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Marine litter database

Lessons learned in compiling the first pan-European beach litter database

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Foreword

The Marine Directors of the European Union (EU), all EU Member States, acceding countries, candidate countries and European Free Trade Association (EFTA) countries have jointly developed a common strategy for supporting the implementation of Directive 2008/56/EC, the *Marine Strategy Framework Directive* (*MSFD*). The main aim of this strategy is to allow a coherent and harmonious implementation of the Directive. The focus of the strategy is on methodological questions related to a common understanding of the technical and scientific implications of the MSFD. In particular, one of the objectives of the strategy is the development of non-legally binding and practical documents, such as this report, on various technical issues of the Directive. In order to support and advise the policy development and implementation process, the MSFD Technical Group on Marine Litter (TG Litter hereafter) has been set up as part of the MSFD Implementation Strategy. The TG Litter is led by Directorate General Environment (DG ENV) and is chaired by the French Research Institute for Exploitation of the Sea (Ifremer), the German Environment Agency (UBA) and the European Commission Joint Research Centre (EC JRC) ([1])).

This report has been prepared by the EC JRC and EMODnet Chemistry Consortium, based on data and information collected through and revised by the TG Litter.

This publication is part of a series of technical reports on specific thematic topics, such as *Top marine beach litter items in Europe: A review and synthesis based on beach litter data*, *Harm caused by marine litter, Identifying sources of marine litter, Riverine litter monitoring: Options and recommendations* and *Guidance on monitoring of marine litter in the European seas.* These thematic reports are aimed at those experts who are directly or indirectly implementing the MSFD in the marine regions.

This technical report provides information to EU Member States on data quality and data management in support of the MSFD and other European policies in determining baselines and thresholds, implementing monitoring programmes and planning measures against marine litter.

Disclaimer:

This document has been developed through a collaborative programme involving the European Commission, all EU Member States, acceding countries, Norway, international organisations (including the Regional Sea Conventions and other stakeholders) and non-governmental organisations. The document should be regarded as presenting an informal consensus position on best practice agreed by all partners. However, the document does not necessarily represent the official, formal position of any of the partners. Hence, the views expressed in the document do not necessarily represent the views of the European Commission.

([1]) Further information can be found on the website of the JRC MSFD Competence Centre: http://mcc.jrc.ec.europa.eu/dev.py?N=41&O=434&titre_chap=TG %20Marine %20Litter.

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Abbreviations

DeFishGear	Project on derelict fishing gear management system in the Adriatic region
DG ENV	Directorate-General for Environment
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
EC	European Commission
EFTA	European Free Trade Association
Emblas	Environmental monitoring of the Black Sea
EMODnet	European Marine Observation and Data Network
EU	European Union
GES	good environmental status
G7	Group of Seven
G20	Group of 20
Helcom	Baltic Marine Environment Protection Commission — Helsinki Commission
Ifremer	French Research Institute for Exploitation of the Sea
Inspire	Infrastructure for spatial information in Europe
JRC	Joint Research Centre
MARLIN	Project on Marine Littering the Baltic Sea Area
MIO-ECSDE	Mediterranean Information Office for Environment, Culture and Sustainable Development
MS	Member State
MSFD	Marine Strategy Framework Directive
NGO	non-governmental organisation
OSPAR	Convention for the protection of the marine environment of the North-East Atlantic Commission
PAME	Protection of the Arctic marine environment
SeaDataNet	Pan-European infrastructure for ocean and marine data management
TG Litter	MSFD GES Technical Group on Marine Litter
UBA	German environment agency
UNEP/MAP	United Nations Environment Programme/Mediterranean Action Plan Barcelona Convention

Abstract

Marine litter is a global concern that represents a threat to all life in the oceans and seas. Reducing litter in the marine environment is recognised as a priority challenge to help preserve the ecosystem and human health. Marine litter, in particular marine plastics, and its reduction is at the core of political action through the Marine Strategy Framework Directive (MSFD), the EU Strategy for Plastics in a Circular Economy and the EU Waste Legislation.

Quantifying the amount of litter items present in the marine ecosystem is a matter of concern for the MSFD and in general for policies that aim to tackle marine litter. EU marine litter data quality and data management are defined by a complex system of datasets, in which a heterogeneity of protocols are still in use at regional and national levels. In accordance with the implementation of Good Environmental Status (GES) and other aspects of the MSFD, adopting consistent and harmonised criteria and methodological standards ensures consistency of data and the possibility of meaningful comparison between marine regions and subregions.

Defining the best possible data management strategy and identifying the most valuable methodology have been pursued by the Joint Research Council (JRC) and the European Marine Observation and Data Network (EMODnet) Chemistry network, within the TG Litter, with the main goal of delivering a single database able to handle marine litter data at European scale. This report proposes a tailor-made standard procedure on a European scale and lists challenges and hindrances faced during the compilation of beach litter data collected by the countries bordering the European seas, generating the first pan-European beach litter database.

The analysis has primarily involved data from 22 European countries and four marine regions. In total 3 063 surveys were performed on 389 European beaches over the period 2012 to 2016. In addition, data from non-European countries facing the seas around Europe have also been included in the database.

The biggest challenge faced during the data-compiling phase was dealing with the heterogeneity related to differences in data formats, data quality and protocols used during the beach surveys. A huge effort has been made to handle a varied set of data to guarantee efficient management of the data. The resulting harmonised marine litter database will be made accessible through the EMODnet Chemistry website. A more dynamic and tailored set of products, including datasets and maps for other marine litter compartments, is currently in development.

Furthermore, this report gives a complete outlook on further harmonisation approaches in other marine litter topics. The report also provides inputs to develop and implement the most efficient management of data to facilitate data-driven decisions in European policies.

1 Introduction

Marine litter, or debris, is defined as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment (Cheshire et al., 2009; MSFD GES Technical Subgroup on Marine Litter, 2013; Schulz et al., 2017). The marine environment acts as a sink of anthropogenic litter, accumulating items from land-based and sea-based sources (see Van Acoleyen et al., 2013; Veiga et al., 2016), and marine litter is found in all marine compartments such as beaches, shallow and deep seafloors, sea surface layer and the water column. Furthermore, marine litter and in particular plastics cause harm to marine biota at different levels of biological organisation and habitats, namely through entanglement in, or ingestion of, litter items by individuals, through chemical transfer, as a vector for transport of biota and by altering or modifying assemblages of species (Werner et al., 2016).

Marine litter is recognised as a worldwide concern by the European Commission (EC) and by global initiatives, such as the United Nations Environment Programme (UNEP), G7 and G20 ([2]), who state the urgency of the threat that ocean plastic waste and marine litter pose to the ecosystem. It causes harm to the environment and generates adverse economic, health and aesthetic impacts.

Quantifying the real amount of litter items present in the marine ecosystem is also a matter of concern for the Marine Strategy Framework Directive (MSFD) and for European policies that aim to tackle marine litter.

Box 1. Marine Strategy Framework Directive

The MSFD (European Parliament and Council of the European Union, 2008) provides the EU legal framework for the protection of the European seas. Marine litter is included as one of the descriptors for achieving and maintaining Good Environmental Status (GES) of European marine waters and protecting marine resources (see D10 in European Commission, 2010). GES should be achieved only when 'properties and quantities of marine litter do not cause harm to the coastal and marine environment'. The revised European Commission Decision COM/2017/848 (European Commission, 2017a) provides details for the assessment of litter in the environment.

In particular, the European framework identified marine plastics and their reduction as the core of political action through the EU Strategy for Plastics in a Circular Economy and the EU Waste Legislation ([3]).

Box 2. EU Plastics Strategy

The EU Plastics Strategy (European Commission COM/2018/028, 2018), *A European Strategy for Plastics in a Circular Economy*, aims to address the challenges caused by plastic throughout its value chain, by taking its entire life cycle into account (DG ENV and DG GROW, 2017) in order to progress towards a European Circular Economy (European Commission, 2017b). Reducing the leakage of plastic into the environment requires sound scientific data and information in order to reinforce measures and ascertain progress.

([2]) UNEP — Sustainable Development Goals SDG 14. See https://sustainabledevelopment.un.org/sdg14 and http://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/global-partnership-marine.
G7, Canada 2018 — Charlevoix blueprint for healthy oceans, seas and resilient coastal communities. See https://g7.gc.ca/en/official-documents/charlevoix-blueprint-healthy-oceans-seas-resilient-coastal-communities/#a1.
G20, Germany 2017 — Marine Litter Action Plan. See https://www.g20germany.de/Content/DE/_Anlagen/G7_G20/2017-g20-marine-litter-en__blob=publicationFile&v=4.pdf

([3]) EU Plastic Strategy. See http://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf.
EU Waste Legislation. See http://ec.europa.eu/environment/waste/legislation/a.htm.

EU marine litter data quality and data management are defined by a complex system of datasets in which a heterogeneity of marine litter monitoring protocols and standards are still in use at regional and national levels. In accordance with the implementation of GES and other aspects of the MSFD, adopting consistent and harmonised criteria and methodological standards ensures consistency of data and enables the meaningful comparison of marine litter data between marine regions and subregions.

The exercise of compiling a 2012-2016 beach litter dataset was set up in order to derive baselines for marine litter for the MSFD. Nevertheless, the worldwide attention to marine litter and the presence of several international initiatives (e.g. Environmental monitoring of the Black Sea (EMBLAS), Protection of the Arctic Marine Environment (PAME)) showed the importance and indeed the necessity of synergised and harmonised data. For this reason, the exercise has been extended to non-European countries facing the European seas. This geographical broadening of the marine litter database will provide an overall picture of litter information in European seas to the EC, which is going to take an active role in international collaborations on tackling the issue of marine litter.

The scope of this report is to define the best possible data management strategy, based on the lessons learned, and to identify the most valuable methodology for delivering a proposal for a single database able to handle marine litter data from beaches both at the European scale and beyond.

After the analysis of the available information and the data heterogeneity, a tailor-made standard procedure on a European scale has been proposed based on the best available reference documents for the beach litter compartment: adapting consolidated data formats to include all the available information. This report lists challenges and hindrances faced during the compilation of the first pan-European beach litter database. Once the critical issues have been resolved, the harmonised marine litter database will be made accessible through the European Marine Observation and Data Network (EMODnet) Chemistry website, in the data section ([4]).

Furthermore, a main outcome from the assessment of the available EU marine litter data was the contribution to the ongoing revision of the MSFD TG Litter Master List of Categories of Litter Items (TG Litter Master List, hereafter) with the aim of improving the data quality in future surveys.

The report gives a complete outlook on further harmonisation approaches in other marine litter topics, such as guidance of monitoring marine litter across EU, the ranking methodology for the identification of the top items and single-use plastics, and the set-up of baseline and threshold values. The report also provides inputs to develop and implement the most efficient data management system as an instrument for the right data-driven decisions in European policies.

([4]) See http://www.emodnet-chemistry.eu/data.

1.1 Baseline concept and harmonised database

Several concepts of 'baseline' have been formulated over time: historical, binonomic, legal and shifting baselines (see Box 3). Nevertheless, a tailor-made definition of a marine litter baseline has been established as follows: *a marine litter baseline is a starting point that provides a first large-scale comprehensive characterisation of marine litter in a specific year or time period and location. It is used to monitor, measure and assess progress and effectiveness during and after the implementation of measures or plans* ([5]).

Box 3. Different baseline concepts

— HISTORICAL (ECOLOGICAL) BASELINE (Grinnel, 1910): refers to the ethnocentric view and the primeval wilderness in which the natural or 'original' (historical) conditions of ecosystems existed with a negligible anthropogenic impact.

— BINONOMIC (ECOLOGICAL) BASELINE (Shelford, 1931): refers to the use of relatively undisturbed environments as the reference point.

— LEGAL BASELINE (Ferraro and Pattanayak, 2006): refers to the use of directive/policy as a reference: 1) year of policy introduction or 2) before the measures came into force.

— SHIFTING BASELINE (Pauly, 1995): refers to the incremental lowering of standards, with respect to nature, in which each new generation 1) lacks knowledge of how the environment used to be; 2) redefines what is 'natural', according to personal experience; 3) sets the stage for the next generations' shifting baseline. NB: a baseline that shifted before it was charted can cause a degraded state to be accepted as normal.

The quantification of litter and its impacts is needed to assess the state of the environment and to prioritise actions, including the monitoring of successful reduction measures, to achieve and maintain a GES. The setting of baseline values is therefore needed in order to provide a reference for trend analysis in marine litter. Deriving baselines on different spatial scales requires the availability of data with sufficient spatial and temporal coverage and a data quality process that is fit for purpose.

A global problem can be mitigated only through coordinated international action and comparable methodologies that facilitate comparison of occurrences and abundances. Moreover, developing a common single source of data should facilitate collaboration, avoid double efforts and reduce errors.

In this context, a consistent, harmonised dataset is crucial to be able to build an organised database, in which data can be used for performing comparative analyses and establishing baseline values of marine litter at any spatial-temporal scale needed.

Infrastructure for Spatial Information in Europe (Inspire) defines data harmonisation as the process of developing a common set of data product specifications in a way that allows the provision of access to spatial data through spatial data services in a representation that allows it to be combined with other harmonised data in a coherent way. This process includes agreements about coordinate reference systems, classification systems, application schemes, etc. ([6]).

([5]) A common definition of baseline and scenario testing was agreed in the TG Litter Marine Litter Baselines workshop, 14-15 March 2017, Brussels (Belgium).

([6]) See further information at http://inspire.ec.europa.eu/data-specifications/2892.

1.2 Data guidance: template and vocabulary

The importance of collection, standardisation, aggregation and sharing of data lies in using the same template, terminology and definitions across Member States (MSs) (e.g. using a standard language). A standard approach allows the creation of a harmonised database and supports any calculation methodology used for comparative analysis.

Guidance and a template ([7]) for gathering and managing marine litter data have been recently developed to facilitate the integration of the data collected using the existing diverse protocols for marine litter monitoring. The main goal is to provide access to harmonised data and data products of marine litter on a European scale (Vinci et al., 2018). The guidance and template have included all the existing European information systems available for the marine litter. Regarding beach litter, all data provided for inclusion in the EMODnet Chemistry Beach Litter Database ([8]) are processed following the guidelines. The data and metadata ingested in the EMODnet Chemistry Beach Litter Database maintain the original information collected according to the protocol and reporting methodology used (OSPAR, UNEP/Mediterranean Action Plan Barcelona convention (MAP) and/or the MSFD).

Data collection for beach litter includes information related to beach metadata, survey metadata, litter data, and stranded or dead animals data ([9]). Each regularly monitored reference beach ([10]) is described with a series of metadata. These data include physical and geographical characteristics of the beach and also the uses and factors that can condition the presence of the litter on the beach. The same set of data should be recorded for the monitored beaches on the European coasts.

The lack of physical barriers in the marine environment leads to the consideration of the potential impact of marine litter from non-EU Member States and neighbouring countries. In developing a pan-European infrastructure for the management of large and diverse sets of marine data that originate from different countries bordering the European seas, it will be important to develop, adopt and have access to common terms and indexes, to create a vocabulary that might be improved and enlarged over time under a shared vision (e.g. SeaDataNet; Figure 1) ([11]). The purpose of standard vocabularies is to make the different data providers (i.e. EU and non-EU countries) apply the same nomenclature, minimising subjectivity and normalising values and information.

([7]) Guidance and a template for gathering marine litter data have been developed in 2018 and are available at http://www.emodnet-chemistry.eu/documents/projectdocuments.

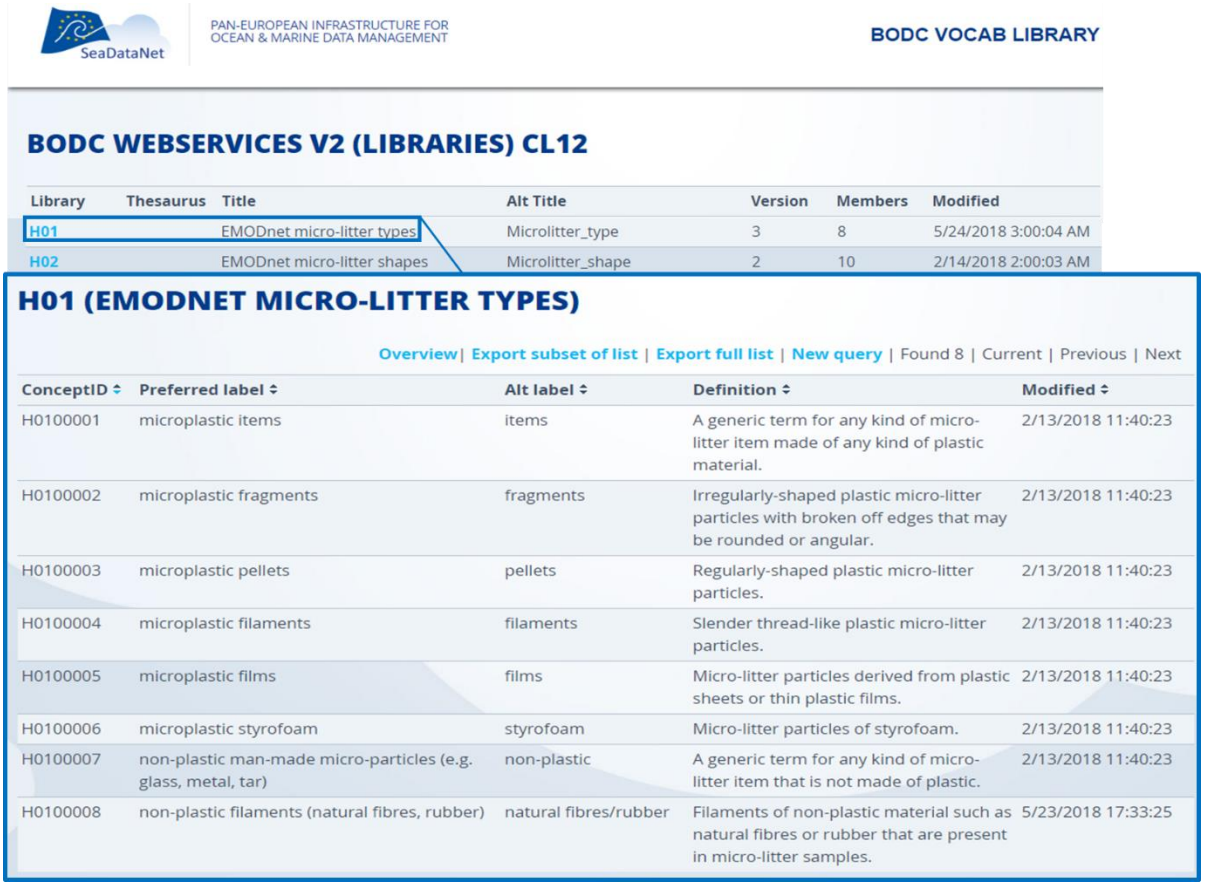
([8]) See further information on EMODnet Chemistry website, section DATA: http://www.emodnet-chemistry.eu/data.

([9]) The EMODnet Chemistry Beach litter format template is available in Annexes 1-4 of this report and online at the EMODnet Chemistry website, section DOCUMENTS: http://www.emodnet-chemistry.eu/doi/documents/Guidelines-Litter_Data_EMODnetChemistry3_rev_20180731.pdf.

([10]) 'Ideally, the selected sites should represent litter abundance and composition for a given region. Not any given coastal site may be appropriate, as they may be limited in terms of accessibility, suitability to sampling (sand or rocks/boulders) and beach cleaning activities' (MSFD GES Technical Subgroup on Marine Litter, 2013).

([11]) See further information at https://www.seadatanet.org/ and https://www.bodc.ac.uk.

Figure 1. Example of standard terms and indexes used for International Standard Organisation Countries (e.g. microlitter types)



Source: BODC Vocabulary Library, SeaDataNet, 2018.
NB: Figure 1 is an example of standard terms for microlitter types and should not be considered an alternative to the TG Litter Master List.

The introduction of a standard list of litter items and their definitions (i.e. the TG Litter Master List ([12]), a draft version of which was developed in the MSFD GES Technical Subgroup on Marine Litter, 2013) enables the comparison of results between regions and environmental compartments and can be used as a basis for preparing assessment protocols. If the list is detailed enough it will make it possible to infer the potential and/or most likely sources of litter, types of items or even the related potential harm that items can cause. This is a crucial step in helping to identify key priorities to tackle, design a programme of measures and support the monitoring of their effectiveness (MSFD GES Technical Subgroup on Marine Litter, 2013).

([12]) Important NB: The TG Litter Master List, published in 2013 as part of guidance for the monitoring of marine litter, is being further developed. Additional information is being gathered for the ongoing revision of the TG Litter Master List. A process for the inclusion of newly found items and thus the mechanism for updating of the TG Litter Master List also needs to be set up.

2 First pan-European beach litter database

This report provides insights into the technical hindrances to data compilation and comparability. These hindrances are related to methodological inconsistencies and the heterogeneity of data collection and/or sampling methods (e.g. the number of surveys, variable transect lengths and sampling units), data reporting or the use of different lists of litter items during the surveys (e.g. language issues and *ad hoc* coding), or the spatial-temporal distribution of data (e.g. no references, yearly/seasonal data).

Following both the agreement ([5]) on the approach for the scenario testing of marine beach litter baselines and the identification of available data, MSs, EMODnet Chemistry project partners and other stakeholders were invited to provide their data to the JRC through the TG Litter, and to the EMODnet Chemistry Consortium through the partnership.

2.1 Metadata of EU beach litter data

Metadata are an essential part of data quality management. They provide basic information about the data: what has been measured, who measured it and/or when/how data were gathered. They allow better organisation of the data and digital identification of the dataset, making resources visible. Therefore, together with quality flagging (which indicates the reliability of the data), they are key for the long-term preservation, use and reuse of the data long after the original measurement. For these reasons, the evaluation and choice of the format for the European beach litter database was focused on integrating the best set of information available.

The metadata included in the EMODnet Chemistry beach litter template (Galgani et al., 2018) are mainly derived from the Convention for the protection of the marine environment of the North-East Atlantic Commission (OSPAR) format, as it is the most complete and developed format available. This format was enriched with additional information to improve data management (i.e. information about data originator, data collator and project). Although the EMODnet Chemistry litter format is based on OSPAR, the template was defined after comparison and evaluation of all the available European beach litter data templates. Therefore, the final format is able to merge litter data from the different protocols and reference systems used by European countries:

- OSPAR: Guideline for monitoring marine litter on the beaches in the OSPAR maritime area, 2010;
- TG Litter: Guidance on monitoring of marine litter in European seas. MSFD Technical Subgroup on Marine Litter, 2013;
- UNEP: UNEP/IOC guidelines on survey and monitoring of marine litter, 2009;
- UNEP Project on marine littering the Baltic Sea area (MARLIN: Beach litter measurement method description (Appendix 1 in the final report of project Marlin — litter monitoring and raising awareness), 2011-2013.

The EMODnet Chemistry beach litter template ([9]) comprises an Excel file divided into four sheets that deal with the different topics separately: beach metadata, survey metadata, animals and litter data.

- The Beach sheet contains 43 fields and provides general information about the beach's position and materials, features about its backshore, main currents and winds, developments on the beach, its usages and cleaning details.
- The Survey sheet contains 58 fields and provides general information about the survey date and position, the weather conditions, the presence and proximity of potential sources of pollution (rivers, cities, human activities) and if animals were found during the survey.
- The Animals sheet contains eight fields and provides specific information about the animals observed, such as the species, the age and sex of the animals and if they are entangled with litter items.
- The Litter sheet contains eight fields and provides specific information about the litter items found, such as the reference list used, litter code and description, and

the quantity. The format foresees the chance to handle the original code and description of the item used by the surveyor and its conversion (when possible) to the official reference list (TG Litter Master List).

Standard vocabularies and definitions are used whenever possible to enable comparability. Some fields (such as those that deal with the data collator and originator) are managed using common vocabularies developed during EMODnet Chemistry activities ([11]). These provide unambiguous descriptions of several kinds of information that are used all over Europe ([13]). For specific litter fields (such as those dealing with survey type and harbour type), dynamic online lists have been created to describe features related to beach litter data ([14]). The latter terms are evolving during the data collection but will be turned into common vocabulary terms when they are stable.

The pan-European beach litter database (containing the marine litter baselines dataset) currently comprises the data collected in the European (and some non-European) beach litter surveys performed between 2001 and 2017 ([15]). However, the dataset is growing continuously to capture all of the available information on this topic.

The dataset currently includes information on 518 beaches from 4 772 surveys conducted in 29 countries (including non-European countries) during the last 17 years (see Table 1 and Figures 2-5). Several litter reference lists were used by the Member States to report their beach litter data: OSPAR, UNEP, UNEP MARLIN, and the TG Litter Master List of categories of litter items. The complete marine litter database will be made accessible through the EMODnet Chemistry website (http://www.emodnet-chemistry.eu).

Table 1. Number of beaches and surveys in the pan-European beach litter database

Country	Number of beaches	Number of surveys
Belgium	3	75
Bulgaria	8	32
Croatia	4	16
Cyprus	24	29
Denmark (incl. Greenland)[1]	21	78
Estonia	10	106
Faroe Islands[2]	1	4
Finland	14	158
France	22	268
Georgia[2]	3	3
Germany	31	604

([13]) For example, beaches classified as rural, urban and peri-urban in the beach litter template refer to the following degrees of urbanisation: a) rural is a thinly populated area, a contiguous set of local areas belonging neither to a densely populated area nor to an intermediate area; b) urban is a densely populated area, a contiguous set of local areas, each of which has a population density > 500 inhabitants per square kilometre, where the total population for the set is at least 50 000 inhabitants; c) peri-urban is an intermediate area, a contiguous set of local areas, not belonging to a densely populated area, each of which has a population density > 100 inhabitants per square kilometre, and either with a total population for the set of at least 50 000 inhabitants or adjacent to a densely populated area. For further information, see European Commission (1999); McKenna et al. (2010).

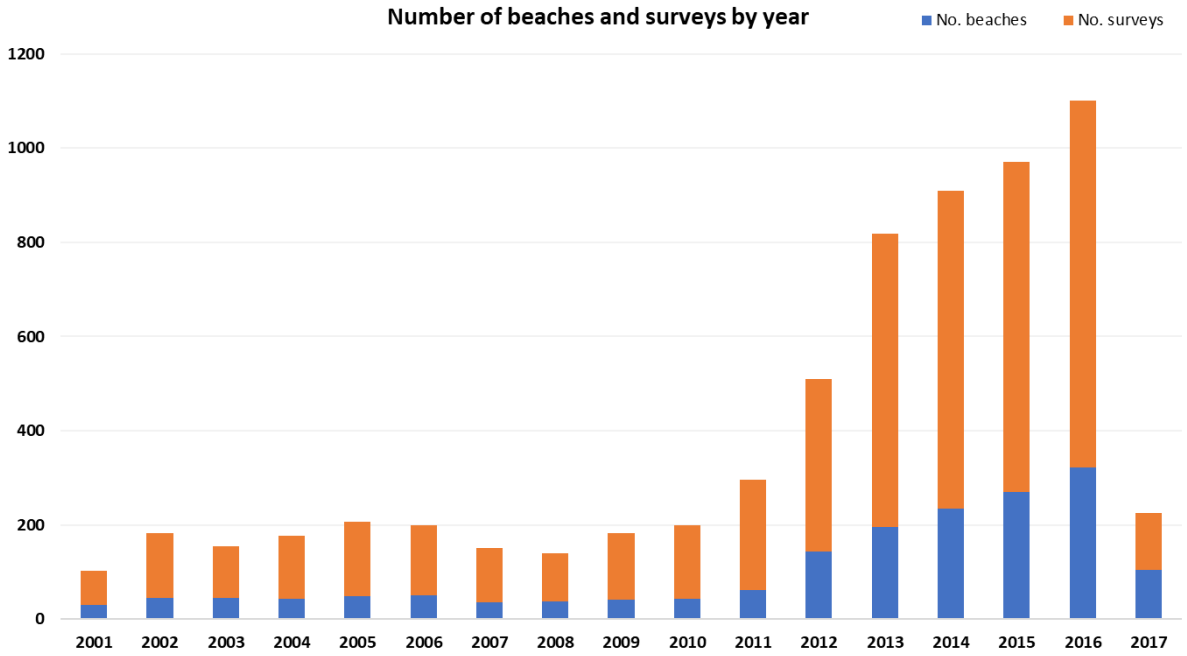
([14]) See http://www.emodnet-chemistry.eu/lists/beach.

([15]) NB: the numbers of beaches and surveys performed during 2017 are incomplete. Data gathering is still ongoing.

Country	Number of beaches	Number of surveys
Greece	6	21
Iceland[2]	5	7
Ireland	4	91
Italy	162	162
Latvia	41	187
Lithuania	4	32
Montenegro[2]	2	8
Netherlands	4	312
Norway[2]	7	49
Poland	15	120
Portugal	13	205
Romania	3	9
Russian Federation[2]	5	5
Slovenia	5	132
Spain	30	563
Sweden	22	333
Ukraine[2]	1	1
United Kingdom	48	1162

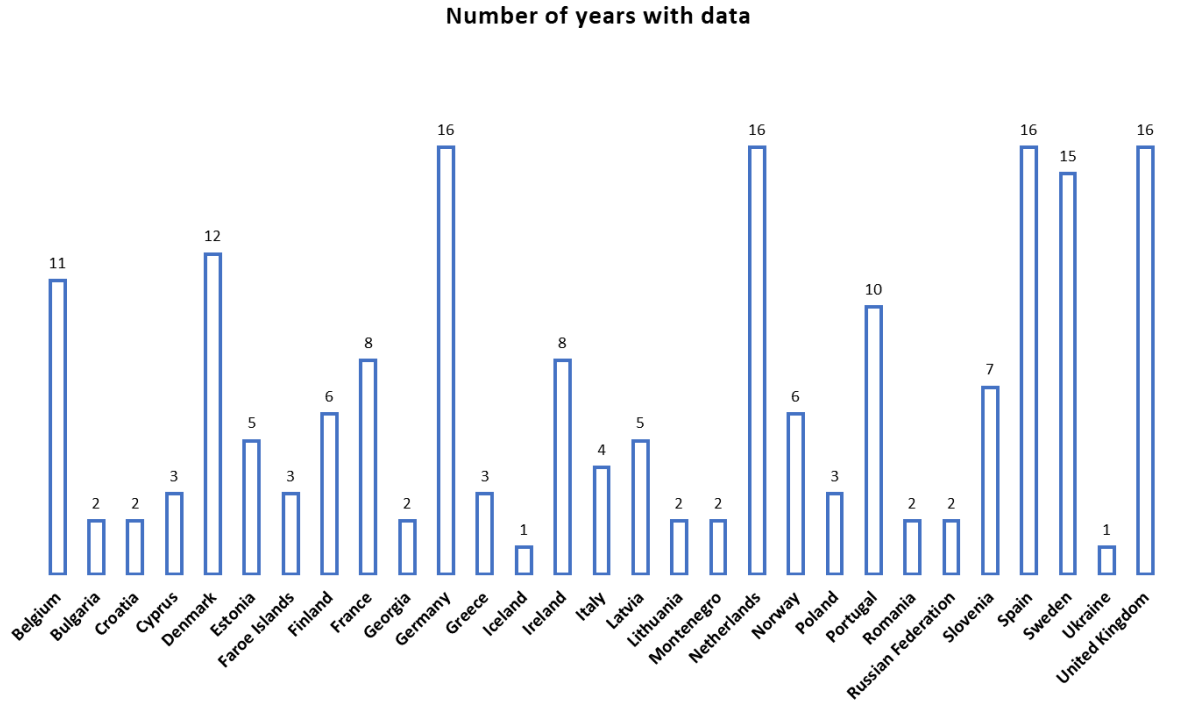
Notes:
[1] Total number of beaches and surveys for Denmark [beaches (5), surveys (24)] and Greenland [beaches (16), surveys (54)].
[2] Non-EU MS. Data from these countries will not be included in the MSFD baseline setting.
The numbers of beaches and surveys performed during 2017 are incomplete. Data gathering is still ongoing. Data at 13/8/2018.

Figure 2. Total number of beaches and surveys by year in the pan-European beach litter database



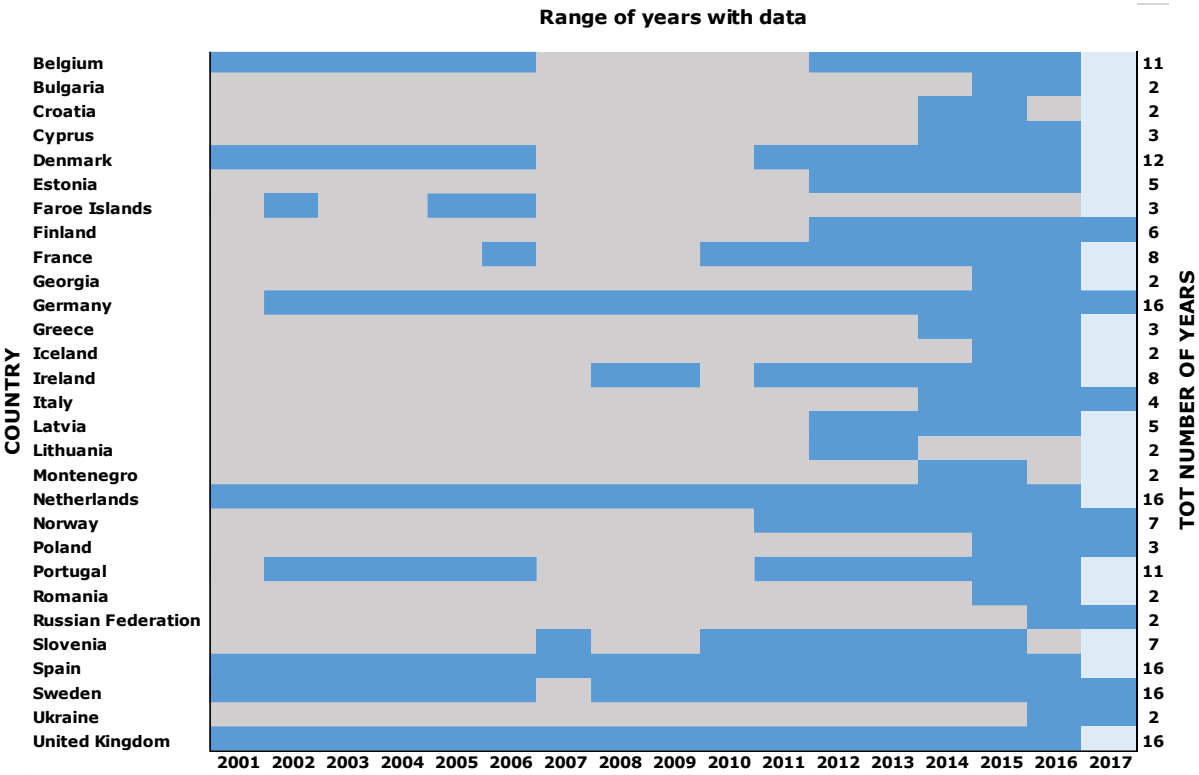
NB: the total numbers of beaches and surveys for each country and year are available in Annex 5 of this report. The numbers of beaches and surveys performed during 2017 are incomplete. Data gathering is still ongoing. Data at 13/8/2018.

Figure 3. Total number of years with data for each country in the pan-European beach litter database



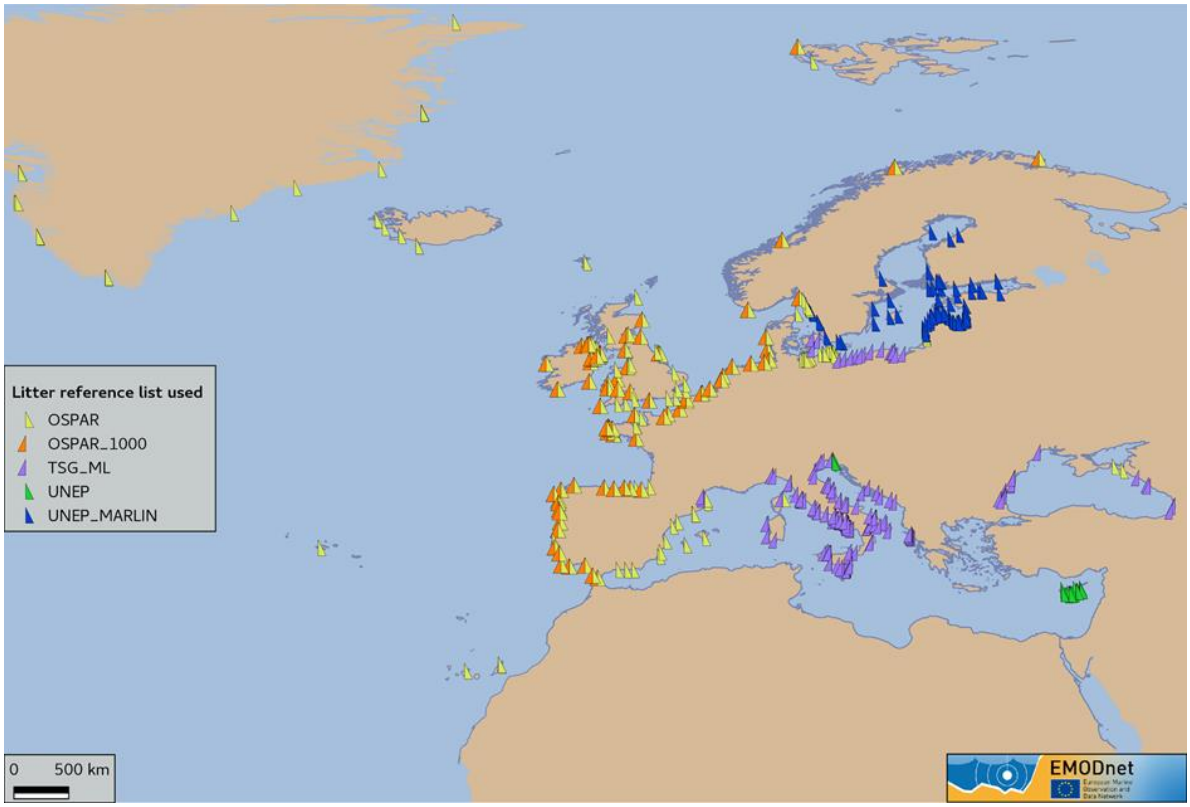
NB: the numbers of beaches and surveys performed during 2017 are incomplete. Data gathering is still ongoing. Data at 13/8/2018.

Figure 4. Range of years with data (in dark blue) and without data (in grey) for each country in the pan-European beach litter database



NB: the numbers of beaches and surveys performed during 2017 (in light blue) are incomplete. Data gathering is still ongoing. Data at 13/8/2018.

Figure 5. Spatial distribution of surveyed beaches in the pan-European beach litter database



NB: the online version is available at http://ec.oceanbrowser.net/emodnet/.

2.2 Challenges of and hindrances to data assembly

During the processing of datasets provided by Member States to the JRC for baseline processing, several hindrances were noticed and partially solved. These obstacles can be classified in two groups:

- Basic group: processing was made more difficult and time-consuming (e.g. the use of mother language, a different geographic coordinate system, several types of data template for beach litter reporting).
- Complex group: it hindered the ingestion process or made it impossible to compare survey results (e.g. different ways of reporting litter information depending on the item, missing survey length data or missing coordinates of the start/end of the transect, missing codes for the items reported, the number of items reported per survey or as a sum or average of sections, an undefined number of items, missing surveys for some seasons).

In general, data originator details are missing in most cases. Only 7 out of 22 European countries provided information on the source of data (originator), which is essential to clarify doubts or address inconsistencies in data.

For example, a direct dialogue with the originators of the Baltic data allowed understanding that some Baltic MSs follow an adapted UNEP protocol for the Baltic Sea (MARLIN, 2013). In this protocol ([16]) three different lengths are surveyed depending on the item type (e.g. cigarette butts) and size (> 50 cm or < 50 cm). This means that items can be reported over a different length basis, or data are recalculated to the unit 'number of litter items per 100 m'. Major errors in future outputs can occur if there is no clear information about how quantities are reported: count, density or both (depending on the type of item).

According to data management rules followed by EMODnet Chemistry, inclusion of the data originator is mandatory (for acknowledgements, negotiations and clarifications) and it is strongly suggested that this information be integrated for all records in the future.

In addition, for some countries, survey length, survey width, survey protocol and survey coordinates were not always provided. The values of these data have been inferred from the protocol each country was supposed to follow (e.g. MSFD, OSPAR or UNEP/MARLINarlin protocols). If these assumptions are wrong, data outputs will be erroneous.

As the EMODnet Chemistry beach litter data format is derived from the OSPAR protocol, beach width was not considered in the template. In order to harmonise data in terms of quantities or densities, it may be useful to include beach width information.

Reference beaches as identified for the MSFD beach litter monitoring and type of activity (e.g. monitoring or clean-up event) were in some cases not classified because of the lack of this information.

It is important to clarify the definitions of 'monitoring' and 'clean-up'. In agreement with the TG Litter and in support of the MSFD implementation, a monitoring event under the MSFD is a survey that should be done in comparison with the baseline values. However, the baselines have not yet been established, while beach-monitoring programmes have been already put in place. On the other hand, a clean-up event is an informal citizen engagement activity to collect litter from the beaches, raising awareness and recording data on litter.

According to European Environment Agency (EEA) Marine LitterWatch ([17]), monitoring events have to follow the MSFD monitoring protocol for beach litter. Monitoring events need to happen on a regular basis and take place at the same location on the beach. Given this, they require a community structure and set-up that will ensure proper quality

([16]) See note in Annex 6 of this report. Further information is available in https://www.hsr.se/sites/default/files/appendix1_measurement_method.pdf.

([17]) See https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/thematic-assessments/marine-litterwatch/get-started/how.

assurance of the data. However, clean-up events may be *ad hoc* or periodic. The data generated through clean-ups will probably support assessments of the state of European coasts and seas, including those prepared by the EEA.

When the information about monitoring activities is missing in the original dataset, the repeat survey at the same beach has been considered and tagged as monitoring in the pan-European database.

Different lists of categories of litter items with different item codes have been used by MSs during the surveys (e.g. OSPAR, UNEP/MAP and Master List). Although a 'Master List of all litter items for use in litter monitoring programme in the European marine environment is being produced on the basis of the comparison of lists, the structure and elaboration of the list is an ongoing process' (MSFD Technical Subgroup on Marine Litter, 2013, p. 112). For this reason, the pan-European database includes the original code and name of litter items provided by Member States and the name and code of litter categories automatically converted in the TG Litter Master List.

As the comparison and conversion of litter item codes from one list to another is not always a 1:1 correspondence (Figure 6) ([18]), this information has been included in the *Note* column. This column has been used to register all the relevant comments related to the items.

Figure 6. Extract from comparative table of OSPAR, UNEP/MAP, TG Litter Master lists of item categories

Code TGML	TGML Master List description	Code OSPAR	OSPAR description	Code UNEP	UNEP description
G1	4/6-pack yokes, six-pack rings	1	4/6-pack yokes	PL05	Drink package rings, six-pack rings, ring carriers
G3	Shopping Bags incl. pieces	2	Bags (shopping)	PL07	Plastic bags (opaque & clear)
G4	Small plastic bags, e.g. freezer bags incl. pieces	3	Small plastic bags, e.g., freezer bags	PL07	Plastic bags (opaque & clear)
G7	Drink bottles <=0.5l	4	Drinks bottles & containers	PL02	Bottles < 2 L
G8	Drink bottles >0.5l	4	Drinks bottles & containers	PL02	Bottles < 2 L
G9	Cleaner bottles & containers	5	Cleaner bottles & containers	PL02	Bottles < 2 L
G10	Food containers incl. fast food containers	6	Food incl. fast food containers	PL06	Food containers (fast food, cups, lunch boxes & similar)
G11	Beach use related cosmetic bottles and containers, eg. Sunblocks	7	Cosmetics bottles & containers	PL02	Bottles < 2 L
G12	Other cosmetics bottles & containers	7	Cosmetics bottles & containers	PL02	Bottles < 2 L
G14	Engine oil bottles & containers <50 cm	8	Engine oil bottles & containers <50 cm		
G15	Engine oil bottles & containers >50 cm	9	Engine oil bottles & containers> 50 cm		
G16	Jerry cans (square plastic containers with handle)	10	Jerry cans (square plastic containers with handle)	PL03	Bottles, drums, jerrycans & buckets > 2 L
G17	Injection gun containers	11	Injection gun containers	PL03	Bottles, drums, jerrycans & buckets > 2 L

Not found/not surveyed items: in the Member States' datasets, missing items are either 'not recorded' at all (i.e. only found items are reported) or identified with 'zero' or 'null' (i.e. empty cells) values. In the pan-European beach litter database, data have been saved as originally reported by the data provider. However, there is no clear indication of the meaning of and difference between zero, null and not recorded values. No protocol or further clarification guarantees that 'zero' means surveyed but not found. In fact, surveys could be carried out by going to the beach and looking for all types of litter, meaning there are no 'unsurveyed' items but only different ways of expressing what has/has not been observed. If a survey has all the values equal to 'null', the survey is recorded but with the column 'litter presence' equal to 'no'.

The inconsistencies due to the characteristics of different datasets ([19]) should be resolved and a decision on how to proceed in this regard should be taken.

2.3 European beach litter database

The pan-European beach litter database is a relational database with spatial features management, based on PostgresSQL and PostGIS. The data model has been designed to support the EMODnet Chemistry beach format, which allows the processing of datasets based on different protocols and reference systems. During the development phase of both the format and the database, the content of a variety of datasets in a range of formats was

([18]) A list of non-compatibilities of litter categories and further suggestions can be found in Annex 6 of this report.
([19]) A list of detailed hindrances by country can be found in Annex 7 of this report.

analysed. This was made in order to identify the key information and common aspects among the different methodologies with the objective of creating a database where the information is both classifiable and comparable.

The final structure of the database resembles the organisation of the EMODnet Chemistry beach litter template ([9]). The main table is 'surveys' and is linked to the parent table 'beaches'. These two tables contain the information necessary to identify the beach, the survey transect and the surveying conditions. Litter information is stored in the 'items' table, while information about any animals found is stored in the 'animals' table. The rest of the tables contain the metadata and supporting information about reference lists, interrelations between tables and import records. In total, the database comprises 37 tables (the number of tables per heading is indicated in brackets):

- Beaches (2): beach ID, beach name, position, country and other metadata (beach geography, major usage, cleaning details, etc.) (Figure 7).
- Surveys (5): beach, survey ID, date, position, surveyor and other metadata (town, food outlets, harbours, etc.) (Figure 8).
- Animals (1): survey ID, animal description and retrieve conditions (Figure 9).
- Items (1): survey ID, original name given, quantity, list or lists used, litter code (Figure 10).
- Reference lists (14): item description, codes, relationship between lists (Figure 11).
- Accessory vocabularies and lists (13): referenced in the EMODnet Chemistry beach litter format (Figure 12).
- Import log (1): record of data importation into the database (Figure 13).

Figure 7. Beaches tables in the pan-European beach litter database

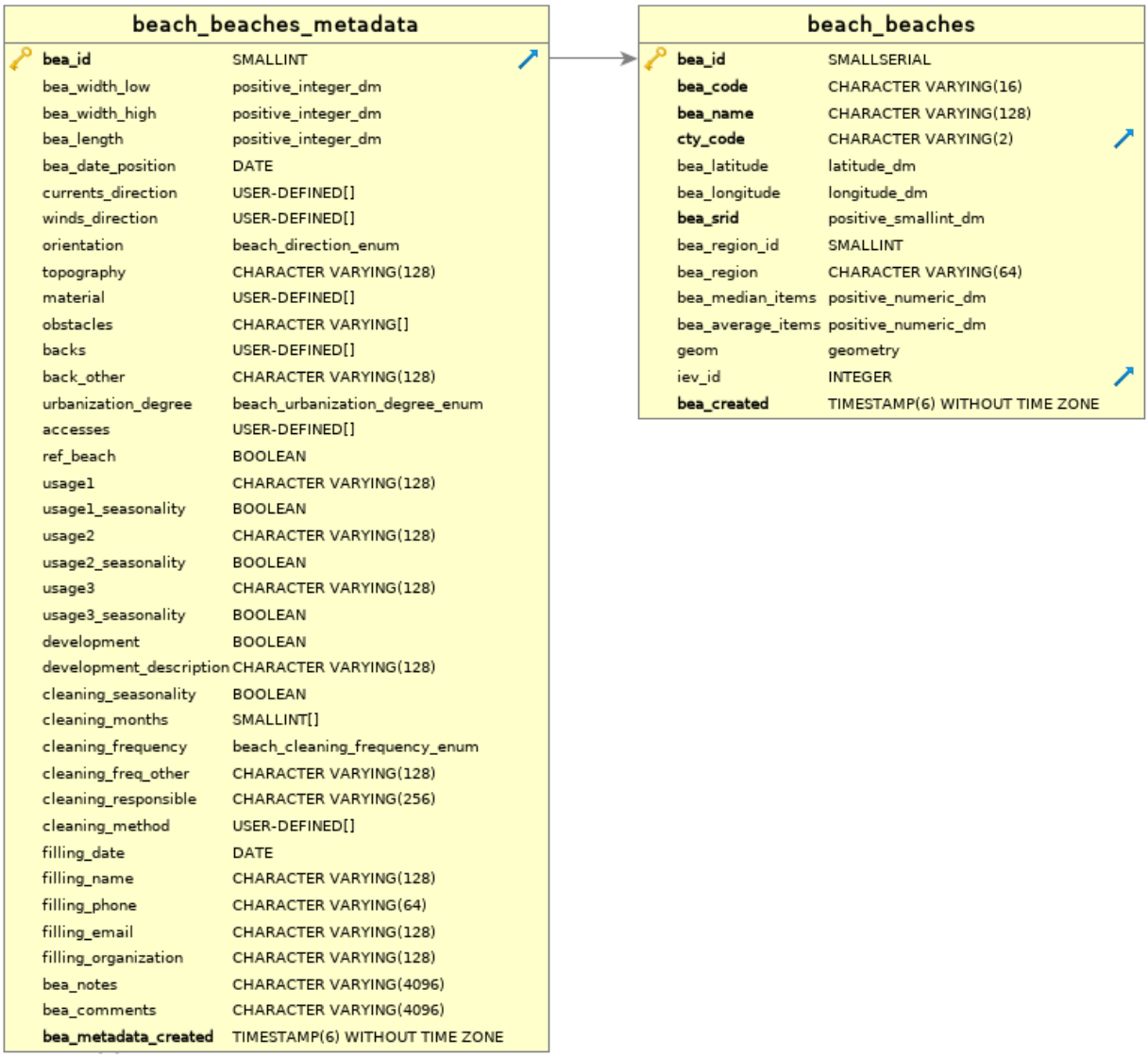


Figure 8. Survey tables in the pan-European beach litter database

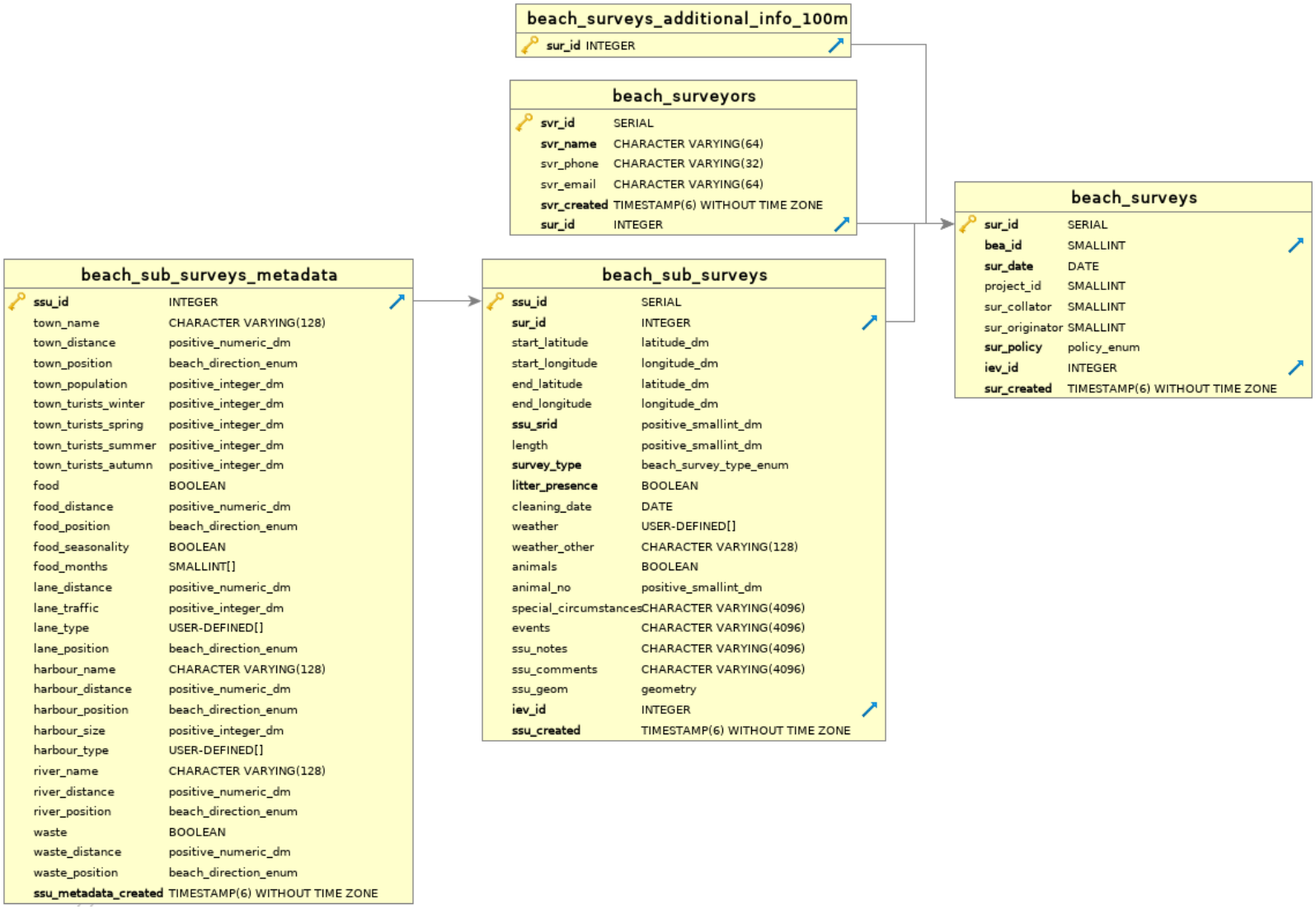


Figure 9. Animals table in the pan-European beach litter database

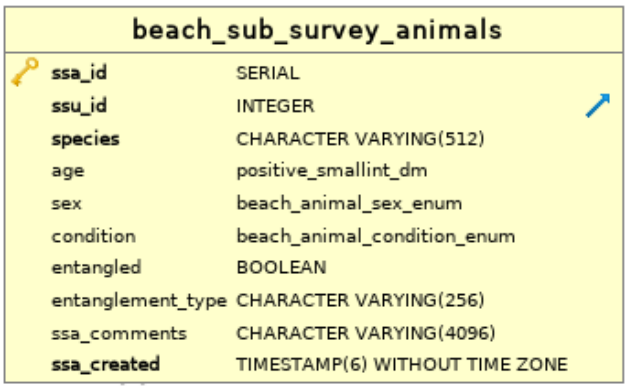


Figure 10. Item table

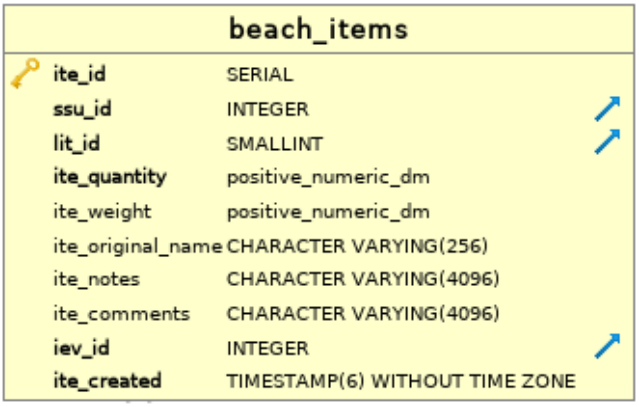


Figure 11. Reference lists tables in the pan-European beach litter database

Figure 12. Accessory vocabularies and lists tables in the pan-European beach litter database

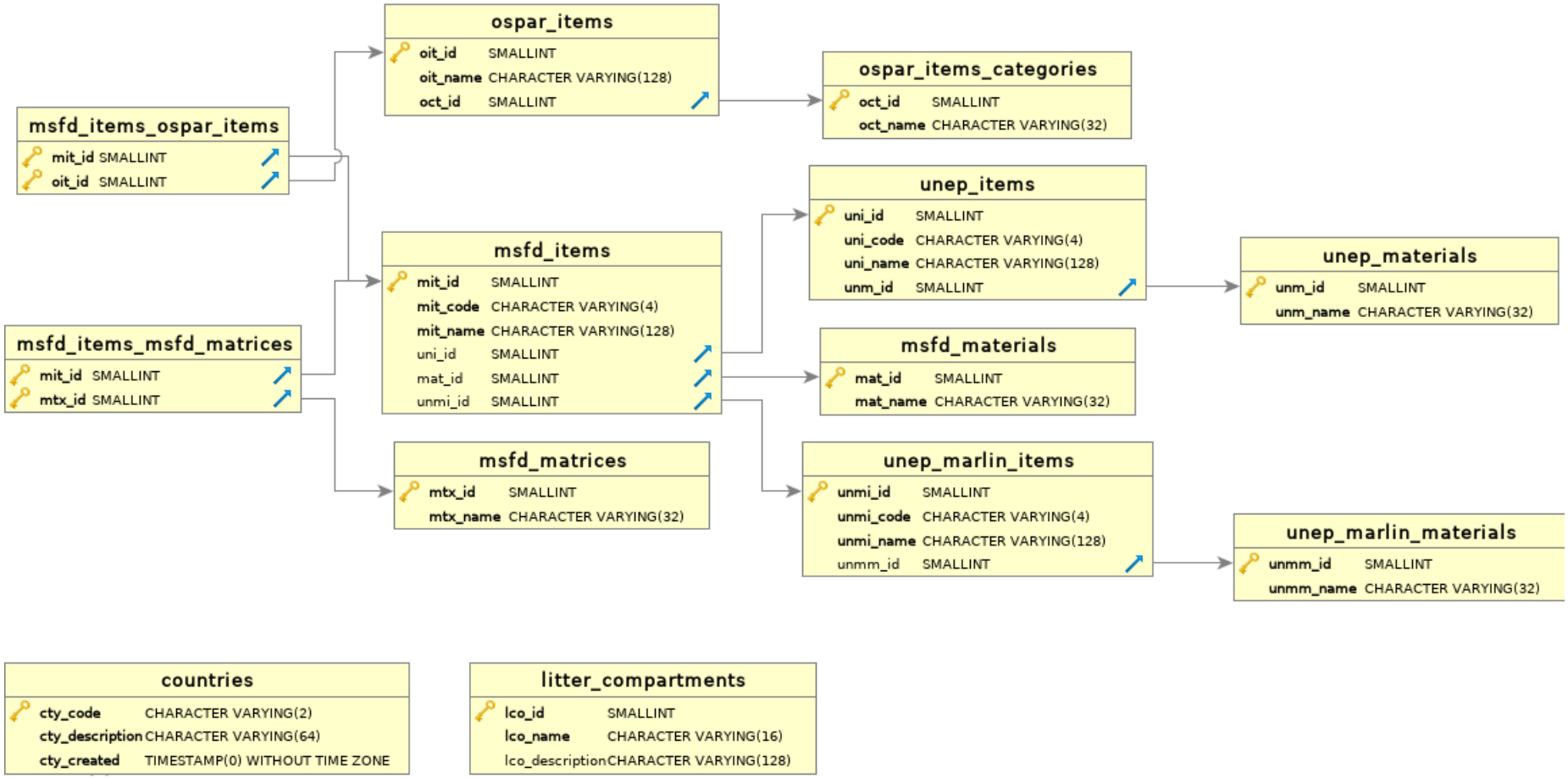
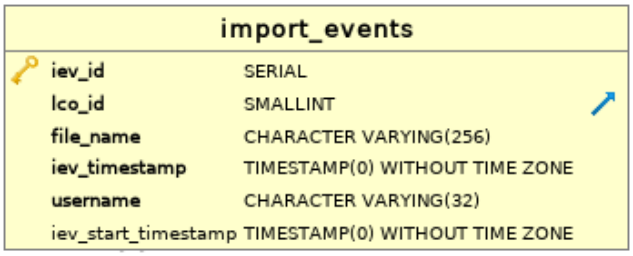


Figure 13. Import log table in the pan-European beach litter database



The aim of the database structure was to incorporate all the relevant and available datasets collected by Member States, to group all the information, to define what is available and the state of the art (protocols, standards, language used), to highlight gaps and hindrances, and to start, where possible, a comparison of the beach litter situation around all surveyed European beaches. Currently, 518 beaches and 4 772 surveys from 29 countries (including from a number of non-EU MSs) are included in the pan-European beach litter database.

The database was populated in several steps. A first group of datasets (from 15 countries) were collated by the JRC and then shared with EMODnet Chemistry for incorporation into the database. OSPAR data (from 13 countries) were directly downloaded by the available services and in contact with the Marine Conservation Society. Finally, another set of data (from six countries) was collected by the EMODnet Chemistry partners in direct contact with data originators.

Despite the main effort of gathering and compiling data being made to support the marine litter baseline process (i.e. the application of different scenarios on the dataset, the setting of baseline values as a reference for trend analysis), type and scale of the data are the important elements to consider in the baseline discussion. In particular, the data availability, quality, and accessibility, as well as temporal and spatial/geographical scale are the key drivers of the derived marine litter baseline.

While an international (i.e. Europe and beyond) database of marine litter, as outlined in this report, is a very useful resource to understand marine pollution in depth and tackle it, only a subset of the beach litter database that is approved by MSs will be used for deriving the baseline scenario testing at the European scale.

Not all of the beach litter data in the pan-European beach litter database have been acquired through MS-driven official monitoring activities: some have been acquired through other initiatives (e.g. 'citizen science' activities or clean-up events). As the definition of baselines is a process driven by MSs under the MSFD implementation procedure, an approved and fit for purpose database is essential for the baseline process. Therefore, a subset of the pan-European beach litter database should be created *ad hoc* for the marine litter baseline study. This should lead to an agreement within the TG Litter on the datasets that are needed to compose the baseline database and are to be used for the baseline scenario testing exercise.

3 Outlook and conclusion

This report aims to define the best possible data management strategy, based on the lessons learned from previous research, and to identify the most valuable methodology for delivering a proposal for a single database able to handle marine litter data from beaches both at the European scale and beyond (i.e. pan-European beach litter database) in order to support policy actions.

Available information and procedures for deriving the beach database show considerable lessons learned, challenges and hindrances (e.g. see Section 2). Nevertheless, the marine litter database reveals consistent and dynamic management of litter categories and types across Europe, providing valuable information that can be applied to other parameters of marine litter and enhances influence on data-driven decisions at different policy levels, in particular at EU level.

3.1 Contribution to further harmonisation

The creation of the pan-European database and data portal is an essential prerequisite for providing easy access to data and data products. In addition to setting the basis for other marine litter datasets, the database structure will directly influence the development of baselines, the setting of thresholds and the enhancement of monitoring guidance and litter category lists.

Indeed, the technicalities of data acquisition in terms of monitoring methods need to be further improved and harmonised in order to avoid the loss of existing data from any contributing country. The data collection process was rather challenging because of the different data sources (regional, NGOs, national, etc.), different survey approaches and different data formats. The outcomes of this report will be considered in the upcoming revision process of guidance on the monitoring of marine litter.

A further important point is the identification of items in the litter category list. The Master List needs to be further improved and reorganised, in a hierarchical and pragmatic structure, and single-use- and risk-based assessments should be included in the classification. The shortcomings faced in this report related to item classification have led to an improvement of the upcoming revision of the master list of categories of litter items (18[18]).

Finally, data availability, quality and accessibility, as well as the temporal and spatial scale are important elements that have to be considered in the baseline discussion. Only a long-term, large spatial scale, standard and harmonised data acquisition process can provide litter trend data that enable reasonable policy decisions for medium- and long-term strategies. The traceability of the data and quality control of the metadata will be key in the process for setting baseline and threshold values. The further work will then include the selection of items and item groups, spatial aggregation scales and types of scenarios, which are based on the final approved database of marine litter. An important note: while data collation is being finalised in a pan-European database of marine litter, including all the data available for beach litter, the selection of the sub-dataset that has to be used in the next baseline scenario analysis needs to be authorised by Member States.

3.2 Input to European policies

While data collection has been initiated in order to derive a Europe-wide comparable dataset for the establishing of baseline values in the context of the MSFD, the exercise also provides process-related information. The EU Plastics Strategy and related legislative tools depend on datasets for the identification of priority litter items and the verification of the successful implementation of measures. Policy depends on sound scientific information and on fit for purpose data that allow decisions to be made based on facts.

In close collaboration with the Regional Sea Conventions, such a data compilation exercise can provide a means for further harmonisation beyond Europe, as there is an obvious

interest in providing comparable litter data in shared marine basins. Many litter issues are cross-border, so datasets that allow the evaluation of long-range litter transport and of sources are needed. This links to EU activities in neighbourhood policy and to collaboration with associated and other neighbouring countries. In addition, EU activities on the global scale, e.g. supporting UN Sustainable Development Goal (SDG) 14, are related, as monitoring approaches and database structures can also be used on a larger spatial scale.

3.3 Conclusion

An extensive effort has been made in data gathering and compilation of beach litter data, because of the incompatibility of data formats. The main bottlenecks observed during the data aggregation were spatial-temporal heterogeneity, inconsistencies in the different litter identification lists, and variability in the survey protocols, data sources (e.g. regional, NGOs, national), etc. The key to overcoming all of these challenges and moving towards effective and confirmed marine litter reduction is close collaboration at different technical and policy levels, endorsing European standards at an interdisciplinary scale.

While harmonisation and comparability of results across Europe are needed for the implementation of the MSFD, and to support the EU Plastics Strategy and waste legislation, it should be noted that there is increasing interest in global comparability of monitoring results that will enable prioritisation at a larger scale.

A global partnership on marine litter has been launched to prevent and reduce marine litter in order to preserve human health and the marine ecosystem, and to mitigate the economic cost and impact of marine litter. An international action plan on marine litter has been recognised as an urgent need by the G7, the G20 and UN SDG 14, and a strong commitment to take action towards a resource-efficient life-cycle management approach to plastics has recently been signed ([2]).

The European Union is fully engaged in these international action plans against plastic litter, and the pan-European database outlined in this report has an active role in contributing to global efforts to tackle marine litter.

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Boxes

Figures

Tables

List of footnotes

([1]) Further information can be found on the website of the JRC MSFD Competence Centre: http://mcc.jrc.ec.europa.eu/dev.py?N=41&O=434&titre_chap=TG %20Marine %20Litter.

([2]) UNEP — Sustainable Development Goals SDG 14. See https://sustainabledevelopment.un.org/sdg14 and http://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/global-partnership-marine;
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G20, Germany 2017 — Marine Litter Action Plan. See https://www.g20germany.de/Content/DE/_Anlagen/G7_G20/2017-g20-marine-litter-en___blob=publicationFile&v=4.pdf

([3]) EU Plastic Strategy. See http://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
EU Waste Legislation. See http://ec.europa.eu/environment/waste/legislation/a.htm

([4]) See http://www.emodnet-chemistry.eu/data.

([5]) A common definition of baseline and scenario testing was agreed in the TG Litter Marine Litter Baselines workshop, 14-15 March 2017, Brussels (Belgium).

([6]) See further information at http://inspire.ec.europa.eu/data-specifications/2892

([7]) Guidance and template for gathering marine litter data have been developed in 2018 and are available in http://www.emodnet-chemistry.eu/documents/projectdocuments.

([8]) See further information at EMODnet Chemistry website, section DATA http://www.emodnet-chemistry.eu/data.

([9]) EMODnet Chemistry Beach litter format template is available in Annexes 1-4 of this report and online at the EMODnet Chemistry website, section DOCUMENTS http://www.emodnet-chemistry.eu/doi/documents/Guidelines-Litter_Data_EMODnetChemistry3_rev_20180731.pdf.

([10]) 'Ideally, the selected sites should represent litter abundance and composition for a given region. Not any given coastal site may be appropriate, as they may be limited in terms of accessibility, suitability to sampling (sand or rocks/boulders) and beach cleaning activities' *(*MSFD GES Technical Subgroup on Marine Litter, 2013)

([11]) See further information at https://www.seadatanet.org/ and https://www.bodc.ac.uk.

([12]) Important NB: The TG Litter Master List, published in 2013 as part of guidance for the monitoring of marine litter, is being further developed. Additional information is being gathered for the ongoing revision of the TG Litter Master List. A process for the inclusion of newly found items and thus the mechanism for updating of the TG Litter Master List also needs to be set up.

([13]) For example, beaches classified as rural, urban and peri-urban in the beach litter template refer to the following degrees of urbanisation: a) rural is a thinly populated area, a contiguous set of local areas belonging neither to a densely populated area nor to an intermediate area; b) urban is a densely populated area, a contiguous set of local areas, each of which has a population density > 500 inhabitants per square kilometre, where the total population for the set is at least 50 000 inhabitants; c) peri-urban is an intermediate area, a contiguous set of local areas, not belonging to a densely populated area, each of which has a population density > 100 inhabitants per square kilometre, and either with a total population for the set of at least 50 000 inhabitants or adjacent to a densely populated area. For further information, see European Commission (1999); McKenna et al. (2010).

([14]) See http://www.emodnet-chemistry.eu/lists/beach

([15]) NB: the numbers of beaches and surveys performed during 2017 are incomplete. Data gathering is still ongoing.

([16]) See note in Annex 6 of this report. Further information is available in https://www.hsr.se/sites/default/files/appendix1_measurement_method.pdf.

([17]) See https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/thematic-assessments/marine-litterwatch/get-started/how

([18]) A list of non-compatibilities of litter categories and further suggestions can be found in Annex 6 of this report.

([19]) A list of detailed hindrances by country can be found in Annex 7 of this report.

Annexes

Annex 1. EMODnet Chemistry Beach Format Template — Beach Metadata

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
General info	BeachCode	Code for the beach. In case you don't have a code, it has to be created with the country code and a number code (6 digits)	alphanumeric sequences + "/" (slash), "-" (hyphen) , "_" (underscore)	no	yes	character	FR0006
	BeachName	Name of the beach		no	yes	character	Sein
	Country	Identifier for the country that performed the survey from ISO countries reference code list	http://vocab.nerc.ac.uk/collection/C32/current/	no	yes	character	FR
	BeachInfoAmendment	Is this an amendment to an existing beach info questionnaire?	{yes, no}	no	yes	boolean	no
	FillingDate	Date when the questionnaire was filled in. Date format ISO 8601 (**YYYY-MM-DD**)		no	yes	date	41065
	FillingName	Name of the person who filled the questionnaire		no	no	character	Helen Smith
	FillingPhone	Phone number of the person who filled the questionnaire		no	no	character	331-705-960
	FillingMail	E-mail of the person who filled the questionnaire		no	no	character	h.smith@gmail.com
	FillingInstitute	Institution in charge of filling the questionnaire		no	no	character	Cedre
	UrbanizationDegree	Degree of urbanization of the beach area (Urban: Densely populated area, 500 inhabitants/km2 and total population at least 50,000 inhabitants. Periurban: Intermediate area,100 inhabitants/km2 and at least 50,000 inhabitants or adjacent to a densely-populated area. Rural: Thinly-populated area)	{Rural, Urban, Periurban}[1]	no	no	enum	Rural
	ReferenceBeach	Indicate if the beach is considered a sampling unit within any litter survey programme	{yes, no}	no	no	boolean	yes
Beach geography	BeachWidthLow	Beach width in **metres** at mean low spring tide		no	no	integer	450
	BeachWidthHigh	Beach width in **metres** at mean high spring tide		no	no	integer	10
	BeachLength	Total length of the beach in **metres**		no	no	integer	500
	BeachLatitude	Latitude of the beach position (**Degree.Decimal Degree of latitude**)	[-90.0, +90.0]	no	no	decimal	48.039
	BeachLongitude	Longitude of the beach position (**Degree.Decimal Degree of latitude**)	[-180.0, +180.0]	no	no	decimal	-4.85
	CoordinateSystem	Coordinate reference system used: if not differently specified WGS84 (EPSG:4326) reference system is assumed. Please specify the "Identifier"	http://vocab.nerc.ac.uk/collection/L10/current/	no	no	integer	4326
	BeachBack	Elements on the back of the beach	{Cliffs, Dunes, Rocks, Forest, Bush, Crops, Fields, BuiltupArea, Road, Other}[1]	yes	no	enum	Dunes
	BeachBackOther	If the back beach category cannot be selected from the dropdown list ("BeachBack" field) it should be listed here.		yes	no	character	Promenade
	BeachBackDevelopment	Is there any development behind the beach?	{yes, no}	no	no	boolean	No
	DevelopmentDescription	Description of the development behind the beach		no	no	character	
	PositionMeasurementDate	Date when the position of the beach was measured. Date format ISO 8601 (**YYYY-MM-DD**)		no	no	date	41974
	CurrentsDirection	Prevailing currents off the beach	{N, NE, E, SE, S, SW, W, NW}[1]	yes	no	enum	W
	WindsDirection	Prevailing winds	{N, NE, E, SE, S, SW, W, NW}[1]	yes	no	enum	SW
	BeachOrientation	In which direction the beach is facing when looking from the beach to the sea?	{N, NE, E, SE, S, SW, W, NW}[1]	no	no	enum	SW
	BeachMaterial	Define beach sediment as in EMODnet Geology five class sediment categorization (Modified from Folk Triangle)	{MudToSandyMud, Sand, CoarseSediment, MixedSediment, RockAndBoulders}[1]	no	no	character	CoarseSediment
	BeachTopography	Short description of the beach topography		no	no	character	slope 20%
	Obstacles	Objects in the sea that influence the currents		yes	no	character	pier; reef

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
Major usage and access	Usage1	Usage of the beach		no	no	character	Coastal walking
	Usage1Seasonality	Is the usage seasonal?	{yes, no}	no	no	boolean	yes
	Usage2	Usage of the beach		no	no	character	Wildlife watching
	Usage2Seasonality	Is the usage seasonal?	{yes, no}	no	no	boolean	no
	Usage3	Usage of the beach		no	no	character	
	Usage3Seasonality	Is the usage seasonal?	{yes, no}	no	no	boolean	
	BeachAccess	Possibilities of access to the beach	{Boat, Pedestrian, Vehicle}[1]	yes	no	enum	Vehicle; Pedestrian
Beach Cleaning	BeachCleaningSeasonality	Is the beach cleaning sesonal?	{yes, no}	no	no	boolean	no
	SeasonalityMonths	List the number of the months in which the cleaning is accomplished	[1,12]	yes	no	integer	2; 5; 8; 11
	CleaningFrequency	Indicate the frequency of beach cleaning	{Daily, Weekly, Monthly, Other}[1]	no	no	enum	Other
	OtherDescription	If frequency is “Other”, please describe it		no	no	character	4 times/year
	CleaningMethod	Used cleaning method	{Manual, Mechanical}[1]	no	no	enum	Manual
	CleaningResponsible	Responsible for cleaning		no	no	character	Natural marine Parc of Iroise - PNMI (Parc naturel marin d'Iroise) agents, also in charge of the OSPAR survey
Other	Notes	Additional comments and observations about the beach		no	no	character	

NB:

[1] The updated lists of admitted values are in http://www.emodnet-chemistry.eu/lists/beach

— If data type is **enum** the unique admitted values for the field are listed in the field ‘admitted values’

— If data type is **boolean** only yes or no is admitted

— When multiple values are admitted, use ‘;’ (semicolon) to separate the different values

— Decimal numbers must be expressed with ‘.’ (dot) to separate the integer part from de decimal part

Annex 2. EMODnet Chemistry Beach Format Template — Survey Metadata

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
General info	BeachCode	Code for the beach referring Beach_metadata sheet. In case you don't have a code, it has to be created with the country code and a number code (6 digits)	alphanumeric sequences + "/" (slash), "-" (hyphen) , "_" (underscore)	no	yes	character	FR0006
	SurveyCode	Number code that must be unique in the whole file		no	yes	integer	1
	SurveyType	Type of survey	{Cleaning, Monitoring}[2]	no	yes	enum	Monitoring
	SurveyDate	Date of the survey. Date format ISO 8601 (**YYYY-MM-DD**)		no	yes	date	2015-01-19
	Originator	EDMO code for data originator organization	http://seadatanet.maris2.nl/v_edmo/welcome.a	no	yes	integer	1887
	Collator	EDMO code for data collator organization	http://seadatanet.maris2.nl/v_edmo/welcome.a	no	yes	integer	2688
	ProjectCode	Project code from EDMERP (European Directory of Marine Environmental Research Projects)	http://seadatanet.maris2.nl/v_edmerp/browse.asp	no	no	integer	12038
	SurveyStartLatitude	Latitude of the survey starting point (**Degree.Decimal Degree of latitude**)	[-90.0, +90.0]	no	**yes**[1]	decimal	
	SurveyStartLongitude	Longitude of the survey starting point (**Degree.Decimal Degree of latitude**)	[-180.0, +180.0]	no	**yes**[1]	decimal	
	SurveyEndLatitude	Latitude of the survey ending point (**Degree.Decimal Degree of latitude**)	[-90.0, +90.0]	no	**yes**[1]	decimal	
	SurveyEndLongitude	Longitude of the survey ending point (**Degree.Decimal Degree of latitude**)	[-180.0, +180.0]	no	**yes**[1]	decimal	
	CoordinateSystem	Coordinate reference system used: if not differently specified WGS84 (EPSG:4326) reference system is assumed. Please specify the "Identifier"	http://vocab.nerc.ac.uk/collection/L10/current/	no	**yes**[1]	integer	4326
	SurveyLength	Length of the survey in **metres**		no	**yes**[1]	integer	100
	SurveyWidth	Width of the survey in **metres**		no	no	integer	10
	Surveyor1Name	Name of the surveyor 1		no	no	character	
	Surveyor1Phone	Phone number of the surveyor 1		no	no	character	
	Surveyor1Mail	E-mail of the surveyor 1		no	no	character	
	Surveyor2Name	Name of the surveyor 2		no	no	character	
	Surveyor2Phone	Phone number of the surveyor 2		no	no	character	
	Surveyor2Mail	E-mail of the surveyor 2		no	no	character	

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
Nearest town/development/outlets/line/harbour/river	TownName	Name of the nearest town		no	no	character	Sein
	TownDistance	Distance to the nearest town in **kilometres**		no	no	decimal	0.3
	TownPosition	Position of the town in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	SE
	TownPopulation	Residential population of the nearest town		no	no	integer	200
	WinterTourists	Number of tourists during winter		no	no	integer	
	SpringTourists	Number of tourists during spring		no	no	integer	150
	SummerTourists	Number of tourists during summer		no	no	integer	
	AutumnTourists	Number of tourists during autumn		no	no	integer	
	FoodOutlets	Are there food and/or drink outlets on the beach?	{yes, no}	no	no	boolean	no
	FoodOutletsDistance	Distance of the nearest food/drink outlet in **kilometres** in relation to survey area		no	no	decimal	0.05
	FoodOutletsSeasonality	Is the opening seasonal?	{yes, no}	no	no	boolean	yes
	SeasonalityMonths	List the number of the months in which the outlets are present	[1,12]	yes	no	integer	6;7;8
	FoodOutletsPosition	Position of the nearest food outlet in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	N
	ShippingLaneDistance	Distance from the beach to the nearest shipping lane in **kilometres**		no	no	decimal	30.0
	ShippingLaneTraffic	Estimated traffic of the shipping lane (number of ships/year)		no	no	integer	450
	ShippingLaneTypes	Type of ships that navigate along this lane	{Passengers, Merchant, Fishing, Military, Recreational, Other, AllKinds}[2]	yes	no	enum	Merchant; Passengers
	ShippingLanePosition	Position of the nearest shipping lane in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	E
	HarbourName	Name of the nearest harbour		no	no	character	
	HarbourDistance	Distance from the beach to the nearest harbour in **kilometres**		no	no	decimal	50.0
	HarbourPosition	Position of harbour in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	N
	HarbourType	Type of Harbour	{Passengers, Merchant, Fishing, Military, Recreational, Other, AllKinds}[2]	yes	no	enum	Fishing
	HarbourSize	Total number of ships		no	no	integer	100
	RiverName	Name of the nearest river		no	no	character	Le Goyen
	RiverDistance	Distance from the beach to the nearest river mouth in **kilometres**		no	no	decimal	30.0
	RiverPosition	Position of river mouth in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	E
	WasteWaterDischarges	Is the beach located near waste water discharges?	{yes, no}	no	no	boolean	no
	WasteWaterDistance	Distance from the beach to the nearest discharge point in **kilometres**		no	no	decimal	3.0
	WasteWaterPosition	Position of the nearest discharge point in relation to survey area	{N, NE, E, SE, S, SW, W, NW}[2]	no	no	enum	N

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
Additional Info	LitterPresence	Was litter collected during this survey?	{yes, no}	no	no	boolean	yes
	LastCleaning	When was the beach last cleaned. Date format ISO 8601 (**YYYY-MM-DD**)		no	no	date	41963
	WeatherConditions	Did any weather conditions affect the data of the surveys?	{Wind, Rain, Snow, Ice, Fog, SandStorm, ExceptionallyHighTide, Other}[2]	yes	no	enum	Rain
	WeatherConditionsOther	If any other weather conditions affected the survey, describe it		yes	no	character	
	AnimalsFound	Did you find stranded or dead animals?	{yes, no}	no	no	boolean	yes
	AnimalsNumber	If so, how many		no	no	integer	2
	SurveyCircumstances	Any circumstances influencing the survey (e.g. tracks on the beach…)		no	no	character	
	SpecialEvents	Events that lead to unusual types and/or amounts of litter on the beach		no	no	character	New Year Eve party
	Notes	Additional comments and observations about the survey		no	no	character	

NB:
[1] Either survey coordinates or survey length must be filled
[2] The updated lists of admitted values are available in http://www.emodnet-chemistry.eu/lists/beach

Annex 3. EMODnet Chemistry Beach Format Template — Litter Data

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
	SurveyCode	Number code referring Survey_metadata sheet that must be unique in the whole file		no	yes	integer	1
	LitterReferenceList	Name of the Litter reference list used. It is strongly recommended the use of TSG_MLGeneral_code	{UNEP, OSPAR, C_TS_REV, RECO_LT, TSG_ML, UNEP_MARLIN, OSPAR_1000}[1]	no	yes	enum	TSG_ML
	ItemCode	Litter parameter code of the Litter Reference list used	Codes from the used list	no	yes	character	G1
	ItemName	Litter parameter name of the Litter Reference list used	Names for the list used	no	no	character	4/6-pack yokes, six-pack rings
	ParameterOriginalName	Litter parameter name as reported by the surveyor (can be also in national original language)		no	no	character	4/6-pack yokes
	NoItems	Number of items;for “other Pollutants” frequency (estimated number/m); for Pellets (Y/N)		no	yes	integer/decimal/boolea	4
	Notes	Special observations		no	no	character	

NB:
[1] The updated lists of admitted values are available in http://www.emodnet-chemistry.eu/lists/beach

Annex 4. EMODnet Chemistry Beach Format Template — Animals

	Field	Description	Admitted values	Multiple values	Mandatory	Data type	Example
	SurveyCode	Number code referring Survey_metadata sheet that must be unique in the whole file		no	yes	integer	1
	Animal	Please describe the animal, or note the species name if known		no	yes	character	seagull
	State	Is it alive or dead?	{Alive, Dead}[1]	no	no	enum	Dead
	Sex	Please specify sex of the animal if known	{Female, Male}[1]	no	no	enum	Female
	Age	Please specify the age of the animal if known		no	no	integer	
	Entanglement	Is the animal entangled in litter?	{yes, no}	no	no	boolean	no
	EntanglementNature	If so please describe nature of the entanglement and type of litter		no	no	character	

NB:
[1] The updated lists of admitted values are available in http://www.emodnet-chemistry.eu/lists/beach

Annex 5. Number of beaches and surveys for each country and year.

Country	Year	Beaches	Surveys	Country	Year	Beaches	Surveys
Belgium	2001	2	4	France	2012	10	40
Belgium	2002	2	8	France	2013	11	40
Belgium	2003	2	8	France	2014	10	33
Belgium	2004	2	8	France	2015	11	35
Belgium	2005	2	6	France	2016	15	62
Belgium	2006	2	5	Georgia	2015	2	2
Belgium	2012	2	5	Georgia[1]	2016	1	1
Belgium	2013	2	7	Germany	2002	5	15
Belgium	2014	2	7	Germany	2003	5	14
Belgium	2015	2	9	Germany	2004	4	10
Belgium	2016	2	8	Germany	2005	4	16
Bulgaria	2015	8	24	Germany	2006	4	15
Bulgaria	2016	8	8	Germany	2007	4	5
Croatia	2014	4	4	Germany	2008	4	13
Croatia	2015	4	12	Germany	2009	4	14
Cyprus	2014	6	6	Germany	2010	4	15
Cyprus	2015	7	8	Germany	2011	4	15
Cyprus	2016	13	15	Germany	2012	14	48
Denmark	2001	1	1	Germany	2013	27	95
Denmark	2002	1	2	Germany	2014	30	115
Denmark	2003	2	3	Germany	2015	27	103
Denmark	2004	1	2	Germany	2016	26	96
Denmark	2005	1	4	Germany	2017	15	15
Denmark	2006	1	4	Greece	2014	6	6
Denmark	2011	1	2	Greece	2015	6	9
Denmark	2012	1	1	Greece	2016	6	6
Denmark	2013	1	2	Iceland	2016	5	7
Denmark	2014	1	2	Ireland	2008	4	8
Denmark	2015	5	15	Ireland	2009	4	4
Denmark	2016	5	16	Ireland	2011	4	12
Denmark (Greenland)	2016	16	24	Ireland	2012	3	3
Estonia	2012	6	18	Ireland	2013	4	16
Estonia	2013	6	18	Ireland	2014	4	16
Estonia	2014	10	30	Ireland	2015	4	16
Estonia	2015	10	30	Ireland	2016	4	16
Estonia	2016	10	10	Italy	2014	19	19
Faroe Islands	2002	1	2	Italy	2015	28	28
Faroe Islands	2005	1	1	Italy	2016	51	51
Faroe Islands	2006	1	1	Italy	2017	64	64
Finland	2012	8	22	Latvia	2012	35	35
Finland	2013	8	24	Latvia	2013	38	38
Finland	2014	9	26	Latvia	2014	38	38
Finland	2015	11	29	Latvia	2015	38	38
Finland	2016	11	27	Latvia	2016	38	38
Finland	2017	13	30	Lithuania	2012	4	16
France	2006	4	10	Lithuania	2013	4	16
France	2010	5	14	Montenegro[1]	2014	2	2
France	2011	9	34	Montenegro[1]	2015	2	6

Country	Year	Beaches	Surveys	Country	Year	Beaches	Surveys
Netherlands	2001	4	5	Spain	2002	2	8
Netherlands	2002	4	30	Spain	2003	2	8
Netherlands	2003	4	10	Spain	2004	3	10
Netherlands	2004	4	24	Spain	2005	3	10
Netherlands	2005	4	22	Spain	2006	2	8
Netherlands	2006	4	16	Spain	2007	4	8
Netherlands	2007	4	16	Spain	2008	6	24
Netherlands	2008	4	16	Spain	2009	6	23
Netherlands	2009	4	22	Spain	2010	6	24
Netherlands	2010	4	27	Spain	2011	6	24
Netherlands	2011	4	33	Spain	2012	2	5
Netherlands	2012	4	23	Spain	2013	25	104
Netherlands	2013	4	16	Spain	2014	26	107
Netherlands	2014	4	16	Spain	2015	26	96
Netherlands	2015	4	21	Spain	2016	26	100
Netherlands	2016	4	15	Sweden	2001	5	14
Norway[1]	2011	5	6	Sweden	2002	6	14
Norway[1]	2012	6	9	Sweden	2003	6	17
Norway[1]	2013	5	7	Sweden	2004	5	11
Norway[1]	2014	5	10	Sweden	2005	6	18
Norway[1]	2015	6	8	Sweden	2006	6	12
Norway[1]	2016	6	9	Sweden	2008	3	5
Poland	2015	15	47	Sweden	2009	3	5
Poland	2016	15	64	Sweden	2010	3	7
Poland	2017	9	9	Sweden	2011	6	14
Portugal	2002	5	8	Sweden	2012	14	42
Portugal	2003	6	12	Sweden	2013	14	42
Portugal	2004	5	11	Sweden	2014	16	40
Portugal	2005	7	22	Sweden	2015	16	45
Portugal	2006	7	13	Sweden	2016	16	47
Portugal	2011	1	1	Ukraine[1]	2017	1	1
Portugal	2013	10	29	United Kingdom	2001	17	44
Portugal	2014	9	38	United Kingdom	2002	19	51
Portugal	2015	9	34	United Kingdom	2003	18	37
Portugal	2016	9	37	United Kingdom	2004	20	57
Romania	2015	3	7	United Kingdom	2005	21	59
Romania	2016	1	2	United Kingdom	2006	19	66
Russian Federation[1]	2016	3	3	United Kingdom	2007	20	68
Russian Federation[1]	2017	2	2	United Kingdom	2008	16	36
Slovenia	2007	3	19	United Kingdom	2009	20	73
Slovenia	2010	3	6	United Kingdom	2010	19	62
Slovenia	2011	3	28	United Kingdom	2011	19	64
Slovenia	2012	5	32	United Kingdom	2012	29	68
Slovenia	2013	5	29	United Kingdom	2013	31	140
Slovenia	2014	3	3	United Kingdom	2014	31	157
Slovenia	2015	3	15	United Kingdom	2015	22	64
Spain	2001	2	4	United Kingdom	2016	31	116

NB:
[1] No European MS
Number of beaches and surveys performed during 2017 are incomplete. Data gathering is still on going. Data in the table at the date 13-08-2018.

Annex 6. List of non-compatibilities of litter categories and further suggestions.

TG Litter Master List is a complete and useful reference document to convert from one coding to another. Taking the opportunity of the ongoing revision of the Master List, the mapping between the different lists could be improved. Here is the list of suggestions (general and specific comments) for the revision of the Master List from the JRC-EMODnet Chemistry experience gained during the first year of marine litter data management.

General comments:

- There is not always a 1:1 correspondence between lists terms and this brings uncertainty in the conversion from one list to another (e.g. UNEP-PL09 Gloves vs. TG Litter-G39/G40 Gloves & Gloves washing up) and sometimes are mixed categories (e.g. UNEP-RB03 Rubber Gloves vs. TG Litter-G41 Artificial polymer materials) (Fig. A1).
- A unique Master List for all ML, should include all available lists (i.e. MEDITS, ICES etc.). TG Litter general name should be more comprehensive item description and include the item description present in other lists.
- Indication about whether item is a single use item should be considered as an extra column to add in the TG Litter Master List.
- Review the management of the information of litter items in a more useful order (e.g. by alphabetic? by function?) AND/OR flexible way with a set of hierarchic categories. The Master List manages at the same 'level' items categories with others that might be considered subcategories (e.g. TG Litter-G2 Bags/-G3 Shopping Bag) (Fig. A2). For further details, see paragraph *Specific comments.*
- Master List uses coarse microlitter categories that merges the material, type and size of the items. (e.g. TG Litter-G103-G111 Plastic fragments and pellets < 5 mm). A more flexible approach could be used following the example of guidelines for microlitter data management developed in the Chemistry project (Fig. A3).

TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials
G39		PL09	Gloves	Artificial polymer materials
G40	25	PL09	Gloves (washing up)	Artificial polymer materials
G41	113	RB03	Gloves (industrial/professional rubber gloves)	Artificial polymer materials

Figure A1. Example of no 1:1 correspondence among lists of categories of litter items.

OSPAR- Code	UNEP- Code	Level 1 - Materials	level 2	level 3	level 4	level 5
4	PL02	Artificial polymer materials	packaging	Bottles & containers	Drink bottles	Drink bottles <=0.5l
4	PL02	Artificial polymer materials	packaging	Bottles & containers	Drink bottles	Drink bottles >0.5l
5	PL02	Artificial polymer materials	packaging	Bottles & containers	Cleaner bottles & containers	
6	PL06	Artificial polymer materials	packaging	Bottles & containers	Food containers incl. fast food containers	
7	PL02	Artificial polymer materials	packaging	Bottles & containers	cosmetics bottles & containers	Beach use related cosmetic bottles and containers, *e.g.* Sunblocks
7	PL02	Artificial polymer materials	packaging	Bottles & containers	cosmetics bottles & containers	Other cosmetics bottles & containers
12	PL02	Artificial polymer materials	packaging	Bottles & containers	Other bottles & containers (drums)	
8		Artificial polymer materials	packaging	Bottles & containers	Engine oil bottles & containers <50 cm	
9	PL03	Artificial polymer materials	packaging	Bottles & containers	Engine oil bottles & containers >50 cm	
10	PL03	Artificial polymer materials	packaging	Bottles & containers	Jerry cans (square plastic containers with handle)	
11		Artificial polymer materials	packaging	Bottles & containers	Injection gun containers	

Figure A2. Example of hierarchical structure, suggested for the Master List of categories of litter items.

TSG_ML General-Code	UNEP- Code	Level 1 – litter types	Level 2- shapes	Level 3 -Sizes	Level 4 -Colors	Level 5 -Polymer types	N. of items (count)
		microplastic items	rounded	1 to 2 millimitres	BLACK/GREY	polyethylene	15
	PL23	microplastic pellets	cylindrical	2 to 5 millimetres	WHITE/CREAM	polystyrene	10
		microplastic fragments	rounded	1 to 5 millimetres			9

Figure A3. Example of hierarchical structure, suggested for categories of microlitter items.

NB:

- EMODnet Chemistry Guidance for microlitre: http://nodc.ogs.trieste.it/doi/documents/Proposal-EMODnet-TG-ML-Micro-Litter-Data-Gathering-20180221.pdf (from page 24-27.
- Level 1-Litter types: http://seadatanet.maris2.nl/v_bodc_vocab_v2/browse.asp?order=conceptid&formname=search&screen=0&lib=h01&v0_0=&v1_0=conceptid %2Cpreflabel %2Caltlabel %2Cdefinition %2Cmodified&v2_0=0&v0_1=&v1_1=conceptid&v2_1=3&v0_
- Level 2-Shapes: http://seadatanet.maris2.nl/v_bodc_vocab_v2/browse.asp?order=conceptid&formname=search&screen=0&lib=h02&v0_0=&v1_0=conceptid %2Cpreflabel %2Caltlabel %2Cdefinition %2Cmodified&v2_0=0&v0_1=&v1_1=conceptid&v2_1=3&v0_2=&v1_2=preflabel&v2_2=3&v0_3=&v1_3=altlabel&v2_3=3&v0_4=&v1_4=modified&v2_4=9&v0_5=&v1_5=modified&v2_5=10&x=8&y=22&v1_6=&v2_6=&v1_7=&v2_7=
- Level 3-Sizes: http://seadatanet.maris2.nl/v_bodc_vocab_v2/browse.asp?order=conceptid&formname=search&screen=0&lib=h03&v0_0=&v1_0=conceptid %2Cpreflabel %2Caltlabel %2Cdefinition %2Cmodified&v2_0=0&v0_1=&v1_1=conceptid&v2_1=3&v0_2=&v1_2=preflabel&v2_2=3&v0_3=&v1_3=altlabel&v2_3=3&v0_4=&v1_4=modified&v2_4=9&v0_5=&v1_5=modified&v2_5=10&x=31&y=25&v1_6=&v2_6=&v1_7=&v2_7=
- Level 4-Colours: http://seadatanet.maris2.nl/v_bodc_vocab_v2/browse.asp?order=conceptid&formname=search&screen=0&lib=h04&v0_0=&v1_0=conceptid %2Cpreflabel %2Caltlabel %2Cdefinition %2Cmodified&v2_0=0&v0_1=&v1_1=conceptid&v2_1=3&v0_2=&v1_2=preflabel&v2_2=3&v0_3=&v1_3=altlabel&v2_3=3&v0_4=&v1_4=modified&v2_4=9&v0_5=&v1_5=modified&v2_5=10&x=57&y=13&v1_6=&v2_6=&v1_7=&v2_7=
- Level 5-Polymer types: http://seadatanet.maris2.nl/v_bodc_vocab_v2/browse.asp?order=conceptid&formname=search&screen=0&lib=h05&v0_0=&v1_0=conceptid %2Cpreflabel %2Caltlabel %2Cdefinition %2Cmodified&v2_0=0&v0_1=&v1_1=conceptid&v2_1=3&v0_2=&v1_2=preflabel&v2_2=3&v0_3=&v1_3=altlabel&v2_3=3&v0_4=&v1_4=modified&v2_4=9&v0_5=&v1_5=modified&v2_5=10&x=53&y=20&v1_6=&v2_6=&v1_7=&v2_7=

Specific comments:

Master List of Categories of Litter Item										NOTES from JRC-EMODnet Chemistry
TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials	Core	Beach	Seafloor	Floating	Biota	It could be helpful to avoid these different ML compartements (i.e Beach, Seafloor, Floating, Biota, Core), and merges all compartments in one (e.g. Macro Litter). EXCEPT FOR Microlitter: it could be useful to have a specific dedicated list or column in the Masterlist.
G2		PL07	Bags	Artificial polymer materials	x		x	x		Should be considered CATEGORY
G3	2	PL07	Shopping Bags incl. pieces	Artificial polymer materials		x				Should be considered SUBCATEGORY of G2
G4	3	PL07	Small plastic bags, *e.g.* freezer bags incl. pieces	Artificial polymer materials		x				
G5	112		Plastic bag collective role; what remains from rip-off plastic bags	Artificial polymer materials		x				
G36	23		Fertiliser/animal feed bags	Artificial polymer materials		x				
G37	24	PL15	Mesh vegetable bags	Artificial polymer materials		x				
G101	121		Dog faeces bag	Artificial polymer materials	x	x				
G6	4	PL02	Bottles	Artificial polymer materials	x		x	x		Should be considered CATEGORY
G7	4	PL02	Drink bottles <=0.5l	Artificial polymer materials		x				Should be considered SUBCATEGORY of G6
G8	4	PL02	Drink bottles >0.5l	Artificial polymer materials		x				
G13	12	PL02	Other bottles & containers (drums)	Artificial polymer materials	x	x				Should be considered as one CATEGORY with G18 (G13+G18)
G18	13	PL13	Crates and containers / baskets	Artificial polymer materials		x	x	x		

Master List of Categories of Litter Item										NOTES from JRC-EMODnet Chemistry
TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials	Core	Beach	Seafloor	Floating	Biota	
G9	5	PL02	Cleaner bottles & containers	Artificial polymer materials	x	x				Should be considered SUBCATEGORY of G13+G18
G10	6	PL06	Food containers incl. fast food containers	Artificial polymer materials	x	x	x			
G11	7	PL02	Beach use related cosmetic bottles and containers, *e.g.* Sunblocks	Artificial polymer materials		x				
G12	7	PL02	Other cosmetics bottles & containers	Artificial polymer materials	x	x				
G14	8		Engine oil bottles & containers <50 cm	Artificial polymer materials		x				
G15	9	PL03	Engine oil bottles & containers >50 cm	Artificial polymer materials		x				
G16	10	PL03	Jerry cans (square plastic containers with handle)	Artificial polymer materials		x				
G17	11		Injection gun containers	Artificial polymer materials		x				
G100	103		Medical/Pharmaceuticals containers/tubes	Artificial polymer materials		x				
G20		PL01	Plastic caps and lids	Artificial polymer materials			x			Should be considered CATEGORY
G21	15	PL01	Plastic caps/lids drinks	Artificial polymer materials		x				Should be considered SUBCATEGORY of G20 with better definition otherwise deleted
G22	15	PL01	Plastic caps/lids chemicals, detergents (non-food)	Artificial polymer materials	x	x				
G23	15	PL01	Plastic caps/lids unidentified	Artificial polymer materials		x				
G24	15	PL01	Plastic rings from bottle caps/lids	Artificial polymer materials		x				

Master List of Categories of Litter Item										NOTES from JRC-EMODnet Chemistry
TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials	Core	Beach	Seafloor	Floating	Biota	
G30	19		Crisps packets/sweets wrappers	Artificial polymer materials		x				it is difficult to consider them different categories if other lists merged them in a unique code
G31	19		Lolly sticks	Artificial polymer materials		x				
G34	22	PL04	Cutlery and trays	Artificial polymer materials		x				it is difficult to consider them different categories if other lists merged them in a unique code
G35	22	PL04	Straws and stirrers	Artificial polymer materials		x				
G38			Cover / packaging	Artificial polymer materials				x		Should be considered CATEGORY
G67	40	PL16	Sheets, industrial packaging, plastic sheeting	Artificial polymer materials		x	x	x		Should be considered SUBCATEGORY of G38
G39		PL09	Gloves	Artificial polymer materials			x	x		Should be considered CATEGORY and it should include also rubber gloves
G40	25	PL09	Gloves (washing up)	Artificial polymer materials	x	x				Should be considered SUBCATEGORY of G39
G41	113	RB03	Gloves (industrial/professional rubber gloves)	Artificial polymer materials	x	x				
G48			Synthetic rope	Artificial polymer materials			x	x		Should be considered CATEGORY
G49	31	PL19	Rope (diameter more than 1cm)	Artificial polymer materials	x	x				Should be considered SUBCATEGORY of G48
G50	32	PL19	String and cord (diameter less than 1cm)	Artificial polymer materials	x	x				
G52		PL20	Nets and pieces of net	Artificial polymer materials	x	x				Should be considered CATEGORY
G51		PL20	Fishing net	Artificial polymer materials			x	x		Should be considered SUBCATEGORY of G52
G45	28	PL15	Mussels nets, Oyster nets	Artificial polymer materials		x				
G53	115	PL20	Nets and pieces of net < 50 cm	Artificial polymer materials		x				
G54	116	PL20	Nets and pieces of net > 50 cm	Artificial polymer materials		x				
G62	37	PL14	Floats for fishing nets	Artificial polymer materials	x	x				
G56	33	PL20	Tangled nets/cord	Artificial polymer materials		x				Should be separated and considered SUBCATEGORY of G52 and G48

Master List of Categories of Litter Item										NOTES from JRC-EMODnet Chemistry
TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials	Core	Beach	Seafloor	Floating	Biota	
G55		PL18	Fishing line (entangled)	Artificial polymer materials			x			Should be considered CATEGORY
G59	35	PL18	Fishing line/monofilament (angling)	Artificial polymer materials	x	x	x			Should be considered SUBCATEGORY of G55
G57	34	PL17	Fish boxes - plastic	Artificial polymer materials		x		x		Is there any real difference between plastic and expanded polystyrene categories? Should be considered to merged them in one category
G58	34	PL17	Fish boxes - expanded polystyrene	Artificial polymer materials		x		x		
G63	37	PL14	Buoys	Artificial polymer materials		x		x		Should be considered CATEGORY
G73	45	FP01	Foam sponge	Artificial polymer materials		x				Should be considered CATEGORY
G74			Foam packaging/insulation/polyurethane	Artificial polymer materials				x		Should be considered SUBCATEGORY of G73
G112		PL23	Industrial pellets	Artificial polymer materials	x				x	Should be considered CATEGORY
G107			cylindrical pellets <5mm	Artificial polymer materials						Should be considered SUBCATEGORY of G112 OR reconsider to avoid coarse microlitter categories that merges the material, type and size of the items.
G108			disks pellets <5mm	Artificial polymer materials						
G109			flat pellets <5mm	Artificial polymer materials						
G110			ovoid pellets <5mm	Artificial polymer materials						
G111			spheruloids pellets <5mm	Artificial polymer materials						
G123			Polyurethane granules <5mm	Artificial polymer materials				x		
G103			Plastic fragments rounded <5mm	Artificial polymer materials						
G104			Plastic fragments subrounded <5mm	Artificial polymer materials						
G105			Plastic fragments subangular <5mm	Artificial polymer materials						
G106			Plastic fragments angular <5mm	Artificial polymer materials						

Master List of Categories of Litter Item										NOTES from JRC-EMODnet Chemistry
TSG_ML General-Code	OSPAR- Code	UNEP- Code	General Name	Level 1 - Materials	Core	Beach	Seafloor	Floating	Biota	
G122			Plastic fragments (>1mm)	Artificial polymer materials					x	Should be considered CATEGORY + reconsider the range size
G75	117		Plastic/polystyrene pieces 0 - 2.5 cm	Artificial polymer materials		x				Should be considered SUBCATEGORY of G122 + reconsider minimun size (e.g. value=zero?)
G78			Plastic pieces 0 - 2.5 cm	Artificial polymer materials		x				Should be deleted because equal to G75 and should be considered SUBCATEGORY of G122
G81			Polystyrene pieces 0 - 2.5 cm	Artificial polymer materials		x				
G76	46		Plastic/polystyrene pieces 2.5 cm > < 50cm	Artificial polymer materials		x				Should be considered SUBCATEGORY of G123
G79			Plastic pieces 2.5 cm > < 50cm	Artificial polymer materials		x		x		Should be deleted because equal to G76 and should be considered SUBCATEGORY of G123
G82			Polystyrene pieces 2.5 cm > < 50cm	Artificial polymer materials		x		x		
G77	47		Plastic/polystyrene pieces > 50 cm	Artificial polymer materials		x				Should be considered SUBCATEGORY of G124
G80			Plastic pieces > 50 cm	Artificial polymer materials		x		x		Should be deleted because equal to G77and should be considered SUBCATEGORY of G124
G83			Polystyrene pieces > 50 cm	Artificial polymer materials		x		x		
G135		CL01	Clothing (clothes, shoes)	Cloth/textile				x		Should be considered CATEGORY excluded shoes
G136		CL01	Shoes	Cloth/textile			x			Should be considered CATEGORY
G137	54	CL01	Clothing / rags (clothing, hats, towels)	Cloth/textile	x	x	x			should be redefined
G138	57	CL01	Shoes and sandals (*e.g.* Leather, cloth)	Cloth/textile		x				should be redefined
G145	59	CL06	Other textiles (incl. rags)	Cloth/textile		x	x	x		should be redefined
G146			Paper/Cardboard	Paper/Cardboard			x			Should be deleted
G157			Paper	Paper/Cardboard					x	should be redefined or deleted

Annex 7. Specific hindrances by country*.

Dataset	Country	Data originator	Data collator	Hindrances
OSPAR	Belgium, Denmark, France, Germany, Ireland, Netherlands, Portugal, Sweden, United Kingdom	MISSING Except for - Portugal: Direcção Genral do Ambiente (Ministry of Environment) - Denmark_Atlantic: KIMO Danmark	EMODnet	• Complete set of metadata. OSPAR coding was used. Flat text format for metadata fields is not always easy to adapt to DB structure, though almost all metadata were ingested into the DB. • Survey length of 1km and 100m have been included in the DB. Survey width is variable:transect width follow OSPAR Guidance. the beach width and for most of the beach is total from low tide line to the background of the beach dunes or cliffs.
Bulgaria	Bulgaria	Black Sea Basin Directorate – Varna	JRC	• Dataset only contained basic metadata but everything was clear. TGML coding was used, including OSPAR and UNEP/MAP coding. However, some additional UNEP codes were missing and have been inserted by JRC-EMODnet. Multiple TGML code assigned cannot be considered in the data entering, thus TGML general code for general material/item has been used e.g. G2 Plastic bag and detailed note has been added in the dataset. • Survey length: 1000 m were reported on the original dataset, additionally explained with "data is collected from 2 or 3 sections and assessed for all of them". Following MSFD protocol it was considered a survey length of 300 m (3 sections x 100 m). This point has already been clarified with MS contact.
Croatia	Croatia	IOF, Institute of Oceanography and Fisheries	JRC	• Complete dataset with extended metadata. OSPAR template was used to perform the surveys but TGML coding was used. • Beach width registered as both low and high tide, but has been indicated only coordinates start/end for transect 100m length x 10m width. These coordinates have been included in the marine litter dataset.
Cyprus	Cyprus	Isotech Ltd	JRC	• This dataset did not come from an official Member State body but from a private monitoring company (Isotech Ltd). • Very incomplete dataset with some important missing information as survey length or the use of a standard reference list to describe the items. • Survey length is provisionally "0" where it was missing in order to ingest data into DB. • There was a lack of item codes. UNEP litter reference list codes were derived from item names found in the original file. This has been done in order to be able to code items and enter them in the DB.
Denmark_Baltic	Denmark_Baltic	Danish Environmental Protection Agency. Aarhus University, DCE (Danish Centre for Environment and Energy)	JRC	• Dataset only contained basic metadata but everything was clear. TGML coding was used.
Estonia	Estonia	Keep the Estonian Sea Tidy Association	JRC	• Dataset was initially sent without survey coordinates and survey length. After further contacts with data originator this information was provided. No survey width was provided. • UNEP-MARLIN[1] protocol and coding was used to perform the survey. According to the protocol, three different measurement areas were provided. The same type of item has been counted over a 100 m length (area 2) and 1000 m (area 3) length. Data for the three areas were aggregated during ingestion in the DB. The same type of item has been counted over a 100 m length (area 2) and 1000 m (area 3) length.

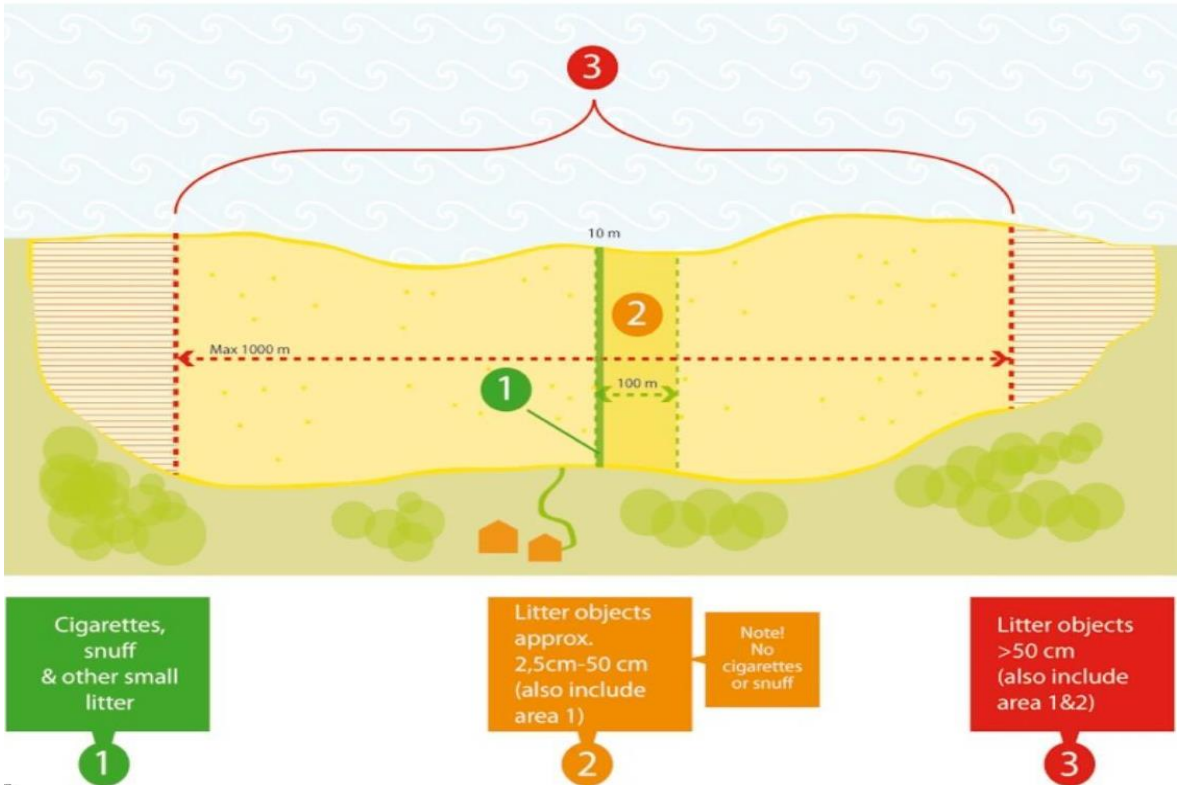
Dataset	Country	Data originator	Data collator	Hindrances
Finland	Finland	Keep the Estonian Sea Tidy Association	JRC	• File from JRC was replaced with file from EMODnet partner because it is more complete. • UNEP-MARLIN[1] protocol and coding was used. From the information obtained by the EMODnet partner (that was in direct contact with the originator) we understood that cigarette butts were counted over a different length basis than the survey length provided. All other items were counted over 100 meter basis (area 2). When presenting results, only 100 m survey should be considered and therefore areas 1 and 3 should be recalculated to the unit: number of litter items per 100 m.
France _Mediterranean Sea	France _Mediterranean Sea	Cedre	JRC	• Data was provided in original language. • Generally, OSPAR coding was used. For one beach double coding (OSPAR and TGML) was used depending on convenience. It is uncertain in this case which protocol was used to perform the survey. • Survey width values are missing. Geographic coordinate for Golo beach were missing, later provided by data originator. • Metadata will be improved thanks to EMODnet French partner (IFREMER), dataset under processing.
Germany_Baltic	Germany_Baltic	State Agency for Environment, Nature and Geology, Mecklenburg-Vorpommern, EUCC - The Coastal Union Germany (EUCC-D), National Park Authority Vorpommern, Jordsand Association, Nature and Biodiversity Conservation Union Germany (NABU), Regional School "Windland" Altenkirchen, Southeast Rügen Biosphere Reserve Office	JRC	• UTM coordinates were converted into geographical coordinates. • OSPAR coding was used. • Survey width values and type of protocol are missing.
Greece	Greece	MISSING	JRC	• Surveys with 0 data for all item types were found. Were the surveys without data actually performed and no litter was found, or were they not performed? • Survey date without day value (i.e., only season is indicated). To ingest data, it was decided to use 1 st day of the month of the season indicated in the data set (i.e. Winter = 1 st of January; Spring = 1 st of April; Summer= 1 st of July; Autumn= 1 st of October). • Average values of items were provided in the beginning; later they were replaced with original counts provided by data originator.
Italy	Italy	Legambiente	JRC	• Data were not provided by the official national body (i.e. Ministry of Environment) but by Legambiente NGO. • Dataset only contained basic metadata but everything was clear. TSG-ML coding was used. • Survey width values are missing. • Survey locations are always on different beaches, which are indicated only with specific code per each region. No names are available (already requested). It is not clear if it is monitoring data or cleaning.

Dataset	Country	Data originator	Data collator	Hindrances
Latvia	Latvia	Foundation for Environmental Education FEE Latvia	JRC	• Data was provided in original language. • UNEP-MARLIN[1] protocol and coding was used. It must be clarified how UNEP-MARLIN protocol was used and which length basis was used to count items. • Important missing information on the original dataset as: day and month of survey date, survey length/coordinates. This information has been found in the project report. • Survey width:from water line to first stable vegetation (differs every time). • To enter data into DB survey date was assumed 1st of July in all cases.
Lithuania	Lithuania	MISSING	JRC	• OSPAR coding was used. • Item quantities for OSPAR categories 3, 4 and 6 are often repeated in the same survey. Values were ingested as they were in the original file.
Poland	Poland	MISSING	JRC	• TGML coding was used but multiple codes were provided for some items. Data ingestion was not possible. It was decide to proceed aggregating items. • Reporting quantities not admissible by the DB were provided. As before a provisional decision was taken. • Metadata included useful survey width but sometimes reported in approximate ranges or preceded by ca. (circa), so it is not acceptable by the DB. • Data had different lines considering size that were aggregated and info related to size was kept in notes.
Romania	Romania	National Institute for Marine Research and Development "Grigore Antipa" (NIMRD)	National Institute for Marine Research and Development "Grigore Antipa" (NIMRD)	• File from JRC was replaced with file from EMODnet data provider (NIMRD) because it was more complete.
Slovenia	Slovenia	Institute for Water of the Republic of Slovenia	JRC	• UNEP and TGML coding were used. Depending on the item description one or multiple codes from TGML were provided. Data ingestion was not possible. It was decided to use only UNEP coding and to search equivalent UNEP codes where they were missing. Therefore, the complete UNEP coding was used for the data ingestion into DB. • Some survey dates were missing. To enter data into the DB, the survey date was assumed to be 15th as most of the other surveys were performed around the half of the month.
Spain	Spain	MISSING	JRC	• Data was provided in original language and through MS-Access database. • OSPAR coding was used. TGML coding was recorded in the DB as alternative coding. • Survey width values are missing. • Data IDs with empty survey ID were present and ignored (request already sent). • Different codes for beaches with same name were found. Only one code was maintained.
Sweden_Baltic	Sweden	MISSING	JRC	• UNEP-MARLIN[1] protocol and coding was used to perform the survey. Original dataset had three different measurement areas that were aggregated during DB ingestion. • The same type of item has been counted over a 100 m length (area 2) and 1000 m (area 3) length. During DB ingestion these data were aggregated. However, this issue should be clarified in order to know if these data can be aggregated and which survey length must be considered. • Errors on beach codes were detected and corrected before ingestion.

NB:

*Data gathering is still on going Data in the table at the date 31-10-2018.

[1] Survey areas (1-2-3) and type of items are collected according to UNEP MARLIN protocol. In this protocol three different lengths are surveyed depending on the item types (e.g. cigarette butts) and size (>50cm or <50 cm). This means that items are reported over a different length basis. While transect width is variable and based on the beach, transect length is set up based on litter item size: Area 1 (**green**) is for cigarette butts and snus measured on 10 metre length beach. Area 2 (**orange**) is for the ordinary litter between 2,5 cm to 50 cm on 100 m beach and Area 3 (**red**) is for larger litter items >50 cm measured on 1000 m beach. This difference is considered by Baltic countries when they report their data at regional level, but it needs to be accounted when using the data for comparison at EU level. See figure below:



Source: Final report of Baltic marine Litter project Marlin — litter monitoring and raising awareness, 2011-2013. (https://www.hsr.se/sites/default/files/appendix1_measurement_method.pdf)

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