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Agenda Item 4: 2023 Mediterranean Quality Status Report (QSR): Marine Litter Ecological Objective (EO10)

2023 Mediterranean Quality Status Report (QSR): Marine Litter Ecological Objective (EO10)

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Note by the Secretariat

In line with the Programme of Work and Budget for 2018-2019 adopted by the 20nd Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 20) held in Tirana, Albania; the Programme of Work and Budget for 2020-2021 adopted by the 21st Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 21) held in Naples, Italy; the Programme of Work and Budget for 2022–2023 adopted by the 22nd Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 22) held in Antalya, Türkiye, MED POL Programme prepared a Proposal of the 2023 MED QSR Pollution Chapters which is based on thematic assessments provided for IMAP Ecological Objective 10 (EO10) and its Common Indicators 22 (CI22) and 23 (CI23).

Further to Decision IG.23/6 of COP 20 related to the 2017 Mediterranean Quality Status Report (MED QSR), and Decision IG.24/4 of COP21 providing the 2023 MED QSR Roadmap implementation (Naples, Italy, December 2019), UNEP/MAP – MED POL implemented activities to address key priority needs towards a DPSIR-based GES assessment of the 2023 MED QSR. This resulted in the preparation of the present Proposal of the 2023 MED QSR Marine Litter Chapters by building on the following key achievements within the implementation of the 2023 MED QSR Roadmap:

a) Developing and establishing assessment criteria (i.e., updated Baseline Values (BV) and Threshold Values(TV)) for IMAP Common Indicators 22 (CI22) and 23 (CI23).
b) Setting the integration and aggregation rules for monitoring and assessment including: (i) the methodology for proposing the spatial scales of assessment from the scales of monitoring as defined in national IMAP Pollution and Marine Litter Cluster monitoring programmes, as well as by also considering the areas of assessment as defined in national MSFD monitoring strategies by the Contracting Parties which are EU Member States; (ii) the rules for integration of monitoring and assessment areas within the IMAP Pollution and Marine Litter Cluster (EO5, EO9, EO10); (iii) the rules for aggregation – integration of assessments for specific IMAP Common Indicators/Ecological Objectives towards integrated GES assessment for IMAP Pollution and Marine Litter Cluster.
c) Development, testing and implementation of the following GES and alternative environmental assessment methodologies by applying the above defined integration and aggregation rules along with the sales of assessment, the assessment criteria and the DPSIR approach within the IMAP nested scheme: (i) the CHASE+ assessment methodology for IMAP EO10 CI22 and CI23; and (ii) the NEAT IMAP GES assessment methodology for the case of the Adriatic for IMAP EO10 CI22 and CI23.

The proposed chapters on marine litter for the 2023 MED QSR have been based and developed explicitly on data officially uploaded by the Contracting Parties to the Barcelona Convention through IMAP InfoSystem. Despite the significant achievement for having numerous countries uploading data, still efforts are to be strengthened to: (i) increase the number of Contracting Parties submitting data for IMAP EO10 CI22 and 23; (ii) support a timelier and quality-controlled process.

The proposed assessment has been undertaken at the level of the Mediterranean region and its four (4) sub-regions, for IMAP EO10 CI22 and 23 and in particular: (i) beach macro-litter; (ii) floating microplastics, and (iii) seafloor macro-litter.

The preparation of the present Proposal of the 2023 MED QSR Pollution Chapters was undertaken successively further to the conclusions and recommendations of the Meetings of CORMON on Marine Litter Monitoring held on 30 March 2021 and 31 May 2022, as well as the Integrated CORMON held on 1-3 December 2020

While for IMAP EO10 CI22 the updated BV and the TV were officially endorsed by the Contracting Parties to the Barcelona through Decision IG.25/9 of COP22 (Antalya, Türkiye), the respective values (BV and TV) for IMAP EO10 CI23 are submitted in parallel to the present CORMON Meeting on Marine Litter Monitoring. The respective values have been used to prepare and elaborated GES/nonGES assessment for IMAP EO10 CI22 and CI23.

The present Proposal of the 2023 MED QSR Marine Litter Cluster Chapter is submitted for the review and approval of the present Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring with a view of further processing and submitting the chapter to the upcoming Meeting of Integrated CORMONs foreseen in June 2023

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List of Abbreviations / Acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
ALDFG	Abandoned, Lost and Discarded Fishing Gear
ASI	ACCOBAMS Survey Initiative
BAT	Best Available Technique
BEP	Best Environmental Practices
BV	Baseline Values
CHASE	Chemical Status Assessment Tool
CI	Common Indicator
COP	Conference of the Parties
CORMON	Ecosystem Approach Correspondence Group on Monitoring
CP	Contracting Party
DPSIR	Driver, pressure, state, impact, response
DS	Data Standard
EcAp MED III	EU-Funded Project "Mediterranean Implementation of the Ecosystem Approach, in Coherence with the EU MSFD"
EO	Ecological Objective
EPR	Extended Producer Responsibility
FAO	Food and Agriculture Organization of the United Nations
FML	Floating Marine Litter
GES	Good Environmental Status
GFCM	General Fisheries Commission for the Mediterranean
GPML	Global Partnership on Marine Litter
GPS	Global Position System
GRID	Green, Resilient, Inclusive Development
ICZM	Integrated Coastal Zone Management
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
IMO	International Maritime Organization
MAP	Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MED QSR	Mediterranean Quality Status Report
MEPC	Marine Environment Protection Committee
MPA	Marine Protected Areas
MPAs	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
MTS	Mid-Term Strategy
NAPs	National Action Plans
NEAT	Nested Environmental Status Assessment Tool
nonGES	Not Achieving Good Environmental Status
PET	Polyethylene terephthalate
PPCP	Pharmaceuticals and Personal Care Products
PWP	Plastic Waste Partnership (Basel Convention)
SAU	Special Assessment Unit
SCP	Sustainable Consumption and Production
SOPs	Standard Operations and Procedures
SPAMIs	Specially Protected Areas of Mediterranean Importance
SUDS	Sustainable Urban Drainage Systems
SUPs	Single-Use Plastics
TV	Threshold Value

List of Abbreviations / Acronyms (continued)

UHMWPE	Ultra-high Molecular Weight Polyethylene
UNEA	United Nations Environmental Assembly
UNEP	United Nations Environmental Program
USWM	Urban Storm Water Management
WWTP	Wastewater Treatment Plants

1. Key messages

1. Key messages for IMAP EO10 Common Indicator 22 are lister hereunder:

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
b) Overall, 29% of the monitored beaches achieve GES, 71% do not achieve GES, and 41 % fall into the moderate category
c) Cigarette butts and filters are the most commonly found marine litter items in the Mediterranean, followed by Plastic/polystyrene pieces 2.5 cm, and plastic caps and lids. These 3 times seem to account for approximately 50% of the recorded marine litter.

2. Key messages for IMAP EO10 Common Indicator 23 are lister hereunder:

A. Floating Marine Litter:

a) Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.42 ± 2.1 items/km2.
b) Almost all stations (99%) that have been monitored do not achieve GES, and most of them fall into the poor (52 %) and bad (31 %) 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 (39%) have been found predominant, followed by Filaments (29%), Pellets (21%), Fragments (5%), Foam (5%), and Granules (1%).
e) Some 41 000 floating mega-debris 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 debris per km.
f) More than two thirds of the mega-debris 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.

B. Seafloor Marine litter:

a) The average seafloor litter concentration on the Mediterranean coastline is found equal to 176 ± 179 items/km2.
b) The majority (92%) of the seafloor stations monitored do not achieve GES, and most of them (63%) fall into the bad category.
c) Fisheries-related items comprise in up to 10% of the total recorded marine litter.
d) 3 items are the most commonly recorded seafloor marine litter items: (i) Synthetic ropes/strapping bands (L1i) with 39%; Fishing nets (polymers) (L1f) with 27%; and Fishing lines (polymers) (L1g) with 25%.

2. Background information and methodology

3. In the context of implementing the Ecosystem Approach Roadmap adopted by the Contracting Parties to the Barcelona Convention and its Protocols in 2008 (Decision IG.17/6), UNEP/MAP delivered in 2017 the first ever Quality Status Report for the Mediterranean (2017 MED QSR). The 2017 MED QSR was a region-wide assessment product, endorsed by COP 20 Decision IG.23/6, was fully based on the structure of the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast (IMAP) and its respective Ecological Objectives (EO) and Common Indicators (CIs).

4. The report built upon existing data, complemented with inputs from numerous diverse sources and was prepared following a multi-step comprehensive review process, involving all relevant MAP Components, Contracting Parties and key partners. The latter also applied for the marine litter chapters (IMAP EO10), also supplemented by the findings of the UNEP/MAP 2015 Marine Litter Assessment for the Mediterranean.

5. The main findings of the 2017 MED QSR set the basis for the evolvement and expansion of marine litter monitoring in the region, as well as for the development of the 2023 MED QSR, and are summarized hereunder:

a) Information on beach marine litter (CI22) exists but the picture is still fragmented and is geographically restricted to the northern part of the Mediterranean. Plastics are the major components with cigarette butts, food wrappers and plastic bags being the top marine litter items. Land-based sources are predominant, but they have to be further specified. Tourism is directly affecting marine litter generation on beaches.
b) Information on the distribution, quantities and identification of beach marine litter sources needs to be further advanced. For the moment information and data are inconsistent for the Mediterranean. There is an urgent need to develop and implement the Integrated Monitoring and Assessment Programme for the Mediterranean Sea and Coast (IMAP) related to CI22, and corresponding data are submitted to the Secretariat at national level.
c) Accumulation rates of floating litter vary widely in the Mediterranean Sea and are subject to factors such as adjacent urban activities, shore and coastal uses, winds, currents, and accumulation areas. Additional basic information is still required before an accurate global litter assessment can be provided. Moreover, the available data are geographically restricted in the northern part of the Mediterranean Sea.
d) The abundance of floating litter (CI23) in Mediterranean waters has been reported at quantities measuring over 2 cm range from 0 to over 600 items per square kilometer. The 2015 UN Environment/MAP Marine Litter Assessment report states that approximately 0.5 billion litter items are currently lying on the Mediterranean Seafloor. There is great variability in the abundance of seafloor marine litter items ranging from 0 to over 7,700 items per km² depending on the study area. The information on floating and seafloor marine litter in the Mediterranean is fragmented and is spatially restricted mainly to its northern part and no basin-scale conclusions can be exerted as information is only available at local level. However, there are many areas with significant marine litter densities, ranging from 0 to over 7,700 items per km² depending on the study area. Plastic is the major marine litter component, found widespread in the continental shelf of the Mediterranean, ranging up to 80% and 90% of the recorded marine litter items.
e) Data on floating and seafloor marine litter are inconsistent and geographically restricted in only few areas of the Mediterranean Sea. In addition to that, the lack on long-term assessment data makes the assessment of trends of the years extremely difficult. Sources needs also to be further specified and linked to macro- and micro-litter contribution. Moreover, monitoring and assessment of marine litter should be done in a consistent way, based on common protocols and standardized methods, leading to comparable results at basin scale. Effective management practices are also missing, requiring strong policy will and societal engagement. Further work

should also be promoted towards identifying marine litter sources more precisely. Cooperation and collaboration between the major marine litter partners in the region with common priority actions is also considered important.

6. MAP implementation has since progressed with the establishment of national IMAPs, development of a centralized data collection and management infrastructure (IMAP InfoSystem), refinement of technical specifications on IMAP common indicators, building of knowledge on candidate indicators, and development of methodologies for integrated assessment. A specific Roadmap is currently under implementation for the preparation of a fully-data based Quality Status Report in 2023 (2023 MED QSR), as adopted by the Contracting Parties in 2019, through their COP 21 Decision IG.24/4.

7. The development and review of relevant action plans and programmes under the Ecosystem Approach Roadmap implementation is looked at on a multilayer perspective, covering all the aspects of the legal and policy framework of the UNEP/MAP- Barcelona Convention. In a nutshell, the Ecosystem Approach has been raised by the Contracting Parties to the programmatic level and reaffirmed as an overarching principle of the Barcelona Convention and as such has been integrated into the legal and policy framework of the Barcelona Convention including legally and non-legally binding instruments.

8. In order to ensure an efficient and coordinated implementation of the Ecosystem Approach Roadmap, a multi-level governance mechanism has been established, comprising the Ecosystem Approach Coordination Group composed of Contracting Parties representatives, and three specific correspondence groups, (i.e. on GES and targets: COR GEST, on monitoring: CORMON and on economic and social analysis, COR ESA), which are composed of national experts designated by the Contracting Parties, invited experts and respective MAP components.

9. The Ecosystem Approach Roadmap is implemented through activities included in the biennial UNEP/MAP Programmes of Work, while additional external resources are mobilized to support the different steps of its implementation. Three EU-funded Projects are recently launched, namely the IMAP MPA, ECAP MED III, and Marine Litter MED, which expect to boost the implementation of IMAP towards delivery of the next 2023 MED QSR.

10. Since 2016, the Mediterranean countries with the support of UNEP/MAP and the UNEP/MAP executed 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).

11. 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).

12. Decision IG.23/6 of COP20 on the 2017 MED QSR recommended the following general directions in order to address several gaps and ensure successful delivery of the 2023 MED QSR:

a) Harmonization and standardization of monitoring and assessment methods;
b) Improvement of availability and ensuring of long time series of quality assured data to monitor the trends in the status of the marine environment;
c) Improvement of availability of the synchronized datasets for marine environment state assessment, including use of data stored in other databases where some of the Mediterranean countries regularly contribute;
d) Improvement of data accessibility with the view to improving knowledge on the Mediterranean marine environment and ensuring that Info-MAP System is operational and continuously upgraded, to accommodate data submissions for all the Integrated Monitoring and Assessment Programme (IMAP) Common Indicators.

13. In line with the aforementioned decisions, UNEP/MAP and its MED POL Programme implemented activities to address the following key priority needs towards a DPSIR-based GES assessment of the 2023 MED QSR, including the following:

a) Development of scale(s) of monitoring, assessment and reporting, to enable comparable data sets and assessments.
b) Development of the necessary methodological tools and assessment criteria to be agreed on to allow and promote integrated assessment of GES;
c) Development of monitoring protocols and data quality assurance and quality control for IMAP Common Indicators are to be made available to guide Contracting Parties.
d) Supporting national capacities and address knowledge gaps to ensure region-wide coherence and data availability; and
e) Join forces with regional partners and streamline project implementation based on IMAP criteria to enable input process in a coordinate manner.

2.1 Assessment Criteria for IMAP Ecological Objective 10

14. 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.

2.1.1 Assessment Criteria for Common Indicator 22

15. For the elaboration and determination of the Baseline and Threshold Values s for IMAP Common Indicator 22 (beach macro litter), data were used from the Contracting Parties to the Barcelona Convention between 2016 and 2018 deriving from monitoring programmes, projects and initiatives, after taking into consideration the comparability of the submitted data sets. The selection of the 2016-2018 period is due to the availability of full years data in a significant number of countries.

16. For IMAP Common Indicator 22 (beach marine litter), thirteen (13) Countries have contributed with data. All the surveys have been collected in a database in accordance with the IMAP reporting templates for IMAP CI22. The extreme values that have been observed (outliers) were retained in the datasets and were checked and verified case by case. The number of surveys conducted in each country and the year when it was undertaken for beach marine litter (IMAP CI22) are presented per 4 Mediterranean subregions (Western Mediterranean (WM); Central Mediterranean (CM); Adriatic Sea (AS); Eastern Mediterranean (EM)) in Table 1 hereunder.

Table 1: Number of surveys by country (beach litter)

Sub-regions	Country	Surveys	Years	Sources
WM	Algeria	111	2018	SWIM H2020 Support Mechanism
	France	88	2016, 2017, 2018	MED POL Focal Point France
	Italy	162	2016, 2017, 2018	MEDPOL Focal Point Italy
	Malta	24	2017, 2018	MED POL Focal point Malta
	Morocco	16	2018	MED POL Focal point Morocco
	Spain	139	2016, 2017, 2018	MED POL Focal Point Spain
CM	Greece	3	2018	MED POL Focal Point Greece
	Italy	66	2016, 2017, 2018	MED POL Focal Point Italy
	Libya	12	2018	MED POL Adopt-a-Beach Pilots in Libya
AD	Italy	132	2016, 2017, 2018	MED POL Focal Point Italy
	Slovenia	16	2017	MED POL Focal Point Slovenia
	Montenegro	4	2018	MED POL Adopt-a-Beach Pilots in Montenegro
	Albania	4	2018	MED POL Adopt-a-Beach Pilots in Albania
	Croatia	6	2017, 2018	MED POL Focal Point Croatia
EM	Cyprus	31	2016, 2018	EMODnet
	Israel	8	2017, 2018	MED POL Focal Point Israel

17. The BV for IMAP CI22 was based on the calculation of the median values for the Mediterranean sub-regions, whereas the TV for IMAP CI22 was calculated based on the 15th percentile of the BV. The respective BV and TV that were approved by COP22 (Decision IG.25/9) for IMAP CI22 are reflected under Table 2 hereunder:

Table 2: 2016 (Agreed) and 2019 (Proposed/Updated) Baseline Values; Proposed Threshold Values; and percentage reduction in baseline values to achieve GES.

IMAP Indicators	Categories of Marine Litter	BV-2016	Proposed BV-2021	Proposed TV-2021
CI22	Beach Marine Litter	450-1400 items/100m	**369 items/100m**	**130 items/100m**

18. The said assessment criteria comprising of the baseline and threshold values for IMAP Common Indicator 22 are used for the needs of the present 2023 MED QSR.

2.1.2 Common Indicator 23

19. For the elaboration and determination of the Baseline and Threshold Values for IMAP Common Indicator 23 (seafloor macrolitter and floating microplastics), the data used correspond to data collected from the Contracting Parties to the Barcelona Convention between 2016 and 2020 in the framework of the respective IMAP-based national monitoring programmes, and officially submitted and validated through the IMAP InfoSystem. The selection of the 2016-2020 period is due to the availability of full years data in a significant number of countries.

20. For IMAP Common Indicator 23 (seafloor macrolitter and floating microplastics), nine (9) countries have contributed with data. The data were submitted by the respective Focal Points through an official submission through IMAP InfoSystem, and have undergone thorough quality checks, and thus do not contain erroneous data.

21. All data from for the total number of surveys have been collected for the current exercise into the IMAP InfoSystem, in accordance with the region-wide reporting templates (i.e., DS and DD) as proposed by UNEP/MAP and adopted by its institutional meeting (i.e., CORMON Marine Litter, MED POL Focal Points, and EcAp Coordination Group Meetings). As also applied for the case of

elaboration of BV and TV for IMAP CI22, the extreme values that were observed (outliers) were retained in the datasets and were checked and verified case by case. The number of surveys conducted in each country and the year when it was undertaken for seafloor macrolitter (IMAP CI23) is presented in Table 3 hereunder.

Table 3: Number of surveys per respective Contracting Party used for the elaboration of updated BV and proposal of TV for seafloor macrolitter (IMAP CI23)

Country	Number of Trawl Surveys	Years
Croatia	27	2017, 2018, 2019, 2020
Cyprus	130	2016, 2017, 2018, 2019, 2020
France	332	2016, 2017, 2018, 2019, 2020, 2021
Israel	30	2019, 2020
Malta	39	2016, 2017
Morocco	11	2018, 2019
Slovenia	32	2017, 2018, 2019, 2020
Tunisia	10	2018, 2020
Türkiye	55	2016, 2019
TOTAL	**666**	

22. The BV for IMAP CI23 was based on the calculation of the median values for the Mediterranean sub-regions, whereas the TV for IMAP CI23 was calculated based on the 15th percentile of the BV. The respective BV and TV were submitted to the present Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring (CORMON Marine Litter, Athens, 3 March 2023) for review and approval and are reflected under Table 4. hereunder:

Table 4: 2016 (Agreed) and 2022 (Proposed/Updated) Baseline Values and Threshold Values for IMAP CI23, seafloor macrolitter and floating microplastic.

IMAP Indicators	Categories of Marine Litter	BV-2016	Updated BV-2022	Proposed TV-2022
CI23	Seafloor Macro-litter	130-230 items/km^2	95 items/km^2	16 items/km^2
CI23	Floating Microplastics	200,000–500,000 items/km^2	53,931 items/km^2	1,320 items/km^2

2.2 Methodology for GES Assessment for IMAP Ecological Objective 10

23. All quality status environmental assessment methods, require two assessment criteria: (i) a threshold value for each parameter/element monitored, which defines the quality status; and (ii) a decision rule regarding the spatial extent within an assessment area, that achieves such quality status. Then the GES assessment follows specific methods (i.e., numeric calculations) which aggregate and integrate the monitoring data at the appropriate assessment scales, as explained in UNEP/MED WG.492/13. For example, it is possible that an element/parameter measured across an assessment area gets values both above and below the threshold value (e.g., beach litter concentrations measured in 10 beaches is found above threshold in 3 of them and below threshold in 7 of them), so a decision needs to be taken regarding the achievement or not of GES for the particular assessment area or Spatial Assessment Unit.

24. Upgrading the baselines and threshold values for IMAP CI22 and CI23 in the Mediterranean Sea is an ongoing process and UNEP/MAP has undertaken important steps in this regard. The assessment criteria used in the present assessment analysis, i.e., the GES and nonGEs boundaries are based on the TV values defined under Chapter 2.1 to the present document. Monitoring data for each

station and for each CI are compared against the respective TV to provide a classification between the GES and nonGES status.

25. After setting/upgrading the threshold values, a decision rule is needed on how to assess GES not on monitoring stations but on optimal spatial scale of assessment. As stated in UNEP/MAP (2019b) and recommended by the EU MSFD (SWD (2020) 62 final), it is considered more appropriate, to define the proportion of the assessment area that needs to achieve the threshold value in order to consider the assessment area in GES. For example, if for a specific parameter 95% of stations sampled in an assessment area get values below threshold then the area is considered in GES. The value of the proportion, whether it will be 95% or lower is considered the decision rule. For the purposes of IMAP CI17 in areas with limited data availability the rule of 75% of stations classified in GES has been applied to define the classification of the whole are in GES. For EO10 the same rule is proposed on the subdivision and/or subregion level.

26. Apart from the spatial integration of the assessment results on the level of Common Indicator, the quality status assessment of a specific area can be conducted also at the level of Ecological Objective. In this case aggregation methods need to be applied. The choice of the most appropriate aggregation method is critical and is dependent on the type of the EO whether it is related to pressure/impact or state.

27. Aggregation methods should ensure that information within an EO is not lost so that progress towards GES, and additional information on the effectiveness of measures can follow. There are several aggregation methods proposed in the literature. Usually these combine a methodology for the aggregation of the information from the parameter level to higher levels of CIs and EOs and a decision rule for the assignment of GES on the appropriate spatial scale. For aggregating CIs within the same EO it is important that all CIs have the same level of maturity and that sufficient monitoring data are available. The methods should allow for transparency of the various steps of aggregation-integration. This means that details on the assessment results which are relevant for management purposes can be unfolded.

28. Several assessment methods have been developed for contaminants. In particular the CHASE+ and the NEAT aggregation-integration methodologies have been applied for EO9- CI17 UNEP/MED WG.533/5[3] and can be considered relevant also for EO10 and its CI22 and CI23. In both cases the aggregation per contaminant's data is based on averaging station data for all sampling dates. Then this value is compared against the threshold, i.e., a score ratio of concentration value to the TV is calculated. For GES status scores are ≤ 1 and for non-GES >1. Aggregation of all CIs data on the EO level for each station is further conducted by averaging the individual score ratios. The score result, whether it falls above or below 1 determines the status of a specific station regarding the EO in question.

29. For the assessment of an area (from monitoring stations to spatial assessment) the CHASE+ methodology considers the rule of a predefined percentage of stations (i.e., 75%) that should be in GES i.e., with score ratio of ≤ 1. The NEAT methodology on the other hand, requires information on spatial assessment units and integrates the score ratios of individual stations following a methodology of weighting averages; the weights based on the spatial assessment surface area. Furthermore, both methodologies consider two status classes under GES (high, good) and three status classes under the non-GES (moderate, poor, bad) depending on distance of the score ratio from 1.

30. It is very important to note that for a sound quality status assessment using the above-described methodologies on aggregation-integration of data, substantial spatial data coverage for all CIs is required. Otherwise, any attempt to aggregate variable amount of data per CI and /or spatially integrate results from limited data or uneven distribution of monitoring stations is prone to meaningless assessments. The latter applies also for the application of stations percentage decision rules for spatial assessments.

31. 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 is calculated. Classification of stations is conducted following the status classes described in Table 5. 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).

2.3 Monitoring Floating marine litter with aerial observation survey (ACCOBAMS)

32. Context: As an answer to the crucial need of monitoring marine biodiversity dynamics in a changing world, standardized aerial visual observation surveys have become prevalent in the biologist, ecologist and conservationist toolbox. They are particularly useful to monitor of highly mobile, cryptic and elusive marine species, whose distributional ranges can span entire ocean basins, and which are otherwise very difficult to observe at the population scale. These characteristics of large-sized pelagic species largely entails their important exposition to anthropogenic threats, from shipping noise and collisions, habitat alteration, resource depletion, to pollution.

33. Aerial surveys are recognized opportunities to implement multi-target monitoring in the marine environment, and such surveys are increasingly used to routinely monitor all visible wildlife (primary targets: cetaceans, seabirds, fishes, turtles), but also anthropogenic activities and pollutions (litter, oil; see for example, Laran et al., 2017; Pettex et al., 2017; Rogan et al., 2018; ACCOBAMS, 2021; Hammond et al 2017). Such an approach subsequently permits to analyze and assess the potential exposition of wildlife to particular threats.

34. This kind of approach is particularly appealing when it comes to study, understand and monitor the natural populations living in environments strongly impacted by human activities, as is the case with the Mediterranean and Black Sea (Micheli et al., 2013; Halpern et al., 2015, 2019).

35. In this context, 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). Yet, since a crucial part of conservation management lies in mediating the interactions between nature and human activities (Johnson et al., 2017), 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.

36. The ASI was composed of two parts (ACCOBAMS, 2021): an aerial survey conducted in summer 2018, and a boat-based survey carried out in summers 2018 and 2019. The monitoring of floating marine litter was implemented for the aerial component of the survey. The methodology applied, including survey design and implementation, the observation protocol as well as the post-survey analysis of FML abundance and distribution, is presented hereafter.

37. Survey design and implementation: Following distance sampling (DS) principles, the layout of a survey design is of uttermost importance, as it conditions the validity of the recorded data to reliably estimate abundance and distribution of target species (Buckland et al., 2015). The main requirement is to ensure a representative sampling of the study area with a uniform coverage. Given the Mediterranean is wide and composed of several ecoregions with particular biotic and abiotic characteristics, these requirements imply a stratified design must be used.

38. The Mediterranean was divided into large blocks, subsequently divided into sub-blocks within which the observation transects were laid out. The organisation of blocks (and resulting transects) was first designed to create ecologically relevant units, with blocks of homogeneous oceanographic and physiographic conditions. This original design was then modified to incorporate political or jurisdictional constraints, and logistic issues regarding fuel availability, plane endurance, airport locations and issuing of flight permits.

39. Inside the blocks, transects were laid out to ensure the most uniform coverage possible (Buckland et al., 2015; Strindberg and Buckland, 2004). Different designs are available: transects can either be parallel to each other or set up in a zigzag layout. The type and the final layout of transects (angles, spacing…) condition the final coverage of the study area, but also the amount of off-effort transit time. These parameters must be fine-tuned to find the best compromise between logistic constraints (fueling, airport locations) and maximizing the coverage uniformity. Dedicated tools exist in the DS toolbox to help the survey designers achieving such goals.

40. Following all these principles and constraints, the final block design for the ASI divided the Mediterranean into 32 large blocks, within which transects were located with a zigzag layout.

41. Observation protocol and data collection: All observers were distributed into eight observation teams, based on previous experience in leading and participating to aerial surveys, resulting in teams of equivalent overall experience. They all participated to common theoretical and practical training sessions focused on familiarizing them to field work activities, species to be encountered, protocols and data collection. Training flights were also operated to simulate real field conditions and ensure all observers follow the same principles and carry out the protocol similarly.

42. Each team was associated to a plane, operating in predefined sector of the survey. Three different models of plane were used, all high-winged, double-engined and equipped with bubble-windows to ensure observation under the plane: four Partenavia, two Britten Norman Islander and two Cessna Skymaster O-2 push-pull. The crew were composed of the pilot plus three observers. Following common practice, the altitude during observation sessions was set to 183 m, with a constant speed of 10 knots (Laran et al., 2017; Pettex et al., 2017; Rogan et al., 2018; ACCOBAMS, 2021; Hammond et al 2017). Data collection was done with a software specifically designed for aerial surveys – the SAMMOA software (Observatoire Pelagis, 2018). The software is connected to a GPS, recording the precise location of the plane track, and to an audio recording system, ensuring the whole flight is audio-saved for future data validation. The teams used this software to record the flight plan, the observers position inside the plane, the environmental conditions of observation (sea state, cloud cover, sun glare, etc.) and all sightings made. Every day after the flights, data were validated with the voice recording.

43. The main target of the survey were marine mammals and large fishes (elasmobranchs, tunas, swordfish). For those, observers followed a line-transect protocol: for every sighting, they recorded the declination angle to the track line when the animal or its group were abeam of the plane (Figure 1). As specified above, the multi-target protocol also included the recording of seabirds, sea turtles, sunfish as well as FML and boats, but following a strip-transect protocol (Figure 1): all sightings made within a strip of 200 m (birds, turtles, sunfish and FML) or 500 m (boats) on each side of the track line were recorded. For the particular case of FML, observers recorded the type of the items (fishing trash, plastic trash, etc.) whenever possible. When the item was reliably recognizable, its nature was also recorded (inflatable mattress, fish box or balloons, for example).

44. Alongside target sightings, observers recorded all observation conditions potentially affecting the detection of targets, such as sea state, glare severity, turbidity, cloud coverage, and derived an overall subjective assessment of the detection conditions (from poor to excellent), estimating the likelihood of seeing a small cetacean present within the searching area. Since the weather directly affects the detectability of target species, flights were only done in good weather.

45. Post-survey analysis of FML: As said above, FML were recorded following a strip transect methodology. Such method estimates the abundance of targets in the study area by relying on the assumption that the detection of all items within the strip around the track line is perfect. Although the flight was restrained to best possible observation conditions, this assumption does not hold true and the effective detection probability of FML is directly dependent upon observation conditions.

46. Therefore, FML data necessitated building a dedicated analytical method to correct for this bias. This was achieved with a hierarchical Species Distribution Model in the Bayesian framework (Lambert et al., 2020), which permits modelling both the measurement process (here, the detectability) and the process of interest (here, presence). The idea was to first estimate the detection probability based on sampling units where FML were sighted, as a function of observation conditions. Second, we modelled the presence of FML based on corrected detection and estimated it spatially throughout the study area. Thanks to the Bayesian approach, the uncertainty around estimated parameters (detection and presence probabilities) were easily extracted.

47. Finally, the total abundance of FML was derived from this presence probability map (Lambert et al., 2020). Assuming the presence probability was linked to abundance through a Poisson process, the number of FML present in each cell was estimated from the presence probability and the average number of sighted items (corrected for detection). The abundance was also estimated at the block scale, using a bootstrap procedure on the number of items sighted per transects, for both surveyed and un-surveyed blocks. Again, uncertainties were duly propagated through the analysis, from which was derived the 80% credibility interval around the total estimated abundance of FML.

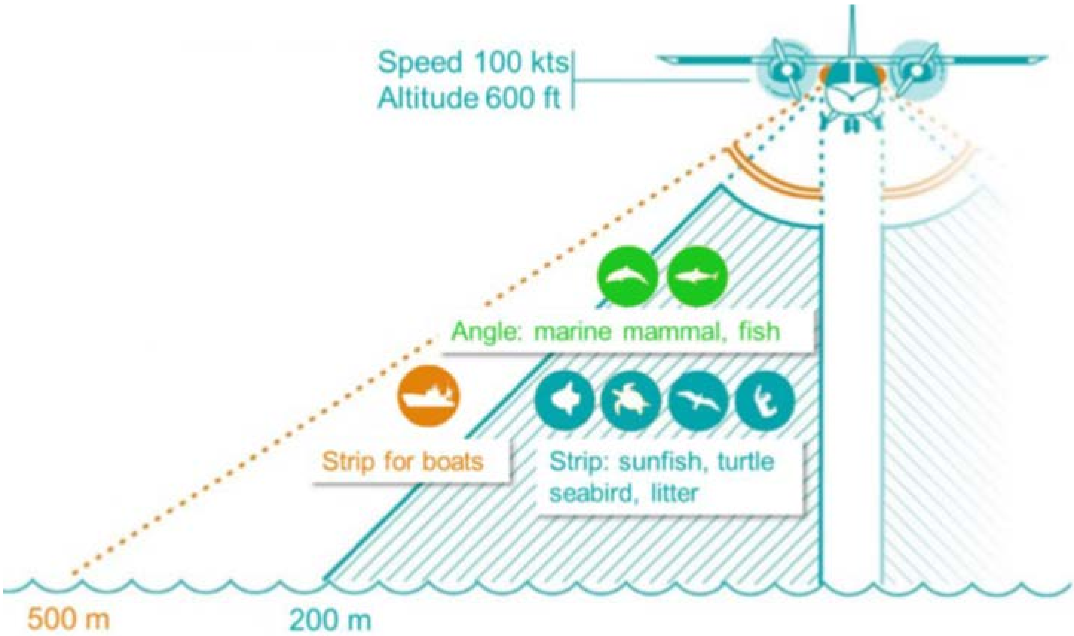


Figure 1: Data collection protocol. Observers scanned the sea surface and subsurface as well as the air column below the aircraft and recorded all sighted items: seabirds, turtles, sunfish and FML were recorded within a band of 200 m, boats within a band of 500 m, cetaceans and large fish were recorded without distance limit but with a detection angle.

3. Drivers, Pressures, State, Impact, Response (DPSIR)

48. The methodology for integration of assessment results within the DPSIR approach was elaborated further to the discussion that took place during the Meetings of CORMON Marine litter and MED POL Focal Points in 2021. The two approaches were introduced to guide comparison/connecting the known pressures/drivers already defined by expert judgment for a specific assessment with the GES assessment results obtained by applying the GES/Environmental assessment methodologies tested and agreed for application for the specific Common Indicators.

49. The methodology builds on the work undertaken to map the interrelations between sectors, activities, pressures, impacts and state of marine environment for EO10, within the preparation of the working document UNEP/MED WG.490/3 "Addressing Interrelation of Pressures-Impacts of Marine Litter and the Status of Marine Ecosystem Components". The interactions between pressures and impacts for EO10, as measured by IMAP Common Indicators, is shown here below in Tables 6 and 7. They are presented in the GRID/Table approach that takes into account the geographical scales for the assessment to the sub-division level. The proposed interrelations were agreed further to the discussion that took place during the Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring (30 March 2021).

50. Pressures for marine litter can be considered in the two following ways: (i) at source, i.e. focusing on the primary and main activities generating the pressure; this aspect is relevant for setting environmental targets and defining measures aiming at reducing the pressures in order to achieve or maintain GES; and (ii) at sea, i.e. the level of pressure in the marine environment to which the different elements of the ecosystem are subjected; this aspect is particularly relevant for determining GES for both IMAP pressure-based and status-based Common Indicators.

51. The Intensity of natural and anthropogenic pressures have been evaluated according to the following color code, grouped by sub-regions, and ordered by the worst result obtained (Table 5).

Table 5: Intensity of natural and anthropogenic pressures

3	Significant Contribution of the Activity to Pressure
2	Minor Contribution of the Activity to Pressure
1	No Activity but Possible Development of the Activity
0	No Contribution to Pressure

52. Tables 6 and 7 provides a tabular representation of interactions between pressures and impacts and IMAP EO10 respectively its Common Indicators 22 and 23. The introduced table cross-maps all the anthropogenic activities with significant contribution to pressures with the Common Indicators used for IMAP EO10 marine litter monitoring and assessment. Expert judgment, including inputs received from 6 Contracting Parties, contributed to better refine the specific interactions, for these activities contributing to pressures at Common Indicator level considering sub-regions, or, if relevant and appropriate, sub-divisions or lower geographical units (using as appropriate the nested approach). Certainly, additional expert input is required for a more accurate regional representation however Tables 1 and 2 already include a very useful analysis which could facilitate setting the scene for the way forward.

53. <u>Pressure analysis for IMAP Common Indicator 22 (CI22):</u> The assessed greatest pressure in all sub-areas is generated by the sector of tourism, followed by other sectors i.e., coastal urbanization, solid waste management, and agricultural and forestry practices (Table 6).

54. Renewable energy facilities are those that produce the less important pressure, followed by the extraction of genetic resources, research and activities, defense activities, and cables and pipes installation.

55. There are some differences between sub-regions: in the Western Mediterranean, tourism stands out as the greatest pressure in all its sub-areas. However, in the Adriatic, coastal construction, aquaculture, and solid waste management are also highlighted as important pressures.

56. As far as the Central and Eastern Mediterranean are concerned, the most important pressures coincide, i.e., agricultural and forestry activities, cruises, coastal urbanization, fishing (including recreational fishing), and solid waste management. In general, the variations between the sub-regions are small, although resulting to be the same greatest pressures in all of them.

57. Pressure analysis for IMAP Common Indicator 23 (CI23): The greatest pressure in all sub-areas is generated by the fishing sector, followed by aquaculture (Table 7). Renewable energy facilities, energy extraction, research and education activities, and the extraction of genetic resources are the ones that produce the least pressure.

58. However, there are some differences between sub-regions. In Western Mediterranean, tourism, wastewater discharge, and fishing stand out as those that produce the most pressure; while in the Adriatic, fishing and aquaculture stand out as important pressures.

59. As far as the Central and Eastern Mediterranean are concerned, the most important pressures coincide, i.e., agricultural and forestry activities, cruises, coastal urbanization, fishing (including recreational fishing), and solid waste management. This is also the case for IMAP CI22 where the same types of pressured are highlighted as important.

60. In general, the fundamental and main pressures for IMAP EO10 CI22 and CI23 are not the same. While tourism and coastal construction are the most important for IMAP EO10 CI22; fisheries and aquaculture are those that fundamentally affect IMAP EO10 CI23.

Table 6: Interrelation of natural and anthropogenic pressures (selected based on the main activities in terms of pressures as provided by ICZM Protocol and other Barcelona Convention`s Protocols) affecting the marine ecosystems and the measurement IMAP Common Indicator 22.

Pressures vs. measures IMAP EO10 Common Indicator 22	**Sub-Regions**	**Non-Construction Zone**	**Natural Hazards**	**Natural disasters**	**Climate Change**	**Agric. and forestry runoffs**	**Coastal Urbanization**	**Damming (demand on water)**	**Waste-water discharges**	**Industry**	**Tourism frequentation**	**Yachting**	**Marine mining**	**Dredging**	**Desalinization**	**Coastal artificialization.**
Common Indicator 22 (Ecological Objective 10)	**Western Med. Sea**															
	Adriatic Sea															
	Central Med. Sea															
	Aegean and Levantine Sea															
	Mediterranean Average															

Pressures vs. measures IMAP EO10 Common Indicator 22	**Sub-Regions**	**Port operations**	**Offshore structures**	**Cables and pipelines**	**Shipping**	**Oil and gas extraction**	**Renewable energy**	**Fishing (incl. recreational)**	**Sea-based food harvesting**	**Extraction of genetic resources**	**Aquaculture**	**Solid waste disposal**	**Storage of gases**	**Research and education**	**Defense operations**	**Damping of munitions**
Common Indicator 22 (Ecological Objective 10)	**Western Med. Sea**															
	Adriatic Sea															
	Central Med. Sea															
	Aegean and Levantine Sea															
	Mediterranean Average															

Table 7: Interrelation of natural and anthropogenic pressures (selected based on the main activities in terms of pressures as provided by ICZM Protocol and other Barcelona Convention`s Protocols) affecting the marine ecosystems and the measurement IMAP Common Indicator 23.

Pressures vs. measures IMAP EO10 Common Indicator 23	**Sub-Regions**	**Non-Construction Zone**	**Natural Hazards**	**Natural disasters**	**Climate Change**	**Agric. and forestry runoffs**	**Coastal Urbanization**	**Damming (demand on**	**Waste-water discharges**	**Industry**	**Tourism frequentation**	**Yachting**	**Marine mining**	**Dredging**	**Desalinization**	**Coastal artificialization.**	**Port operations**	**Offshore structures**	**Cables and pipelines**	**Shipping**	**Oil and gas extraction**	**Renewable energy**	**Fishing (incl. recreational)**	**Sea-based food harvesting**	**Extraction of genetic**	**Aquaculture**	**Solid waste disposal**	**Storage of gases**	**Research and education**	**Defense operations**	**Damping of munitions**
Common Indicator 23 (Ecological Objective 10)	**Western Med. Sea**																														
	Adriatic Sea																														
	Central Med. Sea																														
	Aegean and Levantine Sea																														
	Mediterranean																														

61. Results for both indicators integrating the most significant contribution of the corresponding sectors/ activity(ies) to pressure for the four Mediterranean Subregions (red colour; Tables 1 and 2) give us information on those that mostly contribute to generation of marine litter impacts in the Mediterranean Basin (Table 8).

Table 8: The most significant contribution of corresponding sectors/ activity(ies) to pressures on marine ecosystem from marine litter in the four Mediterranean Subregions

	CI22	CI23
Agricultural and Forestry Runoffs	✓	✓
Coastal Urbanization	✓	✓
Waste-Water Discharges	✓	✓
Tourism Frequentation	✓	✓
Yachting	✓	✓
Fishing	✓	✓
Aquiculture	✓	✓
Solid Waste Disposal	✓	✓
Damping of Munitions	✓	✓

62. Further to the interrelation of IMAP EO10-Marine Litter and its respective Common Indicators 22 and 23 with the relevant natural and anthropogenic pressures, by applying GRID approach, as provide above in Tables 6 and 7, a Scoreboard method was applied in order to initially quantify the magnitude of impacts of the pressures with the most significant contribution over the ecosystem components.

63. The approach applied is based on Excel tool used for an expert-based evaluation both of category of pressures and impact scores. It allows estimating (in %) how many categories of pressures have the potential to threat the marine ecosystem regarding marine litter. Experts involved in such evaluation provide an assessment for each pressure type through a 0/1 score: 1 indicating the presence of the potential risk and 0 its absence. The final score is than expressed in percentage, dividing the sum of all scores for the number of scored pressured (activity types)/

64. The same Excel tool enables to estimate the magnitude of impacts (in %) by adapting its conceptual objective. Thus, for each category of pressures the experts involved in the evaluation are invited to express a 0 to 3 score: 0 indicating the absence of the impact, while 1, 2 and 3 respectively indicating the presence of an impact with low, moderate and high magnitude. Similarly, to the analysis on the occurrence of potential threats, the final score is expressed in percentage and is obtained by dividing the sum of all scores by the maximum theoretical score (equal to the number of scored items i.e., category of pressures multiplied by 3).

65. The quantitative estimation of the overall impacts of pressures related to IMAP CI22 (Table 6) was provided for inland and coastal areas; while quantification of impacts of pressures of relevance for IMAP CI23 (Table 7) was provide in offshore areas. The value of the % of total impact on the Mediterranean is considered as the current average situation (Table 8), the higher values for each subregion can be considered high (red; Figures 1 and 2) and the lower values as moderate (orange; Figures 1 and 2)

Table 8: Scoreboard approach results

	Overall, of Pressure-Impact (%)	**Inland % of total impact**	**Coastal Area % of total impact**	**Offshore % of total impact**
WM	16	6	17	23
AD	32	24	30	41
CM	23	18	23	28
EM	23	13	25	28
Mediterranean Sea	22	12	24	27

66. Accordingly, it can be concluded that 22% of category of pressures recorded in Mediterranean against the list of main activities in terms of pressures as provided by ICZM Protocol and other Barcelona Convention`s Protocols, contribute to generation of marine litter impacts on ecosystem components. The 24% and 27 % of all categories of pressures related to marine litter generate impacts over ecosystems in coastal and offshore areas respectively (Table 4).-According to this it can be concluded that 24% respectively 27 % of all categories of pressures related to marine litter generate impacts over ecosystems of coastal respectively offshore areas.-Moreover, 12% of all categories of pressures related to marine litter generate impacts over ecosystems from inland areas.

67. In order to reach the GES, efforts should be focused in decreasing the impact of the 3 specific activities as identified the most important on marine litter generation (Table 8). This would allow the decrease of the total amount of marine litter recorded in the surveys. If the implementation of key/selected reduction and prevention measures in the Mediterranean is applied in a coherent way across the region, there is an indication for WM, AD and CM reaching GES, while EM will reach a medium colour status range, decreasing the effects and impacts on marine and coastal environment.

68. A number of measures can be proposed (listed hereunder) to be applied at national level, focusing on the activities that are contributing with a high level of interaction in the respective sub-regions (Tables 6 and 7): i.e., urbanization, tourism, fishing and agriculture. The other activities with high impact in the Mediterranean (Table 8) have an irregular relevance depending on the subregion:

- Coastal Urbanization:
    - Control of new urban development and their proximity to the coastline.
    - Control of waste management in coastal urbanizations (litter bins distribution, collection schedule and location of final waste disposal).
    - Promotion of prevention policies against waste generation (limitation of the single-use items and containers sale).
    - Promotion of recycling projects that generate added value from the reutilization of waste as new materials (Circular Economy).

- Tourism:
    - Control of waste generation in hotels, commercial, and recreational facilities. Incentives for the prevention of waste generation.
    - Promoting the elimination of single-use products in hotels, commercial, and recreational activities sectors.
    - Incentives for the creation of practices related to collection and recycling of the waste generated by hotels and commercial facilities.

- Fishing:
    - Education and awareness of the fisheries sector regarding the environmental improvement (e.g., zero waste into seas).
    - Promotion of “Fishing for litter” activities among the fishing fleet.
    - Education and awareness of the stakeholders regarding the benefits achieved by the removal of marine litter from the environment (practices improvements derived from the habitat improvements of the commercial target species, reduction of vessel accidents and breakdowns due to the presence of marine litter).
    - Promoting the implementation of storage areas for marine litter collection in ports.

- Agriculture:
    - Education and awareness of the stakeholders about the benefits derived from proper waste management.
    - Promoting the creation of waste management systems derived from agricultural practices.

4. Good environmental status (GES) / alternative assessment

4.1 Theme selected for GES assessment

69. The theme selected for GES assessment under the present chapter on marine litter in the framework of 2023 MED QSR is IMAP Ecological Objective 10 and its two Common Indicators:

a) EO10: 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).
b) EO10: Common Indicator 23 (CI23): Trends in the amount of litter in the water column including microplastics and on the seafloor

70. The assessment for IMAP EO10 CI22 mainly focuses on marine litter items found deposited on beaches (beach marine litter), and for IMAP EO CI23 focused on seafloor macro-litter and floating microplastics. For the current assessment data explicitly deriving from IMAP InfoSystem have been used.

71. The assessment is focusing one 3 main elements: (a) GES – nonGES assessment; (b) quantitative findings and assessment, and (c) qualitative findings and assessment.

4.2 GES Assessment for CI/ alternative assessment for CI

Geographical scale of the assessment	Regional and Sub-regional
Contributing countries	Bosnia-Herzegovina, Croatia, France, Greece, Israel, Lebanon, 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

4.2.1 GES Assessment / Alternative Assessment for IMAP EO10 Common Indicator 22

72. **Beach Litter (CI22)** data are reported in the IMAP InfoSystem from 10 CPs covering all 4 sub-divisions (ADR, CEN, EM, WM). In total 80 beaches are monitored during the period 2017-2021 in the following countries: Bosnia-Herzegovina, Croatia, France, Greece, Israel, Lebanon, Spain, Slovenia, Türkiye. A total of 647 surveys (EM: 94, CM: 18, ADR: 60, WM: 475) were stored and uploaded to IMAP InfoSystem reflecting the collection and removal of 206,921 marine litter items from the Mediterranean coastline (EM: 53,728; CM: 2,135; ADR: 26,433; WM: 124,625).

73. Concentrations of Beach Litter (items/100m) are highly variable fluctuating between 8 and 9,394 items /100m. Average beach litter concentration on the Mediterranean coastline is found equal to 531 ± 1322 items/100 m.

74. Following the assessment methodology explained in Chapter 2.2, and using the TV of 130 items/100m, temporal average data form the 80 beaches are compared against the threshold, resulting in their classification under 4 status classes (High, good, moderate, poor, bad) shown in Table 10. Overall, 71% of the beaches monitored do not achieve GES, and most of them (41 %) fall into the moderate category, i.e., beach litter concentrations are up to two times higher than the TV. In Table 11 the classification results are given for each sub-Region separately.

Table 10: The GES – nonGES classification of the 80 monitored beaches in the Mediterranean Region.

Mediterranean Region				
Boundary limits	**GES- nonGES classes**	**No of Beaches**	**% of Beaches**	
≤ 0.5xTV	HIGH	7	9	**29% GES**
0.5xTV< ≤ 1xTV	GOOD	16	20	
1xTV< ≤2xTV	MODERATE	33	41	**71 % nonGES**
2xTV< ≤5xTV	POOR	11	14	
> 5xTV	BAD	13	16	
80 beaches				

75. On the sub-Region level, the Adriatic appears the most affected by beach litter with only 32% out for the 16 beaches monitored falling into the GES category, most of them falling into the moderate class (56% of total). The Western Mediterranean sub-region follows with 42% of the beaches monitored falling into the GES class. In this case too, the highest percentage of beaches (42%) are classified under the moderate class. The Central Mediterranean sub-region shows an equal distribution of beaches between the GES and non-GE classes; however, this subregion is monitored in only 6 beaches. Finally, the Eastern Mediterranean subregion is the only area where the majority (60%) of the monitored beaches are classified under GES class. These results are depicted spatially in the maps of Figures 2 to 5.

Table 11: 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	19	**32% GES**
0.5xTV< ≤ 1xTV	GOOD	2	13	
1xTV< ≤2xTV	MODERATE	9	56	**68 % nonGES**
2xTV< ≤5xTV	POOR	0	0	
> 5xTV	BAD	2	13	
16 beaches				
Central Mediterranean sub-Region				
≤ 0.5xTV	HIGH	1	17	**50% GES**
0.5xTV< ≤ 1xTV	GOOD	2	33	
1xTV< ≤2xTV	MODERATE	3	50	**50% nonGES**
2xTV< ≤5xTV	POOR	0	0	
> 5xTV	BAD	0	0	
6 beaches				
Eastern Mediterranean sub-Region				
≤ 0.5xTV	HIGH	9	36	**60% GES**
0.5xTV< ≤ 1xTV	GOOD	6	24	
1xTV< ≤2xTV	MODERATE	4	16	**40% nonGES**
2xTV< ≤5xTV	POOR	0	0	
> 5xTV	BAD	7	28	
25 beaches				
Western Mediterranean sub-Region				
≤ 0.5xTV	HIGH	3	9	**42% GES**
0.5xTV< ≤ 1xTV	GOOD	11	33	
1xTV< ≤2xTV	MODERATE	14	42	**58% nonGES**
2xTV< ≤5xTV	POOR	0	0	
> 5xTV	BAD	5	15	
33 beaches				

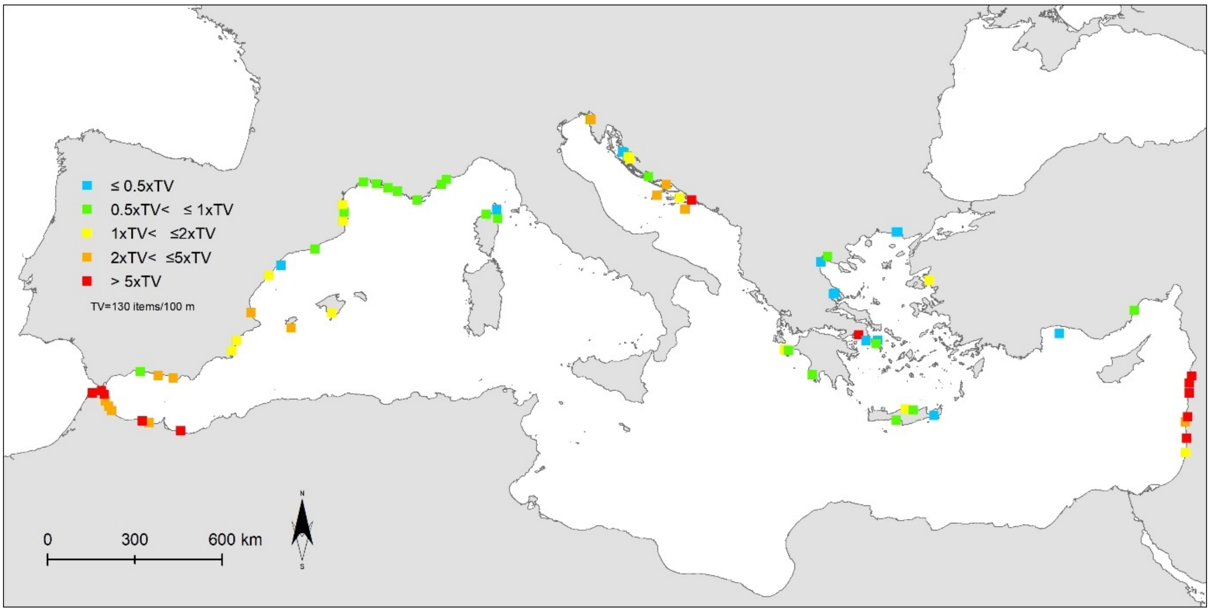


Figure 2: GES assessment classification of the beaches monitored for marine litter in the Mediterranean Region.

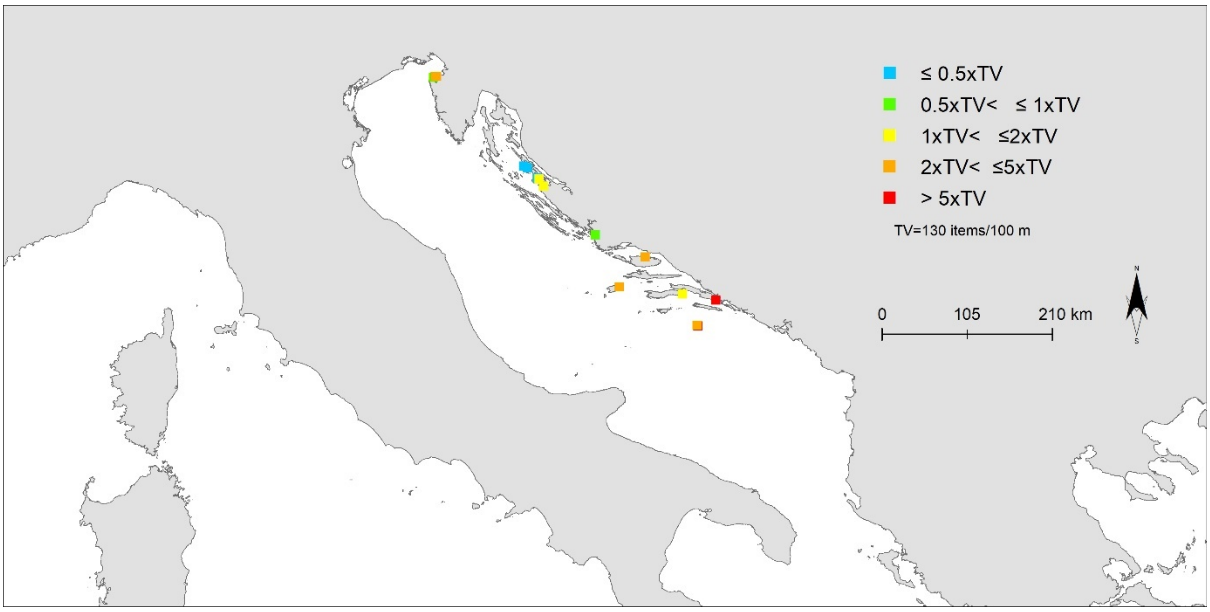


Figure 3: GES assessment classification of the beaches monitored for marine litter in the Adriatic and Central Mediterranean sub-regions.

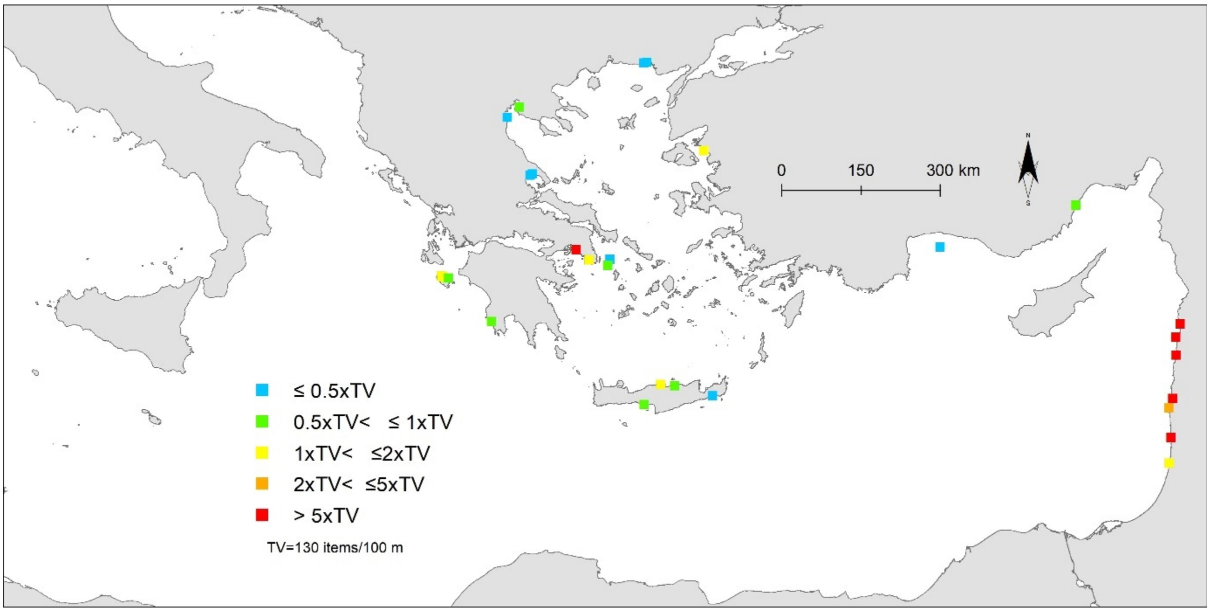


Figure 4: GES assessment classification of the beaches monitored for marine litter in the Eastern and Central Mediterranean sub-Regions.

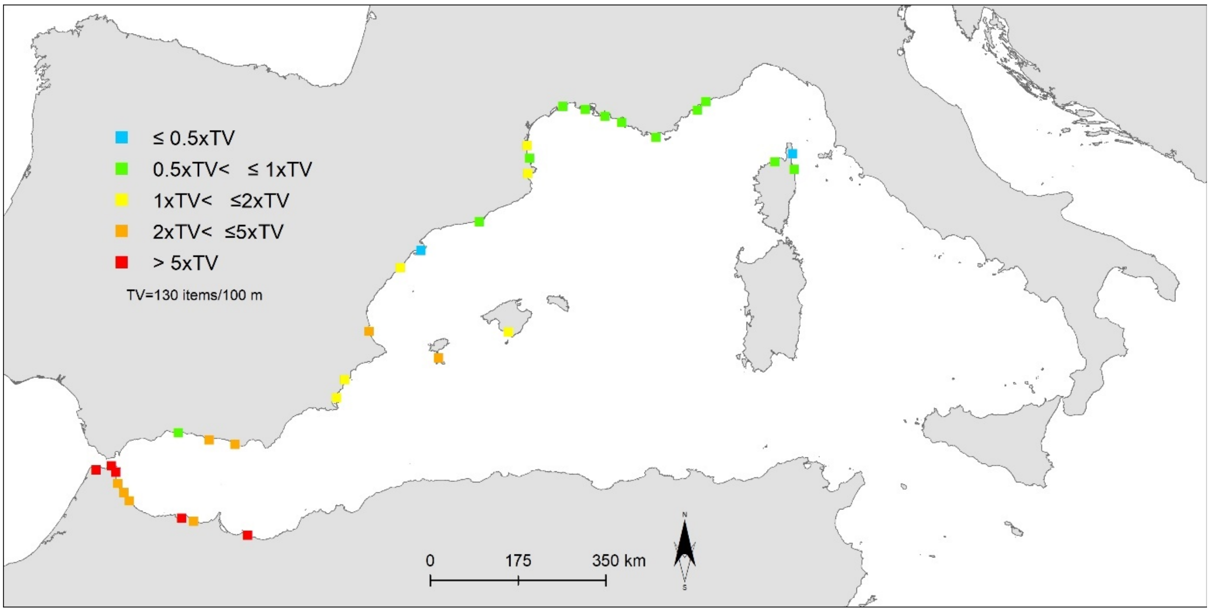


Figure 5: GES assessment classification of the beaches monitored for marine litter in the Western Mediterranean sub-Region.

76. The average beach marine litter density from the 10 countries varied between a maximum of 5716 to 94 items/100m.The average beach marine litter densities are presented hereunder (Table 12).

Table 12: Average beach marine litter densities in the Mediterranean Countries

Country	Average Density (items/100m)
Bosnia & Herzegovina (BA)	1443 (±1743) items/100m
Croatia (HR)	258 (±1743) items/100m
France (FR)	94 (±20) items/100m
Greece (GR)	344 (±1183) items/100m
Israel (IL)	483 (±251) items/100m
Lebanon (LB)	5716 (±3252) items/100m
Morocco (MA)	697 (±343) items/100m
Slovenia (SI)	436 (±240) items/100m
Spain (ES)	287 (±212) items/100m
Türkiye (TR)	105 (±46) items/100m

77. An analysis was undertaken on the Top-10 items that have been recorded in the respective countries. For 7 countries, the top-10 item list represents more than 70% of the collected litter items; for 2 Countries represents approximately 68-69% of the collected litter items; and for 1 country approximately 25% 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%), Greece (72.2%), Israel (72.0%), Türkiye (71.5%), Spain (68.9%), Morocco (67.7%) and France (25.3%). The analysis and detailed list of the Top-10 item list per country is provided hereunder (Table 13).

Table 13: 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	4864	56.2%
2	G178	1080	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	3331	26.6%
2	G27	1938	15.5%
3	G95	1719	13.7%
4	G21/24	1380	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	G134	451	3.2%
2	G70	406	2.8%
3	G145	397	2.8%
4	G7/G8	372	2.6%
5	G30/31	361	2.5%
6	G35	351	2.5%
7	G158	332	2.3%
8	G33	317	2.2%
9	G32	314	2.2%
10	G200	312	2.2%

Greece			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G35	2284	15.4%
2	G27	1661	11.2%
3	G21/24	1549	10.4%
4	G30/31	1335	9.0%
5	G100	1230	8.3%
6	G95	1165	7.8%
7	G7/G8	438	2.9%
8	G10	415	2.8%
9	G33	345	2.3%
10	G50	304	2.0%

Israel			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G76	6202	18.3%
2	G4	3648	10.7%
3	G21/24	2867	8.4%
4	G33	2755	8.1%
5	G37	2014	5.9%
6	G10	1590	4.7%
7	G30/31	1540	4.5%
8	G27	1535	4.5%
9	G35	1433	4.2%
10	G50	876	2.6%

Lebanon			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	5975	34.8%
2	G76	2029	11.8%
3	G21/24	1654	9.6%
4	G208a	1619	9.4%
5	G124	1322	7.7%
6	G30/31	1182	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	5852	17.4%
2	G21/24	4067	12.1%
3	G30/31	3851	11.5%
4	G7/G8	2443	7.3%
5	G5	1870	5.6%
6	G124	1207	3.6%
7	G33	1180	3.5%
8	G4	856	2.5%
9	G153	721	2.1%
10	G70	670	2.0%

Slovenia			
Top 10	**Beach Litter Item**	**Total Items**	**%**
1	G27	1334	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	12116	15.8%
2	G76	9235	12.0%
3	G50	7868	10.3%
4	G21/24	6876	9.0%
5	G95	4701	6.1%
6	G124	4260	5.6%
7	G30/31	3092	4.0%
8	G73	2112	2.8%
9	G3	1506	2.0%
10	G204	1148	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%

78. The aforementioned analysis provides very interesting results for the top item list at the level of the Mediterranean. The Top-10 item lists from the 10 countries, extracts into 37 common items (table w). From the 38 items:

- 3 items have a share of more than 10%, respectively: the *Cigarette butts and filters* (G27) with 23.3%, *Plastic/polystyrene pieces 2.5 cm > < 50 cm* (G76) with 14.8%, and *Plastic caps and lids* (including rings from bottle caps/lids) (G21/24) with 12.9%.
- 2 items have a share between 5-10%, respectively: *Crisps packets/sweets wrappers/Lolly sticks* (G30/31) with 8.0%, and *String and cord (diameter less than 1 cm)* (G50) with 6.0%,
- 12 items have a share between 5-1%: *Other plastic/polystyrene items (identifiable) including fragments* (G124) with 4.7%, *Cotton bud sticks* (G95) with 4.4%, *Small plastic bags, e.g. freezer bags incl. pieces* (G4) with 3.2%, *Cups and cup lids* (G33) with 3.0%, *Drink bottles* (G7/G8) with 2.6%, *Straws and stirrers* (G35) with 2.2%, *Shopping bags incl. pieces* (G3) with 1.6%, *The part that remains from rip-off plastic bags* (G5) with 1.6%, *Food containers incl. fast food containers* (G10) with 1.4%, *Foam sponge [items (i.e. matrices, sponge, etc.)]* (G73) with 1.4%, *Mesh bags (e.g., vegetables, fruits and other products) excluding aquaculture mesh bags* (G37) with 1.3%, and *Glass fragments >2.5cm* (G208a) with 1.1%.
- 20 items have a shared of less than 1%, respectively: G100, G95, G204, G178, G153, G70, G145, G134, G70, G--, G158, G45, G32, G200, G28, G158, G165, G53, G152, G49.

4.2.2 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
GE**S Target(s)**	Decreasing trend in the number/amount of marine litter items in the water surface and the seafloor
Baseline and Threshold Values	BV: 369 items/100m | TV: 130 items/100m

4.2.2.1 GES Assessment for Floating Microplastics (IMAP EO10 CI23)

79. **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 361 surface manta net trawls/stations are monitored during the period 2017-2021 in the following countries: Bosnia-Herzegovina, Croatia, France, Greece, Israel, Italy, Lebanon, Türkiye, Slovenia, Spain.

80. Concentrations of Floating Microplastics (items/km^2) are highly variable fluctuating between 0 and 31 items /km^2. Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.42 ± 2.1 items/km^2.

81. Following the assessment methodology explained in Chapter 2.2, and using the TV of 0.00132 items/km^2, temporal average data from the 361 stations are compared against the TV, resulting in their classification under 4 status classes (High, good, moderate, poor, bad) shown in **Table 14**. Practically all stations monitored (99%) do not achieve GES, and most of them fall into the poor (52 %) and bad (31 %) 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 14: The classification of the 361 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	3	**1**	**1 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	**0**	
1xTV< ≤10xTV	MODERATE	43	**12**	**99 % non-GES**
10xTV< ≤100xTV	POOR	188	**52**	
100xTV< ≤1000xTV	BAD	111	**31**	
>1000x TV	VERY BAD	16	**4**	

82. It is clear from Table 15 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 33% of monitored stations exceed the bad class with concentrations more than 1000 times the TV and are classified as 'very bad'. In the WM only 2 % of stations are found above 1000xTV. These results are depicted spatially in the maps of Figures 6 to 9.

Table 15: 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	1	**1**	**97 % non-GES**
10xTV< ≤100xTV	POOR	31	**44**	
100xTV< ≤1000xTV	BAD	37	**52**	
>1000x TV	VERY BAD	0	**0**	
		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	6	**55**	
100xTV< ≤1000xTV	BAD	5	**45**	
>1000x TV	VERY BAD	**0**	**0**	
		11 stations		
Eastern Mediterranean sub-Region				
≤ 0.5xTV	HIGH		**0**	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD		**0**	
1xTV< ≤10xTV	MODERATE		**0**	**100 % non-GES**
10xTV< ≤100xTV	POOR	7	**19**	
100xTV< ≤1000xTV	BAD	17	**47**	
>1000x TV	VERY BAD	12	**33**	
		36 stations		
Western Mediterranean sub-Region				
≤ 0.5xTV	HIGH		**0**	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD	1	**0**	
1xTV< ≤10xTV	MODERATE	42	**17**	**100 % non-GES**
10xTV< ≤100xTV	POOR	58	**24**	
100xTV< ≤1000xTV	BAD	138	**57**	
>1000x TV	VERY BAD	4	**2**	
		243 stations		

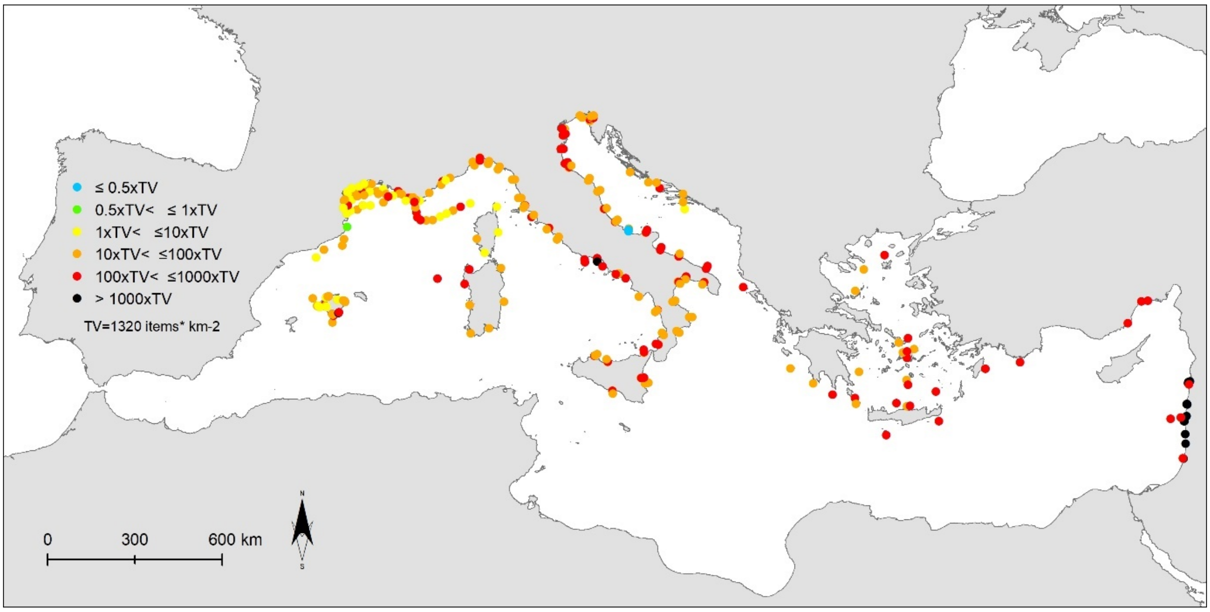


Figure 6: GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Mediterranean Region

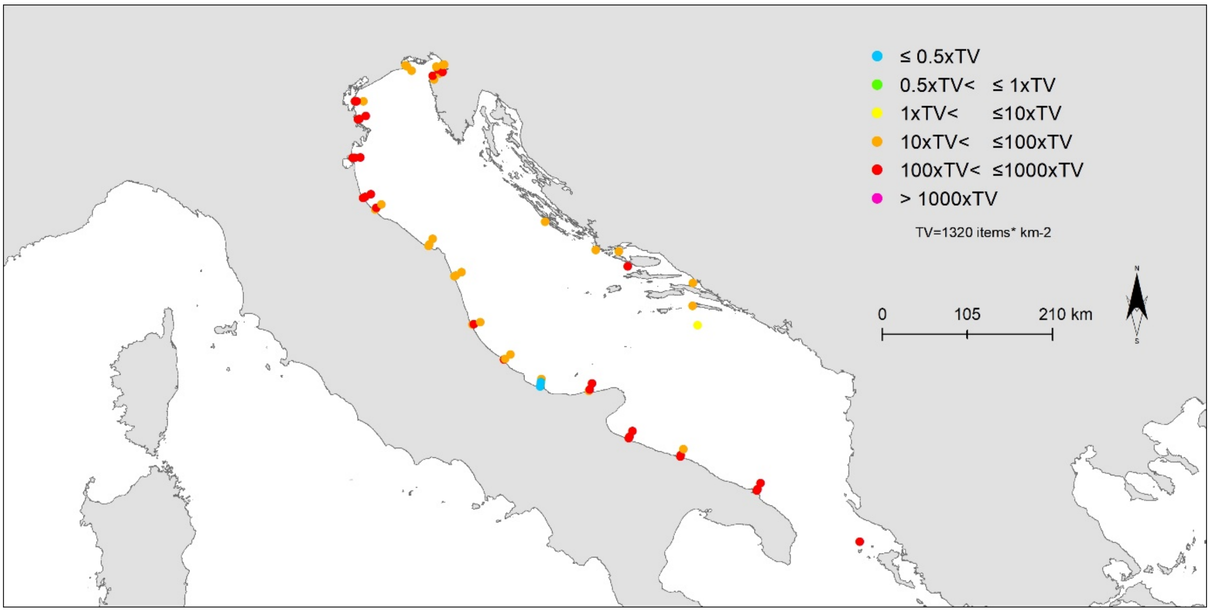


Figure 7: GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Adriatic Mediterranean sub-region

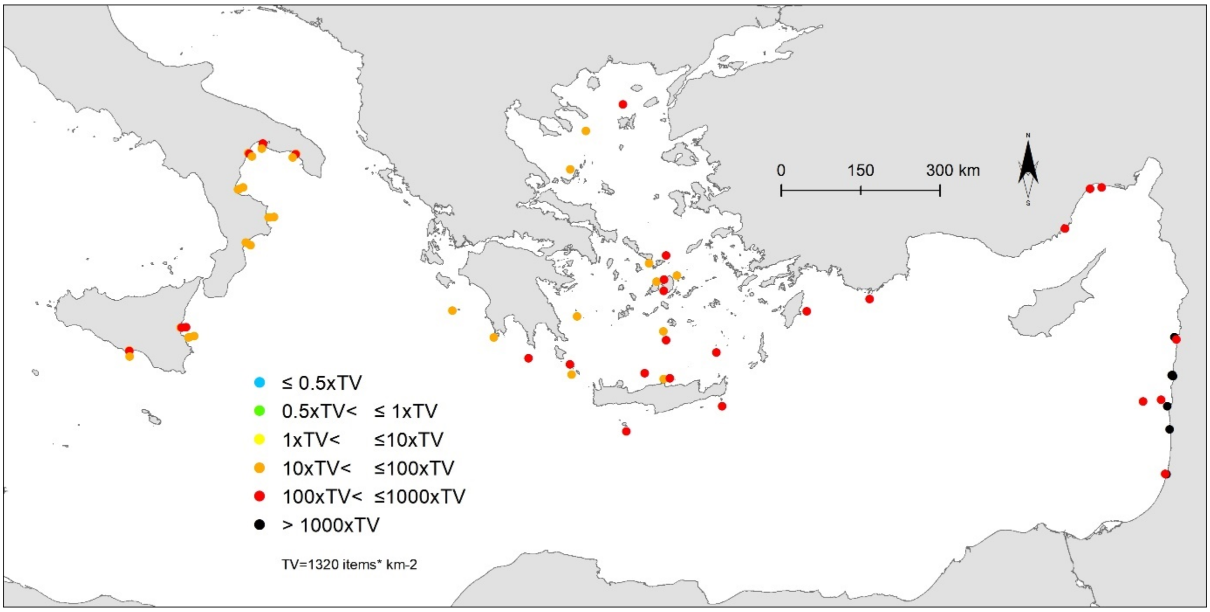


Figure 8: GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Eastern and Central Mediterranean sub-Regions.

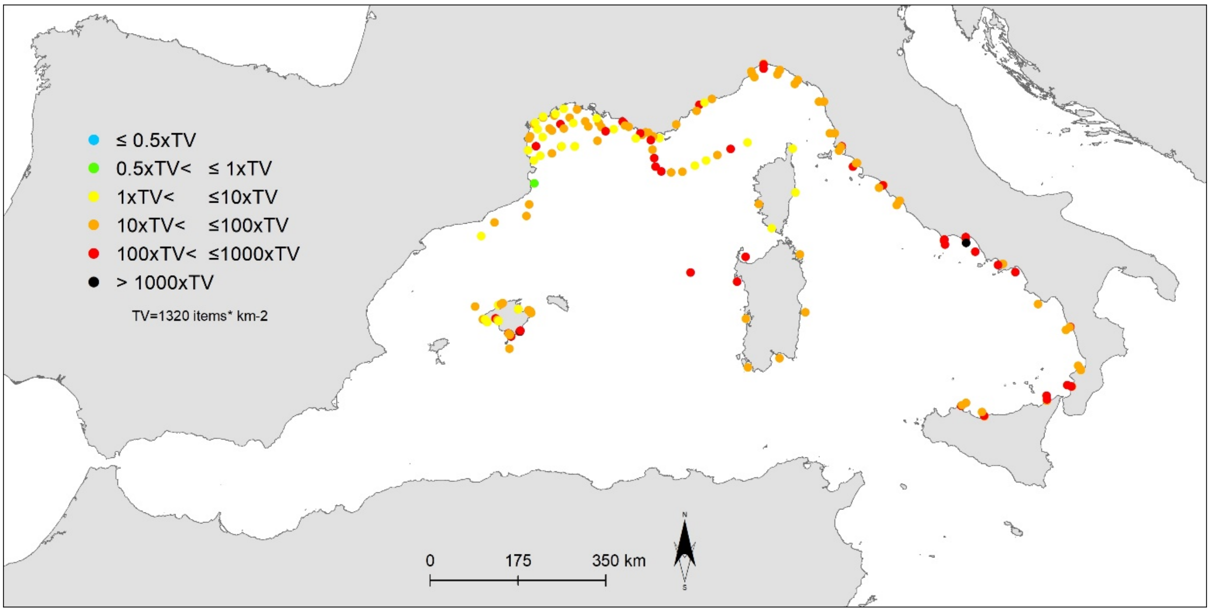
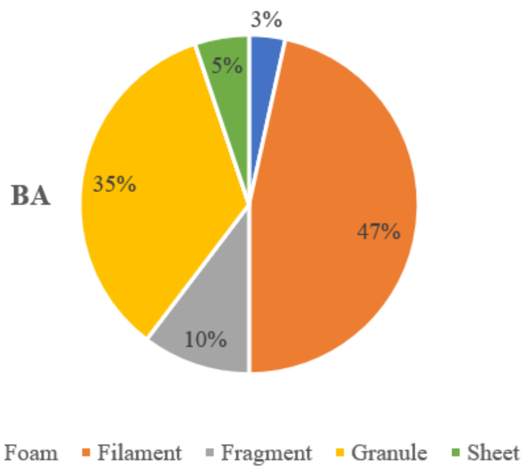
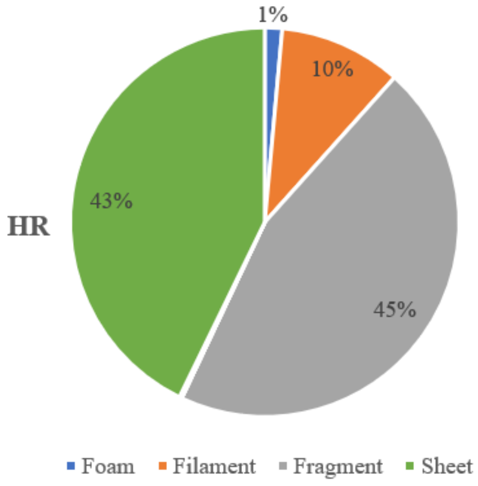


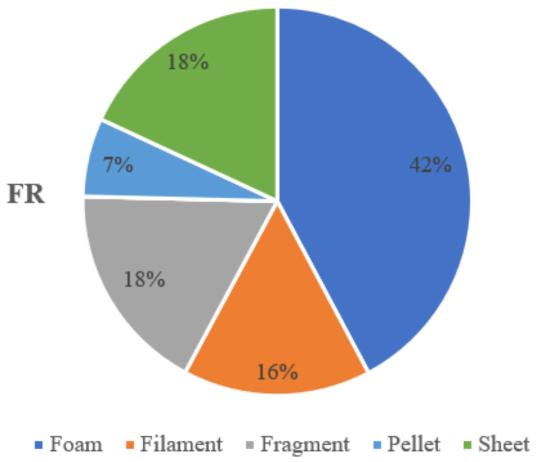
Figure 9: GES assessment classification of the monitored stations for sea surface floating microplastics CI23 in the Western Mediterranean sub-Region

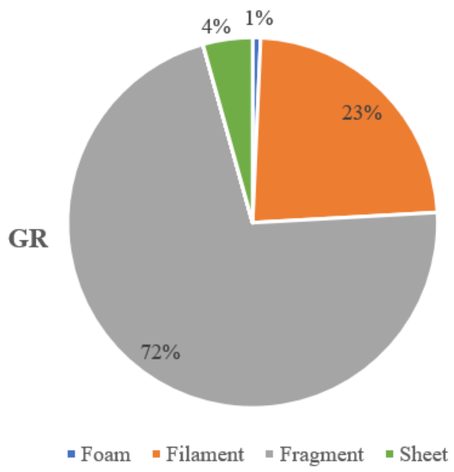
83. The data submitted for floating microplastics from the 11 Countries, also provide interesting results regarding the qualitative composition and the different types of microplastics. Predominant in abundance are the Sheets (39%), followed by Filaments (29%), Pellets (21%), Fragments (5%), Foam (5%), and Granules (1%).

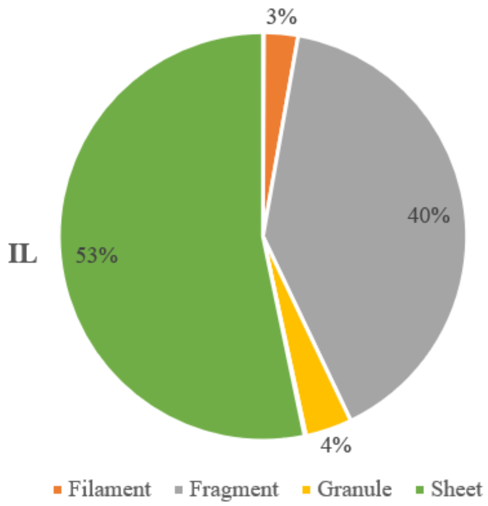
84. The graphs below are representing the qualitative composition (different types of microplastics) per respective country:

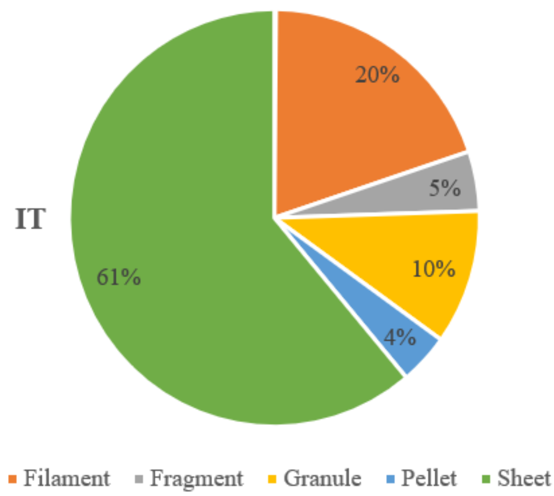

BA
3%
5%
35%
47%
10%
Foam
Filament
Fragment
Granule
Sheet

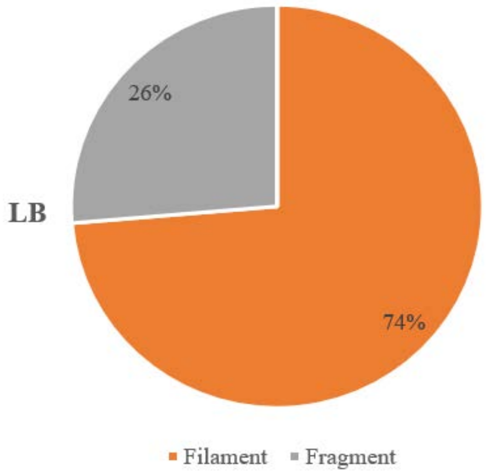

HR
1%
10%
43%
45%
Foam
Filament
Fragment
Sheet

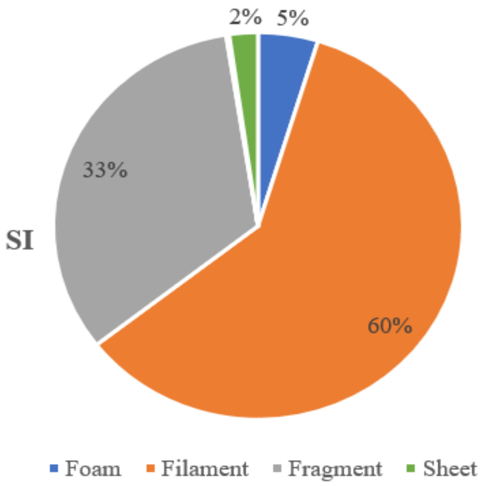

FR
18%
7%
42%
18%
16%
Foam
Filament
Fragment
Pellet
Sheet

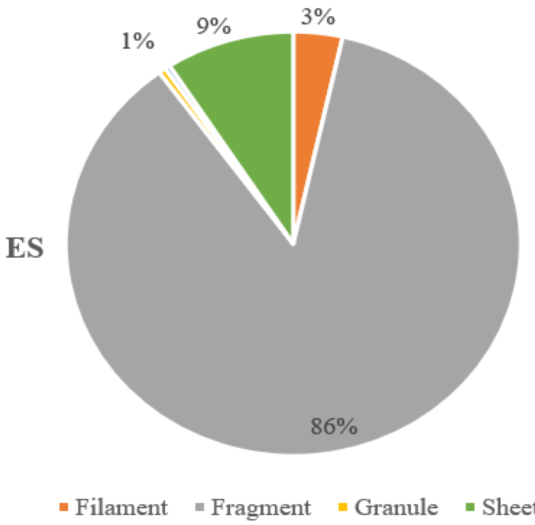

GR
4%
1%
23%
72%
Foam
Filament
Fragment
Sheet

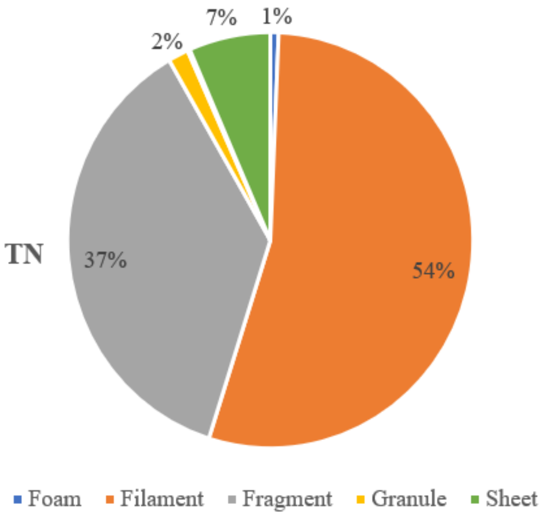

IL
3%
40%
53%
4%
Filament
Fragment
Granule
Sheet

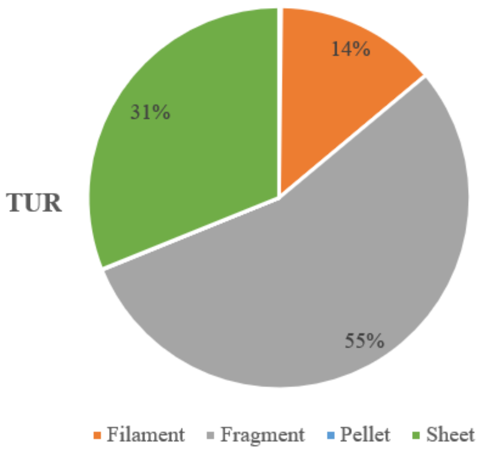

IT
20%
5%
10%
4%
61%
Filament
Fragment
Granule
Pellet
Sheet


LB
26%
74%
Filament
Fragment


SI
2%
5%
33%
60%
Foam
Filament
Fragment
Sheet


ES
1%
9%
3%
86%
Filament
Fragment
Granule
Sheet


TN
2%
7%
1%
37%
54%
Foam
Filament
Fragment
Granule
Sheet


TUR
14%
31%
55%
Filament
Fragment
Pellet
Sheet

4.2.2.2 The Mediterranean litterscape assessed from the air during the ACCOBAMS survey initiative

85. Garbage patches in the world’s oceans are well documented, but quantitative assessments of floating debris are still lacking in some major areas. The Mediterranean Sea is one such area, despite being recognized as one of the most plastic polluted environments. Coordinated by the ACCOBAMS Secretariat between 2017 and 2022, the ACCOBAMS Survey Initiative (ASI), was the first international basin-wide survey of the Mediterranean Sea primarily aiming at estimating cetacean abundance and distribution. Additional objectives of this project were to provide the first basin-wide estimate of other marine megafauna, including seabird, sea turtles and other large vertebrates, as well as of floating mega-debris (>30 cm) and their distribution across the entire Mediterranean Sea.

86. The aerial component of the ASI was conducted from June to August 2018 over most of the Mediterranean Sea (Figure 10). Data collection followed a strip-transect protocol and coverage of the study area was optimized using a zig-zag layout for transects. High-wing double-engine aircrafts were used during the ASI survey, fitted with bubble-windows to offer better observation condition at the vertical of the aircraft. Observers were trained to search for all mega-debris larger than 30 cm in size present in a 200 m strip on both side of the aircraft, distinguishing between fishery, plastic and processed wood debris when possible. The aircraft flew at a constant speed of c.167 km/h (90 knots) at a height of c.183 m (600 feet) above sea level. Observation conditions (e.g., sea state, turbidity, cloud cover, glare severity, glare orientation) were systematically recorded during active survey effort. A total distance of 55 738 km was flown during the ASI.

87. 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-debris were recorded in total during the ASI (Figure 11), with an average encounter rate of 0.8 mega-debris per km (standard deviation 3.2), ranging between 0 and 111 debris per km. More than two thirds of the mega-debris 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 debris were 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- debris 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.

88. During the ASI, only 20% of the Mediterranean was free of floating mega-debris. 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-debris 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), 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.

89. The spatially explicit modelling of mega-debris presence revealed a very heterogeneous distribution of floating mega-debris during summer: highest densities of debris 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

km2. 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 debris 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.

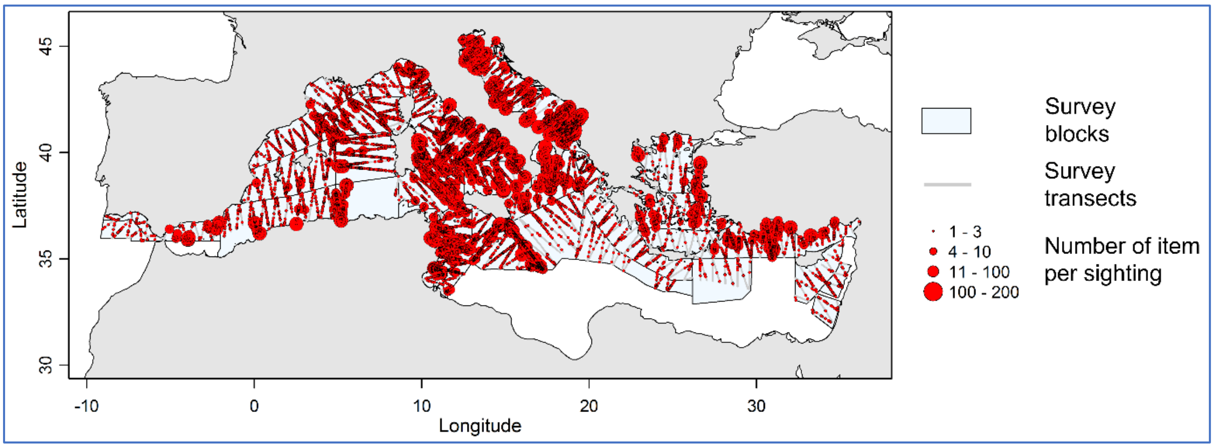


Figure 10: ACCOBAMS Survey Initiative (ASI) blocks, sampled transects and distribution of sighted floating mega-debris. Transects were sampled once by 14 different teams operating 8 planes simultaneously in different areas. There was no aerial survey effort off the coasts of Morocco, Libya, Egypt and east of Cyprus where the ASI survey was conducted by boat.

90. 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.

91. 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.

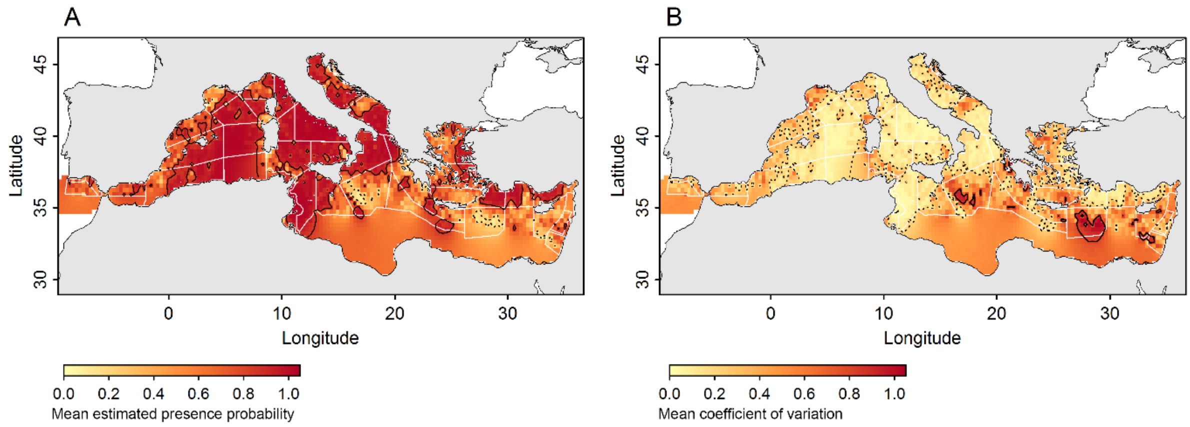


Figure 11: (A): Estimated presence probability (posterior mean) of floating mega-debris. (B): Uncertainty in estimated presence probability (coefficient of variation). Isolines corresponding to contours 20% probabilities are shown in dotted black lines and 80% contours in solid black lines. ASI survey blocks are shown in solid white lines.

4.2.2.3 GES Assessment for Seafloor Macroplastics (IMAP EO10 CI23)

92. **Seafloor marine litter (CI23)** data are reported in the IMAP InfoSystem from 8 CPs covering three sub-divisions of the Mediterranean region (ADR, EM, WM). In total 230 seafloor trawls/stations are monitored during the period 2017-2021 in the following countries: Cyprus, Türkiye, Israel, Malta, Croatia, Slovenia, France Tunisia. All trawls are situated on fishing grounds, thus in most of the cases in soft-bottom grounds.

93. Concentrations of seafloor marine litter (items/km^2) are highly variable fluctuating between 0 and 9394 items /km^2. Average seafloor litter concentration on the Mediterranean coastline is found equal to 176 ± 179 items/km^2.

94. Following the assessment methodology explained in Chapter 2.2, and using the TV of 16 items/km^2, temporal average data from the 230 seafloor stations are compared against the threshold, resulting in their classification under 4 status classes (High, good, moderate, poor, bad) shown in Table 16. Overall, 92% of the seafloor stations monitored do not achieve GES, and most of them (63 %) fall into the bad category, i.e., seafloor litter concentrations are up to five times higher than the TV. In Table 17 the classification results are given for each sub-Region separately.

Table 16: The classification of the 230 seafloor stations monitored in the Mediterranean Region

Mediterranean Region				
Boundary limits	**GES- nonGES classes**	**No of stations**	**% of stations**	
≤ 0.5xTV	HIGH	12	**5**	**8 % GES**
0.5xTV< ≤ 1xTV	GOOD	8	**3**	
1xTV< ≤2xTV	MODERATE	13	**6**	**92 % nonGES**
2xTV< ≤5xTV	POOR	53	**23**	
> 5xTV	BAD	146	**63**	

95. On the sub-region level the Western Mediterranean highly appears affected by seafloor marine litter since all stations monitored (100%) are classified as bad and fall in the nonGES category. The Adriatic sub-region follows with 89% of the stations monitored falling into the nonGES class. In this case, the highest percentage of seafloor stations are classified under the poor (39 %) and bad (33 %) classes. The Eastern Mediterranean subregion is also affected by seafloor litter, since 84 % of the monitored stations are classified under nonGES class, with elevated percentages under the poor (34 %) and bad classes (42 %). These results are depicted spatially in the maps of Figures 12 to 15 from where the uneven distribution of stations within each sub-region can be seen, for example the WM is covered only by France (Gulf of Lions and Corsica).

Table 17: The classification of the monitored seafloor stations in three Mediterranean sub-Regions

Boundary limits	GES- nonGES classes	No of seafloor stations	% of Stations	
Adriatic sub-Region				
≤ 0.5xTV	HIGH	2	**11**	**11% GES**
0.5xTV< ≤ 1xTV	GOOD		**0**	
1xTV< ≤2xTV	MODERATE	3	**17**	**89 % non-GES**
2xTV< ≤5xTV	POOR	7	**39**	
> 5xTV	BAD	6	**33**	
18 stations				
Eastern Mediterranean sub-Region				
≤ 0.5xTV	HIGH	10	**9**	**16% GES**
0.5xTV< ≤ 1xTV	GOOD	8	**7**	
1xTV< ≤2xTV	MODERATE	10	**9**	**84% non-GES**
2xTV< ≤5xTV	POOR	39	**34**	
> 5xTV	BAD	48	**42**	
115 stations				
Western Mediterranean sub-Region				
≤ 0.5xTV	HIGH	0	**0**	**0 % GES**
0.5xTV< ≤ 1xTV	GOOD	0	**0**	
1xTV< ≤2xTV	MODERATE	0	**0**	**100 % non-GES**
2xTV< ≤5xTV	POOR	6	**6**	
> 5xTV	BAD	93	**94**	
99 stations				

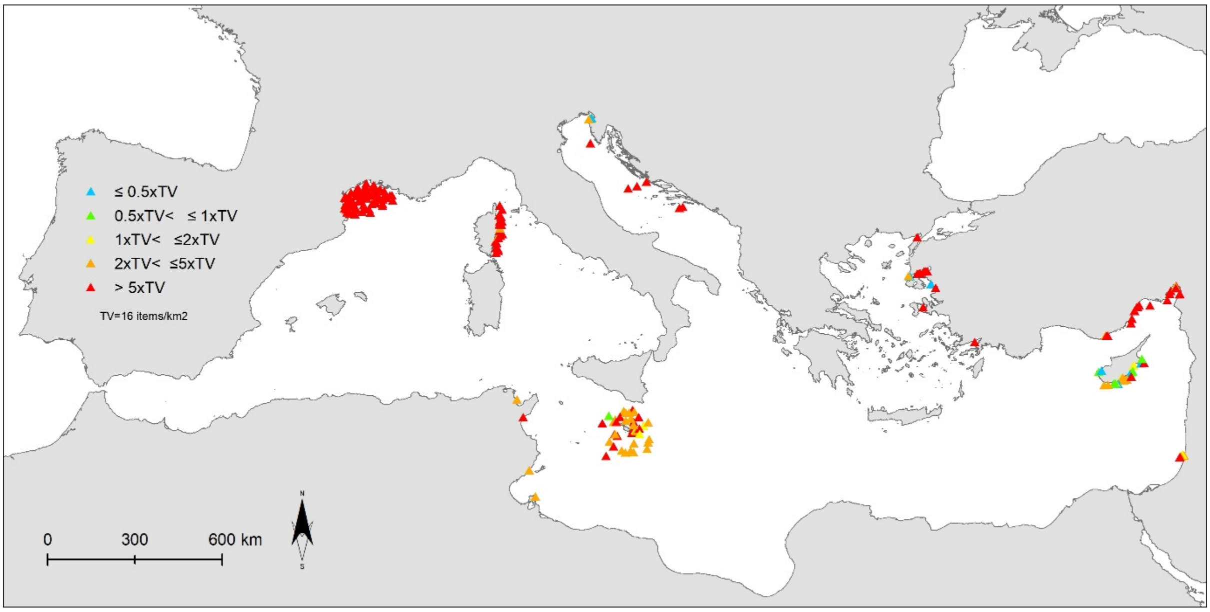


Figure 12: GES assessment classification of the seafloor stations monitored for marine litter in the Mediterranean Region.

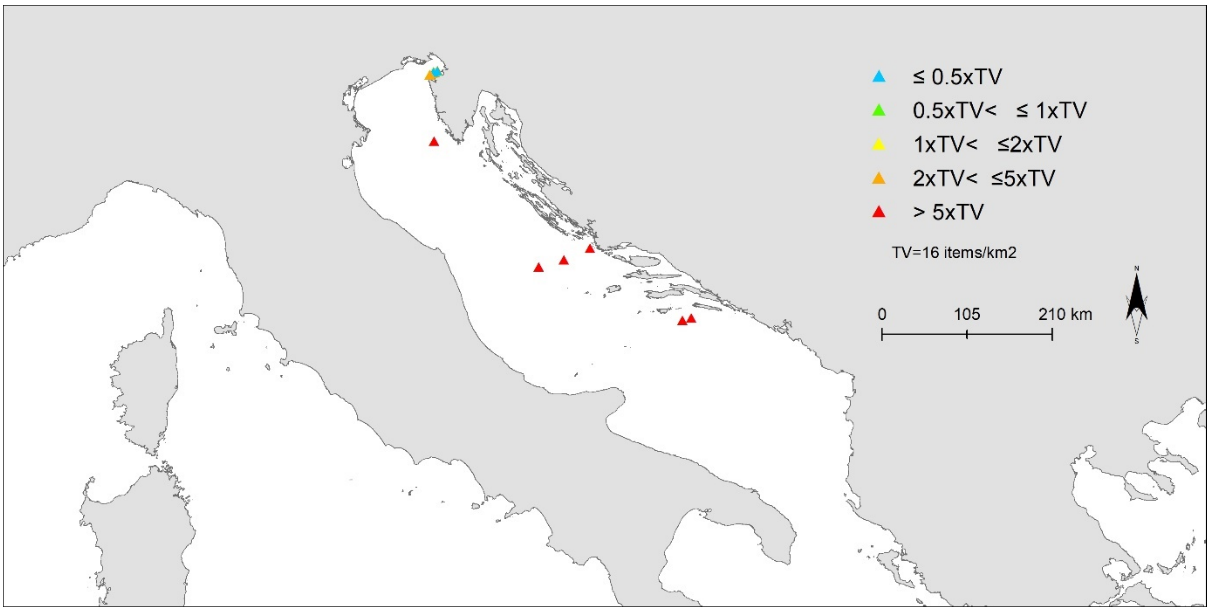


Figure 13: GES assessment classification of the seafloor stations monitored for marine litter in the Adriatic Mediterranean sub-regions.

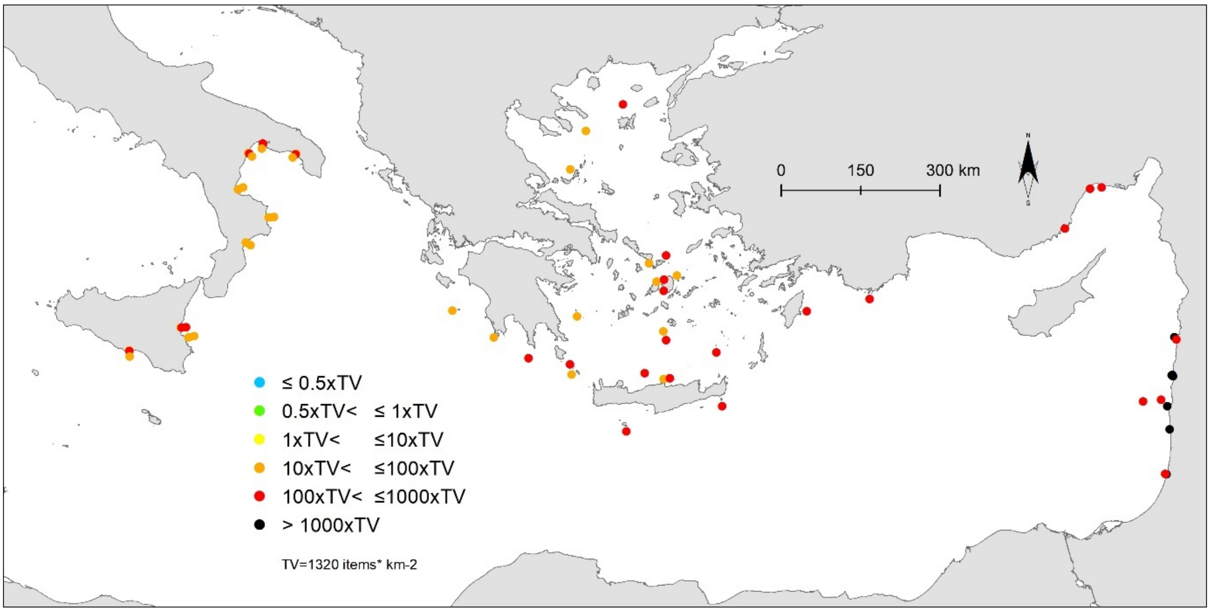


Figure 14: GES assessment classification of the seafloor stations monitored for marine litter in the Eastern and Central Mediterranean sub-Regions.

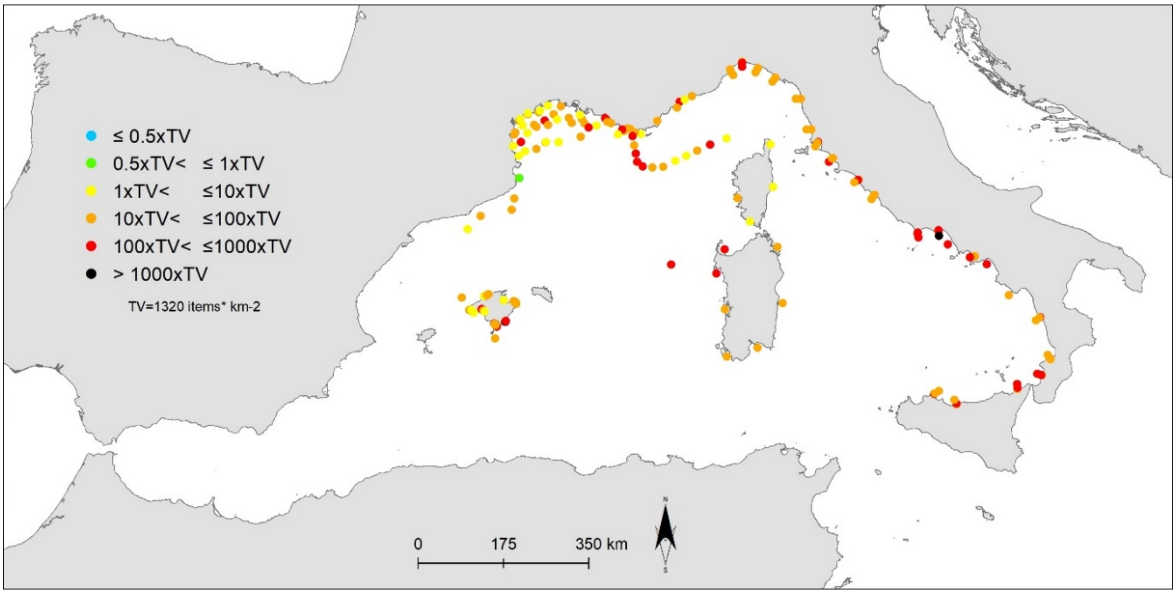


Figure 15: GES assessment classification of the seafloor stations monitored for marine litter in the Western Mediterranean sub-Region

96. Further to the submission of data for seafloor macrolitter, 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.

97. A small component (10%) of seafloor macrolitter was represented by fishery-related items. The most common items recorder 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%).

98. 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.

99. 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 Figures 16, 17 and 18, below:

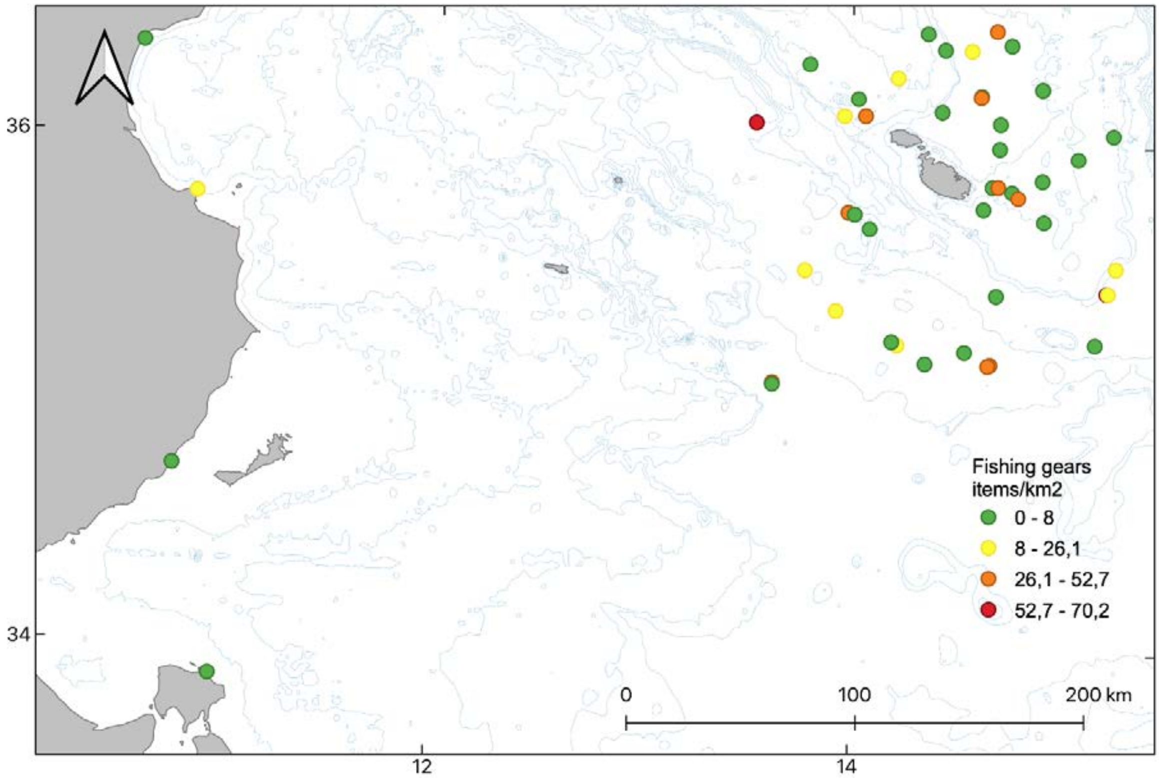


Figure 16: Fishing gear distribution on the seafloor of the Central Mediterranean sub-region.

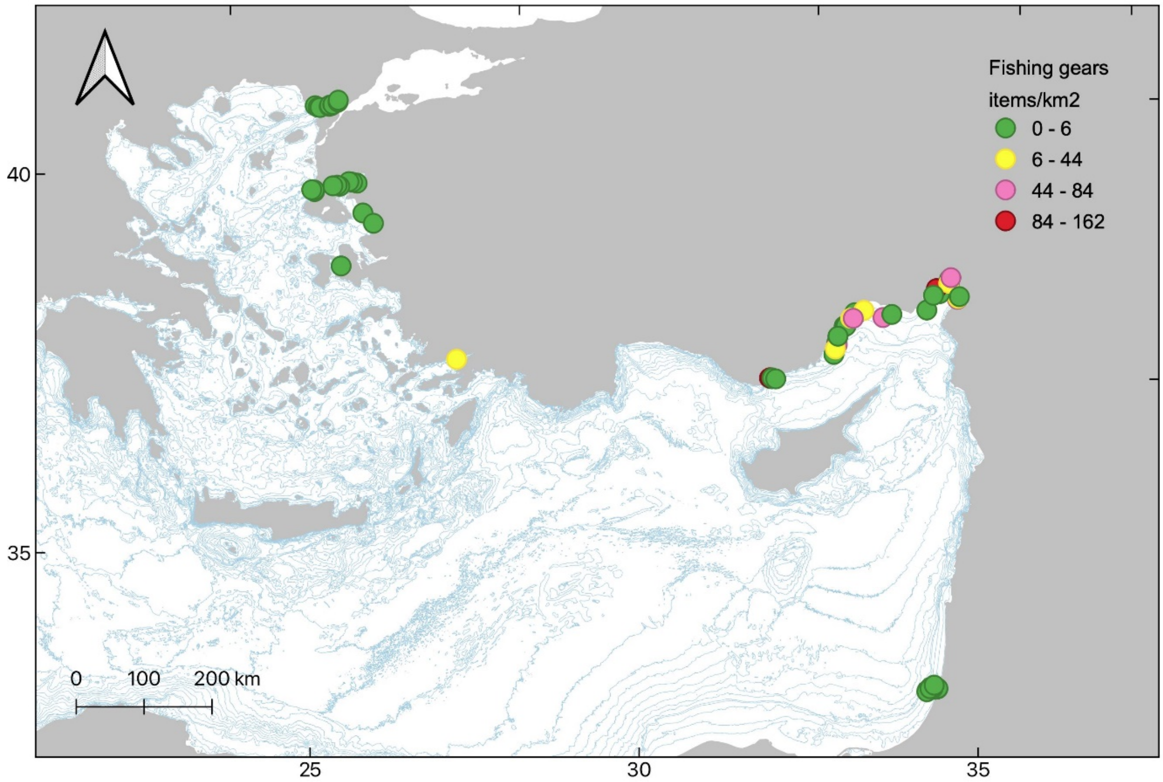


Figure 17: Fishing gear distribution on the seafloor of the Eastern Mediterranean sub-region.

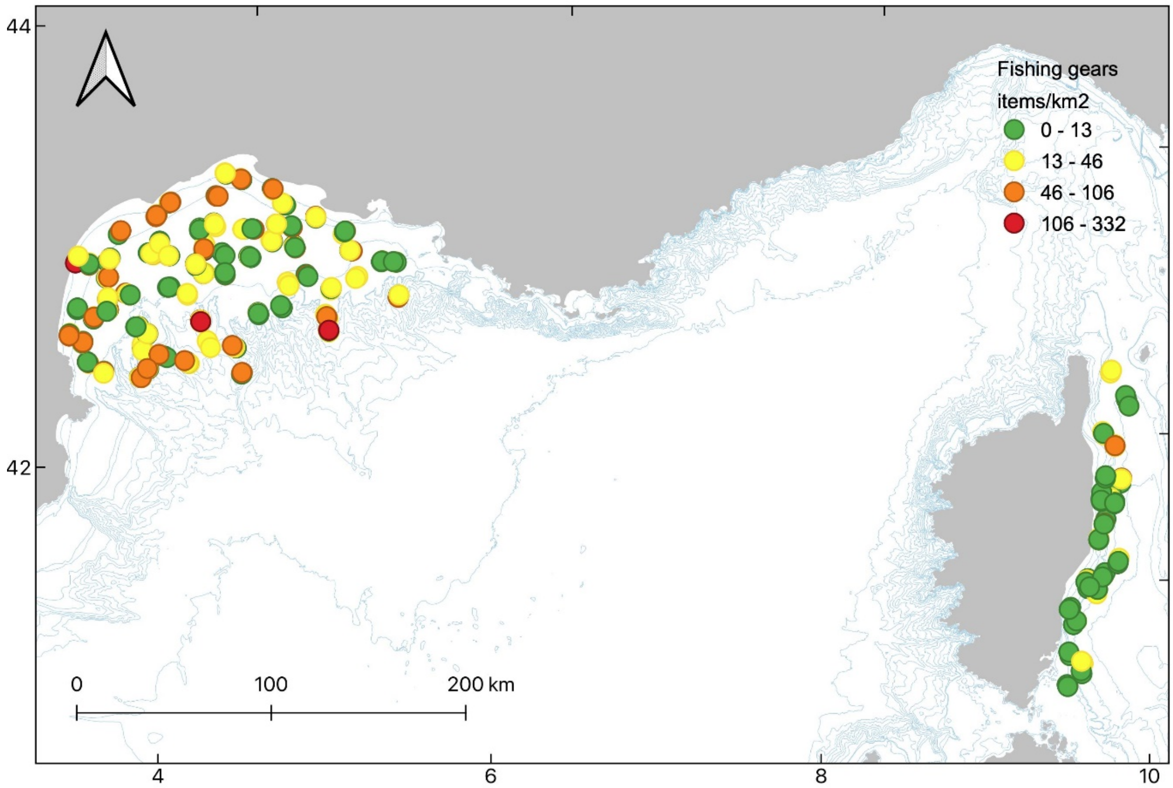


Figure 18: Fishing gear distribution on the seafloor of the Western Mediterranean sub-region.

4.3 GES Assessment for the EO / alternative assessment for EO

4.3.1 Application of the NEAT Assessment Tool for EO10 for the Adriatic Sub-region

4.3.1.1 Defining the assessment areas

100. The present work applies the methodology defined by UNEP/MAP in 2021 on Integration and Aggregation Rules for Monitoring and Assessment. The scope of the work is to provide an assessment on the Quality Status for the Adriatic Sea subregion of the Mediterranean Sea focusing on the level of IMAP Ecological Objective 10 (EO10) on Marine Litter and both Common Indicators CI22 and CI23. In brief, the nested approach is followed (UNEP/MAP 2016 and 2019,) which 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 within the Adriatic Sea based on the areas of monitoring.

101. 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).

102. 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 19. 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).

103. 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.

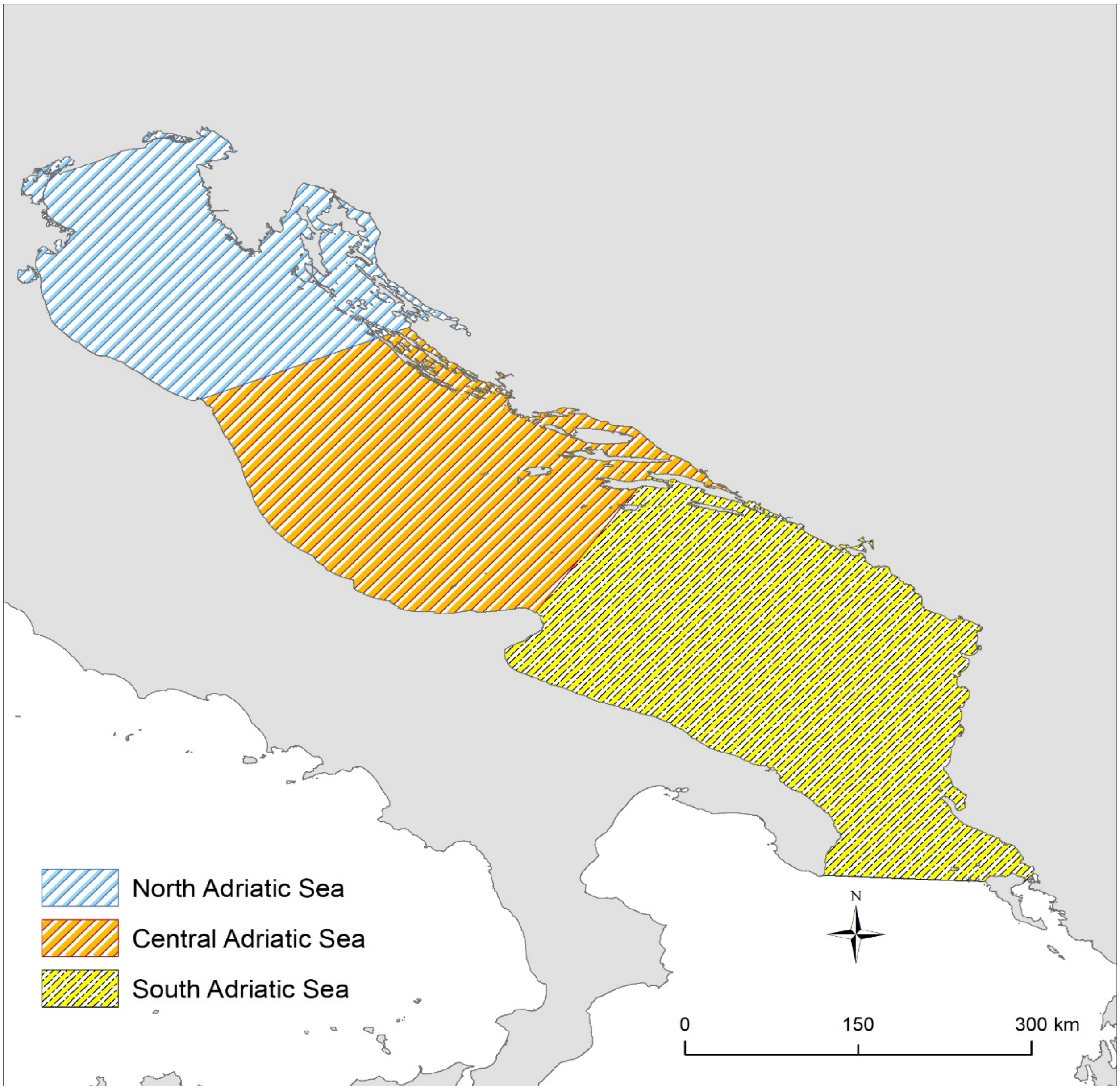


Figure 19: The 3 subdivisions of the Adriatic subregion.

104. 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 19). The NEAT assessment methodology is applied on the nesting scheme of SAUs and SubSAUs which has the ability to provide aggregated-integrated assessment results.

4.3.1.2 Data availability

105. Data on IMAP EO10 CI22 (beach macro-litter) have been collected from IMAP InfoSystem from 3 CPs (i.e., Bosnia and Herzegovina, Croatia and Slovenia) and off-line (i.e., through direct exchange with UNEP/MAP Secretariat during 2019) from another 3 CPs (i.e., Albania, Italy and Montenegro), bordering the Adriatic Sea for the years 2016 to 2018. In the present QSR data

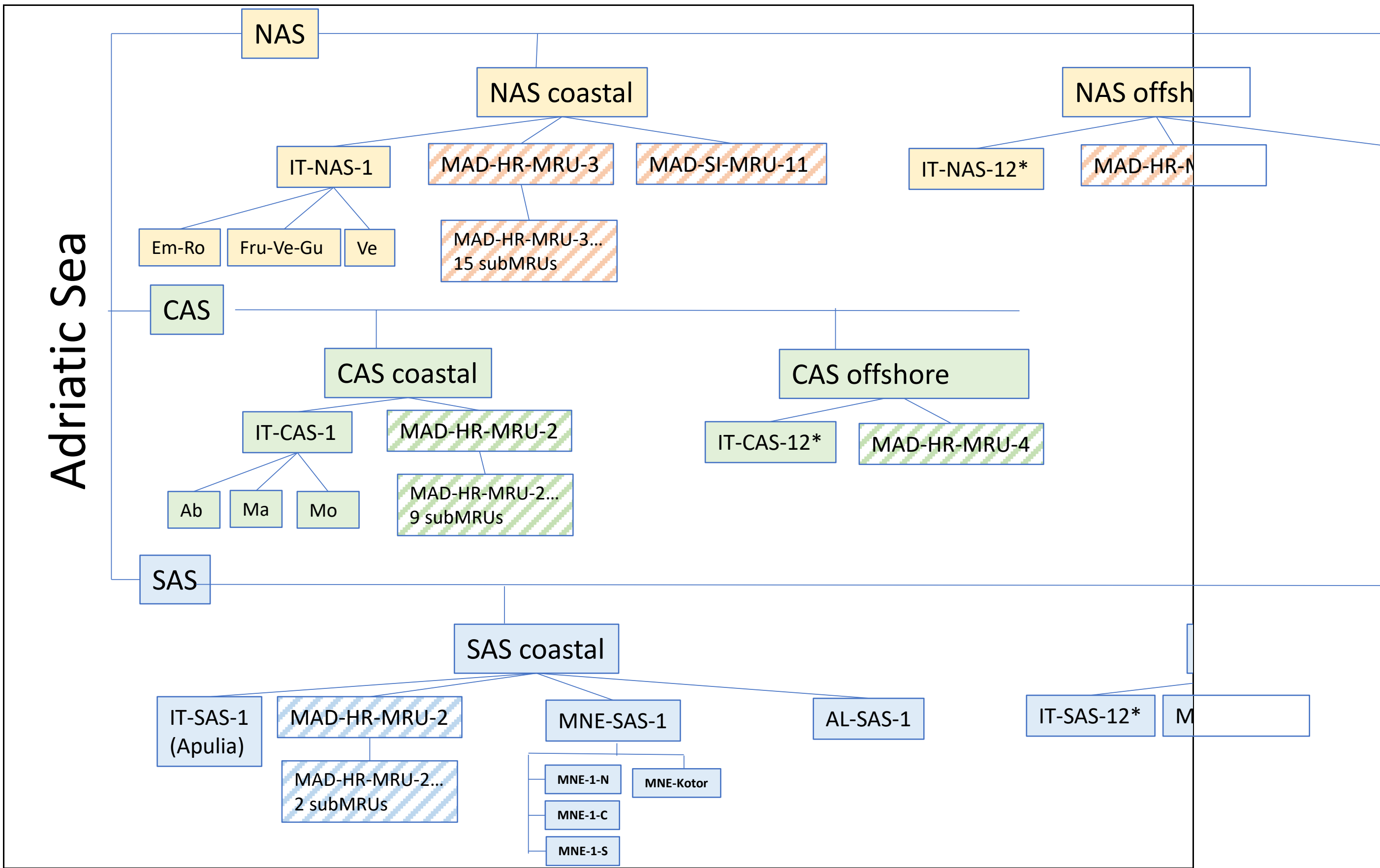
exclusively submitted through IMAP InfoSystem have been used, however for the present exercise and in order to be able to document an integrated assessment (i.e., both for CI22 and CI23), additional data sources were used in order to strengthen the present exercise (application of Neat Tool). Data on IMAP EO10 CI23 (seafloor macro-litter) were reported to the IMAP InfoSystem only by Slovenia and Croatia. Data on IMAP EO10 CI23 (floating microplastics) data sets were reported by 5 CPs (Bosnia & Herzegovina, Croatia, Greece, Italy, Slovenia). Details on the temporal and spatial availability of data per IMAP SAU, are provided in Tables 18 and 19.

106. The spatiotemporal coverage of monitoring varies largely among the CPs and the IMAP SAUs. Of a total of 52 national subSAUs, 27 subSAUs lack of data on either CI22 or CI23. Existing data on CI22 (beach macro-litter) and CI23 (floating microplastics) correspond to 18 subSAUs each. Finally, for CI23 (seafloor macro-litter) data exist for only 5 subSAUs. Only three subSAUs, namely MAD-Sl-MRU-11, MAD-Sl-MRU-12, HRO-0423-KOR, are monitored for all 3 EO10 parameters (beach macro-litter, seafloor macro-litter, and floating microplastics); the rest are covered by either two or one parameter.

107. On the subdivision level the highest coverage corresponds to CAS, where 8 out of 14 SubSAUs are monitored for at least one EO10 parameter, then follows the SAS with 9 out of 16 subSAUs and finally the NAS is the least covered area with only 8 out of 22 subSAUs monitored.

108. Beach litter data correspond to a total of 36 beaches, Seafloor litter to 18 seafloor monitoring stations and floating microplastics to 71 monitoring stations. The number of monitoring stations and their spatial distribution results to a rather insufficient spatial coverage of the Adriatic Sea sub-Region which is critical for the assessment of EO10 due to the high variability of the relevant parameters observed worldwide.

109. Regarding the temporal coverage, data from all CPs cover the years 2017, 2018, 2019, 2020. Exception to this are the data reported by Bosnia-Herzegovina (2019, 2021) and Greece (2020). Overall, this spatiotemporal coverage, hinders a meaningful integrated assessment. Having this in mind the results from the application of the NEAT tool 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.



* 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 19: 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

Table 18: Spatial coverage of monitoring CI22, CI23 data collected for the Adriatic Sea. The number of monitoring stations/beaches in the SAUs of the Adriatic Sea is shown.

Sub-division	Zone	SAU	sub-SAU	No beaches	No of Seafloor stations	No of Floating MPs stations
North Adriatic (NAS)						
	NAS coastal					
		MAD-HR-MRU-3				
			HRO-O423-KVJ	4		
		IT-NAS-1				
			Emilia Romagna	4		4
			Friuli Venezia Giulia	4		4
			Veneto	4		6
		MAD-SI-MRU-11		4	2	4

Sub-division	Zone	SAU	sub-SAU	No beaches	No of Seafloor stations	No of Floating MPs stations
	NAS Offshore					
		MAD_Sl_MRU_12			**10**	**3**
		MAD-HR-MRU-5			**1**	
		IT-NAS-O				**7**
Central Adriatic (CAS)						
	CAS coastal					
		MAD-HR-MRU-2				
			HRO-0423-BSK	1		**1**
			HRO-0423-KOR	1	**1**	**1**
		IT-CAS-1				
			Abruzzo Marche Molise	4 4 1		2 2 3
	CAS offshore					
		MAD-HR-MRU_4		1	4	1
		IT-CAS-O				10
South Adriatic (SAS)						
	SAS coastal					
		IT-SAS-1	Apulia	3		
		MAD-HR-MRU-2				
			HRO-O423-MOP	2		2
			HRO-0313-NEK			1
		MNE-1				
			MNE-1-N MNE-Kotor	1 1		
		AL-1		2		
		BiH-1		2		
	SAS offshore					
		IT-SAS-O				4
		MAD-EL-MS-AD				1

Table 19: Temporal coverage of the monitoring beach litter data collected for the Adriatic Sea. The years of data collected per SAU are shown.

Sub-division	Zone	SAU	sub-SAU	Years monitored beaches	Years monitored Seafloor Stations	Years monitored Floating MPs Stations
North Adriatic (NAS)						
	NAS coastal					
		MAD-HR-MRU-3				
			HRO-O423-KVJ	2017 to 2020		
		IT-NAS-C				
			Emilia Romagna	2017 to 2020		2017 to 2020
			Friuli Venezia Giulia	2017 to 2020		2017 to 2020
			Veneto	2017 to 2020		2017 to 2020
		MAD-Sl-MRU-11		2017	2017 to 2020	2019-2020
	NAS Offshore					
		MAD-Sl-MRU-12			2017 to 2020	2019-2020
		MAD-HR-MRU-5			2017 to 2020	
		IT-NAS-O				2017 to 2020
Central Adriatic (CAS)						
	CAS coastal					
		MAD-HR-MRU-2				
			HRO-0423-BSK	2017 to 2020		2017 to 2020
			HRO-0423-KOR	2017 to 2020	2017 to 2020	2017 to 2020
		IT-CAS-C				
			Abruzzo	2017 to 2020		2017 to 2020
			Marche	2017 to 2020		2017 to 2020
			Molise	2017 to 2020		2017 to 2020
	CAS offshore					
		MAD-HR-MRU_4		2017 to 2020	2017 to 2020	2017 to 2020
		IT-CAS-O				2017 to 2020
South Adriatic (SAS)						
	SAS coastal					
		IT-SAS-C	Apulia	2017 to 2020		
		MAD-HR-MRU-2				
			HRO-O423-MOP	2017 to 2020		2017 to 2020
			HRO-0313-NEK			2017 to 2020
		MNE-C				
			MNE-1-N	2018		
			MNE-Kotor	2018		
		AL-C		2018		
		BiH-C		2019-2021		2019
	SAS offshore					
		IT-SAS-O				2017 to 2020
		MAD-EL-MS-AD				2020

4.3.1.3 Setting the assessment criteria

110. 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 have been submitted for review to the CORMON Meeting for Marine Litter Monitoring on 3 March 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 16 items/km^2 for seafloor litter, and the TV equal to 0.00132 items/m2 for floating microplastics.

111. 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.

112. The 5 NEAT status classes for CI22 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 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.

113. 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 Tables 20 and 21.

Table 20: 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 Seafloor Litter	**1/2(TV)**	**TV**	**2(TV)**	**5(TV)**	
Thresholds for CI23 Floating Microplastics	**1/2(TV)**	**TV**	**10(TV)**	**100(TV)**	

Table 21: 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/km^2)	0	8	16	32	80	2000
Floating Microplastics (items/m^2)	0	0.00066	0.00132	0.0132	0.132	1.076

114. A data matrix to be used for the NEAT software was prepared and given below in Table 22.

Table 22: 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)	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	753 ± 90 n=22		0.330 ± 0.093 n=4
			Friuli Venezia Giulia	1218 ± 252 n=23		0.042 ± 0.006 n=4
			Veneto	744 ± 159 n=21		0.270 ± 0.046 n=6
		MAD-Sl-MRU-11		402 ± 56 n=24	59 ± 3 n=2	0.123 ± 0.014 n=4
	NAS Offshore					
		MAD-Sl-MRU-12			33 ± 7 n=10	0.113 ± 0.023 n=3
		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	1151± 185 n=20		0.122 ± 0.026 N=2
			Marche	782 ± 152 n=22		0.151 ± 0.009 n=2
			Molise	209 ± 48 n=6		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 Adriatic (SAS)						
	SAS coastal					
		IT-SAS-C	Apulia	826 ± 128 n=17		
		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-C				
			MNE-1-N	1911 ± 1529 n=2		
			MNE-Kotor	968 ± 190 n=2		
		AL-C		757 ± 187 n=4		
		BiH-C		1240 ± 611 n=2		0.011 n=1
	SAS offshore					
		IT-SAS-O				0.391 ± 0.230 n=4
		MAD-EL-MS-AD				0.168 n=1

4.3.1.4 Results of the NEAT tool for the Assessment of the IMAP EO10/CI22/CI23 status in the Adriatic subregion

115. The results obtained from the NEAT tool are shown in Table 23 and in Figures 20-23.

116. 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 (MAD-HRU-MRU-3, HRO-0423-KVJ, HRO-0423-KOR) and one under ‘Moderate’ (MAD-HRU-MRU-2). All other subSAUs are classified under ‘Poor’ or ‘Bad’ status. For the case of Seafloor Litter, the few subSAUs monitored in Slovenia and Croatia are classified under either ‘Poor’ or ’Bad’ status. Finally, for CI23 Floating Microplastics all subSAUs monitored are classified as non-GEs and under ‘Poor’ and ‘Bad’ classes.

117. Integration of data per each EO10 parameter on higher levels within the nesting scheme (bold lines in Table 6) shows that the NAS subdivision is classified under ‘Good’ status regarding Beach Litter and under ‘bad’ regarding Seafloor Litter and Floating MPs. The CAS subdivision is classified as ‘poor’ regarding Beach Litter and Floating Microplastics and under ‘bad’ regarding Seafloor Litter. Finally, the SAS subdivision is classified under ‘bad’ status for both Beach Litter and Floating Microplastics, while no data exist for Seafloor Litter.

118. When aggregating all EO10 parameters data per SubSAU, SubSAUs MAD-HRU-MRU-3, HRO-0423-KVJ fall into ‘Good’ class and IT-Mo-1 into ‘Moderate’. All other SAUs are classified under ‘poor’ or ‘bad’.

119. 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 23: Results of the NEAT tool on the assessment of IMAP EO10 in the Adriatic subregion. 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	CI22_SFL	CI23
Adriatic Sea	**139783**	**0**	**0.241**	**poor**	95	**0.362**	**0.145**	**0.229**
Northern Adriatic Sea	**31856**	**0**	**0.288**	**poor**	100	**0.607**	**0.16**	**0.199**
NAS-Coastal	**9069**	**0**	**0.548**	**moderate**	79	**0.607**	**0.288**	**0.209**
MAD-HR-MRU-3	6422	0	0.695	good	71	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	71	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	0.19	bad	75	0.17		0.209
IT-Em-Ro-1	371	0.003	0.171	bad	95	0.185		0.158
IT-Fr-Ve-Gi-1	575	0.004	0.234	poor	95	0.116		0.352
IT-Ve-1	1646	0.012	0.178	bad	82	0.186		0.171
MAD-Sl-MRU-11	55	0	0.277	poor	100	0.327	0.288	0.215
NAS-Offshore	**22788**	**0**	**0.185**	**bad**	82		**0.16**	**0.198**
MAD-HR-MRU-5	5571	0.056	0.157	bad	100		0.157	
IT-NAS-O	10540	0.106	0.197	bad	68			0.197
MAD-Sl-MRU-12	129	0.001	0.314	poor	97		0.396	0.232
Central Adriatic	**63696**	**0**	**0.277**	**poor**	100	**0.272**	**0.133**	**0.312**
CAS-Coastal	**9394**	**0**	**0.323**	**poor**	100	**0.463**	**0.093**	**0.291**
MAD-HR-MRU-2	7302	0	0.344	poor	44	0.555	0.093	0.303
HRO-0313-NEK	253	0.005	0.375	poor	100			0.375
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						

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence %	CI22_BL	CI22_SFL	CI23
HRO-0423-BSK	613	0.013	0.284	poor	100	0.285		0.282
HRO-0423-KOR	1564	0.034	0.362	poor	100	0.714	0.093	0.279
HRO-0423-MOP	2480	0						
IT-CAS-C	2092	0	0.249	poor	100	0.244		0.254
IT-Ab-1	282	0.005	0.171	bad	88	0.126		0.217
IT-Ma-1	319	0.006	0.188	bad	84	0.18		0.196
IT-Mo-1	229	0.004	0.429	moderate	75	0.478		0.38
CAS-Offshore	**54303**	**0**	**0.269**	**poor**	100	**0.191**	**0.14**	**0.315**
MAD-HR-MRU-4	18963	0.178	0.22	poor	99	0.191	0.14	0.328
IT-CAS-O	22393	0.21	0.311	poor	100			0.311
Southern Adriatic Sea	**44231**	**0**	**0.155**	**bad**	81	**0.163**		**0.155**
SAS-Coastal	**7276**	**0**	**0.186**	**bad**	49	**0.163**		**0.217**
MAD-HR-MRU-2	4252	0	0.2	poor	100	0.17		0.23
HRO-0313-ZUC	13	0						
HRO-0423-MOP	1756	0.031	0.2	poor	44	0.17		0.23
IT-SAS-C (Ap-1)	1810	0.013	0.18	bad	93	0.174		0.187
MNE-SAS-1	483	0	0.083	bad	81	0.083		
MNE-1-N	86	0.002	0.013	bad	80	0.013		
MNE-1-C	246	0						
MNE-1-S	151	0						
MNE-Kotor	85	0.002	0.153	bad	96	0.153		
AL-SAS-C	646	0.005	0.184	bad	72	0.184		
BiH-SAS-C	12.9	0	0.113	bad	86	0.113		
SAS-Offshore	**36955**	**0**	**0.149**	**bad**	86			**0.149**
IT-SAS-O	22715	0.241	0.145	bad	86			0.145
MNE-SAS-O	2076	0						
MNE-12-N	513	0						
MNE-12-C	713	0						
MNE-12-S	849	0						
AL-SAS-O	716	0						
MAD-EL-MS-AD	2253	0.024	0.192	bad	100			0.192

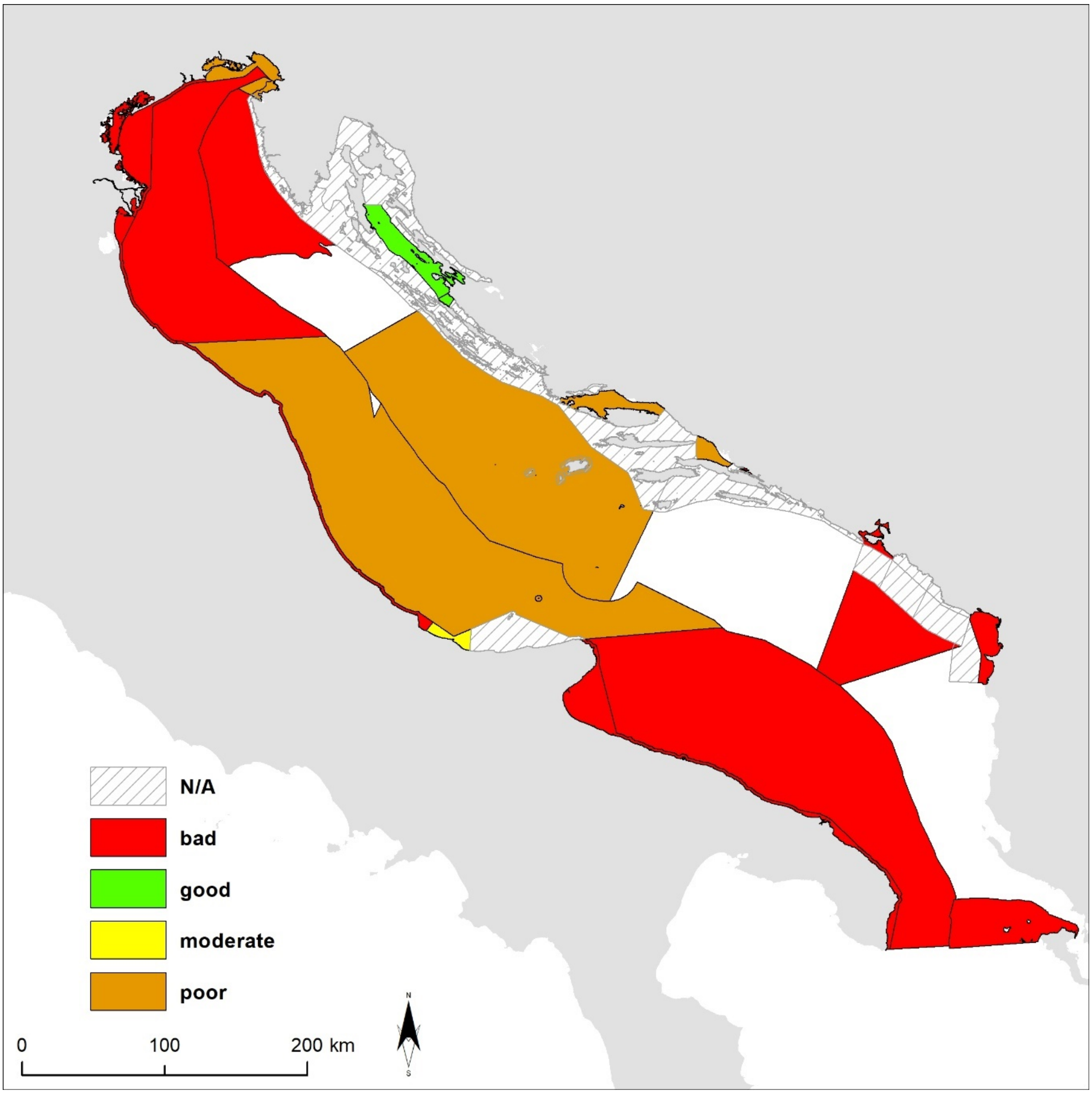


Figure 20: The aggregated-integrated assessment of EO10 in the Adriatic sub-Region following the NEAT assessment methodology.

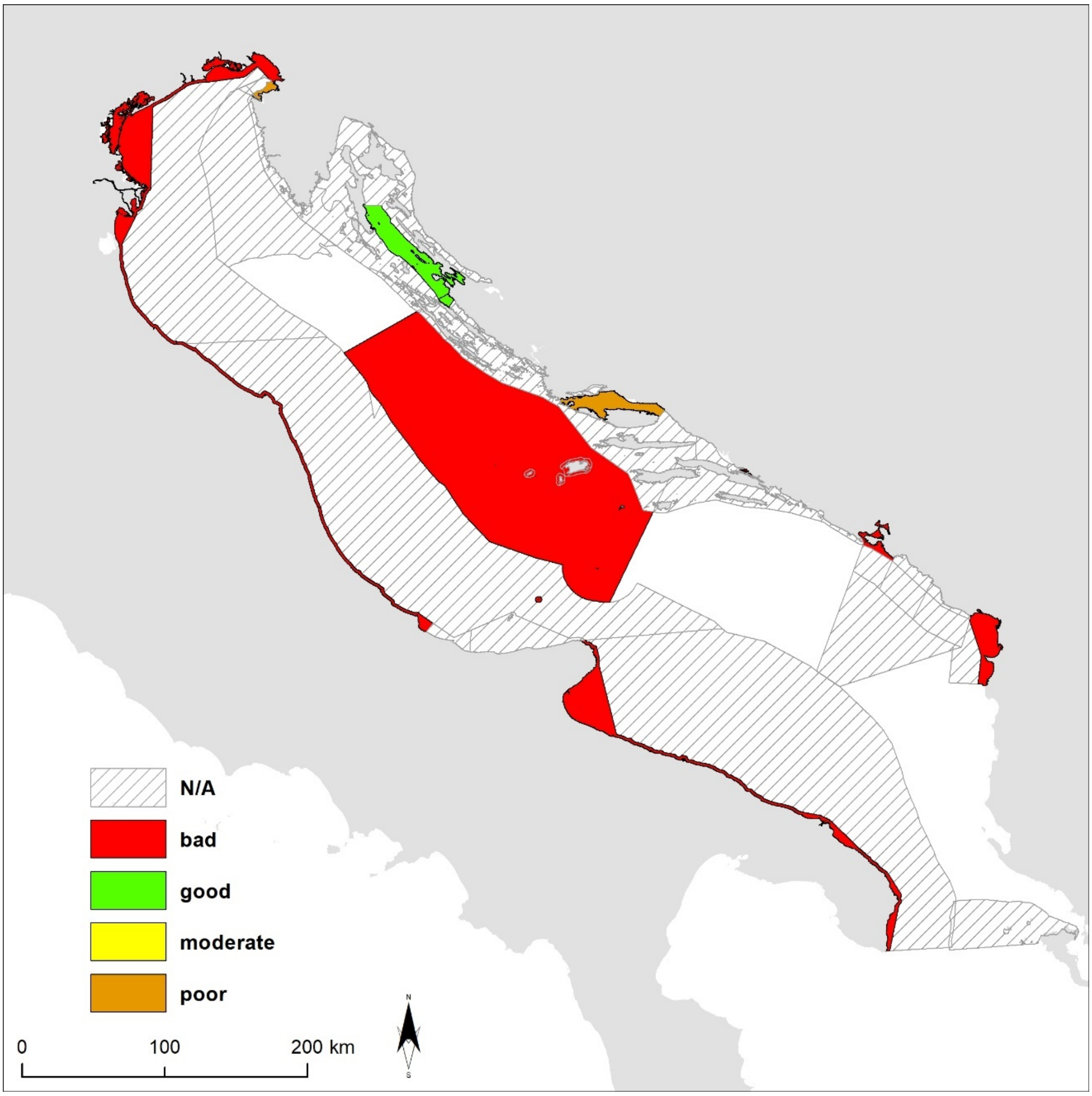


Figure 21: The assessment of CI22-Beach Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

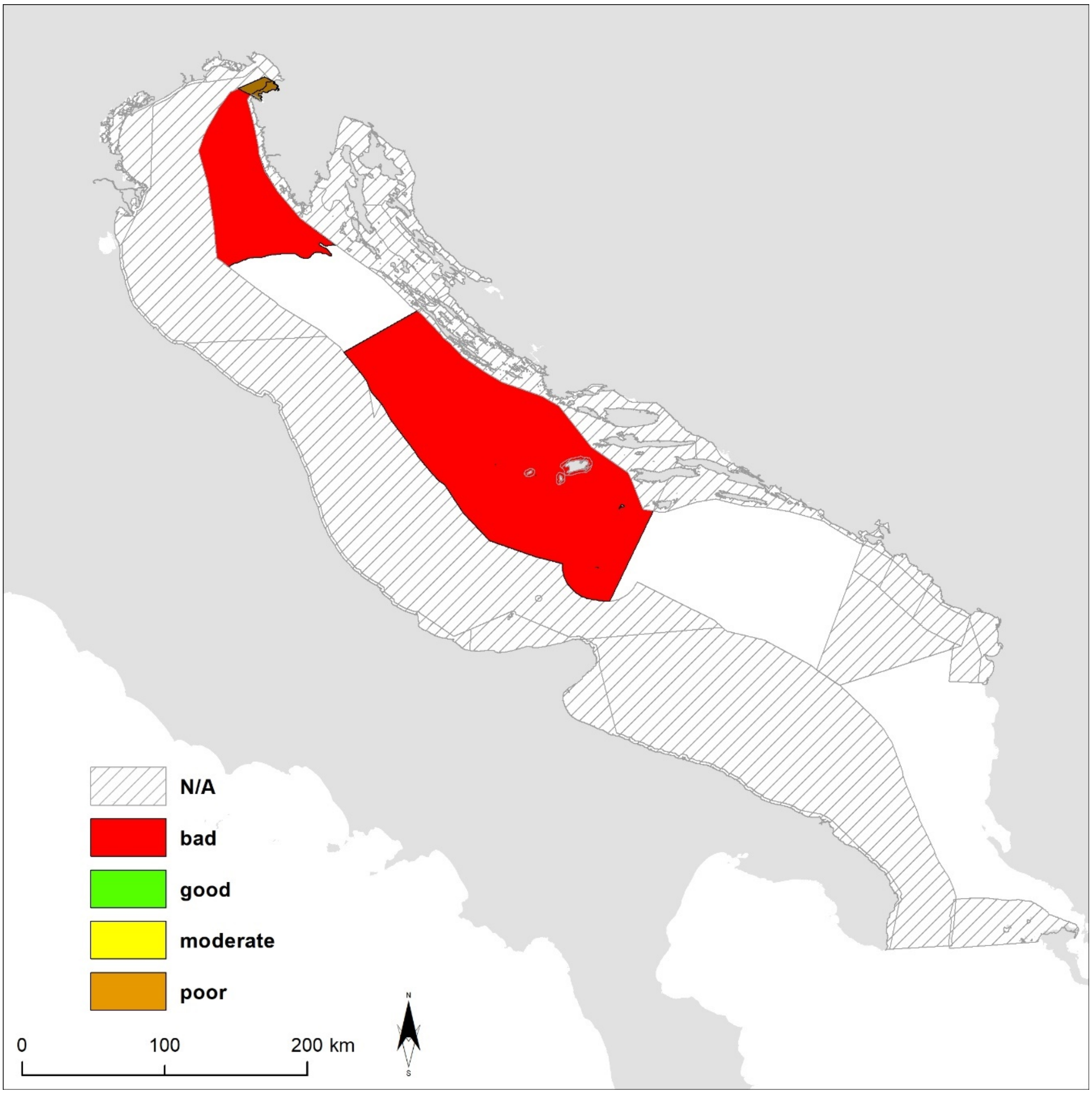


Figure 22: The assessment of CI22-Seafloor Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

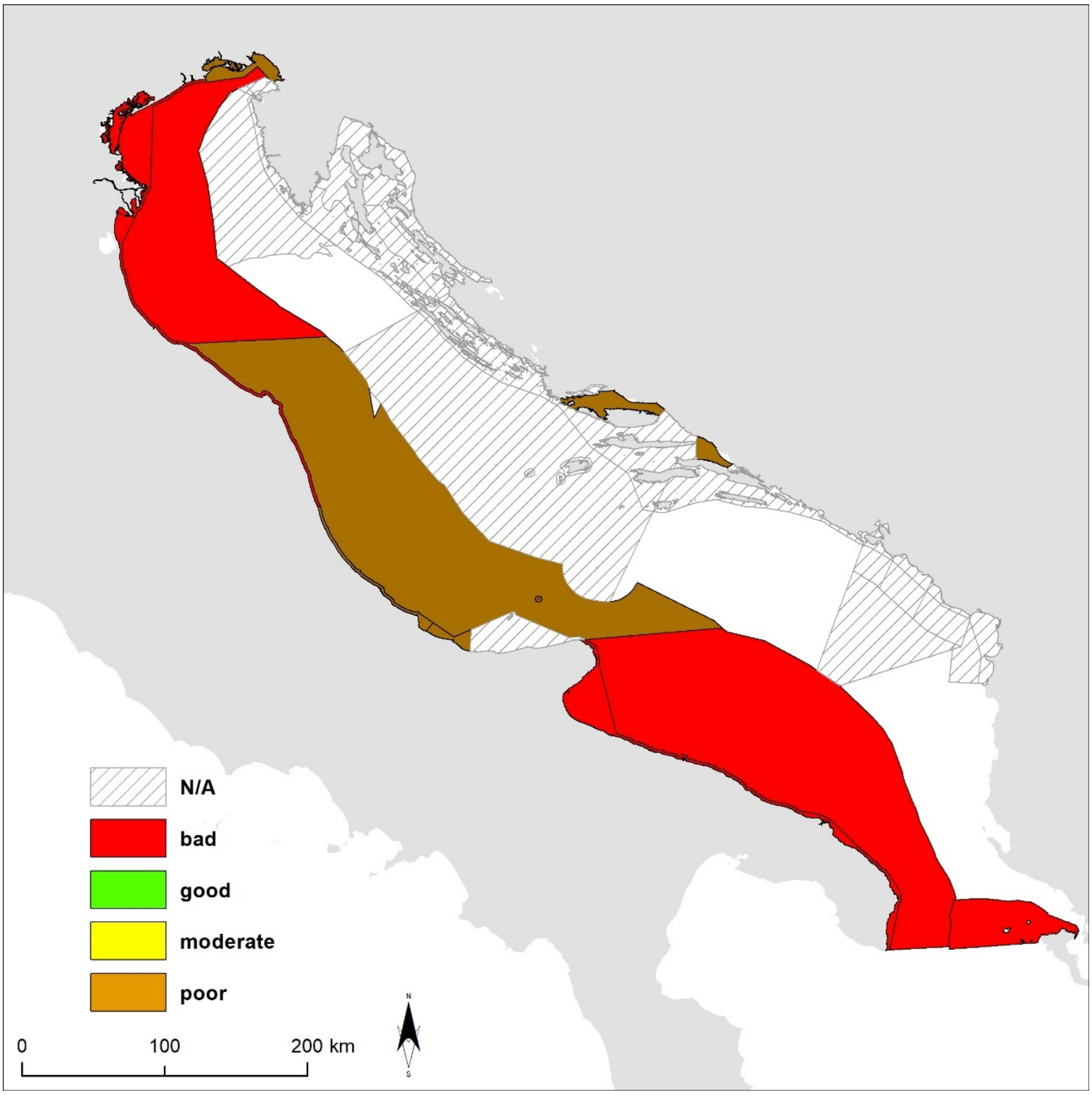


Figure 23: The assessment of CI23-Seasurface Floating MPs spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

4.3.1.5 Sensitivity analysis of the assessment results.

120. 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 Table 24 the results of the error analysis are presented.

121. 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 Table 24. For example, the overall status for the SAU MAD-HRU-MRU-3 is reported as 'good'. However, from Table 7, it is understood that out of 1000 iterations, 712 lead to Good status, and 162 to Moderate and 126 to High Status. These results imply a rather high uncertainty (confidence 71%), in contrast to MAD-HRU-MRU-5 where all 1000 iterations led to High status (confidence 100%).

Table 24: 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	0	947	53	0	0	95
Northern Adriatic Sea	0	1000	0	0	0	100
Central Adriatic	0	1000	0	0	0	100
Southern Adriatic Sea	809	134	4	6	47	81
NAS-C	0	0	785	215	0	79
NAS-O	815	185	0	0	0	82
CAS-C	0	1000	0	0	0	100
CAS-O	0	1000	0	0	0	100
SAS-C	488	405	105	2	0	49
SAS-O	864	78	5	0	53	86
MAD-HR-MRU-3	0	0	162	712	126	71
IT-NAS-C	752	248	0	0	0	75
MAD-Sl-MRU-11	0	1000	0	0	0	100
MAD-HR-MRU-5	1000	0	0	0	0	100
IT-NAS-O	680	320	0	0	0	68
MAD-Sl-MRU-12	0	972	28	0	0	97
MAD-HR-MRU-2	436	416	93	53	2	44
IT-SAS-C (Ap-1)	929	71	0	0	0	93
MNE-SAS-C	812	56	128	4	0	81
AL-SAS-C	718	278	4	0	0	72
BiH-SAS-C	856	93	20	7	24	86
IT-SAS-O	864	78	4	1	53	86
MAD-EL-MS-AD	1000	0	0	0	0	100
MAD-HR-MRU-2	0	1000	0	0	0	100
IT-CAS-C	0	1000	0	0	0	100
MAD-HR-MRU-4	11	988	1	0	0	99
IT-CAS-O	0	1000	0	0	0	100
HRO-0423-KVJ	0	0	162	712	126	71

SAU	bad	poor	moderate	good	high	Confidence %
IT-Em-Ro-1	949	51	0	0	0	95
IT-Fr-Ve-Gi-1	48	952	0	0	0	95
IT-Ve-1	819	181	0	0	0	82
HRO-0423-MOP	436	416	93	53	2	44
MNE-1-N	796	56	14	11	123	80
MNE-Kotor	956	44	0	0	0	96
HRO-0313-NEK	0	1000	0	0	0	100
HRO-0423-BSK	0	1000	0	0	0	100
HRO-0423-KOR	0	1000	0	0	0	100
IT-Ab-1	876	124	0	0	0	88
IT-Ma-1	840	160	0	0	0	84
IT-Mo-1	0	193	748	58	1	75

122. As for any assessment results, the accuracy of the results described above, is dependent also by the amount of data available for each SAU. Many subSAUs totally lack of 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.

5. Key findings per CI

123. The key findings for IMAP EO10 Common Indicator 22 are lister hereunder:

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 9,394 items/100m.
c) Overall, 29% of the monitored beaches achieve GES, 71% do not achieve GES, and 41 % fall into the moderate category (i.e., beach litter concentrations are up to two times higher than the TV).
d) The Adriatic appears the most affected by beach litter with only 32% out for the 16 beaches monitored falling into the GES category, most of them falling into the moderate class (56% of total).
e) The Western Mediterranean sub-region follows with 42% of the beaches monitored falling into the GES class, with the highest percentage of beaches (42%) being classified under the moderate class.
f) The Central Mediterranean sub-region shows an equal distribution of beaches between the GES and non-GE classes; however, this subregion is monitored in only 6 beaches.
g) The Eastern Mediterranean subregion is the only area where the majority (60%) of the monitored beaches are classified under GES class.
h) For 7 countries (Bosnia and Herzegovina, Lebanon, Slovenia, Croatia, Greece, Israel, Türkiye), the top-10 item list represents more than 70% of the collected litter items; for 2 Countries (Spain, Morocco) represents approximately 68-69% of the collected litter items; and for 1 country (France) approximately 25% of the collected litter items.
i) At the level of the Mediterranean the cigarette butts and filters are the most commonly found marine litter, followed by Plastic/polystyrene pieces 2.5 cm, and plastic caps and lids. These 3 times seem to account for approximately 50% of the recorded marine litter.
j) 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.

124. The key findings for IMAP EO10 Common Indicator 23 are lister hereunder:

A. <u>Floating Marine Litter:</u>

a) Monitoring efforts are more evident in the Western horizontal half of the Mediterranean and monitoring for IMAP EO10 CI23 floating microplastics should be further strengthened also in the Southern horizontal half of the Mediterranean.
b) Concentrations of Floating Microplastics (items/km2) are highly variable fluctuating between 0 and 31 items /km^2.
c) Average floating microplastics concentration on the Mediterranean Sea surface is found equal to 0.42 ± 2.1 items/km2.
d) Almost all stations (99%) that have been monitored do not achieve GES, and most of them fall into the poor (52 %) and bad (31 %) 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 the 33% 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 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-debris were recorded in total during the ASI, with an average encounter rate of 0.8 mega-debris per km, ranging between 0 and 111 debris per km.
l) More than two thirds of the mega-debris 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.
m) During the ASI, only 20% of the Mediterranean was free of floating mega-debris.
n) 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 9394 items /km2.
b) The average seafloor litter concentration on the Mediterranean coastline is found equal to 176 ± 179 items/km^2.
c) The majority (92%) of the seafloor stations monitored do not achieve GES, and most of them (63%) fall into the bad category (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 as bad and fall in the nonGES category.
e) The Adriatic sub-region follows with 89% of the stations monitored falling into the nonGES class with the highest percentage of seafloor stations to be classified under the poor (39 %) and bad (33 %) classes.
f) The Eastern Mediterranean subregion is also affected by seafloor litter, since 84 % of the monitored stations are classified under nonGES class, with elevated percentages under the poor (34 %) and bad classes (42 %).
g) An uneven spatial distribution of stations within each sub-region is evident in the present study, for example the WM is covered only by France (Gulf of Lions and Corsica).
h) Fisheries-related items comprise in up to 10% of the total recorded marine litter.
i) 3 items are the most commonly recorded seafloor marine litter items: (i) Synthetic ropes/strapping bands (L1i) with 39%; Fishing nets (polymers) (L1f) with 27%; and Fishing lines (polymers) (L1g) with 25%.
j) Another set of 3 items is 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%.
k) Interesting results have been obtained from limited scuba-dive surveys and IMAP should further provide additional support and guidance to further expand this monitoring component for marine litter (IMAP EO10).

6. Measures and actions required to achieve GES

125. 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.

126. 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.

127. 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.

128. The Regional Plan also incorporates a number of additional, important principles and measures are addressed, 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.

129. Monitoring and assessment should be further be linked and connected with the implementation of measures. Specific and well-elaborated findings can provide the basis for the implementation of targeted measures.

130. 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.

131. Based on the assessment findings for both IMAP CI22 and CI23, the majority of the stations are under nonGES status and urgent action is required.

132. 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.

133. 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.

134. 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.

135. 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.

136. 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.

137. 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 pollutants in air emissions

138. 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.

139. A Conceptual flow of plastic from production to consumption, waste management and leakage into the environment (i.e., land, rivers and ocean) with 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.

140. 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.

141. 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.

142. 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.

143. 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.

144. 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).

145. 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.

146. 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).

147. 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.

148. 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.

149. The Fisheries sector, including both fishing and aquaculture activities have a contribution on marine litter generation.

150. 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).

151. 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.

152. There are several strategies and guidelines developed by FAO/GFCM to assist a sustainable growth for aquaculture sector in, 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. The strategy is led by three key principles: (a) 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; (b) Aquaculture should improve human well-being and equity for all relevant stakeholders; and (c) Aquaculture should be developed in the context of other sectors, policies and goals.

153. The 5R's' (i.e., Reduce, Re-use, Recycle, Recover and Refuse) principle do perfectly fit when touching upon measures targeting to reduce the contribution of aquaculture on marine litter plastic generation (Huntington, 2019):

a) Reduce:
   - Replace to the extent possible plastic infrastructure components with other of physical nature;
   - Use higher density plastics (e.g., Polyethylene terephthalate (PET) or Ultra-high molecular weight polyethylene (UHMWPE)) which are more resistant to fragmentation, UV-irradiation;
   - Develop and intensify maintenance schemes to reduce equipment failure, and contingency plans for equipment being susceptible to extreme weather conditions;
   - Re-design aquaculture operations to reduce intentional or unintentional dumping of plastic into the marine environment (e.g., plastic bag feed sacks) and put in place mitigations plans and actions.
   - Develop awareness raising trainings for aquaculture staff similar to those offered from the shipping sector (e.g., HELMEPA).

b) Re-use:
   - Reduce single-use plastic with the introduction of relevant alternatives and invest in developing recovery, cleaning and re-distribution schemes;
   - Establish mandatory plastic waste collection points connected with the recycling schemes being placed in the mainland;
   - Train aquaculture staff for maintaining and fixing, rather than replacing, appropriate equipment;

c) Recycle:
   - Establish partnerships with aquaculture industry to develop recycling schemes from which industry could benefit from lower-cost primary material;
   - Develop mandatory recycling policies and schemes, including the establishment of plastic inventory and Standard Operations and Procedures (SOPs) for inactive and damaged equipment stored on the sea cages and along the shorelines for long periods;
   - Establish mandatory recycling schemes for aquaculture sites/firms that are closing.

d) Recover:
   - Locate and assess hotspot areas where aquaculture gear is accumulating on the seafloor and propose environment sound ways to remove them (e.g., Fishing-for-litter based schemes, campaigns with scuba divers);
   - Recover lost or damaged equipment right after extreme weather events;
   - Introduce GPS tracking systems for heavy material (e.g., plastic cage rings, cage nets, etc.);

e) Refuse:
   - Reduce to the extent possible the use of single-use plastics and establish relevant policies;
   - Minimize the use of plastic types with low levels of recyclability;
   - 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).

154. 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.

155. 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).

156. 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.

157. 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).

158. 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.

159. 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.

160. 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.

161. 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.

162. 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.

163. 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.

164. 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.

7. References

ACCOBAMS, 2021. Estimates of abundance and distribution of cetaceans, marine mega-fauna and marine litter in the Mediterranean Sea from 2018-2019 surveys. By Panigada S., Boisseau O., Canadas A., Lambert C., Laran S., McLanaghan R., Moscrop A. Ed. ACCOBAMS - ACCOBAMS Survey Initiative Project, Monaco, 177 pp.

Buckland, S. T., Rexstad, E. A., Marques, T. A., & Oedekoven, C. S. (2015). Distance sampling: methods and applications (Vol. 431). New York, NY, USA: Springer.

Halpern BS, Frazier M, Afflerbach J, Lowndes JS, Micheli F, O'Hara C, Scarborough C, Selkoe KA. 2019. Recent pace of change in human impact on the world's ocean. Scientific Reports 9: 11609.

Halpern BS, Frazier M, Potapenko J, Casey KS, Koenig K, Longo C, Lowndes JS, Rockwood RC, Selig ER, Selkoe KA, et al. 2015. Spatial and temporal changes in cumulative human impacts on the world's ocean. NATURE COMMUNICATIONS: 7.

Hammond PS, Lacey C, Gilles A, Viquerat S, Börjesson P, Herr H, Macleod K, Ridoux V, Santos MB, Scheidat M, Teilmann J, Vingada J, Øien N. 2017. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Report to the European Commission. 40 pp.

Johnson CN, Balmford A, Brook BW, Buettel JC, Galetti M, Guangchun L, Wilmshurst JM. 2017. Biodiversity losses and conservation responses in the Anthropocene. Science 356: 270–275.

Lambert C, Authier M, Dorémus G, Laran S, Panigada S, Spitz J, Van Canneyt O, Ridoux V. 2020. Setting the scene for Mediterranean litterscape management: The first basin-scale quantification and mapping of floating marine debris. Environmental Pollution: 114430

Lambert, C., Authier, M., Dorémus, G., Laran, S., Panigada, S., Spitz, J., Van Canneyt, O., Ridoux, V. (2020) Setting the scene for Mediterranean litterscape management: the first basin-scale quantification and mapping of floating marine debris. Environmental Pollution, Vol 263, part A. DOI.org/10.1016/j.envpol.2020.114430

Laran S, Authier M, Van Canneyt O, Dorémus G, Watremez P, Ridoux V. 2017. A Comprehensive Survey of Pelagic Megafauna: Their Distribution, Densities, and Taxonomic Richness in the Tropical Southwest Indian Ocean. Frontiers in Marine Science 4: 139

Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, Fraschetti S, Lewison R, Nykjaer L, Rosenberg AA. 2013. Cumulative Human Impacts on Mediterranean and Black Sea Marine Ecosystems: Assessing Current Pressures and Opportunities. PLOS ONE 8: e79889

Observatoire Pelagis LRUniv-CNRS - Code Lutin, version 1.1.2. SAMMOA, Software dedicated for aerial survey of marine megafauna. 2018.

Pettex E, David L, Authier M, Blanck A, Dorémus G, Falchetto H, Laran S, Monestiez P, Van Canneyt O, Virgili A, et al. 2017. Using large scale surveys to investigate seasonal variations in seabird distribution and abundance. Part I: The North Western Mediterranean Sea. Deep Sea Research Part II: Topical Studies in Oceanography 141: 74–85.

Rogan E, Breen P, Mackey M, Cañadas A, Scheidat M, Geelhoed SCV, Jessopp M. 2018. Aerial surveys of cetaceans and seabirds in Irish waters: occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland, p. 297pp.

Strindberg S, Buckland ST. 2004. Zigzag survey designs in line transect sampling. Journal of Agricultural, Biological, and Environmental Statistics 9: 443.