ZERØ BEACH

TOWARDS THE PREVENTION OF MARINE LITTER AT THE BEACH

Baseline report of Zero Beach project: Analysis of marine litter generation and benchmark of good practices in waste prevention in European beaches

eco-union

BEYOND PLASTIC MED

Rezerø
Fundació prevenció residus i consum

Date of Publication: May 2019

This report is supported by the Catalan Waste Agency and the programme Beyond Plastic Med (Bemed - https://www.beyondplasticmed.org/).

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Executive Summary

It is estimated that 80% of marine litter originates from land-based sources it is caused by tourism and recreational activities developed at the beach. However, only 15% of marine litter is accumulated at the beach, 70% lies on the seabed, and the remaining 15% floats on the surface waters. Plastic products represent 80-85% of marine litter found at the beach, and more than a half of it includes single use plastic products.

Among the many factors that led to the current situation, the following stand out: generalized availability of plastics, trend of consumption for comfort, lack of incentives to guarantee the collection and the correct treatment of waste. These factors have led to a poor waste management and the need to improve the infrastructures, as included in the European Directive of single-use plastic products.

In fact, the beach spaces are not properly integrated in waste management frameworks adapted to its particularities as public spaces in contact with the sea. Particularly, at the south of Europe, the beaches are predominant tourists and leisure spaces for visitors and locals that receive millions of users every year. However, this research reveals few waste prevention strategies has been developed for these spaces, considering the vast amount of waste that every year is collected by municipal waste companies.

The benchmark analysis reveals that few initiatives has been found after asking to more than 30 environmental NGOs from all over Europe. The initiatives found are very recent and diverse, opening a new period where the beach is receiving more attention in the south of Europe.

This baseline report is produced to establish the bases for the design of waste prevention measures at beaches, concretely at Catalonia, where the pilot measures will be tested. However, the knowledge gather through Zero Beach can be transferred and capitalized in other countries.

The report is divided in two parts. The first analyses the issue of marine litter and waste generation in coastal areas, and particularly at beaches. IT considers what kind of waste and estimates quantitative data at different scales. It also analyses the role of tourism and leisure waste generation at beaches and introduce key management schemes in beaches. The second part of the report is a benchmark of waste prevention measures in beaches at the European level. The benchmarked measures are analysed, and key findings are provided. Theses measures were used as inspiration for the development of pilot test of Zero Beach protocols.

Part I: The problem of marine litter at the littoral

1 Introduction: the problem of marine litter at the littoral and beaches

The amount of marine litter is constantly increasing, affecting the ecosystems, the biodiversity and potentially human health, and public administrations need to spend a high amount of money in cleaning the marine and coastal environment.

It is estimated that 80% of marine litter originates from land-based sources it is caused by tourism and recreational activities developed at the beach. However, only 15% of marine litter is accumulated at the beach, 70% rests on the seabed, and the remaining 15% floats on the surface waters. Plastic products represent 80-85% of marine litter found on the beach, and more than a half of it includes single-use plastic products. Marine litter is a symptom of a society that consumes disposable products and overuses natural resources.

The decisive factors of plastic waste increase and its spread along the marine environment are related to not only the value chain and the plastic market but also to individual and social tendencies. Some of the factors that led to the current situation are the generalized availability of plastics, the tendency to consume for conformity, the lack of incentives to guarantee the collection and the correct treatment of waste, leading to poor management and insufficient infrastructures, as included in the European Directive of single-use plastic products. Moreover, low biodegradability of plastic products has also influenced significantly its accumulation on the seabed, water surface and coastal areas.

The increase of marine litter generation is an urgent, complex and multidimensional issue that requires cooperation of all the agents (public administrations, environmental entities, economic activities, citizenship...) in order to slow down the current model of the consumption of resources and encourage an efficient economy, low in carbon emissions, focused on circular economy and zero waste.

This study is part of the project "*Zero Beach: Protocols for the prevention of marine litter and solid waste at the Catalan beaches*", and it aims to define measures for the prevention of marine litter from leisure at the beach, because they are one of the main sources of marine litter generation.

2 Conceptual Frame: Marine Litter

According to the UNEP, marine litter includes "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, rivers or beaches; brought indirectly to the sea with rivers, sewage, storm water or winds"[1]. Marine litter mainly includes very low degradability materials, such as plastic, metal, glass, wood and leather.

Marine litter can be found in all the seas and oceans of the Earth, including remote areas, or floating on the surface waters, in the water column of deep water, on the seabed or at the beach.

This debris is easily spread along marine and coastal environments as a result of the maritime transport, tourism and uncontrolled deposition of municipal waste, among other sources.

Marine litter includes a great variety of various types of debris classified as follows:

- **Plastic**: foams, nets, ropes, buoys, fishing gear, tobacco products, bags, packaging (drinks, food and other products), microplastics...
- **Metal**: including drink packaging, aerosols, aluminium foil...
- **Glass**: drinking and eating packaging, bulbs and fluorescent lightings, flat glass...
- **Wood**: pellets, boxes, desks...
- **Paper and cardboard**: glasses, tableware, bags
- **Gum**: tyres, balloons and gloves
- **Cloth**: shoes and clothes, towels and accessories
- **Waste related to residual water**: cotton buds, diapers, intimate care and pads (period products, sanitary napkins, condoms...)

Marine litter can be classified according to their size, as indicated in the following table:

Table 1: Classification of marine litter according to its dimensions and examples of waste by category.[2]

Size of marine litter	Nano <1 um	Micro < 5mm	Meso <2.5	Macro <1 m	Mega > 1n
Example of marine litter	Nanofibers of clothes, nanoparticles of pharmaceutical products	Fragmentation of plastic waste such as polystyrene, particles of incinerated material	Bottle caps, butts, plastic pallets	Bottles, plastic bags, packaging, balls	Fishing ropes, plastic wrap from agriculture

[1] United Nations Environment Programme (2016). Marine Litter Legislation: A Toolkit for Policymakers

[2] UN Environment. (2017). Annual Report 2017. Towards a pollution free planet.

3 Marine Litter in the Mediterranean and in the Catalan Littoral

In the Mediterranean region, marine litter at the beach and marine environments represents a major issue, exacerbated due to the limited exchanges of water between the basin and other oceans through the Strait of Gibraltar, the densely populated coasts, the development of the tourism sector, maritime transit, and various additional disposals of litter coming from rivers and very urbanised areas.

Moreover, marine litter is especially persistent in the Mediterranean because it presents a semi-arid climate where annual precipitation is concentrated in a few months. During the raining period, waste is moved by overflow and sediments until it arrives to the coast or marine environment[3].

In the Catalan littoral, marine currents have an influence in the transport and accumulation of floating solids in the coasts. The North Current is almost permanent and flows direction South-West, alongside the coast. In addition, the speed of the surface currents of the Catalan coast decreases during summer, and it causes a risk of accumulation of floating solids at the littoral during this time of the year[4].

All these phenomena lead to having a higher amount of marine litter in the Mediterranean Sea than in other seas or oceans. Some studies suggest that the Mediterranean is the sixth region of the Earth with more marine litter, right after the big concentrations of plastics at the main oceans.

3.1 Sources of generation and mechanisms of transport of the marine litter

Products and objects become marine litter when they are discharged, disposed or lost in the environment during any stage of the chain of production, distribution, consumption, disposal or treatment, and they end up on beaches, seas or oceans.

In order to identify the drivers and deficiencies in the value chain of the products that lead to the generation of marine litter and be able to introduce effective prevention and management measures, it is essential to understand the origin and mechanisms that lead the objects to be discharged and disposed in marine and coastal environments.

Marine litter is often classified according to its marine or land-based origin or its source, generally described as an economic sector or human activity, which is responsible of its initial discharge. Fishing activities, coastal tourism and installations of waste management are some of the examples.

Land-based waste is generated directly at the coast (for example, due to recreational activities at the beach, harbours or docks) or further (such as municipalities or interior industrial areas), and they are transported to be discharged in marine or coastal environments. Waste originated from sewage discharges or sanitation systems of wastewater is also considered land-based waste. Waste in rivers, despite being originated in boats navigating along the river, is also considered land-based waste.

The main land sources of marine litter are the following:

- Coastal tourism and recreational activities at the coast
- Harbours and docks
- Population centres
- Horticulture/Agriculture
- Illegal landfills and inadequate waste management
- Industrial activities
- Sewage treatment

[3] United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP) (2012). State of the Mediterranean Marine and Coastal Environment. Barcelona Convention, Athens

[4] Catalan Water Agency (ACA). (2014). Floating solid materials at the beaches of the Catalan littoral. Issue assessment 1st Meeting of the Beaches Follow-up Commission (10th of April 2014)

On the other hand, marine litter is discharged at the sea directly (accidentally or deliberately) due to activities developed offshore. The main sources of marine origin are the following:

- Maritime transport
- Fishing activities
- Aquaculture
- Cruise ships, ferries and recreational boats

Some objects are easily identified due to its functionality, origin or discharge source, such as fishing nets (disposed due to fishing activities) or cotton buds (from population centres and inadequately disposed in the toilet), but most of the objects are difficult to identify, especially when this litter has been disposed in the water during a long period of time and it is transformed in small pieces.

Some objects might have been discharged through various sources and ended up in marine and coastal environments by many means of transport and therefore, it is not easy to determine its origin. Drink packaging is an example, it might have been originated from tourism activities at the beach or thrown from boats at the sea or disposed in urban or natural environments far from the coast and moved due to the overflows or wind.

Microplastics are one of the most complex fractions of marine litter when it comes to determine their origin or release. They can originate from various sources and end up in coastal and marine environments through various ways and transport mechanisms. The main sources include fragmentation of bigger items in the environment, release of abrasive additives originated from cosmetics or other products, release of fibres when washing clothes or disposal of pallets or transit particles used in plastic production processes[5].

Therefore, waste can originate locally, when it is disposed directly at the beach or sea, or it can come from far away and, due to many transport mechanisms has ended up at the sea, for example, rivers, wind, overflow, sewage systems or marine currents or tides.

The following table and diagram indicate the main types of waste generated by various land or sea based and the mechanisms transports that intervene in their movement leading to their accumulation in marine or coastal environment.

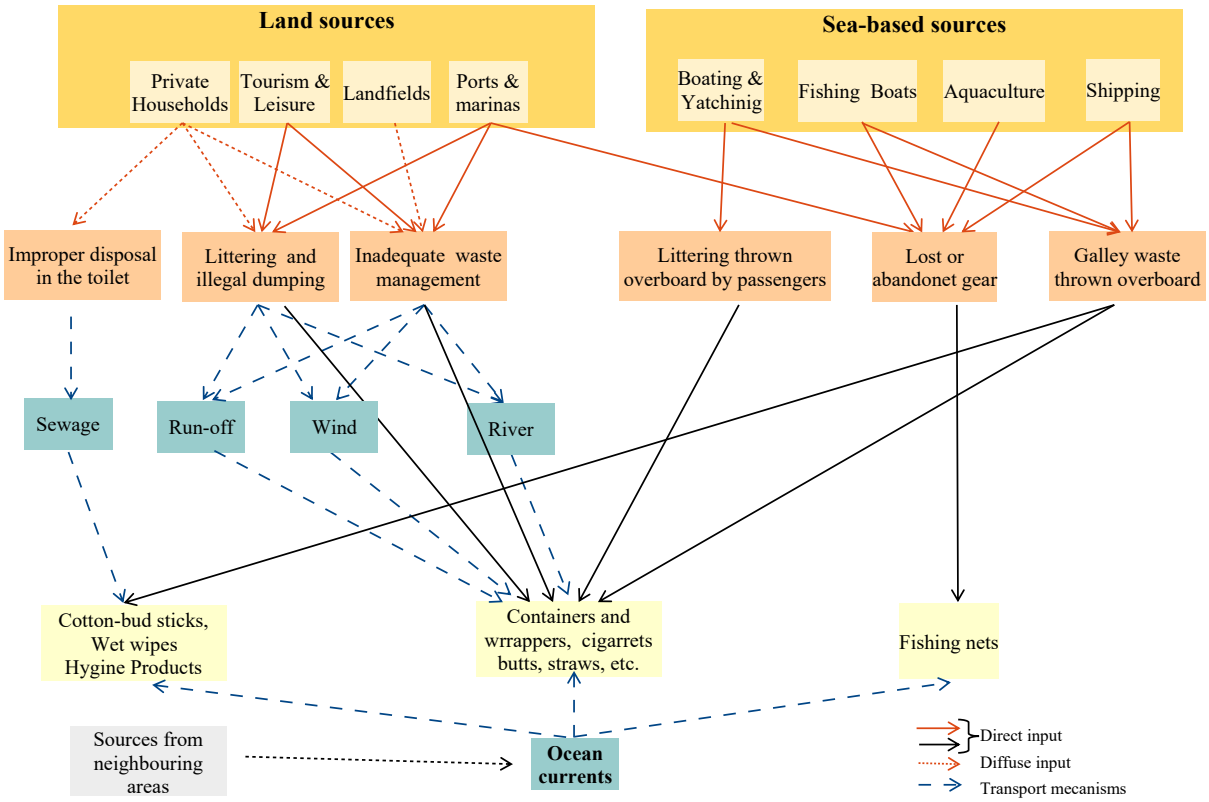
[5] Veiga, J.M., et al. (2016). Identifying Sources of Marine Litter. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report.

Table 1: Most common marine debris by type of activity and mechanisms of transport influencing its accumulation in beaches and marine environments[6]

ORIGIN	SOURCE	TYPE OF WASTE	RELEASE MECHANISM	GEOGRAPHICAL ORIGIN	TRANSPORT MECHANISM
Land-based sources	Population centres	Cotton buds, pads and other products of intimate hygiene.	Inadequate disposal in the toilet	Home-based	Waste water, sewage, overflows, rivers, currents and tides
		Packaging, cigarette butts, organic waste	Inadequate disposal in a public or natural area	Far (municipality)	Wind, rivers, overflows, currents and tides
	Coastal tourism and recreational activities	Packaging, cigarette butts, organic waste	Inadequate disposal at the beach sand, overflowing bins	Local (coastal municipalities, beaches and maritime walks)	Winds and tides
	Illegal landfills	Any type of waste	Inadequate management	Local or distant	Wind, rivers, overflows, currents and tides
	Horticulture and Agriculture	Plastic fishing used in the field	Inadequate disposal or unintentional loss	Distant	Wind, rivers, overflows, currents and tides
	Industries	Any type of plastic, packaging and pallets	Inadequate disposal or unintentional loss	Distant	Wind, rivers, currents and tides
	Sewage treatment	By-pass systems	Water venues	Distant	Waste water, rivers, currents and tides
Sea-based sources	Maritime transport	Any type of plastic, packaging and pallets	Unintentional disposal or loss at the sea	Local, regional or distant	Wind, currents and tides
	Fishing activities	Fishing nets, boxes, ropes and packaging tapes	Unintentional disposal or loss at the sea or land as well as run-off from the harbour	Local, regional or distant	Wind, currents and tides
	Aquaculture	Nets, buoys, ropes	Unintentional disposal or loss at the sea	Local, regional or distant	Wind, currents and tides
	Cruises, ferries, boats and recreational boats	Packaging, cigarette butts, organic waste, sun cream, toxic waste of surf board	Inadequate or involuntary disposal at the sea	Local, regional or distant	Wind, currents and tides

[6] Adapted from Veiga, J.M., et al. (2016). Identifying Sources of Marine Litter. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report.

Figure 1: Marine and land-based sources of marine litter and potential mechanisms entering the marine environment[7]



80% of global waste is estimated to originate from land-based sources, the remaining is generated by the activities carried out offshore[8]. Several studies show that most of the marine litter of the Mediterranean Sea originates also from land-based sources. One of the main sources of marine litter release in the Mediterranean are tourism activities (40%[9]) and recreational activities (more than 50%[10]).

Waste generated at populations centres, including waste disposed incorrectly at the toilets or surroundings represent a major source of marine litter at the Mediterranean, around 40%[11].However, in Catalonia the uncontrolled release of debris is less common than in other Mediterranean regions, it is also a cause of marine litter.

The fishing industry and maritime transport also play an important role in the Mediterranean regarding marine sources of litter generation[12]. Maritime activities are responsible of 5% of the marine litter in the Mediterranean.

[7] Adapted from Veiga, J.M., et al. (2016). Identifying Sources of Marine Litter. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report.

[8] Jambeck, J.R., *et al. (*2015). Plastic waste inputs from land into the ocean. *Science*, Vol. 347:768–771.

[9] Van Acoleyen, M., *et al.* (2014) Marine litter study to support the establishment of an initial headline reduction target. SFRA0025. European commission /DG ENV, project number BE0113.000668, 127 pages.

[10] Mehlhart, G. and Blepp, M. (2012) Study on Land sourced Litter in the Marine Environment. Review of sources and literature. Olko Institut report.

[11] Van Acoleyen, M., *et al.* (2014) Marine litter study to support the establishment of an initial headline reduction target. SFRA0025. European commission /DG ENV, project number BE0113.000668, 127 pages.

[12] United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP). (2015). Marine Litter Assessment in the Mediterranean. Athens

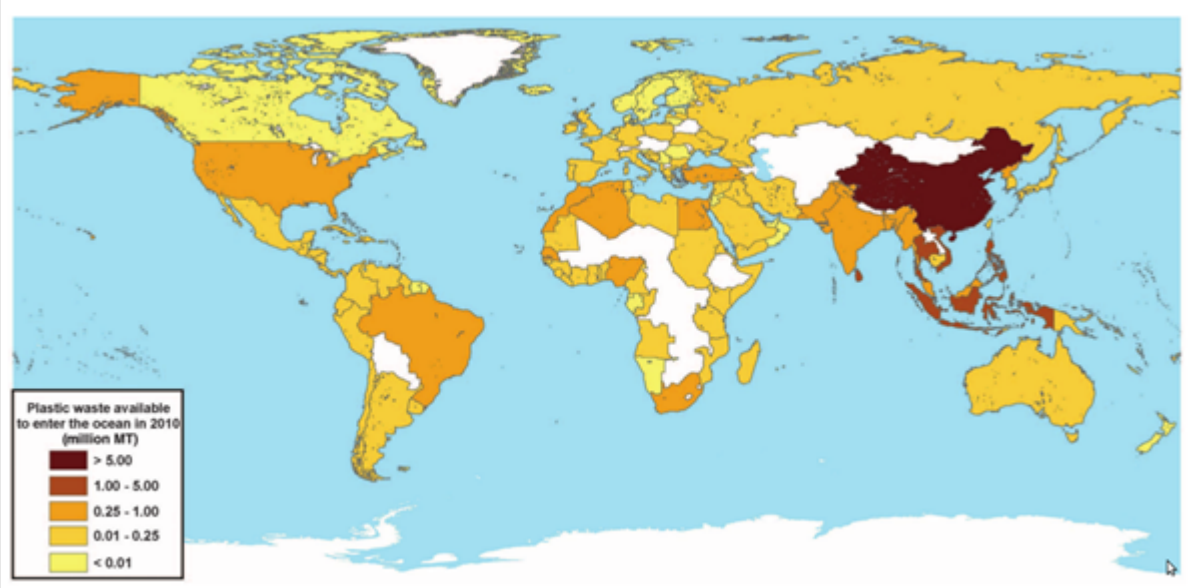
Despite not having identified studies assessing the impact of boats in the generation of marine litter in the Mediterranean Sea, it is expected that its contribution is significant, taking into account that 30% of the maritime transit at a global level is in the Mediterranean Sea[13].

Composition and abundance of marine litter

It is complicated to estimate the amount of marine litter discharged at the sea and oceans, but it is estimated that it is about 10 million tones annually, 8 million of which are plastics[14].

Some authors[15] estimated that 99.5 million of metric tones (MT) of plastic waste were generated in coastal areas around the world in 2010. Among them, 31.9 million of MT were incorrectly managed and 4.8 to 12.7 million of MT ended up in the seas and oceans that same year. In most of the countries of the Mediterranean region, it is estimated that in 2010 0.01 to 0.25 million of MT of plastic waste were incorrectly managed, being even higher in some regions (Morocco, Algeria, Egypt and Turkey), and this waste became eventually marine litter (figure 4).

Figure 2: Global map indicating the estimated amount of plastic waste (millions of MT) generated and managed incorrectly in 2010 by populations living 50 km far from the coast. [16]



When it comes to rate, it is estimated that 21% to 54% of the world plastic particles are accumulated in the Mediterranean Sea, as well as 5% to 10% of the world plastic mass[17]. Regarding microplastics, it is estimated that 677 tones are discharged every year at the Mediterranean[18].

It is common to throw solid waste at the beach (mainly caused by the contribution of solid materials during periods of intense rains and the recreational use of beaches). However, most of the solid waste in the marine environment is found on the seabed. 15% of the marine litter is found at the beach, 15% floats at the sea and 70% rests on the seabed[19].

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[13] Idem.

[14] UN Environment, 2017. (2017). Annual Report 2017. Towards a pollution free planet.

[15] Jambeck, J.R., *et al. (*2015). Plastic waste inputs from land into the ocean. *Science*, Vol. 347:768–771.

[16] Idem.

[17] Suaria G. and Aliani, S. (2014). Floating debris in the Mediterranean Sea. *Marine Pollution Bulletin,* Volume 86, Issues 1–2, 15, Pages 494–504.

[18] Tweehuysen G. (2015). Sampling River litter: Preliminary results. Micro-2015. Seminar of the Defishgear project, Abstract book, Piran 4-6 May 2015, p 29.

[19] Catalan Waste Agency (ARC) (2018). Marine litter from the surface to the deep waters.

Many analyses carried out at various locations of the Mediterranean Sea have enabled to identify the main composition of marine litter located at the beach, floating on the surface waters or lying on the seabed. In any case, the results show that synthetic material (bottles, bags, taps, nets and small unidentified fractions) and cigarette butts are major fractions in unitary terms. The various analysis carried out show single-use plastic products as a significant part of the problem, because they are more prone to escape of the waste management and collection systems.

3.1.1 Waste at the beach

The last environmental report of Ocean Initiatives includes data obtained during beach clean-ups around Europe in 2017, through citizen action initiatives. This report demonstrates the 10 most common objects in European coast are the following:

- Cigarette butts
- Plastic pieces of 2,5-50 cm
- Plastic packaging
- Polystyrene pieces of 2,5-50 cm
- Plastic bags and bag pieces
- Glass pieces
- Bottle taps
- Food containers
- Bags and snack packaging
- Fishing nets

Plastics are a big proportion of the waste found at the beach (between 80% to 85%), and 49% of it is single-use plastic[20]. According to Ocean Initiative this rate increases up to 78%[21].

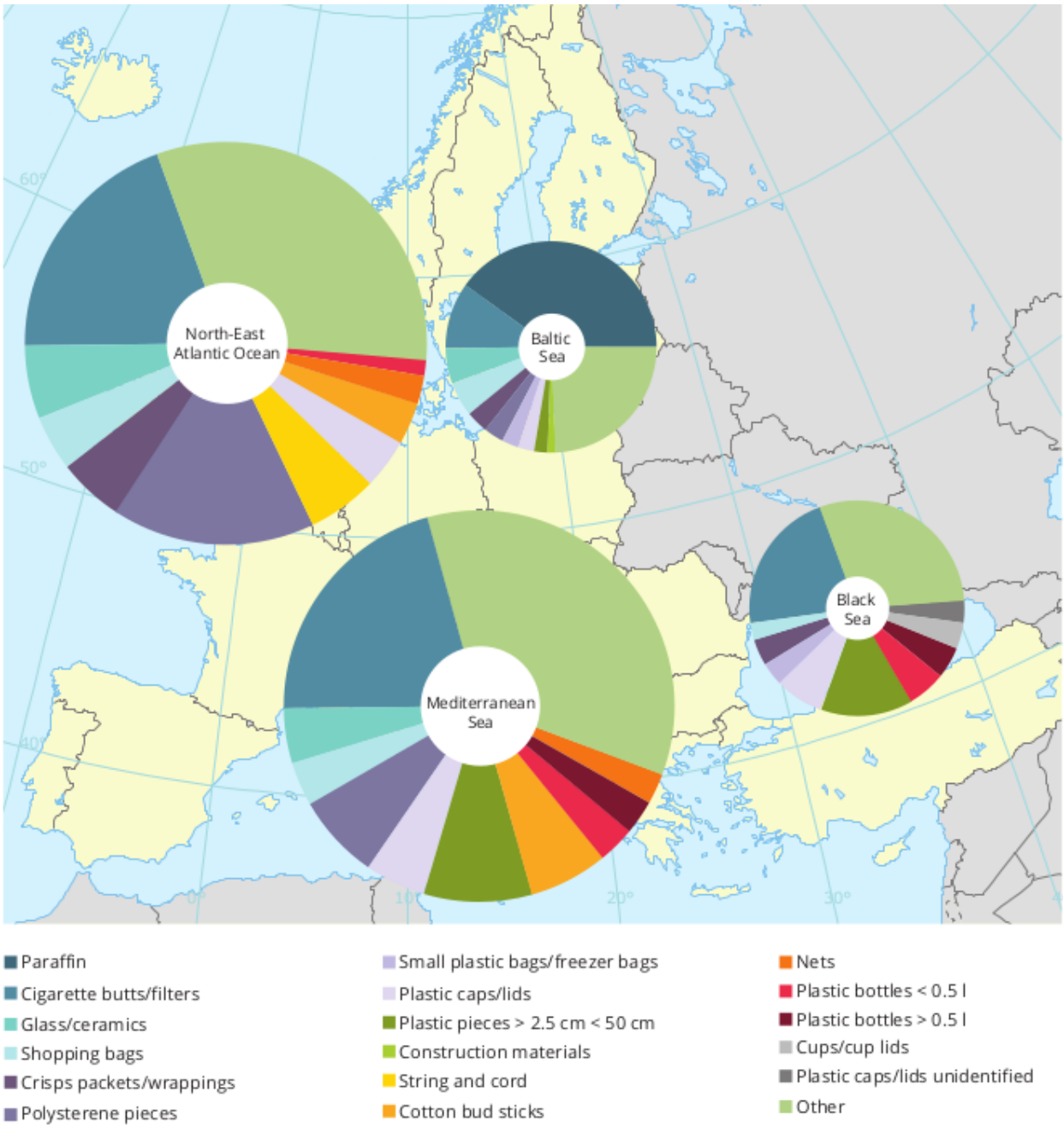
This report also includes an analysis of the main articles collected in the Western region of the Mediterranean (including the results obtained in France, Spain, Italy, Morocco, Tunisia and Algeria). The results show that cigarette butts, plastic bottles, 2.5 to 50 cm plastic pieces, plastic bags and bag fragments and 2.5 to 50 cm polystyrene pieces are the main debris collected in this region. Cigarette butts represent 25.33% of waste collected at this part of the Mediterranean, and plastic bottles are 17.23%. A significant result is that 3.64% of collected waste are plastic buds, as well as sanitary products, such as wet wipes at the beach.

The results obtained during the beach clean-ups developed in the frame of the initiative Marine Litter Watch of the Environmental European Agency match the results indicated previously by the Mediterranean, where plastic waste represented a major proportion of litter found at the beach and cigarette butts almost represent a quarter of the total (Figure 3).

[20] Seas at Risk (2017). Single – use plastics and the marines Environment. Leverage points for reducing single-use plastics.

[21] Ocean Initiatives (2017) Environmental Report of the Ocean Initiatives 2017.

Figure 3: Main typologies of marine litter identified at the beach around Europe. [22]



Another study analyses the composition of waste according to 8 typologies of objects (artificial polymers, gum or rubber, cloth, paper, metal, wood, glass, undetermined) in various locations at the Mediterranean Sea, show artificial polymers (plastic) prevail, representing almost 90% in all sample points[23].

With regards to density, most of the studies carried out show densities of an object by square meter, but also a great variability in the density of waste according to their use and characteristics of every beach[24]. Another study[25] demonstrates waste production, its composition and density depend on the degree of urbanisation of the beach. Urban beaches are generally more extensive and include more users than other kinds of

[22] Marine Litter Watch (2018. *Citizens collect plastic and data to protect Europe's marine environment*. European Environment Agency.

[23] Prevenios, M., *et al.* (2018). Beach litter dynamics on Mediterranean coasts: Distinguishing sources and pathways. *Marine Pollution Bulletin*, Vol. 129 (2): 448-457

[24] Veiga, J.M., et al. (2016). Identifying Sources of Marine Litter. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report.

[25] Ariza, E., *et al.* (2008). Seasonal evolution of beach waste and litter during the bathing season on the Catalan coast. Waste Management 28: 2604-2613

beaches, such as urbanised or natural beaches and, consequently concentrate a major amount of waste. In Catalonia, it is estimated the most affected beaches are in Barcelona and its surroundings, because it is the most densely populated area[26].

The study carried out by ICTA-UAB in the frame of the project Blue Islands[27] also identifies the rests of the plastics and cigarette butts as the main issue at the beaches of various Mediterranean islands, accumulating **a daily average of 250.000 diverse debris by square meter in Summer** (0.25 items per square meter).

Moreover, another study carried out recently in the frame of the Interreg project Med ACT4LITTER shows how marine litter is present even in ecologically virgin coastal areas and in protected areas of the Mediterranean. In the frame of this project, 17.344 items were recorded, and the average density of objects was estimated at **1.048 articles per 100m of extension or 0.6 articles per square meter.** In this case, most of the identified objects were also artificial polymer (82%) and it is estimated that litter originated from coastal activities, such as tourism, recreational activities and insufficient management of waste represented 27% of the collected waste, while waste originated from maritime activities (fishing and aquaculture) represented 10% of them. In this case, the objects most commonly found were small pieces of plastic and polyethylene (21.9%), taps and plastic taps (5%) and mussel fishing nets (5%). Single-use plastic products (bottles, food packaging, cups, taps straws and mixers) correspond to a fifth (21%) of the collected objects[28].

In particular, in Catalonia, data obtained in 39 beach clean-ups carried out in 2018, in the frame of Marnoba Platform of Vertidos Cero Association, show how the composition of marine litter in Catalonia is similar to the results obtained in other regions of the Mediterranean Sea. In this case, 15 objects collected more frequently at the beach were the following:

Table 2: Objects collected more frequently at Catalan beaches developed in the frame of Marnoba *(Platform of Vertidos Cero Association)*

Article	Rate (%)	Unities
Cigarette butts	33,7	5,529
Cotton buds	9.7	1,585
Plastic pieces of 2,5-50 cm	9.6	1,577
Taps and plastic taps	5.2	860
Plastic bags	4.6	759
Packaging, food containers, lollipop sticks	4.5	740
Drink bottles	3.9	647
Paper napkin and table covers	3.0	496
Straws, cutlery and plastic cups	2.0	323
Bricks	2.0	334
Drink cans	1.9	318
Plastic food packaging and cosmetics	1.7	284
Plastic pieces 0-2,5 cm	1.4	222
Taps, pull tabs	1.3	213
Feminine hygiene products	1.2	190

[26] Catalan Water Agency (2014). Floating solid materials at the beaches of the Catalan littoral. Issue assessment 1st Meeting of the Beaches Follow-up Commission

[27] ICTA – UAB (2018). Litter accumulated at the beaches of the Mediterranean islands are tripled during Summer.

[28] Vlachogianni, T. (2019). *Marine Litter in Mediterranean coastal and marine protected areas –How bad is it. A snapshot assessment report on the amounts, composition and sources of marine litter found on beach*. Interreg Med ACT4LITTER & MIO-ECSDE

Cigarette butts are the most common items found at the Catalan beaches, although participants only collect them from the most superficial layer of the sand. Plastic items associated with tourism and recreational activities at the beach also stand out, such as taps or plastic taps and food and drink packaging. On the other hand, among the most common items, there are also cotton buds, feminine hygiene products incorrectly disposed in toilets.

In this line, the results of characterisations of waste carried out in various beaches of the Mediterranean area of Barcelona in 2014 show how 80.5% of the volume of collected waste at the beach includes packaging (51.22% in weight), mainly drinks. These results integrate waste found on the sand (excluding the sand) and bins[29].

Table 3: Weight and volume of collected waste at metropolitan beaches.[30]

Fraction	Weight (%)	Volume (%)
PET	7.86	26,34
HDPE	0,59	1,16
Remaining plastics	13.07	25,26
Brick	0,42	1,71
Metal	6.61	13,17
Cardboard	9.41	15,35
Organic	16.84	1,93
Glass	18.45	6,82
Other	14.76	6,75
Liquids	3.26	0,25
Small pieces	8.75	1,26

3.1.2 Floating waste on the surface waters

The analysis of the composition of waste floating in the Mediterranean Sea, including items smaller than 2.5 cm (mesoparticles and microplastics) show that plastics represent between 85% and 95% of the total[3132], similar in density to other coastal areas. This presence of floating plastics is caused mainly because the low density of many synthetics' polymers, such as polyethilene or polypropilene, enables them to float on the surface, while heavier items, such as metals and glass, tend to sink[33].

62 million of waste is estimated to be floating on the surface of the Mediterranean basin. 78% of the items analysed in this region presented an anthropogenic origin and, among them, 95.6% originated from plastics[34]. It is estimated that in the Mediterranean Sea, the average concentration of plastics on 423 g/km2 of surface water amounts to 243.853 articles/km2 (illustration 6), and most of the items are fragments of bigger rigid

[29] Rezero (2014). *Implantació d'un sistema de retorn d'envasos de begudes. Oportunitats econòmiques pels municipis catalans*. Ordered by Retorna

[30] Idem.

[31] Cózar, A., *et al*. (2015). Plastic Accumulation in the Mediterranean. Sea, PLoS ONE 10(4): e0121762

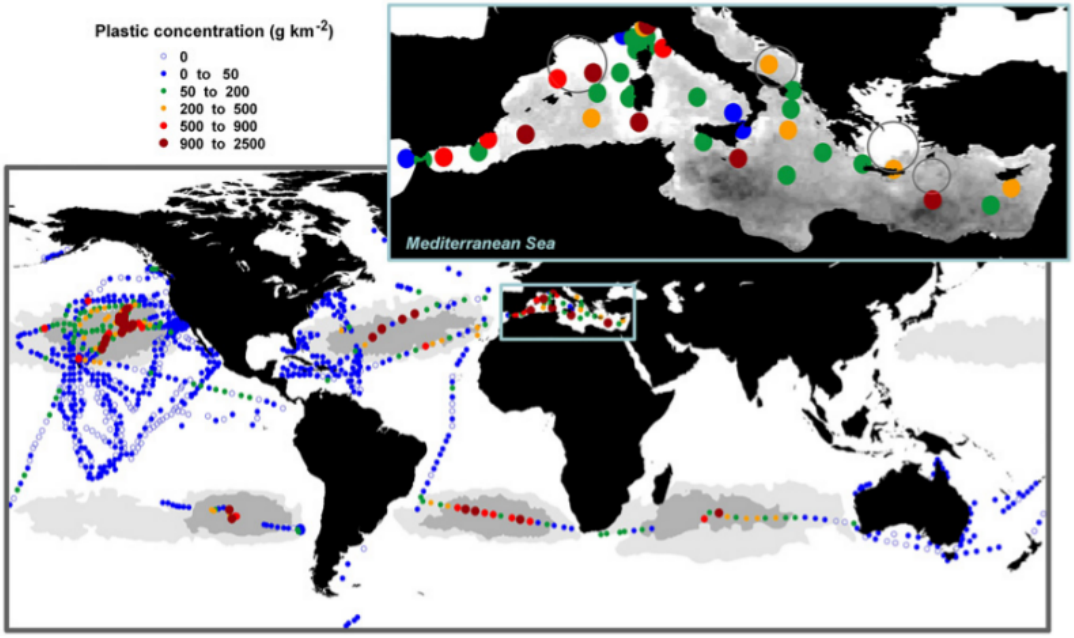
[32] Suaria G. and Aliani,S. (2014). Floating debris in the Mediterranean Sea. *Marine Pollution Bulletin*, Volume 86, Issues 1–2, 15, Pages 494–504.

[33] United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP). (2015). Marine Litter Assessment in the Mediterranean. Athens

[34] Suaria G. and Aliani,S. (2014). Floating debris in the Mediterranean Sea. *Marine Pollution Bulletin*, Volume 86, Issues 1–2, 15, Pages 494–504.

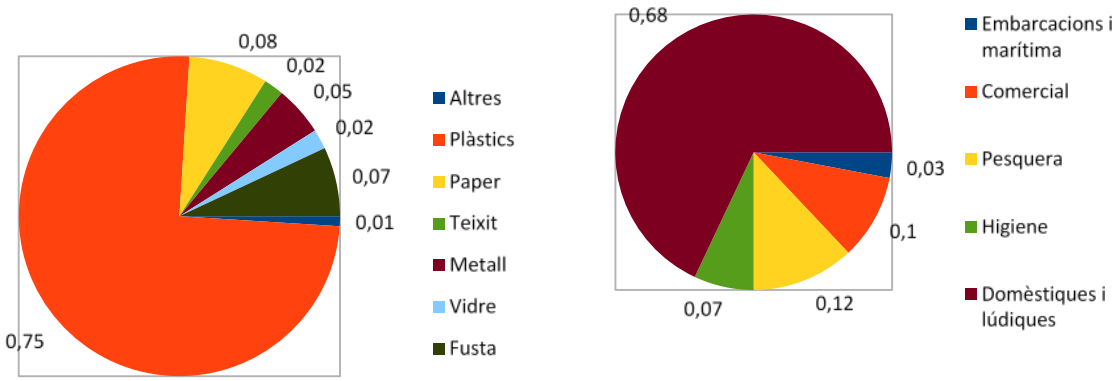
objects (87.7% such as bottles and taps) and small pieces (such as bag pieces or wraps)[35]. 83% of the total number of articles collected in this study were smaller than 5mm of length (microplastics).

Figure 4: Concentrations of marine litter on the surface of the Mediterranean Sea at the basin level (upper right corner), and the comparison between plastic concentrations recorded in the oceans at the global level.[36]



Regarding floating solids in Catalonia, the data collected by ACA indicate how predominant items are plastic objects (79%), most of them being related to domestic and recreational activities and, therefore, land-based (68%). Among the most common articles, plastic bags, pieces, bottles or cigarette butts, among others, are the most common (Table).

Graphic 1: Proportion of floating waste by material (left) and potential origin (right) at the Catalan coast.[37]



[35] Cózar, A., *et al*. (2015). Plastic Accumulation in the Mediterranean. Sea, PLoS ONE 10(4): e0121762

[36] Idem.

[37] Agència Catalana de l'Aigua (ACA). (2014). Sòlids flotants a les platges del litoral de Catalunya. Avaluació de la problemàtica. 1ª Reunió de la Comissió de seguiment de platges (10 d'abril de 2014)

Table 4: Proportion of floating waste by typology of product at the Catalan coast.[38]

Article	Rate (%)
Plastic bags	19
Plastic pieces	13
Plastic bottles	7
Cigarette butts	6
Porexpan pieces	5
Hygiene waste	5
Drink cans	4
Plastic trays (fish)	4
Paper pieces	4
Plastic taps	4
Wood boxes (fish)	4
Wood board and sticks	3
Cardboard boxes	3
Pull tabs of drink cans	2
Plastic cups	2
Ready meal packaging	2
Cloth pieces	2
Glass bottles	1

3.1.3 Marine litter on the seabed

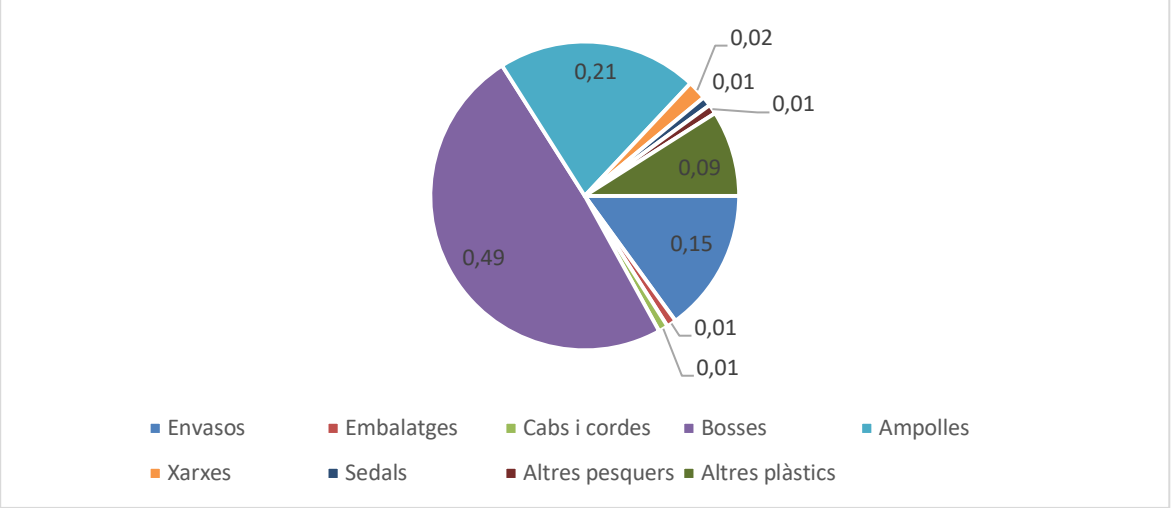
Regarding waste accumulated at the seabed, plastic objects are also predominant, representing between 45% to 95% of the total[39]. In Catalonia, the results obtained in the frame of the project Marviva, indicate that the objects disposed at the seabed or the lowest part of the water column including plastic (80%), cloth (8%), metals (4%), hygienic waste (3%), glass (2%), paper, gum and wood (3%).

When it comes to plastic, the most common item found on the seabed of the Catalan coasts are the plastic bags followed by bottles and food packaging. The other three items are objects originating from the sea such as nets, fishing lines and ropes. The results show that 86% of the plastic waste found at the seabed of the Catalan coast include single-use objects that need a very long period to degrade.

[38] Idem.

[39] United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP). (2015). Marine Litter Assessment in the Mediterranean. Athens

Graphic 2: Rates of plastic items of the litter analysed during the project Marviva. *Source: Sapena, 2017*



3.2 Persistance of marine litter

The persistence of many types of marine litter, especially plastic and glass, is widely accepted but it exists in many interpretations about degradation time of the various fractions. The degradation process takes places in various stages, from the beginning of fragmentation to the chemical decomposing of the materials. Plastics are a good example because they fragment in microplastics and it takes them hundreds of years, but the time needed for their total chemical decomposing is unknown and they may never be completely decomposed[40]. Actually, degradation ratio can change substantially according to the levels of UV light, temperatures, oxygen levels, wave power and presence of abrasive factors such as sand or gravel[41].

Table 5: Ratio of degradation by some examples of marine litter. *Source: Mouat, J., et al. (2010)*

Material	Degradation rate (years)
Cotton rope	1
Untreated wood boards	1-3
Cigarette butts	1-5
Plastic bags	10-30
Fishing nets	30-40
Plastic buoy	80
Can	80-500
Plastic bottles	450
Glass bottles	1 million

3.3 The role of tourism and leisure

The Mediterranean region is one of the main tourism destinations of the world and their coasts receive a big volume of floating population, especially during summer months. Local economies depend on tourism as

[40] Mouat, J., *et al.* (2010) *Economic Impacts of marine litter*. KIMO International, pp. 105.

[41] Cheshire, A.C., *et al.* (2009*) UNEP/IOC Guidelines on Survey and Monitoring of Marine Litt er.* UNEP Regional Seas Reports and Studies, No. 186; IOC Technical Serious No. 83.

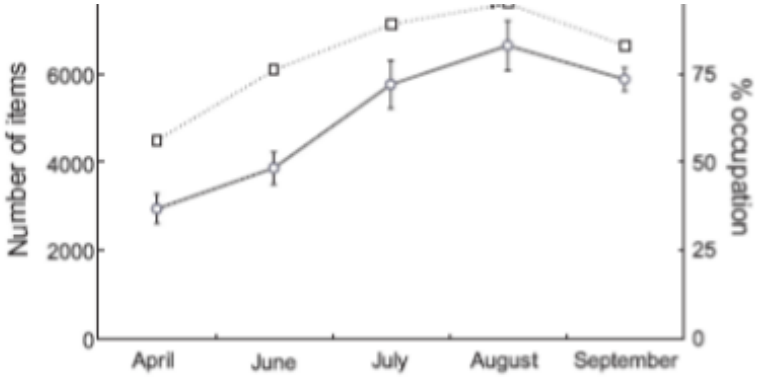
income source and occupation generation.

In Catalonia, tourism represents 12% of the GDP (General Direction of Economic Analysis, 2018) and it interacts directly with other sectors such as transport, leisure and sport, etc. Catalonia is a reference destination in the Mediterranean and European region, and it is the main market of tourism. Catalonia receive 19.12 million of tourists in 2018, and 75% of them came from Europe (IDESCAT, 2018). Catalonia has about 600.000 beds for tourism, regulated, and 80% of them are located in the littoral. It is estimated that the number of non-regulated hotel beds is higher than a million of beds (General Direction of Economic Analysis, 2018). During the last decades, tourists travelling to the Catalan cost increased by 43% and 33% of overnight stays[42]. This big volume of tourists, concentrated in a short period of time, represents a big increase in the generation of waste, puts pressure on waste management infrastructures and it is one of the **main sources of marine litter release at the Mediterranean Sea, as shown above**.

Actually, tourism tends to generate more solid waste than other industrial activities[43] because it causes a more intensive use of single-use products and hotel services. According to some statistics obtained in Tourism destinations of the Mediterranean, tourists generate an average of 10% to 15% of waste than the inhabitants of the municipality[44]. In fact, in some touristic areas, more than 75% of the waste generated annually are generated during summertime, and it is estimated that the density of marine litter increases about 40% due to the increase of tourism[45].

Many studies analyse the seasonality of marine litter generation, showing that the amount of waste originated by recreational and tourism activities is increased during and after the tourism season[464748]. Litter accumulated at the beaches of the Mediterranean islands are tripled during Summer. [49]. A study[50] analysing the origin and abundance of marine litter in the main tourism destinations in the Balearic Islands shows that during summer months, the waste collected in the beach was doubled compared to winter records and these represent a direct link to hotel occupation (Graphic 3).

Graphic 3: Monthly variation of items identified at the beach with the rate of hotel occupation. *Source: Martinez-Ribes et al., 2007*



[42] González D., A., et al. (2018) *Hacia una ordenación espacial marítima del turismo en la demarcación Levantino-Balear.* Informe final del proyecto PLANMEDTUR. Editado por Eco-union.
[43] Arbulú, I., *et al*. (2015). Tourism and solid waste generation in Europe: A panel data assessment of the Environmental Kuznets Curve. Waste management (New York, N.Y.).
[44] Veiga, J.M., *et al*. (2016). *Identifying Sources of Marine Litter*. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report
[45] Galgani, S., *et al*. (2019) Editorial: Impacts of Marine Litter. Front. Mar. Sci. 6:208.
[46] Martinez-Ribes, L., *et al*. (2007). Origin and abundance of beach debris in the Balearic Islands. Scientia Marina. 71. 305-314.
[47] Suaria G. and Aliani,S. (2014). Floating debris in the Mediterranean Sea. Marine Pollution Bulletin, Volume 86, Issues 1–2, 15, Pages 494–504.
[48] Ariza, E., *et al.* (2008).Seasonal evolution of beach waste and litter during the bathing season on the Catalan coast. Waste Management 28: 2604-2613
[49] ICTA – UAB (2018). Litter accumulated at the beaches of the Mediterranean islands are tripled during Summer.
[50] Martinez-Ribes, L., *et al*. (2007). Origin and abundance of beach debris in the Balearic Islands. Scientia Marina. 71. 305-314.

Another study written during the European project **BlueIslands**[51] shows a major impact of tourism on the generation of marine litter at the beach, identifying three times more waste during summer months and increasing 7 times in the most visited beaches. According to the results, during high season (from May to September), tourists launch at the beach an average of 250.000 objects a day per square kilometre, an amount that increases up to an average of 316.000 objects a day per square kilometre during the months of July and August and it contrasts with the average 81.000 of daily objects thrown during the low season.

In Catalonia, a study [52]analysed the amount and evolution of waste generation in various urban and urbanised beaches of coastal municipalities of the North of Catalonia (Blanes, Lloret de Mar and Tossa de Mar) during the swimming season. The results demonstrate that the density of waste was very constant in most of the beaches between the months of July and August, and drastically reduced at the beginning of September. The maximum concentration (%) of plastic waste, packaging and drink cans was detected during the high season of the beaches (28th of July to 18 of August), whereas the proportion of organic and domestic waste was lower.

[51] ICTA – UAB (2018). Litter accumulated at the beaches of the Mediterranean islands are tripled during Summer.

[52] Martinez-Ribes, L., *et al*. (2007). Origin and abundance of beach debris in the Balearic Islands. Scientia Marina. 71. 305-314.

4 Marine Litter Impacts

Environmental, social and economic issues associated with marine litter is a complex system in which various social, political, economic and ecological stakeholders interfere. Marine litter generation does not come from a unique source and it has more than one solution, it is an emerging issue and some of its impacts are still unknown or there is very little scientific evidence. Even if there is not enough knowledge of its multiple effects neither on the ecosystems nor their effects in human health, society and economy.

It is necessary to understand the various ecological, social and economic impacts in order to promote the global and effective measures having an impact on the production and consumption model and focused on the prevention and circular economy. According to the size of marine litter, there are various environmental, economic and social impacts (Table 7).

Table 7 Environmental impacts of marine litter according to their size and scientific evidence.[53]

Scientific evidence	Significant void of evidence and scientific knowledge	Very little knowledge and scientific evidence	Understanding of certain cause factors or connections but a little evidence	Knowledge or scientific evidence	Good knowledge or scientific evidence

Environmental impact	Size of marine litter, types and impacts					
	Size of marine litter	**Nano <1 um**	**Micro < 5mm**	**Meso <2.5**	**Macro <1 m**	**Mega > 1n**
	Intake of litter	Intake and chemical transfer. Example: Mussels, corals, phytoplankton	Intake and chemical transfer. Example: Fish, birds, corals	Intake and chemical transfer. Example: birds, fish	Intake and chemical transfer. Animals become entangled in litter. Example: Birds, crustacean, turtles	Intake and chemical transfer. Animals become entangled in litter. Example: whales, dolphins, turtles
	Pressures	Modification of animal movement: Microbes, larvae, jellyfish				Modification of animal movement
	Impacts on the organism	Sublethal impact at low levels of cellular organisation. Example: Cellular intrusion Unclear damages to health	Potential effects of the physical presence or plastic intake, concern about the transfer of chemicals, reduction of fishing. Example: Modification of genetic expression	Damages of the organs or other impacts on the organism: Death, food reduction, impacts on health or reproduction.	Damages to the organs or other impacts on the organism: Death, food reduction, impacts on health or reproduction.	
	Ecological impacts	Population might decrease and ecosystem functions could be modified. For example: Modification of microbial community.	Population might decrease and ecosystem functions could be modified. Example: Endocrine disruption in fish	Population might decrease and ecosystem functions could be modified. Example: Population decrease of turtles due to the intake of litter.	Entanglement of marine life and modification of ecosystem functions. Example: Mass entanglements of marine turtles	Population decrease, entanglement of marine life and modification of ecosystem functions. Example: changes of population due to ghost fishing

mic impac	Size of marine litter, types and impacts					
	Size of marine litter	**Nano <1 um**	**Micro < 5mm**	**Meso <2.5**	**Macro <1 m**	**Mega > 1n**

[53] UN Environment *(2017) Marine Litter. Socio-economic study. United Nations Environment Programme, Nairobi. Kenya.*

	Fish and aquaculture	(Subjective) potential risk perceived by chemical contamination of fish, seafood and edible water plants. Perception issues can cause a lower demand and/or value of the fish/seafood.		Their intake can result in a lower quality fish and thus a lower quality market.	It can cause damages to fishing boats, fish loss and associated income. Potential risks for the community cohesion/local identity/cultural values	Production loss and thus livelihood; damages to boats and gear.
	Tourism and leisure	There is a need to publish new information of the impacts it has on health	Very unlikely	It can discourage recreation at the beach, this decrease of tourists could reduce the income and well-being.	Decrease of tourism numbers, income and well-being. Increase of cleaning costs and boat damage.	Income decrease due to polluted beaches. Increase of cleaning costs.
	Navigation	No	Very unlikely	Damages to boats (refrigeration systems)	Damages to boats (propellers, refrigeration systems); productivity loss and income due to delays or accidents affecting supply chains.	
	Local and municipal authorities	Degradation of the natural environment Potential cost increase of waste water		Degradation of natural/heritage environment; cleaning cost and infrastructures. Income loss and livelihood	Degradation of the natural/heritage environment Cleaning cost and infrastructures. Income loss and livelihood	

Size of marine litter, types and impacts

	Size of marine litter	Nano <1 um	Micro < 5mm	Meso <2.5	Macro <1 m	Mega > 1n
Social impact	**Human health**	Risk of nanoparticles uptake to cell walls. Risk perception of chemical polluters from fishing.	(Subjective) risk perception of chemical pollution due to the intake of fish and seafood, with the risk to transfer pathogens.		Damage at the beach, danger for fishermen, loss of mental health due to a degraded environment.	Risk for individuals to become entangled and risk due to mental health caused by a degraded environment.
	Communities	Concern about community health. Uncertain current impacts		Cleaning expense, well-being loss due to degraded spaces.	Cleaning expense, well-being loss due to degraded spaces. Risk of community cohesion, local identity and cultural values.	Livelihood loss, well-being loss due to degraded environments, risk of community cohesion, local identities and cultural values.
	Poverty	Perception according to the level of awareness regarding well-being loss when living in a degraded environment.		Lower well-being when living in polluted environments		Lower well-being, fish and tourist's loss.

4.1 Environmental Impacts

Marine litter is probably one of the strongest anthropogenic pressures acting on the habitats and the biodiversity on seas and oceans of the planet[54]. Accumulation of marine litter causes significant damages to the species that live in the sea and the coastal areas and they have negative impacts on the normal functions of the ecosystems. Negative impacts of marine litter include damages caused by chemical components[55].

Physical damage

Marine litter has negative impacts on individuals, lethal or sublethal effects.

[54] Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel—GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

[55] UN Environment (2017). Marine Litter. Socio-economic study. United Nations Environment Programme, Nairobi. Kenya.

The first register of species affected by marine litter was produced at the beginning of the sixties and there is a clear tendency to increase the frequency of the reports not only for the number of individuals but also for the number of affected species[56].

The most well-known physical effects caused by marine litter are related to their intake or attachment to the body of the individual. These effects can modify the physical conditions of the individuals as well as compromise their movement and reproduction capacity, because it can affect their ability to hunt, digest, modify their hunger sensations and capacity to escape from predators[57].

Marine litter associated with fishing (nets, ropes, traps, floats, etc.) affects also the species that live in a marine environment. This kind of litter still fishes indiscriminately during a long period, known as ghost fishing. In addition, there are other non-biodegradable marine litter that can persist in the environment during centuries and, due to their exhibition to light, they can fragment in smaller particles, affecting a wide diversity of species of various sizes[58].

Chemical damages

Some marine litter, especially plastic products, contain potentially toxic chemical substances added during their manufacturing (bisphenol A, phthalates, antimicrobians...) that can pollute the environment. These substances can also be consumed by various organisms[59]. Some experimental studies have shown that *phtalates* and BPA affect the reproduction of some species and, together with other chemical components, they can become endocrine disruptors. Even smaller species, such as zooplancton can transfer hydrophobic contaminants (and plastic additives) to trophic networks[60].

On the other hand, marine water can also be polluted with oils, solvents, paints, detergents, etc., derived from the activities of boats which can have a harmful and toxic effect to animals and plants. Boats use products such as biocides and bleach, in order to clean and avoid being colonized by bacteria and algae. Some products such as antifouling are used to eliminate the organisms stack at the boat, which have a negative effect on the environment, such as toxicity for fish and molluscs as well as the biodiversity decrease[61].

Other anthropogenic activities such as surf or kitesurf can also cause negative effects on the ecosystems. Some materials used in the design of tables and neoprene contain toxic or difficult to degrade materials. For example, toluene diisocyanate and other polyester components are used in order to create a core of the surf table, glass fibre is treated with chemical products such as chromium, even the wax used for the traction of surf tables is made of a toxic mix of paraffin, vaseline, microcrystalline wax, chemical aroma and synthetic dyes[62].

On the other hand, the intensive use of sun cream at the beach can also have a negative impact on the marine environment. UV filters (organic, physical or mixed) are a source of toxic chemical substances for the environment. Filters can prevent marine phytoplankton from growing and cause bioaccumulation and contamination of the trophic chain. Inorganic filters interact with the marine wildlife through absorption in the surface of organisms, cell interaction, retention of filter organisms, intake by benthic fauna, etc[63].

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[56] Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel—GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

[57] Werner, S., *et al.* (2016) Harm caused by Marine Litter. MSFD GES TG Marine Litter - Thematic Report. JRC Technical report; EUR 28317 EN; doi:10.2788/690366.

[58] Galgani L, *et al.* (2019) Editorial: Impacts of Marine Litter. Front. Mar. Sci. 6:208.

[59] Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel—GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

[60] Galgani L, et al. (2019) Editorial: Impacts of Marine Litter. Front. Mar. Sci. 6:208.

[61] Darbra, R.M. (2005). Una nova metodologia per a l'avaluació de la gestió ambiental en ports de mar. Departament del territori i sostenibilitat (2019). Configuració del litoral català. Territori i urbanisme.

[62] J B Davies, H. (2009). Environmental Issues in Surfing – Behaviours and Attitudes. *The Plymouth Student Scientist*

[63] González D., A., et al. (2018) *Hacia una ordenación espacial marítima del turismo en la demarcación Levantino-Balear.* Informe final del proyecto PLANMEDTUR. Editado por Eco-union

4.2 Economic Impacts

Economic costs associated with marine litter can be divided in three groups[64]:

- Real economic costs linked to expenses: cleaning costs at the beach, costs related to the damages, loss of fishing gear or motor obstruction, hospitalization costs causing impacts on the human health, etc.
- Economic costs caused by the production or income loss: income loss of fishing industry caused by a reduction of the fishing population or its pollution, income loss of tourism, etc.
- Economic costs related to well-being: impacts on the human health, aesthetic and cultural loss, etc.

The main economic sectors economically affected by the marine litter are the commercial fishing activities and aquaculture, recreational boating, coastal towns and coastal tourism. Other sectors also affected are agriculture (caused by the transport of marine litter to the fields) and emergency rescue services[65].

Beach clean-up, tourism and recreational activities

Coastal towns need to assume high cleaning costs at the beach in order to maintain clean, safe and attractive beaches for tourism and recreational activities. Among direct costs, there are collection, transport, management and elimination of litter, as well as management costs related to the contract management and coordination with cleaning services. In the most touristic coastal towns, a beach cleaned regularly can reduce costs significantly.

For example, it is estimated that in the United Kingdom the elimination of marine litter at the beach of all the coastal towns increase up to 18 million € annually, costing 146.000€ for each town every year[66]. It is estimated that the average cost for the collection of marine litter at the beach ranges from 7.000 to 7.300€ per km and year, and this amount can be increased if the cleaning operations are more intense, especially in touristic and densely populated areas. In the Spanish towns assessed, the cleaning costs ranged from 38.190€ to 87.500€ per km and year, and this amount has increased the recent years[67].

Various organisations and volunteers are also playing an important role in the collection and categorisation of marine litter at the beach and coastal environments. These cleaning actions carried out by the citizens also involve some operational expenses, public funds or aids to buy material or insurances, apart from the time dedicated to volunteers.

On the other hand, coastal towns, especially those where the beach contributes significantly to the local economy, the indirect economic impacts of the marine litter are even more important. Various studies show how the presence of marine litter can cause a decrease of visitants (loss of hotel occupation and contract of recreational activities at the coast) and a lower expense in the local economy. This phenomenon is interesting if tourism is one of the main sources of marine litter, as indicated above[68].

Maritime transport and recreational boating

Navigation industries also cause economic impacts because of the pollution of marine litter. Harbours, sport harbours and nautical stations need to face the costs of collecting the litter in their facilities and the surface waters in order to keep them safe and attractive for the users and avoid material damages for interferences with the propeller, the tiller and aspiration valves. It is estimated that in the United Kingdom these costs can increase up to 2.4 million € annually, i.e. 8.000€ for each harbour annually, or even higher in bigger harbours

[64] Newman S., *et al.* (2015). The Economics of Marine Litter. In: Bergmann M., Gutow L., Klages M. (eds) *Marine Anthropogenic Litter*. Springer, Cham

[65] Idem.

[66] Mouat, J., *et al.* (2010). Economic Impacts of marine litter. KIMO International, pp. 105.

[67] Idem.

[68] Newman S., *et al.* (2015). The Economics of Marine Litter. In: Bergmann M., Gutow L., Klages M. (eds) *Marine Anthropogenic Litter*. Springer, Cham

with more activity. Regarding the harbours of Spain, it is estimated that the costs are 7 times higher than those of the United Kingdom[69].

A questionnaire carried out at the Barcelona's harbour, one of the biggest of the Mediterranean Sea, shows how the annual costs related to the collection of 35.000 kg of litter floating on surface waters add up to 300.000€, i.e. 8.900€ per ton annually in an area of 4 km^2 [70].

Fishing and aquaculture

The fishing sector needs to face, on the one hand, the direct economic impacts related to the need to repair or substitute fishing gear (propellers, tillers, pipes...) broken or lost when crashing with marine litter and, on the other hand, to the income loss caused by the reduction of captures or litter 'capture'. Lost and abandoned fishing gear are an important fraction of marine litter and they can cause a high cost for the fishing activities when producing what it is known as ghost fishing (captures produced by devices and lost or abandoned fishing gear still functioning). This phenomenon can cause a reduction of the potential captures and put at risk its sustainability[71].

This sector experiences indirect economic losses related to the value loss of the fishing resources, either the reduction of the fish or seafood or caused by impacts on the quality of the captures (for example, when it comes to the intake and pollution by plastic products or persistent organic pollutants; POPs). It was estimated that the direct economic impact of the marine litter on the Scottish fishing boats range from 17.000€ to 19.000 € annually by boat[72].

It is estimated that the concentration of marine litter in the Mediterranean Sea is even higher than the Atlantic Ocean; moreover, the related costs are also higher. The total cost of marine litter deposed of by boats at the European level is approximately 62 million € a year[73].

Marine litter can also cost money for the aquaculture industry due to the material damages of its infrastructures, such as the propellers tangled in plastic film or other litter and obstruction of pipelines, and also the time needed to eliminate litter ending up in the fish farms and their surroundings has to be taken into account[74].

4.3 Social Impacts

The impact caused by the marine litter results in an intangible cost for the society that affects the quality of life, the recreational activities and the aesthetic value. Social impacts associated with marine litter can be divided in two groups[75]:

- Direct social impacts at the short term, such as public health (injuries, navigation risks, etc.)
- Indirect social impacts at the long term about the quality of life, such as recreational activities at the coastal areas or the loss of aesthetic values.

Bad practices in the management of solid litter, the lack of infrastructures and the lack of awareness among the general public about how the consequences of their actions deter the situation.

Reduction of recreational opportunities and loss of aesthetic values

[69] Mouat, J., *et al.* (2010). Economic Impacts of marine litter. KIMO International, pp. 105.

[70] Clean Sea (2013). Socio-economic Assessment of the costs of marine litter. Clean Sea Project.

[71] Newman S., *et al.* (2015). The Economics of Marine Litter. In: Bergmann M., Gutow L., Klages M. (eds) Marine Anthropogenic Litter. Springer, Cham

[72] Clean Sea (2013). Socio-economic Assessment of the costs of marine litter. Clean Sea Project.

[73] Arcadis (2014); Marine litter study to support the establishment of an initial headline reduction target- SFRA0025. European commission /DG ENV

[74] Mouat, J., *et al.* (2010). Economic Impacts of marine litter. KIMO International, pp. 105.

[75] Idem.

Accumulation of marine litter at the river, beach and marine areas is of deep concern by coastal cities which can become less attractive for their residents and local tourists. A questionnaire carried out recently in the EU shows that more than 70% of the visitors encounter marine litter during their visit to the coast, and they consider it bothering and a factor to consider when deciding the next holidays[76].

Impact on health and public safety

Marine litter accumulated at the beach can cause an impact on the public health and the public safety. Beach users can cut themselves or get injured with the litter on the beach. People practising coastal activities, such as swim, scuba diving or sport activities can become entangled in nets, although they can usually get freed, but they can get injured or even die[77].

Water pollution caused by marine litter could also cause major problems such as a bacterial and viral pollution risk (for example, E. Coli) of the surrounding coastal waters. Consumption and contact to polluted water can lead to hepatitis, cholera, typhoid fever, diarrhoea, bacillary dysentery and cutaneous infection. These issues can lead to the closing of beaches[78].

Navigation danger

Marine litter can interfere in the operation of boats. Some of this debris can be stack on the propeller, reducing its stability on the water and its capacity to turn. Incidence evidence putting boat safety at risk is anecdotal and most of the incidents are not registered[79].

[76] Thompson, R. C. (2017) Future of the Sea: Plastic Pollution. Foresight, Government Office for Science, United Kingdom.

[77] United States Environmnetal Protection Agency (2017) Impacts of Mismanaged Trash. Accés: 13-03-2019

[78] Potts, T. and Hastings E. (2011) Marine Litter Issues, Impacts and Actions. Marine Scotland.

[79] Mouat, J., *et al.* (2010). Economic Impacts of marine litter. KIMO International, pp. 105.

5 Limitations of available data

Most of the available data about composition, quantity and impact of the marine litter at the Mediterranean region involves all the region, and it is difficult to obtain specific data of the Catalan coast, apart from those indicated in this document.

Even if some useful data about marine litter in the Mediterranean region is available, it is still incoherent, and the various characterisation protocols used around the region are not harmonized, which complicates follow-up and monitoring.

Collection and characterisation of marine litter at the beach through initiatives of citizen science is the simplest and cost-effective method, and the main source of available data. Some studies about marine litter at the beach are based on infrequent samples (quarterly, annually or occasionally) and provide data about the material found at the beach during long periods (standing stocks). Information obtained from the sampling of standing stocks is useful in order to assess compositional changes of marine litter in time, but they do not enable to monitor in detail the changes related to the quantity of marine litter generated[80].

On the other hand, regular, frequent samples with harmonized protocols registering and collecting litter at the beach can provide information about the quantity of litter at the beach and they can also be used to establish net accumulation ratios in time[81]. Unfortunately, there are currently no studies of this kind in Catalonia or in the Mediterranean region and most of the available data about litter at the beach come from occasional or monthly samples, indicating mainly the composition of the litter.

Even if the citizen participation in beach cleaning and categorisation of litter is normally strong in the region, it is not constant, which conditions the quantity of monitored and characterised items. Moreover, through these initiatives it is often not possible to identify fragments smaller than 2.5 cm, which are often buried in the sand and thus they are limited to register the presence of bigger articles.

Most of the studies assessing the issues of marine litter at the Mediterranean or the Catalan coast are based on the objects found at the beach, and very few analyses have been done regarding litter at the seabed or floating on surface waters.

In order to obtain a precise and significant assessment of debris, a systematic control at a bigger scale is needed, not only about the debris at the beach or floating on surface waters but also on the seabed, and a wide range of sizes should be included.

[80] Ryan, P., Moore, C., Van Franeker, J., Moloney, C. (2009). Monitoring the abundance of plastic debris in the marine environment. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*. 364. 1999-2012.

[81] Veiga, J.M., *et al.* (2016). Identifying Sources of Marine Litter. MSFD GES TG Marine Litter Thematic Report; JRC Technical Report.

PART II: Benchmark of waste prevention measures in European beaches

6 Introduction, methodology and research proposal

6.1 Introduction

As shown in the part I of the marine litter analysis in Catalonia, the accumulation of debris and marine litter in the beach of the territory has become a significant ecological problem in order to preserve the environmental quality of the coastal ecosystems in Catalonia and in the Mediterranean region.

The disposal and accumulation of marine litter at the Catalan coast has recently increased due to a growing tendency to consume products easily becoming debris, such as single-use plastic products. This issue is intensified due to massification and an inappropriate use of the beach caused by a market that does not offer alternatives to detrimental products for the ecosystem and a lack of policies and regulations aiming to prevent litter, such as single-use plastics products used at the beach.

The current situation has led to the promotion and implementation of various measures and initiatives at different administrative and institutional levels. Public administrations, not-for-profit organizations and private companies have developed and implemented actions aiming to mitigate and prevent the impact of waste at the beach. Institutions such as the European Commission have voted in the Parliament for the Agreement for the ban of single-use plastics for 2021[82].

The analysis of this section is focused on assessing an identification and evaluation of measures created by public administrations, due to its political and legislative nature. These strategies and norms promote the implementation of tools allowing the protection of the coast not only in urban but also in natural areas.

This selection and analysis of measures at the municipal and regional level aims at showing examples of good practices executed at various levels successfully implemented. These initiatives aim at encouraging municipalities with similar socio-environmental characteristics and affected by the same issue to proceed to the creation and implementation of a legal frame implying a turning point in the prevention of waste in the targeted areas.

The initiatives aim at reducing some typologies of single-use-plastics and propose various measures in order to avoid the disposal and accumulation at the beach. These measures include norms that limit the beaches where smoking is allowed, the establishment of deposit return systems of cups at beach bars or the ban of other single-use plastic, as well as the awareness of their users regarding the preservation of natural areas.

These measures have been used to adapt waste prevention protocols of the Zero Beach Project that will be implemented in a pilot test during the months of June and July in 2019 in the municipalities of Castelldefels, El Prat de Llobregat and Gavà, all belonging to the Metropolitan Area of Barcelona (Catalonia).

The study has had various difficulties limiting the scope and depth of the research. These difficulties are explained below (See 7.5. Limitations of the Research).

6.2 Aim of the Research

This study is based on the analysis of norms and institutional initiatives carried out in various European regions, as well as the development and the implementation at the proposed scale.

This research aims at identifying measures and analysing the characteristics to understand the mechanisms (tools, management), objectives and results of prevention and awareness aimed to achieve during the implementation.

The final objective is to **identify the state of the measures to prevent solid waste and marine litter at the beach**. The results of the research aim at informing about the development of the marine litter prevention measures at the beach.

[82] Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment

In any case, the effectiveness of the measures has not been assessed because the respondent have not provided with relevant information and no evidences were found in public documentation; therefore, the analysis consisting of:

- Identification of administrations responsible for the design, implementation and effectiveness of the adopted measures within its competences.
- Observation of the creation and integration in municipalities or regions with a growing problem of marine litter and waste.
- Analysis of the scope of the measures and the perception and results during the implementation phase.
- Identification of strategies and political instruments created to prevent debris at the beach.

6.3 Methodology

Methodology used for this research combines various types of analysis

Creation of questionnaires targeted to technical officers of the public administration responsible for the application of the measures presented at the case studies. These questionnaires aim at obtaining information detailing the mechanisms, strategies and indicators used to guarantee and evaluate the implementations of the measures, as well as the perspective of certain aspects by the technical officers. The sample analysed consists of 5 case studies corresponding to various types of waste. The following table shows the information used to assess the prevention of waste and marine litter.

Table 6 indicators of information to assess the prevention measures

INDICATOR	DESCRIPTION
Lead Insitution	Municipality/Region/Country
Type of measure	Indication of the type of measure
Scope	Type of waste, territorial scope, actors affected
Objectives/Tools	Objectives, type of tools used (legal, communication, economical...)
Specificities	Quantitative, by typology of waste, etc.
Results	Quantitative, experience acquired
Existing problems	Effectiveness of measure, indicators

Simultaneously to the questionnaires, an analysis was carried out about the official documents issued by the administrations for the implementation of measures. In certain cases, no response to the questionnaire was submitted or there was no official document, the research has been carried out through available information on the website of the administration and the collection of information from local communication media, which has published specific news about measures.

6.4 Identifications of study cases

The identification criteria of the analysed measures lie in the selection of measures targeted to waste prevention having a major ecological impact on the Catalan and European coasts, according to their typology and abundance. Those measures not targeted to avoid waste disposal at the beach, such as selective recycling, campaigns to raise awareness or beach clean-ups were discarded. Moreover, measures coming from countries outside the European Union were also discarded. Measures with a direct effect in single-use plastic prevention at the beach, such as deposit return systems, were not included in the analysis, despite being present at the European level. Identification of study cases was done as follows:

- **Mass consultancy to environmental entities** at the European level including organisations of many countries (European Environmental Bureau[83], Zero Waste Europe[84]) and the European network ACR+[85], which includes a network of cities and European regions.

[83] https://eeb.org/

- **Identification of European projects** focused on waste management at coastal municipalities funded by Interreg programme and H2020: Atc4Litter[86], BlueIslands[87] and Urban Waste[88].
- **Consultancies to regional and national governments** of Europe: Regional Governments of Sardinia and Environmental Agency of Denmark and the municipality of Bornholm (Denmark).

The results of this consultancy were 7 study cases identified at the European beaches. Study cases were focused on plastic waste, which represents a major proportion of debris found at the beach in the Western Mediterranean region, together with cigarette butts, which are almost a quarter of the total, according to the European Agency of Environment and various investigations as mentioned in other sections of this report. Many of these cases have been applied just recently. Measures to prevent smoking are the most common initiatives. During the investigation process, more government initiatives were identified, mainly in Spain, which announced campaigns for smoke-free beaches. Regarding the prevention of single-use plastics from drinks and food consumption, there are cases that define specific measures for the beach. In other countries of the North of Europe where the beach is less visited than in the South of Europe, the evidence of measures for prevention at the beach were less numerous.

Table 7 : Measures identified by type of single-use plastic at European beaches

TYPE OF WASTE	IDENTIFIED PREVENTION INITIATIVES	TOOLS
	2 x Spain 1 x Italy 2 x United Kingdom	2 Norms (prohibition) 1 Communication and equipments 2 Only awareness campaigns
	2 x Italy	Norms (prohibition)
	2 x Italy	Norms (prohibition)
	2 x Italy	Norms (prohibition)
	2 x Italy	Norms (prohibition)
	2 x Italy	Norms (prohibition)
	1 x Cyprus	Incentives

Five case studies were analysed. Table 10 shows the case studies with the kind of information used in order to assess the experiences.

[84] https://zerowasteeurope.eu/
[85] http://www.acrplus.org/en/
[86] https://act4litter.interreg-med.eu/
[87] https://blueislands.interreg-med.eu/
[88] http://www.urban-waste.eu/

Table 8 Summary of analysed measures in beach waste prevention

Name of the measure	Type of waste	Localisation	Source of information	Coordination organisation	Year of application
Las Canteras, smoke-free beach	Cigarette butts	Las Palmas de Gran Canaria, Spain	Official document	**Concejalía de Ciudad de Mar -** Ayuntamiento de Las Palmas de Gran Canaria	2017
Praias Sen Fume	Cigarette butts	Galicia, Spain	Questionnaire	Consejeria de Sanidade - Servicio Galego de Saúde	2016
A les platges, residu zero	Single-use plastic products (resable cups)	Barcelona, Spain	Questionnaire	Ajuntament de Barcelona - Departament de Gestió de Residus	2017
Ordinanza Balneare 2019 ***Regió de Puglia***	Single-use plastic products and other waste	Puglia, Italy	Official document	Puglia Conselleria de Pressupost, Secció Domini i Patrimoni.	2019
Ordinanza Balneare 2019 ***Comune di Lerici***	Cigarette butts	Lerici (Liguria) Italy	Official document	Ajuntament de Lerici (La Spezia)	2019

6.5 Limitations of the Research

Some external factors have prevented the initially established methodologies from being carried out when selecting and analysing the study cases. Difficulties encountered are the following:

- **A lack of collaboration of the institutions:** in many occasions, administrations have not answered the questionnaire used to obtain relevant information. In certain occasions, communication with the technical staff has been impossible, despite the perseverance of the researchers.
- **A lack of public information of implemented measures:** in many cases, evidence show the existence of net measures, but there is no official information providing technical details.
- **Incomplete information in sources other than the official ones**: if contacting the administration was impossible, digital communications in local media has been the next step taken. Local media provide information with no confirmation, without showing whether it was validated by the administration.

These limitations have conditioned the study, providing as a result the reduction of initially previewed cases, the lack of information of key aspects or the need to consult sources other than the official ones. There are some sections included in specific study cases and not observed in others, the reason behind it lies in the responses of only some of the sections of the questionnaire or the available public information.

The reduced number of the measures analysed is also due to the nature of the targeted measures in the study. One of the selection criteria included: measures implemented in beaches and targeted to their users, which broadens the limitation of research.

However, there has been many initiatives focused on the beach, but the number keeps growing and many are still in the implementation phase, without showing significant results. Among these difficulties, there is also the organisation of the workshop with Officers of the Catalan public administration, used to add information at the autonomous level, in the frame of Zero Beach project. The meeting has enabled the discussion and brainstorming in order to improve the protocols of the project in deposit return systems and limitations to smoke in beaches.

7 Results

As exposed in the first part of this report, urgent measures need to be adopted in order to guarantee the prevention of waste at the beaches. The Mediterranean region is an area with unique biodiversity but also very fragile, and it is exposed to constant disturbance of anthropic origin. Public administration must implement urgent waste prevention measures using the needed legal instruments in order to guarantee an effective and strict application helping to the preservation of marine ecosystems of the region.

Measures and actions developed specifically at the beach are targeted to the users and aim to raise awareness among the citizenship who, in turn, can see its positive consequences in the natural spaces such as the beach.

The approved and implemented measures include smoking limitations, plastic prohibitions, deposit return systems with economic incentive and campaigns to raise awareness related to the mentioned measures and to problems of other kinds.

Among the analysed cases and others, the following stand out:

- The number of measures should be higher at all the levels and scales. There have been many advances around the visibility of the issue of marine litter and the impact it has on the environment, but there is a need for long term measures including more typologies of waste and using sanction tools.
- In order to guarantee the compliance of ordinances and legislations regulating the prevention of waste, there are common tools, such as the punishing proceeding, modifications of technical sheet and information campaigns to raise awareness.
- Measures limiting the consumption of tobacco at the beach show a great efficiency and a high degree of acceptance by the citizenship. Measures that can be carried out in economic terms and availability of human resources should be included and adapted by the coastal municipalities.
- Measures targeted to the prohibition of other single-use plastic products used in hospitality are just starting to be implemented in various places in Europe. It is necessary to encourage all public administrations, from the municipal scale to the state in order to follow EU policies approved in the agreement voted by the Parliament regarding the prohibition of single-use plastics from 2021, and countries such as France have done it recently and it will come into force in 2020.
- Despite being accepted and efficient in countries such as Germany or municipalities such as Cadaqués during the project Retorna, the return of bottles with an economic incentive is not a measure counting with the major support of the Catalan administrations or the Spanish state. The administrations, pressured by the lobbies of the companies responsible to produce bottles and packaging, block the advancement of the implementation of these kinds of measures. Initiatives such as the return system of cups at beach bars in various municipalities, such as Barcelona, have successful results despite difficulties. These measures need to spread along municipalities and broaden the scope of the targeted waste, considering single-use products.
- There should be more spaces and initiatives to exchange experiences among officers of public administrations. There are many and functional proposals at various levels, either at the municipal, regional or state level that should be shared among countries, regions and municipalities aiming at preventing and improving the health of the coastal ecosystems.

8 Benchmark analysis of waste prevention measures at beaches

The study cases of this section show planning and execution examples of certain measures for waste prevention and citizen's awareness adopted in various countries and various administrative scales.

Table 7.5: Description, scale and type of tool used in the measures

Name of the measure	Short description	Scale	Type of tool
Beach at the city of Barcelona	Prevention measure focused on the reduction of single-use plastic cups of the beach bars of the city of Barcelona through returnable cup	Municipal	-Sanction regime -Campaign to raise awareness
Praias Sen Fume	Measure to raise awareness focused on the reduction of tobacco at the beaches of Galicia	Regional	-Informative campaign to raise awareness
A les platges, residu zero	Implementation of returnable cups at the beach bars of Barcelona in order to reduce single-use plastic cups.	Municipal	-Technical brochures -Campaign to raise awareness
Ordinanza Balneare 2019 ***Comune di Lerici***	Ordinance to ban smoking and disposal of tobacco waste at the beaches of Lerici	Municipal	-Sanction regime -Informative campaign
Ordinanza Balneare 2019 ***Regió de Puglia***	Prohibition of single-use plastic and various types of waste at the beaches of Puglia region	Regional	-Informative campaign

8.1 *Barcelona (Spain):* Returnable cups at the beach bars[89]

Type of waste	Responsible institution	Implementation scope	Spatial area	Period of execution	Analysis method	Implication of the waste administration
Single-use plastic cups	Barcelona City Council	Municipal	Beaches at the city of Barcelona	2+2 years, according to the concession with the beach bars	Questionnaire submittal and return	Yes

Description of the measure

Barcelona City Council included in the technical sheet of the concession of 15 beach bars the obligatory nature to implement a deposit return system. This system aims at substituting single-use cups with returnable cups.

When customers buy a drink to take away, they pay 1€ deposit for the cup. This amount is returned when the dirty cups are given back.

Each beach bar has established its own cups; therefore, there are various models of cups with images of each bar. The cup needs to be returned at the same bar. Some beach bars have bought cups and they wash them themselves, others have outsourced the rent and washing of the cups.

Tools used

- Technical sheet
- Information campaign with environmental educators

[89] http://ajuntament.barcelona.cat/premsa/wp-content/uploads/2018/06/180626-NP-Platges-i-residusok.pdf

Cost
No cost Internal staff
Scope of the measure
The measure is focused on the 15 beach bars of Barcelona. Beach bars need to implement the system, but final users of the cups are the citizens.
Use of resources and specificities
Coordination between waste prevention and certificates of the Barcelona City Council. Communication of Urban Ecology has also intervened and used various channels to communicate the action as well as a team of inspectors-informants.
Results
120.000 single-use cups saved. The questionnaire carried out to the beach users of Barcelona created by the Department of Opinion Studies of the Municipal Office of Data of the Barcelona City Council manifests that the measure to use reusable cups in bars, leaving 1€ deposit is assessed as very good by 83.0% among its users. On the contrary, beach bars have been very reluctant to the measure.
Response/Citizen's perception
A poll was realised to users of the beaches of Barcelona carried out by the Department of Opinion Studies of the Municipal Office of Data of the Barcelona City Council, where the measure to use reusable cups in beach bars, leaving 1€ deposit is assessed as very good by 83.0% among its users.
Existing problems
-Achieve beach bar's complicity. -Street vending drinks cause a double issue: unfair competition to beach bars and single-use cups. -Lack of positive attitude by the beach bars when collaborating with the application of the measure.
To improve
Intensify the inspections and sanctions -the first year there was no sanction.

8.2 Galicia (Spain): Free Smoke Beaches[90]

Type of waste	Responsible institution	Implementation scope	Spatial area	Period of execution	Analysis method	Implication of the waste administration
Cigarette butts	General Directive of Public Health of the Health Department of the Xunta de Galicia (Spain)	Autonomous Community, province and municipality	Beaches at the Galician territory	Annually Official swimming season (15th June-15th September) Implemented in 2016, currently in force	Questionnaire submittal and return	No. The programme does not include waste prevention among its objectives. Regarded as an indirect measure of the project.

Description of the measure

The Galician network of Free Smoke Beaches "Red Gallega de Playas Sin Humo" was created in 2016, with the aim to educate, raise awareness, promote health and protect the environment. This measure does not pretend to collect funds, and its compliance is voluntary.

At the beaches included in the network, smoking is not allowed on the sand, despite outdoor locals being excluded, regulated by the Law 28/2005. There is no surveillance or sanction in case of no compliance.

The main objective of this initiative is the following:

- Promote life without tobacco.
- De-naturalise the consumption of tobacco among the society.
- Promote beaches that respect and take care of the environment.

This network was led by the General Directive of Public Health of the Department of Health of the Xunta de Galicia, and it includes territorial directives of health (at a province level) and city councils.

Tools used

[90] https://www.sergas.es/Saude-publica/Praias-sen-fume

- Informative campaign to raise awareness

Cost

The project cost comes from the designs, the creation or distribution of informative materials, dissemination, panelling and accreditation of the "network".

These costs change annually, because it is related to the number of city councils and beaches participating in each edition.

Scope of the measure

The measure is targeted to users of beaches of all the coast of Galicia.

Use of resources and specificities

Coordination among administrations of the Department of Health and local administrations (city councils). Coordination and organisation of the programme from the central services (General Direction of Public Health), with the participation of the Provincial Territorial Head Office.

Summer monitoring is established in order to prove the acquired compromises when belonging to the Network of Beaches (panelling and information activities to raise awareness targeted to the population). The programme is assessed annually.

Results

In 2019, participation was:

- 64 city councils
- 141 beaches

Indicators to prove the effectiveness of the measure

Compliance of the acquired compromises when belonging to the network of beaches (panelling and information activities to raise awareness targeted to the population).

Expansion of the network to other environments not regulated currently (river beaches and sportive harbours) as an indicator of the perception of the initiative.

Response/Citizen's perception

The assessment of the initiative is very good or good according to the 71.6% of the beach users and 78.1% of the general population. 68.7% of the beach users would like to extend this initiative to other beaches. 67% of the beach users would like to broaden the network to other leisure spots.

Evaluation of results

The evolution of the project is very positive, city councils have implemented it with no problem, and the exponential growth of participation from the beginning proves it. The compliance of smoking prohibition at the beaches of the network, analysed through users' questionnaires, improves compared to the first year of implementation, proving an active participation of the society.

8.3 Gran Canaria (Spain): Las Canteras, a beach without smoke[91] [92]

Type of waste	Responsible institution	Implementation scope	Spatial area	Period of execution	Analysis method	Implication of the waste administration
Cigarette butts	Method of analysis	Municipal	Beaches of Las Canteras, in Las Palmas de Gran Canaria (Spain)	Start: December 2017 End: September 2018	Consultancy of the municipal government	Yes

Description of the measure

Inclusion of the smoking prohibition in the beach of Las Canteras, possibility to claim and sanction the lack of compliance.

This is a horizontal measure in force for various reasons, such as the health of the citizens, the improvement of cohabitation among the beach users, the state of the environment and the management and treatment of waste at the beach.

Objectives

The campaign "Las Canteras, una playa libre de humo" was launched with the aim of encouraging social joint responsibility, to recommend to the smokers not to smoke on the sand for the common good and to improve the quality of life of the citizens, encourage dialogist and respectful attitudes when managing the possible conflicts that can rise at the beach, making it easier to implement the measure previously when the new norms comes into force.

The objective is to generate an active and educative attitude by all in these proceedings of the beach, focusing in the transmission of reasons and arguments that give sense to the smoking limitation. The campaign will also inform about the consequences in case of no compliance, once the new regulation comes into force: complaint and corresponding economic sanction.

Tools used

·Modification of the Municipal Regulations of Coasts and Beaches included the smoking prohibition at the beach Las Canteras, making it possible to claim and sanction its non-compliance.

·Campaign to raise awareness

·Use of municipal services to develop tasks at the beach: local police, cleaning, rescue and first aid.

·Actions focused on involving companies and establishments that develop their activities at the beach, the maritime walk and its limitations, maintaining them informed about the campaign and the implementation of the measure, its

[91] Ordenanza municipal reguladora de los usos, actividades e instalaciones, en las playas, paseos marítimos y resto del litoral de Las Palmas de Gran Canaria: Article 19 and 20.

[92] Las Canteras, Una Playa Libre de Humos

arguments and previewed deadlines.

Cost

N/A

Scope of the measure

N/A

Use of resources and specificities

This measure was approved after a binding citizen consultancy in December 2017, and the citizenship voted that Platja de las Canteras should be a "smoke-free beach" (89% of the 4.232 participants voted yes).

The campaign to raise awareness was developed in Eastern in September and counted with the following actions:

· Presence of informants at the beach and the maritime walk all Fridays and Sundays from 12h to 16h.

· Messages were incorporated with recommendations to avoid smoking.

· Advertising campaign through media.

· Advertising campaign through social networks.

· Environmental education activities to raise awareness of students.

Simultaneously, the sand access areas will be reinforced with ashtrays/bins making it easier for smokers to smoke with comfort and respectful with the environment and the rest of the users. Panelling at the beach and the walk will also be modified when the new norm comes intno force, adapting to the new situation of a "smoke-free beach".

Results

- N/A

Indicators to prove the effectiveness of the measure

Compliance of the acquired compromises when belonging to the network of beaches (panelling and information activities to raise awareness targeted to the population).

Expansion of the network to other environments not regulated currently (river beaches and sportive harbours) as an indicator of the perception of the initiative.

Response/Citizen's perception

The binding citizen consultancy previous to the implementation of the measure already guaranteed a strong support of its application.

Evaluation of results

N/A

8.4 Lerici (Italy): law 55/2019 to prohibit smoking at the beaches[93]

Type of waste	Responsible institution	Implementation scope	Spatial area	Period of execution	Analysis method	Implication of the waste administration
Waste from tobacco	Lerici City Council (La Spezia), Liguria, Italy	Municipal	Beaches and rock areas of Lerici	From the 1st of June, 2019	Consultancy of the municipal government	Yes

Description of the measure

The City Council of Lerici has written and applied a measure that prohibits smoking and leaving tobacco waste, with the aim to take care of the health of citizens and limit and prevent marine litter.

Objectives

Its objective is to guarantee and improve public health, reduce tobacco consumption and fight against environment pollution.

Tools used

- Administrative sanction ranging from 25€ to 500€. This sanction can be doubled in case of non compliance with the norm in the presence of vulnerable people, such as pregnant women or children.

Cost

N/A

Scope of the measure

The areas where the ordinance is applied are the following:

- Beaches free from public management
- Free equipped beaches, managed privately or through a concession.
- Within "stabilimenti balneari" (beach bars, privately managed beaches)
- Natural or artificial stones
- Any artificial infrastructures, such as bridges or berth, within the swimming area.
- In docks

[93] Ordinanza Balneare 2019 Comune di Lerici (Provinzia della Spezia)

Smoking areas in bars and restaurants are possible only with a previous authorisation of the Office of Maritime Domain.
Use of resources and specificities
The managers of beach bars and concession beaches are subject to guaranteeing the respect of the ordinance within the beaches of the concession. Users are informed through panels including the names of the people responsible for the management of the beach.
Results
N/A
Indicators to prove the effectiveness of the measure
N/A
Response/Citizen's perception
N/A
Evaluation of results
N/A

8.5 Puglia (Italy): Balearic Ordinance 2019 [94]

Type of waste	Responsible institution	Implementation scope	Spatial area	Period of execution	Analysis method	Implication of the waste administration
Single-use waste, such as non- compostable packaging, plates, cups, cutlery and straws, such as plastic materials or others, such as cigarette butts.	Region of Puglia, Department of Budget and Heritage	Regional	Areas of maritime-land public domain of the Region of Puglia	From the 13th of April 2019 to the eventual promotion of a new measure (Art. 7.8)	Consultancy of official document of the regional government	Yes

Description of the measure
Regulations implemented in the whole area of maritime-land public domain of the Region of Puglia (Art. 3.1): -In all the areas of maritime-land public domain of the Region of Puglia, the following are banned: · Use of non-compostable and single-use food containers, plates, cups, cutlery and straws · Disposal of any kind of waste on land or sea. **Regulation implemented in the areas of the concession "Stabilimenti balneari"** -Drinks of any kind cannot be sold or provided in glass containers in any of the bars, restaurants during the realisation of activities at the beach (Art. 4.6). These need to be consumed only within the locals. ·Food and drinks packaging to take away or to eat in, plates, cups, cutlery, straws and other products, either single-use or non-compostable. ·To finish with the remaining plastic bottles in storehouses, they will be allowed until the 30th of September of 2019.
Objectives
Improve the environment sustainability of beaches and the conservation of the marine environment. Ban the single-use products at the beach during the development of activities along the coasts of the Region of Puglia.
Tools used
N/A

[94] Regione de Puglia. Ordenanza Balneare 2019. *Bollettino Ufficiale della Regione Puglia*, a - n. 39 del 11-4-2019

Cost
N/A
Scope of the measure
N/A
Use of resources and specificities
Managers of the beach bar and beaches in concession are subject to guarantee the respect of the ordinance within the targeted areas of the concession. Users are also informed through informative panels with the names of the responsible managers of the beach.
Results
There are currently no results due to the recent application date.
Indicators to prove the effectiveness of the measure
N/A
Response/Citizen's perception
N/A
Evaluation of results
N/A

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