UNITED NATIONS

EP

UNEP/MED WG.601/5

29 December 2024
Original: English

Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring
(CORMON Marine Litter)

Videoconference, 29 January 2025

Agenda item 4: Proposal for Updating the Environmental Targets for IMAP Ecological Objective 10 (EO10) on Marine Litter

Updated Environmental Targets for IMAP Ecological Objective 10 (EO10) on Marine Litter

UNEP/MAP
Athens, 2024

Note by the Secretariat

Decision IG.22/10 (Annex III) of COP19 in 2016 defined for first time a number of environmental targets for Integrated Monitoring and Assessment Programme (IMAP) Ecological Objective 10 (EO10 – Marine Litter) common and candidate indicators.

Since 2016, IMAP implementation for IMAP EO10 Marine Litter has been significantly improved, assessment criteria (i.e., threshold values (TV)) and updated baseline values have been prepared, and most importantly 2 regional assessment products have been produced (the 2017 and 2023 Mediterranean Quality Status Reports (MED QSR)), including an extended number of marine litter datasets that have been uploaded to IMAP InfoSystem for IMAP EO10 Common Indicators.

The Secretariat is initiating the process for updating the environmental targets for IMAP EO10 Marine Litter, with the support provided from the EU-funded Marine Litter MED II Project (2022 – 2024).

The aim of this document is to assess, further define, update, and develop environmental targets for IMAP EO10 Marine Litter, with an outmost scope to reduce the quantities of marine litter found around the Mediterranean.

The present document is submitted to the Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring (CORMON Marine Litter), for review and endorsement, and further submission to the Meeting of the MED POL Focal Points (June 2025).

Table of Contents

1. Introduction

1. Decision IG.22/10 (Annex III) of COP19 in 2016 was defined for first time a number of environmental targets for the Integrated Monitoring and Assessment Programme (IMAP) Ecological Objective 10 (EO10 – Marine Litter) Common and Candidate Indicators. The 2016 environmental targets included a specific reduction target for beach macro-litter (20% by 2024), whereas for the rest of the indicators the environmental targets had a more aspirational approach mainly referring to statistically significant decrease.

2. Since 2016, IMAP implementation has been significantly improved, assessment criteria (i.e., threshold values (TV)), and updated baseline values have been prepared, and most importantly two regional assessment products have been produced (the 2017 and 2023 Mediterranean Quality Status Reports (MED QSR)), including an extended number of marine litter datasets that have been uploaded to IMAP InfoSystem for IMAP EO10 Common Indicators.

3. In this regard, it is sensible to start a process for updating the environmental targets for IMAP EO10 Marine Litter, and the Secretariat is initiating this process through support provided by the EU-funded Marine Litter MED II Project (2022 – 2024).

4. The aim of this document is to assess, further refine, update, and develop environmental targets for IMAP EO10 Marine Litter, with an outmost scope to reduce the quantities of marine litter found around the Mediterranean.

2. Context Analysis

5. The definition of environmental targets enables the establishment of targeted measures to prevent and mitigate marine litter. Already in 2016, the first baseline values (BV) for IMAP EO10 - Marine Litter, were established at the level of the Mediterranean. This exercise was repeated in 2021-2022 taking into consideration numerous data deriving from the national IMAP-based monitoring programmes on marine litter, corresponding to the time series between 2016 and 2021, thus determining updated BVs and establishing for first time TVs for IMAP Common Indicators 22 (CI22) (beach macro litter) and Common Indicators 23 (CI23) (seafloor macro-litter, floating microplastics). A process is also ongoing for updating BV and establishing TV for IMAP Candidate Indicator 24 (Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles (EO10)).

6. The result of comparing the progress between the 2016 and 2021/2023 BVs indicated that for CI22 and CI23 (i.e., beach marine litter, seafloor marine litter and floating microplastics) a clear downward trend has been reached (Table 1). However, this analysis did not allow an estimation of the required time for reaching the TV and thus reaching Good Environmental Status (GES). To answer this question, it is necessary to implement an analysis that allows the establishment of a predictive trend model, i.e., based on a known time series of data, to establish a future curve.

Table 1: Decreasing trends for IMAP EO10 CI22 and CI23.

IMAP EO10	Marine Litter Categories	BV-2016	BV-2021/23	Decreasing trend (%)
CI22	Beach macro-litter	925 items/100m	369 items/100m	65%
CI23	Seafloor Macro-litter	180 items/km^2	135 items/km^2	63%
CI23	Floating Microplastics	0,35 items/m^2	0.044338 items/m^2	80%

7. An approach based on the methodology developed by Walvoort et al. (2021) is proposed which allows forecasting the expected decrease in the coming years of the total number of beach marine litter counts based on the available data and under the assumption that the current asymptotically modelled trend will remain stable in the future. The same approach has been applied for the case of seafloor macro-litter and floating microplastics.

8. However, there are many factors that can lead to a deviation from the predicted curve in the future, so this model can in turn indicate the values that should be approached in short periods of time (i.e., intermediate target values) to reach the defined threshold values.

9. Data have been used from the data generated by the Contracting Parties in the framework of their IMAP-based national monitoring programmes, supported by various sources (e.g., projects and other initiatives) and officially reported and uploaded through IMAP InfoSystem for the preparation of the 2023 Mediterranean Quality Status Report (MED QSR). The time series considered for this exercise is provided hereunder and in Table 2 and Figure 1:

- IMAP CI22 (beach macro-litter): 2017-2021
- IMAP CI23 (seafloor macro-litter): 2017-2021
- IMAP CI23 (floating microplastics): 2016-2022

Table 2: Barcelona Convention Contracting Parties reporting data for IMAP EO10 CI22 and CI23:

Countries	IMAP EO10 CI22 (beach macro-litter)	IMAP EO10 CI23 (seafloor macro-litter)	IMAP EO10 CI23 (floating microplastics)
BA	ü		**X**
CY	ü	ü	
ES	ü	ü	ü
FR	ü	ü	ü
GR	ü		ü
HR	ü	ü	ü
IS	ü	ü	ü
IT	ü		ü
LB	ü		ü
MA	ü	ü	
ME		ü	
MT		ü	
SI	ü	ü	ü
TN		ü	
TR	ü	ü	ü
Nº Survey sites	**166**	**364**	**679**
Nº Surveys	**931**	**948**	**2683**

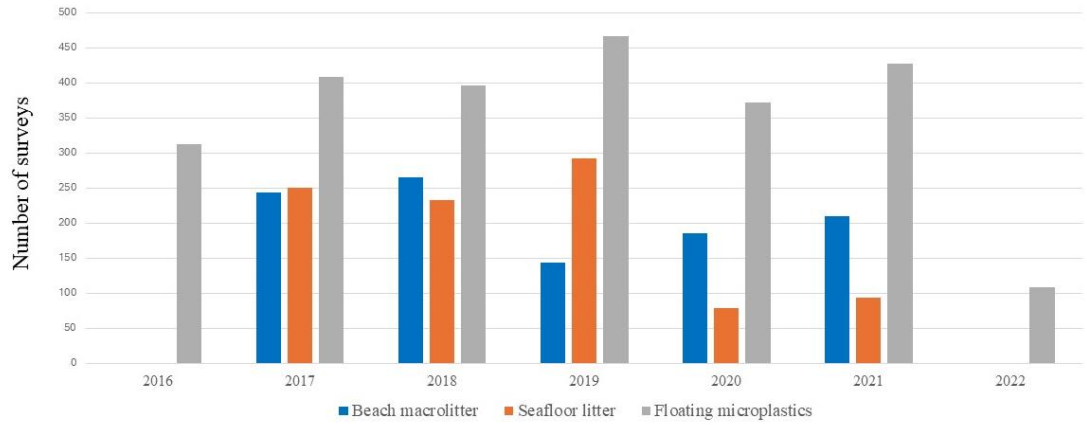

Figure 1: Total number of marine surveys conducted per year for IMAP EO10 CI22 and CI23.

3. Methodology

10. In general, setting environmental targets for marine litter in different scenarios requires a large amount of data and long sampling periods (Baggelaar et al., 2014; Dennis Walvort et al., 2021; Hanke et al., 2019; Marcus Schulz et al., 2013).).

11. Based on the data obtained and their spatial coverage, it has been chosen to assess the evolution with simple methods that can respond to the objectives as a negative binomial generalized linear model with the log-link function (NB-GLM) (Van Loon et al, 2020). For this purpose, BVs and TVs established in 2016 and 2021 for IMAP EI10 IC22, and 2023 for IC23 are considered (Table 3).

Table 3: 2016 and 2021/2023 Baseline Values (BVs) and Threshold Values (TVs) for IMAP CI22 and CI23.

IMAP Indicators	Categories of Marine Litter	BV (2016)	Updated BV (2021and 2023)	TV (2021 and 2023)
CI22	Beach macrolitter	450-1400 items/100m	369 items/100m	130 items/100m
CI23	Seafloor macrolitter	130-230 items/km^2	135 items/km^2	38 items/km^2
CI23	Floating Microplastics	0,2–0,5 items/m^2	0.044338 items/m^2	0,000845 items/m^2

12. Considering that in 2016 ranges were proposed for BVs, in this document we will take as a reference the average of the proposed ranges, to establish the necessary comparison (Table 4).

Table 4: 2016 average and 2021/2023 (Updated) Baseline Values and Threshold Values for IMAP CI22 and CI23.

IMAP Indicators	Categories of Marine Litter	BV (2016) Average Values	Updated BV-2021/23	Proposed TV-2021/23
CI22	Beach macrolitter	925 items/100m	369 items/100m	130 items/100m
CI23	Seafloor Macro-litter	180 items/km^2	135 items/km^2	38 items/km^2-
CI23	Floating Microplastics	0,35 items/m^2	0.044338 items/m^2	0,000845 items/m^2

13. This document describes the statistical method used to analyze the reduction of litter on beaches by calculating a +5 years forecast regression. Considering that we are working with data from 2016 to 2022 we will estimate a forecast of achievable marine litter reductions from 2023 to 2030, a period in which target values will be defined and a time limit for the forecast of compliance with the threshold values to 2030.The objective of this forecast would be estimating an expectation of the evolution of marine litter (CI22 and CI23) and identifying warning signals about the deviation from the targets to take preventive decisions.

4. Data Analysis

14. The model dataset will be calculated with the median statistic due to the huge deviation of the data. A negative binomial data model would fit the marine litter data, which show heteroscedasticity, so we will use as a first approximation an asymptotic GLM model for the expected asymptotic decreases of marine litter in the three indicators (i.e., CI22 beach macro-litter, CI23 seafloor macro-litter, CI23 floating microplastics).

15. The method described in modelling and forecasting of beach litter assessment values (Walvoort et al., 2021), developed to predict total beach macrolitter counts from OSPAR and EU surveys, has been considered the most appropriate for the development of this study. This model has been developed in view of the need to predict when the TV for beach litter will be reached.

16. It is a generalized model known as negative binomial (NB-GLM). This model is suitable for modelling asymptotic trends and is a natural choice for survey data with overdispersion such as marine litter (Walvoort et al., 2021). The model fits surveys with a decreasing trend, although this decreasing trend has not been recorded for all cases provided for this study. The decreasing trend appears in the case of CI22-beach macrolitter and CI23-floating microplastics, but not in CI23-seafloor macrolitter for which more appropriate fitting curves must be found. To be able to carry out this analysis, in the case of CI23-seafloor macrolitter, the value of the baseline calculated in 2016 has been included so that a possible downward trend can be assessed.

17. The model must satisfy the following requirements (Walvoort et al., 2021):

a) The model must be able to capture an asymptotically decreasing trend (Van Loon et al., 2020).
b) The model should not allow for unrealistic extrapolations. This rules out, for example, the use of polynomial regression models.
c) The model should preferably be linear in its parameters, so that linear algebra can be used for inference.
d) The model should consider that marine litter data are based on surveys and should be robust to extreme values. The natural data distributions that fit the count data are the Poisson distribution and the negative Binomial distribution. The latter is the more flexible of the two because it can model overdispersion. The Poisson distribution is more restricted, as its variance is always equal to its mean (Hanke et al., 2019).

5. Setting Environmental Targets

18. Due to the nature of the model, long-term forecasts may lead to unrealistic marine litter counts. We will limit the extrapolation period to a 5-year period (equal to the one analysed) to avoid this problem, bearing in mind that model forecasts can be updated periodically when new data become available, thus refining the results.

19. It is recommended to adjust the results through intermediate analyses (Walvoort et al., 2021). For this exercise, 2 intermediate environmental targets (IET) will be set for the years 2026 and 2028, while noting that a first approximation will be set for the final environmental target (FET) of 2030.

Figure 2: Timeline for establishing environmental targets on marine litter.

20. Whereas IET-2026 and IET-2028 follow a progressive approach, the FET-2030 is introduced considering that a number of measures envisaged in the framework of the Regional Plans the Post-2020 SAPBIO, adopted and implemented in the framework of UNEP/MAP have an interim timeline for the majority of their measures by 2030 (final end date 2035), as well as the Secretariat's preliminary proposal for undertaking the next MED QSR assessment in 2030, as well as the proposed mid-term evaluation of EcAp proposed for 2030 (end date 2035).

21. Considering the time series introduced for the trend calculation (i.e., 2016-2022), the IET-2026 and IET-2028 can provide quite reliable results. Therefore, FET-2030 can be considered as an acceptable approximation in the event and/or further to the assessment hopefully confirming that the IET-2026 and IET-2028 are achieved. Certainly, a longer time data series would be more appropriate for the calculation of FET-2030. It is recommended to recalculate this value (FET-2030) with a longer data series, at least until 2025, in order to improve its accuracy. Thus, a relevant update in the data series could be considered in the near future.

22. It is recommended to enter the data within a six-year cycle, and preferably within a three-year period to obtain a more up-to-date assessment (Walvoort et al., 2021). In this case we will proceed with a 5-year period for CI22-beach macro-litter and CI23-seafloor macrolitter in accordance with the approach followed for establishing assessment criteria (i.e., TVs and updated BVs) for IMAP Ecological Objective 10 (i.e., using a period of 5 years). To optimize the results, sampling sites that meet certain continuity and representativeness requirements are selected (Figure 3).

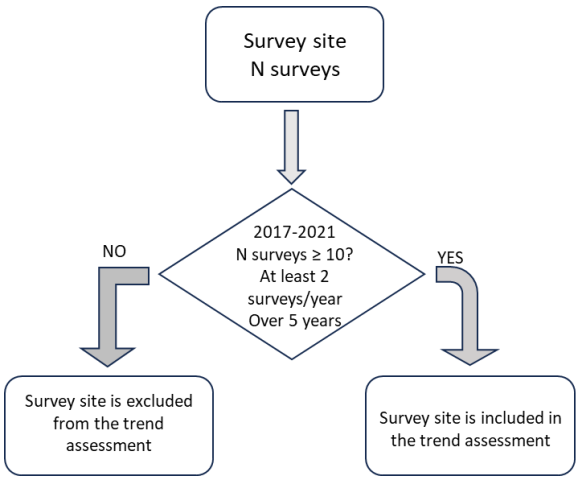

Figure 3: Decision scheme for inclusion of survey sites in the trend assessment (adapted from Lacroix et al. 2022).

23. Following this data selection (Figure 3), the selected information is shown in Table 4.

Table 4: Selected information for trend calculation

	IMAP EO10 CI22 (beach macro-litter)	IMAP EO10 CI23 Seafloor macro-litter	IMAP EO10 CI23 floating microplastics
Nº Survey sites	142	347	669
Nº Surveys	886	878	2147

24. To proceed with the application of the model, the R-source code (R Core Team, 2020) has been modified to align with the requirements of the UNEP/IMAP forms and accommodate the various scenarios studied.

25. Model efficiency is usually quantified by validation. This is the actual reason for data being split into two mutually exclusive sets: (a) one for calibration (fitting); and (b) one for validation (testing). To validate a model for forecasting purposes, the data are usually split over time. Older data are used for calibration and newer data for validation (Walvoort et al., 2021). However, in our situation, this type of validation is not possible due to a limited number of data/years. Cross-validation is also not useful, as it only validates predictions in the data period (the past) and does not validate predictions (the future) (Walvoort et al., 2021). Therefore, it is recommended to proceed with validation in the future, when more data becomes available.

6. Results

6.1 Beach Macro-Litter (IMAP EO10 CI22)

26. The pre-processing of the data for IMAP EO10 CI22 (Figure 4) has resulted in the removal of 5% of the original data (886 surveys, Table 4).

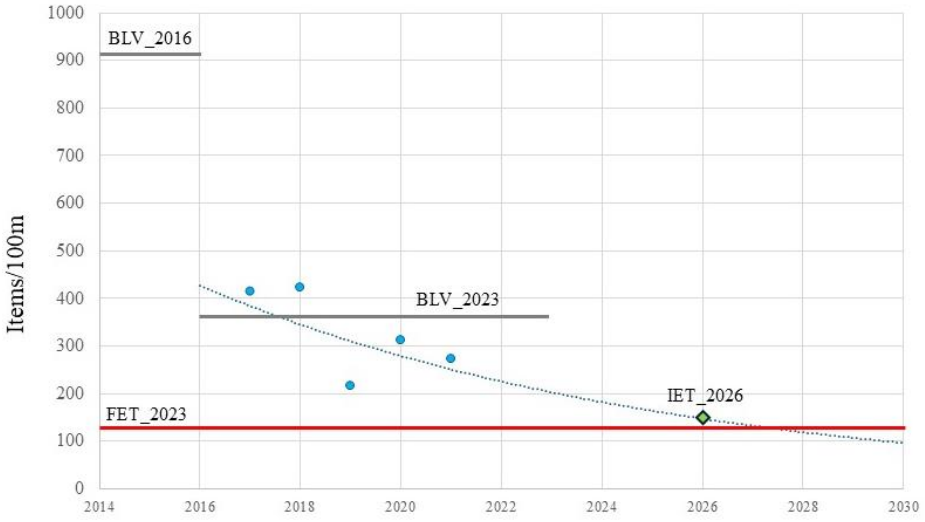

Figure 4.- Beach marine litter base line values as function of time. Grey line = assessment base line values. FET_2023 = assessment threshold value 2023. Blue points = year median value. IET= intermediate environmental target (green point).

27. Baseline values for CI22 (beach marine litter) would fall below the FET approx. in 2027, if the current trend is maintained (Figure 4). An intermediate target can be set for 2026 of 150 items/100m (Figure 4).

6.2 Seafloor Macro-Litter (IMAP EI10 CI23)

28. In general, the data for IMAP EO10 CI23 seafloor macro-litter do not follow a decreasing trend, with most countries showing an increasing trend until 2019, and some countries do not yet show a decreasing trend from 2019, either due to a gap in data or because it has not yet happened.

29. To be able to apply the model, countries with insufficient information have been eliminated (Figure 5). This has meant restricting the available information by 7,5% of the original information (878 surveys, Table 4).

Figure 5.- Seafloor macro-litter base line values as function of time (Grey line: assessment base line values; FET_2023: assessment threshold value 2023; Blue points: year median value; Green point: intermediate environmental target (IET).

30. Seafloor macro-litter baseline values would fall below the TV beyond 2030, if the current trend continues (Figure 5). Considering the time series introduced for the trend calculation (2016-2021), the values for the intermediate environmental targets (ET 2026 and 2028) are reliable, while their extrapolation to 2030 is too far away from the introduced time series, thus making this exercise and value calculation unreliable.

31. In addition, differences in behavior between countries suggest different rates of progress towards achieving GES, so three intermediate targets of 66 items/km^2 in 2026, 58 item/km^2 in 2028, and 50 item/km^2 in 2030.

6.3 Floating microplastics (IMAP EO10 CI23)

32. Pre-processing of the data for CI23 floating microplastics (Figure 6) has resulted in the removal of 20% from the original data (2,147 surveys, Table 4).

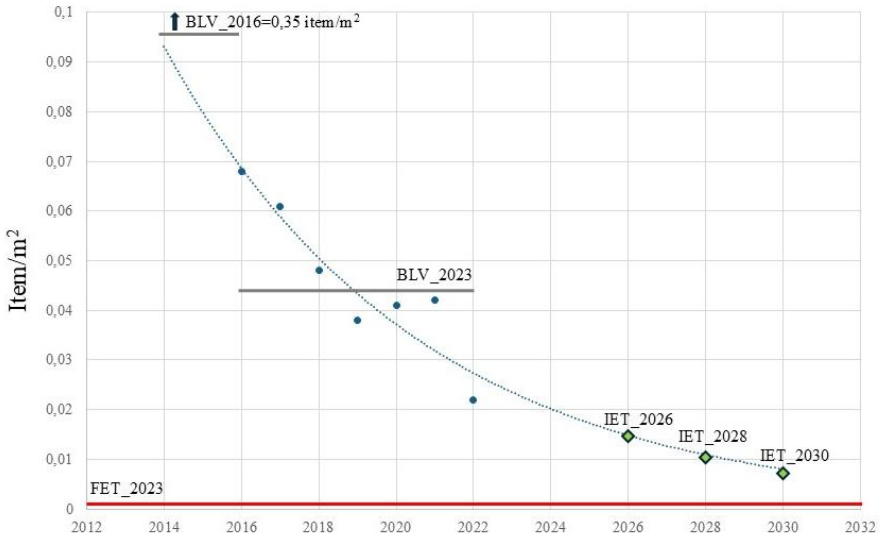

Figure 6: Floating microplastics base line values as function of time. Grey line= assessment base line values. FET= assessment threshold value 2023. Blue points = year median value. IET= intermediate environmental target (green point).

33. Values for floating microplastics would approach the FET beyond 2030, provided that the current trend is maintained (Figure 6). However, an intermediate target can be set for 2026 (0.015 items/m^2), 2028 (0.01 item/m^2) and 2030 (0,008 item/m^2).

7. Conclusions

34. In all three cases the future projection for the BV to be equal to or below the FET implies time periods at or above the validation period, although the integration of new data can provide a better fit to the results, especially for CI23-seafloor macro-litter.

The reduction percentages (RP) required to achieve FET are higher than 60% in all indicators (Figure 7), but it is especially high for CI23_floating microplastics where it reaches 80% reduction.

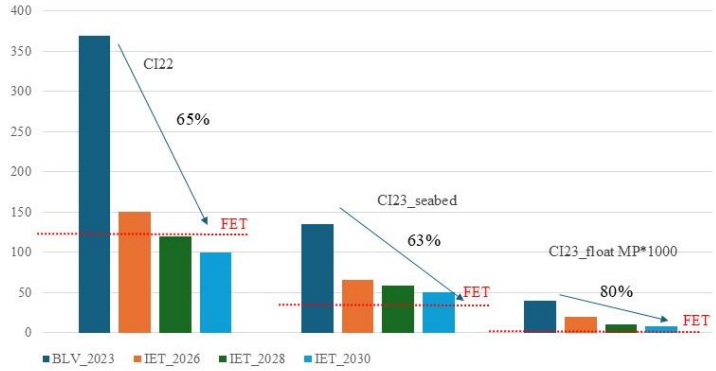

Figure 7.- Reduction percentage evolution.

35. The environmental targets obtained from the analysis performed for each of the indicators are as follows (Table 5):

Table 5.- Intermediate environmental targets (IET) and Final Environmental Target (FET).

IMAP Indicators	Marine Litter Categories	ML Average Concentrations*	BLV 2023	IET 2026	IET 2028	IET 2030	FET	RP**	Drop down to FET
CI22 (item/100m)	Beach Macrolitter	6,425±9,075	369	150	-	-	130	65%	Approx. 2027
CI23 (item/km^2)	Seafloor Macrolitter	570± 2,588	135	66	58	50	38	63%	> 2030
CI23 (item/m^2)	Floating Microplastics	0.36 ± 1.9	0.044338	0.015	0.010	0.008	0.000845	80%	> 2030

* Source: 2023 MED QSR

** RP=Reduction Percentage from BLV 2023 to FET (Figure 7)

36. Considering the time series introduced for the trend calculation, the values for the intermediate environmental targets (ET 2026 and 2028) are reliable, while their extrapolation to 2030 becomes unreliable. Therefore, the IET 2030 is considered an acceptable approximation if the 2026 and 2028 EITs are achieved. Therefore, it is recommended to recalculate this value (IET 2030) with a longer data series in 2025, to improve its accuracy.

References

Baggelaar, Paul K. and Van der Meulen Eit C.J. 2014. "Evaluation and fine-tuning of a procedure for statistical analysis of beach litter data". Dutch Ministry of Infrastructure and the Environment.

Dennis Walvoort, Willem van Loon, Marcus Schulz, Silvère André, 2021. Modelling and forecasting of beachlitter assessment values. Wageningen Environmental Research, Report 3090. 46 pp.

Hanke, G., Walvoort, D., Van Loon, W., Addamo, A., Brosich, A., Del Mar Chaves Montero, M., Molina Jack, M., Vinci, M., Giorgetti, A., 2019. EU marine beach litter baselines (No. EUR 30022 EN,). European Joint Research Centre, Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/16903

Lacroix, C., André, S., and van Loon, W. 2022. Abundance, Composition and Trends of Beach Litter. In: OSPAR, 2023: The 2023 Quality Status Report for the North-East Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/beach-litter/

Marcus Schulz, Daniel Neumann, David M. Fleet, Michael Matthies. 2013. A multi-criteria evaluation system for marine litter pollution based on statistical analyses of OSPAR beach litter monitoring time series. Marine Environmental Research Volume 92, December 2013, Pages 61-70.

Marthe Larsen Haarr, Jannike Falk-Andersson, Joan Fabres. 2022. Global marine litter research 2015–2020: Geographical and methodological trends. Science of the Total Environment 820.

Santiago García-Rivera, Jose Luis Sánchez Lizaso, Jose María Bellido Millán. 2018. Spatial and temporal trends of marine litter in the Spanish Mediterranean seafloor. Marine Pollution Bulletin 137, pp. 252-261.

UNEP/MED. 2023. 2023 Mediterranean Quality Status Report. 23rd Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols. Portorož, Slovenia, 5-8 December 2023.

Van Loon, W., Hanke, G., Fleet, D., Werner, S., Barry, J., Strand, J., Eriksson, J., Galgani, F., Gräwe, D., Schulz, M., Vlachogianni, T., Press, M., Blidberg, E. and Walvoort, D., "A European threshold value and assessment method for macro litter on coastlines", EUR 30347 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21444-1, doi:10.2760/54369, JRC121707.

Walvoort, D., van Loon, W., 2020. litteR: Litter analysis; R package version 0.8.2; available at https://CRAN.r-project.org/package=litteR.