Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring

Madrid, Spain, 28 February – 2 March 2017

Best Practices on Marine Litter Monitoring: Training Session

Draft Marine Litter Monitoring Training Material
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a) Monitoring Beach Marine Litter (EO10, Common Indicator 22)
Marine LitterWatch: Citizens in action to track marine litter

Ana Tejedor Arcevedillo

Political commitments on marine litter turning to action

Global
“significant reduction in marine litter by 2025” - Rio 2012
2030 Sustainable Development Goals

EU
EU-wide quantitative headline reduction target by 2020
(7EAP)
Marine Strategy Framework Directive (MSFD)
Circular economy package waste reduction targets 2020

G7 Action Plan to combat marine litter

Regional
Regional Action Plans: Northeast Atlantic, Baltic and Mediterranean seas + Black Sea objectives

Member States obligation to monitor (MSFD)
Society & Citizens
Industry & Business
Key EU policy commitments for action on marine litter

To achieve Good Environmental Status (GES) of the EU’s marine waters by 2020

- Implementing the GES elements of the MSFD 2011–2021
- Monitoring programmes done
- GES 2020
- Progression of measures done

**Circular Economy package (2015)**
- 30% headline reduction target by 2020 - for top 10 items found on beaches in the 4 marine regions in the EU
- Develop strategy on plastics in the circular economy

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**Marine LitterWatch – Aims**

- **Help filling data gaps on beach litter** for policy implementation and assessments

- **Collaborate with existing communities**, as well as provide a setup for new ones to emerge

- **Explore benefits of involving citizens** in collecting and monitoring of marine litter

- **Support a collective approach to managing marine litter**, by engaging with government bodies, industry & citizens
Concept

The past

The future?

How does it work?

- Pin or create a community
- Community sets up a beach and an event
- Carry out a survey

MLW app

MLW webpage (EEA)

MLW web portal

App + community

Database

Information

use and share the information

community curates the data quality

European Environment Agency
Monitoring vs Clean-up Event

**MSFD Guidelines 2013**

Monitoring events need to follow the MSFD guidelines

Communities responsible for adopting monitoring protocol and ensuring quality of data

Capacitation need: communication and training of event organizers & volunteers

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**Marine LitterWatch – Timeline**

**Focus on:**
- Building community and experience
- Developing and adapting tools
- Collecting data from clean-up events

**2014**
- Launch @ HOPE Conference
- Behavioural Design Study
- App Android

**2015**
- EU Clean-Up Day
- 1st MLW community Workshop
- App iOS

**2016**
- 2nd MLW community Workshop
- Data visualization tool (Tableau)

**2017-2019**
- EEA indicator beach litter (MLW + other data)
- 3rd MLW community Workshop

**Focus on:**
- Nurturing community
- Supporting monitoring events
- Building EU dataset on beach litter

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European Environment Agency
**Marine LitterWatch concept**

- MLW Web Portal
- MLW app
- EEA database
- WISE Marine Data Information System
- MLW data visualization tool

**Marine LitterWatch App**

- For communities, NGO’s, volunteers, citizens and government usage
- Possibility to set up beach location (name, GPS location (ESRI); 100 m buffer zone as additional function for “Monitoring” events, beach type, number of participants, etc.)
- Builds on MSFD Master list (165 categories for beach litter)
- Submitting the survey data
- Also possible to work in offline mode (for remote areas)
Marine LitterWatch Portal

- Designed for community management and QC and QA of collected data
- Easy setting (adding) up new beach locations – supported by geographic information system (ESRI)
- Offers possibility to create your own TOP 20 litter litter items custom list (for easier field work)
- Enables also manually importing beach litter data through Web Portal
- Free text box for additional information is also available (e.g. for weather conditions, particularities, animals found on beach during the survey, etc.)
- Generating reports in several formats (PDF, Excel, TIFF, image, Word, CSV, XML, etc.)

[http://discomap.eea.europa.eu/map/Marine_litterWatch/]

Marine LitterWatch Web Portal

*[http://discomap.eea.europa.eu/map/Marine_litterWatch/]
Marine LitterWatch data visualization tool

- The MLW data viewer provides a map and graphs of beach litter data collection events organised by MLW communities (5 tabs on top of application);
  1) Map of events; interactive map showing the beaches and the litter collection events – filter options (by country, by community, by data source, by event type, by time interval, by year, etc.);
  2) Overview of results; overview of distribution of collected litter items and the TOP 10 items (data can be filtered by time, community and type of event);
  3) Total items summary; summary of items collected thorough MLW (% of total material, total items and % of total items collected);
  4) Community overview; showing the date when they started collecting data and the total items collected;
  5) Community activity; activity of each MLW community by number of events carried out in each quarter of the year

Marine LitterWatch – overview of results

Communities: 29
Total events: 734
Total items collected: 488,449
<table>
<thead>
<tr>
<th>Year</th>
<th>Number of communities</th>
<th>Events</th>
<th>Total items collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>6</td>
<td>45</td>
<td>17,438</td>
</tr>
<tr>
<td>2014</td>
<td>12</td>
<td>101</td>
<td>68,706</td>
</tr>
<tr>
<td>2015</td>
<td>23</td>
<td>417</td>
<td>282,247</td>
</tr>
<tr>
<td>2016</td>
<td>29</td>
<td>171</td>
<td>120,106</td>
</tr>
<tr>
<td>SUM</td>
<td>29</td>
<td>734</td>
<td>488,449</td>
</tr>
</tbody>
</table>

- EEA organized 1st Marine LitterWatch community workshop for key Non-govermental organisations and research institutes from all regional seas (EU/EEA countries) that were already using MLW or were potential MLW users;

From Clean up`s towards Monitoring events

- 1st Marine LitterWatch community workshop outcomes:
- 14 communities attended 1st MLW workshop
- Distinction between a monitoring and clean-up event was better understood after workshop presentations and discussions;
- Monitoring events started in 2016 with small target groups within interested communities with the aim to test the monitoring strategy and learn from experience
- 2 Online webinars were performed with close collaboration with Mediterranean Information Office for Environment, Culture and Sustainable Development in order to educate coordinators for „Monitoring events“
Monitoring vs Clean-up Events

✓ Standardized protocol – MSFD
✓ Engage with public authorities
✓ Selected beaches (based on agreed criteria)
✓ Regular surveys (covering 4 seasons, same time)
✓ Fixed survey area on the beach
✓ Survey length 100m; from water line to dune
✓ Register litter items from MSFD ‘master list’
✓ Items bigger than 2.5cm
✓ Set-up beach & events in MLW web portal
✓ Use full list in app
✓ Qualify check data at the end

No need for protocol

✓ Set-up beach & events in MLW web portal or app
✓ Register litter from community (or default MLW) top 20 list in app
✓ Option to use full list in app

MLW Supporting material for “Monitoring events”

- Monitoring guidelines for usage of MLW Web Portal, Android and iOS app version were prepared;
- Three background supporting documents were prepared (Regional Sea Conventions beach litter baseline, beach litter protocols and marine litter items linkage);
- The one-month pilot beach surveys deployed a harmonized monitoring approach (MLW developed with close collaboration with EEA, Mediterranean Information Office for Environment, Culture and Sustainable Development and IPA Adriatic funded DeFishGear project*, following the Guidance Document on Monitoring of Marine Litter in European Seas**


**Marine LitterWatch Month (September - October 2016)**

- European Environment Agency and 14 NGO’s and research institutes joined forces during the Marine Litter Watch Month.

- The MLW community participating in the MLW Month were: Coalition Clean Baltic (acting as regional communication hub only), Estonian Green Movement, HELMEPA, Institute for Water of the Republic of Slovenia, Keep Sweden Tidy, Legambiente, Marine Conservation Society, MARNOBA, MIO-ECSDE, National Institute for Marine Research and Development of Romania, Plastic Change, Portuguese Association of Marine Litter, Seas at Risk (acting as European communication hub only), Surfers Against Sewage, Surfrider Foundation Europe and St. Petersburg Institute of Law (as part of EMBLAS II research project).

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**Marine LitterWatch Month (September - October 2016)**

- 33 of Europe’s beaches were monitored in all 4 EU Regional Sea’s.
**Marine LitterWatch Month First Results**

- First preliminary results show that 29,974 beach litter items were collected in The Marine Litter Watch Month, where plastic is a dominant material (87.57%) followed by glass and ceramics (2.73%) and processed wood (2.42%) of all collected items.

<table>
<thead>
<tr>
<th>Material</th>
<th>% of total</th>
<th>Total number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic</td>
<td>87.56</td>
<td>26,246</td>
</tr>
<tr>
<td>Rubber</td>
<td>0.80</td>
<td>239</td>
</tr>
<tr>
<td>Cloth/textile</td>
<td>1.91</td>
<td>573</td>
</tr>
<tr>
<td>Glass/ceramics</td>
<td>2.74</td>
<td>820</td>
</tr>
<tr>
<td>Metal</td>
<td>1.96</td>
<td>588</td>
</tr>
<tr>
<td>Paper/Cardboard</td>
<td>1.38</td>
<td>414</td>
</tr>
<tr>
<td>Processed wood/Worked wood</td>
<td>2.42</td>
<td>726</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1.09</td>
<td>328</td>
</tr>
<tr>
<td>Unidentified</td>
<td>0.13</td>
<td>40</td>
</tr>
<tr>
<td>Grand total</td>
<td>100</td>
<td>29,974</td>
</tr>
</tbody>
</table>

**MLW Month TOP 10 items (Mediterranean)**

- Cigarette butts
- Plastic pieces 2.5-50cm
- Shipping bags incl. pieces
- Cotton bud sticks
- Plastic caps lids drinks
- Polyethylene pieces 2.5-50 cm
- Glass ceramics fragments 2.5cm
- String and cord (less than 1mt)
- Crisps packets/wraps wrappers
- Drink bottle<=0.5l
- Other
The DeFishGear project: Paving the Way for Harmonized Marine Litter Monitoring in the Adriatic and Ionian Seas

Monitoring Marine Litter on Beaches

Thomais Vlachogianni, PhD
MIO-ECSDE Programme Officer
DeFishGear ML Monitoring & Assessment Work Package Leader
Member of the MSFD TG10 & the UNEP/MAP CORMON

THE STUDY AREA

The pilot beach litter surveys were carried out on beaches located in all countries of the Adriatic-Ionian macroregion, namely Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Montenegro and Slovenia.
THE STUDY AREA

31 study sites located on the coastline of the Adriatic and Ionian Seas

SITE SELECTION

The beaches investigated, which varied in terms of:
- distance from neighbouring town, harbour, river outflow, shipping lane, etc.;
- prevailing sea currents, prevailing winds, beach orientation, beach material type, slope, size, etc.;
- usage, such as tourism and recreational activities, agriculture, industrial activities, etc.

From October 2014 to April 2016 some **180 beach transects** were surveyed, covering ~ 33,200 m² and extending over 18 km of coastline.
SURVEY METHOD

All surveys performed followed the DeFishGear “Methodology for Monitoring Marine Litter on Beaches (Macro-Debris > 2.5 cm)”.

The methodology was prepared based on:
- the EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas”,
- the OSPAR “Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area”
- the NOOA “Marine Debris Monitoring and Assessment: Recommendations for Monitoring Debris Trends in the Marine Environment”
- taking into consideration the draft UNEP/MAP MEDPOL “Monitoring Guidance Document on Ecological Objective 10: Marine Litter”
SITE SELECTION

<table>
<thead>
<tr>
<th>Site location</th>
<th>Site features</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ In the vicinity of ports or harbors;</td>
<td>✓ Having a minimum length of 100 m;</td>
</tr>
<tr>
<td>✓ In the vicinity of river mouths;</td>
<td>✓ Low to moderate slope;</td>
</tr>
<tr>
<td>✓ In the vicinity of coastal urban areas;</td>
<td>✓ Clear access to sea;</td>
</tr>
<tr>
<td>✓ In the vicinity of tourists destinations;</td>
<td>✓ Accessible to survey teams throughout the year;</td>
</tr>
<tr>
<td>✓ In relatively remote areas.</td>
<td>✓ Ideally the site should not be subject to cleaning activities;</td>
</tr>
<tr>
<td></td>
<td>✓ Survey activities posing no threat to endangered or protected species.</td>
</tr>
</tbody>
</table>

Photo: Thomas Vlahoumi

FREQUENCY AND TIMING OF SURVEYS

**Frequency:** 4 surveys/year (minimum)

**Surveys timing:**
- Autumn: mid Sep-mid Oct
- Winter: mid Dec-mid Jan
- Spring: Apr
- Summer: mid Jun-mid Jul
The sampling unit was a 100-metre stretch of beach along the strandline and covering a width of 10 m towards the back of the beach. Two (2) sampling units (100 m * 10 m) were monitored on each beach, wherever possible, and were separated at least by a 50-metre stretch. Half-way through the beach pilot surveys it was decided to expand the sampling unit width all the way back to the end of the beach. Therefore, both the initially defined sampling unit (100 m * 10 m) and the expanded sampling unit (100 m * (beach width (m))) were surveyed, wherever applicable.
**SIZE LIMITS AND CLASSES TO BE SURVEYED**

- Scale
  - "mega" to "nano"
  - Survey techniques not addressed

**Marine Debris Survey Techniques**

- At-sea visual survey
- Benthic survey
- Shoreline survey
- Surface water survey

**Terminology**

- "macro" to "nano"


- **There are no upper size limits** to litter recorded on beaches.
- **Litter items with a lower limit of 2.5 cm** in the longest dimension will be monitored, ensuring the inclusion of caps & lids and cigarette butts.
- **In case**, the latter classes are found in extremely high numbers, a 1-meter transect will be used instead, to monitor these items, thus saving energy and time.

**COLLECTION & IDENTIFICATION OF LITTER ITEMS**

According to the ‘Master List’, which consists of a set of 159 beach litter items:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>40-pack cans, six-pack rings</td>
</tr>
<tr>
<td>03</td>
<td>Shopping bags incl. plastic</td>
</tr>
<tr>
<td>04</td>
<td>Small plastic bags, e.g. freezer bags incl. Ice packs</td>
</tr>
<tr>
<td>05</td>
<td>Plastic bottles &amp; containers</td>
</tr>
<tr>
<td>07</td>
<td>Drink bottles (≤5 L)</td>
</tr>
<tr>
<td>08</td>
<td>Drink bottles (&gt;5 L)</td>
</tr>
<tr>
<td>09</td>
<td>Cleaner bottles &amp; containers</td>
</tr>
<tr>
<td>10</td>
<td>Food containers incl. fast food containers</td>
</tr>
<tr>
<td>11</td>
<td>Beach co-related cosmetic bottles and containers, e.g. Sunblocks</td>
</tr>
<tr>
<td>12</td>
<td>Other cosmetic bottles &amp; containers</td>
</tr>
<tr>
<td>13</td>
<td>Other bottles &amp; containers (50cm)</td>
</tr>
<tr>
<td>14</td>
<td>Engine oil bottles &amp; containers ≤50 cm</td>
</tr>
<tr>
<td>15</td>
<td>Engine oil bottles &amp; containers &gt;50 cm</td>
</tr>
<tr>
<td>16</td>
<td>Lorry cans (square plastic containers with handles)</td>
</tr>
<tr>
<td>17</td>
<td>Injection gun containers</td>
</tr>
<tr>
<td>18</td>
<td>Glass bottles &amp; containers</td>
</tr>
<tr>
<td>19</td>
<td>Oil parts</td>
</tr>
<tr>
<td>20</td>
<td>Plastic caps/lids drinks</td>
</tr>
<tr>
<td>21</td>
<td>Plastic caps/lids chemicals, detergents (non-food)</td>
</tr>
<tr>
<td>22</td>
<td>Plastic caps/lids unrefined</td>
</tr>
<tr>
<td>23</td>
<td>Tobacco pipes / plastic cigarette box packaging</td>
</tr>
<tr>
<td>24</td>
<td>Cigarette lighters</td>
</tr>
<tr>
<td>27</td>
<td>Cigarette butts and filters</td>
</tr>
<tr>
<td>28</td>
<td>Pens and pen lids</td>
</tr>
<tr>
<td>29</td>
<td>Comb &amp; tooth brushes/braiders</td>
</tr>
<tr>
<td>30</td>
<td>Chips packets/sweets wrappers</td>
</tr>
<tr>
<td>31</td>
<td>Lolly sticks</td>
</tr>
<tr>
<td>32</td>
<td>Toys and party peppers</td>
</tr>
<tr>
<td>33</td>
<td>Caps and cap lids</td>
</tr>
<tr>
<td>34</td>
<td>Clothing and toys</td>
</tr>
<tr>
<td>35</td>
<td>Shoes and slippers</td>
</tr>
<tr>
<td>36</td>
<td>Fertilizer/animal feed bags</td>
</tr>
<tr>
<td>37</td>
<td>Multi-vegetable bags</td>
</tr>
<tr>
<td>40</td>
<td>Shires (washing-up)</td>
</tr>
</tbody>
</table>
Data collection and data processing

✓ Coordinated
✓ Harmonized
✓ Comparable
✓ Reliable

All 180 transects datasets were collected by MIO-ECSDE from the nine project partners via the use of the DeFishGear ‘Beach Litter Reporting Template’ developed to also facilitate the uploading of the datasets on the DeFishGear web GIS database (http://defishgear.izvrs.si/defishgearpublic).

Data processing

- Macro-debris density was calculated, \( C_M = \frac{n}{(w \times l)} \)
- Clean Coast Index (CCI) = \( \frac{(\text{Total litter on sampling unit} / \text{total area of sampling unit}) \times K} \)
Sources of ML
- Shoreline, including poor waste management practices, tourism and recreational activities;
- fisheries and aquaculture;
- shipping;
- fly-tipping;
- sanitary and sewage related;
- medical related;
- agriculture;
- non-sourced.

ABUNDANCE AND DISTRIBUTION OF ML
TOP 20 ITEMS IN THE ADRIATIC AND IONIAN SEAS

SOURCES OF ML
The DeFishGear results bring to light an issue that had not been identified before in the region and that is the importance of the fisheries and aquaculture sector with regards to marine litter. On an aggregated basis at regional level, mussel nets ranked in the 7th position of the top 20 items found, while in Italy these items were the 3rd most abundant items recorded.
**BEACH LITTER DENSITIES REPORTED IN THE ADRIATIC AND IONIAN SEAS**

<table>
<thead>
<tr>
<th>Study area</th>
<th>No of surveyed beaches</th>
<th>Averaged litter density (items/m²)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adriatic &amp; Ionian Seas</td>
<td>31</td>
<td>0.67</td>
<td>present study</td>
</tr>
<tr>
<td>Albania</td>
<td>3</td>
<td>0.22</td>
<td>present study</td>
</tr>
<tr>
<td>Bosnia &amp; Herzegovina</td>
<td>2</td>
<td>0.17</td>
<td>present study</td>
</tr>
<tr>
<td>Croatia</td>
<td>4</td>
<td>2.91</td>
<td>present study</td>
</tr>
<tr>
<td>Greece</td>
<td>10</td>
<td>0.24</td>
<td>present study</td>
</tr>
<tr>
<td>Italy</td>
<td>7</td>
<td>0.28</td>
<td>present study</td>
</tr>
<tr>
<td>Montenegro</td>
<td>2</td>
<td>0.37</td>
<td>present study</td>
</tr>
<tr>
<td>Slovenia</td>
<td>3</td>
<td>0.45</td>
<td>present study</td>
</tr>
<tr>
<td>Slovenia</td>
<td>6</td>
<td>1.51</td>
<td>Laglauer et al, 2014</td>
</tr>
<tr>
<td>Italy</td>
<td>5</td>
<td>0.2</td>
<td>Munari et al, 2016</td>
</tr>
</tbody>
</table>

**COMPARABILITY OF RESULTS**

Comparison of average litter densities recorded by the DeFishGear beach surveys (in red) with those reported worldwide (in green).
MORE INFO...

- Marine Litter Assessment in the Adriatic and Ionian Seas
- Methodology for monitoring marine litter on beaches (macro debris >2.5 cm)
- Methodology for monitoring marine litter on the sea surface
- Methodology for monitoring marine litter on the seafloor – bottom trawl surveys
- Methodology for monitoring marine litter on the seafloor – scuba/snorkelling
- Methodology for monitoring macro- and micro-litter in biota
- Methodology for sampling plastic pellets for POPs determination
- Methodology for monitoring microplastics on the sea surface and in beach sediments

STOPPING MARINE LITTER TOGETHER

For more than twenty years joining forces & building bridges in the Euro-Mediterranean area

ylachogianni@mio-ecsde.org
www.mio-ecsde.org
www.defishgear.net
www.marlisco.eu
b) Monitoring Benthic & Floating Litter (EO10, Common Indicator 23)
Monitoring sea-floor litter in the framework of the MEDITs cruises using bottom trawling

Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring
Madrid, Spain, 28 February – 2 March 2017

Maria Teresa Spedicato
COISPA Tecnologia & Ricerca, Bari, Italy
The MEDITS project started in 1994, as an EU funded study, in the framework of cooperation between research Institutes from four Mediterranean Countries of the European Union: France, Greece, Italy and Spain.

In the following years the survey was extended also to Slovenia, Croatia, Albania, Malta, Montenegro and Cyprus involving 16 Research Institutes. FAO Regional project play a support role in some areas.
THE MEDIT PROJECT
The MEDITS survey and the Data Collection Framework EU Reg. 199/2008

Since 2002, the European countries bordering the Mediterranean Sea are committed to carry out MEDITS surveys yearly according to the European Data Collection Regulation/Framework.

In 2010, nine Mediterranean countries collaborated in the project (including cooperating countries), and permanent links are maintained with the relevant bodies of the European Union (e.g. RCMed&BS; STECF) and GFCM.

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Since 2016 the MEDITS survey is part of the EUMAP program
(Commission Implementing Decision (EU) 2016/1251 of 12 July 2016 adopting a multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019)

According to the EU Regulations access to MEDITS data is managed by European Member States.
THE MEDIT PROJECT

The MEDIT TARGETS

Aims are to produce basic information on:

- benthic and demersal species in terms of distribution abundance indices;
- population and community distribution;
- life history traits of key species;
- demographic structure of the target species;
- population and community indicators

…and more recently additional information for MSDF

THE MEDIT PROJECT

THE MEDIT ORGANIZATION

The International coordinator

The National coordinators

The GSA coordinators

Scientists belonging to the Organizations involved in the survey

The MEDIT group is open to all the scientists involved in the MEDIT surveys.
The main objective of MEDITs is to conduct a common bottom trawl survey in the Mediterranean, in which all the participants apply standardised methods using:

- the same gear;
- the same sampling scheme;
- the same protocols for collecting and analysing data.
The sampling frame is a stratified random sampling by depth, with haul allocation proportional to the surface of depth strata (bathymetric limits: 10-50m, 51-100, 101-200, 201-500, 501-800) and of the 44 different sub-regions.

The sampling substrata overlay with the GFCM Geographical sub-areas.

The sampling design cover 546474 km² with 1262 hauls.
THE MEDIT PROJECT

The standardized MEDITS protocol

- Haul duration is 30 minutes on the shelf and 60 minutes on the slope.
- Hauls are allowed only during daytime.
- The standard fishing speed is 3 knots on the ground.
- Hauls and gear geometry are monitored using SCANMAR or SIMRAD, DST and satellite navigation technology.
- Specific studies have been conducted to complete the knowledge about the efficiency and geometry of the gear
  (Fiorentini et al. 1996; Fiorentini & Drerière 1996; Drerière et al. 1999; Fiorentini et al. 1999).

THE MEDIT PROJECT

Basic methodological aspects

Research and commercial vessels are used, depending on the area.

Thus different logistic conditions are faced in the different GSAs.
Since 2012 the list of taxonomic categories has been expanded to the current 43 taxonomic categories, which are linked to 1470 observed taxa, including mammalia, birds, reptilia, etc.

83 species, of which 31 are Elasmobranchs. For all the 83 species, individual length and total weight are collected.

This list has been further split into two groups:

- MEDITS G1 includes 41 species with 10 demersal (4 bony fish, 4 crustaceans and 2 cephalopods) and 31 Selachians. For these species individual length, total weight and also biological parameters such as sex, maturity, individual weight and age are collected;

- MEDITS G2 includes 42 species for which only individual length and total weight should be collected;

For the other species in the TM List total weight and number are collected.

The repository
THE MEDIT PROJECT

The Data exchange format

• TA
• TB
• TC
• TE
• TL

Data exchange format to exchange data within the group and transmitting to the Member States or to the Official Data Call

THE MEDIT PROJECT

Protocol for monitoring Marine Litter on sea bottom

In 2013 – A Pilot implementation on a voluntary basis

Collecting data on litter during MEDIT surveys

Fabio Fiorentino, Evgenia Lefkaditou, Angelique Jadaud, Pier Luigi Carbonara, Giuseppe Lembo and Francois Galgani

<table>
<thead>
<tr>
<th>Campaign</th>
<th>Date</th>
<th>Weight (kg)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(mandatory for category and subcategory)</td>
<td>(facultative for subcategory)</td>
</tr>
<tr>
<td>L00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Protocol presented at CIESM 2013
Protocol for monitoring Marine Litter on the sea bottom

- to standardize the procedure to collect data on litter from the MEDITS trawl surveys;
- to record information in terms of total weight of litter and number and weight by litter categories;
- to estimate standardized indices (by km²) of litter mass (total, by categories and sub-categories);
- reporting litter data in a specific form to be integrated with haul information.

34 different typologies have been identified in the protocol including:

- 9 main categories related to litter material class;
- 27 sub-categories related to source and main litter findings.

THE LIST OF THE LITTER TYPOLOGY AND CODES:

- L0 No litter in the net
- L1 Plastic (including PVC, polypropylene, polyethylene)
  - L1a. Bags
  - L1b. Bottles
  - L1c. Food wrappers
  - L1d. Sheets (table-cover, etc.)
  - L1e. Hard plastic objects (crates, containers, tubes, ash-trays, lids, etc.)
  - L1f. Fishing nets
  - L1g. Fishing lines
  - L1h. Other fishing related (pots, floats, etc.)
  - L1i. Synthetic ropes/strapping bands
  - L1j. others
### THE MEDITS PROJECT

**Protocol for monitoring Marine Litter on sea bottom**

#### THE LIST OF THE LITTER TYPOLOGY AND CODES:

<table>
<thead>
<tr>
<th>Litter Type</th>
<th>Sub-Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L2 Rubber</strong></td>
<td>2 sub-categories</td>
</tr>
<tr>
<td>- L2a. Tyres</td>
<td></td>
</tr>
<tr>
<td>- L2b. Other (gloves, floats, boots/shoes, oilskins, sanitaries)</td>
<td></td>
</tr>
<tr>
<td><strong>L3 Metal</strong></td>
<td>7 sub-categories</td>
</tr>
<tr>
<td>- L3a. Beverage cans</td>
<td></td>
</tr>
<tr>
<td>- L3b. Other food cans/wrappers</td>
<td></td>
</tr>
<tr>
<td>- L3c. Middle size containers (of paint, oil, chemicals)</td>
<td></td>
</tr>
<tr>
<td>- L3d. Large metallic objects (barrels, pieces of machinery, electric appliances)</td>
<td></td>
</tr>
<tr>
<td>- L3e. Cables</td>
<td></td>
</tr>
<tr>
<td>- L3f. Fishing related (hooks, spears, etc.)</td>
<td></td>
</tr>
<tr>
<td>- L3g. Remnant from the war</td>
<td></td>
</tr>
<tr>
<td><strong>L4 Glass / Ceramic/Concrete</strong></td>
<td>4 sub-categories</td>
</tr>
<tr>
<td>- L4a. Bottles</td>
<td></td>
</tr>
<tr>
<td>- L4b. Pieces of glass</td>
<td></td>
</tr>
<tr>
<td>- L4c. Ceramic jars</td>
<td></td>
</tr>
<tr>
<td>- L4d. Large objects (ceramic basins, etc.)</td>
<td></td>
</tr>
<tr>
<td><strong>L5 Cloth (textil) / Natural fibres</strong></td>
<td>4 sub-categories</td>
</tr>
<tr>
<td>- L5a. Clothing (clothes, shoes, etc.)</td>
<td></td>
</tr>
<tr>
<td>- L5b. Large pieces (carpets, mattresses, etc.)</td>
<td></td>
</tr>
<tr>
<td>- L5c. Natural ropes</td>
<td></td>
</tr>
<tr>
<td>- L5d. Sanitaries (diapers, cotton buds, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
THE MEDITS PROJECT

Protocol for monitoring Marine Litter on sea bottom

THE LIST OF THE LITTER TYPOLGY AND CODES:

- L6 Wood processed (palettes, crates, etc.)
- L7 Paper and cardboard
- L8 Other
- L9 Unspecified

THE MEDITS PROJECT

Cross-cutting table between MEDITS and IBTS

<table>
<thead>
<tr>
<th>Main Categories</th>
<th>MEDITS Sub-categories</th>
<th>MEDITS cod</th>
<th>IBTS Sub-categories</th>
<th>IBTS cod</th>
<th>Main Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bags</td>
<td>L1a</td>
<td>Bag</td>
<td>A3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food wrappers</td>
<td>L1c</td>
<td>Bottle</td>
<td>A1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottles</td>
<td>L1b</td>
<td>Caps/lids</td>
<td>A4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sheets</td>
<td>L1d</td>
<td>Cable ties</td>
<td>A9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L1. Plastic</td>
<td></td>
<td></td>
<td></td>
<td>A. Plastic</td>
</tr>
<tr>
<td></td>
<td>Hard plastic objects</td>
<td>L1e</td>
<td>crates and containers</td>
<td>A11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(crates, containers,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ash-trays, tubes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lids, etc.) (specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing nets</td>
<td>L1f</td>
<td>syringes</td>
<td>B5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing line</td>
<td>L1g</td>
<td>Fishing lines</td>
<td>A5</td>
<td>Fishing lines</td>
</tr>
<tr>
<td></td>
<td>Ropes/strapping bands</td>
<td>L1i</td>
<td>monofilament</td>
<td>A6</td>
<td>entangled</td>
</tr>
<tr>
<td></td>
<td>Other fishing related</td>
<td>L1h</td>
<td>synthetic rope</td>
<td>A7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(pots, floats, ecc.)</td>
<td></td>
<td>strapping band</td>
<td>A10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>L1j</td>
<td>Other</td>
<td>A12</td>
<td></td>
</tr>
</tbody>
</table>
### Cross-cutting table between MEDITS and IBTS

<table>
<thead>
<tr>
<th>MEDITS</th>
<th>IBTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Categories</strong></td>
<td><strong>Sub-categories</strong></td>
</tr>
<tr>
<td>L2: Rubber</td>
<td>Tyres</td>
</tr>
<tr>
<td></td>
<td>Other (gloves, boots/shoes, olskins etc.) specify</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beverage cans</td>
</tr>
<tr>
<td></td>
<td>Other food cans/wrappers</td>
</tr>
<tr>
<td></td>
<td>Middle size containers (of paint, oil, chemicals)</td>
</tr>
<tr>
<td></td>
<td>Large metallic objects (barrels, pieces of machinery, electric appliances) (specify)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fishing related (hook, spears, etc.) (specify)</td>
</tr>
<tr>
<td></td>
<td>Remnant from the war</td>
</tr>
</tbody>
</table>

---

### Cross-cutting table between MEDITS and IBTS

<table>
<thead>
<tr>
<th>MEDITS</th>
<th>IBTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Categories</strong></td>
<td><strong>Sub-categories</strong></td>
</tr>
<tr>
<td>L4: Glass/Ceramic</td>
<td>Bottles</td>
</tr>
<tr>
<td></td>
<td>Pieces of glass</td>
</tr>
<tr>
<td></td>
<td>Ceramic jars</td>
</tr>
<tr>
<td></td>
<td>Large objects (specify)</td>
</tr>
<tr>
<td>L5: Cloth (textil)/natural fibres</td>
<td>Clothing (clothes, shoes)</td>
</tr>
<tr>
<td></td>
<td>Large pieces (carpets, matresses, etc.)</td>
</tr>
<tr>
<td></td>
<td>Natural ropes</td>
</tr>
<tr>
<td></td>
<td>Sanitaries (diapers, cotton buds, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**E: Glass/Ceramics**

**B: Sanitary waste**

**F: Natural product**

**G: Miscellaneous**
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Cross-cutting table between MEDITS and IBTS

<table>
<thead>
<tr>
<th>MEDITS</th>
<th>IBTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Categories</td>
<td>Sub-categories</td>
</tr>
<tr>
<td>L6: Wood processed (palettes, crates, etc)</td>
<td>L6</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>L7: Paper and cardboard</td>
<td>L7</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>L8: Other</td>
<td>L8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>L9: Unspecified</td>
<td>L9</td>
</tr>
</tbody>
</table>
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MEDITS estimates (indices)

Thus global indices are calculated following the usual statistical procedure of the stratified mean and variance:

\[ I = \sum_{i=1}^{N} \frac{W_i}{n_i} x_i \]

\[ \text{var}(I) = \sum_{i=1}^{N} \frac{W_i^2 S_{x_i}^2}{n_i} \left(1 - f_i\right) \]

whilst:

GLM, GAM, Delta-GLM and Delta-GAM have been used to predict abundance indices on a spatial grid and/or to standardize the annual indices.

THE MEDITES PROJECT

MEDITS estimates (indices)

Routine developed for common work on litter data in R environment
(Litter routine on Marine litter for common work; Authors: M.T. Facchini, L. Bitetto, M.T. Spedicato, G. Lembo, P. Carbonara)

Standard numerical outputs and maps:
- number and percentage of hauls positive to litter by category and sub-category;
- percentage of litter by category by GSA (from mass indices);
- standardized indices (N/km² and N/h; kg/km² and kg/h) for each category and subcategory;
- stratified overall mean of relevant variables with CV for each category and sub-category by depth macro-strata: 10-800 m; 10-200 m and 200-800 m.
THE MEDITS PROJECT

THANK YOU FOR YOUR ATTENTION
Summary of size definitions of marine plastic litter and common sources

<table>
<thead>
<tr>
<th>Size categories of marine plastic litter</th>
<th>Micro &lt;5 mm</th>
<th>Meso &lt;2.5 cm</th>
<th>Macro &lt;1 m</th>
<th>Mega &gt;1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Primary microplastics</td>
<td>Direct and indirect: including fragmentation of larger plastic items</td>
<td>Direct: lost items from maritime activities or from rivers</td>
<td>Direct: abandoned gear, catastrophic events</td>
</tr>
<tr>
<td></td>
<td>Secondary microplastics – fragmentation of larger plastic items</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples of marine litter</td>
<td>Primary: resin beads, microbeads from personal care products; Secondary: textile fibres, tyre dust</td>
<td>Bottle caps, fragments</td>
<td>Plastic bags, food and other packaging, fishing floats, buoys, balloons</td>
<td>Abandoned fishing nets and traps, rope, boat hulls, plastic films from agriculture</td>
</tr>
</tbody>
</table>

- There are primary (originally manufactured to be that size) and secondary (have resulted from the breakdown of larger items) microplastics.
- Processes of fragmentation and degradation are poorly understood.
- Microplastics are littered into the environment at all steps in the life cycle of a plastic product.
Sources of plastics and microplastics by usage sectors

<table>
<thead>
<tr>
<th>Category</th>
<th>Source sector</th>
<th>Description</th>
<th>Entry points</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers/</td>
<td>Plastic Producers,</td>
<td>Pallets &amp; fragments</td>
<td>Rivers, Coastline,</td>
<td>High</td>
</tr>
<tr>
<td>Converters</td>
<td>Fabrications &amp; Recyclers</td>
<td></td>
<td>Atmosphere</td>
<td></td>
</tr>
<tr>
<td>Sectoral consumers</td>
<td>Agriculture</td>
<td>Greenhouse-sheets, pots, pipes, nutrient</td>
<td>Rivers, Coastline,</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Fishing</td>
<td>pellets, nutrient pellets</td>
<td>Atmosphere</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aquaculture</td>
<td>Buoy lines, nets, PVC pipes</td>
<td>Rivers, Coastline,</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>EPS, packaging</td>
<td>Marine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maritime Transport</td>
<td>Pellets, tyres, tyre dust</td>
<td>Rivers, Coastline,</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Shipping/Offshore industry</td>
<td>Paints, pipes, clothes, miscellaneous,</td>
<td>Rivers, Marine</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Tourism industry</td>
<td>Consumer goods, packaging, microbeads,</td>
<td>Rivers, Coastline,</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Textile industry</td>
<td>textile fibres</td>
<td>Marine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sport</td>
<td>Synthetic turf</td>
<td>Rivers, Coastline,</td>
<td>Low</td>
</tr>
<tr>
<td>Individual consumers</td>
<td>Food &amp; drink single-use</td>
<td>Containers, plastic bags, bottles, caps,</td>
<td>Rivers, Coastline,</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>packaging</td>
<td>cups, plates, straws, spoons, etc.</td>
<td>Atmosphere</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cosmetics &amp; personal care</td>
<td>Microbeads, packaging, toothbrushes, etc.</td>
<td>Rivers, Coastline,</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>products</td>
<td>Fibres</td>
<td>Marine</td>
<td></td>
</tr>
<tr>
<td>Waste management</td>
<td>Solid waste</td>
<td>Unmanaged or poorly managed waste disposal</td>
<td>Rivers, Coastline,</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Water &amp; wastewater</td>
<td>Microbeads, fragments, fibres</td>
<td>Atmosphere</td>
<td></td>
</tr>
</tbody>
</table>

DISTRIBUTION, FATE AND ‘HOT-SPOTS’

Microplastics movement is complex and driven by many factors (winds, buoyancy, biofouling, polymer type, size/shape, currents, etc.)

Microplastics are mainly distributed between the ocean surface, the seafloor, the shoreline and in biota.

Fluxes and hot-spots of microplastics distribution requires understanding movements. Physical, chemical and biological processes.
METHOD DEVELOPMENT AND HARMONIZATION

Methods of defining microplastics, sampling and measurement vary considerably among studies, source sectors and geographical regions making it difficult to synthesize data across studies.

A number of factors may affect the representativeness of data on microplastics (spatial and temporal variability, types of particles, proximity to rivers, variety of approaches, sampling methods, size limits, extraction methods, characterization and reporting units).

In seawater, surface layers are generally sampled, since many of the most mass-produced polymers (e.g. polyethylene and polypropylene) are buoyant and accumulate at the surface.

During rough weather, researchers have found that buoyant plastics are mixed below the surface, causing an underestimate in the quantity of microplastics. Correction factors can be applied for sampling surface layers at sea during rough weather (Kukulka et al. 2012).

Sampling methods used to examine the spatial distribution, abundance, mass, type, and/or size of microplastics in seawater are based on volume reduced samples,

The majority of the method inconsistencies can be related to: (i) differences in the lower and upper size limit examined; (ii) the sensitivity of the applied extraction technique; and, (iii) differences in sampling technique, all leading to a wide variety of efficiencies and reporting units.

The protocols are relevant for large Microplastics (above 300μm)

Surface water sampling techniques mainly include manta trawls and neuston nets that sampled the top 10 cm of water. Mesh sizes of the nets range from 0.053 to 3 mm, with a majority of the studies using 330 μm aperture mesh.

Units commonly used for abundance estimates are number of particles per km², m² (or m³, using flow metres to estimate the volume of water sampled when sampling water column).
Analysis of microplastics: Chronology

1. Field collection (optimum strategy)
2. Sample conditioning
3. Sample treatment (remove organic matter, cleaning, storage)
4. Visual observation/counting - weighting
5. MPs characterization
6. Data management

MATERIAL
- 1 Manta net with a collector (alternate device: plankton net, 300 µm)
- Sieving device (330 µm)
- 1 pulvérisator (5l) / 1 funnel
- Flasks (1l, glass), Formaldehyde 10% final with dispenser
- gloves

- Net apertures, or the size of the mouth of the net, vary from 0.03 to 2 m², depending on the type and shape of the net.

- Mesh sizes smaller than 330µm increase net resistance and clogging.
The net is collected vertically, washed externally with sea water to gather all particles in collectors. Samples in collectors are sieved through 330μm, recovered in flasks and fixed with formaldehyde 1-2% final, stored in dark for further analysis.

Visual examination is the most common method used to assess size and quantities of microplastics.

It is important to record/identify the type (pellets, filaments, plastic films, foamed plastic, granules, extruded polystyrene foam), shape (cylindrical, disks, flat, ovoid, spheroids etc.), condition (degraded, rough, eroded, broken, presence of fractures) and colour (opaque, clear, pigmented, etc.).
REMARKS

Various imaging approaches, such as zooscan or semi-automated methods (flow/cytometer, cell sorter, coulter counters) may be practical for the visualization or counting of microplastic particles.

There is still a lack of analytical methods capable of characterizing and quantifying small sized particles (but in progress),

for small particles, there is a need to harmonize procedures to mitigate airborne contamination.

More generally, research will have to focus on developing new tools and strategies in order to optimize sampling effort (considering spatial and temporal variability), and adequately count and characterize microplastics particles.

Caracterisation may be necessary

<table>
<thead>
<tr>
<th>Method</th>
<th>Approach and information obtained</th>
<th>Sample preparation (excluding separation)</th>
<th>Advantages/limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM</td>
<td>Interaciton of an electrons beam/sample producing a sample image</td>
<td>Requires coating under vacuum</td>
<td>High-resolution image</td>
</tr>
<tr>
<td>FT-IR</td>
<td>Spectra collected in Transmittance, Reflectance or Attenuated Total Reflectance (ATR) modes.</td>
<td>No sample preparation required other than clean-up</td>
<td>May require coating, Charge effects, Possible visualization of samples, spectra and maps samples, Need a dust free environment for the microscope</td>
</tr>
<tr>
<td>GC-MS</td>
<td>Mass spectrometry of microplastics by analyzing their thermal degradation products</td>
<td>Sampler equipped with a thermal desorption system</td>
<td>Analyse polymer type and organic plastic additives in one run, avoiding background contamination</td>
</tr>
<tr>
<td>Raman</td>
<td>Laser excitation, informs about bonding within the material, and about molecule and networking structures</td>
<td>No sample preparation required other than clean-up</td>
<td>Destructive, No contact and non-destructive, Apply to very much different materials, Interference with colour/pigment spectra</td>
</tr>
<tr>
<td>EDS</td>
<td>Diffraction and reflection of emitted radiation from microplastics surface</td>
<td>No requirement of coating due to work in low vacuum</td>
<td>Chemical and morphological characterization of particles</td>
</tr>
<tr>
<td>ESEM-EDS</td>
<td>Diffraction and reflection of emitted radiation from microplastics surface</td>
<td>No sample preparation required</td>
<td>Elemental composition and surface morphology of microplastics, Interference with colour/pigment spectra</td>
</tr>
<tr>
<td>FIA</td>
<td>Focal Plane Array-Based Reflectance Micro-FT-IR Imaging</td>
<td>30% hydrogen peroxide (H2O2) pre-treatment</td>
<td>No charge effects, Works in organic-rich waste water samples</td>
</tr>
<tr>
<td>TGA</td>
<td>Thermogravimetry (TGA) with TOS-GCMS detection Identyf: and quantify polymer particles</td>
<td>No sample preparation required</td>
<td>Works in organic-rich waste water samples, Destructive</td>
</tr>
</tbody>
</table>

UNEP (DEPI)/MED WG.429/Inf.5
Page 48
Conclusions

Relevant methods for large floating microplastics (>300μm)

Harmonizing the multiple existing approaches to sampling, measuring and quantifying microplastics will improve local, regional and global understanding.

Further research on methods needs to consider sampling design and analytical methods capable of characterizing and quantifying small sized particles, e.g. 20 to 30 μm and nanosized particles.
c) Effect of Marine Litter on Biota: Ingested Litter by Marine Organisms (EO10, Candidate Indicator 24)
Monitoring and assessment of marine litter on marine mammals

Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring
Madrid, Spain, 28 February – 2 March 2017

Maria Cristina Fossi with the contribution of Cristina Park and Matteo Biaura
Department of Physical, Earth and Environmental Sciences, University of Siena, Siena, Italy

Impact of marine litter on Marine Mammals

The threat from entanglement in plastics is well known for seals and turtles and the threat from plastic ingestion is well characterized for some bird species. Entanglement of cetaceans is also a well known impact of discarded ‘ghost’ nets and other marine debris and recently ingestion are also reported for several species.
Impact of marine litter on Marine Mammals: global scale

- Three categories of impact:
  - Entanglement
  - Ingestion of macrolitter
  - Ingestion of microplastics

Impact of marine litter on Marine Mammals: global scale

### Entanglement

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Type of Litter</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whale</td>
<td>Nylon rope</td>
<td>5</td>
</tr>
<tr>
<td>Dolphin</td>
<td>Plastic bag</td>
<td>2</td>
</tr>
<tr>
<td>Seagull</td>
<td>Metal ring</td>
<td>0.5</td>
</tr>
<tr>
<td>Fish</td>
<td>Net</td>
<td>1</td>
</tr>
</tbody>
</table>

### Ingestion

- Marine Anthropogenic Litter

- Algal (marine algae): 10%
- Polystyrene: 20%
- HDPE: 15%
- Polyethylene terephthalate (PET): 10%
- Polypropylene (PP): 15%
- Other: 20%

Comparison with the earlier study shows that marine litter significantly affects marine life, especially marine mammals. The increase in marine litter has led to a decrease in marine life, indicating the need for immediate action to reduce the litter in marine environments.
Impact of marine litter on Cetaceans: global scale

Ingestion of debris has been documented in **48 (56% of) cetacean species**, with rates of ingestion as high as 31% in some populations. Debris-induced mortality rates of 0–22% of stranded animals were documented, suggesting that debris could be a significant conservation threat to some populations.

Impact of marine litter on Cetaceans: Mediterranean Sea

- Entanglement of cetaceans in discarded ‘ghost’ nets
- Marine litter ingestion
- Microplastic ingestion
Monitoring and assessment of marine litter in marine mammals: the three fold approach

Phase 2: Plastic tracers detections
- Persistent Organic Pollutants
- Phthalates
- Bisphenol A

Phase 1: Marine Litter detections
- Measure of intake by organisms
- Effects at DNA level
- Effects at cellular level

Phase 3: Toxicological effect detections
- Effects at DNA level
- Alteration of proteins and metabolism
- Alteration of cell functions

Biomarkers RESPONSES

These three fold monitoring approach can be applied singularly or simultaneously. For stranded cetaceans it is possible to detect the occurrence and rate of marine litter ingestion, to quantify the possible contaminants accumulation and the relative biological effects (specimen in good state of conservation). For stranded organisms (not in good state of conservation), the analysis of contaminants and gastro-intestinal content can be carried out.

An indirect approach can be used for free-ranging animals where the levels of plastic additives, PBT compounds and biological effects can be measured to evaluate the exposure to marine litter.

Protected species

Stranded organisms

Free-ranging animals
Monitoring and assessment of marine litter in stranded marine mammals: marine litter detection

Sperm whale in submarine canyons and impact with marine litter

Monitoring and assessment of marine litter in stranded marine mammals: plastic tracers detection

Phthalate (DEHP concentrations) in blubber samples of stranded fin whales collected along the Italian coasts was used as a plastic tracers.
Monitoring and assessment impact of plastic in free-ranging cetaceans: plastic tracers and biomarkers detection

*Balaenoptera physalus*

Monitoring and assessment impact of plastic in free-ranging cetaceans: skin biopsy approach

**Multi-Trial Biomarker Diagnostic Tool in Skin Biopsy**

**DIAGNOSTIC MARKERS FOR ANTHROPOGENIC CONTAMINANTS**
- Markers of Exposure
- Metabolites
- Markers of General Stress
- Markers of Reproductive Alterations
- Markers of Immuno-suppression
- Markers of Susceptibility

**SKIN**

**DIAGNOSTIC MARKERS FOR FOOD DEPLETION**
- Markers of Nutritional status
- Fat and seafood contamination

**DIAGNOSTIC MARKERS FOR CLIMATE CHANGE**
- Markers of Stress
- Markers of Susceptibility

**DIAGNOSTIC MARKERS FOR IMMUNOSUPPRESSION**
- Markers of Immunosuppression
  - Macrophages, cytokines

**BLUBBER**

**ANALYSIS OF ANTHROPOGENIC CONTAMINANTS**
- PCBs
- Dioxins
- Metals
- Trace Elements (in skin)

**NEW FRONTIER BIOMARKERS**
- PCR
- Microarray
- Proteomics

**EXPERT SYSTEM**
Baleen whales, during their filtrating activity for feeding, potentially undergo to the ingestion of micro-litter. Fin whale with each mouthful it can trap each time about 70,000 litres of water and could undergo to the risk of the ingestion and degradation of microplastics and related contaminants such as plastic additives and PBTs.
Fin whale as indicator of the health status of a sea basin

Experimental work: two phases in two areas

Pelagos Sanctuary

Sea of Cortez

a) Microplastics sampling

b) Skin biopsy sampling

Potential MPs intake routes for fin whale

MEHP ranging from 8.87 ng/g to 21.79 ng/g in M. norvegica

In addition to direct intake, fin whales may also indirectly ingest microplastics (MPs) through the consumption of large quantities of euphausiids and small schooling fish contaminated with microplastics.
Fin whales and convergence areas affected by microplastics

The overall goal of the PLASTIC PELAGOS pilot project was to investigate whether the fin whale feeding ground overlaps with convergence areas characterized by high concentration of microplastics and macroplastics in the SPAMI Pelagos Sanctuary.

5 data sets are used (8-18 September 2014):

- **Model 1** - Models of ocean circulation (to identify gyres)
- **Model 2** - Model of fin whale feeding ground
- **Map 1** - Microplastics abundance
- **Map 2** - Macroplastics abundance
- **Map 3** - Fin whales sightings (and other species)
Concentration model ROMS and "Risk Areas prediction"

The multi-layer approach used to investigate the possible overlap between microplastics convergence areas and fin whale feeding ground allow us to suggest potential risk areas for whale feeding.

Marine mammals as sentinels of ocean health

Bottlenose dolphin and pinnipeds: coastal sentinels

Striped dolphin: sub-basin sentinel

Fin whale: basin sentinel

Sperm whale: world-ocean sentinel

Sentinel species with physiology and/or diet similar enough to humans, such as marine mammals, may provide early indication of potential adverse health effects and provide insight into toxic mechanisms of a given hazardous agent (Schiracker et al., 2013). Multiple stress factors due to bioaccumulation of anthropogenic contaminants, marine litter, combined with infectious diseases, food depletion and climate change pose potential hazard to marine mammals worldwide. For this reason, more recently, attention has focused on marine mammals as charismatic sentinels of ocean change. Marine mammals have similar mammalian physiology to humans and are long living top predators, so they may be effective indicators for chronic, or slow developing pathologies that are more difficult to be detected in human populations exposed to lower levels of the same hazard (Bossart, 2011).
Main conclusion

Why is it important to assess the impact of marine litter on marine mammals?

- Endangered or threatened species
- Top predator species/long living species
- Mammal species species with physiology and/or diet similar to humans
- Potential wide indicators of health status of the sea at basin scale

Thank you
d) Monitoring Riverine Marine Litter
e) Baseline Values on Marine Litter Indicators: Definition of Methodology
Baseline Values on Marine Litter Indicators: Definition of Methodology

IMAP / Methodological standards:

I. The assessment of the status of the marine environment and the determination of GES
II. Environmental targets
III. Monitoring
IV. Achievements of reduction measures

Meeting of the Ecosystem Approach Correspondence Group on Marine Litter Monitoring, Madrid, Spain, 28 February – 2 March 2017

F. Galliari / 28 February 2017, Madrid
In the Decision on criteria and methodological standards on GES, ECAP identified 3 common indicators, for the environmental objective 10 (Marine Litter):

<table>
<thead>
<tr>
<th>Common Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source</td>
</tr>
<tr>
<td>17</td>
<td>Trends in the amount of litter in the water column including microplastics and on the seafloor</td>
</tr>
<tr>
<td>18 (Trial basis)*</td>
<td>Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds and turtles</td>
</tr>
</tbody>
</table>

For each indicator: Monitoring, Achievement of GES and reduction measures need baselines, thresholds and targets (environmental and operational).

**DEFINITIONS:**

**Assessment:** An assessment is a process by which information is collected and evaluated following agreed methods, rules and guidance. It is carried out from time to time to determine the level of available knowledge and to evaluate the environmental state. It classifies the environmental status in relation to Good Environmental Status (GES).

**Baseline:** A baseline is a description of environmental state at a specific point against which subsequent values of state are compared. It may 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 state.

**Degradation:** Degradation is the reduction in the quality status of the ecosystem, or any part of it, compared to a more healthy state.

**Descriptor:** Ecosystem Approach (ECAP) provided a list of 'Descriptors' which constitute the basis for the assessment of GES. These descriptors are further specified through indicators, criteria and methodological standards, based on specific characteristics determined by Member States. Marine Litter is the descriptor 10 of the ECAP.

**Ecosystem approach:** The main elements of the ecosystem approach can be described, as defined in the MEDPOL statement, as the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.

**Environmental Target:** ECAP defines "environmental target" as a "qualitative or quantitative statement on the desired condition of the different components of marine waters in respect of each marine region or sub region. The main purpose of environmental targets is to guide progress towards achieving GES."
Good Environmental Status: In this document, GES describes the desired status of the environment and its elements, based on criteria and methodological standards set out in accordance with ECAP. "GES boundary" is used to provide an expression for the deviation from the baseline or reference condition which marks the difference between a state that is acceptable and a state that is not acceptable. For descriptor 10 (Marine Litter) within ECAP, GES is when Litter and its degradation products do not cause harm to marine life and damage to marine habitats.

Impact: An impact is the environmental effect of a pressure resulting from human activities. It is permanent or temporary, and related to any type of harm (physical, chemical or biological) that is undesirable. It also includes the consequence for human welfare based on the use of the marine environment (socio-economic impact).

Indicator: For the purposes of assessing environmental status, an indicator specifies the criteria and supports their assessment. For other purposes, "indicators" are understood in general as a scientific/technical assessment tool. An indicator consists of one parameter chosen to represent ("indicate") a certain situation or aspect and to simplify a complex reality and within ECAP, to support the determination of GES and assessment of the status of the marine environment.

Methodological standard: Methodological standards are understood as established scientific or technical methods for assessing and classifying environmental status. Methodological standards can include assessment tools, methods for aggregation, common elements (contaminants, species, habitats, etc.), criteria, descriptors or approaches to define scale.

Parameter / metric: A parameter is a measureable characteristic value (e.g. number, Density of Litter, concentration, etc.). Metric relates to the unit in which the parameter is measured (e.g. number of items/km2, total weight, etc.). Parameters and metrics for assessment of GES are part of the criteria and methodological standards.

Pressure: A pressure is the result from anthropogenic activities at source which acts directly or via pathways on physical, chemical or biological elements of the marine ecosystem. At particular levels of intensity, it has the potential to have a direct or indirect impact on any component of the ecosystem.

Reference state / Reference conditions
For assessment purposes, it is often necessary to define a reference level against which current and future state is compared. Reference state/condition describe the state of the environment (or a component) in which there is considered to be no, or very minor, disturbance from the pressures of human activities.

Reference points
This relates to values, which must be achieved or not exceeded respectively, in order to bring a pressure or impact to a level that achieves the environmental target and consequently allows the marine waters concerned to move towards GES.

Scale: The scale defines the spatial and temporal extent of ecosystem components, their assessment (descriptor/indicators) and good environmental status.
INTERNATIONAL INSTITUTIONS: Baselines used/proposed

UN/UNCLOS: Not yet defined. The UN Regular Process of assessment is currently under development.

CBD: need for baselines to be articulated for several targets within the 2011-2020 Strategic Plan for Biodiversity.

OSPAR Convention. No baseline identified. EcoQOs use varied baselines (historic, recent or current baseline).

QSR assessment uses former natural conditions as baseline.

WFD: Baseline is conditions which are not, or are only minimally, anthropogenically impacted i.e. Reference conditions. Reference conditions are specified for each water body/habitat type.

MSFD: Guidance - ideal baseline is reference conditions. A Process to be started in 2017.

INTERNATIONAL INSTITUTIONS: Targets

UN/UNCLOS: Criterion targets are not yet defined under the UN Regular Process.

CBD: Some indicator targets have been identified but many under development or articulated as trends over time.

OSPAR Convention. Each EcoQO has an associated target value for the North Sea region.

WFD: Class boundaries (thresholds) are determined through intercalibration across MSs within Geographic Intercalibration Groups (GIGs).

MSFD: No indicator targets are identified within the Directive or guidance. A Process to start in 2017.
BASELINES:

- There is currently no accepted Mediterranean or sub regional detailed baselines against which to measure progress.

- Not all contracting parties have fulfilled data collection, Unequal spread of available data-sets,

- Some indicators poorly covered, Very few data in offshore waters

- Some countries belong to two or more sub regions (Tunisia, Italy, Greece),

- For general objectives/ environmental targets, it was recommended recently (UNEP/MAP/CORMON, 2015) that common baselines for the various litter indicators (beaches, sea surface, sea floor, microplastics, ingested litter) must be considered at the level of the entire basin (Mediterranean Sea) rather than at the sub regional level

BASELINES:

- Joint work on baselines and thresholds/reference values is needed. Some have expressed objection against the setting of thresholds for marine litter.

- Baselines are necessary to establish trends on which IMAP /D10 and RAPs are based. The availability of data for the development exercises will be crucial.

- Different aspects of ML assessments, such as data comparability, representativeness of sampling, spatial and coverage and frequency of data acquisition, data aggregation, etc. Must be considered

- The amount of existing information may be limited set definitive baselines that may be adjusted after monitoring programmes could provide additional data
Proposed general baselines for monitoring marine litter in the Mediterranean Sea
(UNEP /MAP/, 2015)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>minimum value</th>
<th>maximum value</th>
<th>mean value</th>
<th>Proposed baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. beaches (items/100 m)</td>
<td>11</td>
<td>3600</td>
<td>920</td>
<td>450-1400</td>
</tr>
<tr>
<td>17. Floating litter(items/km²)</td>
<td>0</td>
<td>195</td>
<td>3.9</td>
<td>3-5</td>
</tr>
<tr>
<td>17. sea floor(items/km²)</td>
<td>0</td>
<td>7700</td>
<td>179</td>
<td>130-230</td>
</tr>
<tr>
<td>17 Microplastics (items/km²)</td>
<td>0</td>
<td>4860000</td>
<td>340 000</td>
<td>200 000-500 000</td>
</tr>
<tr>
<td>18 (Sea Turtles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affected turtles (%)</td>
<td>14%</td>
<td>92.5%</td>
<td>45.9%</td>
<td>40-60%</td>
</tr>
<tr>
<td>Ingested litter(g)</td>
<td>0</td>
<td>14</td>
<td>1.37</td>
<td>1-3</td>
</tr>
</tbody>
</table>

TARGETS

In December 2013, the Contracting Parties of the Barcelona Convention adopted the RPML Management in the Mediterranean. The plan defined only general objectives which are
(i) The prevention an reduction to the minimum marine litter pollution in the Mediterranean and its impact on ecosystem services, habitats, species in particular the endangered species, public health and safety,
(ii) The removal to the extent possible already existent marine litter by using environmentally respectful methods,
(iii) A better knowledge on marine litter, and
(iv) A management in accordance with accepted international standards and approaches and in harmony with programmes and measures applied in other seas.

The Mediterranean Action Plan describes also some strategic, operational objectives and lists a series of prevention and remediation measures

The establishment of both “state” and “pressure” complementary targets can then better reflect and support the effectiveness of specific operational objectives
**Environmental targets** are qualitative or quantitative statement on the desired condition of the different components of marine Mediterranean waters. They are important for management as they will enable to:

(i) link the aim of achieving objectives such as Good Environmental Status (GES) to the measures and effort needed,

(ii) measure progress towards achieving the objective by means of associated indicator(s),

(iii) assess the success or failure of measures to prevent marine litter from entering the seas and to support management and stakeholder awareness.

Setting targets on marine litter may consider:

(i) Location (Beaches, floating, estuaries, marine life, etc.),

(ii) Composition or types (Plastic bags, cigarette bugs, microparticles, etc.),

(iii) Sources an pathways (Rivers, ship-based litter, landfills, etc.),

(iv) Sectors (Fisheries, recreation, industrial pellets, etc.), and

(v) Measures (Reduce urban waste production, Improved waste collection of land-based sources/sectors, Improved collection of ship-based waste in the port reception facilities, Improved waste water treatment, reduce consumer littering, Inspection at sea, etc.).

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**REMARKS ON TARGETS**

The level of ambition of the proposed target is depending on the litter management policies from Contracting Parties.

The setting of marine debris targets will encourage the implementation of monitoring programmes.

Pressure/operational-oriented targets can complement efforts, as referring to human processes and activities which are easier to monitor and influence.

Formulating a sub-set of targets for specific sources of marine litter (e.g. litter generated by fisheries) or even particular types of items should also facilitate the process.

Due to a large set of factors affecting the quantities and distribution of marine litter in a certain area (Floating litter may be transported from one country/sub basin to another, sources of microplastics cannot be distinguished by uses), it can be very challenging to detect clear reduction trends in the sea that can be associated to the implementation of measures in a particular area.
There is quite a wide diversity of targets that may be defined by contracting parties, in terms of nature, ambition and measurability, even between neighboring countries.

Some examples (within the context of various management schemes): some contracting parties have proposed various targets such as:
(i) Reduction of litter from beaches based on a five year moving average,
(ii) Negative annual trend in beach litter,
(iii) Reduction in litter on sea surface, water column and seabed,
(iv) Reduction towards zero over the longterm of harmful litter,
(v) Entanglement and strangulation reduced towards a minimum,
(vi) Less than X% of sea turtles having more than Xg of plastic in their stomachs,
(vii) Various targets regarding better waste collection in coastal regions,
(viii) Reduced inflow from rivers and sewers, and
(ix) Targets dedicated to education, as related to changes in behaviour (littering, etc.).

With regards to the coordinated monitoring strategy in the Mediterranean sea and technical or scientific considerations, Accessible targets were proposed by Medpol (Unep/map/Cormon, 2015) considering baselines that may be optimized after first results of monitoring.
Conclusions / Next steps (suggestions)

1) Review /compile literature
2) Review methods to define/update operational global baselines, or items baselines
   (zero litter, mean values, regional value/ regional differences),

3) Define a strategy for operational baselines/targets basin/ sub basin, global/specific items, mean values/specific value

4) Iteration (update after results from monitoring)
f) Citizen engagement in marine litter data collection