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Athens, Greece, 3 March 2023

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

Application of the NEAT Assessment Tool in the Adriatic Sea

UNEP/MAP
Athens, 2023

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List of Abbreviations / Acronyms

CAS	Central Adriatic Sea
CI	Common Indicator
COP	Conference of the Parties
CORMON	Correspondence Group on Monitoring
CPs	Contracting Parties
EMODNET	European Marine Observation and Data Network
EIONET	European Environment Information and Observation Network
EO	Ecological Objective
EU	European Union
GES	Good Environmental Status
nonGES	not Good Environmental Status
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
MAP	Mediterranean Action Plan
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MED QSR	Mediterranean Quality Status Report
MSFD	Marine Strategy Framework Directive
MRU	Marine Reporting Unit
MSs	Member States
NAS	North Adriatic Sea
NEAT	Nested Environmental Assessment Tool
SAS	South Adriatic Sea
SAU	Spatial Assessment Unit
TV	Threshold value

1. Introduction

1. The present work applies the methodology on Integration and Aggregation Rules for Monitoring and Assessment as developed by UNEP/MAP in 2021 and elaborated under the following working and information documents (i.e., UNEP/MED WG.492/13 and UNEP/MED WG.492/Inf. 10). The scope of the work is to support an assessment on the Quality Status for the Adriatic Sea focusing on IMAP Common Indicators 22 & 23(i.e., beach and Seafloor macrolitter; floating microplastics) after the elaboration of the updated Baseline Values (BV) and establishment of Threshold Values (TV) as approved by COP22 in 2021 and proposed during the CORMON Marine Litter Meeting on 3 March 2023.

2. In brief, the nested approach is followed (UNEP/MAP 2016 and 2019) which ensures a balance 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.

3. As it is already elaborated (UNEP/MAP 2016, 2019, and 2021) for a nested approach, two types of scales (i.e., scales of monitoring and scales of assessment) are interrelated, however a clear description of them is needed for a better comprehension of this interrelationship. The scales or units of monitoring refer to the physical spatio-temporal space where the observations are made (or samples taken) (i.e., the points in time and space which are monitored). Monitoring scales are usually defined upon significance of the environmental parameters that are monitored, the expected variability and the types of pressures posed on a particular area/habitat. The parameters monitored within a specific monitoring unit may reflect the environmental conditions/impacts/extent of impacts of the monitoring unit itself or the environmental conditions/ impacts/ extent of impacts of a larger unit.

4. 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. This can be defined by applying relevant criteria (e.g., representativeness/importance of the areas of monitoring for establishing areas of assessment; presence of impacts of pressures in monitoring areas; sufficiency of quality assured data for establishing the areas of assessment covering as many as possible IMAP Common Indicators) and ensuring that adequate consideration is given to the risk-based principle (i.e., both in pristine areas and areas under pressure). Taking into consideration these criteria may not necessarily lead to assessment areas compatible with the national/local administrative geographical divisions.

5. The harmonization of the scales approach between the CPs is the starting point for the integration process (i.e., to scale up the marine assessment to sub-regional and regional scales as required) under IMAP. In order to support harmonization, there is a need to define integration rules for monitoring activities, which refer to a set of guidelines that should be followed when implementing monitoring programmes to produce coherent datasets that will facilitate the subsequent process for a nested GES assessment.

6. For the purposes of the present work, data on marine litter collected during the preparation and elaboration of the updated Baseline Values (BV) and establishment of Threshold Values (TV) have been used as well as data submitted to the IMAP InfoSystem by the CPs for the period 2017-2021. Detained information regarding the availability of data is provided under Chapter 3 to the present document.

7. The harmonized application of the nested approach requires also defining integration rules for assessments. Given the differences among the EOs, these rules should be better defined at the level of IMAP Cluster, after taking into consideration the interrelationships of the respective CIs within the same and across other clusters of the IMAP. Interrelationships between the IMAP Ecological Objectives respectively the IMAP Common Indicators and status of the ecosystem elements and impacts of pressures are important to ensure the integrated assessment of GES. In the present document the rules already defined for the

Eutrophication, Pollution and Marine Litter Cluster and described in UNEP/MAP 2021 (‘*4.2 Rules for integration of assessments within the nested approach’* and Table 5 therein) are applied.

8. This document also follows on the definition of integration and aggregation as provided in UNEP/MAP 2021. ‘Rules of Integration of Assessments’ refer to the principles that underlie meaningful assessments on appropriate scales of assessment. ‘Rules for aggregation and integration of GES assessments’ refers to the methods (i.e., numerical calculations) for combining data in order to produce findings on the status of a specific area of assessment. The use of ‘aggregation’ and ‘integration’ in the concept of GES assessment methods has been introduced by Borja et al (2014)[1]. The term aggregation is used for the combination of comparable elements across temporal and spatial scales, indicators and criteria, within a descriptor. The term integration is used for the combination of different elements (e.g., across descriptors) to produce a single value of GES for a region. Under this concept, which is also followed by the MSFD, integration is conceived only across descriptors and in the ecosystem space as a whole.

2. From monitoring areas to IMAP Spatial Assessment Units (IMAP SAUs) in the Adriatic Sea in line with the nested approach

9. In the absence of declared areas of monitoring by the CPs, following the rationale of the IMAP-based national monitoring programmes and the distribution of monitoring stations, as well as the methodology described in UNEP 2021, two zones of areas of monitoring are defined for the purposes of the present work: (i) the coastal zone and (ii) the offshore zone.

10. Detailed explanation on the data sources used and methodology followed for setting of the two zones (coastal and offshore) is provided for the purpose of the present work, as elaborated in UNEP/MED WG.533/Inf.5. In summary, GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) by the MEDCIS project (https://www.lifewatchitaly.eu/en/related-projects/medcis-3/) were used for the present work for Slovenia, Croatia and Italy; for Albania, Montenegro and Greece these data were not accurate or do not include the relevant information and therefore were replaced/corrected in line with relevant national sources i.e. results of GEF Adriatic Project and provisions of relevant national legal acts. The MEDCIS work takes into consideration the existence of bays and inlets which are numerous in particular in the east part of the Adriatic Sea and calculates the baseline using the straight baseline method by joining appropriate points.

11. Following the rules of integration of assessments within the nested approach (UNEP, 2021) and Table 5, for the assessment of IMAP EO10 Common Indicators 22 &23, the coastal monitoring zone is equal to the respective assessment zone as defined for the purposes of the present work and explained above. Due to the transboundary movements of marine litter, data on beach marine litter provide information not only on the status of the local coasts but also of the offshore waters. In that sense IMAP CI22 data can be integrated also to the offshore assessment areas. For those CPs which are also EU MSs the stations/beaches monitored are considered representative of a wider offshore area as officially declared by the countries for the purposes of the MSFD implementation (Marine Reporting Units-MRUs). For these cases the offshore IMAP SAUs are based on the MSFD MRUs.

[1] For the purpose of building the methodology for aggregation and integration rules contained in this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.

12. For IMAP EO10 CI 22, CI23, integration of assessments up to the subdivision level is considered meaningful. Three main subdivisions of the Adriatic Sea, namely, North, Central and South Adriatic (NAS, CAS, SAS) have been chosen following the specific geomorphological features as available in relevant scientific sources (e.g., bottom depths and slope areas, existence of deep depression, salinity and temperature gradient, water mass exchanges) (Cushman-Roisin et al., 2001). The coverage of the 3 sub-divisions is shown in Figure1.

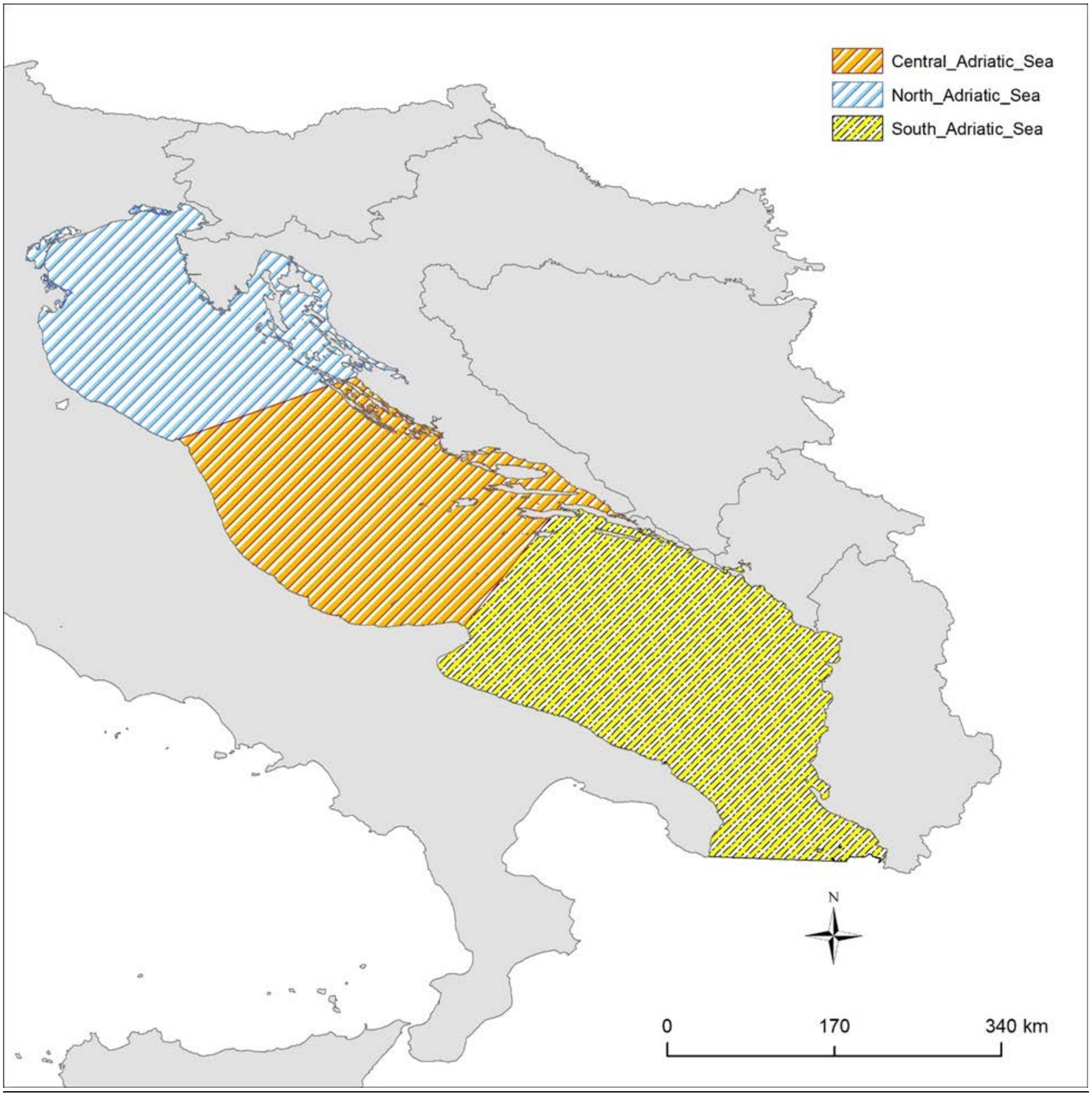

Figure 1. The 3 subdivisions of the Adriatic subregion defined based on Cushman-Roisin et al. (2001).

13. The IMAP SAUs used for the assessment of CI22 & CI23 are based on those developed for the assessment of EO9. This is done in order to follow a common harmonized methodology on the Eutrophication-Pollution-Marine Litter cluster level that will allow in the future to proceed to one integrated assessment across all EOs of the cluster. The following working steps have been followed to accomplish the objectives of the work on EO9 (UNEP/MED WG.556/Inf.6). The resulting IMAP SAUs have been used also for the present work on EO10. Details on the definition of the IMAP SAUs for each Adriatic country can be found in WG 533/Inf.5; WG 566/Inf.6.

14. **Step 1 Defining coastal and offshore waters:** By using the information from the MEDCIS project, it was possible to define the two zones i.e., the coastal zone and the offshore zones for the purposes of the present work in the Adriatic Sea Subregion as elaborated in UNEP/MED WG.533/Inf.5. It was found however that this MEDCIS datasets had errors for the case of Montenegro and Albania. Therefore, for these two countries data from the GEF Adriatic project were used as well as the national legislation of Albania and Montenegro (*Albania:* Degree No. 4650 of March 1970 and the Decree on a Modification to Decree No. 4650, dated 9 March 1970, on the State Border of the People's Socialist Republic of Albania, 1990; ; *Montenegro*: Decree on the Proclamation of the Law on the Sea "Official Gazette of Montenegro", No. 17/07 date on 31.12.2007, 06/08 dated on 25.01.2008, 40/11 dated on 08.08.2011). In addition, the MEDCIS data do not include any information for Greece, however the number and position of monitoring stations were pointed in the offshore waters only, as explained in detail in UNEP/MED WG.533/Inf.5.

15. **Step 2 Recognizing scope of IMAP areas of monitoring:** In the absence of monitoring areas reported by the CPs, the distribution of monitoring stations was investigated by considering the coordinates of their positions provided by the CPs in the IMAP Info System. Monitoring stations are grouped under the two zones coastal and offshore defined under Step 1, following the IMAP methodology as described in UNEP/MED WG. 493/13 for the needs of EO9, and in line with the IMAP monitoring stations design (hotspots, coastal, offshore). This was followed by the preparation of relevant GIS layers/maps containing positions of IMAP monitoring stations on the two zones; in this way and in the absence of the areas of monitoring (i.e., monitoring transects) delimited by the CPs, the areas of monitoring were recognized based on distribution of the monitoring stations. As explained above, spatial coverage of the coastal waters and the offshore territorial waters is based on available data from MEDCIS and the GEF Adriatic Projects. For Greece only one monitoring station exists in South Adriatic waters at a distance 6 nm from land. In the absence of any known pollution sources in this area, for this country only the offshore monitoring area is considered.

16. **Step 3 Setting IMAP areas of assessment:** This step included the definition of the IMAP areas of assessment (IMAP SAUs) based on the anticipated areas of monitoring. To recognize the areas of monitoring, the criteria already set for that purpose in UNEP/MED WG.492/13 were taken into consideration to the largest possible extent. Namely: (i) the spatial distribution of monitoring stations in relation to the sufficiency of quality-assured data as collated for NEAT application, having in mind the risk-based principle; (ii) representativeness/importance of the areas of monitoring for setting of the areas of assessment; and (iii) in the case of Montenegro, information available regarding the presence of impacts of pressures in monitoring areas was also taken into account; to that purpose the cumulative pressures layer from GEF Adriatic Project has been used. In addition, the interrelations of the MRUs for the CPs that are EU MSs with the IMAP monitoring areas was investigated and whether these fit for their use as IMAP SAUs, following the criteria described previously. Final results are GIS layers/maps of IMAP SAUs prepared per country from the GIS layers (WG 533/Inf.5; WG 566/Inf.6). They also provide the positions of monitoring stations in the areas of monitoring that were recognized within present work. This was based on the equalization of the areas of monitoring with the SAUs for Albania, B&H and Montenegro, while for Slovenia, Croatia and Greece the SAUs uses to the extent possible the areas already set by the CPs. For

Italy, the approach followed is slightly different because its MRUs do not fully fit the purposes of the IMAP. Details per each country separately are presented in WG 533/Inf.5; WG 566/Inf.6.

17. **Step 4 - Nesting of the areas of assessment within application of NEAT tool:** For the step of nesting, the areas of assessment were first classified under the 3 subdivisions of the Adriatic Sea (i.e., North, Central, South); then a nesting scheme approach was followed. The delimitation of the three Adriatic subdivision was made according to Cushman-Roisin et al, (2001). The approach followed for the nesting of the areas is 4 levels nesting scheme where 1st level is the finest and 4th level is the highest:

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

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

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

19. The graphical depiction of this nesting scheme is shown in Figure 2. The description of the IMAP SAUs and details on specificities for each country are provided in UNEP/MED WG.533/Inf.5, while the summary is provided in Section 2.1 of UNEP/MED WG.533/Inf.4.

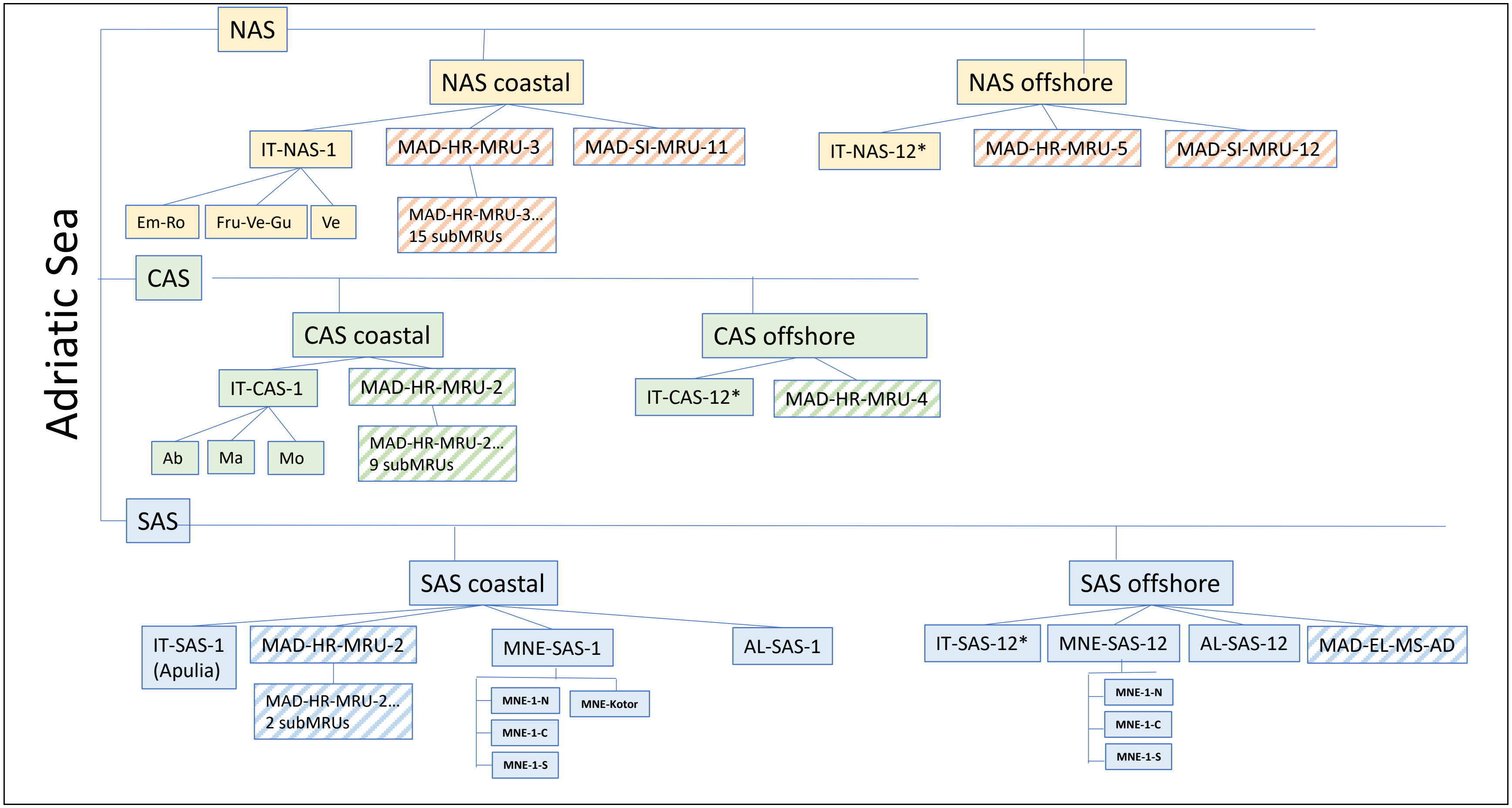

Figure 2: The nesting scheme of the SAUs defined for the Adriatic Seabased on the available information[2]. Shaded boxes correspond to official MRUs declared by the countries that are EU MSs and that were decided to be used as IMAP SAUs.

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

20. The following maps show the nested approach per sub-divisions of the Adriatic Sea Sub-region. For each sub-division, the IMAP SAUs of every country have been selected and showed in the maps of Figures. 3, 4, 5, while Table 1 provides consolidated information of the maps for further use.

21. In North Adriatic Sea (NAS) (Figure 3) Italy has 1 offshore SAU and 3 coastal SAUs, Slovenia has 1 offshore SAU and 1 coastal SAU and Croatia has 2 offshore SAUs and 16 coastal SAUs.

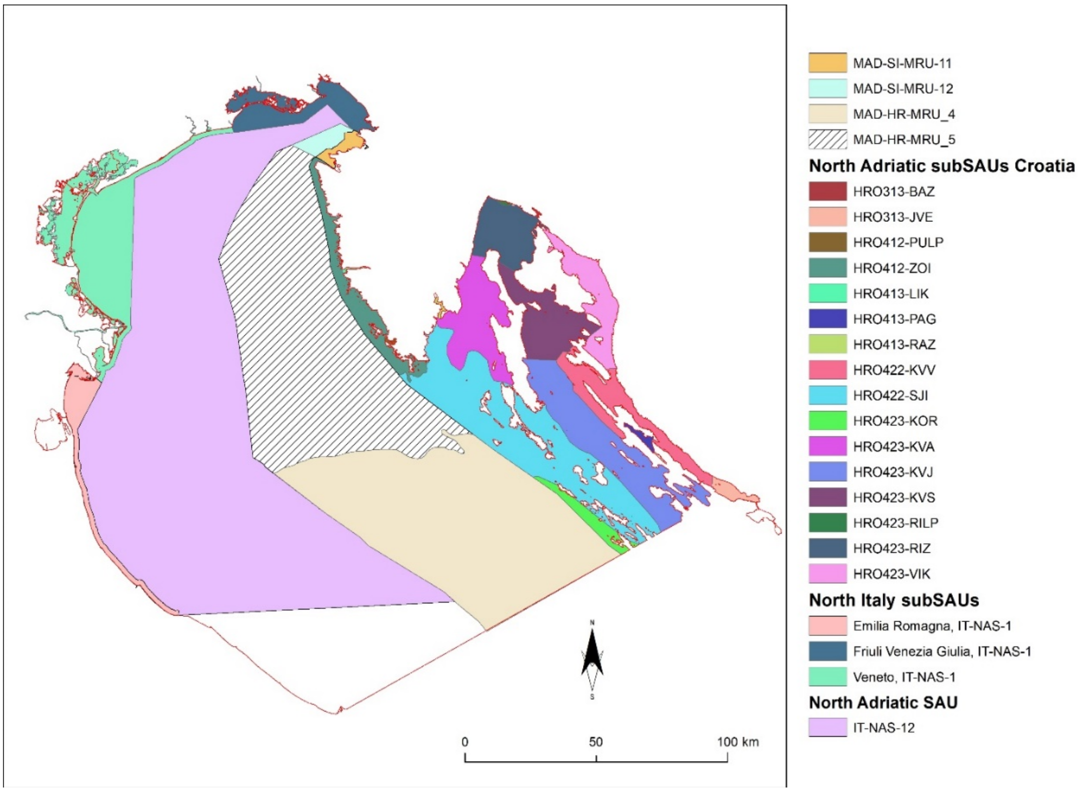

Figure 3. The nesting approach of the IMAP SAUs in North Adriatic Sea based on spatial assessment units defined for testing of NEAT application in the Adriatic Sea Sub-region.

22. In Central Adriatic Sea (CAS) (Figure 4), Italy has 1 offshore SAU and 4 coastal SAUs, Croatia has 1 offshore SAU, and 12 coastal SAUs. In Italy the offshore SAU of the Central Adriatic Sea has a shape defined by its official Central Adriatic Sea MRU as explained in the Meeting documents UNEP/MED WG.533/Inf.4 & UNEP/MED WG.533/Inf.5.

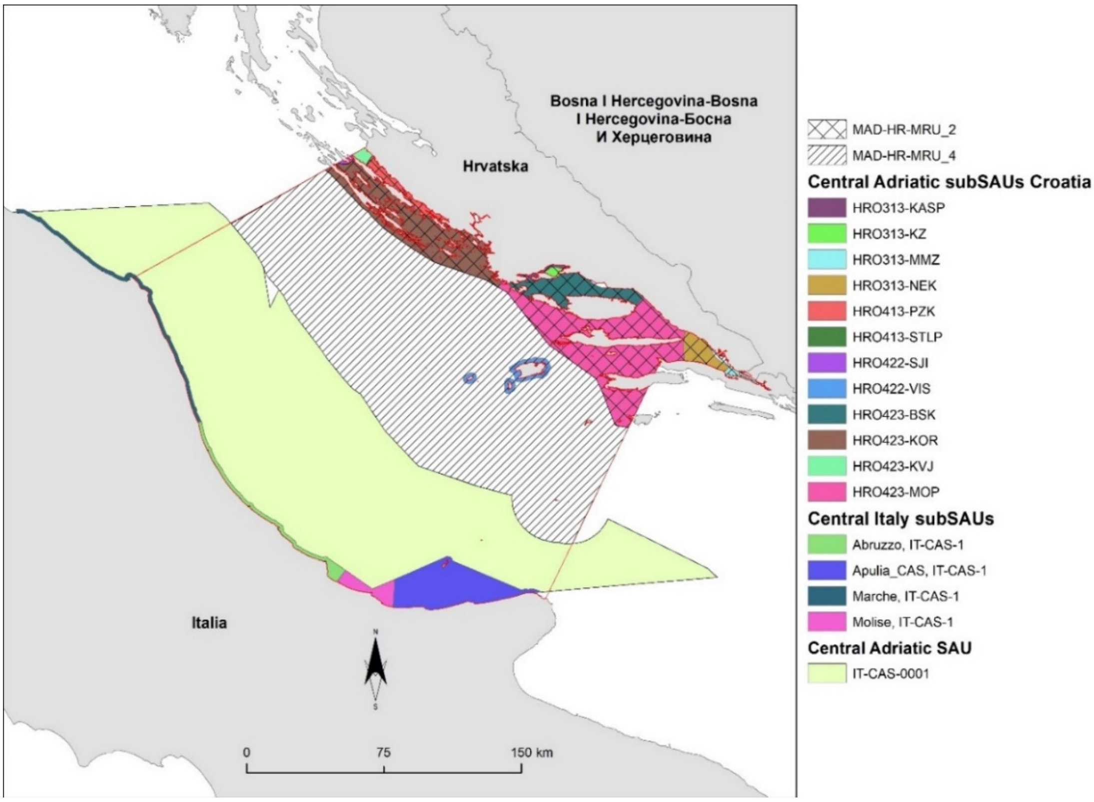

Figure 4. The nesting approach of the IMAP SAUs in Central Adriatic Sea based on the spatial assessment units defined within testing of NEAT application in the Adriatic Sea Sub-region.

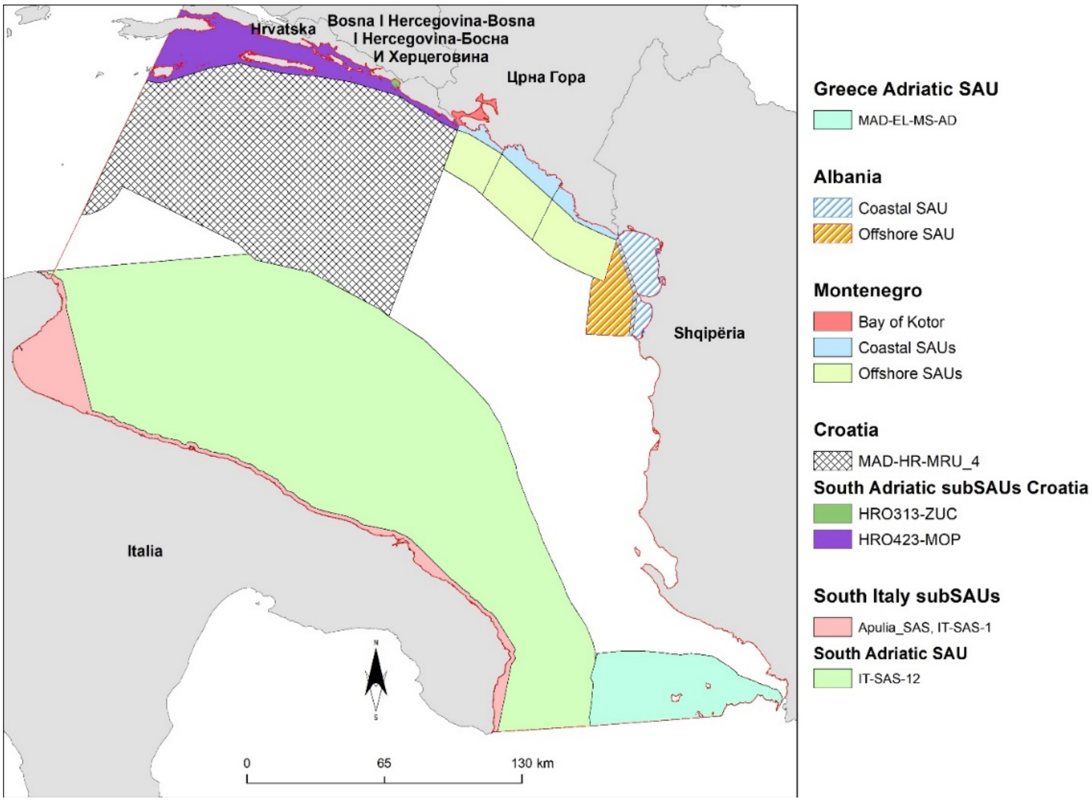

Figure 5. The nesting approach of the IMAP SAUs in South Adriatic Sea based on the spatial assessment units defined within testing of NEAT application in the Adriatic Sea Sub-region.

23. In South Adriatic Sea (SAS) (Figure 5) Italy has 1 offshore SAU and 1 coastal SAU, Croatia has 1 offshore SAU and 2 coastal SAUs, B&H has 1 coastal SAU, Montenegro 3 offshore SAUs and 4 coastal SAUs, Albania has 1 offshore SAU and 1 coastal SAU and Greece 1 offshore SAU in absence of coastal stations.

Table 1. The spatial assessment units (SAUs) for the Adriatic sub region and their respective surface area (km^2).

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP subSAU	Area (km^2)
North Adriatic (NAS)				**31856**
	NAS coastal			**9069**
		MAD-HR-MRU_3		6422
			HRO3-0313-JVE	73
			HRO-O313-BAZ	4
			HRO-O412-PULP	7
			HRO-O412-ZOI	473
			HRO-O413-LIK	7
			HRO-O413-PAG	30
			HRO-O413-RAZ	10
			HRO-O422-KVV	494
			HRO-O422-SJI	1923
			HRO-O423-KVA	686
			HRO-O423-KVJ	1089
			HRO-O423-KVS	577
			HRO-O423-RILP	6
			HRO-O423-RIZ	475
			HRO-O423-VIK	455
		IT-NAS-1		2592
			Emilia Romagna	371
			Friuli Venezia Giulia	575
			Veneto	1646
		MAD_SI_MRU_11		55
	NAS offshore			**22788**
		IT-NAS-12		10540
		MAD_SI_MRU_12		129
Central Adriatic (CAS)				**63696**
	CAS coastal			**9394**
		MAD-HR-MRU-2		7302
			HRO-0313-NEK	253
			HRO-O313-KASP	44
			HRO-O313-KZ	34
			HRO-O313-MMZ	55
			HRO-O413-PZK	196
			HRO-O413-STLP	1

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP subSAU	Area (km^2)
			HRO-O423-BSK	613
			HRO-O423-KOR	1564
			HRO-O423-MOP	2480
		IT-CAS-1		2092
			Abruzzo	282
			Marche	319
			Molise	229
	CAS offshore			**54303**
		IT-CAS-12		22393
		MAD-HR-MRU_4		18963
South Adriatic (SAS)				**44231**
	SAS coastal			**7276**
		MAD-HR-MRU_2		4252
			HRO313-ZUC	13
			HRO423-MOP	1756
		IT-SAS-1	(Apulia)	1810
		MNE-1		483
			MNE-1-N	86
			MNE-1-C	246
			MNE-1-S	151
			MNE-Kotor	85
		AL-1		646
	SAS offshore			**36955**
		IT-SAS-12		22715
		MNE-12		2076
			MNE-12-N	513
			MNE-12-C	713
			MNE-12-S	849
		AL-12		716
		MAD-EL-MS-AD		2253

3. Data availability

22. Data on IMAP EO10/CI22-Beach Litter have been collected from 6 CPs bordering the Adriatic Sea for the years 2016 to 2018 (i.e. Albania, Bosnia & Herzegovina, Croatia, Italy, Montenegro, Slovenia), except from Greece. Beach Litter data used were either reported by the CP to the IMAP IS or shared with the IMAP Secretariat. Data on seafloor litter were reported to the IMAP IS only by Slovenia and Croatia. floating microplastics (MPs) data sets were reported by 5 CPs (Bosnia & Herzegovina, Croatia, Greece, Italy, Slovenia).

23. Details on the temporal and spatial availability of data per IMAP SAU, are provided in Tables 1 and 2.

24. 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 MPs) 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, floating MPs); the rest are covered by either two or one parameter.

25. 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.

26. Beach litter data correspond to a total of 36 beaches, Seafloor litter to 18 seafloor monitoring stations and Floating MPs 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.

27. 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).

28. 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.

Table 2: Spatial coverage of monitoring marine litter 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	subSAU	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-Sl-MRU-11		4	2	4
	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	4		2
			Marche	4		2
			Molise	1		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

Sub-division	Zone	SAU	subSAU	No beaches	No of Seafloor stations	No of Floating MPs stations
		MNE-1				
			MNE-1-N	1		
			MNE-Kotor	1		
		AL-1		2		
		BiH-1		2		
	SAS offshore					
		IT-SAS-O				4
		MAD-EL-MS-AD				1

Table 3: 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	’17, ’18, 19, ‘20		
		IT-NAS-C				
			Emilia Romagna	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			Friuli Venezia Giulia	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			Veneto	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
		MAD-Sl-MRU-11		‘17	’17, ’18, 19, ‘20	’19, ‘20
	NAS Offshore					
		MAD-Sl-MRU-12			’17, ’18, 19, ‘20	’19, ‘20
		MAD-HR-MRU-5			’17, ’18, 19, ‘20	
		IT-NAS-O				’17, ’18, 19, ‘20
Central Adriatic (CAS)						
	CAS coastal					
		MAD-HR-MRU-2				
			HRO-0423-BSK	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			HRO-0423-KOR	’17, ’18, 19, ‘20	’17, ’18, 19, ‘20	’17, ’18, 19, ‘20
		IT-CAS-C				

Sub-division	Zone	SAU	sub SAU	Years monitored beaches	Years monitored Seafloor stations	Years monitored Floating MPs stations
			Abruzzo	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			Marche	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			Molise	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
	CAS offshore					
		MAD-HR-MRU_4		’17, ’18, 19, ‘20	’17, ’18, 19, ‘20	’17, ’18, 19, ‘20
		IT-CAS-O				’17, ’18, 19, ‘20
South Adriatic (SAS)						
	SAS coastal					
		IT-SAS-C	Apulia	’17, ’18, 19, ‘20		
		MAD-HR-MRU-2				
			HRO-O423-MOP	’17, ’18, 19, ‘20		’17, ’18, 19, ‘20
			HRO-0313-NEK			’17, ’18, 19, ‘20
		MNE-C				
			MNE-1-N	‘18		
			MNE-Kotor	‘18		
		AL-C		‘18		
		BiH-C		’19, ‘21		’19
	SAS offshore					
		IT-SAS-O				’17, ’18, 19, ‘20
		MAD-EL-MS-AD				‘20

4. Setting the assessment criteria

29. The baselines and threshold values for IMAP CI 22 in the Mediterranean Sea have been endorsed by the 8th Ecosystem Approach Coordination Group Meeting (10-17 September 2021) and have been annexed to Decision IG.25/9[3] approved by COP22. The respective values for IMAP CI23 (seafloor macro-litter and floating microplastics) have been submitted for review to the CORMON Marine Litter Meeting (3 March 2023) and discussions are expected to be undertaken towards their approval for use for the preparation of the 2023 Mediterranean Quality Status Report (2023 MED QSR). Their present status and the agreed threshold value are provided in UNEP/MED WG.514/07 and WG555/03. The threshold value between Good and non-Good Environmental Status used in the NEAT assessment is the TV equal to 130 items/100m as provided by UNEP/MED WG.514/07 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 as provided in WG555/03.

[3] “*Amendments to the Regional Plan on Marine Litter Management in the Mediterranean in the Framework of Article 15 of the Land Based Sources Protocol*”

30. 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.

31. 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

32. 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 3 and 4.

Table 4: Relation of assessment status classes set in line with the IMAP methodology and NEAT tool and respective colour coding. The position of the 2 boundary limit values and the thresholds for the NEAT tool are shown.

	GES		**nonGES**		
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 Seasurface Floating MPs	**1/2(TV)**	**TV**	**10(TV)**	**100(TV)**	

Table 5: Boundary limits and the GES-nonGES Threshold value introduced in the NEAT tool. All other threshold values are generated by 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 MPs (items/m^2)	0	0.00066	0.00132	0.0132	0.132	1.076

33. For the application of the NEAT software, data on beach litter, seafloor litter and floating microplastics, were grouped per SAUs in all the Adriatic sub-divisions (NAS, CAS, SAS). Average concentrations (arithmetic means) per parameter and their respective standard errors were then calculated in the respective groups as follows:

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

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

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

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

34. A data matrix to be used for the NEAT software was prepared and given below in Table 6.

Table 6: Average values and standard error (SE) for EO10 parameters per SAU of the Adriatic subregion. (n the number of records per SAU, i.e. station number x times sampled)

Sub-division	Zone	SAU	sub SAU	Beach Litter (items/100m)	Seafloor Litter (items/km^2)	Seasurface Floating MPs (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
	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		

Sub-division	Zone	SAU	sub SAU	Beach Litter (items/100m)	Seafloor Litter (items/km^2)	Seasurface Floating MPs (items/m^2)
		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

5. Application of the NEAT software for the assessment of IMAP Common Indicators related to Ecological Objective 10

35. NEAT is a structured, hierarchical tool for making marine status assessments (Berg et al., 2017; Borja et al., 2016), and freely available at www.devotes-project.eu/neat. NEAT was developed to assess biodiversity status of marine waters under the MSFD and has been used to assess different ecosystem components and geographical areas (Nemati et al., 2017; Borja et al., 2019; Pavlidou et al. 2019; Kazanidis et al., 2020; Borga et al., 2021).

36. NEAT uses a combination of high-level integration of habitats and spatial units and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale. As explained here-below, the use of NEAT is not limited to the assessment of biodiversity but can be used for assessment of pollution impact. The analysis provides an overall assessment for each case study area and a separate assessment for each of the ecosystem components included in the assessment. The final value has an associated uncertainty value, which is the probability of being determinative in a certain class status (GES - nonGES) (Uusitalo et al., 2016).

37. Essentially, the final assessment value is calculated as a weighted average. The weighting factors are based on the respective surface of the areas and are combined with the respective monitoring data for the indicator in question. Detailed explanation on the calculation of the weighting factors is given in Annex I. No special rules are applied but the tool design allows assigning different aggregation rules at the various steps in the calculation of the overall assessment value. In order to assess the uncertainty in the final assessment value, the standard error/ standard deviation of every observed indicator value is used (Borja et al., 2016). Therefore, the standard error values as obtained from to the monitoring data play a major role in the uncertainty associated with the final assessment result. This emphasizes the importance of the standard deviation for the accuracy and evaluation of the final assessment result.

38. The main principles of NEAT are:

- **Indicators**: they constitute the basis of the assessment. NEAT integrates an indicator catalogue (Teixeira et al., 2016) as a source for choosing predefined indicators for the biodiversity assessment. However, the tool is not limited to those indicators; it allows the addition of as many indicators as required, not only related to biodiversity, but any kind of indicator, specific to each assessment performed (e.g. eutrophication, organic pollution, etc.). In practice these refer to the parameters/elements of the criteria that are subject of assessment (i.e. IMAP Common Indicators or MSFD Criteria) and can be either synthetic biological metrics/indices (i.e. Eutrophication Index E.I., BENTIX, AMBI) or individual parameter values (i.e. nutrients, chlorophyll-a, chemical contaminants concentrations). Under 'Indicators' the actual monitoring data reported by the CPs are introduced for preparing 2023 MED QSR assessments. Threshold/boundary values correspond to the parameters ('Indicators') used.
- **Habitats***:* Some examples are pelagic, benthic, rocky, ice habitats and may include sub-categories in a hierarchical order.
- **Ecosystem Components**: Examples are phytoplankton, microbes, mussel, sediments.
- **Weighting and hierarchies**: the central principle in the NEAT method is a hierarchical, nested structure of spatial assessment units (SAUs) and habitats. Thus, it avoids the dominance of certain indicators or habitats or SAUs by using a proper weighting procedure, which considers what information is available for different real spatial scales. The weighting factors are based on the respective surface of the areas and are combined with the respective monitoring data for the indicator in question (see Annex I). In addition, each indicator is related to a specific ecosystem component, which exists in a certain habitat, and information has been collected for a specific area or SAU (e.g., North Adriatic Sea (NAS)). Thus, no bias is introduced into the assessment by the choice of the indicators.

- **Aggregation**: In order to aggregate monitoring data, they are all normalized into a scale of 0 to 1, independently of their original scale. Specific boundaries of the indicators (e.g. boundary between moderate and good status) are also normalized. By default, aggregation is done across all indicators assessed within concerned SAU, either by ‘Ecosystem Component’ or by ‘Habitat’. For example, the method can be used to aggregate all indicators of a specific SAU and show the status divided among the different ecosystem components of that SAU, in line with the aggregation and integration rules as defined in the documents of UNEP/MAP (2021). The first level of the spatial aggregation of the ‘Indicators’ data is not shown by default.
- **Integration** is done spatially across all the SAUs used with a weighting factor related to the SAU surface area, in line with the aggregation and integration rules as defined in the documents of UNEP/MAP (2021).
- **NEAT value**: the outcomes of the aggregation are visualized into a number (NEAT value) and a colour, which corresponds to the status (i.e. high, good, moderate, poor and bad). This NEAT value is obtained for the whole assessed area but can be visualized in different forms. For example, it is possible to visualize how the information from the different ecosystem components (e.g. fish, phytoplankton, etc.) has contributed to the assessment, or how the information available to the different areas contributes to the overall assessment.
- **Confidence**: each NEAT value is accompanied by its quantitative estimate of the confidence of the result. This estimate is performed using the standard deviation (entered at the same time as the indicator value/monitoring data), and performance of Monte Carlo simulations, as a mean to understand how this error propagates throughout the assessment. More explanation on the confidence of the assessments is provided in Chapter 6.1.

39. The tool is primarily designed for assessing biodiversity status and works well with other MSFD descriptors of either state or pressure/impact, especially when these are linked to one type of pressure/impact. The way the tool makes the aggregation of data theorizes that all Indicators’ data introduced for a specific habitat or ecosystem component have the same type of impact on the ecosystem, hence they are related (for example nutrients and chlorophyll-a are interrelated for the eutrophication EO5 status; beach litter data and floating microplastics are both related to a common pressure and interrelated for assessing the EO10 status). For chemical contaminants status the above assumption is not true. Pollution from one chemical compound is not necessarily related to another. Therefore, for assessing the chemical status of an area it is important to get also a detailed picture per contaminant (i.e. first level spatial aggregation of the Indicators data inserted in the tool). This approach is described in UNEP/MAP WG533/5, WG533/Inf.4, WG566/Inf.5 for CI17 NEAT assessment in the Adriatic sub-region. Although the EO10 CIs are closely related to each other, as noted previously, still it is useful to discriminate any assessment status differences between macro- and micro litter/plastics, in order to target mitigation and prevention measures accordingly.

40. Therefore, for the transparent assessment of IMAP EO10/CIs, the approach followed for EO9 is considered useful to get the information on the status of each marine litter parameter (beach litter, floating microplastics, seafloor macrolitter, ingested litter) separately per SAU. In order to get this information the following adjustments were made in the NEAT software, regarding the use and meaning of ‘Indicators’, ‘Habitats’ and ‘Ecosystem Components’:

- *Indicators*: These refer to all the parameters measured under the CIs of EO10 (beach litter, floating microplastics, seafloor macrolitter, ingested litter).
- *Habitats:* The expected data for marine litter cover ‘beaches’, ‘waters’, ‘seafloor’ and ‘biota’. These can be used to under ‘Habitats’. Assessment results are aggregated for each of them separately to get the status of EO10 in ‘beaches’, ‘waters’, ‘seafloor’ and ‘biota’ separately for all SAUs. Alternatively, under ‘Habitats’ it is possible to use the macro- or micro- litter/plastic and get an overall assessment status (for all matrices together) for the macro- or micro-litter/plastic separately.

- *Ecosystem Components*: Here, instead of using ecosystem categories, the Ecological Objective 10 (EO10) is used as ecosystem component, and the 'Indicators' are listed again as subcategories of EO10 in a hierarchical structure. In this way an aggregated assessment status result on the EO10 level can be achieved and at the same time the assessment result on each of the 'Indicators'- EO10 parameters listed is provided.

41. This approach can support also EO5 and EO9 and produce a final assessment on the IMAP Pollution Cluster level. For the present analysis however, available data are confined to macro- litter on beaches.

5.1 Insertion of data and the class boundaries of GES- non-GES in the NEAT software per each Indicator and SAUs.

42. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, as described in Chapter 2, the scope of all Adriatic SAUs and subSAUs were defined. All of them were introduced in the NEAT tool along with their respective codes and surface area (km^2) as provided in Table 1.

43. Within each SAU under 'habitats' beach, seafloor and sea surface are introduced; under 'ecosystem component' the CI22 Beach Litter, CI22 Seafloor Litter and CI23 Sea surface floating microplastics are assigned.

44. For each SAU, 'Ecological Component' (CI22_BL, CI22_SFL and CI23 in our case) and 'Habitat' (beaches, seafloor, sea surface) the 'Indicator' on CI22_BL, CI22_SFL and CI23 data (average value and standard error) are inserted as explained in Chapter 4 and provided in Table 6.

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

46. Then the data (average values inserted) as well as boundary limits and the GES-nonGES threshold value are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and facilitate aggregation on the CI or EO level.

47. Threshold concentrations are normalized in a 0 to 1 scale as follows:

$0 \leq$ bad $< 0.2 \leq$ poor $< 0.4 \leq$ moderate $< 0.6 \leq$ good $< 0.8 \leq$ high ≤ 1

48. NEAT further aggregates data by calculating the average of normalized values of the EO10 parameters on the SAU level. This is done either per parameter (beach macro litter, floating microplastics, seafloor macro-litter etc.) and habitat (beaches, waters, seafloor, biota) separately or for all parameters aggregated together per habitat (beaches, waters, seafloor, biota) within a specific SAU. The first option leads to one value for each EO10 parameter separately for a specific SAU.

49. The process is then repeated for all nested SAUs (in a weighted or non- weighted mode) and in the end one NEAT value for the larger/nested SAU is obtained (i.e. for the Adriatic Sea) either for all ecosystem components – EO10 parameters separately, or for all ecosystem components by habitat (beaches, waters, seafloor, biota). In the weighted mode a weighting factor based on the surface area of each SAU is used (Annex I).

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

51. The decision rule of GES/ non-GES is by comparison to the boundary class defined by the Threshold value (TV) and this is above/ below Good (0.6). More details on the data insertion process in the NEAT tool can be found in UNEP/MED WG.533/Inf.5.

6. Results of the NEAT tool for the Assessment of the IMAP EO10-CI22-CI23 status in the Adriatic subregion

52. The results obtained from the NEAT tool are shown in Table 7 and in Figures 6-9.

53. 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 Sea surface floating MPs all subSAUs monitored are classified as non-GEs and under ‘Poor’ and ‘Bad’ classes.

54. Integration of data per each EO10 parameter on higher levels within the nesting scheme (bold lines in Table 7) shows that the NAS subdivision is classified under ‘Good’ status regarding Beach Litter and under ‘bad’ regarding Seafloor Litter and Floating MPs. The CAS subdivision is classified as ‘poor’ regarding Beach Litter and sea surface Floating MPs and under ‘bad’ regarding Seafloor Litter. Finally the SAS subdivision is classified under ‘bad’ status for both Beach Litter and Floating MPs, while no data exist for Seafloor Litter.

55. 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’.

56. 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 7: Results of the NEAT tool on the assessment of IMAP EO10 CI22-CI23 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						
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						

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence %	CI22_BL	CI22_SFL	CI23
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

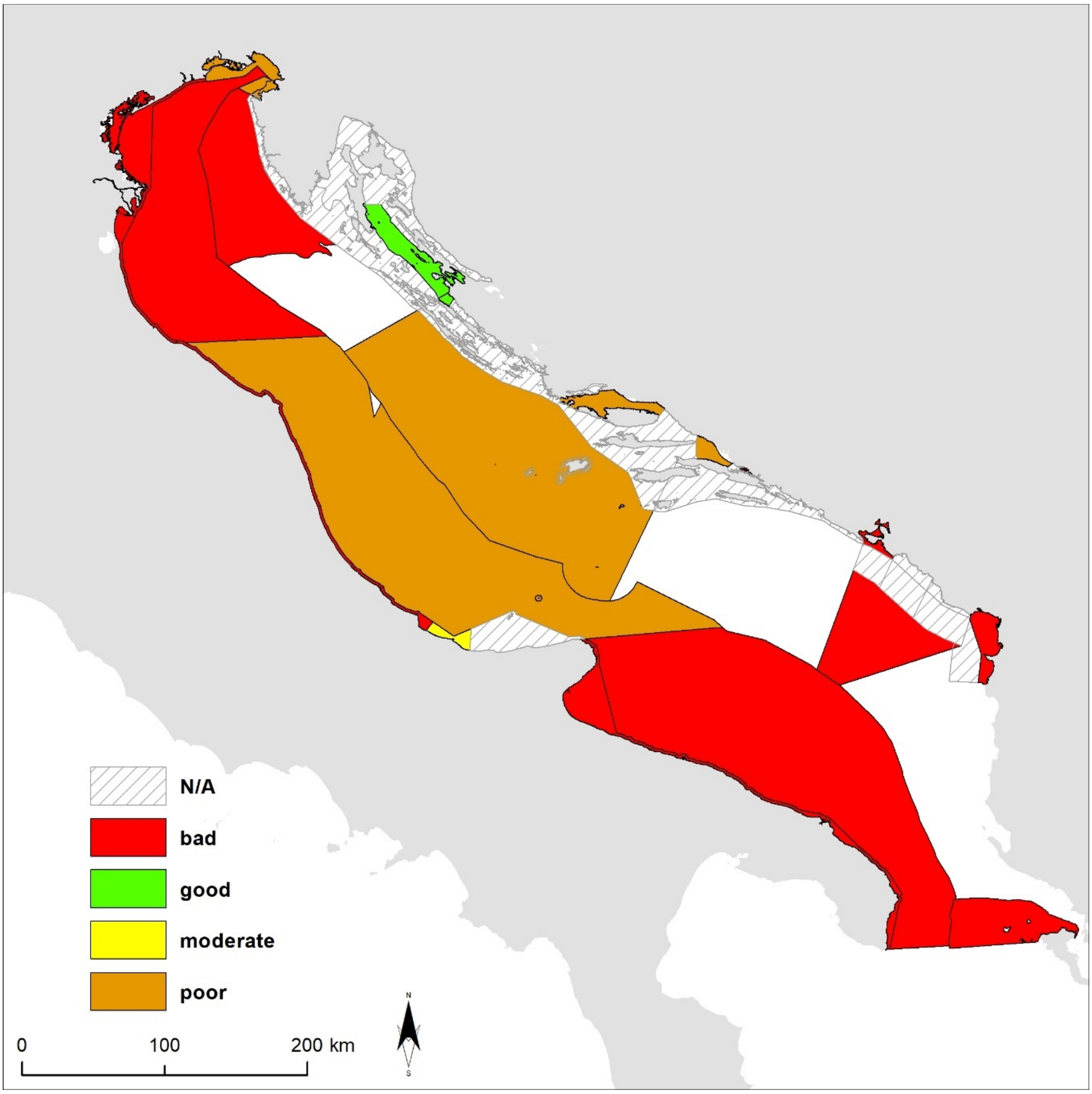

Figure 6: The aggregated-integrated assessment of EO10 in the Adriatic sub-Region following the NEAT assessment methodology.

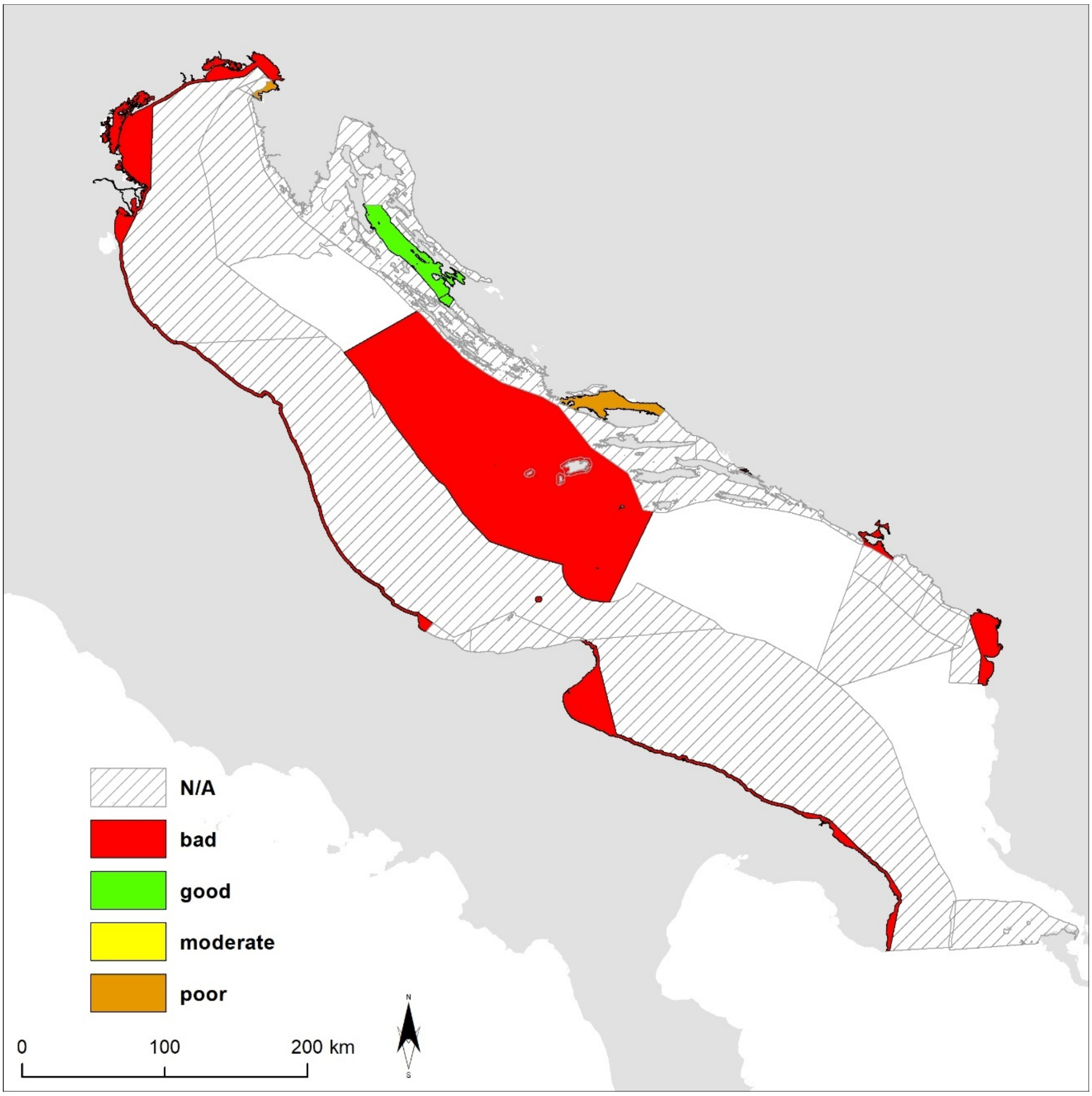

Figure 7: The assessment of CI22-Beach Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

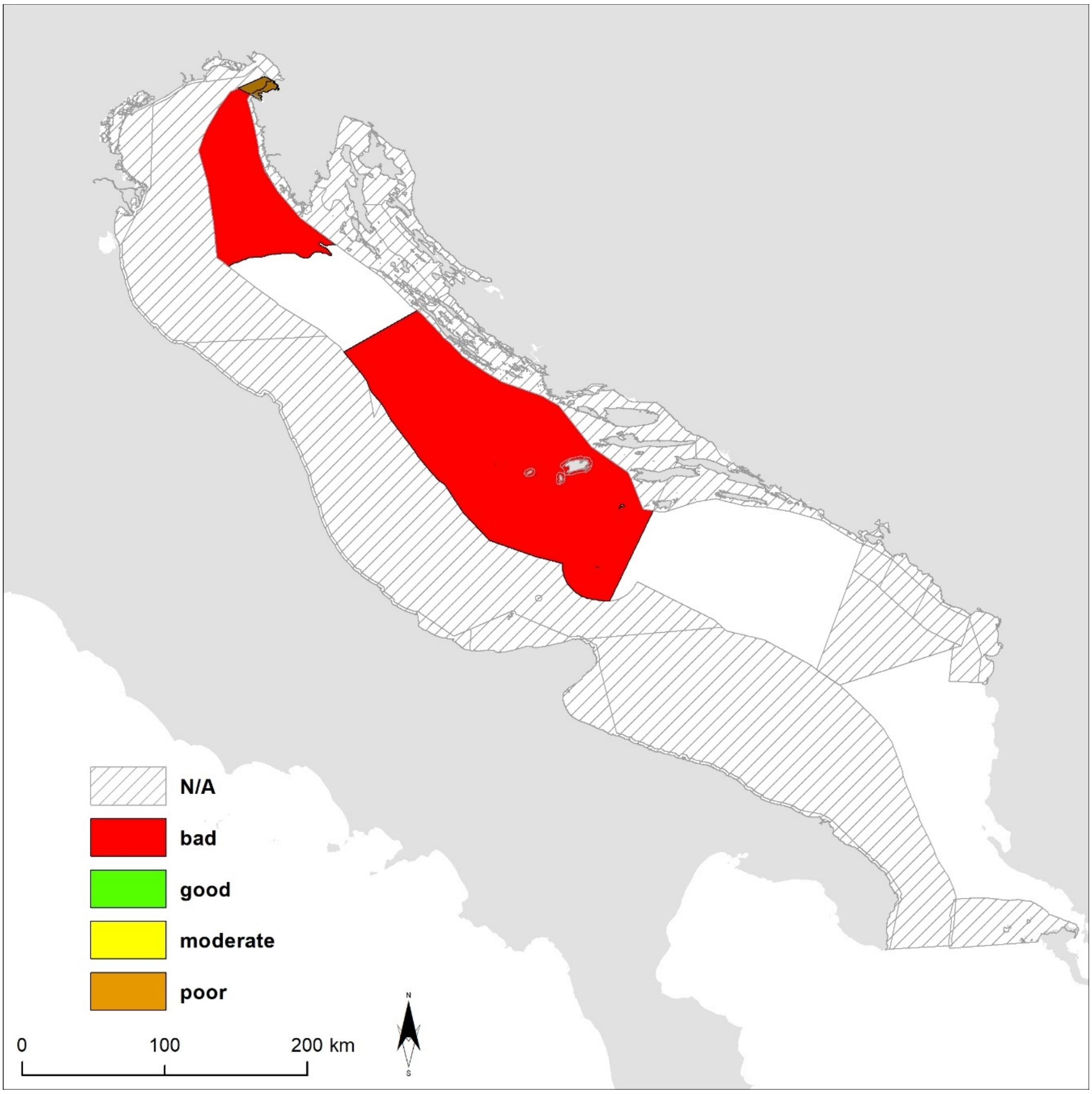

Figure 8: The assessment of CI22-Seafloor Litter spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

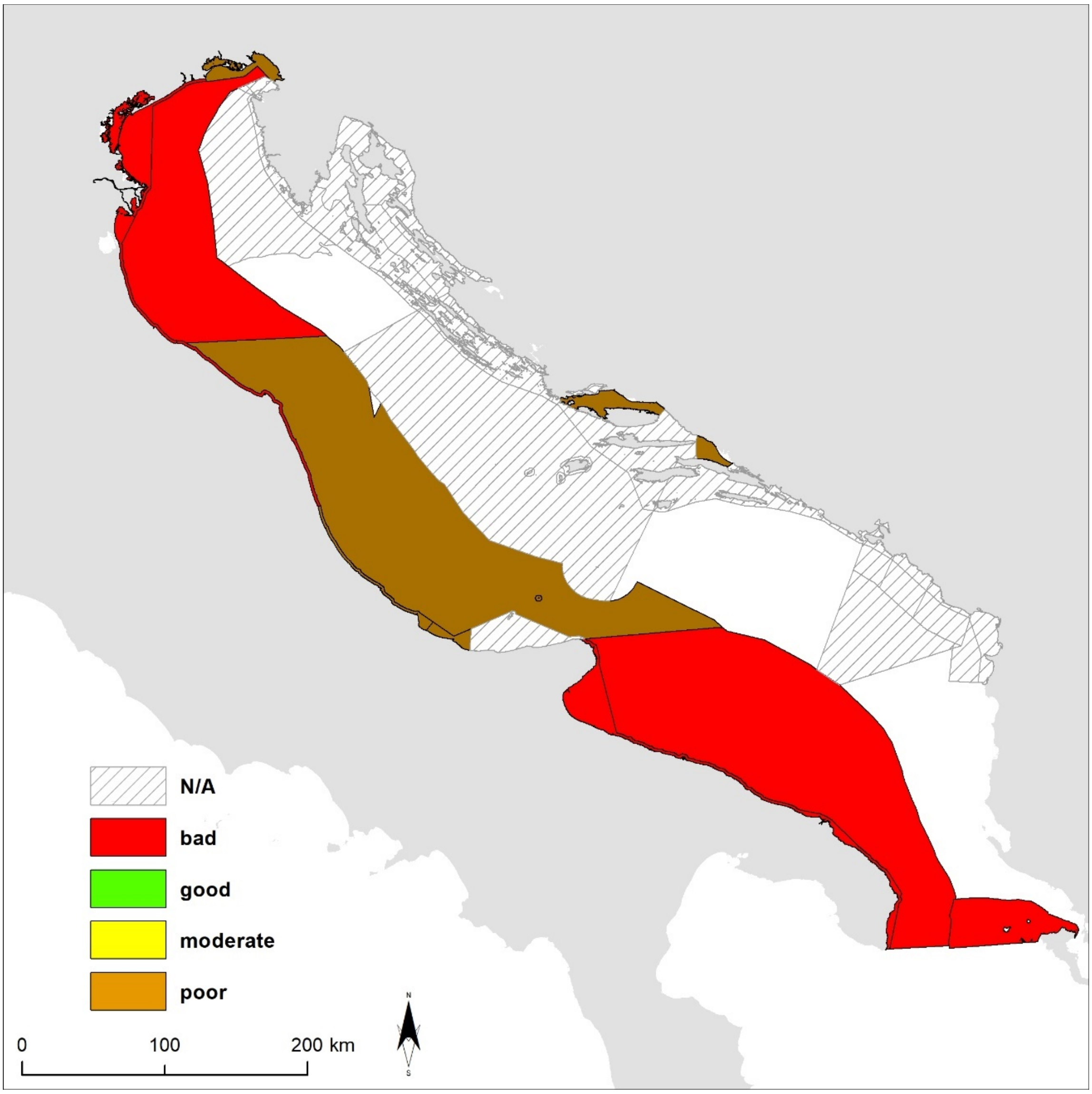

Figure 9: The assessment of CI23-Seasurface Floating MPs spatial integration in the Adriatic sub-Region following the NEAT assessment methodology.

6.1 Sensitivity analysis of the assessment results

57. 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 7 the results of the error analysis are presented.

58. 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 7. 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 8. 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
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

59. 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.

Annex I

Calculation of the SAU weight factors by the NEAT tool

Annex I: Calculation of the SAU weight factors by the NEAT tool.
(provided by the NEAT developers: Torsten Berg and Angel Borja)

The total weight of a SAU is not the simple ratio of each SAU area to the total area of the parent SAU. The process of distributing the weight is more complex. SAU weighting by the NEAT tool has two options: i) do not weight by SAU area: weights are calculated based just on the nesting hierarchy of the SAUs; ii) weight by SAU area: weights are calculated based on the nesting hierarchy and the SAU surface area.

The overall principle is that the sum of all weights in the nesting scheme (SAU tree) is equal to 1. By adding up the weights of all individual SAUs in a SAU nesting scheme, this sum will always be 1.

The next thing is, a SAU without data will have a total weight of zero, e.g. for the present case there is no contaminants data for the top SAU, the Adriatic Sea. So, its weight will be zero and this will give more weight to the SAU lower in the hierarchy (or to siblings on the same hierarchy level).

i) Weighting based on the nesting hierarchy only - NEAT option *'Do not weight by SAU area'*:

For the case that every SAU has data for at least one chemical parameter and we do not weight by area (and we use no priority factors). Then the area is treated as if it were 1. There is one top-level SAU (the Adriatic Sea) and below there are the Northern, Central and Southern Adriatic Seas. Hypothetically it is assumed there are also 4 SAUs beneath the Northern Adriatic Sea .

The calculation starts by assigning the total weight of the SAU tree that must be 1. This weight needs to be distributed among all SAUs in the tree. That means, the top SAU cannot have it all, it must share the 1 with its three children (Northern, Central, Southern). In total, this makes 4 SAUs that need to share the total weight of 1. So, the top-level SAU (the Adriatic Sea as a whole) and each of the children (Norther, Central, Southern) get 0.25 of the total tree weight:

w(total) = 1

w(Adriatic) = 0.25
v(Northern) = 0.25
v(Central) = 0.25
v(Southern) = 0.25

Note that we write w = final weight, and v = inherited weight.

For the top-level SAU, the 'w(Adriatic) = 0.25' is its final weight as it has shared the weight of 1 (which was inherited in the first place) among itself and its children. Now, each of the children must do the same. The weight which they now got, is not their final weight (named w above). It is the weight they inherit from their parent SAU (named v above) and that they need to share with their children. Hypothetically it is assumed that the 4 children of the Northern Adriatic Sea are called N1, N2, N3 and N4. The inherited weight of 0.25 needs to be shared among the Northern Adriatic Sea and N1, N2, N3 and N4. This is 5 SAUs. So, 0.25 is divided by 5 and it gets 0.05. That is the final weight of the Northern Adriatic Sea and the weight its children will inherit in the first place:

w(total) = 1 = v(Adriatic)
w(Adriatic) = v(Adriatic)/4 = 0.25

w(Northern) = v(Northern)/5 = 0.05
v(N1) = 0.05
v(N2) = 0.05
v(N3) = 0.05
v(N4) = 0.05

The total weight of 1 is the same as the weight inherited to the whole Adriatic Sea. And the final weight is its inherited weight divided by the number of SAUs involved.
The same principle can be applied to all further children in any possible SAU tree. If the tree stopped here, the one could take all w(...) values and add them together. As N1 through N4 have no children (as well as the Central and the Southern Adriatic) their inherited weight is the same as their total weight as they do not need to share it with any children. There are no further children anymore:
w(Adriatic) + w(Northern) + w(Central) + w(Southern) + w(N1) + w(N2) + w(N3) + w(N4)
= 0.25 + 0.05 + 0.25 + 0.25 + 0.05 + 0.05 + 0.05 + 0.05 = 1
The total weight of the tree is 1, as expected.

ii) Weighting based on the nesting hierarchy and the SAU surface area - NEAT option: *'Weight by SAU area'*:

In this case, the area is used instead of 1 but making sure the total weight is still 1. The one use a() for the area, for example:

a(Adriatic) = 139783 km^2
a(Northern) = 31856 km^2
a(Central) = 63696 km^2
a(Southern) = 44231 km^2

w(total) = 1 = v(Adriatic)
w(Adriatic) = v(Adriatic)*a(Adriatic)/[a(Adriatic) + a(Northern) + a(Central) + a(Southern)]
= 1 * 139783 / (139783 + 31856 + 63696 + 44231)
= 1 * 139783 / 297566
= 0.4698

Here, instead of adding the number of SAUs (the one at the top-level plus all its children), their areas are just added. The value of 0.4698 will now be the inherited weight for the Northern, Central and Southern Adriatic sub-divisions and is placed in the formula instead of the 1 above. So, v(Northern) will be 0.4698 and this weight is distributed among itself and N1 through N4. Again, the one add the areas of all those 5 SAUs, divide the area of the Northern Adriatic Sea by this sum and multiply with the inherited weight of 0.4698 and this will give the final weight of the Northern Adriatic Sea (and of its children if they do not have any children themselves).

The above apply under the assumption that there are data inserted to each of the nested SAUs. In the present analysis for the IMAP CI17 this is not the case and the weight calculation becomes more complex.

Annex II
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Annex II: References

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