measures targeting specifically on aquaculture farming should focus on overall recommendations and to propose measures scoping to reduce marine litter from aquaculture, block the relevant pathways to the marine environment and reduce the contribution to marine plastic pollution by aquaculture. Moreover, a second level of measures should be introduced touching upon the specific requirements and standards to be applied on a mandatory basis for aquaculture practices.

873. Measures that can contribute to reduced generation of marine litter from aquaculture include the following:

a) Replace to the extent possible plastic infrastructure components with other of physical nature.
b) Use higher density plastics (e.g., Polyethylene terephthalate (PET) or Ultra-high molecular weight polyethylene (UHMWPE)) which are more resistant to fragmentation, UV-irradiation.
c) Reduce single-use plastic with the introduction of relevant alternatives and invest in developing recovery, cleaning and re-distribution schemes.
d) Minimize the use of plastic types with low levels of recyclability.
e) Reduce to the extent possible the use of equipment consisting of different types of plastic (i.e., different lifespan and different approach for collection and recycling).
f) Ensure to the extent possible that all packaging is reusable or recyclable.
g) Reduce to the extent possible packaging and over-packaging to minimize packaging waste.
h) Develop awareness raising trainings for aquaculture staff similar to those offered from the shipping sector (e.g., HELMEPA).
i) Reduce to the extent possible the use of single-use plastics and establish relevant policies;
j) Minimize the use of plastic types with low levels of recyclability;
k) Reduce to the extent possible the use of equipment consisting of different types of plastic (i.e., different lifespan and different approach for collection and recycling).

874. Moreover, aquaculture should ideally apply a circular approach planning considering the whole life cycle of the used equipment. High procurement standards should be introduced, especially when dealing with purchasing of equipment, packaging, polystyrene boxes and other types of consumables and equipment.

875. With regards to plastic pollution, the updated Regional Plan on Marine Litter Management calls for:

a) Innovative business practices to prevent plastic waste generation in line with the Extended Producer Responsibility approach through the establishment of Deposit/Refund System for expandable polystyrene boxes in the commercial and recreational fishing and aquaculture sectors; and
b) Prevention measures aiming to achieve, to the extent possible, a circular economy for plastics (Regulate the use of primary microplastics, Implement Sustainable Procurement Policies, Establish voluntary agreements, Establish procedures and manufacturing methodologies, Identify single-use plastic products, Set targets to phase out production and use, increase the reuse and recycling, Phase-out chemical additives used in plastic products, Promote the use of recycled plastics, substitute plastics, Implement standards for product labelling, Establish

dedicated collection and recycling schemes, minimize the amount of marine litter associated with fishing/aquaculture, Scale-up and replicate sustainable models).

876. During the 21st Meeting of the Contracting Parties to the Barcelona Convention, Decision IG.24/14 was adopted. It provides a clear mandate for the development/update of technical guidelines addressing estimation techniques for pollutant releases from agriculture, catchments runoff and aquaculture in the Mediterranean. The proposed techniques and guidelines constitute effective tools that would enable the generation of compatible data to evaluate the effectiveness of adopted measures in the National Action Plans (NAPs) and in the Regional Plan for Aquaculture Management in the Mediterranean.

877. Shipping is particularly evident in the Mediterranean, thus contribution proportionally to waste and marine litter generation. Although most of the marine litter in the Mediterranean region originates from land-based sources, studies confirmed that ship-originated litter are found at sites under major shipping routes and lost fishing gear are also recognized as an important source of marine litter in the region (UNEP/MAP 2015).

878. While the international maritime organization IMO adopted in 1973 the International Convention for the Prevention of Pollution from Ships (MARPOL) which is the main international convention covering the prevention of pollution of the marine environment by ships from operational and accidental causes. The MARPOL convention under its Annex IV Prevention of pollution by sewage from ships present requirement to control the pollution of sewage into the sea.

879. MARPOL Annex V seeks to eliminate and reduce the amount of garbage being discharged into the sea from ships, which means all ships operating in the marine environment, from merchant ships to fixed or floating platforms to non-commercial ships like pleasure crafts and yachts must follow the same regulation.

880. The IMO’s Marine Environment Protection Committee (MEPC) recently adopted its strategy to address marine plastic litter from ships with substantial actions to reduce marine plastic litter from, fishing vessels; shipping, and improve the effectiveness of port reception and facilities and treatment in reducing marine plastic litter. The strategy also aims to achieve further outcomes, including enhanced public awareness, education and seafarer training; improved understanding of the contribution of ships to marine plastic litter; improve the understanding of the regulatory framework associated with marine plastic litter from ships; strengthened international cooperation; targeted technical cooperation and capacity-building.

881. Under the Mediterranean Strategy for the Prevention of, Preparedness, and Response to Marine Pollution from Ships (2022-2031) in its common strategy also addresses the prevention and reduction of litter, in particular plastics entering the marine environment from ships thought the fully implementation of the IMO Action Plan and the UNEP/MAP updated Regional Plan on Marine Litter Management in the Mediterranean.

882. Through the updated Regional Plan on Marine Litter Management in the Mediterranean, the Contracting Parties of the Barcelona Convention have set measures and a timetable to be implemented in relation to sea-based sources of marine litter, especially related to the establishment of best practices to create incentives for fishing vessels to retrieve derelict fishing gear, collect other items of marine litter, and deliver it to port reception facilities. It also presents incentives to the delivering of waste in port reception facilities such as the non-special fee system.

883. Under the Prevention and Emergency Protocol of the Barcelona Convention in its article 14 relevant to the provision of adequate Port Reception Facilities, the Contracting Parties to the Barcelona Convention are invited to explore ways to charge reasonable costs for the use of Port facilities.

884. When facing plastic pollution at large, the following measures or aspects can be also considered:

a) Introducing a number of prevention elements/measures at regional, sub-regional and national levels, having a focus to minimize the production, use and consumption of plastics (especially of single-use plastics), as well as to minimize their leakage into the marine and coastal environment (so, before the introduction of effect/impact);
b) Revising of the current legal framework of the Mediterranean Countries at the National level (e.g., updated/new National Action Plans and/or Programmes of Measures) and development of data base on the production and consumption of plastic products at the national level;
c) Development of compulsory, legally binging EPR systems for priority products (e.g., food and beverage packaging);
d) Progressive minimum recycled content in priority products;
e) Reduction targets in production and consumption of virgin plastic feedstock;
f) Promote behavioral change for achieving sustainable consumption patterns and increase rates of separation, collection, and recycling;
g) Develop mandatory requirements with the industry with a focus on specific, priority single-use plastic items (e.g., information on the composition of plastics on the market and even standards to ease the recycling of certain single-use plastic products);
h) Strengthen the acceptance criteria of the plastics for admission to the organized landfill, facilitating the recycling, reducing plastic disposal at organized landfills, and solicitating and promoting the separation, and recycling at sub-national level (i.e., municipalities, cities, or agglomerations);
i) Minimize the introduction of incentivized interventions, and rather focus on structural changes at governance/national administration, industry, and society levels.