Pilot project '4 Seas'– plastic recycling cycle and marine environmental impact

Case studies on the plastic cycle and its loopholes in the four European regional seas areas

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Executive summary

The European Commission has launched three parallel studies, of which this study is one, to gather strategic information and support the implementation of the European Marine Strategy Framework Directive (MSFD) requirements on marine litter and further develop the policy framework for this issue.

Marine litter consists of items that have been made or used by people and have been deliberately dumped into the sea or rivers; brought indirectly to the sea by rivers, effluents, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately littered by people on beaches and shores.

Marine litter is an environmental, economic, human health and aesthetic problem. It poses a complex and multi-dimensional challenge with significant implications for the marine and coastal environment and human activities all over the world.

The main objective of this project is to pinpoint the major possible sources of marine litter in four study-sites, indicative for each of the four European seas. The case-studies illustrate the process of litter and waste entering the marine environment. They indicate the main loopholes in the local material and waste cycles and identify which economic sectors or actors are the main sources of marine litter. Furthermore the study designs a set of feasible measures to address the loopholes. Based on multi criteria analysis four sites are selected: Riga (Latvia-Baltic Sea), Oostende (Belgium-North Sea), Barcelona (Spain-Mediterranean) and Constanta (Romania-Black Sea). These areas include river discharge, commercial ports and important coastal cities.

A bottom-up approach is followed to achieve the objectives including additional site surveys on the four selected sites, the organisation of regional workshops as part of a step-wise consultation process (led by the regional partners). Stakeholders were interviewed to check the analysis results on the main sources and loopholes of marine litter, to inform about existing measures and propose new measures, to give input for the feasibility assessment and to give feedback on the draft proposal of the measures.

Though the approach and methodologies used in the different sites are consistent and comparable, they have been adjusted to different cultural and economic contexts. Distinct profiles of marine litter lead to adapted sets of measures to meet the local needs.

The policy mixes proposed include between 21 (North Sea Case) and 28 (Mediterranean Sea Case) measures. The main findings are summarized below:

1. Recreational & tourism activities are responsible for the majority of marine litter (incl. consumption packaging, plastic cutlery, straws, cigarette butts):in all the marine regions (between 35% and 58 % of the marine litter observed), resulting in a common set of measures including appropriate penalties for beach littering, adequate and sufficient receptacles in beach area, optimal cleaning strategies, sensitization of the coastal tourists (e.g. inform about risks and alternatives to plastic bottles) and sectors (e.g. promotion of proper use and disposal of plastic bags, commitment on touristic sector to reduce use of plastic bottles,

cutlery/straws, environmental awards, promotion of stewardship concepts such as adopt-a-beach) combined with clean-up activities at the beach. For some of these measures efforts have been made in the last decade including regular cleaning during bathing season and several education and behavioural change campaigns, however there is still need to invest in capacity during top days and in more efficient bins along the coast, to invest in mechanical and manual cleaning in a sound way as well as in a continued effort to change the social perception and behaviour of the public to waste. Other measure evaluated as feasible for some regional seas are the establishment and effective control of a clean-up plan for cultural events at the beach (e.g. sport activities, music festivals, fireworks) and the implementation of the tourist tax.

2. Land-based household waste (including sanitary waste) affecting the marine environment through the sewerage system and in some cases through the inland rivers is the main problem in the Mediterranean, Black and Baltic Sea. Measures proposed here are related to the improvement of collection, treatment and disposal of domestic solid waste. Some of these measures are easy to implement like better maintenance and cleaning of the river beds and sewerage systems, or improved waste collection and street cleaning. But also some infrastructural higher cost measures to improve the sewerage system (separate sewers for rain and domestic water), to improve the storage capacity, to reduce the release of waste into the sea through grit chambers have been proposed by the stakeholders in the Mediterranean and Baltic Sea. More general measures to reduce the household waste, proposed in these regional seas, are to improve waste management services by promoting reuse of plastic products and selective collection (e.g. implementation of deposit refund systems for bags and plastic bottles, improve Extended Producer Responsibility (EPR) systems for plastic packaging). Specifically for the Mediterranean and the Baltic Sea region extra measures have been defined to reduce the input and impact of sanitary waste into the marine environment. On the one hand this includes public awareness campaigns to persuade the public to change their behaviour and avoid flushing through the toilet, and on the other hand manufacturers are approached to make the products more environmental friendly. Compared to the other regional seas, litter coming from poorly managed dumpsites and illegal dumping still plays a considerable role in the Black Sea Region. Measures proposed here include the enforcement of the technical requirement of the Landfill Directive close to the coast as well as to identify and close non-compliant landfills and illegal dumpsites close to the coast. More general measures to reduce the household waste, also proposed in other regional seas, are to improve waste management services by improving the infrastructural capacity (e.g. maintenance and cleaning sewerage system, more bins), by promoting selective collection (e.g. implementation of deposit refund systems for bags and bottles).
3. In contrast to the other marine regions where land-based activities are generating most of the marine litter, sea-based waste from shipping and fisheries takes a dominant role in the North Sea region. Nevertheless, common to all marine regions, the proposed policy mix includes measures related to the enforcement of MARPOL Annex V. Specifically for the North Sea region extra measures have been defined to minimize the loss of fishing gear, to stimulate

and improve the collection of fishery related waste, and to increase awareness of the marine sectors about these issues. As a result of the final stakeholder consultation, some of these measures (e.g. sensitize the marine sectors to promote sustainable use and anti-littering) have been added to the policy mix of the other regional seas. Finally, a need has been expressed by the stakeholders of the North, Mediterranean and Baltic Sea for more guidance for cargo transport and port cargo handling operations.

4. Next to these measures tackling specific issues of marine litter, there is also need for measures to improve knowledge on main sources & loopholes of marine litter to be able to specify the marine litter strategy per regional sea for the coming years. There is a general support by all regional seas for the implementation of an improved and harmonized EU monitoring system (provided by the MSFD Technical Sub-Group on Marine Litter). It is important that this monitoring system will be implemented in the 4 regional seas, starting from the beach, and later to be extended for the floating and seabed compartment.

From the cost-effectiveness analysis it became clear that to realize some of these local solutions, European support will be needed. Both in terms of:

- Methodological support: by setting up an EU harmonized monitoring system for the three main compartments (beach litter, floating litter and litter on the seabed);
- Legal support: not only by providing EU Directives, but also by coordinating their implementation and enforcement; and
- Financial support: by providing EU financial support mechanisms.

Coordinated action at different levels (local, regional and European) to reduce marine litter will in this way contribute to a good environmental status by 2020.

Glossary

Consumer waste	means materials purchased, used and discarded by the buyer, or consumer, as opposed to those discarded in a manufacturing process[1]. It is considered that consumer plastic waste includes all waste arising beyond the plastic manufacturing process e.g. waste arising during wholesale trade or manufacturing activities (e.g. agriculture) where plastic (packaging) products are used and may arise as waste.
Deposit refund system	A deposit refund system on a packaging (drink bottle, can, plastic bag) considers that the consumer pays for the packaging and gets the money back in exchange when returning the empty packaging. A deposit refund system has, inter alia, its benefits in combating generation of the waste.
Discarding	Discarding is defined as any waste management operation serving or carrying out the final treatment and disposal of waste. It covers the following main operations: a) Final treatment: Incineration without energy recovery (on land; at sea) Biological, physical, chemical treatment resulting in products or residues that are discarded, i.e. going to final disposal; b) Final disposal: Deposit into or onto land (e.g. landfill), including specially engineered landfill; Deep injection Surface impoundment Release into water bodies Permanent storage[2]
Eurostat	Eurostat is the statistical office of the European Union situated in Luxembourg. Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions[3].
Extended producer responsibility (EPR)	EPR is an environmental policy approach in which a producers' responsibility for a product goes beyond the point of manufacturing & sale, throughout the entire life cycle and finally to the end of life. Producers take the responsibility for the post-consumer stage of the product life cycle and need to pay for the take-back, recycling and finally disposal. By this approach, producers are stimulated to design consumer products which are more environmentally friendly. The mean motivation is the prospect of reduced costs associated with the management of the waste stage. Producers may fulfil their obligations either individually or joining recovery organisation scheme which overtakes organisation of EPR for its members. The scheme is applicable to packaging waste and for WEE, ELV and ELB[4]

[1] source: http://glossary.eea.europa.eu/terminology/concept_html?term=consumer%20waste
[2] Eurostat definitions, available at: http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL_GLOSSARY&StrNom=CODED2&StrLanguageCode=EN)
[3] http://epp.eurostat.ec.europa.eu/portal/page/portal/about_eurostat/introduction (accessed on 18/05/2012)
[4] WEE: Waste of electronic equipment, ELV: End of life vehicles; ELB: End of life batteries

Fly tipping	is the British term for waste dumping[5]. Waste dumping is the disposal of solid waste without environmental controls[6]. A distinction is made between fly tipping, which is throwing or loosing waste in the environment due to negligence while consuming a good outdoors (e.g. candy wrap, beverage packaging, cigarette buds) and dumping, which is a deliberate act of bringing waste to unattended dumpsites (e.g. household waste, mattresses, discarded equipment)
Informal sector	"The informal sector is broadly characterised as consisting of units engaged in the production of goods or services with the primary objective of generating employment and incomes to the persons concerned. These units typically operate at a low level of organisation, with little or no division between labour and capital as factors of production and on a small scale. Labour relations - where they exist - are based mostly on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees." [7]
Litter	means waste (garbage and trash) disposed of in the wrong place by unlawful human action and can vary in size of incident, occurrence or items. Discarded or lost manmade materials resulting from inappropriate human activities [UNEP 2009a]
Manufacturing waste	means materials discarded in a manufacturing process (as opposed to those discarded as consumer waste)
Marine Litter	Marine litter can be any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It consists of items that have been made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches, including such materials transported into the marine environment from land by rivers, draining or sewage systems or winds. For example, marine litter consists of plastics, wood, metals, glass, rubber, clothing or paper. (see[EC 2011h])
Marine debris/ Marine litter	For the purposes of the present project "marine debris" means the same as "marine litter". It designates any anthropogenic, manufactured, or processed solid material (regardless of its source and size) discarded, disposed of, or abandoned that ends up in the marine environment. In several relevant documents the terms marine litter and marine debris are defined as follows: "Marine debris, or marine litter, is defined to include any anthropogenic, manufactured, or processed solid material (regardless of size) discarded, disposed of, or abandoned that ends up in the marine environment. It includes, but is not limited to, plastics, metals, glass, concrete and other construction materials, paper and cardboard, polystyrene, rubber, rope, textiles, timber and hazardous materials, such as munitions, asbestos and medical waste. In some instances, marine debris may also be a vessel for dangerous pollutants

[5] http://kb.keepbritaintidy.org/flytipping/Content/Publications/flylaw.pdf
[6] http://glossary.eea.europa.eu
[7] Source: OECD Glossary of Statistical Terms: http://stats.oecd.org/glossary/detail.asp?ID=1350 (accessed on 27/01/2012)

	that are eventually released into the marine environment. Marine debris may result from activities on land or at sea." (source: [UNEP_GPA_IGR.3_INF_9 2012])
	"Any litter that has entered into the marine environment, including manufactured materials (including processed timber) found on beaches or material that is floating or has sunk at sea. In some countries organic material (e.g. faeces or food waste) are included as litter. In this document organic waste has not been included." (source: [UNEP 2009a])
	"Any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately left by people on beaches and shores. Although in some countries organic material (e.g. faeces) may be included in litter, in the present document only manufactured material (including processed timber) is considered." (source: strategic framework for marine litter management under the Barcelona Convention [UNEP-DEPI-MED IG-20-10 2012])
Municipal waste	means waste from households, as well as other waste which, because of its nature or composition, is similar to waste from household (Definition from Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
Pre-consumer materials/ waste	means materials that do not reach the intended use or user and are discarded or recycled[8] Note: this includes discarded or recycled materials but no recovered materials.
Post-consumer materials/waste	means paper, plastics, rubber, etc., recovered or recycled from discarded household, commercial, or industrial packages or products[9]. Note this includes only recovered and recycled materials. Note: Pre- and post-consumer materials are not clearly defined. The definitions found are not really satisfying. The terms "manufacturing waste" and "consumer waste" seem to be more appropriate. However, the plastic industry is using the term "post-consumer waste" rather often and project team shall ask them for their definition. The assumption is that they understand post-consumer waste as material collected from discarded plastic products.
PPP	PPP stands for Plastic Packaging Products, thus packaging made of plastics. PPP is predominantly primary packaging, or sale packaging removed by the consumer (e.g. plastic wrap around a biscuit, PET soft drink bottle, …). This fraction could include as well secondary packaging or group packaging . The

[8] source: http://www.businessdictionary.com/definition/pre-consumer-materials.html
[9] source: http://www.businessdictionary.com/definition/post-consumer-materials.html

	second most frequent kind of packaging is quaternary packaging or service packaging: shopping bags, disposable beverage cups for direct consumption, etc.
Recovery	means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy (Definition from Directive 2008/98/EC Of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives). Recovery mainly refers to the following operations: material recovery, i.e. recycling (see below); energy recovery, i.e. re use a fuel; biological recovery, e.g. composting [10]
Recycling	means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations (Definition from Directive 2008/98/EC Of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives).
Re-use	means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived (Definition from Directive 2008/98/EC Of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives)
Rieras	River basin or gully, usually in Mediterranean climates, which only occasionally contains water. When water flushes through a *riera* all debris and possible dumped or fly-tipped waste is transported to the sea.
Separate collection	means the collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment (Definition from Directive 2008/98/EC Of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives)
Waste	means any substance or object which the holder discards or intends or is required to discard. (Definition from Directive 2008/98/EC Of The European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives)

[10] Eurostat definitions, available at: http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL_GLOSSARY&StrNom=CODED2&StrLanguageCode=EN

1 Introduction and scope

1.1 Situating the problem

For the purposes of this study, the definition of marine litter according to [UNEP 2009] is used: *"Any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment"*.

Marine litter consists of items that have been made or used by people and have been deliberately dumped into the sea or rivers; brought indirectly to the sea by rivers, effluents, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately littered by people on beaches and shores.

Marine litter is an environmental, economic, human health and aesthetic problem. It poses a complex and multi-dimensional challenge with significant implications for the marine and coastal environment and human activities all over the world. These impacts are both cultural and multi-sectoral, rooted primarily in poor practices of solid waste management, lack of infrastructure, various human activities, an inadequate understanding on the part of the public of the potential consequences of their actions, the lack of adequate legal and enforcement systems and a lack of financial resources [UNEP 2009].

Marine Litter is a global issue, affecting all the major bodies of water on the planet, from the surface to the sea-bottom. It can negatively impact wildlife, habitats, the economic health and burden of coastal communities and maritime activities but also become an issue of public safety, considering the emerging concerns over ingestion of micro plastics by marine particle feeders ([DAVISON 2011]; [MURRAY 2011]). Plastic revolutionised society in many ways, due to its versatility, lightweight, durability and low cost of production but due to its large scale use and extreme persistence in the environment it represents a considerable fraction of marine litter and the one that tends to receive more attention. Marine plastic litter poses therefore a complex and multi-dimensional societal challenge, requiring adjustments in the different phases of life-cycle and across sectors.

1.2 Scope of the exercise

The European Commission has launched three parallel studies, of which this study is one, to gather strategic information and support the implementation of the European Marine Strategy Framework Directive (MSFD) requirements on marine litter and further develop the policy framework for this issue. The qualitative descriptors for determining good marine and coastal environmental status include : *(10) Properties and quantities of marine litter do not cause harm to the coastal and marine environment.*

The main objective of this project is to pinpoint the major possible sources of marine litter in four study-sites, representative for each of the four European seas. The case-studies illustrate the process of litter and waste entering the marine

environment. They indicate the main loopholes in the local material and waste cycles and identify which economic sectors or actors are the main sources of marine litter. Furthermore the study designs a set of feasible measures to address the loopholes. Based on multi criteria analysis four sites are selected: Riga (Latvia-Baltic Sea), Oostende (Belgium-North Sea), Barcelona (Spain-Mediterranean) and Constanta (Romania-Black Sea). These areas include river discharge, commercial ports and important coastal cities. Though the approach and methodologies used in the different sites are consistent and comparable, they have been adjusted to different cultural and economic contexts. Distinct profiles of marine litter lead to adapted sets of measures to meet the local needs.

Key results of this study include : overviews of main types of litter found in coastal and marine environment, the process and the results of identification of their main sources, pathways and loopholes in the case areas, an analysis on potential measures that could be used to avoid litter to enter the marine environment, and an evaluation of its feasibility in order to evaluate its economic, administrative and institutional implications within an adapted policy mix. The process included a participatory approach to gather local knowledge and obtain a concerted view on where, how and why (mainly plastic) litter is entering the marine environment in the four different areas. Its final scope is the design of an adequate mixture of policy measures and strategies, targeting different key sectors and material flow phases.

1.3 Key actors, possible gaps and loopholes

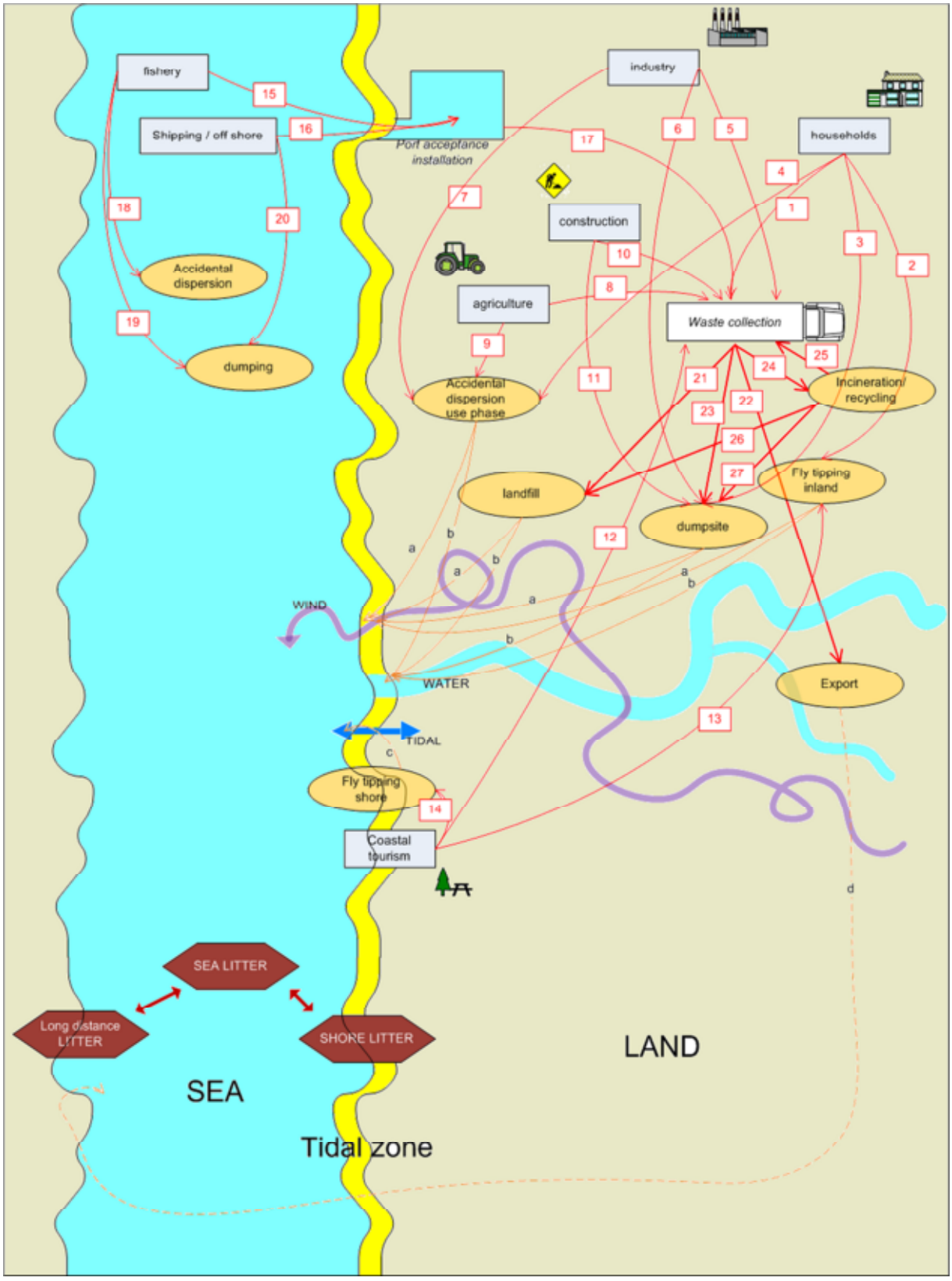


Figure 1: Possible gaps and loopholes

The figure above gives a preliminary overview of possible sources, vectors and pathways for litter entering the marine environment.

- Potential important sources of marine litter can be fishery, merchant navy, pleasure crafting, off shore activities, coastal tourism, industry, agriculture, construction and demolition, households, …
- Potential releases can be accidental loss at sea, dumping at sea, accidental loss at land in the user phase or in logistics, fly-tipping and dumping, accidental or deliberate losses in the waste treatment cycle, …
- Vectors can be human (waste left on site in a marine context), wind (landfill windblown waste, street litter…), water (inland waters, sewage systems…), tidal movements
- Exchanges between land waste, coastal litter and sea waste.

Using a bottom up approach, this exercise will identify which of these are important for which regional sea, based on the analysis of litter found and its context in the four case studies. In this way, sources can be named and feasible measures can be evaluated to close the gaps.

2 Site selection

The selection of the study-sites was made in a two-stage approach, using a multi-criteria analysis with gradually more detailed criteria. Only the sites that fulfilled the first level criteria were considered in the second stage for selection. The methodology and results of the selection process are described below.

2.1 Criteria for site selection

A set of criteria was defined for the first and second stage of the selection process (priority level 1 and 2, respectively).

In the first stage (priority level 1), a long list of potential sites is analysed using a multi-criteria matrix for which basic criteria were defined. These criteria reflect key aspects that should make a site eligible for consideration and that were included in the terms of reference : knowledge of marine litter monitoring data associated, proximity to port city, river discharge and incidence of team's competences but also first impressions on how easy it would be to access the data (e.g. if data is public). These criteria could be assessed in a straightforward and quick way, allowing to analyse a long list of sites and trim it down to a limited number of appropriate sites.

The set of sites resulting from the initial selection were evaluated in terms of more detailed sort criteria (level 2 priority), which require a qualitative assessment of the nature of available data (e.g. if data is public or if not; if it could be effectively obtained from data owners; if data is up-to-date; if data recording was made using categories of use/sector or relevant specification of items; etc.).

The list of criteria used in the 2-stage approach is presented below.

Table 1: site selection criteria

Criterion	Nr.	Description and Relevance	Priority level (1 to 2)
DATA			
Availability of data, including geo-referencing	1	Has data been collected in the area?	Level 1
Accessibility of data	2	Is it likely that the Team will have prompt access to the raw data? (e.g. is the data public available or does the team know that the data owner will provide access).	Level 1
	3	Are there associated costs to obtain these data?	Level 2
Data quality	4	Do we have access to raw data or processed data? *If only processed data are available, is criterion 6 fulfilled (level of detail)?*	Level 2

Criterion	Nr.	Description and Relevance	Priority level (1 to 2)
	5	Which compartment was surveyed? (Beach, sea surface, sea-bottom)	Level 2
	6	Which types and categories of litter were recorded? Within plastic litter for example, is there further specifications in terms of items and/ or use? (e.g. fishing lines/ nets, plastic bags, PET bottles,…) *This is a very important criterion that will determine whether the existing data can be useful in the scope of this project.*	Level 2
Data reliability	7	Which methodology was applied? (e.g. 100 m items; size range; trawling; visual census, etc.). *The methodology used may have limitations that need to be considered case-by-case (e.g. standardized, maturity, spatial coverage, floating items only, certain ranges of size, etc.).*	Level 2
	8	What is the frequency and time period of the data collection? When was the most recent data collected? *Data only relevant if data is fairly recent (e.g. at least within last 2 years). Long-time series can give information about importance of certain sources of marine litter.*	Level 2
Waste management Data	9	Do we have data/ knowledge on waste management and waste dumping of potential sources (e.g., industries, tourism, shipping, offshore activities) *Data important for loop hole analysis.*	Level 2
SITE CHARACTERISTICS			
Team coverage	10	Is the site located in a country/ area in which the Team has competences?	Level 1
Location of the site (proximity)	11	Is the site located in the proximity of a port? Is the site influenced by port activities?	Level 1
	12	Is the site located in the proximity of a major river discharge? Is the site affected by riverine inputs?	Level 1
	13	Is the site located in the proximity of a (tourist) city? What is the magnitude of that city? What is the tourist pressure?	Level 1
Hydrodynamic aspects	14	Is the site downstream from port/ river/ city, in respect to littoral drift?	Level 2
	15	Is the site known or expected to be an area of	Level 2

Criterion	Nr.	Description and Relevance	Priority level (1 to 2)
		accumulation of debris?	
OPERATIONAL CAPACITY			
NGO	16	Is there an NGO active who deals with marine litter?	Level 2
Stakeholders	17	Does the team have good contacts with potential stakeholders in the area? *Important for the multiple stakeholder events planned and for data gathering*	Level 2
Survey capacity	18	Is there an appropriate site for beach surveys (i.e. accessibility of beach, absence of cleaning strategies by local authorities/ business?)	Level 2
	19	Is experience/ equipment available for in situ surveys?	Level 2

2.2 Results of the 1st stage of selection

All regional partners were requested to identify potential study-sites for each of the four case-study areas.

The results originating from the first level analysis are presented in Annex 1. The sites that fulfilled all five first level criteria (dark green) were the sites selected to go through the second stage analysis.

Annex 1: Multi criteria matrix of potential sites (1st stage of selection)

An initial list of 53 potential sites was reduced to 21 sites based on proximity to port, river basin, data availability and accessibility and capacity of the team to address it.

2.3 Results of the second stage of selection

Regional partners collected information to address the 2-level priority criteria, which were mainly related to details of quality of existing data and monitoring programmes – aspects that are critical to accomplish the objectives of this task.

In order to objectively assess the robustness and quality of data associated to the sites, the Team developed a scoring system to the criteria associated to data, which is presented in the table below.

Table 2: Scoring system to check site data and site situation qualities

Categories of items recorded	Significance	Score
Only material type (e.g. Plastic, Metal, Paper)	**Low**	**0**
Some categories of use and/or some general categories of items (e.g. "Packaging", "Fishing", "smoking items", "plastic bottles", "public/consumer")	**Medium**	**2**
Specification of items and distinction of sizes of plastic items/fragments (e.g. "drink plastic bottles < 0.5 L", "plastic caps", "plastic bags", "Gloves", "paint tins", "plastic fragments < 50cm, specification of items that don't fall in established categories or OSPAR items categories)	**High**	**5**
Additional information/item (e.g. description of labels, identification of country of production, etc.)	**Additional strength**	**+ 2**
Time-series of data-set since 2008 (incl.)	**Significance**	**Score**
1 year	**Low**	**0.5**
2 years	**Medium**	**1**
3 years	**High**	**2**
≥ 4 years	**Very high**	**3**
Frequency of surveys of best data set IF not older than 2008	**Significance**	**Score**
Older than 2008	**Low**	**0**
1 survey/year	**Medium**	**1**
2 - 3 surveys/year	**High**	**2**
≥ 4 surveys/year : Minimum of frequency suggested by OSPAR and TSG	**Very high**	**3**
Age of data collection of most RECENT survey in the site	**Significance**	**Score**
> 5 years	**Low**	**0.5**
2008-2009	**Medium**	**1**
2010 - 2011	**High**	**3**
2012	**Very high**	**4**
Site of data collection	**Significance**	**Score**
Upstream from Port/River	**Low**	**0**
> 5 km downstream	**Medium**	**1**
< 5 km downstream	**High**	**2**

The scores obtained for each site, together with a qualitative comparison of the other criteria, were used to select the two more appropriate sites for each European regional Sea. This selection was made during an extended project team meeting, in which all regional partners participated and where the strengths, weaknesses and interesting aspects of each site was presented.

Especially for the Mediterranean and the North sea cases a more detailed multi criteria analysis was needed to make the final selection. A report of this is included in Annex 2.

Annex 2: Multi criteria analysis site selection Mediterranean Sea and North Sea

2.4 Final selection of study-sites

In Figure 2 the location is given of the proposed study-sites, for each EU Regional Sea (1st choice in yellow; 2nd choice in red).

The 4 selected cases are:

- North Sea: Oostende (Belgium)
- Mediterranean Sea: Barcelona (Spain)
- Baltic Sea: Riga (Latvia)
- Black Sea: Constanta (Romania)

Figure 2: Final site selection

A description of the 4 selected sites can be found in Annex 3, including:

- Site features (general location, port description, river description, tourism pressure);
- Access to stakeholder input and data on waste management;
- Data to be generated/ potential surveys to be carried out;
- Weaknesses and strengths.

Annex 3: Final selection of study sites

3 Data collection on marine litter

To pinpoint the major possible sources of marine litter in the four study-sites the following data collection approach has been used and further discussed below:

- Starting from the existing data: in many regional seas monitoring activities and studies have been done on marine litter. A literature study on these data formed the basis for the further analysis.
- Need for fine-tuning the existing results: as the link towards possible sources and pathways is often not clear from the available data, additional surveys haven been conducted to complement the existing data and provide enough level of detail.
- Detailed (Access) analysis on the gathered information to identify the main sources and loopholes.
- Quality control and revision by local stakeholders: First, workshops have been set up per regional sea to check the existing results and to complement them from a practical perspective. Secondly, in depth interviews have taken place with local stakeholders to verify and analyse possible loopholes and gaps and to identify measures to fill loopholes and gaps (see Chapter 5).

3.1 Inventory of existing data sources

Existing marine litter data, obtained in monitoring programmes, projects and/or recorded during clean-ups in each of the selected study sites are summarised below. Regional Partners contacted data-owners and proceeded with requirements to access and utilise the data for their study.

Table 3: Existing data sources for Oostende (North Sea case)

OOSTENDE	
P1: OSPAR (100 m)	
Site surveyed	Oosteroever
Compartments	Beach 100m
Data owner and accessibility	OSPAR, Dienst Marien Milieu/ BMM; free access
Time series, frequency and age of data	2001-2006 (3 or 4 surveys/year)
Location of site ref. port/river	Downstream (East) Oostende Port and Channel Bruges-Oostende (Plassendale)
Methodology and categorisation of items	Beach litter count and recording over 100m length. OSPAR protocol (107 type of items, divided in 11 categories)
P2: OSPAR (1 km)	
Site surveyed	Oosteroever
Compartments	Beach 1km

OOSTENDE	
Data owner and accessibility	OSPAR, Dienst Marien Milieu/ BMM; free access
Time series, frequency and age of data	2001-2006 (3 or 4 surveys/year)
Location of site ref. port/river	Downstream (East) Oostende Port and Channel Bruges-Oostende (Plassendale)
Methodology and categorisation of items	Beach litter count and recording over 1km. (21 type of items, divided in 5 categories)
P3: AS-Made research project (beach)	
Site surveyed	De Haan: Beach site 5 km from Oostende port
Compartments	Beach 100 m
Data owner and accessibility	UGent/ Coördinatiepunt Duurzaam Kustbeheer; data accessible through contacts
Time series, frequency and age of data	2010-2011 (3 surveys/year)
Location of site ref. port/river	Beach site, downstream from port/river.
Methodology and categorisation of items	Beach litter count and recording over 100m length. OSPAR protocol (107 type of items, divided in 11 categories) including micro-litter; agreement to have insight in data on our request.
P3: AS-Made research project (sea)	
Site surveyed	Offshore Belgian part North Sea, including in front of Oostende port
Compartments	Sea surface (floating) – water column – sea bottom
Data owner and accessibility	UGent/ Coördinatiepunt Duurzaam Kustbeheer; data accessible through contacts
Time series, frequency and age of data	2010-2011 (3 surveys/year)
Location of site ref. port/river	Offshore site surveyed in front of port of Oostende
Methodology and categorisation of items	OSPAR categorization (water)

Table 4: Existing data sources for Barcelona (Mediterranean Sea case)

BARCELONA	
P1: SILMAR Badalona Monitoring Station	
Site surveyed	Badalona, Pont del Petroli
Compartments	Bottom 100mx5m
Data owner and accessibility	Fundación Mar. Free access
Time series, frequency and age of data	Badalona SILMAR (bottom): 2010 and 2011 (3 each year)
Location of site ref. port/river	Badalona beach : 5 km downstream Masnou fishing and leisure harbour and *Rieras**; 35 km downstream of Mataró *Rieras* (2) and harbour
Methodology and categorisation of items	Bottom surveys of items found and precise locations.
P2: SILMAR Llobregat Monitoring Station	
Site surveyed	Llobregat delta area
Compartments	Bottom 100mx5m
Data owner and accessibility	Fundación Mar. Free access
Time series, frequency and age of data	2011 (Sept/Oct)
Location of site ref. port/river	Llobregat beach right at the mouth of Llobregat river and right next to the maritime entry of Barcelona Port.
Methodology and categorisation of items	Bottom surveys of items found and precise locations.
P3: Med Centre EUCC Beach Survey	
Site surveyed	Barcelona San Sebastian
Compartments	Beach 100m
Data owner and accessibility	EUCC. Free access to raw data.
Time series, frequency and age of data	March 2011.
Location of site ref. port/river	Barcelona beach: downstream Barcelona leisure Olympic harbour and the Besos river mouth
Methodology and categorisation of items	OSPAR 100m (107 type of items, divided in 11 categories)
P4: Clean-Up the Med	
Site surveyed	Badalona and Barcelona San Sebastián beaches
Compartments	Beach
Data owner and accessibility	Badalona Casa del Mar, Barcelona Centro de la Playa and Med Centre EUCC. Free access

BARCELONA	
Time series, frequency and age of data	Badalona 2006, 2008 and 2011 (once a year) Centro de la Playa 2008, 2009, 2010, 2011 (at least once a year); Med Centre 2006 and 2008 (once a year)
Location of site ref. port/river	Badalona beach : 5 km downstream Masnou fishing and leisure harbour and *Rieras**; 35 km downstream of Mataró *Rieras* (2) and harbour Barcelona beach: downstream Barcelona leisure Olympic harbour and the Besos river mouth
Methodology and categorisation of items	Materials (Badalona 2 types of plastics)
P5: Litter collected by Barcelona Port Authority	
Site surveyed	Area within the Port of Barcelona
Compartments	Floating and bottom litter
Data owner and accessibility	Barcelona Port Authority
Time series, frequency and age of data	2011
Location of site ref. port/river	Within the Port area
Methodology and categorisation of items	Floating and bottom collection, calculation of weight and description of key categories in detail

Table 5: Existing data sources for Riga (Baltic Sea case)

RIGA	
P1: Environmental School for Children	
Site surveyed	Vakarbulli beach
Compartments	Beach
Data owner and accessibility	Environmental School for Children
Time series, frequency and age of data	October 2011
Location of site ref. port/river	Bordering the port area. Downstream.
Methodology and categorisation of items	only material type (plastic) and amount of plastic bottles
P2: Fund Environmental Education	
Site surveyed	Vakarbulli/Daugavgrina
Compartments	Beach
Data owner and accessibility	Education fund Environmental
Time series, frequency and age of data	No data available
Location of site ref. port/river	Downstream

RIGA	
Methodology and categorisation of items	UNEP/beach survey 100m. 77 categories

Table 6: Existing data sources for Constanta (Black Sea case)

CONSTANTA	
P1: Coastwatch	
Sites surveyed	Constanta tourist beach
Compartments	Beach
Data owner and accessibility	Mare Nostrum NGO. Accessing this data involves cost as the NGO will be involved in the study. There is raw and processed data available.
Time series, frequency and age of data	Mare Nostrum has done the beach survey yearly from 2005 onwards.
Location of site ref. port/river	5km upstream (North) of the Danube navigational channel and Constanta Port
Methodology and categorization of items	Beach litter count. Mare Nostrum identified the following type of items: • Packaging PET (plastic bottles) • Plastic lids (including those of PET packaging) • Plastic cups and plates • Packaging of various foods and non-foods products • Plastic bags and sacks • Other. There have been encountered following types: lighters, disposable cutlery, straws, toys, scrap loungers, plastic crates, boxes of medicines, parts from other objects.

The selected study sites had different number of data sets, level of inherent quality and time series.

Oostende, as part of the OSPAR reference beach programme, had a good time series of data, with a good detail of categorization of items, though the data had only been collected until 2006. However, the research initiative AS-MADE, which applied the OSPAR methodology for its beach surveys and had also surveyed other marine compartments, could be used for filling in this temporal gap.

For Barcelona and Constanta there had been several initiatives that included recording litter, in particular associated to beach clean-ups, but some of these did not provided sufficient detail on items. An interesting aspect of the data in Barcelona, is the fact that the programme SILMAR and the floating litter collection inside the port of Barcelona, may reflect input from local sources, *i.e.* river

discharge and port activities (though in this last one, a considerable fraction of the floating litter accumulated in the port is believed to brought by currents, from the sea and not generated in the area).

For Riga, there is data associated to an education campaign, with beach clean-up and some level of recording of items but the key data to be used was still to be generated. The project MARLIN (a Baltic Interreg initiative) had surveys foreseen for a timing that fits with this pilot project and their recording methodology could be adapted and the data used for the purpose of our project.

3.2 Additional surveys and data collection methodology

Within the frame of this exercise, additional surveys haven been conducted to complement the existing data and provide enough level of detail, even if these would only represent a " snap-shot" of the reality. Given the easy accessibility from the Regional Partners to the coastal areas in the sites, they planned 2 or 3 beach surveys between the period of April and June, 2012, set-up in such way to capture the situation before and during the bathing season.

NORTH SEA – OOSTENDE	
Beach surveys	Two additional 100-metre beach surveys have been performed at the **Oostende 'Oosteroever' beach** (after breakwater one), in March and April 2012. Oostende 'Oosteroever' is the same beach as surveyed during the OSPAR project (2002-2005).
River Surveys	No river surveys have been performed.
Port Surveys	On two different days, the port of Oostende was visited: at March 26th and April 26th 2012.
MEDITERRANEAN SEA – BARCELONA	
Beach surveys	Four additional beach surveys were executed. Two additional surveys were carried out in **Badalona municipality**, one on 30th of April 2012 after a rain (not especially heavy) episode, and another on 18th of July in order to monitor the influence of heavy tourist use. The pont del petroli and estation beaches receive, depending on currents and winds, inputs from maritime transport related to Barcelona port, the river Besos. This area receives direct input from the northern coast with strong tourism pressure and from the seven *rieras* that cross the municipality of Badalona. Five of the *rieras* are connected to the sanitation system. The two northern ones are not connected and discharge directly to the sea. The survey of 30th of April covered a larger area in order to monitor the overflow channels (on the beach itself) of the sewage system, directly linked to the influence from *rieras*. The other survey was carried out at one **beach at Prat the Llobregat**, on 11 of May 2012. It is a naturist beach, the closest to the Nature Park at the Llobregat Delta. The beach should be cleaned mechanically but due to difficulty of access for machinery it is cleaned manually.

	The **Delta beach** is not accessible due to breading session. It was surveyed early august as it is of interest due due to the absence of cleaning (only 2 clean-ups a year). The late timing of this survey did not allow to take this survey into account for the detailed analysis.
	One **floating litter survey** has been carried out in Barcelona. The municipal services allowed us to carry out a survey of the litter collected during a morning at the beaches covering the area from the Olympic port to the end of San Sebastian beach (beaches of San Sebastian, Sant Miguel, Barceloneta and Somorrostro, covering about 2,5 km). The wind from land to sea resulted on a small collection of litter items. The municipal services confirmed that in different weather conditions the number of items would have been considerably higher.
River Surveys	No specific river surveys were carried out. The monitoring of Badalona beach on the 30th of April did address the input from *rieras* as part of sewage overflow channels.
Port Surveys	Due to the detailed characterisation carried out by the Port (two surveys in winter 2011) and the plan to repeat it in the summer/autumn 2012, no additional survey was carried out. However, the results of the port surveys were adapted to the methodology used for the pilot study, and the identification of the main sources and pathways (marine litter tree) has taken these results into account.
BALTIC SEA - RIGA	
Beach surveys	Due to stream directions in the Southern part of the Gulf of Riga, the survey sites were selected **on both sides of Riga city**. The city has also established official coastal bathing areas in both sides – West and East side. The beach surveys were conducted near to the border of active bathing zone. Two sections were selected in Vakarbulli (sequentially) and Daugavgriva (on the both sides of the active beach zone) and 1 section in Vecaki (towards port area). One 100 m section was also chosen for river banks. The first survey was performed just after the snow melt, the ice pieces still present on the shore line. Thus, the litter that accumulated during the winter season could be collected and analysed. The second survey of coastal beach sites was performed after the beginning of the official beach season (15 May). This means, that waste management companies have been collecting beach waste daily. The survey was also performed just after a stormy weekend, thus giving a chance to record washed out items, as the Gulf of Riga does not have tidal regime.
River Surveys	Two sites on the left and right banks of the river Daugava were surveyed according to the project methodology.
Port Surveys	No port surveys have been performed.

BLACK SEA - CONSTANTA	
Beach surveys	**Constanta Beach**: The beach from Constanta (1 km) was divided into 5 sectors of approximately 150-200 meters. The first set of surveys was performed on each of these 5 sectors before the summer season start (May 1st). For the second set of surveys we selected 2 beach sectors as being representative for the whole beach. This second set of surveys for these 2 sectors was implemented after the summer season start in order to observe the direct influence of tourism on the litter types and quantities. **Navodari Beach**: from the total beach length (1,5 km), 2 representative sectors of 100-200 meter were selected. On each of these sectors, 2 surveys were performed; one before the summer season start and one after.
River Surveys	**Danube- Black Sea Channel**: Due to the fact that the Danube-Black Sea channel has 2 branches, the initial purpose was to perform a set of 2 surveys on each of these branches. On the South Branch this was impossible due to high concrete walls on each side. So the surveys were performed only on the North branch that goes to Midia (a satellite of Constanta Port). 2 surveys were performed, again one before and one after the summer season on a section of approximately 200 meters.
Port Surveys	**Constanta touristic port**: One visual survey was performed within the touristic port. **Constanta industrial port**: With the help of Constanta Port Administration one visual survey was performed within the industrial port of Constanta. Due to the large size of the port, the survey was focused on an area known for accumulation of waste.

Appropriate guidance were developed for these supplementary beach surveys. It is strongly based on the methodological tool provided by the MSFD Technical Sub-Group on Marine Litter but additional guidelines are added for the sake of this pilot project. The guidelines include a visual guide, with illustrations of items that could be difficult to identify, a template for a data recording sheet with the different categories of items, including additional categories created or sub-divisions within OSPAR 100m categorization (see paragraph 3.3.1 below). The project team surveyed, wherever possible and appropriate, the banks of the river that discharged in the area. This could provide some insight into the river contribution but it should be stressed that this is still an undeveloped knowledge area, with several limitations in terms of obtaining reliable data. The guidelines are included in Annex 4.

Annex 4: Guidelines for additional surveys pilot project '4 Seas'

3.3 Detailed analysis of collected data

3.3.1 Parameters of the " Marine Litter Tree"

A series of parameters are identified, going beyond the traditional classification on material types and categories of item (Table 7). The parameters are designed to enable:

- to pinpoint sources, pathways, loopholes and gaps of marine litter;
- to identify key strategies to address dysfunctions in the system.

For the categorization of items, we used the OSPAR categorization (after 2009 adjustments). Some of these categories were further specified, for example, OSPAR ID 7 "Cosmetic bottles and containers" was further specified in 2 sub-categories: those items that are beach related (e.g. sun-block bottles) and those that are related to hygiene (e.g. aftershave containers). This is because OSPAR categorisation includes categories of items that can have very distinct sources, i.e. likely from beach or coastal recreation and shipping or other non-recreational activities.

Table 7: Parameters used in the marine litter tree

Parameter	Choice options	Kind of attribution
Material *(the main material of which the litter is composed)*	Plastic/Polystyrene; Rubber; Cloth/textile; Paper/cardboard; Processed wood; Metal; Glass; Sanitary; Medical; Other pollutants; Ceramic/pottery; Faeces (bagged); Other	one single selection
Life cycle phase	Pre-consumer phase – industrial process phase Pre-consumer phase – transport Post-Consumer phase – waste/litter disposal by industry or private consumers Post disposal phase – waste treatment chain escapes	Attribute likelihoods (4 levels)
Use category	Packaging Use item (consumption good) Raw material Recreational item (as a specific form of use item)	one single selection
Packaging type *According to Article 3.1 Packaging and Packaging Waste Directive 1994/62/EC*	Primary – product packaging e.g. candy wraps Secondary – group packaging e.g. six-packs Tertiary – shipment packaging e.g. pallets Quaternary – service packaging e.g. shopping bags Unknown/multiple Not relevant (in case of other use categories)	one single selection
Use durability	Short life, single use Long lasting item Multiple-dose/use	one single selection

Parameter	Choice options	Kind of attribution
Source activity	Individual/Consumer Professional/Industrial Unknown	one single selection
Sector of origin	Fishing; Shipping; Other Maritime Industries; Aquaculture; Coastal/Beach tourism; Recreational boating; Agriculture; Port activities; Construction & demolition; Other industrial activities; General household waste littering or fly tipping; Toilet; Dump sites/ landfills; Waste collection/transport	Attribute likelihoods (6 levels)
Main origin	Sea-based Land-based	Attribute likelihoods (4 levels)
Release	Intentional, including negligence Accidental	Attribute likelihoods (4 levels)
Pathways	Direct (on site dumping) Diffuse (sewage) Diffuse (inland waterways and *rieras*) Diffuse (others)	Attribute likelihoods (4 levels)
Geography of origin	*In situ* generation Local (short distance) Long distance or transnational	Attribute likelihoods (4 levels)
Fragmenting	Early (will fragment in decades) Late (will fragment in centuries)	one single selection
Risk/impact	Ingestion; Entanglement; Maritime safety; Beach-use safety; Aesthetics; Invasive species; Toxic	Multiple selection

3.3.2 Likelihood approach

Several monitoring or beach clean-up programmes have defined "item-indicators" to assess the contribution of different sources (e.g. OSPAR, clean-up campaigns from the Marine Conservation Society (MCS)). While some items are straight forwardly related to specific sectors (e.g. fishing gear) most marine litter items can originate from multiple-sources and usually some of the categories of source-indicator items are very broad (e.g. "public litter" or "tourism/recreation", used by MCS and OSPAR, respectively).

For this study, we used the *Matrix Score Technique* [TUDOR & WILLIAMS 2004], which allocates different levels of likelihoods of each litter category to potential sources. The likelihoods are then given a score and the relative contribution of the different sources calculated. This method allows for the possibility of specific item types originating from more than one source; this flexibility and transparency means that is less prescriptive than some other methods.

The attribution of likelihoods was made based on the type of litter, distance to each source, dimension of the activity in the area, waste management practices and any other local factor that is known to affect litter contribution. It is therefore crucial that this exercise is made considering the local conditions and with a close knowledge of the activities in the area, including waste management practices. The team used regional workshops, where stakeholders from key sectors were present, to discuss and define, consensually, likelihoods for the top marine litter items found in the area.

The likelihood methodology was not only used for the *Source-Sector* parameter but also to attribute other parameters, including *Pathways* through which litter may reach the marine environment (Table 7).

3.3.3 Data sheets and processing to pinpoint sources and pathways

Regional Partners collected existing or new raw data. An excel template was prepared to collect the data. This excel sheet includes

- the categories of items;
- the numbers of occurrence in the examined data sources and in the additional surveys;
- the parameters as indicated above in Table 7 with scroll-down optional answers and the 4 or 6 levels of likelihoods for certain number of parameters.

The data collection exercise and the analysis on the properties, the probable and possible sources and pathways leads to excel sheets, one for each major data source, summarising the parameters for each found category of marine litter.

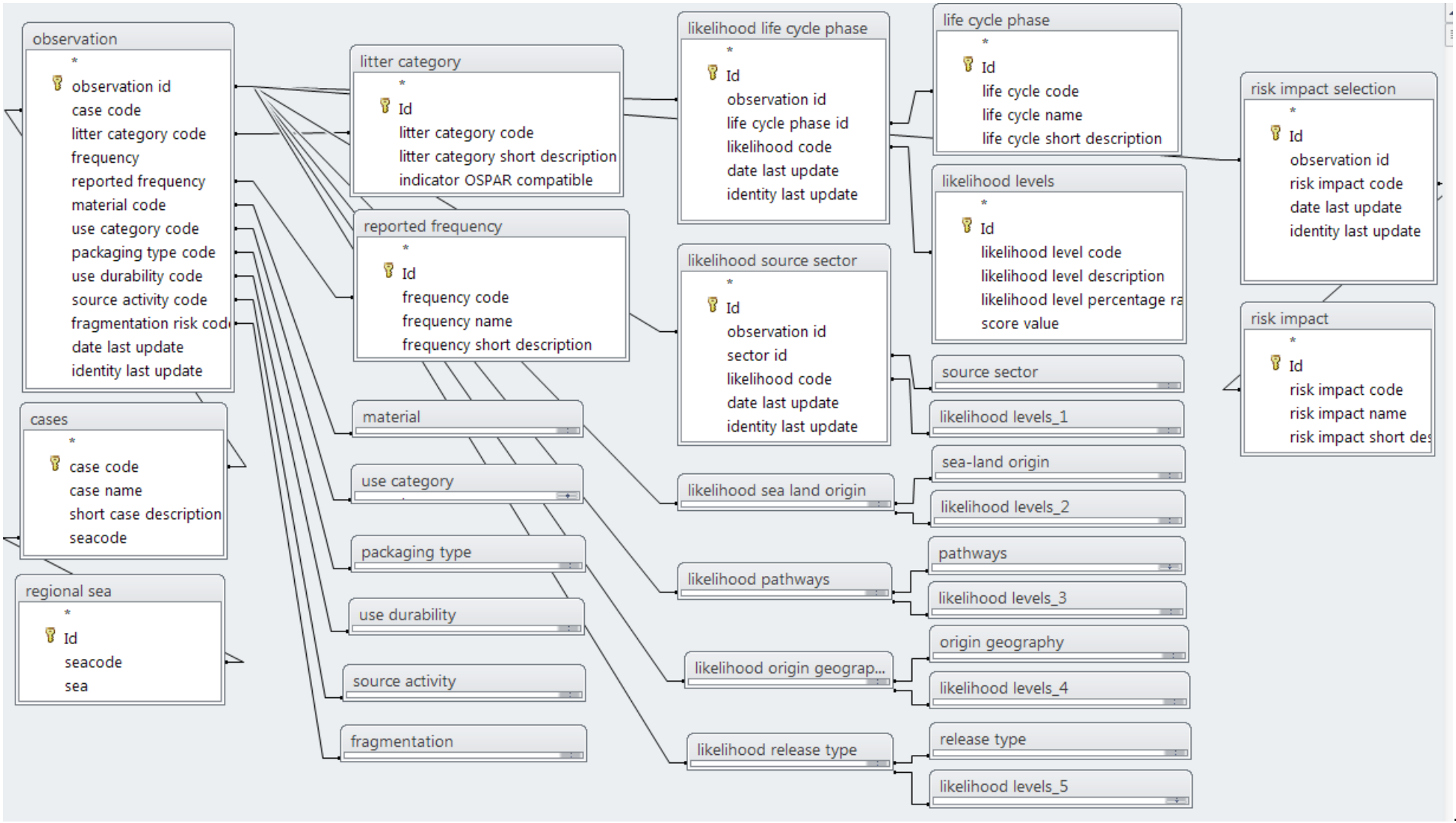
3.3.4 Detailed Access Analysis

After a consistency and quality revision, all data excel sheets were converted to Microsoft Access to allow a more detailed analysis. An Access application is developed in which all datasets with parameters can be introduced, to facilitate the analysis on possible relations, trends and similarities or differences between the four regional seas. Scope of the analysis is to identify for each regional case the main driving factors (either sources, gaps, loopholes or vectors) having impact on the marine litter in this specific case. Because of the careful selection of the case, the results might be extrapolated as a trend representative for the whole regional sea. The application also allows structured comparison between the different cases, although this is not its first scope.

The database structure starts from the individual observation of marine litter categories. It is identified by referring to its extended OSPAR identification code, to the case and to the data source in which it is found. Quantitative data on the number of observations of this category are added.

Three kinds of links are connected with this observation:

- Straight one-to-one links on specific characteristics and parameters linked to the observation; e.g. the nature of the material, …
- Likelihoods ; the observed or analysed chance that the category is linked to a specific parameter like a source, a sector
- A one-to-many relation with (possible multiple, simultaneous) hazard characteristics.


observation
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case code
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material code
use category code
packaging type code
use durability code
source activity code
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litter category
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litter category code
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likelihood release type
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life cycle short description
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likelihood levels_1
sea-land origin
likelihood levels_2
pathways
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origin geography
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release type
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The Access application uses SQL queries to find answers to following and comparable questions:

- What are the predominant categories of marine litter observed in a case? What is the predominant material?
- Are there significant differences in the composition of the marine litter between: the different cases/seas, the winter and summer data-sources, the nature of the data gathering/the kind of data source …?
- Taking into account the identified likeliness's and the observed frequencies of occurrence, what are the major sectors contributing to the marine litter?
- Are there different key sectors when comparing cases/seas?
- What are, taking into account the identified likeliness's and the observed frequencies of occurrence, the predominant pathways? For which litter categories?
- What is the balance between fly tipping and deliberate dumping, and accidental losses or escapes from waste collection cycles?
- What is the balance between pre-consumer and post-consumer marine litter?
- What is the balance between waste from offshore or shipping sources and land-based sources?
- What is the balance between industrial origin or private, consumer origin of the marine litter? What are the predominant life-cycle-phases in the material streams in which marine litter does originate?
- …

Likelihoods are scored using the methodology described in *Matrix Score Technique* [TUDOR & WILLIAMS 2004] (Table 8). The likelihood level used for each parameter can be found in Table 7.

Table 8: Likelihood levels and score values

likelihood levels		
likelihood level description	**likelihood level percentage range**	**score value**
6 level codes		
very likely	parameter attribution is almost certain ~100%	16,00
Likely	parameter attribution high >70% chance	4,00
Possible	parameter attribution is more or less 30%-70% chance	2,00
Unlikely	parameter attribution low	1,00
very unlikely	parameter attribution is very unlikely	0,25
not to be considered	parameter attribution is extremely unlikely or impossible ; ~0% chance	0,00
4 level codes		
likely	4 level code ; parameter attribution high chance 70% to 100% chance	4,00
possible	4 level code ; parameter attribution is more of less chance 30%-70% chance	2,00
unlikely	4 level code ; parameter attribution low chance	0,25
not to be considered	4 level code ; parameter attribution is extremely unlikely or impossible; ~0% chance	0,00

3.4 Regional stakeholder workshops

The general objectives of workshops were:

- To inform the local stakeholders about the project;
- To gather knowledge on potential loopholes in waste management and sectors in the area that can lead to marine litter;
- To establish consensual likelihoods for sources and pathways of the main items of marine litter reflected by existing and/or collected data.

Regional Partners identified key local stakeholders, in particular those that have institutional responsibility on waste management or representing key sectors that may be involved in litter generation. Preference was given to " hands-on", technical staff of these entities, because they may have a more empirical insight into their sectors and loopholes.

The general setting for the workshops, including key activities and proposed process in sub-groups was provided and coordinated by EUCC. Regional Partners adjusted the activities, order and process to their regional context and participants involved.

The workshops were organised and conducted in an adaptive approach: because the workshops ran in different occasions, it was possible to critically evaluate the first ones and use lessons learned, what activities and processes worked best in the subsequent ones. A summary of the four workshops is given below. Detailed reports are presented in Annex 5. All workshops have been able to involve enthusiast participants that showed a big interest in the theme.

Annex 5: Regional workshop reports

3.4.1 North Sea - Oostende

Location and date	Oostende, 6th June 2012
Nr of entities invited / Nr of participants	26 participants registered / 22 participants took part
Sectors / entities represented	**Government / Authorities:** FOD Dienst Marien Milieu, MDK, Municipality of Oostende. **Port:** Port Authority of Oostende, SDVO **Waste Management:** OVAM, SITA **Research:** BMM, ILVO, eCoast, University of Gent **Association/Foundation:** Waste Free Oceans Foundation, Vzw Federplast
Main activities	- Plenary session and discussion, where participants, in turns, presented their views and experience regarding how marine litter affects their own sector, possible loopholes and solutions that may be in place or needed. - Independent attribution of likelihoods of main litter items registered in the surveys and OSPAR data to their sectorial sources and pathways of entry in the marine environment.
Main points of discussion and conclusions	Plastic is the main fraction of marine litter; a lot of effort has been made in Belgium but there is still a long way to go; results of measures can take some years to produce visible results; "litter creates litter" – attention should be given to remove litter as quick as possible to avoid other people to add their own; major problem in

Location and date	Oostende, 6th June 2012
	EU is "dumped" litter, improperly disposal by people in general. **Loopholes:** land-based and port waste collection is evaluated as being well organised and effective, minor loopholes may occur due to seagulls disturbing curbsite collection and public bins, or maladapted street cleaning activities near the quays. Seabased loopholes on waste management are considered a predominant factor. **Main sources:** Main sources are believed to be ship-based activities (incl. anchoring area) and coastal tourism **Pathways**: On site generation of waste and litter, directly disposed of in the marine environment is considered a major pathway. Riverine influence or influence occurs, but influence from waste water treatment and sewerage only occurs in case of extreme weather conditions and overflow systems. **Measures:** More coordination and cooperation for litter responsibilities and initiatives; More control and enforcement; combination of adequate infrastructures and proper consumer disposal; sensitization targeting coastal tourism requires a common EU approach as tourists are changing all the time; Awareness of non-EU countries that share EU regional seas; recycling is the future.

3.4.2 Mediterranean Sea - Barcelona

Location and date	Barcelona, 31st May 2012
Nr of entities invited / Nr of participants	22 participants registered / 12 participants took part
Sectors / entities represented	**Regional Government**: the agency responsible for water quality (inland and coastal waters); **Local Governments**: The metropolitan agency in charge of waste collection and management (incl. beaches); the municipalities of the area (representatives from sanitation and beach management); **Ports**: Port Authority of Barcelona and Ports of Catalonia **Companies**: CLABSA (Management of the sewage system); ECOEMBLES (in charge of collection and recycling of drinking containers); **Projects**: LIFE +3R'Fish - management of waste produced on board of fishing boats; **Research**: CSIC (Spanish High Council of Research) and University of Barcelona; **Associations**: Two associations related to waste prevention and responsible consumption.
Main activities	- Identification of loopholes in the different sectors in Barcelona region; - Attribution of likelihoods of main litter items registered in the surveys to their sectorial sources and pathways of entry in the marine environment; - Brainstorming on corrective measures;
Main points of discussion and	**Loopholes:** during intense rain periods, the waste water collection and treatment limit is reached and the system is open, releasing untreated water, which can

Location and date	Barcelona, 31st May 2012
conclusions	include solid waste. "*Rieras*" were identified as an important pathway. High number of cotton bud sticks reflects improper disposal of items in the household (toilet). The sanitation system is therefore a very important pathway to transport solids from household, toilet flush and *rieras*. **Main sources:** Coastal tourism (beach and marina users), recreational boating, domestic household, street littering and litter collection around beaches and marinas. **Pathways**: direct for most of them but 2 very important diffuse pathways, namely sewage and "*rieras*" (connected or not to the sanitation system).. **Measures:** Solutions should not only be based on increasing capacity to deal with increasing waste production. Technology should be improved but it was recognised that the priority should lie waste production itself – e.g. improving consumption patterns (refuse, reduce, reuse), the design of materials and products (biodegradable, reusable, increased value), regulation of disposal, improving the recycling system and possibly return-deposit system for bottles and others.

3.4.3 Baltic Sea - Riga

Location and date	Riga, 6th June 2012
Nr of entities invited / Nr of participants	14 participants took part
Sectors / entities represented	**Government / Authorities:** Ministry of Environmental Protection and Regional Development (MoEPRD); Riga City Council – Beach Management in Pardaugava district, Ziemeju District, Housing and Environmental Department); **Port:** Free Port of Riga Authority; **Waste Management:** "Green Dot" – packaging waste management organisation; waste management association **Research:** Latvian Institute of Aquatic Ecology; **Association/Foundation:** MARLIN Project/Foundation for Environmental Education; Baltic Environmental Forum;
Main activities	- Discuss loopholes in the plastic cycle and, in particular, review gaps in the waste management system that can cause marine litter; - Attribution of likelihoods of top marine litter items found in surveys to sectorial sources, type of release, pathways and geographical origin.
Main points of discussion and conclusions	**Loopholes:** waste management, in certain municipalities, e.g. poor compliance of existing waste management regulations, lack of separation schemes and lack of complete regulation on local level. Lack of awareness of people on the impacts of marine litter was considered as an important reason for littering. Summer houses in coastal area: many owners dump their household litter in order to avoid the payment for waste tax of a second-house. Collection points can be found on main beaches but not on connecting areas. Shipping litter is seen as unintentional, i.e. blown-off or washed overboard. Passengers' ferries are seen as intentional key source, with litter thrown overboard. Fishery sector seems not to be in focus of litter

Location and date	Riga, 6th June 2012
	problem. Economic restrictions is considered to limit the improvement of waste management in the municipalities; though Latvia implemented a tax on carrier plastic bags, this revenue should be allocated to improve waste management; waste management is not considered a priority in Latvia and therefore difficult to prioritize allocation of funds; Responsibilities are not always clearly defined; **Main sources:** In line with HELCOM report – household and tourism as key land-based sources and shipping (cargo and cruising) and fishing as main sea-based sources. **Pathways**: Direct disposal or windblown litter are considered important pathways. The river Daugava crosses multiple countries and could be a source of litter transported over long distance. **Measures:** Better regulation/guidance for shipping, to avoid litter to go overboard; awareness and educational activities towards general public; penalty system is seen as the most effective strategy to address improper disposal.

3.4.4 Black Sea - Constanta

Location and date	Constanta, 21st June 2012
Nr of entities invited / Nr of participants	14 participants took part
Sectors / entities represented	**Government / Authorities:** Environmental Protection Agency; Black Sea- Danube Channel Authority **Port:** Port Authority of Constanta **Waste Management:** Eco-Rom Ambalaje **Research:** National Institute for Marine Research **Association/Foundation:** Mare Nostrum (local NGO)
Main activities	- Discussion about weaknesses and strengths of the waste management sector as well as the loopholes in the various sectors causing marine litter in the area; - Attribution of likelihoods of main litter items registered in the surveys to their sectorial sources and pathways of entry in the marine environment; - Elaboration of proposals for the measures improving the present system.
Main points of discussion and conclusions	**Loopholes:** Lack of clear and coherent legal framework for dealing with marine litter; lack of correlation between waste management and marine litter legislation; lack of monitoring system for marine litter; lack of rapid response system, especially in applying the producer responsibility principle; difficulties in mobilising the responsible authorities in dealing with marine litter; lack of environmental awareness of public at large; illegal waste dumping close-by water bodies. Due to the setup of the workshop, more based on presentations by stakeholders, less time was made for discussing aspects other than the above mentioned loopholes. These other aspects will be taken into account during the planned individual interviews.

3.5 Interviews with stakeholders

In depth interviews have taken place with key stakeholders with a two-folded purpose:

- To verify and analyse possible loopholes and gaps (Task 3);
- To identify measures to fill loopholes and gaps (Task 4)

As the majority of the identified stakeholders can contribute to both of these objectives, for reasons of efficiency one questionnaire has been made up dealing with both aspects.

3.5.1.1 Stakeholder identification

Stakeholders have been identified at three levels: 1) European/ international level, 2) Regional level and 3) Local level.

A list of stakeholders selected for interviews can be found in Annex 6. In total 61 interviews have been planned, of which 49 resulted in relevant feedback. Mainly at the European and regional level interviews were cancelled at the last moment or the interviewee indicated to have no competence on such a specific topic. At the local level 34 of the 35 interviews were done, resulting in valuable information.

Annex 6: List of stakeholders selected for interviews

3.5.1.2 Questionnaire

A questionnaire has been developed with a double goal; act as a semi-structured guidance for the face-to-face interviews, and as a tool to support telephone interviews. The questionnaire is divided in several subdivisions:

- Identifying the stakeholder/interviewee and its role in the marine litter issue, both as possible source and as aggrieved party.
- Quality check on the conclusions of predominant marine litter and its possible sources, pathways loopholes and gaps in the case area.
- Inventory of existing and possible new measures for marine litter.
- Analysis on effectiveness and feasibility of the proposed measures.
- Administrative, legal, infrastructural, political, geographical context in which measures have to be situated.
- Financial and economic aspects of measures.
- Timeliness, coherence, community added value, measurability.
- Other comments

The questionnaires are tailor made: for contact persons operating at EU level, the specific questions 3 and 4 on quality check of data collected for the regional seas area put in more general phrases. For each regional sea questions 3 and 4 are adapted to the local conditions. The example included in Annex 7 is developed for the European level.

Annex 7: Questionnaire stakeholder interviews (European level)

4 Identification of main sources, loopholes and gaps

4.1 General situation

4.1.1 North Sea

Marine litter monitoring activities

The OSPAR Pilot Project on Monitoring Marine Beach Litter (2000–2006) has been the first region-wide attempt in Europe to develop a method for monitoring marine litter on beaches and to assess presence of marine litter on the beaches in the OSPAR region, using a standardised methodology. A total of 614 regular beach surveys were conducted on altogether 51 reference beaches in eight countries during the pilot project period, 2001–2006. In addition, 10 surveys were made during 2006 on 4 beaches in France (not classified as regular reference beaches). The final report, presents the results based on the statistical analyses of data from the 609 surveys made on regular reference beaches [OSPAR 2007].

The results for the OSPAR Pilot Project on Marine Beach Litter Monitoring showed that from 2001 to 2006 there was no statistically significant increase or decrease of the amount of marine beach litter in the Northeast Atlantic (in surveys of 100m of beach stretch). However, the spatial distribution of marine beach litter was significantly different throughout the area.

Despite the consistent picture of large amounts of marine litter, there are still gaps in the data characterizing the status of marine litter in this region. Most of the available information comes from beach monitoring of litter, but outside the OSPAR monitoring programme almost all the monitoring is undertaken by local authorities or NGOs with very little harmonisation between countries. The data is also not collected centrally within Contracting Parties and in relation to floating litter at sea and on the seabed there are relatively few studies being conducted. Therefore, analyzing the problem in the Wider Atlantic is extremely difficult [UNEP 2009].

Top items reported for the North Sea

In terms of most common items found in all OSPAR reference beaches: plastics/polystyrene pieces (smaller than 50 cm) accounted for approximately 28% of the items recorded. The second most common item on the regular reference beaches on the 100-metre stretches was small pieces of ropes, cords and nets (smaller than 50 cm), which accounted for approximately 14 per cent of all items found.

The most common item found on the 1-km stretches of regular reference beaches was other wooden items, which accounted for approximately 19 per cent of all items found in these surveys. Larger pieces of ropes, cords and nets (>50 cm) were the second most common item found on 1 km-stretches on regular reference beaches, accounting for approximately 18 per cent.

Of all marine litter items found in all 100-metre surveys on the regular reference beaches, an average of 75 per cent were made of non-degradable plastic/polystyrene. Plastic was the most common type of marine litter found also in the 1-km surveys on the reference beaches, accounting for almost 66 per cent of the total, on average.

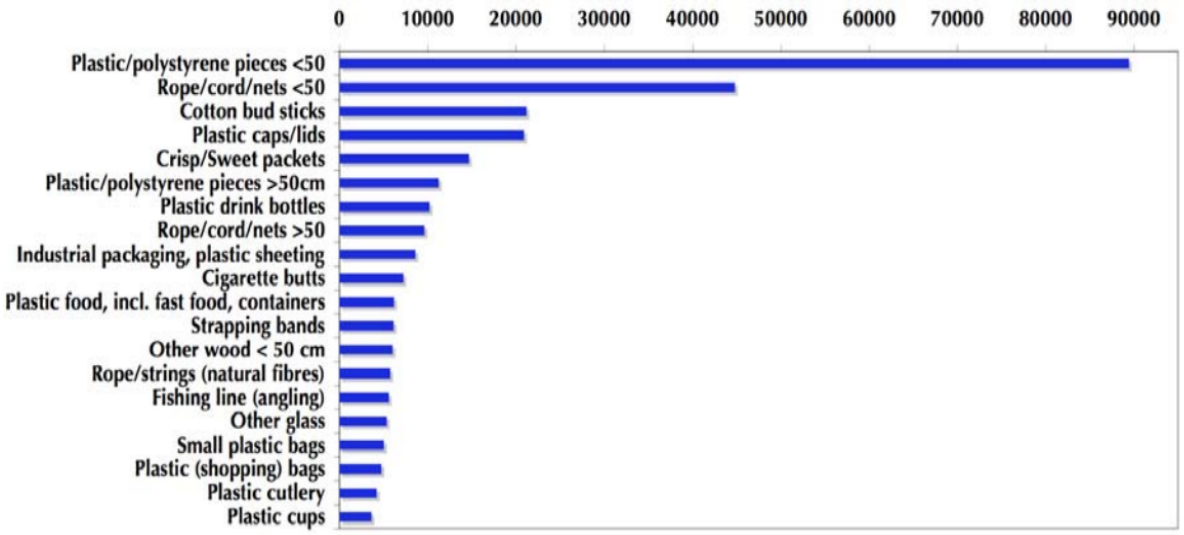

Figure 3: North Sea, most common items on OSPAR reference beaches (Source: [OSPAR 2007])

4.1.2 Mediterranean Sea

Marine litter monitoring activities

Marine litter has been an issue of concern in the Mediterranean since the 1970s. Within the framework of the Convention for the Protection of the Mediterranean Sea against Pollution (the Barcelona Convention), Mediterranean countries adopted the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources and in Annex I of this Protocol, litter is defined as one of the categories of substances.

Numerous activities on marine litter have been organized by the Mediterranean Action Plan (MAP), together with regional NGOs and a large number of international organizations and NGOs have conducted surveys and beach clean-up campaigns yielding data and information on marine and coastal litter pollution of the Mediterranean Sea. These efforts, which continue to the present, are considered a reliable source of data and information for this region [UNEP 2009].

Top items reported for the Mediterranean Sea

According to the UNEP MAP/MED POL report on marine litter[11], when examining the data trends associated to the *International Coastal Clean-Up* events (ICC) (2002-2006), it has been inferred that the total number of items increased while the total weight of litter collected decreased, probably indicating a proliferation of lighter marine litter items in the Mediterranean, including plastics, aluminium and smoking-related litter, as opposed to heavier items from dumping activities such as household appliances, construction materials, tires, etc. Based on data collected from the ICC campaigns but also other surveys, the report identifies the main types (material) of marine litter found in the Mediterranean area.

[11] UNEP/MED POL (2011). Results of the Assessment of the Status of Marine Litter in the Mediterranean. Athens. 89pp.

Table 9: Top 12 marine litter items in Mediterranean (2002-2006) (Source: UNEP/MED POL, 2009)

Item	Counts	%
Cigarettes/Cigarette filters	222,563	27
Cigar tips	86,146	10
Plastic bottles 2 lt or less	81,238	9.8
Plastic bags	70,912	8.5
Aluminum beverage cans	63,282	7.6
Caps/lids	60,920	7.3
Beverages bottles (glass)	48,085	5.8
Cups/plates/forks/knives/spoons	32,037	3.8
Tobacco packaging/wrappers	23,648	2.8
Food wrappers/containers	21,029	2.5
Straws/stirrers	17,184	2.1
Pull tabs	15,488	1.9

4.1.3 Baltic Sea

Marine litter monitoring activities

In 1974, all the Baltic Sea coastal countries signed the Convention on the Protection of the Marine Environment of the Baltic Sea Area, also known as the Helsinki Convention HELCOM. This was a pioneering agreement on many fronts. It was the first regional agreement ever to cover all sources of pollution, whether from land, sea or air. In the light of political changes in Europe, and developments in international environmental and maritime law, a new updated convention was signed in 1992 by all the states bordering on the Baltic Sea, and the European Community.

To date, marine litter has not been seen as a major problem in the Baltic. However, there have not been any comprehensive studies on this topic and the lack of comparable and reliable data has been a significant obstacle to addressing marine litter issues in the region. Information is dispensed and has been collected using a variety of methodologies depending on the reporting organization or authority. Some scattered information is available in a few member states.

The HELCOM marine litter project, co-funded by UNEP, is the first effort in the region to study the scale of the problem, assess the availability of information, and determine the actions needed in order to develop and implement a regional strategy for addressing marine litter [UNEP 2009].

Top items reported for the Baltic Sea

According to the document *Marine Litter in the Baltic Sea Region: Assessment and priorities for response* that was prepared by HELCOM in 2009, the amounts reported by the countries and the information provided by NGOs suggest that there is no clear descending or ascending trend in the occurrence of marine litter found on coasts of the Baltic Sea. The amounts can be substantial at some sites near the sources of litter (e.g. shipping routes, rivers, and public beaches). In the data from the Baltic Sea, the highest amounts found similar to the level found on the beaches of the northern North Sea, as reported in the Final Report of OSPAR Pilot Project on Monitoring. [UNEP 2009]

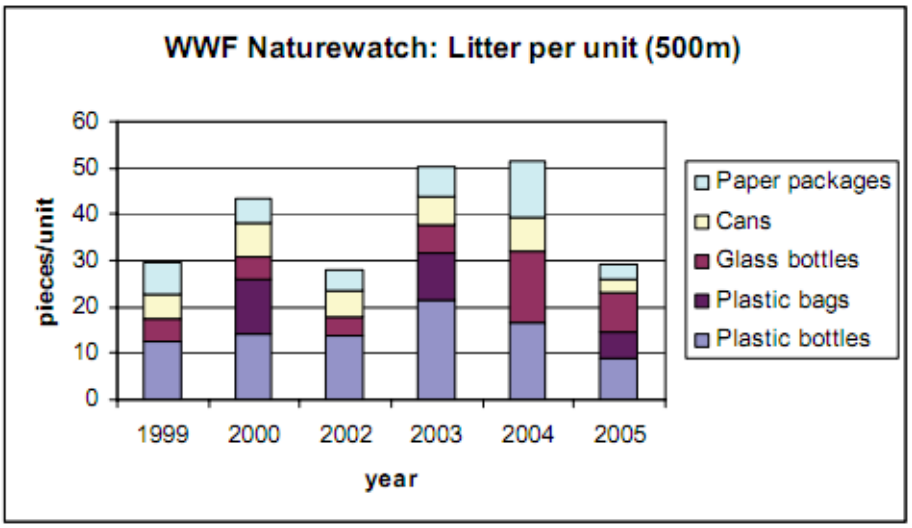

Figure 4: Total number of items of litter found in the Baltic coast *(Source: [HELCOM 2009])*

4.1.4 Black Sea

Marine litter monitoring activities

In 1992, six Black Sea (BS) countries signed the Convention for the Protection of the Black Sea against Pollution (Bucharest Convention), and later established a Commission on the Protection of the Black Sea Against Pollution (BSC) and its Permanent Secretariat (PS) to help with the regional implementation of the Convention and its Protocols. In 1996 BS countries adopted a Strategic Action Plan for the Protection and Rehabilitation of the Black Sea [BS SAP 1996].

Among numerous activities organized by BSC PS, the Regional Activity on Marine Litter, supported by UNEP, was launched at the end of 2005. Main outputs of this activity, which were completed in mid-2007, were the documents Marine Litter in the Black Sea Region: A Review of the Problem (Review Document) and the Strategic Action Plan for Management and Abatement of Marine Litter in the Black Sea Region [UNEP 2009].

Top items reported for the Black Sea

According to the assessment made by UNEP [UNEP 2009] and the Black Sea Commission [BSC 2007; 2009], national experts from Black Sea countries referred as the 4 main sources of marine litter (by order of priority): municipal waste/sewage (household waste); marine transport and ports (shipping waste); recreation activities in coastal area (litter produced by local population and tourists); and river run-off. UNEP report also indicates which are the main marine litter "hot-spots" in each of the 6 Black Sea countries. Plastic items are reported to be the main material type of marine litter in this region. It has been reported that unprotected coastal landfills (e.g. Georgia and Turkey) or even direct dumping are relevant sources of marine litter.

4.2 Main sources, loopholes and gaps per regional sea

Based on the outcome of the data collection (Chapter 3), the analysis of the data, the regional workshops, the interviews the main sources, loopholes and gaps have been identified for the 4 selected study sites. A summary of the results is given below. More detailed information can be found in Annex 5 (Regional workshop reports) and Annex 8.

Annex 8: Regional analysis of existing data

4.2.1 North sea - Oostende

Litter composition

The data collected in the Oostende area, indicates predominantly **sea-based or offshore activities** generating marine litter. **Ropes and nets** are amongst the most found items at the beach, mainly disposed at sea but the port surveys also showed evidence of small pieces of ropes disappearing trough the sewerage system.

Used and discarded consumer goods or production goods are the most frequently occurring kind of material (64%), although **packaging** is as well present. Packaging is predominantly primary packaging, or sale packaging removed by the consumer. This fraction could include as well secondary packaging or group packaging. In surveys the distinction between both can sometimes not be made. The second most frequent kind of packaging is quaternary packaging or service packaging: shopping bags, disposable beverage cups for direct consumption, etc. Tertiary or transport packaging, pallets and other industry or logistics related packaging is remarkably more present (in relative accounts) than in the other European regional seas.

76% of the litter observed in the North Sea case is **plastic**. Unlike other regional seas, sanitary waste does not occur frequently.

In addition, some marine litter issues have been identified by the stakeholders as underestimated in the Oostende surveys (one-time event) or as upcoming elements important to be further considered: **cigarette butts, balloons, fireworks debris, and plastic pellets.** Plastic resin pellets are present but only occasionally observed, depending on the weather conditions, in the tide line. They tend to remain in the floating fraction or on the sea bottom, or cannot be identified during a standard screening. A recent study focusing on micro pellets showed that industrial plastic pellets were the most abundant type of plastics in the four Belgian beach study sites [CLAESSENS 2012] emphasizing that plastic pellets are often an overlooked item in beach surveys. The highest concentrations of micro plastics are found at the high water mark. Since plastic pellets are only used in plastic industry, the presence of pellets on Belgian beaches can only be attributed to accidental spillage during transport or port handling operations [CLAESSENS 2012]. The study also revealed the high occurrence of floating debris (average density of 3.875 items per km² recorded with neuston net). The majority of items floating on the Belgian part of the North Sea are smaller than 1 cm and hence almost imposable to spot from a distance. This explains the high discrepancy with the density of floating debris observed through visual observations (0,66 items/km²) [CLAESSENS 2012].

In general **discarded long-lasting goods** with a long intended use time are **as important as short life single use items**. This in contrast to the other regional seas, where short life single use goods or packaging dominate.

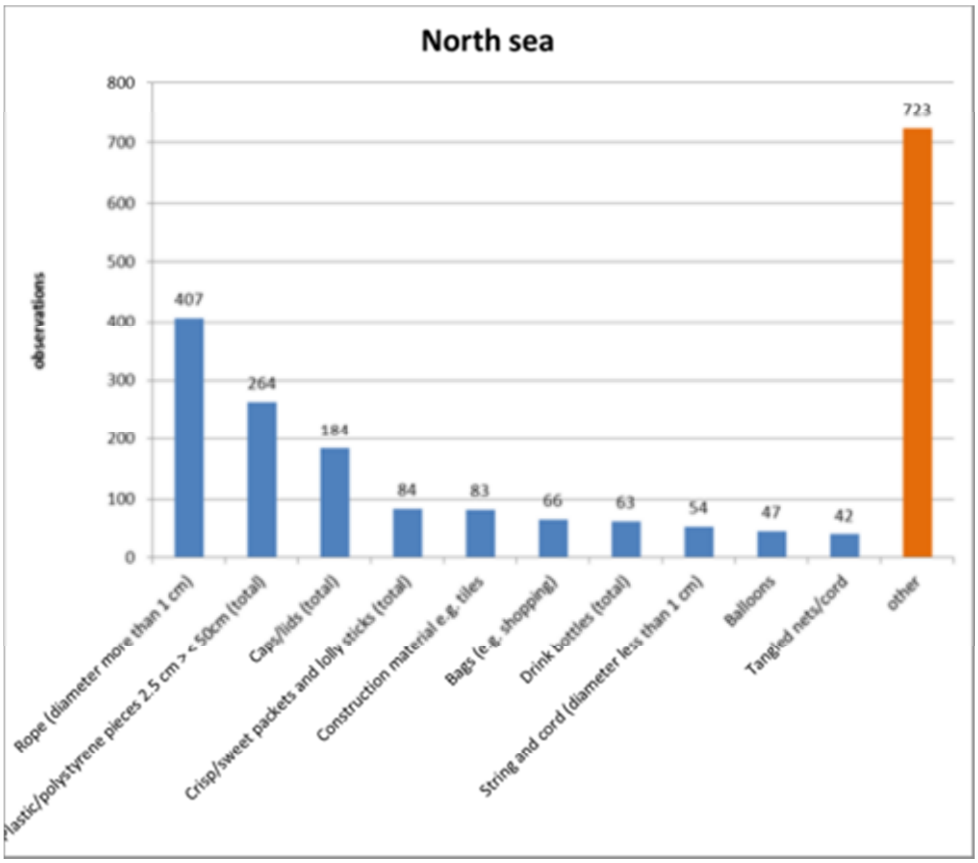

Figure 5: Top ten items in site surveys Oostende (March – June 2012)

Litter sources

In general the **sea-based sources**[12] **seem to be at least as important as the land-based sources**, which is not the case in the other regional seas.

Nearly **40% can be attributed to recreational or tourism activities**[13] (both land- and sea-based). More than half of this fraction indicates **coastal/beach tourism** as its main source. 4**0% is caused by marine activities** like fishing, shipping, port and maritime industries, in which fishing and shipping is responsible for half of this waste. For example, in case of northwest winds waste from the Westhinder anchorage zone can be found frequently on the beach. While 'older' ropes and nets mainly come from fisheries, stakeholders noted that fragments of new, high quality ropes or ropes with a decoration woven into it are not used in the fishery industry, and have thus to be retraced to sailing yachts. A limited fraction of rope and cord can come from coastal protection works, dune fortification.

The remaining fraction of observed litter indicate **various land-based sources**. Household related waste forms a small fraction (10%), unlike the other regional seas (ca. 30 to 50%). Waste escaping from waste collection and transport is generally attributed to seagull nuisance for curb site waste waiting for collection. Ports are a likely source of land-based fishery waste, like rope waste from repaired nets or EPS boxes.

[12] For the purpose of this pilot project the following activities have been classified as sea-based sources: fishing, shipping, aquaculture, other maritime activities, recreational boating). The other activities are considered as land-based.
[13] For the purpose of this pilot project recreational & tourism activities include coastal/beach tourism, recreational boating and recreational fishing.

Industrial sources or sources higher up in the life cycle of products, are as important as consumer sources. Coastal/beach tourism remains however the largest individual source of marine litter (26%).

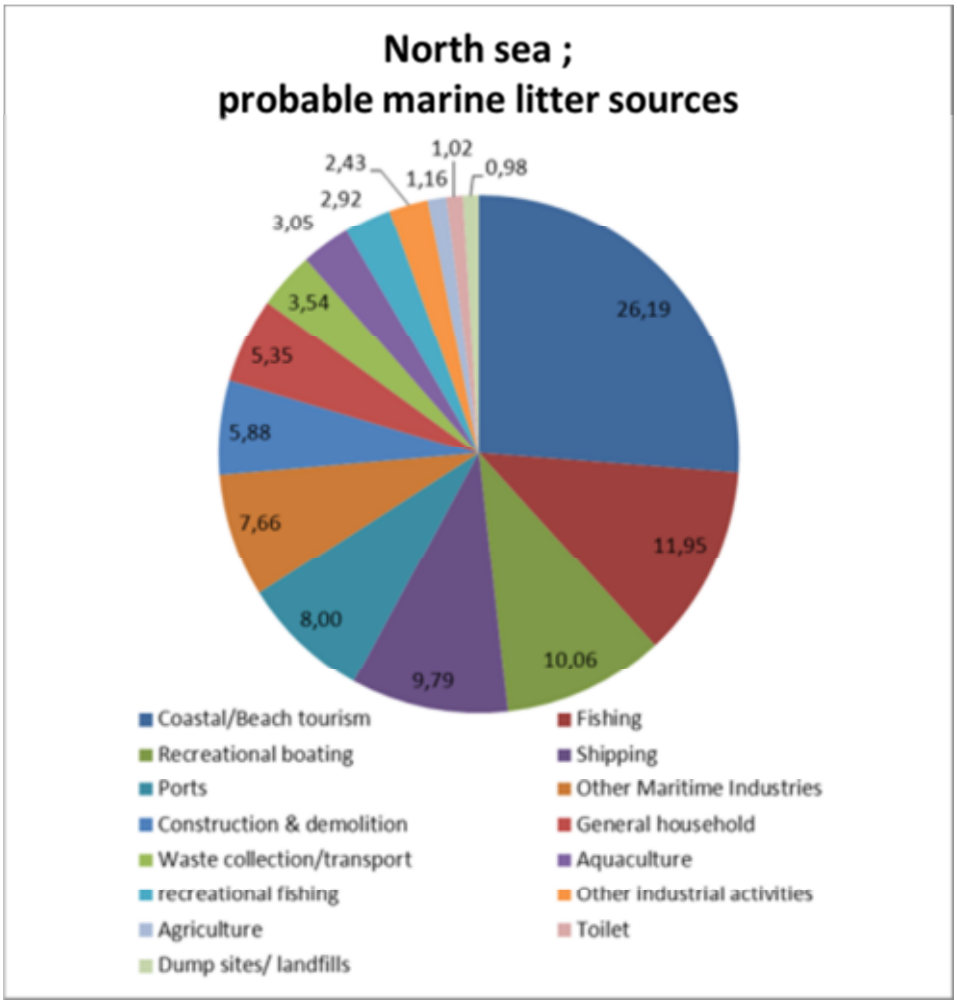

Figure 6: Probable marine litter sources as indicated by site surveys Oostende

Litter pathways

Land-based litter seems to be under control due to a well performing household and industrial waste collection and treatment infrastructure and a good working sewerage system, although some leakage can still occur. An example is the direct disposal of waste from the typical tourist fish stalls on the quay into the marina's by their owners or by firemen cleaning the quay at the end of a tourist day. Important to note is also the role that transport and port handling operations can play in the release of plastic pellets to the marine environment.

A potential pathway indicated by the stakeholder interviews consists of household waste transported **by rivers** to the marine environment. Despite the lack of good data from riverine input in Belgium, the relevance of this pathway is considered to be less important compared to the other regional seas.

Waste reaches the marine environment mainly because it is **disposed directly** on the beach or in the sea, mainly intentionally disposed or through neglect (fly-tipping). Only

36% could come from accidental losses including the accidental spillage of plastic pellets during transport or port handling operations. The main source is thus a **problem of individual behaviour and lack of social control.** It tends not to travel too long before it reaches the beach, although long distance waste does occur.

The nature of the litter indicates that it can be present a long time before it is degraded or before it enters the micro plastic or microliter phase after fragmentation. The litter predominantly generated aesthetic nuisance, apart from risks on ingestion by marine fauna (observed by 95% of Northern Fulmars), entanglement of nets leading to amongst others ghost fishing or causing security risks for shipping. Recent studies show for example that 95% of Northern Fulmars had ingested some kind of plastic and that 0,6 % of beached birds (majority Northern Gannets) were found entangled mainly by lost fishing gear [CLAESSENS 2012]. Some stakeholders also pointed to the neglected toxic risk of cigarette butts. Other risk aspects are less predominant.

4.2.2 Mediterranean sea - Barcelona

Litter composition

The data collected in the Barcelona area, indicates predominantly land-based activities generating marine litter, of which household activities and sanitation are the largest factors. **Sanitary waste**, especially cotton buds but also other related fractions are the largest waste fraction found in the survey exercises, representing one third of the observed litter in terms of number of items.

Next to sanitary waste, **plastic packaging and plastic use items** are almost equally important litter types. **50% of the observed litter** items in the Barcelona case is made of **plastic**. Also the Barcelona's Provincial Government stated that 80% of volume and 35% of weight of litter collected on the beaches is empty plastic packaging (interview Fundación de Prevención de Residuos y Consumo, 2012).

Packaging is predominantly primary packaging, or sale packaging removed by the consumer. This fraction could include as well secondary packaging or group packaging. The second most frequent kind of packaging is quaternary packaging or service packaging: shopping bags, disposable beverage cups for direct consumption, etc.

In general discarded short-life or **single use goods** are the main constituent of marine litter. This is caused by the sanitary waste and the larger fraction littered household waste, as well as through the waste from coastal tourism. Industrial sources or sources higher up in the life cycle of products are clearly less important than consumer sources. The high occurrence of **BBQ charcoal** emphasizes the role of cultural events in coastal areas. Charcoal is not usually present in Barcelona or Prat de Llobregat[14]. Fires and BBQs are prohibited in beach areas, but a strong surveillance is lacking.

Similar patterns can be observed in recent **river and port surveys** performed by the port of Barcelona . In 2011 the port's "water cleaning services" recovered 128.954 kg of floating debris with a total volume of 764,87 m^3. The average composition in volumes is 29% plastics, 22% wood, 21% organic matter and 28% other fractions. The 3 main items (> 95%) observed in the port surveys are crisps/sweets packaging & lolly sticks, cigarette

[14] The high numbers were found in Badalona some days after St Joan festivities in which there are lots of illegal fires and BBQs at the beaches. Another potential reason are cultural changes towards outdoor leisure (some section of the population has a stronger outdoors and BBQ culture).

butts and cotton bud sticks. The plastic fraction in the port survey would even be higher, if we deduct the biodegradable fraction (wood/organic matter) of the found items.

In addition, some marine litter items have been identified by the stakeholders as underestimated in the Barcelona surveys from April – June 2012 (one-time event) or as upcoming elements important to be further considered: **cigarette butts, plastic bags, drink cans, bagged dog faeces and plastic pellets.**

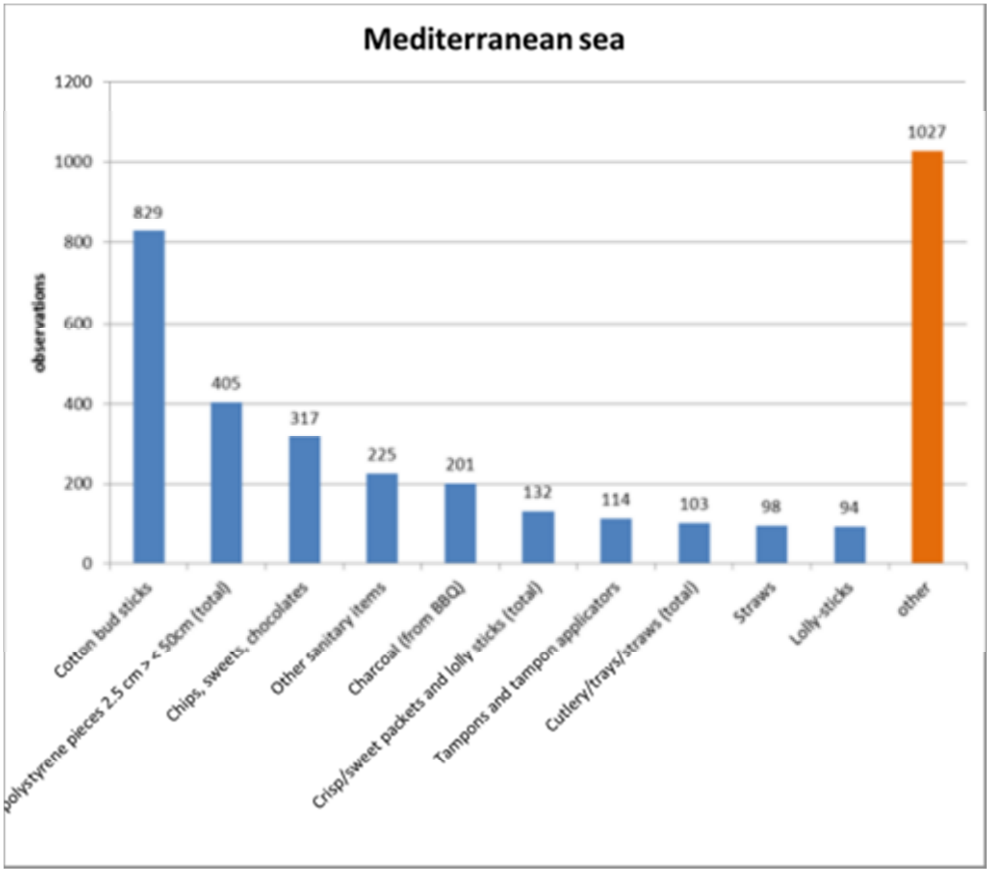

Figure 7: Top ten items in site surveys Barcelona (March – June 2012)

Litter sources

One third of the litter observed indicates **coastal/beach tourism** as its main source. Recreational and tourism activities[15] as a whole represent more than 40% of the observed litter. **More than 25%** can be attributed to toilet and **sanitary** sources ('flush by the toilet). If we take into account the sanitary sources as well, more than 40% can be referred to **household activities**, household litter and its treatment. In line with this we can assess that **land-based sources**[16] are the main source of marine litter in Barcelona.

Only 10% is caused by marine activities like fishing, shipping, port and maritime industries, in which fishing and shipping is responsible for more than half of this waste. Also leisure boating was pointed out as a considerable waste source.

[15] For the purpose of this pilot project recreational & tourism activities include coastal/beach tourism, recreational boating and recreational fishing.
[16] For the purpose of this pilot project the following activities have been classified as sea-based sources: fishing, shipping, aquaculture, other maritime activities, recreational boating). The other activities are considered as land-based.

The Barcelona Metropolitan Area (AMB) Beach services and the Catalan Water Agency (collecting floating litter from 2002 to 2009) confirmed that almost 20% of marine litter comes from the sea and 80% is land-based.

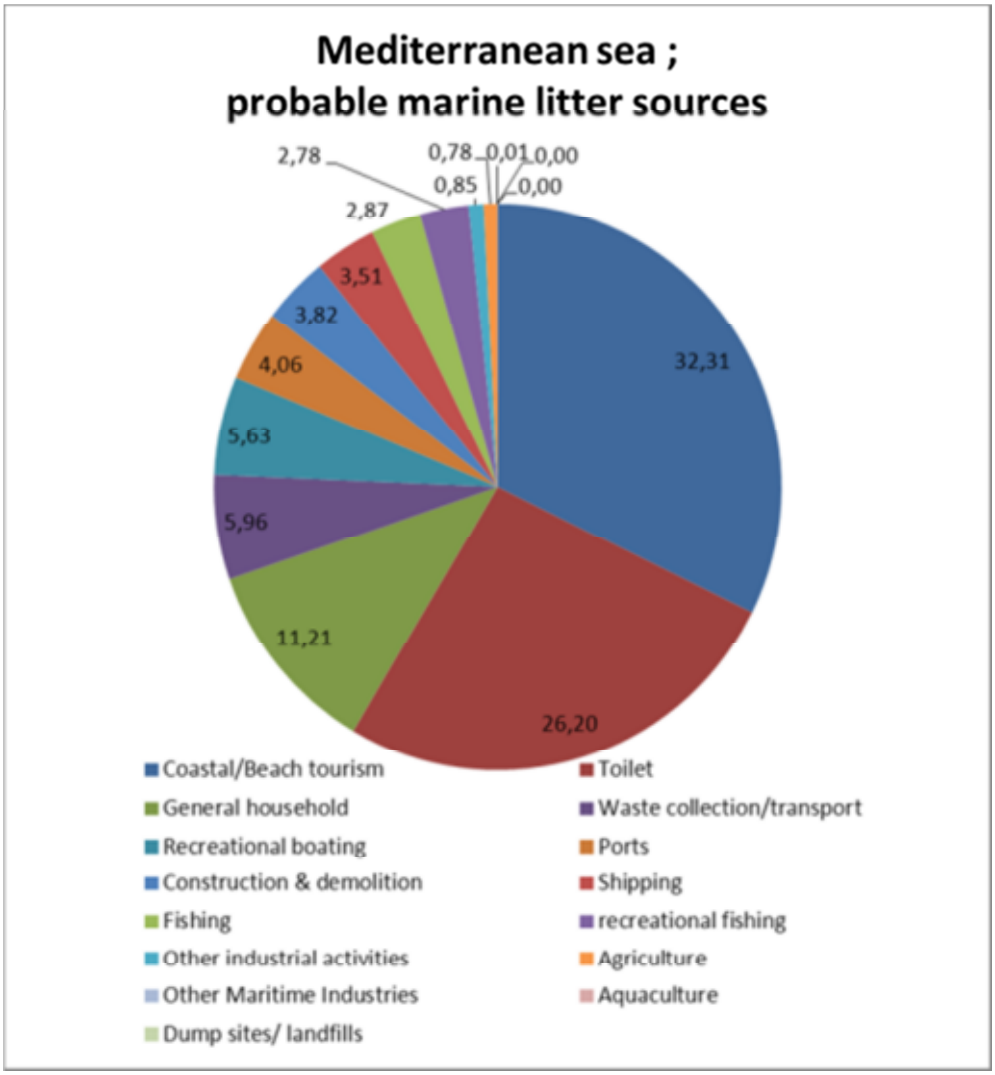

Figure 8: Probable marine litter sources as indicated by site surveys Barcelona

Differences beach & riverine litter

In the Mediterranean sea case a substantial higher frequency of sanitary waste occurs in riverbank waste.

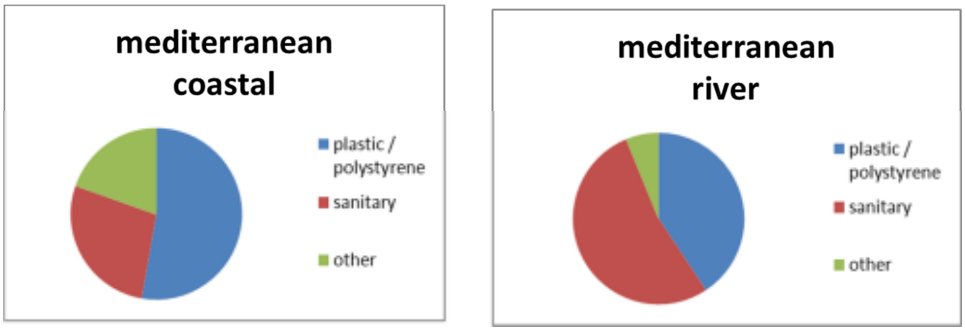

Figure 9:Litter composition as indicated by site surveys Barcelona

In the Barcelona case typical coastal sources can also be found in riverside litter. This is caused by the site selection, which is not an actual riverbank, but a coastal area largely influenced by *rieras* runoff. The Mediterranean sea case shows, as in the analysis on waste composition, a predominance of toilet activities and lower coastal tourism for riverbank litter origins.

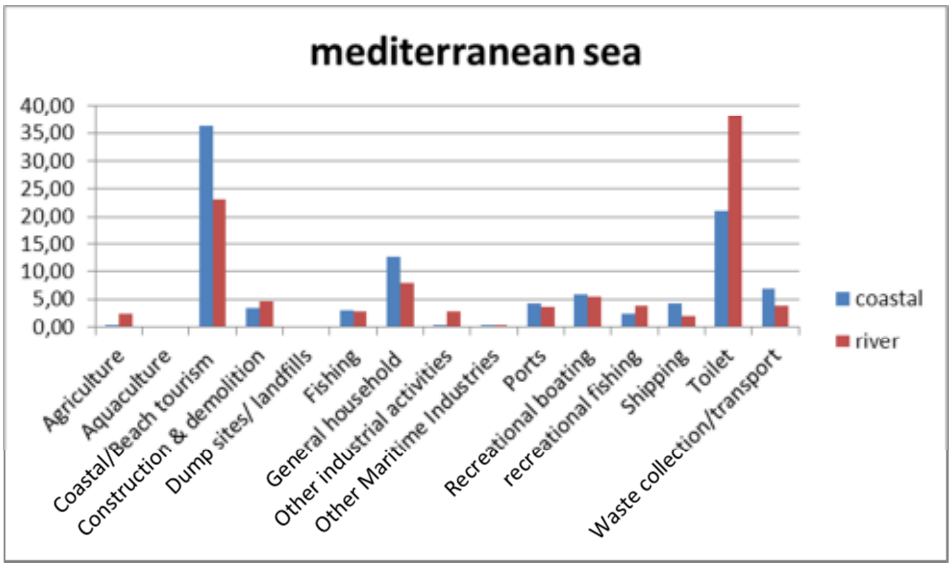

Figure 10:Litter sources as indicated by site surveys Barcelona

There is no large difference between riverbank litter and beach litter regarding its household or industrial origin. Where a distinctive differentiation can be made the industrial fraction is larger on the beaches than on riverbanks. This can be due to offshore industrial or economic activities, including professional fishery industry, or due to a larger impact of failing household waste management on rivers than on the shore.

Litter pathways

Land-based litter seems not to be under control. The largest loophole for the Barcelona case appears to be a malfunctioning **sewerage system.** Most of Barcelona province's coastal municipalities have unitary sewerage systems (collecting in the same system waste and rain water). In rain episodes, the system (the sewerage network, the collectors/manifold and the water treatment plants) is not able to cope with the volume increase. The consequent opening of the overflow channels results on direct dumping into the sea.

Another important pathway consists of household waste transported **by rivers and '*rieras*'**[17]; especially after strong rains and storms and ending up in the port area or at the beaches. Surveys in rain season could reflect a much higher influence of rivers, rieras and sewerage system, compared to the current beach survey results.

Although direct disposal in the marine environment remains important, waste reaches the marine environment mainly through **diffuse sources** (> 60% of observed litter) like

[17] Riera/Rambla: refers to a coastal stream or stream system which a temporal or occasional flow mainly influenced by rainfall. , i.e. a flow channel with temporary or occasional basis. They are usually illegally used as disposal places and when unmanaged bring their solid inputs to the sea in raining season.

sewerage and inland waters (including *rieras*). It tends not to travel too long before it reaches the beach, although long distance waste does occur. If dumped intentionally, the main source is a **problem of individual behaviour.** Lack of education and awareness is identified as an important loophole.

In the Mediterranean case the share of sea-related pathways is in comparison rather low (only 20% of marine litter). It is however important to notice that **MARPOL** V (up to recently) allowed the spilling of organic matter in open waters when triturated without plastics and that monitoring proper compliance is rather difficult.

Waste is **usually disposed intentionally or through neglect**. Only 26% could come from accidental losses. The nature of the litter indicates that it fragments rather quickly or that it enters rather quickly the micro plastic or microliter phase after fragmentation. The possible impacts associated to the type of items found during the surveys are mainly at the level of aesthetics of the coast/beach and their potential to be ingested by marine animals. However also the role of marine litter as vector or mean of transport of alien species and organic pollutants should not be underestimated.

4.2.3 Baltic sea - Riga

Litter composition

The data collected in the Riga area indicates predominantly land-based activities generating marine litter, of which household activities and sanitation are the largest factors. **Sanitary waste,** especially cotton buds but also other related items are the main waste fraction found in the survey exercises, representing about a quarter the observed litter. The comparatively high amounts of cotton bud sticks collected during the surveys, was rather a surprising observation for many stakeholders leading to speculations on the origin: leakage through sewerage system, cargo loss, etc.

Similar as in the other regional seas, different types of **packaging waste** forms the bulk of the marine litter. Packaging is predominantly primary packaging, or sale packaging removed by the consumer. The second most frequent kind of packaging is quaternary packaging or service packaging: shopping bags, disposable beverage cups for direct consumption etc.

Other important marine litter items observed are: **cigarette butts, glass bottles,** wood chips, coal and plastic micro-pellets.

51% of the observed litter items in the Riga case is made of **plastic**, followed by material from sanitary origin. In contrast to the other regions, also paper/cardboard waste is important in the Baltic case.

In general discarded **short-life or single use goods** are the main constituent of marine litter. This is caused by the sanitary waste and the larger fraction littered household waste, as well as through the waste from coastal tourism. Long lasting consumer (incl. multi-dose use) only represent 16% of the marine litter in the Riga case. Except for the North sea, this is the case in the other European regional seas as well. Industrial sources or sources higher up in the life cycle of products are clearly less important than consumer sources.

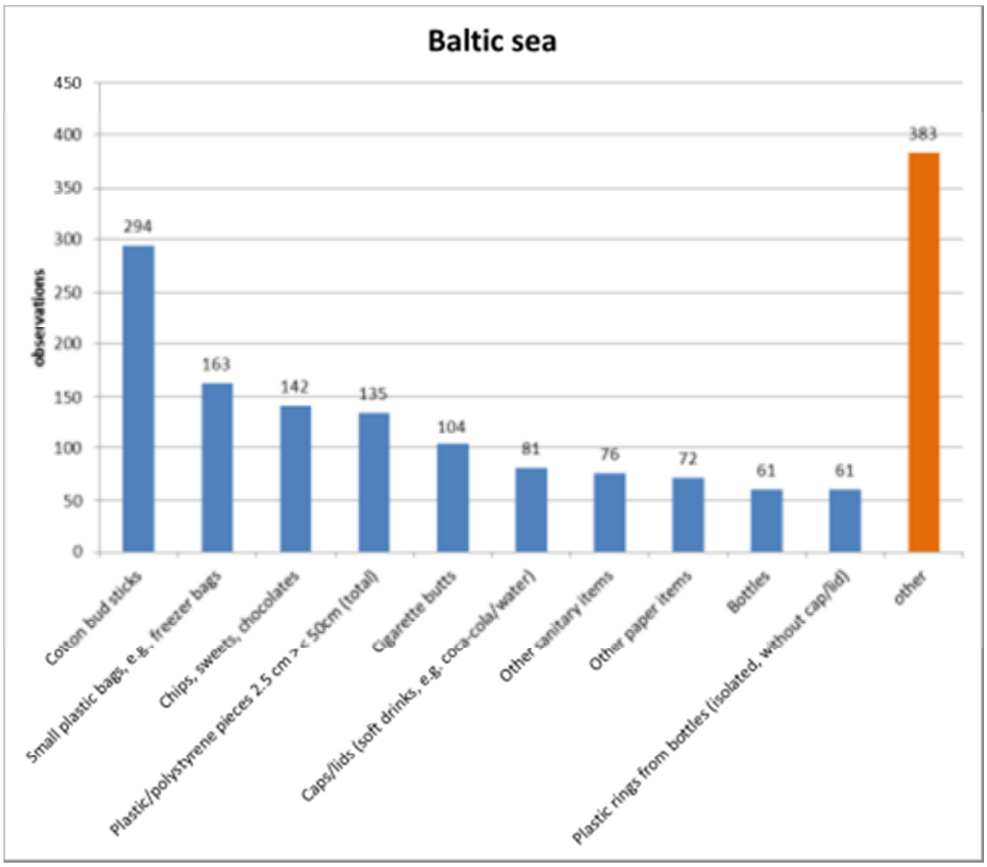

Figure 11: Top ten items in site surveys Riga

Litter sources

Nearly **one third** of the litter observed indicates **toilet and sanitary sources** as its main source. If we take into account the sanitary sources as well, more than 48%, can be referred to household activities, household litter and its treatment. About **25%** can be attributed to **coastal/beach tourism**. Recreational and tourism activities[18] as a whole represent about one third of the observed litter, little less than in the other regional seas (between 40 and 60%). This is relevant not only for packaging waste, but also to sanitary waste recorded during the surveys. Loopholes are caused by human behaviour (low level of environmental awareness, consumption habits) during recreation as well by a lack of adequate infrastructure (insufficient amount of waste bins, location of waste bins, toilets, etc.) and quality of the waste management service. In line with this we can assess that **land-based sources**[19] are the main source of marine litter in Riga.

Only 12% is caused by professional marine activities like fishing, shipping, port and maritime industries, in which fishing and shipping is responsible for about 7% of this waste. So although fishery activities are minor near Riga, items such as strings, cords, strapping bands, pieces of fish box, floating buoys, have been found on the beach indicating sea-based origin of this group of litter.

[18] For the purpose of this pilot project recreational & tourism activities include coastal/beach tourism, recreational boating and recreational fishing.
[19] For the purpose of this pilot project the following activities have been classified as sea-based sources: fishing, shipping, aquaculture, other maritime activities, recreational boating). The other activities are considered as land-based.

As waste landfills are located inland, there is no risk for generation of litter by dumping or landfilling activities in the Riga case study area. The same stands for agriculture, which is not practised along the coastal areas due to low soil fertility. Different story is with small garden plots and summer houses which are located along river banks and in the coastal areas, thus being a potential source for household type of waste.

As far as can be identified from the observed litter, taking into account weighted probabilities, the litter is mainly **generated by consumers**. Only a fraction is generated by industrial sources.

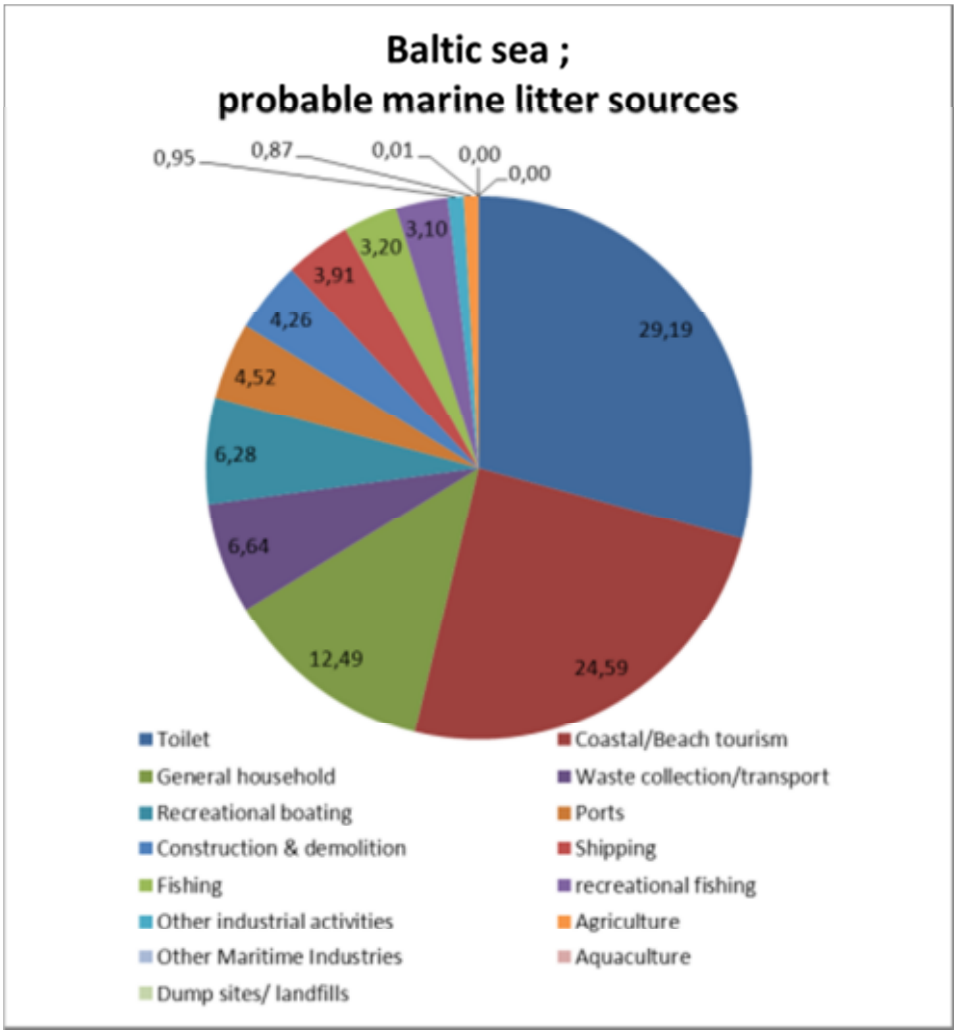

Figure 12: Probable marine litter source sectors as indicated by site surveys Riga

Differences beach & riverine litter

In the Baltic sea case only small differences in composition can be found between coastal and riverbank waste.

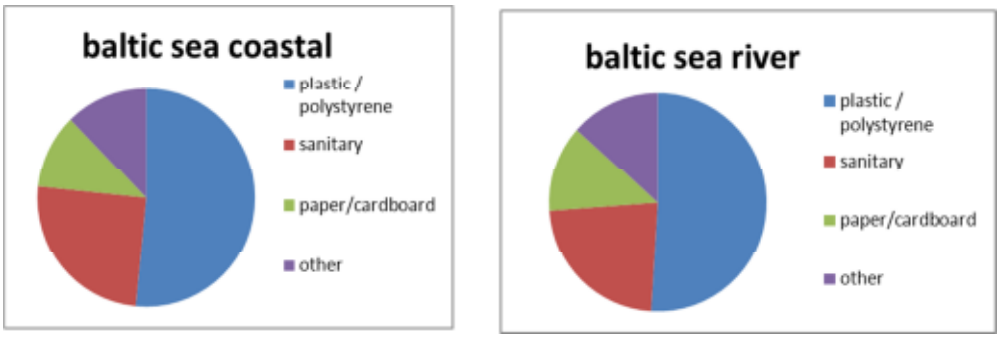

Figure 13:Litter composition as indicated by site surveys Riga

The Baltic sea case shows only minor differences between coastal and riverbank litter.

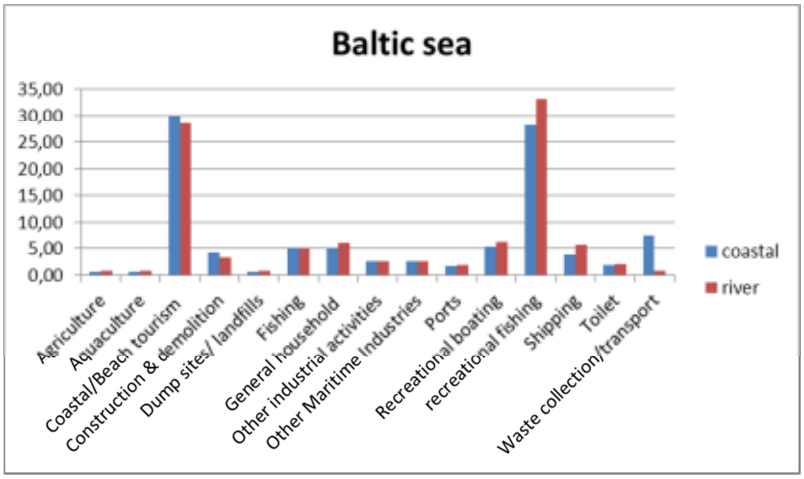

Figure 14:Litter sources as indicated by site surveys Riga

There is no large difference between riverbank litter and beach litter regarding its household or industrial origin. Where a distinctive differentiation can be made the industrial fraction is larger on the beaches than on riverbanks. This can be due to offshore industrial or economic activities, including professional fishery industry, or due to a larger impact of failing household waste management on rivers than on the shore.

Litter pathways

Land-based litter seems not to be under control. Post disposal, or waste that escapes from the **waste collection and treatment chain**, accounts for nearly 29% which indicates still some deficiencies in the household and industrial waste collection and treatment infrastructure and sewerage system. An example is the lack of full coverage of the waste management services. Diffuse pathways like indirect water based sources, sewerage and other unknown pathways are thus occurring in the Baltic Sea case.

However, waste reaches the marine environment mainly because it is disposed directly on the beach or in the sea, **mainly intentionally disposed or through neglect (fly-tipping).**. The main source is thus a **problem of individual behaviour and lack of social control.**

Nearly 40 % could come from accidental losses. The accidental losses are mainly related to **cargo transport and handling operations.** Some of collected items such as coal and

wood chips are related to the profile of Riga harbour. Generally, bulk cargos of black coal and wood chips are transported in a closed way, therefore it is unclear how a certain amount is blown over the ship board. An up-coming problem are plastic pellets, not always transported in an environmental friendly way, and mainly found on the beach after stormy events.

Observed marine litter tends to travel. A considerable part even travels far, which is less the case in the other regional seas. Nevertheless in situ generation remains important. More than 75% of the observed litter is of a nature indicating relatively quick fragmentation and/or degradation in a marine environment. The litter predominantly generated aesthetic nuisance, apart from risks on ingestion by marine fauna. Other risk aspects are less predominant.

4.2.4 Black sea – Constanta

Litter composition

The data collected in the Constanta area indicates predominantly **land-based activities** (> 80%) generating marine litter. Sea-based sources do play, compared to the land-based sources, a very modest role in the litter generation.

Packaging waste (70%) is clearly more important than waste from used and discarded consumer goods or production goods. 46% of the observed waste concerns identifiable packaging waste from **snacks and beverages**, like bottles, cans, bottle caps, sweets, food, etc. Packaging is predominantly primary packaging, or sale packaging removed by the consumer. This fraction could include as well secondary packaging or group packaging. In surveys the distinction between both can sometimes not be made. The second most frequent kind of packaging is quaternary packaging or service packaging: shopping bags, disposable beverage cups for direct consumption, etc. A large fraction of packaging could not be identified or attributed to one of these categories.

65% of the litter observed in the Black Sea case is **plastic**, nearly larger than in the Mediterranean or Baltic seas. Second most frequently occurring materials are metal and paper/card. Only in the Black and Baltic seas large quantities of **paper waste** can be found. Also **rubber and glass** occur in the top ten, unlike in other regions. No large quantities of sanitary waste is observed, unlike in the Baltic or Mediterranean seas. Cotton bud sticks are rarely found.

In addition, some of the stakeholders underlined that litter found at the floodgates and along the channel banks is slightly different from the litter present on the beaches, mainly due to the litter source. The main source of litter in the channel area is illegal dumping by both the households living in the area as by passers that want to get rid of their waste.

In the Black sea case a substantial higher frequency of plastic and metal waste occurs in riverbank waste. Riverbank waste shows a large impact of households and of failing waste management. There is no large difference between riverbank litter and beach litter regarding its household or industrial origin. Where a distinctive differentiation can be made the industrial fraction is larger on the beaches than on riverbanks. This can be due to offshore industrial or economic activities, including professional fishery industry, or due to a larger impact of failing household waste management on rivers than on the shore.

Marine litter originates generally from **short life or single use goods**, like disposable packaging. Long lasting consumer goods to which we could add a small fraction of multiple use or dose packaging only represent 18% of the marine litter in the Constanta

case. Except for the North sea this is the case in the other European regional seas as well.

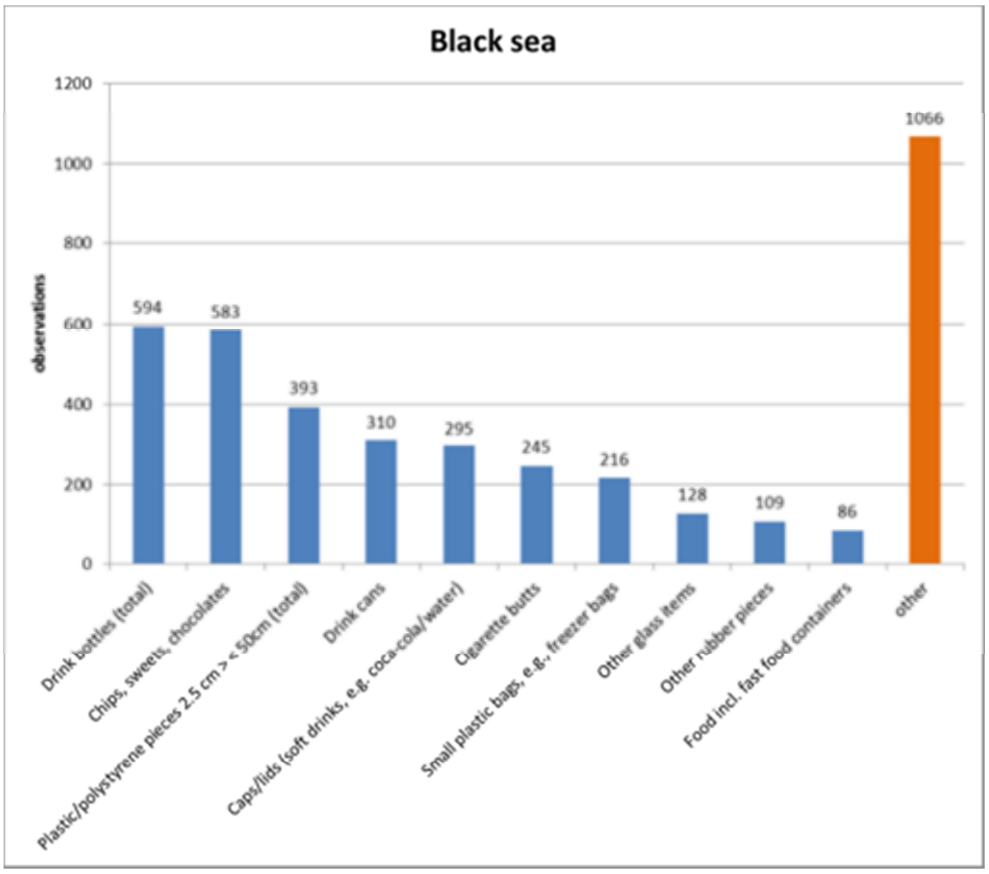

Figure 15: Top ten items in site surveys Constanta (March – June 2012)

Litter sources

Tourism and recreational activities[20] cover in total **about 59%** of the marine litter.

More than **28%** can be referred to **household activities**, household litter and its treatment (including landfills). Compared to the other regional seas, litter coming from **poorly managed dumpsites** still plays a considerable role. Only 8% is caused by professional marine activities like fishing, shipping, port and maritime industries. Shipping and fisheries related waste represents only 3,7%, which is less than in the three other European regional seas.

In line with this we can assess that **land-based sources** are the main source of marine litter in Constanta. Industrial sources or sources higher up in the life cycle of products are clearly less important than consumer sources.

[20] For the purpose of this pilot project recreational & tourism activities include coastal/beach tourism, recreational boating and recreational fishing.

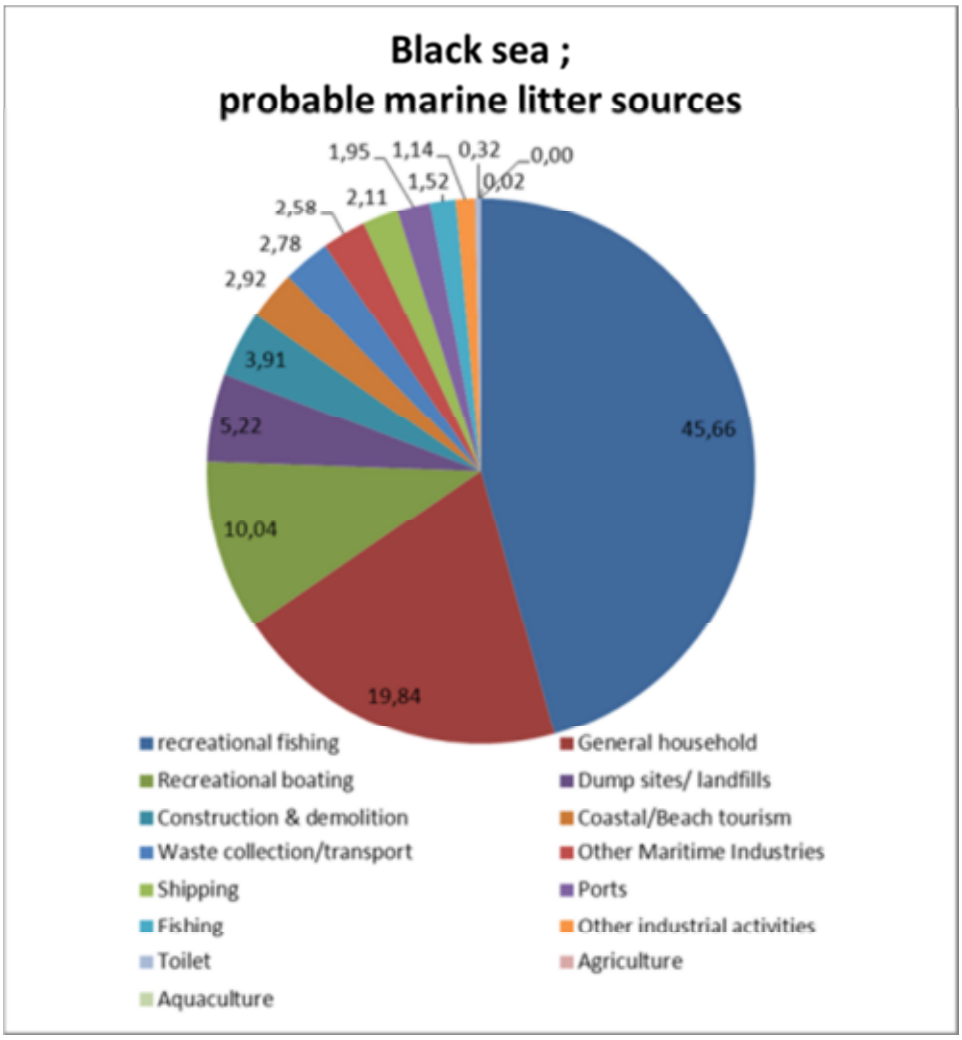

Figure 16: Probable marine litter sources as indicated by site surveys Constanta

Differences beach & riverine litter

In the Black sea case a substantial higher frequency of plastic and metal waste occurs in riverbank waste.

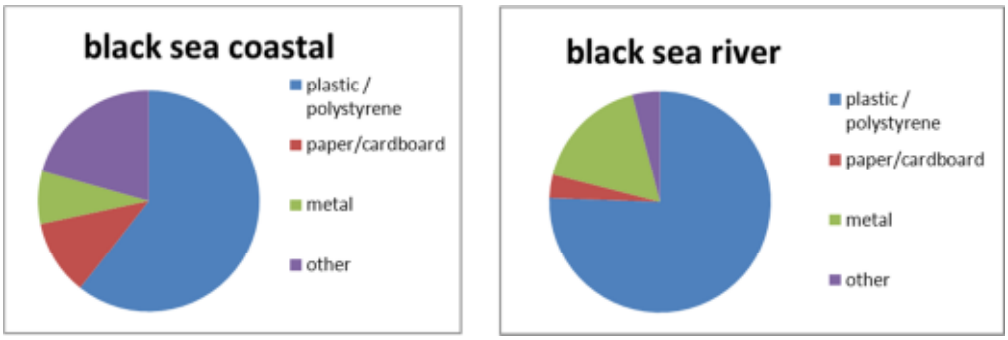

Figure 17:Litter composition as indicated by site surveys Constanta

Riverbank waste shows a large impact of households and of failing waste management.

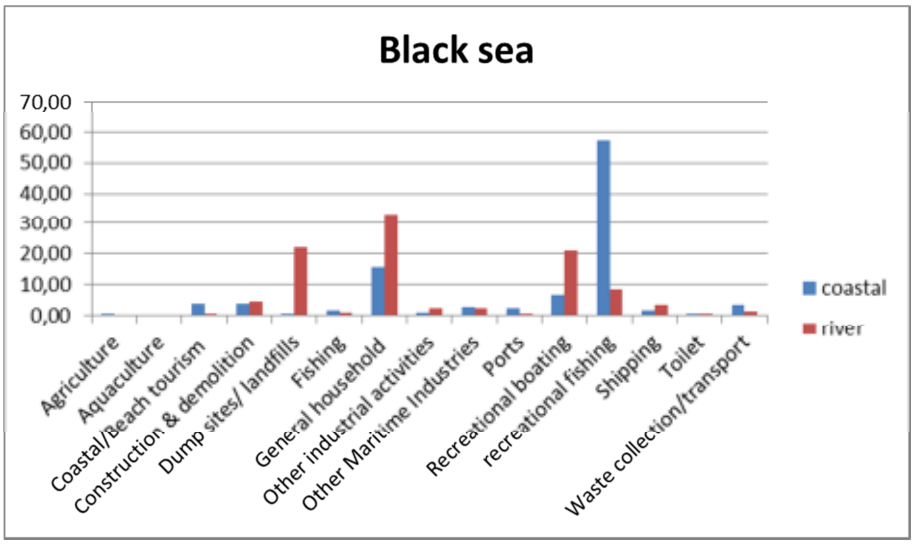

Figure 18:Litter sources as indicated by site surveys Constanta

There is no large difference between riverbank litter and beach litter regarding its household or industrial origin. Where a distinctive differentiation can be made the industrial fraction is larger on the beaches than on riverbanks. This can be due to offshore industrial or economic activities, including professional fishery industry, or due to a larger impact of failing household waste management on rivers than on the shore.

Litter pathways

Land-based litter seems not to be under control. The household and industrial waste collection and treatment infrastructure appears to show leakage through loopholes. Especially fly-tipping and dumping of household waste can be an important pathway. **Badly managed dumpsites or illegal dumping** are indicated as another source, although it is difficult to conclude this from the observed marine litter.

Another indirect pathway indicated by the stakeholder interviews consists of household waste transported by **inland waters** (Danube-Black Sea Channel) and sewerage. Despite the lack of good data from riverine input in Romania, the relevance of this pathway is considered to be less important compared to the direct ones. Moreover, the waste carried by channel waters is being collected regularly at the floodgates.

Waste reaches the marine environment mainly because it is **disposed directly** on the beach, in the Danube channel, in the port or in the sea, mainly intentionally disposed (illegal dumping) or through neglect (fly-tipping). The main source is thus a **problem of individual behaviour and lack of social control.** Only 17% could come from accidental losses including cargo transport handling and old industrial facilities. It tends not to travel too long before it reaches the beach.

The nature of the litter indicates that it can be present a long time before it is degraded or before it enters the micro plastic or microliter phase after fragmentation. Its impact is mainly on the aesthetic value of the marine environment and on ingestion, invasive species and beach-use safety.

4.3 Regional differences main sources and pathways

To conclude, based on the regional analysis of the main sources and loopholes some common findings for the 4 regional seas can be observed:

1. The dominant fraction of the marine litter items observed is made of plastic (between 50 (Mediterranean Sea) and 75% (North Sea) of the observed litter).
2. Different types of packaging waste, predominantly primary packaging (consumers) forms an important part of marine litter. Another important marine litter item observed in all regional seas are cigarette butts. Micro plastics are an up-coming element, underestimated by the existing monitoring strategies.
3. Recreational & tourism activities are responsible for the majority of marine litter (incl. consumption packaging, plastic cutlery, straws, cigarette butts) in the four marine regions (between 35% (Baltic Sea) and 58 % (Black Sea) of the marine litter observed).
4. Land-based litter seems not to be under control in the Mediterranean, Baltic and Black Sea. The largest loopholes appear to be a malfunctioning sewerage system and deficiencies in the waste collection and treatment infrastructure.

However some regional differences can also be observed:

5. With respect to the land-based household waste (including sanitary waste) affecting the marine environment, an important pathway for the Barcelona region consists of household waste transported by inland rivers (rieras), especially after strong rains and storms. This in contrast to the Black sea where litter coming from poorly managed dumpsites still plays a considerable role.
6. While sanitary waste is responsible for half of the household waste observed in the Barcelona and Riga case, this fraction was minimal in the two other regional seas.
7. In contrast to the other marine regions where land-based activities are generating most of the marine litter (about 80%), sea-based waste from shipping and fisheries takes a dominant role in the North Sea region (> 40% compared to ca. 10-15% in the other regional seas). Ropes and nets are amongst the most found items at the beach.

5 Inventory of measures

Measure to address marine litter can be divided into different main categories of measures, which are linked to different factors influencing the marine litter process.

- measures having a **legal or regulatory** basis for reducing marine litter (traditional command and control instruments such as prohibitions, bans, limits, etc.)
- measures which aim at modifying **behaviour** of the selected target group by affecting the cost or price in the market (Economic or market-based instruments such as fiscal measures, product taxes, subsidies, etc.)
- measures which are implemented to **prevent** littering (preventive measures including technical, technological or research oriented measures, aimed at changing the quality of infrastructure and product and packaging design);
- measures which aim at **reducing** littering by influencing behaviour of the selected target group (behavioural measures, aimed at changing the attitudes and perceptions that drive littering);
- measures which aim at **cleaning up** litter in the environment (clean-up measures, addressing the context that drives littering).

In practice, there is considerable overlap between these types; for example, the provision of more litter bins by public authorities is a preventive measure as people are less likely to drop litter if more bins are present, thus it also has a behavioural aspect. Another example is removal of man-made constructions after exploitation that both can be categorized as a regulatory or preventive measure.

In addition, while some measures have the objective of reducing litter in general, others are targeted at particular types of litter, particular groups of litterers or particular locations (regional seas).

5.1 Types of measures

The following typology of measures has been developed for the purpose of this project, in close cooperation with the development of the Marine Litter Toolbox:

5.1.1 Command and control measures

Command-and-control or regulatory instruments (CAC) have a direct influence on the behaviour of actors by imposing rules that limit or prescribe the actions of the target group. Examples of such instruments are regulation (including spatial and temporal controls, zoning), norms and standards, bans, operating permits, etc. These instruments have a legal basis and enforcement and control is a key element in the success of the instrument.

5.1.2 Economic or market-based instruments

Economic or market-based instruments are defined by the OECD as tools that 'affect estimates of the costs and benefits of alternative actions open to economic agents'. The common underlying rationale is to modify the behaviour and decisions of actors and individuals to enhance the protection of the environment, to secure an optimal level of pollution or to achieve optimum rates of resource use and depletion, e.g. inspired by the polluter-pays principle [MATTHEIβ 2009] . Or to put it more simply, if a tool affects the

cost or price in the market, it is a market-based / economic instrument. This definition focuses on the economic signals and incentives, and can either be an incentive (e.g. subsidies) or a disincentive (e.g. tax on non-reusable items). They differ from regulatory measures, including fines, as individuals have a choice in whether or not to alter their behaviour.

If it changes the cost or price of a good (e.g. plastic bags), service (e.g. waste collection), activity (e.g. waste dumping), input (e.g. materials), or output (e.g. pollution) then it is a market-based instrument.

Economic instruments have both an incentive-effect and a revenue-raising effect, with the relative importance depending on the ability of the market to respond to the "price signal".

Examples of such instruments are fee-based systems, subsidies, liability and compensation regimes and trading systems.

5.1.3 Preventive measures

Preventive measures include technical, technological or research oriented measures to aid litter prevention or encourage the correct disposal of litter.

Examples of technical, technological or research oriented measures are mitigation and remediation tools addressing the pressures in the EU regional seas including removal of man-made constructions, clean-up actions, contingency planning, monitoring, etc.

Preventive measures can also include the design of products or packaging to limit the potential for littering or the provision of infrastructure which is designed to aid litter prevention or encourage the correct disposal of litter. The number, location and aesthetic design of receptacles can impact the amount of use that they receive, as well as the cleanliness of the area around them.

Following subcategories of preventive measures have been used within the Marine Litter Toolbox:

- Infrastructure & equipment
- Research & development
- Monitoring (waste, litter)

5.1.4 Behavioural measures

The majority of behavioural measures use information (education, training) and awareness raising techniques, in the form of posters, advertising, leaflets, TV campaigns, stickers, web pages etc., to stimulate a change in behaviour. A key feature of this type of instruments is the voluntary aspect of actions. Good or bad image building and associated perception from society (e.g. through communication, stakeholder coordination or certification) can provide important incentives to adapt behaviour.

5.1.5 Clean-up Measures

Closely related to behavioural measures, are clean-up measures. In practice, the distinction is not always easy to make. Clean-up measures remove litter and waste from the environment. Many clean-up initiatives set a particular date where participants takes part in one big clean-up, rather than smaller on-going clean-up activities, as this has a bigger impact in demonstrating the problem.

Many clean-up projects also provide educational programmes, outreach, or research. Often projects aim to attract support by highlighting the harm caused to marine life. This type of initiative generally publicises the harm and distress caused to marine mammals,

birds and turtles as they tend to be more popular than fish and crabs etc. Fishing for Litter initiatives also have a behavioural element; encouraging fishermen to collect litter means they will be less likely to dump their own litter.

5.2 Identification of measures

A long list of potential measures to tackle marine litter has been made up based on:

- literature research, with special emphasis on the two parallel marine litter studies and the study Economic assessment of policy measures for the implementation of the Marine Strategy Framework Directive [DG ENV 2012]. An overview of literature sources used is given in Annex 9.
- stakeholder interviews (see Chapter 1.1)

Annex 9: Overview literature research on marine litter measures

The inventory of proposed concrete measures contains both existing measures that have proven to be successful, and more innovative measures adapted to the identified sources and loopholes. The long list has been structured according to the Honolulu strategy[21] (Annex 10). The inventory includes information about the year of implementation of the measure, the lead organisation, the regional sea targeted, category and type of the initiative, the category and type of litter targeted, the sector addressed, indications on its effectiveness and costs, etc. In total about 270 measures have been identified in the list.

Annex 10: Structured long list of potential measures to address marine litter

5.3 Identified measures per regional sea

The identified measures below are compiled based upon the outcome of the regional workshops and the interviews with individual stakeholders.

5.3.1 North sea - Oostende

Existing measures

Regarding the measures in place some stakeholders gave the following remarks concerning the effectiveness and areas for improvement:

- A combination of manual and mechanical cleaning is used in Belgium. Mechanical cleaning is conducted in heavily frequented urban sandy beaches, which are accessible to the machines. Manual cleaning should as much as possible be applied in less frequented beaches or outside the bathing season. In any case, beach cleaning should respect conservation criteria principally with regard to sediment loss and harm to vegetation. The efficiency of beach cleaning can still be improved by optimizing the time and place of cleaning; cleaning should occur after spring tide and in accumulation areas on the beach.
- As 'Waste creates waste' regular cleaning of the coastal area is crucial; with increased capacity of municipal services during bathing season including regular emptying of the

[21] The Honolulu Strategy, published by UNEP and the NOAA Marine Debris Program, is a framework for a comprehensive and global effort to reduce the ecological, human health, and economic impacts of marine debris. It is intended to help improve collaboration and coordination among the multitude of groups and governments across the globe in a position to address marine debris. It is intended to serve as a common frame of reference for action among these communities, as well as a tool for groups to develop and monitor marine debris programs and projects. (http://ec.europa.eu)

bins. The last decade there has been invested in service capacity and closed bin infrastructure in Oostende. There is however still need to invest in capacity during top days and more efficient bins (e.g. closed, sorting system) along the Belgian coast.

- All Belgian ports surveyed within the ASMADE project meet the EU Directive on Port Waste Reception Facilities (EC200/59) and encourage vessels to dispose of waste, particularly old ropes and nets, using harbour facilities. In total 80% of harbours have also set up recycling facilities for vessels' waste including recycling facilities for glass, paper, plastic, oil, batteries, etc. [CLAESSENS 2012]
- The waste collection system in the port based on a fixed fee-system included in the demurrage of marinas seems to be effective thanks to the good location of the port reception facilities (central lock to be passed by all ships entering the marina) and the timing of waste delivery (when leaving the port, reducing the risk of illegal disposal at sea). A revision of the status of 'exempt ships' and a (strengthening) of the weak elements within MARPOL legislation in correspondence with EU policy (e.g. EU zero discharge policy) is however still needed.
- Illegal disposal of waste is heavily controlled within the port area. The strategy of enforcement and control (penalty system) seems to be more effective than increasing the number of containers (shifted the problem of illegal dumping to other areas).
- Awareness actions to inform the users of harbours and marinas about marine litter issues are taking place in the majority of the Belgian harbours. This is typically done through posters, letters and pamphlets. The majority of the marinas surveyed held some form of award (Blue Flag award, Golden Anchor) [CLAESSENS 2012].
- 'Fishing for Litter' (FFL) activities are taken place on the Belgian Part of the North Sea, and are recently extended (e.g. cooperation with ports in UK). Some stakeholders question the impact of these actions on marine litter. FFL is more about awareness, then effective clean-up. Statistical proof is recommended.
- Standardized litter monitoring (OSPAR methodology) has taken place between 2000-2006, but was discontinued. Monitoring is supported by all stakeholders as a prerequisite to get more insight in the problem of marine litter, its main sources and loopholes, but should take place in a well-organized way and on a European scale.

Proposed measures

Additional measures proposed by stakeholders during the workshop and in the interviews are:

- Measures related to strengthen implementation of waste minimization and proper waste storage at sea and at port reception facilities (MARPOL Annex V):
  - Better coordination between the responsible authorities within the harbour (fishery port, main port, marinas) to regulate and control the enforcement of measures related to waste management (incl. the existing waste management plans).
  - Revise the fee system for 'exempt ships'.
- Measures to improve waste management and minimization discharge solid waste into waterways:
  - As stated before, despite the efforts already done, an increased capacity of municipal waste services during bathing season (June-September) or other top-

weekends (e.g. bank holidays) in some coastal areas is needed; this can be done for example by using student workers (already common practice in Oostende).

- Investment in adequate waste receptacles in public beach area.

- Market-based instruments incl. incentives for collection and treatment of waste:
  - Increase the return of fishing gear, industrial boxes, trays from fishermen and reusable materials for fisheries boxes and trays.
  - Establish or improve Extended Producer Responsibility (EPR): e.g. a product-sustainability test for packaging to enter the market, separate collection of plastic waste in construction sector (www.cleansitesystem.be), separate internal and external sewer system as a condition in the operational permit of production plants, etc.
- Manage and conduct clean-up activities:
  - Find a good balance in cleaning frequency and combine cleaning activities with awareness actions. Too much cleaning generates neglect and can be counter-productive. The general public is not aware of the magnitude of the marine litter problem; clean beaches are seen as 'normal'. Use of multi-media (e.g. 'Facebook' as a tool to show status beach before and after busy day) can be a powerful tool in awareness campaigns. Clean-up/ awareness can further be combined with effective control at end of day and appropriate penalty system.
  - Engage beach private sector in the measures (e.g. beach kiosks).
  - Increase efficiency on the collection of waste by taking advantage of winds and currents and collect them only at the accumulation areas.
  - Promote good practices in waste management for ALL activities within the port and along the coast, including the organisation of events.
- Further research on the presence, distribution and impact of waste (especially litter) in the marine environment using standardized monitoring systems within the different regional seas. Differentiate between beach litter, floating litter, litter on the sea bed and riverine input.
- Need for indices to measure the waste stream in the coastal area, and more specifically beach litter to assess the effectiveness of clean-up actions. Indices mentioned by the stakeholders are: Tidyness index (focus inland litter), Cleanliness index.
- Education & outreach (awareness) on marine litter
  - An important aspect is the social perception of litter and littering: littering a plastic bag is generally considered as socially unacceptable, while throwing away a cigarette butt, chewing gum or an apple core is not considered littering and is still socially accepted. Insist in a change of consumer's behaviour to the waste.
  - Education, awareness and behavioural change programmes and campaigns for fishery and shipping to improve sorting behaviour (e.g. awareness as part of 'training sailors').
  - Open communication is needed in awareness campaigns about costs of cleaning, coupled to communication on potential actions that should have been able with this "invested 'cleaning' budget"; and this in a constructive way.
  - Awareness campaigns should take place on a global scale, as a main fraction of the litter is originating from 'foreign vessels' (in particular Asian/ African crew).

5.3.2 Mediterranean sea – Barcelona

Existing measures

Regarding the measures in place some stakeholders gave the following remarks concerning the effectiveness and areas for improvement:

- Mechanical cleaning is conducted in heavily frequented urban beaches, which are accessible to the machines. Beach cleaning should respect conservation criteria principally with regard to sediment loss and harm to vegetation. The same applies to *'rieras'.*
- Focus just on cleaning actions is very expensive and doesn't address the origin and causes of marine litter. It is necessary to prioritize prevention, reuse and recycle measures; complemented with a minimum cleaning of the beaches and floating waste.
- Regarding the 'One-fee-system' for all vessels and all ports, the way it is applied in Spain with one fee for all type of vessels and ports (instead of one fee per type of vessel and type of port) is hampering its effectiveness. Financial losses on waste management make the ports reject the waste which is not clearly identified within MARPOL, most probably resulting in illegal dumping. A revision (strengthening) of the weak elements within MARPOL legislation is needed.
- The increase of capacity of the sewerage system (e.g. building pluvial rain deposits until the treatment plants can cope with the water flow) needs to be carried out in a sound manner, analysing the need case by case, as it represents a very large financial investment. Other options as better management (cleaning) of the system and improvement of the overflow channels so they retain solids, should be further studied.

Proposed measures

Additional measures proposed by stakeholders during the workshop and in the interviews are:

- Measures related to strengthen implementation of waste minimization and proper waste storage at sea and at port reception facilities (MARPOL Annex V):
  - Set up one single and independent body (independent from IMO, UN and trade organisations) to regulate and control (coastguards) the enforcement of measures related to maritime transport and maritime activities.
  - Establish a fee to be paid by all ship and boats entering a port which should be used to improve the marine environment.
- Measures to improve waste management and minimization discharge solid waste into waterways:
  - Enhancement of cleaning and maintenance of riverbeds and *'rieras'.*
  - Improve the maintenance (cleaning) of the sewerage system and ensure that it implies removing the accumulations instead of pushing them with pressure water towards the overflow channels.
  - Regarding the sewerage system overflow channels, the scrabble/rough-hew system should be introduced or enhanced (case but case) as well as the grids in order to be able to retain solids when the channels are opened (due to rains or to system failures).

- Enhance street cleaning to avoid litter to enter the unitary sewerage system.

- Market-based instruments incl. incentives for collection and treatment of waste:
  - Increase the return of industrial boxes, trays from fishermen and reusable materials for fisheries boxes and trays.
  - Involve the fisheries sector directly in the design and setting up of fishing for litter programmes.
  - Introduction of taxes: dissuasive taxes as the one on plastic bags and others as the tourist tax (to cover the additional costs for the municipalities for the tourism use and disposal and to finance other measures).
  - Introduction of the Packaging Return System.
  - Regulation on package and synthetics production.
- Manage and conduct clean-up activities:
  - Engage beach private sector in the measures (e.g. beach kiosks).
  - Increase efficiency on the collection of floating waste by taking advantage of winds and currents and collect them only at the accumulation areas.
  - Try out different systems for manual collection of floating waste without the use of vessels (e.g. use of a net perpendicular to the coastline which can be brought back to the beach manually when significant litter is captured)
  - Promote good practices in waste management for ALL activities within the port and along the coast, including the organisation of events.
- Further research on the presence, distribution and impact of waste (especially litter) in the marine environment using standardized monitoring systems within the different regional seas. Differentiate between beach litter, floating litter, litter on the sea bed and riverine input.
- Education & outreach (awareness) on marine litter
  - Insist in a change of consumer's behaviour to the waste, especially hygienic one.
  - Education, awareness and behavioural change programmes and campaigns

5.3.3 Baltic sea – Riga

Existing measures

Regarding the measures in place some stakeholders gave the following remarks concerning the effectiveness and areas for improvement:

- The waste collection system in the port is based on a no special fee system which encourages the ships to deliver waste. A Ship-Generated Waste Management Plan has been adopted and implemented in the Free Port of Riga area. The Plan foresees that vessels[22] shall pay sanitary fee irrespective of whether or not that particular ship will actually make use of the reception facilities (no special fee system).
- As 'Waste creates waste' regular cleaning of the coastal area is crucial. Daily cleaning of beaches in touristic season (between 15 May and 15 September) ensures that the litter disposed by tourists and beach visitors during their recreation is collected and brought to landfill. The containers and sanitary infrastructure is installed during the

[22] except for fishing and leisure craft, that shall carry not more than 12 passengers

season. In Riga, the City Council contracts an external company which carries out the practical work.

- Availability of infrastructure in recently set up in parking lots along the coastal zone.
- A 'Plastic bag tax' was enforced in Latvia on 01.01.2008. It has resulted in a decreased use of plastic bags, and consequently also in littering potential.
- Regular educational initiatives for beach cleaning activities ensures the involvement of schools and general public in practical cleaning works which are performed either in Spring or Autumn (e.g. the annual national environmental campaign "Big Clean-up Day" held in Spring).
- Blue flag movement ensures higher standards for beach management. The visibility of cleaning works also prevents littering.

Proposed measures

Additional measures proposed by stakeholders during the workshop and in the interviews are:

- Measures related to strengthen implementation of waste minimization and proper waste storage at sea and at port reception facilities (MARPOL Annex V):
  - Installed infrastructure for closed cargo up-load and download from ships can prevent that items became a litter.
  - Better regulations/guidance for cargo transports (shipping) to avoid waste losses (the requirements for uploading the cargoes). Some of the observed litter items such as coal and wood chips are related to the profile of Riga harbour.
  - Code of conduct both for ferries and fisheries to prevent fishermen from dumping into the sea and cruise passengers from throwing emptied packaging into water.
- Measures to improve waste management and minimization discharge solid waste into waterways:
  - Install separate waste collection containers on the beach (currently, containers for mix waste are available). In the summer of 2012 (15 April – 1 October), several city beaches in Latvia (Liepaja, Jurmala, Carnikava) have installed waste containers for separate packaging waste collection. This test-case needs to be evaluated.
  - There is still need to invest in capacity and more efficient bins (e.g. closed, sorting system) to avoid fly tipping.
  - Organisation of durable financial means for sustainable waste management by integrating beach waste management in the overall municipal waste management system. The larger support/interest is also wished from local governments as the beach is local resource for economic development and not only burden and financial loss.
- Market-based instruments incl. incentives for collection and treatment of waste:
  - Increase in tax on packaging waste and plastics.
  - Enforcement of deposit refund system (metal cans, plastic bottles, glass). At the moment there is a political will to introduce deposit system in Latvia, but the producers of packaging and packaging responsibility organisations are not supporting the politicians.

- Enforcement of producers responsibility by stronger targets towards waste management.
- Tourism tax could be imposed.

- Manage and conduct clean-up activities:
  - Better coordination and sharing of responsibility between responsible authorities (local municipalities, state, private business) (comment: the duties for beach maintenance for private business should be more explicitly defined. Currently, private business receives income, while does not put adequate efforts in maintenance of the beach).
- Further research on the presence, distribution and impact of waste (especially litter) in the marine environment using standardized monitoring systems within the different regional seas. Differentiate between beach litter, floating litter, litter on the sea bed and riverine input.
- Education & outreach (awareness) on marine litter
  - Behavioural actions towards waste handling (general public) and tourists/cruise ship passengers; can be combined with penalty system (specific info boards or posters could be installed on beach, beach equipment and cruise ships). In Riga, the safeguards are actually keeping an eye on the enforcement of beach rules. The smoking is forbidden on beach, also use of alcohol. The goal is to broaden this measure to other (more remote) area's in Latvia.
  - Awareness of importance of waste management as priority issue to organise finances. Almost all respondents stated that the country is having a lack of administrative and institutional capacity. The marine litter issue has not been recognised yet as important waste management problem.

5.3.4 Black sea - Constanta

Existing measures

Regarding the measures in place some stakeholders gave the following remarks concerning the effectiveness and areas for improvement:

As 'Waste creates waste' regular cleaning of the coastal area is crucial; with increased capacity of municipal services during bathing season including regular emptying of the bins. There is still need to invest in capacity and more efficient bins (e.g. closed, sorting system).

Education, awareness and behavioural change programmes and campaigns are considered as important and are currently taking place.

Monitoring activities have taken place, but not in a standardized manner. The Romanian Naval Authority has recently set up the Clean Sea Net, including internal monitoring procedures for waste types and quantities. Monitoring is supported by all stakeholders as a prerequisite to get more insight in the problem of marine litter, its main sources and loopholes, but should take place in well-organized way and on a European scale.

Proposed measures

Additional measures proposed by stakeholders during the workshop and in the interviews are:

- Measures related to strengthen implementation of waste minimization and proper waste storage at sea and at port reception facilities (MARPOL Annex V):
  - Better coordination between the responsible authorities within the port area (fishery port, main port, marinas) to regulate and control the enforcement of measures related to maritime transport and maritime activities.
  - Illegal discarding of ship generated waste is not under control within the port area. Better enforcement and control (penalty system) is necessary.The problem is that the Port Administration is not empowered to apply fines in case they encounter situations where ships discard their waste into the port basin (area).
  - Implement a rapid response system to deal with hazardous waste.
- Measures to improve waste management and minimization discharge solid waste into waterways:
  - As part of Europe, Romania is in the process of implementing the existing EU regulation on waste into national policy, but this takes time (especially approval of the application methodology). It is clear that certain waste management frameworks should be strengthened, for example the legal framework on beach use. This could be in the form of a leasing system for beach sectors with clear obligations regarding waste management, combined with a yearly evaluation by the lending authority. In case of non-compliance, the operator could for example lose its priority for lending a beach sector.
  - Applying fines have been mentioned as good instruments for enforcement as they support the 'Polluter Pays Principle', but there is a lack of administrative capacity to effectuate the controls and competence to issue fines (persons performing monitoring activities are not empowered to apply fines).
  - Improve the waste management services by improving the infrastructural capacity (more containers, sufficient and adequate waste receptacles in public beach area), by promoting selective collection and improving the access roads to the waste collection facilities.
  - Old industrial pipelines and installations that are not in use anymore should be removed definitely.
  - Closure of existing (currently in operation till 2028) landfills and illegal dumpsite close to the coast.
- Market-based instruments incl. incentives for collection and treatment of waste:
  - Introduction of taxes: dissuasive taxes as the one on plastic bags and others as the tourist tax (to cover the additional costs for the municipalities for the tourism use and disposal and to finance other measures).
  - Introduction of the Packaging Return System.
  - Regulation on package and synthetics production.
- Manage and conduct clean-up activities:
  - Find a good balance in cleaning frequency and combine cleaning activities with awareness actions. The general public is not aware of the magnitude of marine litter problem; clean beaches are seen as 'normal' Moreover, too much cleaning

generates neglect and can be counter-productive. The challenge is to trigger people with original campaigns and clean up events . Use of multi-media (e.g. 'Facebook' as a tool to show status beach before and after busy day) can be a powerful tool in awareness campaigns. Clean-up/ awareness can further be combined with effective control and an appropriate penalty system.

  - Engage beach private sector in the measures (e.g. beach kiosks).

- Further research on the presence, distribution and impact of waste (especially litter) in the marine environment using standardized monitoring systems within the different regional seas. Differentiate between beach litter, floating litter, litter on the sea bed and riverine input.
- Education & outreach (awareness) on marine litter
  - Continue to invest in education, awareness and behavioural change programmes and campaigns. Previous campaigns need to be evaluated in order to see what should be changed or how new campaigns have to be designed to obtain the best results.
  - An important aspect is the social perception of litter and littering: littering a plastic bag is generally considered as socially unacceptable, while throwing away a cigarette butt, chewing gum or an apple core is not considered littering and is still socially accepted. Insist in a change of consumer's behaviour to the waste.

5.4 Selection of measures for further analysis

The long list of possible measures to address marine litter has been further refined to address the main sources and loopholes identified in the regional cases. In this step priority setting by the different stakeholders was important. Measures that were mentioned by several stakeholders during the workshop or the interviews, and showing a direct link to the main sources and pathways were given a higher weight to be selected. Also a first qualitative estimate of the costs related to the measure (low versus high) and their link to existing policies was considered. The results of this initial assessment is given in Annex 11.

This process resulted in 46 measures selected for further analysis (Table 10). A detailed description of the selected measures is given in Annex 12.

Annex 11: Matrix selected measures pilot study '4 Seas'

Annex 12: Description of the 46 selected measures pilot study '4 Seas'

As a result of the synergies taking place between the three pilot EU marine litter studies, all proposed measures have been described according to a common template. The template for the Marine Litter Fact Sheets has been based on the template developed for the Marine Litter Toolbox[23], and extended with criteria to feed the feasibility assessment (see Chapter 1).

Annex 13: MLFS selected measures pilot study '4 Seas'

[23] Toolbox developed for the marine litter high-level preparatory meetings of which the third preparatory meeting took place in Brussels on 27 Feburary 2012.

Table 10: List of 46 selected measures (Dark green: Measures Pilot project '4 seas'; Light green: Measures BIPRO/RPA

N°	Specific measures (proposed shortlist)
1	Enact or change public behaviour regarding beach littering by appropriate penalties
2	Enforcement of existing international waste regulations, more specifically the revised MARPOL ANNEX V
2a	*Stronger (financial) incentives to deliver ship-generated waste at the port reception facilities and to discourage dumping at sea; Can be a penalty or reward system.*
2b	*Adequate port reception facilities and timely handling and safe disposal*
2c	*Enforcement and inspection related to the points above*
2d	*Guidance for ships' Garbage management plans'*
2e	*Optimize logistics of merchant premises in fishing ports to avoid escape of EPS boxes during the trade, transport of fish; provide for intermediate storage facilities for waste collected in fishing ports which allow for waste separation and adequate storage, in particular of EPS boxes to foster recycling*
3	Guidance for cargo transport and port cargo handling operations *(including reducing loss of pellets into the marine environment)*
4	Conduct education and outreach campaigns to promote the use of technologies that minimize loss of fishing gear and ghost fishing (incl. technical standards)
5	Improve collection, treatment and disposal of domestic solid waste and waste water (broken down in several options)
5a	*Maintenance of river beds, rieras (in dry periods)*
5b	*Maintenance and cleaning of sewer systems*
5c	*Separate sewers for rain and domestic waste water (in case of renovation/new urbanizations)*
5d	*Connect unconnected sewers to WWTP (avoid direct discharge of litter and waste water into sea)*
5e	*Removal mechanisms for unconnected sewers (filter litter)*
5f	*Reduce overflow frequency through improved storage capacity; can be by dredging the existing overflow basins or enlarging the current storage capacity*
5g	*Improved waste collection and street cleaning*
5h	*Enforcement of the technical requirements of the Landfill Directive close to the coast) and intensify inspections/implement fines*
5i	*Identify and close non-compliant landfills and illegal dumpsites close to the coast (controls, penalties, closure)*
6	Provide adequate waste (and recycling) receptacles in beach areas. Including ensuring that the bin design/container design prevents plastic packaging escape (e.g. blown away, bottles taken away; bins with holes, or covered, sufficient container volume).
7	Include requirements on density and proximity of collection points (bins and container collection) in the settlements (near the shore greater density) in the national legislation
8	Provide deposit-refund system for fishing gear incl. EPS fish boxes; related to fishing provide alternatives to EPS boxes --> PP hard boxes on the ships with cooling systems, fibre based boxes
9	Place obligation on retailers of certain size to implement deposit refund system for multi carrier bags of all type, including robust plastic bags for multi-use (Deposit refund system for refillable beverages (plastic) bottles in retail sector

N°	Specific measures (proposed shortlist)
10	Allocation of certain percent of touristic tax (s) to the environmental funds for the prevention of littering on the beaches and for preventive and mitigating actions; Inform tourists that a certain share of tourist tax is allocated to the maintaining the beaches clean (
11	Establish or improve Extended Producer Responsibility (EPR) systems for PPPs (plastic packaging products
12	Improvement and extension Fishing for litter on a cross-European scale
13	Add clean-up of construction sites as a specific clause to construction contracts
14	Increased capacity of municipal waste services during top season including daily cleaning of touristic public beaches within bathing season
15	Combination of manual and mechanical cleaning in the less urban and less frequented areas.
16	Establishment and effective control of clean-up plan for cultural events at the beach (e.g. sport activities, music festivals, fireworks).
17	Develop and promote joint action to reduce the input & impact of sanitary waste (e.g. cotton bud sticks, tampons (applicators), disposable nappies) into the marine environment
17a	*1) A mixture of public awareness campaigns to persuade the public to change to the solid waste route for the disposal of their domestic sanitary waste.*
17b	*2) Pressure to be applied to manufacturers to minimize material and make products more environmental friendly*
18	Implementation of improved and harmonized EU monitoring system for beach litter
19	Establishment of monitoring system for marine litter (sea)
20	Portable beach ashtrays
21	Develop, promote and support community-based clean-up campaigns (awareness combined with effective clean-up actions)
21a	*a. beach clean up*
21b	*b. floating litter*
22	National and regional coordination of awareness campaigns (joint action with neighboring countries)
23	Sensitization of coastal tourists (individual level) + promote recycling & sustainable use
23a	*a. Inform tourists and coastal users on importance of use of alternatives to plastic bottles and risks associated with improper use (*
23b	*b. Organize rewards for tourists to reduce use of plastic bottles during their stay via lottery (*
24	Sensitization of coastal sectors (sectoral level) to promote sustainable use and anti-littering
24a	*a. Involve retail sector /touristic sector in promotion of proper use and disposal of plastic bags (designer cotton/canvas bags with prints as a part of marketing campaigns for shops and hotels,*
24b	*b. Introduce system of environmental awards for municipalities/retail sector/tourism sector which are front runners in use reduction and proper separate collection of plastic bags/bottles;*
24c	*c. Place a commitment on touristic sector to reduce use of plastic bottles in accommodation facilities/other service providing facilities and provide alternatives to the consumers (hydration stations, glass bottles, filtered tap water, etc.), self-commitment implementation ca. 5 years; after that legislative obligations;*

N°	Specific measures (proposed shortlist)
24d	*d. Organize environmental awards for hotels and similar facilities to facilitate use reduction of plastic packaging products and substitution with other materials (with the focus on plastic bottles and bags, funds available via environmental funds)*
24e	*e. Involve beach watch personnel in promotion of anti-littering on the beaches (wearing t-shirts with anti-littering massages, on different languages)*
24f	*f. Create and promote stewardship concepts such as adopt-a-beach or adopt-a dive site program (others Blue flag movement)*
25	Sensitization of marine sectors (fishermen/ shipping industry) (sectoral level) to promote sustainable use and anti-littering
25a	*a. Provide clearly visible information in fishing ports of correct use and disposal of EPS boxes; provide information to the fishermen and other actors involved in fish trade and transport (leaflets, meetings) on importance of correct disposal of EPS boxes; inform fishermen on measures to prevent EPS boxes*
25b	*b. Awareness raising on marine litter for shipping, fishing and recreational sectors*

6 Feasibility analysis

6.1 Feasibility analysis – methodology

This section will describe the methodology to assess the feasibility of proposed measures (46 in total) to minimize marine litter. The feasibility assessment consists of the following steps.

Step 1: Development of evaluation criteria

Firstly, a long list of common criteria has been developed between the three "marine litter projects" starting from the Marine Litter Toolbox. The main criteria categories are listed in Table 11. The full list of 42 criteria is added in Annex 14. About half of the criteria were identified as priorities. The prioritization of the evaluation criteria has been made based on data availability and importance in the decision process. Even though the project gained substantial information from the interviews and the literature review, it appeared that the level of detail was insufficient to score all criteria.

Annex 14: Common set of feasibility criteria

Table 11: Main groups of evaluation criteria used

Category	Evaluation issue	Used for
1. Feasibility	1.1 Administrability	Feasibility
2. Costs	2.1 Financial	Feasibility
3. Effectiveness	3.1 Relevance	Selection of measure for the region
	3.2 Effectiveness	Feasibility
	3.3 Coherence	Policy mix of measures
	3.4 Community added value	Feasibility
	3.5 Sustainability	Policy mix of measures
	3.6 Monitorability	Feasibility
4. Distributional analysis/ stakeholder analysis	4.1 Who causes the problem?	Policy mix of measures
	4.2 Who pays (incurs costs)	Policy mix of measures
	4.3 Who benefits (positively impacted)	Policy mix of measures
	4.4 Who loses out (negatively impacted)	Policy mix of measures
5. Wider issues	5.1 Transferability (applicability)	Policy mix of measures

The evaluation criteria have been used in this project for following purposes:

- Feasibility assessment of the measures
- Selection of best policy mix of measures

An overview of which criteria have been used for the feasibility assessment and which for the selection of the policy mix of measures shown in Table 11.

Step 2: Scoring criteria – Development of fact sheets

For each of the measures, the criteria are scored and finally resulted in a fact sheet for each measure (Annex 13). Each evaluation criterion is scored qualitatively on a 5-point scale (++, +, 0, - and - -). A specific interpretation of the scores is tailored to each indicator. Scores are given based on information gathered through literature review and interviews with stakeholders at case study level, regional level and EU level; expert judgement was also used. Fact sheets from all three projects have been used.

For each score, a textual justification is given, in order to allow transparency in the scoring approach and also to allow a review by stakeholders and/or when better data comes available. The scoring is based on regional and case study information. Yet, at this step, however, regional differences in scoring were not addressed. Regional differences in the scoring have been considered in step 4 for the indicators 'cost', 'administrative capacity' and 'effectiveness'. The other criteria did not show sensitivity to regional differences.

Step 3: First compilation and comparison of scores

For the feasibility assessment, following the feedback of stakeholders and new insights in the measures, a 2nd revision of the evaluation criteria is done. Thus, a selection of evaluation criteria to be used in the feasibility assessment is made and linked to criteria for the feasibility assessment as shown in Table 12.

The measures were finally analysed across the eight criteria shown in Table 12 (left column). The feasibility criteria can be described as following:

- **Cost**: Estimate of costs to implement a measure, covering an approximation and aggregation of the upfront costs and annual costs over a 10-year period including staff costs, investment and materials. The 10-year period is common practice from the EU Impact Assessment methodology.
- **Possibilities for cost recovery**: Possibilities to recover the cost to implement a measure partly or fully, from the users and polluters of the marine environment and/or the benefits of a measure
- **Support by stakeholders**: Do local stakeholders and/or decision-makers support the measures?
- **Administrative capacity**: capacity of authorities needed to implement and manage a measure. It consists of a broad variety of aspects related to governance, including the performance of e.g. port reception facilities, waste management, sea authority, …), inspection and enforcement, capacity to charge and process fees, ...
- **Effectiveness**: Impact of a measure on the quantities of marine litter produced or entering in the marine system
- **Community added value** : related to impact of a measure on employment
- **Time lag**: Time needed to implement a measure
- **Monitorability**: Measurability of the effectiveness of a measure on marine litter

Table 12: Relationships between the evaluation criteria from the fact sheets and the criteria used for the feasibility assessment, including data availability for the indicators. The numbers refer to the evaluation issues listed in Table 11

Criteria for the feasibility assessment	Evaluation issue n°	Criterion
Cost	2.1	public costs
	2.1	costs for industry
Possibilities for cost recovery	-	Not included explicitly in fact sheets; scored based on text fields in the fact sheet
Support by stakeholders	1.1	opposition by stakeholders
Administrative capacity	1.1	existing administrative mechanisms
	1.1	costs involved for new capacities
Effectiveness	3.2	change in amount of litter on beach
	3.2	change in amount of litter entering marine system
Community added value	2.1	negative and positive costs related to employment
Time lag	1.1	Time needed to implement measure
	2.1	Time needed for implementation
Monitorability	3.6	Monitoring strategy

For the feasibility assessment, the scores in the fact sheet (++ to --) are translated into scores from 0-5 (++ corresponds to 5, -- is 1). The 0-score in the fact sheet is converted to a score of 3 for the feasibility assessment. The translation is done mainly to allow a semi-quantitative approach (calculation of averages, visualisation on a spider diagram). When 2 evaluation criteria are linked to one feasibility criterion (e.g. effectiveness), the average is taken for the feasibility score. The only exception on this rule is the cost criterion. Here, the lowest score (i.e. most expensive score) of the two is taken as the feasibility score instead of the average. The argument is that a low cost combined with a high cost still results in a high cost.

The results of the feasibility assessment are represented in tabular form using traffic light colours and in graphical form using spider diagrams. Table 13 shows an example scoring table and Figure 19 a spider diagram, specifically for measure 2a (Stronger (financial) incentives to deliver ship-generated waste at the port reception facilities). Spider diagrams of the other selected measures are presented in Annex 15.

Annex 15: Spider diagrams feasibility selected measures pilot study '4 Seas'

In the table, scores for the individual criteria, high scores (4 to 5) are highlighted in green; low scores (1 to 2) are highlighted in red. The "grey polygon" in Figure 19 shows the scores of the measures for each the feasibility criteria. The "bold black line" (score of 3) in Figure 19 is the threshold for feasibility. A criteria that scores 1or 2 are less feasible; Score of 4-5 are highly feasible. Criteria with scores between 2-4 have a neutral feasibility.

In addition to the scores of the individual feasibility criteria, two types of summary scores have been used:

8. **Average score**: could range from 1-5; Measures > 3.5 are considered highly feasible whereas measures below 3 are less feasible
9. **Number of criteria** for each feasibility category (high, moderate, low)

Table 13: Example scoring table for measure 2a (Stronger (financial) incentives to deliver ship-generated waste at the port reception facilities), including an interpretation of the scores

FEASIBILITY CRITERIA	2a	Conclusion
Cost	2	Less feasible
Possibilities for cost recovery	5	Highly feasible
Support by stakeholders	2	Less feasible
Administrative capacity	4.5	Highly feasible
Effectiveness	3.5	Highly feasible
Community added value	3	Neutral
Time lag	4	Highly feasible
Monitorability	4	Highly feasible
Average	3.5	Highly feasible

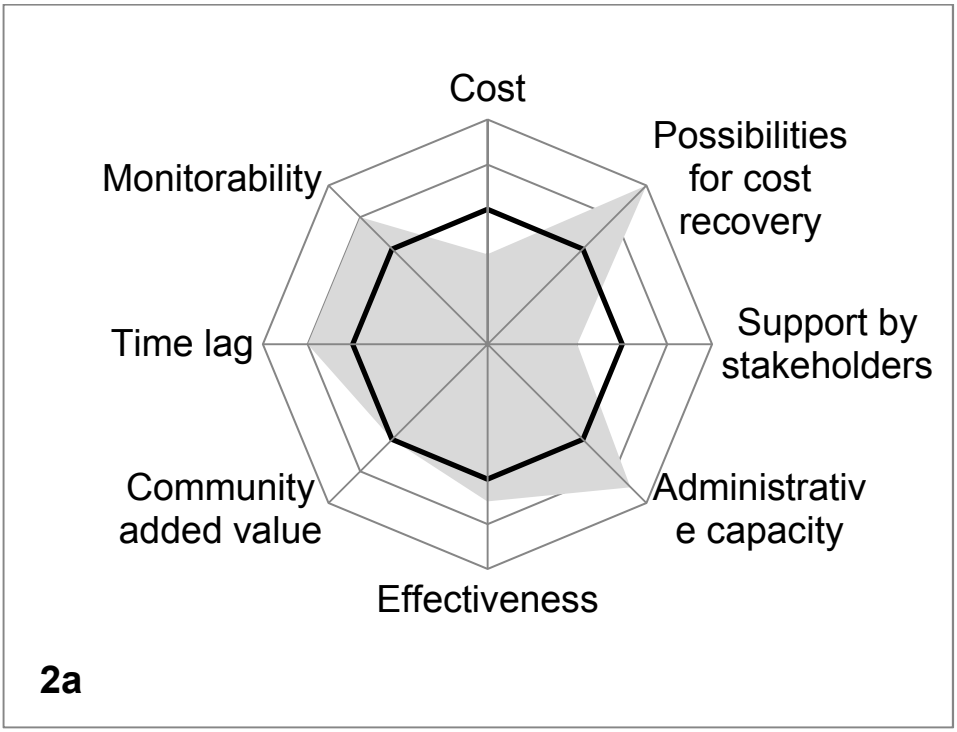

Figure 19: Example spider diagram for measure 2a (Stronger (financial) incentives to deliver ship-generated waste at the port reception facilities).

The "grey polygon" shows the scores of the measures for each the feasibility criteria. The "bold black line" (score of 3) is the threshold for feasibility. A criteria that scores 1or 2 are less feasible; Score of 4-5 are highly feasible. Criteria with scores between 2-4 have a neutral feasibility.

Step 4: Cost-effectiveness analysis

An important aspect in the feasibility analysis is the cost-effectiveness analysis. Cost-effectiveness (CE) refers to the cost relative to the effectiveness. The most cost-effective measure is defined as the measures that can achieve the same level of results (assuming that effectiveness is comparable) at the lowest cost. Considering that quantitative cost estimate are lacking for the majority of measures, costs have been classified in "orders of magnitude" as shown in Table 14. Cost estimates will hence be used in relative terms as a means to compare cost scores between measures and in order to compare cost scores to effectiveness. Consequently, the cost scores (1-5) correspond to exponential costs. An effectiveness score of 5 is the best, whereas a 1 score is the lowest. As a consequence of the limited data availability on costs and effectiveness, a qualitative assessment of cost-effectiveness is done. Using Table 15, the combination of a cost score (1-5) and an effectiveness score (1-5), results in a score for cost-effectiveness (also ranging from 1-5). The most cost-effective measure has a score of 5 and the least cost-effective a score of 1. The description of the scores is shown in Table 14.

Table 14: Description of the scoring system (from 1-5) used in the cost-effectiveness analysis. The assessment of cost-effectiveness is done in Table 15.

Score	Cost	Effectiveness	Cost-effectiveness
1	100 million €	very low	very low
2	10 million €	low	low
3	1 million €	moderate	moderate
4	100,000 €	high	high
5	10,000 €	very high	very high

The conversion of the cost and effectiveness scores into a score of cost-effectiveness (CE) is done by means of the matrix inTable 15. Hence, the CE of a measure is very high (score 5) if both the cost and effectiveness are either high or very high. A high CE (score 4) is assigned if cost and effectiveness are both at least moderate. A measure e.g. with a high or very high effectiveness (score 4 or 5) and a cost of 1 million Euro (score 3) is considered to be highly cost-effective. Likewise, a measure with moderate effectiveness (score 3) and a cost less than 10,000 Euro (score 5) is highly cost-effective. Measure with a low to moderate effectiveness and costs above 1 million Euro have a low or very low cost-effectiveness. Finally, the CE of measures can be moderate for different reasons: 1) effectiveness is high, but measures are also very expensive (above 10 million Euro); 2) the cost and effectiveness are both moderate; and 3) measures have low effectiveness, but a low cost. Even though the latter three groups have the same CE, the first group of measures is preferred as it brings the intended change but a high cost.

Table 15 : Qualitative assessment of cost-effectiveness as a matrix of cost scores and effectiveness scores

	Effectiveness				
Cost	**5**	**4**	**3**	**2**	**1**
1	3	3	2	1	1
2	3	3	3	2	1
3	4	4	3	2	2
4	5	4	3	2	2
5	5	5	4	3	2

6.2 Feasibility analysis - Results

6.2.1 Overview of results

The full results of the feasibility assessment are shown in Annex 16.

Annex 16: Results feasibility assessment pilot study '4 Seas'

In average, 90% of the proposed measures are considered feasible as shown in Figure 20: 46% are highly feasible (21 measures), 43% are moderately feasible (20 measures) and 5 out 46 measures (11%) are less feasible. The feasibility of the individual measures is visualised in Figure 21. Even though the feasibility of measures depends on the local context, some general observations can be made. Most measures scored well on effectiveness and administrative capacity. This is explained by the fact that effectiveness, relevance and required administrative capacity of a measure were a criterion for shortlisting a measure in the case study. The possibilities for cost recovery were good in only 30% of measures. The effectiveness of measures can in most cases be measured, though mostly indirectly (e.g. awareness raising campaigns). The impact of the measures on employment depends for a large extent on the context and might need to be further encouraged.

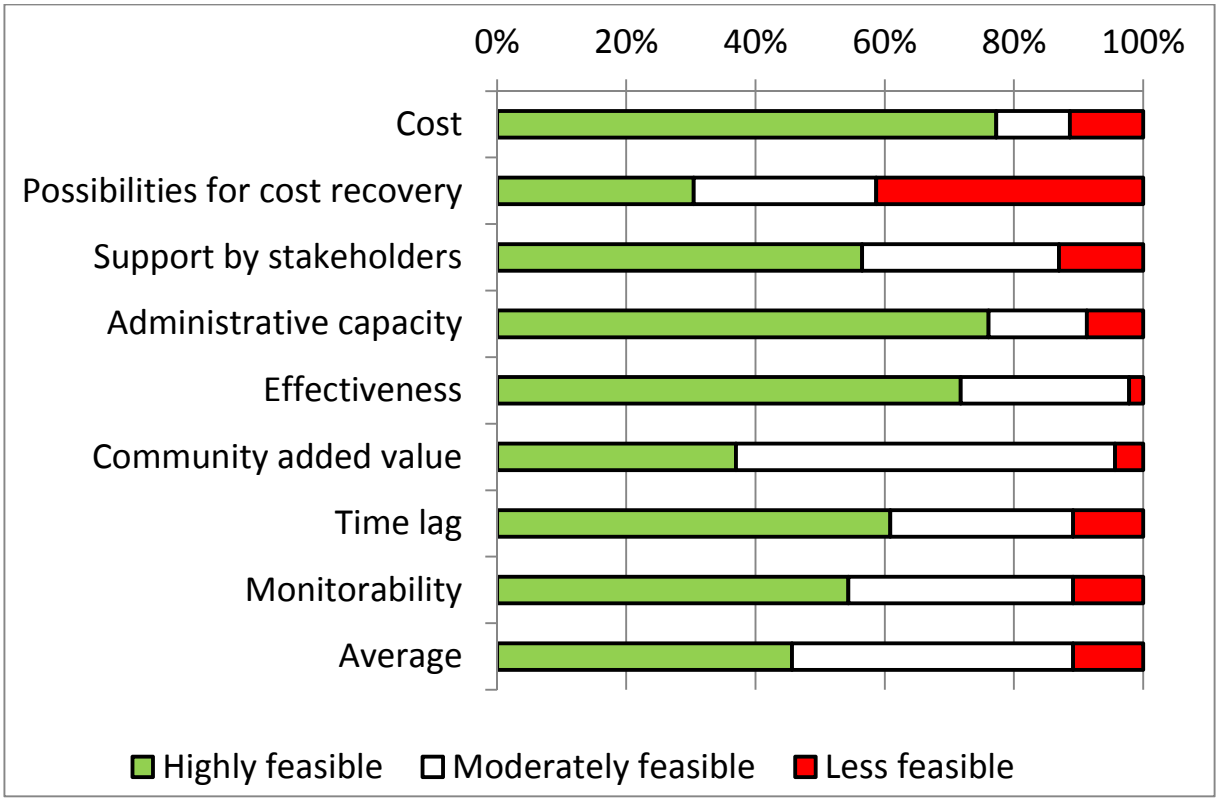

Figure 20: Overview of feasibility of measure grouped according to criteria

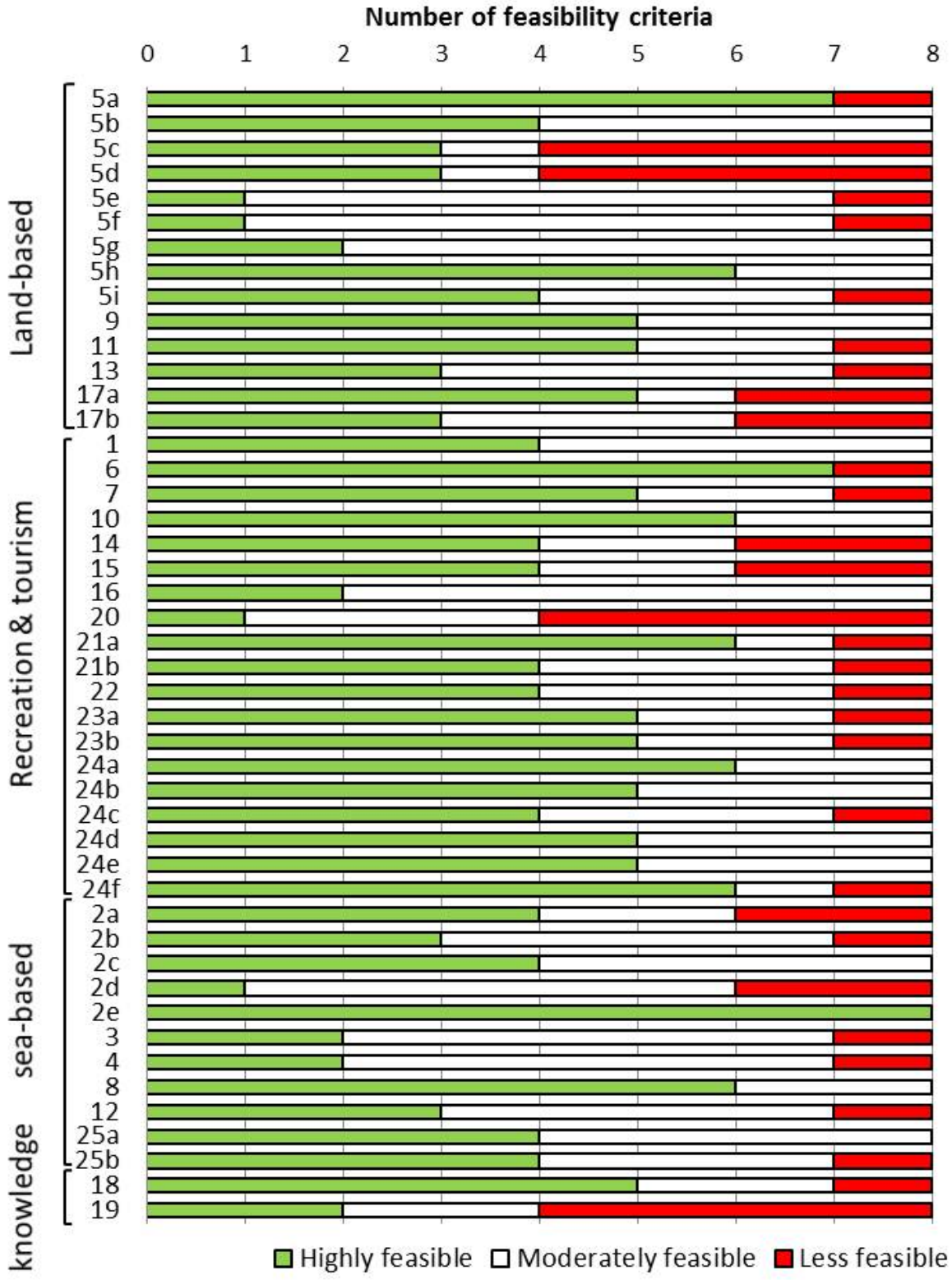

Figure 21: Overview of feasibility of measures

Some of the highly feasible measures include:

- Maintenance of river beds, *rieras* (in dry periods) (measure 5a): regular removal of plastics in the dry river bed can avoid flushing into the marine environment when rain falls. All criteria score high except for cost recovery.
- Enforcement of the technical requirements of the Landfill Directive close to the coast to prevent wind-blown plastic bags, litter control, surface water control and general tidiness (measure 5h): Low cost measure with high scores on all criteria
- Provide adequate waste (and recycling) receptacles in beach area (measure 6): Low cost measure with high effectiveness and stakeholder support. All criteria score high except for cost recovery.
- Allocation of certain percentage of touristic tax for actions on marine litter (measure 10): Many high scores, but stakeholder support and time lag can be challenging.
- Sensitization campaigns (measure 24 and sub-measures)

The measures that have been found the less feasible are:

- Guidance for ships' Garbage management plans' (2d): Even though this measure is recently recommended by the MARPOL convention, it was mostly unknown to the case study stakeholders. The lack of administrative capacity and the additional costs – and limited potential for cost recovery – for shipping companies were considered to be the weakest points.
- Separate sewers for rain, and domestic waste water (measure 5c); can only be done for new developments, This measure is extremely costly, has low support with stakeholders, lack of administrative capacity and a big time lag to implement the measure
- Connect unconnected sewers to WWTP (avoid direct discharge of litter and waste water into sea) (measure 5d): Similar to measure 5c, this measure is extremely costly, has low support with stakeholders, lack of administrative capacity and a big time lag to implement the measure.
- Eco-alternatives for plastic beach ashtrays (measure 20): A concept tested in Barcelona resulted initially in more marine litter as the plastic ashtrays were left on the beach. Recent observations show that ash trays are nowadays rarely found at the beach in Barcelona. The effectiveness of the measure and support by stakeholders is considered to be low.

Finally, the feasibility of the establishment or harmonization of a monitoring system for marine litter has not been straightforward. The elaboration of a monitoring system is supported by most stakeholders as a means to increase knowledge on the state of the environment and severity of the marine litter problem. In addition, the European Marine Strategy Framework Directive (MSFD) asks for a monitoring system to be operational from 2014 onwards. Yet, monitoring is also a broad term and the feasibility (incl. costs) depends on which parameters are monitored and by which method. Beach monitoring (measures 15, 18) can be done manually (or mechanically) and against low cost (3 week FTE per monitored beach), whereas monitoring of floating litter (measure 19) is more expensive and requires trawling (about 1 million Euro/year). Implicitly included in measure 19 is the monitoring of marine litter in the water column and sea bottom.

Measures that assess the monitoring of land-based sources, water column, sea bottom, marine litter ingested by marine animals and micro-plastics have not been assessed in this project. In addition to the state-based monitoring as described above, also pressure-based monitoring can be done, e.g. by through monitoring and/or better inspection at port reception facilities (measures 2b-c).

6.2.2 Cost-effectiveness analysis: Results

Results of the cost-effectiveness analysis are shown in Figure 22. The cost scores of the measures are plotted against the effectiveness scores. The cost-effectiveness (CE) score categories as described in Table 14-Table 15 are visualised as colour bands in Figure 22. It can be noticed that the measures closest to the upper right corner are the most cost-effective.

The further away from the upper right corner, the less cost-effective. Measures in the upper right dark green triangle are considered as measures with very high CE. These are measures with a high or very high effectiveness and a cost at or below 100,000 Euro. They can be considered as quick wins (easy gain with small efforts). The measures with high CE are shown on a light green back drop. The highly cost-effective measures are either to change behaviour (awareness) or management practices. The CE of expensive, but potentially highly effective measures such as port reception facilities incl. inspection (measures 2a-c) and waste water and solid waste treatment related measures (measures 5c-g), is moderate. The latter score might be underestimated and an in-depth study needs to be done in order to better assess the cost and effectiveness of the latter group of measures.

The five **most cost-effective measures** are:

- 2e: Optimise logistics of merchant premises in fishing ports to avoid escape of EPS boxes during the trade, transport of fish;
- 6: Provide adequate waste (and recycling) receptacles in beach areas;
- 10: Allocation of certain percentage of touristic tax (daily touristic fees in accommodation facilities, parking fees, beach fees) to the environmental funds for the prevention of littering on the beaches and for preventive and mitigating actions;
- 21a: Develop, promote and support community-based clean-up campaigns (awareness combined with effective clean-up actions): beach clean-up;
- 24f. Create and promote stewardship concepts such as adopt-a-beach or adopt-a dive site programme (others Blue flag movement).

The three **least cost-effective measures** are:

- Separate sewers for rain and domestic waste water (measure 5c);
- Connect unconnected sewers to WWTP (avoid direct discharge of litter and waste water into sea) (measure 5d);
- Eco-alternatives for plastic beach ashtrays (measure 20), a low-cost measure with low effectiveness.

The results of the CE analysis need to be considered with care. Considering the qualitative nature of the presented CE assessment, the scores of cost and effectiveness are relative to each other. An effectiveness of "5" is hence simply substantially better than a score of "2.5" and cannot be considered as twice the effectiveness.

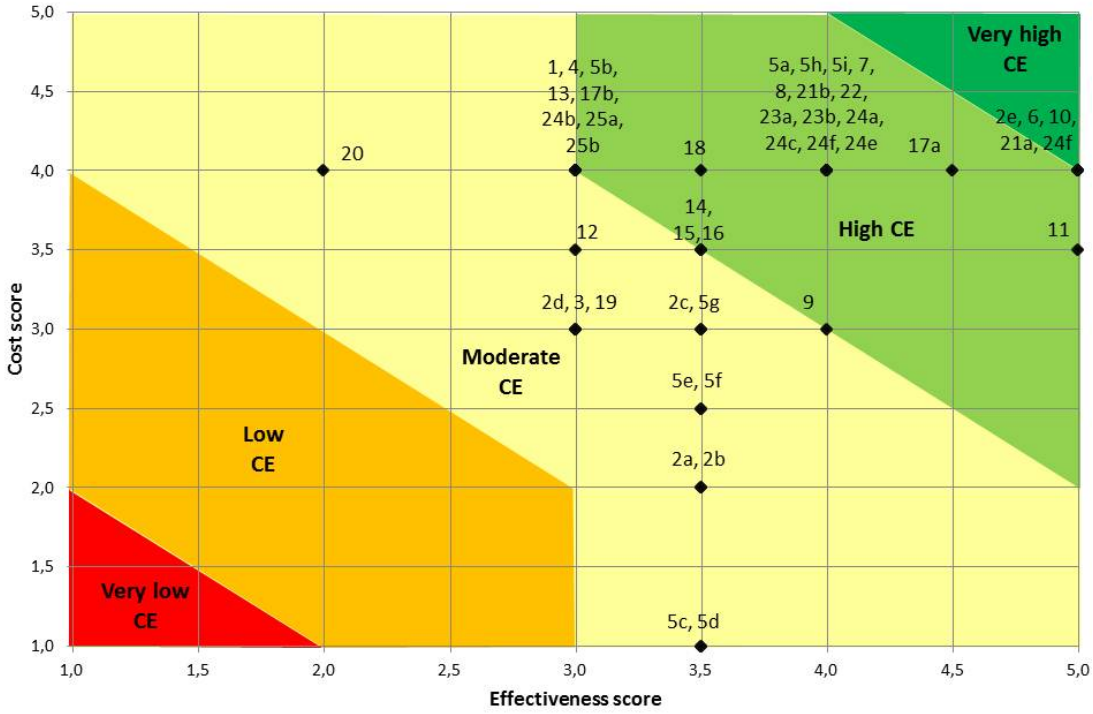

Figure 22: Results of the cost-effectiveness analysis

Cost-effective measures that score high on the possibilities for cost recovery are considered as most affordable. These are the measures 2e, 10 and 11. Other highly cost effective measures, with but limited potential for cost recovery (5a, 5i, 6, 7, 17a,18, 21b, 22, 23a, 23b) are also expected to be affordable, mainly as a consequence of their low cost and high stakeholder support. Measures that are close to the bottom-right corner (high effectiveness, but expensive) are only affordable with substantial financial support of decision-makers. Measures with good possibilities for cost recovery can be considered to be more affordable. Measures that are expensive, effective and with good possibilities for cost recovery and thus potentially affordable are 2a, 2b, 5c and 5d.

7 Policy advice

7.1 Identifying a mix of measures

The final scope of this study is the design of an adequate mixture of policy measures and strategies, targeting different key sectors and pathways. This section describes the methodology used to compose policy mixes for each case study, building on the information gathered in the previous tasks.

The whole process is bottom-up oriented according to the following steps:

1. Based on observations of marine litter and stakeholder input, key sources and pathways for marine litter in the four regional cases were identified (Chapter 1);
2. Starting from local knowledge, measures were identified and further narrowed down to come to a final set of 46 measures (Chapter 1);
3. This final set of 46 measures has been classified in four broad categories, directly linked to the major sources and pathways identified. A detailed description can be found in Annex 12:
   - Measures to reduce land-based waste affecting the marine environment;
   - Measures to reduce consumption waste by recreational and tourism activities directly affecting the marine environment;
   - Measures to reduce sea-based waste directly affecting the marine environment;
   - Measures to improve knowledge on main sources & loopholes of marine litter.
4. Adapted to each regional situation, policy mixes have been composed that:
   - Address the main waste streams identified as loopholes and gaps in the case study area;
   - Resulted as preferred options from the feasibility assessment (Chapter 1);
   - Strive for a balanced distribution:

a) between measures addressing the consumers and the industry;

b) across different sectors;.

c) between end-of-pipe measures and structural measures (higher in the life cycle).

d) between fund spending and fund generating measures.

e) between 'Low hanging fruits' measures with direct effect (short term) on marine litter (e.g. providing more bins on the beach) and more difficult measures aiming at long-term sustainable effects (e.g. monitoring).
   - Consider the financial distribution of 'who causes the problem - who pays - who benefits - who loses out'; and in this way has attention for the 'polluter pays principle';
   - Look for an optimal coherence between measures, referring to the dependency of simultaneous implementation of measures, including amongst others following combinations:

f) Legal + infrastructure (e.g. appropriate penalties for beach littering + adequate and sufficient bins in beach areas)

g) Legal + information (e.g. incentives to deliver ship-generated waste at port reception facilities + provide clearly visible information of correct use and disposal of waste)

h) Awareness + infrastructure (e.g. sensitization of coastal tourists + adequate and sufficient bins in beach areas)

i) Awareness + clean-up campaigns (e.g. adopt-a-beach + beach clean-up)

- Search for synergies with existing policies (e.g. Landfill Directive, MARPOL V, WFD) (e.g. improvements sewage system);
- Include the transferability of the measures within a regional sea (e.g. problem of *rieras* (inland rivers) used as dump sites during dry seasons is characteristic for Barcelona region; but indicated by regional stakeholders as less relevant for Greece in the Mediterranean Sea case).

5. The draft policy mixes have been the subject of a final stakeholder consultation, coordinated by the project team with the support of the regional partners. Feedback both on the results of the main sources and loopholes and on the proposed measures (including feasibility assessment), resulted in an adapted set of measures included in the final policy proposal (see Chapter 7.2).

7.2 Proposed policy mix per regional sea

A policy mix has been proposed for each regional case and described in detail in Annex 17 to Annex 20. The policy proposals summarize the results of the different tasks performed in this pilot study '4 Seas' and are structured according to the following chapters:

- Context;
- Main sources and loopholes of marine litter;
- Existing and proposed measures;
- Proposed policy mix.

Annex 17: Policy proposal North Sea Region

Annex 18: Policy proposal Mediterranean Sea Region

Annex 19: Policy proposal Baltic Sea Region

Annex 20: Policy proposal Black Sea Region

The summary tables of the policy proposals show clearly that for each regional case a set of feasible measures can be proposed to help tackling the main causes of marine litter. Only a limited amount of measures are identified as less feasible (see also Chapter 6), but that often in these examples investments should be seen on a longer time scale (e.g. infrastructural investments in case of extension or improvements of existing sewerage system) and in synergy with other existing legal frameworks.

From the overview table below, a fairly even distribution is obtained in the Black, Baltic and Mediterranean Seas in measures addressing the consumers and the industries, and between end-of-pipe and structural measures. The similarities may be attributed to the fact that all these regional seas mainly have to address land-based household waste affecting the marine environment resulting in a (to a certain degree) comparable set of measures. The North Sea region is slightly different as here sea-based activities are generating most of the marine litter, giving a higher responsibility to the industrial sectors.

In general, all measures proposed will contribute to reduced levels of marine litter, a better environmental quality, higher aesthetic values of the coastal area. In this sense the whole region will benefit, and in particular coastal tourism. No real 'losers' can be identified (except if you relate it to the costs to be paid).

Common for all regional seas is the dominance of fund spending measures including awareness actions and monitoring activities. These latter groups of measures also contribute to the high number of measures where effects on marine litter will take some time. Public authorities are responsible for the implementation of almost half of the measures, mainly related to waste management infrastructure, awareness and monitoring. The other measures have to be financed by industrial sectors or the consumer himself (penalties, taxes), resulting in a high support of the 'Polluter Pays Principle' (40 to 50% of the measures).

Table 16: Comparison policy mix criteria for the regional cases

	North Sea	Mediter. Sea	Baltic Sea	Black Sea
Total # measures	21	28	27	24
Consumer vs Industry	7 / 12	15 / 11	13 / 12	13 / 9
End-of-Pipe vs Structural	7 / 13	16 / 12	13 / 14	12 / 12
Fund spending vs Fund generating	17 / 4	23 / 5	21 / 6	18 / 6
Direct vs Long term effect	8 / 13	10 / 18	8 / 19	9 / 15
Polluter pays principle	10	11	13	9

7.3 Regional differences policy mix

The policy mixes include between 21 (North Sea Case) and 28 (Mediterranean Sea Case) measures. Some main findings are summarized below:

1. Recreational & tourism activities are responsible for the majority of marine litter (incl. consumption packaging, plastic cutlery, straws, cigarette butts):in all the marine regions (between 35% and 58 % of the marine litter observed), resulting in a common set of measures including appropriate penalties for beach littering, adequate and sufficient receptacles in beach area, optimal cleaning strategies, sensitization of the coastal tourists (e.g. inform about risks and alternatives to plastic bottles) and sectors (e.g. promotion of proper use and disposal of plastic bags, commitment on touristic sector to reduce use of plastic bottles, cutlery/straws, environmental awards, promotion of stewardship concepts such as adopt-a-beach) combined with clean-up activities at the beach. For some of these measures efforts have been made in the last decade including regular cleaning during bathing season and several education and behavioural change campaigns, however there is still need to invest in capacity during top days and in more efficient bins along the coast, to invest in mechanical and

manual cleaning in a sound way as well as in a continued effort to change the social perception and behaviour of the public to waste. Other measure evaluated as feasible for some regional seas are the establishment and effective control of a clean-up plan for cultural events at the beach (e.g. sport activities, music festivals, fireworks) and the implementation of the tourist tax.

2. Land-based household waste (including sanitary waste) affecting the marine environment through the sewerage system and in some cases through the inland rivers is the main problem in the Mediterranean, Black and Baltic Sea. Measures proposed here are related to the improvement of collection, treatment and disposal of domestic solid waste. Some of these measures are easy to implement like better maintenance and cleaning of the river beds and sewerage systems, or improved waste collection and street cleaning. But also some infrastructural higher cost measures to improve the sewerage system (separate sewers for rain and domestic water), to improve the storage capacity, to reduce the release of waste into the sea through grit chambers have been proposed by the stakeholders in the Mediterranean and Baltic Sea. More general measures to reduce the household waste, proposed in these regional seas, are to improve waste management services by promoting reuse of plastic products and selective collection (e.g. implementation of deposit refund systems for bags and plastic bottles, improve EPR systems for plastic packaging). Specifically for the Mediterranean and the Baltic Sea region extra measures have been defined to reduce the input and impact of sanitary waste into the marine environment. On the one hand this includes public awareness campaigns to persuade the public to change their behaviour and avoid flushing through the toilet, and on the other hand manufacturers are approached to make the products more environmental friendly. Compared to the other regional seas, litter coming from poorly managed dumpsites and illegal dumping still plays a considerable role in the Black Sea Region. Measures proposed here include the enforcement of the technical requirement of the Landfill Directive close to the coast as well as to identify and close non-compliant landfills and illegal dumpsites close to the coast. More general measures to reduce the household waste, also proposed in other regional seas, are to improve waste management services by improving the infrastructural capacity (e.g. maintenance and cleaning sewerage system, more bins), by promoting selective collection (e.g. implementation of deposit refund systems for bags and bottles,).
3. In contrast to the other marine regions where land-based activities are generating most of the marine litter, sea-based waste from shipping and fisheries takes a dominant role in the North Sea region. Nevertheless, common to all marine regions, the proposed policy mix includes measures related to the enforcement of MARPOL Annex V. Specifically for the North Sea region extra measures have been defined to minimize the loss of fishing gear, to stimulate and improve the collection of fishery related waste, and to increase awareness of the marine sectors about these issues. As a result of the final stakeholder consultation, some of these measures (e.g. sensitize the marine sectors to promote sustainable use and anti-littering) have been added to the policy mix of the other regional seas. Finally, a need has been expressed by the stakeholders of the North, Mediterranean and Baltic Sea for more guidance for cargo transport and port cargo handling operations.
4. Next to these measures tackling specific issues of marine litter, there is also need for measures to improve knowledge on main sources & loopholes of marine litter to be able to specify the marine litter strategy per regional sea for the coming years. There

was a general agreement within all regional seas that an improved and harmonized EU monitoring system has to be implemented in the 4 regional seas, starting from the beach, and later to be extended for the floating and seabed compartment.

From the cost-effectiveness analysis it became clear that to realize some of these local solutions, European support will be needed. Both in terms of:

- Methodological support: by setting up an EU harmonized monitoring system for the three main compartments (beach litter, floating litter and litter on the seabed);
- Legal support: not only by providing EU Directives, but also by coordinating their implementation and enforcement; and
- Financial support: by providing EU financial support mechanisms.

Coordinated action at different levels (local, regional and European) to reduce marine litter will in this way contribute to a good environmental status by 2020.

8 Integration of results from three Marine Litter Studies

This chapter brings together in a comprehensive way the results of three studies on marine litter financed by the European Commission. It also provides a 'reading guide' to certain elements of these three studies.

8.1 Background

Marine litter poses a serious threat to the marine environment around the globe and raises growing environmental, economic and health concerns. It contains a range of persistent, manufactured or processed solid materials (such as plastic, glass, wood, metals, etc.) which are discarded, disposed of or lost into the sea and on beaches, including materials which are transported into the marine environment from land by rivers, drainage or wind.

Plastics are the most abundant debris found in the marine environment and comprise more than half of marine litter in European Regional Seas. More than half of the plastic fraction is composed of plastic packaging waste with plastic bottles and bags being predominant types of plastic packaging. However, the lack of a systematic approach to monitoring marine litter means that determining trends in the amount and type of litter is difficult. Recent information indicates that significant differences exist in the types of marine litter found between the seas bordering the EU. Additional beach surveys performed as part of one of the studies, confirmed these findings. Predominant types of litter other than packaging materials include sanitary waste, smoking-related material and fishing-related material.

Considerable efforts have been made to combat the problem of marine litter. However, the problem is growing in scale, in particular due to non-degradability or slow degradation of litter in the marine environment. At local, regional, national and international scale numerous measures and initiatives have been taken, either targeting marine litter specifically or comprising general litter management or environmental stewardship and sustainable practices. Coordination of these actions within a coherent strategy, with exchange of experiences by learning from good practice examples or drawbacks and taking account of the origin, activities and actors to which marine litter is linked, should enable the implementation of measures that successfully mitigate/prevent the (increasing) pressure of (plastic) litter in the coastal and marine environment.

8.2 Three new projects on marine litter – an overview

The European Commission is a very active player in addressing the issue of marine litter. Commission policies, strategies, legislation and environmental projects, research and other initiatives aim to increase the knowledge base and to foster cooperation and dialogue.

Three studies have been contracted by the European Commission, DG Environment (see table below) to aggregate data on marine litter in European Marine Environments, to contribute to achieving good environmental status with respect to descriptor 10 on marine litter of the Marine Strategy Framework Directive and to help to further develop (European) policy for marine litter. The results of the three studies will also contribute to

the Rio +20 commitment to take action to achieve significant reductions in marine debris and the achievement of the goals and strategy objectives of the Honolulu strategy[24].

Honolulu strategy - Main goals

Goal A: Reduced amount and impact of land-based sources of marine debris introduced into the sea

Goal B: Reduced amount and impact of sea-based sources of marine debris including solid waste, lost cargo, Abandoned, lost or otherwise discarded fishing gear (ALDFG), and abandoned vessels introduced into the sea

Goal C: Reduced amount and impact of accumulated marine debris on shorelines, in benthic habitats, and in pelagic waters

All three projects propose a mixture of feasible and affordable measures in order to improve the situation concerning marine litter whilst adopting a slightly different focus, as shown in the following project overview:

Table 17 : Project overview of the three marine litter studies

Project	PROJECT 41 Pilot project '4 Seas': *Case studies on the plastic cycle and its loopholes in the 4 EU regional seas* (ENV.D.2/ETU/2011/0041)	PROJECT 42 Anti-Littering Instruments: *Feasibility study of introducing instruments to prevent littering* (ENV.D.2/ETU/2011/0042)	PROJECT 43 Plastic Packaging Loopholes: *Loopholes in the flow of plastic packaging material* (ENVD.2/ETU/2011/0043)
Contractor	ARCADIS (MILIEU, EUCC) www.arcadisbelgium.be	RPA (ARCADIS, ABPmer) www.rpaltd.co.uk	BiPRO GmbH www.bipro.de
Objectives	• Identify main sources and loopholes of **marine litter in the 4 regional seas** • Focus on four **case studies**: Oostende (North Sea), Barcelona (Mediterranean Sea), Riga (Baltic	• Identify best practices in **plastic and other littering** prevention and cleaning up • **No geographic restriction** • Build on initiatives concerning **plastic bags and**	• Identify loopholes in the **plastic packaging** cycle • Focus on Member States (**MS) lagging behind and 3 non-EU Mediterranean** Countries • Build on initiatives concerning **plastic**

[24] The Honolulu Strategy, published by UNEP and the NOAA Marine Debris Program [UNEP 2012], is a framework for a comprehensive and global effort to reduce the ecological, human health, and economic impacts of marine debris. It is intended to help improve collaboration and coordination among the multitude of groups and governments across the globe in a position to address marine debris. It is intended to serve as a common frame of reference for action among these communities, as well as a tool for groups to develop and monitor marine debris programs and projects. (http://ec.europa.eu)

Project	PROJECT 41 Pilot project '4 Seas': *Case studies on the plastic cycle and its loopholes in the 4 EU regional seas* (ENV.D.2/ETU/2011/0041)	PROJECT 42 Anti-Littering Instruments: *Feasibility study of introducing instruments to prevent littering* (ENV.D.2/ETU/2011/0042)	PROJECT 43 Plastic Packaging Loopholes: *Loopholes in the flow of plastic packaging material* (ENVD.2/ETU/2011/0043)
	Sea) and Constanta (Black Sea) • Building on **local knowledge** through regional workshops and stakeholder interviews • Proposal of **possible measures** and feasibility assessment	**biodegradable plastic as well as initiatives outside the field of litter** • Assessment of the feasibility of **different options to prevent littering** (including plastic) **and increase public awareness**	**bags and biodegradable plastic** • Proposal of **possible measures** and feasibility assessment
Differentiation	• **Marine litter** including PPW • Geographical area: 4 selected case studies • **Bottom-up** approach	• **All litter** sources including PPW • Policy support • No geographical limitation but case studies cover specific areas	• **Plastic packaging** waste (PPW) • Geographical area: selected EU MS (BG, CY, EE, ES, FR, GR, IE, IT, PL, RO, UK) + Egypt, Lebanon, Morocco • **Top-down** approach
Synergies	• Identification and proposal of measures • Feasibility assessment • Include bags, bottles • Policy support	• Identification and proposal of measures • Feasibility assessment • Include bags, biodegradable plastics and all types of litter • Policy support	• Identification and proposal of measures • Feasibility assessment • Consideration bags and biodegradable plastics • Policy support

8.3 Common methodology

In order to recommend a programme of measures, the three studies looked at existing measures which address the problem of littering, each with their specific focus (Table 17). These long-lists of measures were structured according to the goals and strategies of the Honolulu strategy for project 41. Project 42 divided the measures into three major types linked to the different factors driving littering behaviour. The three major types of measures are to reduce littering by influencing behaviour, to prevent littering and to clean up litter. In project 43 the measures were allocated to the steps of the plastic packaging life cycle and most relevant actors who are in the position to close existing plastic packaging loopholes.

These long-lists of measures were further screened to produce short-lists of measures which were then analysed in greater detail (feasibility assessment). This aimed to determine how effective and efficient these measures were at achieving the objectives of preventing, cleaning up and reducing the quantity of litter that could potentially reach the marine environment.

As a result of the synergies taking place between the three EU marine litter studies, all short-listed measures have been described according to a common template. The template for the Marine Litter Fact Sheets has been based on the template developed for the Marine Litter Toolbox[25], and extended with criteria to feed the feasibility assessment. A long list of common feasibility criteria has been developed between the three studies. The full list of criteria can be found in the main report. The main criteria categories are listed in Table 11. It should be noted that even though the project gained substantial information from stakeholder interviews (project 41 and 43) and literature reviews, it appeared that the level of detail was insufficient to score all criteria. Detailed results of the feasibility assessment can be found in Chapter 6 of report 41, Chapter 4 of report 42 and in Chapter 9 and Annex 6 of report 43.

Table 18: Main groups of evaluation criteria used for the feasibility assessment

Category	Evaluation issue
1. Feasibility	1.1 Administrability
2. Costs	2.1 Financial
3. Effectiveness	3.1 Relevance
	3.2 Effectiveness
	3.3 Coherence
	3.4 Community added value
	3.5 Sustainability
	3.6 Monitorability
4. Distributional analysis/ stakeholder analysis	4.1 Who causes the problem?
	4.2 Who pays (incurs costs)
	4.3 Who benefits (positively impacted)
	4.4 Who loses out (negatively impacted)
5. Wider issues	5.1 Transferability (applicability)

[25] Toolbox developed for the marine litter high-level preparatory meetings of which the third preparatory meeting took place in Brussels on 27 February 2012.

In addition, case studies were used in project 42 to identify the success factors and barriers to particular measures. The case studies incorporated the analysis of similar instruments in different Member States, the analysis of different measures targeted at particular types of litter, the analysis of different measures aimed at particular target groups, and the analysis of different measures targeted at a particular location.

This common approach allowed an exchange of relevant measures between the three studies to compose an adequate mixture of policy measures and strategies targeting all relevant key actors and pathways.

The proposed mixture of affordable and feasible measures in the three studies target the most important materials and sources contributing to marine litter: sanitary waste, cigarette butts, ropes & nets and plastics (project no 41), specifically plastic packaging (project no 43) as well as other relevant waste materials (project no 42).

8.4 Main findings

1) The three projects showed that plastic is the dominant fraction and that plastic packaging waste (PPW) in marine litter comes primarily from land based activities, although with some important regional differences (see below). The most relevant plastic packaging items present in marine litter are plastic bags and bottles, and consumer packaging (e.g. crisps/ sweets). Therefore, measures within a strategy to close the largest loopholes in the plastic packaging cycle should target plastic bottles and plastic bags, and specifically address the responsible actors in the production, consumption and waste management stage of plastic packaging which could bring about improvements by changing their behaviour and implementing practical actions to do so. More specific information on selected feasible and affordable measures to close the largest loopholes contributing to marine litter in plastic packaging flows is available in Chapter 9 and Annex 6 of report 43, Chapter 5 of report 41. Information on measures targeting packaging, which could be adapted for use in different Member States can be found in Chapter 4 and Annex 3 of report 42.

2) The three studies identified individual behaviour and people's attitudes and perceptions as a major influential factor with regards littering. Other important factors include context (e.g. cleanliness of the area, administrative capacity and competences, etc.) and available waste infrastructure (e.g. sewerage systems) and facilities (e.g. port reception facilities, suitable receptacles).

   Consumer's purchasing, consumption and disposal behaviour is also considered a key aspect which needs to be changed in order to close the largest loopholes by which marine litter, including plastic packaging, enters the marine environment. Therefore, the measures should in particular influence these specific behaviours and involve all relevant actors which could influence consumer behaviour.

   There is a key role here for retailers, as they are in direct contact with millions of consumers daily, the tourism industry to address coastal tourists and residents, waste management companies to improve consumer's disposal behaviour and local competent authorities to provide for relevant informative, economic, administrative and infrastructural measures. Consumers could also have a direct impact by modifying their behaviour. The combination of individual actions will lead to significant and measureable results in terms of the reduction of plastic waste in the environment.

Simply starting to reject single use bags in stores, use alternative cotton bags, drink tap water (where possible) instead of buying bottled water, discard your waste properly, etc. can make an impact on litter levels. Other ways of improving management of waste in our society and preventing it from becoming marine litter is outlined in each report (Chapter 5 of report 41, Chapter 4 and 5 of report 42 and Chapter 10 of report 43).

Due to the important impact that individual behaviour has on marine litter, increased knowledge of the behaviour of individuals and organisations responsible for litter can assist with the formulation of effective policy measures to address the problem of marine litter.

3) Project 41 and 43 show that appropriate waste management is another crucial issue to close the largest loopholes for household waste including plastic packaging waste. Therefore, relevant actors in waste management (waste collectors, operators of waste treatment facilities) must improve the performance of the waste management system. This could be managed by, for example, increasing the waste collection frequency, increasing capacity of municipal waste services during busiest tourist days (summer season), better maintenance of and improvements to the sewerage system, provision of information to consumers on proper disposal behaviour, organisation of training for personnel involved in waste collection and disposal, etc. (see Chapter 5 of report 41, Chapter 10 of report 43 for further specific recommendations).

4) Finally, producers should be involved and fulfil the extended responsibility over the whole product life cycle and should implement measures to optimise the performance of the PPP (plastic packaging products) production (e.g. through design for re-use, recycling, prevention, low material demand, etc.). The plastic industry can prove its commitment to contribute to the GES indicator 10 by supporting and financing various types of measures which aim at improving the situation concerning plastic packaging litter in the marine environment (see Chapter 10 of report 43 for further specific recommendations) or by providing more environmentally friendly alternatives to, amongst others, sanitary products use (Chapter 5 report 41).

In addition to these common findings, the studies - particularly project 41 and 42, identified variability with regards to marine litter across Europe and its regional seas. This variability spans types, sources and trends in litter. While land-based activities, for example, generate most of the marine litter in the Mediterranean, Baltic and Black Sea (also confirmed by the findings of the project 43, Chapter 4 and Annex 2), sea-based activities are almost equally important in the North Sea region (including ropes and nets). Project 41 highlights the importance of sanitary waste in the Mediterranean and Baltic region, while this is not observed in the surveys from the North Sea and Black Sea cases. Equally, the factors influencing littering behaviour can be very context specific (project 41, 42 and 43).

On the basis of the evidence collected from literature, together with the (rather limited) data on costs and effectiveness of individual measures the key finding of the assessment showed that the measures need to be tailored to particular circumstances in order to successfully prevent (marine) littering. This makes it rather difficult to recommend a single

programme of measures that are equally cost-effective and applicable across Europe. However, by tailoring measures to particular contexts it ensures that the measures which are implemented are those which are most suitable to the circumstances in which they are applied.

The three studies therefore, set out an approach for responsible authorities to identify and select measures for particular circumstances. Policy mixes have been proposed per regional sea as part of project 41 and are available in Chapter 7 and Annex 17 to 20. The recommendations cover actions at different levels, by different actors (local/regional authorities, Member State governments and the Commission as well as other partners) and focus on coordination and partnerships to maximise the effectiveness:

- Local (and/or regional) authorities have a key role in litter prevention. An overall reduction in the amount of litter entering the environment, both at inland and coastal locations, is likely to result in a reduction in marine litter. The three projects set out an approach which local authorities could take to help solve the marine litter problem. This includes a wide range of measures such as identifying the problem, educational/informative initiatives and actions to raise environmental awareness among different target groups according to their needs, promotion and reward for good practice examples, promotion of measures to prevent PPW becoming marine litter, provision of adequate waste collection and treatment infrastructure, monitoring the measure post-implementation, etc.
- Regarding Member States, it is recommended that they assist and work with local and regional authorities to enhance their programmes of action on marine litter. Member State authorities can support the local authorities' programmes through facilitating funding, adjusting and enforcing regulative provisions and drafting new legislative requirements which can be placed on relevant market players, exchanging experiences, working through partnerships, and coordinating efforts at regional sea levels.
- The role of the policy makers at EU level would be to provide a platform for national and local authorities thus supporting their actions. Moreover, policy makers could further utilise social media applications to engage stakeholders and the public in the prevention and clean-up of marine litter. Their role would also consist of making additional funding available, facilitating further exchange of experience, coordinating efforts across regional seas and enforcing the existing European guidelines.

Policy should establish specific targets to be achieved at these different levels (local, regional, national or EU wide) for the long term reduction of plastic packaging in marine litter. This can be accomplished by adopting targets aiming to reduce litter inputs to the marine environment by improving the resource efficiency, waste management, consumer behaviour or specific pollution sources (for example by increasing targets for re-use, recycling and recovery of PPW and setting targets to divert plastic packaging from being landfilled) or by establishing environmental targets regarding the presence of marine litter in European Regional Seas (e.g. to decrease beach litter by 50% per decade). Further recommendations on actions and measures to reduce marine litter applicable on a local/regional or EU wide level can be found in Chapter 4 and 5 of report 42 and Chapter 10 of report 43.

8.5 Recommendations and Follow-up

The three projects shall provide important input for the development of a "Marine Litter Strategy" as a systematic approach addressing mitigation and prevention actions, identifying responsible actors and policy instruments in order to reduce/prevent future inputs of litter into the European Seas.

In practice each stakeholder can take specific action against marine litter. The measures proposed within the three projects seek to provide information on possible ways to support actions by stakeholders to prevent and mitigate the impact of littering. The following messages can be addressed to specific stakeholders.

What can consumers do?

- Reject single use plastic bags and bottles and use re-usable alternatives
- Drink tap water (where possible)
- Think before you buy! Consider environmental impacts whilst purchasing
- Buy regional/local products (reduction of primary, secondary, tertiary packaging)
- Separate waste at home and participate in systems for separate collection and deposit refund systems
- Do not litter! Take your waste with you during consumption "on the go", "away from home" and "on the beach"
- Don't flush domestic sanitary waste down the toilet! Change to the solid waste route for the disposal of this waste
- Participate in organised clean-ups

What can the plastic industry do?

- Promote and support closed loop business models and eco-design (promote re-use and recycling, and use less (plastic) material for products and their packaging)
- Extend and improve producer responsibility over the entire product life cycle
- Exchange information, knowledge and best practices on innovative technologies, production processes and sustainable plastic packaging products
- Promote and finance marine litter initiatives
- Incorporate eco-labelling criteria in product design

What can retailers do?

- Motivate and inform your customers on sustainable consumption
- Participate in separate collection and deposit refund systems for bottles and bags and promote and establish individual small scale deposit systems at local level
- Provide your customers with alternatives to plastic bottles and bags
- Procure re-usable and recyclable packaging
- Commit to targets for reduction of plastic packaging
- Exchange ideas and best practices with other retailers

What can the tourism and recreational sector do?

- ... do generally the same as retailers, and
- Sensitise tourists to the impacts of litter on the marine environment
- Provide eco-alternatives for plastic beach ashtrays
- Establish water dispensers in the hotel lobbies and other communal areas
- Participate in eco-tourism certification schemes
- Create and promote stewardship concepts such as adopt-a-beach
- Clean-up plan for events

What can waste management professionals do?

- Inform, motivate and encourage inhabitants to improve source separation
- Organise training for professionals in waste operations (collection, disposal, etc.) to introduce simple measures to improve waste management and minimum requirements for landfills
- Exchange ideas and best practices with other waste professionals, municipalities, etc.

What can policy makers at local/regional level do?

- Invest in research and monitoring activities for:
  - identifying the problem: what are the main types of litter and who are the main litterers
  - determining what the main targets for a litter prevention/clean-up programme should be
  - mapping existing relevant measures that are already being implemented in the area and analyse gaps that need to be filled
  - Selecting measures to fill the gaps
  - Working with the local community, voluntary organisations, businesses etc. to agree the programme and to help to deliver it; and
  - Monitoring the impacts of the programme
- Motivate and inform citizens on sustainable consumption (e.g. initiate public awareness, establish public water dispensers, promote consumption of tap water, seasonal bans on plastic bags in coastal cities, ban plastic bottles during beach events and concerts, avoid plastic packaging in public procurement, etc.)
- Inform, motivate and encourage inhabitants to improve source separation
- Inform, motivate and implement beach and street cleanliness
- Check and improve local waste management services (availability of collection infrastructure, bin design, bin marking, regulatory compliance of landfills, eradication of illegal dumpsites, consideration of littering in local waste management plans and river management, etc.)
- Cooperate with retailers/tourism and waste management professional and exchange best practices with other municipalities
- Increase waste management services during top days (bathing season)

What can policy makers at Member State level do?

- Establish and adopt environmental targets aiming to reduce litter inputs to the marine environment
- Share information with local authorities, NGOs and stakeholders in the private sector on amounts and sources of marine litter, particularly from monitoring to meet the requirements of the MSFD
- Encourage NGOs and stakeholders in the private sector to launch relevant behavioural, preventive and clean-up initiatives by increasing funding and facilitating bottom-up approaches to take place
- Assist local authorities to identify target groups responsible for littering
- Ensure that neighbouring authorities i.e. within the context of regional seas are aware of each other's actions, to facilitate coordination
- Provide a platform for local authorities, NGOs and stakeholders in the private sector to share information and collaborate, allowing for the expansion of programmes and projects
- Provide guidance and resources to help local authorities select and implement measures to address marine litter
- Assist local authorities and NGOs to monitor the effectiveness of measure

What can policy makers at EU level do?

- Support the actions of local and Member State authorities by funding research
- Facilitate experience and information exchange; e.g. through hosting a database of published marine litter survey information, guidance on marine litter monitoring, common recording templates, etc.
- Coordinate efforts across regional seas and enhance networking between authorities and other stakeholders
- Host an expanded version of the marine litter toolbox (ideally including broad costs of measures)
- Provide information or links to locally implemented measures to encourage working in partnership and consistency between neighbouring authorities
- Foster effective enforcement of existing waste legislation
- Foster effective enforcement of extended producer responsibility scheme
- Increase existing recycling targets for plastic packaging waste and establish reduction targets for plastic (packaging) waste being sent for disposal in landfills
- Establish (ambitious) environmental targets for marine litter reduction
- Strengthen the relationship between water and waste management policies
- Support development of Strategic Regional Action Plans on marine litter and their inclusion in relevant Regional Seas Conventions
- Support international activities to combat marine litter such as the Honolulu Strategy and the Rio +20 commitment to take action to achieve significant reductions in marine debris
- Establish a harmonized EU monitoring strategy for beach litter, floating litter and litter on the seabed, as well as for micro litter

9 References

This list should be seen in addition to the literature analyzed as part of the literature research on marine litter (Annex 9).

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