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

Videoconference, 29 January 2025

Agenda Item 3: Proposal for Revising IMAP Ecological Objective 10 (EO10) on Marine Litter

Proposal for updating the Baseline Values (BV) and establishing Threshold Values (TV) for IMAP Candidate Indicator 24

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UNEP/MAP
Athens, 2024

Note by the Secretariat

In 2016 during COP19 (Decision IG.22/10) Baseline Values (BV) were established for all IMAP EO10 Marine Litter Common and Candidate Indicators.

Since then updated BVs have been agreed and TVs have been established for IMAP Common Indicators 22 (beach macro-litter) and Candidate Indicator 23 (seafloor macro-litter and floating microplastics), yet not for Candidate Common Indicator 24 (ingestion and entanglement of marine litter from sea turtles).

With the support provided from the EU-funded Marine Litter MED II Project (2022 – 2024), Data Standards (DS) and Data Dictionaries (DD) have been developed based on the agreed standardized monitoring protocols, including data quality assurance and quality control tools, to enable the reporting to the Secretariat of national data with regards to IMAP Candidate Indicator 24, through the IMAP InfoSystem. Moreover, 3 national IMAP-based monitoring programmes have been established for Lebanon, Morocco, Tunisia, including the data generation and submission to IMAP InfoSystem.

The aim of this document is to develop the methodology for statistical analysis for data collected by Contracting Parties, which will support the process for updating the BV and establishing TV for IMAP Candidate Common Indicator 24 at the level of the Mediterranean region.

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
2. Data availability 1
3. Methodology 2
3.1 Ingestion 3
3.2 Entanglement 4
4. Determination of Baseline and Threshold Values 5
4.1 Ingestion 5
4.2 Entanglement 7
5. Conclusions 9
References 10

1. Introduction

1. The aim of this document is to develop the methodology for providing a statistical analysis for data collected by Contracting Parties, towards providing a first proposal for updating the Baseline Value (BV) and establishing Threshold Value for IMAP EO10 Candidate Common Indicator 24.

2. Definition of Baseline Value (BV): According to the definition provided by the UNEP/MAP (UNEP/MED WG.514/7[1]), "A baseline is a description of environmental state at a specific point against which subsequent values of state are compared". It may refer to a specified level of an impact or a pressure and act as a reference against which limit can be set or trends for the assessment of GES. Baselines can be derived from reference conditions, initial assessment values, the present state, or a potential/predicted issue."

3. Definition of Threshold Values (TV): The approach elaborated and used for the establishment of TV for the needs of preparation of the marine litter chapter[2] of the 2023 MED QSR, is in line with the New GES Decision (2017/848) of the European Commission (EC), which provides a definition for the Threshold Values for marine litter: "Threshold value means a value or range of values that allows for an assessment of the quality level achieved for a particular criterion, thereby contributing to the assessment of the extent to which good environmental status is being achieved."

2. Data availability

4. Data have been made available thanks to the EU-funded projects: INDICIT I and II; INTERREG MED Plastics Busters MPAs and the Marine Litter MED I and II (Table 1) corresponding to 467 specimens belonging to two species (Caretta caretta (Cc) 90% and Chelonia mydas (Cm) 10%). Analysis shows that 42% of the specimens sampled were affected by ingestion of marine litter items, 39% by entanglement, 1% by both ingestion and entanglement, while 18% refer to specimens caught by accidental entanglement in active fishing gears and unknow (Figure 1).

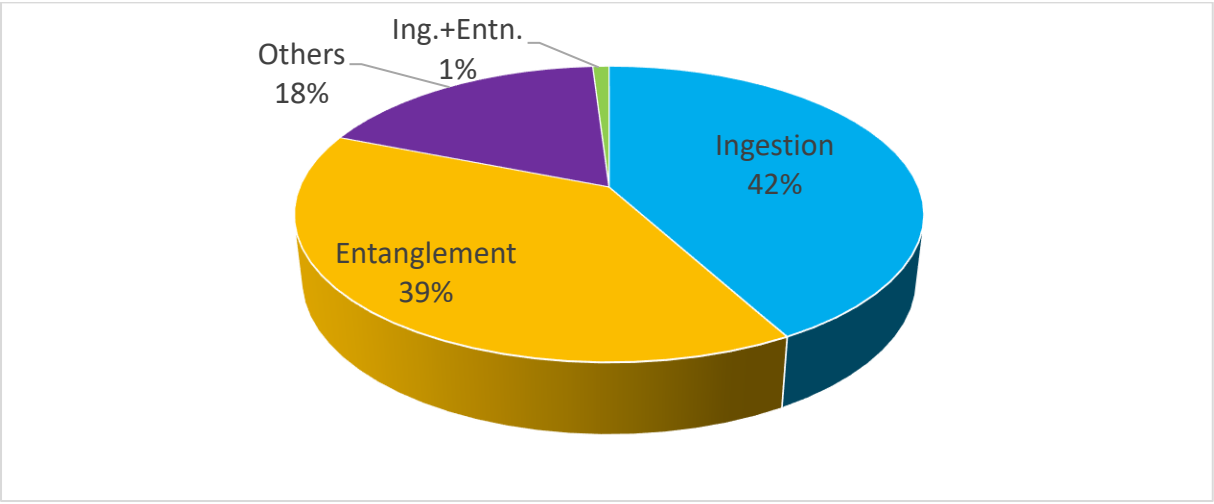


Figure 1: Percentage distribution by type of damage (i.e., ingestion, entanglement, ingestion and entanglement, other).

[1] 8th Meeting of the Ecosystem Approach Coordination Group (EcAp CG) Videoconference, 9 September 2021
[2] 2023 Mediterranean Quality Status Report (MED QSR): Marine Litter Ecological Objective (EO10), in UNEP/MED WG.555/4 (CORMON Marine Litter, 3 March 2023, Athens, Greece)

Table 1: Data collected from the respective Contracting Parties:

Country	Ingestion	Entanglement	Years
Cyprus	-	4	2013, 2018, 2019, 2020
France	82	9	2007, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Greece	0	105	2010, 2011, 2012 2014, 2015, 2016, 2017, 2018, 2019, 2020
Italy	40	27	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020
Lebanon	93	-	2021, 2022, 2023
Spain	-	32	1995, 1998, 2000, 2011, 2012, 2013, 2015, 2016, 2017, 2018, 2019, 2020
Tunisia	25	24	2011, 2017, 2019, 2020, 2023
Turkey	4	22	2012 2014, 2015, 2016, 2017, 2018, 2019, 2020
Total	**244**	**223**	

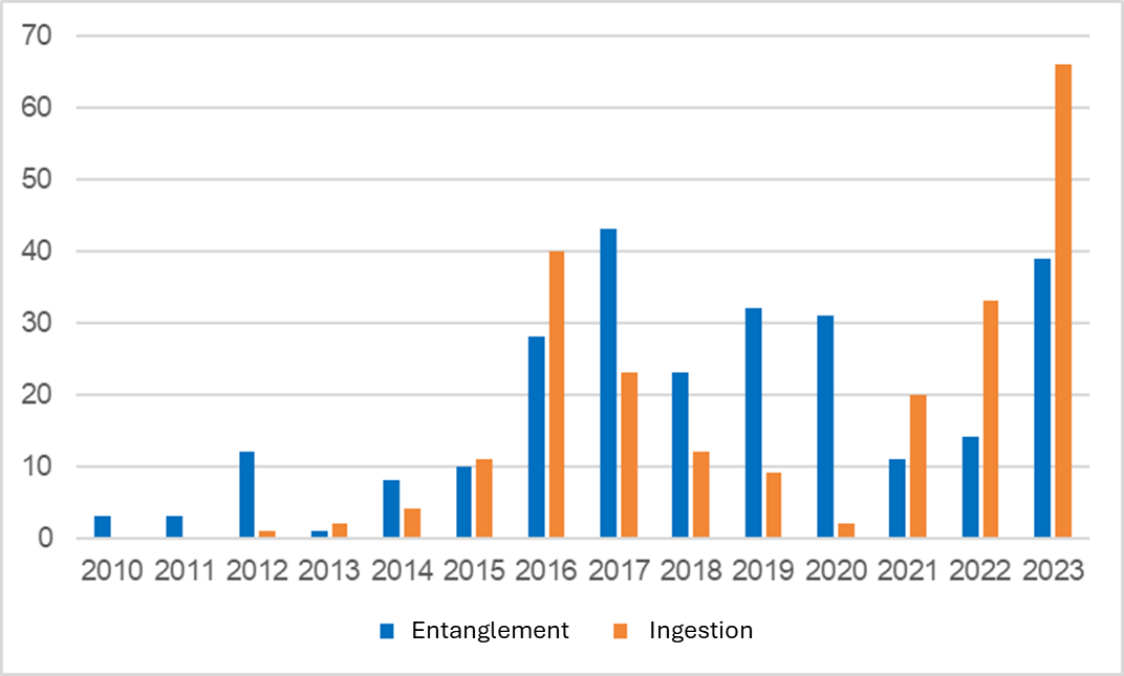


Figure 2: Data received by year

5. An analysis is provided in document respectively for ingestion and entanglement, considering ingestion data in the first output and entanglement data in the second output.

3. Methodology

6. Due to the mobility of marine turtles, for example loggerhead turtles that can travel long distances, the transit time of ingested litter items (usually between 10 and 14 days (Valente et al., 2008; Solomando et al., 2022), and their different degree of conservation (i.e., alive, recently dead, mummified, etc.), it is not possible to attribute the encounter with marine litter (i.e., ingestion and/or entanglement) to the coordinates where they were located, so the analysis is approached globally and not according to the country which reports the data.

7. The data collected can be used to calculate, for specific samples:

a) Frequency of occurrence: the proportion of turtles that have plastic in their stomachs (also called "incidence" or "prevalence");
b) Arithmetic mean and standard deviation of the mean mass of marine litter found in the gastrointestinal tract (GI) of each specimen or the number of entangled objects. In case of a high standard deviation (non-normal distribution) the median is considered as a most appropriate value for the establishment of the baseline value (BL).
c) Threshold Value (TV): The reference level for the presence of plastics in the stomachs of turtles (or any marine organism) is zero, as synthetic materials are exclusively man-made and were only introduced into the marine environment in the mid-20th Century (Kühn et al., 2022). However, assuming that accidental losses are inevitably occurring, an attempt will be made to indicate a possible TV.

8. All statistical analyses were performed with R 4.3.2 Statistical Programme (R Core Team, 2023).

3.1 Ingestion

9. Since the first scientific publications on the topic, over 500 marine species have been listed for ingesting marine litter and sea turtles were among the first taxa recorded. Given their propensity to ingest litter, their wide distribution, and the large range of habitats used during their life, sea turtles, in particular the loggerhead species (Caretta caretta), have been chosen as indicator species for the Mediterranean basin (Matiddi et al., 2019).

10. A specific protocol to collect data on marine litter ingested by sea turtles has been developed and tested by ten partners in seven countries in the Mediterranean Sea and Atlantic Ocean within the European Project INDICIT (GA n°11.0661/2016/748064/SUB/ENV.C2). This protocol provides standardized methodologies for the analysis of marine litter ingested by sea turtles to support the new Commission Decision (EU)8, Criteria D10C3, and could be useful to support the IMAP Candidate Indicator cCI24: “Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles”.

11. The proposed protocol to catalogue the litter ingested by sea turtles will be useful in gathering data on the composition and abundance of litter and assess its impact on marine environments. Moreover, collecting this type of standardized data will help to define threshold values (Matiddi et al., 2019).

12. For updating the BV for Candidate Indicator CI24, the median value of the amount of macrolitter ingested by marine animals is considered as a better measurement of the central location of a value, than the average value in the case of a non-symmetric distribution (Baggelaar, Paul K. and Van der Meulen Eit C.J., 2014; Van Loon et al., 2020). This is due to the reason that, the median value is not sensitive to extreme values (Van Loon et al. 2020).

13. The definition of TV followed during the development of the 2023 MED QSR (UNEP/MED WG.550/13) and the EU GES assessment method for marine litter on beaches (Van Loon et al., 2020), recommend a TV equal to the 15th percentile of the total abundance of marine litter, a statistical method commonly used in assessments when accurate reference values of pristine areas are not available (Van Loon et al., 2020).

14. From the analysis of the ingested litter data, we considered those data that were provided as complete information. This included 104 specimens from two countries, France and Italy, collected between 2012 and 2020 (Table 2).

Table 2: Data of ingested litter considered.

Year	FR	IT	Total per Year
2012	1	0	1
2013	2	0	2
2014	4	0	4
2015	11	0	11
2016	15	25	40
2017	20	3	23
2018	11	1	12
2019	0	9	9
2020	0	2	2
Total per Country	**64**	**40**	**104**

15. The analysis was based on the percentage of the dry weight of ingested marine litter and the total dry weight of the total ingestion. This ratio was established for each specimen and then grouped by year based on the median value, thus obtaining an annual value. The annual values were grouped by averaging them all to obtain the value corresponding to the baseline CI24-ingesta.

16. In addition, an analysis was carried out according to the frequency of occurrence of each of the types of marine litter. The results in this regard highlight which objects have the greatest impact on marine organisms, specifically sea turtles in the Mediterranean.

3.2 Entanglement

17. Data concerning entanglement have been reported by 8 countries (Table 3). An analysis based on the percentage of affected specimens versus the total number of collected specimens is proposed, including individuals trapped by active fishing nets. This relationship could be the baseline for interpreting the degree of affection derived from this interaction with marine litter.

Table 3: Data of considered entangled litter:

Year	CY	ES	FR	GR	IT	LB	TN	TR	Total per Year
2010			1	1					2
2011				1			1		2
2012				12					12
2013		1							1
2014				6				2	8
2015		1	1	5	1			2	10
2016		2		22	4			2	28
2017		1	2	31	6		1	3	44
2018		1	5	13	1			3	23
2019	4	5		9	7		2	4	31
2020		17		1	7		1	5	31
Total per Country	**4**	**28**	**9**	**101**	**26**	**0**	**5**	**21**	**194**

18. To obtain a more homogeneous sample for the analysis, the period 2010-2020 was chosen, comprising 194 specimens (Table 3). Data from previous years were excluded as they were not representative of most countries and contained a very low number of specimens.

4. Determination of Baseline and Threshold Values

4.1 Ingestion

19. 42% of the Mediterranean turtles sampled (Table 1) confirmed the presence of marine litter in their digestive system, mostly plastic fragments, however, this data cannot be considered as a baseline as it may be affected by harvesting distortions.

20. Another way to approach the calculation of the baseline is through the quantities (weight and/or units) found in the digestive system (Mattidi et al. 2024). The mean values per turtle obtained were 13 particles and 0.23 g (Table 4). However, due to a very high standard deviation and a non-normal distribution of the sample (Figure 3), the median value of 4 particles and 0.01 g is considered more representative (Table 4).

Table 4: Descriptive statistics parameters:

	Average	Standard Deviation	Median
Nº marine litter items	13	23,23	4
Weight marine litter (gr)	0,23	1,02	0,01

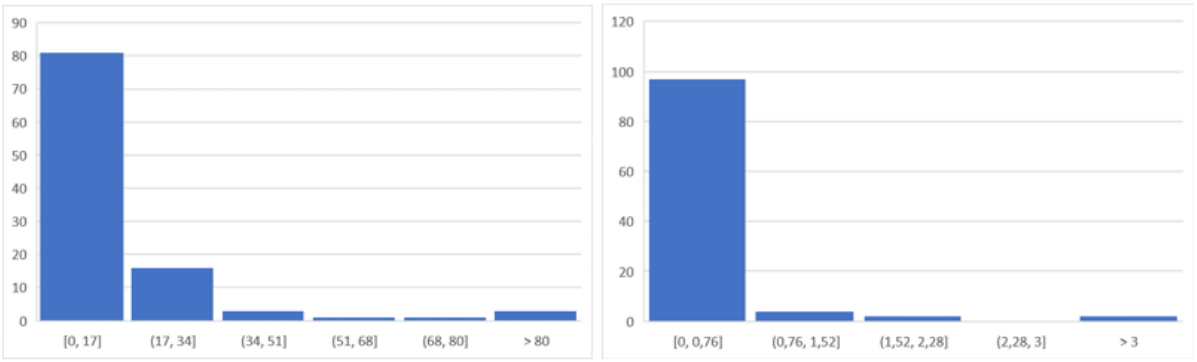


Figure 3: Frequency Histogram (Left: Item Number; Right: Marine Litter Dry Weight).

21. From these results, the **BV** can be set at the presence of **4 particles of marine litter in the digestive tract of the Mediterranean turtles and a weight of 0.01 g**. Considering the proposed threshold value of Mattidi et al. (2024), this corresponds to the 15th percentile, thus establishing TV in less than 15% of the sea turtles with more than 0.002 g of marine debris in the Gastrointestinal trac (GI).

22. To provide general information on the level of reduction to be applied to the BV, a percentage reduction should be applied to meet the proposed/calculated TV. The percentage reduction is calculated according to Van Loon et al. (2019) as follows:

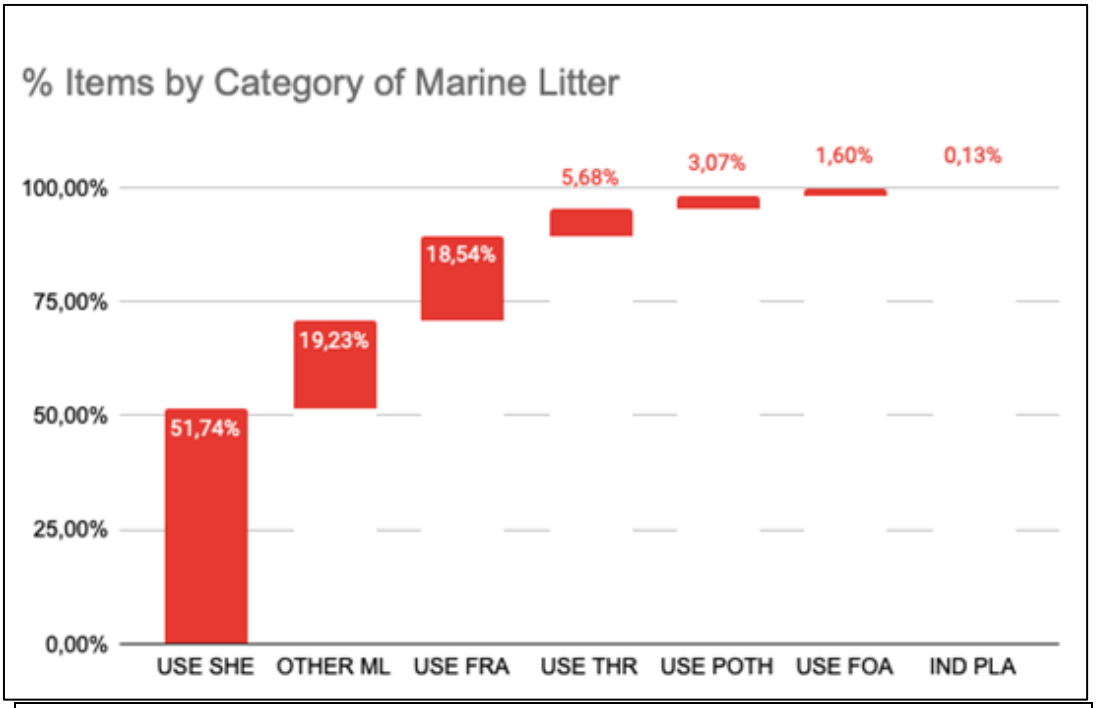
$$\textit{Reduction Percentage} = ((\textit{median} - \textit{TV}) / \textit{median}) \times 100$$

23. Accordingly, it is found that the reduction percentage between the proposed BV and the proposed TV for Common Indicator 24 in the Mediterranean, is approximately 80%.

24. The proposed values (i.e., BV and TV) should be understood as a first approximation due to the limited data available. A differential statistical analysis has been applied on a small sample and the results may be affected by this, since differential statistics analysis should be done in large groups of data.

25. This type of analysis is in line with the analysis carried out for other marine litter indicators (i.e., CI22 and CI23) but for its proper application it is necessary to improve the quality and quantity of the data through the proper application of sampling and reporting protocols.

26. The most frequent item category is Remains of Plastic Sheets (USE SHE), e.g. from plastic bags, cling film, agricultural films, garbage bags, etc., which is assessed at the level of 52% (Figure 4), followed by the "Other Marine Litter" (19%) (Figure 4).



USE SHE:	Remains of plastic sheets from bags, cling film, agricultural films, garbage bags
USE FRA:	Fragments, broken pieces of thicker type plastics, can be a bit flexible, but not like sheet like materials.
USE THR:	Threadlike materials, e.g. pieces of nylon wire, net-fragments, woven clothing, etc.
USE POTH:	Any other plastic type of plastics, including elastics, dense rubber, balloon pieces, soft air gun bullets, etc.
USE FOA:	All foamed plastics e.g. polystyrene foam, foamed soft rubber (as in mattress filling), etc.
IND PLA:	Industrial plastic granules, usually cylindrical but also sometimes oval spherical or cubical shapes, or suspected industrial item, used for the tiny spheres (glassy, milky, etc.).
OTHER ML:	Other marine litter.

Figure 4: Most frequent marine litter categories (% nº item) (% items by category of marine Litter)

27. If we consider the weight (g) of the items, they are concentrated in only 2 categories that account for 96% of the total weight of marine litter (USE SHE and USE FRA, Figure 5).

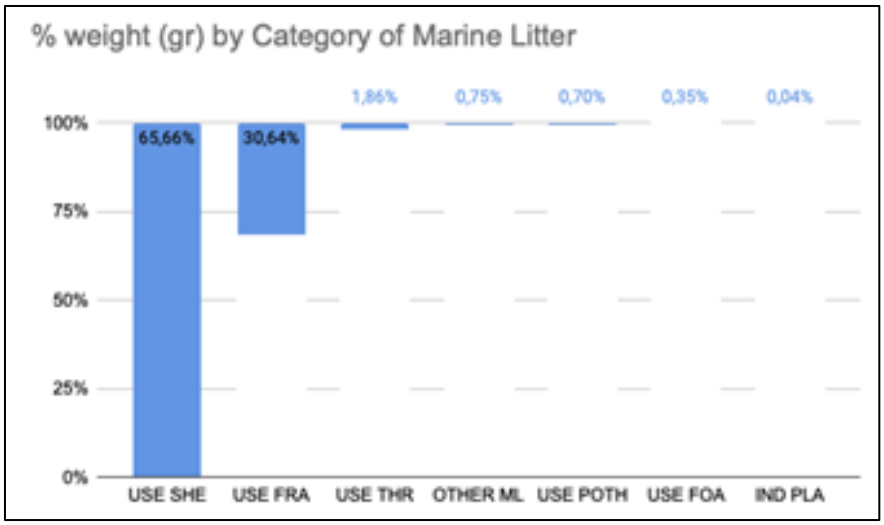


Figure 5: Most frequent marine litter categories (% weight)

28. In both cases (Figures 4 and 5), the most frequent category, well above the other categories, is USE SHE, (remains of sheet, e.g. from bag, cling-foil, agricultural sheets, rubbish bags, etc.)

4.2 Entanglement

29. 39% of the entanglement samples were affected by entanglement (Figure 1), whereas 10% of entangled turtles were not damaged. Most of the damaged ones were from “non identified” or undescribed lesion (U: 42%), abrasion (AB: 28%) and cutting (C: 20%) (Figure 6).

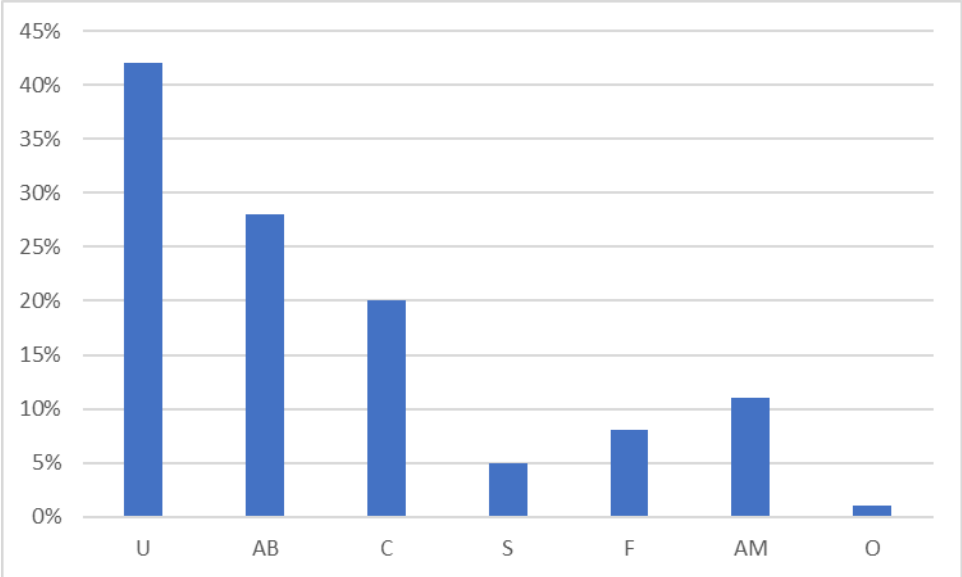


Figure 6: Damages identified in the marine turtles.

30. The 83% of the entangled specimens shows fin damage (F), whereas 60% of the entangled specimens show head damage. (Figure 7).

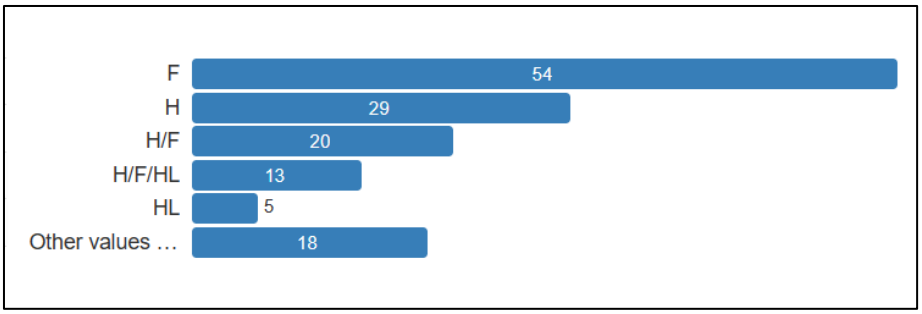


Figure 7: Entangled body parts of marine turtles

31. The 31% of the turtles were classified with presence of injury but no information relating to marine litter. The 40% of the turtles were classified with presence of injury and with information related with the source of marine litter: fishing or aquaculture items (FN: 21%, R: 21%, FL: 19%; Figure 8).

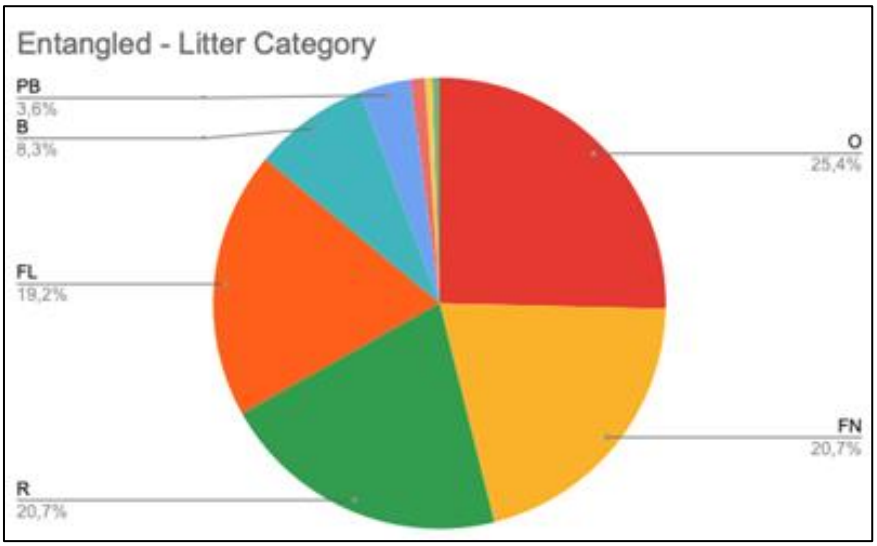


Figure 8: Entangled marine litter items categories (O: Other Material, FN: Fishing Net, R: Ropes, FL: Fishing line, B: Buoys/Fenders, PB: Plastic bags).

32. It is important to consider that 80% of the data classified under the category “other materials” relates to heavy-duty sacks (Figure 8, which are usually associated to maritime transport.

33. Most of abrasion and cut injuries are because of ropes (R) or fishing lines (FL), while suffocation is mainly attributed to fishing nets (FN) and ropes (R) (Table 4).

Table 4: Damage/object relationship:

Injuries	B	FL	FN	P	PB	R	RB
AB	12,50%	16,67%	**20,83%**	4,17%	4,17%	**41,67%**	
AB/C	5,88%	**29,41%**	11,76%			**41,18%**	11,76%
AB/C/AM	50,00%	50,00%					
AB/C/AM/S						100,00%	
AB/C/F/AM		100,00%					
AB/C/S			100,00%				
AB/S	33,33%	33,33%				33,33%	
AM		50,00%			50,00%		
C	16,67%	**41,67%**	8,33%			**33,33%**	
C/F		100,00%					
C/F/AM		**77,78%**				22,22%	
C/S		50,00%			50,00%		
F/AM			100,00%				
S	28,57%	14,29%	14,29%		28,57%	14,29%	

5. Conclusions

34. Based on the results of the approximations tested with the available data and considering that the sample is very low and irregular in time, the following BV and TV can be suggested (Table 5).

35. For ingestion:

a) **An updated BV can be established at the presence of 4 particles of marine litter in the digestive tract of Mediterranean turtles and a weight of 0.01 g**.
b) **A TV can be proposed at the 15th percentile which is set at less than 15% of sea turtles with more than 0.002 g of marine litter in the Gastrointestinal trac (GI).**

36. For entanglement:

c) **An updated BV can be established at the presence of 39% of affected marine turtles.**
d) **A TV can be proposed at the presence < 39% of affected marine turtles**

Table 5: Proposal for updating the BV and establishing TV for IMAP Candidate Indicator 24:

IMAP Indicator	Categories of Marine Litter	Updated BV (2024)	Proposed TV (2024)
Candidate Indicator 24	Ingestion	4 particles and 0,01g	< 15 % affected sample with more than 0,002 gr of ML
Candidate Indicator 24	Entanglement	39 % affected sample	< 39%

37. It should be considered that the percentage of turtles affected by entanglement in the total sample (Table 5) may be affected by harvest biases, so it is not recommended to include it as an indicator.

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