OSPAR COMMISSION

Abundance, Composition and Trends of Beach Litter

Common indicator assessment

OSPAR

QUALITY STATUS REPORT 2023

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Abundance, Composition and Trends of Beach Litter

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays‐Bas, le Portugal, le Royaume‐Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

Key Message

Beach litter levels remain high with plastic items predominating. Over the last six years, significant decreases in litter and plastic abundance have been observed at the OSPAR Maritime Area scale and in four OSPAR Regions. To substantially reduce marine litter, it is necessary to continue current efforts and take additional measures.

Background (brief)

The reduction of marine litter pollution is one of the great environmental challenges facing society today. Under its North-East Atlantic Environment Strategy (NEAES) 2010-2020, OSPAR had the strategic objective "to substantially reduce marine litter in the OSPAR Maritime Area to a level where properties and quantities of marine litter do not cause harm to the coastal and marine environment".

One of the indicators currently used at OSPAR level to assess marine litter pollution is the "Abundance, composition and trends of marine litter washed ashore and/or deposited on coastlines, including analysis of its spatial distribution and, where possible, sources", referred to as "beach litter". The indicator, also used in the EU Marine Strategy Framework Directive (MSFD), reflects spatial differences and temporal changes in abundance, composition and sources of marine litter in the coastal environment and is used as a proxy for litter pollution in the OSPAR marine environment.

The present assessment describes beach litter quality status and trends in the OSPAR Area. To provide a snapshot of the current situation, litter abundance and composition were assessed from 2018 to 2020 and current trends over a six-year period, from 2015 to 2020. All parameters were calculated using median-based robust calculation methods which are representing the most typical pollution situation without being influenced by extreme values[1].

Beach Litter in Norway (courtesy of Bo Eide)

[1] The median value is the centre value found in the middle of a set of numbers sorted from low to high value. The median is better suited as the centre value for skewed distributions such as beach litter data, since it is not affected by extreme values. The mean value is the arithmetic average of a set of numbers and is strongly influenced by extreme values (outliers). Therefore the mean (average) is not robust for the assessment of beach litter data.

To complement the present report, factsheets were elaborated to provide key results at both OSPAR Area and OSPAR Region scales. Specific factsheets were also prepared for MSFD-country sub-regions to support European Union (EU) Member States in their MSFD reporting.

Background (extended)

Beach litter is defined by OSPAR as any persistent, manufactured or processed, solid material discarded, disposed of, from inland or abandoned in the marine and coastal environment, and encountered on beaches. A part of this litter originates from the sea, through deliberate or accidental losses from vessels (including cargos and waste), and is transported to, and deposited on the coast from the sea by winds, waves and water currents. Another part is directly deposited on the coast - e.g. by beach users - or is the result of fly-tipping. Litter is also deposited further inland on riverbanks, directly into rivers, in urban areas and in the countryside and is subsequently transported by rivers, rain and wind into the marine environment and onto beaches. In addition, sewage infrastructures discharge litter items directly or indirectly, via rivers and sewage outlets into the sea and these items can be washed ashore.

The present report aims at assessing in OSPAR Area and Regions: (i) marine beach litter quality status, (ii) current beach litter trends and (iii) extent to which OSPAR objectives have been achieved.

To do so, it provides an assessment of the abundance, composition, distribution and trends of marine litter washed ashore and / or deposited on coastlines of the OSPAR Area. The total litter abundance, based on median values (hereafter refered to as medians[1]), reflects the magnitude of the pollution in adjacent waters and coastal areas. Composition shows how common the different litter types (e.g. string and cords, cotton bud sticks, caps and lids, cigarette filters) or litter material categories (e.g. plastic, wood) are. Composition is assessed using medians, and if appropriate percentages, of individual litter types or litter categories. The distribution highlights regional specificities that can relate to regional differences in sources, activities, human habits and transport mechanisms (through ocean current, tides, wind, buoyancy of items, etc.). Trends in the abundance of total litter, individual litter types or litter categories (e.g. plastics, single-use plastics, maritime related items) reflect changes in the level of pollution.

The report also provides information on the coverage of both the OSPAR Regional Action Plan on Marine Litter (ML RAP) 2014 - 2020 and European Directive 2019/904, also known as the Single-use plastics Directive (SUP), by assessing percentages of litter directly targeted, or not, by these two measures.

It also assesses the adequacy of the OSPAR beach litter survey list by evaluating percentages of litter which are identified by the list, non-identified, and those which are non-identifiable because they are too fragmented.

The present assessment relies on survey sites distributed in the five OSPAR Regions, as presented in **Figure a**. Only sites with a sufficient number of surveys and / or long enough time series are included (**Table a**). For the beach litter status assessment from 2018 to 2020, 1 137 surveys collected on 114 survey sites are considered. For the trends assessment from 2015 to 2020, 1 693 surveys collected on 83 sites are considered. These data represent the most extensive set of fit-for-purpose beach litter monitoring data in the North-East Atlantic.

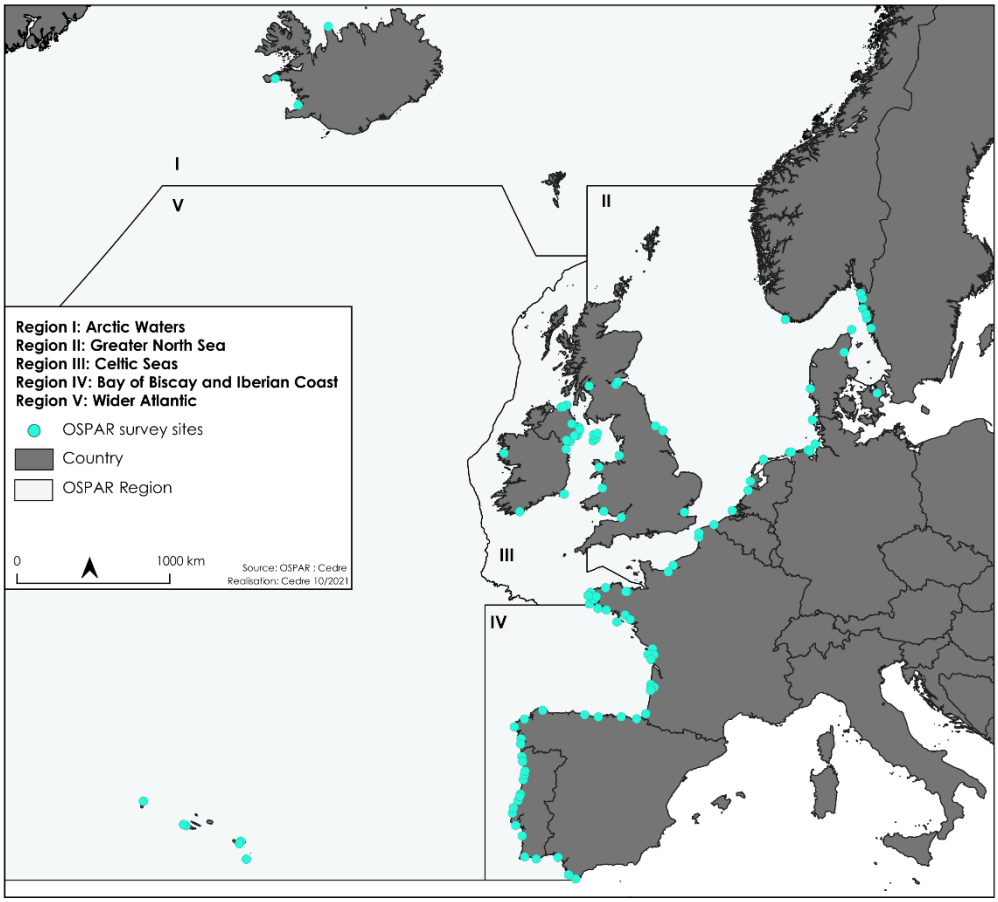

Figure a: Locations of the 114 OSPAR survey sites considered in the assessment

Table a: OSPAR beach litter survey sites considered in the assessment and associated data availability. Purple cells indicate years and surveys which are not used in the assessment and / or highlight when a survey site is not included in status or trend analyses.

Survey site reference number	OSPAR Region	Country	Survey site name	Number of surveys available						Total number of surveys considered	Inclusion in status assessment (Yes/No)	Inclusion in trends assessment (Yes/No)
				2015	2016	2017	2018	2019	2020			
DE001	Greater North Sea	Germany	Sylt (island)	4	3	4	4	4	4	23	Yes	Yes
DE002	Greater North Sea	Germany	Scharhörn (island)	3	3	3	3	3	2	17	Yes	Yes
DE003	Greater North Sea	Germany	Minsener Oog (island)	4	4	4	4	4	4	24	Yes	Yes
DE005	Greater North Sea	Germany	Juist	4	4	4	4	4	4	24	Yes	Yes
DE006	Greater North Sea	Germany	Sylt Hörnum North	0	0	0	4	4	4	12	Yes	No

DE007	Greater North Sea	Germany	Mellum West	0	0	3	4	4	4	12	Yes	No
DE008	Greater North Sea	Germany	Juist Wilhelmshöhe	0	0	3	4	4	4	12	Yes	No
DK001	Greater North Sea	Denmark	MSFD Nymindegab Strand	3	3	3	3	3	3	18	Yes	Yes
DK004	Greater North Sea	Denmark	MSFD Skagen Skagen Strand	3	3	3	3	3	3	18	Yes	Yes
DK006	Greater North Sea	Denmark	MSFD Limfjorden	0	0	0	2	3	3	8	Yes	No
DK007	Greater North Sea	Denmark	Risoe-Roskilde	3	4	4	4	4	4	23	Yes	Yes
ES001	Bay of Biscay and Iberian Coast	Spain	A Lanzada	4	4	4	4	4	3	23	Yes	Yes
ES002	Bay of Biscay and Iberian Coast	Spain	Baldaio	4	4	4	4	4	3	23	Yes	Yes
ES003	Bay of Biscay and Iberian Coast	Spain	Valdevaqueros beach	4	4	4	4	4	3	23	Yes	Yes
ES004	Bay of Biscay and Iberian Coast	Spain	O Rostro	4	4	4	4	4	3	23	Yes	Yes
ES005	Bay of Biscay and Iberian Coast	Spain	La Vega	4	4	4	4	4	3	23	Yes	Yes
ES007	Bay of Biscay and Iberian Coast	Spain	Agiti	4	4	4	4	4	3	23	Yes	Yes
ES008	Bay of Biscay and Iberian Coast	Spain	Menacoz	4	4	4	4	4	3	23	Yes	Yes
ES010	Bay of Biscay and Iberian Coast	Spain	Covas	4	4	4	4	4	3	23	Yes	Yes
ES011	Bay of Biscay and Iberian Coast	Spain	Castilla	4	4	4	3	4	3	22	Yes	Yes
ES012	Bay of Biscay and Iberian Coast	Spain	Castilnovo	4	4	4	3	3	3	21	Yes	Yes
ES013	Bay of Biscay and Iberian Coast	Spain	Oyambre	4	4	4	4	4	3	23	Yes	Yes
ES014	Bay of Biscay and Iberian Coast	Spain	Rodas	4	4	4	4	4	3	23	Yes	Yes
FR004	Greater North Sea	France	Les Basses Falaises	0	0	0	0	4	3	7	Yes	No
FR015	Greater North Sea	France	Le Mont St Frieux	0	2	4	4	4	3	17	Yes	Yes
FR016	Greater North Sea	France	Les Boucaniers	0	3	4	2	4	3	16	Yes	Yes
FR021	Greater North Sea	France	Les Dunes	0	1	4	4	4	3	16	Yes	Yes
FR022	Greater North Sea	France	L'Hôpital	0	0	3	4	4	3	11	Yes	No
FR006	Celtic Seas	France	Kourrijou	4	4	4	4	4	4	24	Yes	Yes
FR007	Celtic Seas	France	Koubou	4	4	4	4	4	4	24	Yes	Yes
FR008	Celtic Seas	France	Kerizella	4	4	4	4	4	4	24	Yes	Yes
FR011	Celtic Seas	France	Larmor	4	4	4	4	4	3	23	Yes	Yes

FR012	Celtic Seas	France	Trielen	4	4	4	4	3	3	22	Yes	Yes
FR019	Celtic Seas	France	La Grandville	0	2	4	4	4	3	17	Yes	Yes
FR020	Celtic Seas	France	La Grève des Courses	0	2	4	4	4	3	17	Yes	Yes
FR027	Celtic Seas	France	Le Cosmeur	0	0	0	0	3	3	6	Yes	No
FR002	Bay of Biscay and Iberian Coast	France	Le Stang	0	0	0	0	4	3	7	Yes	No
FR017	Bay of Biscay and Iberian Coast	France	La Barre	4	4	4	4	4	3	23	Yes	Yes
FR023	Bay of Biscay and Iberian Coast	France	Donnant	0	0	0	3	4	3	10	Yes	No
FR031	Bay of Biscay and Iberian Coast	France	Pen Loc'h	0	0	0	0	3	3	6	Yes	No
FR032	Bay of Biscay and Iberian Coast	France	Boëd	0	0	0	0	3	4	7	Yes	No
FR033	Bay of Biscay and Iberian Coast	France	La Marche aux Bœufs	0	0	0	0	3	3	6	Yes	No
FR035	Bay of Biscay and Iberian Coast	France	Les Selliers	0	0	0	3	4	3	10	Yes	No
FR038	Bay of Biscay and Iberian Coast	France	La Cornerie	0	1	0	3	4	3	10	Yes	No
FR039	Bay of Biscay and Iberian Coast	France	Les Trois Pierres	0	0	0	4	4	3	11	Yes	No
FR040	Bay of Biscay and Iberian Coast	France	La Baie de Gatseau	0	0	0	3	4	3	10	Yes	No
FR042	Bay of Biscay and Iberian Coast	France	Le Grand Crohot Sud	0	0	0	2	4	3	9	Yes	No
FR043	Bay of Biscay and Iberian Coast	France	La Pointe du Teich	0	0	0	2	4	3	9	Yes	No
FR044	Bay of Biscay and Iberian Coast	France	Le Banc d'Arguin	0	0	0	3	4	3	10	Yes	No
FR045	Bay of Biscay and Iberian Coast	France	Le Wharf	0	0	0	3	4	2	9	Yes	No
IR001	Celtic Seas	Ireland	Long Strand	4	4	4	4	4	4	24	Yes	Yes
IR002	Celtic Seas	Ireland	Silver Strand	4	4	4	4	4	4	24	Yes	Yes
IR003	Celtic Seas	Ireland	Carnesore	4	4	4	4	4	4	24	Yes	Yes
IR004	Celtic Seas	Ireland	Clogherhead - South	4	4	4	4	4	4	24	Yes	Yes
IS002	Arctic Waters	Iceland	Budavik	0	2	3	3	3	2	13	Yes	Yes
IS003	Arctic Waters	Iceland	Bakkavik	0	2	4	4	3	3	16	Yes	Yes
IS007	Arctic Waters	Iceland	Vikur	0	0	0	2	3	2	7	Yes	No
NL001	Greater North Sea	Netherlands	Bergen	4	4	4	4	4	4	24	Yes	Yes
NL002	Greater North Sea	Netherlands	Noordwijk	4	4	4	4	4	4	24	Yes	Yes
NL003	Greater North Sea	Netherlands	Veere	4	4	4	4	4	4	24	Yes	Yes
NL004	Greater North Sea	Netherlands	Terschelling	4	4	4	4	3	4	23	Yes	Yes

NO005	Greater North Sea	Norway	Kviljo	2	2	2	2	2	2	12	Yes	Yes
PT001	Bay of Biscay and Iberian Coast	Portugal	Praia da Barra	4	4	4	4	4	3	23	Yes	Yes
PT004	Bay of Biscay and Iberian Coast	Portugal	Ilha de Faro	4	4	4	4	4	3	23	Yes	Yes
PT005	Bay of Biscay and Iberian Coast	Portugal	Batata	4	4	4	4	4	3	23	Yes	Yes
PT007	Bay of Biscay and Iberian Coast	Portugal	Cabedelo	4	4	4	4	4	4	24	Yes	Yes
PT008	Bay of Biscay and Iberian Coast	Portugal	Osso da Baleia	4	4	4	4	4	3	23	Yes	Yes
PT009	Bay of Biscay and Iberian Coast	Portugal	Amoeiras	4	4	4	4	4	3	23	Yes	Yes
PT010	Bay of Biscay and Iberian Coast	Portugal	Fonte da Telha	4	4	4	4	4	3	23	Yes	Yes
PT011	Bay of Biscay and Iberian Coast	Portugal	Monte Velho	4	4	4	4	4	3	23	Yes	Yes
PT012	Bay of Biscay and Iberian Coast	Portugal	Barranha	4	4	4	4	4	3	23	Yes	Yes
PT014	Bay of Biscay and Iberian Coast	Portugal	Paredes de Vitória	0	0	3	4	4	3	11	Yes	No
PT015	Bay of Biscay and Iberian Coast	Portugal	Furadouro Sul	0	0	0	4	4	2	10	Yes	No
PT016	Bay of Biscay and Iberian Coast	Portugal	Aberta-Pedrogão	0	0	0	4	4	3	11	Yes	No
PT017	Bay of Biscay and Iberian Coast	Portugal	Baleal Leste	0	0	1	4	4	3	11	Yes	No
PT019	Bay of Biscay and Iberian Coast	Portugal	São Félix da Marinha	0	0	0	1	4	3	8	Yes	No
PT018	Wider Atlantic	Portugal	Areia - Corvo - Azores	0	4	4	4	4	3	19	Yes	Yes
PT020	Wider Atlantic	Portugal	Almoxarife - Faial - Azores	0	4	4	4	4	2	18	Yes	Yes
PT021	Wider Atlantic	Portugal	Praia do Norte - Faial - Azores	0	4	4	4	4	2	18	Yes	Yes
PT022	Wider Atlantic	Portugal	Praia da Maia - São Miguel - Azores	0	4	4	3	4	2	17	Yes	Yes
PT023	Wider Atlantic	Portugal	Pedreira - São Miguel - Azores	0	4	3	2	2	2	13	Yes	Yes
PT024	Wider Atlantic	Portugal	São Lourenço - Santa Maria - Azores	0	4	4	3	4	3	18	Yes	Yes
SE004	Greater North Sea	Sweden	Haby	3	3	3	3	3	3	18	Yes	Yes
SE005	Greater North Sea	Sweden	Edsvik	2	3	3	3	3	3	17	Yes	Yes
SE006	Greater North Sea	Sweden	Saltö	2	3	3	3	3	3	17	Yes	Yes
SE007	Greater North Sea	Sweden	Grönevik	3	2	3	3	3	3	17	Yes	Yes

SE008	Greater North Sea	Sweden	Edshultshall	3	3	3	3	3	3	18	Yes	Yes
SE009	Greater North Sea	Sweden	Gröderhamn	3	3	3	3	3	3	18	Yes	Yes
UK011	Greater North Sea	United Kingdom	Cramond Beach	4	4	4	4	4	2	22	Yes	Yes
UK043	Greater North Sea	United Kingdom	Jubilee Beach	5	7	4	4	3	2	25	Yes	Yes
UK047	Greater North Sea	United Kingdom	Kinghorn Harbour	3	4	4	4	3	1	19	Yes	Yes
UK048	Greater North Sea	United Kingdom	Formby (Freshfields)	1	3	5	3	3	1	16	Yes	Yes
UK049	Greater North Sea	United Kingdom	Robin Hood's Bay	1	4	4	4	4	1	18	Yes	Yes
UK050	Greater North Sea	United Kingdom	Saltburn	2	4	4	4	3	2	19	Yes	Yes
UK002	Celtic Seas	United Kingdom	Tan-y-Bwlch Beach	4	4	4	4	3	3	22	Yes	Yes
UK020	Celtic Seas	United Kingdom	Sand Bay	4	4	4	6	4	2	24	Yes	Yes
UK021	Celtic Seas	United Kingdom	Langland Bay	3	4	3	4	4	2	20	Yes	Yes
UK025	Celtic Seas	United Kingdom	Ardglass	0	4	4	4	4	3	19	Yes	Yes
UK026	Celtic Seas	United Kingdom	Ballyhornan	0	4	4	4	4	3	19	Yes	Yes
UK028	Celtic Seas	United Kingdom	Ballywalter	0	4	4	4	4	3	19	Yes	Yes
UK031	Celtic Seas	United Kingdom	Hazelbank	0	2	0	0	3	3	6	Yes	No
UK032	Celtic Seas	United Kingdom	Kilkeel North	1	4	4	4	4	3	20	Yes	Yes
UK033	Celtic Seas	United Kingdom	Portavogie	0	4	4	4	4	3	19	Yes	Yes
UK034	Celtic Seas	United Kingdom	Rathlin	0	4	4	4	4	1	17	Yes	Yes
UK035	Celtic Seas	United Kingdom	Rostrevor	0	4	4	4	4	2	18	Yes	Yes
UK036	Celtic Seas	United Kingdom	Runkerry	0	4	4	3	4	2	17	Yes	Yes
UK037	Celtic Seas	United Kingdom	Tyrella	0	4	4	4	4	2	18	Yes	Yes
UK038	Celtic Seas	United Kingdom	White Park Bay	0	4	4	4	4	2	18	Yes	Yes
UK039	Celtic Seas	United Kingdom	Tal-y-Foel	1	3	3	5	2	1	15	Yes	Yes
UK045	Celtic Seas	United Kingdom	Lunderston Bay	1	3	4	3	5	2	18	Yes	Yes
IM001	Celtic Seas	United Kingdom	Castletown	0	0	5	4	4	0	8	Yes	No
IM002	Celtic Seas	United Kingdom	Douglas	0	0	5	4	4	1	9	Yes	No

IM003	Celtic Seas	United Kingdom	Kirk Michael	0	0	4	4	4	0	8	Yes	No
IM004	Celtic Seas	United Kingdom	Ramsey	0	0	4	3	4	1	8	Yes	No

The assessment follows OSPAR's beach litter monitoring and assessment methodology, which is described in OSPAR's Coordinated Environmental Monitoring Programme (CEMP) guidelines on marine monitoring and assessment of beach litter (OSPAR Agreement 2020-02). This methodology advises surveying four times a year fixed 100 m beach sections, on which all beach litter items (> 5 mm) visible on the sand surface, are collected, identified and counted using the OSPAR survey list (**Figure b**). It is important to note that selection of survey sites is not made randomly and results can only be regarded as representative for the group of beaches monitored.

Figure b: Example of litter collected during an OSPAR beach litter survey *(beach "Le Stang", France, Bay of Biscay and Iberian Coast Region, 09/01/2020, photo by Cedre).*

The assessment of beach litter pollution is based on time series of abundance of individual litter types, litter categories and total count of litter items recorded on OSPAR beach litter survey sites. Non-identifiable meso-plastic fragments (5 mm – 2,5 cm) are not included in the assessment because they are monitored with less accuracy, due to their small size and the occurrence of very high numbers on some beaches (Hanke et al., 2019). Only identifiable litter types and macro-litter fragments (> 2,5 cm) are considered in the present assessment.

It is important to appreciate the dynamics of beached litter to understand what assessments of beach litter data can tell us. In between any two beach litter surveys, litter items that have been washed ashore by tides or deposited directly on to the beach can be buried, washed or blown away again by subsequent tides and winds. Also during strong wave action buried litter items can resurface (Tudor and Williams, 2004) and litter can be blown onto a site from adjacent land or streets. Therefore, the number of litter items recorded during one survey generally constitutes a minimum value for litter being deposited at the site. However, on beaches in small bays, enclosed for example by rocky promontories, the dynamics of litter is different. Such sites can trap litter, which is subsequently only redistributed within the bay by waves and wind action. Therefore, the number of litter items recorded during a survey could potentially represent litter accumulation over time.

The composition of litter recorded on beaches also reflects its ability to reach the shore. The litter washed ashore is biased towards litter items that float and those that do not disintegrate, dissolve or decay quickly in the marine environment. The main category of litter found on beaches is plastic (also named artificial polymer material), which often floats and does not disintegrate rapidly in water (OSPAR Intermediate Assessment 2017; Addamo, 2017). The main components of the other common categories all float and/or

decay slowly (wood, bottles, jars, light bulbs, tins and cans). Metal and glass from seaborne sources, are therefore probably under-represented because they are more likely to sink than items made of plastic, rubber and wood. Paper is probably also under-represented because it will generally disintegrate more rapidly in water than other materials. This significantly reduces the likelihood of environmental harm caused by paper litter. On beaches used intensively for recreation, the greater part of beach litter is often composed of items abandoned by beach visitors (e.g. sweet[and] fast-food packaging and cigarette butts) rather than litter washed ashore.

Assessment Method

Confidence assessment

In the present assessment, there is high confidence in both the methodology and data availability except for the Arctic Waters Region where data are limited, especially for trends assessment.

Sites and surveys

The survey sites of the OSPAR Beach Litter Monitoring Programme are located on the North-East Atlantic coasts of Denmark (including beaches in East Greenland and Faeroe islands), France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom (**Figure a**).

In the present assessment, only survey sites with sufficient data availability were included to ensure a robust assessment. In total, 114 out of the 211 survey sites registered in the OSPAR Beach Litter Database are considered. Survey sites were selected according to the decision scheme presented in **Figure c**. For the beach litter status assessment (from 2018 to 2020), only sites with at least three surveys per year over two years are selected (114 sites with 1 137 surveys). For the trends assessment (from 2015 to 2020), only survey sites with at least two surveys per year over five years are included (83 sites with 1 693 surveys). In general at least three surveys per years are needed and available (Schulz et al., 2017), but the use of two surveys per year allows to include more data for the Arctic Waters Region. A detailed list of sites and surveys included in the assessment are presented in **Table a**.

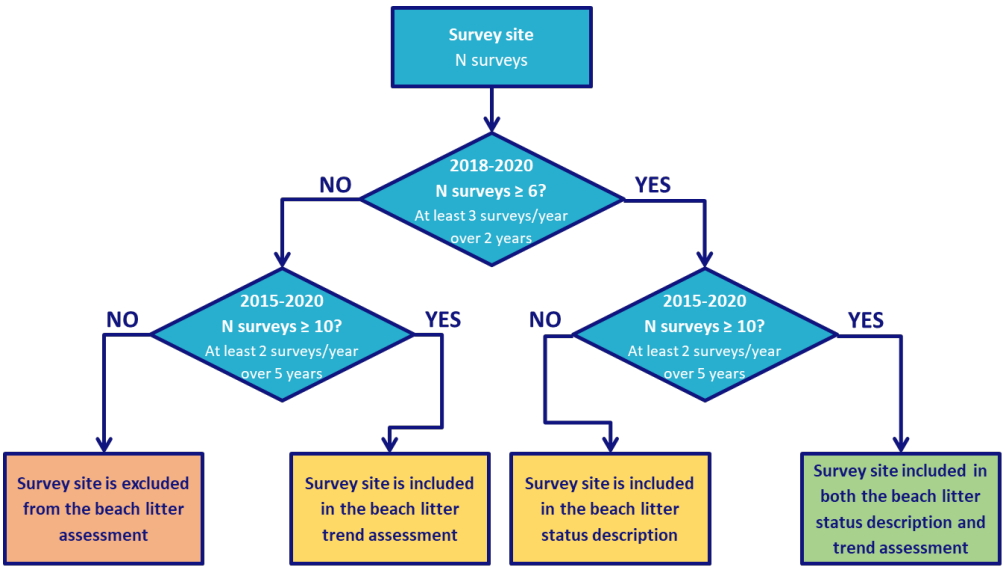

Figure c: Decision scheme for inclusion of survey sites in the beach litter assessment

The surveys are carried out according to OSPAR's Coordinated Environmental Monitoring Programme (CEMP) guidelines for marine monitoring and assessment of beach litter. Collected data are reported in the OSPAR Beach Litter Database.

The beaches, on which the survey sites are situated, mainly comprise sand or gravel and are exposed to the open sea. They are in most cases accessible to surveyors all year round for surveying and litter removal. However some sites, such as in the north of the OSPAR Area (Arctic Waters Region), are not accessible or not possible to survey during the winter survey period. For this assessment, a minimum of two surveys per year has been allowed for Arctic areas but a minimum number of three surveys per year will be used in the future. The beaches have a minimum length of 100 m, are generally free of buildings all year round, and are (in most cases) not subject to litter collection activities (beach cleaning). National coordinators of the surveys have used expert judgement and local knowledge of coastal areas when selecting the survey sites. For example, in some countries local conditions do not allow for selection of beaches mainly comprising sand, and in some locations it is not possible to select beaches of 100 m in length. The start and end points of the survey sites are marked clearly and registered into the OSPAR Beach Litter Database, to ensure that exactly the same site is monitored for all surveys.

Litter sampling and classification

According to the Beach litter CEMP guidelines, at each survey site, all litter items should be recorded four times a year using the OSPAR beach litter monitoring protocol. The survey periods are as follows: winter (between mid-December and mid-January), spring (April), summer (between mid-June and mid-July), and autumn (between mid-September and mid-October). However, due to limitations dictated by weather conditions, availability of manpower etc. not all survey sites included in this analysis have been surveyed as regularly as this for the whole period (see **Table a**). Some survey sites have only recently been added to the monitoring programme and surveys on other sites have been discontinued.

During each survey, the number of individual pieces of litter is recorded and allocated to one of the 112 predefined litter types, identified with a unique OSPAR identification number (ID), which are in the OSPAR beach litter survey list (**Table b**).

Table b: OSPAR beach litter survey list and associated categories attribution. Measures considered are the ML RAP 2014 – 2020 and the EU SUP Directive 2019/904.

OSPAR ID	Litter type	Included in Total	Single-use plastics	Maritime-related	Identifiable ?	Targeted by measures?
ARTIFICIAL POLYMER MATERIAL (PLASTIC)						
5	4/6-pack yokes	x	x		identified	not directly targeted
2	Bags	x	x		identified	directly targeted *RAP action 44* *SUP Directive*
3	Small plastic bags	x	x		identified	not directly targeted

112	Plastic bag ends	x	x		identified	not directly targeted
4	Drinks (bottles, containers and drums)	x	x		identified	directly targeted *SUP Directive*
5	Cleaner (bottles, containers and drums)	x	x		identified	not directly targeted
6	Food containers incl. fast food containers	x	x		identified	not directly targeted
7	Cosmetics (bottles & containers)	x			identified	not directly targeted
8	Engine oil containers and drums < 50 cm	x			identified	not directly targeted
9	Engine oil containers and drums > 50 cm	x			identified	not directly targeted
10	Jerry cans	x			identified	not directly targeted
11	Injection gun containers	x			identified	not directly targeted
12	Other bottles, containers and drums	x			identified	not directly targeted
13	Crates	x			identified	not directly targeted
14	Car parts	x			identified	not directly targeted
15	Caps/lids	x	x		identified	directly targeted *SUP Directive*
16	Cigarette lighters	x			identified	not directly targeted
17	Pens	x			identified	not directly targeted
18	Combs/hair brushes	x			identified	not directly targeted

19	Crisp/sweet packets and lolly sticks	x	x		identified	directly targeted *SUP Directive*
20	Toys & party poppers	x			identified	not directly targeted
21	Cups	x	x		identified	directly targeted *SUP Directive*
22	Cutlery/trays/straws	x	x		identified	directly targeted *SUP Directive*
23	Fertiliser/animal feed bags	x			identified	not directly targeted
24	Mesh vegetable bags	x			identified	not directly targeted
25	Gloves (typical washing up gloves)	x			identified	not directly targeted
113	Gloves (industrial/professional gloves)	x			identified	not directly targeted
26	Crab/lobster pots	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
114	Lobster and fish tags	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
27	Octopus pots	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
28	Oyster nets or mussel bags incl. plastic stoppers	x		x	identified	directly targeted

						RAP action 35 *SUP Directive*
29	Oyster trays	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
30	Plastic sheeting from mussel culture	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
31	Rope (diameter more than 1 cm)	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
32	String and cord (diameter less than 1 cm)	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
115	Nets and pieces of net < 50 cm	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
116	Nets and pieces of net > 50 cm	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
33	Tangled nets/cord/rope and string	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
34	Fish boxes	x		x	identified	not directly targeted
35	Fishing line (angling)	x		x	identified	directly targeted

						RAP action 35 *SUP Directive*
36	Light sticks (tubes with fluid)	x		x	identified	directly targeted *RAP action 35* *SUP Directive*
37	Float/Buoys	x		x	identified	directly targeted *SUP Directive*
38	Buckets	x			identified	not directly targeted
39	Strapping bands	x			identified	not directly targeted
40	Industrial packaging, plastic sheeting	x			identified	not directly targeted
41	Fibre glass	x			identified	not directly targeted
42	Hard hats	x			identified	not directly targeted
43	Shtogun cartridges	x			identified	directly targeted *RAP action 48*
44	Shoes/sandals	x			identified	not directly targeted
45	Foam sponge	x			identified	not directly targeted
117	Plastic/polystyrene pieces 0 - 2,5 cm				excluded	excluded
46	Plastic/polystyrene pieces 2,5 - 50 cm	x			non-identifiable	not directly targeted
47	Plastic/polystyrene pieces > 50 cm	x			non-identifiable	not directly targeted
48	Other plastic/polystyrene items	x			non-identified	not directly targeted

64	Cigarette butts	x	x		identified	directly targeted *RAP action 48* *SUP Directive*
97	Condoms	x			identified	not directly targeted
98	Cotton bud sticks	x	x		identified	directly targeted *RAP action 48* *SUP Directive*
99	Sanitary towels/panty liners/backing strips	x	x		identified	directly targeted *SUP Directive*
100	Tampons and tampon applicators	x	x		identified	directly targeted *SUP Directive*
101	Toilet fresheners	x			identified	not directly targeted
103	Containers/tubes	x			identified	not directly targeted
104	Syringes	x			identified	not directly targeted
121	Bagged dog faeces	x			identified	not directly targeted
RUBBER						
49	Balloons, incl. plastic valves, ribbons, strings etc.	x	x		identified	directly targeted *RAP action 48*
50	Boots	x			identified	not directly targeted
52	Tyres and belts	x			identified	not directly targeted
53	Other rubber pieces	x			non-identified	not directly targeted

CLOTH						
54	Clothing	x			identified	not directly targeted
55	Furnishing	x			identified	not directly targeted
56	Sacking	x			identified	not directly targeted
57	Shoes (leather)	x			identified	not directly targeted
59	Other textiles	x			non-identified	not directly targeted
PAPER / CARDBOARD						
60	Bags	x			identified	not directly targeted
61	Cardboard	x			identified	not directly targeted
118	Cartons e.g. tetrapak (milk)	x			identified	not directly targeted
62	Cartons e.g. tetrapk (other)	x			identified	not directly targeted
63	Cigarette packets	x			identified	not directly targeted
65	Cups	x			identified	not directly targeted
66	Newspapers & magazines	x			identified	not directly targeted
67	Other paper items	x			non-identified	not directly targeted
PROCESSED / WORKED WOOD						
68	Corks	x			identified	not directly targeted
69	Pallets	x			identified	not directly targeted

70	Crates	x			identified	not directly targeted
71	Crab/lobster pots	x			identified	directly targeted *RAP action 35*
119	Fish boxes	x			identified	directly targeted *RAP action 35*
72	Ice lolly sticks/chip forks	x			identified	not directly targeted
73	Paint brushes	x			identified	not directly targeted
74	Other wood < 50 cm	x			non-identified	not directly targeted
75	Other wood > 50 cm	x			non-identified	not directly targeted
METAL						
76	Aerosol/Spray cans	x			identified	not directly targeted
77	Bottle caps	x			identified	not directly targeted
78	Drink cans	x			identified	not directly targeted
120	Disposable BBQs	x			identified	not directly targeted
79	Electric appliances	x			identified	not directly targeted
80	Fishing weights	x			identified	directly targeted *RAP action 35*
81	Foil wrappers	x			identified	not directly targeted
82	Food cans	x			identified	not directly targeted

83	Industrial scrap	x			identified	not directly targeted
84	Oil drums	x			identified	not directly targeted
86	Paint tins	x			identified	not directly targeted
87	Lobster /crab pots and tops	x			identified	directly targeted *RAP action 35*
88	Wire, wire mesh, barbed wire	x			identified	not directly targeted
89	Other metal pieces < 50 cm	x			non-identified	not directly targeted
90	Other metal pieces > 50 cm	x			non-identified	not directly targeted
GLASS AND CERAMICS						
91	Bottles	x			identified	not directly targeted
92	Light bulbs/tubes	x			identified	not directly targeted
93	Other glass items	x			non-identified	not directly targeted
94	Construction materials e.g. tiles	x			identified	not directly targeted
95	Octopus pots	x			identified	directly targeted *RAP action 35*
96	Other ceramic/pottery items	x			non-identified	not directly targeted
UNDEFINED						
102	Other sanitary items	x			non-identified	not directly targeted

105	Other medical items (swabs, bandaging etc.)	x			non-identified	not directly targeted

Table c: List of statistical indicators calculated at each geographical scale and corresponding calculation methods

Beach litter indicator	Survey site scale	Higher scales (OSPAR Area and Regions)
Abundance	Median of survey site data for the three-year period from 2018 to 2020	Median of survey sites medians
Percentage	100 × median of the category considered divided by the sum of medians of the different categories	
Trend	Theil-Sen slope of survey site data for the six-year period from 2015 to 2020 p-value of Theil-Sen slope	Median of survey sites slopes p-value of aggregated survey sites
Top 10/15	Ranking of medians of individual litter types and presentation of the 10/15 highest ranking types	

The survey list allows for the registration of identifiable items, unknown items and litter fragments in different size categories. Litter items which do not fit into a definite litter type category, are registered under the litter types "other" for the given material or use category (e.g. litter type "other plastic/polystyrene items", OSPAR ID 48). Multilingual photo guides are available to assist surveyors with the identification and categorisation of litter items. All litter items are normally removed from the beach during the survey.

Paraffin and other chemicals, which - although included in the OSPAR Beach Litter Database - are recorded using a different method than for litter items, are not analysed here.

Assessment method

The assessment method used in the present report is described in the Beach litter CEMP guidelines and is briefly described below. Non-identifiable meso-plastic fragments (5 mm – 2,5 cm) and waxes/other pollutants are excluded from the analysis.

For the present assessment, each litter type is classified:

-according to its material composition as defined in MSFD recommendations (MSFD Technical Group on Marine Litter – TG-ML., 2013): Artificial polymer material (also known as plastic), Rubber, Cloth / Textile, Paper / cardboard, Processed / worked wood, Metal, Glass / ceramics and Undefined;

-as either Single-use plastics (SUP), Maritime-related plastic items (SEA) or other items. The attribution to the SUP category relies on the attribution defined in MSFD recommendations (MSFD TG-ML Online Photo Catalogue of the Joint List of Litter Categories). The SEA category is based on the FISH category defined in MSFD recommendations (Hanke et al., 2019), except that non- plastic items are excluded. In addition, the

name “FISH” was replace by SEA as “FISH”appears to be too restrictive knowing the category also includes aquaculture-related items. It must be noted that some slight differences exist between SUP and FISH MSFD categories and the SUP and SEA categories used in the present assessment due to differences between OSPAR and MSFD beach litter survey lists.

-as litter type either directly targeted or not by existing measures, specifically OSPAR ML RAP 2014 – 2020 and EU SUP Directive 2019/904.

-as either identified litter type, non-identified litter type, and non-identifiable plastic fragments. Identified litter types include all items which can be identified and attributed to defined litter types. Non-identified litter types include all items which do not correspond to existing litter types in the OSPAR survey list and are recorded in “other” categories. Non-identifiable plastic fragments correspond to plastic fragments which are too fragmented to be identified.

Categories attribution for each litter type is detailed in **Table b**.

Analyses were performed using the software package litteR (Walvoort et al., 2021) and Excel.

Calculations were performed using median-based robust statistical methods which are appropriate (i) for the skewed beach litter data distributions (Schulz et al., 2017, 2019) and (ii) to support decision-making as they provide a snapshot of the typical situation without influence of extreme events. It must be noted that median values are in general lower than mean (average) values, because the extreme values are excluded from the calculations. In addition, median values of all individual litter types do not directly add up to a Total Count value, and adjusted calculation methods are needed to combine median values (see e.g. the calculation of median-based percentages below).

Status is assessed over a three-year period (from 2018 to 2020) and trends over a six-year period (from 2015 to 2020).

Analyses were done at beach scales and results were aggregated at higher spatial scales (OSPAR Area and Regions) using the blocking method (Van Belle and Hughes, 1984). In the present assessment, it is considered that at least three sites are needed to make calculations at an aggregated scale. If fewer than 3 sites are available, results should be used with care and are considered to be indicative (with lower information). This is for example the case for trend results in the Arctic Waters Region.

At survey site scale, abundances were assessed by calculating the median of survey data for a single site and trends were assessed by calculating slopes and associated p-value using the median-based Theil-Sen method.

At higher scales (OSPAR Area and Regions), abundances were assessed by calculating the median of medians obtained for each survey site and trends were assessed by calculating the medians of slopes obtained for each survey site and the p-value of aggregated survey sites.

All percentages were calculated by dividing the median of a selected litter group by the sum of all litter groups considered (e.g. percentage of Artificial polymer material is obtained by dividing the median of Artificial polymer material by the sum of the medians of all material categories).

Top 10 or Top 15 litter types were assessed based on ranking of medians of individual litter types.

Most widespread litter types were also identified by ranking litter types according to the number of survey site Top 10 they are present in).

Medians and trends were calculated for specific items targeted by OSPAR’s Regional Action Plan on Marine Litter (ML RAP) 2014 – 2020: plastic bags, cigarette filters, cotton buds sticks, hunting cartridges and balloons.

The methods used to calculate abundances, percentages, trends and Top 10 at the survey site and higher scales are summarised in **Table b**.

Results (brief)

The median total count in the OSPAR Area over the period from 2018 to 2020 is 252 items/100 m. Although there is no adopted operational total abundance objective at the OSPAR level, this value is much higher than the European Threshold Value (EU TV) of 20 items/100 m (van Loon et al., 2020). The magnitude of beach litter pollution varies between the five OSPAR Regions from 50 to 360 items/100 m, being minimal in the Wider Atlantic Region and maximal in the Bay of Biscay and Iberian Coast Region.

The analysis of litter composition highlights a predominance of items made of artificial polymer materials, also known as plastics. At the OSPAR Area scale, plastic items represent 94% of the pollution, with a median of 194 items/100 m whereas other materials do not exceed 3 items/100 m. Similar results are observed at the OSPAR Regions scale with plastic representing between 92% (Celtic Seas) and 97% (Arctic Waters) of litter observed.

Single-use plastics (SUP) and maritime-related plastic items (SEA) are of great interest since these use categories are targeted by the EU Directive 2019/904 to reduce the impact of certain plastic products on the environment. The SUP category includes also specific litter items that are directly targeted by OSPAR's Regional Action Plan on Marine Litter (ML RAP) 2014-2020, e.g. plastic bags, cigarette filters, cotton bud sticks, hunting cartridges, and balloons. In the OSPAR Area, the median number of items of SUP and SEA use categories are 45 items/100 m and 36 items/100 m respectively. Overall, these groups represent respectively 26% and 21% of litter observed. The highest percentage of SUP is observed in Bay of Biscay and Iberian Coast (37%) whereas the highest percentage of SEA items is observed in the Greater North Sea (25%). SUP and SEA items are directly targeted by Governments' measures and are expected to decrease in the coming years.

Over the last six years, decreasing trends in total and plastic counts are observed at the OSPAR Area scale and in all Regions, except in Arctic Waters where robust results could not be obtained due to low data availability. However, these decreasing trends appear to be rather small, decreases in total count ranging from 9 to 12 items/year in OSPAR Regions and being of 11 items/year at the OSPAR Area scale. Decreasing trends are also observed for SUP and SEA in Greater North Sea, Celtic Seas, and Bay of Biscay and Iberian Coast Regions, with slopes ranging from -2 to -5 items/100 m per year.

At the OSPAR Area scale, 54% of litter items recorded are directly targeted by measures in EU Directive 2019/904 or the ML RAP indicating a rather good coverage. A good adequacy is observed between the OSPAR survey list and the beach litter composition as only 8% of litter items is non-identified whereas 79% are identified and the remaining 13% being non-identifiable plastic fragments.

Results (extended)

Assessment of abundance between 2018 and 2020

The median total count of the OSPAR Area over a three-year period between 2018 and 2020, is 252 litter items per 100 m of coastline, which is much higher than the Threshold Value of 20 litter items/100 m adopted at European level (van Loon et al., 2020). To reach this Threshold Value, a reduction of the total count would be required in the OSPAR Area.

The median total counts of the different OSPAR Regions over the period from 2018 to 2020 are presented in **Table d** and their spatial distribution is shown in **Figure d**. It appears that pollution levels vary between OSPAR Regions, from 50 litter items/100 m for the OSPAR Region Wider Atlantic to 360 litter items/100 m for the OSPAR Region Bay of Biscay and Iberian Coast. Abundance in the Wider Atlantic is significantly lower than in the four other Regions. Nevertheless, all the median total counts are higher than the European Threshold Value, indicating beach litter is abundant whatever the OSPAR Region.

Figure d: Median total counts in the five OSPAR Regions over the three-year period from 2018 to 2020

At the beach scale, pollution levels range from 10 to 16 272 litter items/100 m (see **Figure e** and table in Appendix 1).

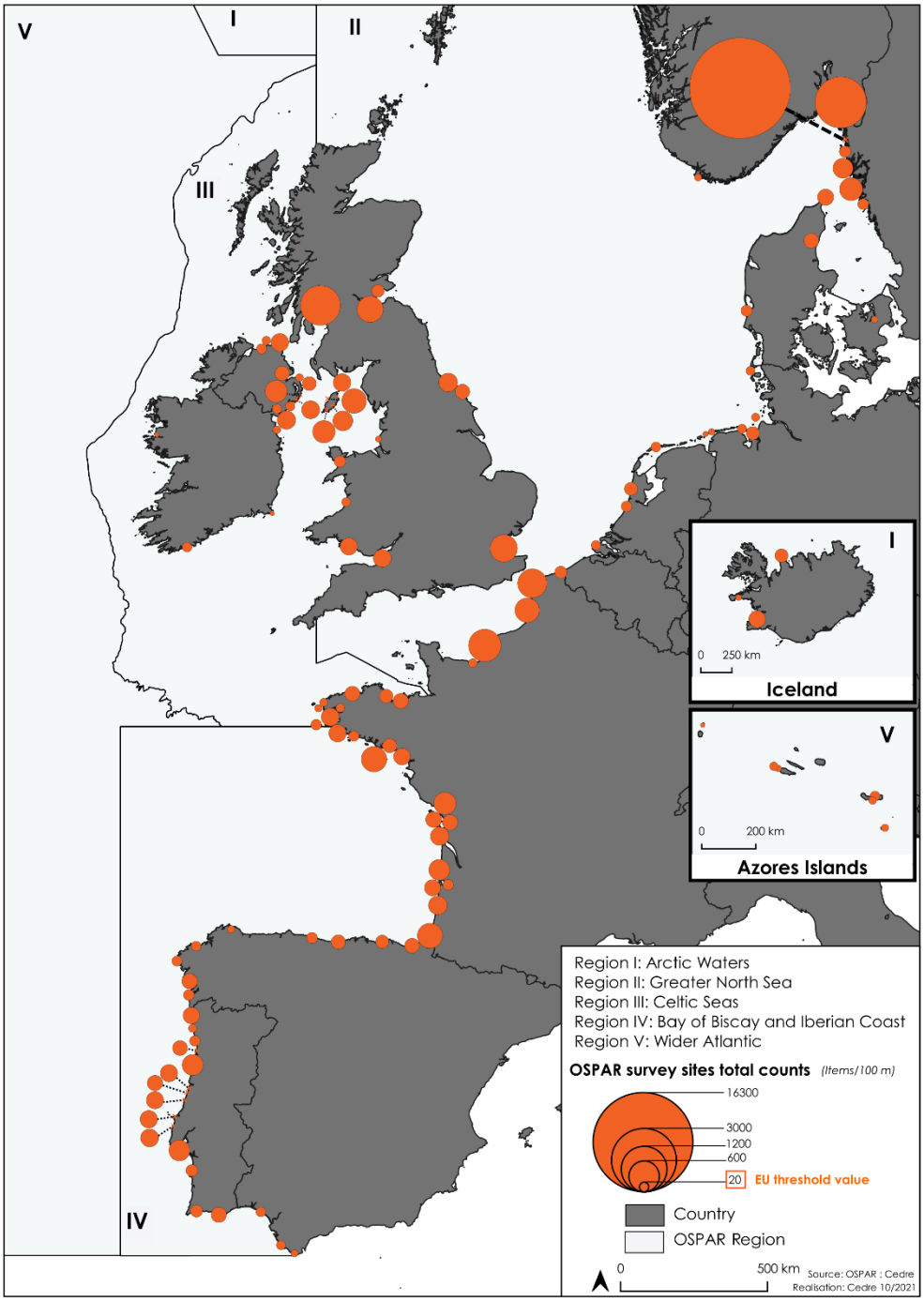

Figure e: Median total counts for the 114 survey sites considered in the status assessment, over the three-year period from 2018 to 2020. The numerical results per survey site are presented in Appendix 1.

It must be noted that several phenomena can influence beach litter abundance. Regular beach clean-up can decrease the pollution level whereas transboundary transport of pollution due to wind and currents can exacerbate it in some areas like the Skagerrak sub-region (e.g. on the Sweden coast). Though these phenomena are known to occur, their extent and effect on beach litter monitoring is currently not well quantified in the OSPAR Area.

Material composition of beach litter between 2018 and 2020

The composition of beach litter pollution in the OSPAR Area and Regions is presented in **Figure f**. A major part comes from artificial polymer material (plastic) category with a median of 194 litter items/100 m

recorded at the OSPAR Area scale. All other material categories have medians equal or inferior to 3 litter items/100 m. Similar results are observed in OSPAR Regions as artificial polymer material remains the most important material, from 35 litter items/100 m for OSPAR Region Wider Atlantic (95% of the beach litter pollution of the Region) to 284 litter items/100 m for OSPAR Region Bay of Biscay and Iberian Coast (95% of the beach litter pollution of the Region). This confirms that artificial polymer materials also known as plastics, represent the most important part of the pollution regardless of the geographical scale, indicating this material must be tackled in priority to substantially reduce beach litter pollution.

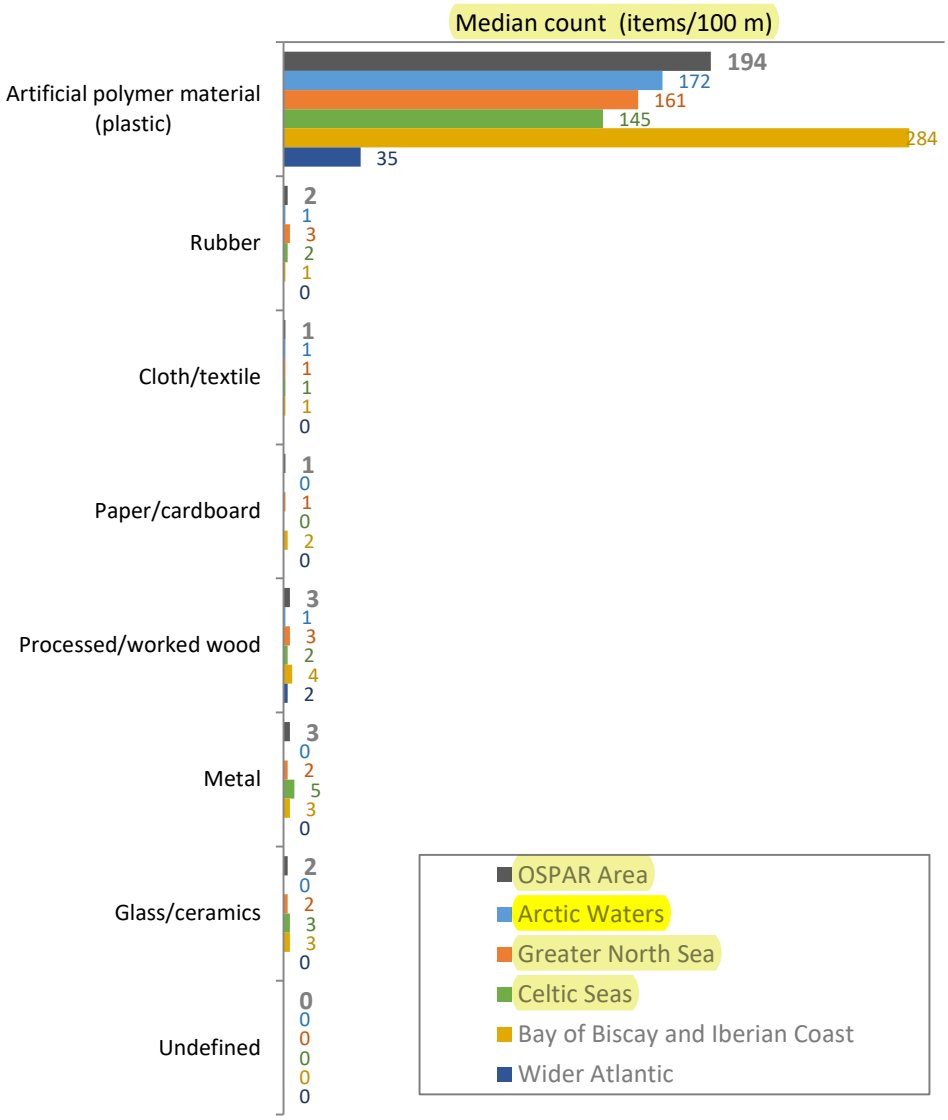

Figure f: Material composition of beach litter in OSPAR Area and Regions from 2018 to 2020

Use categories: single-use plastics and maritime-related plastic items

The use categories "Single-use Plastics" (SUP) and "Maritime-related plastic items" (SEA) are of great interest in the OSPAR Area since they are targeted by measures. In addition, the two groups represent a considerable part of beach litter pollution (47%) (**Figure g**). The details of their median counts are presented for the OSPAR Area and Regions in **Table e**.

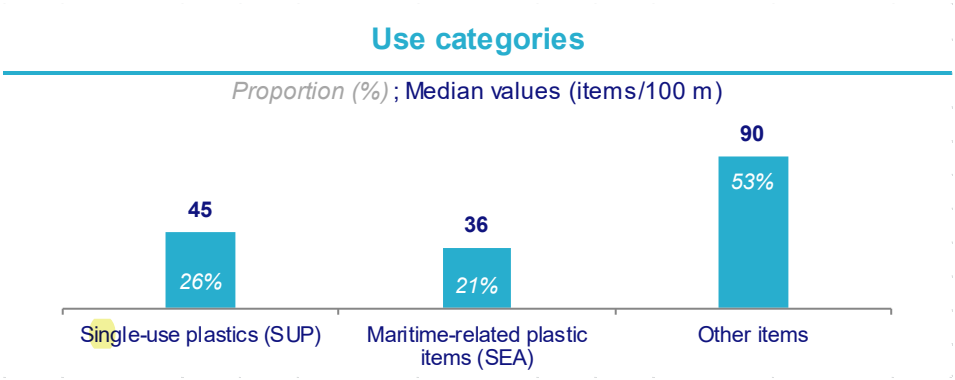

Figure g: Medians and percentages of Single-use plastics and Maritime-related plastic items at the OSPAR Area scale from 2018 to 2020.

At the OSPAR Area scale, SUP show a median total count of 45 items/100 m. When looking at the regional distribution of this use group, the OSPAR Region Bay of Biscay and Iberian Coast appears to be the most affected by the presence of SUP, with a median value of 93 items/100 m, representing 37% of the pollution. The three OSPAR Regions - Arctic Waters, Greater North Sea, and Celtic Seas - present similar median values, with 30 items/100 m (13% of the Region's pollution), 37 items/100 m (24% of the Region's pollution) and 37 items/100 m (23% of the Region's pollution), respectively. Finally, the OSPAR Region Wider Atlantic presents the lowest median values in SUP items with 6 items/100 m (15% of the Region pollution).

The use group "Maritime-related plastic items" (SEA), which includes plastic fishing and aquaculture related litter as well as strings and cords (which can come from different sources but are often mainly related to fishing), has a median value of 36 litter items/100 m in the OSPAR Area. Though the Greater North Sea presents the highest percentage of SEA items (25%), the regional distribution is rather homogeneous between Regions, except for the Wider Atlantic, which has recorded very low quantities of SEA items (1 item/100 m as median value, 3% of the Region's pollution). The four other Regions have medians ranging from 29 litter items/100 m for the OSPAR Region Celtic Seas to 51 litter items/100 m for the OSPAR Region Bay of Biscay and Iberian Coast, and SEA items represent between 12% (Arctic Waters) and 25% (Greater North Sea) of the pollution, indicating that maritime activities are regular sources of litter pollution in the OSPAR Area.

Trends over the six-year period from 2015 to 2020

Several significant decreases in litter abundance are observed over the period from 2015 to 2020 as detailed in **Table d**. Significant decreases in both total counts and plastic items are observed at the OSPAR Area scale and in all Regions except Arctic Waters (not enough data). Decreases in total counts range from 9 to 12 items/100 m per year whereas decreases in plastic counts range from 8 to 11 items/100 m per year, indicating that these decreasing trends remain rather limited.

Table d: Median total and plastic counts (from 2018 to 2020) and associated trends (from 2015 to 2020) in the OSPAR Area and Regions.

Geographical scale	**Median total count** (items/100 m)	**Trend** (slope in items/100 m per year) ↓ significant decrease ↑ significant increase	**Median plastic count** (items/100 m)	**Trend** (slope in items/100 m per year) ↓ significant decrease ↑ significant increase
OSPAR Area	**252**	↓ *-11*	**194**	↓ *-9*

Arctic Waters	**252**	*-6[a]*	**172**	*-16[a]*
Greater North Sea	**205**	↓ *-9*	**161**	↓ *-8*
Celtic Seas	**278**	↓ *-12*	**145**	↓ *-11*
Bay of Biscay and Iberian Coast	**360**	↓ *-11*	**284**	↓ *-11*
Wider Atlantic	**50**	↓ *-11*	**35**	↓ *-11*

[a] trend slopes provided for information (lower confidence due to a limited number of sites and / or surveys)

Table e: Median counts in Single-use plastics (SUP) and Maritime-related plastic items (SEA) (from 2018 to 2020) and associated trends (from 2015 to 2020) in the OSPAR Area and Regions.

Geographical scale	**Median SUP count** (items/100 m)	**Trend** (slope in items/100 m per year) ↓ significant decrease ↑ significant increase	**Median SEA count** (items/100 m)	**Trend** (slope in items/100 m per year) ↓ significant decrease ↑ significant increase
OSPAR Area	**45**	↓ *-4*	**36**	↓ *-2*
Arctic Waters	***30***	*-4[a]*	***30***	*-5[a]*
Greater North Sea	***37***	↓ *-4*	***40***	↓ *-2*
Celtic Seas	***37***	↓ *-5*	***29***	↓ *-2*
Bay of Biscay and Iberian Coast	***93***	↓ *-4*	***51***	↓ *-4*
Wider Atlantic	***6***	*0*	***1***	*0*

[a] trend slopes provided for information (lower confidence due to a limited number of sites and / or surveys)

Table f: Most widespread litter types on the 114 considered sites from 2018 to 2020 (most widespread litter types are ranked according to the number of survey site Top 10 they are present in)

OSPAR ID	**Litter type**	**Most widespread litter type ranking**	**Number of survey sites where the litter type is in the Top 10**	**Percentage of survey sites where the litter type is in the Top 10**
46	Plastic/polystyrene pieces (2,5-50 cm)	1	107	94%
32	String and cord (diameter less than 1 cm)	2	93	82%
15	Caps/lids	3	90	79%

19	Crisp/sweet packets and lolly sticks	4	83	73%
48	Other plastic/polystyrene items	5	56	49%
98	Cotton bud sticks	6	50	44%
31	Rope (diameter more than 1 cm)	7	41	36%
4	Drinks (bottle, containers and drums)	8	38	33%
64	Cigarette butts	9	37	32%
74	Other wood < 50 cm	10	36	32%
115	Nets and pieces of net < 50 cm	11	35	31%
45	Foam sponge	12	34	30%
33	Tangled nets/cord/rope and string	13	27	24%
3	Small plastic bags	14	24	21%
43	Shotgun cartridges	15	21	18%
22	Cutlery/trays/straws	15	21	18%
6	Food containers including fast food containers	15	21	18%
28	Oyster nets or mussel bags including plastic stoppers	18	18	16%
49	Balloons including plastic valves, ribbons, etc.	18	18	16%

Decreasing trends are also observed for SUP and SEA items at the OSPAR Area scale and in three Regions: Greater North Sea, Celtic Seas, and Bay of Biscay and Iberian Coast with reductions ranging from 2 to 5 items/100 m per year (**Table e**). It should be noted that the SUP Directive was implemented after the reporting period considered in the present assessement, so it has not been the reason for the reduction in SUP litter items.

At the beach scale and considering the 83 survey sites selected for the trend assessment, 25 survey sites present significant decreasing trends of total count (30%) and five surveys sites present significant increasing trends (6%) over the last six years (2015-2020). Overall, results indicate that a few sites show increasing trends, only a limited number of survey sites exhibit decreasing trends and no trend can be attributed to the majority of survey sites (see **Figure h**).

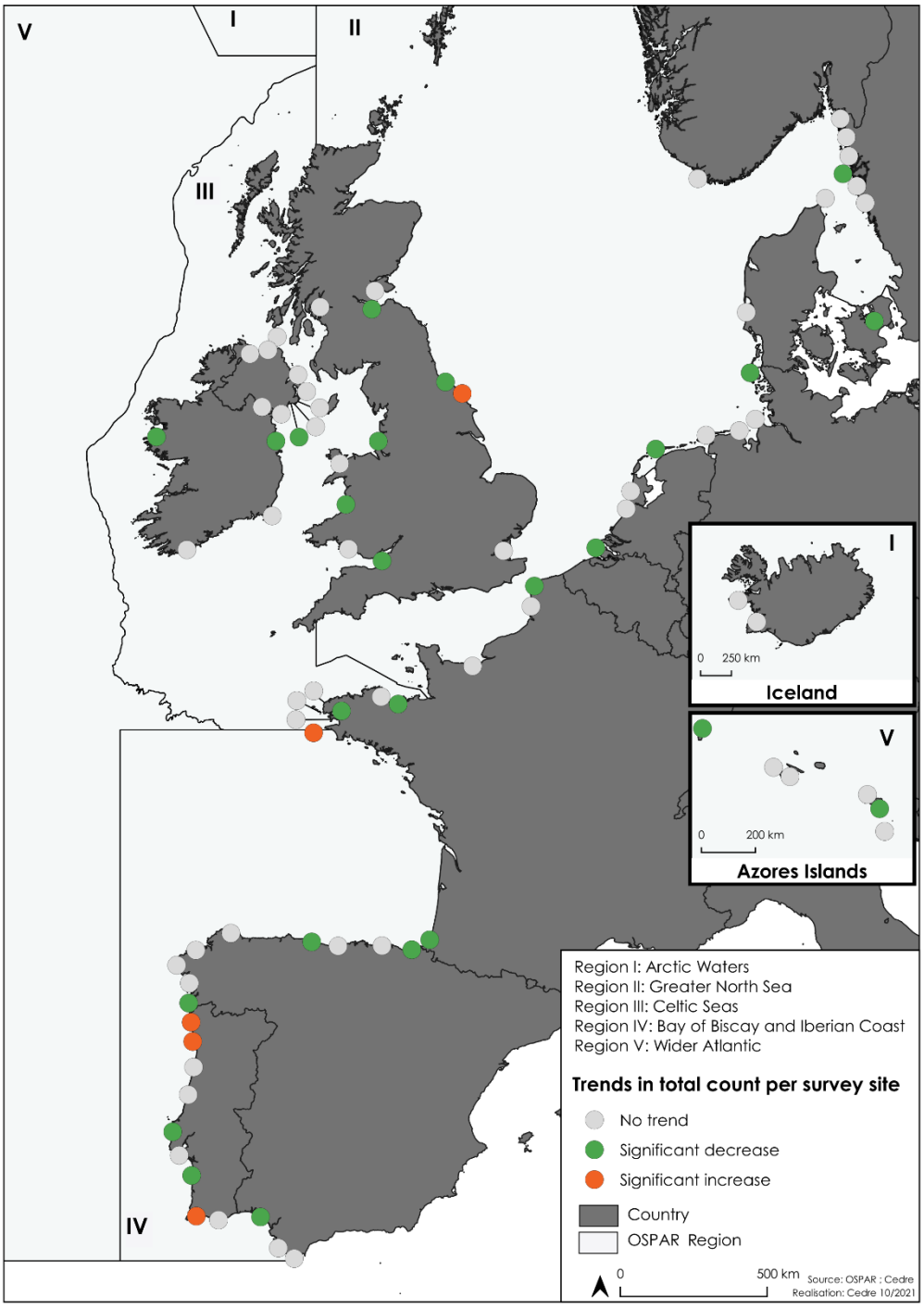

Figure h: Trends in total count for the 83 survey sites considered in the trends assessment, over the six-year period from 2015 to 2020. The numerical trends per survey site are presented in Appendix 1.

Top litter types and most widespread top litter items in the OSPAR Area and Regions

The top 15 litter types in the OSPAR Area are presented in **Figure i**. Among the 15 litter types presented, four litter types belong to the maritime-related plastic items (SEA) category, including "string and cord (diameter less than 1 cm)" litter type, which presents a median value of 17 litter items/100 m (24% of the beach litter pollution) in the OSPAR Area. In addition, six litter types belong to Single-use plastics (SUP) category: "caps and lids" (8 litter items/100 m; 12%), "crisp/sweet packets and lolly sticks" (6 litter items/100 m; 9%), "drinks (bottles, containers and drums)", "cutlery/trays/straws" and "cotton bud sticks" (2 litter items/100 m both; 3%) and "sanitary towels/panty liners/backing strips" (1 litter item/100 m, 1%). All these litter types show

the importance of the use categories “Single-use plastics” and “Maritime-related plastic items”. However, unidentified plastic/polystyrene pieces (2,5 - 50 cm) is still the most abundant litter type with a median value of 21 litter items/100 m (30%) in the OSPAR Area. This confirms the important fragmentation of plastic in the environment, increasing the number of items, making recovery more difficult and raising concern in terms of environmental impact with an increasing risk of ingestion as litter breaks down into smaller parts.

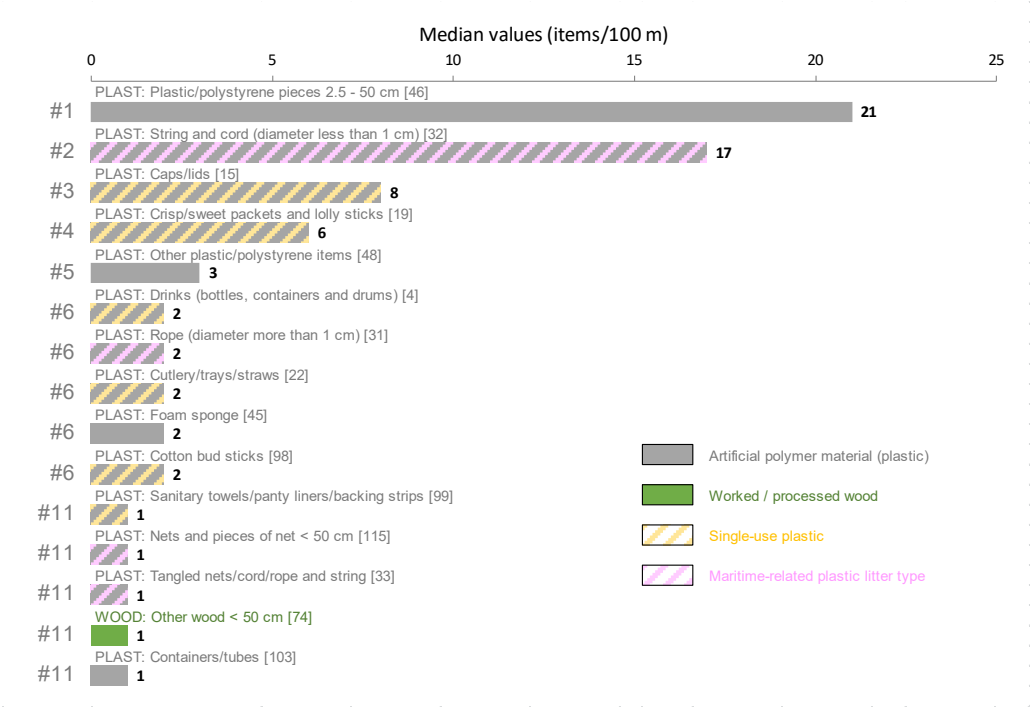

Figure i: Top 15 litter types in OSPAR Area (from 2018 to 2020)

In addition to being the most abundant litter type, “plastic/polystyrene pieces (2,5 – 50 cm)” is also the most widespread top litter type, being recorded in the top 10 of 94% of the survey sites, as indicated by **Table f** showing the top litter types present in more than 15% of the survey sites. Other widespread top litter types are “String and cord (diameter less than 1 cm)” (82% of the survey sites), “Caps/lids” (79% of the survey sites), “Crisp/sweet packets and lolly sticks” (73% of the survey sites), “Other plastic/polystyrene items” (49% of the survey sites) and “Cotton bud sticks (44% of the survey sites).

It is also worth to note the presence of “cigarette butts” in top litter items in 32% of the survey sites though absent from the top litter type rank of the OSPAR Area with a median value of 0 item/100 m (**Table f).** This is explained by an important spatial heterogeneity, “cigarette butts” being mainly observed in the OSPAR Region Bay of Biscay and Iberian Coast (Top 6), where a median value of 6 cigarette butts/100 m is recorded.

Overall, the analysis of top litter types shows there are a limited number of abundant individual litter types and an important number of litter types exhibiting low abundances (medians of 1 or 2 items/100 m), indicating spatial heterogeneity and a large diversity in beach litter composition in the OSPAR Area (**Figure i**).

Case studies on potential sources of beach litter pollution in Germany and Spain

The identification of beach litter sources is of great importance in the development of measures and the subsequent assessment of their efficiency. Though there is no method adopted yet at the OSPAR level to assess beach litter sources, Contracting Parties were asked to test the Matrix Scoring Technique (Tudor and Williams, 2004) and several, such as Germany and Spain, launched studies.

Germany case study

In Germany, the Matrix Scoring Technique was applied to the OSPAR beach litter data from the Country-sub-region Germany – Greater North Sea in the time period from 2011 to 2017 (Schäfer, Scheele and Papenjohann, 2019) following the recommendation of Veiga et al., (2016). In the Matrix Scoring Technique litter types are attributed to potential sources. The German application used ten source categories (Appendix 2). The method uses likelihood categories in combination with a scoring system, which allows qualitative statements to be made, such as "it is very likely that…" or "it is unlikely that…" but also quantitative assessments of relative quantities of litter and their attribution to various sources.

The assessment included a detailed examination of identifiable litter items from the OSPAR Country-sub-region Germany – Greater North Sea, which could be attributed to OSPAR litter types, the consideration of the prevailing regional hydrological and wind conditions, drift, and the opinions of regional stakeholders and experts. The examination of litter items included 1 712 photographs of a total of 1 120 litter items collected on the German North Sea coast, leading to a good overview of the variability of litter items in each OSPAR litter category. The following information was recorded for each item:

-Type of packaging e.g. type of drink bottle or of food container

-Product type

-Product brand

-Manufacturer

-Writing on the item or on labels i.e. language, best-before-date, barcode, website

-Size

-Physical condition e.g. broken, damaged, abraded and the occurrence of fouling i.e. growth of animals and plants on the item in order to assess the amount of time the item has been in the marine environment.

A total of 17 074 marine litter items recorded during OSPAR beach litter surveys were included in the matrix scoring analysis; 62% (10 670) of the litter items could be attributed to individual sources. The remaining 38% (6 404) of the litter items could not be allocated because they were either unidentifiable fragments or objects recorded under the OSPAR litter categories "other items" of the various material classes.

These "other items" are a mixture of litter types, which, individually, do not occur frequently on the survey sites. Fragments are the disintegrated remains of diverse plastic objects. Both were excluded from the further analysis, because they could not be allocated to sources.

One of the main conclusions was that marine litter found on the German North Sea coast is chiefly released by local or regional activities. On the basis of drift experiments, Schöneich-Argent and Freund (2020) also concluded that litter emitted locally into the freshwater and marine environment generally stays local. However, there is evidence that some floating litter items from distant sources, e.g. in France or the Netherlands, are transported to the German North Sea with coastal water currents.

Sea-based sources were considered to account for 60% of the litter items recorded and land-based sources for the remaining 40%. Fishing activities were considered to account for about a third of the litter items and tourism and recreational activities for a further fifth. The proportion of litter items considered attributable to each of the ten sources are presented in Appendix 2.

Spain case study

A very similar method was applied in Spain using also the Matrix scoring system with some differences in the sources considered and the scores assigned to each litter item according to regional specific characteristics. The assessment made by Spain using the beach litter results for the period between 2013 and 2018, corresponding to 275 surveys on 12 survey sites located in all cases in the OSPAR Region Bay of Biscay and Iberian Coast, shows that the most frequent sources of litter in those beaches are fishing (19%) and tourism (16%) followed by "other activities on land" (15%) which includes the riverine inputs, aquaculture (10%) and

shipping (10%). Sea-based sources were considered as responsible for 42% of the litter items recorded and land-based sources for the remaining 58%.

The two case studies conducted in Germany and Spain suggest that sea-based sources contribute importantly and fishing, recreational activities and tourism are identified as important contributors of beach litter pollution. Overall, regardless of the precise contributions of specific sources to beach litter pollution, stringent measures to reduce and eliminate litter emissions from all sources will probably be needed to reach OSPAR objectives and the EU beach litter TV in the future.

Measures coverage and OSPAR survey list adequacy

The good adequacy of the OSPAR Regional Action Plan on Marine Litter (ML RAP) 2014-2020and the EU SUP Directive 2019/904 is estimated by assessing the total number of litter items directly targeted by these measures (**Figure j**). At the OSPAR Area scale, 54% of the litter items recorded are directly targeted either by the Directive or the ML RAP and 46% are not directly targeted. This shows that the Directive and the ML RAP measures directly cover a good proportion of beach litter pollution, but there is still room for improvement.

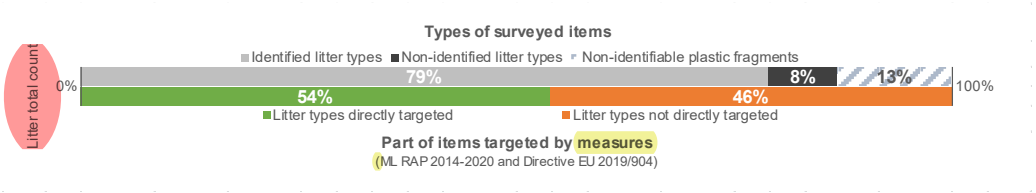

Figure j: Assessment of OSPAR survey list adequacy and measures coverage in the OSPAR Area from 2018 to 2020. Measures considered are the ML RAP 2014 – 2020 and the EU SUP Directive 2019/904.

Looking more closely at these figures, an important part, 13%, of the beach litter pollution appears to be non-identifiable as it includes the fragments of artificial polymer materials recorded in surveys. These litter items could be linked to multiple sources or activities, which prevents the implementation of dedicated measures to combat them. They are, however, most probably also the result of disintegration of e.g. single-use plastics (SUP) and maritime-related plastic items (SEA) which are covered by measures. In addition, 8% of the beach litter pollution is made of non-identified litter items. This value reflects the capacity of the OSPAR litter reference list to cover all the items collected. To improve the coverage of the OSPAR list, the addition of new litter types could be considered, however this would not guarantee a reduction of the proportion of non-identified litter items.

Complementary information

Key results obtained at the OSPAR Area and Regions scales are summarised in Technical Supplements 1-7.

Conclusion (brief)

Beach litter is abundant in the OSPAR Area and Regions. Plastic appears to be predominant in all Regions. Single-use plastics and maritime-related plastic litter are important components of beach litter pollution in the OSPAR Area though some regional specificity in proportions of these two groups of litter types is observed.

At present, an important reduction in abundance is required at the OSPAR level to reach the threshold value of 20 litter items/100 m adopted at the EU level, which is an indicative value of beach litter status in the OSPAR Area.

Significant decreasing trends are observed in all regions (except in Arctic Waters where they could not be assessed robustly), especially for total counts and plastics. However, levels of marine litter remain high.

Overall, the present assessment shows that current measures should be continued and strengthened, and additional measures taken, to obtain a greater reduction of beach litter in the OSPAR Area in order to

substantially reduce beach litter pollution and achieve OSPAR objectives, especially the objective S4.O3 recently adopted in the North-East Atlantic Environment Strategy 2020-2030 of reduction by at least 50% by 2025 and by at least 75% by 2030, of the prevalence of the most commonly found single-use plastic items and of maritime-related plastic items on beaches.

Conclusion (extended)

Beach litter is abundant in the OSPAR Area and in OSPAR Regions. Plastic appears to be predominant in all OSPAR Regions, reaching a median value of 194 litter items/100 m at the OSPAR Area scale and representing 94% of the pollution. The Bay of Biscay and Iberian Coast is the Region presenting the highest level of pollution whereas the Arctic Waters Region has the lowest. Single-use plastic and maritime-related plastic items present median values of 45 items/100 m and 36 items/100 m respectively on the OSPAR coastline (respectively 26% and 21% of the pollution). However, regional specificities are observed in term of litter composition in the different OSPAR Regions, single-use plastics being predominant in the Bay of Biscay and Iberian Coast Region (37% of the pollution) and maritime-related plastic items being predominant in the Greater North Sea Region (25% of the pollution).

At present, an important reduction in total count would be required at the OSPAR level to reach the Threshold Value (TV) of 20 litter items/100 m adopted at the EU level, which is an indicative value of beach litter status in the OSPAR Area. All OSPAR Regions exhibit assessment values above the EU TV.

Significant decreasing trends are observed in litter abundance in the OSPAR Area and in four of the five OSPAR Regions over the last six years. However, reductions appear limited suggesting the 2010-2020 North-East Atlantic Environment Strategy objective requiring a substantial reduction has not been achieved in any OSPAR Region.

Case studies conducted in Germany and Spain suggest that sea-based sources contributes importantly to pollution as respectively, 60% and 42% of litter are identified as originating from these sources on German and Spanish coastlines. Fishing and recreational activities and tourism are identified as important contributors of beach litter pollution.

The classification of the beach litter items by the OSPAR survey list seems adequate since 79% of litter collected are identified by the OSPAR survey list and only 8% are not identified. Results confirm the presence of numerous non-identifiable fragments reaching 13% of litter found on the OSPAR coastline which cannot be used to identify pollution sources.

Existing measures have been well selected as they appear to address 54% of litter found on OSPAR coastline, directly targeted by either OSPAR's Regional Action Plan on Marine Litter (ML RAP) 2014-2020 or the EU SUP Directive 2019/904.

Overall, and in view of observed trends, results suggest actions should be continued and strengthened to speed up the reduction of marine litter in the OSPAR Area.

Knowledge Gaps (brief)

Transboundary pollution is known to occur in the OSPAR Area, however this phenomenon is not well quantified and should be studied.

The composition and origins of the numerous plastic fragments observed should be investigated.

More information should be collected on non-identified items and on certain litter types targeted by OSPAR's Regional Action Plan on Marine Litter (ML RAP) which are not included in the survey list used so far.

More studies should be performed to identify litter sources.

More comprehensive information on environmental conditions and human activities need to be made available for all the survey sites in a useable form.

The effects of weather phenomena should be analysed to assess their influence on beach litter data.

Knowledge Gaps (extended)

The present assessment allows the identification of existing knowledge gaps which hinder a precise assessment of beach litter pollution. These gaps are:

- Nearly 13% of beach litter observed in the OSPAR Area are non-identifiable fragments. These large quantities of fragments appear to be problematic as they could be linked to various sources or activities. This therefore prevents the implementation of dedicated measures. More research is needed to improve the knowledge of the composition and sources of fragments;

- The non-identified litter items represent 8%, of which the litter type "other plastic/polystyrene items" is present in the top litter types with a median value of 3 items/100 m, indicating they do not have a proper category to be classified in and cannot be counted individually. Further investigations should be made to improve knowledge of these items and assess if they require to be targeted by action and as a consequence, if they need to be individually monitored;

- Some litter types are known to be abundant on European coastlines (e.g. foamed polystyrenes). As a consequence, these groups of items are already targeted by measures (OSPAR's Regional Action Plan on Marine Litter). However, in some cases, they are not individually monitored in the OSPAR beach litter surveys. It is recommended to adapt the monitoring litter list to existing measures in order to ensure a better knowledge of their abundance and a proper assessment of the efficiency of measures;

- Sources of beach litter have not been identified in the present study except on the German and Spanish coasts. This type of source characterisation may in the future be improved and applied at a larger scale. Beyond the identification of sources of the different litter types, the development of new methodologies could make it possible to estimate transboundary pollution, i.e. to determine the proportion of litter items that did not originate from the country, region or area where they have been collected. In that sense, the MSFD Technical Group on Marine Litter (TG ML) has planned to develop a suitable model to estimate transboundary pollution in the mid-term future (van Loon et al., 2020). This method could lead to being able to estimate the proportion of litter items of the present study that comes from outside the OSPAR Area or that is transferred between OSPAR Regions.

- The survey sites which supplied the data used in the analysis of beach litter for the OSPAR Regions are situated on beaches, which are very variable in their topography, hydrography, geography, proximity to point source,s and human use, all of which can influence the amount of litter deposited on the beach. Differences in the topography, geography of the beaches and hydrodynamic conditions (tides, waves, currents, etc.) were succinctly considered in aggregation method but need to be considered further in future assessments.

- Weather phenomena can also influence litter deposition. In future, the effects of weather phenomena, such as the North Atlantic Oscillation (NAO), should be analysed to assess their influence on abundance and trends in the beach litter data set.

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Assessment Metadata

Field	Data Type	
Assessment type	List	Indicator Assessment
Summary Results (template Addendum 1)	URL	https://odims.ospar.org/en/submissions/ospar_beach_litter_msfd_2022_06/
SDG Indicator	List	14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
Thematic Activity	List	Human Activities
Relevant OSPAR Documentation	Text	OSPAR Agreement 2020-02 - CEMP Guidelines for marine monitoring and assessment of beach litter
Metadata date	Date	2022-06-30
Linkage	URL	https://cran.r-project.org/web/packages/litteR/index.html
Conditions applying to access and use	URL	https://oap.ospar.org/en/data-policy/
Data Snapshot	URL	https://odims.ospar.org/en/submissions/ospar_bl_indicator_data_snapshot_2022_06/
Data Results	Zip File	https://odims.ospar.org/en/submissions/ospar_bl_indicator_data_results_2022_06/
Data Source	URL	https://beachlitter.ospar.org/

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