

European Marine Strategy Framework Directive  
Working Group on Good Environmental Status  
(WG-GES)

# Monitoring Guidance for Marine Litter in European Seas

**Draft Report**

**CHAPTER 3**

**BEACH LITTER**

**July 2013**



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**Draft Guidance Report:**

TSG-ML was tasked to deliver guidance so that European Member States could initiate programmes for marine litter monitoring. As monitoring must be operational by 2014, first guidance was required by mid-2013. The draft Guidance report provides the basis for the marine litter programme however since new information continues to be compiled TSG-ML can review and update this guidance later in 2013.

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**Disclaimer:** This report has been prepared by a group of experts nominated by EU Member States and Stakeholders. It aims to provide guidance for the implementation of MSFD Descriptor 10 on Marine Litter. It does not constitute an official opinion of the European Commission, nor of the participating Institutions and EU Member States.

## 3. Beach Litter

### 3.1. Introduction to Beach Litter

Numerous reviews of monitoring methods for assessing litter in the marine environment have been published over the last decades (e.g. Dixon & Dixon 1981, Ribic *et al.*, 1992, Rees & Pond 1995, Ryan *et al.*, 2009, Cheshire *et al.*, 2009, Opfer *et al.*, 2012).

The recent overviews by UNEP, in Cheshire *et al.* (2009), and by NOAA, in Opfer *et al.* (2012), are the most comprehensive and useful overviews for monitoring methods on the coast. The UNEP overview includes a comprehensive comparison of existing marine litter survey and monitoring methods and protocols in which beach surveys were assessed (Cheshire *et al.*, 2009).

Much of the information included here is taken from the UNEP Operational Guidelines for Comprehensive Beach Litter Assessment (Cheshire *et al.*, 2009) and the NOAA Marine Debris Shoreline Survey Field Guide (Opfer *et al.*, 2012).

A minimum set of requirements for beach litter monitoring within the MSFD are recommended, which are based on the OSPAR (OSPAR Commission 2010a), UNEP and NOAA guidelines. When designing marine litter surveys it is necessary to differentiate between standing-stock surveys, where the total load of litter is assessed during a one-off count, and the assessment of accumulation and loading rates during regularly repeated surveys of the same stretch of beach with initial and subsequent removal of litter.

Both types of survey provide information on the amount and types of litter, however, only the accumulation surveys provide information on the rate of deposition of litter and trends in litter pollution. As the MSFD requires an assessment of trends in marine litter recorded on coastlines only methods for the assessment of accumulation are recommended in this protocol.

### 3.2. Scope

The TSG-ML has evaluated existing methods for monitoring litter on the coastline with regard to their capacity to fulfil the requirements of the MSFD. The TSG-ML recommends a harmonised method that can be applied to assess litter on all (regional seas) coastlines which will ensure comparability of the results of coastline assessments of litter within and between regions. In this chapter, the difficulties associated with applying the method and its limitations are presented. It also addresses data quality assurance and quality control for trend and other analyses.

### 3.3. Existing protocols

Litter monitoring on the coasts of the European seas has developed from a number of campaigns of mostly non-governmental organizations. Originally designed to heighten public awareness or to make a simple assessment of the magnitude of the problem, they have developed over a thirty year period into a monitoring tool for litter occurring on beaches.

Most existing protocols that have been used on European coasts are based on simple counts of the number, in some cases also the measurement of the weight or volume, of litter items found on a given length of beach or water line. Such surveys have their limitations and are perhaps not a practical method for extremely litter-polluted coastlines and generally do not supply data on the amount of litter recorded for a given area of beach unless the area of beach being surveyed is measured. Because the abundance of beach litter is very much influenced by water currents, prevailing winds and the exposure of the beach, the use of exactly defined stretches of coast is vital when using this type of survey if trends in the amount of litter over time are to be measured.

### 3.4. Needs and requirements for MSFD monitoring

Monitoring of litter on the coastline should quantify and characterise litter pollution and provide comparable datasets to support national and regional assessments of marine litter. Consequently it should provide the basis for the development of management, control and enforcement measures and allow the effectiveness of mitigation strategies to be measured. It should also help us to understand the level of threat posed by marine litter to biota and ecosystems (Cheshire *et al.*, 2009).

The EC Decision of 1<sup>st</sup> September 2010 on criteria and methodological standards on good environmental status of marine waters established that the characteristics of litter in the coastal environment should be evaluated. The evaluation should allow for the assessment of trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source.

The monitoring methods applied on the coastline should provide reliable and, if possible, easily understandable information on all of these factors.

### 3.5. Harmonised Protocol

The comparison of beach litter data between assessment programmes is the primary aim of a harmonised protocol. Comparison is difficult if different methods, different spatial and temporal scales, different size scales of litter items and different lists or categorisation of litter items recorded on beaches are used within the regional seas and the EU as a whole.

The type of survey selected depends on the objectives of the assessment and on the magnitude of the pollution on the coastline. A single survey method is recommended here – with different spatial parameters for light to moderately polluted coastline and for heavily polluted coastlines.

Amounts of litter on the shore can be relatively easily assessed during surveys carried out by non-scientists using unsophisticated equipment. Coastal surveys are thus a cost effective way of obtaining large amounts of information. Amounts of litter washed ashore, however, can vary between surveys and between seasons being also dependent on prevailing currents and winds as well as the exposure of the beach to the sea. Amounts deposited on the coastline can also vary greatly; especially on a seasonal basis i.e. larger amounts are deposited during the tourist season or during special events. Therefore, coastal surveys should focus on fixed sites, which fulfil the requirements of the protocol, and the timing of the survey (i.e. season) could take into account the potential sources of litter to the site (e.g. flooding in rainy seasons may increase the amounts). Sites can be placed to reflect the amounts of litter in so-called reference areas (far from known sources) but also close to sources. By using temporal trends for assessments, both of the survey strategies give important information for managers.

#### Trends in amounts of litter

The variation in the amount of litter present on a given beach between surveys and the variation between beaches, even in the same region, can be extremely large. This makes the identification of trends difficult. Moreover, as litter accumulates on beaches, regular surveys are important in order to get time series of equal accumulation periods.

#### Composition of litter

The assessment of composition of litter is one of the great strengths of coastal assessments. A detailed assessment of litter composition provides information on potential harm to the environment and in some cases on the source of the litter found. The assessment of composition must follow commonly agreed categories in order to have comparable results over larger regions.

#### Spatial distribution

Amount and composition of marine litter varies over geographical scales and reflects hydrographical (e.g. tides, currents, wave exposure, wind directions) and geomorphological (e.g. steepness of a shore, amounts of inlets islands) characteristics of the coast. Hydrographical characteristics determine the amount of litter accumulating in areas, whereas geomorphological characteristics determine how much litter becomes washed ashore. For example, archipelagos and coastlines with several inlets have much more

shoreline than straight open sea coast and therefore amounts of litter may be distributed over larger areas.

### Sources of marine litter

The source of litter found on the coast can be clearly identified for some litter items. These are mostly items which originate from fisheries, or debris flushed down sewerage systems. Even with these items some caution is needed e.g. a fish box may originate from a fishing vessel or from a fishing port.

A comprehensive master list of items and categories has been developed within the TSG-ML (see Chapter 8). This list designates each litter item to a potential source, or to a number of sources. The sources for some items need to be designated at a regional level, because initial assessments of litter on coastlines show that sources for a given item can be different between regions.

The master list will enable at least a rough estimate of the sources of litter found on coastlines, but it should be evaluated in survey sites against known local sources. If detailed information is required it will, be necessary to carry out detailed research into the sources involved e.g. to identify between litter deposited on the beach from litter arriving from adjacent waters. In addition drift analysis of litter in adjacent waters could provide valuable information on its geographical origin.

### Selection of survey sites

Ideally the selected sites should represent litter abundance and composition for a given region. The sites should be randomly selected; however, this is not always possible because of a number of problems regarding coastal sites such as accessibility, suitability to sampling (sand or rocks/boulders) and beach cleaning activities. If possible the criteria below should be used:

- A minimum length of 100m.
- Low to moderate slope (15 – 45°), which precludes very shallow tidal mudflat areas that may be many kilometres wide at low tide.
- Clear access to the sea (not blocked by breakwaters or jetties) such that marine litter is not screened by anthropogenic structures.
- Accessible to survey teams year round, although some consideration needs to be given to sites that are iced-in over winter and the difficulty in accessing very remote areas.
- Ideally the site should not be subject to any other litter collection activities, although it is recognized that in many parts of Europe large scale maintenance cleaning is carried out periodically; in such cases the timing of non-survey related beach cleaning must be known such that litter flux rates (the amount of litter accumulation per unit time) can be determined.
- Survey activities should be conducted so as not to impact on any endangered or protected species such as sea turtles, sea birds or shore birds, marine mammals or sensitive beach vegetation; in many cases this would exclude national parks but this may vary depending on local management arrangements.

Within the above constraints, the location of sampling sites within each zone should be stratified such that samples are obtained from beaches subject to different litter exposures, including:

- Urban coasts, i.e. mostly terrestrial inputs;
- Rural coasts, i.e. mostly oceanic inputs;
- Coasts within close distance to major riverine inputs.

### Documentation and characterisation of sites

It is very important to document and characterise the survey sites. As surveys should be repeated on exactly the same site the coordinates of the site should be noted.

It is strongly recommended to use the Marine Litter Beach Documentation and Characterization Form included in appendix XX based on the OSPAR form (OSPAR Commission 2010b).

### Frequency of surveys

At least four surveys per year in spring, summer, autumn and winter are recommended. However, circumstances may lead to inaccessible and unsafe situations for surveyors: heavy winds, slippery rocks and hazards such as rain, snow or ice, etc. The safety of the surveyors **must** always come first.

The survey periods below are suggested:

- 1) Winter: Mid-December–mid-January
- 2) Spring: April
- 3) Summer: Mid-June–mid-July
- 4) Autumn: Mid-September–mid-October

Preferably, the surveys should be carried out within the shortest timeframe possible within a survey period for all participating beaches in the classified regions. Coordinators within these regions should try and arrange the survey dates bilaterally. Furthermore a given beach should be surveyed on roughly the same day each year if possible.

### **Sampling unit**

Once a beach is chosen sampling units can be identified. A sampling unit is a fixed section of beach covering the whole area between the water edge (where possible and safe) or from the strandline to the back of the beach.

- At least 2 sections of 100m on the same beach are recommended for monitoring purposes on lightly to moderately littered beaches
- At least 2 sections of 50 m for heavily littered beaches

Permanent reference points must be used to ensure that exactly the same site will be monitored for all surveys. The start and end points of each sampling unit can be identified by different methods. For example numbered beach poles could be identified and registered. Coordinates obtained by GPS or Google Earth are useful information for identifying the reference beaches. However, as they have a 10-metre deviation, this method may not be suitable for the survey site identification.

### **Units (quantification) of litter**

The unit in which litter is assessed on the coastline can be number, weight or volume, or a combination of these units. Counts of items are recommended as the standard unit of litter to be assessed on the coastline.

The assessment of weight of litter is problematical because it is dependent on whether litter items are wet or dry and often whether they are covered with or full of sand and gravel (Jambeck & Farfour 2011). Some items are even too big to be weighed and their weight must be estimated. The results of weight-based surveys and number-of-item-based surveys cannot be compared directly. Estimates of the weight of items counted could be made if average weights of the litter items assessed are known. However, this would not be possible for all items e.g. nets, which occur on beaches in a wide range of sizes and weights.

The assessment of the volume of litter is also problematical because it depends on the level of compression of the litter involved. Measurements of litter volume are not easily reproducible and only give a rough idea of the amount of litter recorded.

### **Collection and identification of litter**

All items found on the sampling unit should be entered on the survey forms. On the survey forms, each item is given a unique identification number. Data should ideally be entered on the survey form while picking up the litter. Collecting the litter first and identifying it later may alter numbers as collected litter tends to get more entangled or broken.

Unknown litter or items that are not on the survey form should be noted in the appropriate “other item box”. A short description of the item should then be included on the survey form. If possible, digital photos should be taken of unknown items so that they can be identified later and if necessary be added to the survey form.

### **Disposal of litter**

The litter collected should be disposed of properly. Regional or national regulations and arrangements should be followed. If these do not exist local municipalities should be informed.

Larger items that cannot be removed (safely) by the surveyors should be marked, with for example paint spray (for marking trees) so they will not be counted again at the next survey.

Many municipalities will have their own cleaning programme, sometimes regularly, sometimes seasonal or incident related. Arrangements should be made with the local municipalities so that they either exclude

the reference beach from their cleaning scheme or they provide their cleaning schedule so surveying can be carried out a few days before the municipality will clean the beach.

Preferably a set time should be established for each beach between the date when the beach was last cleaned and the date when the survey is carried out. It is advisable to contact the municipality before starting a survey to obtain the latest information on beach cleaning activities. Sometimes an incident, for example a storm, will alter their cleaning programme.

### **Litter Categorization**

A master list of litter categories and items is included in Chapter 8. This master list includes a list of categories and items to be recorded during beach litter surveys. Please refer to this list.

### **Size limits and classes of items to be surveyed**

There are no upper size limits to litter recorded on beaches.

If lower size limits are not set, the lower limit will be determined by the possibility of detection by the naked eye and depends on the visual perception (eyesight) of the surveyors and on the conspicuousness of the litter items, which in turn depends on their size, colour and form. The lower limit of detection, when walking a beach, is probably somewhere around 0.5 cm (plastic pellets), however, it is doubtful that such small items can be monitored effectively and in a repeatable fashion during beach surveys.

A lower limit of 2.5 cm in the longest dimension is recommended for litter items monitored during beach surveys. This would ensure the inclusion of caps & lids and cigarette butts in any counts.

### **Timing and safety**

Monitoring should start about one hour after high tide to prevent surveyors being cut off by incoming tide. If working on remote beaches it is recommended to work with a minimum of two people.

Dangerous or suspicious looking items, such as ammunition, chemicals and medicine should not be removed. Inform the police or authorities responsible.

### **Photo guide**

It is strongly recommended to produce regional photo guides including pictures of all litter items on the regional survey protocol. This will assist in the correct identification and allocation of recorded items. The OSPAR photo guide 100m<sup>23</sup> (OSPAR Commission 2010c) can be used in some regions and modified for others.

## **3.6. Quality Assessment /Quality Control**

Based on the UNEP Guidelines (Cheshire *et al.*, 2009), any long term marine litter assessment programme will require a specific and focussed effort to recruit and train field staff and volunteers. Consistent, high quality training is essential to ensure data quality and needs to explicitly include the development of operational (field based) skills. Staff education programmes should incorporate specific information on the results and outcomes from the work so that staff and volunteers can understand the context of the litter assessment programme.

Quality assurance and quality control should be primarily targeted at education of the field teams to ensure that litter collection and characterization is consistent across surveys. Investment in communication and the training of the country/regional and local survey coordinators and managers is thus critical to survey integrity.

The quality assurance protocol of Ocean Conservancy's National Marine Debris Monitoring Program (USA) required a percentage of all locations to be independently re-surveyed immediately following the scheduled assessment of litter (Sheavly, 2007). The collected litter from the follow-up survey could then be added to that of the main collection and could be used to provide an estimate of the error level associated with the survey. This approach should be employed as a component of beach litter surveys.

<sup>23</sup> [http://www.robindesbois.org/macrodechets/Ospar\\_Photo\\_100m\\_lr.pdf](http://www.robindesbois.org/macrodechets/Ospar_Photo_100m_lr.pdf)

### 3.7. Data Management

Data collation should be undertaken through an online, relational database management system under the control and direction of the local managers. Responsibility for review and approval of uploaded data should be undertaken by the regional/country coordinator who will clarify any issues with local managers. This would ensure a high level of consistency within each region as well as create a hierarchy of quality assurance on data acquisition. The use of such a system will also support comprehensive analysis of the data providing the opportunity to undertake statistically robust comparisons through time and between survey locations (Cheshire *et al.*, 2009).

### 3.8. The costs of beach litter monitoring

The following costs of beach litter monitoring include the necessary costs of coordination and execution of the surveys. Costs are presented in man-hours. The actual financial costs of the surveys will vary from country to country depending on the costs of employing personnel.

The following estimate of the costs of setting up and running a beach litter monitoring programme is based on the OSPAR monitoring system of four surveys a year on four permanent survey sites surveying the number of all litter items on 100 meters of coastline.

#### Coordination

Without coordination at a regional/national level, a monitoring system for beach litter cannot be permanently maintained.

Tasks of the regional coordinator are:

- identification and setting up of survey sites
- contact with the organizations/institutions carrying out the surveys
- development & maintenance of the survey system
- training of surveyors
- entering the data into the database/QA of data
- maintaining the database
- data analysis
- reporting
- (further) development of methodology
- participation in national and international workshops, working groups, etc.

The coordination requires an office with communication facilities (phone, e-mail, internet access) and transportation.

For the overall coordination of four survey sites ca. 330 hours will be necessary in order to set up the monitoring system and about 250 hours/year will be required to maintain the system (see Table 3 below).

Task	Hours/year setting up the programme	Hours/year running the programme
Contact with the organizations who carry out the surveys*	65	30
Setting up and running the monitoring program	65	30
Training of surveyors **	65	40
Data input		40
Running the database	30	5

Task	Hours/year setting up the programme	Hours/year running the programme
Data analysis		30
Reporting	8	40
(Further) development of methods	40	10
Participation on national and international workshops, working groups, etc	50	30
<b>TOTAL</b>	<b>327</b>	<b>247</b>

\* 4 for survey sites; \*\* Central training event

**Table 3:** Estimation of effort for beach litter monitoring

### Carrying out the surveys

The actual cost of carrying out the surveys will depend on whether professional surveyors are paid to do the work or whether a system of volunteer surveyors from for example nature or environmental groups and societies is used. Using volunteers will increase the work load of the regional coordinator using professional workers will increase the costs of the surveys themselves.

If the weight of the litter is to be recorded (e.g. HELCOM Recommendation) this will increase the cost of the surveys considerably, since the effort (= number of hours) is significantly larger.

For preparation and carrying out the surveys (2 persons) and reporting for 4 surveys/year it is estimated that ca. 48 person-hours will be required to actually carryout the surveys for each site.

When litter is removed during the survey additional costs for disposal of the litter will occur.

In addition costs for travel and if necessary for board and lodging will occur depending on the location and accessibility of the survey sites.

Carrying out the survey	
Days/survey site/year	8
Person-hours/day	6
Hours/survey site/year	48

### Data Management

Database structures are available for OSPAR litter data and could be used/adapted for other regions.

## 3.9. Conclusion: Key message to MSFD implementation process

Standard coastal litter survey methods should, where possible, be applied at all levels from local to regional seas level in, order to enable comparisons within and between that regions.

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