STATUS ON BEACH LITTER MONITORING IN DENMARK 2015

Amounts and composition of marine litter on Danish reference beaches

Scientific Report from DCE – Danish Centre for Environment and Energy No. 177 2016

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Data sheet

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Abstract: Amounts and composition of marine litter have been monitored at five Danish reference beaches in 2015. The beaches represent coastlines in both the North Sea/Skagerrak and the Baltic Sea and inner Danish waters. The data showed significant regional differences in amounts of litter with the highest levels present on the Skagerrak reference beach and the lowest levels in the Baltic Sea. A similar trend appears when comparing with data from neighbouring countries. The composition of litter items indicates that fishery, galley waste and operational waste from ships together with sanitary waste and public littering all are important sources to marine litter in Denmark.

Keywords: Marine litter, beach litter, monitoring, Danish beaches

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Preface

This assessment report describes results of the national monitoring programme for marine litter on reference beaches in Denmark, which has been performed by DCE - Danish Centre for Environment and Energy at Aarhus University together with KIMO Denmark. The national monitoring programme using the environmental indicator “beach litter” has in 2015 been initiated by the Danish Nature Agency at the Ministry of Environment and Food, so it can be used for the national implementation of EU’s Marine Strategy Framework Directive (MSFD) in relation to assessments of state, impact and trends of litter in the marine environment.

Summary

This report describes the first results from the national monitoring programme of marine litter, so-called “beach litter”, on selected reference beaches in Denmark. The monitoring programme has been initiated in 2015 by the Danish Nature Agency at the Ministry of Environment and Food. This monitoring activity is aiming to provide data that can be used for assessments of state, impact and trends of marine litter in the marine environment as described in EU Marine Strategy Framework Directive (MSFD).

The national monitoring programme has in 2015 included four reference beaches, where two are located at the Baltic Sea and two are located at the North Sea and Skagerrak, where the practical surveys have been performed by DCE - Danish Centre for Environment and Energy at Aarhus University together with KIMO Denmark. In addition, data for a fifth reference beach located in Roskilde Fjord are included in this report as it has also been monitored by DCE parallel to the other reference beaches in 2015. All surveys have been performed systematically during three seasons (spring, summer and autumn) according to the national guideline developed for beach litter monitoring. The national guideline is based on the international guideline for monitoring of marine litter on beaches in the OSPAR maritime area, but the list of types of litter items to categorise has been expanded with relevant beach litter codes from the recent EU master list for marine litter items.

The monitoring data showed that in 2015 there were huge regional differences in amounts of marine litter washed ashore on the reference beaches. The highest levels with 2146-9137 litter items per 100 m were found on the Skagerrak beach at Skagen followed by 193-413 litter items at the North Sea beach Nymindegab and 31-204 litter items per 100 m on the beaches at the Baltic Sea and Roskilde Fjord. Similar tendency with the highest levels found in the Skagerrak region is also present when comparing the Danish data with monitoring data from the neighbouring countries Germany, Norway and Sweden. The amounts of litter items registered on the Danish beaches in 2015 seem to be a little higher for the North Sea and Baltic Sea beaches when compared to corresponding beaches in the neighbouring countries.

Litter items made of plastic materials were with 48-84% of all registered litter items the dominating type of litter at all the reference beaches in 2015, but also marine litter made of rubber, metal, machined wood, glass / pottery, cloth and paper / cardboard were registered at all beaches.

Remains from fishery and public littering are assessed to be the dominating sources to marine litter followed by sanitary waste, operational waste and galley waste. The majority of registered litter items could not be assigned to specific sources. Comparisons of the monitoring data from reference beaches with reported data from clean-up activities on beaches in Denmark made by volunteers support that the monitored reference beaches reflect marine litter washed ashore from the sea. The clean-up data reflect litter that can be related to public littering from activities on or close to the beaches, and they also generally register fewer types of litter items per survey.

The Danish monitoring data on amounts of beach litter do not yet fulfil the requirements for performing temporal trend assessments according to

OSPAR recommendations, even though KIMO Denmark has for several years monitored beach litter on a few North Sea beaches. A minor statistical analysis on the data reported by KIMO Denmark for the North Sea beach Nymindegab indicates a decline in the numbers of plastic drink containers, glass fragments from bottles and galley waste in the period 2011-2015.

Sammenfatning

Denne rapport beskriver resultaterne af den nationale overvågning af marint affald på referencestrande (på engelsk kaldet ”beach litter”) i Danmark, som Naturstyrelsen ved Miljø- og Fødevareministeriet har igangsat fra 2015. Denne overvågning skal bidrage til at tilvejebring data, som kan bruges til at vurdere status, miljøpåvirkninger og trends af marint affald i havmiljøet, som beskrevet i EU’s havstrategidirektiv (HSD).

Overvågningsprogrammet har i 2015 omfattet fire referencestrande, hvoraf to strande er lokaliseret ved Østersøen, henholdsvis ved Pomlenakke på Østfalster og Kofoeds Enge på det sydlige Amager, og to strande på den jyske vestkyst, henholdsvis ved Nymindegab og Skagen ud til Nordsøen og Skagerrak. Derudover er der i denne rapport også inddraget tilsvarende data fra en referencestrand i Roskilde Fjord, som i 2015 er blevet overvåget af DCE ved Aarhus Universitet parallelt med de andre strande. Alle undersøgelserne er udført systematisk over tre gange i løbet af året i henhold til den tekniske anvisning, som er udarbejdet til brug for dette overvågningsprogram. Denne tekniske anvisning er baseret på den internationale guideline fra OSPAR, men listen over alle kategoriserbare typer af marint affald er udvidet til at også omfatte alle relevante koder fra EU’s ’masterlist’ over marint affald på strande.

Overvågningen viser, at der i 2015 er store regionale forskelle i mængderne af marint affald, der forekommer på strandene. De højeste niveauer af affald blev registeret på Skagerrak-stranden ved Skagen med 2146-9137 stykker affald pr. 100 m, efterfulgt af 191-413 stykker affald ved Nymindegab, og 31-204 stykker affald pr. 100 m ved strandene i Østersøen og Roskilde Fjord. Tilsvarende tendens til regionale forskelle er også til stede, når de danske data sammenlignes med overvågningsdata fra vores nærmeste nabolande, hvor også de største mængder af affald findes på strandene i Skagerrak. Mængderne af affald på de danske strande ved Østersøen og Nordsøen ligger dog generelt over middel sammenlignet med tilsvarende strande i vores nabolande.

Plastik udgjorde gennemgående den dominerende materialetype med 48-84 % af alt affald fundet ved de danske referencestrande i 2015, men der blev på alle strandene også registreret affald bestående af gummi, metal, forarbejdet træ, glas / lertøj, stof og papir / pap.

Fiskeri og affald fra turisme og andre rekreative aktiviteter vurderes at være de dominerende kilder til affald på referencestrandene, efterfulgt af sanitært affald, operationelt affald og kabysaffald fra skibe. Hovedparten af affaldet kunne dog ikke umiddelbart relateres til specifikke kilder. Sammenligning af overvågningsdata fra referencestrandene med rapporterede data fra andre strandrensningsaktiviteter, fx fra Hold Danmark Rent, understøtter, at de overvågede referencestrande, som tiltænkt, i højere grad afspejler marint affald, som skylles op på kysten fra havet. Strandrensningsdata afspejler derimod i højere grad belastning fra turisme og andre rekreative aktiviteter på eller tæt på de pågældende strande samtidig med, at der også generelt registreres færre forskellige typer af affald.

De danske overvågningsdata har endnu ikke en sådan beskaffenhed, at de opfylder betingelserne for at vurdere eventuelle tidslige udviklinger i mængden af affald på strandene i henhold til OSPARs anbefalinger. Dette på trods af at KIMO Danmark nu i en årrække har overvåget affald på enkelte strande på den jyske vestkyst. En mindre statistisk analyse af affald registreret af KIMO Danmark på stranden ved Nymindegab indikerer dog et fald i drikkeflasker af plastik, glasskår fra flasker og køkkenaffald fra skibe i perioden 2011-2015.

1 Introduction

Beach litter, i.e. registration of amounts and composition of marine litter on reference beaches, has from 2015 been included in the national monitoring and management plans in Denmark, which have been developed by the Danish Nature Agency at the Ministry of Environment and Food, so beach litter together with three other marine litter indicators can be used for the national implementation of EU's Marine Strategy Framework Directive (MSFD) (NST 2012a).

The five national marine litter indicators for the period 2015-2017 are:

- Beach litter (new national sampling campaigns established)
- Sea floor litter (sampling coordinated with national BITS and IBTS trawl surveys)
- Plastic particles in fulmars' stomachs (sampling opportunity based)
- Microplastic in sediments (sampling coordinated with national contaminant monitoring)
- Microplastic in fish stomachs (sampling coordinated with national fish stock surveys).

Marine litter has with descriptor 10 in the MSFD (EU 2008) been recognized as an important environmental pressure factor and identified as one of the eleven qualitative descriptors which is needed to describe what the environment should look like to achieve or maintain good environmental status (GES) in the marine environment by 2020 (EU 2010). In descriptor 10, one of the elements in criteria 10.1 on "Characteristics of litter in the marine and coastal environment" concerns the beach litter indicator defined by "Amount, composition, spatial distribution and where possible the source of litter washed ashore and/or deposited on coastlines". The overall target for the MSFD indicators for GES have been defined as "decreasing trends in amounts of litter items". Subsequently, the MSFD implies establishment of monitoring programmes for assessment, enabling the state and impact of the marine waters to be evaluated on a regular basis.

In line with this, the international commissions for protecting the marine environments in the northeast Atlantic (OSPAR) and the Baltic Sea (HELCOM) have as part of their Regional Action Plans (RAPs) also recommended the beach litter indicator as a relevant indicator for assessing state, impact and trends of marine litter in their sea regions (OSPAR 2014; HELCOM 2015). Thereby the beach litter indicator has also become highly relevant for assessments of the environmental conditions in the Danish marine waters.

In Denmark, it has been recognized that today there is only a limited amount of national data and other information available about the regional differences in amounts, composition, impact and sources of marine litter in the Danish parts of the Baltic Sea and the North Sea (NST 2012b), so there is a need for a more systematic monitoring. Regarding the beach litter indictor, some national data exist from the North Sea reference beaches generated by KIMO Denmark within the framework of "Save the North Sea" (Intereg. III project) and other projects in the period 2001-2014, where data have been submitted to the OSPAR beach litter database (www.mcsuk.org/ospar). Aarhus University has also generated some project data from a reference

beach in Roskilde Fjord 2014-2015 which have been submitted to the database "Marine LitterWatch" at the Environmental Agency (EEA) (http://www.eea.europa.eu/themes/coast_sea/marine-litterwatch). In addition, there exist in the EEA database "Marine LitterWatch" also some other beach litter data generated by Danish NGOs like "Hold Danmark Rent" from clean-up activities by volunteers on Danish beaches. However, these beaches can generally not always be characterised as reference beaches for marine litter, because they often represent beaches highly impacted by public littering from activities directly on or nearby the beaches.

This report describes the status of the national monitoring data on beach litter from 2015 that can be used as initial reference levels for amounts and composition of marine litter on reference beaches in Denmark. In addition, the report includes comparisons with other relevant data available for assessment of beach litter in Denmark.

These assessments are:

- 2015-levels for amounts of marine litter on reference beaches in Denmark and with comparisons to neighbouring countries.
- Top ten litter items, material composition, and source characterisation for litter items registered on beaches in Denmark.
- Temporal trend analyses of potential adequate time series for assessment of 2015-levels compared with previous Danish beach litter data registered in the OSPAR database.

Figure 1.1. Sign marking survey area for beach litter monitoring at the Danish North Sea beach Nymindegab. The sign is placed to avoid the interference from clean-up activities performed routinely by the local municipality. Photo: Jakob Strand.

2 Locations and methodology

2.1 Locations of monitored reference beaches

The reference beaches in the national monitoring programme 2015 include four representative beaches, where two are located at the Baltic Sea and two located at the North Sea and Skagerrak.

The beaches located at the west coast of Jutland at “Nymindegab” and “Skagen” are representing the North Sea and Skagerrak, respectively, whereas the two Baltic Sea beaches “Pomlenakke” and “Kofoeds Enge” are located at the east coasts of the islands Falster and Zeeland, respectively. The beach “Kofoeds Enge” is located in Køge Bight relatively close to Copenhagen, whereas “Pomlenakke” is located in a much more rural area. However, all the specific monitored 100 m stretches are chosen, so they represent coastlines that only to a limited extent are impacted by public littering from activities directly on the beaches, because of only few daily visitors. Thereby the litter items registered at the coasts are expected mainly to originate from litter washed ashore from the sea.

In addition, a fifth reference beach “Roskilde Bredning” has been included in this assessment of 2015-levels, because it has also been systematically monitored by Aarhus University parallel with the four other beaches in 2015 and it is regarded to represent a reference beach in the inner Danish waters.

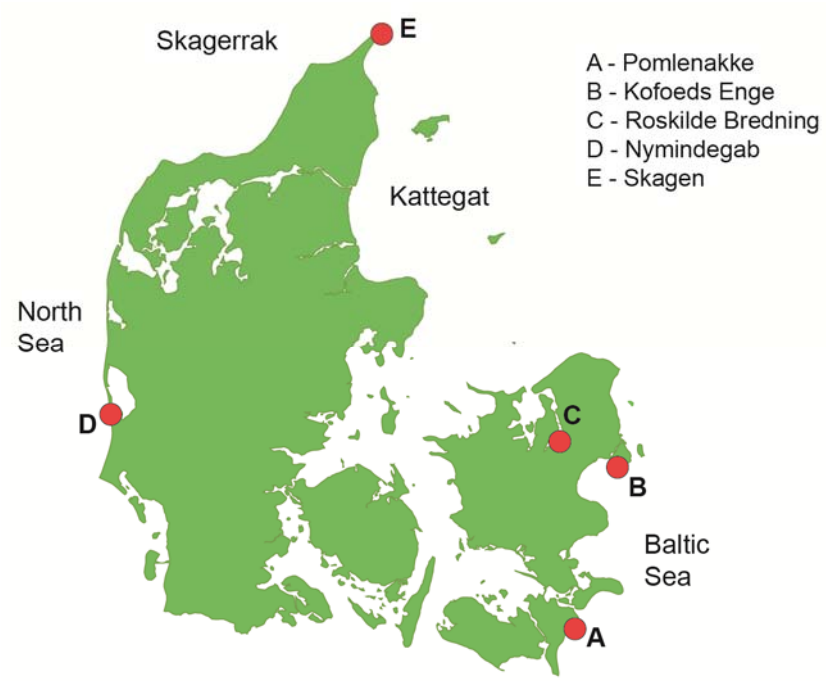


Figure 2.1. Map of locations for the four reference beaches monitored in 2015 as part of the national monitoring program on marine litter in Denmark. In addition, location of a supplementary reference beach in Roskilde Fjord is included because it was also monitored systematically in 2015 by Aarhus University.

The reference beach Nymindegab has been chosen, because it has been monitored by KIMO Denmark since 2011. A reference beach at Skagen has also previously been monitored by KIMO Denmark in 2002-2006, but the monitoring has probably not been performed on the exact same 100 m stretch because the exact location defined by GPS position was unknown.

2.2 Methodology

The methodology for national monitoring in Denmark follows the descriptions in the national guideline for beach litter monitoring in relation to selection of reference beaches, characterisation of litter items and reported data formats (Strand & Metcalfe 2015). The national guideline is mainly based on the outline described in the OSPAR guideline for monitoring marine litter on the beaches in the OSPAR maritime area (OSPAR 2010). However, the list of litter items has been expanded to also include all relevant types of beach litter items identified at the EU master list for marine litter (EU 2013). Both types of database codes for the different litter items at the OSPAR list and the EU master list are assigned to every type of litter items – and thereby data can be reported in data formats required for reporting the data to both the OSPAR beach litter database (www.mcsuk.org/ospar) and the EU database "Marine LitterWatch" at the European Environment Agency (EEA) (http://www.eea.europa.eu/themes/coast_sea/marine-litterwatch).

The surveys have in 2015 been performed at the same 100 m stretches on every beach during the following three periods: April, 15 June - 15 July and 15 September - 15 October.

Danish Centre for Environment and Energy (DCE) at Aarhus University has been responsible for performing the practical surveys at the three Baltic Sea beaches (Pomlenakke, Kofoeds Enge and Roskilde Bredning), whereas KIMO Denmark has been responsible for the surveys at the two North Sea and Skagerrak beaches (Nymindegab and Skagen).

Prior to the initiation of the national monitoring activities in 2015, Aarhus University and KIMO Denmark organized a practical workshop on the methodologies for sampling and registration of beach litter items as part of the quality assurance with the aim of securing harmonisation of the data provided by the two institutions. This workshop also included an intercalibration exercise on registration of 100 representative marine litter items according to the EU master list, which found a general consensus on how to characterise litter items.

3 2015-levels for beach litter

3.1 2015-levels on five Danish reference beaches

Marine litter items were found to be present at all the monitored reference beaches and during all three seasons with field surveys in 2015. The reported data indicated a clear regional difference in amounts of litter items on the reference beaches with the lowest numbers on the three beaches in the Baltic Sea and the inner Danish waters, followed by the North Sea beach Nymindegab, and with the highest numbers on the Skagerrak beach at Skagen. The numbers of litter items found on the Skagerrak beach at Skagen were more than 10 times higher than found on the beaches in the Baltic Sea, both in relation to total plastic items (*figure 3.1*) and total litter items (*figure 3.2*). The lowest number of plastic items was found on Pomlenakke situated at the east coast of the island Falster in the western Baltic Sea, although the level was still somewhat comparable with the levels found on the two other Baltic Sea beaches at Kofoeds Enge and Roskilde Bredning, which are situated closer to urban areas.

However, the amounts of marine litter washed ashore on the monitored reference beaches are regarded to be highly influenced by local hydrographic conditions. Thereby it is from a limited number of beaches difficult to make spatial assessments based on the exact amounts of registered litter items, and thereby also for setting regional reference levels for e.g. the Danish part of the North Sea and the Baltic Sea. At the moment, the monitoring data from 2015 can be used for deriving initial reference levels based on median-values (and range) for the different litter categories on each monitored beach (*table 3.1*), which can be used for spatial and temporal trend analyses to be performed in the coming years.

The 2015-data showed a general effect of season in the number of litter items registered on the reference beaches. The numbers of litter items recorded during the spring survey in April were generally 2-6 times higher than the later surveys in June / July and September / October, which is probably due to a longer period of time since the last sampling survey in autumn 2014 and more frequent winter storms may have deposited more litter items at the coasts. Nymindegab beach was one exception from this tendency, because the lowest number of recorded litter items was registered in April. This might be a result of severe erosion of the large dunes in the back of the beach at Nymindegab during wintertime 2014 / 2015 which may have buried litter lying on the upper part of the beach.

Figure 3.1. Total number of plastic litter items (median, range) found per survey on the five Danish reference beaches monitored three times (Apr., Jun./Jul. and Sep./Oct.) in 2015.

Notice the logarithmic scale.

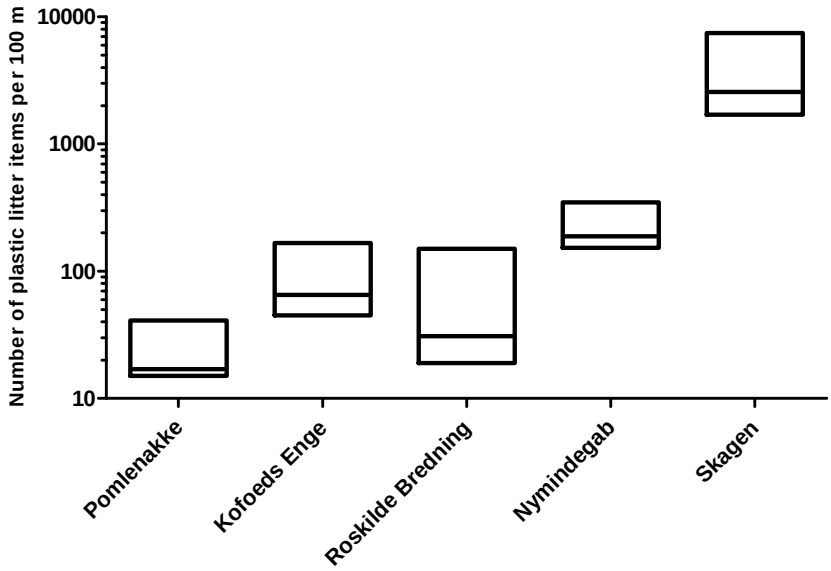


Figure 3.2. Total number of litter items (median, range) found per survey on the five Danish reference beaches monitored three times (Apr., Jun./Jul. and Sep./Oct.) in 2015.

Notice the logarithmic scale.

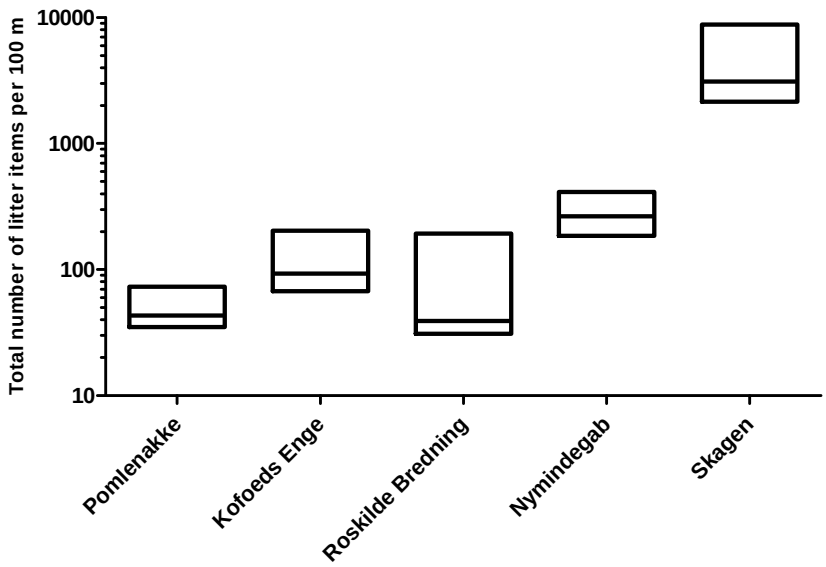


Table 3.1. Reference levels for amounts of litter items per survey (median numbers and range) registered from 100 m stretches on the five reference beaches each monitored three times in 2015.

	Baltic Sea and inner Danish waters			North Sea and Skagerrak	
Marine litter category	**Pomlenakke**	**Kofoeds Enge**	**Roskilde Bredning**	**Nymindegab**	**Skagen**
Plastic and polystyrene	17 (15-41)	65 (45-167)	31 (19-150)	188 (158-347)	2562 (1703-7813)
Rubber	3 (0-4)	2 (1-4)	2 (0-2)	25 (9-28)	68 (68-251)
Cloth	0 (0-5)	2 (0-3)	1 (0-3)	3 (0-6)	5 (0-31)
Glass and pottery	17 (11-21)	3 (0-4)	1 (0-1)	3 (1-6)	50 (28-67)
Sanitary waste	0 (0-1)	1 (1-4)	0 (0-0)	12 (4-12)	371 (245-767)
Medical waste	0 (0-0)	1 (0-1)	0 (0-1)	0 (0-1)	12 (6-28)
Paper and cardboard	1 (0-3)	5 (2-8)	1 (0-8)	3 (3-4)	5 (0-7)
Wood (machined)	2 (1-3)	8 (8-14)	9 (5-16)	16 (6-19)	29 (21-102)
Metal	2 (1-2)	4 (4-5)	1 (0-12)	2 (0-4)	19 (8-45)
Soild pollutants	0 (0-1)	0 (0-0)	0 (0-0)	2 (0-5)	16 (15-43)
Other materials	0 (0-0)	0 (0-2)	0 (0-0)	0 (0-2)	0 (0-0)
Total item numbers	**43 (35-73)**	**93 (67-204)**	**39 (31-193)**	**265 (191-413)**	**3102 (2146-9137)**

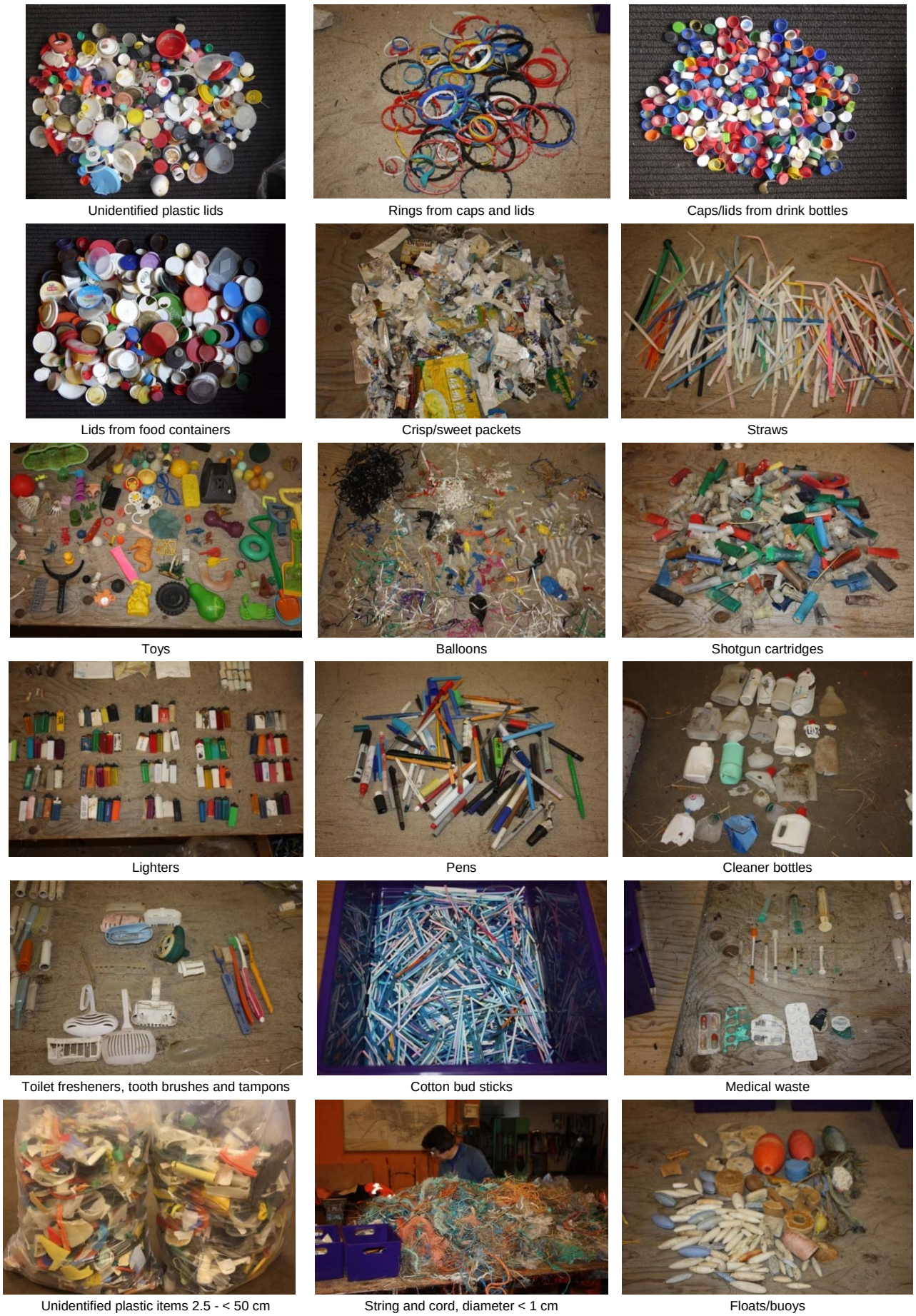


Figure 3.3. Examples of the piles of typical plastic litter items of the 9137 litter items collected during just one survey on the 100 m beach stretch at Skagen beach in Skagerrak from the survey in April 2015.

Similar regional differences with increasing amounts of beach litter from the Baltic Sea, the North Sea and to the Skagerrak are also evident when comparing monitoring data from the neighbouring countries Germany, Norway and Sweden in the period 2011-2015, and also with plastic items as the main contributor to litter (*table 3.2*). The Norwegian and Swedish data also support that the highest amounts can be found on the reference beaches in the Skagerrak region, although high variability can occur between beaches within the same region and within the same station during the assessed period.

Table 3.2. Regional levels for amounts of litter items per survey (median numbers and range) registered from 100 m stretches on reference beaches in neighbouring countries reported to the OSPAR database (OSPAR 2015) or the MARLIN project database for the Swedish Baltic Sea data (Keep Sweden Tidy 2014). N is the number of national surveys (and number of beaches) in the assessed period.

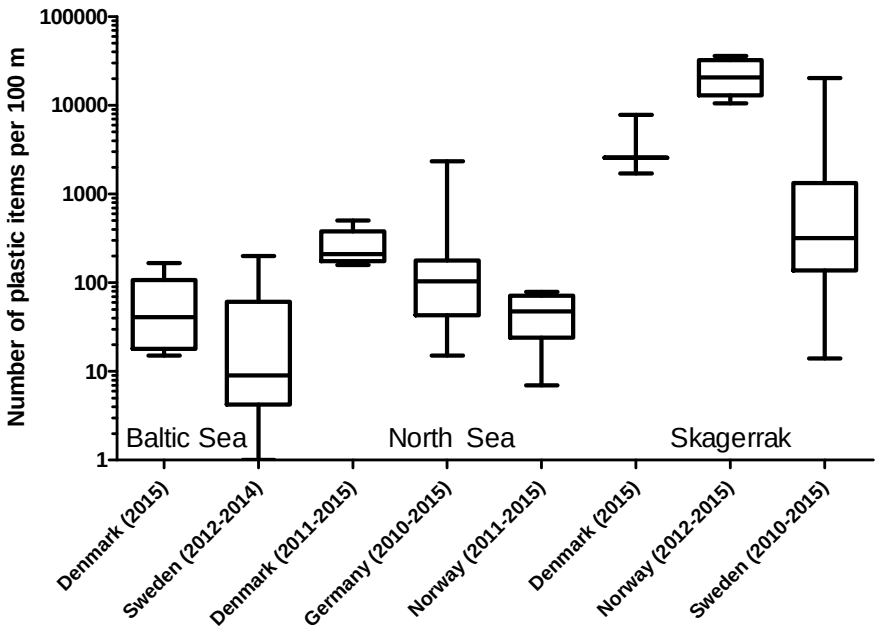
Marine litter category	**Germany, North Sea** *2010-2015, n = 91(4)*	**Sweden, Baltic Sea** *2012-2014, n = 40(6)*	**Sweden, Skagerrak** *2010-2015, n = 97(6)*	**Norway, North Sea** *2011-2015, n = 8(1)*	**Norway, Skagerrak** *2012-2015, n = 4(1)*
Plastic/polystyrene	104 (15 - 2334)	9 (0 - 201)	457 (14 - 20283)	48 (7 - 79)	20711 (10532 - 35914)
Rubber	3 (0 - 41)	0 (0 - 6)	12 (0 - 314)	2 (0 - 32)	511 (315 - 596)
Cloth	0 (0 - 7)	0 (0 - 14)	1 (0 - 27)	0 (0 - 1)	14 (5 - 18)
Glass/pottery	4 (0 - 91)	0 (0 - 6)	1 (0 - 114)	2 (1 - 4)	9 (9 - 14)
Sanitary waste	0 (0 - 10)	0 (0 - 30)	8 (0 - 2782)	1 (0 - 2)	356 (216 - 831)
Medical waste	0 (0 - 4)	(0 - 2)	0 (0 - 67)	0 (0 - 0)	9 (5 - 22)
Paper/cardboard	1 (0 - 26)	0 (0 - 83)	3 (0 - 352)	1.5 (0 - 2)	27 (16 - 31)
Wood (machined)	5 (0 - 48)	2 (0 - 35)	5 (0 - 138)	2 (0 - 15)	56 (33 - 167)
Metal	2 (0 - 428)	2 (0 - 30)	1 (0 - 260)	1 (0 - 4)	17.5 (11 - 21)
Solid pollutants	0 (0 - 103)	0 (0 - 1)	0 (0 - 207)	0 (0 - 1)	37 (24 - 100)
Other materials	0 (0 - 200)	0 (0 - 24)	0 (0 - 4)	0 (0 - 3)	56 (0 - 333)
Total item numbers	**147 (17 - 2554)**	**18 (0 - 350)**	**541 (14 - 23983)**	**64 (25 - 99)**	**21957 (11529 - 37378)**

The amounts of plastic litter registered on the Danish reference beaches in the Baltic Sea and the North Sea seem generally to be somewhat higher compared to the data (median values and percentiles) from the neighbouring countries (*figure 3.4*). For Skagerrak, the highest amount of plastic litter is registered from one Norwegian reference beach “Ytre Hvaler” in the northern part of Skagerrak, although it seems based on the available data in the OSPAR database that this reference beach is only monitored once per year. Continuation of the monitoring activities in the coming years will show, if this regional tendency and the minor differences between neighbouring countries are consistent.

Figure 3.4. Total number of plastic litter items (median, range) found per 100 m survey on reference beaches in Denmark and neighbouring countries divided into beaches from the Baltic Sea, North Sea and Skagerrak.

Data for German, Norwegian and Swedish North Sea and Skagerrak beaches are extracted from the OSPAR database (OSPAR 2015), whereas Swedish data for the Baltic Sea are extracted from the MARLIN Project database (Keep Sweden Tidy 2014).

Notice the logarithmic scale.



The described regional differences support that the significant higher levels on the reference beach Skagen probably are due to the fact that Skagerrak is a depositional area for the North Sea ocean currents coming from e.g. the southern North Sea (Strand et al. 2015). However, having this in mind, it is difficult to assess to what extent local land- or sea-based sources in the Skagerrak-region also can be important contributors to the huge amounts of litter found here. For instance, it cannot be excluded that some important contribution also may derive from e.g. unintended and potential illegal discharge of plastic-containing garbage and waste from ships before entering or after leaving the Baltic Sea or from other sea-based activities in the Skagerrak region. According to Danish legislation based on the international MARPOL convention Annex IV and V, ships in special areas like the North Sea and Baltic Sea are only allowed to discharge comminuted or ground food waste, cargo residues and sanitary sewage in the sea, if the ship is more than 12 nautical miles from nearest land, and if the discharge meets other conditions as well (Ministry of Business and Growth 2014; Ministry for Environment 2008).

4 Top ten items, material composition and source assessments

Marine litter is entering the sea from many sources, because materials can get lost during production, transport, use and disposal of the materials. Lists of top ten items, material composition and some general source characterisation of litter items found on reference beaches can be used for assessment of what type of litter and their sources are the main contributors to beach litter.

4.1 Top ten items on reference beaches

Lists of top ten of the most commonly registered litter items show more specifically, what type of litter items that are the dominant contributors to beach litter. The top ten item lists have been derived by ranking item counts from every survey on each beach in 2015, and then again rank the sum of those rank numbers. Thereby the distribution of litter items for every survey on each beach is equally weighted.

The regional top ten lists registered for the North Sea / Skagerrak compared to the Baltic Sea / the inner Danish waters show that five of the ten types of litter items occur at both lists (*table 4.1*) and both lists have uncategorised pieces of plastic / polystyrene in size of 2.5-50 cm and string and cords with diameter < 1 cm in top of lists. The other three types of litter items occurring at both lists are: crisp / sweet packets incl. lolly sticks, foam sponges and shotgun cartridges.

Table 4.1. Regional lists for top ten items in the North Sea/Skagerrak and the Baltic Sea/inner Danish waters based on 2015-data from the Danish reference (OSPAR codes for litter items in brackets).

North Sea and Skagerrak	Baltic Sea and inner Danish waters
Plastic/polystyrene 2.5-50 cm (46)	Plastic/polystyrene 2.5-50 cm (46)
String and cord (< 1cm) (32)	String and cord (< 1cm) (32)
Cotton bud sticks (98)	Other processed wood < 50 cm (74)
Plastic caps/lids (15)	Crisp/sweet packets, lolly sticks (19)
Balloons (49)	Foam sponges (45)
Crisp/sweet packets, lolly sticks (19)	Shotgun cartridges (43)
Rope (> 1 cm) (31)	Small plastic bags (3)
Foam sponges (45)	Plastic cups (21)
Shotgun cartridges (43)	Metal drink cans (78)
Plastic food containers (6)	Other paper items (67)

Looking closer at the top ten of the most common litter items registered using OSPAR codes on each of the five Danish reference beaches in 2015, they also show some variations between the beaches within the same region (*table 4.2* and *4.3*).

On the two reference beaches in the North Sea and Skagerrak, i.e. Nymindegab and Skagen, six of the top ten items were found on both beaches (*table 4.2*). These were plastic / polystyrene 2.5-50 cm, string and cord (< 1 cm), plastic caps / lids, cotton bud sticks, balloons and crisp / sweet packets, lolly sticks. A significant number of shotgun cartridges, plastic food containers, foam sponges and cutlery / trays / straws were found on the northern beach at Skagen. More industrial plastic packaging, rope, plastic beverage containers

and tangled string / cord / nets were found on the North Sea beach Nymindegab.

Table 4.2. Top ten items on the two monitored reference beaches in the North Sea and Skagerrak (OSPAR codes for litter items in brackets).

Skagen	Nymindegab
Plastic/polystyrene 2.5-50 cm (46)	String and cord (< 1 cm) (32)
Plastic caps/lids (15)	Plastic/polystyrene 2.5-50 cm (46)
String and cord (< 1cm) (32)	Balloons (49)
Cotton bud sticks (98)	Cotton bud sticks (98)
Shotgun cartridges (43)	Plastic caps/lids (15)
Crisp/sweet packets, lolly sticks (19)	Industrial plastic packaging (40)
Plastic food containers (6)	Crisp/sweet packets, lolly sticks (19)
Foam sponges (45)	Rope (> 1 cm) (31)
Balloons (49)	Plastic drink containers (4)
Cutlery/trays/straws (22)	Tangled strings/cords/nets (33)

On the two reference beaches at the Baltic Sea, also six items were observed as top ten items on both beaches (*table 4.3*). These were plastic / polystyrene 2.5-50 cm, string and cord, foam sponges, other processed wood < 50 cm, crisp / sweet packets, lolly sticks and other paper items. Four of these items also appeared in the surveys conducted at Roskilde Bredning. All the items found here with the exception of rope (> 1 cm) were also found as top ten items on the two other Baltic reference beaches. The common items in the Baltic area included items of paper, metal and processed wood as well as plastics. This differed from the two beaches at the North Sea and Skagerrak, where the items collected were predominantly plastic materials and balloons made of rubber.

Table 4.3. Top ten items on monitored reference beaches in the Baltic Sea and Roskilde Fjord 2015 (OSPAR codes for litter items in brackets).

Pomlenakke	Kofoeds Enge	Roskilde Bredning
Construction materials, pottery (94)	Plastic/polystyrene 2.5-50 cm (46)	Plastic/polystyrene 2.5-50 cm (46)
Plastic/polystyrene 2.5-50 cm (46)	Foam sponges (45)	Shotgun cartridges (43)
String and cord (< 1 cm) (32)	Other processed wood < 50 cm (74)	Other processed wood < 50 cm (74)
Other items of glass/pottery (96)	String and cord (< 1 cm) (32)	Crisp/sweet packets, lolly sticks (19)
Foam sponges (45)	Crisp/sweet packets, lolly sticks (19)	String and cord (< 1 cm) (32)
Crisp/sweet packets, lolly sticks (19)	Metal drink cans (78)	Small plastic bags (3)
Small plastic bags (3)	Shotgun cartridges (43)	Plastic cups (21)
Other processed wood < 50 cm (74)	Plastic cups (21)	Other processed wood > 50 cm (75)
Balloons (49)	Plastic caps/lids (15)	Metal drink cans (78)
Other paper items (67)	Other paper items (67)	Rope (> 1 cm) (31)

Pieces of plastic / polystyrene 2.5-50 cm were the top item found on three of the five beaches. It is also recorded as the second highest ranking item on the other two beaches. The plastic pieces were often weathered and broken pieces of larger plastic objects and are therefore “undefined”, although about 25 % (range 2-75 %) were registered as polystyrene according the EU master list codes. Other plastic pieces that cannot be identified and placed in other OSPAR categories were also recorded in this category.

Two items, “string and cord (< 1 cm)” as well as “crisp / sweet packets, lolly sticks” were found as top ten items on all of the Danish beaches. “String and cord (<1 cm)” ranked among the top five items on all beaches. The category “crisp / sweet packets, lolly sticks” was found in the midrange, ranking from number four to number seven.

Other top items found on over half of the beaches (three of five beaches) were “shotgun cartridges”, “balloons” and “plastic caps / lids”. The majority of items found in high numbers on all the reference beaches were made of plastic materials.

4.2 Material composition and source characterization on reference beaches

The marine litter items found on the beaches can be grouped according to both material composition and source characterization (OSPAR 2010).

The material composition is according to OSPAR litter categories grouped into: plastic / polystyrene, rubber, cloth, glass / pottery / ceramics, sanitary waste, medical waste, paper / cardboard, machined wood, metal, pollutants (e.g. wax) and other materials.

The different materials of marine litter can enter the sea from many sources, because materials can get lost during production, transport, use and disposal of the materials. OSPAR has also identified five major sources / activities which generate solid waste which ends up as marine litter on beaches in the OSPAR region:

- Fishing, including aquaculture (litter items with OSPAR codes 10, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 80, 113, 115 and 116).
- Galley waste, i.e. non-operational waste from shipping, fisheries and off-shore activities (litter items with OSPAR codes 5, 13, 25, 62, 76, 82 and 118).
- Shipping, including offshore activities, i.e. operational waste (litter items with OSPAR codes 11, 39, 40, 42, 69, 84 and 92).
- Sanitary and medical waste, i.e. sewage-related waste (litter items with OSPAR codes 97, 98, 99, 100 and 101).
- Public littering, e.g. from tourism and other recreational activities (litter items with OSPAR codes 1, 2, 4, 6, 19, 78, 91).

Plastic was the most common material for litter items on the five Danish reference beaches in 2015 (*figure 4.1*). Plastic accounts generally for 76 % to 84 % of the materials collected in the survey areas with the exception of the Baltic Sea beach Pomlenakke, where plastic only contributes with 48 %. On Pomlenakke, litter items of glass and pottery materials contributed with 32 %, mainly due to findings of pieces of bricks categorised as construction materials on the mixed sandy and stony beach. There was a tendency that plastic contributed a little bit more on the beaches in the North Sea and Skagerrak than in the Baltic Sea and Roskilde Fjord. The five main defined plastic types in Denmark in 2015 were plastic caps and lids (4979 items), rope and cord (< 1 cm) (4865 items), cotton ear buds (2598 items), shotgun shells (1140 items) and crisp / sweet packets, lolly sticks (894 items).

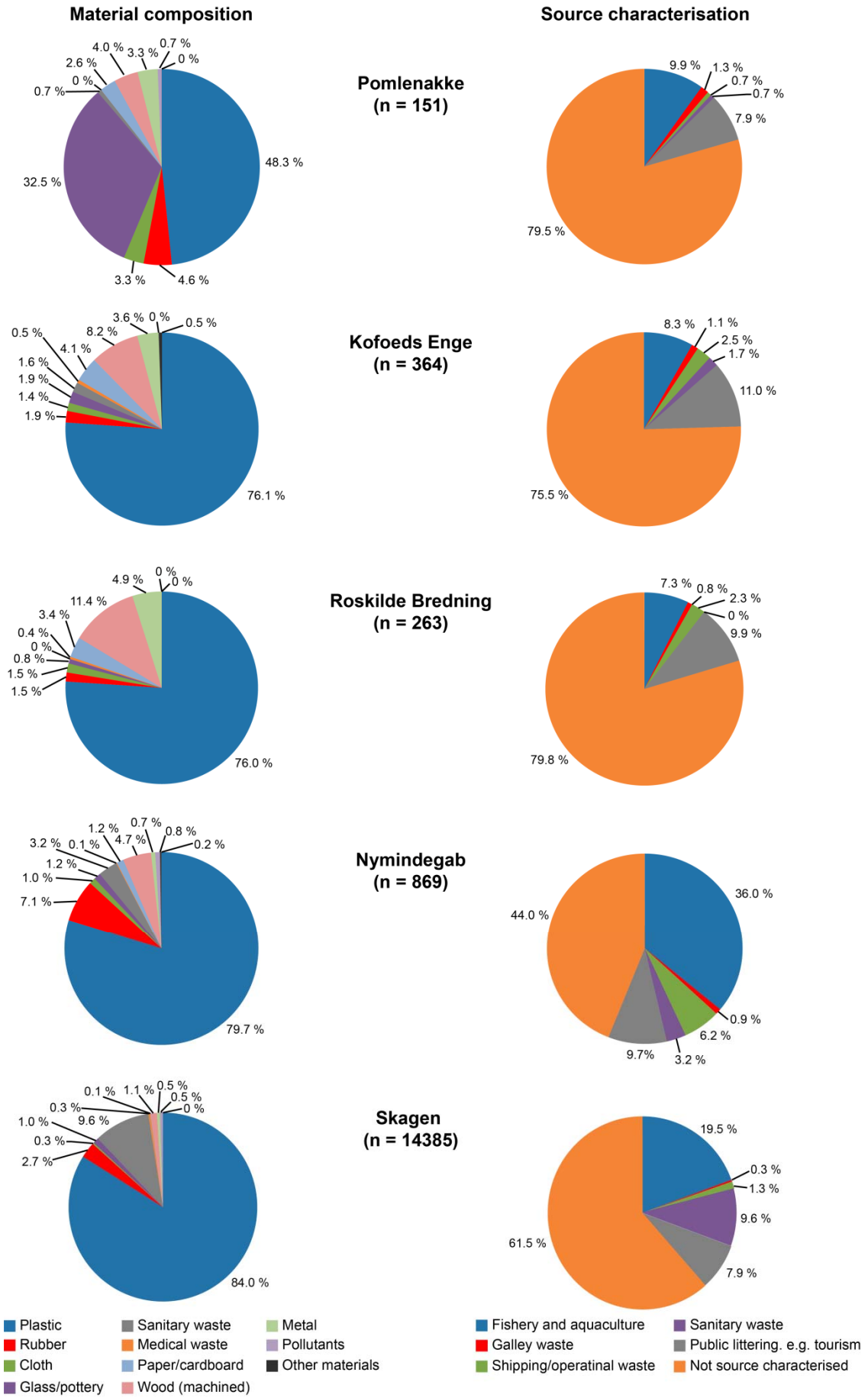


Figure 4.1. Material composition and source characterisation of litter registered on five Danish reference beaches in 2015.

Regarding other material groups, rubber and sanitary waste items were found more frequent at the western coast of Denmark. 10 % of the items found at Skagen were categorised as sanitary items (mainly cotton buds) and 7 % of the items at Nymindegab were rubber (mainly balloons). 3 % of the items in Skagen were also rubber balloons. Higher numbers of glass/pottery, machined wood, metal, cloth and paper items were found on the eastern coast. 8 % of items found on Kofods Enge and 11 % at Roskilde Bredning were machined-wooden items < 50 cm. A higher contribution of metal items (3-5 %), mainly from beverage cans and lids, were found on the eastern beaches than on the western beaches, where metals only contributed with about 1 % of the litter items.

The beaches on the west coast of Denmark, especially Skagen, received more marine litter in 2015 than the east coast. 14385 items were registered at Skagen from the three seasonal 100 m surveys in 2015 compared to 869 at Nymindegab and 364, 263, and 151 items in total per beach on the three reference beaches at the Baltic Sea and Roskilde Fjord.

It is difficult to point towards well-defined sources of marine litter using OSPAR's source specific indicators as 44-80 % of the items are not source characterised. Litter collected on the west coast of Denmark had more defined sources. 20-36 % originated from fishery and aquaculture, 3-10 % were sanitary waste and 6-9 % were from public littering. Some litter items can be defined as operational waste (1-6 %) and galley waste. These percentages would probably be higher if it was possible to define the waste that is not possible to categorise according to specific source categories.

The highest percentages of characterised waste on the east coast of Denmark were from public littering (8-11 %) as well as fishery and aquaculture (7-10 %). Minor contributions were from galley waste, operational waste and sanitary waste.

4.3 Beach litter data from volunteer clean-up activities

A top ten list of the most common types of marine litter is also drawn from information collected through other volunteer clean-up activities in Denmark. Several clean-up activities on Danish beaches in the period 2013-2015 have been reported to the EEA using the Marine LitterWatch App. This includes data from communities such as "Hold Danmark Rent"and comprises in total 21 surveys in the Baltic Sea area, 11 surveys in Kattegat/Limfjorden and 3 surveys in the North Sea/Skagerrak area. These clean-up activities mainly report datasets for beaches which are more influenced by public littering, i.e. tourism and recreational activities directly on or nearby the beaches. They can therefore not be regarded as reference beaches.

Lists of top ten items per region, i.e. the Baltic Sea/Belt Sea, the Kattegat/Limfjorden and the North Sea/Skagerrak, have been derived by ranking item counts in each survey, and then again ranking the sum of those rank numbers. *Table 4.4* presents an overview of the top ten items collected from clean-up activities in Denmark. All top ten items are the same for clean-ups in the Baltic Sea/Belt Sea and the Kattegat/Limfjorden. Seven of the items are also found in the top ten for clean-ups in the North Sea/Skagerrak. Only three types of litter items, i.e. cigarette butts, shopping bags and metal bottle caps, were only present on the top ten list from clean-up surveys in both the Baltic Sea/Belt Sea, the Kattegat/Limfjorden and the North Sea/Skagerrak

and not on the top ten lists for any of the five reference beaches – and this supports that the clean-up data are from beaches more affected by public littering than the reference beaches. In addition, there is also indications in the clean-up surveys, that the volunteers report datasets with less differentiation in the identification of litter items than those surveys conducted by more experience field workers familiar with the beach litter monitoring guidelines. Cotton bud sticks can for example be mistakenly identified as lolly sticks by untrained volunteers. This could be a reason why this item is almost missing from the clean-up dataset. The most frequent litter item on the reference beaches plastic / polystyrene 2.5-50 cm seems also not to be fully reported as this type of litter items is not contributing to marine litter to the same extent in the clean-up datasets, and even missing from one of the top ten lists.

Table 4.4. Top ten items based on reported data from other clean-up activities in the Danish part of the Baltic Sea/Belt Sea (n = 21), the Kattegat/Limfjorden (n = 11) and the North Sea/Skagerrak (n = 3) in 2013-2015, which have been reported as part of the registered community in the EEA database Marine LitterWatch (numbers in brackets refer to OSPAR codes).

Clean-ups Baltic Sea and Belt Sea	Clean-ups Kattegat and Limfjorden	Clean-ups North Sea and Skagerrak
Cigarette butts (64)	Cutlery/trays/straws (22)	Plastic caps/lids (15)
Plastic caps/lids (15)	Plastic food containers (6)	Balloons (49)
Plastic/polystyrene 2.5-50 cm (46)	Cigarette butts (64)	String and cord (< 1 cm) (32)
Crisp/sweet packets, lolly sticks (19)	Crisp/sweet packets, lolly sticks (19)	Plastic drink containers (4)
Metal drink cans (78)	Plastic caps/lids (15)	Cutlery/trays/straws (22)
Plastic food containers (6)	Shopping bags (2)	Strapping bands (39)
Shopping bags (2)	Metal drink cans (78)	Shopping bags (2)
Cutlery/trays/straws (22)	Plastic drink containers (4)	Plastic food containers (6)
Plastic drink containers (4)	Plastic/polystyrene 2.5-50 cm (46)	Crisp/sweet packets, lolly sticks (19)
Metal bottle caps (77)	Metal bottle caps (77)	Cigarette butts (64)

Material composition and source characterisation for litter items clean-up datasets are shown graphically in *figure 4.2*. Plastic and paper items are the main materials found in the clean-up activities. Once again plastic materials are the majority of items (80 %) found in the North Sea and Skagerrak area. Plastic items account for 42 % in both the Baltic Sea / Belt Sea and Kattegat and Limfjorden. Paper items account for 11 % in the western clean-ups but 41-49 % in clean-ups on beaches at the Baltic Sea / Belt Sea and Kattegat / Limfjorden, and this is mainly due to cigarette butts being categorised as paper materials. There were 10551 cigarette butts counted in one of the Baltic clean-up events.

Regarding the source characterisation based on the clean-up surveys, fishery and aquaculture are responsible for the majority (44 %) of items reported on the North Sea / Skagerrak beaches by clean-up activities. This is higher than the items which are not source characterised. 13 % of the items are categorised as operational waste and 9 % as originating from public littering from tourism.

The datasets from clean-ups in both the Baltic Sea / Belt Sea and the Kattegat / Limfjorden indicate that a large majority of the source-categorised litter originates from public littering with 27 % of totally reported litter items. Only 1-3 % of the items are characterised as originating from fishery and aquaculture in these areas and thereby this source distribution differs from the findings on the reference beaches. However, most of the litter items cannot be source categorised using the OSPAR method, which also were observed for the reference beaches.

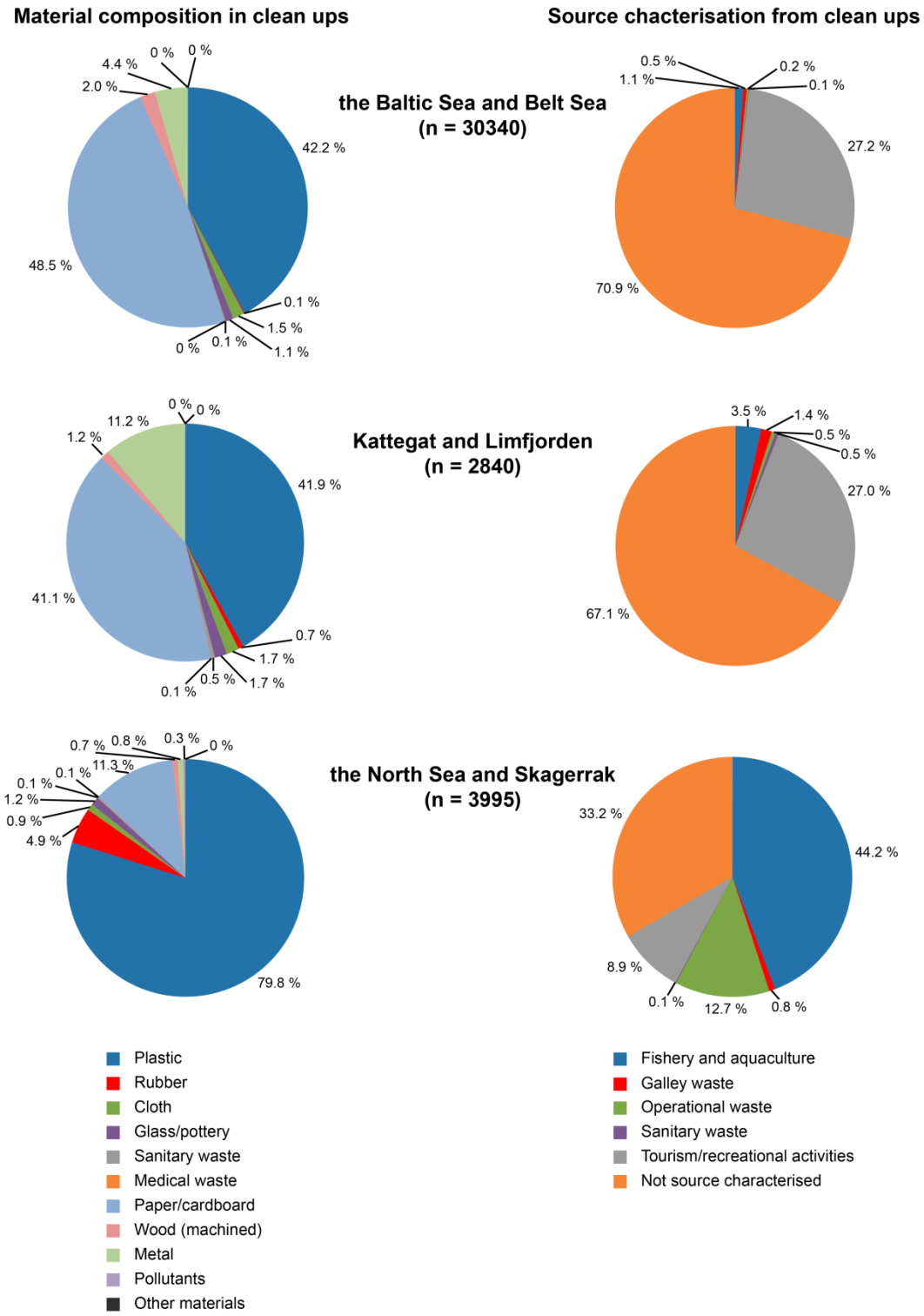


Figure 4.2. Material composition and source characterisation of litter clean-up activities on Danish beaches for the Baltic Sea/Belt Sea (n = 21 surveys), the Kattegat/Limfjorden (n = 11 surveys) and the North Sea/Skagerrak (n = 3 surveys) in 2013-2015, which have been reported as part of the registered community in the EEA database Marine LitterWatch.

5 Temporal trend assessments of beach litter

Only few reference beaches from the North Sea and Skagerrak have been monitored repeatedly over more than one year, where data have been reported to the OSPAR database, see *table 5.1*. The North Sea beach "Hvide Sande" and the Skagerrak beach at Skagen were monitored by KIMO Denmark in the period 2001-2003 and 2002-2006, respectively, in relation to the "Save the North Sea" project. KIMO Denmark has from 2010 and onwards monitored yearly on another North Sea beach, called Nymindegab, and data are therefore not fully comparable with the data from the previously monitored beach at "Hvide Sande". Likewise the new "Skagen beach" monitored from 2015 is not fully comparable with the Skagen beach monitored 2002-2006, because the exact location defined by GPS position was unknown.

Table 5.1. Yearly frequency of Danish data for beach litter on reference beaches in the North Sea (Nymindegab and Hvide Sande) and Skagerrak (Skagen) in the period 2001-2015 reported to the OSPAR database.

Year	Nymindegab (DK001)	Hvide Sande (DK005)	Skagen* (DK004)
2001		1	
2002		2	
2003		2	1
2004		2	2
2005		2	4
2006		2	4
2011	2		
2012	1		
2013	2		
2014	2		
2015	3		3

* Datasets for beach litter on Skagen beach may not be fully comparable since exact GPS position is missing for the 100 m stretch monitored in the period 2003-2006.

Because of the limited time period for the Danish data on beach litter reported to the OSPAR database, it cannot yet fulfil the requirements for performing statistical analysis for temporal trend assessment using the software program Litter Analyst (version 2.0.1, August 2015), which has been developed according to the recommendations from OSPAR ICG-ML (Baggelaar & van der Meulen 2014).

In the Litter Analyst software, only time series that comply with the following criteria for trend analysis are included:

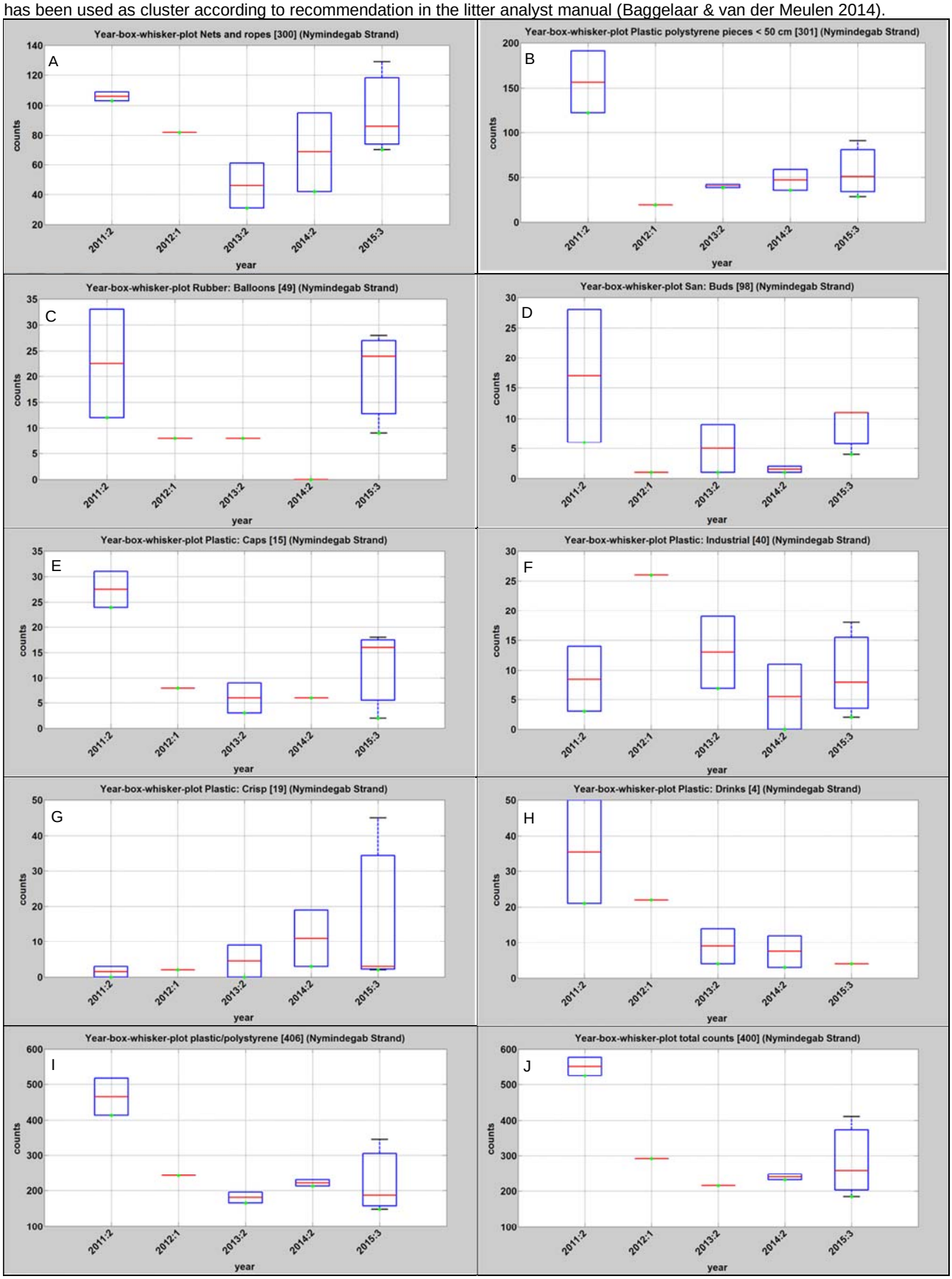
- the series length is at least 4.5 years (period between first and last measurement)
- the series contains at least five values
- the series has at least one value in each of the three four-year periods 2002-2005, 2006-2009 and 2010-2013 (criterion for homogeneous distribution of data in time).

The longest Danish time series from Nymindegab with nine surveys during four years and three months (period 1/7/2011-14/11/2015) does not fulfil the requirements described in bullet 1 or 3. Therefore, the temporal trends for total and the specific top eight items at Nymindegab are only presented at Year-box-whisker-plot prepared with the Litter Analyst software in *figure 5.1A-J*, but without any statistical analyses of the trends.

The Nymindegab data for the period 2011-2015 show different year-to-year variations depending on the type of litter items in focus. More marine litter was generally reported in 2011 for litter items like nets/rope, plastic/polystyrene < 50 cm, caps and drink containers also affecting the total numbers of litter items reported that year compared to the following years (*figure 5.1*). At first glance, this could look as decreasing tendencies for these litter items during this period; however, this might also be due to longer time for accumulation of litter prior to the first beach litter survey on this beach in 2011 or maybe some specific wind and sea current conditions in 2010/2011. For some other litter items like crisp/sweet/lolly sticks and industrial packaging relatively more items have been reported in the following years that could indicate increasing trends.

As an alternative to the litter Analyst software, statistical analyses on the temporal trends for litter items in the Nymindegab datasets for the period 2011-2015 were made by Spearman's rank correlation (using Graphpad Prism software) on the annual counts of each reported type of litter items as well as for the OSPAR categories for material composition and sources. These statistical analyses were only made for litter types and categories. Only datasets with maximum three surveys without any registration of the specific type of litter items (i.e. max. three counts of zero) during the ten surveys performed in the period were included, so potential trends in the data set were not based on a too low number of observations. Among the 28 litter items with maximum three counts of zero, only the litter items [4] plastic drink containers ($p < 0.02$) and [91] glass fragments of bottles ($p < 0.03$) showed significant decreasing trends in the period. None of the material categories showed any statistical trends, but one source category, i.e. galley waste ($p < 0.05$), expressed a statistical decreasing trend during the period 2011-2015.

Figure 5.1. Temporal trends of beach litter on the North Sea beach Nymindegab for top eight items A) nets and ropes, B) plastic/polystyrene < 50 cm, C) balloons, D) cotton bud sticks, E) plastic caps/lids, F) industrial plastic packaging, G) crisp/ sweet packets, H) drinks (bottles, containers), I) total plastic/polystyrene items and J) total litter items shown with Year-box-whisker-plot of numbers/counts of items (median, range) registered per 100 m survey area in the period 2011-2015 using the Litter Analyst software. A broader group called "Net and ropes", which includes sum of OSPAR codes 31, 32, 115 and 116, has been used as cluster according to recommendation in the litter analyst manual (Baggelaar & van der Meulen 2014).



6 Conclusions

The assessment of the 2015-data for amounts and compositions of beach litter on five Danish reference beaches indicates that:

- the 2015-data from monitoring activities on five selected reference beaches can be used for deriving initial reference levels based on median values (and range) for the different categories of litter items that can be used for spatial and temporal trend analyses to be performed in Denmark in coming years.
- considerably higher amounts of beach litter were found washed ashore on the Skagerrak beach, followed by the North Sea beach and generally with lowest reported amounts on the beaches in the Baltic Sea and Roskilde Fjord. A similar regional tendency also occurs when comparing beach litter data from the neighbouring countries.
- the composition of beach litter is dominated by plastic materials (48-84 %) on all the monitored Danish reference beaches, but other groups of materials such as rubber, glass/pottery, machined wood and sanitary waste can also be significant contributors in some areas.
- the sources to beach litter include fishing, galley waste, shipping (operational waste), sanitary waste and public littering (e.g. tourism) with fishery as a more pronounced contributor in the North Sea/Skagerrak region. However, most litter items could not be source characterised, and thereby the contributions from the characterised sources are probably underestimated.
- beach litter data from clean-up activities reported to e.g. the EEA database “Marine LitterWatch” can provide supplementary data, e.g. top ten items lists mainly from beaches more affected by public littering directly on or nearby the beach.
- the Danish datasets for beach litter need further continuation of monitoring activities on the selected reference beaches in both the Baltic Sea and the North Sea/Skagerrak before the datasets can fulfil the requirements for performing statistical analysis for temporal trend assessment using the software program Litter Analyst which has been recommended for OSPAR assessments. Alternative trend analyses performed for litter on the North Sea beach Nymindegab indicated, however, decreasing trends for especially plastic drink containers, glass fragments of bottles and galley waste in general during the period 2011-2015.

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Annex 1 - Comparison of database codes for litter items in the OSPAR and EU master lists

Table A1.1. Translation of data extracts from EEA database using EU master list (EU 2013) and OSPAR list (OSPAR 2010) for beach litter items were translated using the table below.

OSPAR codes	EU master list codes	Materials	OSPAR source characterisation
1	G1	Plastic	Public littering
2	G3	Plastic	Public littering
3	G4	Plastic	Not source characterised
112	G5	Plastic	Not source characterised
4	G7,G8	Plastic	Public littering
5	G9	Plastic	Galley waste
6	G10	Plastic	Public littering
7	G11,G12	Plastic	Not source characterised
12	G13	Plastic	Not source characterised
8	G14	Plastic	Not source characterised
9	G15	Plastic	Not source characterised
10	G16	Plastic	Fishery and aquaculture
11	G17	Plastic	Shipping
13	G18	Plastic	Galley waste
14	G19	Plastic	Not source characterised
16	G26	Plastic	Not source characterised
17	G28	Plastic	Not source characterised
18	G29	Plastic	Not source characterised
15	G21,G22,G23,G24	Plastic	Not source characterised
19	G30,G31	Plastic	Public littering
20	G32	Plastic	Not source characterised
21	G33	Plastic	Not source characterised
22	G34,G35	Plastic	Not source characterised
23	G36	Plastic	Not source characterised
24	G37	Plastic	Not source characterised
25	G40	Plastic	Galley waste
26	G42	Plastic	Fishery and aquaculture
27	G44	Plastic	Fishery and aquaculture
28	G45	Plastic	Fishery and aquaculture
29	G46	Plastic	Fishery and aquaculture
30	G47	Plastic	Fishery and aquaculture
31	G49	Plastic	Fishery and aquaculture
32	G50	Plastic	Fishery and aquaculture
33	G56	Plastic	Fishery and aquaculture
34	G57,G58	Plastic	Fishery and aquaculture
38	G65	Plastic	Not source characterised
35	G59,G132	Plastic	Fishery and aquaculture
36	G60	Plastic	Not source characterised
37	G62,G63,G64	Plastic	Fishery and aquaculture
39	G66,G93	Plastic	Shipping
40	G67	Plastic	Shipping
41	G68	Plastic	Not source characterised
42	G69	Plastic	Shipping
43	G70	Plastic	Not source characterised
44	G71,G102	Plastic	Not source characterised

OSPAR codes	EU master list codes	Materials	OSPAR source characterisation
45	G73a,b	Plastic	Not source characterised
64	G27	Paper/Cardboard	Not source characterised
121	G101	Plastic	Not source characterised
98	G95	Sanitary waste	Sanitary waste
99	G96	Sanitary waste	Sanitary waste
101	G97	Sanitary waste	Sanitary waste
102	G98	Sanitary waste	Sanitary waste
104	G99	Medical waste	Not source characterised
103	G100	Medical waste	Not source characterised
46	G76,G79,G82,G84,G85,G86,G87, G88,G89,G90,G91,G92,G25	Plastic	Not source characterised
47	G77, G80,G83, G72	Plastic	Not source characterised
117	G78,G81,G112	Plastic	Not source characterised
105	G211	Medical waste	Not source characterised
113	G41	Plastic	Fishery and aquaculture
114	G43	Plastic	Not source characterised
115	G53	Plastic	Fishery and aquaculture
116	G54	Plastic	Fishery and aquaculture
49	G125	Rubber	Not source characterised
50	G127	Rubber	Not source characterised
52	G128, G129,G130	Rubber	Not source characterised
53	G126,G131,G134	Rubber	Not source characterised
97	G133	Sanitary waste	Sanitary waste
54	G137	Cloth	Not source characterised
57	G138	Cloth	Not source characterised
56	G139,G140	Cloth	Not source characterised
55	G141	Cloth	Not source characterised
59	G142,G143,G145	Cloth	Not source characterised
100	G144	Sanitary waste	Not source characterised
60	G147	Paper/Cardboard	Not source characterised
61	G148	Paper/Cardboard	Not source characterised
118	G150	Paper/Cardboard	Galley waste
62	G151	Paper/Cardboard	Galley waste
63	G152	Paper/Cardboard	Not source characterised
65	G153	Paper/Cardboard	Not source characterised
66	G154	Paper/Cardboard	Not source characterised
67	G149,G155,G156,G158a,b	Paper/Cardboard	Not source characterised
68	G159	Wood (machined)	Not source characterised
69	G160,G161	Wood (machined)	Shipping
70	G162	Wood (machined)	Not source characterised
71	G163	Wood (machined)	Not source characterised
119	G164	Wood (machined)	Not source characterised
72	G165	Wood (machined)	Not source characterised
73	G166	Wood (machined)	Not source characterised
74	G167,G171	Wood (machined)	Not source characterised
75	G172	Wood (machined)	Not source characterised
76	G174	Metal	Galley waste
78	G175	Metal	Public littering
82	G176	Metal	Galley waste
81	G177	Metal	Not source characterised
77	G178	Metal	Not source characterised
120	G179	Metal	Not source characterised

OSPAR codes	EU master list codes	Materials	OSPAR source characterisation
79	G180	Metal	Not source characterised
80	G182	Metal	Fishery and aquaculture
87	G184	Metal	Not source characterised
83	G186	Metal	Not source characterised
88	G191	Metal	Not source characterised
84	G187,G188,G189	Metal	Shipping
86	G190	Metal	Not source characterised
89	G181,G193,G194,G195,G198	Metal	Not source characterised
90	G199	Metal	Not source characterised
91	G200	Glass/Ceramics	Public littering
92	G202,G205	Glass/Ceramics	Shipping
94	G204	Glass/Ceramics	Not source characterised
95	G207	Glass/Ceramics	Not source characterised
96	G201,G203,G206,G208,G210	Glass/Ceramics	Not source characterised
108	G213a	Pollutants	Not source characterised
109	G213b	Pollutants	Not source characterised
110	G213c	Pollutants	Not source characterised
111	G212, G214, G215, G216	Other materials	Not source characterised

OSPAR codes 48, 93, and 96 are avoided due to overlapping definitions with EU's ML-codes, e.g. connected to OSPAR codes 46 and 47. Neither is the EU codes G2, G6, G20, G38, G39, G48, G51, G52, G55, G61, G75, G76, G77, G157, G168, G169, G170, G17, G196, G197and G209 used due to overlapping definitions with other codes. EU's ML-code G213 for paraffin / wax items is split into G213a, b and c to be used for the size-dependent OSPAR codes 108, 109 and 110.

In addition, some extra national codes for beach litter have been defined in the national guideline for beach litter monitoring in Denmark (Strand & Metcalfe 2015):

- G73a, b, where a) relates to soft foamed plastic mainly used for furniture and b) foamed plastic mainly used as insulating materials.
- G158a, b, where a) relates to toilet paper mainly originating from sanitary waste and b) other paper fragments.
- G212, G214 and G215 for slack / coal, oil / tar and food waste (galley waste), respectively.

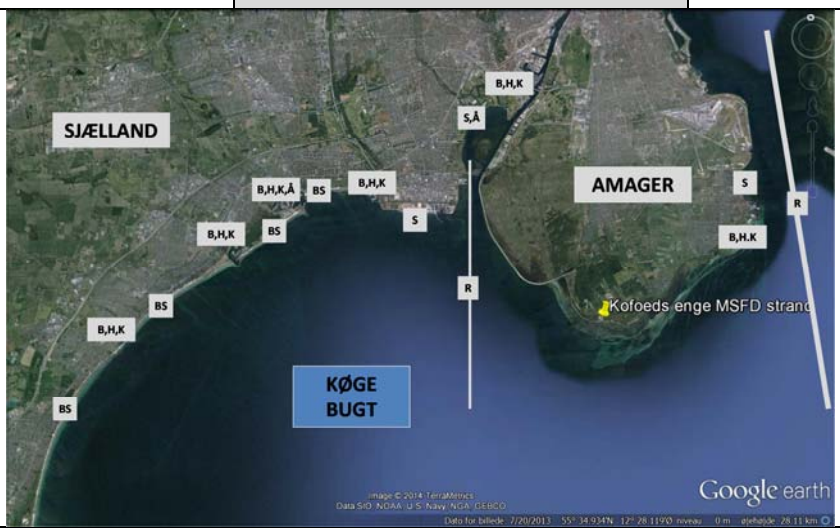
Annex 2 – Descriptions of the Danish reference beaches selected for the MSFD monitoring

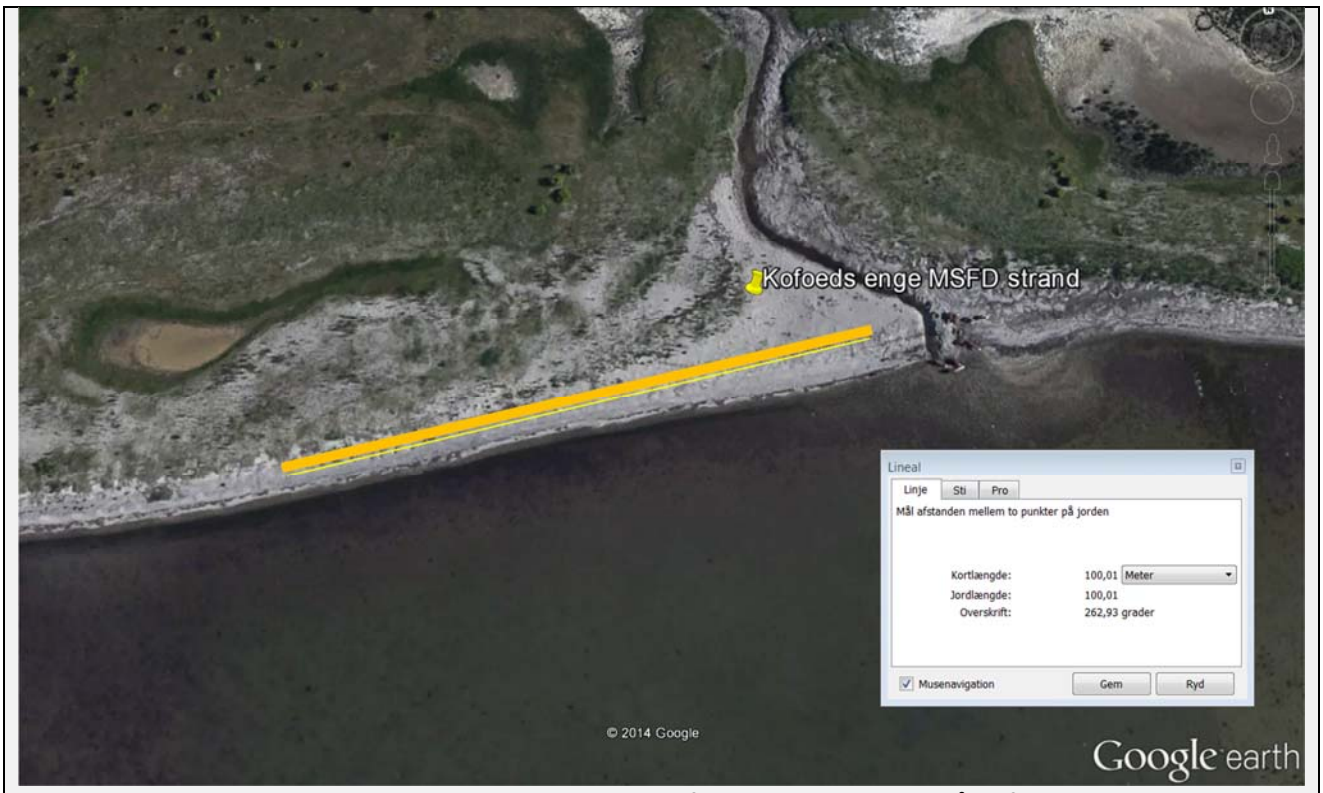
Kofoeds Enge:

Lokalitetsnavn:	**Kofoeds Enge, MSFD strand**	**Længde af strækning:**	**100 m**
Område:	Østersøen, Køge Bugt, Amager	Kommune:	Dragør
GPS position, start:	55°33.463'N; 12°34.609'Ø	Bredde af stranden ved lavvande:	10 - 20 m
GPS position, slut:	55°33.456'N; 12°34.514'Ø	Bredde af stranden ved højvande:	5 - 15 m
Sammensætning af strand:		Sand: 95 % / Mindre sten: 5 % / Større sten/klipper: 0%	
Type af strand (Landlig eller Bynær/Urban):		Bynær (urban)	
Nærmeste havneby:	København (og Dragør)	Antal indbyggere:	1.700.000 (Hovedstadsområde)
Afstand til nærmeste havneby:	12 km	Havnetype: og antal bådpladser (ca.):	Lystbåde, fragtskibe, Fiskeri: 3000 - 4000
Afstand til nærmeste udledning af byspildevand:	8 km (Avedøre Holme)	Afstand til nærmeste udløb fra større å eller flod:	11 km (Harrestrup Å)
Primær brug af stranden til rekreative aktiviteter: (fx lokale, strandgæster, lystfiskeri, sejlads m.v.)		Stort set ingen rekreative aktiviteter på denne strækning af stranden, få fodgængere	
Adgang til stranden (fx for fodgængere, sejlads, motorkørertøjer)		Til fods langs stranden fra P-plads ved Kongelunds-stranden.	
Retning mod havet:	N [ ] S [X] Ø [ ] V [ ]	Bagenden af stranden, type: (fx klitter, skrænt, strandeng, træer/buske etc.)	Strandeng
Dominerende vindretning	N [ ] S [ ] Ø [ ] V [X]	Hældning på stranden:	2 %
Dominerende strømretning	N [X] S [ ] Ø [ ] V [ ]	Objekter på stranden som kan påvirke strømmen	ingen

Afmærkning af de nærmeste aktiviteter, som potentielt set kan være væsentlige kilder til affald på strandene.

Nærmeste by(er): B
Nærmeste havn(e): H
Kiosker/spisesteder: K
Spildevandsudledning: S
Å-udløb: Å
Større sejlruter: R





Præcis angivelse af 100 m strækningen på Kofoeds Enge, MSFD strand

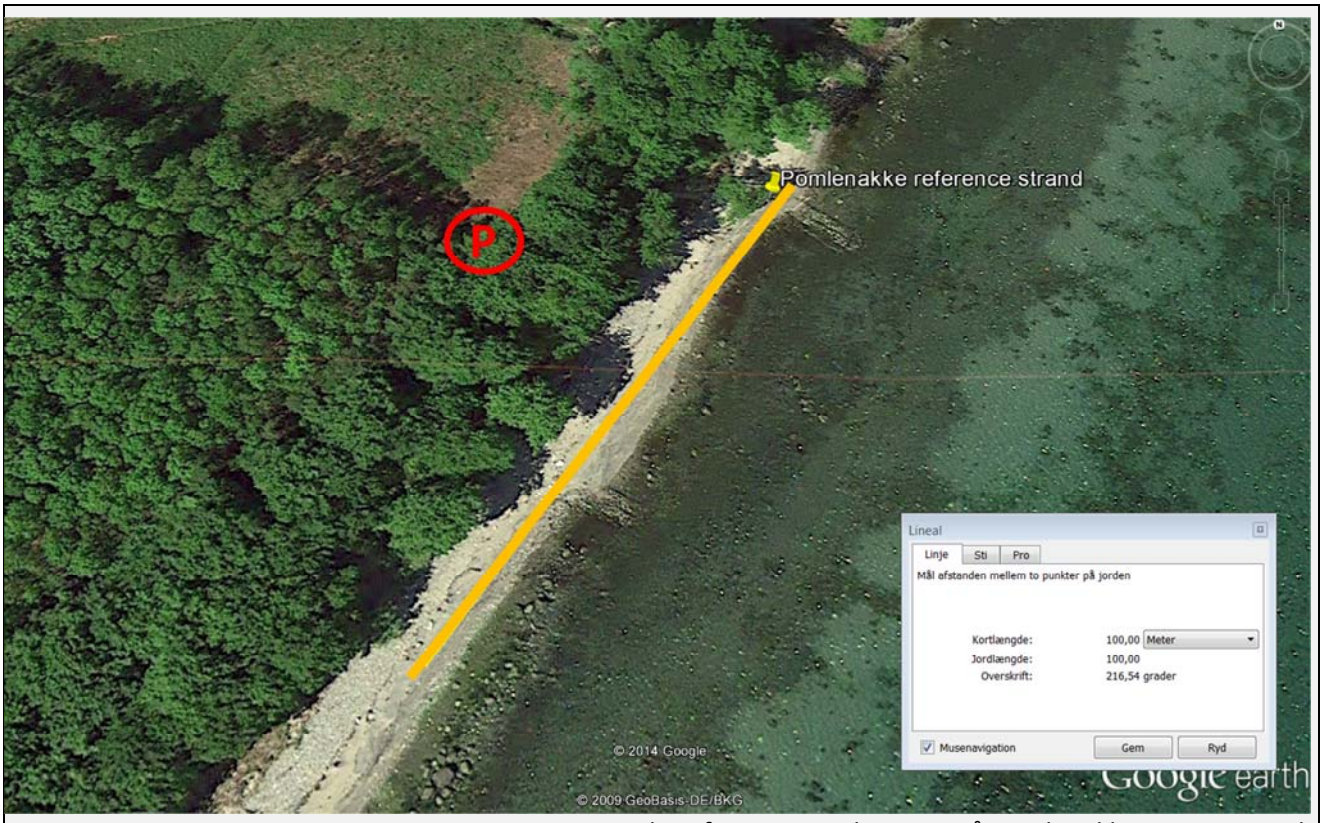
Foto af lokaliteten for Kofoeds Enge, MSFD strand.

Pomlenakke, the Baltic Sea

Lokalitetsnavn:	**Pomlenakke, MSFD strand**	**Længde af strækning:**	**100 m**
Område:	Østersøen, Hesnæs, Falster	**Kommune:**	Guldborgsund
GPS position, start:	54°48.382'N; 12°07.478'Ø	Bredde af stranden ved lavvande:	15 - 20 m
GPS position, slut:	54°48.338'N; 12°07.422'Ø	Bredde af stranden ved højvande:	10 - 15 m
Sammensætning af strand:		Sand 25 % / Mindre sten 70 % / Større sten/klipper 5 %	
Type af strand (Landlig eller Urban/bynær):		Landlig (Rural)	
Nærmeste havneby:	Hesnæs (Stubbekøbing)	Antal indbyggere:	50 (2250)
Afstand til nærmeste havneby:	2 km	Havnetype: og antal skibe (ca):	Fiskeri, lystbåde 10 - 30
Afstand til nærmeste udledning af byspildevand:	2 km (Hesnæs inkl. Moseby)	Afstand til nærmeste udløb fra større å eller flod:	70 km (Warnow, Rostock)
Primær brug af stranden til rekreative aktiviteter: (fx lokale, strandgæster, lystfiskeri, sejlads m.v.)		Stort set ingen rekreative aktiviteter på stranden	
Adgang til stranden (fx for fodgængere, sejlads, motorkørertøjer)		Til fods langs stranden eller fra skovvej, der fører til (P) på kortet nedenfor.	
Retning mod havet:	N [ ] S [ ] Ø [X] V [ ]	Bagenden af stranden, type: (fx klitter, skrænt, træer/buske etc.)	Skovbeklædt skrænt
Dominerende vindretning	N [ ] S [ ] Ø [ ] V [X]	Hældning på stranden:	1 %
Dominerende strømretning	N [ ] S [X] Ø [ ] V [ ]	Objekter på stranden som kan påvirke strømmen	2 mindre høfder

Afmærkning af de nærmeste aktiviteter, som potentielt set kan være væsentlige kilder til affald på strandene.

Nærmeste by(er): B
Nærmeste havn(e): H
Kiosker/spisesteder: K
Spildevandsudledning: S
Å-udløb: Å
Større sejlruter: R
Badestrande: BS



Præcis angivelse af 100 m strækningen på Pomlenakke, MSFD strand

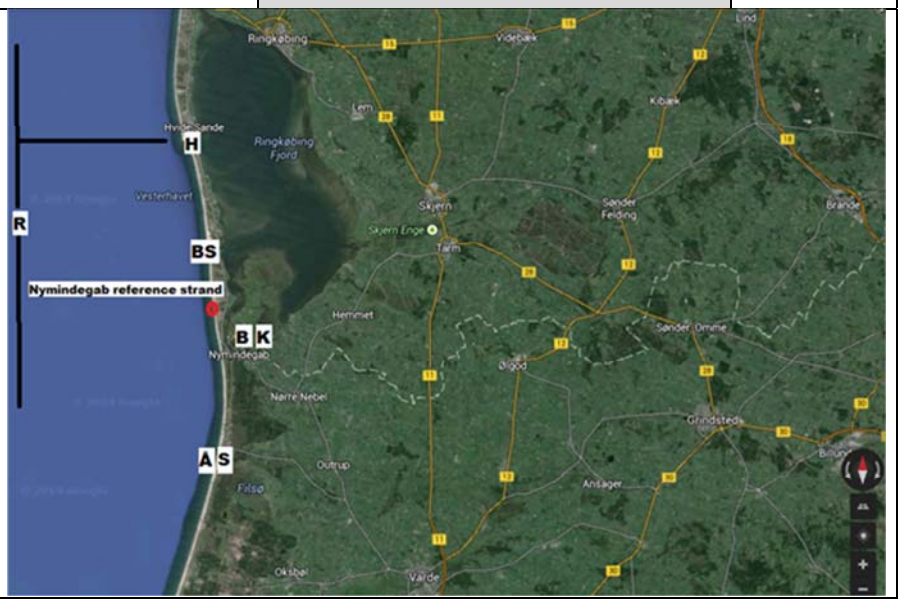
Foto af lokaliteten for Pomlenakke, MSFD strand.

Nymindegab, the North Sea

Lokalitetsnavn:	**Nymindegab, MSFD strand**	**Længde af strækning:**	**100 m**
Område:	Nordsøen, Jyske vestkyst	Kommune:	Ringkøbing-Skjern
GPS position, start:	55°50'29.43 N 8°9'49,69 E	Bredde af stranden ved lavvande:	70 m
GPS position, slut:	55°50'26.43 N 8°9'50,06 E	Bredde af stranden ved højvande:	30 m
Sammensætning af strand:		Sand: 99 % / Mindre sten: 1 % / Større sten/klipper: %	
Type af strand (Landlig eller Urban/bynær):		Landlig (Rural)	
Nærmeste havneby:	Hvide Sande	Antal indbyggere:	
Afstand til nærmeste havneby:	18 km	Havnetype: og antal skibe (ca):	Moderne fiskerihavn (60 skibe)
Afstand til nærmeste udledning af byspildevand:	14 km	Afstand til nærmeste udløb fra større å eller flod:	14 km
Primær brug af stranden til rekreative aktiviteter: (fx lokale, strandgæster, lystfiskeri, sejlads m.v.)		Lokale og strandgæster (ture på stranden), svømning	
Adgang til stranden (fx for fodgængere, sejlads, motorkørertøjer)		Fodgængere – Kommunale og militære køretøjer	
Retning mod havet:	N ☐ S ☐ Ø ☐ V ☒	Bagenden af stranden, type: (fx klitter, skrænt, træer/buske etc.)	Klitter
Dominerende vindretning	N ☐ S ☐ Ø ☐ V ☒	Hældning på stranden:	5 %
Dominerende strømretning	N ☐ S ☒ Ø ☐ V ☐	Objekter på stranden som kan påvirke strømmen	Nej

Afmærkning af de nærmeste aktiviteter, som potentielt set kan være væsentlige kilder til affald på strandene.

Nærmeste by(er): B
Nærmeste havn(e): H
Kiosker/spisesteder: K
Spildevandsudledning: S
Å-udløb: Å
Større sejlruter: R
Badestrande: BS



Præcis angivelse af 100 m strækningen på Nymindegab, MSFD strand

Foto af lokaliteten for Nymindegab, MSFD strand.

Skagen, Skagerrak

Lokalitetsnavn:	**MSFD Skagen strand**	**Længde af strækning:**	**100 m**
Område:	Skagerrak, Jyske vestkyst	Kommune:	Frederikshavn
GPS position, start:	57°44.55.268'N; 10°34.54.766'Ø	Bredde af stranden ved lavvande:	60 m
GPS position, slut:	57°44.56,163'N; 10°35.0.399'Ø	Bredde af stranden ved højvande:	25 m
Sammensætning af strand:		Sand: 20 % Mindre sten: 80 % Større sten/klipper: 0 %	
Type af strand (Landlig eller Urban/bynær):		Landlig (Rural)	
Nærmeste havneby:	Skagen	Antal indbyggere:	8200
Afstand til nærmeste havneby:	1 km (5 km ad vandvejen til Skagen havn rundt om Grenen)	Havnetype: og antal skibe (ca.):	Erhvervshavn, fortrinsvis fiskeri, ca. 1000 fiskefartøjer og 550 fragtskibe pr. år
Afstand til nærmeste udledning af byspildevand:	Ingen i området, kun overfladevand	Afstand til nærmeste udløb fra større å eller flod:	Uggerby å, 30 km
Primær brug af stranden til rekreative aktiviteter: (fx lokale, strandgæster, lystfiskeri, sejlads m.v.)		Strandgæster, fortrinsvis lokale.	
Adgang til stranden (fx for fodgængere, sejlads, motorkørertøjer)		Offentlig adgang til fods fra Buttervej eller Batterivej (ca. midtvejs). Adgang med bil fra Buttervej for kommunale køretøjer/arbejdskørsel.	
Retning mod havet:	N: X S: ☐ Ø: ☐ V: X	Bagenden af stranden, type: (fx klitter, skrænt, træer/buske)	Klitter med bred forstrand
Dominerende vindretning	N: ☐ S: ☐ Ø: ☐ V: X	Hældning på stranden:	5 %
Dominerende strømretning	N: X S: ☐ Ø: X V: ☐	Objekter på stranden som kan påvirke strømmen	Ingen

Afmærkning af de nærmeste aktiviteter,
som potentielt set kan være væsentlige kilder til affald på strandene.

Nærmeste by(er): B
Nærmeste havn(e): H
Kiosker/spisesteder: K
Spildevandsudledning: S
Å-udløb: Å
Større sejlruter: R
Badestrande: BS

Præcis angivelse af 100 m strækningen på MSFD Skagen strand

Foto af lokaliteten for MSFD Skagen strand.

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STATUS ON BEACH LITTER MONITORING IN DENMARK 2015

Amounts and composition of marine litter on Danish reference beaches

Amounts and composition of marine litter have been monitored at five Danish reference beaches in 2015. The beaches represent coastlines in both the North Sea/Skagerrak and the Baltic Sea and inner Danish waters. The data showed significant regional differences in amounts of litter with the highest levels present on the Skagerrak reference beach and the lowest levels in the Baltic Sea. A similar trend appears when comparing with data from neighbouring countries. The composition of litter items indicates that fishery, galley waste and operational waste from ships together with sanitary waste and public littering all are important sources to marine litter in Denmark.

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